APPENDIX F

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

San Luis District

P.O. Box 957, Taft, CA 93268-0957

Fort Irwin
Desert Tortoise Protection Project Report

January 5, 2009

During fiscal year 2008, USDA APHIS Wildlife Services entered into an agreement with Fort Irwin Army National Training Center. The main objective of Wildlife Services efforts was to protect the threatened and endangered desert tortoises from predation by coyotes in the Southern Expansion Area of the Fort Irwin Desert Tortoise Translocation Project.

On May 19, 2008, an initial site visit was made by Wildlife Services employees. Wildlife Services met with Fort Irwin employees to discuss the goals and expectations of the desert tortoise protection project but was denied permission to lethally remove coyotes until further notice. On May 20, 2008, Wildlife Services was given permission to lethally remove coyotes and began setting equipment and spotlighting to initiate tortoise protection from depredating coyotes. Fourteen padded foothold traps were set to target depredating coyotes. On May 21, 2008, an additional seven traps were set. On May 22, 2008, all foothold traps were removed. Due to adverse weather, no coyotes were removed at this time.

On July 29, 2008, Wildlife Services was again contacted by Fort Irwin and requested to submit an estimate for two weeks of predator control. Wildlife Services wrote a cost estimate for a two week time period and filed the appropriate NEPA paperwork to conduct predator control. On August 12, 2008 Wildlife Services met with the Deseret Tortoise Recovery group to discuss protection of the species, and it was determined at this time that the recovery group was not ready to initiate predator control.

On August 18, 2008, a second site visit was made and equipment was set. From August 18th through the 26th, twenty-seven padded foothold traps were set. Two coyotes were removed during this two week control effort, one with padded foothold traps and the other by calling and shooting. One bobcat was captured in a padded foothold trap but was released unharmed upon discovery. On August 29, 2008, Wildlife Services completed the two week desert tortoise protection protect.

Wildlife Services personnel spent a total of 253 hours conduction predator control efforts and associated administrative duties. A total of 182 trap nights, 10 call stands and three nights of spotlighting were conducted in an effort to remove coyotes in areas in and adjacent to desert tortoise translocation plots. A trap night is defined as one trap set for one night. Two traps set for one night would be considered two trap nights, etc. A call stand is an attempt to lure a predator to a specific location with the use of distress sounds in an attempt to remove an offending animal. Spotlighting is done by shining a spotlight from a vehicle in an attempt to locate the eye shine of a predator and lethally removing that predator once positive identification can be made.

On October 29, 2008, Wildlife Services met with the Desert Tortoise Recovery group and it was determine that a four year agreement be set to protect the desert tortoise

from depredating coyotes. Wildlife Services has put together all necessary paperwork and posted the position in order to fulfill this agreement.

During the 2009 fiscal year, Wildlife Services would like Fort Irwin, the Desert Management Group and the BLM Barstow Field Office to continue to monitor and report all depredation losses and coyote activity. Feel free to contact the San Luis District Supervisor, Eric Covington, at (661) 765-2511 with any questions concerning the Fort Irwin Desert Tortoise Protection Project.

Eric Covington
District Supervisor
USDA Wildlife Services
San Luis District, California

The Desert Tortoise Recovery Office (Service 2014) used these annual density estimates to evaluate range-wide trends in the density of desert tortoises over time. This analysis indicates that densities in the Northeastern Mojave Recovery Unit have increased by approximately 13.6 percent per year since 2004, with the rate of increase apparently resulting from increased survival of adults and subadults moving into the adult size class. The analysis also indicates that the populations in the other 4 recovery units are declining: Upper Virgin River (-5.1 percent), Eastern Mojave (-6.0 percent), Western Mojave (-8.6 percent), and Colorado Desert (-3.4 percent; however, densities the Joshua Tree and Piute Valley conservation areas within this unit seem to be increasing). The following figure shows linear trends in the log-transformed densities in each desert tortoise conservation area by recovery unit. Data for the Upper Virgin River Recovery Unit are from 1999 to the present; data for all other recovery units are from 2004 to the present.

(I did not include your figure here but it will be in the biological opinion.)

Allison (2013) also evaluated changes in size distribution of desert tortoises since 2001. In the Western Mojave~~, Eastern Mojave,~~ and Colorado Desert recovery units, ~~the median size of large individuals has increased, indicating less recruitment of younger (therefore smaller)~~the relative number of juveniles to adults indicates that juvenile numbers are declining faster than adults. In the Eastern Mojave, the number of juvenile desert tortoises is also declining, but not as rapidly as the number of adults (Allison, *personal communication*). ~~In the Western Mojave and Colorado Desert recovery units, the relative number of smaller desert tortoises is about half what it was in 2001. Taken together, these trends suggest fewer small desert tortoises are reaching sexual maturity, which may be explained because they comprise a smaller proportion of the population or possibly because their survival rates are relatively lower than those of adults. Either possibility indicates that smaller size classes, like adults, are affected by ongoing threats; however, because most small desert tortoises die before reaching 180 millimeters in length, we do not know whether the reduced number of small animals has directly contributed to the observed declining trends in adults. For instance, a small increase in adult mortality would have a much larger effect on adult densities. None of these demographic rates have been measured in parallel with this study, so we cannot point to specific demographic rates that are associated with these overall population declines.~~In the Upper Virgin River Recovery Unit, trends in juvenile numbers are similar to those of adults, while in the Northeastern Mojave Recovery Unit, the number of juveniles is increasing, but not as rapidly as are adult numbers in that recovery unit (Allison, *personal communication*). It is clear that juvenile numbers, like adult densities, are responding in a directional way, with increasing, stable, or decreasing trends, depending on the recovery unit where they area found.

As an aside, we have been including the following section in which we attempt to bring anthropogenic impacts into the acreages provided by habitat model. In the March 2014 white paper, how did you use the model? I.e., did you cut the acreage off at 0.5? Do your numbers of desert tortoises reflect the loss of shown in Xian? I was going to use the table in the March paper but I am concerned that we could be driving people (and ourselves) crazy if we are using all sorts of different methodologies. The explanation under the table says we used "all" modeled habitat. To me, that implies we went all the way down to 0.1 and included impervious surfaces. I think that would greatly inflate the estimated number of desert tortoises that are out there. Which makes me wonder what value we used in the following table that has been in all our biological opinions. Hmmm.

The following table depicts acreages of habitat (as modeled by Nussear et al. 2009) within various regions of the desert tortoise's range and of impervious surfaces as of 2006 (Xian et al. 2009). Impervious surfaces include paved and developed areas and other disturbed areas that have zero probability of supporting desert tortoises.

Comment [A1]: I used these same numbers from columns 2 and 3. I applied estimated 2004 and 2012 densities for each recovery unit to the area in column 2 – area in column 3. The exception is that your table only has one recovery unit for both the Northeastern Mojave and Eastern Mojave; this was contemplated at one time, but the 2011 recovery plan has 5, not 4 recovery units. In the table, I indicate the numbers I used for the 2 separate RUs.

Regions[1]	Modeled Habitat (acres)	Impervious Surfaces within Modeled Habitat	Percent of Modeled Habitat that is now Impervious
Western Mojave	7,582,092	1,864,214	25
Colorado Desert	4,948,900	494,981	10
Northeast Mojave	7,776,934	1,173,025	15
Northeastern Mojave	3,013,677	378,497	
Eastern Mojave	4,763,257	794,546	
Upper Virgin River	232,320	80,853	35
Total	20,540,246	3,613,052	18

[1]The regions do not correspond to recovery unit boundaries; we used a more general separation of the range for this illustration.

From: Allison, Linda
To: Ray Bransfield
Cc: Raymond Vizgirdas
Subject: Re: Question
Date: Monday, May 05, 2014 9:53:56 AM
Attachments: Questions to Linda about incorporating March 2014 into a BO_lja.docx

---

OK, I read your attachment and have provided some tracked changes. I no longer use the analysis of shifts in size of juveniles and just stick with trends in the proportion of juveniles relative to adults. Since this was only briefly touched on in the March 2014 paper, I added some Allison (pers comm) statements, if you really want them. I assume you should stick with the sentences that don't use the Allison (pers. comm.) citation, but provide them for your reading pleasure.

Finally, your concern about how I calculated areas for each recovery unit turns out to be unwarranted. I used exactly the same numbers as in your table (we both work with Cat, after all!), although your table is based on only 1 recovery unit for both the Northeastern and Eastern Mojave recovery units. That was once considered but we went back to 5 recovery units for the 2011 recovery plan revision. (I added numbers to the table to show you how we now split out areas for Northeastern and Eastern Mojave RUs.)

Again, let me know if any questions,

Linda

~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Linda Allison
Desert Tortoise Monitoring Coordinator
U.S. Fish and Wildlife Service
Desert Tortoise Recovery Office
1340 Financial Blvd, #234
Reno, NV 89502
775-861-6324
Linda_Allison@fws.gov

http://www.fws.gov/nevada/desert_tortoise/dtro/dtro_monitor.html

On Mon, May 5, 2014 at 9:20 AM, Allison, Linda <linda_allison@fws.gov> wrote:

> Hi Ray and Ray,
>
> I will get to the attachment you sent, but wanted to answer a couple of the embedded questions now.
>
> How did I get the population estimates for 2004 and 2012? The trend estimates give me specific density estimates for each year and in each recovery unit. I focused on the earliest starting year common to all recovery units (we had earlier data for Upper Virgin River, but for all RUs by 2004) and the latest year covered by our estimates (2012). To apply these tortoise densities for each recovery unit to areas outside of TCAs, I estimated the area of potential habitat based on Nussear et al. (2009). Their model assigns probability of occupancy to 100 ha grid cells. We only considered areas assigned a probability of occupancy > 0.5 as potential habitat (Liu et al. 2005), and removed any area identified as an impervious surface due to human construction activities (Fry et al. 2011). So density X area = population estimate. That this is extrapolating outside of the area I actually sampled, and there are actually probably fewer tortoises outside of TCAs than this method indicates, but this is a reasonably way to describe overall population changes. For instance, it shows how a population increase in the relatively small NE Mojave Recovery Unit does little to compensate for the absolute number of tortoises that must be gone when we apply the population trend for the Western Mojave to such a relatively large area.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~

What summary information should be used for juvenile trends? I would definitely use the MOG summary sheet, not the earlier summary, although I haven't been able to find a copy of what I gave you. Until early 2014, I was trying to use nonparametric statistics to describe juvenile trends, but "*non*-parametric" means I can't estimate the *parameter* (the change in juvenile relative abundance). So I was able to describe whether trends went up or down, but not by how much - not very useful for wildlife conservation. Please use only my recent summaries because these will be consistent with the path forward from here.

I'll look at that attachment you sent now, but if you have questions about the stuff above, let me know,

Linda

~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Linda Allison
Desert Tortoise Monitoring Coordinator
U.S. Fish and Wildlife Service
Desert Tortoise Recovery Office
1340 Financial Blvd, #234
Reno, NV 89502
775-861-6324
Linda_Allison@fws.gov

http://www.fws.gov/nevada/desert_tortoise/dtro/dtro_monitor.html

On Sun, May 4, 2014 at 8:55 AM, Ray Bransfield <ray_bransfield@fws.gov> wrote:

> Linda,
>
> Greetings. We have a couple more biological opinions almost ready to roll out. In them, we are summarizing the March 2014 trend white paper and using that summary to replace the info you gave us before in an email on trends. That led me to wonder if we should use the short discussion in the March 2014 paper about recruitment to replace other info that we received from you via email during the Stateline consultation. Last, I am wondering how you derived the overall numbers of desert tortoises from the March 2014 paper.
>
> I attached this rewrite; can you take a look to see if it makes sense, please? I did not try to do anything in terms of summarizing the table showing the overall numbers of desert tortoises; I have too many questions to start on that yet.
>
> I will be out this week except for a brief time on Monday morning. Maybe I can catch you to discuss before I take off. Could you please send your thoughts to Ray V also? We are hoping to move his biological opinion out the door a bit wheile I am on leave.
>
> Thanks.
~~~~~~~~~~~~~~~~~~~~~~~~~~~~

The Other Ray

P.S. Is it too early on Monday for me to ask questions like this?

AVIAN MORTALITIES AT SOLAR FACILITIES

Amedee Brickey

April 14, 2014

Background

- CA/NV Desert – Few facilities prior to 2009
- Solar Development driven by:
  - Financing incentives (Grants, Loans Guarantee, Tax Breaks)
  - State RE Portfolio Standards

Background

- Older Solar Facilities (prior to 2009)
  - Mostly on private land
  - No systematic mortality monitoring
  - No reporting requirements

California RE Action Team

- Renewable Energy Action Team (REAT)
  - Established in 2009
  - Streamline agency review and permitting
- FWS worked with BLM and CEC
  - Require development of ABPP/BBCs
  - Agency review of documents

Project-level Avian Plans

- ABPP/BBCS include:
  - Measures to avoid take during construction
  - Systematic mortality monitoring
  - Reporting requirements
  - Some include adaptive management

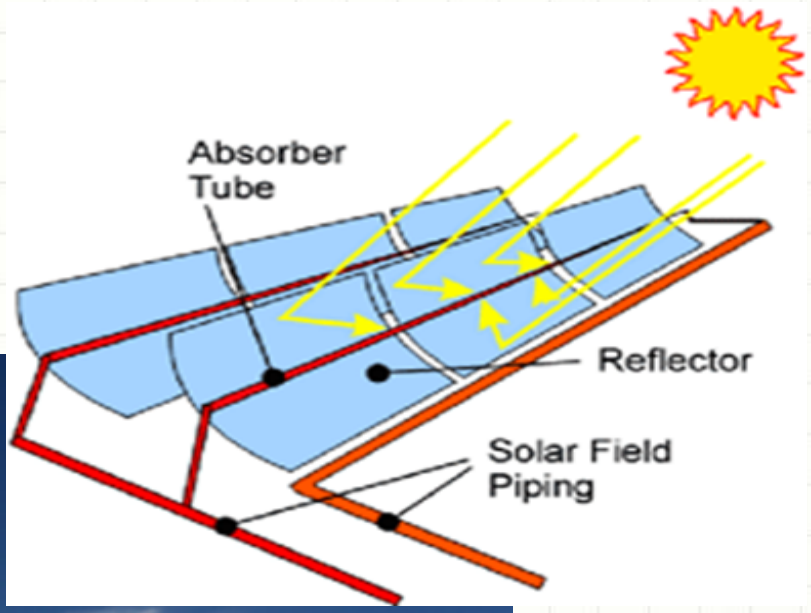
Mortality Information

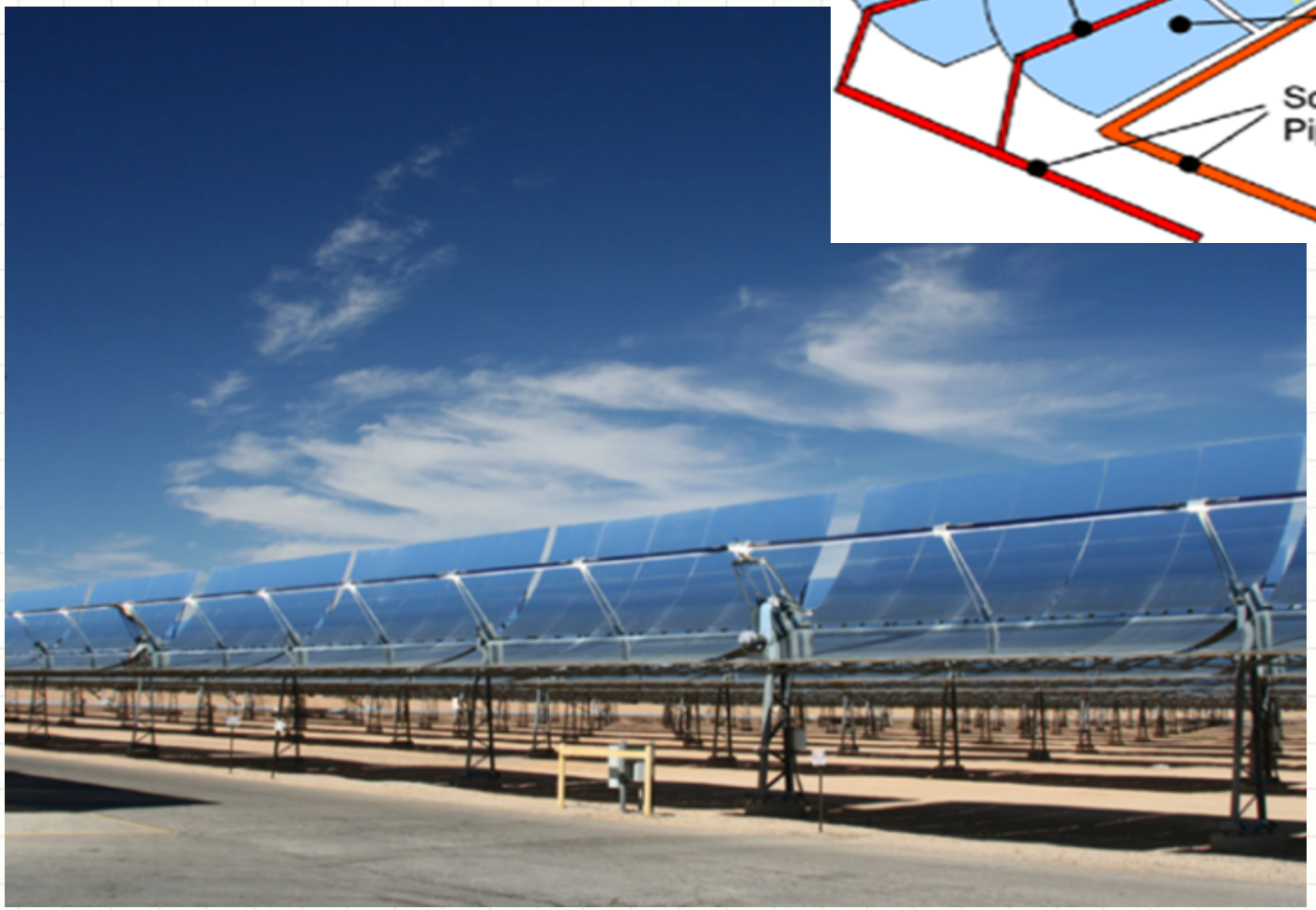
- Database created to track injury and mortality
- Collisions will panels and other project features
  - All 3 solar technology types
  - Wide range of avian species affected

Photovoltaic



Parabolic Trough





Power Tower



Concentrated Solar Flux Effects

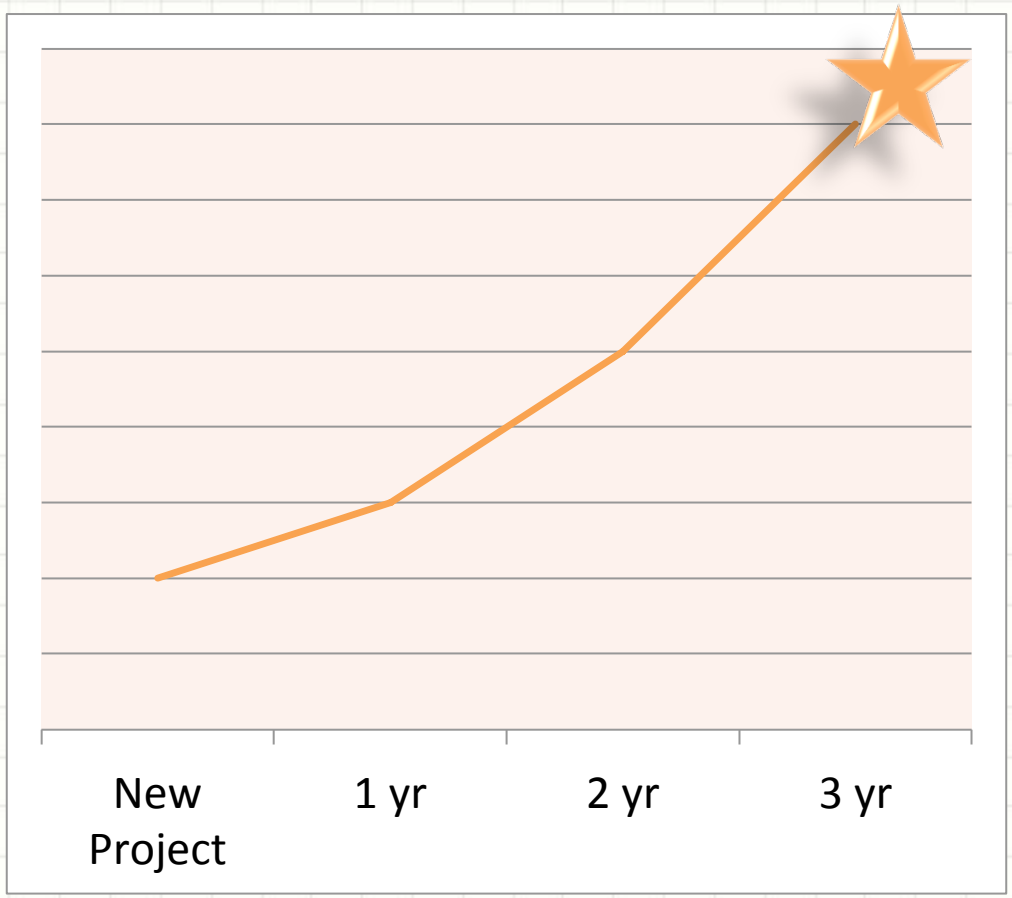
- ISEGS fully operational for less than 6 months
- Incidental reporting (raptors, passerines, humming birds, butterflies, etc.)
- First quarterly report expected in May 2014

Concentrated Solar Flux Effects



Why - Cause and Effect

Our learning curve



It may take 2-3 years to answer some questions

Status

- Meetings with Solar Developers
  - September 2013
    - Discussed avian mortality concerns
  - February 2014
    - Discussed avian mortality data summary
    - Discussed research needs
    - Encouraged developers to get organized and help collect needed information to address avian collisions.

Summary

- Collaboration between industry and agencies will be needed to address the avian mortality issue.
- A framework that includes funding for research, adaptive management, and the eventual development of best management practices.
- Other stakeholders will need to be included.

QUESTIONS?

From: Tera Baird
To: kmarsden@blm.gov
Subject: 10a1A Permit/McCoy Project
Date: 06/29/2012 01:41 PM

Kim:

Here is some info about attaching transmitters, marking (notching) and/or performing health assessments on desert tortoises located on the NextEra McCoy project under an existing 10a1A permit prior to the issuance of a BO. After discussing this issue with members of the DTRO here is what we decided:

1. Conducting disease testing early in the process under a recovery permit would be useful information and help us develop better translocation plans
2. The latest version of the translocation guidance indicated that it would be possible to conduct "pre-project" activities under a recovery permit
3. Alice Karl has an existing recovery permit, but she will need to amend it to cover work at NextEra Mcoy. Her current permit only allow her to search for lost tortoises with transmittters from a previous study and to remove those transmitters.

Tera Keeler Baird
Wildlife Biologist
Palm Springs Fish and Wildlife Office
777 East Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
phone: 760-322-2070 ext. 217
email: Tera_Baird@fws.gov

22-04-2018

Doc No.	Type	File Name
1	Rpt	20110815_Tetratech_McCoy Eagle Risk Assessment.pdf
2	email	20110901_1032 EMix_McCoy site visit.pdf
3	email	20110914_0959 DMG_NOI.pdf
4	email	20120103 1138 Re_ estimating DT densities.pdf
5	email	20120104 1240 RE_ Eagle Risk Assessment August 2011.pdf
6	doc	20120104_BLM_Tentative_Schedule.pdf
7	jpg	20120119_site photos_NextEra .jpg
8	jpg	20120119_site photos_NextEra McCoy 004.jpg
9	jpg	20120119_site photos_NextEra McCoy 005.jpg
10	jpg	20120119_site photos_NextEra McCoy 006.jpg
11	jpg	20120119_site photos_NextEra McCoy 007.jpg
12	jpg	20120119_site photos_NextEra McCoy 009.jpg
13	jpg	20120119_site photos_NextEra McCoy 010.jpg
14	jpg	20120119_site photos_NextEra McCoy 011.jpg
15	jpg	20120119_site photos_NextEra McCoy 012.jpg
16	jpg	20120119_site photos_NextEra McCoy 013.jpg
17	jpg	20120119_site photos_NextEra McCoy 014.jpg
18	jpg	20120119_site photos_NextEra McCoy 015.jpg
19	jpg	20120119_site photos_NextEra McCoy 016.jpg
20	jpg	20120119_site photos_NextEra McCoy 017.jpg
21	jpg	20120119_site photos_NextEra McCoy 018.jpg
22	jpg	20120119_site photos_NextEra McCoy 019.jpg
23	jpg	20120119_site photos_NextEra McCoy 020.jpg
24	jpg	20120119_site photos_NextEra McCoy 021.jpg
25	jpg	20120119_site photos_NextEra McCoy 022.jpg
26	jpg	20120119_site photos_NextEra McCoy 023.jpg
27	jpg	20120119_site photos_NextEra McCoy 024.jpg
28	jpg	20120119_site photos_NextEra McCoy 025.jpg
29	email	20120124 1630 Re_ NextEra McCoy Site Visit_Figure Attached.pdf
30	email	20120126_0720_tetratech_Grading_techniques.pdf
31	Rpt	20120201_McCoy_dBA_11211_rev1_12_20_11_rev2_1_16_12_rev_02_03_12.pdf
32	Rpt	20120202_Raven Mgmt Plan.pdf
33	txt	20120203 Site_Visit_GPS.txt
34	Rpt	20120203_Figures from Translocation Plan.pdf
35	doc	20120209_meeting_agenda_DT_translocation_plan.pdf
36	email	20120213 1224 RE_ Tortoise Data Sheets.pdf
37	email	20120217 1237_USFWS_translocation_discussion.pdf
38	email	20120223 1347_NM comments - McCoy BA.pdf
39	email	20120229 1205 EMix_McCoy BA figures.pdf
40	email	20120301 1143_BLM_DFG_WesternBoundary_Unit2.pdf
41	email	20120312 1624 RE_ Genesis_McCoy Survey.pdf
42	email	20120313 1010 RE_ Genesis_McCoy Survey.pdf
43	email	20120313 1723_survey_request.pdf
44	email	20120503 0936_DFG_RivCo_update_CUP_EIS_EIR_process.pdf
45	ltr	20120511_10B0593-12F0356_USFWS_BLM_Intitiation_letter.pdf
46	email	20120611 1022 Re_Has FWS sent acceptance letters to BLM for McC.pdf

22-04-2018

Doc No.	Type	File Name
47	email	20120629 1341 10a1A PermitMcCoy Project.pdf
48	ltr	20120705 1459 McCoy GE Risk Assessment - revised delete old vers.pdf
49	GIS	20110621 230_Switchyard.dbf
50	GIS	20110621 230_Switchyard.prj
51	GIS	20110621 230_Switchyard.sbn
52	GIS	20110621 230_Switchyard.sbx
53	GIS	20110621 230_Switchyard.shp
54	GIS	20110621 230_Switchyard.shp.xml
55	GIS	20110621 230_Switchyard.shx
56	GIS	20110921 McCoy_Site_Boundary_WP.dbf
57	GIS	20110921 McCoy_Site_Boundary_WP.prj
58	GIS	20110921 McCoy_Site_Boundary_WP.sbn
59	GIS	20110921 McCoy_Site_Boundary_WP.sbx
60	GIS	20110921 McCoy_Site_Boundary_WP.shp
61	GIS	20110921 McCoy_Site_Boundary_WP.shp.xml
62	GIS	20110921 McCoy_Site_Boundary_WP.shx
63	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.dbf
64	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.prj
65	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.sbn
66	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.sbx
67	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.shp
68	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.shp.xml
69	GIS	20110928 Waters_Delineation-23-McCoy_Site_veg_lines.shx
70	GIS	20111027 Dist_line_and_access_rd.dbf
71	GIS	20111027 Dist_line_and_access_rd.prj
72	GIS	20111027 Dist_line_and_access_rd.sbn
73	GIS	20111027 Dist_line_and_access_rd.sbx
74	GIS	20111027 Dist_line_and_access_rd.shp
75	GIS	20111027 Dist_line_and_access_rd.shp.xml
76	GIS	20111027 Dist_line_and_access_rd.shx
77	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.dbf
78	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.prj
79	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.sbn
80	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.sbx
81	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.shp
82	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.shp.xml
83	GIS	20111110 McCoy_Eastern_Linear_Corridor_Route_Widths.shx
84	GIS	2011_Tortoise_Data-15-Primary_Recipient_Area.dbf
85	GIS	2011_Tortoise_Data-15-Primary_Recipient_Area.prj
86	GIS	2011_Tortoise_Data-15-Primary_Recipient_Area.sbn
87	GIS	2011_Tortoise_Data-15-Primary_Recipient_Area.sbx
88	GIS	2011_Tortoise_Data-15-Primary_Recipient_Area.shp
89	GIS	2011_Tortoise_Data-15-Primary_Recipient_Area.shx
90	GIS	2011_Tortoise_Data-15-Tortoise_Signs.dbf
91	GIS	2011_Tortoise_Data-15-Tortoise_Signs.prj
92	GIS	2011_Tortoise_Data-15-Tortoise_Signs.sbn

22-04-2018

Doc No.	Type	File Name
93	GIS	2011_Tortoise_Data-15-Tortoise_Signs.sbx
94	GIS	2011_Tortoise_Data-15-Tortoise_Signs.shp
95	GIS	2011_Tortoise_Data-15-Tortoise_Signs.shp.xml
96	GIS	2011_Tortoise_Data-15-Tortoise_Signs.shx
97	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.dbf
98	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.prj
99	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.sbn
100	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.sbx
101	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.shp
102	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.shp.xml
103	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polygons.shx
104	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.dbf
105	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.prj
106	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.sbn
107	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.sbx
108	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.shp
109	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.shp.xml
110	GIS	20120125 Waters_Delineation-23-McCoy_Waters_Vegetation_polylines.shx
111	GIS	20120223 Colorado_River_substation.dbf
112	GIS	20120223 Colorado_River_substation.prj
113	GIS	20120223 Colorado_River_substation.sbn
114	GIS	20120223 Colorado_River_substation.sbx
115	GIS	20120223 Colorado_River_substation.shp
116	GIS	20120223 Colorado_River_substation.shp.xml
117	GIS	20120223 Colorado_River_substation.shx
118	GIS	20120223 McCoy_Project_Map.mxd
119	GIS	20120223 USGS_Model_poly.dbf
120	GIS	20120223 USGS_Model_poly.prj
121	GIS	20120223 USGS_Model_poly.sbn
122	GIS	20120223 USGS_Model_poly.sbx
123	GIS	20120223 USGS_Model_poly.shp
124	GIS	20120223 USGS_Model_poly.shx
125	GIS	20120223 USGS_Model_poly_1.dbf
126	GIS	20120223 USGS_Model_poly_1.prj
127	GIS	20120223 USGS_Model_poly_1.sbn
128	GIS	20120223 USGS_Model_poly_1.sbx
129	GIS	20120223 USGS_Model_poly_1.shp
130	GIS	20120223 USGS_Model_poly_1.shp.xml
131	GIS	20120223 USGS_Model_poly_1.shx

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY GARRISON
FORT IRWIN, CA 92310-5000

REPLY TO
ATTENTION OF:

IMNT-PWE

25 February 2012

Diane Noda
US Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Rd, Ste. B
Ventura, California 93003

SUBJECT: Biological Opinion Annual Reporting

Dear Ms. Noda,

The United States Army Garrison (USAG) Fort Irwin is submitting the attached annual reports per requirements outlined in two active biological opinions. These biological opinions (BO) are:

1. Attachment 1: Reinitiation of Formal Consultation on the Army's Current Mission at the National Training Center, Fort Irwin, California (1-8-95-F-16R).

2. Attachment 2: Proposed Off-Road Vehicle Area, U.S. Anny National Training Center, Fort Irwin, San Bernardino County, California (1-8-00-F-78).

The attached reports provide information in accordance with the reporting requirements outlined in each of the biological opinions. The annual report for BO #8-8-11-F-38R, Proposed Addition to Maneuver Training Lands at Fort Irwin, California, including information required by USFWS Permit TE-102235-5, will be submitted seperately.

Should you have any questions regarding these reports please contact Clarence Everly, Natural Resources Program Manager, at (760) 380-3740, or clarence.a.everly.civ@mail.mil.

Sincerely,

Muhammad A. Bari
Acting Director of Public Works
Fort Irwin, California

2 Attachments

Attachment 1

Biological Opinion # 1-8-95-F-16R

Re-initiation of Formal Consultation on the Army's Current Mission at the National Training Center, Fort Irwin, California

a. Abstract

Each Federal agency shall insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation, to be critical, unless such agency has been granted an exemption. In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available. Pursuant to submission of a biological assessment identifying the potential effects of military training activities on threatened, endangered and sensitive species, within the original boundaries of Fort Irwin and the National Training Center, the US Fish and Wildlife Service rendered a biological opinion. The Service stated in its opinion that the effects of military training activities described were not likely to jeopardize the continued existence of the desert tortoise or adversely modify critical habitat. The opinion further requires Fort Irwin submit an annual report summarizing:

1. the number of desert tortoises moved by authorized biologists
2. the number of desert tortoises killed or injured providing the specific information for each tortoise described in term and condition 12 of the opinion
3. any new ITAM program data
4. recommendations for modifying the terms and conditions to enhance desert tortoise protection
5. acreage disturbed, if any, below the UTM 90 line

Fort Irwin conducted fifty-six (56) survey and monitoring efforts in support of projects on the installation during the reporting period. As a result of these activities, two (2) live desert tortoises were observed during construction project actions; fourteen (14) potential or suspected tortoise burrows, one (1) caliche cave and one (1) summer pallet were cleared for occupancy of tortoises. Fourteen (14) tortoise skeletal remains were also recorded (unknown cause of mortality).

In 2012 there were a total of 40 (13 live, 27 carcass) incidental desert tortoise observations within the original boundaries of Fort Irwin.

b. Introduction

The National Training Center (NTC) at Fort Irwin is the army's premier Combat Training Center (CTC) training 10 brigade combat teams each year in exercises called rotations. Rotations last from 28 to 35 days each and involve approximately 6,500 soldiers and Department of the Army civilians. Training at Fort Irwin is designed to replicate combat conditions to provide soldiers the skills and experience needed in order to accomplish their assigned tactical missions.

c. Results

Table 1 is a summary listing of all reported live desert tortoise encounters within the original Fort Irwin boundary for calendar year 2012. In addition to recording these observations, DPW Natural Resources biologists, in accordance with term and condition 9 of the biological opinion, marked three (3) previously un-marked tortoises encountered within the original boundaries of Ft Irwin using a uniquely numbered Floy tag. The purpose of this program is to allow for a passive system of monitoring Fort Irwin tortoises encountered by personnel throughout the installation. ID numbers of animals thus marked are included in Table 1. A total of seventeen (17) tortoises have been tagged since the program's inception in spring of 2010. Since tagging began, no tortoises tagged under this program have been sighted again in the training area.

In 2012, there were a total of forty (40) incidental observations of desert tortoises within the original boundaries of Fort Irwin as reported to DPW (see Figure 1). Thirteen (13) of these observations were of live tortoises. Of the live sightings, eight (8) involved observation of a desert tortoise with no further action taken. Five (5) incidents involved relocating a desert tortoise out of harm's way. Three of these tortoises were tagged with a uniquely-numbered Floy tag. One non-desert tortoise incident involved the capture of an escaped pet Russian tortoise (*Agrionemys horsfieldii*) recovered near the housing area on garrison. This animal tested sero-positive for *Mycoplasma agassizii* and was transferred to Dr. Kristin Berry of USGS Riverside, for further testing. Results of testing on this individual will be included in the CY 2013 report.

Table 1. Desert tortoise encounters in 2012.
UTM coordinates reported in UTM NAD 83, Zone 11

Date (MM/DD) (2012)	Easting	Northing	Age/Sex	ID#	Condition /Activity	Action Taken
03/12	525000	3893100	unk/female	None noted	Walking	relocated
03/14	525421	3893334	Juvenile / unk	None noted	Walking	relocated
03/14	525634	3893178	Adult/ male	NTC1060	Walking	relocated
03/15	538400	3893400	unk/unk	None noted	Walking	none
03/26-29	525622	3899301	Unk	None noted	In burrow	none
03/26-29	525168	3898952	Unk	None noted	In burrow	none
04/09	515508	3894943	Adult/ unk	50	In Burrow	none
05/03	515703	3894515	unk/ unk	547	Walking	none
05/08	550336	3894206	unk/unk	None noted	In Burrow	none
07/25	514672	3900694	Adult /male	None noted	In shade of creosote	none

07/31	562745	3917898	Adult/ male	NTC1180	Resting under rock overhang	relocated
09/05	549220	3907220	unk / unk	None noted	Walking	none
09/12	534988	3890755	Adult/ male	NTC1176	Walking to burrow	relocated

Of the forty (40) incidental observations of desert tortoises twenty-seven (27) involved the discovery of tortoise skeletal remains. The increased number of desert tortoise carcasses reported this year (27) over past years is due, in part, to increased cooperation with UXO-removal contractors on Fort Irwin. Field personnel understand the importance of their reporting all tortoise observations, live and dead, during the course of carrying out their regular duties. Additionally, surveys for a proposed alternative energy project by the Fort Irwin main gate resulted in discovery of 13 desert tortoise skeletal remains. A summary of desert tortoise carcasses/skeletal remains found is provided in Table 2 below. Time since death, when provided, was estimated using methods discussed in the proceedings from a workshop on tortoise shell – skeletal remains conducted by Dr. Kirstin Berry (Berry 2002). Of the two most recently-deceased animals, one showed evidence of having drowned in a wash during late summer precipitation events and the second is potentially due to vehicle strike or other major trauma which caused complete separation of the anterior portion of the body.

Table 2. Desert tortoise carcasses recorded on Fort Irwin in 2012.
UTM coordinates reported in UTM NAD 83, Zone 11

Date (2012)	Easting	Northing	Time since Death	ID#	Cause of Death
03/26-29	525065	3898729	Unknown	None	Unknown
03/26-29	525657	3899455	Unknown	None	Unknown
03/26-29	524832	3898615	Unknown	None	Unknown
03/26-29	525773	3899773	Unknown	None	Unknown
03/26-29	525062	3899162	Unknown	None	Unknown
03/26-29	525142	3899221	Unknown	None	Unknown
03/26-29	525078	3899340	Unknown	None	Unknown
03/26-29	524575	3898870	Unknown	None	Unknown
03/26-29	524254	3898602	Unknown	None	Unknown
03/26-29	524528	3898850	Unknown	None	Unknown
03/26-29	523731	3898222	Unknown	None	Unknown

03/26-29	523574	3898144	Unknown	None	Unknown
03/26-29	523858	3897792	Unknown	None	Unknown
04/10	533400	3912780	Unknown	N/A	Unknown
04/17	508451	3893281	Unknown	N/A	Unknown
04/25	553936	3914718	Unknown	N/A	Unknown
05/08	550461	3894021	Unknown	N/A	Unknown
05/08	550010	3894496	Unknown	N/A	Unknown
07/18	533956	3889824	Unknown	N/A	Unknown
09/16	522350	3901250	Unknown	N/A	Unknown
09/26	530334	3888269	> 4 years	N/A	Unknown
09/26	530327	3888264	2-4 years	FW2553	Unknown
09/26	530600	3887770	1-2 years	notched	Possible predation.
09/26	531987	3888130	> 4 years	none	Unknown
09/26	532539	3887348	< 1 year	Possibly notched	Unknown
09/26	532684	3887610	< 1 year	Unreadable Floy tag	Probable drowning
10/25	532523	3890438	> 4 years	None noted	Severe trauma to plastron – possible vehicle strike

Summary of 2012 Survey and Monitoring Efforts within the original boundaries of Fort Irwin

Table 3, below, presents a consecutive summary of all 2012 construction-related tortoise survey and monitoring efforts conducted within the original boundaries of Fort Irwin. All construction-related survey and monitoring efforts for the year resulted in two (2) live tortoise encounters. Fourteen (14) potential tortoise burrows were identified and cleared of any occupancy by tortoises. Fourteen (14) tortoise skeletal remains consisting of disarticulated bone were observed. Based on the condition of the skeletal remains, time since death and cause of death could not be determined.

d. New ITAM Program Data

There is no new ITAM program data to report at this time.

e. Recommendations

We have no recommendations or modifications to suggest at this time to improve or enhance desert tortoise protection.

f. Acres disturbed below the UTM 90 line

One-hundred-twenty-two kilometers (249 acres) of unauthorized tactical vehicle track were documented below the 90 Gridline in the SEA in late January/early February of the reporting year. Fifteen (15) burrows identified as potential tortoise burrows were impacted; four incidents of other tortoise sign, including fecal scat and carcasses (incl. in Table 2), were also recorded in the impacted area. No live tortoises were found to be injured or killed as a result of this disturbance (US Army 2012). As of April, 2012 the portion of the Southern Expansion Area (SEA) below the 90 Grid Line was opened to military training activities. All remaining tortoises that were identified for translocation have been transferred to a USGS disease research facility (known as the Western Expansion Disease Enclosure or WEDE) in the Western Expansion Area of Fort Irwin.

Table 3. Construction Survey and Monitoring efforts on Fort Irwin in CY 2012

Date(s) of Survey	Project Name / Description	# of Surveyors	Area surveyed (m^2)	Nearest recorded historic tortoise sighting	RESULTS of SURVEY	
					Tortoise sign documented	Other special status species
17-Jan-12	J4 Demo Training deep firing point pit	3	70,000	1.2 km (carcass)	None	None
19-20,Jan 2012	Echo Valley Demo Training	2	320,000	1.3 km	None	None
20-Jan-12	Citadel Gray Water Pits	2	3,200	180 m	None	None
25-Jan-12	McLean Kitchen Pits	3	4800	not determined	None	None
25-Jan-12	CAV Kitchen Pit	2	2500	100 m	None	None
25-Jan-12	NELT8 Well Site	2	10,000	645 m	Category 5 tortoise burrow	None
26-Jan-12	NELT9 & NELT9A Well Sites	2	5,000	1.4 km	None	None
31-Jan-12	G3 Culverts	2	80,000	not determined	Caliche shelf	None
2-Feb-12	Al Jaff Emergency chemical spill excavation	N/A	4	1.7 km	N/A	N/A
3-Feb-12	Denver Expansion Gray Water Pits	2	14,000	1.5 km	None	None
13-Feb-12	SKM Berm Extension	2	10,000	680 m	None	Loggerhead shrike (*Lanius ludovicianus*)
14-Feb-12	Runway at Painted Rocks	2	50,000	630 m	None	None
22-Feb-12	CAV March Kitchen Pit	2	72,000	1.5 km	None	None
24-Feb-12	11th ACR Fighting Positions	2	6,300	1.1 km	None	None
1-Mar-12	11th ACR Field ASP	3	209,000	303 m	Burrow	None
1-Mar-12	Drinkwater Target Pits	2	42,500	1.2 km (Carcass)	None	None
26-Mar-12	11th ACR Proposed Kitchen Pits	2	3,600	1.3 km	None	None
26-29-Mar-12	Solar Energy Project	Unk	1,537,800	not determined	Pallet, 9 burrows, 1 egg, 13 carcasses	Burrowing owl, loggerhead shrike

2-Apr-12	Livefire Theatre Fiber Installation	2	6,000	386 m	None	None
20-Apr-12	Eagle 03 Memorial marker	2	25	1 km	None	None
27-Apr-12	Bike Lake Graywater Pits	3	10,000	930 m (carcass)	None	None
12-May-12	SACON Village Gray Water Pit	3	40,000	1.3 km (carcass)	None	None
21 May 12	Limaville SACON staging area and access road	2	180,000	2 km	None	None
24-May-12	Bike Lk Taxiway and Helipad	2	38,200	1,200 m	None	None
31-May-12	Alpine Valley Target Pits	2	375,000	1.8 km	None	None
5-Jun-12	LRS Snowcone TUAS	2	10,000	2 km	None	None
7-Jun-12	Hidden Valley Objective	2	10,000	300 m (carcass)	None	None
11-13 June 12	Hidden Valley Target Pits	3	40,000	500 m	None	None
13-Jun-12	Gary Owen Target Pits	2	35,000	3.5 km	None	None
19-Jun-12	Gary Owen Objective	2	165,000	3 km	None	None
27-Jun-12	Appended, Gary Owen Target Pits	2	25,000	3.5 km	None	None
27-Jun-12	Appended, Hidden Valley Target Pits	2	2,500	500 m (carcass)	None	None
27-Jun-12	Appended, Hidden Valley Objective	2	5,000	500 m	None	None
2-Jul-12	Appended, Alpine Valley Target Pits	1	4,000	1.8 km	None	None
13-Jul-12	Emergency Construction Project	2	2,500	$\leq$2 km	None	None
17-Jul-12	Snowcone TUAS Revised	2	70,000	1 km	None	None
20-Jul-12	Demo Training, Race Track	2	180,000	750 m	None	Loggerhead shrike *(Lanius ludovicianus)*
23-Jul-12	Survey of Berms at WWT	2	150,000	900 m	None	None
1-Aug-12	Range 18 Trail Improvement	2	22,500	1.1 km	None	None
13-Aug-12	Alpine Valley Target Pits Adjustments	2	58,000	1 km	None	None
27-Aug-12	B2 Kitchen Pit	1	5,700	2 km	None	None

Attachment 1

12-Sep-12	Install RCS Repeater Site	1	4,900	300 m	None	None
17-Sep-12	Al Ameen and Tabook Deconstruction	1	10,000	700 m	None	None
18-Sep-12	Seattle Hub Hole	1	100	600 m	None	None
19-Sep-12	Reno Hub Hole	1	100	1.5 km	None	None
19-Sep-12	Denver Hub hole	1	100	480 m	None	None
25-Sep-12	Tank Fighting Positions	2	25,000	550 m	None	None
26-Sep-12	Miami Hub Hole	2	225	1.1 km	None	None
26-Sep-12	Kuhnjab Village Build	2	173,375	870 m	None	None
2-17 Oct 12	B1 trail improvement	2	800,000	On Site	None	Burrowing owl (*Athene cunicularia*)
4-Oct-12	CPV Solar Project	2	52,243	500 m	None	None
12-Oct-12	TF Livefire AHA	2	15,625	1.2 km	None	None
22 - 31 Oct	C1-C3 Trail Improvement	4	1,448,000	On Site	tortoise carcass and unoccupied burrows (2)	Burrowing owl (*Athene cunicularia*)
26 Oct and 1 Nov-12	Seeding project	3	405,900	400 m	None	Burrowing owl (Athene cunicularia) scat
14-Nov-12	Tiefort Mtn Fiber Repair	2	40,000	700 m	None	None
28-30 Nov and 3 Dec-12	D1-E2 Trail Improvement	3	1,448,400	On site	Tortoise burrow (unoccupied)	Burrowing owl (*Athene cunicularia*) burrow, Golden eagle (*Aquila chrysaetos*), loggerhead shrike (*Lanius ludovicanus*)

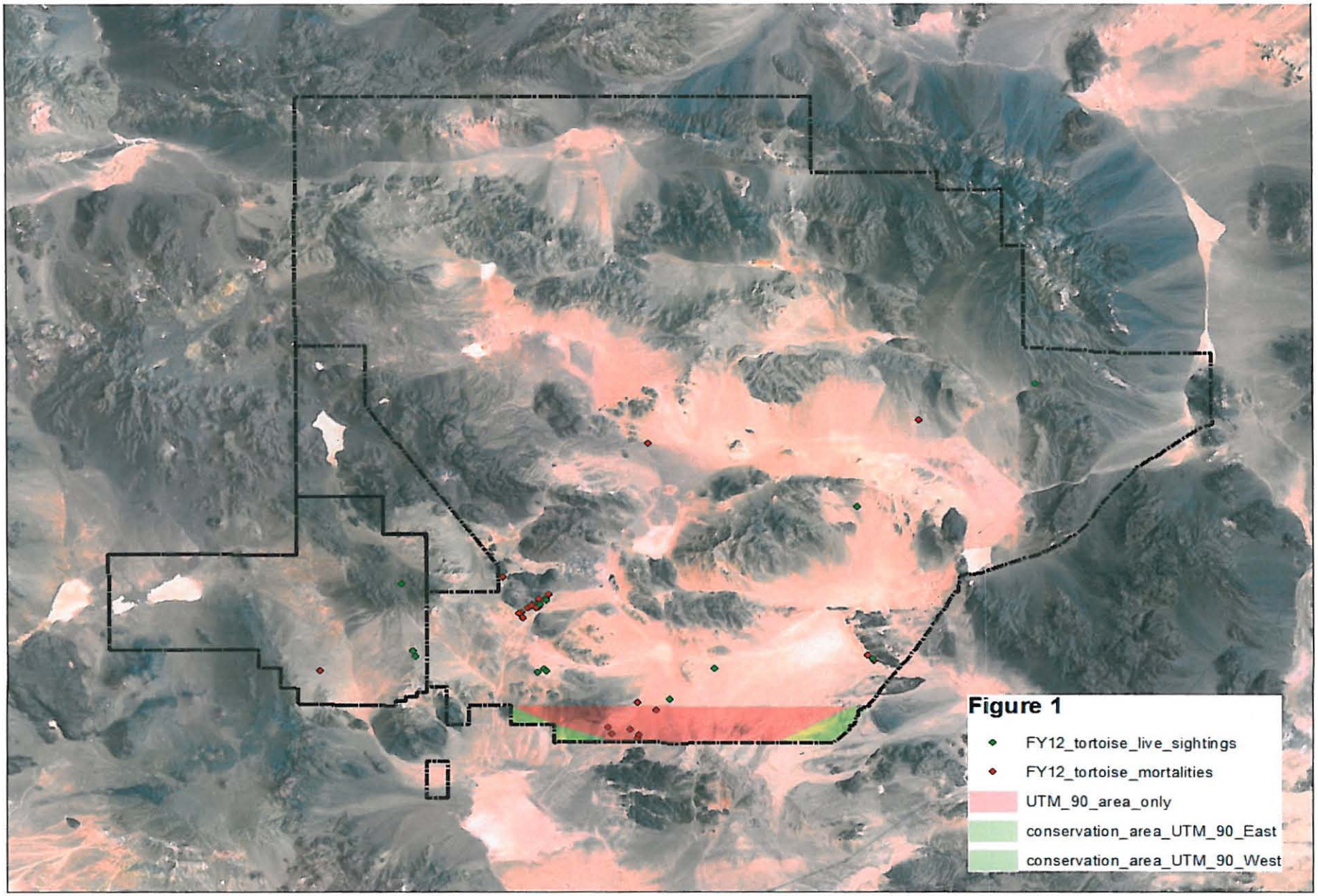


Figure 1
FY12_tortoise_live_sightings
FY12_tortoise_mortalities
UTM_90_area_only
conservation_area_UTM_90_East
conservation_area_UTM_90_West

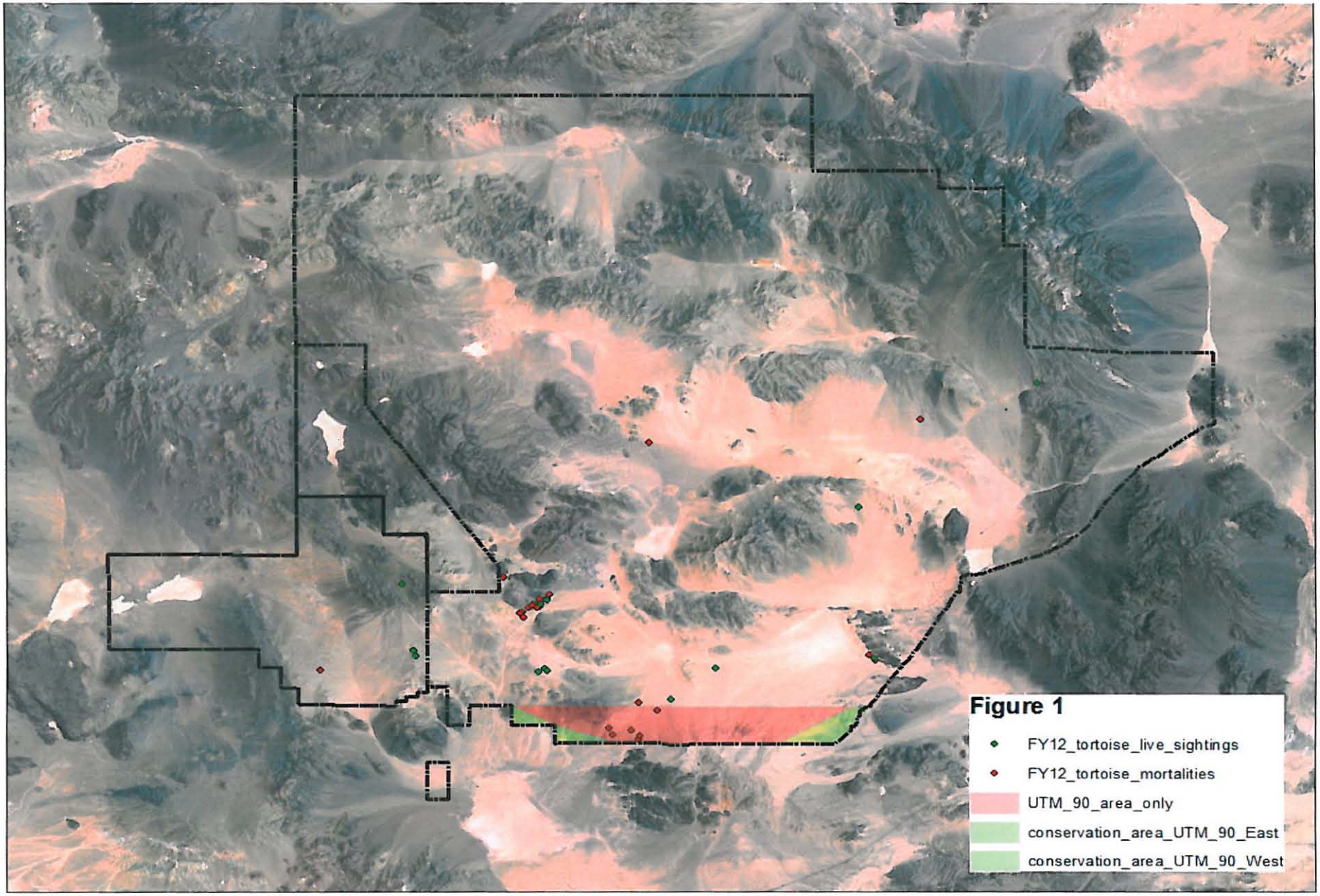


Figure 1
FY12_tortoise_live_sightings
FY12_tortoise_mortalities
UTM_90_area_only
conservation_area_UTM_90_East
conservation_area_UTM_90_West

LITERATURE CITED

Berry, K.H. 2002. Workshop on tortoise shell – skeletal remains (proceedings). US Geological Survey, Riverside, CA.

US Army. 2012. Report on Southern Expansion Area (SEA) 90 Gridline unauthorized vehicle travel: January 2012. DPW – Environmental, Fort Irwin, CA.

Attachment 2

Biological Opinion # 1-8-00-F-78

Proposed Off-Road Vehicle Area, U.S. Army National Training Center, Fort Irwin, San Bernardino County, California

INTRODUCTION

Fort Irwin established an ORV Area for military personnel and their dependents to use in their leisure time. There was no authorized area for this type of activity on Fort Irwin. As a result, some soldiers and/or their dependents used various areas of the installation for ORV activity. The availability of a single, officially sanctioned location for ORV use will ensure that other areas of the installation are not further damaged by this type of activity, thereby protecting the desert tortoise and other sensitive species. The established ORV Area is the only authorized area on post upon which this activity is allowed. Established in 2003, the ORV area encompasses approximately 70 acres. It is completely enclosed by triple strand smooth wire and tortoise proof fencing.

Pursuant to a review of the current status of the desert tortoise, the environmental baseline for the action area, the effects of the proposed Outdoor Recreation Vehicle (ORV) Area and cumulative effects, the US Fish and Wildlife Service rendered a biological opinion. The Service stated in its opinion that the ORV Area, as proposed, is not likely to jeopardize the continued existence of the desert tortoise. The opinion further requires Fort Irwin submit an annual report summarizing:

1. Compliance with NTC and Fort Irwin Regulation 350-3 detailing the amount of use occurring at the ORV Area
2. Types and occurrences of violations, such as breaches of the perimeter fence
3. Corrective measures taken to prevent further violations if any occurred

RESULTS

The Fort Irwin OHV area has been closed since October, 2011 due to a lack of maintenance funding. Fort Irwin has no current plans to re-open the facility at this time. There were no patrons to report and zero days of operation resulting in no reports of desert tortoise encounters within the boundaries of the OHV area.

Tortoise fencing surrounding the facility was inspected quarterly. There were no breaches of the OHV area perimeter fence found during the year. No violations of the NTC and Fort Irwin Regulation 350-3 were reported or observed.

DRAFT **DRAFT** **DRAFT**

~~Muhammad A. Bari~~
~~Director of Public Works~~
~~Headquarters, United States Army Garrison~~
~~Building 237, B Avenue, P.O. Box 105021~~
~~Fort Irwin, California 92310-5000~~
Jonathan P. Braga
Colonel, Department of the Army
Headquarters, United States Army Garrison Building 237, B Avenue, P.O. Box 105021
Fort Irwin, California 92310-5000

Formatted: Indent: Left: 0"

Subject: Biological Opinion for the Operations and Activities at Fort Irwin, California

Dear ~~Mr. Bari~~Colonel Braga:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion regarding the effects on the federally threatened desert tortoise (*Gopherus agassizii*) and its critical habitat, in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), ~~of~~for all identified existing and future similar actions that are likely to occur on Fort Irwin. This document also describes the criteria by which the U.S. Army will determine whether its actions are likely to adversely affect the desert tortoise or its critical habitat and our concurrence with actions that are undertaken within the framework of these criteria.

Comment [c1]: Recommend deleting the word "similar". "Similar" used with the phrase "likely to occur" appears redundant at best or implies a limitation on the projects contemplated in the consultation and that limitation is unclear.

This biological opinion is based on information in our files and discussions with your staff during the course of consultation. A complete record of this consultation can be made available at the Ventura Fish and Wildlife Office.

Consultation History

In response to a request for formal consultation from the Army, dated November 14, 201~~4~~3, for the construction and operation of a solar facility, staff from the Army and Service discussed the basic concepts of this base-wide consultation. The Army and Service agreed to consult formally on future base-wide operations and activities rather than the single solar project. Based on these discussions and our general knowledge of the activities at Fort Irwin from past consultations, we provided a draft biological opinion to the Army. This final biological opinion incorporates the Army's comments on the draft biological opinion.

The Service and Army are aware of only one other federally listed species within the boundaries of Fort Irwin, the endangered Lane Mountain milk-vetch (*Astragalus jaegerianus*). Because of the extremely limited distribution of this species, the Army and Service agreed that we would not include this species in this programmatic consultation. Instead, the Army will manage the Lane Mountain milk-vetch according to the provisions of its integrated natural resources management plan and consult with the Service on a case-by-case basis if any future activity may affect this species. The Army developed the following conservation measures for the Lane Mountain milk-

vetch ~~as~~ during consultation on the use of additional training lands at Fort Irwin.

The Army will ensure the long term survival of the Lane Mountain milk-vetch by:

1. Maintaining the National Training Center - Gemini Conservation Area adjacent to the southern boundary of the Goldstone Deep Space Communications Complex. This 2,471-acre Off-Limits area was fenced in 2003, restricting most vehicle traffic. Most of this population of the Lane Mountain milk-vetch is contained within this conservation area.

2. Maintaining the 4,300-acre East Paradise Conservation Area. This conservation area contains 80 percent of the East Paradise population of the Lane Mountain milk-vetch.

3. Maintaining the 3,700-acre Brinkman Wash Restricted Access Area that contains 1,872 acres of Lane Mountain milk-vetch habitat.

4. Erecting and maintaining signs along the perimeter of the Restricted Access Area at approximately 100 meter intervals and by erecting restricted access signs along all routes that access the Brinkman Wash Restricted Access Area.

5. Incorporating information regarding the off-limits areas into environmental awareness briefings.

6. Delineating all Lane Mountain milk-vetch conservation areas on all training maps.

7. Prohibiting and eliminating all vehicular travel in Lane Mountain milk-vetch conservation areas with the following exceptions: (1) access for yearly monitoring and research approved by the Fort Irwin Natural Resources Program Manager; (2) emergency vehicles, particularly those needed for wildfire control; (3) exceptional natural resource activities, such as feral burro roundups or cultural surveys, approved by the Fort Irwin Natural Resources Program Manager.

8. Utilizing observer/controller teams to prevent unnecessary habitat destruction by rotational units unfamiliar with the terrain and travel routes.

9. Identifying and conserving potential habitat for the Lane Mountain milk-vetch within the region. Fort Irwin will:

   - Identify and survey for small pockets of potential habitat, defined by soil, bedrock geology, and elevation, found within the boundaries of Fort Irwin.

   - If potential habitat for the Lane Mountain milkvetch is found, attempt to reduce training in the area by reclassifying the area as “No Dig.” If reclassification is possible and does not limit the Army’s mission, the Army will erect signs and siebert stakes around the periphery of the area and notify Integrated Training Area

Management GIS so that the reclassification will appear on the next update of the range map.

10. Conserving host plants and using the viability of host plants as an indicator of ecosystem health in Lane Mountain milk-vetch habitat.

11. To ~~prevent~~monitor impacts to the Lane Mountain milk-vetch from fugitive dust, erect passive dust monitoring stations so that dust deposition can be monitored.

12. Appling soil binders to main supply routes and battalion staging areas to reduce dust production.

13. Monitoring and controlling invasive plants and weeds and monitoring and mapping the spread of exotic species in Lane Mountain milk-vetch habitat.

ADMINISTRATION OF THE CONSULTATION

The Army will evaluate future actions that may affect the desert tortoise or its critical habitat at Fort Irwin ~~in the following manner~~. The Natural and Cultural Resources Program Manager of the Directorate of Public Works at Fort Irwin will review all discretionary actions that the Army proposes on Fort Irwin. Based on the nature of the activity, its potential to adversely affect desert tortoises or their critical habitat, and any measures that can be implemented to avoid or minimize the effect, the Army will determine whether the action will not affect, is not likely to adversely affect, or is likely to adversely affect the desert tortoise or its critical habitat.

The Army will maintain a record of all its activities that undergo this evaluation. For actions that do not affect or are not likely to adversely affect the desert tortoise or its critical habitat, the Army will include in its record:

1. The title of the action;
2. A description of the proposed action;
3. Location;
4. Size; and
5. The rationale that it used to reach its determination regarding effects to the desert tortoise or its critical habitat.

For actions that are likely to adversely affect the desert tortoise or its critical habitat, the Army will include in its record:

1. The title of the proposed action;
2. A description of the proposed action;
3. Location;
4. Size;
5. The number of desert tortoises that are killed, injured, and moved from harm's way;
6. The amount of habitat disturbed or lost, with a notation as to whether the affected area was designated critical habitat;
7. A list~~ed~~ of authorized biologists who worked on actions covered by this consultation in the reporting year; and

8. A brief but comprehensive discussion of the protective measures used and whether the protective measures were effective. If the measures were not effective, the Army will explain why the measures did not function as expected and recommendations for implementing more effective measures.

In past consultations with the Army, the Service has authorized biologists to implement protective measures and handle desert tortoises on a project-by-project basis. Upon completion of this consultation, the Army will not request such authorization on a project-by-project basis. From this point, any person ~~that is~~ approved by the Service to undertake the duties of an authorized biologist for Army actions may also perform those duties on future Army actions if those actions are within the scope of~~proposed by the Army that are covered by~~ this biological opinion~~ may also perform those duties on future actions~~. If the Army determines that an authorized biologist is not performing his or her duties in a satisfactory manner, the Army will notify the Service at the earliest possible time it makes this determination.

The Service and Army agree ~~that some~~ actions ~~may be~~ proposed in the future ~~that~~ may result in effects which may be beyond the scope of those considered in this biological opinion. In the case of such actions, the Army and Service will ~~discuss~~determine whether this biological opinion sufficiently considered the proposed actions's effects to the desert tortoise and its critical habitat ~~in light of the proposed action~~ and whether re-initiation of formal consultation or initiation of a separate consultation is appropriate.

If staff from the Service and Army cannot agree on a course of action after discussions on this or other issues, any disagreement will be elevated to the Palm Springs Fish and Wildlife Office's Deputy Assistant Field Supervisor and the Army's Natural and Cultural Resources Program Manager for resolution. If further elevation is required, the Assistant Field Supervisor of the Palm Springs Fish and Wildlife Office and the Director of Public Works at Fort Irwin will be contacted to resolve the issue. Although the elevation of issues is likely to be an infrequent occurrence, the Army and Service consider this procedure to be a useful tool to maintain efficient processes and a healthy working relationship between our agencies.

The Army will provide the Service with an annual report of the activities that it conducts under the auspices of this consultation. The annual report will include the information that the Army will maintain in its records for any activity it determined was likely to adversely affect the desert tortoise or its critical habitat, as described in this section. The annual report will be provided to the Service by January 31 of each year this biological opinion is in effect.

Comment [c2]: What is the term of this biological opinion? Do we need one given that we will essentially meet and review the document annually?

The annual report will also contain information on conservation activities that the Army undertook in the previous year. Such activities may include, but are not limited to, acquisition of land through the Readiness and Environmental Preparedness Initiative and results of research on desert tortoises conducted or funded by the Army. In some cases, such as when the Army funds range-wide sampling of the desert tortoise, the Army would not provide the results of the work because the Service would summarize these findings in its annual reporting on the sampling effort.

The Palm Springs Fish and Wildlife Office's Deputy Assistant Field Supervisor and the Army's

Natural and Cultural Resources Program Manager, and appropriate staff, will meet annually to review how this consultation is functioning and to discuss any potentially important events in the upcoming year. If the Service and Army agree that such a meeting is unnecessary in any given year, the meeting may be cancelled.

Criteria for Use in Reaching Appropriate Determinations

The Army will use the following ~~outline~~protocol to determine the appropriate level of consultation required for each proposed action.

1. Projects in which any effects would occur outside of desert tortoise habitat would have no effect on the species; the Army will document its determinations in these situations for its own records but would not need to contact the Service. If the Army requires technical assistance from the Service to determine if suitable habitat for desert tortoises would be affected, it will contact us by phone or electronic mail.

2. If the following criteria are met, a determination of not likely to adversely affect the desert tortoise would be appropriate:

   a. The project is within habitat of the desert tortoise;

   b. Desert tortoise habitat is present, but degraded or disturbed, in the project area. For the purposes of this consultation, the Army and Service consider degraded habitat to be ~~that~~ habitat which has been affected by previous activities. Degraded habitat will generally exhibit a lower diversity and density of native shrubs and disrupted substrates than undisturbed habitat. The Army and Service ~~may~~ consider certain washes to be disturbed habitat; the fundamental characteristic for~~guidance in~~ such areas is ~~that~~ the evidence of the project activity would no longer be visible after an event where water flows in the wash. The loss or disturbance of a minor amount of undisturbed habitat may also be considered as being not likely to adversely affect the species, when considered with regard to its distribution in the action area; and

   c. Neither desert tortoises nor their diagnostic sign are observed during surveys or a habitat assessment.

   d. I~~n~~f the Army concludes a determination of adverse impact to the desert tortoise is not clear, then ~~cases where a determination is not entirely clear from a verbal description,~~ the Army will provide a verbal description of the habitat and appropriate photographs of the project site to the Service ~~with a photograph (aerial or otherwise, as appropriate) of the project site to~~which will assist in ~~its~~the determination.

3. If the following criteria are met, a determination of not likely to adversely modify or destroy~~affect~~ critical habitat for the desert tortoise w~~ould~~ill be appropriate:

   a. The project is within designated critical habitat, but the primary constituent elements of desert tortoise critical habitat are not present;

b. The primary constituent elements would not be affected by the proposed project; or

c. Effects to the primary constituent elements would be so minor that they are not measurable when considered within the context of the critical habitat unit. Such effects may occur, for example, when a narrow strip of land supporting the primary constituent elements of critical habitat at the edge of an existing road may be affected by an action.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Unless otherwise noted, the information in this section is from the integrated natural resources management plan for Fort Irwin (Army 2006 - 2011). The mission of Fort Irwin is to provide tough, realistic training for Army brigade combat teams under full battle conditions. Fort Irwin's battlefield is large and instrumented to record training activities; the instrumentation allows the Army to provide continuous and real-time feedback and heighten learning at all levels. Fort Irwin also serves as a laboratory and data source for training, doctrine, organization, and equipment.

Training on maneuver lands includes brigade-level force-on-force training and other operations that occur on a more limited scale. Brigade-level training generally involves 3,000 to 5,000 soldiers and 1,400 vehicles during an exercise. Force-on-force training is the movement of soldiers and equipment over the battlefield in realistic training exercises.

The Army also develops and operates training sites that specifically address military operations in urban terrain. These sites, which can vary in size from 500 meters by 500 meters to 4 square kilometers depending on their use and number of facilities to be replicated, simulate urban combat environments in which soldiers may find themselves worldwide; they provide soldiers the opportunity for combat training in realistic urbanized environments. Training may involve numerous soldiers and role players living at some facilities for up to ~~2 weeks~~18 days at a time.

Comment [c3]: The Army will experiment with an 18 day rotation in Jan, 2015. If it goes well, they may go to that model permanently. If they do, the number of rotations annually may be reduced to 8. Not sure how this will work yet.

All of the activities on Fort Irwin require the Army to continually maintain and upgrade its infrastructure. It also implements numerous activities that are related to overall management of the installation. The Army generally divided these activities into five categories (Everly 2014).

Training Area Activities

These activities include: monitoring and maintenance of improvised explosive device training culverts; deconstruction/relocation of existing training villages; construction of new training villages; deconstruction of existing forward operating bases (removal of concrete slabs, removal of command and control buildings, leveling of protective berms, removal of HESCO barriers [HESCO barriers are large wire and canvas containers that units can fill with soil that are used to provide cover]); construction of forward operating bases to include building protective berms, installing HESCO barriers, pouring concrete pads for tents, and construction of small command and control facilities; installation of trench complexes serving as defensive positions, obstacles

for breach training activities, and gap crossing exercises; construction/refurbishment of helipads (compacted dirt/gravel or poured concrete); construction/refurbishment of forward arming and refuel points (compacted dirt/gravel or poured concrete); building/refurbishing unmanned aerial vehicle runways (compacted dirt/paved); refurbishing Goldstone Airfield to include realignment of Goddard Road, construction of a hangar facility and related infrastructure (utilities, fiber); building/refurbishing flight landing strips (compacted dirt) for use in conducting forced entry and ~~lodgement~~ airfield seizure and lodgement expansion operations. ~~The c~~Construction of flight landing strips will include a mock tower, mock fuel storage facility, taxiway, aircraft parking area, and temporary aircraft refueling pad. All of these activities involve the use of heavy construction equipment (bulldozers, graders, dump trucks) to clear and compact dirt in the construction footprint. Access to the construction sites will be by existing dirt/paved roads. Drop zone areas, in proximity to the flight landing strip locations, may also be designated. While drop zones normally require no construction activities they are areas used for parachutists to land in as well as for dropping equipment and supplies, by parachute, for use by soldiers delivered to the battlefield by parachute. Impacts to designated drop zone lands result from the landing of parachutists and their equipment.

Training Area Management/Safety Activities

These activities include: maneuver trail improvement and maintenance involving the re-contouring of existing trails, installation of gabions and rolling ditches and repair of existing dirt trails as a result of use/erosion events; monitoring and maintenance of erosion control culverts; application of dust suppressants on dirt trails (soil cement/magnesium chloride) on Fort Irwin and the Manix Trail right-of-way; closing of existing dirt trails; development of new trail networks; installation of communication sites consisting of antennae construction (including a concrete pad) or refurbishment of an existing structure, installation of communication equipment cabinets, installation of power generation equipment/hardwire sites in from existing utility lines; installation of fiber optic lines and associated equipment vaults; habitat restoration to include mechanical/hand seeding and emplacement of native plant seedlings; move/add/replace targets to include digging of target pits to house target lifting mechanisms; building, upgrading, maintaining combat training ranges (small arms ranges, hand grenade range, urban assault range) including building/replacing backstop berms, digging fighting positions, digging up/replacing/emplacing new electrical wiring and fiber, emplacing new target lifting mechanisms, repairing/replacing/installing new range towers, emplacing safety markers, building shoot houses and urban obstacles/targets. All of these activities involve the use of heavy construction equipment (bulldozers, graders, backhoes, dump trucks) to clear and compact dirt in the construction footprint. Access to the construction sites will be by existing dirt/paved roads.

Cantonment Infrastructure Activities

These activities include: utilities (water, sewer, gas, electric) maintenance, repair, replacement and installation of new lines and associated structures (water tanks, transformers, LPG tanks, etc.); destruction/removal of existing facilities; maintenance, repair, replacement, and/or construction of new facilities (barracks, hospital, housing, water treatment plant, company operations facilities, aircraft hangars, warehouses, maintenance buildings, office buildings, headquarters buildings, etc.); activation of new units to include construction/renovation/repair of

related housing, office, maintenance and training facilities; deactivation of existing units to include destruction/removal of facilities no longer needed and the repair/renovation of associated housing, office, maintenance and training facilities; construction, repair and maintenance of roads and related structures (culverts, bridges, overpasses, etc.); fence installation, maintenance, and repair; and sign installation, maintenance and repair.

Alternative Energy Activities

These activities include: construction, operation and maintenance of solar energy sites within the boundaries of Fort Irwin (includes grading/ leveling of the site, installation of solar technology, trenching for laying of electrical wire, installation of associated infrastructure, interconnection to existing electrical transmission capabilities, etc.); construction of shade structures with attached solar technology and related electrical connection infrastructure; and construction of a waste-to-energy facility including excavation of materials from the existing landfill, modification to existing baler/solid waste receiving facilities, and construction of a pyrolytic conversion facility (building, concrete pad, utilities) for conversion of solid waste to electrical energy~~;~~.

Comment [c4]: Ray, Should we include development of wind energy sites as well? We will not currently erect any because of the effects to aircraft training and testing in the R2508. However, if technology changes such that no effects from wind turbines exist to military AC systems it may be something we would want to investigate.

Recreation and Related Activities

These activities include: Hunting of state authorized game species, planning, constructing (identifying the course route, digging pits to be filled with water, creating dirt mounds over which contestants must rung, etc.) and deconstructing "mud run" courses, conducting tours of old mining towns and historic sites utilizing off road capable buses (tours will utilize existing roads and trails), off highway vehicle use following designated routes, and construction, operation and deconstruction of a paint ball course. Rock hounding in designated areas, camping in designated areas, construction, operation, maintenance and deconstruction of athletic fields and playground sites (in cantonment), and the erection, use and tear down of tents, portable generators, trailers, booths, etc. for use during holiday celebrations (in cantonment).

Research and Education Activities

These activities include: sensitive species inventory, survey and monitoring (includes access by existing roads to survey/monitoring sites; surveys/monitoring will be conducted on foot or by vehicle driven at very low speeds); digging, fence installation, burning, trimming, seeding, equipment installation (cameras, weather stations, etc.) in support of research projects; off limits area fence installation, maintenance, and repair; Siebert stake installation, maintenance and repair; off limits area sign installation, maintenance and repair; fire management in off limits areas (respond to wildfires); and feral burro removal.

Comment [c5]: I was reminded that we conduct portions of our burrowing owl surveys by vehicle using existing roads and trails.

The Army will also undertake numerous actions in the course of managing natural resources on Fort Irwin. These measures include but are not limited to:

1. Continuing the control of invasive species to reduce degradation of plant and wildlife habitats on Fort Irwin.

2. Continuing control of feral burros on Fort Irwin to better protect natural resources.

3. Undertaking surveys of project sites and buffers that may affect desert tortoises to document plant and animal species.

4. Conducting post-project monitoring of certain activities that have the potential to affect federally listed species. The purpose of this monitoring is to ensure that avoidance and minimization measures have been properly implemented, to assess the effectiveness of these measures, and to allow for modifications to minimization measures, as needed.

Protective Measures

The Army will continue to implement procedures designed to minimize impacts to desert tortoises. These procedures will ensure that potential impacts are minimized ~~as much as possible~~ by being assessed during the project planning and approval process and monitored for compliance and effectiveness.

1. The Army will minimize incidental injury and mortality of desert tortoises by employing the following measures. Actual measures will be based on the results of site-specific field surveys and will be implemented, as needed, at the ~~discretion~~professional judgement of the Army's environmental personnel (hereafter 'environmental staff'), including:

   a. Clearly delineating the boundaries of new construction or new target and test sites on the ground by flagging, survey lath, or wooden stakes;

   b. Placing signs, as needed, to indicate the need to reduce speeds on roadways and that activities are to be strictly confined to the project site;

   c. Biological monitoring of operations involved with the active removal of desert tortoise habitat known to be near the project site. Activities within existing test and target operations (operations including area preparation, target set-up, the actual test event and the target removal and site clean-up) would not require biological monitoring. The purpose of the biological monitoring is to ensure that avoidance and minimization measures have been properly implemented, to assess the effectiveness of these measures and to allow for modifications to minimization measures, as needed.

   d. Placing desert tortoise-proof fences around projects or portions of projects in desert tortoise habitat where~~,~~ the probability of injuring or killing a desert tortoise, without such fencing in place, is considered to be reasonably foreseeable.

2. Desert tortoise burrows located within 100 feet of the limits of construction or establishment of new target or test site boundaries will be protected by conducting additional on-site project personnel briefings (tailgate). If necessary, the Army will either (1) place temporary (short-term) desert tortoise-proof fencing to completely enclose the burrow at a minimum distance of 20 feet from the burrow or, (2) for longer duration construction projects, fence the limits of construction to avoid any potential impacts to desert tortoises.

Comment [c6]: I would like to use a qualifying term here so that someone in the future cannot argue that FWS is giving blanket discretion to the Army's environmental staff.

3. Desert tortoise burrows that cannot be avoided will be excavated by hand either by or under the direct supervision of an authorized biologist. Burrow excavation and subsequent handling of any desert tortoises will follow the most up-to-date guidelines that are acceptable to the Service.

4. The Army will submit the credentials of personnel to be designated as authorized biologists to the Service at least 30 days prior to the onset of the activities to be monitored. The general qualifications and the request form are located on the Ventura Fish and Wildlife Office's website at http://www.fws.gov/ventura/species_information/protocols_guidelines/index.html.

5. All trash and debris will be promptly contained within containers that common ravens (*Corvus corax*) cannot access. These containers will be regularly removed from project sites to reduce the attractiveness of the area to common ravens and other desert tortoise predators.

6. Environmental staff will conduct awareness briefings for all personnel working in desert tortoise habitat. These briefings will be conducted either in person or via a video presentation of the briefing. At a minimum, the briefings will include discussions of:

   a. the general provisions of the Endangered Species Act;

   b. the necessity for adhering to the provisions of the Act~~, including both civil and criminal penalties for noncompliance. The penalties for these violations can be a maximum fine of up to $50,000 or imprisonment for one year, or both, and civil penalties of up to $25,000 per violation, may be assessed;~~

   c. the potential for civil and criminal penalties associated with violating the provisions of the Act;

   d. the specific requirements for complying with the provisions of the Act as they relate to each project;

   e. the exact boundaries of the site within which the project activities may be accomplished;

   f. the procedures to be accomplished by project personnel should any problem arise with respect to complying with environmental requirements~~constraints~~;

   g. general behavior and ecology of the desert tortoise and its sensitivity to human activities;

   h. all personnel will be advised of the potential for desert tortoises to take refuge under vehicles and of the proper procedures to follow in that event; and

   i. specific procedures to be followed to move a desert tortoise that may be in imminent danger (on a heavily traveled road, on an active project site, or under a vehicle).

7. All personnel will check beneath their vehicles while in desert tortoise habitat prior to moving the vehicle. If a desert tortoise is found beneath the vehicle, it will be moved by environmental staff or by project personnel in accordance with guidelines provided to them during the awareness briefings. ~~All personnel will be advised of the potential for desert tortoises to take refuge under vehicles and of the proper procedures to follow in that event.~~ The Army will report any removals of desert tortoises to the Service in its annual report.

Comment [c7]: Already stated in h. above.

8. The primary means to eliminate or minimize impacts to desert tortoises or their habitat will continue to be implemented through the use of avoidance and minimization procedures. These methods include the following:

    a. To the extent possible, project sites will be selected so that they are located in previously disturbed areas.

    b. Surveys for desert tortoises will be accomplished for any project that occurs in potential habitat. Surveys will be conducted to support the analysis conducted under the National Environmental Policy Act for new surface disturbing projects and where new disturbance may occur in desert tortoise habitat. Biologists will conduct surveys in accordance with the most current Service survey guidelines., ~~except s~~Surveys may be conducted year-round due to the short timelines associated with the Army's activities.

    c. If new projects are located in desert tortoise habitat, environmental staff will, in conjunction with project proponents, attempt to reduce impacts by assessing the feasibility of adjusting a project's size, footprint, orientation, and construction method;

    d. If new projects ~~have to~~will be located where desert tortoises are known to occupy the project site, desert tortoises will be relocated by Service-authorized biologists prior to start of any activities. Authorized biologists are responsible for adhering to Service protocols and guidelines for handling and relocating desert tortoises.

    e. New land-disturbing activities that have occurred within habitats that support desert tortoises will continue to be documented in annual reports submitted to the Service.

9. The Army will maintain coordination with Service and fulfill annual reporting requirements.

Management of Common Ravens

The integrated natural resources management plan (Army 2006 – 2011) for Fort Irwin notes that the Army will alter landfills and sewage ponds to reduce the number of predators (including common ravens) that use these sites. The Army will also implement predator control programs and participate in regional plans sponsored by the Desert Managers Group to control common ravens. As a standard practice, the Army requires soldiers and contractors to bag and dispose of all trash and food items generated by training, construction, and maintenance activities.

Relocation of Desert Tortoises

In the event that future development or activities would result in the clearing of suitable desert tortoise habitat, the Army would relocate desert tortoises from these sites to other habitat. Depending on the type of development and its location, desert tortoises may be moved to suitable habitat immediately off-site or to other suitable habitat on the installation where they would be less likely to be affected by the Army's activities; the Army may move desert tortoises to a conservation area if it provides the best fit. The authorized biologist and Natural Resources Program Manager will determine the appropriate locations. The authorized biologist will examine all desert tortoises that are moved away from the site of their capture for clinical signs of disease prior to moving them. If a desert tortoise exhibits clinical signs of disease, in consultation with the Service it will either be moved immediately off site or removed from the wild if the Service determines that is the best course of action.

On occasions when desert tortoises may be at risk of being injured or killed by other types of activities (e.g., it is on or near a road), the Army will assess the situation and implement the most appropriate measure. The Fort Irwin Natural Resources Program Manager or the unit's Environmental Compliance Team personnel will choose from a suite of measures depending on the circumstances. For example, if a desert tortoise is in a road and blocking a few vehicles, the drivers will avoid the desert tortoise by driving around it. If the desert tortoise is on a road that will be used throughout the day, the Army will notify other units in the area and may assign someone to monitor the desert tortoise. In some cases, the Army may be familiar with the animal's b~~o~~urrow(s) and use of the area and may move it out of danger into areas it frequents.

Extent of Future Development

The Environmental Baseline – Previous Consultations in the Action Area section of this biological opinion describes the previous biological opinions that addressed the Army's training activities at Fort Irwin (Service 1991a, 2012). In these biological opinions, we analyzed the effects of the Army's various training activities on the desert tortoise and its critical habitat throughout Fort Irwin, with the exception of the western expansion area. (We describe the current situation in the western expansion area in the Environmental Baseline – Previous Consultations in the Action Area section of this biological opinion.) Consequently, because we have already conducted these analyses, this biological opinion addresses only the development of new infrastructure at Fort Irwin and the operation and maintenance of new and existing infrastructure.

Comment [c8]: Recommend clarifying. This section is more a discussion of the history of consultations rather than a discussion of the Environmental Baseline. If the idea is to incorporate by reference the discussion of the Environmental Baseline from prior BiOPs, then recommend inserting a sentence or two into this document. One sentence would incorporate the prior BiOPs and the second would say the prior discuss is current.

Comment [c9]: Can different terms be used as a substitute for "The Environmental Baseline"? The use here is confusing as it creates the expectation a discussion of the environmental baseline will follow. The actual Environmental Baseline seems to start on page 32 of the document.

To ensure that its activities do not result in numerous injuries to or mortalities of desert tortoises, the Army has proposed to examine any incident that results in injury or mortality and determine whether additional protective measures are needed to reduce the potential for future injury or mortality. The Army may informally consult with the Service regarding the need for or nature of additional measures if it so chooses. The Army has also proposed to re-initiate formal consultation if five desert tortoises are killed or injured in a calendar year as a result of the actions considered in this biological opinion.

Past training activities at Fort Irwin have disturbed most areas within the valley bottoms and lower alluvial fans within the installation's original~~former~~ boundary; the Service's (2012)

biological opinion on the use of additional training lands in the Eastgate parcel and the southern expansion area considered the effects of training on habitat, including critical habitat, in these areas. In combination, these biological opinions recognized that training activities, including force-on-force maneuvers and the construction and operation of training sites for military operations in urban terrain, have either already removed (in the case of the area within the ~~former~~original boundary) or would eventually remove most habitat value from training areas. Additionally, we recognize that, even considering the future development of solar fields at Fort Irwin, the development of new infrastructure would be a minor fraction of the area that would be affected by training; consequently, the Army and Service agreed that we would not include a threshold for re-initiation of formal consultation in this document that addressed the disturbance of habitat in general or critical habitat.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 Code of Federal Regulations 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the status of the species, which describes the range-wide condition of the desert tortoise, the factors responsible for that condition, and its survival and recovery needs; (2) the environmental baseline, which analyzes the condition of the desert tortoise in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the desert tortoise; (3) the effects of the action, which determine the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the desert tortoise; and (4) the cumulative effects, which evaluate the effects of future, non-federal activities in the action area on the desert tortoise.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the current status of the desert tortoise, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the desert tortoise in the wild.

Adverse Modification Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of the critical habitat of listed species. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 Code of

Federal Regulations 402.02. Instead, we have relied on the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the status of critical habitat, which describes the range-wide condition of designated critical habitat for the desert tortoise in terms of primary constituent elements, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the environmental baseline, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the effects of the action, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated and interdependent activities on the primary constituent elements and how that will influence the recovery role of the affected critical habitat units; and (4) cumulative effects, which evaluates the effects of future non-federal activities in the action area on the primary constituent elements and how that will influence the recovery role of affected critical habitat units.

Comment [sc10]: If they are relying on the statutory provisions of the Act, then why are they citing policy and regulation – should they not cite the Act?

For purposes of the adverse modification determination, the effects of the proposed Federal action on the critical habitat of the desert tortoise are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the primary constituent elements to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the desert tortoise.

STATUS OF THE DESERT TORTOISE AND CRITICAL HABITAT

Status of the Desert Tortoise

Section 4(c)(2) of the Endangered Species Act requires the Service to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review); these reviews, at the time of their completion, provide the most up-to-date information on the range-wide status of the species. For this reason, we are appending the 5-year review of the status of the desert tortoise (Appendix 1; Service 2010e) to this biological opinion and are incorporating it by reference to provide most of the information needed for this section of the biological opinion. The following paragraphs provide a summary of the relevant information in the 5-year review.

In the 5-year review, the Service discusses the status of the desert tortoise as a single distinct population segment and provides information on the Federal Register notices that resulted in its listing and the designation of critical habitat. The Service also describes the desert tortoise's ecology, life history, spatial distribution, abundance, habitats, and the threats that led to its listing (i.e., the 5-factor analysis required by section 4(a)(1) of the Endangered Species Act). In the 5-year review, the Service concluded by recommending that the status of the desert tortoise as a threatened species be maintained.

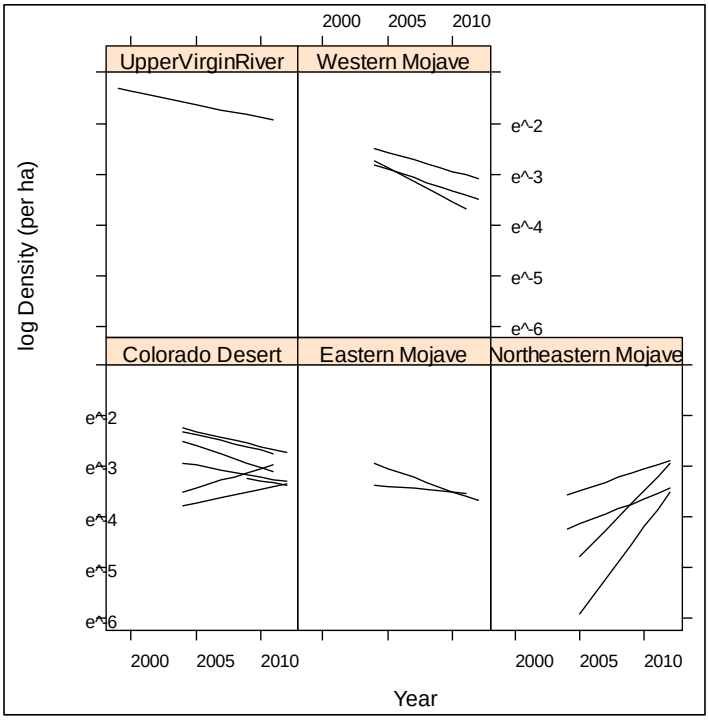
With regard to the status of the desert tortoise as a distinct population segment, the Service

concluded in the 5-year review that the recovery units recognized in the original and revised recovery plans (Service 1994 and 2011e, respectively) do not qualify as distinct population segments under the Service's distinct population segment policy (61 Federal Register 4722; February 7, 1996). We reached this conclusion because individuals of the listed taxon occupy habitat that is relatively continuously distributed, exhibit genetic differentiation that is consistent with isolation-by-distance in a continuous-distribution model of gene flow, and likely vary in behavioral and physiological characteristics across the area they occupy as a result of the transitional nature of, or environmental gradations between, the described subdivisions of the Mojave and Colorado deserts.

In the 5-year review, the Service summarizes information with regard to the desert tortoise's ecology and life history. Of key importance to assessing threats to the species and to developing and implementing a strategy for recovery is that desert tortoises are long lived, require up to 20 years to reach sexual maturity, and have low reproductive rates during a long period of reproductive potential. The number of eggs that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition. Predation seems to play an important role in clutch failure. Predation and environmental factors also affect the survival of hatchlings.
In the 5-year review, the Service also discusses various means by which researchers have attempted to determine the abundance of desert tortoises and the strengths and weaknesses of those methods. Due to differences in area covered and especially to the non-representative nature of earlier sample sites, data gathered by the Service's current range-wide monitoring program cannot be reliably compared to information gathered through other means at this time.

The Service provides a summary table of the results of range-wide monitoring, initiated in 2001, in the 5-year review. This ongoing sampling effort is the first comprehensive attempt to determine the densities of desert tortoises across their range. Table 1 of the 5-year review provides a summary of data collected from 2001 through 2007; we summarize data from the 2008 through 2012 sampling efforts in subsequent reports (Service 2012a, 2012b, 2012c, 2012d).

The Desert Tortoise Recovery Office (Service 2014) used these annual density estimates to evaluate range-wide trends in the density of desert tortoises over time. This analysis indicates that densities in the Northeastern Mojave Recovery Unit have increased by approximately 13.6 percent per year since 2004, with the rate of increase apparently resulting from increased survival of adults and subadults moving into the adult size class. The analysis also indicates that the populations in the other 4 recovery units are declining: Upper Virgin River (-5.1 percent), Eastern Mojave (-6.0 percent), Western Mojave (-8.6 percent), and Colorado Desert (-3.4 percent; however, densities in the Joshua Tree and Piute Valley conservation areas within this unit seem to be increasing). The following figure shows linear trends in the log-transformed densities in each desert tortoise conservation area by recovery unit. Data for the Upper Virgin River Recovery Unit are from 1999 to the present; data for all other recovery units are from 2004 to the present.



Allison (2014) also evaluated changes in size distribution of desert tortoises since 2001. In the Western Mojave and Colorado Desert recovery units, the relative number of juveniles to adults indicates that juvenile numbers are declining faster than adults. In the Eastern Mojave, the number of juvenile desert tortoises is also declining, but not as rapidly as the number of adults. In the Upper Virgin River Recovery Unit, trends in juvenile numbers are similar to those of adults; in the Northeastern Mojave Recovery Unit, the number of juveniles is increasing, but not as rapidly as are adult numbers in that recovery unit. Juvenile numbers, like adult densities, are responding in a directional way, with increasing, stable, or decreasing trends, depending on the recovery unit where they are~~a~~ found.

In the 5-year review, the Service provides a brief summary of habitat use by desert tortoises; more detailed information is available in the revised recovery plan (Service 2011e). In the absence of specific and recent information on the location of habitable areas of the Mojave Desert, especially at the outer edges of this area, the 5-year review also describes and relies heavily on a quantitative, spatial habitat model for the desert tortoise north and west of the Colorado River that incorporates environmental variables such as precipitation, geology, vegetation, and slope and is based on occurrence data of desert tortoises from sources spanning more than 80 years, including data from the 2001 to 2005 range-wide monitoring surveys (Nussear et al. 2009). The model predicts the probability that desert tortoises will be present in any given location; calculations of the amount of desert tortoise habitat in the 5-year review and in this biological opinion use a threshold of 0.5 or greater predicted value for potential desert

tortoise habitat. The model does not account for anthropogenic effects to habitat and represents the potential for occupancy by desert tortoises absent these effects.

To begin integrating anthropogenic activities and the variable risk levels they bring to different parts of the Mojave and Colorado deserts, the Service completed an extensive review of the threats known to affect desert tortoises at the time of their listing and updated that information with more current findings in the 5-year review. The review follows the format of the five-factor analysis required by section 4(a)(1) of the Endangered Species Act. The Service described these threats as part of the process of its listing (55 Federal Register 12178; April 2, 1990), further discussed them in the original recovery plan (Service 1994), and reviewed them again in the revised recovery plan (Service 2011e).

To understand better the relationship of threats to populations of desert tortoises and the most effective manner to implement recovery actions, the Desert Tortoise Recovery Office is developing a spatial decision support system that models the interrelationships of threats to desert tortoises and how those threats affect population change. The spatial decision support system describes the numerous threats that desert tortoises face, explains how these threats interact to affect individual animals and habitat, and how these effects in turn bring about changes in populations. For example, we have long known that the construction of a transmission line can result in the death of desert tortoises and loss of habitat. We have also known that common ravens, known predators of desert tortoises, use the transmission line's pylons for nesting, roosting, and perching and that the access routes associated with transmission lines provide a vector for the introduction and spread of invasive weeds and facilitate increased human access into an area. Increased human access can accelerate illegal collection and release of desert tortoises and their deliberate maiming and killing, as well as facilitate the spread of other threats associated with human presence, such as vehicle use, garbage and dumping, and invasive plants (Service 2011e). Changes in the abundance of native plants because of invasive weeds can compromise the physiological health of desert tortoises, making them more vulnerable to drought, disease, and predation. The spatial decision support system allows us to map threats across the range of the desert tortoise and model the intensity of stresses that these multiple and combined threats place on desert tortoise populations.

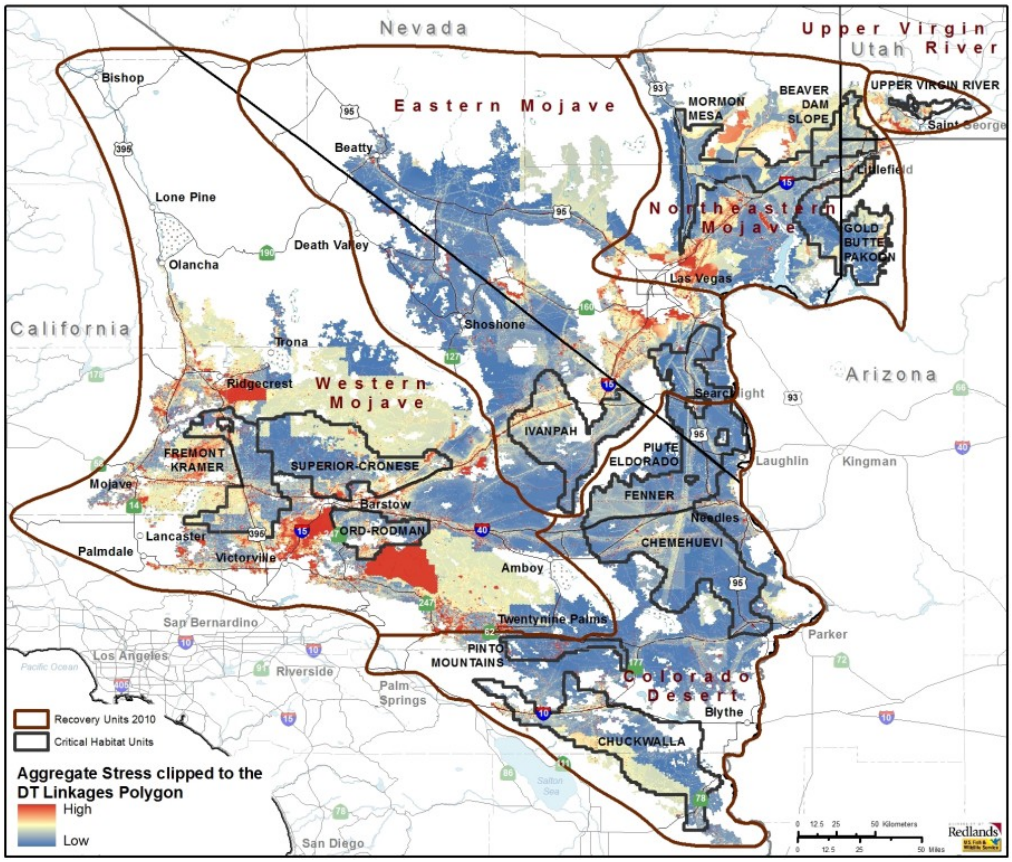
The threats described in the listing rule and both recovery plans continue to affect the species. Indirect impacts to desert tortoise populations and habitat occur in accessible areas that interface with human activity. Most threats to the desert tortoise or its habitat are associated with human land uses; research since 1994 has clarified many mechanisms by which these threats act on desert tortoises. As stated earlier, increases in human access can accelerate illegal collection and release of desert tortoises and deliberate maiming and killing, as well as facilitate the spread of other threats associated with human presence, such as vehicle use, garbage and dumping, and invasive weeds.

Some of the most apparent threats to the desert tortoise are those that result in mortality and permanent habitat loss across large areas, such as urbanization and large-scale renewable energy projects, and those that fragment and degrade habitats, such as proliferation of roads and highways, off-highway vehicle activity, and habitat invasion by non-native invasive plant species. However, we remain unable to quantify how threats affect desert tortoise populations.

DRAFT **DRAFT** **DRAFT**

The assessment of the original recovery plan emphasized the need for a better understanding of the implications of multiple, simultaneous threats facing desert tortoise populations and of the relative contribution of multiple threats on demographic factors (i.e., birth rate, survivorship, fecundity, and death rate; Tracy et al. 2004).

The following map depicts the 12 critical habitat units of the desert tortoise, linkages between conservation areas for the desert tortoise, and the aggregate stress that multiple, synergistic threats place on desert tortoise populations. Conservation areas include designated critical habitat, lands managed by the National Park Service, and other lands managed for the long-term conservation of the desert tortoise (e.g., the Desert Tortoise Natural Area in Kern County, California). The revised recovery plan (Service 2011e) recommended the linkages based on an analysis of least-cost pathways (i.e., areas with the highest potential to support desert tortoises) between conservation areas for the desert tortoise. This map illustrates that, across the range, desert tortoises in areas under the highest level of conservation management remain subject to numerous threats, stresses, and mortality sources.



Since the completion of the 5-year review, the Service has issued several biological opinions that affect large areas of desert tortoise habitat because of numerous proposals to develop renewable energy within its range. These biological opinions concluded that proposed solar plants were not likely to jeopardize the continued existence of the desert tortoise primarily because they were located outside of critical habitat and desert wildlife management areas that contain most of the land base required for the recovery of the species. The proposed actions also included numerous measures intended to protect desert tortoise during the construction of the projects, such as translocation of affected individuals. In aggregate, these projects would result in an overall loss of approximately 37,503 acres of habitat of the desert tortoise. We also predicted that these projects would translocate or kill up to 1,732 desert tortoises; we concluded that most of the individuals in these totals would be juveniles. To date, 372 desert tortoises have been observed during construction of projects; most of these individuals were translocated from work areas, although some desert tortoises have been killed (see Appendix 2). The mitigation required by the Bureau of Land Management and California Energy Commission, the agencies permitting these facilities, will result in the acquisition of private land within critical habitat and desert wildlife management areas and funding for the implementation of various actions that are intended to promote the recovery of the desert tortoise. Although most of these mitigation measures are consistent with recommendations in the recovery plans for the desert tortoise and the Service continues to support their implementation, we cannot assess how desert tortoise populations will respond because of the long generation time of the species.

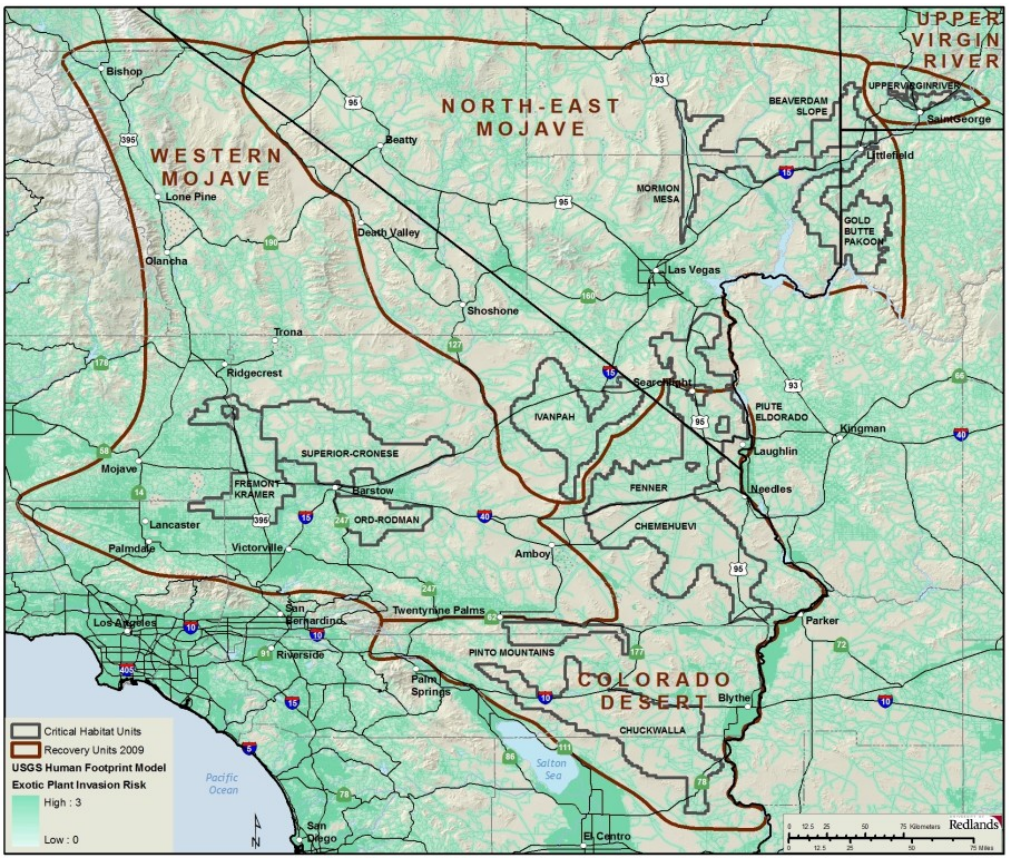
In addition to the biological opinions issued for solar development within the range of the desert tortoise, the Service (2012e) also issued a biological opinion to the Department of the Army for the use of additional training lands at Fort Irwin. As part of this proposed action, the Department of the Army removed approximately 650 desert tortoises from 18,197 acres of the southern area of Fort Irwin, which had been off-limits to training. The Department of the Army would also use an additional 48,629 acres that lie east of the former boundaries of Fort Irwin; much of this parcel is either too mountainous or too rocky and low in elevation to support numerous desert tortoises. We provide results of the translocation later in this section.

The Service also issued a biological opinion to the Marine Corps that considered the effects of the expansion of the Marine Corps Air Ground Combat Center at Twentynine Palms (Service 2012f). We concluded that the Marine Corps' proposed action, the use of approximately 167,971 acres for training, was not likely to jeopardize the continued existence of the desert tortoise. Most of the expansion area lies within the Johnson Valley Off-high Vehicle Management Area.

The incremental effect of the larger actions (i.e., solar development, the expansions of Fort Irwin, and the Marine Corps Air Ground Combat Center) on the desert tortoise is unlikely to be positive, despite the numerous conservation measures that have been (or will be) implemented as part of the actions. The acquisition of private lands as mitigation for most of these actions increases the level of protection afforded these lands; however, these acquisitions do not create new habitat and Federal, State, and privately managed lands remain subject to most of the threats and stresses we discussed previously in this section. Although land managers have been implementing measures to manage these threats, we have been unable, to date, to determine whether the measures have been successful, at least in part because of the low reproductive

capacity of the desert tortoise. Therefore, the conversion of habitat into areas that are unsuitable for this species continues the trend of constricting the desert tortoise into a smaller portion of its range.

As the Service notes in the 5-year review (Service 2010e), "(t)he threats identified in the original listing rule continue to affect the (desert tortoise) today, with invasive species, wildfire, and renewable energy development coming to the forefront as important factors in habitat loss and conversion. The vast majority of threats to the desert tortoise or its habitat are associated with human land uses." Oftedal's work (2002 in Service 2010e) suggests that invasive weeds may adversely affect the physiological health of desert tortoises. Current information indicates that invasive species likely affect a large portion of the desert tortoise's range (see following map). Furthermore, high densities of weedy species increase the likelihood of wildfires; wildfires, in turn, destroy native species and further the spread of invasive weeds.



Global climate change is likely to affect the prospects for the long-term conservation of the desert tortoise. For example, predictions for climate change within the range of the desert tortoise suggest more frequent and/or prolonged droughts with an increase of the annual mean

temperature by 3.5 to 4.0 degrees Celsius. The greatest increases will likely occur in summer (June-July-August mean increase of as much as 5 degrees Celsius [Christensen et al. 2007 in Service 2010e]). Precipitation will likely decrease by 5 to 15 percent annually in the region with winter precipitation decreasing by up to 20 percent and summer precipitation increasing by up to 5 percent. Because germination of the desert tortoise's food plants is highly dependent on cool-season rains, the forage base could be reduced due to increasing temperatures and decreasing precipitation in winter. Although drought occurs routinely in the Mojave Desert, extended periods of drought have the potential to affect desert tortoises and their habitats through physiological effects to individuals (i.e., stress) and limited forage availability. To place the consequences of long-term drought in perspective, Longshore et al. (2003) demonstrated that even short-term drought could result in elevated levels of mortality of desert tortoises. Therefore, long-term drought is likely to have even greater effects, particularly given that the current fragmented nature of desert tortoise habitat (e.g., urban and agricultural development, highways, freeways, military training areas, etc.) will make recolonization of extirpated areas difficult, if not impossible.

The Service notes in the 5-year review that the combination of the desert tortoise's late breeding age and a low reproductive rate challenges our ability to achieve recovery. When determining whether a proposed action is likely to jeopardize the continued existence of a species, we are required to consider whether the action would "reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 Code of Federal Regulations 402.02). Although the Service does not explicitly address these metrics in the 5-year review, we have used the information in that document to summarize the status of the desert tortoise with respect to its reproduction, numbers, and distribution.

In the 5-year review, the Service notes that desert tortoises increase their reproduction in high rainfall years; more rain provides desert tortoises with more high quality food (i.e., plants that are higher in water and protein), which, in turn, allows them to lay more eggs. Conversely, the physiological stress associated with foraging on food plants with insufficient water and nitrogen may leave desert tortoises vulnerable to disease (Oftedal 2002 in Service 2010e), and the reproductive rate of diseased desert tortoises is likely lower than that of healthy animals. Young desert tortoises also rely upon high-quality, low-fiber plants (e.g., native forbs) with nutrient levels not found in the invasive weeds that have increased in abundance across its range (Oftedal et al. 2002; Tracy et al. 2004). Compromised nutrition of young desert tortoises likely represents an effective reduction in reproduction by reducing the number that reaches adulthood. Consequently, although we do not have quantitative data that show a direct relationship, the abundance of weedy species within the range of the desert tortoise has the potential to negatively affect the reproduction of desert tortoises and recruitment into the adult population.

Data from long-term study plots, which were first established in 1976, cannot be extrapolated to provide an estimate of the number of desert tortoises on a range-wide basis; historical densities in some parts of the desert exceeded 100 adults in a square mile (Desert Tortoise Recovery Office 2014). Using data from the long-term study plots, the Service (2010) concluded that "appreciable declines at the local level in many areas, which coupled with other survey results, suggest that declines may have occurred more broadly." Other sources indicate that local

declines are continuing to occur. For example, surveyors found "lots of dead [desert tortoises]" in the western expansion area of Fort Irwin (Western Mojave Recovery Unit) in 2008 (Fort Irwin Research Coordination Meeting 2008). After the onset of translocation, coyotes killed 105 desert tortoises in Fort Irwin's southern translocation area (Western Mojave Recovery Unit); other canids may have been responsible for some of these deaths. Other incidences of predation were recorded throughout the range of the desert tortoise during this time (Esque et al. 2010). Esque et al. (2010) hypothesized that this high rate of predation on desert tortoises was influenced by low population levels of typical prey for coyotes due to drought conditions in previous years. Recent surveys in the Ivanpah Valley (Eastern Mojave Recovery Unit) for a proposed solar facility detected 31 live desert tortoises and the carcasses of 25 individuals that had been dead less than 4 years (Ironwood 2011); this ratio of carcasses to live individuals over such a short period of time may indicate an abnormally high rate of mortality for a long-lived animal. In summary, the number of desert tortoises range-wide likely decreased substantially from 1976 through 1990 (i.e., when long-term study plots were initiated through the time the desert tortoise was listed as threatened), although we cannot quantify the amount of this decrease. Additionally, more recent data collected from various sources throughout the range of the desert tortoise suggest that local declines continue to occur (e.g., Bureau of Land Management et al. 2005, Esque et al. 2010).

The distribution of the desert tortoise has not changed substantially since the publication of the original recovery plan in 1994 (Service 2010e) in terms of the overall extent of its range. Prior to 1994, desert tortoises were extirpated from large areas within their distributional limits by urban and agricultural development (e.g., the cities of Barstow and Lancaster, California; Las Vegas, Nevada; and St. George, Utah; etc.; agricultural areas south of Edwards Air Force Base and east of Barstow), military training (e.g., Fort Irwin, Leach Lake Gunnery Range), and off-road vehicle use (e.g., portions of off-road management areas managed by the Bureau of Land Management and unauthorized use in areas such as east of California City, California). Since 1994, urban development around Las Vegas has likely been the largest contributor to habitat loss throughout the range. Desert tortoises have been essentially removed from the 18,197-acre southern expansion area at Fort Irwin (Service 2012e).

The following table depicts acreages of habitat (as modeled by Nussear et al. 2009, using only areas with a probability of occupancy by desert tortoises greater than 0.5 as potential habitat) within various regions of the desert tortoise's range and of impervious surfaces as of 2006 (Fry et al. 2011). Impervious surfaces include paved and developed areas and other disturbed areas that have zero probability of supporting desert tortoises.

Recovery Units	Modeled Habitat (acres)	Impervious Surfaces within Modeled Habitat	Percent of Modeled Habitat that is now Impervious
Western Mojave	7,582,092	1,864,214	25
Colorado Desert	4,948,900	494,981	10
Northeastern Mojave	3,013,677	378,497	13

Eastern Mojave	4,763,257	794,546	17
Upper Virgin River	232,320	80,853	35
Total	20,540,246	3,613,0~~52~~91	18

Using the acreages of remaining habitat and the densities of the recovery units, the Desert Tortoise Recovery Office (2014) then estimated the number of desert tortoises greater than 180 millimeters in length in each recovery unit. The following table contains these numbers. We acknowledge that these numbers are not precise but consider it a reasonable way to describe overall changes in the population. For example, we base the density estimate of each recovery unit on surveys conducted within desert tortoise conservation areas and then extend this density to the entire recovery unit although we presume densities are highest within the conservation areas.

Recovery Units	2004	2012	Change
Western Mojave	152,967	76,644	-76,323
Colorado Desert	111,749	85,306	-26,443
Northeastern Mojave	13,709	40,838	+27,129
Eastern Mojave	68,138	42,055	-26,083
Upper Virgin River	12,678	8,399	-4,280
Total	359,242	253,242	-106,000

In conclusion, we have used the 5-year review (Service 2010e), revised recovery plan (Service 2011), and additional information that has become available since these publications to review the reproduction, numbers, and distribution of the desert tortoise. The reproductive capacity of the desert tortoise may be compromised to some degree by the abundance and distribution of invasive weeds across its range; the continued increase in human access across the desert likely continues to facilitate the spread of weeds and further affect the reproductive capacity of the species. Prior to its listing, the number of desert tortoises likely declined range-wide, although we cannot quantify the extent of the decline; since the time of listing, data suggest that declines continue to occur throughout most of the range, although recent information suggests that densities may have increased in the Northeastern Mojave Recovery Unit. The continued increase in human access across the desert continues to expose more desert tortoises to the potential of being killed by human activities. The distributional limits of the desert tortoise's range have not changed substantially since the issuance of the original recovery plan in 1994; however, desert tortoises have been extirpated from large areas within their range (e.g., Las Vegas, other desert cities). The species' low reproductive rate, the extended time required for young animals to reach breeding age, and the multitude of threats that continue to confront desert tortoises combine to render its recovery a substantial challenge.

Status of Critical Habitat of the Desert Tortoise

The Service designated critical habitat for the desert tortoise in portions of California, Nevada, Arizona, and Utah in a final rule published February 8, 1994 (59 Federal Register 5820). The Service designates critical habitat to identify the key biological and physical needs of the species

and key areas for recovery and to focus conservation actions on those areas. Critical habitat is composed of specific geographic areas that contain the biological and physical features essential to the species' conservation and that may require special management considerations or protection. These features, which include space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats, are called the primary constituent elements of critical habitat. The specific primary constituent elements of desert tortoise critical habitat are: sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow; sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance and human-caused mortality.

Critical habitat of the desert tortoise would not be able to fulfill its conservation role without each of the primary constituent elements being functional. As examples, an area with a sufficient amount of forage species cannot fulfill its conservation role if human-caused mortality is excessive; an area with sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow would not support desert tortoises without adequate forage species.

The final rule for designation of critical habitat did not explicitly ascribe specific conservation roles or functions to the various critical habitat units. Rather, it refers to the strategy of establishing recovery units and desert wildlife management areas recommended by the recovery plan for the desert tortoise, which had been published as a draft at the time of the designation of critical habitat, to capture the "biotic and abiotic variability found in desert tortoise habitat" (59 Federal Register 5820, see page 5823). Specifically, we designated the critical habitat units to follow the direction provided by the draft recovery plan (Service 1993) for the establishment of desert wildlife management areas. The critical habitat units in aggregate are intended to protect the variability that occurs across the large range of the desert tortoise; the loss of any specific unit would compromise the ability of critical habitat as a whole to serve its intended function and conservation role.

Despite the fact that desert tortoises do not necessarily need to move between critical habitat units to complete their life histories, both the original and revised recovery plans highlight the importance of these critical habitat units and connectivity between them for the recovery of the species. Specifically, the revised recovery plan (Service 2011a, pages 34 and 35) states that:

> (A)ggressive management as generally recommended in the 1994 Recovery Plan needs to be applied within existing (desert) tortoise conservation areas (defined as critical habitat, among other areas being managed for the conservation of desert tortoises) or other important areas … to ensure that populations remain distributed throughout the species' range …. (Desert tortoise) conservation areas capture the diversity of the Mojave population of the desert tortoise within each recovery unit, conserving the genetic breadth of the species, providing a margin of safety for the species to withstand catastrophic events, and providing potential opportunities for continued evolution and adaptive change …. Especially given uncertainties related to the effects of climate change on desert

tortoise populations and distribution, we consider (desert) tortoise conservation areas to be the minimum baseline within which to focus our recovery.

The 12 critical habitat units range in area from 85 to 1,595 square miles. However, the optimal reserve size recommended to preserve viable desert tortoise populations was 1,000 square miles (Service 1994); only 4 critical habitat units meet this threshold. Consequently, for some smaller critical habitat units, their future effectiveness in conserving the desert tortoise is largely dependent on the status of populations immediately adjacent to their boundaries or within intervening linkages that connect these smaller critical habitat units to other protected areas. Although the Service (1994) recommended the identification of buffer zones and linkages for smaller desert tortoise conservation areas, land management agencies have generally not established such areas.

Population viability analyses indicate that reserves should contain from 10,000 to 20,000 adult desert tortoises to maximize estimated time to extinction (i.e., approximately 390 years, depending on rates of population change; Service 1994). However, during the three most recent years of monitoring within the critical habitat units, only three (in 2009 and 2010) to five (in 2008) of the critical habitat units met this target (McLuckie et al. 2010; Service 2009, 2012a, 2012b). Some critical habitat units share boundaries and form contiguous blocks (e.g. Superior-Cronese and Fremont-Kramer Critical Habitat Units), and those blocks in California include combined estimated abundances of over 10,000 adult desert tortoises. Conversely, the Ord-Rodman Critical Habitat Unit is much smaller and not currently connected to other protected habitat by preserved habitat linkages.

We did not designate the Desert Tortoise Natural Area and Joshua Tree National Park in California and the Desert National Wildlife Refuge in Nevada as critical habitat because they are "primarily managed as natural ecosystems" (59 Federal Register 5820, see page 5825) and provide adequate protection to desert tortoises. Since the designation of critical habitat, Congress increased the size of Joshua Tree National Park and created the Mojave National Preserve. A portion of the expanded boundary of Joshua Tree National Park lies within critical habitat of the desert tortoise; portions of other critical habitat units lie within the boundaries of the Mojave National Preserve.

Within each critical habitat unit, both natural and anthropogenic factors affect the function of the primary constituent elements of critical habitat. As an example of a natural factor, in some specific areas within the boundaries of critical habitat, such as within and adjacent to dry lakes, some of the primary constituent elements are naturally absent because the substrate is extremely silty; desert tortoises do not normally reside in such areas. Comparing the acreage of desert tortoise habitat as depicted by Nussear et al.'s (2009) model to the gross acreage of the critical habitat units demonstrates quantitatively that the entire area within the boundaries of critical habitat likely does not support the primary constituent elements; see the following table. The acreage for modeled habitat is for the area in which the probability that desert tortoises are present is greater than 0.5. The acreages of modeled habitat are from Service (2012b); they do not include loss of habitat due to human-caused impacts. The difference between gross acreage and modeled habitat is 653,214 acres; that is, approximately 10 percent of the gross acreage of the designated critical habitat is not considered modeled habitat.

Critical Habitat Unit	Gross Acreage	Modeled Habitat
Superior-Cronese	766,900	724,967
Fremont-Kramer	518,000	501,095
Ord-Rodman	253,200	184,155
Pinto Mountain	171,700	144,056
Piute-Eldorado	970,600	930,008
Ivanpah Valley	632,400	510,711
Chuckwalla	1,020,600	809,319
Chemehuevi	937,400	914,505
Gold Butte-Pakoon	488,300	418,189
Mormon Mesa	427,900	407,041
Beaver Dam Slope	204,600	202,499
Upper Virgin River	54,600	46,441
Totals	6,446,200	5,792,986

Condition of the Primary Constituent Elements of Critical Habitat

Human activities can have obvious or more subtle effects on the primary constituent elements. The grading of an area and subsequent construction of a building removes the primary constituent elements of critical habitat; this action has an obvious effect on the primary constituent elements of critical habitat. The revised recovery plan identifies human activities such as urbanization and the proliferation of roads and highways as threats to the desert tortoise and its habitat; these threats are examples of activities that have a clear effect on the primary constituent elements of critical habitat.

We have included the following paragraphs from the revised recovery plan for the desert tortoise (Service 2011a) to demonstrate that other anthropogenic factors affect the primary constituent elements of critical habitat in more subtle ways. All references are in the revised recovery plan (i.e., in Service 2011a); we have omitted some information from the revised recovery plan where the level of detail was unnecessary for the current discussion.

> Surface disturbance from [off-highway vehicle] activity can cause erosion and large amounts of dust to be discharged into the air. Recent studies on surface dust impacts on gas exchanges in Mojave Desert shrubs showed that plants encrusted by dust have reduced photosynthesis and decreased water-use efficiency, which may decrease primary production during seasons when photosynthesis occurs (Sharifi et al. 1997). Sharifi et al. (1997) also showed reduction in maximum leaf conductance, transpiration, and water-use efficiency due to dust. Leaf and stem temperatures were also shown to be higher in plants with leaf-surface dust. These effects may also impact desert annuals, an important food source for [desert] tortoises.
>
> [Off-highway vehicle] activity can also disturb fragile cyanobacterial-lichen soil crusts, a dominant source of nitrogen in desert ecosystems (Belnap 1996). Belnap (1996) showed that anthropogenic surface disturbances may have serious implications for nitrogen budgets in cold desert ecosystems, and this may also hold true for the hot deserts that

> [desert] tortoises occupy. Soil crusts also appear to be an important source of water for plants, as crusts were shown to have 53 percent greater volumetric water content than bare soils during the late fall when winter annuals are becoming established (DeFalco et al. 2001). DeFalco et al. (2001) found that non-native plant species comprised greater shoot biomass on crusted soils than native species, which demonstrates their ability to exploit available nutrient and water resources. Once the soil crusts are disturbed, non-native plants may colonize, become established, and out-compete native perennial and annual plant species (DeFalco et al. 2001, D'Antonio and Vitousek 1992). Invasion of non-native plants can affect the quality and quantity of plant foods available to desert tortoises. Increased presence of invasive plants can also contribute to increased fire frequency.
>
> Proliferation of invasive plants is increasing in the Mojave and Sonoran deserts and is recognized as a substantial threat to desert tortoise habitat. Many species of non-native plants from Europe and Asia have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. As non-native plant species become established, native perennial and annual plant species may decrease, diminish, or die out (D'Antonio and Vitousek 1992). Land managers and field scientists identified 116 species of non-native plants in the Mojave and Colorado deserts (Brooks and Esque 2002).
>
> Increased levels of atmospheric pollution and nitrogen deposition related to increased human presence and combustion of fossil fuels can cause increased levels of soil nitrogen, which in turn may result in significant changes in plant communities (Aber et al. 1989). Many of the non-native annual plant taxa in the Mojave region evolved in more fertile Mediterranean regions and benefit from increased levels of soil nitrogen, which gives them a competitive edge over native annuals. Studies at three sites within the central, southern, and western Mojave Desert indicated that increased levels of soil nitrogen can increase the dominance of non-native annual plants and promote the invasion of new species in desert regions. Furthermore, increased dominance by non-native annuals may decrease the diversity of native annual plants, and increased biomass of non-native annual grasses may increase fire frequency (Brooks 2003).

This summary from the revised recovery plan (Service 2011a) demonstrates how the effects of human activities on habitat of the desert tortoise are interconnected. In general, surface disturbance causes increased rates of erosion and generation of dust. Increased erosion alters additional habitat outside of the area directly affected by altering the nature of the substrate, removing shrubs, and possibly destroying burrows and other shelter sites. Increased dust affects photosynthesis in the plants that provide cover and forage to desert tortoises. Disturbed substrates and increased atmospheric nitrogen enhance the likelihood that invasive species will become established and outcompete native species; the proliferation of weedy species increases the risk of large-scale fires, which further move habitat conditions away from those that are favorable to desert tortoises.

The following paragraphs generally describe how the threats described in the revised recovery plan affect the primary constituent elements of critical habitat of the desert tortoise.

Sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow.

In considering the following discussion, bear in mind the information provided previously in this biological opinion regarding the recommended and actual sizes of critical habitat units for the desert tortoise. The original recovery team based the recommended size of desert wildlife management areas on the amount of space required to maintain viable populations. (The recovery plan [Service 1994] defined conservation areas for the desert tortoise as 'desert wildlife management areas;' we based the boundaries of critical habitat on the recovery team's general recommendation for the desert wildlife management areas.) The current low densities of desert tortoises within critical habitat units exacerbate the difficulties of effecting recovery within these areas.

Urban, industrial, and agricultural development, concentrated use by off-road vehicles, and other activities of this nature completely remove habitat. Although we are aware of local areas within the boundaries of critical habitat that have been heavily disturbed, we do not know of any areas that have been disturbed to the intensity and extent that this primary constituent element has been compromised. To date, the largest single loss of critical habitat is the use of 18,197 acres of additional training land in the southern portion of Fort Irwin. In our biological opinion for that proposed action (Service 2012e), we stated:

> The proposed action would essentially eliminate the primary constituent elements from approximately 2.40 percent of the Superior-Cronese Critical Habitat Unit; additionally, the conservation role of the remainder of this critical habitat unit and the other critical habitat units has been compromised by substantial human impact on the second and sixth primary constituent elements. However, the protective measures that the Army implemented as part of the proposed action offset, at least to some extent, the adverse effects of the use of the additional training lands in the southern expansion area. Consequently, we have concluded that, although the second and sixth primary constituent elements are not functioning appropriately throughout most of designated critical habitat of the desert tortoise and the proposed action would result in substantial disturbance to 18,197 acres of the Superior-Cronese Critical Habitat Unit, the change in the condition of critical habitat brought about by the Army's proposed action (i.e., use of the southern expansion area for training and implementation of the conservation actions) is not likely to cause an overall decrease in the conservation value and function of the Superior-Cronese Critical Habitat Unit.

The widening of existing freeways likely caused the second largest loss of critical habitat. Despite these losses of critical habitat, which occur in a linear manner, the critical habitat units continue to support sufficient space to support viable populations within each of the six recovery units.

In some cases, major roads likely disrupt the movement, dispersal, and gene flow of desert tortoises. Highways 58 and 395 in the Fremont-Kramer Critical Habitat Unit and Fort Irwin Road in the Superior-Cronese Critical Habitat Unit are examples of large and heavily travelled

roads that likely disrupt movement, dispersal, and gene flow. Roads that have been fenced and provided with underpasses may alleviate this fragmentation to some degree; however, such facilities have not been in place for sufficient time to determine whether they will eliminate fragmentation.

The threats of invasive plant species described in the revised recovery plan generally do not result in the removal of this primary constituent element because they do not convert habitat into impervious surfaces, as would urban development.

Sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species.

This primary constituent element addresses the ability of critical habitat to provide adequate nutrition to desert tortoises. As described in the revised recovery plan and 5-year review, grazing, historical fire, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stress of "nutritional compromise." Paved and unpaved roads through critical habitat of the desert tortoise provide avenues by which invasive native species disperse; these legal routes also provide the means by which unauthorized use occurs over large areas of critical habitat. Nitrogen deposition from atmospheric pollution likely occurs throughout all the critical habitat units and exacerbates the effects of the disturbance of substrates. Because paved and unpaved roads are so widespread through critical habitat, this threat has compromised the conservation value and function of critical habitat throughout the range of the desert tortoise, to some degree. See the Status of the Desert Tortoise section of this biological opinion for a map that depicts the routes by which invasive weeds have access to critical habitat; the routes shown on the map are a subset of the actual number of routes that actually cross critical habitat of the desert tortoise.

Suitable substrates for burrowing, nesting, and overwintering.

Surface disturbance, motor vehicles traveling off route, use of off-highway vehicle management areas, off-highway vehicle- events, unpaved roads, grazing, historical fire, wildfire potential, altered hydrology, and climate change leading to shifts in habitat composition and location, storms, and flooding can alter substrates to the extent that they are no longer suitable for burrowing, nesting, and overwintering. Erosion caused by these activities can alter washes to the extent that desert tortoise burrows placed along the edge of a wash, which is a preferred location for burrows, could be destroyed. We expect that the area within critical habitat that is affected by off-road vehicle use to the extent that substrates are no longer suitable is relatively small in relation to the area that desert tortoises have available for burrowing, nesting, and overwintering; consequently, off-road vehicle use has not had a substantial effect on this primary constituent element.

Most livestock allotments have been eliminated from within the boundaries of critical habitat. Of those that remain, livestock would compact substrates to the extent that they would become unsuitable for burrowing, nesting, and overwintering only in areas of concentrated use, such as around watering areas and corrals. Because livestock grazing occurs over a relatively small portion of critical habitat and the substrates in most areas within livestock allotments would not

be substantially affected, suitable substrates for burrowing, nesting, and overwintering remain throughout most of the critical habitat units.

Burrows, caliche caves, and other shelter sites.

Human-caused effects to burrows, caliche caves, and other shelter sites likely occur at a similar rate as effects to substrates for burrowing, nesting, and overwintering for the same general reasons. Consequently, sufficient burrows, caliche caves, and other shelter sites remain throughout most of the critical habitat units.

Sufficient vegetation for shelter from temperature extremes and predators.

In general, sufficient vegetation for shelter from temperature extremes and predators remains throughout critical habitat. In areas where large fires have occurred in critical habitat, many of the shrubs that provide shelter from temperature extremes and predators have been destroyed; in such areas, cover sites may be a limiting factor. The proliferation of invasive plants poses a threat to shrub cover throughout critical habitat as the potential for larger and more frequent wildfires increases.

In 2005, wildfires in Nevada, Utah, and Arizona burned extensive areas of critical habitat (Service 2010a). Although different agencies report slightly different acreages, the following table provides an indication of the scale of the fires.

Critical Habitat Unit	Total Area Burned (acres)	Percent of the Critical Habitat Unit Burned
Beaver Dam Slope	53,528	26
Gold-Butte Pakoon	65,339	13
Mormon Mesa	12,952	3
Upper Virgin River	10,557	19

The revised recovery plan notes that the fires caused statistically significant losses of perennial plant cover, although patches of unburned shrubs remained. Given the patchiness with which the primary constituent elements of critical habitat are distributed across the critical habitat units and the varying intensity of the wildfires, we cannot quantify precisely the extent to which these fires disrupted the function and value of the critical habitat.

Habitat protected from disturbance and human-caused mortality.

In general, the Federal agencies that manage lands within the boundaries of critical habitat have adopted land management plans that include implementation of some or all of the recommendations contained in the original recovery plan for the desert tortoise. (See pages 70 to 72 of Service 2010b.) To at least some degree, the adoption of these plans has resulted in the implementation of management actions that are likely to reduce the disturbance and human-caused mortality of desert tortoises. For example, these plans resulted in the designation of open routes of travel and the closure (and, in some cases, physical closure) of unauthorized routes. Permittees have relinquished numerous livestock allotments and cattle no longer graze

these allotments. Because of these planning efforts, some of the Bureau's records of decision included direction to withdraw some areas of critical habitat from mineral entry. Because of actions on the part of various agencies, many miles of highways and other paved roads have been fenced to prevent desert tortoises from wandering into traffic and being killed. The Service and other agencies of the Desert Managers Group in California are implementing a plan to remove common ravens that prey on desert tortoises and to undertake other actions that would reduce subsidies (i.e., food, water, sites for nesting, roosting, and perching, etc.) that facilitate their abundance in the California desert (Service 2008).

Despite the implementation of these actions, disturbance and human-caused mortality continue to occur in many areas of critical habitat (which overlap the desert wildlife management areas for the most part and are the management units for which most data are collected) to the extent that the conservation value and function of critical habitat is, to some degree, compromised. For example, many highways and other paved roads in California remain unfenced. Twelve desert tortoises were reported to be killed on paved roads from within Mojave National Preserve in 2011, and we fully expect that desert tortoises are being killed at similar rates on many other roads, although these occurrences are not discovered and reported as diligently as by the National Park Service. Employees of the Southern California Gas Company reported two desert tortoises in 2011 that were crushed by vehicles on unpaved roads.

Unauthorized off-road vehicle use continues to disturb habitat and result in loss of vegetation within the boundaries of critical habitat (e.g., Coolgardie Mesa in the Western Mojave Recovery Unit); although we have not documented the death of desert tortoises as a direct result of this activity, it likely occurs. Additionally, the habitat disturbance caused by this unauthorized activity exacerbates the spread of invasive plants, which displace native plants that are important forage for the desert tortoise, thereby increasing the physiological stress faced by desert tortoises.

Although the Bureau has approved, through its land use planning processes, the withdrawal of areas of critical habitat from mineral entry, it has not undertaken the administrative procedures to complete withdrawals in all areas. Absent this withdrawal, new mining claims can be filed and further disturbance of critical habitat could occur.

Finally, the Bureau has not allowed the development of solar power plants on public lands within the boundaries of its desert wildlife management areas (which largely correspond to the boundaries of critical habitat). Conversely, the County of San Bernardino is considering the approval of the construction and operation of at least two such facilities within the boundaries of the Superior-Cronese Critical Habitat Unit north of Interstate 15 near the Minneola Road exit.

Summary of the Status of Critical Habitat of the Desert Tortoise

As noted in the revised recovery plan for the desert tortoise and 5-year review (Service 2011a, 2010a), critical habitat of the desert tortoise is subject to landscape level impacts in addition to the site-specific effects of individual human activities. On the landscape level, atmospheric pollution is increasing the level of nitrogen in desert substrates; the increased nitrogen exacerbates the spread of invasive plants, which out compete the native plants necessary for desert tortoises to survive. As invasive plants increase in abundance, the threat of large wildfires

increases; wildfires have the potential to convert the shrubland-native annual plant communities upon which desert tortoises depend to a community with fewer shrubs and more invasive plants. In such a community, shelter and forage would be more difficult for desert tortoises to find. Invasive plants have already compromised the conservation value and function of critical habitat to some degree with regard to the second primary constituent element (i.e., sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species). These effects likely extend to the entirety of critical habitat, given the numerous routes by which invasive plants can access critical habitat and the large spatial extent that is subject to nitrogen from atmospheric pollution. (See maps from previous sections of this biological opinion regarding the extent of the threat of invasive plants and the aggregate stress that multiple threats, including invasive plants, place on critical habitat.)

Critical habitat has been compromised to some degree with regard to the last primary constituent element (i.e., habitat protected from disturbance and human-caused mortality) as a result of the wide variety of human activities that continues to occur within its boundaries. These effects result from the implementation of discrete human activities and are thus more site-specific in nature.

Although the remaining primary constituent elements have been affected to some degree by human activities, these impacts have not, to date, substantially compromised the conservation value and function of the critical habitat units. We have reached this conclusion primarily because the effects are localized and thus do not affect the conservation value and function of large areas of critical habitat.

Land managers have undertaken actions to improve the status of critical habitat. For example, as part of its efforts to offset the effects of the use of additional training maneuver lands at Fort Irwin (Service 2004), the Army acquired the private interests in the Harper Lake and Cronese Lakes allotments, which are located within critical habitat in the Western Mojave Recovery Unit; as a result, cattle have been removed from these allotments. Livestock have been removed from numerous other allotments through various means throughout the range of the desert tortoise. The retirement of allotments assists in the recovery of the species by eliminating disturbance to the primary constituent elements of critical habitat by cattle and range improvements.

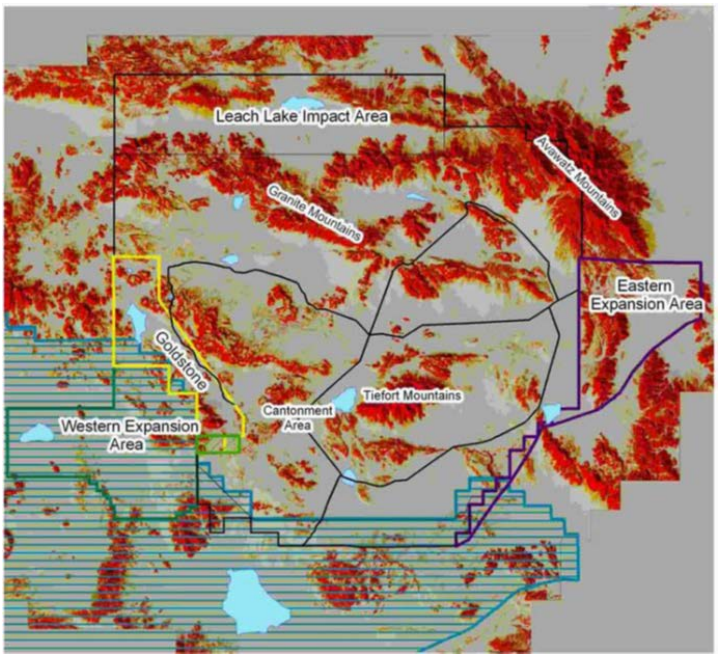
ENVIRONMENTAL BASELINE

Action Area

The implementing regulations for section 7(a)(2) of the Act define the “action area” as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations 402.02). The action area for this biological opinion is the footprint of Fort Irwin, which consists of approximately 755,606 acres and the route of the Manix Trail, which extends from Interstate 15 south of Fort Irwin to the southern area of the installation east of Fort Irwin Road, as depicted on the following map. The Army uses the Manix Trail to bring equipment to Fort Irwin; the portion outside of Fort Irwin is approximately 14 miles long.

General Description of Fort Irwin

To accommodate these activities, the Army has divided Fort Irwin into several major areas. The following map and discussion provide information on the location and activities in these areas.



The blue crosshatched area depicts critical habitat of the desert tortoise (i.e., a portion of the Superior-Cronese Critical Habitat Unit). Blue areas are dry lakes. The southern expansion area is the area where critical habitat overlaps the southern portion of Fort Irwin. The Manix Trail lies to the east of the southernmost dry lake.

Leach Lake Gunnery Range

The Leach Lake Gunnery Range is located within the Leach Lake Impact Area and covers 92,625 acres in the northern portion of Fort Irwin. Since 1967, the Air Force, Navy, and Marine Corps have used this range year-round for air-to-air and air-to-ground gunnery and as an east-west, low-level flight corridor. Numerous types of military aircraft (fighters and bombers) use Leach Lake. The Leach Lake Gunnery Range is extensively contaminated with unexploded ordnance, which has been deposited since World War II. Unexploded ordnance ranges from 2,000-pound bombs to highly sensitive cluster bombs. The Air Force periodically removes unexploded ordnance from this area; the Air Force personnel follow the same procedures used to protect desert tortoises that the Army uses throughout Fort Irwin when conducting these activities (Everly 2014).

Goldstone Deep Space Communications Complex

The Army leases 33,241 acres, generally on the western boundary of Fort Irwin, to the National Aeronautics and Space Administration to operate the Goldstone Deep Space Communications Complex. The National Aeronautics and Space Administration tracks satellites and conducts other deep-space work at this facility. Little military training occurs within this area. The Army has ultimate responsibility for the management of natural resources on Goldstone, although the National Aeronautics and Space Administration has its own environmental program for the area. This biological opinion addresses any actions that the Army may undertake in this area, including future activities on approximately 1,000 acres of the leased area for which the Army will soon resume management.

Cantonment Area

The cantonment area is located in the southwestern portion of Fort Irwin. The cantonment area is nearly completely developed and supports the installation's day-to-day operations, administrative activities, family housing and neighborhood parks, barracks, maintenance yards, indoor recreation, restaurant facilities, and equipment ~~posts~~yards. This area occupies 15,314 acres.

Downrange Operations Area

Task force live-fire exercises are conducted primarily north of the Granite Mountains (the northern corridor). The majority of force-on-force maneuvers take place in the central corridor, which lies south of the Granite Mountains and north of Tiefort Mountain. The southern corridor lies south of Tiefort Mountain and is used primarily for staging and also for maneuver training.

The Downrange Operations Area includes the western expansion area, the southern expansion area, and the Eastgate parcel. The entire area covers 501,551 acres. Approximately 3,250 acres of Fort Irwin are off limits to military training because of archeological resources; the Army uses an additional 7,166 acres for recreation.

Conservation Areas

As part of its proposed action for using additional maneuver training lands, the Army established four conservation areas for the desert tortoise along the boundary of the installation. The 4 conservation areas and a 500-meter-wide buffer to the north of the Boulder Utility Corridor comprise approximately 11,016 acres. All of these conservation areas have been designated by the Army as off limits to training and secured through the placement of desert tortoise fencing and signing. This fencing separates the conservation areas from the southern expansion area where training would occur.

Habitat Characteristics of the Action Area

The integrated natural resources management plan (Army 2006 - 2011) contains detailed information on the habitat characteristics of Fort Irwin. The plant communities on base that are of importance to the desert tortoise are creosote bush scrub, Mojave mixed woody scrub, saltbush scrub, Joshua tree woodland, blackbush scrub, and Mojave desert wash scrub. Some

areas of Fort Irwin show signs of intense training; these areas are generally located where vehicles, included tracked and wheeled vehicles, can traverse the terrain. Other areas that are more inaccessible to vehicles exhibit much less disturbance.

Previous Consultations in the Action Area

Prior to the withdrawal of the lands for the expansion of Fort Irwin in 2002, the Bureau and Service conducted one substantial consultation on the desert tortoise that affected management of the Superior Valley parcel. On April 11, 1991, we issued a biological opinion to the Bureau in which we concluded that the Bureau's ephemeral sheep grazing program in the western Mojave Desert was likely to jeopardize the continued existence of the desert tortoise (Service 1991b). Sheep have not grazed within the Superior Valley parcel since 1989 because of drought and, since 1991, because of the Service's biological opinion.

In 1991, the Army and Service formally consulted on the effects of the ongoing training at Fort Irwin on the desert tortoise (Service 1991a). This biological opinion addressed the Army's training activities within its boundaries prior to expansion; it did not address any other activities. The area south of the UTM 90 line (i.e., the northern limit of the southern expansion area) was established as off-limits to vehicles traveling off-road as a result of the consultation; at the time the consultation was completed, the distribution and abundance of desert tortoises had already been altered by decades of training (Service 1991a). The Service concluded that the continued training at Fort Irwin was not likely to jeopardize the continued existence of the desert tortoise because most activities occurred in areas that had been affected by training prior to the listing of the desert tortoise.

The Service (1992) issued a biological opinion to the National Aeronautics and Space Administration for the installation of a fiber optic cable within the boundaries of the Goldstone Deep Space Communications Complex. The Service concluded that the proposed action was not likely to jeopardize the continued existence of the desert tortoise; to the best of our knowledge, no desert tortoises were killed during the installation of the cable.

On February 23, 1998, the Service issued a biological opinion to the National Aeronautics and Space Administration for construction activities at the Goldstone Deep Space Communications Complex. In this biological opinion, the Service concluded that routine construction, operations, and maintenance activities at the Goldstone Deep Space Communications Complex were not likely to jeopardize the continued existence of the desert tortoise or result in destruction or adverse modification of its critical habitat because a relatively small number of desert tortoises and amount of critical habitat would be affected. We are not aware of any desert tortoises that have been injured or killed as a result of operations at the Goldstone Deep Space Communications Complex. In 2012, workers observed two desert tortoises on roads within the complex and moved these animals to safety (National Aeronautics and Space Administration 2013).

On April 19, 2002, we issued a biological opinion to the Army regarding a survey of the revised boundary of Fort Irwin (Service 2002). We found that the proposed action was not likely to jeopardize the continued existence of the desert tortoise or adversely modify its critical habitat

because the Army included measures in its project description to avoid desert tortoises, few individuals were likely to be killed or injured by the surveys, and disturbance of habitat would be temporary. The proposed action involved placement of markers along the new boundaries of the installation; access was by pick-up truck and all-terrain vehicles, and on foot. The Army committed to attempting to avoid desert tortoises when traveling through the project area. The survey was completed in 2004; no desert tortoises were encountered during the work (Army 2009b).

On May 31, 2002, the Service (2002) issued a biological opinion to the Army for the development and operation of an off-road vehicle area for use by Army personnel. The Service concluded that the development and operation of this 625-acre area was not likely to jeopardize the continued existence of the desert tortoise.

On June 9, 2003, we issued a biological opinion to the Army regarding the installation of a fiber optic cable between Fort Irwin and the Naval Air Weapons Station, China Lake (Service 2003b). We found that the proposed action was not likely to jeopardize the continued existence of the desert tortoise or adversely modify its critical habitat because the Army included measures in its project description to avoid killing or injuring animals and only a small area of habitat would be temporarily disturbed. The cable was installed in a 12-inch wide trench along a 32-mile long route; most of the installation was either within roads or their shoulders. The cable was installed in 2006. Only one desert tortoise was observed and moved from harm's way during installation; installation of the cable disturbed approximately 114 acres of critical habitat within the Superior-Cronese Critical Habitat Unit (Army 2009c).

The initial biological opinion for the current proposed use of additional training lands (Service 2004) analyzed the effects that closure of existing mines and installation of an exclusion fence on the boundary of Fort Irwin might have on the desert tortoise. The mine work has been completed; no desert tortoises were found in the mines that were closed (Everly 2009b). To the best of our knowledge, no desert tortoises were killed or injured during installation of the perimeter fence.

Additionally, as part of the 2004 consultation, the Army proposed to create an improved transit route for vehicles through the Goldstone Deep Space Communications Complex, which is managed by the National Aeronautics and Space Administration. The Army has completed the 3-mile long transit route; it did not report any issues with desert tortoises during this work, which is not unexpected, given the low numbers of desert tortoises in the area crossed by the road. The Army has not added gravel or a resin-impregnated topcoat (e.g., latex-polymer impregnated into the top few inches of surface gravels) to control dust as use of this road for training purposes is in abeyance until the Army concludes analysis on the future use of the western expansion area~~; this work is scheduled to occur in the summer of 2012~~. We do not expect that the road coating, if and when applied, would affect desert tortoises or their habitat because it would occur entirely on the existing disturbed surface. This transit route would be used to transport troops and equipment between the cantonment area and the ~~Superior Valley~~Western Expansion parcel.

We discussed the most recent biological opinion regarding the use of additional maneuver training lands in the Status of the Desert Tortoise and Critical Habitat - Status of the Desert Tortoise section of this biological opinion.

Existing Conditions in the Action Area

In this section, we discuss the anthropogenic and natural conditions in the action area as they relate to desert tortoises and their habitat. Unless we have noted otherwise by citing a biological opinion, the anthropogenic conditions present in the action area were constructed or instituted prior to the listing of the desert tortoise. We summarized the following information from the integrated natural resources management plan (Army 2006 -2011) and communications with personnel at Fort Irwin.

Use by Feral and Domestic Livestock

Feral burros (*Equus africanus asinus*) graze portions of Fort Irwin. Burros likely have the same effect on desert tortoises as domestic livestock. That is, they can trample desert tortoises, particularly small individuals and degrade habitat though the trampling and grazing of the plants that desert tortoises use for food and shelter. Burros also introduce surface disturbance that can facilitate the spread of invasive plants. They also likely trample the burrows of desert tortoises, which would remove their shelters and possibly trap them inside. As of 2006, the Army noted that approximately 70 burros resided in the Leach Lake area and at Bitter Springs. Burros also reside in the western expansion area; the Army did not know the size of this herd. The grazing of domestic livestock does not occur at Fort Irwin.

Non-native Species

The processes of grazing, urbanization, agriculture, and road and utility construction have resulted in the introduction into the western Mojave Desert of invasive annuals, particularly split grass (*Schismus barbatus*), cheat grass (*Bromus tectorum*), red brome (*B. madritensis* ssp. *rubens*), filaree (*Erodium cicutarium*), and Sahara mustard (*Brassica tournefortii*). The abundance and diversity of non-native species in any area vary in relation to the seasonal weather; consequently, the composition of the non-native plant flora may be substantially different from year to year. An overabundance of weedy species likely compromises the nutritional status of desert tortoises, as we discussed in the Status of the Desert Tortoise section of this biological opinion. We do not have specific information on the distribution of non-native species nor on their specific effects on desert tortoises in the action area. The Army acknowledges the presence of invasive plant species in its integrated natural resources management plan and has mechanisms in place to manage weeds.

Formatted: Font: 12 pt

Paved and Unpaved Roads

Fort Irwin Road is the main paved road that traverses desert tortoise habitat within Fort Irwin, although desert tortoises likely attempt to cross the outermost paved roads that lie adjacent to the cantonment area. Fort Irwin Road provides access to the base by most workers and is heavily used. We expect that the density of desert tortoises adjacent to this road is depressed, as

discussed by Hoff and Marlow (2002), but we are not aware of surveys that quantify this effect within Fort Irwin.

Utilities

The most substantial ongoing effect of utility poles is their ongoing use by common ravens for perching and nesting. The presence of this additional nesting substrate, which allows common ravens to nest far above the reach of ground-dwelling predators, likely contributes substantially to the increase in the number of common ravens in the desert. As previously discussed, common ravens prey on desert tortoises and are likely detrimental to the recovery of the desert tortoise.

The need for road maintenance on the utility corridors has left permanent bare areas. Roads along and above utility corridors are occasionally used for maintenance. Most transmission lines on Fort Irwin are located within or lead to the cantonment area.

Status of the Desert Tortoise in the Action Area

The Army has not undertaken any systematic surveys of the entire area within its boundaries. With a few exceptions, however, the Army and Service have a reasonable understanding of the status of desert tortoises at Fort Irwin. In the following paragraphs, we will provide this information for each general area of the installation.

Leach Lake Gunnery Range

The Army has not conducted surveys for desert tortoises within the Leach Lake Gunnery Range because unexploded ordnance renders the area unsafe. Based on the elevation within the gunnery range and its location within the central Mojave Desert, we expect that desert tortoises occur in the area although desert tortoises are absent from or very sparsely distributed in the area immediately to the north of Leach Lake, which lies within Death Valley National Park.

Within this area, we expect that desert tortoises would occur in low densities in target areas. The potential exists for desert tortoises to occur in at least slightly higher densities on the upper slopes of alluvial fans in this area, farther away from targets.

Goldstone Deep Space Communications Complex

Information regarding the status of desert tortoises within the Goldstone Deep Space Communications Complex comes from surveys conducted in 1983 and 1989. We included the following description of the status of the desert tortoise in this area from the biological opinion for the complex's routine operation (Service 1998; all citations in the following paragraphs are from Service 1998.).

> Within suitable habitats, [desert tortoises] are probably more common in less rocky, alluvial areas and less common on rocky hillsides and mountainous areas. This statement is supported by two comprehensive surveys performed on the [Goldstone Deep Space Communications Complex] in 1983 (Woodman et al. 1984 in [Circle Mountain Biological

Consultants] 1997) and in 1989 (Woodman and Goodlett 1990 in [Circle Mountain Biological Consultants] 1997). These surveys documented limited signs in predominantly rocky areas, hard pan, or loose, sandy soils. The more favorable habitats occurred on firm sandy-loam to gravelly soils of alluvial fans or bajadas. Higher estimated tortoise densities were noted within an elevation range of 1,600 to 3,600 feet. These more preferred habitats were typically represented by the creosote scrub plant community (Munz 1974 in [Circle Mountain Biological Consultants] 1997) dominated by creosote bush, white bursage, desert senna (*Cassia armata*), goldenhead (*Acamptopappus sphaerocephalus*), and Cooper goldenbush.

Anecdotal accounts indicate that desert tortoises may be more common in areas south of Goldstone Lake and south and east of the Venus Site (LaRue, pers. obs. and maps maintained at [Goldstone Deep Space Communications Complex] in [Circle Mountain Biological Consultants] 1997). Goldstone Deep Space Communications Complex personnel regularly see desert tortoises crossing NASA Road between its junction with Goldstone Road and the southern boundary of [Goldstone Deep Space Communications Complex]. Various studies performed by [Circle Mountain Biological Consultants] and Tierra Madre Consultants, Inc. (1991, 1992, 1993a, 1993b in [Circle Mountain Biological Consultants] 1997) tend to support this generalization.

Cantonment Area

Most of the cantonment area is developed with infrastructure and is heavily used by Fort Irwin's personnel. Consequently, the remaining areas of desert tortoise habitat exist in smaller patches. Desert tortoises occasionally wander into this area but it generally does not support a viable population.

Downrange Operations Area

Within the boundary of Fort Irwin prior to its expansion, desert tortoises occur in extremely low numbers in areas that have been used for force-on-force training. More desert tortoises occur on the upper slopes of the alluvial fans that surround training areas, probably because the more rugged terrain in these areas is not conducive to the large-scale movement of military vehicles.

The southern expansion area comprises the southernmost portion of the downrange area. As a result of the consultation on the use of additional maneuver training lands, the Army translocated most of the desert tortoises in this area onto Army lands south of the training areas. We expect that the surveys to remove desert tortoises missed a few individuals and that others may have moved into this area from surrounding habitat on Fort Irwin; the Army also left desert tortoises in place that it deemed were not suitable for translocation (i.e., those that had evidence of disease but were not so debilitated that they were euthanized). At the present time, when the Army finds healthy desert tortoises in this area, it translocates them to its conservation areas on the southern edge of Fort Irwin. A mesh fence to exclude desert tortoises separates the southern expansion area from the conservation areas and other desert tortoise habitat to the south.

The western expansion area supports approximately 626 to 658 adult desert tortoises; the

approximate confidence interval for this estimate is from 516 to 1,143 adults. The 2004 biological opinion for the use of additional maneuver training lands describes how these numbers were derived (Service 2004). Desert tortoises are generally distributed patchily in this area, with the lowest densities near the Superior Dry Lakes. The Army initially separated this area from adjacent habitat with a mesh fence to prepare to translocat~~ion~~ desert tortoises; during the time that it is evaluating the future use of this area, it has installed openings in the fence to allow passage by desert tortoises.

Desert tortoises within the Eastgate parcel are generally confined to the area where the alluvial fan joins the mountainous areas to the west of the alluvial fan (Everly 2012b). The alluvial fan downslope from this area is extremely rocky. The alluvial fan is also somewhat below elevations at which desert tortoises most frequently occur and thus may be hotter and receive less rainfall than areas to the east. These factors may be responsible for desert tortoises being largely restricted to the upper alluvial fan where, presumably, temperatures are cooler and rainfall more abundant. In 2004, the Army estimated that approximately 288 desert tortoises reside in this parcel (Service 2004).

Conservation Areas

These areas to the south of the southern expansion area generally contain high quality habitat for desert tortoises; surveys completed in preparation of the translocation of desert tortoises from the southern expansion area indicated that these areas generally supported numerous desert tortoises. Since that time, the Army has translocated additional desert tortoises into these areas. During the first year after the translocation, drought conditions in the area caused coyotes to prey heavily on translocated, resident, and ~~resident~~control desert tortoises; although the predation was greatest closer to areas of human habitation, some desert tortoises also perished in the conservation areas. We do not know current densities in these areas.

Effects of Army Activities on the Desert Tortoise

The original biological assessment for use of additional training lands (Charis Professional Services Corporation 2003) notes that 36 desert tortoises were killed at Fort Irwin during military maneuvers between 1994 and 2002; an additional 85 desert tortoises were moved from harm's way during this period. By letter dated June 16, 2003, the Army (2003) notified us that four desert tortoises had been killed in fiscal year 2003 as of the date of the letter. The following table provides information on encounters with desert tortoises at Fort Irwin since that time.

Calendar Year	Encounters with Desert Tortoises	Carcasses	Relocations	Mortality Resulting from Army Activity
1994 - 2002	-	-	85	40
2003	-	-	-	4
2004	27	4	3	0
2005	20	2	2	1
2006	14	11	3	0
2007	9	14	2	0
2008	6	5	2	0

2009	30	16	14	1
2010	34	0	16	0
2011	37	2	12	1
2012	13	26	5	1
Totals	190	8~~1~~0	144	48

'Encounters with Desert Tortoises' includes observations of live animals that were not at risk and not relocated.
'Carcasses' includes observations of dead animals where the cause of death seemed to be natural or could not be determined.
'Relocations' includes desert tortoises that were moved from harm's way.
A dash indicates that data are not available.
The information contained in this table is from Charis Professional Services Corporation (2003), Army (2003), and the Army's annual reports (Army 2005, 2006, 2007, 2008, 2009a, 2010c, 2011b, 2012b, 2013).

The Army is unlikely to find every desert tortoise that dies as a result of its activities. Although we expect that the Army's activities have killed more than 4~~4~~8 desert tortoises since its listing, we also expect that the overall number of animals that have died is unlikely to be substantially more than that observed by the Army. We have reached this conclusion because the generally low density of desert tortoises on base in areas of high levels of activity likely decreases the frequency of interactions between the Army's activities and desert tortoises; additionally, the Army moved almost all of the desert tortoises within the southern expansion area either into its conservation areas or into the southern translocation area as a result of consultations on the use of additional training lands at Fort Irwin. Finally, the intensity of monitoring employed by the Army and the general high level of awareness of desert tortoises by base personnel in general likely add further protection to individuals of this species.

Status of Critical Habitat of the Desert Tortoise in the Action Area

We obtained the information in this section from the Service's (2012) biological opinion regarding the use of additional training maneuver lands at Fort Irwin. Fort Irwin overlaps the Superior-Cronese Critical Habitat Unit, extending along the southern portion of the installation from its southwestern corner in the western expansion area to as far east as the Whale. Within Fort Irwin, critical habitat can generally be thought of as occurring within three general areas: the western expansion area, the Goldstone Deep Space Communications Complex, and the southern expansion area.

Congress transferred the approximately 70,045 acres within the western expansion area from the Bureau to the Army in 2002. (The entire amount of land transferred was 118, 674 acres, of which 48,629 acres are in the Eastgate parcel.) Since that time, the Army fenced the boundary to prevent access from adjacent lands; this fence also includes mesh to preclude entry by desert tortoises. After the Army postponed use of the western expansion area for training in 2012, it opened some sections of the desert tortoise fence to allow animals to move in and out of this area. This area was previously grazed by domestic sheep prior to 1989; we do not know how habitat conditions have changed since this grazing ended. The area includes several unpaved roads that were present when the land transfer occurred.

Comment [c11]: 21 November 2011 per the G3 guys (Crosbie and Negrete).

Critical habitat overlaps approximately 4,284 acres within the Goldstone Deep Space Communications Complex (Everly 2014). The Army does not conduct maneuvers in this area but uses roads to traverse the complex. In general, habitat within this area is relatively undisturbed.

The southern expansion area covers approximately 23,214 acres. This area is within the original boundaries of Fort Irwin. At the time the desert tortoise was listed in 1989, the nature of training at Fort Irwin did not include the extensive use of this area for force-on-force training because the areas to the north largely accommodated the Army's needs. After the listing of the desert tortoise in 1989, the Army did not conduct force-on-force training in the area south of the UTM 90 line, which generally represented the area that it had not used extensively in the past. When the Service designated critical habitat for the desert tortoise in 1994, it used the UTM 90 line as the general northern edge of critical habitat.

The Service's (2012e) biological opinion on the use of additional training lands at Fort Irwin included consideration of the southern expansion area as an area that would be used for force-on-force training and other training activities. In that biological opinion, the Service stated that: "The intensity of disturbance resulting from force-on-force training would be such that most of the primary constituent elements would not be functional for decades after training in those areas ceases."

In general, we expect that the condition of the primary constituent elements within the western expansion area and the Goldstone Deep Space Communications Complex is similar to that within the remainder of the Superior-Cronese Critical Habitat Unit. That is, although we expect that the first, third, fourth, and fifth primary constituent elements have been affected to some degree by human activities, these impacts have not, to date, substantially compromised the conservation value and function of the critical habitat. We expect that invasive plants have compromised the conservation value and function of critical habitat to some degree with regard to the second primary constituent element (i.e., sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species). Because most of the critical habitat within these areas experiences fewer disturbances than public lands off base, we expect that the sixth primary constituent element (i.e., habitat protected from disturbance and human caused mortality) has not been appreciably affected by human activities. We expect that force-on-force training will eventually cause severe degradation of the primary constituent elements of critical habitat within the southern expansion area.

EFFECTS OF THE ACTION

As we described in the Description of the Proposed Action section of this biological opinion, the Army and Service evaluated each of the Army's proposed activities and listed the aspects of the activity that may affect desert tortoises or their habitat (including critical habitat). See the following table.

DRAFT **DRAFT** **DRAFT**

Activities Associated with the Proposed Action and Potential Effects on Desert Tortoises and Their Critical Habitat										
		Driving off Road	**Driving on Road**	**Ground Distur-bance**	**Explosions (potential for fire)**	**Non-native Plants**	**Common Ravens**	**Moving from Harm's Way**	**Personnel on Foot**	**Habitat Conversion**
Training Area Activities	Desert tortoise	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Critical Habitat	N/A								
Training Area Management /Safety Activities	Desert tortoise	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Critical Habitat	Y	Y	Y	N	Y	N	N	N	Y
Alternative Energy Development	Desert tortoise	Y	Y	Y	N	N	Y	Y	Y	Y
	Critical Habitat	N/A								
Research and Education	Desert tortoise	Y	Y	Y	N	N	N	Y	Y	N
	Critical Habitat	Y	N	Y	N	Y	N	N	N	N
Recreation and Related Activities	Desert tortoise	Y	Y	Y	N	Y	Y	Y	Y	N
	Critical Habitat	N	N	N	N	N	N	N	N	N
Cantonment Infrastruct-ure Activities	Desert tortoise	Y	Y	Y	N	Y	Y	Y	Y	Y
	Critical Habitat	N/A								
Y = Associated activity may affect the desert tortoise or its critical habitat in this manner. (Activities would affect critical habitat and habitat not designated as critical in the same basic manner; however, we do not consider effects to non-critical habitat in assessing whether a proposed action is likely to destroy or adversely modify critical habitat.)										
N = Associated activity does not affect the desert tortoise or its critical habitat.										
N/A = Associated activity does not occur in area of concern (desert tortoise habitat or critical habitat).										

In this section of the analysis, we will provide a general description of how these various aspects affect desert tortoises and their habitat (including critical habitat). After we review the general mechanisms of how the Army's activities may affect desert tortoise and their critical habitat, we

will analyze the potential effects of the injury or death of up to five desert tortoises per year and the loss of critical habitat. The Army and Service developed the threshold of five desert tortoises upon which to base the analysis of future activities in this biological opinion and to provide a trigger for the re-initiation of formal consultation.

Desert tortoises less than 180 millimeters in length (including hatchlings and eggs) are difficult to detect. Surveyors are less likely to detect them than desert tortoises greater than 180 millimeters because they can take shelter in smaller burrows and are more difficult to see due to their cryptic nature and their small size. Consequently, we expect that most hatchlings and eggs likely remain in work areas that have been cleared of larger desert tortoises; we expect that some desert tortoises closer to 180 millimeters in length would be detected and moved from harm's way. We anticipate that future activities are likely to result in injury or mortality of small (i.e., less than 180 millimeters in length) desert tortoises because they are more difficult to detect. Because of their cryptic nature and small size, these mortalities have potential to go undetected. We acknowledge that smaller desert tortoises and eggs may be killed during the implementation of the Army's activities; however, because they are difficult to detect and because larger individuals are more important for the long-term conservation of the species, we focused our analysis on larger individuals.

As described in the Analytical Framework for the Jeopardy and Adverse Modification Determinations - Jeopardy Determination section of this biological opinion, we have based the analysis in this biological opinion on the conditions as they now exist within Fort Irwin. Specifically, desert tortoises are uncommon in areas that have been historically used for force-on-force training and have been essentially removed from the southern expansion area as a result of preparing this area for training. The fence that the Army placed between the southern expansion area and the on-base conservation areas and land managed by the Bureau generally to the south of Fort Irwin will prevent desert tortoises from re-inhabiting training areas on base. Floods, accumulation of sand, and vandalism can compromise fences that are intended to exclude desert tortoises from an area. If the fence along the southern portion of Fort Irwin is breached, desert tortoises may re-enter the installation and alter the environmental baseline upon which we based this biological opinion. At such point in time, the Army would be required to re-initiate formal consultation with the Service, pursuant to the implementing regulations of section 7(a)(2) of the Endangered Species Act (50 Code of Federal Regulations 402.16).

Driving Off Roads

Desert Tortoise

In general, the use of vehicles off of roads (paved or unpaved) can injure or kill desert tortoises; vehicles traveling off road can also crush desert tortoise burrows trapping individuals in their collapsed burrows. In general, the Army's training activities have greatly reduced the number of desert tortoises in areas that are easily accessed by vehicles; additionally, the Army has translocated most, if not all, of the desert tortoises from the southern expansion area. In these areas, we expect that the Army's future activities are likely to kill or injure few desert tortoises because of the low numbers of animals present and because the Army will implement measures

during the implementation of its activities to protect desert tortoises during the use of vehicles off road.

Desert tortoises are likely more common is areas where vehicles are less likely to travel, such as areas that are steep and rugged or that have no value for training. The greater number of desert tortoises in these areas increases the risk of injury or mortality to some degree; however, we do not expect that the Army would use these areas as frequently and it would implement protective measures during such use. Consequently, we expect that use of vehicles off road in these areas is also likely to injure or kill few desert tortoises.

Critical Habitat

In general, the use of vehicles off of roads (paved or unpaved) can destroy plants needed for cover and food, erode and compact substrates, cause proliferation of weeds, and increase in the number and location of wildfires. We do not expect that the use of vehicles off of roads, at the extent likely to be conducted by the Army, would have a measurable effect on the first primary constituent element of critical habitat (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow). We have reached this conclusion because the Army's use would be relatively infrequent and monitored to the extent that it would not reduce the amount of habitat within critical habitat and prevent movement, dispersal, and gene flow.

The second through fifth primary constituent elements (sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites; sufficient vegetation for shelter from temperature extremes and predators) are related to the biological and physical aspects of critical habitat. We expect the low level of use of vehicles off roads, which will be appropriately monitored, would not affect the function of these aspects of the desert tortoise's habitat in a measurable manner.

This aspect of the Army's activities would minimally affect the sixth primary constituent element (habitat protected from disturbance and human caused mortality) because it would occur infrequently and be monitored.

Driving on Roads

Desert Tortoise

Desert tortoises are generally more easily observed on roads, because of their more even surfaces and lack of plant cover. Roads often allow vehicles to travel at higher speeds, which reduce the likelihood of drivers detecting and avoiding desert tortoises. Rises and turns in roads also decrease the ability of drivers to detect desert tortoises. Along heavily used roads, the number of desert tortoises is depressed for some distance from the edge of the road as a result of road-associated mortality; this distance varies with the level of use of the road. In general, vehicle use is likely to result in at least some mortalities of and injuries to desert tortoises; the extent of the loss is related to the condition of the road, the time of the year when vehicle use occurs, the

abundance of desert tortoises, and the awareness of the driver. Even the most careful drivers may occasionally strike a desert tortoise.

The Army addresses this threat in its protective measures by posting signs for reduced speed limits where appropriate. Additionally, all personnel who travel in desert tortoise habitat at Fort Irwin are briefed so that they are aware of the potential presence of desert tortoises on roads. We expect this threat to persist throughout the action area.

Critical Habitat

The use of existing roads will not affect the second through fifth primary constituent elements because these physical and biological aspects of critical habitat are no longer present within roads. Roads that experience high levels of traffic can essentially form a barrier to movement, dispersal, and gene flow (first primary constituent element); the only road within Fort Irwin that likely experiences this level of traffic is Fort Irwin Road, which connects the cantonment area to Barstow. High levels of traffic may affect the sixth primary constituent element (habitat protected from disturbance and human caused mortality) by increasing the number of desert tortoises that are injured or killed. At least portions of the desert tortoise habitat adjacent to Fort Irwin Road are heavily used for training and other activities; desert tortoises are likely less common in these degraded areas and therefore less likely to enter the road.

Ground Disturbance

Desert Tortoise

We consider ground disturbance to include any activity where the Army's activities disrupt vegetation and substrate through the use of heavy equipment and materials. Desert tortoises may be injured or killed or trapped in their burrows during these activities. Some of the Army's activities may cause negligible amounts of ground disturbance. Conversely, the construction of a new target or building may result in ground disturbance over a larger area.

Because the Army would use standard and successful measures and experienced staff to avoid injuring or killing desert tortoises during ground-disturbing activities, we expect that relatively few individuals are likely to be injured or killed as a result of ground disturbance.

Critical Habitat

Ground disturbance has the potential to adversely affect all the primary constituent elements of critical habitat. Small amounts of ground disturbance that are temporary in nature would generally affect critical habitat less than larger areas of permanent disturbance, although some indirect effects of smaller projects (e.g., the proliferation of weeds) can extend well beyond the temporal and spatial footprint of a project.

Explosions

Desert Tortoise

Ordnance or other materials associated with explosions could strike a desert tortoise directly. Such events are likely extremely rare, given the large area of the target sites, the sparse distribution of desert tortoises, and the relatively small area that the explosion would affect. Some potential exists that explosions can cause vibrations that would cause nearby burrows to collapse and trap desert tortoises inside.

Desert tortoises may be injured by noise associated with explosions. Bowles et al. (1999) found that subsonic and supersonic aircraft noise did not elicit substantial responses from desert tortoises. If a desert tortoise were close to a large explosion, however, we expect that the noise would have the potential to cause physical damage to the animal. Few desert tortoises are likely to be injured or killed by explosions, primarily because the areas used for such training are relatively limited in area and because of the overall low density of desert tortoises.

The integrated natural resources management plan Army (2006-2011) notes that the gunnery ranges at Fort Irwin experience frequent fires. Therefore, we will consider the~~s~~se fires as a likely effect of explosions. Fires can injure or kill desert tortoises that are away from their burrows; the use of fire equipment to fight fires could also kill desert tortoises. Larger fires during times of the year and day when desert tortoises are active are more likely to injure or kill desert tortoises than smaller fires when desert tortoises are inactive (i.e., in their burrows). Desert tortoises are less likely to be present in areas that have repeatedly burned, where non-native grasses predominate; to the extent that at least some fires occur in such areas, the risk of desert tortoises being injured or killed by fire is somewhat reduced.

The integrated natural resources management plan notes that the Army responds rapidly to fires to suppress them as quickly as possible. The Army's fire management measures are likely to reduce the potential for fires started at gunnery ranges. This measure is protective of desert tortoises because fires can kill desert tortoises that may be above ground.

Critical Habitat

The Army's use of explosives would not directly impair the value and function of critical habitat with regard to the first primary constituent element (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow). We have reached this conclusion because the explosions occur in relatively small areas that are used repeatedly. Most explosions would likely occur in areas that have been previously used for such work. However, if a large fire spread from target sites, the potential exists that habitat conditions could be altered to the extent that desert tortoises would no longer traverse such areas.

Large explosions would likely alter the quality and quantity of forage species and the soil conditions to provide for the growth of these species in new target areas (the second primary constituent element); target areas that have been used previously likely no longer support these features. Smaller explosions likely have little or no direct effect on this primary constituent element. As we previously discussed, fire spreading from a target area would likely reduce the value and function of this primary constituent element.

Large explosions likely damage substrates for burrowing, nesting, and overwintering (third primary constituent element) and burrows, caliche caves, and other shelter sites (fourth primary constituent element). Because most explosions would occur in previously used, defined target areas, damage to substrates and shelter sites is likely to be minimal. Fire may affect substrates and shelter sites if it removes sufficient plant cover to increase erosion during storm events. Large explosions would remove vegetation that desert tortoises use for shelter from temperature extremes and predators (the fifth primary constituent element), but generally in a limited area. This adverse effect would be reduced by the use of existing target sites. Fire would affect shelter sites provided by shrubs if it spreads beyond the disturbed target site.

The repeated use of target sites would reduce the potential for explosions to have a measurable effect on the sixth primary constituent element (habitat protected from disturbance and human-caused mortality) because the disturbance and potential for mortality of desert tortoises would be limited to a relatively small portion of critical habitat. Conversely, the creation of new bombing targets in critical habitat would require the Army to clear additional lands. As with the other primary constituent elements, fire that spreads beyond disturbed areas around the target sites would increase the adverse effect.

The Army's fire management measures likely reduce the potential that fires started at target sites would have a measurable effect on the primary constituent elements of critical habitat of the desert tortoise. The goal of the integrated natural resources management plan is to protect lands and natural resources from wild fires. This goal is protective of the primary constituent elements of critical habitat. In the event of a wildfire that may affect desert tortoises or their critical habitat, the Army and Service would consult under the emergency provisions of section 7(a)(2) of the Endangered Species Act.

Non-native Plant Species

Desert Tortoise

Vehicles, ground disturbance, fire, and other human activities contribute to the dispersal of non-native plant species. These non-native plants include species that are already present in the California desert and newly introduced species. As we discussed in the Status of the Species and Critical Habitat section of this biological opinion, non-native plants can alter the quality and quantity of plant foods available to desert tortoises and thereby affect their nutritional intake.

Critical Habitat

The spread of non-native plant species may impair the value and function of the first primary constituent element (sufficient space to support viable populations within each of the six recovery units and to provide for movement, dispersal, and gene flow) if they become so widespread and dense that they reduce the ability of desert tortoises to forage over wide areas. This threat is most prominent in the action area where fires have the potential to alter habitat conditions on a large scale.

As we discussed in the Status of Critical Habitat of the Desert Tortoise section of this biological opinion, the function and value of the second primary constituent element (sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species) have been compromised to some degree throughout the range of the desert tortoise. The Army's activities, particularly near targets where fires are more likely, may exacerbate this threat.

The spread of non-native plant species is not likely to affect the third and fourth primary constituent element (suitable substrates for burrowing, nesting, and overwintering; burrows, caliche caves, and other shelter sites). We have reached this conclusion because the plants would not generally affect substrates or shelter sites used by desert tortoises.

Non-native plant species can degrade vegetation that desert tortoises use to seek shelter from temperature extremes and predators (the fifth primary constituent element), primarily by supporting larger and more intense fires. Most shrubs in the California desert are not adapted to fire. Once fire kills these shrubs, they are unlikely to return, thus depriving desert tortoises of shelter sites.

Habitat that is degraded by the presence of a large component of non-native species has not been protected from disturbance and human-caused mortality (the sixth primary constituent element). Consequently, spread of non-native plant species has the potential to further degrade the value and function of this primary constituent element.

As we discussed in the Status of the Desert Tortoise section of this biological opinion, current information indicates that invasive species likely affect a large portion of the desert tortoise's range. Non-native species can occur in densities that can increase the risk of fires, which, in turn, destroy native species and may result in future habitat loss. We expect that the non-native plant species routinely found in the Mojave Desert occur throughout Fort Irwin.

The Army's goal with regard to non-native plant species is to "control noxious and invasive exotic plants to support the military mission, promote sustained ecosystem functionality, favor native species biodiversity, and add to the quality of life" at Fort Irwin (Army 2006-2011). This goal is protective of critical habitat of the desert tortoise.

Common Ravens

Desert Tortoise

The Army has proposed to manage its trash and debris to reduce the attractiveness of Fort Irwin to common ravens. This protective measure would likely be effective in reducing some level of food subsidies to common ravens. We expect that buildings and other structures on Fort Irwin would continue to provide common ravens with more perching, roosting, and nesting sites than would be found in a natural setting. We also expect that common ravens ~~also~~ derive at least some food and water from the residential area of the installation. Future development may lead to an increase in the number of people using the residential area, which may, in turn, increase the amount of food and water available to common ravens. Any increase in the number of common

ravens would likely result in increased predation of desert tortoises.

Critical Habitat

Common ravens do not affect the primary constituent elements of critical habitat.

Moving Desert Tortoises from Harm's Way

Desert Tortoise

Biologists considered translocation to be an ineffective tool in reducing the impacts of projects on desert tortoises and raised concerns regarding its numerous potential adverse effects (e.g., overcrowding, increased disease transmission, increased mortality, elevation of stress hormones, vulnerability to drought, etc.). Over the past approximately 10 years, several researchers (including several studies funded by the Army at Fort Irwin) have undertaken studies to more carefully evaluate the effects of translocation on desert tortoises; some of these studies have included the monitoring of control and resident animals. (Desert tortoises used as controls inhabit areas that are disjunct from those occupied by translocated animals; resident animals occupy areas into which desert tortoises have been translocated.) These studies have indicated that translocated, resident, and control animals do not have significant differences in mortality rates or in levels of stress hormones. The reproductive output of translocated animals is slightly lower than that of residents or controls for the first year after translocation and translocated animals tend to move more but settle down after a period of time.

The Service's (2013) biological opinion for the Stateline and Silver State South solar projects contains an~~d~~ extensive discussion of the potential effects of translocation on desert tortoises; we incorporate that analysis herein by reference. Because of the results of the studies on translocation, we expect that the movement of desert tortoises from harm's way during the Army's activities is likely to have a negligible effect on these individuals. The potential exists that a small number of translocated or resident desert tortoises may die or be injured during the translocation because of the specific circumstances; however, we consider this likelihood.to be low.

Comment [c12]: Since we are discussing moving tortoises out of harm's way, the majority of these animals will be moved a short distance by a biologist on foot, does this sentence make sense? It seems to be discussing something different than what is described in the next paragrapyh.

Critical Habitat

Moving desert tortoises from harm's way will not affect critical habitat because this activity primarily involves the transport of individuals a relatively short distance by a biologist who is traveling on foot. Neither the desert tortoises themselves nor the personnel who transport them will affect the primary constituent elements of critical habitat. The construction of artificial burrows would disturb limited areas where annual plants could grow and their supporting substrates; however, this disturbance will not measurably affect the value or function of the primary constituent elements of critical habitat.

Personnel on Foot

Desert Tortoise

Because of their small size, hatchlings and slightly larger desert tortoises could be trampled by foot traffic. Nests are also vulnerable, but their typical location, near the mouth of a burrow, likely protects them to some degree.

We expect that few desert tortoises would be injured or killed in this manner because most Army personnel working in desert tortoise habitat will receive specific training, which would increase their awareness of this potential threat. Additionally, we expect that the likelihood of stepping on desert tortoises would generally be low because most activities involving personnel on foot would occur in a relatively limited area of the base and most frequently in situations where the Army has conducted surveys to protect desert tortoises.

Critical Habitat

This activity will not affect the primary constituent elements of critical habitat because of the general low intensity of use.

Habitat Conversion

Desert Tortoise

Various activities that the Army may undertake have the potential to cause habitat conversion. The act of converting habitat from an area that is suitable for desert tortoises into some other environment has the potential to kill the individuals living in that area. Generally, the heavy equipment that is involved in the conversion of habitat would crush any desert tortoises that are present.

As we have discussed previously in this biological opinion, other factors, such as fire and an overabundance of non-native species can, either together or separately, convert an area of suitable habitat for desert tortoises into something that is far less able to support them. Over time, desert tortoises that are forced to live in such areas are likely to die as a result of starvation; prior to that, their reproductive output would likely be lower because of their poorer physiological condition.

Critical Habitat

Suitable habitat generally is that which contains the primary constituent elements of critical habitat in a functioning condition. In the context of critical habitat, habitat conversion would occur when the amount of disturbance or alteration of a primary constituent element removes its function or value. Any ground-based activity that the Army undertakes could potentially disturb or alter, to some degree, the primary constituent elements. As examples, the extensive use of off-road vehicles could decrease the amount of space needed to support a viable population of desert tortoises and to provide for movement, dispersal, and gene flow within the Western Mojave Recovery Unit. Vehicles traveling off roads could decrease the quality and quantity of forage species and the substrate conditions that support the growth of these species and for burrowing; off-road travel could also destroy burrows, caliche caves, and other shelter sites and

the perennial vegetation that desert tortoises use for shelter from temperature extremes and predators. Off-road vehicle use would increase the amount of disturbance and human-caused mortality in the area in which it occurred.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Most of the action area is entirely located within Fort Irwin and is therefore on Federal lands; any future actions will be subject to the consultation requirements of section 7(a)(2) of the Act. The only portion of the action area that is not within Fort Irwin is the Manix Trail. Most of the route traverses lands managed by the Bureau, which is also subject to the consultation requirements of section 7(a)(2) of the Act. Portions of the Manix Trail cross non-federal lands; however, we are unaware of any non-federal actions that are reasonably certain to occur in this area.

CONCLUSION

Desert Tortoise

The regulatory definition of "to jeopardize the continued existence of the species" focuses on assessing the effects of the proposed action on the reproduction, numbers, or distribution of the species being considered in the biological opinion. For that reason, we have used those aspects of the desert tortoise's status as the basis to assess the overall effect of the proposed action on the species.

In the first portion of the Effects of the Action section of this biological opinion, we provided a general description of how the various activities that the Army expects to undertake are likely to affect desert tortoises. In the following sections, we will use the proposed re-initiation threshold of five desert tortoises killed in a year to determine how the future operation of Fort Irwin would affect the reproduction, number, and distribution of the desert tortoise. We will then assess the effects of the proposed action on the recovery of the species and whether it is likely to appreciably reduce the likelihood of both the survival and recovery of the desert tortoise. We reach our conclusion regarding whether an action is likely "to jeopardize the continued existence of the species" through an analysis of how a proposed action affects the listed taxon within the action area in relation to the range of the entire listed taxon. For the desert tortoise, this process involves considering the effects at the level of the action area, then at the level of the recovery unit (in this case, the Western Mojave Recovery Unit), and then finally for the range of the listed taxon. Logically, if an aspect of the proposed action is unlikely to cause a measurable effect within the action area, it is unlikely to affect the recovery unit or the remainder of the range.

<u>Reproduction</u>

The reproductive output of individuals of a species is determined in part by the species' breeding ecology, overall abundance of breeding individuals, and the condition of the habitat in which

they live. The reproductive output of the desert tortoise is governed by several aspects of its breeding ecology: the delayed onset of breeding, many years of reproduction, high mortality rates of eggs and young, and low mortality rates among adults. If the population of desert tortoises at Fort Irwin was stable or increasing, the loss of five individuals per year to human activities would be unlikely to have a measurable effect on its overall reproductive capacity. The long reproductive life of female desert tortoises and the normally low mortality rates among adult animals are factors that would protect the reproductive output of a population.

The overall abundance of breeding individuals would also influence how the loss of five desert tortoises per year affects their reproductive output at Fort Irwin. In general, desert tortoises occur at low densities in most areas of the base. In some areas, their densities are extremely low. The effects of the mortality of five desert tortoises per year within Fort Irwin may negatively affect the amount of reproduction for several reasons. First, the loss of even a small number of individuals in a low-density population could render finding mates more difficult. Second, desert tortoises require from 13 to 20 years to reach sexual maturity. Third, females produce a relatively small number of eggs per year. Fourth, desert tortoises also experience high mortality early in life (including as eggs). Consequently, even moderate downward fluctuations in adult survival rates can result in rapid population declines; slow reproductive rates and high juvenile mortality limit the capacity of populations to increase rapidly after a decline (Service 2011).

The desert tortoise possesses two safeguards against the loss of reproduction in areas of low population density. First, female desert tortoises can store sperm for several years; this trait provides some hedge against low densities precluding reproduction because females do not need to encounter males every year to produce young. Second, breeding-age desert tortoises would continue to produce young over their long reproductive life; this reproductive output could replace individuals that are killed by the Army's activities.

The amount and timing of rainfall in the desert greatly influences the production of native annual plants upon which desert tortoises feed. A high diversity and abundance of annual plants provide desert tortoises with the appropriate quality and quantity of food to persist and to produce eggs. The widespread invasion of non-native annual plants has likely reduced the desert tortoise's ability to obtain the appropriate quality and quantity of forage plants on a consistent basis. Human disturbance of substrates and increased frequency of fires render desert habitat more susceptible to invasion by non-native annual plants. The potential exists that non-native plants are already established at Fort Irwin to the degree that the Army's activities would not exacerbate the situation. The Army's program to manage non-native plants is unlikely to substantially alter the flora of Fort Irwin to one that is predominantly native species; conversely, it is likely to prevent the spread of new weeds throughout the base. If the Army introduced new species of invasive plants during its activities or expanded the area of infestation of invasive species already on base, the quality of desert tortoise habitat would likely further decrease; such a decrease would negatively affect the ability of Fort Irwin to support the reproduction of desert tortoises at the highest levels of productivity.

Based on these factors, we conclude that the loss of five individuals per year to the Army's activities is likely to cause a minor depression of reproduction of desert tortoises at Fort Irwin. We acknowledge that all five individuals may not be of reproductive age; the loss of non-

reproductive individuals would not have an immediate effect on reproduction. We also acknowledge that the loss of younger animals would reduce their potential recruitment into breeding age individuals.

Our determination with regard to whether a proposed action is likely to jeopardize the continued existence of a species is based on the status of the listed taxon throughout its range and not just within the action area. Consequently, although the loss of five individuals per year at Fort Irwin is likely to cause a minor depression of reproduction of desert tortoises at Fort Irwin, this loss is unlikely to have a measurable effect on the reproduction of desert tortoises within the Western Mojave Recovery Unit or range wide. We have reached this conclusion because Fort Irwin supports a small portion of the estimated number of desert tortoises that occur within the Western Mojave Recovery Unit and an even smaller portion of the number within the species' range. The next section of this analysis provides insight into the numbers of desert tortoises within Fort Irwin, the Western Mojave Recovery Unit, and range wide.

Number

We used the estimate provided by the Desert Tortoise Recovery Office (2014) to assess how the loss of five individuals per year at Fort Irwin would affect the desert tortoise, first within the Western Mojave Recovery Unit (where Fort Irwin is located) and then throughout its range. The numbers in the following table are based on desert tortoises that are greater than 180 millimeters and are based on sampling conducted within desert tortoise conservation areas where densities may be greater than they are outside of these areas. To provide a longer perspective of how the loss of 5 individuals per year may affect the population of desert tortoises over time, we have included a cumulative loss of 100 individuals (i.e., 5 desert tortoises each year for 20 years of activities) in the table.

Number of Desert Tortoises Killed	**Percentage of Annual Mortality Estimate Compared to Overall Population**	
	Western Mojave Recovery Unit 76,323	**Range-wide 106,000**
Year 1 - 5	0.0065	0.0047
Year 20 - 100	0.1310	0.0943

We acknowledge that we cannot predict whether the numbers of desert tortoises at Fort Irwin, within the Western Mojave Recovery Unit, or range wide would change over the next 20 years. We expect the overall factors that affect the status of desert tortoises to be similar within and outside Fort Irwin. If the number of desert tortoises at Fort Irwin decreases, we expect that the Army would encounter fewer individuals while it is implementing actions and, therefore, fewer individuals are likelier to die. If more desert tortoises ~~number~~ occur at Fort Irwin in the future, the risk that desert tortoises would die at any given project would increase but the Army's proposed protective measures (including a commitment to re-initiate formal consultation if five are killed in a year) would prevent an appreciable increase in mortalities.

Consequently, based on the best available information, we conclude that the loss of five desert tortoises per year is not likely to appreciably diminish the number of desert tortoises, either

within the Western Mojave Recovery Unit or range wide.

We did not discuss the injury of desert tortoises in this section. The implementing regulations for section 7 of the Endangered Species Act at 50 Code of Federal Regulations 402.14(i)(1)(iv) require the Service to specify the procedures to be used to handle or dispose of any individuals of a species that is killed or injured during the implementation of a proposed action that has undergone formal consultation. Consequently, in the Incidental Take Statement - Disposition of Dead or Injured Specimens section of this biological opinion, we will direct the Army to take injured desert tortoises to a qualified veterinarian for treatment and to contact us regarding the final disposition ~~any~~of these animals. If they recover from their injuries to the extent that they can be released to the wild, these animals would not be included in the annual count of dead desert tortoises.

Distribution

With the exception of the consultations in which the Service analyzed the effects of training on desert tortoises, previous consultations with the Army generally involved numerous actions that affected scattered, relatively small areas of desert tortoise habitat across Fort Irwin. We expect this general pattern to continue. One exception is the Army's proposal to allow for the development and operation of solar plants within Fort Irwin. We are aware that solar plants may occupy up to several thousand acres.

In its biological opinion on the use of additional maneuver training lands at Fort Irwin, the Service (2012) concluded th~~eat~~ proposed action was not likely to appreciably diminish the distribution of the desert tortoise in the Western Mojave Recovery Unit. In that biological opinion, the Service noted that the desert tortoise was near the northern edge of its range in this portion of the Mojave Desert and that the region north of the southern expansion area supported relatively few desert tortoises because of past training.

Future development at Fort Irwin, including solar plants, would reduce the amount of habitat on base and increase, to some degree, the amount of fragmentation on a local scale. Most of the activities associated with infrastructure improvements and the development of solar plants would occur within the boundaries of Fort Irwin as they existed prior to the recent expansion. Desert tortoises have been virtually extirpated within Fort Irwin north of the southern expansion area and occur in low densities, if they occur at all, within the southernmost portion of Death Valley National Park, which lies to the north of Fort Irwin; these animals are few in number and likely already isolated from the remainder of the population in the Western Mojave Recovery Unit, at least across the existing training areas of Fort Irwin.

Little, if any, development would occur in the western expansion area or on the Eastgate parcel. The Army will not undertake substantial activities in the western expansion area until it determines its future training needs, at which time it would re-initiate formal consultation with the Service. The Eastgate parcel is generally too steep and far removed from the cantonment area to support large-scale development.

For these reasons, we have concluded that future development at Fort Irwin would not

appreciably diminish the distribution of the desert tortoise within the Western Mojave Recovery Unit.

Effects on Recovery

Fort Irwin occupies a relatively small portion of the Western Mojave Recovery Unit and an even smaller portion of the range of the desert tortoise. Consequently, the activities that the Army conducts on base under consideration in this biological opinion are unlikely to have an appreciable direct effect on the recovery of the desert tortoise. The relatively small number of desert tortoises that we expect the Army to kill annually is unlikely to appreciably diminish the ability of the desert tortoise to reach stable or increasing population trends in the future.

After reviewing its current status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the desert tortoise. We have reached this conclusion for the following reasons. First, the Army's activities are unlikely to affect the reproductive capacity of desert tortoises within Fort Irwin. Second, the few desert tortoises that the Army is likely to kill comprise a minor fraction of the number of desert tortoises within the Western Mojave Recovery Unit and range-wide. Third, future development within Fort Irwin would not appreciably diminish the distribution of the desert tortoise within the Western Mojave Recovery Unit or range-wide. Fourth, the Army's activities within Fort Irwin are not likely to have a measurable effect on the recovery of the desert tortoise.

Critical Habitat of the Desert Tortoise

Critical habitat of the desert tortoise occurs in three portions of Fort Irwin: the southern expansion area, the western expansion area, and the Goldstone Deep Space Communications Complex. In its biological opinion on the use of additional maneuver training lands at Fort Irwin, the Service (2012) concluded that training activities, such as force-on-force maneuvers and the construction of sites for military operations in urban terrain, would disturb 18,197 acres of critical habitat in the southern expansion area. We concluded that this area would no longer support the conservation values and function of critical habitat within the Superior-Cronese Critical Habitat Unit. The effects of the actions considered in this biological opinion are likely to be somewhat different than those in the 2012 document. That is, the Army's proposed actions would occur in an area that the Service has already determined had lost the conservation value and function of critical habitat; therefore, we will not consider future development by the Army in the southern expansion area to affect the baseline conditions of critical habitat. Even considering the disturbance of 18,197 acres within the southern expansion area, the Superior-Cronese Critical Habitat Unit includes approximately 5,699,681 acres of modeled critical habitat.

The Army would not engage in any large-scale development in the western expansion area; activities in that area would mostly be limited to general maintenance actions, such as repair of the fence around this area and of other existing facilities. Such activities would disturb a small portion of the 70,549 acres of critical habitat within the western expansion area.

The Goldstone Deep Space Communications Complex includes 4,284 acres of critical habitat

(Everly 2014). As with the western expansion area, the Army would limit its activities to general maintenance actions in this area. Such activities would disturb a small portion of the critical habitat within the Goldstone Deep Space Communications Complex.

After reviewing the current status of critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to result in the destruction or adverse modification of critical habitat of the desert tortoise. We have reached this conclusion because the small amount of disturbance of critical habitat we anticipate within the western expansion area and Goldstone Deep Space Communications Complex would comprise a negligible portion of the approximately 5,699,681 acres of modeled critical habitat remaining in the Superior-Cronese Critical Habitat Unit and an even smaller portion of critical habitat range wide. Therefore, the proposed action is not likely to affect the conservation value and function of critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not the purpose of, the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement and the avoidance and minimization measures proposed by the Army.

The measures described below are non-discretionary; the Army must implement these measures during the conduct of its activities or include them as binding conditions of any grant or permit issued to its customers and contractors, as appropriate, for the exemption in section 7(o)(2) to apply. The Army has a continuing duty to regulate the activity covered by this incidental take statement. If the Army fails to assume and implement the terms and conditions or fails to require its customers and contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Army must report the progress of the actions and its impact on the species to the Service as specified in the incidental take statement (50 Code of Federal Regulations 402.14(i)(3)).

The Service anticipates that five desert tortoises per year are likely to be taken, in the form of mortality, as a result of the operation of Fort Irwin. We derived this number through discussions with the Army and used it as the basis of our section 7(a)(2) analysis in this biological opinion. This number also serves as a basis for the re-initiation of formal consultation.

We do not expect removing desert tortoises from harm's way during the implementation of the Army's activities to result in their injury or mortality. Therefore, we are not including an anticipated amount or extent of this form of take (i.e., capture).

REASONABLE AND PRUDENT MEASURE

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize take of desert tortoises during activities related to operations and activities at Fort Irwin:

> The Army must ensure that desert tortoises do not re-enter the southern expansion area from the conservation areas and other lands adjacent to the southern expansion area.

Our evaluation of the proposed action includes consideration of the protective measures proposed by the Army and described in the Description of the Proposed Action section of this biological opinion. Consequently, any changes in these protective measures may constitute a modification of the proposed action that causes an effect to the desert tortoise that was not considered in the biological opinion and require re-initiation of consultation, pursuant to the implementing regulations of the section 7(a)(2) of the Act (50 Code of Federal Regulations 402.16).

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the Act, the Army must comply with or ensure that any contractor complies with the following term and condition, which implements the reasonable and prudent measure described in the previous section of this biological opinion, and the reporting and monitoring requirements. This term and condition is discretionary.

> The following term and condition implements the reasonable and prudent measure:
>
> The Army must ensure that the fence separating the southern expansion area from its conservation areas and other adjacent lands remains intact and functional. To this end, the Army must inspect the fence regularly to determine whether it has been compromised by vandalism, blowing sand, or any other factor. The Army must also inspect the fence after any storm event that may generate flooding. When desert tortoises are active and have a greater likelihood of re-entering the southern expansion area, the Amy must effect repairs within 3 days of finding the breakage in the fence. When desert tortoises are inactive and have a lesser likelihood of re-entering the southern expansion area, the Amy must affect repairs within 7 days of finding the breakage in the fence. The Army's Natural and Cultural Resources Program Manager is responsible for determining the activity levels of desert tortoises.

REPORTING REQUIREMENTS

Pursuant to 50 Code of Federal Regulations 402.14(i)(3), the Army must provide a report to the

Service that provides details on each desert tortoise that is killed or injured by its activities. In addition to the information that the Army will provide to the Service in its annual report, as described in the Administration of the Consultation section of this biological opinion, the report must also include information on any instances when desert tortoises were killed, injured, or handled, the circumstances of such incidents, and any actions undertaken to prevent similar instances from re-occurring. The report must also include a description of the monitoring efforts that occurred during implementation of actions that occur with desert tortoise habitat.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Within 3 days of locating any dead or injured desert tortoises, the Army must notify the Ventura Fish and Wildlife Office by telephone (805 644-1766) and by facsimile or electronic mail. The report must include the date, time, and location of the carcass, a photograph, cause of death, if known, and any other pertinent information.

The Army must take any injured desert tortoises to a qualified veterinarian for treatment. If any injured desert tortoises survive, the Army must contact the Service regarding their final disposition.

Care must be taken in handling dead specimens to preserve biological material in the best possible state for later analysis, if such analysis is needed. The Service will make this determination when the Army provides notice that a desert tortoise has been killed by project activities.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

We recommend that the Army:

1. Assist the Service in implementation of the management plan for the common raven, control of feral dogs, management of subsidies for coyotes (*Canis latrans*), and numerous other activities that are intended to reduce the mortality levels of desert tortoises and improve habitat conditions.

2. Mark small desert tortoises from within project sites prior to their movement from harm's way or translocation. This marking would provide some information on their post-project status if they are encountered during future surveys or monitoring efforts. If the Army determines that it will include this requirement, we suggest that the authorized biologist contact the Desert Tortoise Recovery Office to ascertain the most appropriate means of marking the animals.

The Service requests notification of the implementation of any conservation recommendations so we may be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

RE-INITIATION NOTICE

This concludes formal consultation on operations and activities at Fort Irwin. As provided in 50 Code of Federal Regulations 402.16, re-initiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (1) if the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) will have lapsed and any further take would be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending re-initiation.

Sincerely,

Kennon A. Corey
Assistant Field Supervisor

APPENDICES

1. Mojave population of the desert tortoise (*Gopherus agassizii*). 5-year review: summary and evaluation. Available on disk or hard copy by request or at http://ecos.fws.gov/docs/five_year_review/doc3572.DT%205Year%20Review_FINAL.pdf.

2. Solar projects for which the U.S. Fish and Wildlife Service has issued biological opinions or incidental take permits.

RANGE-WIDE MONITORING OF THE MOJAVE DESERT TORTOISE (*GOPHERUS AGASSIZII*):

2012 ANNUAL REPORT

PREPARED BY LINDA ALLISON
DESERT TORTOISE MONITORING COORDINATOR
U.S. FISH AND WILDLIFE SERVICE

DECEMBER 2012

DRAFT

DRAFT

Recommended Citation: U.S. Fish and Wildlife Service. 2012. DRAFT Range-wide Monitoring of the Mojave Desert Tortoise (*Gopherus agassizii*): 2012 Annual Report. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada.

TABLE OF CONTENTS

Executive Summary 5
Introduction 8
Methods 9
Study areas and transect locations 9
Distance sampling transect completion 10
Proportion of tortoises available for detection by line distance sampling, G_0 15
Field observer training 16
Telemetry training 16
Distance sampling training 16
Data management including quality assurance and quality control 23
Tortoise encounter rate and development of detection functions 24
Proportion of available tortoises detected on the transect centerline, *g(0)* 24
Estimates of tortoise density 26
Estimating the area of each stratum sampled and the number of tortoises in that area 27
Modification of previous procedures 28
Debriefing to describe strengths and weaknesses of project preparation and execution 28
Results 29
Field observer training 29
Proportion of tortoises detected at distances from the transect centerline 29
Quality assurance and quality control 33
Transect completion 34
Burrow encounter rate 39
Tortoise encounter rates and detection functions 39
Proportion of tortoises available for detection by line distance sampling, G_0 42
Proportion of available tortoises detected on the transect centerline, *g(0)* 42
Estimates of tortoise density 43
Area of each stratum sampled and the number of tortoises in that area 45
Evaluating transect classification 45
Number of tortoises based on density and area sampled 46
Possibility of using burrow counts to estimate tortoise abundance at smaller scales 46
Debriefing to identify strengths and weaknesses in preparation for future years 47
Earlier review of the first field data 47
Training improvements to make more effective use of same time period 47
Discussion 48
Quality control and quality assurance 48
Improving ability to detect trends in desert tortoise abundance 48
Consequences of insufficient transects 48
Literature Cited 50

DRAFT

LIST OF TABLES

Table 1. Training schedule for 2012 18
Table 2. Proportion of tortoise models detected by teams within 1-, 2-, or 5-m of the transect centerline. Values that scored below the target of 0.90 at 1- and 2-m are highlighted..... 30
Table 3. Diagnostics for individual teams after training..... 31
Table 4. Number and type of transects in each stratum. 34
Table 5. Availability of tortoises (G_0) during the period in 2012 when transects were walked in each group of neighboring strata..... 42
Table 6. Recovery unit and stratum-level encounters and densities in 2012 for tortoises with MCL ≥ 180mm. 44
Table 7. Estimated density of desert tortoises in monitored areas of each recovery unit in the Mojave and Colorado deserts in 2012. 45
Table 8. Transects completed other than as planned and any resulting reclassification..... 45
Table 9. Estimated tortoise abundance in sampled areas of each stratum 46

LIST OF FIGURES

Figure 1. Sampled areas 2012. 11
Figure 2. Planned (dotted lines) and reflected transect paths at administrative boundaries, now also applied to stratum edges. A) One-corner reflection. B) Two-corner reflection. 14
Figure 3. Data flow from collection through final products. 23
Figure 4. Relationship between single-observer detections (by the leader, *p*) and dual-observer (team) detections, *g(0)*. 25
Figure 5. Process for developing density estimates in 2012. For each type of estimate, the full set of data was subdivided appropriately, as indicated by columns. 27
Figure 6. Detection curves for each of the 2012 GBI teams during training. Curves are based on 16 km trials with approximately 100 detections. 32
Figure 7. Detection curves for each of the 2012 IWS trainee teams. Curves are based on 16 km trials with approximately 100 detections. 32
Figure 8. Detection curves for each of the 2012 Kiva trainee teams. Curves are based on 16 km trials with approximately 100 detections. 33
Figure 9. Distribution of distance sampling transects and live tortoise observations in the Northeastern Mojave Recovery Unit (Coyote Springs Valley, Mormon Mesa, Beaver Dam Slope, and Gold Butte-Pakoon monitoring strata). 35
Figure 10. Distribution of distance sampling transects and live tortoise observations in the Eastern Mojave Recovery Unit (Eldorado Valley and Ivanpah monitoring strata) and the eastern part of the Colorado Desert Recovery Unit (Fenner, Piute Valley, and Chemehuevi monitoring strata)..... 36

DRAFT

Figure 11. Distribution of distance sampling transects and live tortoise observations in the Western Mojave Recovery Unit (Fremont-Kramer, Superior-Cronese, and Ord-Rodman monitoring strata). 37
Figure 12. Distribution of distance sampling transects and live tortoise observations in the western portion of the Colorado Desert Recovery Unit (Pinto Mountains, Joshua Tree, Chocolate Mountain, and Chuckwalla monitoring strata). 38
Figure 13. Observed detections (histogram) and the resulting detection function (smooth curve) for live tortoises with MCL ≥ 180mm found by GBI. This curve uses only the 151 observations found within 21 m of the line. 40
Figure 14. Observed detections (histogram) and the resulting detection function (smooth curve) for live tortoises with MCL ≥ 180 mm found by IWS. This curve uses only the 28 observations found within 15 m of the line. 41
Figure 15. Observed detections (histogram) and the resulting detection function (smooth curve) for live tortoises with MCL ≥ 180mm found by Kiva. This curve uses only the 73 observations found within 14 m of the line. 41
Figure 16. Detection pattern for the leader (p) and by the team ($g(0)$) based on all observations out to a given distance (x) from the centerline in 2012. Note convergence of $g(0)$ on 1.0 as x goes to 0. 43
Figure 17. Scatter plot of stratum densities and burrow encounter rate. 47

DRAFT

ACKNOWLEDGEMENTS

Funding or support-in-kind was provided by Fort Irwin National Training Center, the National Park Service portion of Grand Canyon-Parashant National Monument, Joshua Tree National Park, and the Arizona Strip Office of the Bureau of Land Management.

The original design for this project and considerations for optimizing it based on new information and experience were first set out in Anderson and Burnham (1996) and Anderson et al. (2001). Estimation methods were further refined during a 2008 workshop for distance sampling held by S. Buckland, L. Thomas, T. Marques, E. Rexstad, and D. Harris in Marshall, California.

Personnel from Kiva Biological Consulting (California) led by I. Daly, from the Institute for Wildlife Studies (California and Nevada) led by N. Gregory, and from the Great Basin Institute (Nevada, Arizona, and the Beaver Dam Slope of Utah) led by T. Christopher conducted the field surveys. The field monitors from these teams and from Joshua Tree National Park who did the hard work of collecting and verifying the data were: A. Allan, L. Baierl, M. Bassett, A. Bennett, B. Benson, Z. Cava, I. Daly, A. d'Epremesnil, L. Drake, L. Driscoll, T. Faust, K. Foley, P. Fuchs, M. Grode, J. Hamner, K. Harding, M. Immel, A. Johnson, G. Johnson, S. Johnson, M. Jolliff, K. Lalumiere, D. Leach, J. Macmillan, J. MacNaughton, C. Martin, C. McClurg, C. Michaud, N. Mikle, L. Mjos, B. O'Brien, C. O'Leary, A. Paulson, T. Rode, S. Root, J. Ross, R. Salonikios, D. Sanderson, W. Schultz, J. Scott, C. Sherwood, B. Sparks, A. Sturgill, T. Sullivan, D. Summers, C. Taylor, S. Vaghini, M. Vamstad, J. Werba, K. Wickwire, D. Wolfson.

R. Patil (University of Nevada, Reno); M. Brenneman (Topoworks); J. Johnson (Arizona Exotic Animal Hospital); K. Dutcher (San Diego Zoo); J. Stegmeier and R. Parr (Las Vegas Field Office, BLM); and T. Christopher and B. Sparks (GBI) provided specialized training instruction for field crews. D. Zeliff, R. Schultz, and L. Powell (Mojave Desert Ecosystem Program) provided preseason GIS support as well as independent review and post-processing of data submitted by both field groups. R. Patil (University of Nevada, Reno) updated the electronic data-collection forms and procedures used in 2012. M. Brenneman developed GIS tools for correctly reflecting transect paths and tracking completion of assigned transects. She also developed the final databases.

DRAFT

EXECUTIVE SUMMARY

The recovery program for desert tortoises in the Mojave and Colorado deserts (USFWS, 2011a) requires range-wide, long-term monitoring to determine whether recovery goals are met. Specifically, will population trends within recovery units increase for a period of 25 years? In 1999, the Desert Tortoise Management Oversight Group endorsed the use of line distance sampling (Buckland et al., 2001) as the method for estimating range-wide desert tortoise density. From 2001 to 2005, and again from 2007 through 2012, desert tortoise populations in 4 of the 5 recovery units have been part of a coordinated, range-wide monitoring program using line distance sampling. (The Upper Virgin River Recovery Unit is monitored by Utah Division of Wildlife Resources (McLuckie et al., 2012).) The first 5 years of monitoring culminated in a summary report (USFWS, 2006) that included eleven recommendations, seven of which were tied to functioning of the monitoring program and are paraphrased here:

1. The range-wide monitoring program should continue under a formal study plan subject to scientific review.
2. Refine [line distance sampling] techniques to improve sampling efficiency and estimates of trends.
3. Evaluate the spatial scale of the monitoring program.
4. Improve training lines.
5. Evaluate the use of independent field teams to improve data consistency and quality.
6. Refine and formalize/document the QA/QC process.
7. Identify and assess options for securing continued funding for range-wide population monitoring.

This report describes the full set of quality assurance steps and final results for the 2012 monitoring effort. The above issues continue to drive review and improvement of the program, so that reporting also addresses these aspects of the annual effort. The range-wide monitoring effort is directed each year at 16 strata that will be used to describe long-term trends. Data were collected on transects by field personnel working with three different groups, Kiva Biological (10 personnel), the Institute for Wildlife Studies (11 personnel), and Great Basin Institute (26 personnel). Four personnel from Joshua Tree National Park also collected telemetry data in the Park. After an intensive, 12-day specialized training session, crews completed 631 transects (7102 km) between 13 March and 22 May. In the course of these surveys, they reported 236 live tortoises.

Training is provided each year so that field crews are familiar with the specifics of distance sampling. Training also ensures consistency between the many crews collecting data. Inexperienced crews as well as those with prior experience participated in preseason training and testing provided by the USFWS. Crews were passed after demonstrating appropriate detection

DRAFT

patterns (including detection proportion on the transect line), measurement accuracy from tortoise models to the transect line, and other skills.

Four parameter estimates contribute to final reported tortoise densities in each monitoring stratum. The basis for distance sampling is the estimation of the number of tortoises detected at increasing distances from the walked transect. As surveyors look farther from the transect centerline, they will detect fewer and fewer of the tortoises that are actually there, so describing the way detections decrease with distance allows for estimation of the proportion that were present but not detected within a given distance of the centerline. Second, an estimate is made of the proportion above ground or visible in their burrows and available to be detected on transects. Third, the first two estimates are combined with the number of tortoises encountered per kilometer walked to provide the actual density in each stratum. Finally, the proportion detected on the line must be estimated. Unless all tortoises were detected on the centerline, the density estimate must be adjusted to account for the occurrence of these additional tortoises.

Separate detection curves were used to describe the decreasing ability of each team to see tortoises that were farther from the walked transect line. These detection curves will capture any differences between teams in application of the protocol, but are mostly expected to reflect the terrain as well as the extent to which vegetation obscures the view in different parts of the range, since the curves account for tortoises that were present in the same area but not seen. Kiva crews detected 39.7% of tortoises within 14 m of the transect centerline, GBI detected 37.9% out to 21 m, and IWS detected 43.2% to 15 m. The proportion of tortoises that were visible to be counted (G_0) varied in different parts of the range, which were surveyed at different times during the spring season. Visibility was as high as 97.7% in the Coyote Springs Valley telemetry site during 2 weeks in April. During the same weeks, visibility at the Superior-Cronese telemetry sites was also very high, 93.5%. Visibility in Joshua Tree National Park during the last 2 weeks of March and first 2 of April was 94.5%. Unfortunately, during this time visibility was as low as 35.6% in Chemehuevi, and was persistently low during the usual weeks of activity in the eastern part of the range. Visibility is related to encounter rates, which combined with a lack of funds from the BLM in Nevada and California to result in few observations in the central part of the Mojave Desert. On average, crews walked 30.1 km for each tortoise that was observed, but this number varied considerably from one monitoring stratum to the next. Although densities in the Northeastern Mojave Recovery Unit had been estimated at less than 2/km^2 in some previous years, the density was estimated at 3.4/km^{2,} similar to the past 4 years. The Western and Eastern Mojave recovery units had few transects and therefore few observations in some strata; density estimates in 4 strata were based on 1 or 2 observations. These strata had extremely low density estimates which were presumably an artifact of the sampling regime but nonetheless depressed recovery-unit level density estimates as well. Note that funding commitments in California were withdrawn 2 weeks before crews were on the ground so it was not possible to alter the sampling design that was already in place.

AR060101

To enable field crews to complete transects in previously unsampled areas within strata, a set of guidelines was implemented in 2008 and 2009 for shortening transects in areas with rugged terrain or other obstacles (USFWS 2012a). These rules did enable crews to sample entire strata in a more representative way; however, in areas of California with lower funding, the resulting substrata never had enough transects or tortoise observations to separately evaluate tortoise densities in flat compared to rugged terrain. For this reason, in 2010, a more relaxed protocol was implemented in California, under which transects were to be completed to the extent possible along the original 12 km path. Mountainous terrain in the path was circumnavigated without searching for tortoises, then the path was resumed when possible. This method samples walkable areas representatively and also allows the proportion of unwalkable terrain to be estimated; in 2012 it was implemented throughout the range. Our density estimates are applicable to the estimated 88.3% of terrain in critical habitat and other areas managed for tortoises that is also walkable.

DRAFT

RANGE-WIDE MONITORING OF THE MOJAVE DESERT TORTOISE
2012

INTRODUCTION

The Mojave Desert population of the desert tortoise (*Gopherus agassizii*) was listed as threatened under the Endangered Species Act in 1990. This group of desert tortoises north and west of the Colorado River are now recognized as the species *G. agassizii*, separate from *G. morafkai* south and east of the Colorado River (Murphy et al., 2011). The revised recovery plan (USFWS, 2011a) designates five recovery units and to which decisions about continued listing status should be applied. The recovery plan specifies that consideration of delisting should only proceed when populations in each recovery unit have increased for at least one tortoise generation (25 years), and the only means to determine trend is by a rigorous program of long-term monitoring. Before the tortoise was listed, populations were monitored either using strip transects (Luckenbach, 1982) where indications of tortoise presence (live or dead tortoises, scats, burrows, or tracks) were converted to tortoise abundance categories based on calibration transects conducted in areas of better-known tortoise density, or by using capture-recapture population estimates on a limited number of (usually) 1-mi^2 study plots (Berry and Nicholson, 1984). Although data have continued to be collected on transects and study plots in recent years, these methods suffer statistical deficiencies and/or logistical constraints that render them unsuited for monitoring trends in abundance applicable to entire recovery units (Corn, 1994; Anderson et al., 2001; Tracy et al., 2004). In 1999 the Desert Tortoise Management Oversight Group endorsed the use of line distance sampling (Buckland et al., 2001) for estimating range-wide desert tortoise density.

Distance sampling methods use measurements taken from the center of the transect lines to tortoises to model detection as a function of distance from the walked path; tortoises farther from the travelled path have a lower probability of detection. In order to anchor the curve and estimate the true (not relative) proportion of tortoises detection within a given distance from the center of the transect, all tortoises must be detected on the transect centerline (Anderson et al., 2001; Buckland et al., 2001). There are additional assumptions in distance analysis – that distance is measured to the point where the animal was first detected and that distance is measured accurately – but these are easily satisfied in line distance sampling of desert tortoises. The assumption that detection at the centerline of the transect is perfect, however, can be violated during line distance sampling of tortoises, but the use of two observers minimizes the probability that tortoises are missed on the centerline and provides a correction factor in the form of an estimate of the number of tortoises on the line that were missed (USFWS, 2009).

Distance methods have been applied to estimate abundance of Sonoran Desert Tortoises (*G. morafkai*) since 2000 (Swann et al., 2002; Averill-Murray and Averill-Murray, 2005) and for *G. agassizii* in the Upper Virgin River Recovery Unit in Utah since a pilot study in 1997 (McLuckie

AR060103

et al., 2010). The USFWS used line distance sampling to estimate abundance of tortoises in the remaining five recovery units for *G. agassizii* in Utah, Arizona, Nevada, and California starting in 2001 (USFWS 2006, 2009, 2012a, 2012b, 2012c). This report includes results of training exercises for field crews, describes implementation of monitoring, and presents the analysis of desert tortoise density in 2012.

METHODS

Study areas and transect locations

Long-term monitoring strata (Figure 1) will be used over the life of the project to describe population trends in areas managed to conserve tortoises ("tortoise conservation areas," TCAs). Generally each critical habitat unit (CHU) is treated as one monitoring stratum, although the portion of Mormon Mesa CHU that is associated with Coyote Springs Valley is treated as a separate stratum. Chuckwalla CHU is also treated as dual monitoring strata, with potentially unequal sampling effort in the areas managed by the Department of Defense (Chocolate Mountain Aerial Gunnery Range, CMAGR) and by the Bureau of Land Management (BLM). New recovery units were established under the revised recovery plan (USFWS, 2011), so while making the corresponding changes to our databases we also separated the Piute and Eldorado Valleys into 2 distinct strata; they are in different recovery units. The Joshua Tree stratum does not encompass all suitable habitat for desert tortoises in Joshua Tree National Park (JTNP). The national park designation and current boundaries just post-date the designation of CHUs, so some of the Pinto Mountains and Chuckwalla CHUs (and monitoring strata) are in the current JTNP.

The optimal number of transects in a monitoring stratum was determined by evaluating how these samples would contribute to the precision of the annual density estimate for a given recovery unit (Anderson and Burnham, 1996). Power to detect an increasing population size is a function of 1) the magnitude of the increasing trend, 2) the "background noise" against which the trend operates, and 3) the length of time the trend is followed (even a small annual population increase will result in a noticeably larger population size if the increase continues for many years).

The magnitude of the population trend is a function of recovery activities and the population dynamics of the tortoise – neither of these elements are affected by monitoring design and sample size. The second contributor to the power to detect a trend – the level of background variability in the density estimates – is directly affected by the number, length, and placement of transects in the monitoring strata. Anderson and Burnham (1996) recommended that transect number and length be chosen to target precision reflected in a coefficient of variation (CV) of 10-15% for the estimate of importance (here, density for tortoise conservation areas in each recovery unit). The CV describes the standard deviation (a measure of variability) as a

AR060104

proportion of the mean and is often converted to a percentage. Since recovery criteria target trends within recovery units (USFWS, 2011a), precision in that density estimate was the focus. The target CV is achieved based on the number of tortoises that might be encountered there (some strata currently have higher densities than others), as well as the area of the stratum – its proportional contribution to the recovery unit density estimate (Buckland et al., 2001).

The actual number of transects assigned in each stratum was a function of the optimal numbers described above, as well as on available funding. Once the number of transects in a stratum was determined, these were laid out systematically across strata, with a random origin for the lattice of transects. In strata with more assigned transects, nested lattices with smaller spacing (3 km) were used to ensure sufficient transects. In strata with fewer transects, lattices 9 km spacing were used. Systematic placement provides more even coverage of the entire stratum, something that may not occur when strictly random placement of transects is used. In both cases, transects are located at random with respect to the location of desert tortoises.

Distance sampling transect completion

One adaptation that tortoises have for living in the desert is to restrict surface activity to fairly narrow windows of time during the year. In general, tortoises emerge from deep within shelters (burrows) from mid-March through mid-May and then again (less predictably) in the fall. These periods coincide with flowering of their preferred food plants (in spring) and with annual mating cycles (in fall). The annual range-wide monitoring effort is scheduled to match the spring activity period for tortoises.

During this season, not all tortoises are above ground or visible in burrows. To encounter as many tortoises as possible, monitoring is scheduled for early in the day and to be completed before the hottest time of day. Because tortoises are located visually, monitoring is restricted to daylight hours. Based on past experience, we expect tortoises to become most active after 7am at the beginning of April (it is usually too cool before this time), but to emerge earlier and earlier until their optimal activity period includes sunrise by the beginning of May. In May, we also expect daytime temperatures to limit tortoise above-ground activity as the morning progresses to afternoon.

DRAFT

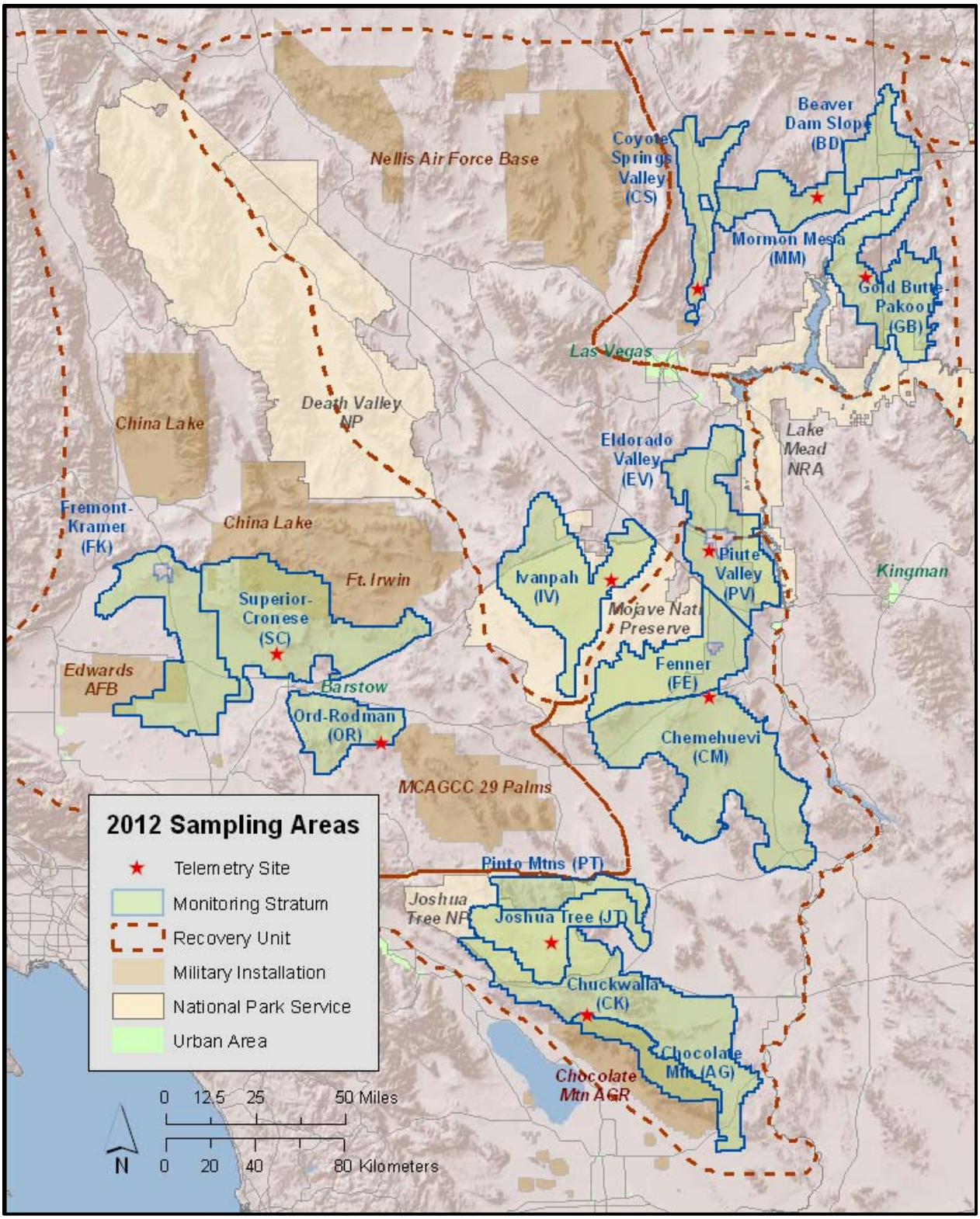


Figure 1. Sampled areas 2012.

Field crews complete transects during this optimal period each day. Start times are decided a week in advance, so crews arrive at transects at similar times on a given morning. However, completion times will be more variable, as a consequence of terrain, air temperature, number of tortoises encountered, etc. Under normal conditions, each team walked one 12 km square transect each day. Teams were comprised of 2 field personnel who switched lead and follow positions at each corner of each transect, so they each spent an equal amount of time in the leader and follower positions. The leader walked on the designated compass bearing while pulling a 25 m length of durable cord; the walked path is also the transect centerline and was indicated by the location of the cord. The length of cord also spaced the two independent observers, guiding the path of the follower; when the cord was placed on the ground after a tortoise or carcass was detected, it facilitated measurement of the local transect bearing. The walked length of each transect was calculated as the straight-line distance between GPS point coordinates that were recorded at 500 m intervals (waypoints) along the transect and/or whenever the transect bearing changed.

Both leader and follower scanned for tortoises independently without leaving the centerline, and the role of the crew member finding each tortoise was recorded in the data. Although the leader saw most of the tortoises, the role of the follower was to see any remaining tortoises near the centerline, so the follower role is crucial to unbiased estimation of tortoise densities.

Distance sampling requires that distance from the transect centerline to tortoises is measured accurately. When a tortoise was observed, crews 1) used a compass to determine the local transect bearing based on the orientation of the 25 m centerline, 2) used a compass to determine the bearing from the point of observation to the tortoise, and 3) used a measuring tape to determine the distance from the observer to the tortoise. These data are sufficient to calculate the perpendicular distance from the observed tortoise to the local transect line. If the tortoise was outside of a burrow, was handled enough to measure midline carapace length (MCL), to determine its sex, assess its body condition (USFWS 2011b), and to apply a small numbered tag to one scute. If a tortoise could not be measured because it was in a burrow, because temperatures precluded handling, or for any other reason, crews attempted to establish by other means whether the animal was larger than 180 mm MCL, the criterion for including animals in density estimates.

Because transects are 3 km on one side, it is not unusual for that path to cross through varied terrain or even be blocked by an obstacle such as an interstate highway. In the first years of this program, smaller transects in inconvenient locations were shifted or replaced, but this compromised the representative nature of the sample. Since 2007, the basic rules for modifying transects involve 1) reflecting or elongating transects to avoid obstacles associated with human infrastructure (large roads, private inholdings, etc.), or 2) shortening transects in rugged terrain. Substrate and access to transects can also make it difficult to complete transects during the

AR060107

optimal period of times, so 3) transects could be shortened to enable completion before 4pm each day.

In 2008 and 2009, the rules for shortening transects were made more restrictive. Crews had the option to complete transects that were 12 km long (in low-relief terrain) or 6 km long (where higher-relief terrain precluded completion of 12 km in a working day). In the latter case, to avoid crews selecting particular terrain, the only way to shorten the transect was to walk it in the southwestern quadrant of the intended 12 km square. If the southwestern quadrant was judged too rugged to be completed safely by transect walkers, the final option was to not complete the transect at all.

In 2010 and 2011, the same option to shorten transects to 6km in rugged terrain were made available to crews in the eastern portion of the range where there was sufficient funding to substratify encounter rates for flat and rugged terrain. In the western part of the range, crews shortened transects by following as much of the planned 12 km route as was possible. This technique was implemented in 2012 for the entire range. If it was anticipated that fewer than 4 km could be walked, the transect should be replaced instead with a transect from the alternate list. I assumed that the proportion of the area that is unwalkable is the same as the proportion of total planned kilometers (12 X number of planned transects) that were unwalkable. As in previous years, unwalked transects were replaced from the list of alternates. More situations were anticipated by additional rules in 2010, as described below.

Transects that crossed stratum boundaries into public lands had previously been walked as planned (squares). Although this added sampling just outside the stratum, it seemed reasonable to assume the land management and tortoise fate would be similar on each side of the invisible boundary. Walking in a square is also less likely to introduce other problems compared to reflecting the transect. Nonetheless, starting in 2010, the protocol used to modify transects that intersected private lands or interstates since 2007 was applied to the portion of any transect that crossed out of monitoring strata, reflecting that portion into the stratum. Whether the segments of those transects outside the boundaries were walked outside the stratum or as a mirror image inside the stratum, the same length of transect was walked at the same distance from the stratum boundary, avoiding undersampling of areas on stratum boundaries (Figure 2). The impetus for this change was the recent large scale development and construction on public lands, often just along the borders of critical habitat, especially for renewable energy facilities and transmission lines.

Specifics of how transect paths were to be modified for rugged terrain (shortened) or for administrative boundaries (reflected) can be found in the *2012 Desert Tortoise Monitoring Handbook* (USFWS 2012d).

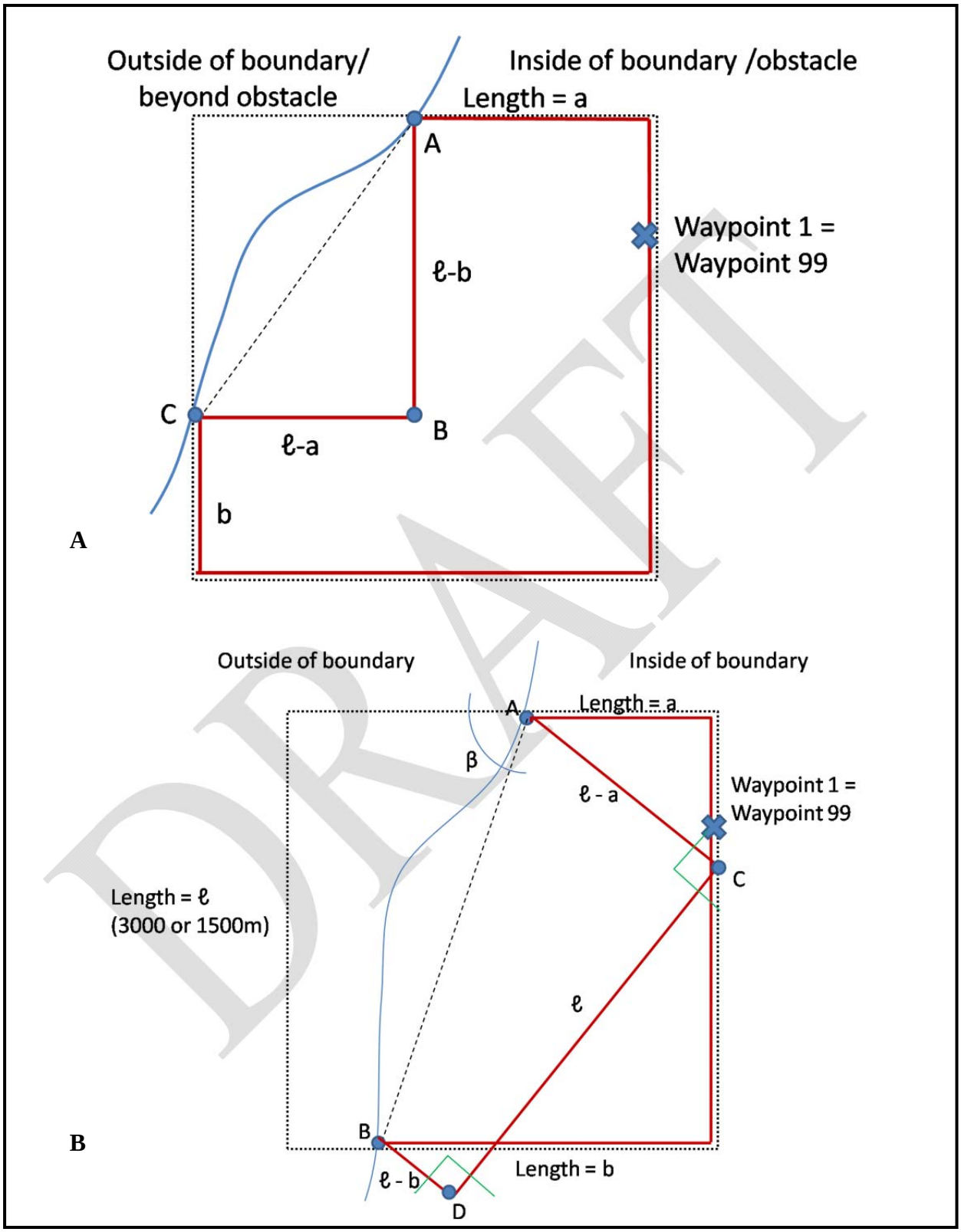


Figure 2. Planned (dotted lines) and reflected transect paths at administrative boundaries, now also applied to stratum edges. A) One-corner reflection. B) Two-corner reflection.

Proportion of tortoises available for detection by line distance sampling, G_0

Although we have general expectations about when tortoises are most active each day, and plan our sampling to match the best season and time of day, the fact remains that basing our density estimates only on the tortoises that are visible will result in density estimates that are consistently underestimated (biased low). Instead, we use telemetry to estimate the proportion of tortoises available for sampling, G_0 ("gee-sub-zero"), which is incorporated in the equation for estimating tortoise density and is used to correct this bias.

Telemetry allows us to locate radio-equipped tortoises that are visible as well as those that are otherwise undetectable in deep burrows or well hidden in dense vegetation. To quantify the proportion that were available for detection ("visible") in 2012, telemetry technicians used a VHF radio receiver and directional antenna to locate 9-19 radio-equipped G_0 tortoises in each of 10 sites throughout the Mojave and Colorado deserts (Fig. 1).

Each time a transmittered tortoise was located, the observer determined whether the tortoise was visible (*yes* or *no*). Through careful coordination, observers at telemetry sites monitored visibility during the same daily time period when field crews were walking transects in the same region of the desert. Observers completed a survey circuit of all focal animals as many times as possible during the allotted time, recording visibility each time. Bootstrapped estimates of G_0 started by selecting one visibility record at random for each tortoise on each day it was located. The average visibility of all tortoise observations at a site on a given day was calculated and used to estimate the mean and variance of G_0 at that site. When there was more than one site in a given area, the G_0 estimate was calculated as the grand mean of all G_0 sites in the group. One thousand bootstrap samples were generated in PASW Statistics (release 18.0.2; SPSS, Inc., 2 April 2010) to estimate G_0 and its standard error.

Use of radio transmitters/receivers to locate tortoises is a technique that is very different from the method used to detect tortoises on line transects. Therefore, in addition to stating whether any part of the tortoise is visible when located, since 2008 behavioral observers and transect walkers have categorized all "visible" tortoises and burrows (when tortoises are found in burrows) as low, medium, or high visibility based on the ability to see part of the tortoise or its burrow from any angle of approach. For the telemetry observers it is a matter of locating a tortoise (visible or not) after they have determined its general location aurally, whereas transect walkers are not searching with certainty of locating a tortoise – they rely only on visual cues. We would therefore not be surprised if the distance sampling method results in detection of a higher proportion of "high" visibility and a lower proportion of "low" visibility tortoises/burrows than when tortoises are located using telemetry. If the odds be being detected differ not only by distance from the line but also a combination of method of detection used (visual or radio receiver) and visibility, we should be able to describe this difference and be able to modify our calculation of visibility following radio-receiver information to more accurately match the visibility to transect walkers.

AR060110

Field observer training

Training for careful data collection and consistency between crews is fundamental part of quality assurance for this project. This training includes instruction as well as required practice time on skills such as tortoise handling, walking practice transects, and developing detection and distance-measuring techniques. The latter skills include practice on a training course with tortoise models (Table 1). The monitoring handbook developed in 2008 was comprehensive, and serves as a training manual and documentation of training that is provided. Chapters are updated each year as needed and printed for training. They are also posted to the Desert Tortoise Recovery Office website (http://www.fws.gov/nevada/desert_tortoise/reports).

In 2012, three teams of field observers participated. Kiva Biological (Kiva) supplied crews for monitoring in the West Mojave and the eastern portion of the Colorado Desert recovery units. The Institute for Wildlife Studies (IWS) monitored in the western portion of the Colorado Desert and in the Eastern Mojave recovery units. Great Basin Institute (GBI) supplied crews for monitoring in the Northeastern Mojave Recovery Unit. Eight of 10 personnel for Kiva had previous experience with this monitoring program, as did 2 of the 11 personnel for IWS, and 12 of the 26 personnel for GBI were returnees. The three teams were trained in 2 overlapping periods, and to enhance consistency in application of field protocols across teams, where possible the same trainers were used in both training sessions and across teams. Also, for small-group training, experienced personnel from each team worked with the trainees from other teams.

Telemetry training

The primary goal of G_0 training is successful implementation of the G_0 protocol by telemetry crews. This includes correct use of telemetry equipment, understanding G_0 data collection fields, observation of as many radio-equipped tortoises as possible during the day, and covering a window of observation that overlaps the day's transect observation period for each sampling area. Although all telemetry crews had some prior telemetry experience, performance on this project differs from others that do not require confirmation of the exact location of the tortoise. Unless the exact location is determined, its visibility cannot be accurately recorded. Beyond instruction and testing on use of the equipment in desert terrain, several days of practice were compulsory to be able to troubleshoot locating the tortoise and confirming the location when it could not be seen, In addition, some instruction for telemetry and transect crews overlapped to help each group better understand the purpose their data serve and how separate data types are related to the final density estimate.

Distance sampling training

Transect walkers were given classroom instruction, field demonstrations, practice transects to complete, and ultimately each team was evaluated based on performance on a field arena outfitted with a high density of polystyrene tortoise models placed in measured locations (Anderson et al., 2001).

AR060111

Polystyrene desert tortoise models were set out on the training course each year using placement instructions (vegetation or open placement, distance along training line, and distance perpendicular from training line). This course was used to determine whether 1) individual teams are able to detect all models on the transect centerline, 2) whether their survey techniques yield useful detection functions, and 3) whether they can accurately report the distance of each model from the transect centerline. For each purpose, many opportunities must be provided, so the course is populated at a very high density of models (410/km^2).

Crews were sent on transects and training lines as paired, independent observers. That is, the follower was 25 m behind the leader, with the opportunity to detect models not found by the leader. If the leader detects 80% of all tortoises that are found, the assumption is that the follower detects 80% of the tortoises that are missed by the leader. If this assumption is true, in this example, the pair together will detect 0.80 + (0.80 X (1 – 0.80)) = 0.96 of all tortoises on the centerline. Because the location of all models was known, data from training lines were also used to 1) assess the dual-observer assumption that all models were equally detectable (detections attributed to the follower occur at the same rate as original detection rate by leader), and 2) to estimate the detection rate using this technique for tortoises elsewhere in the Mojave Desert. These data on models were used to evaluate and correct crew performance before the field season, but were not used in any way to estimate densities of live tortoises once field surveys began.

DRAFT

Table 1. Training schedule for 2012

	Trainees I (IWS, Kiva)			Trainees II (GBI)		
Day/ Date	**Activity**	**Location**	**Trainer**	**Activity**	**Location**	**Trainer**
WEEK 1						
Monday, 12-Mar	Transect methods overview 6 km transect (paper forms)	DTCC DTCC	Allison Experienced crews	Same as Trainees I		
Tuesday, 13-Mar	Desert Tortoise Recovery Program Working on Public Lands Distance Sampling Tortoise Activity/G_0 Transect methods Non-standard transects Juno, Pendragon Database Field crew quality control procedures Compass & GPS for distance sampling	GBI field station	Allison BLM LE Allison “ “ “ Patil “ Allison	Same as Trainees I		
Wednesday, 14-Mar	Tortoise biology and handling 1 Tortoise handling - small groups Compass Exercise Training line preview and crew QA/QC	DTCC " " "	Christopher GBI Staff Crew Allison	Full transects (12km)	LSTS	Allison/ Data spec
Thursday, 15-Mar	Training Lines (practice, 8km) Begin data download from RDAs	DTCC	Allison/AM	Tortoise biology and handling 1 Tortoise handling - small groups Training line preview and crew QAQC Compass Exercise Begin data download from RDAs	DTCC " " "	Woodman, Dutcher GBI Staff Allison/PM Crew
Friday, 16-Mar	Full transects (12km)	LSTS	Allison/ Data specialist	Training Lines (practice, 8km)	DTCC	Allison

DRAFT

	Trainees I (IWS/Kiva)			Trainees II (GBI)		
Day/Date	**Activity**	**Location**	**Trainer**	**Activity**	**Location**	**Trainer**
WEEK 2						
Monday, 19-Mar	Tortoise handling 2 Training line debriefing	DTCC “	Veterinarian Allison	G0 / activity observation	River Mtns	Sparks
Tuesday, 20-Mar	Training Lines (evaluation, 8km)	DTCC Mgmt Area	Crew	Tortoise handling 2 Training line debriefing	DTCC “	Veterinarian Allison
Wednesday, 21-Mar	Training Lines (evaluation, 8km)	DTCC Mgmt Area	Crew	Full transects (rugged or administrative)	LSTS	
Thursday, 22-Mar	Full transects (rugged)	LSTS		Training Lines (evaluation, 8km)	DTCC	Crew
Friday, 23-Mar	G0 / activity observation	River Mtns	Sparks	Training Lines (evaluation, 8km)	DTCC	Crew
WEEK 3						
Monday, 26-Mar	Full transects (administrative obstacle)	LSTS		Tortoise handling 3 Training line debriefing	DTCC “	Staff Allison
Tuesday, 27-Mar	Tortoise handling 3 Training line debriefing	DTCC “	Staff Allison	Repeat training lines as needed *Begin field data collection*		
Wednesday 28-Mar	Repeat training lines as needed *Begin field data collection*					

DRAFT

	Trainees III (experienced Kiva)			QAQC Specialists			G_0 Trainees		
Day/ Date	**Activity**	**Location**	**Trainer**	**Activity**	**Location**	**Trainer**	**Activity**	**Location**	**Trainer**
WEEK 0									
Wed, 7-Mar							Intro to desert, tortoises, test of telemetry skills		Sparks
Thursday, 8-Mar				Datasheet QA/QC, visibility Walkorder review I	GBI field sta. "	Allison	G0 datasheets, daily protocols & QA/QC, visibility Beginning G0 instruction	GBI field station Piute	Allison Sparks
Friday, 9-Mar	Review new data fields Training line practice	DTCC DTCC	Allison						
Saturday, 10 Mar	Training lines (evaluation)	DTCC							
Sunday, 11 Mar	Training lines (evaluation)	DTCC							

DRAFT

Day/Date	Trainees III (experienced Kiva)	QAQC Specialists			G_0 Trainees		
WEEK 1							
Monday, 12-Mar	[Training for CMAGR]				G0 assessment course	River Mtns	Sparks / AM
Tuesday, 13 Mar	[CMAGR south]	Desert Tortoise Recovery Program Working on Public Lands Distance Sampling Tortoise Activity/G_0 Transect methods lecture Non-standard transects RDA/BT GPS, Pendragon Database QA/QC procedures for field crews Compass and GPS for Distance Sampling	GBI field station	Allison BLM LE Allison Allison Allison Allison Patil Patil Allison	Same as Data Specialists		
Wed, 14-Mar	[CMAGR south]	Submit walk order for first 3 weeks		Allison	Tortoise biology & handling Tortoise handling Compass Exercise Training line preview	DTCC " " "	Christopher GBI Staff Crew Allison
Thursday, 15-Mar	[CMAGR south]	Data transfer and QA/QC process Begin data download from RDAs		Patil/ Brenne-man	Training Lines (practice, 8km)	DTCC	Allison
Friday, 16-Mar	[CMAGR south]	Initial QAQC by specialists Paper review with data download of LSTS, G0	GBI field station	Brenne-man DTRO	G0 - practice 1 + data transfer First Juno data collection	CS	Sparks
Saturday, 17 Mar	[CMAGR south]	Data upload by specialist Team1					
Sunday, 18 March		Data upload by specialist Team2					

DRAFT

	Trainees III (experienced Kiva)			QAQC Specialists			G_0 Trainees		
Day/Date	**Activity**	**Location**	**Trainer**	**Activity**	**Location**	**Trainer**	**Activity**	**Location**	**Trainer**
WEEK 2									
Monday, 19-Mar	Tortoise handling 2 Training line debriefing	DTCC "	Johnson Allison	Training line data upload			GBI: G0 and activity observation IWS: Tortoise handling 2	River Mtns DTCC	Sparks
Tuesday, 20 Mar	Full transects (rugged)	LSTS	Crew				GBI: Tortoise handling 2 IWS: Full transects	DTCC LSTS	
Wed, 21 Mar	Repeat training lines as needed *Field data collection*	LSTS		Walk order review	GBI station	Allison	All: G0 - practice 3	IV camp in PI	Sparks
Thursday, 22-Mar							All: G0 - practice 3 continued	CM	Sparks
Friday, 23-Mar							IWS: G0 and activity observation	River Mtns	Sparks
Saturday, 24 Mar				Data upload: transects, training lines, 2 days G0					
WEEK 3									
Monday, 26-Mar							Preliminary GB locations IWS: Full transects	GB LSTS	GBI
WEEK 4									
Monday, 9-Apr				Deliver QA/QC'd training data					

DRAFT

Data management including quality assurance and quality control

Two sets of data tables are maintained through the field season, organizing data collected on transects and at the G_0 sites. Collection data forms, sheets, applications, and databases are designed to minimize data entry errors and facilitate data verification and validation. Data were collected in both electronic and paper formats by the two survey organizations, then combined and processed in a series of phases to create final database products. Data quality assurance and quality control (data QA/QC, also known as verification and validation) is performed during the data collection, data integration, and data finalization phases. During the second, data integration phase, after combining data from separate groups, some attribute fields are added and all fields are formatted for final processing. The third phase, data finalization, involves consolidation, resolution of data inconsistencies, and generation of final spatial and non-spatial data products used for analysis. After data analysis and reporting are completed, electronic data are actively hosted for download from the internet through http://www.mojavedata.gov/deserttortoise_gov/recovery/data.php. Figure 3 describes the overall data flow.

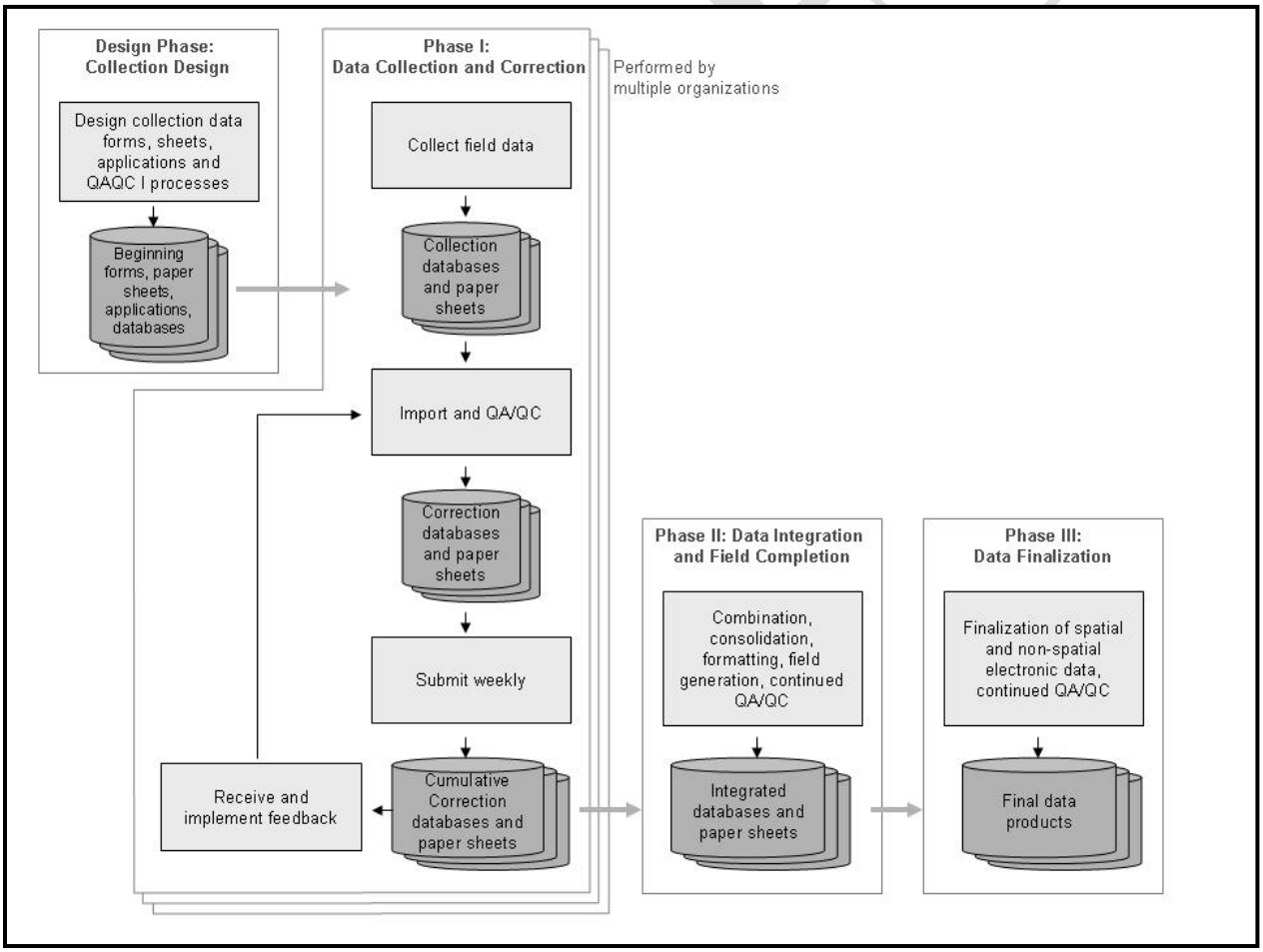


Figure 3. Data flow from collection through final products.

AR060118

Tortoise encounter rate and development of detection functions

The number of tortoises seen in each stratum and their distances from the line are used to estimate the encounter rate (tortoises seen per kilometer walked), the detection rate (proportion of available tortoises that are detected out to a certain distance from the transect centerline), and their respective variances. Detection function estimation is "pooling robust" under most conditions (Buckland et al., 2001). This property holds as long as factors that cause variability in the curve shape are represented proportionately (Marques et al., 2007). Factors that can affect curve shape include vegetation that differentially obscures vision with distance, and different detection protocols used by individual crews (pairs). Field teams (IWS, GBI, Kiva) typically walk different number of transects. For this reason, after the field season I expected to develop at least one curve for each field team, which also corresponds to different regions of the desert. The encounter rate is less sensitive to small sample sizes, so it was estimated for each stratum separately.

I used Program DISTANCE, Version 6, Release 2 (Thomas et al., 2010) to fit appropriate detection functions, to estimate the encounter rate of tortoises in each stratum, and to calculate the associated variances. One record was created for each transect, with additional records for each additional tortoise on that transect. Analysis was applied to all live tortoises larger than 180 mm MCL. Transects were packaged into monitoring strata ("regions" in Program DISTANCE).

I truncated observations to improve model fit as judged by the simplicity (reasonableness) of the resulting detection function estimate (Buckland et al., 2001:15-16)**.** Using truncated data, I used the Akaike Information Criterion (AIC) to compare detection-function models (uniform, half normal, and hazard-rate) and key function/series expansions (none, cosine, simple polynomial, hermite polynomial) recommended in Buckland et al. (2001).

Proportion of available tortoises detected on the transect centerline, *g(0)*

Transects were conducted by 2-person crews using the method adopted beginning in 2004 (USFWS, 2006). Transects were walked in a continuous fashion, with the lead crew member walking a straight line on a specified compass bearing, trailing about 25 m of line, and the second crew member following at the end of the line. This technique involves little lateral movement off the transect centerline, where attention is focused. Use of two observers allows estimation of the proportion of tortoises detected on the line; this provides a test of the assumption is that all tortoises on the transect centerline are recorded ($g(0) = 1$). The capture probability (p) for tortoises within increasing distances from the transect centerline was estimated as for a 2-pass removal estimator (White et al., 1982): p = (lead–follow)/lead, where lead = the number of tortoises first seen by the observer in the leading position and follow = the number of tortoises seen by the observer in the follower position. The corresponding proportion detected on the line by two observers was estimated by $g = 1 - q^2$, where $q = 1 - p$. Figure 4 graphs the relationship between the single-observer detection rate (p) and the corresponding

AR060119

dual-observer detection rate (*g(0); "gee at zero"*). The actual proportion detected can be estimated, but to avoid the necessity of compensating for imperfect detection, during training field crews (pairs) are expected to detect 96% of all models within 1 m of the transect centerline. This corresponds to the leader being responsible for at least 80% of the team's detections near on the centerline in order to meet this standard (Fig. 4) and is the basis for one of the training metrics (see Table 3).

Few or no tortoises are located exactly on the line, and even examining a small interval (such as 1 m on each side of the transect line) results in few observations to precisely estimate *g(0).* Instead, my test of the assumption involves examination of the lead and follow proportions starting with counts of tortoises in larger intervals from the line, moving to smaller intervals centered on the transect centerline. As the intervals get smaller the sample sizes also get smaller, but the estimates are more relevant to the area right at the transect centerline. The expectation is that the estimates should converge on *g(0)* = 1.0.

If the test does not indicate that all tortoises were seen on the transect centerline, the variance of *p* can be estimated as the binomial variance = $q(1 + q)/np$ (White et al., 1982), where *n* = the estimated number of tortoises within 1 m of the transect centerline, and the variance of *g(0)* is estimated as twice the variance of *p*.

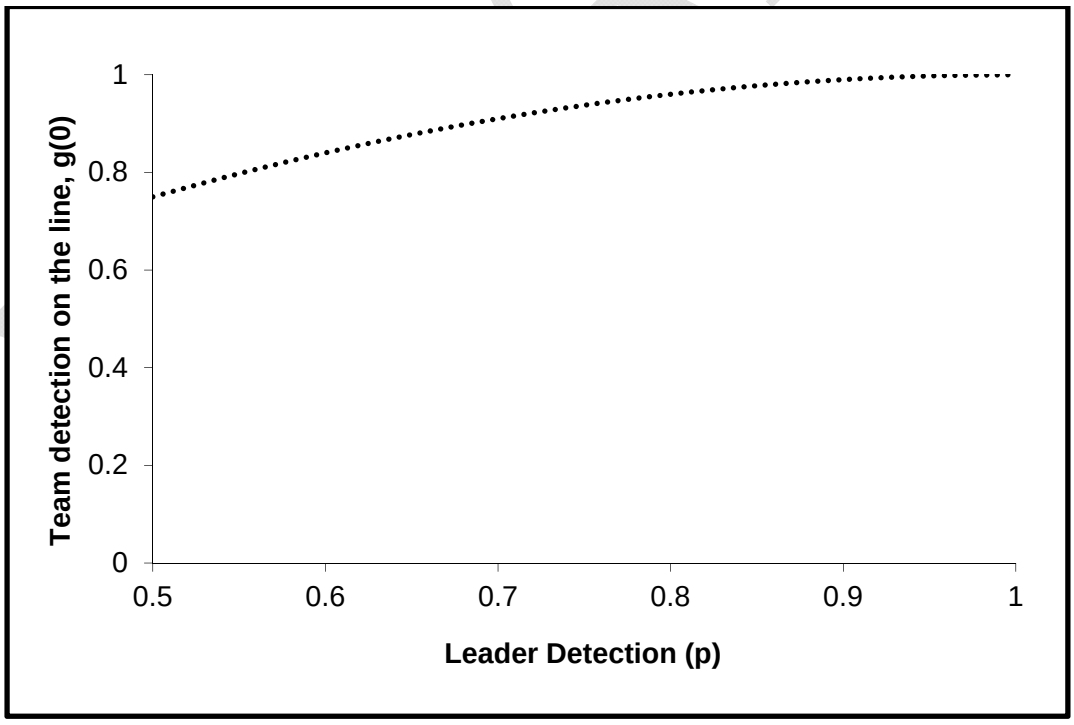


Figure 4. Relationship between single-observer detections (by the leader, *p*) and dual-observer (team) detections, *g(0).*

AR060120

Estimates of tortoise density

Each year, the density of tortoises is estimated at the level of the recovery unit. The calculation of these densities starts with estimates of the density of tortoises in each stratum from Program DISTANCE, as well as their variance estimates:

$$D = \frac{n}{2wLP_aG_0g(0)},$$

where L is the total length of kilometers walked in each stratum and w is the distance to which observations are truncated, so $2wL$ is the area searched in each stratum. This is a known quantity (not estimated). P_a is the proportion of desert tortoises detected within w meters of the transect centerline and was estimated using detection curves in Program DISTANCE. The encounter rate (n/L) and its variance were estimated in Program DISTANCE for each stratum. Calculation of D requires estimation of n/L, P_a, G_0, and $g(0)$. This means that the variance of D depends on the variance of these quantities as well.

For desert tortoise densities, the encounter rate (n/L) is estimated independently for each stratum ("unpooled"), whereas proportion of available tortoises and proportion of available tortoises detected on the transect centerline are estimated jointly for all strata ($g(0)$) or for all strata in the recovery unit (G_0). The detection function, which comes into the above equation as P_a, may be estimated jointly or separately for each team, depending on the number and quality of observations. In 2012, separate detection curves were created for each team (GBI, Kiva, and IWS, pooled across all strata surveyed by that team. A schematic of the process leading to density estimates is given in Figure 5. Contributing estimates in the four left-hand columns are listed with the subsets of the data on which they are based. These estimates combined from left to right to generate stratum and recovery unit density estimates.

Whereas the number of tortoises in the set of strata representing a recovery unit can simply be added together, the variance must be arrived at by accounting for whether this involves pooled or unpooled estimates. As described above, three of the four estimates that contribute to calculating density in a stratum were based on data "pooled" from other strata as well, so when encounter rate and detection probability data from these strata are combined, the correlated nature of the detection probability variances has to be accounted for, for instance. Specifically, the method described in Buckland et al. (2001:89) was used to combine density variances correctly and arrive at the variance (and confidence intervals and CV) for the recovery unit. Pooled and unpooled variance estimates cannot currently be combined as needed in Program DISTANCE, so final construction of density mean and variance estimates from the above components was completed without specialized software.

AR060121

Tortoise encounter rate	**Proportion that are visible, G_0**	**Detection rate, P_a**	**Proportion seen on the line, $g(0)$**	**Density**	**Density**
Stratum or substratified	*Neighboring G_0 sites*	*Data collection group*	*Overall*	*Stratum*	*Recovery unit*
FK	Ord Rodman + Superior Cronese	Kiva	Full set of tortoise observations	FK	Western Mojave
SC				SC	
OR				OR	
AG	Joshua Tree NP + Chuckwalla			AG	Colorado Deserts
JT				JT	
PT				PT	
CK				CK	
PV	Piute + Chemehuevi + Ivanpah	IWS		PV	
CM				CM	
FE				FE	
IV	Piute + Chemehuevi + Ivanpah			IV	Eastern Mojave
EV				EV	
GB	Gold Butte	GBI		GB	Northeastern Mojave
BD	Halfway Wash			BD	
MM				MM	
CS	Coyote Springs			CS	

Figure 5. Process for developing density estimates in 2012. For each type of estimate, the full set of data was subdivided appropriately, as indicated by columns.

Estimating the area of each stratum sampled and the number of tortoises in that area

Before the 2008 field season, based on experience in 2007 and visual examination of DEM overlays, all assigned transects were classified as possible for completion as 12k, shortened, or as unwalkable (USFWS 2012a). These classifications before the field season are advisory only, because exact ground conditions, weather, and crew condition all affect the ability to complete a transect. If a non-standard transect (not 12 km square) is walked, crews indicate the obstacles they encountered that forced the change in protocol. In addition to the above named factors, substrate that is very loose on a steep slope or that includes large boulders can make progress so slow or treacherous that crews modify the transect.

Each year, some transects are repeated, providing new information on ground conditions, and new transects are attempted. At the end of each field season, transects that were completed differently from expected are evaluated. At that point, a decision is made whether to reclassify the transect. The classification is used to advise future transect completion, but also to estimate the proportion of each monitoring stratum that is actually represented by the walked transects. Proportions used in this report reflect experience with this set of transects through November

AR060122

2012, as well as untested transects that were classified using topographic overlays as part of planning for 2013.

Crews completed all transects using the 12 km square path, completing as much of that path as possible. The calculation of unwalkable area in these strata based on the proportion of unwalkable kilometers, not unwalkable transects. Transects completed as 12 km represent the 100% completion option. The total area of the stratum that is walkable is estimated as:

$$Proportion\ walkable = \frac{transect\ kilometers\ walked}{12\ X\ transects\ completed}.$$

If a given stratum covers 5000 km^2, but only 90% was walkable and represented by our sampling design, then the density estimate applies to 4500 km^2, and can be used to generate an estimate for the number of tortoises in those 4500 km^2. Using these area estimates adds another source of imprecision, so abundance estimates are slightly less precise than the density estimates they derive from. The additional error of this estimate is calculated as the error for a binomial proportion.

Modification of previous procedures

Because tortoises are predictably but not reliably above-ground for parts of the year, there has been continuing interest in use of surveys for sign to estimate number of live animals. The uses and limitations of this approach have been discussed at length, with the performance of live tortoise surveys being preferred. However, on smaller areas of land, few tortoises are expected to be found, so estimates based on live tortoise estimates will be imprecise. Krysik (2002) and Duda et al. (2002) explored the correlation between tortoises and sign using 2 approaches. Although the correlation between sign and live animals was not stable, the interest of land managers in developing better estimates of tortoise numbers in areas smaller than an entire management entity (such as a national park) continue. In 2012, transect walkers counted all burrows that they examined, entering these tallies at the next waypoint. We continued estimating tortoise density using our usual approach, but also provide counts and locations of tortoise burrows so that interested parties can focus on particular areas, interpolating from the critical habitat unit to the smaller parcel based on the relative number of burrows at each scale. This comparison is expected to mirror the relative number of tortoises at each scale, with caveats. Because distance sampling surveyors may not have experience identifying all types and conditions of tortoise shelter sites, tallies were made of any soil or rock openings that was examined for live tortoises and was at least 2 tortoise-lengths deep.

Debriefing to describe strengths and weaknesses of project preparation and execution

At the end of each field season, a debriefing meeting was held to review tasks and responsibilities, strengths and weaknesses of the program, and to plan for the next field season. Because the field teams had disbanded by then, field crew members were surveyed prior to the

AR060123

end of the field season to nonetheless gather their direct input as we identified training and logistical issues to target for improvement before the next field season. Although issues and/or tasks may be ascribed to individual entities, this meeting is most beneficial in identifying where centralized and/or coordinated response is required to improve the quality of the program.

RESULTS

Field observer training

The smaller Kiva and IWS groups trained alongside one another and mostly separate from GBI, although experienced crews worked between all three teams. Training started on 7 March and continued through 27 March (Table 1). Final tests of field detection abilities occurred toward the end of this period.

Proportion of tortoises detected at distances from the transect centerline

Table 2 reports the proportion of models that were available and were detected by each team at 1-, 2-, and 5-m from the transect centerline. Teams were tested after a trial run on the detection lines or after returning crews walked practice transects to refresh the search pattern (3 of 4 Kiva crews). Detection on the centerline should be 100%, and many crews achieved this. Teams 21 and 43 had perfect detection within a meter of the line during their practice trial, so their performance is not a concern.

Table 3 reports further statistics for each team after collecting data on 16 km on the evaluation lines. Measurement accuracy reported in Table 3 gives the average absolute difference between the expected and measured perpendicular distances from the model to the walked line. All measurements for all models during the 2-day trial are used for this estimate, and capture inaccuracies from 1) using a compass and measuring tape to record distances to the models, plus 2) inaccurately following the trajectory of the transect. The latter source of error does not occur on monitoring transects, because the walked transect is the true transect. On training lines, measurement error increases if crew paths diverge from the measured line that was used to place the models. The "Available Models Detected by Leader" column reports the proportion of all models that were found first by the leader. During training, this number is easily calculated and is used to identify crews in which one of the observers is not finding at least 80% of all detected. With an 80% detection rate for the leader, a 96% detection rate is expected for the team.

Although some individual metrics were below-par (gray cells in Tables 2 and 3), all teams performed well overall and no further changes were made. During training, detection curves were fit to each crew's set of tortoise model observations. In no case was the best-fitting model a negative exponential one without a "shoulder" describing detections near the centerline. Detection curves reflecting such a model would have led to additional practice. The best-fitting of the 3 remaining basic types of models were then fit to the data to generate density estimates in Table 3. In Figure 6 to Figure 8, all of the crew detection curves for each field team are overlaid.

AR060124

Crews were not evaluated on their ability to match teammates; such overlays were used to focus field personnel on an additional level of conformity they could work toward. Distance sampling and development of a single detection curve from many observers is robust to the effects of pooling across observations from crews with variable search patterns, when observers contribute proportionally to the overall pattern (Marques et al., 2007).

Table 2. Proportion of tortoise models detected by teams within 1-, 2-, or 5-m of the transect centerline. Values that scored below the target of 0.90 at 1- and 2-m are highlighted.

Team Number	1m	2m	5m
1	1.00	0.96	0.93
2	0.94	0.96	0.87
3	1.00	0.93	0.93
4	1.00	0.97	0.81
21	0.86	0.92	0.90
22	0.92	0.93	0.88
23	0.94	0.93	0.92
24	0.94	0.96	0.91
25	1.00	0.86	0.89
41	0.93	0.93	0.86
42	0.86	0.81	0.87
43	0.88	0.89	0.91
44	0.94	0.96	0.91
45	0.93	0.90	0.90
46	0.93	0.93	0.90
47	0.94	0.85	0.89
48	1.00	1.00	0.91
49	1.00	0.96	0.93
50	1.00	0.96	0.88
GBI	0.94	0.92	0.90
Kiva	0.99	0.96	0.89
IWS	0.93	0.92	0.90
Overall	0.95	0.93	0.89

The Kiva teams had very similar detection patterns by the time the field season began (Fig. 8). Within the GBI crews, teams 44, 48, and 50 had the most anomalous curves (broadest shoulders) in Figure 6. The usual concern when crews are successful searching farther from the line is that they will focus less close to the line; this was not the case for any of these 3 teams. They were coached on tightening their search pattern to better match other teams, but the patterns were not of concern. The extra detections by some IWS team 23 past 10m (the single curve with an extra pair of inflections), are of most concern when this indicates that one of the searchers is not detecting tortoises at the line. However, Team 23 was otherwise judged to have fairly healthy

AR060125

diagnostics. The testing arena differs from the normal field setting in ways that make it easier to evaluate trainees (higher encounter rate, for example), but also make it more difficult to use as an absolute standard for search patterns.

Table 3. Diagnostics for individual teams after training

Team	Available models detected		Measured v. exact model distance (m)	Estimated abundance	95% confidence interval	
	Within 2m of centerline by leader	Within 2m of centerline by team			Lower limit	Upper limit
1	0.93	0.96	1.23	499	416.2	598.6
2	0.93	0.96	0.81	440	359.4	538.5
3	0.93	0.93	0.72	470	402.4	549.2
4	0.93	0.97	0.78	472	384.8	580.0
21	0.88	0.92	0.86	377	312.4	454.1
22	0.89	0.93	1.08	389	328.9	459.8
23	0.85	0.93	0.89	435	340.7	555.9
24	0.92	0.96	1.60	386	304.7	489.7
25	0.86	0.86	1.19	360	309.2	418.2
41	0.86	0.93	1.12	410	351.5	477.1
42	0.74	0.81	0.77	410	371.5	451.9
43	0.89	0.89	0.90	425	344.7	525.1
44	0.89	0.96	0.83	436	348.2	545.3
45	0.79	0.90	0.78	422	363.0	491.4
46	0.89	0.93	0.82	411	353.5	476.8
47	0.74	0.85	0.83	402	332.8	486.0
48	0.92	1.00	0.72	424	388.7	461.9
49	0.96	0.96	0.76	409	336.4	496.9
50	0.82	0.96	1.17	356	316.1	400.1
Target	**>0.80**	**>0.90**	**<1**	**410**		
GBI	**0.85**	**0.92**	**0.87**	**410.4**		
Kiva	**0.93**	**0.96**	**0.89**	**470.4**		
IWS	**0.88**	**0.92**	**1.12**	**389.3**		
Overall	**0.87**	**0.93**	**0.94**	**417.5**		

AR060126

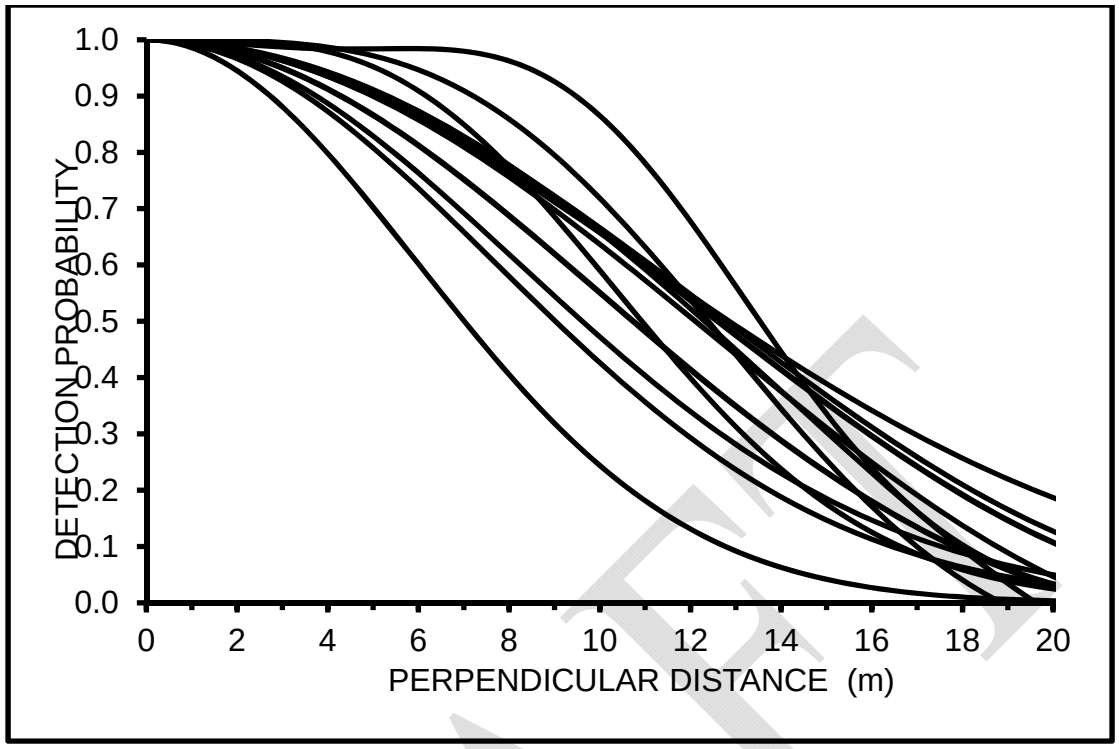


Figure 6. Detection curves for each of the 2012 GBI teams during training. Curves are based on 16 km trials with approximately 100 detections.

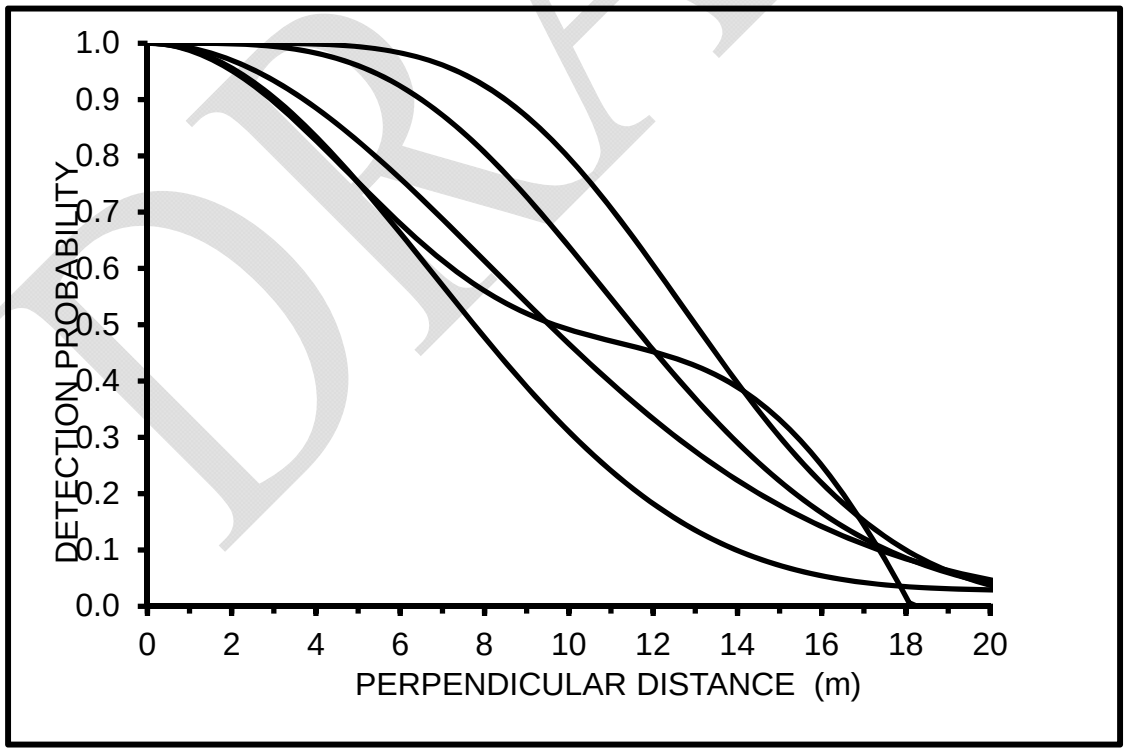


Figure 7. Detection curves for each of the 2012 IWS trainee teams. Curves are based on 16 km trials with approximately 100 detections.

AR060127

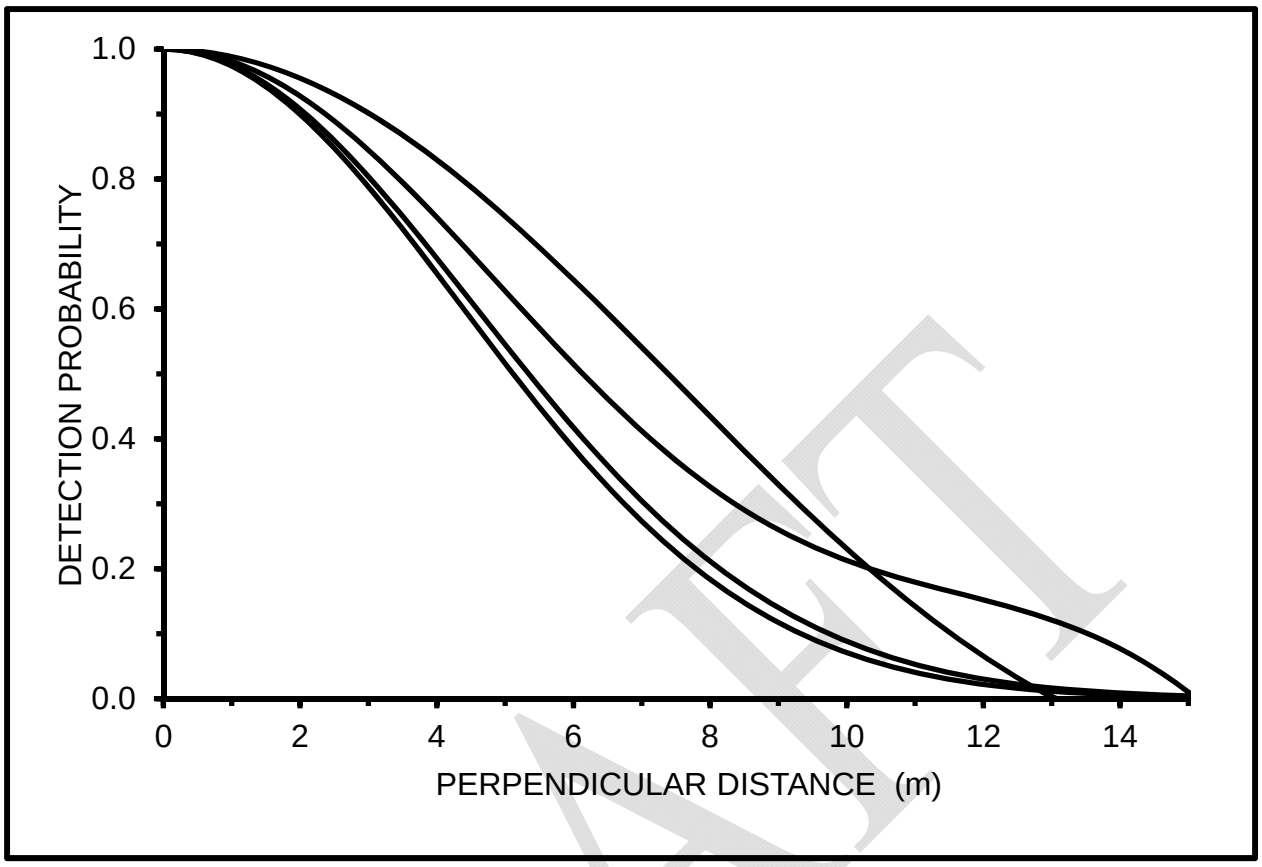


Figure 8. Detection curves for each of the 2012 Kiva trainee teams. Curves are based on 16 km trials with approximately 100 detections.

Quality assurance and quality control

There were 17,654 transect records and 8216 G_0 records associated with the monitoring effort in 2012. After data specialists with the field teams had finished verifying and validating the information in these 2 databases, there were 461 cases where the data were inconsistent with constraints and expectations. (Note that many more issues are addressed each year by data specialists for field crews before the field data are submitted.) Relatively few (378) were errors created by the field crews (sometimes faulty equipment, other times data entry error), of which all were corrected by later phases of QA/QC with recourse to paper datasheets or were identified as correct but unusual data entries (not errors). Another 140 errors were "processing" errors that were identified and corrected before the final database products were created. Processing steps are associated with correcting other errors (perhaps the correct entry is mis-entered), with adding new fields, or any other manipulation that occurs after the data have been collected. When files of scanned datasheets are missing pages, this is a processing error. Other entries violate QA/QC rules but are extreme or explicable entries; there were 301 of these exceptions which require time to research and are one of the costs of QA/QC. Nonetheless, this year of data had relatively few errors, comparable to the previous year of improved QA/QC, and reflecting the improved processes to limit data entry and processing errors.

AR060128

Transect completion

Table 4 reports the number of assigned and completed transects in each stratum. For the second year in a row, no transects were inadvertently completed twice by different crews. Kiva was assigned 160 transects and walked an additional transect. They consistently replaced any assigned but unwalkable transects with alternates in the same strata. All assigned transects were completed or replaced by IWS, although one unwalkable transect in the Eldorado Valley was replaced by an alternate in neighboring Piute Valley. The Great Basin Institute completed 380 transects, replacing any assigned but unwalkable transects with alternates in the same strata. Great Basin Institute used base-camping in route-less areas to provision crews with supplies, including water, to enable crews to complete 17 transects without returning over large or difficult distances to their vehicles.

Table 4 indicates the number of assigned transects that could be completed as standard square 12km transects or by reflecting around property boundaries and infrastructure (column 4). These transects represent flatter topography. An additional number (column 5) were shortened and represent more rugged terrain. Finally, some transects were considered unwalkable (column 6). Figures 9 through 12 show locations of transects and observations of live tortoises.

Table 4. Number and type of transects in each stratum.

Stratum	Assigned transects	Assigned and alternate transects completed*	Assigned, completed 12k	Assigned, completed shortened	Assigned, judged unwalkable
AG	33	33	20	5	8
BD	70	70	58	11	1
CK	20	20	8	5	7
CM	15	15	12	2	1
CS	89	89	59	17	13
EV	29	29	19	6	4
FE	14	14	14	0	0
FK	16	16	15	0	1
GB	100	100	59	20	21
IV	27	27	23	3	1
JT	18	18	5	7	6
MM	110	106	72	27	7
OR	15	15	7	5	3
PT	15	15	2	7	6
PV	15	15	7	3	5
SC	45	45	37	4	4
Total	631	627	417	122	88
GBI	369	365	248	75	42
IWS	100	100	75	14	11
Kiva	162	162	94	33	35

*Assigned transects that were not walked were supposed to be replaced by alternates.

DRAFT

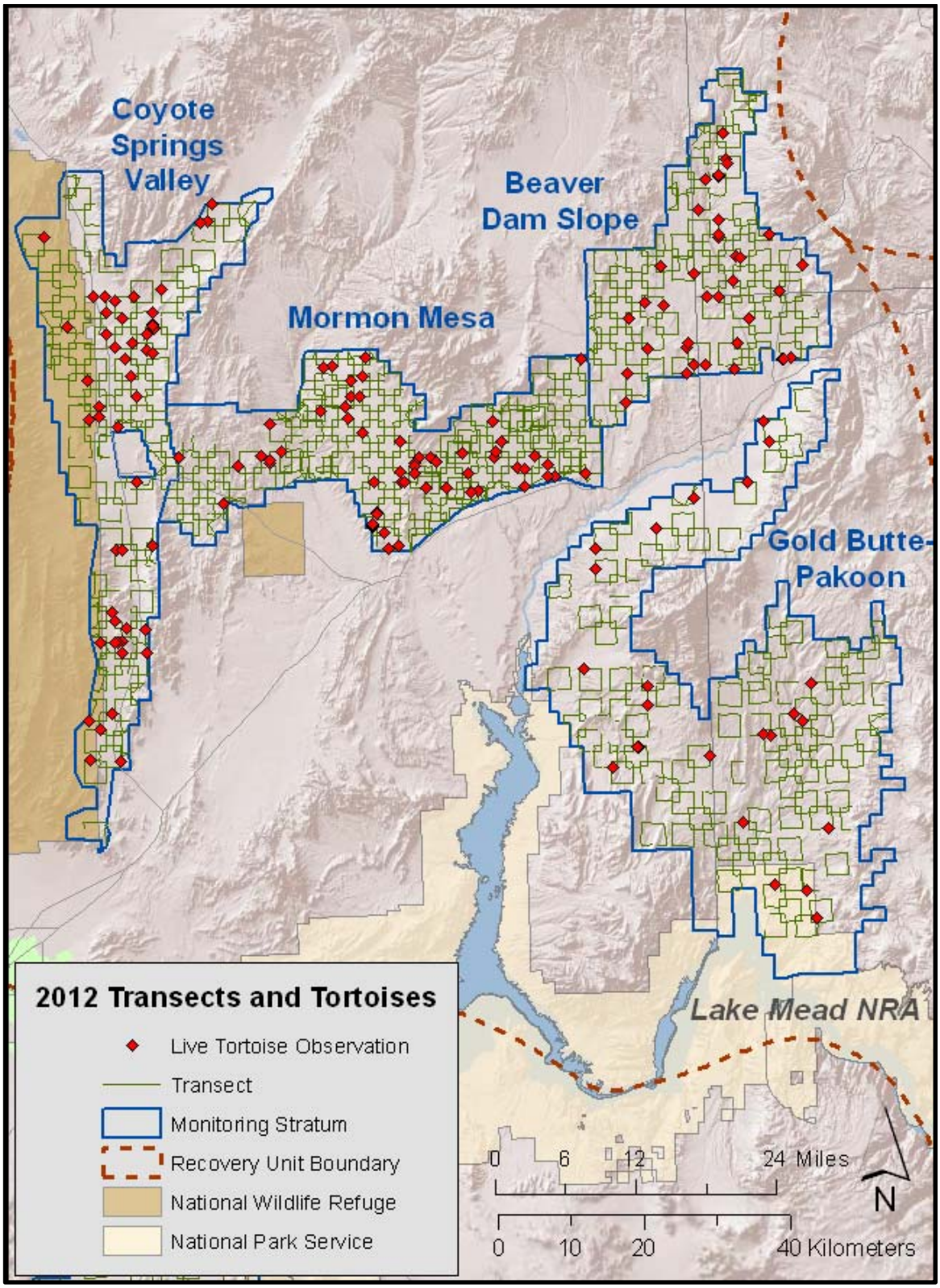


Figure 9. Distribution of distance sampling transects and live tortoise observations in the Northeastern Mojave Recovery Unit (Coyote Springs Valley, Mormon Mesa, Beaver Dam Slope, and Gold Butte-Pakoon monitoring strata).

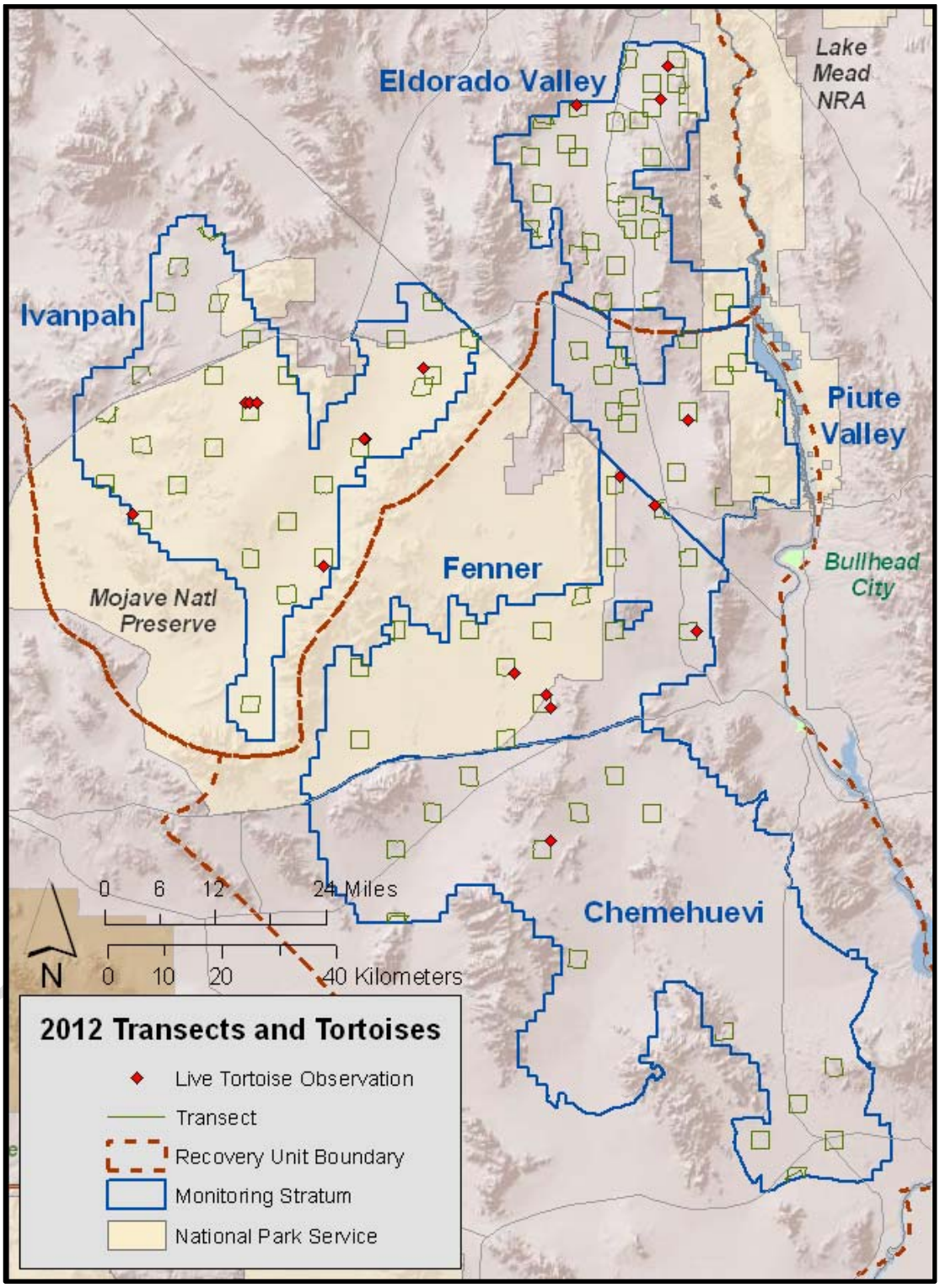


Figure 10. Distribution of distance sampling transects and live tortoise observations in the Eastern Mojave Recovery Unit (Eldorado Valley and Ivanpah monitoring strata) and the eastern part of the Colorado Desert Recovery Unit (Fenner, Piute Valley, and Chemehuevi monitoring strata).

AR060131

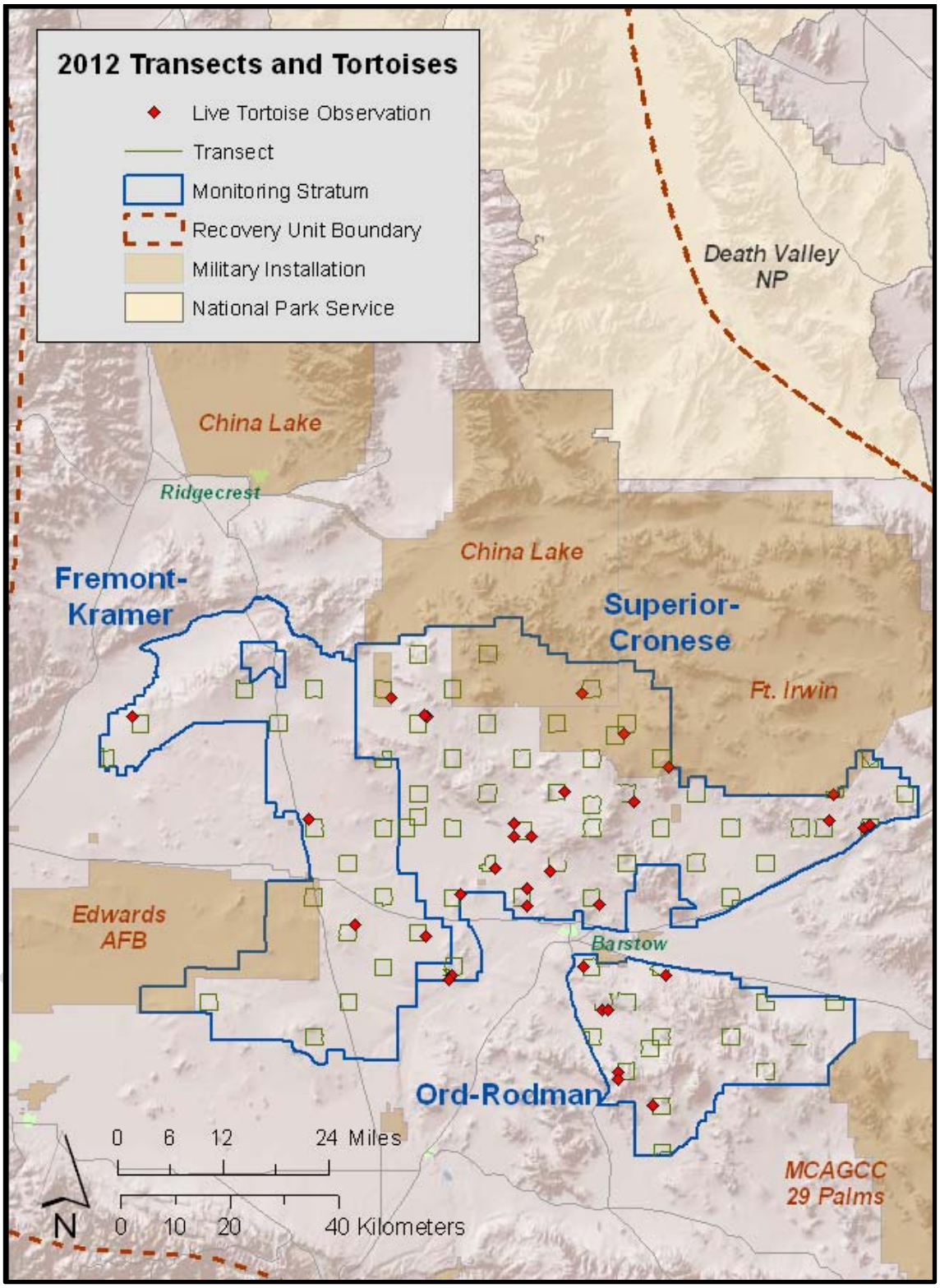


Figure 11. Distribution of distance sampling transects and live tortoise observations in the Western Mojave Recovery Unit (Fremont-Kramer, Superior-Cronese, and Ord-Rodman monitoring strata).

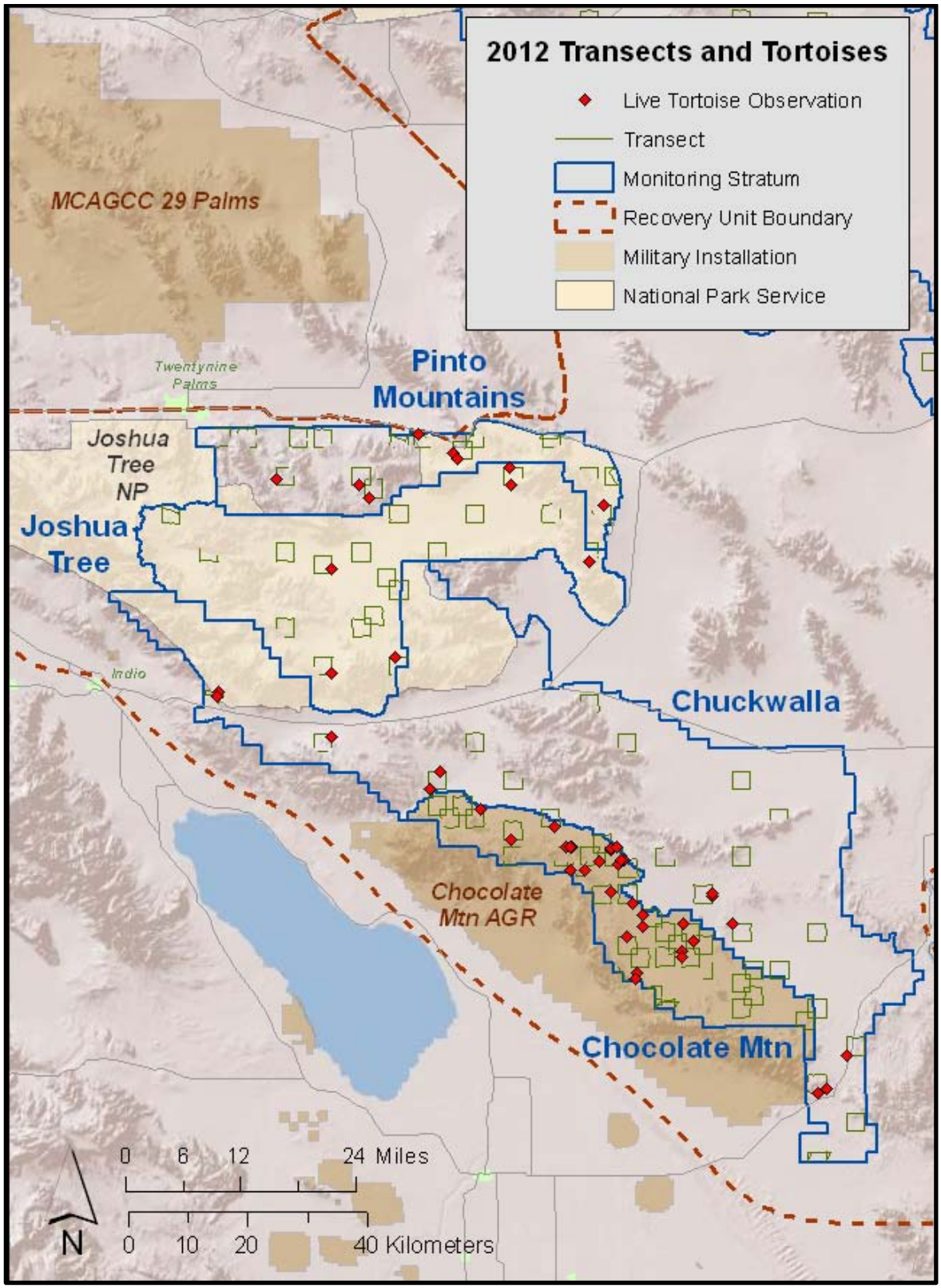


Figure 12. Distribution of distance sampling transects and live tortoise observations in the western portion of the Colorado Desert Recovery Unit (Pinto Mountains, Joshua Tree, Chocolate Mountain, and Chuckwalla monitoring strata).

Burrow encounter rate
We reported tallies of examined burrows at each waypoint, representing a path 500 m long. Crews examined 12,817 burrows, inspecting as many as 30 in a 500 m path between waypoints.

Tortoise encounter rates and detection functions
In 2012, all pairs worked together from the beginning to the end of the season. Each Kiva crew walked on average 41 transects and overall they detected 77 tortoises over 180 mm MCL; GBI crews walked a median of 37 transects and detected 162 tortoises; and IWS crews had considerably lower effort, with a median of 22 transects (days of work). However, each IWS observer subsequently walked 1-person distance transects in a separate study at the Large Scale Translocation Site near Jean, Nevada; altogether IWS personnel completed 31 days of work and the team observed 30 tortoises larger than 180 mm MCL, so the LSTS encounters were used to model the overall IWS detection probability illustrated in Fig. 14. Even when crews have similar levels of effort, if there are sufficient observations to generate separate detection curves for each team, that is preferred to also account for differences in vegetation and other regional differences that may alter detection probabilities.

Figures 13 to 15 are histograms of the observed number of tortoises seen at increasing distance from the transect centerline. There is one histogram for each team (Kiva, IWS, and GBI). These observations were used to model detection curves, overlaid in the same figures. Based on detection function behavior, it is typical to discard a few observations in the tails of the histograms in order to build a more robust model (Buckland et al. 2001). Each figure indicates the customized truncation distance that was applied. Any observations that are not used to estimate detection functions will also not be used to estimate the encounter rate (tortoises detected per kilometer walked). In distance sampling applications for many other species, encounter rate can be estimated with relatively high precision, but tortoise encounter rates are low enough that this becomes a factor in considering how to truncate observations to develop detection functions. Truncation was conservative to maximize the number of observations per stratum.

Kiva detected only 77 tortoises from which a detection curve could be built. All truncation distances considered resulted in approximately the same overall density estimate, so it was preferable to use as many observations as possible to keep precision as high as possible. Use of only observations within 14 m allowed a model with no extra inflections and with all but 5% of the observations. At this distance, the hazard-rate model with no adjustments performed best (Fig. 15). The best-fitting negative exponential model was 3rd best overall.

For GBI, truncation at 21 m required discarding just under 7% of the available observations but provided a fairly simple model fit including g(w) = 10%. The 21 m truncation distance was used

AR060134

(Fig. 13), for which the hazard rate model with 2 parameter estimates but no adjustments fit the data best, and indicate a shoulder of about 2 m – just about 10% of the width.

For IWS, the 5% truncation would be at about 14 m. The model for data truncated at 15 m is a better fit, however, and the hazard rate model with no adjustments performed better than half-normal or uniform models. The shoulder is very narrow, and in fact the best negative exponential model had an AIC slightly less than the selected hazard rate model.

The area below the curves in Figs. 13-15 is the proportion of tortoises that were detected, P_a, estimated as far as the truncation distance (the farthest distance on the x-axis in each figure). Based on these curves, GBI detected 37.9% of the visible tortoises within 21 m of the centerline (CV=0.121). The corresponding estimate of P_a for strata surveyed by IWS was 43.2% (CV=0.263) within 15 m, and for Kiva was 39.7% (CV=0.145) within 14 m.

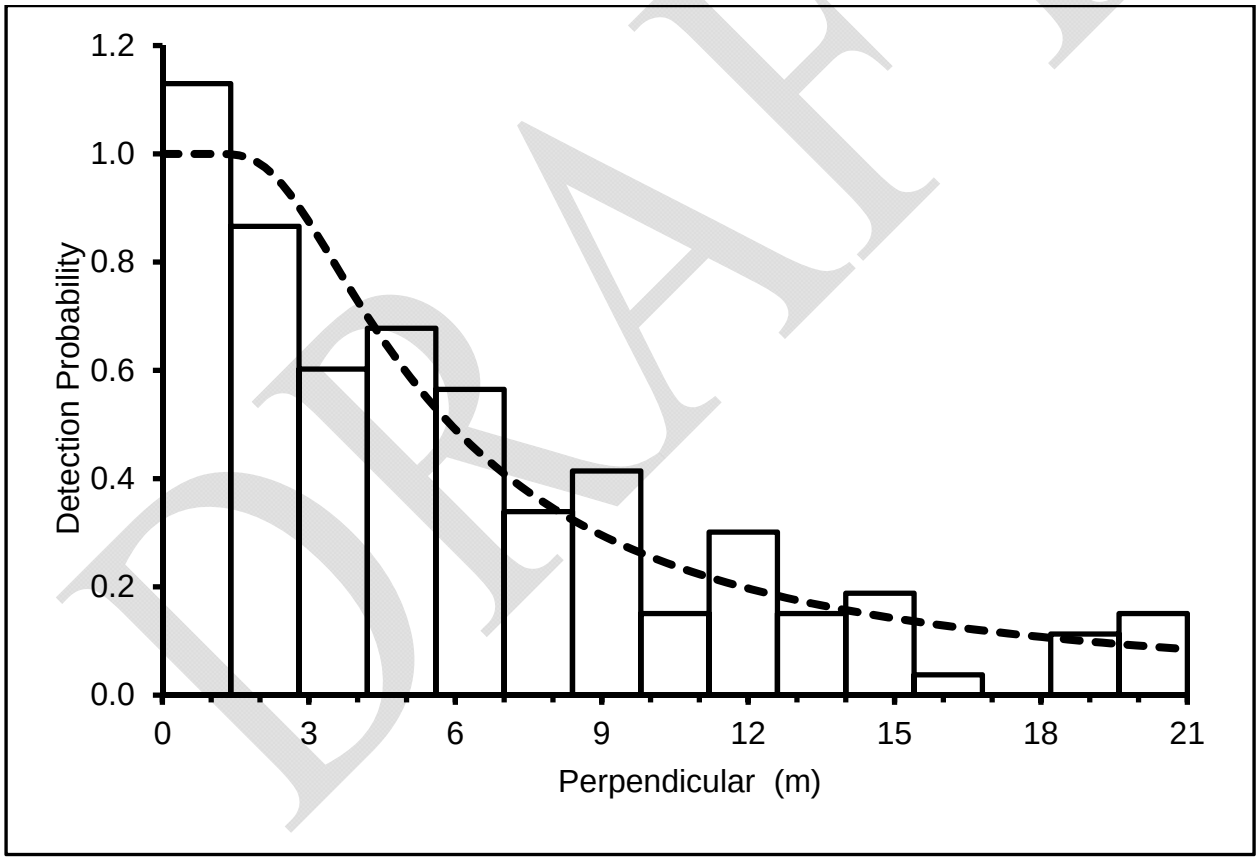


Figure 13. Observed detections (histogram) and the resulting detection function (smooth curve) for live tortoises with MCL ≥ 180mm found by GBI. This curve uses only the 151 observations found within 21 m of the line.

DRAFT

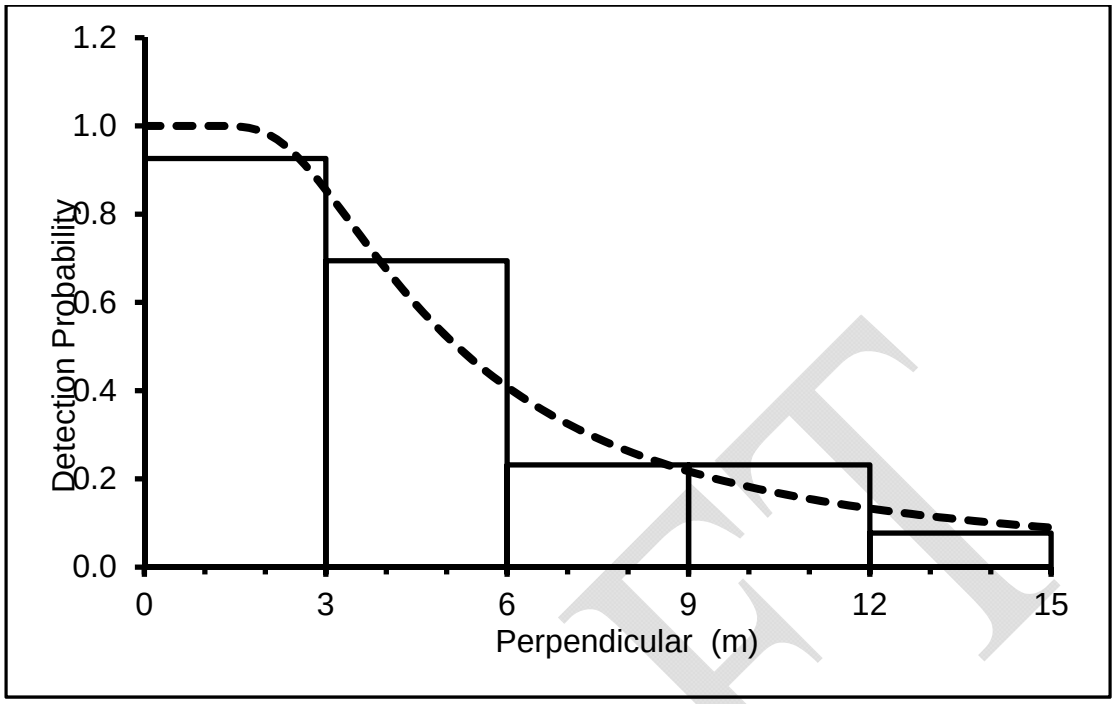


Figure 14. Observed detections (histogram) and the resulting detection function (smooth curve) for live tortoises with MCL ≥ 180 mm found by IWS. This curve uses only the 28 observations found within 15 m of the line.

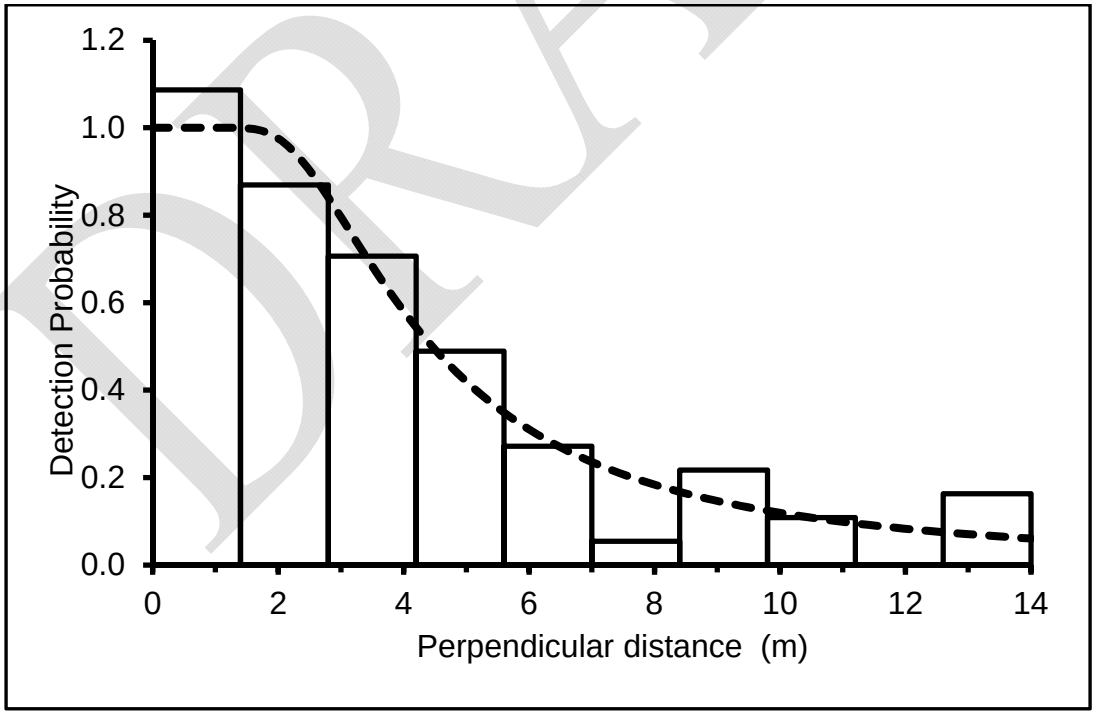


Figure 15. Observed detections (histogram) and the resulting detection function (smooth curve) for live tortoises with MCL ≥ 180mm found by Kiva. This curve uses only the 73 observations found within 14 m of the line.

DRAFT

Proportion of tortoises available for detection by line distance sampling, G_0

In general, telemetry sites and associated transects were completed sequentially, from south to north. This pattern corresponds to the expected timing of tortoise activity; peaking first in the south, later in the north. In 2012, to accommodate access dates on Chocolate Mountain, this stratum was completed before and during training. The remaining strata in the eastern part of the Colorado Desert were started 12 days after this, but visibility from the Chuckwalla and Joshua Tree telemetry sites were high during the entire period, so a single G_0 estimate was used for all of these strata and for the entire 4 week period. Tortoise activity in the eastern part of the range was very delayed compared to typical patterns, and this is reflected in unusually low G_0 estimates for Gold Butte, Halfway Wash, Chemehuevi, Piute-Mid, and Ivanpah, despite the fact that these strata were monitored in April and May. Dates, total days monitored, and G_0 estimates are given in Table 5.

Strata in the western part of the range were apparently sampled during a very active period, reflected in high G_0 estimates. In the eastern part of the range, G_0 remained relatively lower, only increasing slightly in Coyote Springs Valley which was monitored later in the field season.

Table 5. Availability of tortoises (G_0) during the period in 2012 when transects were walked in each group of neighboring strata.

G_0 sites	Strata	Dates	Days	G_0 (Std Error)
Gold-Butte	Gold Butte	27 Mar – 6 Apr	11	0.52 (0.119)
Halfway Wash	Beaver Dam Slope, Mormon Mesa	23 Apr – 21 May	29	0.54 (0.116)
Coyote Springs Valley	Coyote Springs	9 Apr – 22 Apr	14	0.98 (0.049)
Piute/ Ivanpah/ Chemehuevi	Chemehuevi, Eldorado, Fenner, Ivanpah, Piute	28 Mar – 3 May	37	0.52 (0.163)
Joshua Tree/ Chuckwalla	Chocolate Mtn, Chuckwalla, Joshua Tree, Pinto Mtns	13 Mar – 9Apr	28	0.86 (0.107)
Ord-Rodman/ Superior Cronese	Fremont-Kramer, Ord-Rodman, Superior Cronese	10 Apr – 29 Apr	20	0.87 (0.138)

Proportion of available tortoises detected on the transect centerline, *g(0)*

Because they are cryptic, even tortoises that are visible (not covered by dense vegetation or out of sight in a burrow) may not be detected. For 25 detections of tortoises within 1 m of the transect centerline, 21 were found by the observer in the lead position and 4 by the follower, so that the probability of detection by single observer, $p = 0.810$, and the proportion detected using the dual observer method, *g(0 to 1 m)* = 0.964 (SE = 0.11). Figure 16 shows that *g(0)* was converging on 1.0, indicating the assumption of perfect detection on the centerline was met; consequently, no adjustment was made to the final density estimate. The curves since dual

AR060137

observers were first used in 2004 have all supported the premise that complete detection on the transect line was achieved for years in which the dual-observer method was used (USFWS 2009, 2012a, 2012b).

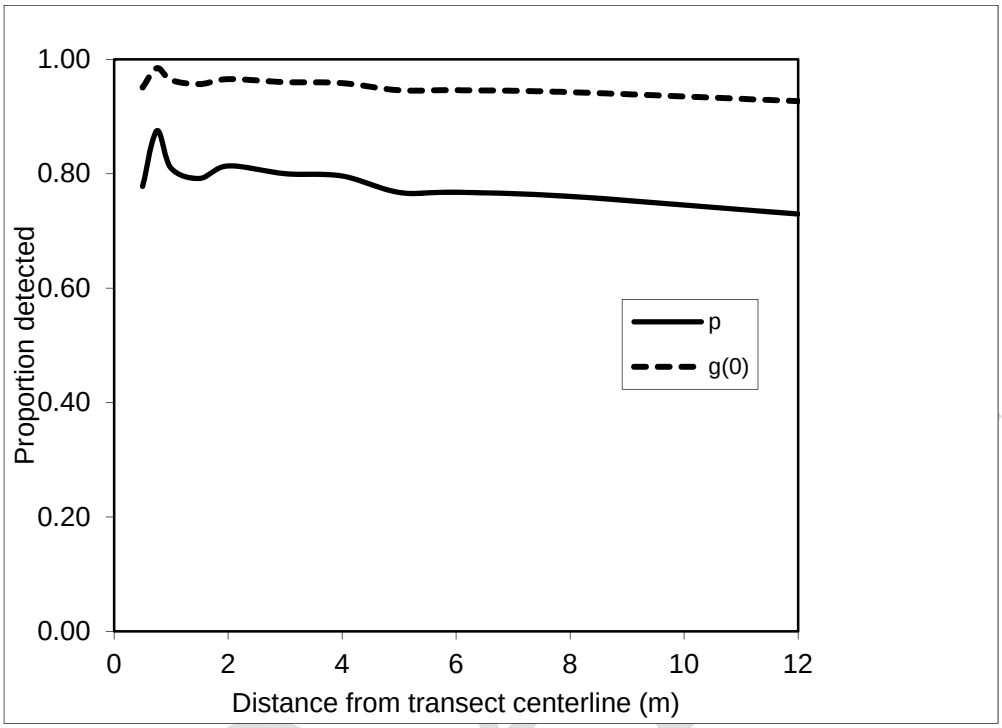


Figure 16. Detection pattern for the leader (*p*) and by the team (*g(0)*) based on all observations out to a given distance (*x*) from the centerline in 2012. Note convergence of *g(0)* on 1.0 as *x* goes to 0.

Estimates of tortoise density

Density estimates were generated separately for each monitoring stratum (Table 6), then weighted by stratum area to arrive at average density in the monitored area of each recovery unit (Table 7). Although encounter rates were estimated separately for each stratum, and have independent variances, the detection function and G_0 were estimated jointly (pooling data from multiple strata), so these variances are not independent (Fig. 5 illustrates how estimates were pooled for 2012).

When the annual estimates are imprecise, it should not be expected that there will be a close match from one year to the next. Over a period of many years, however, we expect any underlying trend in the number of tortoises to be obvious through this "background noise." Some density estimates in 2012 were based on so few observations that the estimates and very high CVs are beyond the expected 20-40% CV. This arose from last-minute funding withdrawals that manifested as sequestration rather than strategic alteration of the sampling design.

AR060138

Table 6. Recovery unit and stratum-level encounters and densities in 2012 for tortoises with MCL ≥ 180mm.

Recovery Unit	Stratum		Area (km2)	Number of Transects	Total transect length (km)	Sampling Dates		Field Observers	*n* (tortoises observed)	*CV(n)*	*Density (/km2)*	*CV(Density)*
						Begin	End					
Colorado Desert			**13530**	**130**	**1403**	**30-Mar**	**24-Mar**		**44**		**2.4**	**26.0**
	Chocolate Mountain	AG	755	33	363	13-Mar	24-Mar	Kiva	21	24.7	6.1	31.26
	Chuckwalla	CK	3509	20	213	14-Apr	22-Apr	Kiva	8	37.5	3.9	42.10
	Chemehuevi	CM	4038	15	176	30-Mar	28-Apr	IWS	1	99.9	0.8	107.85
	Fenner	FE	1841	14	168	30-Mar	27-Apr	IWS	1	100.0	0.9	107.95
	Joshua Tree	JT	1567	18	183	14-Apr	22-Apr	Kiva	6	44.5	3.4	48.45
	Pinto Mountains	PT	751	15	140	14-Apr	22-Apr	Kiva	5	38.5	3.7	42.97
	Piute Valley	PV	1070	15	159	30-Mar	28-Apr	IWS	2	67.4	1.8	78.76
Eastern Mojave			**3720**	**56**	**639**	**30-Mar**	**28-Apr**		**8**		**2.2**	**60.5**
	Eldorado Valley	EV	1153	29	320	30-Mar	28-Apr	IWS	2	69.1	0.9	80.19
	Ivanpah	IV	2567	27	318	30-Mar	28-Apr	IWS	6	49.9	2.8	64.41
Northeastern Mojave			**4889**	**369**	**4184**	**6-Apr**	**27-May**		**164**		**3.4**	**20.1**
	Beaver Dam Slope	BD	828	70	819	20-Apr	10-May	GBI	38	17.0	5.4	29.93
	Coyote Springs Valley	CS	1117	89	996	13-May	27-May	GBI	45	18.3	2.9	22.55
	Gold Butte-Pakoon	GB	1977	100	1116	6-Apr	20-Apr	GBI	21	20.5	2.3	32.89
	Mormon Mesa	MM	968	110	1253	20-Apr	13-May	GBI	47	17.2	4.3	30.03
Western Mojave			**6873**	**76**	**876**	**25-Mar**	**11-Apr**		**33**		**3.6**	**28.8**
	Fremont-Kramer	FK	2417	16	193	25-Mar	9-Apr	Kiva	4	44.8	2.2	49.68
	Ord-Rodman	OR	1124	15	158	27-Mar	10-Apr	Kiva	7	41.2	4.6	46.54
	Superior-Cronese	SC	3332	45	525	25-Mar	11-Apr	Kiva	22	24.3	4.4	32.49

DRAFT

Table 7. Estimated density of desert tortoises in monitored areas of each recovery unit in the Mojave and Colorado deserts in 2012.

Recovery Unit	Sampled area (km^2)	Kilometers walked	Tortoises detected	Density ($/km^2$)	Lower limit 95% CI (Density)	Upper limit 95% CI (Density)	%CV (Density)
Colorado Desert	13530	1403	44	2.4	1.45	3.95	26.0
Eastern Mojave	3720	639	8	2.2	0.75	6.67	60.5
Northeastern Mojave	4889	4184	164	3.4	2.29	5.00	20.1
Western Mojave	6873	876	33	3.6	2.05	6.21	28.8

Area of each stratum sampled and the number of tortoises in that area

Evaluating transect classification

In 2012, 149 of the 627 walked and 88 unwalked transects were not completed or addressed as predicted. Table 8 summarizes conclusions after examining these transects. Sixty were reclassified based on crew experience. In some cases, this reflects discrepancy between interpretation of terrain from imagery; in others, classification is ambiguous because over the course of a 12 km transect, terrain is so variable to that it was not a simple matter to evaluate the ability of a typical crew to complete it. The remaining 89 anomalous transects were not reclassified, because earlier experience indicated that most crews would use the original completion strategy. The 60 transects that were reclassified represent only 2.1% of the 2786 transects evaluated since 2008, so this had very little impact on our estimate of the proportion of each stratum that is walkable.

Table 8. Transects completed other than as planned and any resulting reclassification

Previous substratum	Situation	New substratum	Number of transects
12k	Shortened in 2012, contradicting previous experience. In many cases, shortened on military base for non-terrain issues	12k	30
12k	On-the-ground observation differs from imagery	Shortened	25
12k	Crew attempted the transect but couldn't walk at least 6km	Unwalkable	1
Shortened	On-the-ground experience indicates walkable though rugged	12k	21
Shortened	Lengthened or replaced as unwalkable in 2012, but not enough evidence to override previous crew experience	Shortened	59
Shortened	Crew planners considered unwalkable; reexamination of topo maps matches their interpretation	Unwalkable	6
Unwalkable	On-the-ground experience contradicted imagery	12k	1
Unwalkable	On-the-ground experience contradicted imagery	Shortened	6

AR060140

Number of tortoises based on density and area sampled

The proportion of each stratum represented by distance sampling is calculated as the proportion of planned kilometers that can be walked (Column 3 in Table 9). This proportion is calculated based on all transects evaluated since 2008. Table 9 reports the area of each stratum, the proportion covered by our density estimates, and the associated estimate of tortoise abundance.

Table 9. Estimated tortoise abundance in sampled areas of each stratum

Stratum	Area (km^2)	Proportion sampled	SE(Prop. Sampled)	Sampled area	N (number of tortoises)	95% Confidence Interval	
						Lower Limit	Upper Limit
AG	755	0.94	0.027	706	4287	2350.3	7818.4
BD	828	0.91	0.029	756	4059	2279.1	7230.2
CK	3509	0.80	0.031	2818	11123	5024.3	24623.4
CM	4038	0.93	0.023	3763	3142	561.5	17582.5
CS	1117	0.86	0.031	960	2789	1793.3	4339.1
EV	1153	0.87	0.030	999	916	230.0	3649.6
FE	1841	0.97	0.017	1782	1561	278.8	8744.8
FK	2417	0.97	0.010	2347	5060	2015.2	12707.6
GB	1977	0.82	0.026	1623	3675	1955.5	6906.4
IV	2567	0.95	0.019	2447	6777	2134.8	21512.8
JT	1567	0.74	0.034	1152	3962	1605.0	9780.4
MM	968	0.87	0.033	844	3661	2049.1	6539.8
OR	1124	0.73	0.040	821	3768	1573.5	9023.3
PT	751	0.68	0.052	508	1900	838.1	4308.0
PV	1070	0.87	0.031	927	1714	438.7	6696.5
SC	3332	0.93	0.014	3088	13432	7215.1	25004.1
Total	29012	0.880		25541	71827	46684.8	110508.5

Possibility of using burrow counts to estimate tortoise abundance at smaller scales

Crews examined 12,817 burrows as they collected tortoise observations to arrive at this estimate of N. Because there was different effort (kilometers walked) in each stratum, Figure 17 plots the relationship between cover sites and tortoise abundance as their standardized measures (burrows per kilometer walked *versus* tortoise density). Although some association is apparent it is not a linear one; without the cluster of poorly sampled strata in the lower left of Fig. 17, no association is apparent at all. This is not entirely surprising, although it is worth exploring whether the associate is accurate at smaller spatial scales. In the Colorado Desert, Krysik (2002) has shown that a strong association exists for 9 km^2 plots in a square study area that is 7 km on a side, but is broken when the plots are 64 km apart. Meanwhile, in areas where burrows are in caliche, not dirt, the mechanism for any association (e.g., more desert tortoises construct and maintain more burrows) does not exist, so for either small or large areas with predominantly caliche caves, the associations are not expected to hold up. This is clearly a topic that should be addressed with additional data and at different scales.

AR060141

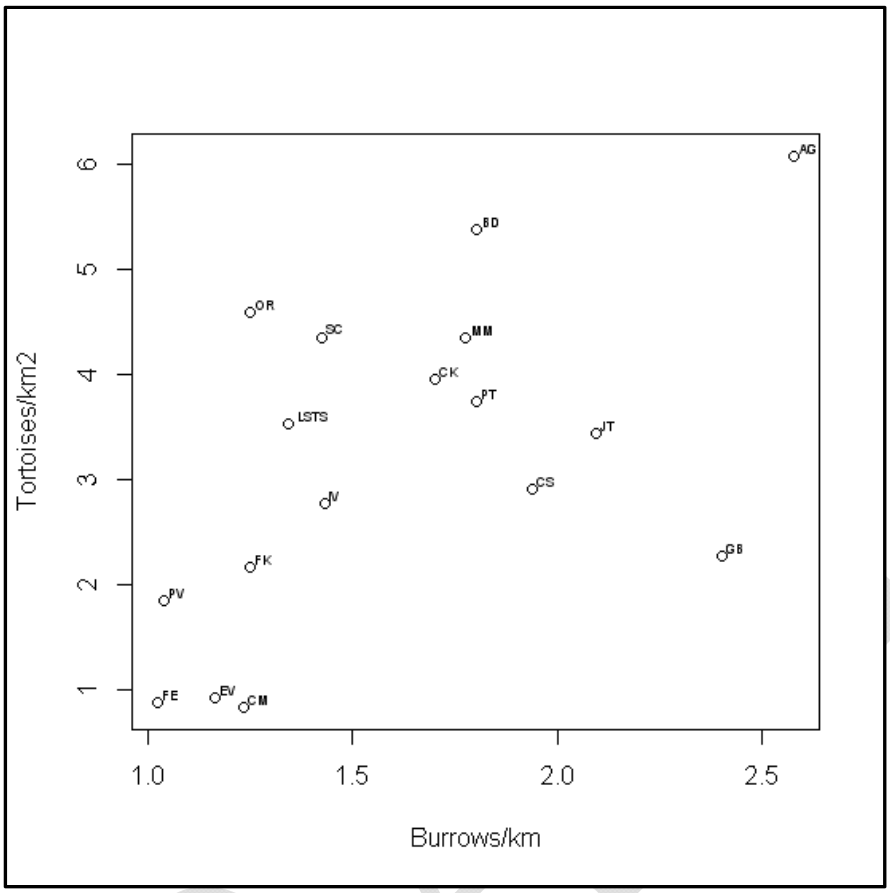


Figure 17. Scatter plot of stratum densities and burrow encounter rate.

Debriefing to identify strengths and weaknesses in preparation for future years

This meeting was held on 31 May, about 1 week after the last field work was completed. Crews were generally well prepared and appropriately addressed any complications in transect and telemetry work. The following issues were identified to be addressed by coordinated effort rather than by efforts of single parties.

Earlier review of the first field data

This was a consistent complaint of crews – that they did not get it in a timely manner, at all, or it did not address their work. There were issues with specialists and USFWS schedules that created unique timing problems this year, but in any year it would helpful to circulate copies of the assessments during training so crews know ahead of time the type of review they will see.

Training improvements to make more effective use of same time period

In general, crews felt they received the appropriate amount of preparation (list of goals) for each training day and their work was reviewed effectively. However, 2 or 3 days of practice transects were completed at the LSTS and crews felt the transects should have been reviewed as if it were the regular field season.

AR060142

To avoid conflicting advice from experienced personnel attempting to fill in gaps in the written information, it was suggested that a FAQ and/or step-through list be created for 2013 G_0. For instance, the book and training should be clear that seeing more tortoises is a priority over having more observations of a small number of tortoises. What should be reported when the tortoise's behavior was apparently in response to seeing the technician first? How often should recently transmittered tortoises be tracked and how should this be documented in our G0 database so that these animals are not included in analyses?

Photos taken on transects should be incorporated in training to illustrate terrain and burrow types not encountered during the pre-season.

DISCUSSION

Quality control and quality assurance

Electronic data collection devices were purchased before the 2011 field season, reducing equipment-related errors, and these were still performing as well or better in 2012 due to greater care with batteries. In addition, the project continued to rely on extensive and intensive feedback to crews and to data specialists during training and the field season. The training emphasis was on review of paper datasheets and standardization of rules for modifying records and documenting these changes. Data managers involved in the final stages of data processing were used to train crews involved in data collection. When project rely on large numbers of relatively independent data collection crews, this sort of standardization reduces identifiable and unidentifiable errors in the final database. The 2012 database products were comparable to those in 2011, with a marked decrease in the number of errors passed through from the field teams to independent reviewers.

Improving ability to detect trends in desert tortoise abundance

The primary goal of the monitoring program is to provide population estimates that are relevant to the recovery plan criteria (USFWS, 2011). The priority for this and every field season is therefore to improve ability to detect trends in desert tortoise abundance at the recovery unit level.

Consequences of insufficient transects

Estimates of tortoise visibility (G_0) were relatively low in the eastern part of the range; associated with this, encounter rates were the lowest that have been reported on this project (under 4 per 100 km walked in all recovery units), but adequate funding in some portions of the range allowed for sufficient transects to nonetheless detect several tortoises per stratum. In 10 of the 16 surveyed strata, fewer than 10 tortoises were detected; this is a rough lower limit for the number of observations to develop an adequate density estimate (Buckland et al. 2001). None of

AR060143

the stratum estimates are meant to stand on their own, and will either be used in combination with other stratum estimates in the same recovery unit (in annual reports such as this one) or with other years of estimates from the same stratum to describe trends; however, the dramatic loss of funding for transects BLM lands in California resulted in such reduced effort and detections that these stratum estimates should probably not be used in any aggregated for either. One way to better utilize available funds is to refrain from sampling in areas without at least a minimum level of funding. Instead of using annual recovery unit estimates to develop trends, description of recovery unit trends will be based on average trends within strata in that recovery unit. Missing years of information should be avoided if it is an important goal to describe annual recovery unit abundance, requiring representation of all associated strata. However, infrequent years of missing data do not prevent trends in individual strata from being described.

Although Anderson and Burnham (1996) targeted CVs between 10 and 15% in each recovery unit, this would be unusually high precision for such an estimate of wildlife abundance. In 2012, 3 recovery units had CVs between 20 and 29% of the density estimate – satisfactory for an annual estimate. The Eastern Mojave Recovery Unit had a density estimate of much lower precision (60.5 %). This is not surprising given the lack of investment in these strata, but is of less concern than the small number of tortoise observations (n=8) on which the density estimate for these 3700 km^2 is based.

DRAFT

LITERATURE CITED

Anderson, D.R., and K.P. Burnham. 1996. A monitoring program for the desert tortoise. Report to the Desert Tortoise Management Oversight Group.

Anderson, D.R., K.P. Burnham, B.C. Lubow, L. Thomas, P.S. Corn, P.A. Medica, and R.W. Marlow. 2001. Field trials of line transect methods applied to estimation of desert tortoise abundance. Journal of Wildlife Management 65:583-597.

Averill-Murray, R.C., and A. Averill-Murray. 2005. Regional-scale estimation of density and habitat use of the desert tortoise (Gopherus agassizii) in Arizona. Journal of Herpetology 39:65–72.

Berry, K.H., and L.L. Nicholson. 1984. The distribution and density of desert tortoise populations in California in the 1970's. Chapter 2 *in* K.H. Berry (ed.), The status of the desert tortoise (*Gopherus agassizii*) in the United States. Desert Tortoise Council Report to the U.S. Fish and Wildlife Service. Order No. 11310-0083-81.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford Univ. Press, Oxford. 432 pp.

Corn, P. S. 1994. Recent trends of desert tortoise populations in the Mojave Desert. Fish and Wildlife Research 13:85-93.

Duda, J.J., Krzysik, A.J. and J.M. Meloche. 2002. Spatial organization of desert tortoises and their burrows at a landscape scale. Chelonian Conservation and biology 4:387-397.

Krzysik, A.J. 2002. A landscape sampling protocol for estimating distribution and density patterns of desert tortoises at multiple spatial scales. Chelonian Conservation and biology 4:366-379.

Luckenbach, R.A. 1982. Ecology and management of the desert tortoise (Gopherus *agassizii)* in California. *In* R.B. Bury (ed.). North American Tortoises: Conservation and Ecology. U.S. Fish and Wildlife Service, Wildlife Research Report 12, Washington, D.C.

Marques, T.A., L. Thomas, S.G. Fancy, and S. T. Buckland. 2007. Improving estimates of bird density using multiple-covariate distance sampling. The Auk 124(4) 1229-1243.

McLuckie, A.M., M. Ratchford, and R.A. Fridell. 2012. Regional desert tortoise monitoring in the Red Cliffs Desert Reserve, 2011. Salt Lake City: Utah Division of Wildlife Resources, Publication Number 12-13. 54 pp.

Murphy, RW, KH Berry, T Edwards, AE Leviton, A Lathrop, JD Riedle, 2011. The dazed and confused identity of Agassiz's land tortoise, *Gopherus agassizii* (Testudines, Testudinidae) with the description of a new species, and its consequences for conservation. ZooKeys 113: 33-71. doi: 10.3897/zookeys.113.1353.

SPSS, Inc. 2010. PASW Statistics, Rel. 18.0.2. Chicago: SPSS Inc.

Swann, D.E., R.C. Averill-Murray, and C.R. Schwalbe. 2002. Distance sampling for Sonoran desert tortoises. Journal of Wildlife Management 66:969–975.

Thomas, L, S.T. Buckland, E.A. Rexstad, J.L. Laake, S. Strindberg, S.L. Hedley, J.R.B. Bishop, T.A. Marques, and K.P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47:5-14.

Tracy, C.R., R.C. Averill-Murray, W.I. Boarman, D. Delehanty, J.S. Heaton, E.D. McCoy, D.J. Morafka, K.E. Nussear, B.E. Hagerty, and P.A. Medica. 2004. Desert Tortoise Recovery Plan Assessment. Report to the U.S. Fish and Wildlife Service, Reno, Nevada.

[USFWS] U.S. Fish and Wildlife Service. 1994. Desert Tortoise (Mojave Population) Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

[USFWS] U.S. Fish and Wildlife Service. 2006. Range-wide Monitoring of the Mojave Population of the Desert Tortoise: 2001-2005 Summary Report. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada.

[USFWS] U.S. Fish and Wildlife Service. 2009. Range-wide Monitoring of the Mojave Population of the Desert Tortoise: 2007 Annual Report. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada.

[USFWS] U.S. Fish and Wildlife Service. 2011a. Revised recovery plan for the Mojave Population of the desert tortoise (*Gopherus agassizii*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. 222 pp.

[USFWS] U.S. Fish and Wildlife Service. 2011b. Health Assessment Procedures for the Desert Tortoise (*Gopherus agassizii*): A Handbook Pertinent to Translocation. Desert Tortoise

AR060146

Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada. Accessible through: http://www.fws.gov/nevada/desert_tortoise/index.html

[USFWS] U.S. Fish and Wildlife Service. 2012a. Range-wide Monitoring of the Mojave Desert Tortoise: 2008 and 2009 Reporting. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada.

[USFWS] U.S. Fish and Wildlife Service. 2012b. Range-wide Monitoring of the Mojave Desert Tortoise: 2010 Reporting. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada.

[USFWS] U.S. Fish and Wildlife Service. 2012c. DRAFT Range-wide Monitoring of the Mojave Desert Tortoise: 2011 Reporting. Report by the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada.

[USFWS] U.S. Fish and Wildlife Service. 2012d. Desert Tortoise Monitoring Handbook. Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service, Reno, Nevada. Version: 6 March 2012. http://www.fws.gov/nevada/desert_tortoise/reports.

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. LA-87-87-NERP. Los Alamos National Laboratory, Los Alamos, NM. 235pp.

DRAFT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Palm Springs Fish and Wildlife Office
777 East Tahquitz Canyon Way, Suite 208
Palm Springs, California 92262

In Reply Refer To:
FWS-SB-15B0100-15CPA0169

MAR - 3 2015

Tracy Creason
Land Use Services
County of San Bernardino
15900 Smoke Tree Street
Hesperia, California 92345

Subject: Planning Project Notice, APN 0607-231-11, Joshua Tree Solar Farm, San Bernardino County, California

Dear Ms. Creason:

The County of San Bernardino (County) is considering the issuance of a conditional use permit to allow for the construction and operation of a photovoltaic generating facility on 10 parcels totaling 115 acres at the former Hi Desert Airport. The U.S. Fish and Wildlife Service (Service) supports the development of alternative energy sources, including solar energy. We fully recognize the importance of such development to both the Nation's economy and the global environment. Any form of economic development, however, including that of renewable energy, comes with certain environmental responsibilities. The purpose of this letter is to inform the project proponent of its responsibilities and potential liabilities associated with the renewable solar energy projects under the natural resource protection laws administered by the Service and to provide the County with our recommendations that would facilitate the component's compliance with these Federal laws.

The Service holds certain resources in trust for the American people; these resources include migratory birds and federally listed threatened and endangered species. The Service administers natural resource protection laws germane to solar energy production and transmission. These statutes include the Migratory Bird Treaty Act (16 U.S.C 703 *et seq.*), the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d.), and the Endangered Species Act (16 U.S.C. 1531 *et seq.*).

Studies on wildlife and solar-energy facilities are limited; however, recent information collected at solar facilities indicates that wildlife, particularly avian species, can be negatively affected by solar-energy development. For example, birds and bats collide with solar panels, mirrors, fences, and ancillary buildings. Birds exposed to elevated levels of solar flux may die as a result of damage to their feathers and internal organs. The construction of solar facilities also destroys large amounts of habitat for wildlife.

The Service would like to help the County make informed decisions in siting, constructing, and operating solar facilities to reduce impacts such as those mentioned above and to ensure the proponent is aware of the potential for liability associated with Federal environmental laws. We offer the following comments to assist you in your planning efforts.

Endangered Species Act

We have discussed this proposed project with NextEra Energy Resources (NextEra) and its consultants in the past. We understand that NextEra has surveyed the site for individuals of the federally threatened desert tortoise (*Gopherus agassizii*) in the past and is planning additional surveys this year. To date, desert tortoises have not been observed on the project site. If desert tortoises are present, the Service would recommend that the County require NextEra to apply for an incidental take permit, pursuant to section 10(a)(1)(B) of the Endangered Species Act, as a condition of your project approval. The County and NextEra should be aware that the process of applying for an incidental take permit under the authorities of section 10(a)(1)(B) of the Endangered Species Act would likely require at least 12 months to complete.

To ensure that the County and NextEra are fully aware of the prohibitions regarding the federally listed animals, included is information regarding section 9 of the Endangered Species Act herein. Section 9 prohibits the "take" of listed animal species. "Take" is defined by the Endangered Species Act as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is an act that kills or injures wildlife. Such act may include significant habitat modification or degradation that actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 Code of Federal Regulations 17.3). "Harass" is defined as an intentional or negligent act or omission that creates the likelihood of injury to listed species by annoying it to such an extent as to significantly impair normal behavior patterns which include breeding, feeding, or sheltering (50 Code of Federal Regulations 17.3). Service may provide an exemption from the take prohibitions through the issuance of a biological opinion for Federal actions (section 7 of the Endangered Species Act) or of an incidental take permit for non-Federal actions (section 10(a)(1)(B)). Absent the Service's provision of an exemption or permit, such take could result in prosecution.

Our final comment with regard to the desert tortoise is that, regardless of the measures included in the conditional use permit, the solar site would likely provide some subsidies to common ravens (*Corvus corax*) in the form of shelter and perching sites. Common ravens are effective predators of desert tortoises and will fly long distances to obtain food and water. The project site is within occupied habitat of desert tortoises; consequently, common ravens that perch and shelter within the boundaries of the proposed projects would likely forage in adjacent habitat where desert tortoises reside. We consider this potential augmentation of the number of common ravens and increased predation pressure on desert tortoises to be a significant impact of the proposed project and recommend that the County require NextEra to participate in the regional comprehensive management plan for common ravens through the payment of the per-acre fee, in addition to the implementation of the proposed measures to reduce the attractiveness of the

project site to common ravens. All fees collected under this program would be used by the Desert Managers Group to manage common ravens in the California desert with the goal of reducing their predation on desert tortoises.

Migratory Bird Treaty Act

The development of the proposed facility would result in the loss of approximately 115 acres of desert scrub habitat that supports breeding and foraging of migratory birds. Additionally, we are aware that many migratory birds have died in association with commercial scale solar fields. For example, migratory water birds have landed at solar facilities in the desert, perhaps mistaking the sites for water bodies. Because certain species of water birds, such as grebes, loons, and some species of ducks, cannot take flight unless they are in water, at least some of the birds that land within solar plants will most likely die. Carcasses of other bird species have been found in association with solar panels, fences, and ancillary building at solar facilities.

The Migratory Bird Treaty Act protects most native species of birds in the United States, including those likely to occur in the project area; you can find a list of species protected by the Migratory Bird Treaty Act at: http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtandx.html. The Migratory Bird Treaty Act is the cornerstone of migratory bird conservation and protection in the United States and implements four treaties that provide for international protection of migratory birds.

The Migratory Bird Treaty Act prohibits the "take" or possession of protected species of migratory birds. Under the Migratory Bird Treaty Act, take means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect (50 Code of Federal Regulations 10.12).

The Migratory Bird Treaty Act is a strict liability statute, meaning that proof of intent, knowledge, or negligence is not an element of a violation of this statute. The statute's language is clear that an action resulting in the "taking" of an individual of a protected species is a violation of this law. The Migratory Bird Treaty Act does not specifically authorize the incidental take of migratory birds; consequently, the Service does not issue permits authorizing such take. In the absence of a permit from the Service, the temporary or permanent possession of protected migratory birds and their carcasses is also a violation of the Migratory Bird Treaty Act.

The Service carries out its mission to protect migratory birds by fostering relationships with entities that have taken effective steps to avoid take, by encouraging others to implement measures to avoid take, and through investigations and enforcement when appropriate. Companies are encouraged to work closely with the Service to identify available protective measures when developing project plans to safeguard wildlife and to implement those measures where applicable. Companies are also strongly encouraged to apply for permits authorizing otherwise prohibited activity, including special purpose utility permits. For this proposed action, NextEra may need to apply for a special purpose utility use permit from the Service. We discuss

this permit with regard to migratory birds later in this letter. Ultimately, those parties involved with the planning, design, construction, operation, maintenance, and decommissioning of projects are responsible for conducting relevant evaluations of the area and for determining, which, if any, bird species may be effected and for seeking and obtaining necessary permits to avoid liability.

Given the potential impacts that the proposed project may have on migratory birds, we recommend that NextEra develop a bird conservation strategy that includes a robust, systematic monitoring protocol to document mortality and habitat effects to birds that incorporates the following three objectives: an estimation of the overall annual avian mortality rate associated with the facility, including mortality associated with all the features of the project that are likely to result in injury and mortality (e.g., fences, ponds, solar panels); a determination of which species are killed at the facility during different times of the day (i.e., during the day vs. night); and a determination of whether mortality rates differ within the solar field (i.e., panels on the edge vs. the interior of the field). We recommend that this protocol address the efficiency of searchers and the rate at which carcasses disappear from the site; absent these components, the results of the mortality monitoring will not present a realistic estimate of the numbers of birds that die within the solar arrays. The bird plan should also include an adequate spectrum of adaptive management measures to avoid and minimize the effects of the facility's operations on bird populations. We recommend that NextEra implement the monitoring program for a minimum of two to three years; if numerous birds die as a result of operation of the project, we would recommend that the duration of monitoring be extended until NextEra can demonstrate that its adaptive management strategy is effectively reducing the number of mortalities. This type of information will be helpful in developing best management practices to minimize adverse effects to birds and address concerns on the potential for cumulative effects.

A bird conservation strategy is not a substitute for complying with the Endangered Species Act, Migratory Bird Treaty Act, or other applicable laws. We encourage NextEra to coordinate development of its bird conservation strategy with the Service during the project-planning phase to ensure the minimization measures and monitoring plan are sufficient.

The development and implementation of a bird conservation strategy to avoid take of migratory birds does not limit or preclude the Service from exercising its authority under any law, statute, or regulation if migratory birds are taken by any structures associated with the proposed solar facility. However, our Office of Law Enforcement focuses its resources on investigating and prosecuting those individuals and companies that do not identify and implement all reasonable, prudent and effective measures to avoid the take of migratory birds (including eagles) and then subsequently take individuals of such species. Ideally, a high quality, scientifically valid, and robust bird conservation strategy that is implemented in a timely and effective manner, and regularly reviewed and revised as needed, can result in the Service regarding such actions as appropriate means to avoid take of species protected under our various laws while allowing for project development in the most environmentally conscientious manner practicable.

If NextEra intends to collect the carcasses of birds, it would need to apply for a special purpose utility permit from the Service to ensure compliance with the Migratory Bird Treaty Act. The County may wish NextEra to collect carcasses to facilitate its monitoring efforts, to avoid attracting scavengers (e.g., common ravens, which also prey on desert tortoises), and to reduce the potential for human health issues. If the County determines that it would like NextEra to collect carcasses, we strongly encourage beginning the process to obtain a special purpose utility permit, which includes developing an acceptable plan to monitor the mortality of birds at the facility, early enough to allow us to issue a permit prior to the onset of construction. The application for this type of permit can be found at http://www.fws.gov/forms/3-202-17.pdf.

Because the development of numerous solar facilities in San Bernardino County and throughout the California desert, we recommend that the County addresses the cumulative impact of the development and operation of these solar facilities in the desert on migratory bird populations and their habitat. Specifically, the Service recommends that the County include a requirement in the conditional use permits for NextEra to mitigate for the loss of this habitat for migratory birds. Possible mitigation could include contributing to a fund to investigate the regional and cumulative effects of the loss of habitat for migratory birds, identifying and reducing sources of mortality, and enhancing habitat. We are willing to work with you and NextEra to develop and implement appropriate mitigation; one of the regional joint ventures that the Service has established for the conservation of migratory birds may have programs in place that would facilitate the implementation of such mitigation. A joint venture is a collaborative, regional partnership of government agencies, non-profit organizations, corporations, tribes, and individuals that conserves habitat for priority bird species, other wildlife, and people. More information on joint ventures is available at:
http://www.fws.gov/birdhabitat/JointVentures/index.shtm.

We appreciate the opportunity to participate in your planning process. We also appreciate the fact that NextEra has proposed to construct this solar facility on a site that has been disturbed by past uses. If you have any questions regarding these comments, please contact Ray Bransfield of my staff at (805) 644-1766, extension 317.

Sincerely,

Kennon A. Corey
Assistant Field Supervisor

DEPARTMENT OF THE ARMY
HEADQUARTERS, NATIONAL TRAINING CENTER & FORT IRWIN
FORT IRWIN, CA 92310-5000

REPLY TO
ATTENTION OF
IMNT-PWE

5 September 2012

Diane Noda
US Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Rd, Ste. B
Ventura. California 93003

SUBJECT: Consultation pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended, with regard to development of an alternative energy project on Fort Irwin.

Dear Ms. Noda,

The Army requests to initiate formal consultation under 50 CFR § 402.16(b) with the US Fish & Wildlife Service with regard to its proposed development of an alternative energy project on Fort Irwin.

The Army proposes to construct and operate a solar photovoltaic (PV) facility on up to 380 ac. The facility would include solar arrays, access/maintenance roads, an electrical tie-in, a transmission line corridor, and potentially a battery energy storage system. This project is part of a Department of the Army program to address threats to the power supply to its installations from stochastic events such as accidents, terrorist attacks, and disruptive natural events such as fire and wind storms. The project also supports federal agency requirements for increasing energy consumption from renewable sources while reducing greenhouse gas emissions.

Initial surveys of the project site showed the presence of a small population of Desert Tortoises with 3 extant tortoises identified within the proposed project area. Fort Irwin, acting as the lead federal agency, has determined that the proposed project may affect and is likely to adversely affect the desert tortoise, but would not jeopardize the continued existence or recovery of the desert tortoise. The proposed project would not adversely modify or destroy designated critical habitat for this species.

No other species protected under the ESA would be affected by the proposed action. Information contained in the attached BA is not to be released outside of the FWS without the permission of the lead agency. The Army requests an expedited 90-day review for the BA, if possible, to support the development of this critical renewable energy initiative.

IMNT-PWE
SUBJECT: Alternative Energy Development Project

Should you have any questions, please contact Clarence Everly by phone at: 760-380-3740 or by email at: *clarence.a.everly.civ@mail.mil.*

Sincerely,

COL. Kurt J. Pinkerton
Garrison Commander
Fort Irwin

Fort Irwin National Training Center Solar Facility Project



Final Biological Assessment

United States Army
National Training Center and Fort Irwin
San Bernardino County, California

September 2012

Summary of Findings, Conclusions, and Determinations

The National Training Center at Fort Irwin Military Reservation in San Bernardino County, California, is proposing to construct and operate a solar photovoltaic (PV) facility on up to 380 acres (ac). The project would include the construction of the following:

- PV modules/panels
- Solar trackers (to position modules with the sun's movement) or fixed-tilt mounting structures
- Direct current-to-alternating current inverters
- Three-phase, pad-mounted medium-voltage transformers, or similar; and high-voltage step-up transformers
- Transmission line extending from the solar facility to North Loop Road
- Permanent exclusion fencing around the solar facility

The project would generate reliable back-up power, reduce consumption of non-renewable energy, and reduce combustion emissions.

Federally Listed Species

Federally listed threatened, endangered, and proposed species were evaluated to determine their potential presence within the action area. The desert tortoise (*Gopherus agassizii*), a federally listed threatened and state listed threatened species, received detailed consideration because documented observations of this species have been recorded within the action area.

Project Effects

Project-related construction will directly affect desert tortoise through permanent loss of habitat, as well as potential harassment or harm of individuals should clearance surveys determine that relocation of individuals will be necessary. Operation of the solar facility and the associated transmission line would not be expected to affect desert tortoise. Maintenance activities within the solar facility would not affect desert tortoise due to the presence of the exclusion fencing. Maintenance activities along the transmission corridor could affect desert tortoise through harassment, injury, or mortality as a result of vehicle and equipment activity in the transmission corridor, as it would not have permanent exclusion fencing.

Project construction and operation would result in approximately 380 ac of permanent effects to desert tortoise habitat. Project components generally include construction, operation, and maintenance of the solar facility site, a transmission line, and construction and operation and maintenance of other related components. The project is within the Western Mojave Recovery Unit but does not lie within a Desert Tortoise Critical Habitat area or a Desert Wildlife Management Area. The Superior-Cronese critical habitat unit is less than 5 miles west of the action area. The project would not result in fragmentation of the desert tortoise critical habitat and would not adversely modify or destroy desert tortoise critical habitat. The project would not affect any other federally listed threatened, endangered, or proposed plants or wildlife.

Avoidance and Minimization Measures

Fort Irwin has designed the project to minimize direct effects to the desert tortoise and its habitat. In addition, Fort Irwin will employ best management practices (BMPs) in order to avoid, minimize, and prevent any potential direct effects to desert tortoise or potential habitat. These measures include:

- Clearance surveys will be conducted after placement of exclusion fencing and prior to construction activities.
- An Authorized Biologist will be onsite during initial site grading activities and any subsequent construction activities that would have the potential to affect desert tortoise. If a desert tortoise is found within or adjacent to the project site during construction or operation, an Authorized Biologist will move it out of harm's way in coordination and consultation with the United States Fish and Wildlife Service.
- An erosion and sediment control plan will be implemented as part of standard Fort Irwin BMPs to prevent project-related construction effects on habitat outside the work areas.
- The action area perimeter, including support facilities, will be surrounded by desert tortoise exclusion fencing during construction. Controlled access gates will be installed at roads entering or exiting the solar farm site. The Project site will be designed, operated, and maintained so that channelization of surface water flow will not undermine the integrity of the perimeter fence or the desert tortoise exclusion fencing.
- The perimeter of the operational solar facility will be surrounded by permanent desert tortoise exclusion fencing. This area may be less than the action area fenced during construction.
- Clearance surveys will be implemented prior to maintenance activities along the transmission corridor during operation because of the potential for desert tortoise to enter this area and be injured or killed by operation of equipment within the transmission corridor.

Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 Code of Federal Regulations §402.02). This definition applies only to Section 7 analysis, and should not be confused with the broader use of this term in the National Environmental Policy Act, or other environmental laws.

No other projects are currently planned in the action area. Consequently, no non-federal projects would contribute to cumulative effects. Because no additional non-federal projects occur in the area, this project would not contribute to cumulative effects.

Finding of Effect

Based on the information discussed through technical assistance with resource agencies, data collected for and presented in this Biological Assessment, and the planned implementation of the avoidance and minimization measures, Fort Irwin has determined that the proposed project would have the following effects:

- Fort Irwin, acting as the lead federal agency, has determined that the proposed project **may affect and is likely to adversely affect the desert tortoise, but would not jeopardize the continued existence of** the desert tortoise.
- The proposed project would **not adversely modify or destroy** designated critical habitat for this species.

No other species protected under the Federal Endangered Species Act would be affected by the proposed action.

Contents

Section **Page**

Summary of Findings, Conclusions, and Determinations ..... **iii**
Federally Listed Species iii
Project Effects iii
Avoidance and Minimization Measures iv
Cumulative Effects iv
Finding of Effect iv

Acronyms and Abbreviations ..... **vii**

1 Introduction **1-1**
1.1 Project Background 1-1
1.2 Summary of Consultation to Date 1-2

2 Project Description **2-1**
2.1 Project Purpose and Need 2-1
2.2 Action Area 2-1
2.3 Project Components 2-2
2.4 Construction Methods and Equipment 2-3
2.5 Construction Schedule 2-4

3 Status of Species **3-1**
3.1 Status of Listed Species 3-1
3.1.1 Desert Tortoise 3-1
3.1.2 Lane Mountain Milk-vetch 3-4
3.2 Status of Designated Critical Habitat 3-5
3.2.1 Desert Tortoise 3-5
3.2.2 Lane Mountain Milk-vetch 3-5

4 Environmental Baseline **4-1**
4.1 Existing Baseline Conditions 4-1
Watershed or Other Relevant Habitat Unit 4-1
4.1.1 Shelter 4-1
4.1.2 Feeding 4-2
4.1.3 Reproduction 4-2
4.1.4 Habitat Connectivity and Migration 4-3

5 Natural History and Species Occurrence **5-1**
5.1 Site Specific Biological Requirements and Project Context 5-1
5.2 Site Specific Critical Habitat and Project Context 5-1
5.3 Site Specific Limiting Factors for Recovery 5-1

6 Analysis of Effect of the Action **6-1**
6.1 Direct Effects 6-1
6.1.1 Direct Effects from Construction 6-1
6.1.2 Direct Effects from Operation 6-2
6.2 Indirect Effects 6-2
6.2.1 Indirect Effects from Construction 6-3
6.2.2 Indirect Effects from Operation 6-3
6.3 Effect of the Proposed Action on Tribal Resources or Interests 6-4
6.4 Estimating Take 6-4

6.5 Cumulative Effects 6-4

7 Avoidance and Minimization Measures 7-1
7.1 Standard Specifications 7-1
7.2 Special Provisions Specifications 7-2
7.3 Summary of Avoidance, Minimization, and Conservation Measures 7-3

8 Finding of Effect 8-1

9 References 9-1

Figures

1-1 Project Location 1-4

3-1 Project Action Area and Desert Tortoise Sign 3-6

Appendixes

A Natural Resources Report

Acronyms and Abbreviations

° F	degrees Fahrenheit
ac	acre (s)
AC	alternating current
amsl	above mean sea level
ATV	all-terrain vehicle
BMP	best management practice
BLM	U.S. Bureau of Land Management
BO	Biological Opinion
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
DC	direct current
DWMA	Desert Wildlife Management Area
ESA	Endangered Species Act
FR	Federal Register
ft^2	square foot/feet
GIS	geographic information system
GPS	global positioning system
km	kilometer
kV	kilovolt
m	meter
mi	miles
mi^2	square miles
MW	megawatt
MWe	megawatt electrical
NASA	National Aeronautics and Space Administration
NPDES	National Pollutant Discharge Elimination System
NTC	National Training Center
PV	photovoltaic
RPMs	Reasonable and Prudent Measures
RWQCB	Regional Water Quality Control Board

SCE	Southern California Edison
SWPPP	Storm Water Pollution Prevention Plan
T&Cs	Terms and Conditions
U.S. EPA	United States Environmental Protection Agency
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USGS	U. S. Geological Survey

1 Introduction

The purpose of this Biological Assessment is to evaluate the potential effects of the Fort Irwin Solar Facility (Proposed Action) on the federally threatened Mojave population of the desert tortoise (*Gopherus agassizii*) (United States Fish and Wildlife Service [USFWS], 1990 [55 Federal Resister (FR) 12178]) and designated critical habitat for this species and to determine whether the species or its habitat are likely to be adversely affected by the action.

This BA will:

1. Provide a conceptual framework of the history of the project, including the legislative action for the withdrawal and reservation of lands and relationship to other actions and processes.
2. Document the evolution of project consultations with the USFWS.
3. Describe the proposed action, including the planned use and all proposed mitigation and conservation measures.
4. Provide detailed information on the natural history of federally listed endangered or threatened species, or species proposed for listing potentially occurring in the vicinity of the project.
5. Evaluate the potential effects of the Proposed Action on federally listed or proposed listed endangered or threatened species and any designated critical habitat for these species.
6. Provide a determination of effect ("no effect," "may affect, not likely to adversely affect, or modify critical habitat," or "may affect, is likely to adversely affect, or modify critical habitat") for the listed and proposed-listed species.

1.1 Project Background

The U.S. Army National Training Center (NTC) at Fort Irwin is located approximately 37 mi northeast of Barstow, California, in the north-central region of the Mojave Desert (Figure 1-1). Fort Irwin is approximately 25 mi from Interstate 15 midway between Las Vegas and Los Angeles. The Fort Irwin reservation encompasses over 755,000 acres (ac), with approximately half of this land used for desert battlefield training. The Superior-Cronese critical habitat unit for desert tortoise extends into the southern and southwestern portions of Fort Irwin (Figure 1-1).

Fort Irwin serves as the Army's premier training center. The NTC is the premier training center for heavy combat maneuver forces. The mission of the NTC is to provide U.S. and allied forces with tough, realistic, joint and combined arms training across the full spectrum of conflict to assist Commanders in developing trained, competent leaders and soldiers prepared for success on future joint battlefields. Fort Irwin has a resident population of approximately 4,500 soldiers and their families. In addition, approximately 4,000 to 6,000 soldiers visit Fort Irwin during training rotations, which occur 10 times a year. A cantonment area occupies approximately 14,000 ac of the installation and provides temporary and permanent living quarters for soldiers and their families. The cantonment area consists of residential areas, support facilities, retail centers, restaurants, and health care facilities.

1.2 Summary of Consultation to Date

Fort Irwin has completed consultation with USFWS regarding potential effects to desert tortoise on multiple occasions. This section discusses past consultations regarding desert tortoise that may be relevant to this Biological Assessment.

On September 15, 1995, USFWS issued a Biological Opinion (BO) on the Army mission at Fort Irwin which determined that the Army mission would not jeopardize the continued existence of the species or adversely modify critical habitat. The BO included an incidental take statement for military training activities and Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&Cs) that the Army would implement to minimize incidental take associated with training activities. The September 15, 1995 BO superseded a previous non-jeopardy BO dated September 24, 1991.

On May 31, 2002, USFWS issued a BO for the proposed installation of an off-road vehicle (ORV) use area located near the cantonment area. The ORV area, located approximately 4.5 miles south-southwest of the Military Police Station at the center of the cantonment area, overlaps the proposed Fort Irwin Solar Facility project area and is used by military personnel and their dependents during leisure time. The BO determined that the ORV use area is not located within critical habitat for the desert tortoise and is not likely to jeopardize the continued existence of the desert tortoise. The BO included an incidental take statement for the ORV use area that the Army would implement to minimize incidental take and to promote conservation of the species.

The Army had considered expansion of Fort Irwin since the 1980s. Between 1991 and 2003 there were multiple consultations on different expansion proposals. On March 15, 2004, USFWS issued a BO for the addition of maneuver training lands at Fort Irwin with a determination that the addition of training lands at Fort Irwin was not likely to jeopardize the continued existence of desert tortoise and Lane Mountain milk-vetch or to destroy or adversely modify critical habitat of the desert tortoise. This BO concluded a multi-year consultation that included revisions to the proposed expansion and inclusion of conservation actions. As a result of this consultation, the Army implemented numerous measures for the conservation of desert tortoise and Lane Mountain milk-vetch, which included:

- Establish three desert tortoise conservation areas within Fort Irwin.
- Establish a 500-meter (m) buffer for desert tortoise along the Boulder Utility Corridor.
- Establish two conservation areas for Lane Mountain milk-vetch.
- Place 1,872 ac of Lane Mountain milk-vetch habitat in the Brinkman Wash-Montana Mine population in a larger no-dig zone.

The conservation areas had no mechanized training, no ground disturbance, and no off-road activity. Vehicle travel had been limited to existing roads, and new roads were created only if needed for conservation management. Aircraft and helicopter overflights were permissible within the limits of airspace restrictions, but no landings were allowed. In the no dig zone, in addition to a prohibition on digging, only dismounted troop maneuvers were allowed and no tactical assembly areas or brigade support areas were allowed.

Subsequent to the March 15, 2004 BO and consistent with the consultation, the U.S. Geological Survey (USGS) developed a plan to guide the translocation of desert tortoises from the Fort Irwin southern expansion area. During the development of the translocation plan, the USGS determined that moving desert tortoises from the southern expansion area to areas directly south of Fort Irwin would be more appropriate than moving them farther away to an area that seemed to have undergone a major decrease in the density of desert tortoises. Because this course of action was substantially different than the one discussed in the 2004 BO, the USFWS issued a re-initiated BO (1-8-05-F-43) on December 29, 2006, that addressed the different translocation strategy, the installation of a desert tortoise-proof fence along Interstate 15, and the construction of pens to hold translocated desert tortoise.

On May 21, 2009 the Army requested reinitiation of formal consultation because the number of desert tortoise found in the southern expansion area exceeded that predicted in the previous BO and because new information regarding elevated levels of predation of translocated desert tortoises became available. Subsequently, the Bureau of Land Management (BLM), which was part of a joint Conservation Mitigation Working Group that also included USFWS, the Army, and the California Department of Fish and Game, determined that its proposed action to allow the Army to release desert tortoise from Fort Irwin onto public lands in the western translocation area was likely to adversely affect the desert tortoise. USFWS determined that the BLM proposed action was likely to adversely affect the desert tortoise in the same manner as the translocation portion of the Army proposed action and determined that it was appropriate to issue a single BO to both agencies.

On July 30, 2009, USFWS provided the Army and BLM a draft BO. The Army provided comments on the draft BO and BLM made the draft BO available for public review as part of the National Environmental Policy Act review for its proposed action of allowing the Army to use public lands for the translocation of desert tortoise. USFWS also received comments on the draft BO from the Center for Biological Diversity, Public Employees for Environmental Responsibility, and Desert Survivors. The Western Watersheds Project commented on the BLM environmental assessment with regard to the draft BO. BLM withdrew from formal consultation on September 21, 2009 and the Army withdrew from formal consultation on September 20, 2010 due to cancellation of the fall desert tortoise translocation. Subsequently, the Army requested reinitiation of formal consultation on January 20, 2011 for an action involving multiple Federal agencies, but for which the consultation and conference responsibilities would be fulfilled by the Army (NTC) as the lead agency in accordance with 50 Code of Federal Regulations (CFR) 402.07. The request for reinitiating formal consultation was based on (1) the increase in the number of desert tortoise found compared to the number analyzed in the original BO and (2) the fact that the original BO was issued prior to the Ninth Circuit Court's decision that invalidated the USFWS regulatory definition of "destruction or adverse modification of critical habitat" at 50 CFR 402.02.

USFWS considered the comments received on the draft BO and incorporated them into its final BO of April 27, 2012, as appropriate. The April 27, 2012 BO for the addition of maneuver training lands at Fort Irwin determined that the proposed action was not likely to jeopardize the continued existence of the desert tortoise and that, while approximately 2.4 percent of the Superior-Cronese Critical Habitat Unit would be adversely affected by subsequent training activities, the action was not likely to adversely modify or destroy critical habitat of the desert tortoise. The BO included an incidental take statement for military training activities and RPMs and T&Cs that the Army would implement to minimize incidental take and to promote conservation of the species.

For the action under consideration in this Biological Assessment, a conference call discussion was conducted on February 15, 2012, with Brian Croft (USFWS, 2012a) regarding desert tortoise presence/absence surveyor requirements and any qualifications that may need to be submitted prior to surveying. Mike Ackerman (US Army Environmental Command) discussed project permitting requirements with Brian Croft on April 29, 2012. Mr. Croft indicated that consultation will be required for the project and mentioned that the USFWS has turned the action over to Erin Nordin in the San Bernardino USFWS office. Mr. Ackerman also spoke with Ms. Nordin regarding the permitting needs for the project. Both USFWS employees indicated that a Biological Assessment with formal consultation would be recommended for the proposed project.

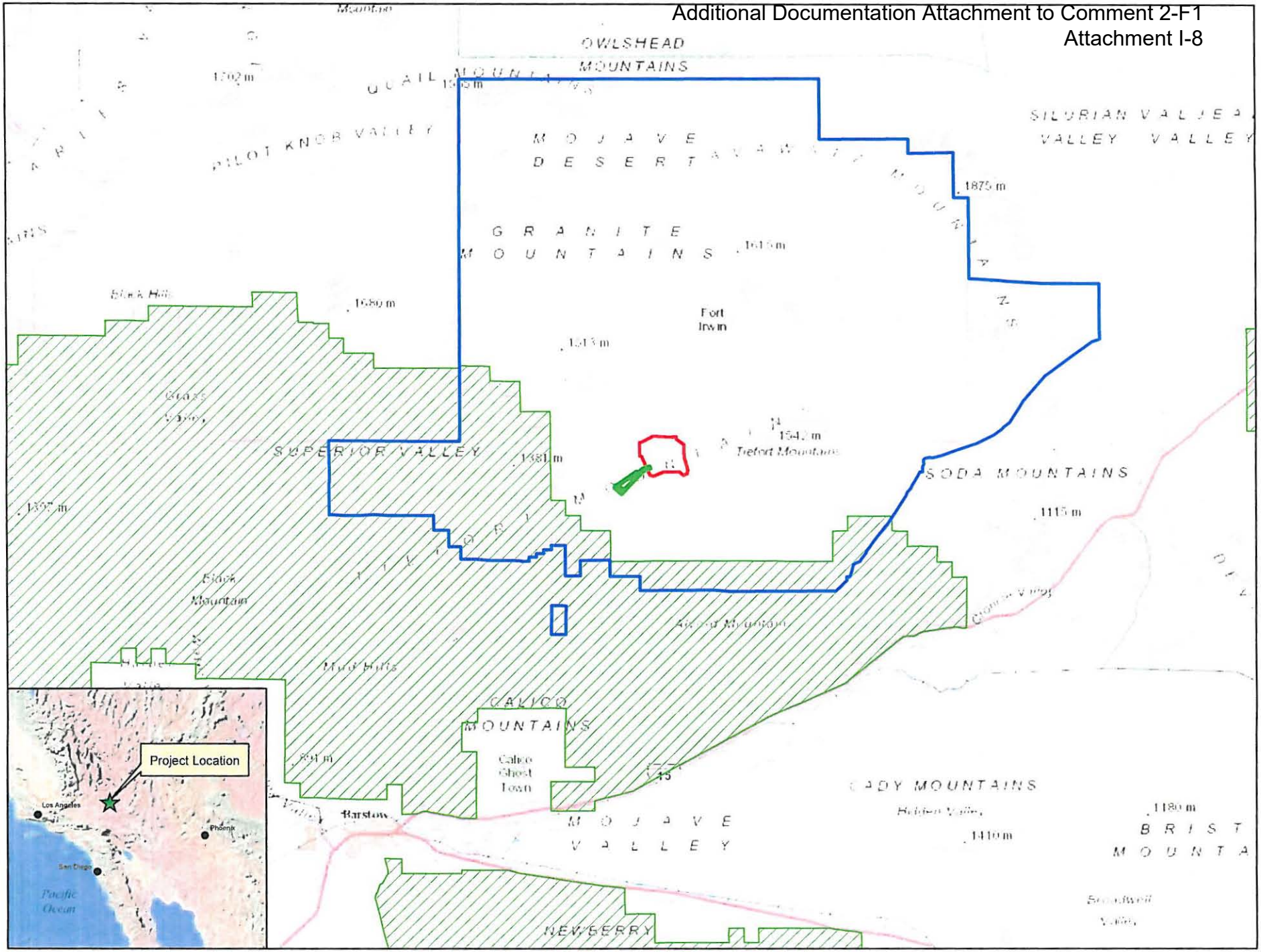


FIGURE 1-1
Desert Tortoise Critical Habitat Area
Fort Irwin National Training Center Solar Facility Project
Natural Resources Report
Fort Irwin, California

AR060166

2 Project Description

Fort Irwin is proposing to construct and operate a solar photovoltaic (PV) facility on up to 380 ac. The facility would include solar arrays, access/maintenance roads, an electrical tie-in, a transmission line corridor, and potentially a battery energy storage system.

2.1 Project Purpose and Need

The project is part of a Department of the Army program to address threats to the power supply to its installations from stochastic events such as accidents, terrorist attacks, and disruptive natural events such as fire and wind storms. The Fort Irwin power supply is vulnerable to disruption. Installation electricity is distributed through a single 30-mile (mi)-long radial 115-kilovolt (kV) power line operated by Southern California Edison (SCE) which, if disrupted, would require the NTC to rely on back-up power generation, resulting in greater amounts of energy consumption and air pollution.

Fort Irwin needs to address the following U.S. Army Senior Energy Council security goals:

- Increase in energy-efficiency across platforms and facilities.
- Increase use of renewable/alternative energy.
- Increase assurance of access to sufficient energy supplies.
- Reduce adverse impacts on the environment.

Fort Irwin must meet the requirements of Congressional legislation and Executive Orders (EOs), including The Energy Policy Act of 2005 (Section 203), EO 13423, EO 13514, the National Defense Authorization Act of 2007, which mandates a 25 percent reduction in the use of nonrenewable energy by 2025, and the Energy Independence and Security Act of 2007, which directs reductions in the use of fossil fuels.

The purpose of the Fort Irwin project is to provide the NTC with enhanced energy security through a protected onsite energy supply to support installation operations and to enhance energy sustainability at the installation.

The Proposed Action would achieve the following objectives:

1. Provide Fort Irwin with a secure and reliable supply of back-up electrical power from a renewable source
2. Meet the goal of 25 percent increased use of renewable energy by 2025

2.2 Action Area

The implementing regulations to Section 7(a)(2) of the Endangered Species Act (ESA) define the action area to be all areas affected directly or indirectly by the federal action and not merely the immediate area affected by the proposed project (50 CFR §402.02). The action area is the area where direct effects from construction and operation (the project footprint) or indirect effects of the proposed action and any interrelated or interdependent human activities may occur. The direct and indirect effects of these activities include associated physical, chemical, and/or biological effects of considerable likelihood. Indirect effects are those that are caused by or would result from the proposed action later in time, but are still reasonably certain to occur. The project is not expected to cause increased amounts of traffic that would result in future increases in light, noise, or vibration disturbances or result in increased potential for traffic mortality.

It is possible that relocation of desert tortoise to the adjacent area and subsequent exclusion of desert tortoise from the solar facility site would result in biological impacts through interaction with other desert tortoise.

Temporary relocation of desert tortoise from the transmission corridor area during construction would not be expected to result in biological impacts because desert tortoise would not be permanently excluded from this area and would be expected to return to it after construction.

Male desert tortoises translocated a short distance move an average of 619 m in the first year following relocation (Walde et al., 2011). Therefore, it is possible that translocated desert tortoise from the solar facility site could reasonably be expected to move up to 619 m to the northwest. Results of the solar facility site survey (Appendix A; CH2M HILL, 2012) indicate that tortoise within the solar facility site already are likely to use a portion of this area, as an occupied burrow was found approximately 100 m within the northwestern boundary of the solar facility site and additional desert tortoise sign were found along and near the northwestern boundary. Because the number of desert tortoise that would be translocated would be small, due to the low desert tortoise density in the solar facility site and the surrounding area, it is unlikely that any biological impacts would result from relocation.

The potential for indirect biological effects is expected to be low in surrounding areas as a result of relocation of desert tortoise and subsequent exclusion of desert tortoise from the solar facility site. No interrelated and interdependent projects are known for this area. Potential indirect effects during construction and operation include storm water runoff from the proposed solar facility site which could affect the immediately surrounding area of the site (discussed further in Section 6.2 of this document). An Erosion and Sedimentation Control Plan and a Storm Water Pollution Prevention Plan (SWPPP) will be implemented to prevent degradation to desert tortoise habitat within and immediately surrounding the construction area. The indirect effect to the desert tortoise from damage to adjacent habitat will be minimized through implementation of these plans. However, other desert tortoise populations may occupy home ranges that overlap the project area. These tortoises could experience indirect impacts from loss of potential habitat.

Therefore, the action area for this project is equal to the area of direct effects and the immediately adjacent area. This includes the 380 ac of desert tortoise habitat that will be affected by the construction of the project, including the solar site, the associated linear facilities (e.g., access roads and transmission line), and related infrastructure. The area for potential operational impacts would not extend beyond the area that will be impacted by construction.

The analyses of environmental baseline, effects of the action on the species and designated critical habitat, cumulative effects, and the impacts of incidental taking, are based upon this action area.

2.3 Project Components

The proposed project is the construction and operation of a PV solar array on approximately 380 ac of land approximately 0.25-mi inside the Fort Irwin main gate. The facility would be 13- to 20-megawatt electrical (MWe) and would connect to existing SCE infrastructure that serves Fort Irwin via a substation adjacent to the proposed project location. A new transmission line would be constructed from the solar facility to existing SCE infrastructure at North Loop Road to provide back-up power to buildings 980, 985, and 988 in the Fort Irwin cantonment area. The final constructed footprint would be approximately 250 ac in size. Construction parking and laydown areas could extend beyond the approximately 250-ac footprint, but would be confined within the approximately 380-ac area.

The major project equipment would include the following:

- PV modules/panels
- Solar trackers (to position modules with the sun's movement) or fixed-tilt mounting structures
- Direct current-to-alternating current inverters
- Three-phase, pad-mounted medium-voltage transformers, or similar; and high-voltage step-up transformers
- Transmission line corridor extending from the solar facility to North Loop Road
- Permanent desert tortoise exclusion fencing

The PV modules, inverters, and transformers would be combined into approximately 1-megawatt (MW) blocks that are repeated to reach the full required capacity (up to 20 MW). Each block would be approximately 500 feet by 700 feet. Trenches for cables would be placed approximately 12 inches underground when needed to connect panel arrays. The solar arrays would be supported in one of three manners depending on wind and geophysical conditions (soils, bedrock, etc.): (1) concrete ballasts set at grade, (2) piles either driven or screwed to a minimum of 4-5 feet in depth, or (3) excavated, cast-in-place concrete footers.

Unpaved access/maintenance roads would be constructed from existing roads to access the site and individual blocks of arrays.

As part of the project plan and for energy security purposes, the PV project would be used to provide power to critical Fort Irwin military facilities during (rare) prolonged outages of the SCE-owned and -operated electrical grid. The PV project would provide power to critical facilities at buildings 980, 985, and 988. The buildings would be connected to a new, "solar circuit" via aboveground or underground conductors installed from the PV project along the north side of Fort Irwin Road that would connect with existing infrastructure upon reaching North Loop Road. An alternative approach to energy security would be to install three portable, 1-megawatt-hour energy storage batteries that would be charged and recharged at the PV facility and trucked to and connected to buildings 980, 985, 988, and/or other buildings in a rotating manner. The PV facility would connect to the Tiefort substation via a 100- to 500-yard electrical tie-in line, which would be installed at or below the height of the existing distribution lines in the vicinity.

Operation of the solar facility would involve limited activity beyond maintenance of the facility (vegetation control, road maintenance, etc.) and annual washing of the solar panels to remove accumulated dust. Water would be trucked to the site to clean the solar panels.

2.4 Construction Methods and Equipment

All temporary use areas and laydown areas would be within the construction footprint. The maximum monthly construction work force would be approximately 145 people. Construction equipment likely to be used includes:

- Scraper
- Motor grader
- Excavator – trench
- Excavator – pier
- Hydraulic ram
- Dozer
- Dump truck
- Pad drum vibratory roller
- 4,000-gallon water truck
- Backhoe loader
- Concrete truck
- Loaders – Bobcats
- Grade-all
- Welders
- Trencher
- Lightweight trucks

Some oversized equipment would be used during construction. However, no equipment would be larger than equipment that is routinely trucked in and out of Fort Irwin on Fort Irwin Road (e.g., tanks).

Prior to construction activities and site clearance survey, high-visibility orange exclusion fencing and desert tortoise exclusion fencing will be installed along the perimeter of the work areas, including the transmission

corridor, to clearly delineate the extent of the construction area. The exclusion fencing will prevent construction encroachment into desert tortoise habitat, as well as excluding desert tortoise from entering the action area. The location of the exclusion fencing will be established in the field by the Authorized Biologist(s). The project's special provisions package will provide clear language regarding fencing installation procedures, acceptable fencing material, prohibited construction-related activities, vehicle operation, material and equipment storage, and other surface-disturbing activities.

Permanent exclusion fencing will be placed around the solar facility at the close of construction and will encompass the minimum area needed for operation and maintenance of the facility. This fencing will prevent desert tortoise from returning to the facility site once it is operational and minimize the potential for inadvertent impacts during operation. During operation of the solar site, routine operation and maintenance activities are expected to be limited to repair of the perimeter fence, access gates, all-weather roads, solar arrays/ module components, support facilities, vehicle and equipment movement, and vegetation removal. Once annually, water would be trucked to the site to clean the solar panels. Use of oversized equipment is not anticipated during operations.

The Authorized Biologist(s) will also obtain required permits before project initiation and prior to handling any desert tortoise or their parts, will conduct clearance surveys within 2 weeks prior of construction to determine the presence of desert tortoise on the site, will conduct all handling and relocation of desert tortoise individuals indentified in the construction area, will train construction workers on desert tortoise regulations and protocols prior to any ground-breaking activities, and will conduct biological monitoring for desert tortoise in the project area during site (or related facilities) mobilization, ground disturbance, grading, construction, operation, and closure activities. The Authorized Biologist(s) will perform these activities to prevent and minimize harm and harassment to desert tortoise individuals during construction and operation of the proposed project. These minimization measures are further discussed in Section 7.2.

An Erosion and Sedimentation Control Plan and a SWPPP will be implemented to prevent indirect effects from degradation to the desert tortoise habitat within and immediately surrounding the construction area. During construction, dust suppression, general housekeeping measures, prohibition of pets in the area, and invasive plant removal will occur to minimize harm and harassment to the desert tortoise and to prevent attracting predators that may harm or harass desert tortoise. These minimization and avoidance measures are further discussed in Section 7.1.

2.5 Construction Schedule

Project construction would likely begin in spring 2013. Construction would last approximately 6 months.

3 Status of Species

3.1 Status of Listed Species

A list of federally endangered and threatened species that may be affected by the proposed project was obtained online from the California Department of Fish and Game (CDFG) California Natural Diversity Database (CNDDB) (CDFG, 2012) and the California Native Plant Society (CNPS) inventory of rare and endangered plants of California (CNPS, 2012). These databases were queried for the USGS Langford Well 7.5-minute quadrangle map, where the project is located, as well as the eight surrounding quadrangle maps. A list of federally listed or proposed wildlife and plant species potentially occurring within the action area (shown in Figure 3-1) was compiled to evaluate potential impacts resulting from project construction. The action area is defined as the areas that would be directly affected by the project, which is the maximum extent of construction-related ground-disturbing activities. Records were reviewed for federally listed species that may occur within the action area.

Two federally listed species, the threatened desert tortoise and the endangered Lane Mountain milk-vetch (*Astragalus jaegerianus*), were identified as having potential to occur within the action area based on habitat suitability and known range (Bagley, 1998; USFWS, 2008).

3.1.1 Desert Tortoise

3.1.1.1 Listing History

The desert tortoise occurs in the Mojave and Sonoran Deserts in southern California, southern Nevada, Arizona, and the southwestern tip of Utah in the U.S., as well as Sonora and northern Sinaloa in Mexico (USFWS, 2012b). The Mojave population of the desert tortoise includes all tortoises north and west of the Colorado River in Arizona, Utah, Nevada, and California (USFWS, 2011a).

In response to the dramatic decrease in numbers of the Mojave population of the desert tortoise throughout its range, the USFWS emergency-listed the species as endangered on August 4, 1989 (54 FR 32326). This listing occurred as a result of continued human-caused habitat destruction through urban expansion, off-road vehicle use, illegal collection for the pet trade, and raven predation on juvenile tortoises. The Mojave population was then proposed under normal listing procedures on October 13, 1989 (54 FR 42270), and subsequently listed as threatened throughout its range on April 2, 1990 (55 FR 12178), when USFWS concluded that listing of desert tortoise was warranted. On March 30, 1993, the USFWS released the *Draft Recovery Plan for the Desert Tortoise (Mojave Population)* (USFWS, 1993). The Final Recovery Plan was released on June 28, 1994 (USFWS, 1994). An additional plan for the desert tortoise, the *Proposed Desert Wildlife Management Areas for Recovery of the Mojave Population of the Desert Tortoise* (Brussard et al., 1994), divided the species' range into six recovery units. In 2011, the *Revised Recovery Plan for the Mojave Population of the Desert Tortoise (Gopherus agassizii)* was published by USFWS. The Revised Recovery Plan reduced the number of recovery units to five based on data collected since the original establishment of recovery units (USFWS, 2011a). Fort Irwin is in the Western Mojave Recovery Unit.

The recovery priority number for the Mojave population of the desert tortoise has been established as 12C (USFWS, 2011a) based on:

- A moderate degree of threat
- A low potential for recovery
- Listed population below the species level
- Potential conflict with development or other forms of economic activity

The degree of threat to the Mojave population of the desert tortoise has increased since its original listing in 1990, but still is not considered to place the species at imminent risk of extinction (USFWS, 2011a).

3.1.1.2 Threats

The majority of threats to the desert tortoise or its habitat are associated with human land uses. The threats identified in the 1994 Recovery Plan formed the basis for listing the desert tortoise and continue to affect the species. However, despite clear demonstration that these threats affect individual tortoises, there are few data available to evaluate or quantify the effects of threats on desert tortoise populations (USFWS, 2011a). The threats to desert tortoise and their habitats include:

- Urbanization
- Unauthorized all-terrain vehicle (ATV) activity
- Authorized vehicular activity
- Illegal collecting
- Mortality on paved roads
- Vandalism
- Livestock grazing
- Feral burros
- Drought
- Non-native plants
- Changes to natural fire regimes
- Environmental contaminants
- Upper respiratory tract disease and other diseases

Urbanization and associated development is a major impact to the species and its habitat. Recreational use of roads and trails and large-volume, high-speed travel on major roads and highways have contributed to desert tortoise mortality, as well as habitat loss, degradation, and fragmentation. Many highways have been fenced to exclude desert tortoise, which includes US 95 south of Las Vegas; US 93 north of Las Vegas; SR 161, 163, 164, and 165; Interstate (I)-15 northeast of Las Vegas and in California; and I-10 and I-40, as well as Highways 58, 62, and 395 in California. In addition, roads and highways create an edge effect that is detrimental to desert tortoise populations (Bury, 1987; Boarman and Sazaki, 2006). Boarman and Sazaki (2006) found that desert tortoise populations are depressed next to major roadways out to a distance of at least 400 m (0.25 mi).

Drought has been implicated as a factor in reduced survival rates among desert tortoise in local areas (Longshore et al., 2003). In this 9-year study, researchers compared two "closely situated, but physiographically different, sites" in the Lake Mead National Recreation Area, Nevada. After a period when survival rates were stable, the survival rate decreased on one of the sites that experienced drought conditions in 3 out of 4 years. The authors postulate that if such local incidents occur on a regular basis, "source-sink population dynamics may be an important factor" in determining the density of desert tortoise populations.

Proliferation of invasive plants is increasing in the Mojave and Sonoran Deserts and is recognized as a significant threat to desert tortoise habitat. Many species of non-native plants from Europe and Asia have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. As non-native plant species become established, native perennial and annual plant species may decrease, diminish, or die out (D'Antonio and Vitousek, 1992). Land managers and field scientists have identified over 116 species of non-native plants in the Mojave and Colorado Deserts (Brooks and Esque, 2002).

Increased levels of atmospheric pollution and nitrogen deposition related to increased human presence and combustion of fossil fuels can cause increased levels of soil nitrogen, which in turn may result in significant changes in plant communities (Aber et al., 1989). Many of the non-native annual plant taxa in the Mojave region

evolved in more fertile Mediterranean regions and benefit from increased levels of soil nitrogen, which gives them a competitive edge over native annuals. Studies at three sites within the central, southern, and western Mojave Desert indicated that increased levels of soil nitrogen can increase the dominance of non-native annual plants and promote the invasion of new species in desert regions. Furthermore, increased dominance by non-native annuals may decrease the diversity of native annual plants, and increased biomass of non-native annual grasses may increase fire frequency (Brooks, 2003).

Nutritional intake affects growth rates in juvenile desert tortoises (Medica et al., 1975) and female reproductive output (Turner et al., 1986, 1987; Henen, 1992). Invasion of non-native plants can affect the quality and quantity of plant foods available to desert tortoise, and thereby affect nutritional intake. Desert tortoise typically are quite selective in their choices of foods (Burge, 1977; Nagy and Medica, 1986; Turner et al., 1987; Avery, 1992; Henen, 1992; Jennings, 1992, 1993; Esque, 1992, 1994), and in some areas the preferences are clearly for native plants over the weedy non-native species.

As native plants are displaced by non-native invasive species in some areas of the Mojave Desert, non-native plants can be a necessary food source for some desert tortoises. However, non-native plants may not be as nutritious as native plants. Recent studies have shown that the availability of calcium and phosphorus is higher in forbs than in grasses and that desert tortoise lose phosphorus when feeding on grasses but gain phosphorus when eating forbs (Hazard et al., 2002). A comparative study on the nutritional qualities of native vs. non-native grasses and forbs commonly consumed by desert tortoises (*Achnatherum hymenoides* [Indian ricegrass] vs. *Schismus barbatus* [Mediterranean grass]; *Malacothrix* spp. [desert dandelion] vs. *Erodium cicutarium*), found that the nutritional value of the two grasses was similar, but both grasses had much lower nutritional value than the forbs (Nagy et al. 1998). This suggests that the proliferation of non-native grasses such as *Schismus* to the exclusion of native forbs and other plants places desert tortoises at a nutritional disadvantage (D'Antonio and Vitousek, 1992). Furthermore, if desert tortoise consume just enough food to satisfy their energy needs (as commonly noted in other vertebrate groups), then the native forbs provide significantly more nitrogen and water than the non-native forbs (Nagy et al., 1998).

Changes in the abundance and distribution of native plants also may affect desert tortoise in more subtle ways. In the Mojave Desert, many food plants are high in potassium (Minnich, 1979), which is difficult for desert tortoise to excrete due to the lack of salt glands that occur in other reptilian herbivores such as chuckwalla (*Sauromalus obesus*) and desert iguana (*Dipsosaurus dorsalis*) (Minnich, 1970; Nagy, 1972). Reptiles are unable to produce osmotically concentrated urine, which further complicates the ability of the desert tortoise to expel excess potassium (Oftedal and Allen, 1996). Oftedal (2002) suggested that desert tortoise may be vulnerable to upper respiratory tract disease or other diseases due to their need to obtain sufficient water and nitrogen from food plants to counteract the negative effects of dietary potassium. Only high quality food plants (as expressed by the potassium excretion potential, or PEP, index) allow substantial storage of protein (nitrogen) that is used for growth and reproduction, or to sustain the animals during drought. Non-native annual grasses have lower PEP indices than most native forbs (Oftedal, 2002; Oftedal et al., 2002). Foraging studies have demonstrated that juvenile Mojave Desert tortoises are highly selective while foraging, selecting both the plant species and plant parts that have the highest PEP value. Impacts to vegetation (such as livestock grazing, invasion of non-native plants, and soil disturbance) that reduce the abundance and distribution of high-PEP plants may result in additional challenges for foraging desert tortoise (Oftedal et al., 2002).

In addition, predation by common ravens and coyotes is considered a threat that may be increasing in severity due to the expansion of human activities into more remote locations throughout the desert or prey shifting because of prolonged drought and a lack of prey species (e.g., lagomorphs). Common raven populations in some areas of the adjacent Mojave Desert have increased 1,500 percent from 1968 to 1988 in response to expanding human use of the desert (Boarman, 2002). Since ravens were scarce in the desert prior to 1940, the existing level of raven predation on juvenile desert tortoises is considered an unnatural occurrence (BLM, 1990). In addition to ravens, domestic and feral dogs have emerged as significant predators of desert tortoises in areas adjacent to residential development (USFWS, 2012b).

3.1.1.3 Recovery Criteria

The *Revised Recovery Plan for the Mojave Population of the Desert Tortoise (Gopherus agassizii)* identifies the following recovery goals and objectives (USFWS, 2011a):

- Recovery Objective 1 (Demography). Maintain self-sustaining populations of desert tortoise within each recovery unit into the future.
  Recovery Criterion 1. Rates of population change for desert tortoise are increasing over at least 25 years (a single tortoise generation), as measured
  - by extensive, range-wide monitoring across tortoise conservation areas within each recovery unit, and
  - by direct monitoring and estimation of vital rates (recruitment, survival) from demographic study areas within each recovery unit.
- Recovery Objective 2 (Distribution). Maintain well-distributed populations of desert tortoise throughout each recovery unit.
  Recovery Criterion 2. Distribution of desert tortoise throughout each tortoise conservation area is increasing over at least 25 years.
- Recovery Objective 3 (Habitat). Ensure that habitat within each recovery unit is protected and managed to support long-term viability of desert tortoise populations.
  Recovery Criterion 3. The quantity of desert tortoise habitat within each desert tortoise conservation area is maintained with no net loss until tortoise population viability is ensured.
  The condition of desert tortoise habitat should also be demonstrably improving.

3.1.2 Lane Mountain Milk-vetch

3.1.2.1 Listing History

Lane Mountain milk-vetch was federally listed as endangered on October 6, 1998 (USFWS, 1998 [63 FR 53596]). The species was first recommended for endangered status in January 1975. On June 4, 2012, USFWS issued a 90-day petition finding in the FR that reclassification of the Lane Mountain milk-vetch from endangered to threatened may be warranted and initiated a status review for the species (USFWS, 2012c).

The discovery and accumulation of knowledge concerning the distribution and abundance of Lane Mountain milk-vetch are discussed by Charis (2002). Intensive plot and transect surveys by Prigge et al. (2000, 2001) and Charis (2002) covered all areas previously known or suspected to support the species, and resulted in a determination of its distribution (Charis, 2002). Lane Mountain milk-vetch is known to occur in four relatively discrete locations (Prigge et al., 2000, 2001; Charis, 2002). For identification purposes, the populations have been named Coolgardie Mesa, Paradise Valley, Brinkman Wash–Montana Mine, and NASA Goldstone. However, the populations identified for Brinkman Wash-Montanan Mine and NASA Goldstone have been determined to be geographically contiguous and are now consolidated as the Goldstone-Brinkman Unit (USFWS, 2011b). The Coolgardie Mesa population and a small portion of the Paradise Valley population are outside of Fort Irwin. A portion of the NASA Goldstone population is on Fort Irwin land permitted for use to the National Aeronautics and Space Administration (NASA). The rest of the Paradise Valley population and the Goldstone-Brinkman Unit are on Fort Irwin but are outside the action area.

The Coolgardie Mesa population is the largest known population, containing an estimated 8,000 to 20,000 individual plants and nearly 46 percent of the total known habitat.

3.1.2.2 Threats

Threats to the Lane Mountain milk-vetch identified by the USFWS include habitat destruction from dry wash gold mining, rock and mineral collecting, and ATV recreation and threats due to military activity (USFWS, 1998). An

increase of non-native grasses spreading from road grading and other ground-disturbing activities increases the potential for fire frequency and species competition, and may have long-term deleterious effects on Lane Mountain milk-vetch. Small populations are vulnerable to extirpation simply by chance due to fluctuating environmental conditions and demographic stochasticity. A small portion of the distribution of the species near Brinkman Wash on Fort Irwin is subject to habitat disturbance associated with military training. However, the area is infrequently used and most of the area has been designated as a "no dig zone" and off-limits for mechanized training since 1991.

3.1.2.3 Recovery Criteria

A recovery plan has not been developed for this species and no recovery criteria have been established (USFWS, 2008).

3.2 Status of Designated Critical Habitat

3.2.1 Desert Tortoise

The Mojave population of the desert tortoise was listed as threatened on April 2, 1990, with a recovery plan published in June 1994. The recovery plan included a supplement that identified proposed Desert Wildlife Management Area (DWMAs). Critical habitat was designated in 1994 (58 FR 45748), under provisions of the ESA (16 U.S.C. 1531, *et seq.*), based largely on the DWMAs identified in the 1994 Recovery Plan and encompassed more than 6.4 million ac. Critical habitat was designated in all four states supporting the species. Designated critical habitat for the desert tortoise occurs on the southern and southwestern portions of Fort Irwin. The boundary of the Superior-Cronese critical habitat unit is less than 5 mi west of the action area, but the critical habitat does not extend into the action area (Figure 1-1).

3.2.2 Lane Mountain Milk-vetch

On April 1, 2010, the USFWS proposed revised designation of critical habitat for Lane Mountain milk-vetch (79 FR 16404-16421) under provisions of the ESA (16 U.S.C. 1531, *et seq.*). Following an extensive review of information and public comments, the USFWS formally designated critical habitat for the species in a final ruling published on May 19, 2011 (76 FR 29108-29129). In total, approximately 14,069 ac of land in 2 units located in the Mojave Desert in San Bernardino County, California, fall within the boundaries of the revised critical habitat designation. The action area does not include any designated critical habitat for the Lane Mountain milk-vetch.

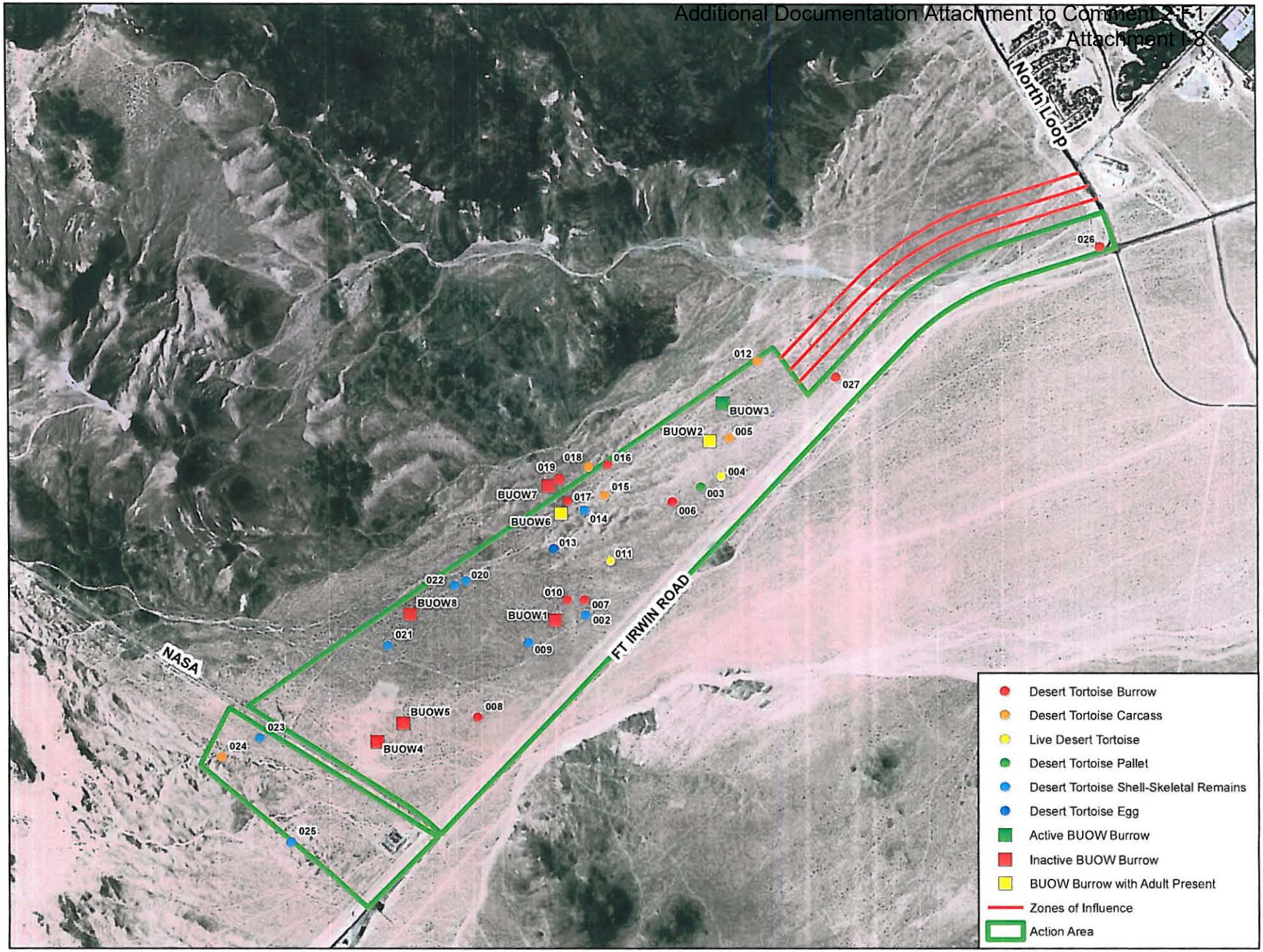


FIGURE 3-1
Project Action Area and Desert Tortoise Sign
Fort Irwin National Training Center Solar Facility Project
Natural Resources Report
Fort Irwin, California

4 Environmental Baseline

This section is limited to a discussion of the desert tortoise. Because Lane Mountain milk-vetch does not occur in the action area and there is no designated critical habitat for it within the action area. Therefore, Lane Mountain milk-vetch is not further discussed as the proposed project would have no potential to affect this species.

Per 50 CFR 402.02, the environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. For the action area, the past impacts to the action area would include military training activities, unauthorized off-road vehicle use, the construction and maintenance of Fort Irwin Road, development of the ORV use area, and the construction and maintenance of the electric substation and associated electrical transmission infrastructure. Military training is no longer conducted in this area and no additional State or private actions are known or planned that would be contemporaneous with this consultation.

4.1 Existing Baseline Conditions

The action area is the 380 ac of desert tortoise habitat adjacent to Fort Irwin Road, as depicted on Figure 3-1. The habitat within the action area is Mojave creosote bush scrub, and is dominated by a sub-association of this vegetation type: the creosote *(Larrea tridentata)* –burrobush *(Ambrosia dumosa)* association. Creosote bush covers extensive portions of the action area in nearly pure stands, and occurs in close association with burrobush in other areas.

Optimal habitat for the desert tortoise has been characterized as creosote bush scrub in which annual precipitation ranges from 2 to 8 inches, where the diversity of perennial plants is relatively high and production of ephemerals also is high (USFWS, 2011a). Soils must be friable enough for digging burrows, but firm enough so that burrows do not collapse. Desert tortoise occur from below sea level to an elevation of 7,300 feet, but the most favorable habitat occurs at elevations of approximately 1,000 to 3,000 feet (USFWS, 2011a).

Desert tortoise most commonly occur within desert scrub vegetation, primarily in creosote bush scrub. They also occur in succulent scrub, cheesebush scrub, blackbrush scrub, hopsage scrub, shadscale scrub, microphyll woodland, Mojave saltbush-allscale scrub, and scrub-steppe vegetation types of the desert and semidesert grassland complex (USFWS, 1994). Throughout most of the Mojave region, desert tortoise occur most commonly on gently sloping terrain with soils ranging from sandy to gravelly, and in areas with scattered shrubs where there is abundant inter-shrub space for growth of herbaceous plants (Gardner and Brodie, 2000).

Watershed or Other Relevant Habitat Unit

The action area is within the Coyote watershed basin and within the Western Mojave Recovery Unit for the desert tortoise, as defined by USFWS (2011a). There are no perennial watercourses within the region. Washes descending from mountains and other elevated landforms provide channels for ephemeral and intermittent flows of surface runoff into topographical depressions or playas where ephemeral lakes form. Water accumulates in these areas during times of greater-than-average precipitation, which occur on average at least once every 10 years.

4.1.1 Shelter

A diversity of plant species within a desert tortoise habitat plays a key role in providing shelter sites for protection from predators and environmental extreme. Desert tortoise are most active during April/ May and September/

October. Desert tortoise may be active during periods of mild or rainy weather in summer and winter. During inactive periods, tortoises rest in subterranean burrows or caliche caves, and spend approximately 98 percent of the time in these shelter sites (Nagy and Medica, 1986). During active periods, they usually spend nights and the hotter part of the day in their burrow. Tortoises also may rest under shrubs or in shallow burrows (pallets) and use an average of 7 to 12 burrows at any given time (Bulova, 1994; TRW Environmental Safety Systems Inc.,1997).

Walde et al. (2003) observed that desert tortoise retreat into burrows when air temperature reach approximately 91.0° F and ground temperatures reach approximately 94.6 °F; 95 percent of observations of desert tortoises above ground occurred at air temperature less than 91 °F. The body temperature at which desert tortoise become incapacitated ranges from 101.5 °F to 113.2 °F (Naegle, 1976; Zimmerman et al., 1994).

The action area is within the central Mojave Desert region of the Desert Floristic Province (Hickman, 1993) and has only one vegetative community type, Mojave creosote bush scrub, and is dominated by a sub-association of this vegetation type: the creosote *(Larrea tridentata)* –burrobush *(Ambrosia dumosa)* association. Creosote bush covers extensive portions of the action area in nearly pure stands, and occurs in close association with burrobush in other areas. Other plant species observed in the action area include Mormon tea (*Ephedra nevadensis*) and brittlebush (*Encelia farinose*). All native plants observed within the action area are identified in the survey report, which is provided as Appendix A. Much of the action area was historically disturbed by military training activities and there are several shallow bomb craters. There was evidence of some ATV use within the action area.

Soils throughout the action area are primarily derived from limestone and dolomite parent material and are characterized by well-drained sandy textures with a relatively high cover of rock fragments on the surface. The soil units present in the action area are the Kimberlina series and the Calvista series, which are suitable for excavation of desert tortoise burrows.

The action area includes shrub vegetation that can provide shelter from potential predators and heat (USFWS, 2012d) and soils suitable for excavation of burrows to provide shelter during resting and dormant periods.

4.1.2 Feeding

Tortoise activity patterns are primarily controlled by ambient temperature and precipitation (Nagy and Medica, 1986; Zimmerman et al., 1994). Desert tortoise are active for approximately 6 weeks to 5 months of the year, depending on annual variations of temperature and rainfall. Desert habitats are characterized by prolonged periods of barely measurable rainfall. In much of the Mojave Desert, droughts of 8 months or more occur frequently. During such times, the desert is virtually devoid of food for tortoises except for cacti and dried grasses (Oftedal, 2002). Most precipitation occurs in winter in the West Mojave Desert, resulting in abundant annual spring vegetation that dries by late May or June. Desert tortoises in the West Mojave Desert are primarily active in May and June, with a secondary activity period from September through October.

In drought years, the ability of desert tortoise to drink while surface water is available following rains may be crucial for tortoise survival. During drought, desert tortoise forage over larger areas, increasing the likelihood of encounters with sources of injury or mortality, including humans and predators.

Although desert tortoise eat non-native plants, they generally prefer native forbs when available (Jennings, 1993; Avery, 1998). The vegetation in the action area, described in Section 4.1.1, provides an assemblage of native species that is suitable as forage for desert tortoise during periods of ephemeral plant growth.

4.1.3 Reproduction

Desert tortoise may live 50 or more years in the wild. Reproduction begins between ages 12-20, with clutch sizes of 1-14 eggs. In years with low rainfall, females may lay few to no eggs. Females can store sperm for 5 years or longer, meaning they can reproduce for several years after mating. Nests are built and eggs are laid in late spring or early summer. The hatchlings appear in 90 to 120 days. There is no maternal care of young, so hatchlings must survive on their own (USFWS, 2012d). An unhatched egg was found in the action area during the 2012 survey (CH2M HILL, 2012, Appendix A).

4.1.4 Habitat Connectivity and Migration

Tortoise activities are concentrated in overlapping core areas, known as home ranges. The size of desert tortoise home ranges varies with respect to location and year. Individual desert tortoise do not migrate in the true sense of the term. However, desert tortoise do move about within their home ranges and the ability to move among burrows, foraging areas, water sources, and mineral deposits to meet life history requirements is crucial to survival of individual desert tortoise. As noted in the discussion of threats in Section 3, human activity can create barriers to movement and affect the ability of a tortoise to meet all these life history needs.

Male desert tortoise actively defend their home ranges against other males. Female desert tortoise typically do not defend territories. In the West Mojave Desert, the estimated mean home range is 111 ac for male desert tortoise and 40 ac for female desert tortoise (Harless et al., 2009). Over an average lifetime, desert tortoise may require more than 960 ac of habitat and a tortoise may make forays of more than 7 mi (Berry, 1986).

The Mojave desert tortoise exhibits broad patterns of migration interrupted by major topographic barriers, based on analysis of gene flow among subunits (USFWS, 2011a). However, migration among populations is not a rapid process and is not expected to occur on the order of decades (USFWS, 2011a).

5 Natural History and Species Occurrence

Two federally listed species, desert tortoise and Lane Mountain milk-vetch, were determined to have the potential to occur within the action area. Desert tortoise were found within the action area during the field surveys. Lane Mountain milk-vetch was not found during field surveys (Appendix A) and is not expected to occur within the action area. Because no potential to impact Lane Mountain milk-vetch or its habitat exists, this species is not further discussed.

5.1 Site Specific Biological Requirements and Project Context

The desert tortoise is well studied at Fort Irwin. Numerous surveys have been conducted over the years to document the distribution and estimated size of tortoise populations throughout the installation. The desert tortoise is known to occur throughout Fort Irwin in low to moderate numbers, with the highest concentration of tortoises in the Superior Dry Lake portion of Fort Irwin, which does not include the action area.

Elevations in the action area range from approximately 2,600 feet above mean sea level (amsl) on the southeastern corner to approximately 3,200 feet amsl on the northwestern edge, which is within the elevation range where desert tortoise occur. As discussed in Section 4, the vegetation and soils in the action area provide suitable foraging and burrow habitat for the species.

The action area, which extends from the main gate access road east toward Tiefort Mountain, was evaluated for the presence of desert tortoise and Lane Mountain milk-vetch. CH2M HILL biologists conducted surveys to identify and map threatened and endangered species habitat within the proposed solar facility site and transmission line corridor from March 26, 2012, through March 29, 2012. Protocol presence/absence surveys (USFWS, 2010) were conducted for desert tortoise within the action area by walking transects at 10-m spacing throughout the action area and three additional 10-m belt transects at 200-m intervals parallel to the northern border of the transmission line corridor (200 m, 400 m, and 600 m from the perimeter), to account for an adjacent zone of influence in accordance with USFWS protocol for a linear site. The survey area is shown in Figure 3-1 and the results of the survey (CH2M HILL, 2012) are provided as Appendix A.

Three desert tortoise were observed during the field survey, two of which were within burrows. Four additional desert tortoise burrows that appeared to be active were observed along with three apparently inactive burrows. One unhatched egg from 2011 was observed. Five relatively intact desert tortoise carcasses were observed and eight other occurrences of shell-skeletal remains were observed (Figure 3-1, Appendix A).

5.2 Site Specific Critical Habitat and Project Context

The project is located within the Western Mojave Recovery Unit (USFWS, 2011a) but is not within designated Desert Tortoise Critical Habitat. The boundary for the Superior-Cronese critical habitat unit is less than 5 mi west of the action area.

5.3 Site Specific Limiting Factors for Recovery

Based on the site survey results, desert tortoise densities in the action area are low (CH2M HILL, 2012) and the tortoise population in the action area represents a very low percentage of the entire Mojave population. Population trend analysis indicates that the Superior-Cronese designated critical habitat unit area to the south of the action area along Fort Irwin Road had a higher than average occurrence of live desert tortoise(Tracy et al., 2004). Historic densities of desert tortoise within the action area and on Fort Irwin prior to military maneuvers

are unknown, as no population studies were conducted. At present, Mojave desert tortoise populations are considered to be depressed and well below the listing level for the species due to a prolonged drought cycle with extremely elevated mortality and decreased reproduction. Low desert tortoise densities observed within the action area (CH2M HILL, 2012), relative to other parts of Fort Irwin and to nearby designated critical habitat, suggest that the action area does not represent tortoise habitat that is crucial for recovery.

6 Analysis of Effect of the Action

This section discusses potential project effects and cumulative effects for the Desert Tortoise. Project effects include direct effects ("take" associated with construction and operation activities and habitat loss, as described in Sections 4 and 5) and indirect effects (for example, from habitat degradation as a result of runoff from increased impervious surfaces).

Permanent effects will be limited to the action area and the immediately surrounding area. Project activities will result in permanent effects to desert tortoise habitat as a result of the following activities: grading, paving, and excavating. A total of approximately 380 ac of permanent effects to desert tortoise habitat would occur during construction. Operation and maintenance of the solar facility and the associated electrical transmission corridor would not further affect habitat. Implementation of the avoidance and minimization measures listed in Section 7 would minimize potential effects to desert tortoise and associated habitat from construction, operation, and maintenance of the solar facility and its associated infrastructure.

While there are potential adverse indirect effects associated with the project, these effects would be reduced or avoided by implementing avoidance and minimization measures. General measures and species-specific measures that Fort Irwin will implement during construction and operation to avoid and minimize project-related effects are described in Section 7.

6.1 Direct Effects

Project actions could result in direct mortality, injury, or harassment of individuals as a result of encounters with vehicles or heavy equipment in the action area. The proposed action contains measures to minimize or eliminate the effects from vehicles straying from designated access or designated areas into adjacent habitat. In addition, direct effects may include individual tortoises being crushed or entombed in their burrows, nest destruction, disruption of tortoise behavior during construction or operation of facilities, and disturbance by noise or vibrations from the heavy equipment.

6.1.1 Direct Effects from Construction

Increased human activity and vehicle travel would occur from the construction and improvement of access roads, which could disturb, injure, or kill individual tortoises. Installation of the exclusion fencing could result in direct effects such as mortality, injury, or harassment of desert tortoise due to equipment operation, installation activities, destruction of tortoise burrows, and tortoise relocation. The Authorized Biologist will oversee installation of the temporary exclusion fencing prior to construction to minimize the potential for impacts to desert tortoise.

Clearance surveys conducted in advance of construction will result in harassment of any desert tortoise within the action area from the presence of the surveyors. Exclusion fencing will be placed around the action area and any desert tortoise within the action area will be translocated outside the exclusion fencing. The exclusion fencing would preclude desert tortoises from re-entering the work areas. This would result in fragmentation of habitat and individual home ranges.

Capturing, handling, and translocating desert tortoises from the site will result in capture and harassment. However, USFWS has stated that it does not expect that the capture and handling of desert tortoises (e.g., to remove them from harm's way), when conducted by Authorized Biologists, is likely to result in injury or mortality (USFWS BO of April 27, 2012).

As noted in the discussion of threats in Section 3, there is an edge effect on desert tortoise populations near major highways that extends out to a distance of at least 400 m (0.25 mi) (Bury, 1987; Boarman and Sasaki 2006).

Desert tortoise densities in the action area appear depressed (CH2M HILL, 2012) and an edge effect along Fort Irwin Road may be contributing to the depressed densities. Because the fence construction would occur within an area that is largely disturbed and where desert tortoise abundance is documented to be low (CH2M HILL, 2012), this activity is expected to affect few, if any, desert tortoises or nests. Once the fence is in place and any tortoise removed from the construction area, no further direct effects to desert tortoise from construction activities would be expected.

Blythe et al. (2003) found that translocated Sonoran Desert tortoises translocated less than 0.5 mi returned to their home ranges within a few days. Tortoises translocated outside their home ranges would likely attempt to return to the area from which they were moved, which would increase the potential for exposure to adverse effects associated with project construction. However, because the action area would be fenced to exclude desert tortoise re-entry and other minimization measures would be adhered to, the probability of direct effects to individuals would be relatively low.

The construction and operation of the proposed solar facility would eliminate 380 ac of habitat from the Western Mojave Recovery Unit. This loss of habitat would represent less than 0.01 percent of the habitat in the Western Mojave Habitat Unit and would not result in an appreciable change in the abundance and distribution of desert tortoise within the unit.

No designated critical habitat for the desert tortoise occurs in the action area. The nearest designated critical habitat for this species is 5 mi away (the northern and eastern part of the Superior-Cronese critical habitat unit). There would be no direct effects to critical habitat for the desert tortoise from construction activities.

6.1.2 Direct Effects from Operation

Desert tortoise have been documented nesting in commercial scale wind energy facilities in numbers and with hatchling success comparable to nearby undisturbed habitat (Ennen et al., 2012). Because the species has been shown to coexist with similar energy projects, no direct effects from operation of the solar facility would be expected. The use of exclusion fencing around the facility would prevent desert tortoise exposure to vehicular traffic that would deliver water and materials for maintenance.

Maintenance activities on the electric transmission corridor could result in interaction with desert tortoise. The transmission corridor would not be fenced and desert tortoise may use the habitat in this corridor and be present during maintenance activities. Because the corridor will be adjacent to Fort Irwin Road, the edge effect from the road may reduce this possibility. Prior to any maintenance activity involving off-road use of vehicles or equipment, the area where vehicles and equipment would be operated would be subjected to a clearance survey and temporary exclusion fencing would be placed around the work areas to prevent desert tortoise entry during maintenance activities. The fencing would be removed when maintenance is complete.

There would be no direct effects to critical habitat for the desert tortoise from operations and maintenance activities.

6.2 Indirect Effects

Indirect effects are those that are caused by, or result from, the proposed action and are later in time, but reasonably certain to occur. In contrast to direct effects, indirect effects are more subtle, and may affect individuals, populations, and habitat quality over an extended period of time, long after construction activities have been completed. Indirect effects are of particular concern for long-lived species such as the desert tortoise because project-related effects may not become evident in individuals or populations until years later. Indirect effects may include increased predation by common ravens, loss or fragmentation of habitat linkages from creation of permanent barriers to movement that disrupt population and genetic connectivity, degradation of habitat and the diet of desert tortoises from the spread of non-native plant species or increased erosion,

degradation of habitat to other desert tortoise populations whose home ranges may overlap the proposed project area, and noise and lighting from human activities.

6.2.1 Indirect Effects from Construction

Should a precipitation event occur during construction, there could be indirect effects to desert tortoise habitat from stormwater runoff across disturbed soils and associated erosion and sedimentation. Scour could remove vegetation and sedimentation could fill burrows or bury vegetation and nests. The Army would require the contractor to implement appropriate best management practices (BMPs) before any initial disturbance and maintain those BMPs throughout construction. Erosion control measures such as application of compost blankets, mulch, riprap, or geotextiles to stabilize slopes could be implemented to protect exposed soil and minimize erosion. BMPs such as directional grading, check dams, slope diversions, and temporary diversion dikes could be implemented for runoff control. Sediment control measures that could be implemented to reduce sediment leaving the site include compost filter berms and socks; fiber rolls or berms; sediment basins, rock dams, filters, chambers, or traps; silt fences; and hay bales. Implementation and maintenance of appropriate BMPs during construction would make it unlikely that indirect effects to desert tortoise habitat would occur from stormwater runoff and associated erosion and sedimentation.

Invasion of non-native plants can affect the quality and quantity of plant foods available to desert tortoises, and thereby affect nutritional intake. Nutritional intake affects growth rates in juvenile desert tortoises (Hazard et al., 2010) and female reproductive output (Henen, 1992). The dominant annual species in the action area found during surveys was Mediterranean grass (*Schismus arabicus*). The presence of this species as a dominant in the action area indicates that forage quality in the action area has already been adversely impacted by invasive exotic species. Soils disturbance during construction can make the area more susceptible to invasion by other non-native species and further degrade the habitat.

Based on the ability to adapt to noise disturbance, noise attenuation as distance from the project increases, and the fact that desert tortoises do not rely on auditory cues for their survival, it is likely that no desert tortoises would be injured or killed as a result of project-related noise. Minimization measures that are part of the proposed action would further protect the species.

Because Fort Irwin Road borders the action area, the erection of permanent exclusion fencing would not be expected to be a major impediment to movement of desert tortoise within their home ranges. Because the desert tortoise population in the action area is depressed, it is unlikely that desert tortoise are routinely traveling across the action area to the opposite side of Fort Irwin Road. Any effects as a result of barriers to desert tortoise movement would be minimal.

No indirect effects to desert tortoise would be expected from maintenance of the transmission corridor. Any maintenance activity would be of short duration and there would be no offsite effects and no effects that would persist.

The project would not result in fragmentation of the existing critical habitat for the desert tortoise, because the project is not located within critical habitat for the species. There would be no indirect effects to critical habitat for the desert tortoise from construction activities.

6.2.2 Indirect Effects from Operation

The solar facility will have a greater amount of impervious area than is present in the action area, which would result in increased stormwater runoff and associated erosion and sedimentation if not controlled. The Army would require implementation of post-construction BMPs to maintain pre-development runoff flow volumes and rates and prevent any offsite effects from stormwater runoff during operation of the solar facility. Post-construction BMPs would include detention ponds and flow diversions, which would maintain pre-development runoff flows for 10-year floods and attenuate larger storm events. Any indirect effects from stormwater runoff and associated erosion and sedimentation would be minimal.

The solar facility and transmission corridor could provide additional temporary and permanent nesting, perching, and roosting sites for the common raven. The potentially increased common raven population within the area could cause the indirect effect of increased predation to juvenile desert tortoises.

Maintenance activities would be conducted inside the fenced solar facility and would not result in offsite effects. Water trucked in for washing the solar panels would be contained within the post-construction stormwater BMPs discussed above. No indirect effects to desert tortoise from routine maintenance of the solar facility during operations would be expected.

The generation of electricity during operation of the solar facility would have no offsite effects and would not result in indirect effects to desert tortoise.

There would be no indirect effects to critical habitat for the desert tortoise from operations and maintenance activities.

6.3 Effect of the Proposed Action on Tribal Resources or Interests

The Army has evaluated the potential for effects to Native American interests and resources and determined that the proposed action would result in no affects to tribal resources or interests.

6.4 Estimating Take

The fundamental duty of a federal lead agency under Section 7 of the ESA is to ensure that federal actions do not jeopardize the continued existence of listed species. As noted on page 4-50 of the ESA Section 7 Consultation Handbook (USFWS and National Marine Fisheries Service, 1998): *Section 7 requires the minimization of the level of take. It is not appropriate to require mitigation for the impacts of incidental take.*

As required by the ESA, Fort Irwin will implement reasonable and prudent measures to minimize and avoid take of listed species. The Fort Irwin project would not jeopardize the continued existence of desert tortoise.

While the proposed project has the potential to affect desert tortoise, the avoidance and minimization measures, as described in Section 7, would minimize the potential adverse effects.

The take associated with construction of the solar facility and transmission corridor would likely be limited to harassment of desert tortoise during surveys and relocation and creation of barriers to movement. While mortality is possible, no mortality would be expected from these actions.

Use of the exclusion fencing would prevent direct mortality during construction.

6.5 Cumulative Effects

Cumulative effects are defined in 50 CFR §402.02 as "those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." The Fort Irwin project would be built and operated entirely within Fort Irwin. No future State or private activities are known for the vicinity of the action area. The closest activities are military training activities and maintenance of Fort Irwin Road, but these represent continued baseline activities and would not change conditions in the action area.

The direct and indirect effects of the project would be minimal, and appropriate avoidance and minimization measures would be implemented. Therefore, the project would not be expected to result in adverse cumulative effects to desert tortoise.

7 Avoidance and Minimization Measures

As required under the ESA, Fort Irwin will implement reasonable and prudent measures to minimize and avoid potential take of desert tortoise.

7.1 Standard Specifications

The following avoidance and minimization measures will be incorporated into the project:

- **Erosion and Sediment Control Plan**. Fort Irwin will prepare and implement an erosion control and restoration plan to control short- and long-term erosion and sedimentation effects, and to restore soils and vegetation in areas affected by construction activities. The plan will include all necessary requirements regarding erosion control, and will include BMPs for erosion and sediment control as required. Only appropriate native plant material will be used for erosion control and restoration. Erosion control will be placed on all disturbed slopes and material disposal sites.
- **SWPPP**. Fort Irwin will submit to the Regional Water Quality Control Board (RWQCB) a notice of intent to discharge stormwater before construction and/or operation activities begin. Also, Fort Irwin will develop and implement a SWPPP, as required by the conditions of a National Pollutant Discharge Elimination System (NPDES) permit. Fort Irwin will prepare a SWPPP that identifies BMPs for discharges and for groundwater disposal from dewatering operations associated with road construction. The SWPPP will identify how and where these discharges would be disposed of during construction and operations. The SWPPP will include provisions for the following:
  - The area of ground disturbance will be minimized. No ground disturbance will be allowed outside the limits defined in permits. Preservation of existing vegetation will be provided to the maximum extent practical. Required BMPs will be in place during construction of the project to minimize effects to desert tortoise habitat. The limits of the construction areas will be marked with high visibility fencing to clearly identify the construction area relative to sensitive areas. These areas also will be surrounded by exclusion fencing to prevent desert tortoise entry.
  - Temporary erosion control devices will be an integral part of construction. Sedimentation fences will be used to contain polluted or turbid runoff from the work site. Other methods of temporary erosion control, including but not limited to hay bale check dams, will be employed to protect areas susceptible to damage from runoff. Erosion control devices will be installed concurrently with construction earthwork.
  - Sediment control will be maintained at construction site entrances/exits.
  - Spill control BMPs will be implemented any time chemicals and/or hazardous substances are stored or used on the project. Employees of contractors will be educated in proper material handling, spill prevention, and clean-up. Clean-up materials will be onsite and located near material storage and use areas.
  - Erosion control devices will be monitored on a regular basis and augmented as necessary. In the event of pending storms, and in compliance with the SWPPP, erosion control devices will be inspected to ensure that they are in place and are functional. Monitoring and maintenance of erosion control devices and adjacent disturbed areas will continue during and immediately after storm events.
- **Dust Control.** If dust control measures are needed, standard dust control BMPs will be used. Any material stockpiles will be watered, sprayed with tackifier, or covered, to minimize dust production and wind erosion.
- **General Housekeeping.** To prevent attraction of predators, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed at least once every 3 days

and all containers that may hold water following a precipitation event or application of water for dust control will be stored in closed areas or inverted to prevent creation of a water attractant.

- **Pets.** To prevent harassment, injury, or mortality of a desert tortoise or destruction of their refuge areas, no pets will be permitted in the action area.
- **Invasive Plant Species**. When practicable, invasive plants in the action area will be removed. Fort Irwin will comply with Executive Order 13112, to reduce the spread of invasive non-native plant species and minimize the potential decrease of palatable vegetation for wildlife species. This order is intended to prevent the introduction of invasive species and provide for their control in order to minimize the economic, ecological, and human health impacts.

7.2 Special Provisions Specifications

- **Permits.** All appropriate State and Federal permits for handling desert tortoises or their parts, must be acquired by the Authorized Biologist(s) or other personnel before project initiation and prior to handling any desert tortoise or their parts, or conducting any activity requiring a permit.
- **Clearance Surveys.** Within 2 weeks of the onset of construction, 100 percent coverage ground surveys of the action area, including all associated linear facilities (transmission corridor, access roads, etc.) will be conducted for desert tortoise, signs of desert tortoise use, or desert tortoise burrows. If no tortoises or active burrows are identified, construction will proceed without interruption. The Authorized Biologist (see Biological Monitoring item below) will direct clearance surveys for desert tortoise within the action area. This will include the clearance of any tortoise burrows within this corridor to ensure that any tortoise present are moved out of harm's way prior to grubbing consistent with the following details. There is ample similar habitat adjacent to the action area and throughout Fort Irwin available for potential relocation of desert tortoise. Desert tortoise could be relocated to other areas with fewer disturbances, including established conservation areas on Fort Irwin, and away from ATV trails. Once the action area is deemed free of desert tortoise and after exclusion fencing (see below) is in place, in accordance with USFWS clearance survey protocols, heavy equipment would be allowed to enter the site to perform earthwork such as clearing, grubbing, leveling, and trenching.
- **Relocation.** Tortoise handling, burrow construction, egg handling, and other procedures will follow those described in the Guidelines for Handling Desert Tortoise during Construction Projects (Desert Tortoise Council, 1994). Unavoidable burrows inhabited by tortoises will be excavated by the Authorized Biologist(s) using hand tools. To prevent re-entry by a tortoise, all burrows within the action area that do not contain tortoises will be collapsed.
- **Exclusion Fencing**. Fort Irwin will instruct the contractor to install temporary desert tortoise exclusion fencing around the entire solar project construction area, including the transmission corridor, prior to start of construction. This fencing will be installed under direction of an Authorized Biologist and would be done prior to the site clearance survey to prevent desert tortoise from reentering the area following the clearance survey. Construction equipment entrances will also be gated to further prevent tortoises from entering the construction site. The fence will be installed with an Authorized Biologist present. Fence design will be a minimum of 18 inches tall and consist of 1-inch horizontal by 2-inch vertical mesh (hardware cloth or plastic) and be installed flush with the ground. Fencing will be inspected daily during construction and weekly during operation. Any damage to the fencing will be repaired. Zero clearance will be maintained between the bottom of the fence and the ground to ensure that any bent portions are properly covered. Temporary exclusion fencing would be removed following completion of construction.
  Upon completion of construction, the solar facility will be surrounded with permanent exclusion fencing to prevent tortoise re-entry into this area. Fence design will be a minimum of 18 inches tall and consist of 1-inch horizontal by 2-inch vertical mesh (hardware cloth or plastic) and will be installed 24 to 36 inches below the ground surface. The transmission corridor would not have permanent exclusion fencing.

- **Worker Training.** The Authorized Biologist(s) will conduct a training session for all construction workers before work is started on the project. The Authorized biologist(s) or designated desert tortoise monitor(s) will inform field management and construction personnel of the need to avoid and protect resources by preparing and implementing a worker environmental awareness program. The program will provide workers with information on their responsibilities with regard to the desert tortoise and other sensitive species. Construction personnel will be educated on the types of sensitive resources located in the action area and the measures required to avoid effects on these resources. All construction personnel will attend an environmental training program before groundbreaking activities. Materials covered in the training program will include environmental rules and regulations for the project, requirements for limiting activities to the construction right-of-way, and avoidance and minimization measures designed to protect demarcated sensitive resource areas. Training will educate construction supervisors and managers on the need for pre-construction surveys; construction drawing format and interpretation; staking methods to protect resources; the construction process; roles and responsibilities; project management structure and contacts; environmental commitments; implementation of BMPs; and emergency procedures.

- **Biological Monitoring.** Authorized Biologist(s) will be appointed to oversee all biological work. The Authorized Biologist will perform the following during any site (or related facilities) mobilization, ground disturbance, grading, construction, operation, and closure activities. The Authorized Biologist may be assisted by desert tortoise monitor(s) who have been approved by the Authorized Biologist, but the Authorized Biologist will remain the contact for Fort Irwin. Desert tortoise monitors will oversee all project construction activities with potential to affect desert tortoise. Desert tortoise monitors will ensure proper implementation of protective measures, record and report desert tortoise and tortoise sign observations in accordance with approved protocol, report incidents of noncompliance in accordance with the BO and relevant permits, and move desert tortoise from harm's way and place these animals in "safe areas" pre-selected by the Authorized Biologist(s) or maintain the desert tortoises in their immediate possession until an Authorized Biologist assumes care of the animal.
  Desert tortoise monitors will assist the Authorized Biologist(s) during surveys. Desert tortoise monitors will not be authorized to conduct desert tortoise presence/absence or clearance surveys unless directly supervised by an Authorized Biologist. "Directly supervised" means the Authorized Biologist is in direct voice and sight contact with the desert tortoise monitor.

The Authorized Biologist's duties will include:

- Be available to supervise, conduct, and coordinate mitigation, monitoring, and other biological resources compliance activities, particularly in areas requiring avoidance or containing sensitive biological resources, such as special-status species or their habitat.
- Clearly mark sensitive biological resource areas and inspect these areas at appropriate intervals for compliance with regulatory terms and conditions.
- Inspect active construction areas where animals may have become inadvertently entrapped within the area prior to the start of construction each day. At the end of the day, inspect for the installation of structures that prevent entrapment or allow escape during periods of construction inactivity. Periodically inspect areas with high vehicle activity (e.g., parking lots) for animals in harm's way.

During operation, the Authorized Biologist will be a Fort Irwin biologist.

7.3 Summary of Avoidance, Minimization, and Conservation Measures

Fort Irwin has designed the project to minimize direct effects to the desert tortoise and its habitat. In addition, Fort Irwin will employ BMPs in order to avoid, minimize, and prevent potential direct effects to desert tortoise or potential habitat. These measures include:

- Clearance surveys will be conducted prior to construction activities within the proposed solar site and prior to installation of the transmission line components.
- An Authorized Biologist will be onsite during initial site grading activities and any subsequent construction activities which would have the potential to affect desert tortoise. If a desert tortoise is found within or adjacent to the project site during construction or operation, an Authorized Biologist will move it out of harm's way in coordination and consultation with the USFWS.
- The construction site perimeter, including support facilities and the transmission line corridor, will be surrounded by temporary desert tortoise exclusion fencing. Controlled access gates, equipped with tortoise grates, will be installed at roads entering or exiting the solar farm site. The solar facility will be designed, operated, and maintained so that channelization of surface water flow will not undermine the integrity of the perimeter fence or the desert tortoise exclusion fencing.
- An erosion and sediment control plan will be implemented as part of standard Fort Irwin BMPs to prevent project-related construction effects on habitat outside the work areas.
- Following construction, permanent desert tortoise exclusion fencing will be constructed and maintained to prevent desert tortoise entry into the solar facility during operations.

8 Finding of Effect

Fort Irwin, acting as the lead federal agency, has determined that the proposed project **may affect and is likely to adversely affect the desert tortoise, but would not jeopardize the continued existence of** the desert tortoise. The proposed project would **not adversely modify or destroy** designated critical habitat for this species.

No other species protected under the ESA would be affected by the proposed action.

9 References

Aber, J.D., K.J. Nadelhoffer, P. Steudler, and J.M. Melillo. 1989. Nitrogen saturation in northern forest ecosystems. Bioscience 39:378-386.

Avery, H.W. 1992. Summer food habits of desert tortoises in Ivanpah Valley, California. Proceedings of the Desert Tortoise Council Symposium 1992:60.

Avery, H.W. 1998. Nutritional ecology of the desert tortoise (*Gopherus agassizii*,) in relation to cattle grazing in the Mojave Desert. PhD dissertation, University of California, Los Angeles.

Bagley, M. 1998. Draft status report for Lane Mountain milk-vetch (Astragalus jaegerianus Munz). Prepared for Bureau of Land Management, California Desert District, Riverside, California.

Berry, K.H. 1986. Desert tortoise (*Gopherus agassizii*) relocation: Implications of social behavior and movements. Herpetologica 42:113-125.

Blythe, A.K., D.E. Swann, R.J. Steidl, and E.W. Stitt. 2003. Movement patterns of translocated desert tortoises. Proceeding of the 2003 Desert Tortoise Council Symposium. p. 81.

Boarman, W.I. 2002. Threats to desert tortoise populations: A critical review of the literature. U.S. Geological Survey, Western Ecological Research Center, Sacramento, California.

Boarman, W.I. and M. Sazaki. 2006. A highway's road-effect zone for desert tortoises (Gopherus agassizii). Journal of Arid Environments 65:94-101.

Brooks, M.L. 2003. Effects of increased soil nitrogen on the dominance of alien annual plants in the Mojave Desert. Journal of Applied Ecology 40:344-353.

Brooks, M.L. and T.C. Esque. 2002. Alien plants and fire in desert tortoise (*Gopherus agassizii*) habitat of the Mojave and Colorado deserts. Chelonian Conservation and Biology 4:330-340.

Brussard, P.F., K.H. Berry, M.E. Gilpin, E.R. Jacobson, D.J. Morafka, C. R. Schwalbe, C.R. Tracy, F.C. Vasek, and J.P. Hohman. 1994. Proposed desert wildlife management areas for recovery of the Mojave population of the desert tortoise. Report to U.S. Fish and Wildlife Service, Region 1, Portland, Oregon.

Bulova, S. J. 1994. Patterns of burrow use by desert tortoises: gender differences and seasonal trends. Herpetological. Monographs 8:133-143.

Burge, B.L. 1977. Daily and seasonal behavior, and areas utilized by the desert tortoise, *Gopherus agassizii*, in southern Nevada. Proceedings of the Desert Tortoise Council Symposium 1977:59-94.

Bury, R.B. 1987. Off-road vehicles reduce tortoise numbers and well-being. U.S. Department of the Interior, Fish and Wildlife Service, National Ecology Research Center, Fort Collins, Colorado. Research Information Bulletin Number 87-6.

California Department of Fish and Game (CDFG). 2012. California Natural Diversity Database (CNDDB) Rarefind 3 (CD-ROM). CDFG: Habitat Conservation Division. Sacramento, California, 2012.

California Native Plant Society (CNPS). 2012. Inventory of rare and endangered plants of California (online edition, version 7.06c). Available at: http://www.Cnps.org/inventory.

CH2M HILL. 2012. Natural Resources Report: Fort Irwin National Training Center Solar Facility Project San Bernardino County, California. Prepared for U.S. Army Environmental Division Fort Irwin, CA

Charis. 2002. Distribution and abundance of Lane Mountain milk-vetch (Astragalus jaegerianus Munz), report of spring-summer 2001 survey.

D'Antonio, C.M., and P.M. Vitousek. 1992. Biological invasions by exotic grasses, the grass/fire cycle, and global change. Annual Review of Ecology and Systematics 23:63-87.

Desert Tortoise Council. 1994 (Revised 1999). Guidelines for Handling Desert Tortoises During Construction Projects. Edward L. LaRue, Jr., editor. Wrightwood, California.

Ennen, J.R., J.E. Lovich, K.P. Meyer, C. Bjurlin, and T.R. Arundel. 2012. Nesting Ecology of a Population of Gopherus agassizii at a Utility-Scale Wind Energy Facility in Southern California. *Copeia* 2012(2):222-228.

Esque, T.C. 1992. Diet selection of the desert tortoise in the northeast Mojave Desert – FY 1991 update. Proceedings of the Desert Tortoise Council Symposium 1992:64-68.

Esque, T.C. 1994. Diet and diet selection of the desert tortoise (*Gopherus agassizii*) in the northeastern Mojave Desert. Master's Thesis. Colorado State University, Fort Collins.

Gardner, T. J. and E. D. Brodie, Jr. 2000. The occupation of steep slopes by desert tortoises (*Gopherus agassizii*) in the western Mojave Desert: A description of occupied habitats, habitat use, and desert tortoise density. Final report.

Harless, M.L., A.D. Walde, D.K. Delaney, L.L. Pater, and W.K. Hayes. 2009. Home range, spatial overlap, and burrow use of the desert tortoise in the West Mojave Desert. Copeia 2009:378-389.

Hazard, L C., Shemanski, D.R., and K. A. Nagy. 2002. Calcium and phosphorus availability in native and exotic food plants. Proceedings Desert Tortoise Council Symposium 2001-2002:63.

Hazard, L C., Shemanski, D.R., and K. A. Nagy. 2010. Nutritional Quality of Natural Foods of Juvenile and Adult Desert Tortoises (*Gopherus agassizii*): Calcium, Phosphorus, and Magnesium Digestibility. *Journal of Herpetology* 44:1, 135-147.

Henen, B.T. 1992. Desert tortoise diet and dietary deficiencies that may limit egg production at Goffs, California. Proceedings of the Desert Tortoise Council Symposium 1992:97.

Hickman, J. ed. 1993. The Jepson Manual. University of California Press, Berkeley.

Jennings, W.B. 1992. Observations on the feeding habits and behavior of desert tortoises at the Desert Tortoise Natural Area, California. Proceeding of the Desert Tortoise Council Symposium 1992:69-81.

Jennings, W.B. 1993. Foraging ecology of the desert tortoise (Gopherus agassizii) in the western Mojave Desert. M.S. Thesis. University of Texas, Arlington.

Longshore, K.M., J.R. Jaeger, and J.M. Sappington. 2003. Desert tortoise (Gopherus agassizii) survival at two eastern Mojave Desert sites: death by short-term drought? Journal of Herpetology 37:169–177.

Medica, P.A., R.B. Bury, and F.B. Turner. 1975. Growth of the desert tortoise (Gopherus agassizii) in Nevada. Copeia 1975:639-643.

Minnich, J.E. 1970. Water and electrolyte balance of the desert iguana, Dipsosaurus dorsalis, in its native habitat. Comparative Biochemistry and Physiology 35:921-933.

Minnich, J.E. 1979. Comparison of maintenance electrolyte budgets of freeliving desert and gopher tortoises (Gopherus agassizi and G. polyphemus). Proceedings of the Desert Tortoise Council Symposium 1979:166-174.

Naegle, S. 1976. Physiological response of the desert tortoise, Gopherus agassizii. Master of Science thesis, University of Nevada, Las Vegas, Nevada.

Nagy, K.A. 1972. Water and electrolyte budgets of a free-living desert lizard, Sauromalus obesus. Journal of Comparative Physiology 79:93-102. Natural Resources Conservation Service (NRCS). 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Nagy, K.A. and P.A. Medica. 1986. Physiological ecology of desert tortoises. Herpetologica 42:73-92.

Nagy, K.A., B.T. Henen, and D.B. Vyas. 1998. Nutritional quality of native and introduced food plants of wild desert tortoises. Journal of Herpetology 32:260-267.

Oftedal, O.T. 2002. The nutritional ecology of the desert tortoise in the Mojave and Sonoran deserts. Pages 194-241 in T.R. Van Devender (ed.), The Sonoran Desert Tortoise; Natural History, Biology and Conservation. University of Arizona Press, Tucson, Arizona.

Oftedal, O.T. and M.E. Allen. 1996. Nutrition as a major facet of reptile conservation. Zoo Biology 15:491-497.

Oftedal, O.T., S. Hillard, and D.J. Morafka. 2002. Selective spring foraging by juvenile desert tortoises (Gopherus agassizii) in the Mojave Desert: Evidence of an adaptive nutritional strategy. Chelonian Conservation and Biology 4:341-352.

Prigge, B.A., M.R. Sharifi, and D. Morafka. 2000. Lane Mountain milk-vetch surveys (Progress Report III). Prepared for the National Training Center, U.S. Department of the Army Contract No. DSCA05-99-P-0759. Domingez Hills Foundation, Carson, California.

Prigge, B.A., M.R. Sharifi, and D. Morafka. 2001. Database of Lane Mountain milk -vetch surveys, 1999 and 2000. Updated and re-edited November 8, 2001

Tracy, C.R., R. Averill-Murray, W. I. Boarman, D. Delehanty, J. Heaton, E. McCoy, D. Morafka, K. Nussear, B. Hagerty, P. Medica. 2004. Desert Tortoise Recovery Plan Assessment. Report to the U.S. Fish and Wildlife Service, Reno, Nevada.

TRW Environmental Safety Systems Inc. 1997. Patterns of burrow use by desert tortoises at Yucca Mountain, Nevada. Unpublished report to U.S. Department of Energy. TRW Environmental Safety Systems Inc., Las Vegas, Nevada.

Turner, F.B., P. Hayden, B.L. Burge, and J.B. Roberson. 1986. Egg production by the desert tortoise (Gopherus agassizii) in California. Herpetologica 42:93-104.

Turner, F.B., P.A. Medica, and R.B. Bury. 1987. Age-size relationships of desert tortoises (Gopherus agassizii) in southern Nevada. Copeia 1987: 974-979.

United States Bureau of Land Management (BLM). 1990. Draft raven management plan for the California Desert Conservation Area. Prepared by Bureau of Land Management, California Desert District, Riverside, California.

United States Fish and Wildlife Service (USFWS). 1990. Endangered and threatened wildlife and plants, determination of threatened status for the Mojave population of the Desert Tortoise. 55 Federal Resister (FR) 12178

USFWS. 1993. Draft recovery plan for the desert tortoise (Mojave population). Prepared for Regions 1, 2, and 6 of the Fish and Wildlife Service. Portland, Oregon. 170 pp. plus appendices.

USFWS. 1994. Desert Tortoise (Mojave Population) Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS. 1998. Endangered and Threatened Wildlife and Plants; Determination of Endangered or Threatened Status for Five Desert Milk-vetch Taxa From California. 63 FR 53596.

USFWS. 2008. 5-Year Review Lane Mountain milk-vetch (*Astragalus jaegerianus*). U.S. Fish and Wildlife Service Ventura Fish and Wildlife Office Ventura, California. June.

USFWS. 2010. Desert Tortoise Pre-project Survey Protocol 2010 Field Season: Preparing For Any Action That May Occur Within The Range of The Mojave Desert Tortoise (Gopherus agassizii). Carlsbad, California.

USFWS. 2011a. Revised recovery plan for the Mojave population of the desert tortoise (*Gopherus agassizii*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. 222 pp.

USFWS. 2011b. Endangered and Threatened Wildlife and Plants; Final Revised Designation of Critical Habitat for *Astragalus Jaegerianus* (Lane Mountain Milk-Vetch); Final Rule. 76 FR 29108

USFWS. 2012a. Conference call with Brian Croft. February 15. Desert tortoise presence/absence surveyor requirements and qualifications.

USFWS. 2012b. Status of the Desert Tortoise and its Critical Habitat- Rangewide. February 9.

USFWS. 2012c. Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition To Delist or Reclassify From Endangered to Threatened Six California Species. Federal Register / Vol. 77, No. 107 / Monday, June 4, 2012 / Proposed Rules. (32922-32927).

USFWS. 2012d. Desert Tortoise Habitat and Life History. Nevada Fish and Wildlife Office. Online: http://www.fws.gov/Nevada/desert_tortoise/dt_life.html. Last updated March 12, 2012.

USFWS and National Marine Fisheries Service. 1998. ESA Section 7 Consultation Handbook.

Walde, A., L. Bol, D. Delaney, and L. Pater. 2003. The desert tortoise: a preliminary analysis of operative and environmental temperatures. Unpublished report submitted to the U.S. Fish and Wildlife Service July 25, 2003.

Walde, A.D., W.I. Boarman, and A.P. Woodman. 2011. Comparing translocation methods and effectiveness for desert tortoises at Fort Irwin, a comprehensive: 2011 report. QinetiQ Team. Prepared for the Department of the Army. Fort Irwin, California.

Zimmerman, L.C., M.P. O'Connor, S.J. Kemp, and J.R. Spotila. 1994. Thermal ecology of desert tortoises in the Eastern Mojave Desert: seasonal patterns of operative and body temperatures and microhabitat utilization. Herpetological Monographs 8:45-59.

Appendix A

Natural Resources Report

Final

Natural Resources Report

Fort Irwin National Training Center Solar Facility Project San Bernardino County, California

Prepared for
U.S. Army Environmental Division
Fort Irwin, CA

May 2012

CH2MHILL®

COPYRIGHT 2012 BY CH2M HILL, INC. • COMPANY CONFIDENTIAL

Summary

This natural resources report describes the existing biological resources for the proposed Fort Irwin National Training Center Solar Facility Project located in the City of Fort Irwin in San Bernardino County, approximately 37 miles (60 kilometers) northeast of Barstow, California. The project site covers approximately 380 acres of disturbed Mojave creosote scrub vegetation. The natural resources survey identified the vegetation communities, common species, and special-status species and their habitat present within the project area. The survey focused on federally listed desert tortoise (*Gopherus agassizii*) and included a protocol level survey on the entire project area.

Two live tortoises were found during the survey, and active or historic desert tortoise sign (active burrow, carcass, etc.) was found within the project area or in the survey's zone of influence.

Two sensitive bird species were observed on the project site (burrowing owl and loggerhead shrike).

Contents

Section **Page**

Summary ..... **iii**

Contents ..... **v**

Acronyms and Abbreviations ..... **vii**

1 Introduction **1-1**
1.1 Project Description 1-1
1.2 Site Location 1-1

2 Methods **2-1**
2.1 Survey Methodology 2-1

3 Results **3-1**
3.1 Site Characteristics 3-1
3.2 Sensitive Species 3-3

4 Conclusions and Recommendations **4-1**
4.1 Conclusions 4-1
4.2 Recommendations 4-1

5 References **5-1**

Appendixes
A Photographs of Special Status Species Sign

Tables

3-1 Observed Flora & Fauna
3-2 Sensitive Species Sign found within the Project area

Figures

1-1 Project Location
2-1 Natural Resources Survey Area with Sensitive Species Sign

Acronyms and Abbreviations

ac	acre(s)
CNPS	California Native Plant Society
GPS	global positioning system
km	kilometer(s)
m	meter(s)
MBTA	Migratory Bird Treaty Act
mi	mile(s)
msl	mean sea level
PV	photovoltaic
USFWS	United States Fish and Wildlife Service
ZOI	zone of influence

SECTION 1

Introduction

This report presents the results of a natural resources survey and protocol level survey for the federally threatened desert tortoise (*Gopherus agassizii*) to support analysis of the environmental impacts associated with the construction and operation of a solar facility at Fort Irwin, California. The natural resources survey was conducted to characterize the proposed solar facility area (approximately 380 acres) and to determine whether the desert tortoise or any other protected species occurs within the proposed project area.

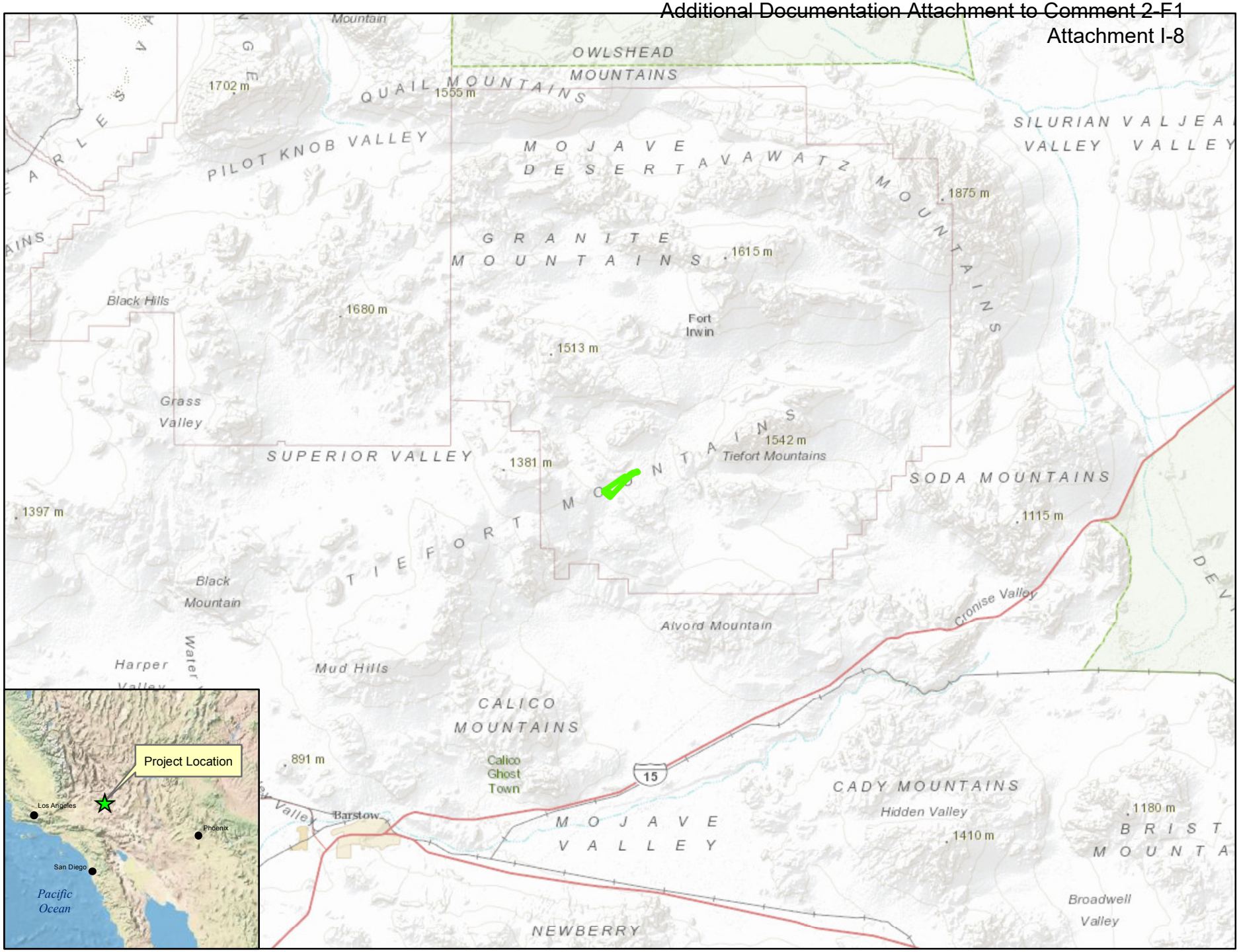
1.1 Project Description

Fort Irwin is proposing to construct and operate a solar photovoltaic (PV) facility on up to 380 acres. The facility will include solar arrays, a battery energy storage system, access/maintenance roads, and an electrical tie-in. The proposed action is required to meet energy reduction requirements in Executive Orders and Department of Defense and U.S. Army mandates.

1.2 Site Location

Fort Irwin, also known as the National Training Center, is located in southeast California 37 miles (mi) (60 kilometers (km) northeast of Barstow in the Mojave Desert in northern San Bernardino County. Fort Irwin was designated as a permanent installation in 1961 and encompasses approximately 996 square mi (2,580 square km). The installation is approximately 25 mi (40 km) from Interstate 15 midway between Las Vegas and Los Angeles (Figure 1-1).

Fort Irwin serves at the Army's premier training center. Over half of the land area of Fort Irwin is used for desert battlefield training. One of the key training opportunities on Fort Irwin includes the use of an Opposing Force, which provides force-on-force and live-fire training for ground and aviation units in a joint scenario. The Fort Irwin cantonment area contains housing, administrative, medical, and other supporting facilities and encompasses approximately 3 square mi (8 square km).



N

0 5 10 20 Miles

Study Area
Major Road

FIGURE 1-1
Project Location
Fort Irwin National Training Center Solar Facility Project
Natural Resources Report
Fort Irwin, California

AR060206

CH2MHILL

SECTION 2

Methods

CH2M HILL biologists conducted a natural resources survey to identify and map federal and state threatened and endangered species habitat within the proposed solar facility site and transmission line corridor from March 26, 2012 through March 29, 2012. The project corridor extends from the main gate access road, west toward Tiefort Mountain. Together, the site and project corridor make up the project area.

2.1 Survey Methodology

The goal of the CH2M HILL survey was to determine the presence or absence of desert tortoises and any other listed species within the proposed project area. The survey was conducted within the proposed solar site and the transmission line corridor by a four-person team of CH2M HILL biologists, Jessica Birnbaum, Gabriel Dupree, Amy Hammontree, and Jason Speights.

The survey was conducted according to the 1992 Field Survey Protocol for Any Federal Action that May Occur within the Range of the Desert Tortoise (U.S. Fish & Wildlife Service [USFWS] 1992; USFWS, 1996; USFWS, 2010) by walking transects at 10-meter (m) spacing throughout all accessible, appropriate habitat on the proposed project site and walking transects within the surrounding zone of influence (ZOI). The ZOI survey consisted of three additional 10-m (approximately 30-foot [ft]) ZOI belt transects at 200-m (approximately 655-ft) intervals parallel to the northern border of the transmission line corridor (200-m, 400-m, and 600-m from the perimeter), in accordance with USFWS protocol for a linear site. The area where survey was conducted is shown in Figure 2-1.

- During the survey, information was collected by the following methods:
- Performing preliminary characterization of plant communities on the site.
- Taking photographs of the site (Appendix A).
- Recording all definitive sign of desert tortoises, including live tortoises, burrows, scat, carcasses, and shell-skeletal remains (Appendix A). Any tortoise or large mammal burrows encountered that could be used by tortoises were visually inspected. Very small burrows that could be used by juvenile tortoises but are much more often rodent burrows were also visually checked when encountered.
- Recording all other sensitive species sightings, including the federally endangered Lane Mountain milk-vetch (*Astragalus jaegerianus*) and other California sensitive plant and animal species. The Lane Mountain milk-vetch is known to occur at Fort Irwin, and designated critical habitat for the species has been identified south of the installation boundary.
- Recording sightings of all common plant and animal species.

Each biologist utilized a global positioning system (GPS) unit to orient and guide the survey. The location of any observed special status species sign was recorded using the GPS unit. All transect routes were generated prior to conducting the field work and uploaded into the Garmin hand-held GPS unit.

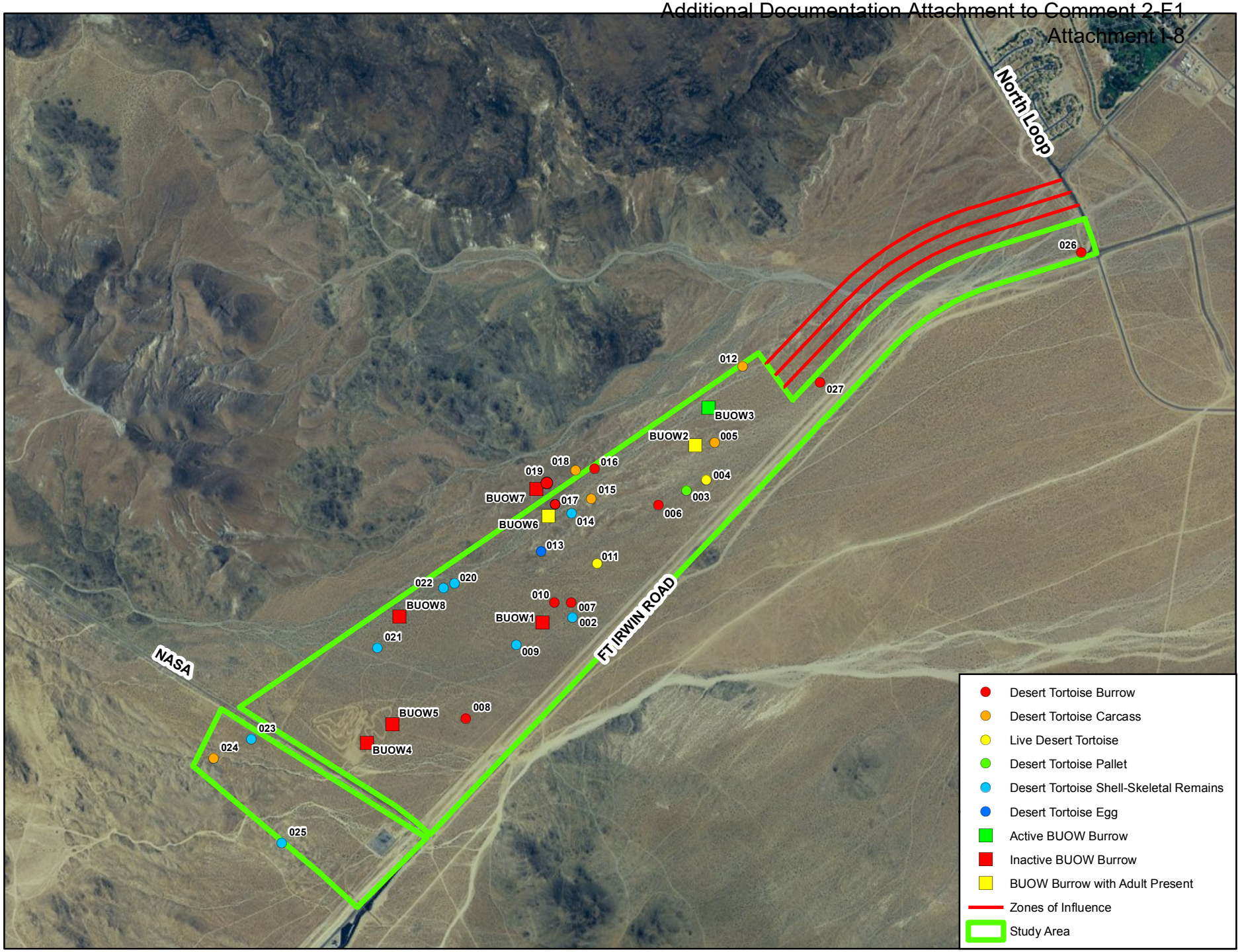


FIGURE 2-1
Natural Resources Survey Area with Sensitive Species Sign
Fort Irwin National Training Center Solar Facility Project
Natural Resources Report
Fort Irwin, California

AR060208

CH2MHILL

SECTION 3

Results

This section provides the results of the natural resources and focused desert tortoise survey, including site characteristics, plants, wildlife, and sensitive species.

3.1 Site Characteristics

Much of the land within the proposed Fort Irwin solar PV facility site has been historically disturbed by military training activities, including several shallow bomb craters. There was also evidence of previous all-terrain vehicle use within the site. The survey area ranged in elevation from approximately 792 m [2,600 ft] above mean sea level (msl) on the southeastern corner to approximately 975 m (3,200 ft) msl on the northwestern edge, and is characterized by creosote bush (*Larrea tridentata*)-white bursage (*Ambrosia dumosa*) series vegetation community (Sawyer and Keeler-Wolf, 1995 and Hollan, 1986). Creosote bush and white bursage are common throughout the site, while common associated species varied. Wildlife observed on the site was typical of that found in surrounding areas. No fish or amphibious species are likely to inhabit the site or immediately surrounding areas because there are no permanent water sources there. All wildlife and plants observed are listed in Table 3-1.

TABLE 3-1
Observed Flora & Fauna
Fort Irwin Solar Photovoltaic Facility Site

Common Name	Scientific Name	Federal Status	State Status
Reptiles and Amphibians			
California whiptail	*Aspidoscelis tigris munda*	N	N
Chuckwalla	*Sauromalus ater*	N	N
Desert tortoise	*Gopherus agassizii*	LT	LT
Fence lizard	*Sceloporus sp.*	N	N
Long-nosed leopard lizard	*Gambelia wislizenii*	N	N
Side-blotched lizard	*Uta stansburiana*	N	N
Zebra-tailed lizard	*Callisaurus draconoides*	N	N
Mammals			
Blacktail jackrabbit	*Lepus californicus*	N	N
Coyote	*Canis latrans*	N	N
Desert cottontail	*Sylvilagus audubonii*	N	N
Desert wood rat	*Neotoma lepida*	N	N
Kit fox	*Vulpes macrotis*	N	N
Birds			
American robin	*Turdus migratorius*	N	N
Ash-throated flycatcher	*Myiarchus cinerascens*	N	N
Black-throated sparrow	*Amphispiza bilineata*	N	N
Blue-gray gnatcatcher	*Polioptila caerulea*	N	N

TABLE 3-1
Observed Flora & Fauna
Fort Irwin Solar Photovoltaic Facility Site

Common Name	Scientific Name	Federal Status	State Status
Brewers sparrow	*Spizella breweri*	N	N
Burrowing owl	*Athene cunicularia*	N	LS
Common raven	*Corvus corax*	N	N
Horned lark	*Eremophila alpestris*	N	N
Loggerhead shrike	*Lanius ludovicianus*	N	LS
Red-tailed hawk	*Buteo jamaicensis*	N	N
Sage sparrow	*Amphispiza belli*	N	N
Turkey vulture	*Cathartes aura*	N	N
White-crowned sparrow	*Zonotrichia leucophrys*	N	N
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	N	LS
Plants			
Beavertail cactus	*Opuntia basilaris*	N	N
Bractscale	*Atriplex serenana*	N	N
Buckwheat	*Eriogonum fasciculatum*	N	N
Brittlebush	*Encelia farinose*	N	N
Cheesebush	*Hymenoclea salsola*	N	N
Chia	*Salvia columbariae*	N	N
Cooper's goldenbush	*Ericameria cooperi*	N	N
Cottontop cactus	*Echinocactus polycephalus*	N	N
Creosote bush	*Larrea tridentata*	N	N
Desert milkweed	*Asclepias erosa*	N	N
Desert trumpet	*Eriogonum inflatum*	N	N
Goldenbush	*Ericameria linearifolia*	N	N
Joshua tree	*Yucca brevifolia*	N	LS
Wolfberry	*Lycium sp.*	N	N
Mojave rabbitbrush	*Ericameria paniculata*	N	N
Mojave woodyaster	*Xylorhiza toriflora*	N	N
Mormon tea	*Ephedra californica*	N	N
Saltbush	*Atriplex polycarpa*	N	N
Silver cholla	*Cylindropuntia echinocarpa*	N	N
Turpentine broom	*Thamnosma montana*	N	N
Turtleback	*Psathyrotes ramosissima*	N	N

TABLE 3-1
Observed Flora & Fauna
Fort Irwin Solar Photovoltaic Facility Site

Common Name	Scientific Name	Federal Status	State Status
White bursage	*Ambrosia dumosa*	N	N

LE = Listed Endangered
LS = Listed State Species of Special Concern
LT = Listed Threatened
N = Not Listed

3.2 Sensitive Species

Nine sensitive species (four plants and five animals) were specifically targeted during the natural resources survey. The four plant species include the federally endangered Lane Mountain milk-vetch and three California state protected species: the alkali Mariposa lily (*Calochortus striatus*), Clokey's cryptantha (*Cryptantha clokeyi*), and the Mohave fishhook cactus (*Sclerocactus polyancistrus*). The five animal species include the desert tortoise (federally listed as threatened) and four state protected bird species: LeConte's thrasher (*Toxostoma lecontei*), burrowing owl (*Athene cunicularia)* loggerhead shrike (*Lanius ludovicianus*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). These species were targeted due to the existence of historical records of occurrence in the project vicinity (California Native Plant Society (CNPS), 2012; California Department of Fish and Game (CDFG), 2012). Figure 2-1 depicts the locations for all desert tortoise and burrowing owl sign found, and GPS locations for each are provided in Table 3-2.

3.2.1 Sensitive Plant Species

3.2.1.1 Alkali Mariposa Lily

Alkali Mariposa lily is a CNPS List 1B.2 bulbiferous herb that blooms from April to June and is historically known to occur most commonly in open, flat, barren sites on the sandy margins of alkali depressions in creosote bush scrub and arid phase saltbush scrub communities at elevations ranging from approximately 70 m to 1,595 m (230 to 5,230 ft) msl. This plant was not observed during the natural resources survey and is not expected to occur due the lack of suitable habitat on the proposed project site (CNPS, 2012).

3.2.1.2 Clokey's Cryptantha

Clokey's cryptantha is a CNPS List 1B.2 annual herb that blooms in April and is known to occur in desert habitat, generally including sandy or gravelly soils within creosote bush scrub communities in the Mojave Desert from elevations of approximately 800 m (2,625 ft) to approximately 1,280 m (4,200 ft) msl. This plant was not observed during the natural resources survey, but it has a moderate potential to occur due to the presence of suitable habitat on the proposed project site (CNPS, 2012).

3.2.1.3 Lane Mountain Milk-vetch

Lane Mountain milk-vetch is a perennial herb that is federally listed as endangered. It is most commonly found in Mojave mixed woody scrub or creosote bush scrub. Habitat for the species is found at elevations of approximately 915 to 1,220 m (3,000 to 4,000 ft) msl with granite substrate, shallow soils with bedrock near the surface, relatively gentle slopes and areas of low ridges, diverse shrub assemblages in Mojave creosote bush scrub, and Mojave mixed woody scrub communities. It is almost exclusively found growing up through shrubs or occasionally through clumps of dead bunchgrass. This plant was not observed during the natural resources survey and is not expected to occur due to habitat on the proposed project site being marginally suitable to support the species (Calflora, 2012).

3.2.1.4 Mohave Fishhook Cactus

Mohave fishhook cactus is a CNPS List 4.2 shrub (stem succulent) that is generally found on basalt rock hillsides, limestone hillsides, and desert pavement, generally on south- to southwest-facing slopes. This plant

was not observed during the natural resources survey, but has a moderate potential to occur due to the presence of suitable habitat on the proposed project site (CNPS, 2012).

3.2.2 Sensitive Wildlife Species

3.2.2.1 Desert Tortoise

Desert tortoises were classified by the USFWS as a threatened species in 1990. This listing occurred as a result of continued human-caused habitat destruction through urban expansion, off-road vehicle use, illegal collection for the pet trade, and raven predation on juvenile tortoises.

The desert tortoise is listed as threatened in over 30 percent of its range. Desert tortoises occur in southeastern California, southern Nevada, southwestern Utah, and northwestern Arizona, often within desert scrub communities (USFWS, 2012).

Two desert tortoises were observed inside their burrows, as well as four other desert tortoise burrows that appeared to be active, with scat observed in or around the entrance of the burrow. One unhatched egg from 2011 was observed. A total of nine desert tortoise burrows were observed during the survey. One pallet, or a shallow depression constructed under low shrubs providing a temporary resting for the tortoise, was observed. Five relatively intact desert tortoise carcasses (indicating that the animals probably died within the past 1 to 2 years) were observed. Eight collections of shell-skeletal remains (indicating the animals had been dead a minimum of 2 years) were observed. See Table 3-2 for the locations of all desert tortoise sign found.

TABLE 3-2
Sensitive Species Sign Found within Project Area

GPS Location	Description of Sign	Easting	Northing
002	DT Shell-Skeletal Remains	525065	3898729
003	DT Pallet	525539	3899257
004	Live DT	525622	3899301
005	DT Carcass	525657	3899455
006	Inactive DT Burrow	525423	3899195
007	Active DT Burrow	525060	3898790
008	DT Burrow	524622	3898309
009	DT Shell-Skeletal Remains	524832	3898615
010	Inactive DT Burrow	524989	3898790
011	Live DT	525168	3898952
012	DT Carcass	525773	3899773
013	DT Egg	524935	3899003
014	DT Shell-Skeletal Remains	525062	3899162
015	DT Carcass	525142	3899221
016	Active DT Burrow	525156	3899346
017	Active DT Burrow	524972	3899145
018	DT Carcass	525078	3899340
019	Active DT Burrow	524920	3899265
020	DT Shell-Skeletal Remains	524575	3898870

TABLE 3-2
Sensitive Species Sign Found within Project Area

GPS Location	Description of Sign	Easting	Northing
021	DT Shell-Skeletal Remains	524254	3898602
022	DT Shell-Skeletal Remains	524528	3898850
023	DT Shell-Skeletal Remains	523731	3898222
024	DT Carcass	523574	3898144
025	DT Shell-Skeletal Remains	523858	3897792
026	Inactive DT Burrow	527180	3900246
027	Inactive DT Burrow	526095	3899705
BUOW1	Inactive BUOW Burrow	524941	3898708
BUOW2	BUOW Burrow with Adult Present	525576	3899446
BUOW3	Active BUOW Burrow	525630	3899600
BUOW4	Inactive BUOW Burrow	524210	3898209
BUOW5	Inactive BUOW Burrow	524316	3898286
BUOW6	BUOW Burrow with Adult Present	524966	3899150
BUOW7	Inactive BUOW Burrow	524913	3899263
BUOW8	Inactive BUOW Burrow	524346	3898733

Notes:
DT = Desert Tortoise; BUOW = Burrowing Owl

3.2.2.2 LeConte's Thrasher

LeConte's thrasher is a California state species of concern and is protected by the Migratory Bird Treaty Act (MBTA). Home range is in saltbush-cholla scrub. Preferred habitat generally consists of sparsely vegetated desert flats, dunes, alluvial fans, or gently rolling hills having a high proportion of one or more species of saltbush or shadscale and/or cylindrical cholla cactus 0.9 to 1.9 m (approximately 3 to 6 ft) tall. It rarely occurs in habitats consisting entirely of creosote bush. The majority of shrubs in the project area rarely exceed 2.5 m (approximately 8 ft) in height, except for isolated desert trees, yuccas, or tall, thin shrubs. This species was not observed during the natural resources survey and is not expected to occur on the project site due to the habitat being marginally suitable.

3.2.2.3 Loggerhead Shrike

The loggerhead shrike is a California state species of concern and is protected by the MBTA. This species is relatively common in lowland California and prefers open habitat with scattered shrubs and trees for nesting (Grinnell and Miller 1944). Marginally suitable foraging habitat for this species occurs within the project area, and suitable nesting habitat is very rare. One individual loggerhead shrike was observed on the project site during the survey.

3.2.2.4 Yellow-headed Blackbird

The yellow-headed blackbird is a California state species of concern and is protected by the MBTA. The species generally occurs in California as a migrant or summer resident, but small numbers winter in the southern deserts. Preferred breeding habitat includes marshes and wetlands with tall emergent vegetation, and the blackbird may forage in surrounding wetlands, grasslands, and croplands. Yellow-headed blackbirds breed at scattered sites throughout the Mojave Desert. Small numbers breed regularly near Victorville, Barstow, and Newberry Springs in San Bernardino County. Marginally suitable foraging habitat for this species occurs within the project area, but no suitable nesting habitat occurs. The yellow-headed blackbird was observed on the project site during the survey.

3.2.2.5 Mohave Ground Squirrel

Mojave ground squirrel (Spermophilous mohavensis) is a California state-listed threatened species restricted to the Mojave Desert in San Bernardino, Los Angeles, Kern, and Inyo Counties. This species favors open desert scrub, alkali desert scrub, and Joshua tree habitats at elevations ranging from approximately 550 to 1,524 m (1,800 to 5,000 ft) msl. It is known to feed in annual grasslands. This species was not observed during the survey but has a moderate potential to occur on the project site.

3.2.2.6 Western Burrowing Owl

The western burrowing owl is a state species of concern and is protected by the MBTA. This ground-nesting raptor occupies burrows in annual grassland or ruderal habitats. It is known to occur in open, dry grasslands, agricultural and range lands, and desert habitats often associated with burrowing animals (CDFW, 1993). This species was observed on the project site (Table 3-1).

SECTION 4

Conclusions and Recommendations

This section presents conclusions about biological resources in the project area and presents recommendations concerning further surveys or permitting that may be required.

4.1 Conclusions

One federally threatened wildlife species and three wildlife California species of concern were determined to occur within the proposed project area:

- Desert tortoise (federally threatened)
- Burrowing owl (California species of concern)
- Loggerhead shrike (California species of concern)
- Yellow-headed blackbird (California species of concern)

Two active desert tortoise burrows were observed during the survey. Other California state-listed wildlife species observed include the burrowing owl, loggerhead shrike, and yellow-headed blackbird. No additional federally protected species or California protected wildlife species were observed during the field survey.

In addition, one California wildlife species listed as threatened and two state plants listed as sensitive are considered to have a moderate or higher potential to exist in the project area but were not observed during the survey:

- Mohave ground squirrel (California threatened species)
- Clokey's cryptantha (California sensitive species)
- Mojave fishhook cactus (California sensitive species)

4.2 Recommendations

A pre-construction survey may be required for the federally threatened desert tortoise. It is recommended that coordination with the CDFG and USFWS be conducted to ensure that no adverse effects occur to this species as a result of project construction.

A pre-construction nesting bird survey or avoidance/mitigation may be required for the loggerhead shrike to comply with the MBTA. Project activities may take place in areas of potential nesting for loggerhead shrikes. If project construction activities are to occur during bird nesting season (generally between February 1 and October 15), it may be necessary to conduct a nesting bird survey prior to vegetation disturbance as deemed necessary by CDFG.

The following surveys would be recommended and deemed necessary by CDFG, if a state permit is required for the project:

- A survey for Mojave ground squirrel may be recommended by CDFG depending upon the permitting needs for the project.
- A pre-construction survey may be required for burrowing owls within 30 days of the initiation of vegetation removal activities on the project site. This survey is typically required by CDFG and consists of walking 30-m transects throughout the project area to identify any owls currently inhabiting areas where project activities may disturb their burrows. During the non-breeding season (October-February) these owls can be passively relocated off the project site after completion of coordination and a relocation plan is approved by CDFG.
- Clokey's cryptantha and Mojave fishhook cactus have a moderate potential to occur at on the project site. A rare plant survey may be required by CDFG depending on project permitting needs.

SECTION 5

References

Holland, R.F. 1986. *Preliminary Descriptions of The Terrestrial Natural Communities of California*. California Department of Fish and Game. Unpublished report.

Sawyer, J. and T. Keeler-Wolf. 1995. *A Manual of California Vegetation*. California Native Plant Society, Sacramento.

Calflora. 2012. Information on California plants for education, research and conservation, based on data contributed by dozens of public and private institutions and individuals, including the Consortium of Calif. Herbaria. [web application]. Berkeley, California: The Calflora Database [a non-profit organization]. Online: http://www.calflora.org/

California Department of Fish and Game (CDFG). 1993. *Burrowing Owl Survey Protocols and Mitigation Guidelines.*

California Department of Fish and Game (CDFG). 2012. State and federally listed endangered, threatened, and rare plants of California. Online: http://www.dfg.ca.gov/bdb/pdfs/TEPlants.pdf

California Native Plant Society (CNPS). 2012. *The California Native Plant Society's Inventory of Rare and Endangered Plants of California* (Online edition, version 7.7). Online: http://www.rareplants.cnps.org/.

Grinnell, J. and A. H. Miller. 1944. *The Distribution of the Birds of California*. Pacific Coast Avifauna. Vol. 27

U.S. Fish and Wildlife Service (USFWS). 1992. Field Survey Protocol for Any Federal Action that May Occur within the Range of the Desert Tortoise.

U.S. Fish and Wildlife Service (USFWS). 1996. *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Plants*. USFWS, September 23.

U.S. Fish and Wildlife Service (USFWS). 2010. *Desert Tortoise Pre-project Survey Protocol 2010 Field Season: Preparing For Any Action That May Occur Within The Range of The Mojave Desert Tortoise (Gopherus agassizii)*.

U.S. Fish and Wildlife Service (USFWS). 2012. *Species Profile: Desert tortoise (Gopherus agassizii). April 2012. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C04L*.

Appendix A
Photographs of Sensitive Species Sign



GPS Location 002. Desert tortoise shell-skeletal remains.



GPS Location 003. Desert tortoise pallet.

AR060221



GPS Location 004. Live desert tortoise burrow.



GPS Location 005. Desert tortoise carcass.



GPS Location 006. Inactive desert tortoise burrow.



GPS Location 007. Inactive desert tortoise burrow.



GPS Location 008. Inactive desert tortoise burrow.



GPS Location 009. Desert tortoise shell-skeletal remains.



GPS Location 010. Inactive desert tortoise burrow.



GPS Location 011. Live desert tortoise burrow.



GPS Location 012. Desert tortoise carcass.



GPS Location 013. Inactive desert tortoise burrow containing a desert tortoise egg from last year.



GPS Location 014. Desert tortoise shell-skeletal remains.



GPS Location 015. Desert tortoise carcass.



GPS Location 016. Active desert tortoise burrow.



GPS Location 017. Active desert tortoise burrow.



GPS Location 018. Desert tortoise carcass.



GPS Location 019. Active desert tortoise burrow.



GPS Location 020. Desert tortoise shell-skeletal remains.



GPS Location 021. Desert tortoise shell-skeletal remains.



GPS Location 022. Desert tortoise shell-skeletal remains.



GPS Location 023. Desert tortoise shell-skeletal remains.



GPS Location 024. Desert tortoise carcass.



GPS Location 025. Desert tortoise carcass.



GPS Location 026. Inactive desert tortoise burrow.



GPS Location 027. Inactive desert tortoise burrow.



GPS BUOW1. Inactive burrowing owl burrow with old whitewash and pellets present.



GPS BUOW2. Active burrowing owl burrow with adult present.



GPS BUOW3. Active burrowing owl burrow with whitewash and pellets present.



GPS BUOW4. Inactive burrowing owl burrow with old whitewash and pellets present.



GPS BUOW5. Inactive burrowing owl burrow with small bones and pellets present.



GPS BUOW6. Active burrowing owl burrow.



GPS BUOW7. Inactive burrowing owl burrow with older whitewash and pellets present.



GPS BUOW8. Inactive burrowing owl burrow with old whitewash and pellets present.

enXco

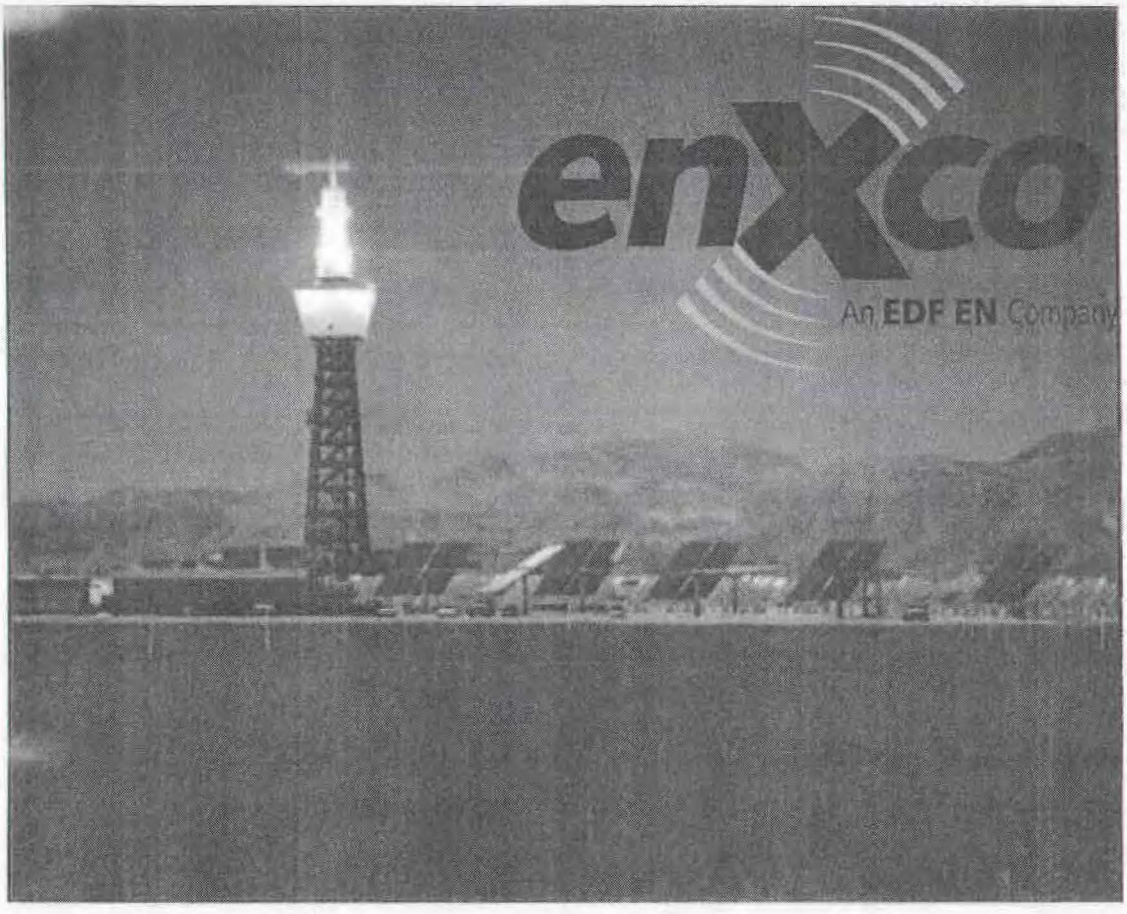
RECEIVED
BUREAU OF LAND MANAGEMENT
09 MAR -4 PM 3:00
PALM SPRINGS-SOUTH COAST
RESOURCE AREA

McCoy Soleil

Plan of Development

Confidential

Submitted to:
Bureau of Land Management Palm Springs Field Office, CA



Submitted by:

enXco Development Corp.

enXco

Project Description 4
1.0 Introduction 4
1.0.1 Executive Summary- Description of facility 4
1.0.2 Schedule for project 4
1.1 Proponent's Purpose and need for the Project 4
1.0.3 Technology overview 5
1.0.4 Technology History 5
1.0.5 Technology Description 6
1.2 General Facility Description, Design and Operation 7
1.2.1 Project Location, Land Ownership and Jurisdiction 7
1.2.2 Legal land description of project area ROW 9
1.2.3 Total Acreage and general dimensions of facilities and components 9
1.2.4 Numbers and General Dimensions of Solar Array 10
1.2.5 Towers, substations, transmission lines, access roads 11
1.2.6 Temporary construction workspace, yards, and staging areas 12
1.2.7 Geotechnical studies and data needs, including solar insolation testing 13
1.2.8 Ancillary Facilities 13
1.2.9 Water usage, amounts, sources 13
1.2.10 Erosion control and stormwater drainage 14
1.2.10.1 Erosion control and stormwater drainage BMPs 14
1.2.11 Vegetation treatment and weed management 16
1.2.12 Waste and hazardous materials management 17
1.2.13 Fire Protection 18
1.2.14 Site Security and fencing during construction and operation 19
1.2.15 Electrical Components, new equipment and system upgrades 20
1.2.16 Interconnection to electrical grid – gen-tie 21
1.2.17 Spill prevention and containment for construction and operation 22
1.2.18 Health and Safety Program 22
1.3 Other Federal, State and Local Agency Permit Requirements 23
1.3.1 Status of Permits 26
1.4 Financial and Technical Capability of Applicant 27
1.4.1 About enXco, EDF EN and the EdF Group 27
1.4.2 Financial Capability 28
1.4.3 Finance structure 28
1.4.4 enXco's Solar Experience 29
1.4.5 enXco's Operating and Maintenance Experience: 29
2.0 Construction of Facilities 30
2.1 Solar Field Design, Layout, installation, and construction 31
2.1.1 Timetable for construction 31
2.2 Phased Project: approach to construction and operations 31
2.3 Access and Transportation System, component delivery, and worker access 32
2.4 Construction Work force numbers, vehicles, equipment, timeframes 33
2.5 Site Preparation, surveying, staking 34
2.6 Site Preparation, vegetation removal and treatment 35
2.7 Site Clearing, Grading and excavation 35
2.8 Solar array assembly and construction 36
2.9 Power Plant Construction 38
2.10 Gravel, aggregate, concrete needs and sources 39
2.11 Electrical Construction Activities 40
2.12 Aviation Lighting 40
2.13 Site Stabilization, protection, and reclamation practices 41
2.13.1 Site Closure and Reclamation 41
3.1 Transmission System Interconnect 42

3.1.1 Existing and proposed Transmission system 42
3.1.2 Ancillary facilities and substations 43
3.1.3 Status of Power Purchase Agreements 43
3.1.4 Status of Interconnect Agreement 43
3.1.5 General Design and Construction Standards 43
3.2 Gas Supply Systems 43
3.3 Other Related Systems 44
3.3.1 Communications system requirements 44
4.0 Operations and Maintenance 44
4.1 Operation and facility maintenance needs 45
4.1.1 Operation Plan 45
4.1.2 Maintenance Program 46
4.2 Maintenance activities including mirror washing, roads 47
4.3 Operations workforce and equipment 48
4.3.1 Staffing 48
4.3.2 Staff Training and Safety 48
4.3.3 Administrative Activities 49
4.3.4 Capital Improvements 50
4.3.5 Operations Equipment 50
5.0 Environmental Considerations 50
5.1 Air Quality 50
5.2 Biological Resources 51
5.3 Cultural Resources 53
5.4 Geologic Resources and Hazards 54
5.5 Hazardous Materials Handling 54
5.6 Land Use 55
5.7 Noise 55
5.8 Paleontological Resources 55
5.9 Public Health 56
5.10 Socioeconomics 56
5.11 Soils 56
5.12 Traffic and Transportation 56
5.13 Transmission Line safety 57
5.14 Visual resources 57
5.15 Waste Management 58
5.16 Water 58
5.16.1 Water Availability 58
5.16.2 Estimate of Daily and Annual Water Consumption Requirements 59
5.16.3 Waste Water 60
5.17 Mitigation Measures proposed by enXco 60

enXco

Project Description

1.0 Introduction

1.0.1 Executive Summary- Description of facility

enXco Development Corp. proposes to develop "McCoy Soleil," a 300 Megawatt renewable energy resource incorporating Solar Reserve's "Solar Power Tower" concentrating solar power (CSP) technology. The proposed project, located approximately.10 miles northwest of the town of Blythe, CA, may use portions of 23 sections of BLM administered land, applied for under serialized application CACA 049490.

The technology that will be used at McCoy Soleil has been proven at the Department of Energy's Solar One and Solar Two facilities just east of Barstow. Solar Reserve holds the exclusive license to develop the technology proven at Solar Two and further refined since. Upon construction the project will consist of approximately 8500 heliostats each 120m2, sited over an approximate two and a half square mile solar field. At the center of that field would be a 600 ft. tower with a solar receiver at the top, two storage tanks at the base of the tower to store molten salt, and several other ancillary buildings also at the base. The project will be interconnected via a new 230kv interconnection at the proposed Midpoint substation approximately 14 miles away.

1.0.2 Schedule for project

McCoy Soleil is currently waiting for the first phase of the transmission study results before proceeding to the next major phase of development. At this time, enXco is predicting a COD of December 2013, to coincide with the predicted on-line date of the Devers Palo Verde 2 transmission project. Please see the Appendix for a detailed chart of the project schedule.

1.1 Proponent's Purpose and need for the Project

enXco is a renewable energy development and operations company which seeks to provide clean, renewable energy to the Southern California electricity system. California is currently experiencing increased load growth and requires new sources to meet demand. In addition, California has passed two important laws, instituting a statewide renewable portfolio standard (RPS) and greenhouse gas reduction plan (AB-32). The RPS currently requires independently owned utilities in California to purchase 20% of their energy from renewable sources by 2010. Governor Schwarzenegger signed an executive order, and the CA state legislature is currently writing a bill to require a 33% RPS by 2020. Utilities and other greenhouse gas (GHG) emitters in California will simultaneously need to reduce their GHG emissions through the implementation of AB-32.

Once operational, McCoy Soleil will be able to provide southern California with high value fully dispatchable electricity generated from a renewable resource. Because solar power produces energy during the peak energy demand, the resource is highly valued by utilities. Thus, McCoy Soleil will help the utility meet its renewable energy requirements, California meet its AB-32 requirements, and it will allow BLM to help meet the challenge of the Energy Policy Act of 2005 to install at least 10,000MW of non-hydro renewable generation capacity on public lands by 2015.

In order to select the best possible site for CSP development using BLM administered lands enXco used the following criteria for McCoy Soleil:

- **Solar Insolation** – This area of the Mojave desert ranks among the highest insolation values in North America, with a corresponding benefit to net capacity factor projections. This will result in a lower cost of electricity for California ratepayers.
- **Road and Transmission Access** – Parcel is located within an area that is readily accessible for roads and transmission right of way.
- **Distance to Point of Interconnect** – The proposed Midpoint substation is located approximately 14 miles to the south of the project boundary.
- **Size** – The heliostat field and power block will cover the majority of the project area. For detailed acreage requirements, please see Table 1.2.3 and the drawings in the Appendix.
- **Environmental Consideration** – Site screening took into consideration potential presence of endangered/threatened species, impacts on surface & groundwater, impacts on ecology & flora, impacts on terrestrial fauna, impacts on soils & agricultural potential, impacts on avifauna, impacts on cultural heritage resources, noise impacts, potential social and visual impact. Please see section 5.0 for a further discussion of environmental considerations.
- **Soil Conditions** – enXco has not yet completed a soil test to determine requirements for foundations for the solar array. Preliminary walk-through by civil engineers suggests that the foundations discussed in section 5.8 will be sufficient for geotechnical needs.

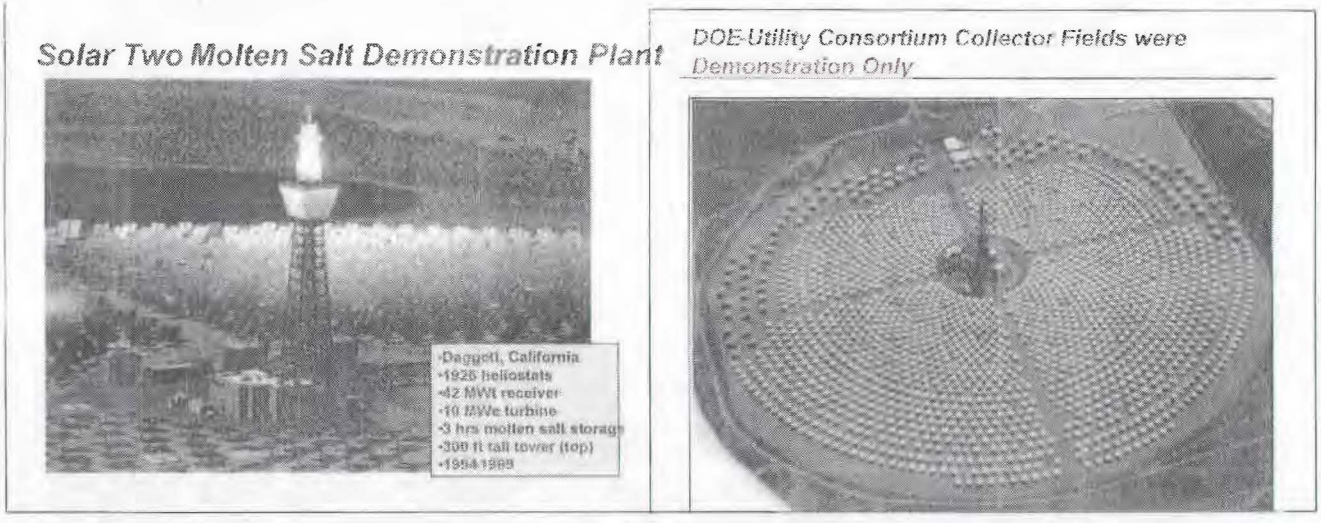
1.0.3 Technology overview

Once operational, McCoy Soleil will use the sun's energy to heat molten salt, which will be used to generate steam, on demand, in order to turn a traditional steam turbine. The unique aspect of this technology is its ability to store the sun's thermal energy in the form of molten salt for extended periods of time. By storing the sun's thermal energy a few hours or a few days, McCoy Soleil will be able to generate electricity at the times it is most critical for the utility to receive firm capacity, during peak and super-peak periods. Additionally, McCoy Soleil will be able to do what most solar based renewables cannot, deliver full capacity to the grid when it's cloudy, or even at night. Thus, McCoy Soleil will deliver zero emission, solar generation to SCE at the times it needs it most.

1.0.4 Technology History

The technology that will be implemented at the McCoy site was proven in a demonstration plant just west of Barstow, CA. The Department of Energy backed 'Solar One' and 'Solar Two' projects of the 1980s and 1990s were the first demonstration of the solar tower power technology that will be used at McCoy Soleil. Located just east of Barstow California, both Solar One and Solar Two were joint projects between the U.S. Department of Energy, the Solar Energy Research Institute (now NREL), Rocketdyne (now part of United Technologies) and a consortium of investor owned utilities. Solar One, which operated from 1982 to 1986, was based on direct steam generation technology. Without an ability to store the thermal energy, Solar One proved to be uneconomical as the loss of the sun's energy (e.g., clouds, night) resulting in a significant drop in plant performance. With Solar Two, Rocketdyne incorporated a molten salt loop in the plant enabling the efficient storage of thermal energy and the ability to continue to

generate power when the sun wasn't available. This also created the ability to deliver solar electricity 24 hours a day, the addition of thermal storage also created the ability to dispatch solar electricity when power is most needed during periods of peak demand. As a result, Solar Two demonstrated a significant increase in overall plant efficiency. Below are pictures of the Solar Two plant.



Pictures of Solar One and Solar Two

In the years since the completion of Solar Two, Solar Power Tower technology has been improved to enhance overall efficiencies and controls. Market conditions and the emergence of renewable portfolio standards have positioned the Solar Power Tower project incorporating molten salt technology as the solar technology with the greatest potential to make electricity competitive for utilities and grid operators. Solar Power Towers are currently being built in southern Spain, and Solar Reserve will have at least one plant operational prior to construction of McCoy Soleil, in order to prove out the technology at large scale.

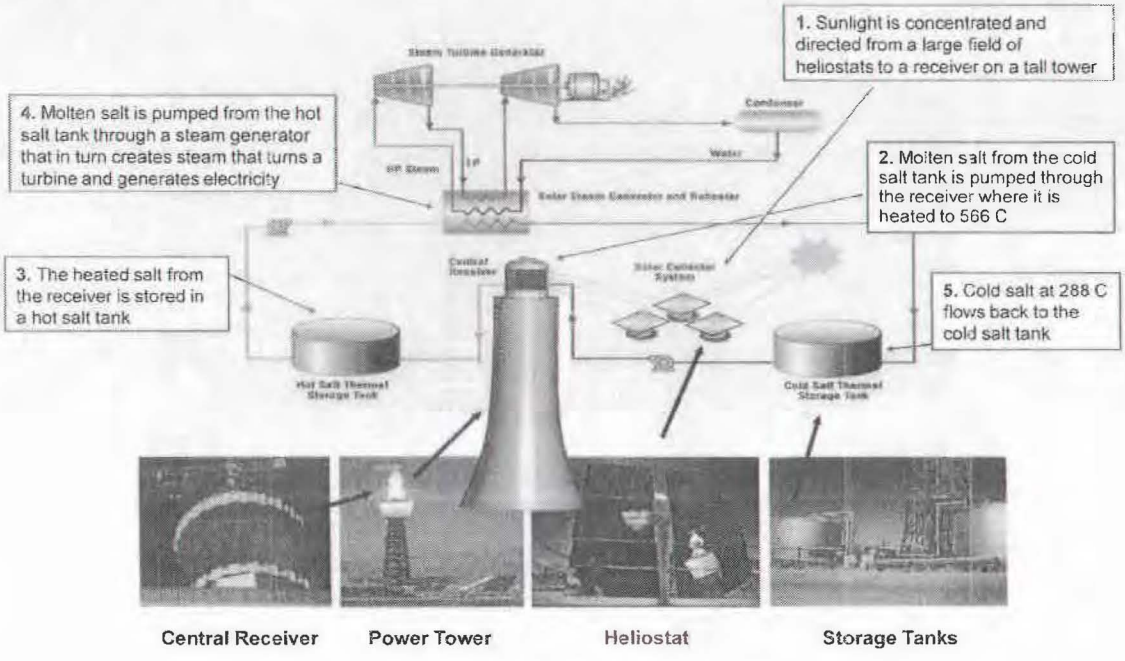
1.0.5 Technology Description

The Solar Power Tower project provides the unique capability to efficiently store solar energy, thereby enabling solar electricity to be generated and dispatched when desired. The plant consists of three major subsystems: 1) a field of heliostats, 2) the molten salt system, and 3) a conventional steam turbine power generation facilities [see Figure 6]. The generation of solar power starts with the heliostats concentrating the solar energy onto a central receiver (step 1). This receiver consists of thin-walled tubes through which molten salt passes, absorbing the solar energy (step 2). The molten salt leaves the central receiver and proceeds to a storage tank, the "hot salt thermal storage tank" (step 3). Since the molten salt material is very efficient at storing solar energy, the Power Tower project provides a firm source of renewable power that can be dispatched when needed. The molten salt then moves through a heat exchanger, which transmits its energy to generate steam which is sent to a steam turbine generating electricity (step 4). After generation of steam in the steam generator heat exchanger, the molten salt is sent to another the cold salt terminal storage tank, (step 5), and the cycle is repeated.

enXco

Solar Power Tower with Energy Storage

SolarReserve



3

1.2 General Facility Description, Design and Operation

1.2.1 Project Location, Land Ownership and Jurisdiction

The site for McCoy Soleil is located in Riverside County, approximately 10 miles northwest of the town of Blythe, CA. Please see section 3.2 for a better understanding of the previous use of Solar Reserve's technology in the California Desert. McCoy Soleil's site consists of nineteen (19) full sections and three (3) partial sections that are administered by the Bureau of Land Management. Please see drawings in the Appendix for a overview of the site, and section 1.2.2 for the list of the BLM property sections considered for this project site. enXco will be siting the solar facilities in one of the two locations identified in the Appendix. At that time, enXco will be pleased to relinquish any unused portions of the application to BLM. Final siting will be determined after detailed biological field studies are completed in order to avoid the most sensitive habitats, such as Desert Wash Woodlands. Final road alignment will likewise be determined by biological and cultural studies.

The McCoy Soleil project location is crossed by a gas ROW through the middle which will be avoided by the solar facilities. The average slope of the land under consideration is under 1%, which makes it ideal for solar CSP. The sections in question contain dry washes that flow predominantly northwest to southeast towards Blythe, and are fed by McCoy Mountains to the northwest. It is enXco's goal to minimize disturbance to the desert washes. Please see section

1.2.10 and drawings in the Appendix for detailed information on stormwater drainage and erosion control.

In addition to the physical characteristics of the site, the area was selected due to its easy access via existing roads. The site is directly off of and easily accessed via the Kaiser Mine road, north of Interstate 10. Although the existing roads would be used to the extent possible, the existing dirt track will need to be upgraded to access the facilities, and unpaved roads would be constructed to serve as access roads from the existing road network to the facilities and heliostat field. Please see section 2.7 for further discussion of grading and roadwork that will be required, and the Appendix for maps and drawings indicating the preliminary road and heliostat layout.

enXco

1.2.2 Legal land description of project area ROW

MTRS	Survey Type	Subdivision
27 0050S 0210E 002	ALL	ENTIRE SECTION
27 0050S 0210E 003	ALL	ENTIRE SECTION
27 0050S 0210E 004	ALL	ENTIRE SECTION
27 0050S 0210E 005	ALL	ENTIRE SECTION
27 0050S 0210E 006	ALL	ENTIRE SECTION
27 0050S 0210E 007	ALL	ENTIRE SECTION
27 0050S 0210E 008	ALL	ENTIRE SECTION
27 0050S 0210E 009	ALL	ENTIRE SECTION
27 0050S 0210E 010	ALL	ENTIRE SECTION
27 0050S 0210E 011	ALL	ENTIRE SECTION
27 0050S 0210E 012	ALL	ENTIRE SECTION
27 0050S 0210E 013	ALL	ENTIRE SECTION
27 0050S 0210E 014	ALL	ENTIRE SECTION
27 0050S 0210E 015	ALIQ	S2;
27 0050S 0210E 017	ALL	ENTIRE SECTION
27 0050S 0210E 018	ALL	ENTIRE SECTION
27 0050S 0210E 019	ALIQ	NE
27 0050S 0210E 020	ALL	ENTIRE SECTION
27 0050S 0210E 021	ALL	ENTIRE SECTION
27 0050S 0210E 022	ALL	ENTIRE SECTION
27 0050S 0210E 023	ALL	ENTIRE SECTION
27 0050S 0210E 024	ALIQ	S2;

1.2.3 Total Acreage and general dimensions of facilities and components

Within the heliostat array fields, the power block area, the permanent facilities located around the perimeter road and in the temporary construction logistics area, clearing would be performed. All vegetation would be removed with a brush rake in order to separate the vegetation from the soil. The proposed disturbed area within the subject BLM right-of-way land is estimated to be 1808 acres. The new transmission line will disturb approximately 56 acres outside of the project area. The roadway to the site will follow an existing trail, but will disturb an additional 5.5 acres. The acres required for McCoy Soleil are described below and depicted in the drawings in the Appendix.

Estimated Overall Project Acreage		
Project Component	**Temporary (acres)**	**Permanent (acres)**
Current Right of Way	13959	13959
Transmission ROW (to be added to current 299 application)	136	136
Solar Heliostat Field	831	831
Operations and Maintenance Areas	8	6.4

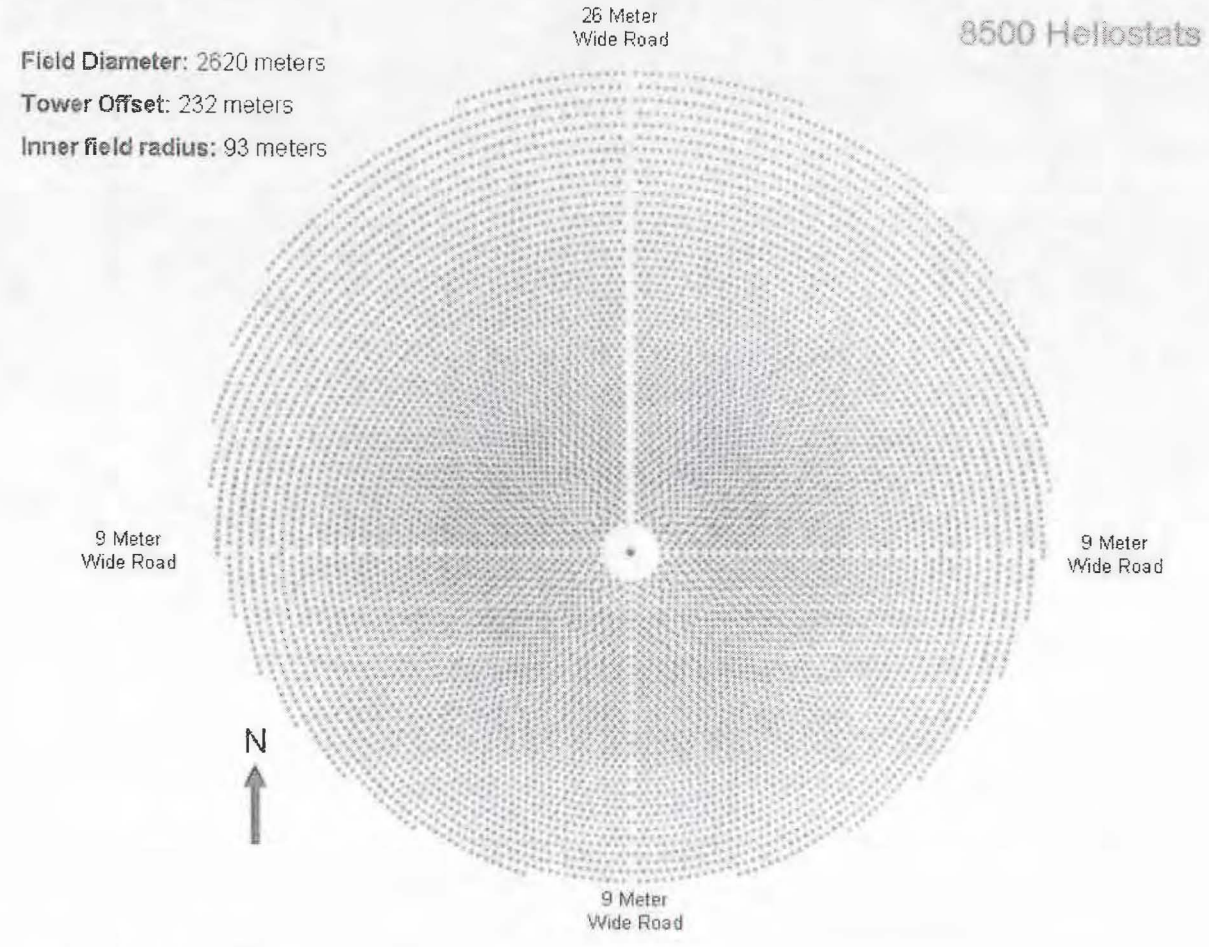
Switchyard	5	3.7
Roads outside project area	8	5.5
Construction Laydown Area	10	2
Transmission Lines disturbed	146	56
Total BLM acres disturbed	1911	1808

1.2.4 Numbers and General Dimensions of Solar Array

Approximately 8500 of these heliostats will be sited around the base of the tower. This sort of solar field technology is unique in that the siting of these heliostats is more flexible than the solar fields of other CSP technologies. By being somewhat modular in nature washes, hills, mounds and other micro-topography may be more easily avoided than in a typical trough plant. Thus a solar tower would require a fraction of the grading necessary for a trough plant, and will thus maintain the integrity of the soil surface. Though enXco anticipates it will have to site a portion of heliostats do to micro-topography, it will endeavor to keep the solar field as tight as possible so to limit the total area affected by the solar field.

enXco

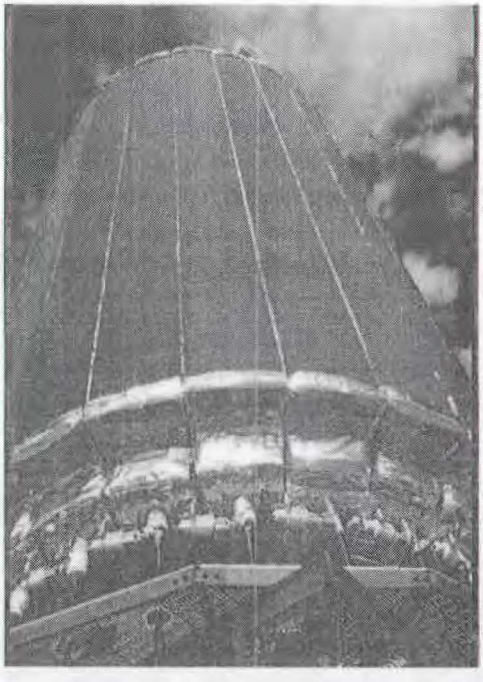
SolarReserve Optimal Heliostat Layout



Solar Field optimal layout.

1.2.5 Towers, substations, transmission lines, access roads

At the center of the heliostat field will stand the receiver tower. The tower will be approximately 600 ft tall, with the solar receiver taking up the top 60 ft. The tower will be made predominantly of slipform concrete, with the solar receiver sitting on top and a few other ancillary elements like walkways and cranes to help service the receiver during scheduled maintenance. The receiver is made of a several panels and a multitude of thin-walled pipes through which the molten salt flows. To the right is an indicative picture of the solar receiver to be used at McCoy Soleil.



From the 'cold storage tank' below molten salt ~500°F will be pumped up the tower, it will flow through the pipes of the receiver and absorb the sun's thermal energy focused by the solar field. After absorbing the sun's heat the molten salt will flow back down to a 'hot storage tank' where the ~1000°F molten salt will be stored until it is pumped to a heat exchange which will generate steam to turn the steam turbine. Upon going through the heat exchanger, the cooled salt will be pumped back to the 'cold storage tank' closing the molten salt loop.

The nitrate salts used in the receiver are similar to that used in fertilizers, consisting of a 60:40 ratio of $NaNO_3$ (sodium nitrate) and KNO_3 (potassium nitrate). Since the molten salt loop is a closed system minimal salts will have to be added once the plant is operational. The small amounts of salt that would escape the loop are relatively harmless once cooled. After being swept up, these salts are innocuous and typically can be disposed of at any local landfill.

Please see the drawings in the Appendix for a diagram of the tower molten salt loop elements and steam turbine elements.

Preliminary layout and road design is based on detailed topographic maps and an on-site walk-through by civil engineers. Final service road alignments will also be dependent upon the final results of the environmental report documenting the results of field investigations. All standard engineering practices are incorporated into the road design and all applicable engineering designs will be applied to minimize soil erosion as caused by normal seasonal precipitation. The project access will use as much of the existing road structure as feasibly possible. Please see drawings in the Appendix for maintenance access road with culverts, typical road layout in the solar field, and road and erosion control treatments.

1.2.6 Temporary construction workspace, yards, and staging areas

enXco and our consultants are still engaged in designing the details of the construction process and will provide extensive drawings of temporary facilities during the NEPA process.

Temporary construction buildings will include 3-4 trailer offices for the management of the construction. enXco has not chosen a final location for these, but they will be along the northern border of the project area, in the vicinity of the entrance gate. Portable latrines will also be located in this area.

A small laydown area will be required adjacent to the heliostat assembly building of approximately 2 acres to accommodate delivery of materials, vehicles, etc. Additional parking and delivery of construction materials will utilize the future heliostat footprint, prior to its construction. Please see the Appendix for location and detail.

enXco does not anticipate that any additional land will be disturbed for laydown in the solar field. However, if additional temporary staging areas are required, they will be detailed in the EIS, and these will be restored to their prior condition once project construction is complete. No temporary disturbance is required outside the ROW application and final perimeter fencing. Please see the table of disturbed acres in section 1.2.3 for temporary and permanent acres required.

1.2.7 Geotechnical studies and data needs, including solar insolation testing

Preliminary geotechnical studies were conducted by civil engineers. The soils analysis was incorporated in the preliminary grading and drainage plan, and in the analysis of foundation requirements for the solar field. A more detailed study will be required as outlined below.

enXco plans to install a pyranometer to collect global horizontal and direct-normal solar radiation data from the site location in order to better predict solar plant electricity production. Installation of the ten (10) foot square non-penetrating cement pad, with solar testing equipment, and surrounded by 40-foot square fence will likely commence in early spring 2011 after the required EA is obtained and approved. The site for the pyranometer will be adjacent to the future O&M building and will be detailed in the EA for the testing ROW.

Additional testing needs that may be undertaken include:

- Aerial (LIDAR) survey to support detailed civil grading and drainage design;
- Hydrologic/drainage study including a regression analysis for detailed site drainage design and erosion and control plan;
- Geotechnical investigation, including borings, soil sampling, and ground penetrating studies for foundation and earthwork design, and dirt access road treatments;
- Test well program and aquifer testing to evaluate potential on-site groundwater sources;

All additional testing that may involve ground disturbance will receive an authorized permit by the BLM before commencement of activities.

1.2.8 Ancillary Facilities

Ancillary structures will include a 60'x 60' O&M building to house several on-site engineers and administrative personnel, small 50' x 50' heliostat assembly and storage shed for spare parts and a small parking area for workers. Please see the Appendix for placement of the facilities.

1.2.9 Water usage, amounts, sources

During Construction, water will be used to minimize fugitive dust as well as for other construction activities such as soil compaction. Based on expected soil moisture content and the optimal moisture of the soil necessary to achieve proper compaction, it is estimated that 1000 acre-feet (AF) of water will be necessary for the first year of construction. For subsequent construction years, 150 AF will be required for on-going dust mitigation. An on-site well will be permitted through the California State Division of Water Resources. Portable bathrooms will be provided during construction, as needed, and will be emptied offsite per regulations.

The proposed station is designed with a dry cooling tower for steam cycle cooling. This facility will require water for make-up of condensate due to normal relief valve losses and minor spills, general facilities and human consumption and water to wash the heliostats. Heliostat washing is a normal, continuous process that will occur regularly, with a wash water requirement of less than 70 acre-feet per year.

Water will be supplied from a well field developed at the project. A water tank will have a sufficient capacity for a one day operation at peak power generation. The water use can be divided into the following three categories based on the quality required:

(1) Service water which includes all other miscellaneous uses;
(2) Demineralized water for make-up to the steam cycle and mirror washing and
(3) Potable water.

The water will be treated using a conventional water treatment system to meet all plant needs. The plant will require a raw water storage tank, on the order of 2 million gallons, which will also contain a minimum of 300,000 gallons of water for fire protection capabilities. Steam cycle process water must meet stringent specifications for suspended and dissolved solids. This water will be processed by means of a demineralized water makeup system. enXco anticipates this will consist of multiple operations, concluding with mixed-bed demineralizers. The feedwater system will also include mechanisms to control dissolved oxygen, maintain a specific pH, and minimize scale formation. Demineralized water will also be used for the washing of heliostats. Potable water that meets regulatory standards for safe drinking water will be further treated on-site. The potable system will supply water to sinks, toilets, showers, drinking fountains, and emergency eye wash safety showers.

Water Consumption Requirements	Approximate Consumption during Construction	Approximate Consumption during Operation
Steam Cycle makeup water (AF)	0	100
Mirror wash water (AF)	0	70
Air cooled condenser augmentation (AF)	0	430
Construction year 1 (AF)	1000	0
Construction subsequent years (AF)	150	0
Total annual (acre-feet/year)	575 (2 years)	600

1.2.10 Erosion control and stormwater drainage

Once the earthwork grading and pad construction has been completed, the following storm water conveyance system and permanent BMPs will be placed. The site's final grade will be such that storm water from within the heliostat field will sheet flow to geocell lined service roadway swales that will convey flows to the southern portion of the project. The detained runoff will discharge offsite to existing natural drainage channels. The post-development sediment/retention basin and discharge points will provide storm water pollution prevention BMP controls along with retention time to reduce the peak offsite discharge to match pre-development conditions. The storm water discharge points will maintain the existing natural drainage course and will provide increased offsite drainage controls for the 100-year return storm event. Secondary storm water release greater than the sediment basin capacity will flow over the southern basin berm and roadway into the natural drainage channel without damaging the solar field improvements or adjacent down stream conditions. The discharge outlets will be constructed with rip rap, which will serve as an energy dissipater for heavy storm water discharge.

The offsite storm water run-on will sheet-flow to a perimeter geocell diversion channel with two controlled offsite concentrated discharge points. The upstream portions will also be protected with a perimeter road berm that will provide site protection from storm water run-on during a 100-year return storm event. The toe of the northern protective berm slope will be armored with soil cement cover and rip-rap to provide for slope erosion protection during a heavy storm event.

Storm water management calculations will be completed to develop drainage and erosion control protection for support of the construction activities, final grading, drainage system sizing for the 25-year return storm event; and the 100-year event flood control protection. These calculations will evaluate the following:

- Identify the site drainage patters and drainage areas for each phase of construction.
- Identify the design storm event
- Determine peak discharge rate
- Determine the required capacity for the drainage control systems
- Develop flood control protection elevations
- Design and size storm water control systems components

1.2.10.1 Erosion control and stormwater drainage BMPs

Construction and industrial operations at the site will be subject to the General Construction and General Industrial Storm Water National Pollution Discharge Elimination System (NPDES) permits, respectively. Compliance with these permits will require preparation and implementation of construction and operation Storm Water Pollution Prevention Plans (SWPPPs) that address the following requirements (among others):

- Identification of activities that may pollute storm water;
- Identification of Best Management Practices (BMPs) to control storm water pollution, including water erosion and wind erosion;
- BMP inspection, maintenance and repair;
- Training; and
- Site inspection and monitoring.

Erosion and sedimentation control BMP's will be designed and implemented to meet the requirements of the General Construction and General Industrial Storm Water NPDES permits as well as any requirements specified by the BLM.

The area of soil disturbance for the project would be kept to a minimum to limit wind and water erosion and enhance successful site rehabilitation/restoration. The areas of soil disturbance would be limited to pipeline alignments, transmission lines, access roads, construction support areas, and the heliostat, power block and operational support facilities.

Soil stabilization measures would be used to prevent soil being detached by stormwater runoff or wind erosion. The Applicant would employ temporary and permanent BMPs to protect the soil surface by covering or binding soil particles or preventing the concentration of runoff. The project would incorporate erosion-control measures required by regulatory agency permits and contract documents as well as other measures selected by the engineer. Site-specific BMPs

would be identified in the SWPPP, with final selection and design by the engineer, and associated figures to be included in the final active project SWPPP.

Project design features and or mitigation measures that will aide in the protection of soil resources could include at a minimum:

- Erosion and sedimentation control calculations performed to verify acceptable stormwater velocities, calculate BMP clean out frequencies and to size rip rap.
- Construction and final drainage designed to promote sheet flow, avoid un-necessary concentration of runoff, and control runoff velocity.
- Stone filters and check dams strategically placed throughout the Site to provide areas for sediment deposition and to promote the sheet flow of stormwater prior to leaving the Site boundary. Where available, native materials (rock and gravel) would be used for the construction of the stone filter and check dams. A stone crusher may be provided on site to utilize local stone for the production of gravel.
- Diversion berms, culverts and water bars would be utilized to redirect stormwater.
- Diversion channels would be armored as required to prevent erosion and scouring.
- Flat detention/infiltration ponds and ditches would be used.
- Where possible, maintenance roads would be designed not to disrupt regional flow patterns.
- Silt fences would be utilized extensively during each phase of construction to minimize wind and water erosion. Silt fence locations have yet to be determined and would be provided on the 90% engineering drawings.
- In areas of temporary disturbance (e.g., pipeline or transmission line alignment, temporary construction support areas), the surface would be recontoured to promote sheet flow and restore and match the original or surrounding drainage function. Native vegetation would be restored to promote healing of the landscape.
- Periodic maintenance conducted as required after major storm events and when the volume of material behind the check dams exceeds 50 percent of the original volume. Stone filters and check dams are not intended to alter drainage patterns but are intended to minimize soil erosion and promote sheet flow.
- Erosion and Sedimentation control BMP design would be in accordance with applicable government codes and standards.

1.2.11 Vegetation treatment and weed management

Excavation will require the removal of all vegetation from the areas to either be excavated (cut) or filled, which include the powerblock and tower, access roads, laydown, parking and O&M facilities. Vegetation under 18" may be able to be maintained within the solar field. At a minimum, all vegetation between every other row will be cleared with a blade to reduce the risk of fire and allow construction and maintenance access. Scarifying by blade will disturb the soil

to several inches and potentially allow some roots to remain to assist in soil stabilization and reduce the possibility of erosion. These scarified areas will serve as the access roads for both installation and continued maintenance and cleaning of the heliostat field. As such, they will be moderately graded to allow regular access with a pick-up truck-mounted tanker for washing. Continued weed management in cleared areas would be maintained through targeted application of herbicides such as Roundup® and/or by occasional scarification. Additional soil disturbance by regular operations of the plant is not expected.

enXco will develop a Weed Management Plan (WMP) for McCoy Soleil that describes non-native, noxious or invasive weed species that occur or are likely to occur at the site and prescribes management actions that may be taken to monitor and eradicate specified species. The WMP will also describe applicable regulations for the use of herbicides on federally managed lands in California, and provide the basis for proper management and use of herbicides at the site.

Typical operations and maintenance requirements for native landscapes are low once established. The WMP will include weeding, annual pruning, and soil monitoring if necessary. Weeding should occur frequently during the initial growth period to ensure that invasive plants do not mature and set seed. Weeding activities will follow the approved WMP. Once the native plant species are established, weeding frequency will drop to less frequent levels.

Vegetation will be allowed to re-grow within the heliostat field to the extent that it doesn't interfere with the movement of the heliostats. Vegetation will not be allowed to grow above 18". The access roads will be kept clear of vegetation and maintained as described further in section 4.1.

1.2.12 Waste and hazardous materials management

The McCoy Soleil project will be designed, constructed, operated and maintained to ensure the safe use and storage of hazardous materials. Storage, handling, and use of all chemicals will be conducted in accordance with applicable laws, ordinances, regulations and standards. Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Workers will be trained to handle hazardous wastes generated at the site.

Once construction is complete, McCoy Soleil will have minimal hazardous and non-hazardous waste at the site. The molten salt is a combination is a 60:40 ratio of Sodium Nitrate ($NaNO_3$) and Potassium Nitrate (KNO_3), in their sold form these two salts are traditionally used as elements in garden fertilizer. Since the salts are only used as a thermal working fluid and are not consumed, it is used continuously for the life of the plant without need for re-processing. Occasional spills of small quantities of salt from a leaking gasket quickly freeze and are picked up by plant staff and put into a waste receptacle. Depending upon the rules of the local jurisdiction this salt can be reused or disposed of in a landfill. At the end of the Solar Two demonstration period, the salt was solidified onsite and sold for fertilizer.

In addition to small quantities of salt which may leak, the turbine plant drains flow to an oily waste separator common to many steam plants and the waste removed by vacuum truck to a qualified facility. This fluid may contain lubricants and oils common to the turbine generator island. The quantity of this waste should be no different than for a similar steam unit of comparable size. Where possibilities exist for spills to occur from plant operations, catchment areas will be constructed to contain the spill. For example, the steam turbine will be sited on a cement pad with integrated containment that can control a possible catastrophic spill. Waste containing high metal concentrations, will be temporarily stored on site in portable tanks, and disposed of off-site by a chemical cleaning contractor in accordance with applicable regulatory requirements.

Electric equipment insulating materials will be specified to be free of polychlorinated biphenyls (PCBs).

Safety showers and eyewashes will be provided adjacent to or in the area of all chemical storage and use areas. State approved personal protective equipment will be used by plant personnel during chemical spill containment and cleanup activities. Personnel will be properly trained in the handling of these chemicals and instructed in the procedures to follow in case of a chemical spill or accidental release. Adequate supplies of absorbent material will be stored on-site for spill cleanup.

Other wastes generated on site will include those typical of a commercial building, such as computer and electronic equipment, paper, food scraps, cleaning agents, oily rags, oil and gasoline for vehicle use, etc. All wastes will be disposed of according to applicable LORS. In addition, no food wastes will be available for wildlife such as ravens to scavenge.

1.2.13 Fire Protection

Fire protection will be provided to limit risk of personnel injury, property loss, and possible disruption of the electricity generated by the project. Fire protection starts with reduced flammable materials in the solar field, including vegetation. This is one of the primary reasons that some vegetation will be removed from the site prior to construction of the solar field. Fire prevention will also be dependent on secure fencing of the site, as described elsewhere. Fire protection also includes appropriate access to all areas of the solar field by fire truck, with turn-around areas. Thus, final plans of the solar facilities will be inspected by local fire marshals for sign-off.

A Fire Protection and Prevention Plan will be prepared for construction and operation of the facility. The plan will include measures to safeguard human life, preventing personnel injury, preservation of property and minimizing downtime due to fire or explosion. Fire protection measures will include fire prevention methods to prevent the inception of fires. Of concern are adequate exits, fire-safe construction, reduction of ignition sources, control of fuel sources, and proper maintenance of fire fighting systems.

During construction, the permanent facility fire suppression system will be placed in service as early as practicable. Prior to installation of the facility's permanent fire suppression system, fire

extinguishers and other portable fire fighting equipment will be available onsite. These fire extinguishers will be maintained for the full construction duration in accordance with local and federal OSHA requirements.

Locations of portable fire extinguishers will include, but not necessarily be limited to office spaces, hot work area, flammable storage areas, and mobile equipment such as work trucks and other vehicles. Fire fighting equipment will be marked conspicuously and be accessible at all times. Portable equipment will be routinely inspected, as required by local and federal LORS, and replaced immediately if defective or in need of charge.

Sprinkler Systems will be installed in the Administration and Operations Building as required by National Fire Protection Association (NFPA) and local code requirements. Handheld fire extinguishers of the appropriate size and rating will be located in accordance with NFPA 10 throughout the facility. The plant will have a minimum of a 3,000,000 gallon raw water storage tank, of which 300,000 gallons will be dedicated to fire protection. One electric and one diesel-powered backup water pump, with a capability of 3,000 gallons per minute, will deliver water to the fire protection pipe system. A smaller jockey-pump will be used to maintain water pressure within the pipe system.

The area with highest fire risk is the power block and tower, as well as the auxiliary and control buildings and the fire protection system will be concentrated on these resources.

1.2.14 Site Security and fencing during construction and operation

Site security will be of the utmost importance due to the high value of the equipment used in construction of McCoy Soleil, and the safety of personnel and the public. At the onset of construction, site access will be controlled for personnel and vehicles. A security fence, which will also be the permanent fence, will be installed around the plant site boundary. At this time, all required laydown areas are expected to be contained within the defined project boundaries, and thus no additional temporary fencing will be required. In addition, security will be enhanced with motion detectors, facility lighting, and cameras in key locations. Care will be taken to prevent undue light pollution from the nighttime security lighting. Exterior lighting will comply with current title 24 regulations from the State of California, limiting uplighting and light pollution from exterior fixtures. Security will be maintained as required by the EPC contractor or a suitable subcontractor to maintain public safety and the security of the facilities.

Security fencing will be erected around the entire perimeter of the project area, with an access gate in the west corner prior to beginning construction. An emergency gate will be in the southwest corner, with access to the existing dirt road..Site perimeter fence will be 8 feet high and have an overall height of no more than 10 feet from the bottom of the fabric to the top barbed wire. The fence will have top rail, bottom tension wire, and three strands of barbed wire mounted on 45 degree extension arms. Posts will be set in concrete.

Controlled access gates will be located at the entrance to the facility. Site gates will be swing or rolling type access gates. Access through the main gate will require an electronic swipe card, preventing unaccompanied visitors from accessing the facility or construction area. All visitors will be logged in and out of the facility during normal business hours. Visitors and non-

employees will be allowed entry only with approval from a staff member of the facility. Visitors will be issued passes that are worn during their visit and returned to the main office when leaving. The facility will be staffed 24 hours/day and 7 days per week to maintain security. Even when the facility is not generating electricity, personnel will be present for maintenance and site security.

To reduce offsite lighting impacts, lighting at the facility would be restricted to areas required for safety, security, and operation. Exterior lights would be hooded, and lights would be directed onsite so that light or glare would be minimized. Low-pressure sodium lamps and fixtures of a non-glare type would be specified. Switched lighting would be provided for areas where continuous lighting is not required for normal operation, safety, or security; this would allow these areas to remain un-illuminated (dark) most of the time and thereby minimize the amount of lighting potentially visible offsite.

1.2.15 Electrical Components, new equipment and system upgrades

Power will be generated by the steam turbine generator (STG) and stepped up through the generator step-up transformer to the utility high voltage system. The generator shall be connected to the step-up transformer by isolated phase bus duct. A low-side generator breaker shall be provided between the generator and the generator step-up transformer (GSU).

The main generator will be synchronized to the utility's transmission system using the generator breaker. The STG will be supplied with metering quality current and potential transformers and meters capable of supplying signals to the control system and performance monitoring system.

A two winding, delta-wye GSU transformer will be designed according to the Institute of Electrical and Electronics Engineers Standards (IEEE) C57.12.00-2000 and supplied for the STG generator. The neutral point of each high voltage (HV) winding will be solidly grounded. The GSU transformer will have metal oxide surge arresters adjacent to the HV terminals.

Accessories will include a local visual enunciator, magnetic liquid-level gauge, pressure-relief device, sudden pressure relay, oil preservation device, valves for top and bottom filter press connections, drain/sampling valves, grounding pads, bushing-mounted current transformers, combustible gas detector, on-line dissolved gas/water monitor with 4-20 milliamp signal out to the controller, and hot spot winding temperature elements.

The GSU will include manual de-energized tap changers located in the HV windings with taps ranging from 5 percent above normal to 5 percent below normal in 2.5 percent increments. GSU transformer auxiliaries will be powered from two 480 V, three-phase, three wire sources for each transformer. Each power supply will be fed from separate sources and routed in separate conduits.

A two-winding, delta-wye UAT transformer will be designed according to the IEEE Standards C57.12.00-2000 and supplied for 4,160 V service. The UAT will be rated to supply facility

startup and maximum operating power requirements. A system calculation showing all connected equipment loads for the UAT transformer will be used to determine the requirements prior to procurement of the UAT. The neutral point of the UAT low voltage (LV) winding will be 1,000 amp (A) low-resistance grounded.

A plant electrical building will house the 4,160 V switchgear, 4,160 V motor controllers, low voltage switchgear, low voltage motor control centers, control panels, power and lighting panels, uninterruptible power supply (UPS), DC station batteries, DC switchboard, and other miscellaneous equipment, steam turbine control equipment and the control I/O cabinets.

The medium voltage switchgear will be single-ended, rated 4,160 V nominal, three-phase, three-wire with ratings not to exceed 3,000 A continuous and the calculated fault current duty. The medium voltage switchgear will receive power from the unit auxiliary transformer through non-segregated phase bus duct.

The medium voltage switchgear lineups will be located indoors, will use vacuum interrupters, and will be rated to continuously distribute the full auxiliary load. Each lineup will contain auxiliary power metering and voltage transformers, a main incoming breaker, and feeder breakers as necessary to distribute the load. All medium voltage breakers will be electrically operated from the control system and equipped with a stored energy mechanism. Breakers will be provided with remote racking mechanisms.

The emergency power for the plant switchyard and other plant critical loads will be supplied by the 125 volt DC (VDC) station battery system.

1.2.16 Interconnection to electrical grid – gen-tie

The project will be connected to the existing SCE transmission system via the Conceptual Midpoint substation located approximately 14 miles south of the project site. The interconnection map, Figure 2 in the Appendix, shows proposed interconnection route approximately 14 miles in length from McCoy Soleil to the proposed Midpoint substation. Results from the System Impact Study from SCE/CAISO are expected by spring of 2010.

McCoy Soleil will likely connect to the SCE line by construction of a single-circuit three-phase 115kV or 230 kV transmission line that would interconnect to the conceptual Midpoint substation. Foundations for the transmission line structures consist of single concrete piers reinforced as necessary to withstand design loads. The poles are approximately 80 feet in height with a span length expected to average approximately 500 feet. As identified in map 4, interconnection route (a) and (b) are both designed to follow major roads, railroads, and other ROW to minimize impact of further road building. Service roads will be required, if they do not already exist, to access the interconnection line. Final path will be subject to results of the Facility Study by the California ISO, final detailed designs, and the secured route easement.

enXco

1.2.17 Spill prevention and containment for construction and operation

Spill Prevention Control and Countermeasure Plans (SPCC) - SPCC Plans will be prepared for construction and operation of the site. The plans will include spill prevention and countermeasures procedures to be implemented including (but not limited to) a spill record (if applicable), analysis of potential spills, description of containment facilities, fill and overfill prevention facilities, spill response procedures, personnel training and spill prevention.

No equipment in the solar field will require containment structures. Only the power tower, powerblock, cooling and substation equipment in the central receiver location will require containment structures, as shown in Figure 4. Again, all equipment will be free of PCBs. The substation pad will be designed to capture any spills of insulator material.

Domestic wastewater will be treated and disposed at the site using a septic disposal system consisting of septic tanks and leach field permitted with the Riverside County Health District. Construction and maintenance vehicles will be maintained in accordance with manufacturer recommendations to minimize the risk of vehicle spills.

1.2.18 Health and Safety Program

As on of the largest independent operators of wind farms in the United States today, enXco is proud of its track record on safety. enXco plans to transfer lessons learned and the high quality of its wind safety program to the construction and operation of large-scale solar plants.

Safety of personnel will remain the Operator's top priority at the plant. The Safety Manual delineates the methods for meeting this goal. This manual will be kept up-to-date with government laws, regulations and policies as well as prudent industry practices.

Annual familiarity training will be conducted with the local authorities, including police and fire departments, as appropriate. Annual First Aid and CPR training will also be conducted.

A Safety Committee, with representatives from maintenance and operations personnel, and chaired by the Plant Manager, will be established. It will meet at least quarterly to review overall personnel and plant safety and make recommendations to the Owner for improvements to plant and personnel safety that are beyond the scope of the Operator. The Safety Committee will maintain a safety incentive program for all plant personnel.

There will be safety meetings for all employees at least monthly to conduct training as well as review procedures and lessons learned from other plants in the area of personnel and plant safety.

Weekly site Safety Surveys will be conducted to verify and inspect the entire plant site. They are intended to look at safety equipment status, signs properly posted and safety equipment operation. The safety program will be evaluated periodically by site wide emergency drills.

There will be continuing training conducted for all plant personnel on current industry issues as well as new changes to safety equipment and procedures.

The Operator will work and cooperate with the Owner's insurers to implement safety recommendations and assist in conducting site inspections.

An Emergency Response Plan will be developed and implemented to provide an integrated procedure for response to oil and hazardous materials spills, plant evacuation, medical/fire/law enforcement, and severe weather emergencies. The Emergency Response Plan will be consistent with applicable laws and regulations governing such emergencies.

1.3 Other Federal, State and Local Agency Permit Requirements

All construction, operation and maintenance activities associated with the proposed project would be conducted in compliance with all relevant federal, state and local regulations and permit requirements. The table at the end of this section details the preliminary list of required permits and authorizations that enXco may be required to obtain prior to construction and operation of the facility.

The primary agency responsible for issuing a permit for the solar facilities will be the BLM, which will issue a Right of Way (ROW). Under federal law, the BLM is responsible for processing requests for ROW to authorize projects such as this one, and associated transmission lines and other appurtenant facilities to be constructed and operated on land it manages. In processing applications, BLM must comply with the requirements of the National Environmental Policy Act (NEPA), which requires federal agencies to consider the environmental impacts associated with projects constructed and operated on their land. In the case of this project, this would be accomplished through the preparation of Draft and Final Environmental Impact Statements (EIS). This process will take approximately 18-24 months from the issuance of a Notice of Intent (NOI) by the BLM in the federal register.

The Bureau of Land Management (BLM) and California Energy Commission (CEC) signed an MOU for solar development that sets up a joint process by which the two agencies will work together to permit solar thermal power plants. This process allows the agencies to coordinate pre-application, data adequacy, discovery, analysis, hearings and proposed decisions. Final permitting approval of the plant will be made by the CEC, while the BLM will prepare a final record of decision (ROD).

The primary document and process that will satisfy the requirements of NEPA and CEQA is the Application for Certification (AFC) that is filed with the CEC. The AFC will assist in coordinating the necessary permits and communication among federal, state and local jurisdictions.

Separate consultation requirements and associated documentation are required for Section 106 of the National Historic Preservation Act and Endangered Species Act (ESA) section 7, should they be required. These consultations will be completed by BLM. BLM is also responsible for Native American consultation, including Government to Government consultation. The result of this cooperative effort is intended to result in a public participation process and environmental document that fully meets BLM requirements.

enXco is in preliminary stages of preparing the AFC, and plans to meet with the CEC for a pre-hearing after final land control is established and initial environmental surveys are complete. A complete list of required permits will be generated after the initial environmental surveys are complete. In [Figure 16], enXco has identified the agencies, permits and timeline that will likely be required for McCoy Soleil.

enXco will also meet with BLM to satisfy the BLM requirements under NEPA, and understands that clear communication and early information will help BLM in this regard. enXco will strive to prepare and release a preliminary draft of the EIS equivalent during the AFC preparation process so that BLM might have up to 60 days to review before AFC submission with the CEC. Sections that would be particularly helpful to BLM have been identified as existing conditions, proposed alternatives, and biological resources.

Preliminary List of Required Permits and Permit Schedule

Required Permits and Permit Schedule		
Air Quality	DOC	An application will be submitted to the South Coast Air Quality Management District (SCAQMD) about the same time as the NEPA documents to obtain a determination of compliance (DOC).
	Federal Title V	May require Federal Operating Permit.
Biological	BLM Fieldwork Authorization	A Fieldwork Authorization will be required from BLM to complete the detailed biological studies for McCoy Soleil.
	Federal Endangered Species Act, HCP/Incidental Take Permit	Wildlife surveys will need to be completed and if endangered species are found, submitted to the U.S. Fish and Wildlife Service (USFWS) for agency approval under the ESA Section 7 Consultation. Depending on findings in the environmental surveys, enXco may require a Low Effect Habitat Conservation Plan for McCoy Soleil. An Incidental Take Permit (ITP) may be required under section 10 of the ESA. BLM will consult with the USFWS regarding the presence of desert tortoise.
	California Department of Fish and Game (CDFG) Incidental Take Permit (ITP)	Wildlife surveys will need to be completed and if endangered species are found, submitted to the CDFG for agency approval. Depending on findings in the environmental surveys, enXco may require an ITP under section 2081 (b) and (c) of the CA Endangered Species Act.
	USFWS and CDFG 2080.1 Consistency Determination	Submit the federal USFWS opinion incidental take permit to the CDFG to obtain concurrence of federal ITC
	RWQCB	It is anticipated that the RWQCB will take jurisdiction of the ephemeral drainages. Pre-notification will be required to obtain an individual permit.

Cultural	BLM Fieldwork Authorization and Cultural Resource Use permit	A Fieldwork Authorization will be required from BLM to complete the Class 3 cultural studies for McCoy Soleil. Any removal of archaeological resources will require a Cultural Resource Use permit from the BLM.
	Historic Preservation Act section 106 consultation	Consultation with the SHPO will be required if the project would affect any property listed in the NRHP; any new site would require NRHP eligibility evaluation
Geological and Soils	BLM Building permit	The BLM requirement will be specified in the Conditions of Approval pending approval of the ROW application
	BLM Grading permit	The BLM requirement will be specified in the Conditions of Approval pending approval of the ROW application
Hazardous Material	Unified Program Facility Permit	Riverside County Fire Department, Haz Mat division, requires a permit prior to storage of hazardous materials on site.
	Aboveground Storage Tank permit	Riverside County Fire Department, Haz Mat division, requires a permit prior to storage of hazardous materials in aboveground storage tanks on site.
Land Use	ROW for Solar Energy Development/NEPA Review	BLM for commercial solar facility, including transmission lines and access roads. BLM will publish an EIS for the project.
	ROW for Solar Energy Testing	BLM for solar testing equipment, prior to the ROW grant for Solar Energy Development
Paleo	BLM fieldwork authorization	No state or local permits will be required. A BLM Fieldwork Authorization will be required for paleo studies.
Transportation and Traffic	NDOT and Caltrans: Oversize load permit	California Department of Transportation requires permits for any oversized (gross weight or dimensions) vehicle deliveries. At least 10 days prior to oversize loads At least 7 days prior to oversize load on State Highways.
	Encroachment permit (for work in County ROW)	Submit plans showing work 30 days prior to construction work in public ROW
	Haz Mat Permit	Federal Motor Carrier Safety Administration; depends on nature of hazardous material transported
	FAA	FAA Form 7460-1; at least 30 days before the application for a construction permit is to be filed

Hazardous Waste	EPA ID No. and register as a Hazardous Waste Generator with Department of Toxic Substance Control	Takes 7-10 business days once the application form has been received
	Hazardous waste generator permit from Riverside Co EHS	Approximately 30 days prior to approval once Business Plan is complete
	Waste Discharge Requirements	Regional water quality control board may require permits
Water Resources	Section 404 Permit U.S. Army Corps of Engineers	If mapping of the washes on site determine that waters of the U.S. are present, a permit will be required from the U.S. Army Corps of Engineers
	NOI for construction phase storm water permit	Construction general permit required. A SWPPP that specifies BMPs for preventing construction pollutants from leaving the site. Approval will take about a month.
	California Regional Water Quality Control Board (CRWQCB) Section 401 Permit	Required if Section 404 permit (above) applies.
	CRWQCB NPDES and SWPPP	Industrial General permit required for operations phase. A separate SWPPP will be required that outlines the monitoring and reporting plan and BMPs for the solar plant.
	Well Drilling Permit	California Department of Water Resources, Southern District permit is required for drilling water wells
Health and Safety	Trenching and excavation permit	Submit completed permit application to any OSHA district of field office prior to commencing construction
	Permit to erect a fixed tower crane	Submit completed permit application to any Cal-OSHA district of field office 24 hours prior to commencing activity

1.3.1 Status of Permits

All permits are in preliminary stages. The only permit filed with any agency at this time is the Standard Form 299, filed with the BLM. At this time, required permits have been identified, and a timeline for acquiring permits has been established. The following permits will be applied for in the next year:

- BLM permit for biological surveys
- BLM permit for cultural surveys
- Well drilling permit to test for water availability

enXco

1.4 Financial and Technical Capability of Applicant

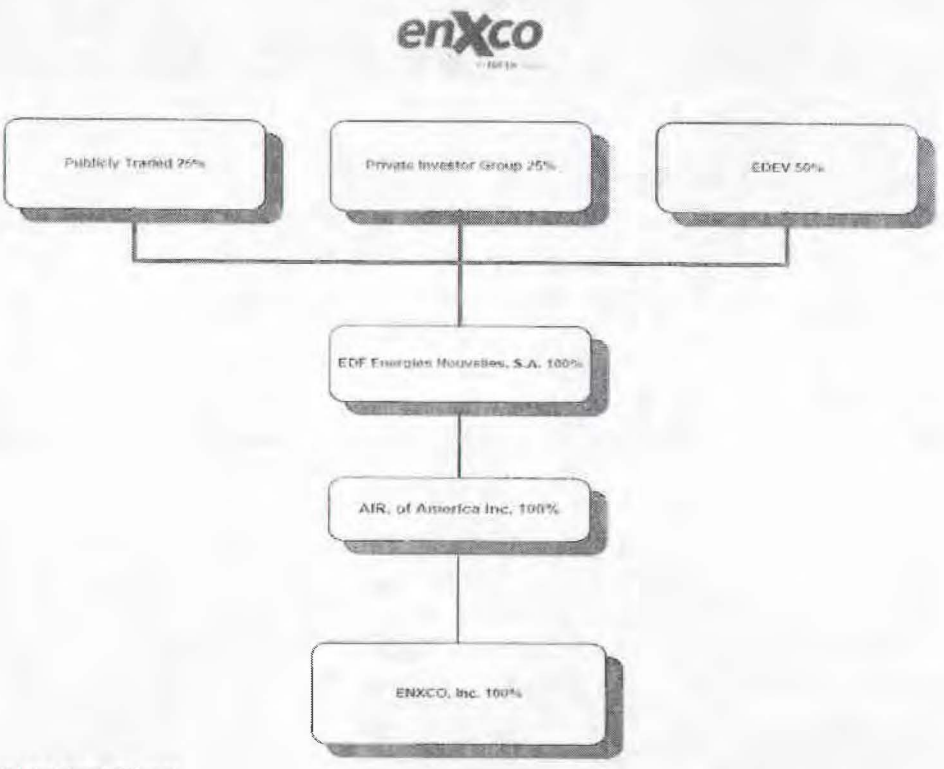
1.4.1 About enXco, EDF EN and the EdF Group

enXco undertakes four core activities in the renewable energy industry: development; ownership, operations and maintenance; and asset management services for renewable energy projects throughout the United States. With more than two decades of experience in the wind industry, enXco has a rich history in renewable energy as one of the oldest full service wind energy companies in the United States, and has emerged as an industry leader in project development, finance, construction and operations and maintenance. In mid 2007 enXco, expanded into solar CSP development. As part of this transition enXco has completed construction of 4500 kW of Solar PV installations as of Dec 2008.

Since 1999 enXco has developed and installed 1,500 MW of renewable generation capacity and operates and maintains over 4000 wind turbine generators or more than 1,300 MW. enXco is a wholly owned affiliate of EDF Energies Nouvelles (formerly SIIF Energies), a 50%-owned subsidiary of the EDF Group. In mid-2007 enXco expanded into Solar development where it has aggressively been entering into the Utility and Distributed Solar PV market places.

The Southwest Region of enXco is proud to have completed construction of its most recent project, a 150 MW wind project in Solano County, CA in December 2008. enXco was the first renewable energy company to complete financing of any wind project in the United States during the financial crisis in Q3-Q4 2008, a testament to the financial strength of enXco and our parent company.

Founded in 1990, EDF Energies Nouvelles (EDF EN) is a world-class player in the green electricity generation market. With a presence in 9 European countries and in the United States, EDF EN operates in four renewable energy segments (wind, hydro, biomass and solar). Non-US gross installed capacity amounted to 1,400 MW (of which 900MW is installed for ownership). With its unique profile as an integrated operator, EDF EN's presence spans the entire value chain, from development and construction through to generation and operations & maintenance. The Group also pursues the development and sale of structured assets, which consists primarily in selling renewable energy generating assets to individuals or to energy services companies. EDF EN is a 50%-owned subsidiary of the EDF group. Please see the following figure for an organizational structural chart of enXco, EDF EN and the EDF Group.



enXco Organizational Chart

1.4.2 Financial Capability

As mentioned above enXco is fully owned by EDF EN. That relationship gives enXco the significant advantage of bringing to bear the financial backing of its parent company. The result is that enXco is able to secure deals with renewable energies' most exclusive players, and enjoys a financial credibility that is envied throughout the development community.

enXco and EdF Energies Nouvelles have extensive experience with renewable energy project financing. enXco and its affiliates are highly active in the capital markets, maintaining significant relationships in both the debt and equity markets for wind energy. Since 2000, enXco has financed more than $550 million of wind projects via a variety of debt and equity structures, and enXco expects to finance nearly $1 billion in additional wind projects in 2008/2009.

enXco's recent financial closing during the financial crisis in Q4 2008 of the 150 MW wind project in Solano County, CA is a testament to the financial strength and capability of enXco.

1.4.3 Finance structure

enXco will provide or secure all necessary capital through the development, construction, and operation phases of the proposed project. enXco has direct experience with a variety of financing structures, including strategic flips, all-equity with and without back-leverage, Pay-As-You-Go, cash and ITC leveraged, and pure cash-leveraged. The appropriate finance structure will be selected upon final negotiation of PPA terms, and long-term capital, both debt and equity as needed, will be arranged by enXco. Preliminary financing work for the Project will begin with the indication from the utility that it intends to execute a definitive PPA with enXco. The formal financing process will be undertaken immediately upon the execution of a power

purchase agreement, giving ample time to complete arrangements on or before the commencement of construction.

1.4.4 enXco's Solar Experience

For more than 20 years EDF EN has been involved in the development of solar thermal and solar electricity projects throughout a majority of Europe. This experience has ranged from residential to small scale distributed electricity to utility size projects.

In addition to an impressive solar profile of installed capacity, EDF EN has consistently sought partnerships that would allow the EDF EN group to grow within regional markets. By uniting developers, manufacturers, contractors and service organizations EDF EN has been able to secure market footholds throughout Europe. In order to further strengthen its presence in solar electricity generation EDF EN established a shareholding in several companies, namely Fotosolar in Spain, RETD in Greece and Photon Power Technologies in France.

Reinforcing enXco's commitment to all viable solar technologies, in July 2007 EDF EN entered into a global supply agreement for 230MW of thin film PV modules over five years. The order covers 230 MW in modules deliverable progressively between mid-2007 and year-end 2011. The First Solar purchase will enable EDF EN to secure part of its construction program of photovoltaic plants both for its own use and for third parties in Europe and the United States. Agreements with other emerging solar panel providers have followed suit, including Nanosolar, Unisolar, and Solar Fun.

enXco completed construction of the 1 MWp Sacramento Soleil project in mid-2008, and EDF EN completed a 7 MWp facility in Narbonne, France in December, 2008. The electricity generated by the Sacramento Soleil facility is under contract with the Sacramento Municipal Utility District (SMUD). EDF EN group, including enXco, has a portfolio of over 1,500 MWp currently under development in France, Spain, Italy, Greece, the United States and Canada.

enXco leverages the vast technical experience of EDF-EN to vet the various CSP technologies that are coming to market. As the world's largest owner of nuclear plants, our parent company, EDF, understands the thermal power industry, and is prepared to make a significant investment in the solar tower market.

1.4.5 enXco's Operating and Maintenance Experience:

In 1987, enXco started providing retrofits of turbines to a young wind energy industry in the United States. This operation quickly grew into one of the largest and most respected providers of wind turbine operations and maintenance services in the world.

These "O&M" services are provided out of offices in Palm Springs, Tracy, and Tehachapi, California, and Colorado, Texas, and Iowa. Major shop facilities in Palm Springs and Tracy provide enXco with in-house capability to perform a full range of component repair.

enXco operates over 4000 wind turbines. Its extensive experience, on a wide variety of wind turbine models and vintages, gives it a unique perspective on getting the best performance out of

each project. The experience includes re-engineering and retrofitting over 1,400 wind turbines to improve reliability and performance.

Results count - and enXco's experience, coupled with proven procedures and trained and experienced personnel, gets those results.

2.0 Construction of Facilities

McCoy Soleil plans to select an EPC contractor with experience in thermal power plant station design and solar technology. The construction team will mobilize as soon as possible after project certification. Site preparation work will include site grading and storm water control. Gravel will be used for temporary roads, laydown, and work areas. Mobile trailers or similar suitable facilities (for example, modular offices) will be used as construction offices for McCoy Soleil and subcontractor personnel. Construction laydown and parking areas will be within the areas of the project site and their locations will be determined by on phase construction scope and sequences. Site access will be controlled for personnel and vehicles. A security fence will be installed around the plant site boundary, including the laydown area. Security will be maintained as required by the EPC contractor, or a suitable subcontractor to maintain public safety.

During construction, temporary utilities will be provided for the construction offices, laydown area, and the project site via existing distribution lines to the west of the site. Temporary construction power will be utility-furnished power. Area lighting will be provided and strategically located for safety and security, and targeted to minimize light pollution for area neighbors.

Communications among personnel during construction, as well as operation, will consist primarily of handheld radios. enXco is aware of Department of Defense (DOD) sensitivity to electronic spectrum use, and will communicate with and obtain confirmation from the DOD of the acceptability of frequency usage by McCoy Soleil.

The following site services will be provided by McCoy Soleil subcontractors:

- Environmental Health Safety Training
- Site Security
- Site First Aid
- Construction testing (NDE, Hydro, etc.)
- Site fire protection and extinguisher maintenance
- Furnishing and servicing of sanitary facilities
- Trash collection and disposal
- Disposal of hazardous materials and waste in accordance with local, state, and federal regulations

Construction of the generating facilities, from site preparation and grading to commercial operation, would be expected to take about 30 months. It would take about 100 man-years of construction workers' time to build the plant. The man loading will follow a bell shaped curve over the 30 months of construction and will peak at approximately 400 to 500 personnel of construction craft people, supervisory, support, and construction management personnel onsite during construction.

Typically, construction would be scheduled to occur between 5AM and 7PM on weekdays and Saturdays. Additional hours may be necessary to make up schedule deficiencies, or to complete critical construction activities (e.g. pouring of concrete at night during hot weather, working around time-critical shutdowns and constraints). During some construction periods and during the startup phase of the project, some activities would continue 24 hours per day, seven days per week.

2.1 Solar Field Design, Layout, installation, and construction

The solar field in McCoy Soleil will cover the majority of the project area, as shown in Figure 3 in the Appendix. For the number of disturbed acres, please see the table in section 1.2.3. See section 2.2 for the proposed sequence of construction.

2.1.1 Timetable for construction

Please see Figure 10 in the Appendix for a projected timetable for development and construction.

2.2 Phased Project: approach to construction and operations

The project will be constructed in one period of time, with one on-line date. However, the construction phases for the proposed project is expected to be as follows:

Site Disturbance – Within the heliostat array fields, the power block area, the permanent facilities located around the perimeter road and in the temporary construction logistics area, clearing would be performed. Vegetation would be removed with a brush rake, as necessary, in order to separate the vegetation from the soil.

Preparation – Parking areas for construction workers and laydown areas for construction materials would be prepared. Detailed information regarding the location within the solar field of the laydown and parking areas would be developed once the project is finalized. Please see the drawings in the Appendix for location of the staging area.

Access Road – Primary access to the site is discussed above. Treatment for the roads is detailed in the next section and shown in the Appendix.

Site Grading – The existing site has a slope of about 1-2%. Grading will take place to generally maintain the minor slopes of the terrain, however, cuts and fills will be made to generate uniform planes for the erection and operation of the heliostat fields. Extensive grading of the site would be limited to the power block areas, receiving towers, the diversion ditches and dikes, and the major access roads (gravel roads between power blocks, and gravel roads servicing the receiving towers from the power blocks). Materials stored temporarily in the lay down area would be stored on dunnage to protect it from ground moisture.

Foundation – All underground piping and wiring would be installed, followed by installation of the foundation for the new power blocks, solar towers, and associated structures.

Plant Construction – After final site design and prior to any soil disturbance, the Applicant would be required to finalize the Drainage, Erosion, and Sediment Control Plan / Construction SWPPP (DESCP / SWPPP). During construction, the Applicant would be required to follow the DESCP/SWPPP to prevent the offsite migration of sediment and other pollutants and to reduce the effects of runoff from the construction site. Best Management Practices (BMPs) to be used at the site would be fully addressed in the DESCP/SWPPP; the DESCP/SWPPP would include the location of BMPs to be used, installation instructions, and maintenance schedules for each BMP.

Site Stabilization – It is expected that site stabilization will include soil binders, geo-grid or the use of aggregate surfacing to allow the movement of maintenance vehicles and mirror wash water trucks to travel within the solar array. The predominant surface soil is expected to be relatively well graded soil, sand, and gravel, and undisturbed existing soil. The power block area would be graded with moderate slopes to direct runoff into the salt containment basin. This will allow the storm water to infiltrate locally. The south western area of the site will contain the detention pond that will provide an area to allow sediment to be deposited and on site storm water to be controlled.

Demobilization – All temporary construction facilities would be removed and recontoured and revegetated as necessary. The project construction team or contractor would mobilize and develop temporary construction facilities and laydown areas adjacent to the power block. Once a final design has been established, the contractor would prepare site maps showing the construction project in detail. Temporary facilities would include:

- Approximately 4 single-wide full-length trailer offices or equivalent
- Chemical toilets
- Parking for approximately 500 vehicles
- Approximately 15 tool sheds/containers
- Equipment parking for approximately 20 pieces of construction equipment
- Construction material laydown area
- Solar field equipment laydown area
- Batch plant
- Rock processing equipment
- Construction Access and Material/Equipment Delivery

2.3 Access and Transportation System, component delivery, and worker access

The access to the project site would be through the existing Arlington Mine Road, and an existing north-south dirt road. The existing dirt road would need to be widened and improved to accommodate the heavy machinery required to construct McCoy Soleil.

Access roads within the project site would include at least three 18-foot wide roads and one 60-foot wide road radiating from the central tower, as seen in Figure 3. Final service road alignments would be dependent upon the final results of the environmental report documenting the results of field investigations, including topography and any other site-specific details to be incorporated into the final design. All standard engineering practices are incorporated into the road design and all applicable engineering designs will be applied to minimize soil erosion as

caused by normal seasonal precipitation. The project access will use as much of the existing road structure as feasibly possible.

Most existing roads will require upgrades to accommodate the load size associated with the equipment required for on site construction and installation of the power block. The modifications will include the reduction of grade or steepness and increase the width to approximately 36 feet, as well as increasing the turning radius of existing curves to allow for equipment hauling.

Each heliostat must be accessed by a small crane and other required heavy equipment during the construction and operation and maintenance phases. The road design will minimize the total amount of disturbed area as well as reduce visual impact. These local project access roads will remain after the project construction is complete for ongoing site activities required by maintenance activities. Again, all standard engineering practices will be incorporated into the design to minimize erosion due to normal seasonal precipitation and maintain the sheet flow across the site. For standard road treatments, please see Figure 7.

2.4 Construction Work force numbers, vehicles, equipment, timeframes

The on-site workforce will consist of laborers, craftsmen, supervisory personnel, supply personnel, and construction management personnel. The on-site workforce is expected to reach its peak of approximately 500 individuals. There will be an average workforce of approximately 250 construction craft people, supervisory, support, and construction management personnel on site during construction.

Construction will generally occur between 7 a.m. and 7 p.m., Monday through Friday. Additional hours may be necessary to correct McCoy Soleil schedule deficiencies or to complete critical construction activities. For instance, during hot weather, it may be necessary to start work earlier to avoid pouring concrete during high ambient temperatures or to avoid heat stroke. During the startup phase of the project, some activities might be performed over the weekend.

Table 4 – Construction Process

Construction Phase	Description	Approximate Number and Type of Construction Equipment and Vehicles
Rough Grading	Grubbing, clearing and bulk grading,	Approximately 20 Scrapers, 5 Compactors, 4 Graders, 2 Loaders, 4 Dozers, 10 Water Trucks, 6 Water Pulls
Finish Grading	Final grading to finish grade	Approximately 4 Scrapers, 8 Graders, 1 Dozer, 4 Water Trucks
Roads, Foundations, Flatwork and Site Utilities	Construction of roads, excavation and construction of foundations for heliostats	Approximately 20 to 40 pieces of equipment will be present at any one time, including concrete trucks, concrete pumps, backhoes, excavators, loaders, graders, foundation drills, paving machines, drum rollers, fork lifts,

		tractors, dump trucks, small cranes and additional support vehicles.
Heliostat Assembly and Deployment	Field assembly of heliostats in temporary shop buildings constructed at the site. Installation of assemblies on cast-in-place piers, or other foundations.	Approximately 8 to 10 crews, each with one or two pieces of equipment including small cranes, forklifts, welding machines, trucks and tractors.
Power Block Construction	Construction of foundations, structural frames and buildings, installation of utilities and equipment, including the STG, condenser, pumps, buildings, ACC cooling structure, TES tanks, and central receiver tower.	An average of 12 to 18 pieces of equipment will be utilized for power block construction over the duration of the project, with more equipment being utilized during the early stages of foundation construction and frame erection. Equipment will include backhoes, excavators, foundation drills, concrete trucks, concrete pumps, forklifts, boom trucks, lifts, cranes, welders, trucks and other support vehicles.
Liquid Salt Preparation	Melting of the delivered dry salt product	Temporary propane fired auxiliary boiler, forklifts, loaders, and trucks.

2.5 Site Preparation, surveying, staking

Site preparation will begin shortly after final permitting is complete for McCoy Soleil. Final surveying, to accommodate existing ROW grants, and setback requirements for the railroad to the east, transmission line, will precede any site work. Surveying will be completed by a surveyor permitted to work in Riverside County. The surveyor will stake the edges of the project area prior to erection of the security fencing.

Security fencing will be erected around the entire perimeter of the project area, with an access gate as shown in Figure 3, prior to beginning construction. Site perimeter fence will be 8 feet high and have an overall height of no more than 10 feet from the bottom of the fabric to the top barbed wire. The fence will have top rail, bottom tension wire, and three strands of barbed wire mounted on 45 degree extension arms. Posts will be set in concrete.

Controlled access gates will be located at the entrance to the facility. Site gates will be swing or rolling type access gates. Access through the main gate will require an electronic swipe card, preventing unaccompanied visitors from accessing the facility or construction area. All visitors will be logged in and out of the facility during normal business hours. Visitors and non-employees will be allowed entry only with approval from a staff member of the facility. Visitors will be issued passes that are worn during their visit and returned to the main office when leaving. The facility will be staffed 24 hours/day and 7 days per week to maintain security. Even when the facility is not generating electricity, personnel will be present for maintenance and site security. See sheet CIV-101 for location of the security fence line and operations area, and sheet CIV-110 for details.

enXco

2.6 Site Preparation, vegetation removal and treatment

Excavation will require the removal of all vegetation from the areas to either be excavated (cut) or filled, which include the powerblock and tower, access roads, laydown, parking and O&M facilities. Vegetation under 18" may be able to be maintained within the solar field. At a minimum, all vegetation between every other row will be cleared with a blade to reduce the risk of fire and allow construction and maintenance access. Scarifying by blade will disturb the soil to several inches and potentially allow some roots to remain to assist in soil stabilization and reduce the possibility of erosion. These scarified areas will serve as the access roads for both installation and continued maintenance and cleaning of the heliostat field. As such, they will be moderately graded to allow regular access with a pick-up truck-mounted tanker for washing. Continued weed management in cleared areas would be maintained through targeted application of herbicides such as Roundup® and/or by occasional scarification. Additional soil disturbance by regular operations of the plant is not expected.

Continued weed management in cleared areas would be maintained through targeted application of herbicides such as Roundup® and/or by occasional scarification. Additional soil disturbance by regular operations of the plant is not expected.

2.7 Site Clearing, Grading and excavation

Excavation will require the removal of all vegetation from the areas to either be excavated (cut) or filled. Grading activities will be completed with traditional earthmoving equipment including but not limited to bull dozers, scrapers, motor graders, excavators, water trucks, water wagons, loaders, and compactors. The majority of the efforts to grade the site will be completed within the first year of construction activities. Early grading will be completed in the area of the roads (to provide access), the laydown area (to provide an early location for storage), and in the power block (to provide an early start to the power block construction activities). Completion of the earthwork within the solar field will follow immediately after or during the early grading activities in order to allow construction of the solar field heliostats. Minor grading will be ongoing in the form of excavation and backfill for foundations, underground piping, duct bank and other miscellaneous facilities for the duration of construction.

Materials suitable for compaction will be stored in stockpiles at designated locations using proper erosion prevention methods. Materials unsuitable for compaction, such as debris and large rocks, will be disposed of at an acceptable location. Top soil will be stockpiled for re-use in landscaped areas. Any contaminated materials encountered during excavation will be disposed of in accordance with applicable laws, ordinances, regulations, and standards.

Compaction will be performed in uniform layers of specified thickness. Materials in each layer will be properly moistened to facilitate compaction to the specified density. To verify compaction, representative density and moisture content tests will be performed in the field during compaction. Structural fill material supporting foundations, roads, parking areas, etc. will be compacted. Prior to placing fill materials, subgrades will be examined for loose or soft areas and further excavated as necessary. Details on the tower foundation will follow shortly after proper geotechnical studies are performed on the site.

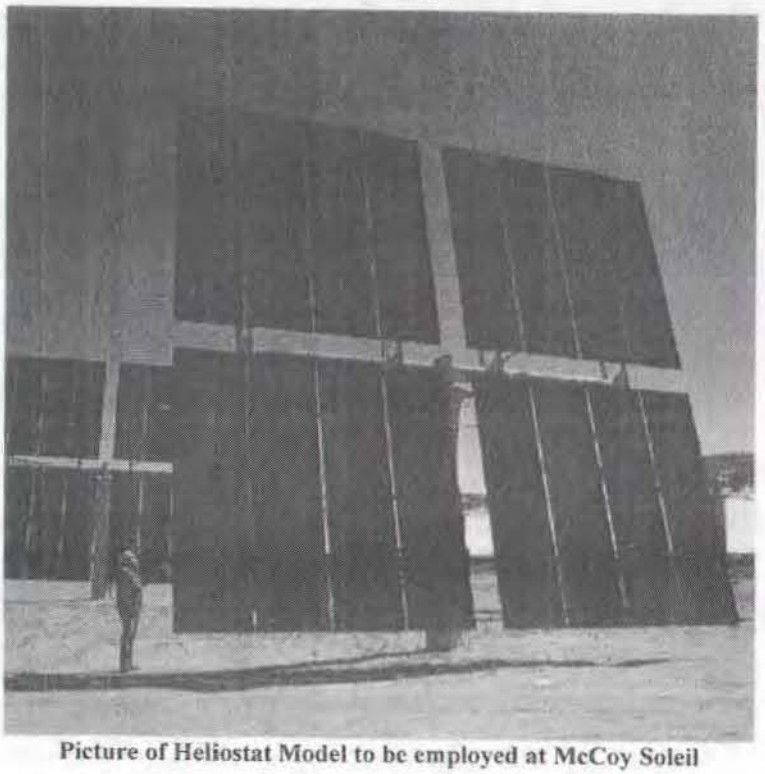
Extensive grading of the site will be limited to the power block area including the receiver tower, the drainage channels and berms, storm water collection ponds, and the major access roads. Within the heliostat array fields, grading cuts and fills will be limited, only as required to obtain smooth graded planes. Vegetation within the solar fields will be cut or removed to the soil surface to reduce the fire risk, as needed.

Existing slopes in the area of the project vary from flat to 1 % from the north to south direction. The watershed area primarily comprises the Little Maria Mountains to the north and the Big Maria Mountains to the northeast. The dry washes passing through the proposed site are tributary to the McCoy Wash. Most of the McCoy Mountain runoff will pass southwest of the solar field in the McCoy Wash. The solar field will ideally maintain a positive terrain slope of approximately 1.0 %. Detention will be provided in the southern section of the solar field allowing temporary flooding during the design rain event. Detained storm water will be released at pre-developed flow rates to follow historic drainage patterns, primarily McCoy wash and the minor wash to the east.

Detailed grading of the solar fields will be designed to minimize net import or export of fill and to minimize the total disturbed area.

2.8 Solar array assembly and construction

The solar field at McCoy Soleil will consist of a field of approximately 8500 heliostats. Each dual-axis tracking heliostat will be set in a foundation of concrete 15 feet tall and 36 to 42 inches around. That foundation will support a dual axis tracking motor which will focus the sun's energy on the top of the tower by pointing a 120m^2 mirrored surface. Please see below for a picture of a typical heliostat.



Picture of Heliostat Model to be employed at McCoy Soleil

Approximately 8500 of these heliostats will be sited around the base of the tower. This sort of solar field technology is unique in that the siting of these heliostats is more flexible than the solar fields of other CSP technologies. By being somewhat modular in nature we will have a better ability to avoid washes, hills, mounds and other micro-topography than that of a typical trough plant. Thus a solar tower would require a fraction of the grading necessary for a trough plant, and will thus maintain the integrity of the soil surface. On completely flat surface, with no natural micro-topography the 8500 heliostats would be arranged as can be seen in the following figure. Though enXco anticipates it will have to site a portion of heliostats do to micro-topography, it will endeavor to keep the solar field as tight as possible so to limit the total area affected by the solar field.

The heliostat assemblies will be mounted on steel or concrete foundations. The geotechnical information and the potential pile test program will provide the information necessary to determine the most cost effective foundation. The most likely foundation will be a reinforced concrete pier foundation that is cast in a drilled hole. Alternate foundations could be concrete or steel piles.

The heliostats consist of glass mirror modules, structural support components, motor drives, a heliostat controller and a foundation. There are a total of approximately 17,350 heliostats each with a mirror surface area of approximately 670 ft^2 (62.4m^2). The total mirror surface area for each plant is approximately 12,000,000 sf^2 (1,081,200m^2). The support structure consists of a steel frame backing to support the mirror modules and a steel tubular post for supporting the heliostat in the ground. Finally, the heliostat assemblies will be mounted on steel or concrete foundations. The geotechnical information and the potential pile test program will provide the

information necessary to determine the most cost effective foundation. The most likely foundation will be a reinforced concrete pier foundation that is cast in a drilled hole. Alternate foundations could be traditional concrete mat foundations, concrete piles, or steel piles.

The Heliostat Array Controller (HAC) includes all hardware and software to control the Collector Field and consists of the Heliostat Control Software (HCS) and Beam Characterization System (BCS). The HCS actively controls the pointing of each heliostat to ensure that the heliostats image is properly positioned to ensure proper flux on the receiver. The actual pointing varies by the time of year and day, ambient temperature and mode of operation. Modes of operation include start-up, normal operation, shut-down and a number of off-nominal conditions (e.g., loss of heliostat power). The BCS automatically calibrates each individual heliostat using a BCS target located on the tower. There are sixteen (16) BCS targets on the tower and heliostat calibration is integrated into normal plant operations on a daily basis. Control/power wire for the HCS will be installed underground throughout the solar field.

2.9 Power Plant Construction

At the center of the heliostat field is the power block with the central receiver tower, steam turbine generator, cooling systems, salt storage tanks, and electrical facilities. The tower will be approximately 600 ft tall, with the solar receiver taking up the top 60 ft. The tower will be made predominantly of slipform concrete, with the solar receiver sitting on top and a few other ancillary elements like walkways and cranes to help service the receiver during scheduled maintenance. The receiver is made of a several panels and a multitude of thin-walled pipes through which the molten salt flows. To the right is an indicative picture of the solar receiver to be used at McCoy Soleil. Please see Figure 4 for a drawing of the central power block, and Figure 8 for a drawing of the tower in the Appendix.



Solar Receiver

The first phase of power block construction would consist of foundation work and underground mechanical work. Foundation construction would involve excavation, form, and rebar work preceding a number of concrete pours. The specific equipment in-use is more variable as the individual foundations and components are erected. The central receiver tower will be constructed of reinforced concrete using a slip-form process. Underground pipe work would require trenching, onsite welding, backfill, and compaction. When the foundations have cured adequately, major equipment and aboveground piping can be installed. During this phase of construction the steam turbine generator (STG), water treatment system, air-cooled condenser, generator step-up transformer, auxiliary transformers, and other

ancillary equipment would be set on their corresponding foundations. Major equipment components would be installed and pump, turbine, and fan alignments would be performed.

With the equipment set on their foundations, aboveground piping and electrical activities can be completed. Piping and electrical cable would be terminated at equipment interfaces. High-voltage bus duct will be installed between the STG and generator step-up transformer. The final construction activities will include switchyard installation, site paving, and control system installation and programming. Once systems are installed and complete, commissioning will begin. Commissioning activities include operating pumps and motors, opening and closing valves, cleaning pipe systems by water flushes and air blows, and energizing equipment. Equipment is operated isolated from other systems to ensure proper operation. Once systems are verified the plant as a whole is operated to ensure all systems function correctly. During start-up, all systems are operated and steam is generated to perform steam blows, which are used to clean the steam piping. Once the steam lines are cleaned steam is introduced into the steam turbine. Once the plant is running reliably, testing is performed to ensure emissions and performance guarantees are met.

Concrete, mechanical, and electrical works would be performed over a period of months, with the aid of graders, rollers, front loaders, dump trucks, trenching machines, concrete mixer and pump trucks, cranes, and pick-ups. Approximately 60,000 cubic yards of concrete will be used to construct the power block and heliostat fields.

Some of the above areas may impinge on areas intended for the later stages of solar field erection. As solar field erection nears completion in the power block area, temporary construction mobilization areas would be reduced as required. Solar field equipment and material laydown areas would be rotated through the site on the quadrants currently being assembled.

Miscellaneous, non-vehicle, motorized equipment will also be used over the length of the job, such as welding machines and compressors.

The HTF system hot and cold tanks would be first preheated to help prevent against thermal shock to the tank and foundation. The cold tank, for example, will be maintained at the preheat temperature for at least a week or longer before fluid salt is pumped into the tank. It is expected to take approximately 2 to 3 months to melt and load the complete volume of salt. An external recirculation loop with a heater will then raise the temperature and maintain it at 550° F.

HTF processing will take place in an area surrounded by temporary earth dikes to prevent potential migration of the salt from the processing area with storm water. Incidental spills of salt would be cleaned up. In the event of inclement weather conditions, stockpiles and storage sacks of salt would be covered with plastic to prevent potential contact with storm water.

2.10 Gravel, aggregate, concrete needs and sources

Gravel will be required for the surfacing of roads, parking areas, and for use in concrete. A geotechnical investigation will provide information necessary to determine if adequate aggregate

can be generated on site. Based on visual observations of the site, it appears that gravel sources within the grading area of the site are available. If on site gravel/sand is available (in quantity and quality), a portable rock processing operation will be used to generate select aggregate from on site sources. The rock processing operation will include screens, crushers, and conveyors to generate material that meets the project requirements.

If adequate material is not available on site, gravel and aggregate will be purchased from commercial sources in Blythe, CA or Parker, AZ and transported to the project.

The construction of the project will require a large quantity of concrete delivered to the site over the duration of the construction timeframe. Two options exist to serve the project needs. First, a portable concrete batch plant can be mobilized and used to batch the concrete necessary for the project. The second option is to obtain concrete from a commercial source in either Blythe, CA or Parker, AZ.

2.11 Electrical Construction Activities

The project will be connected to the existing and proposed Southern California Edison (SCE) transmission system at the Midpoint substation located 14 miles away. The interconnection map in the Appendix shows the proposed interconnection route. enXco is expecting a System Impact Study for this interconnection from the CAISO in the spring of 2010.

Construction activities for the transmission and electrical facilities will commence after the construction of the solar field. Construction will take place continuously along the length of the gen-tie route and require approximately 40 workers. Please see Figure 10 in the Appendix for a detailed preliminary timeline for development and construction

Detailed plans for transmission line and electrical interconnection facilities will continue to be developed during the application process and will likely include the following activities:

- Marshalling Yards: these areas will involve project laydown, parking, and areas for trailers
- Road Building: access roads will be required for each tower. They will be sited to avoid sensitive habitat identified in the detailed environmental surveys
- Pole Erection: poles will be assembled on site, with conductors, insulators and other hardware
- Conductor Pulling: There will be as many as 40 pull sites over the 14 mile interconnection. Pull sites will be limited to existing roads and new access roads where possible. Conductors will be pulled, sagged and connected permanently to the insulators.
- Communication System: Overhead fiber optic cable will be installed using the same pulling sites as for the conductors.

2.12 Aviation Lighting

enXco anticipates no aviation restrictions for this solar plant. Structures will all be less than 10 feet in height, except for transmission towers, and the O&M building, which will both be lower than the height which requires aviation lighting. Since existing transmission facilities are in the

area and along the ROW that enXco proposes to use to reach the substation, the project is anticipated to produce no significant aviation impact. If required, any additional transmission towers will employ the necessary aviation safety lighting.

2.13 Site Stabilization, protection, and reclamation practices

enXco will restore all temporarily disturbed areas to their preconstruction conditions, as required by the BLM. These include temporary construction areas, access roads, as well as transmission access areas. These areas would be revegetated to restore them to preexisting conditions. Where disturbance will occur due to construction, topsoil will be stockpiled, and certain plants that are able to be transplanted will be preserved for the revegetation.

As a part of soil stabilization and dust mitigation, it is expected that road treatments will include soil binders, geo-grid, or the use of aggregate surfacing to allow the movement of maintenance vehicles and heliostat wash water trucks to travel within the solar array. Other procedures for site stabilization are discussed in sections 2.6 and 2.7.

2.13.1 Site Closure and Reclamation

The expected operational lifetime of McCoy Soleil is 30 years, however depending on economic or other circumstances the real life of the project could be longer or shorter.

In case of a temporary closure of the facilities, the BLM, and any other responsible agencies will be notified. If temporary closure involves the threat or actual release of hazardous substances, procedures will be implemented from the Hazardous Materials Business Plan, as developed for the project. Procedures will include, but not be limited to, the following:

- Practices to control any release of hazardous materials;
- Applicable notifications of responsible agencies and the public;
- Emergency response procedures;

When permanent closure is appropriate, a decommissioning plan will be developed and submitted to the BLM for review and approval. Procedures will be designed to ensure public health and safety, environmental protection and compliance with all applicable LORS. Closure may range from temporary "mothballing" to complete removal of equipment and restoration of the land to BLM approved specifications. The procedures for decommissioning are designed to ensure public health and safety, environmental protection, and compliance with applicable regulations. It is assumed that decommissioning would begin 30-50 years after commercial operation date of the solar plant.

Decommissioning will generally include the following goals:

- Remove above ground structures unless converted to other uses
- Restore the lines and grades in the disturbed area to match the natural gradients of the site, and;
- Re-establish native vegetation in the disturbed areas
- Conform with applicable LORS and local/regional plans
- Secure funding decommissioning and restoration

The proposed strategy to achieve the above goals could include the following:

- Analyze alternatives other than full restoration of the site (for instance, removal of old facilities and upgrading to newer solar technology)
- Use industry standard demolition means and methods to decrease personnel and environmental safety exposures by minimizing time and keeping personnel from close proximity to actual demolition activities to the extent practical;
- Plan components of decommissioning to ensure personnel and environmental safety are maintained while efficiently completing the work.
- Provide for recycling the components of the plant: metal, heliostats, concrete, etc, and proper disposal of all other materials.
- Remove all residual materials and chemicals from the site prior to demolition for reuse at other facilities or disposal at licensed facilities.
- Demolition of below-ground facilities to a depth required for restoration of the native habitat.
- Soils clean-up, if needed, particularly at locations where hazardous materials were used or stored to ensure that clean closure is achieved.
- Recontouring of lines and grades to match the natural gradient and restore natural water flow to the site
- Revegetation with native plants

The first stage of dismantling the site consists of removal and demolition of above-ground structures. The second stage consists of dismantling and removing concrete structures so that no concrete remains within 3 feet of final grade as appropriate. The third stage involves removal of underground utilities within 3 feet of final grade. The fourth stage consists of excavation and removal of soils to return the disturbed areas to near the original condition and to a natural gradient while disturbing as little additional areas as is practicable.

3.1 Transmission System Interconnect

3.1.1 Existing and proposed Transmission system

The existing transmission system in the area consists of a number of substations and lines operated by Southern California Edison (SCE). The existing Devers Palo Verde transmission line runs parallel to, and on the southern side of Interstate Highway 10. In addition, 161kV transmission lines run just south of the site from the Kaiser Mine and DWP pumping station to the Blythe Energy center. SCE will be constructing the Devers Palo Verde 2 transmission line from the proposed Midpoint substation to Devers.

Proposed transmission lines are therefore going to be very limited. McCoy Soleil will connect to the Southern California Edison (SCE) high voltage lines either at the proposed Desert Center substation, or as a line tap on the 230 kV DVP2, depending on results of the System Impact Study. enXco expects results of the transmission studies in approximately Q1 2010. Final path will be subject to results of the Facility Study by Southern California Edison (SCE), final detailed designs, and the secured route easement. Detailed transmission drawings will be provided soon after these studies are complete and before publication of the EIS. enXco will submit a revised form-299 that includes the proposed transmission line ROW for interconnection.

Please see drawings in the Appendix for location of existing and proposed transmission lines.

3.1.2 Ancillary facilities and substations

Additional structures necessary for the McCoy Soleil plant will be located away from the tower in order to maximize the output of the solar field. These structures would include, a systems control building, an operations and maintenance building, access roads, parking, security fencing, and other minor structures. An operations, maintenance and control center building of up to approximately 3600 square feet (approximately 60 feet x 60 feet) is required for the purpose of housing the service technicians and tools, maintenance supplies, spare parts, and the electronic control and communication systems. The building is equipped with a bathroom facility for sanitary use by technicians and/or security personnel remaining on site for the duration of the project. A parking area would be required to accommodate approximately 50 full-time employees as well as visitors. Please see the Appendix for a view of the location of the ancillary structures in comparison to the solar field and tower. The ancillary structures will be located near the project entrance as shown in the Appendix.

3.1.3 Status of Power Purchase Agreements

enXco is currently in discussions with two large utilities interested in purchasing power from McCoy Soleil. Our executives have met with the utilities several times each in the past months, and we will be submitting this project for consideration in the 2009 RFP for renewable energy at both utilities. It is enXco's belief that some of the PPAs signed to date will not be able to perform and utilities will be short of their requirements for the 20% RPS by 2010 (2012 with flexible compliance). Our strategy for wind is to develop a quality project and the electricity buyer will follow. We plan to execute the same strategy for our CSP projects.

3.1.4 Status of Interconnect Agreement

enXco expects a System Impact Study from CAISO to be complete in the first quarter of 2010. Information from the SIS will inform the economics of the project and the specific interconnection point, as well as the date of transmission line readiness.

3.1.5 General Design and Construction Standards

McCoy Soleil will likely connect to the SCE line by construction of a single-circuit three-phase 115kV or 230 kV transmission line that would interconnect to the conceptual Midpoint substation. Foundations for the transmission line structures consist of single concrete piers reinforced as necessary to withstand design loads. The poles are approximately 80 feet in height with a span length expected to average approximately 500 feet. As identified in the Appendix, the interconnection route is designed to follow major roads, railroads, and other ROW to minimize impact of further road building. Service roads will be required, if they do not already exist, to access the interconnection line. Final path will be subject to results of the Facility Study by the California ISO, final detailed designs, and the secured route easement.

3.2 Gas Supply Systems

As described above, McCoy Soleil will not require any gas supply.

3.3 Other Related Systems

3.3.1 Communications system requirements

Communication between various components of the plant will be via hard-wired cables. Trenching will be required along the rows of heliostats to connect the solar field to the O&M facilities. Trenches will be 4-feet wide, by 4-feet deep so that final conduit and wiring is at least 3-feet below the final surface. Communication wires will be installed alongside the electrical system wires. Please see drawings in the Appendix for proposed locations of trenching.

The major communication system on site would be the SCADA (Supervisory Control and Data Acquisition) system. The SCADA system is composed of industrial PLC (Programmable Logic Controllers) hardware and software, field instrumentation, meteorological stations, and communications devices designed for site monitoring, control and historical trending of the solar plant.

All data collected from the field would be transmitted to the site Control Room via a fiber or copper communications infrastructure, sited alongside the electrical lines running from the heliostats to the powerblock. The control room will also contain a router for the point of connection to a T1 line or equivalent as well as phone lines for communication to the outside. These will be brought to the site alongside the gen-tie to the transmission system. If communication lines are not available near the site, then microwave communications will be installed.

Communication between employees during both construction and operations phases will be through handheld radios.

4.0 Operations and Maintenance

As of December 2008, enXco operates and maintains over 4,129MW of renewable energy, and employs over 300 renewable energy technicians in the United States. enXco believes that experience counts when it comes to executing development projects and operating those projects once complete.

enXco brings experienced project management skills in order to execute the McCoy Soleil Solar Energy Project. enXco's management teams have executed well in excess of 5,000 MW of power projects including natural gas fired projects, solid fuel projects, wind energy projects and other alternate fuel projects. This experience includes all development, construction, financing and operational aspect of the project. The project management tasks associated with the execution of the project include:

- Land related issues and local approvals
- Environmental Permitting
- FAA approvals
- Water supply
- Public outreach and communications
- Interconnection activities
- Equipment supply and evaluation

- Balance of plant systems and design
- Contractor assessment and selection
- Transportation
- Financing related activities
- Construction management
- Operations and asset management

enXco intends to establish independent operators with experience in operating and maintaining power facilities to operate and maintain the plant following the achievement of commercial. enXco does not expect to select an operator until construction of the plant has commenced. Plant personnel will begin being brought on-board commencing 12 months prior to the scheduled start of commercial operations (up to the total numbers included in the O&M Plan).

4.1 Operation and facility maintenance needs

It is assumed that the plant will commence commercial operations in late 2013.

The plant is assumed to operate at full load, in accordance with the allowable dispatch instructions from the utility.

The plant's performance monitoring system and processes will be updated as required to reflect initial plant operating data to best determine plant operational efficiency and cost effectiveness. Examples of these parameters are:

- Capacity
- Energy Generation
- Receiver and steam turbine performance
- Plant makeup water requirements
- Solar Heat Collected
- Molten Salt Temperatures

Mock emergency exercises will be conducted periodically in cooperation with the local fire and police departments in order to test Emergency Response Plan preparedness and to drill the plant employees in the proper execution of emergency roles and tasks.

4.1.1 Operation Plan

This plan provides the overview for the operations and maintenance of the McCoy Soleil Project (the "plant") for the first twelve (12) months of commercial operation. This plan provides basic assumptions and discussion of operations and maintenance areas and gives a short overview of the other programs used to meet the Owner and Operator objectives.

The Operating Budget provides, on a monthly basis, details for:

- Operations, repairs, and expected improvements.
- Routine maintenance.
- Expected purchases (including capital expenditures and equipment acquisitions).
- Personnel plan.

- Administrative and support activities taken in support of the plant.
- Additional related aspects.

The Operator will contract specific maintenance tasks or will perform them by the plant staff as appropriate and most cost-effective manner.

The Operator will operate and maintain the plant in accordance with approved procedures to comply with the issued Environmental Permits and appropriate government laws.

The Operator will operate the plant and associated systems to ensure that the emission limitations for air and waste water discharge contained in the plant permits are met. In addition, the Operator will ensure that all hazardous waste on the site will be stored and disposed of properly. All environmental issues and associated permits will be the subject of continuing training and management emphasis. Willful violations of environmental laws could result in employee termination for such a serious offense. At least annually, an internal assessment of environmental protection compliance will be made.

4.1.2 Maintenance Program

The Maintenance Program is conducted in accordance with the maintenance manual, vendor technical manuals, and good engineering practices. Subject to scheduled overhauls, the nominal design life for the major components of the plant is 30 years. This program consists of:

- Routine Preventive Maintenance (including "Operator checks") – normally conducted by the plant O&M staff, supported by outside contractors as required for some aspects of the predictive maintenance program (e.g., oil analyses).

- Corrective Maintenance – normally conducted by the plant O&M staff, supported as necessary by outside contractors as required due to special equipment or expertise which is not cost-effective to maintain current on site (e.g., "code" welding) or to augment efforts to return the plant to operation as soon as possible following a forced or unscheduled outage.

The solar plant will be covered by a warranty from the respective suppliers. All warranties will be tracked and compiled with and warranty claims will be made as directed by the Owner's Representative.

The Operator will utilize a Computerized Maintenance Management Software (CMMS) package, vendor and contractor recommendations, and good engineering practices to plan and implement the component preventive maintenance program.

Scheduled Maintenance periods will be planned and coordinated with the utility in accordance with the PPA. There are no planned major equipment outages. Unscheduled corrective maintenance will be decided on a case by case basis. A projected outage maintenance schedule will be submitted separately.

Maintenance Service agreements are anticipated on the following areas, as appropriate:

- Predictive maintenance testing and analysis
- Safety valve setting, calibration and maintenance
- Testing and certification of fire protection system(s)
- Calibration services (beyond the cost-effectiveness of the plant's capability), such as:
    - high voltage protective relay calibration
    - safety relief valve calibration
    - electricity flow metering calibration
- Environmental engineering services
- Consulting engineering services
- Plant security services
- Fire protection services
- Plant janitorial services
- Trash and waste material disposal (including potentially hazardous waste)
- Individual office equipment, such as fax, copies, computers, etc.
- Employee transportation (as required)

4.2 Maintenance activities including mirror washing, roads

Periodic water washes of the heliostats to maintain efficiency at the expected levels will be conducted. This will be accomplished by spraying demineralized water from a high pressure attachment on a small 4WD heliostat-washing vehicle. The quantity of water used will be sufficient for cleaning but controlled such that minimal water runs off the mirrors and onto the ground. There will be no appreciable surface water flows from this activity. Please see a discussion of water quantities and sources required under environmental considerations in section 5.

As discussed in section 2.6, some vegetation treatment will be required to maintain the site free from noxious weeds. At a minimum, the access roads in the heliostat field will be maintained free from significant vegetation through the use of targeted spraying, occasional scarifying, or weeding to reduce fire hazard and allow access to the heliostat arrays.

Roads will be maintained to minimize fugitive dust, and prevent erosion from rain events. Additional gravel or surface treatments such as "seament" on the dirt access roads may be required. Road treatments are detailed in the drawings in the Appendix, and will be reapplied as necessary to reduce dusting of the heliostats and comply with the SWPPP and other permits.

Other maintenance that will be performed in conjunction with the routine maintenance includes but is not limited to:

- Torque electrical fittings
- Clean switch gear
- Calibrate protective relays
- Fire protection system test and annual certification
- Fuse swapping, testing ground fault detection and power quality

enXco

4.3 Operations workforce and equipment

4.3.1 Staffing

Management personnel will provide technical oversight/guidance in four critical areas: overall plant management (by the "Plant Manager"), plant operations and maintenance (by the "Operations Manager"), and human resources, accounting, and administration (by the "Administrative Assistants").

No replacement/rotations of plant personnel are projected during this period. If the need for such a rotation arises, necessary arrangements will be coordinated with the Owner on a case-by-case basis.

As appropriate, O&M personnel will be provided uniforms and proper foot wear.

The Operations staff at the plant consists of:

Operators	10
Solar Field Technicians	24
Water Technicians	2
Shutdown Technicians	6
Heliostat wash technicians	2

The operations crews will work rotating, 12-hour shifts. Vacation and sick day coverage, training, or absences for any other reasons will be provided by off-shift operators/technicians, and qualified maintenance personnel, as required.

On-going training will be provided to maintain operator qualification and certification.

4.3.2 Staff Training and Safety

On-going training will be provided to maintain operator qualification and certification.

The Operator will pursue an ongoing training program in accordance with our Training Manual. The main goal of this manual is to ensure that the O&M staff remains fully competent in the safe, reliable, and efficient operation, maintenance, and administration of the plant.

Following the construction period, final qualifications shall be completed for all plant operators. Following completion of appropriate qualifications, emphasis will be placed on our continuing training program.

The Operator will send the plant staff to formal schools and training sponsored by outside activities and vendors as appropriate to ensure that O&M personnel continue to upgrade their level of knowledge of plant systems and equipment. Formal training is included in preparation of the annual Operating Budget.

The Operator will ensure that its staff is fully trained on all health, safety and environmental issues in accordance with local and national regulations, with the following objectives:

- Maintain personnel safety – the goal is zero accidents.
- Comply with all safety and environmental regulations, policies, and laws.
- Provide meaningful feedback to improve plant procedures and manuals on a continuing basis.

Plant casualty drills will be run on a periodic basis to evaluate the casualty training program. In addition, "Table Top" drill scenarios will be conducted on a monthly basis. These drills include both plant and hazardous material casualties. The written response of each section will be reviewed and critiqued with all personnel. Mock emergency exercises will be conducted periodically in cooperation with the local fire and police departments in order to test Emergency Response Plan preparedness and to drill the plant employees in the proper execution of emergency roles and tasks.

Plant employees will be encouraged to pursue outside educational courses, as well as obtaining degrees or certifications that are job-related. The expenses for these job improvement educational pursuits will be handled on a case-by-case basis.

See section 1.2.18 for a further discussion of enXco's safety history, and the health and safety program.

4.3.3 Administrative Activities

The Administrative staff consists of an Administrative Assistant and a Clerk/Procurement person.

The Operator's Project Manager will work with the Plant Manager and Administrative staff and support staff of the Owner/Operator to continue the development and implementation of the comprehensive Administrative Program.

Budget control and reporting will be administered by the Plant Manager and Administrative staff with assistance and oversight being provided by the Owner/Operator's headquarters staff. Monthly Budget Variance reports will detail financial status with respect to the approved commercial budget. The proposed Operating Budget will be submitted separately.

Plant payroll and local implementation of Operator Human Resources policies will be administered by the Administrative staff under the guidance of the Plant Manager.

Reports will be generated and distributed daily, weekly, and monthly in accordance with the Administrative Manual. These reports will include electricity generation parameters, plant performance, fuel usage, chemical usage, environmental and permitting issues, safety issues, maintenance and outage information, and information on interaction with outside agencies.

Plant Security will be provided for by an outside contractor and/or limited to remote TV cameras. The contractor will provide security for the plant on a twenty-four hour basis.

The Warehouse will be inventoried on a semi-annual basis to verify location and quantity. Additionally, monthly audits will be performed of randomly selected items to verify not only location and quantity but also proper documentation from ordering to receiving to invoicing.

Arrangements will be established with an international freight forwarding company, to expedite parts shipping, customs brokering, and other requirements to receive parts and consumables. The effective arrangements are critical to achieving the target performance.

4.3.4 Capital Improvements

The Owner/Operator will conduct an on-going program to identify any capital improvements that will increase the plant's efficiency and effectiveness. Proposed capital improvements will be submitted as part of the on-going budget process.

4.3.5 Operations Equipment

During Operations we would maintain the following fleet of on site vehicles as follows:

i. Two Heliostat Wash Trucks,
ii. Two scissor lifts or bucket cranes to maintain heliostats
iii. One portable crane
iv. Four pick up trucks for maintenance staff.

5.0 Environmental Considerations

5.1 Air Quality

There is neither combustion nor chemical reaction to produce gaseous effluents. The plant has no emissions to the atmosphere other than condenser effluent and steam relief valve discharge from the turbine generator island.

McCoy Soleil is in the South Coast Air Quality Management District (SCAQMD) and would be responsible for meeting the rules of the air district. The SCAQMD is considered in attainment for most air contaminants; however the basin has been given non-attainment status for particulate matter less than 10 microns in size (PM_{10}). Potential impacts would be considered significant if any PM_{10} emissions could contribute to an existing violation.

The principal sources of emissions from the proposed project would occur during construction; the operation of the solar project and general maintenance activities would have a negligible impact to air quality. Construction-related emissions would include the exhaust from construction equipment (including vehicles transporting personnel, equipment, and supplies) and fugitive dust and particulate matter (PM_{10}) from grading, earth moving, and equipment/vehicles traveling on paved and unpaved roads.

Implementation of the following mitigation measures will ensure that the proposed project will not have a significant adverse impact on air quality.

enXco Development Corp. may adopt, with BLM approval, standard mitigation measures recently applied by CEC staff for power plant and linear facility construction to ensure that impacts to air quality during construction are not significant.

- All unpaved roads and disturbed areas in the project and linear construction sites shall be watered as frequently as necessary to comply with the dust mitigation objectives. No vehicle shall exceed 10 miles per hour within the construction site.
- Main construction site entrances shall be posted with visible speed limit signs.
- All construction equipment vehicle tires shall be inspected and washed as necessary to be cleaned free of dirt prior to entering paved roadways.
- All paved roads within the construction site shall be swept as needed to prevent the accumulation of dirt and debris.
- All vehicles that are used to transport solid bulk material on public roadways and that have potential to cause visible emissions shall be provided with a cover, or the materials shall be sufficiently wetted and loaded onto the trucks in a manner to provide at least one foot of freeboard.
- Wind erosion control techniques (such as water, chemical dust suppressants, and/or vegetation) shall be used on all construction areas that may be disturbed.
- All diesel-fueled engines used in the construction of the facility shall be fueled only with ultra-low sulfur diesel, which contains no more than 15 ppm sulfur.
- All construction diesel engines, which have a rating of 100 hp or more, shall meet, at a minimum, the Tier I California Emission Standards for Off-Road Compression Ignition Engines as specified in California Code of Regulations, Title 13, section 2423(b) (I) unless certified by the on-site AQCMM that such engine is not available for a particular item of equipment.

5.2 Biological Resources

In choosing the McCoy Soleil site, enXco sought to avoid the most sensitive habitats and species. For example, the site is outside of the Desert Wildlife Management Area (DWMA) for desert tortoise.

enXco's consultants have undertaken preliminary biological studies to understand the potential biological resources at the McCoy Soleil site. The consultants have significant history with BLM, and have excercised high quality in their work on past enXco wind projects.

The McCoy site is composed primarily of creosote bush scrub habitat. This habitat type is characterized by widely spaced creosote bushes (*Larrea tridentata*) and includes associates such as brittlebush (*Encelia* sp.), white bursage (*Ambrosia dumosa*), and a variety of seasonal annuals. Desert wash woodland is the second most common habitat in the area. This habitat consists mainly of drought-deciduous leguminous trees growing along ephemeral washes (Bureau of Land Management 2003b). Typical species include ironwood (*Olneya tesota*), catclaw acacia (*Accacia greggii*), and palo verde (*Cercidium* sp.). In some areas, a non-native, invasive tree or shrub called salt cedar (*Tamarisk* sp.) occurs in washes. Wildlife species richness is much higher in native desert wash woodland than in other community types in the desert, and this community is slow to recover from disturbance (Bureau of Land Management 2003b).

Based on research using available geographic information system (GIS) data sets, regional occurrence databases administered by the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG), and the California Natural Diversity Database

(CNDD), T&E species that could potentially occur at the site are limited to the desert tortoise (*Gopherus agassizii*) and the razorback sucker (*Xyrauchen texanus),* though habitat for the latter species does not appear to be present in the project area. enXco is also aware that the desert wash woodland habitat in McCoy wash is a highly sensitive and important habitat. Site selection has been careful to exclude this habitat from any impact whenever possible. enXco's consultants have met with the BLM in order to discover any additional information on biological resources that BLM might have. A more extensive survey of the site will occur during the detailed environmental work in preparation for the EIS/AFC, including tortoise protocol level surveys.

Mitigation will be necessary for the desert tortoise, if any individuals are found, or if sign of the tortoise is recorded in the protocol level surveys. If either of these conditions are present, enXco may adopt, with BLM approval, mitigation including the following standard desert tortoise measures:

- Tortoise-proof fences around the construction area,
- A detailed tortoise "clearing" and relocation plan for any tortoises discovered in the project area,
- A detailed plan to prevent impact to tortoises during construction activities
- Purchase of appropriate habitat to compensate for any habitat impacted by construction activities.
- Other mitigation may also be appropriate, and considered by enXco in partnership with the relevant agencies.

Other special status species that may occur at the site include 4 species of plants, 3 invertebrates, 6 birds, including burrowing owls and 7 mammals.

During the general habitat assessment survey, biologists would note if any burrows are present in the study area that may be suitable for burrowing owl use. The presence of existing burrows is a key component of burrowing owl habitat. If potential burrowing owl habitat is present, a protocol-level burrowing owl survey may be required. Other surveys would be required for the special plant species, and possibly for evidence of nesting by other special status birds.

Table of Special Status Species potentially present at McCoy Soleil

Common Name	Scientific Name	USFWS	CDFG	CNPS
Plants				
Abram's spurge	*Chamaesyce abramsiana*	-	-	2.2
Foxtail cactus	*Coryphantha alversonii*	-	-	4.3
Harwood's milk-vetch	*Astragalus insularis var. harwoodii*	-	-	2.2
Las Animas colubrine	*Colubrina californica*	-	-	2.3
Invertebrates				
A mellitid bee	*Melitta californica*	-	-	
California Mccoy snail	*Eremarionta rowelli mccoiana*	-	-	
Riverside cuckoo wasp	*Hedychridium argenteum*	-	-	
Fish				
Razorback sucker	*Xyrauchen texanus*	E	E	
Reptiles				
Desert tortoise	*Goperus agassizii*	T	T	
Birds				

Black-tailed gnatcatcher	*Polioptila melanura*	-	-	
Burrowing owl	*Athene cunicularia*	-	SC	
Crissal thrasher	*Toxostoma crissale*	-	SC	
Le Conte's thrasher	*Toxostoma lecontei*	-	SC	
Prairie falcon	*Falco mexicanus*	-	-	
Vermilion flycatcher	*Pyrocephalus rubinus*	-	SC	
Mammals				
American Badger	*Taxidea tasux*	-	SC	
Arizona Myotis	*Myotis occultus*	-	SC	
California leaf-nosed bat	*Macrotus californicus*	-	SC	
Cave myotis	*Myotis velifer*	-	SC	
Colorado Valley woodrat	*Neotoma albigula venusta*	-	-	
Hoary bat	*Lasiurus cinereus*	-	-	
Pallid bat	*Antrozous pallidus*	-	SC	

5.3 *Cultural Resources*

A BLM Class 1 cultural study, including preliminary search of tribes, tribal areas, and a site search at the Eastern Information Center located at the University of California, Riverside has been completed for McCoy Soleil. The Archaeological Information Center acts as a branch of the California Historic Resources Information Systems (CHRIS) established by the Office of Historic Preservation (OHP) and maintains information concerning cultural resources and associated studies recorded in Riverside County. Materials reviewed included archaeological site records, historic maps, and listing of resources on the National Register of Historic Places, the California Register of Historical Resources, California Points of Historical Interest, California Landmarks, and National Historic Landmarks. Results of the records search/literature review indicate that only one cultural resources inventory has been conducted within one mile of the proposed project area (Bureau of Land Management 1978) and that two previously identified sites (Table 1) have been recorded within the project area.

enXco's consultant also sent a letter to the Native American Heritage Commission (NAHC) notifying them of the proposed project activities. The NAHC was also asked to conduct a search of the Sacred Lands File and to make a recommendation as to whether any local Native American groups should be contacted regarding their concerns about potential impacts to cultural resources resulting from implementation of the proposed project. Results of this search have not been received at this time. They will be forwarded when they become available.

A draft of the Class 1 Cultural Study was submitted to the BLM for review and comment. Please see the Appendix for a complete copy of the Draft Class 1 Cultural study.

The records search shows that two linear cultural resources cross the eastern side of the project area. The first is P33-872, the "Halchidhoma" trail, a prehistoric foot path that connected the Blythe intaglios with trade routes to the west. This site was first recorded in 1976. Recent attempts to relocate portions of it have failed and its existence within the current project area is not certain. The second resource is P33- 12410 (CA-RIV-7045H), the Atchison, Topeka & Santa Fe Railroad. This portion of the railroad has not been evaluated for eligibility for listing to the NRHP but segments in San Bernardino County have been formally listed. It is recommended that

the area to be effected by the proposed project be intensively surveyed (Class III) for cultural resources prior any ground disturbing activities.

Before construction begins, the Project Archaeologist will conduct a worker education session for the construction crew and supervisory personnel to explain the importance of and legal basis for the protection of significant archaeological resources. Construction crews will be briefed regarding identification of suspected new sites, reporting, and preservation of existing and suspected new sites.

An Archaeological Monitor will be present at the construction sites at times when excavation (subsurface disturbance) is taking place in areas of high cultural sensitivity. These areas will be identified by the Project Archaeologist. If a new cultural resources site is discovered during construction, and determined to be significant, the Project Archaeologist will notify appropriate agencies and implement a mitigation plan in accordance with state regulations on private lands, as well as BLM regulations. The Project Archaeologist will arrange for the curation at a qualified curation facility of any archaeological materials collected during the construction monitoring and mitigation program.

5.4 Geologic Resources and Hazards

As a part of the environmental and permitting studies for the AFC preparation, McCoy Soleil will require a survey for geological hazards and unique geological features. In addition, extensive soil tests will be required in order to determine the proper preparation and engineering of solar plant foundations. A preliminary geotechnical evaluation was completed by civil engineers during a project walk-through. More detailed studies, as indicated in the development and construction timeline in the Appendix will inform final engineering

5.5 Hazardous Materials Handling

The McCoy Soleil project will be designed, constructed, operated and maintained to ensure the safe use and storage of hazardous materials. Storage, handling, and use of all chemicals will be conducted in accordance with applicable laws, ordinances, regulations and standards. Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals will be stored in storage tanks, and other chemicals will be stored in returnable delivery containers. Chemical storage and chemical feed areas will be designed to contain leaks and spills. Workers will be trained to handle hazardous wastes generated at the site.

Once construction is complete, McCoy Soleil will have minimal hazardous and non-hazardous waste at the site. The molten salt is a combination is a 60:40 ratio of Sodium Nitrate (NaNO3) and Potassium Nitrate (KNO3), in their sold form these two salts are traditionally used as elements in garden fertilizer. Since the salts are only used as a thermal working fluid and are not consumed, it is used continuously for the life of the plant without need for re-processing. Occasional spills of small quantities of salt from a leaking gasket quickly freeze and are picked up by plant staff and put into a waste receptacle. Depending upon the rules of the local jurisdiction this salt can be reused or disposed of in a landfill. At the end of the Solar Two demonstration period, the salt was solidified onsite and sold for fertilizer.

In addition to small quantities of salt which may leak, the turbine plant drains flow to an oily waste separator common to many steam plants and the waste removed by vacuum truck to a qualified facility. This fluid may contain lubricants and oils common to the turbine generator island. The quantity of this waste should be no different than for a similar steam unit of comparable size. Where possibilities exist for spills to occur from plant operations, catchment areas will be constructed to contain the spill. For example, the steam turbine will be sited on a cement pad with integrated containment that can control a possible catastrophic spill. Waste containing high metal concentrations, will be temporarily stored on site in portable tanks, and disposed of off-site by a chemical cleaning contractor in accordance with applicable regulatory requirements.

Safety showers and eyewashes will be provided adjacent to or in the area of all chemical storage and use areas. Hose connections will be provided near the chemical storage and feed areas to flush spills and leaks to the plant wastewater collection system. State approved personal protective equipment will be used by plant personnel during chemical spill containment and cleanup activities. Personnel will be properly trained in the handling of these chemicals and instructed in the procedures to follow in case of a chemical spill or accidental release. Adequate supplies of absorbent material will be stored on-site for spill cleanup.

Electric equipment insulating materials will be specified to be free of polychlorinated biphenyls (PCBs). Other possible hazardous materials will include various water treatment and cleaning chemicals.

5.6 Land Use

The Project area is currently designated by BLM as Class "L", "Limited Use" in the Northern and Eastern Colorado Management Plan (NECO). This area may be required to be amended to Class M: which will "provide for activities that require a major modification of the landscape."

A preliminary search of OHV and recreational uses in the NECO indicates that one dirt vehicle trail crosses the project area. enXco will site the solar facilities in such a way as to minimally impact the recreation abilities in the area. The open road that runs north-south through the project area, as well as the natural gas line, will remain open and accessible.

5.7 Noise

During operation, McCoy Soleil will generate some noise. Noise will be created by the steam turbine generator, and cooling towers, as well as vehicles on site. As part of the AFC process, noise level will be modeled at the nearest residential sites to determine if there is any impact. It is predicted that the impact will be less than significant.

5.8 Paleontological Resources

A preliminary literary search determined that the Project site does not contain any known fossil localities. A more detailed field survey will be conducted during preparation of the AFC.

Prior to construction enXco will retain a qualified Project Paleontologist to design and implement a mitigation program during project-related earth-moving activities. The paleontological resource mitigation program will include the preparation of mitigation and

monitoring plan for construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; pre-construction coordination; and reporting.

Construction personnel involved with earth-moving activities will be informed by the Project Paleontologist of the possibility of encountering fossils, how to identify fossils, and proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist. A construction contractor superintendent will be identified and provided with contact information for notifying the Project Paleontologist if any potential paleontological resources are encountered during construction.

Grading and excavation within old alluvium or earthmoving at depths greater than 10 feet should be monitored by a qualified paleontologist, along with older alluvium which occurs at depths less than 10 feet.

5.9 Public Health

A human health risk assessment will be conducted as part of the NEPA process to determine the impact of emissions of toxic air contaminants. The assessment is predicted to find that the project will pose an insignificant incremental cancer and non-cancer health risk.

5.10 Socioeconomics

Project construction is anticipated to have a positive impact on local economics. The city of Blythe is located nearby, providing a considerable labor pool for the project workforce. A more detailed analysis of economic impacts to the area will be undertaken for the AFC.

5.11 Soils

A drainage study will be required that can determine appropriate control structures and possible rerouting of any major washes that flow through the site. Typically, berms will be required on the up-slope side of the site to channel runoff around the collector field. Some internal contouring may also be required due to the size of the site in order to accommodate precipitation that falls within the plant boundary. Because the heliostats being employed are significantly larger than those for Solar Two, they will be able to accommodate greater variation in the slope of the land.

In areas where heavy grading is required, such as at the site of the central tower and powerblock, mitigation measures will be necessary to minimize erosion and control runoff. These measures may include local soil berms and detention areas that can contain storm water runoff during construction. Temporary erosion controls including crushed rock, silt fences and fiber rolls will be used as needed to minimize erosion in these areas. Water will also be used as a method to control dust during construction, likely sprayed from a truck twice per day during heavy grading activities. A more detailed erosion control plan will be developed during the AFC process.

5.12 Traffic and Transportation

The on-site workforce will consist of laborers, craftsmen, supervisory personnel, supply personnel, and construction management personnel. The on-site workforce is expected to reach

its peak of approximately 500 individuals. There will be an average workforce of approximately 250 construction craft people, supervisory, support, and construction management personnel on site during construction.

During construction, the number of truck loads and the tonnage delivered will be on the order of 12,000 loads totaling about 175,000 tons of equipment and materials. The timeframe and specific delivery schedule is still under development. A more detailed traffic study will be completed in the AFC process.

5.13 Transmission Line safety

A detailed study will be performed to determine any increases in EMF levels or audible noise due to construction or operation.

5.14 Visual resources

Because the study area is not given a BLM-designated VRM classification, the BLM California Desert District Office requires the applicant to prepare a visual resource inventory (VRI) for the area, per *VRM Manual 8400*, in order to assign an interim VRM classification. A VRI can provide a better understanding of visual impacts arising from the proposed projects in order to determine visual impacts on viewers and the landscape by identifying several key observation points within view of the area in question; a contrast analysis is then performed that compares project features with features on the existing landscape to better analyze the potential impacts of the proposed projects.

Based on the findings of the VRI and subsequent interim VRM classification, a plan amendment for a proposed application would be required if the interim VRM class is determined to be incompatible with solar development (i.e., Class I or II). The *NECO Plan* did not assign VRM classes to the McCoy Soleil study area. Because of the distance of the BLM Wilderness Areas from the study area, visual impacts from a proposed solar development are not likely to be a significant constraint; however, a VRI is recommended to confirm this.

Once the land use designation is amended to Class III or IV, the area will accept major modifications of the landscape. The 600 foot tower will be the predominant change to the landscape. It is expected that the field of heliostats, though large, will ultimately have minimal impact to visual resources. At certain times of the day and from certain elevations, the mirror field will reflect the sky and resemble a large body of water. While the plant is operational, during peak sunny hours, the receiver tower at the top 60 feet of the central tower will glow brightly as sunlight is heating up the molten salt in the receiver tubes. This effect will create another bright light in the sky from certain vantage points, but as it only occurs when the sun is shining, this is projected to have less of an impact than a nighttime light would have. A more detailed analysis of visual impacts, including the views from different nearby locations, will be carried out for the AFC. It is expected that the project will be able to mitigate any visual impacts that are identified. For instance, targeted landscaping at nearby residences may be proposed to shield them from the view of the tower. Another possible mitigation that enXco proposes is to provide an appropriate viewing platform for the public to educate about the benefits of solar energy in providing electricity while decreasing dependence on fossil fuels and preventing the increase in emissions of greenhouse gases.

enXco

5.15 Waste Management

The McCoy Soleil will produce maintenance and plant wastes typical of power generation operations. Generation plant wastes include oily rags, broken and rusted metal and machine parts, defective or broken heliostats and electrical materials, empty containers, and other miscellaneous solid wastes including the typical refuse generated by workers. These materials will be collected by the local waste disposal.

There is no daily volume of waste generated by the cycle. There will be some removal of office waste and broken components from time to time, but these volumes will be small. Project wastes are not projected to significantly affect the capacity of local hazardous and non-hazardous waste facilities.

5.16 Water

Several ephemeral stream channels running southeast through this study area are visible on aerial photos. These stream channels appear to have connectivity to other streams and channels connecting to the Colorado River (a TNW). If the proposed project impacts the streams in the project area, an evaluation by the USACE must be performed to determine whether they are jurisdictional. Several large washes were viewed during a January 2009 visit to the study area although no water quality-limited segments (water bodies currently not meeting water quality standards) are listed as occurring near this study area (California State Water Resources Control Board 2008). The project area is potentially subject to Section 401 and 404 requirements.

5.16.1 Water Availability

Groundwater is available at the McCoy site, and enXco has requested the assistance of BLM in acquiring water rights to dig a field of wells.

enXco has undertaken a water study for the McCoy Soleil project site and determined that water will likely require a contract with the Bureau of Reclamation for groundwater extraction. The project area lies within a zone extending from the Colorado River to the west that has been designated by the USGS as the "accounting surface," which means that any person withdrawing water from under this surface must have an agreement with the Bureau of Reclamation.

enXco has determined that

- The project area is outside the boundaries of the Palo Verde Irrigation district, and therefore cannot contract water with this agency
- The BLM has an agreement with the Colorado River Board (CRB) for 1,150 acre-ft of water/year, some of which it does not use.
- The BLM is willing to work with enXco to determine how to make water available to solar projects in the Eagle Mountain to Blythe corridor
- The Lake Havasu, BLM office has determined that the Palm Springs Field office of the BLM will need to take the lead on this water issue.
- The Palm Springs office, though willing, has not yet chosen someone to lead the resolution of the water issue

In an effort to move this issue forward, enXco has informed Greg Miller, renewable energy manager for the California Desert District of the current status of water availability in the area. enXco is willing to take on a leadership role to help bring resolution to the challenge of finding water for the solar projects in the area.

Installing a well to obtain water for construction and operations would likely require a permit from the Riverside County Department of Environmental Health. Well yields in this groundwater basin average 1,650 gallons per minute. The McCoy Soleil study area is part of the Colorado River Hydrologic Region and the Palo Verde Mesa Groundwater Basin (California Department of Water Resources 2003).

5.16.2 Estimate of Daily and Annual Water Consumption Requirements

The proposed station is designed with a dry cooling tower for steam cycle cooling. This facility will require water for make-up of condensate due to normal relief valve losses and minor spills, general facilities and human consumption and water to wash the heliostats. Heliostat washing is a normal, continuous process that will occur regularly, with a wash water requirement of less than 100 acre-feet per year.

Water will be supplied from a well field developed at the project. A water tank will have a sufficient capacity for a one day operation at peak power generation. The water use can be divided into the following three categories based on the quality required:

(1) Service water which includes all other miscellaneous uses;
(2) Demineralized water for make-up to the steam Rankine cycle and mirror washing and
(3) Potable water.

The water will be treated using a conventional water treatment system to meet all plant needs. The plant will require a raw water storage tank, on the order of 2 million gallons, which will also contain a minimum of 300,000 gallons of water for fire protection capabilities. Steam cycle process water must meet stringent specifications for suspended and dissolved solids. This water will be processed by means of a demineralized water makeup system. enXco anticipates this will consist of multiple operations, concluding with mixed-bed demineralizers. The feedwater system will also include mechanisms to control dissolved oxygen, maintain a specific pH, and minimize scale formation. Demineralized water will also be used for the washing of heliostats. Potable water that meets regulatory standards for safe drinking water will be supplied from the local Water District or treated on-site. The potable system will supply water to sinks, toilets, showers, drinking fountains, and emergency eye wash safety showers.

Water Consumption Requirements	Approximate Consumption during Construction	Approximate Consumption during Operation
Steam Cycle makeup water (AF)	0	100
Mirror wash water (AF)	0	70
Air cooled condenser augmentation (AF)	0	430
Construction year 1 (AF)	1000	0
Construction subsequent years (AF)	150	0
Total annual (acre-feet/year)	575 (2 years)	600

5.16.3 Waste Water

Water wastes from miscellaneous plant equipment and water treatment system will be collected on-site and processed according to all required LORS. The sanitary wastewater from sinks, toilets, showers, other sanitary facilities will be discharged into an appropriate septic system and leach field that will be permitted under a WDR from the RWQCB. Water streams from plant drains and other miscellaneous equipment will be collected and recycled back into the plant where possible. No water quality impacts from the treatment and discharge of these streams is expected.

There will be minimal waste water during plant construction or operation. During construction, water will be used for dust mitigation, but not to the extent that runoff from the site is expected. Please see a discussion in the section on erosion control and stormwater drainage. Portable bathrooms will be provided during construction, as needed, and will be emptied offsite per regulations.

Water used to wash panels will be demineralized, and not contain any chemicals. The quantity will be carefully monitored to produce no appreciable runoff; that is, the water will soak directly into the ground below the panels, or evaporate, and not travel across the ground.

Sanitary wastewater from sinks, toilets, showers, and other sanitary facilities will be discharged into an appropriate septic system and leach field that will be permitted under a WDR from the RWQCB.

5.17 Mitigation Measures proposed by enXco

In seeking an appropriate site, and choosing the appropriate technology for McCoy Soleil, many factors were considered to minimize the impacts of the facilities. However, some impact will be unavoidable and will be required to be mitigated. Preliminary environmental studies have been completed for McCoy Soleil and the results of the studies are included in the sections above (Section 5). According to the preliminary environmental studies, possible mitigation may be required for air resources such as PM_{10}, biological resources including threatened and endangered species, cultural resources discovered on site, or other resources as determined in cooperation with agencies. Please see a discussion of possible mitigation in each section of Environmental Information, above.

McCoy Soleil

Plan of Development

Appendices

1. Tables Found within the Document
2. Draft Class 1 Cultural Inventory
3. Drawings and Maps
    i. Figure 1: Project Vicinity
    ii. Figure 2: Project Site Plan
    iii. Figure 3: Solar Field
    iv. Figure 4: Power Block Drawings
    v. Figure 5: Solar Field Grading Plan
    vi. Figure 6: Solar Field Drainage Plan
    vii. Figure 7: Road Sections
    viii. Figure 8: Power Tower Elevation
    ix. Figure 9: Oneline Drawings
    x. Figure 10: Development and Construction Schedule

Appendix for McCoy Soleil

Tables found in the POD

MTRS	Survey Type	Subdivision
27 0050S 0210E 002	ALL	ENTIRE SECTION
27 0050S 0210E 003	ALL	ENTIRE SECTION
27 0050S 0210E 004	ALL	ENTIRE SECTION
27 0050S 0210E 005	ALL	ENTIRE SECTION
27 0050S 0210E 006	ALL	ENTIRE SECTION
27 0050S 0210E 007	ALL	ENTIRE SECTION
27 0050S 0210E 008	ALL	ENTIRE SECTION
27 0050S 0210E 009	ALL	ENTIRE SECTION
27 0050S 0210E 010	ALL	ENTIRE SECTION
27 0050S 0210E 011	ALL	ENTIRE SECTION
27 0050S 0210E 012	ALL	ENTIRE SECTION
27 0050S 0210E 013	ALL	ENTIRE SECTION
27 0050S 0210E 014	ALL	ENTIRE SECTION
27 0050S 0210E 015	ALIQ	S2;
27 0050S 0210E 017	ALL	ENTIRE SECTION
27 0050S 0210E 018	ALL	ENTIRE SECTION
27 0050S 0210E 019	ALIQ	NE
27 0050S 0210E 020	ALL	ENTIRE SECTION
27 0050S 0210E 021	ALL	ENTIRE SECTION
27 0050S 0210E 022	ALL	ENTIRE SECTION
27 0050S 0210E 023	ALL	ENTIRE SECTION
27 0050S 0210E 024	ALIQ	S2;

Estimated Overall Project Acreage		
Project Component	**Temporary (acres)**	**Permanent (acres)**
Current Right of Way	13959	13959
Transmission ROW (to be added to current 299 application)	136	136
Solar Heliostat Field	831	831
Operations and Maintenance Areas	8	6.4
Switchyard	5	3.7
Roads outside project area	8	5.5
Construction Laydown Area	10	2
Transmission Lines disturbed	146	56
Total BLM acres disturbed	1911	1808

Water Consumption Requirements	Approximate Consumption during Construction	Approximate Consumption during Operation
Steam Cycle makeup water (AF)	0	100
Mirror wash water (AF)	0	70
Air cooled condenser augmentation (AF)	0	430
Construction year 1 (AF)	1000	0
Construction subsequent years (AF)	150	0
Total annual (acre-feet/year)	575 (2 years)	600

Preliminary List of Required Permits and Permit Schedule

Required Permits and Permit Schedule		
Air Quality	DOC	An application will be submitted to the South Coast Air Quality Management District (SCAQMD) about the same time as the NEPA documents to obtain a determination of compliance (DOC).
	Federal Title V	May require Federal Operating Permit.
Biological	BLM Fieldwork Authorization	A Fieldwork Authorization will be required from BLM to complete the detailed biological studies for McCoy Soleil.
	Federal Endangered Species Act, HCP/Incidental Take Permit	Wildlife surveys will need to be completed and if endangered species are found, submitted to the U.S. Fish and Wildlife Service (USFWS) for agency approval under the ESA Section 7 Consultation. Depending on findings in the environmental surveys, enXco may require a Low Effect Habitat Conservation Plan for McCoy Soleil. An Incidental Take Permit (ITP) may be required under section 10 of the ESA. BLM will consult with the USFWS regarding the presence of desert tortoise.
	California Department of Fish and Game (CDFG) Incidental Take Permit (ITP)	Wildlife surveys will need to be completed and if endangered species are found, submitted to the CDFG for agency approval. Depending on findings in the environmental surveys, enXco may require an ITP under section 2081 (b) and (c) of the CA Endangered Species Act.
	USFWS and CDFG 2080.1 Consistency Determination	Submit the federal USFWS opinion incidental take permit to the CDFG to obtain concurrence of federal ITC

	RWQCB	It is anticipated that the RWQCB will take jurisdiction of the ephemeral drainages. Pre-notification will be required to obtain an individual permit.
Cultural	BLM Fieldwork Authorization and Cultural Resource Use permit	A Fieldwork Authorization will be required from BLM to complete the Class 3 cultural studies for McCoy Soleil. Any removal of archaeological resources will require a Cultural Resource Use permit from the BLM.
	Historic Preservation Act section 106 consultation	Consultation with the SHPO will be required if the project would affect any property listed in the NRHP; any new site would require NRHP eligibility evaluation
Geological and Soils	BLM Building permit	The BLM requirement will be specified in the Conditions of Approval pending approval of the ROW application
	BLM Grading permit	The BLM requirement will be specified in the Conditions of Approval pending approval of the ROW application
Hazardous Material	Unified Program Facility Permit	Riverside County Fire Department, Haz Mat division, requires a permit prior to storage of hazardous materials on site.
	Aboveground Storage Tank permit	Riverside County Fire Department, Haz Mat division, requires a permit prior to storage of hazardous materials in aboveground storage tanks on site.
Land Use	ROW for Solar Energy Development/NEPA Review	BLM for commercial solar facility, including transmission lines and access roads. BLM will publish an EIS for the project.
	ROW for Solar Energy Testing	BLM for solar testing equipment, prior to the ROW grant for Solar Energy Development
Paleo	BLM fieldwork authorization	No state or local permits will be required. A BLM Fieldwork Authorization will be required for paleo studies.
Transportation and Traffic	NDOT and Caltrans: Oversize load permit	California Department of Transportation requires permits for any oversized (gross weight or dimensions) vehicle deliveries. At least 10 days prior to oversize loads At least 7 days prior to oversize load on State Highways.
	Encroachment permit (for work in County ROW)	Submit plans showing work 30 days prior to construction work in public ROW
	Haz Mat Permit	Federal Motor Carrier Safety Administration; depends on nature of hazardous material transported

	FAA	FAA Form 7460-1; at least 30 days before the application for a construction permit is to be filed
Hazardous Waste	EPA ID No. and register as a Hazardous Waste Generator with Department of Toxic Substance Control	Takes 7-10 business days once the application form has been received
	Hazardous waste generator permit from Riverside Co EHS	Approximately 30 days prior to approval once Business Plan is complete
	Waste Discharge Requirements	Regional water quality control board may require permits
Water Resources	Section 404 Permit U.S. Army Corps of Engineers	If mapping of the washes on site determine that waters of the U.S. are present, a permit will be required from the U.S. Army Corps of Engineers
	NOI for construction phase storm water permit	Construction general permit required. A SWPPP that specifies BMPs for preventing construction pollutants from leaving the site. Approval will take about a month.
	California Regional Water Quality Control Board (CRWQCB) Section 401 Permit	Required if Section 404 permit (above) applies.
	CRWQCB NPDES and SWPPP	Industrial General permit required for operations phase. A separate SWPPP will be required that outlines the monitoring and reporting plan and BMPs for the solar plant.
	Well Drilling Permit	California Department of Water Resources, Southern District permit is required for drilling water wells
Health and Safety	Trenching and excavation permit	Submit completed permit application to any OSHA district of field office prior to commencing construction
	Permit to erect a fixed tower crane	Submit completed permit application to any Cal-OSHA district of field office 24 hours prior to commencing activity

Construction Process

Construction Phase	Description	Approximate Number and Type of Construction Equipment and Vehicles
Rough Grading	Grubbing, clearing and bulk grading,	Approximately 20 Scrapers, 5 Compactors, 4 Graders, 2 Loaders, 4 Dozers, 10 Water Trucks, 6 Water Pulls
Finish Grading	Final grading to finish grade	Approximately 4 Scrapers, 8 Graders, 1 Dozer, 4 Water Trucks
Roads, Foundations, Flatwork and Site Utilities	Construction of roads, excavation and construction of foundations for heliostats	Approximately 20 to 40 pieces of equipment will be present at any one time, including concrete trucks, concrete pumps, backhoes, excavators, loaders, graders, foundation drills, paving machines, drum rollers, fork lifts, tractors, dump trucks, small cranes and additional support vehicles.
Heliostat Assembly and Deployment	Field assembly of heliostats in temporary shop buildings constructed at the site. Installation of assemblies on cast-in-place piers, or other foundations.	Approximately 8 to 10 crews, each with one or two pieces of equipment including small cranes, forklifts, welding machines, trucks and tractors.
Power Block Construction	Construction of foundations, structural frames and buildings, installation of utilities and equipment, including the STG, condenser, pumps, buildings, ACC cooling structure, TES tanks, and central receiver tower.	An average of 12 to 18 pieces of equipment will be utilized for power block construction over the duration of the project, with more equipment being utilized during the early stages of foundation construction and frame erection. Equipment will include backhoes, excavators, foundation drills, concrete trucks, concrete pumps, forklifts, boom trucks, lifts, cranes, welders, trucks and other support vehicles.
Liquid Salt Preparation	Melting of the delivered dry salt product	Temporary propane fired auxiliary boiler, forklifts, loaders, and trucks.

Special Status Species Potentially Occurring Near the Study Areas

Common Name	Scientific Name	USFWS	CDFG	CNPS
Plants				
Abram's spurge	*Chamaesyce abramsiana*	-	-	2.2
Foxtail cactus	*Coryphantha alversonii*	-	-	4.3
Harwood's milk-vetch	*Astragalus insularis var. harwoodii*	-	-	2.2
Las Animas colubrine	*Colubrina californica*	-	-	2.3
Invertebrates				
A mellitid bee	*Melitta californica*	-	-	
California Mccoy snail	*Eremarionta rowelli mccoiana*	-	-	
Riverside cuckoo wasp	*Hedychridium argenteum*	-	-	
Fish				
Razorback sucker	*Xyrauchen texanus*	E	E	
Reptiles				
Desert tortoise	*Goperus agassizii*	T	T	
Birds				
Black-tailed gnatcatcher	*Polioptila melanura*	-	-	
Burrowing owl	*Athene cunicularia*	-	SC	
Crissal thrasher	*Toxostoma crissale*	-	SC	
Le Conte's thrasher	*Toxostoma lecontei*	-	SC	
Prairie falcon	*Falco mexicanus*	-	-	
Vermilion flycatcher	*Pyrocephalus rubinus*	-	SC	
Mammals				
American Badger	*Taxidea tasux*	-	SC	
Arizona Myotis	*Myotis occultus*	-	SC	
California leaf-nosed bat	*Macrotus californicus*	-	SC	
Cave myotis	*Myotis velifer*	-	SC	
Colorado Valley woodrat	*Neotoma albigula venusta*	-	-	
Hoary bat	*Lasiurus cinereus*	-	-	
Pallid bat	*Antrozous pallidus*	-	SC	

A CLASS I INVENTORY OF THE MCCOY WASH AREA, RIVERSIDE COUNTY, CALIFORNIA

DRAFT

Prepared for:

WorleyParsons Group
Folsom, California

Prepared by:

Chambers Group
302 Brookside Avenue
Redlands, CA 92373

JANUARY 2009

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SOURCES CONSULTED AND RESULTS 1

3.0 PREHISTORIC OVERVIEW 2
3.1 Paleoindian Period 2
3.2 Archaic Period 2
3.3 Patayan Period 2

4.0 ETHNOGRAPHIC OVERVIEW 3

5.0 HISTORIC OVERVIEW 4

6.0 SUMMARY OF FINDINGS 5

7.0 REFERENCES 6

APPENDICES

Appendix A: Project Area Vicinity Map
Appendix B: USGS Topographic Maps of Project Area
Appendix C: Site Record Forms

3.0 PREHISTORIC OVERVIEW

The Precontact history of the region can be characterized by three general periods: the Paleoindian, the Archaic, and the Patayan. Summaries of these periods are presented below.

3.1 Paleoindian Period

The Paleoindian Period lasted from approximately 12,000 to 7,000 years before present (BP). This period is manifested in the Colorado Desert by the San Dieguito complex. Sites ascribed to this complex commonly contain assemblages of bifaces, choppers, scrapers, crescents, and other tools associated with a generalized hunting-gathering adaptation. Three separate phases have been suggested to represent a developmental sequence within the San Dieguito complex with each phase representing a step towards increasing technological complexity and diversity (Apple et al. 1997).

3.2 Archaic Period

The Archaic Period is characterized as a more diverse hunting-gathering tradition, which lasted from approximately 7,000 to 1,075 years BP. This period is poorly represented in the Colorado Desert region and it has been suggested that this area may have been largely abandoned during this period due to warm and dry conditions characterizing the Middle Holocene (Hayden 1976). An alternative hypothesis is that sites from this period may have been lost or eliminated by natural processes or obscured by later settlements (Weide 1976).

3.3 Patayan Period

The Patayan Period began after 1,075 years BP and lasted until the first Spanish explorers reached the area, around A.D. 1540. During this period, much of the region was populated by groups utilizing a distinctive ceramic technology that was characteristic of the Patayan cultural tradition. It is believed that these groups moved to the area at a time when Ancient Lake Cahuilla formed in the Salton Basin, southwest of the current project area. Lake Cahuilla became the westernmost extent of Patayan groups who populated a large area along the Colorado and Gila rivers and north to the present-day borders of Arizona, Utah, and Nevada. The Hohokam and Anasazi, two other Southwest cultural groups, bordered the Patayan to the southeast and northeast, respectively.

Although the origins of the Patayan are subject for debate, a transition from the Archaic Period to the Patayan Period is visible within the archaeological record. It appears that the adoption of Patayan ceramic technology coincides with a change in mortuary practices. A shift from burial to cremation practices indicates not only technological changes, but also fundamental shifts in cultural values. Although little is known about the organization of the Patayan, they were likely small, dispersed groups with exceptional mobility. Archaeological research has documented numerous trails and shrines that link resources separated by vast stretches of the Colorado Desert (e.g. Ezzo 1994). Most documented Patayan sites appear to consist of temporary camps with few architectural features other than small jacal structures (Cordell 1997). Archaeological sites in Arizona have produced marine shell, steatite, asphaltum, and turtle shells from California, further indicating that these early Patayan groups were extensive travelers and/or traders (Stone 1991). Patayan groups probably subsisted on a wide variety of hunted, gathered, and perhaps planted foods. At archaeological sites in the Salton Trough, numerous fish traps, fish bones, and shell middens indicate that some Patayan groups were highly dependent on exploitation of lacustrine resources.

The Patayan Period has been generally separated into three developmental phases that characterize cultural changes. The phases roughly coincide with the cyclic filling of Ancient Lake Cahuilla and correlate principally with changes in pottery types (Waters 1982). The Patayan I Phase (1,075 to 950 years BP) is characterized by a heavy influence of western Arizona Patayan on Colorado Desert populations (Waters 1982). The inception of this period has been dated by the association of intrusive Hohokam potsherds in two stratified Patayan sites in Arizona and five radiocarbon dates ranging from 1,125 (+/-80) years BP to

conditions of the region created competition for resources, theft of food, petty conflict, and frequently war (McCarthy 1986).

The inhabitants of the region near the Colorado River lived in flat-topped ramada-like dwellings. Ceramic vessels were made to store foodstuffs. The people hunted with the bow and arrow, and fished with nets and weirs. They built boats of balsa wood, and rafts were made of bundled bulrushes and reeds. In 1605, Don Juan de Oñate reported more than 16,000 Indians living in the lower river region between present-day Las Vegas and the tidewater (McCarthy 1986).

5.0 HISTORIC OVERVIEW

The first significant European settlement of California began during the Spanish Period (1769 to 1821) when 21 missions and 4 presidios were established between San Diego and Sonoma. Although located primarily along the coast, the missions dominated economic and political life over the majority of the California region during this period. The purpose of the missions was primarily Indian control, along with economic support to the presidios, forced assimilation of the Indians to Hispanic society, and conversion of the native population to Spanish Catholicism (Castillo 1978; Cleland 1941).

The Mexican Period (1821 to 1848) began with the success of the Mexican Revolution in 1821, but changes to the mission system were slow to follow. When secularization of the missions occurred in the 1830s, the vast land holdings of the missions in California were divided into large land grants called *ranchos*. The Mexican government granted ranchos throughout California to Spanish and Hispanic soldiers and settlers (Castillo 1978).

In 1848, the Treaty of Guadalupe Hidalgo ended the Mexican-American War and marked the beginning of the American Period (1848 to present). The discovery of gold the same year initiated the 1849 California Gold Rush, bringing thousands of miners and settlers to California, most of who settled in the north. For those settlers who chose to come to southern California, much of their economic prosperity was fueled by cattle ranching rather than by gold. California continued to grow, gaining the status of statehood in 1850. During the 1860s, severe floods and droughts slowed growth and bankrupted many ranchos and settlers (Castillo 1978; Cleland 1941).

Despite such setbacks, settlement in California continued throughout the remaining decades of the 19th century. Emigrants were lured to California though advertisements proclaiming mild weather, health benefits and opportunity. The first half of the 20th century saw steady increases in population, especially with the onset of the Great Depression as families sought work in various industries, especially that of agriculture throughout the central valley. One of the greatest booms to California population and economy came with America's entrance into World War II. The establishment of military bases and manufacturing plants associated with the war effort brought yet another wave of American emigrants westward where many settled permanently.

Desert cities developed more slowly than those in settlements closer to the coast or within fertile valley areas. The earliest European explorers to visit the Colorado River and the hostile desert area of Arizona were Francisco de Coronado and his company of men in 1540. The same year, the expedition of Hernando de Alarcón, sent by the Spanish government to find Coronado, towed boats up the Colorado River. While Alarcón was searching for the Coronado expedition, Coronado sent one of his officers, Melchior Díaz, on a supply-seeking foray with a small group of soldiers. Historians are not certain of the extent of the travels of either Alarcón or Díaz. Some, however, believe that Alarcón traveled up the Colorado River as far as present-day Blythe before turning back to Mexico, and that Díaz crossed the river in the Blythe area and explored the desert on the California side (Forbes 1965).

Little European activity took place in the harsh Colorado Desert over the next two centuries, except for occasional expeditions like that of Don Juan de Oñate, the Spanish colonizer of New Mexico. In 1605, Oñate and a company of men set out on a wealth-seeking expedition from the New Mexico colonies to

7.0 REFERENCES

Apple, R., A. York, A. Pigniolo, J. Cleland, and S. Van Wormer

1997 Archaeological Survey and Evaluation Program for the Salton Sea Test Base, Imperial County, California. On file at the Imperial Valley College Desert Museum and Information Center.

Bureau of Land Management

1978 California Desert Program: Archaeological Sample Unit Records for the Big Maria Planning Unit. Unpublished manuscript number RI-01249.

Castillo, Edward D.

1978 The Impact of Euro-American Exploration and Settlement. In Handbook of North American Indians, Volume 8, California, R.F. Heizer, ed., pp. 99-127. William C. Sturtevant, general editor. Smithsonian Institution, Washington D.C.

Cleland, Robert G.

1941 The Cattle on a Thousand Hills: Southern California, 1850-1870. Huntington Library, San Marino, California.

Cordell, Linda S.

1997 Archaeology of the Southwest. Academic Press, Orlando.

Ezzo, Joseph A.

1994 *On the Trail to Avikwaame: Results of a Noncollection Class II Cultural Resources Survey of Quien Sabe/Big Maria Terrace, Riverside County, California.* Technical Series No. 49. Statistical Research, Tucson.

Forbes, Jack D.

1965 Warriors of the Colorado. University of Oklahoma Press.

Gunther, Jane D.

1984 Riverside County, California, Place Names: Their Origins and Their Stories. Rubidoux Printing Company, Riverside.

Hayden, Julian D.

1976 "Pre-Altithermal Archaeology in the Sierra Pinacates. Sonora, Mexico." American Antiquity 41(3):274-289.

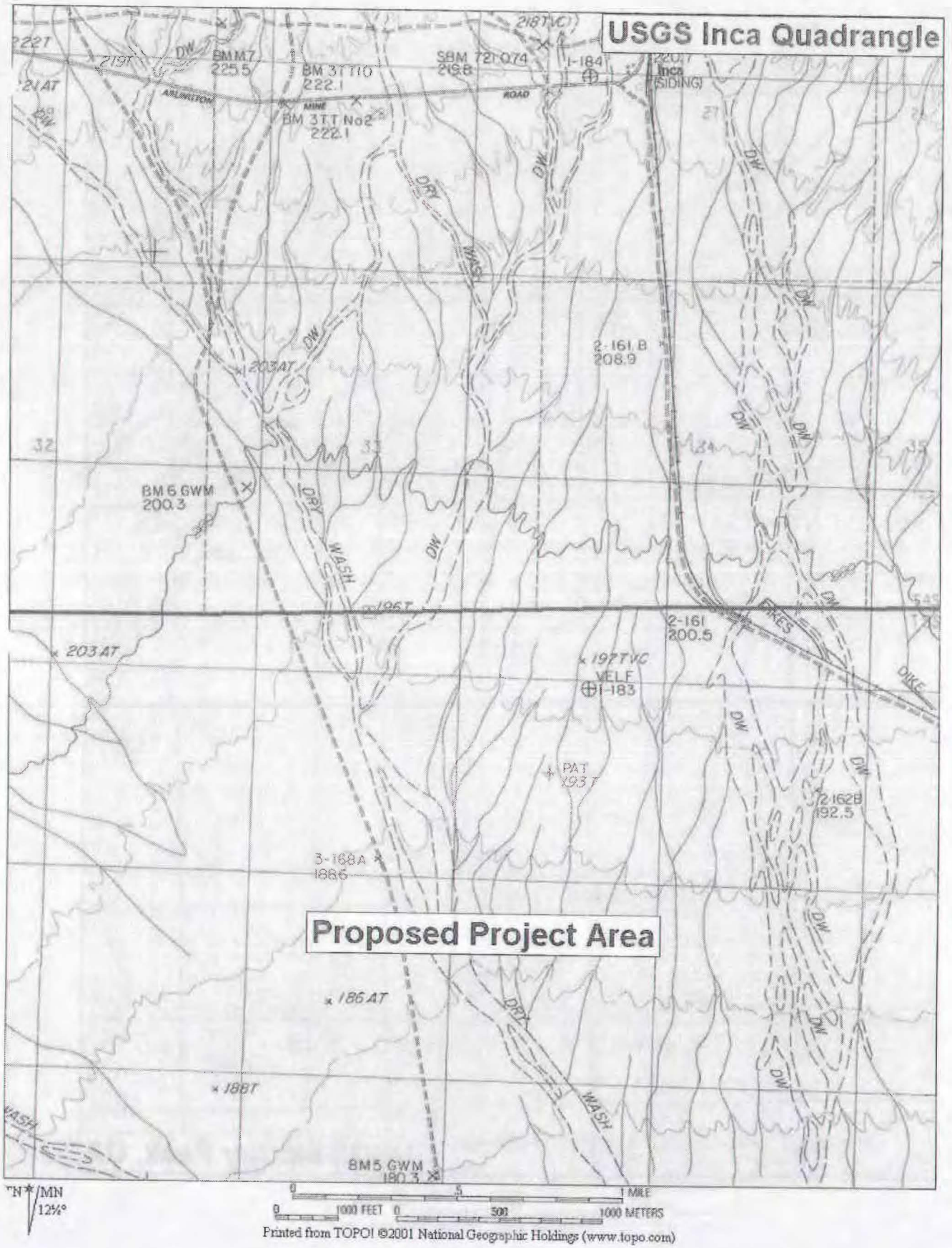
McCarthy, Daniel F.

1986 A Cultural Resources Assessment of a Proposed Prison Site Near Blythe in Riverside County, California. Archaeological Research Unit, University of California, Riverside. July.

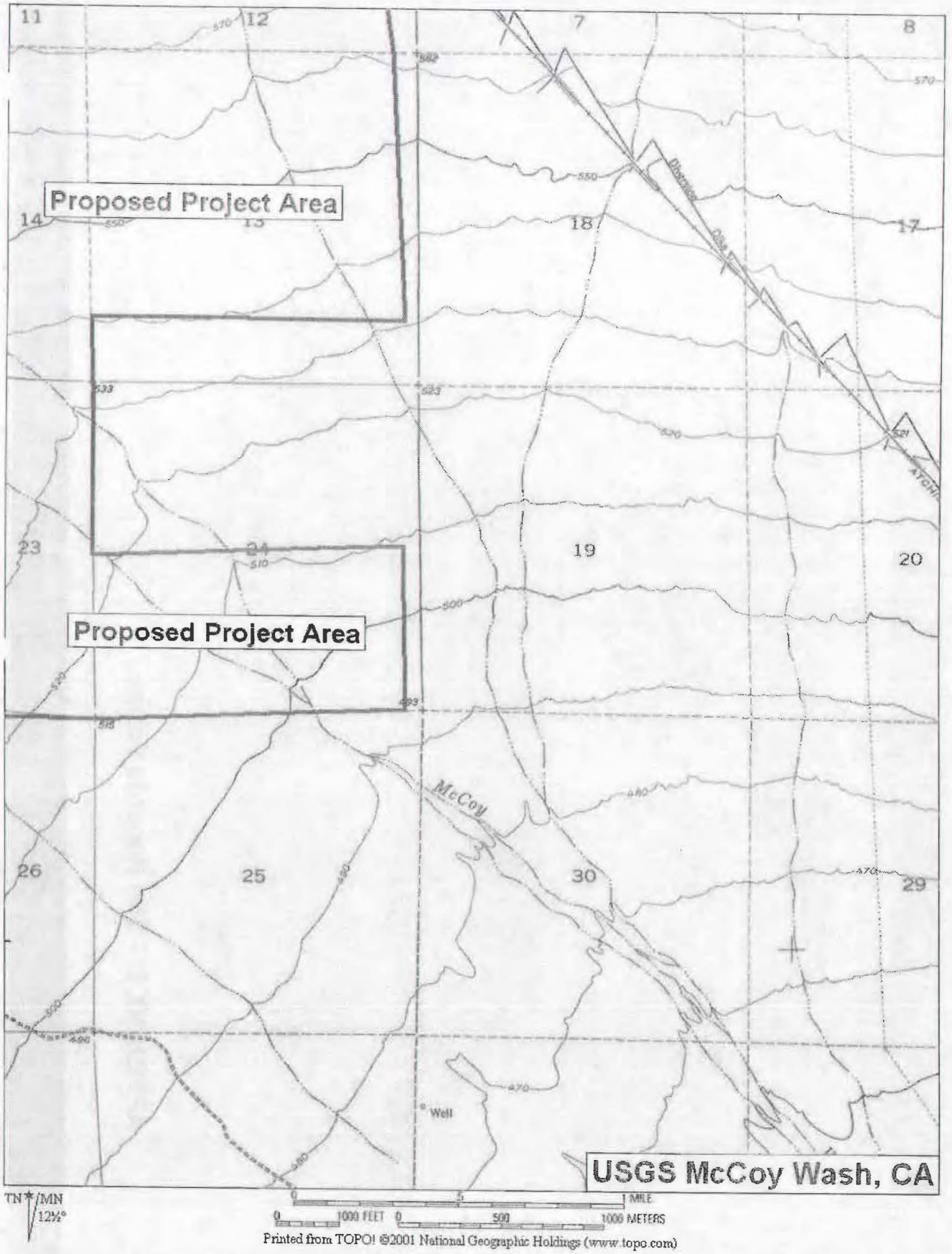
APPENDIX A– Project Area Vicinity Map

CHAMBERS GROUP

APPENDIX B – USGS Topographic Maps of Project Area



Printed from TOPO! ©2001 National Geographic Holdings (www.topo.com)


Proposed Project Area
Proposed Project Area
McCoy
Well
USGS McCoy Wash, CA
TN 12½° MN
1 MILE
1000 FEET
500
1000 METERS
Printed from TOPO! ©2001 National Geographic Holdings (www.topo.com)

33 - 872

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #:
HRI #:
Trinomial: CA-RIV-872 Update
NRHP Status Code:
Other Listings:
Review Code: Reviewer: Date:

Page 1 of 2 **Resource Name or #: (Assigned by recorder):**

P1. Other Identifier: SBCM Report

P2. **Location:** ▪ Not for Publication ☐ Unrestricted a. **County:** Riverside
Taken from 1976 site record:

b. **USGS 7.5' Quad:** Big Maria Mts. SW Date: 1975 T 4S ; R 23E; Unsectioned; SBM
c. Address: None
d. UTM: Zone 11 ; NAD 1927; 528560 mE/ 3743360 mN, 524300 mE/ 374360 mN (note missing # in second northing)
e. Other Locational Data (e.g., parcel #, directions to resource, elevation, etc., as appropriate): The site location was originally described as, "Trail runs parallel to jeep trail East Northeast for 4 miles (approx), then swings south-southeast for ⅛ mile and then due east for 2.5 miles to a junction with Hwy 95. Trail runs NW-SE along foot of Little Maria Mtns."

P3a. **Description** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries): This site was recorded in 1976 by Savio simply as a trail one meter wide and 9600 meters long. A portion of the recorded location was revisited in 1997 by Eighmey, O'Neill, and Giacomini, but the trail was not relocated. A separate portion was revisited during the current survey, but again, no trail was found. This portion may have been destroyed by the All American Pipeline or Midland Road.

P3b. **Resource Attributes** (List attributes and codes): AP13. Trail (Not Relocated)

P4. **Resources Present:** ☐Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photograph or Drawing (Photo required for buildings, structures, and objects)

RECEIVED IN
JAN 2 3 2002
EIC

P5b. Description of Photo (View, date, accession #):

P6. **Age and Sources:**
☐ Historic ▪ Prehistoric
☐ Both

P7. **Owner and Address:**
Bureau of Land Management

P8. **Recorded by** (Name, affiliation, and address):
D. James and S. Briggs
Tierra Environmental Services
9903-E Businesspark Avenue
San Diego, CA 92131

P9. **Date Recorded:**
February 28, 2001

P10. **Survey Type** (Describe):
Intensive Surface Inventory

P11. **Report Citation** (Cite survey report and other sources, or enter "none"): Pigniolo, Andrew R., John Dietler, and Stephanie Murray 2001 Cultural Resources Survey Report for the All American Pipeline Replacement Project, Daggett to Blythe Segment, San Bernardino and Riverside Counties, California.

Attachments: ☐ NONE ▪ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #:
HRI #:
Trinomial: CA-RIV-872 (Update)
NRHP Status Code:
Other Listings
Review Code Reviewer Date

Page 1 of 2 *Resource Name or #: (Assigned by recorder) CA-RIV-872 (Update)

P1. Other Identifier: SBCM Report

*P2. Location: ■ Not for Publication ☐ Unrestricted *a. County: Riverside
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
*b. USGS 7.5' Quad Big Maria Mts. SW Date 1971,1975 T 4S ; R 22,23E ; _ ¼of _ ; ¼of Sec 36 ; San Bernardino B.M.
c. Address: City: Zip:
d. UTM: (Give more than one for large and/or linear resources) Zone 11 ; 528560,524300 ME/ 3743360 MN
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) The trail was not relocated. The location information given above reflects the original site recording done by Savlo on June 29, 1976. A sketch map accompanying the initial recording indicates that a trail passing through section 36 was identified, extending east for about 10 miles, to Highway 95. (This is a portion of the "Halchidhomi" trail extending from the Blythe geoglyph to Redlands). It was recorded in the 1950's by Johnston and Johnston as RIV-53T. They only found segments preserved along the reconstructed route and in this area reported the trail but did not record it as preserved.

*P3a. Description: (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries) The site is described as a trail running "NW-SE along foot of Little Maria Mtns". The area given is 1 meter by 9600 meters.

*P3b. Resource Attributes: (List attributes and codes)
*P4. Resources Present: ☐Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photograph or Drawing (Photo required for buildings, structures, and objects)

P5b. Description of Photo (View, date, accession #)

*P6. Date Constructed/Age and Sources: ☐Historic ■ Prehistoric ☐Both

*P7. Owner and Address:
Bureau of Land Management
63-500 Garnet Ave
North Palm Springs, Calif.92258-2000

*P8. Recorded by: (Name, affiliation, and address) Eighmey, O'Neill, Giacomini
ASM Affiliates, Inc.
543 Encinitas Blvd., Ste 114
Encinitas, CA 92024

*P9. Date Recorded: May, 1997

*P10. Survey Type: (Describe):
Pedestrian Survey; 100% coverage of power line right-of-way and designated access roads. Recordation of all pre-1945 resources.

*P11. Report Citation: (Cite survey report and other sources, or enter "none") A Cultural Resources Inventory and Evaluation of the Parker-Blythe 161KV Transmission Line No. 2 Riverside and San Bernardino Counties, California. ASM Affiliates, Encinitas, California.

*Attachments: ☐NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building, Structure, and Object Record
☐ Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record
☐Photograph Record ☐Other (List):

DBR 523a (1/95) *Required information

University of California

UTM {528560 ME 3743360 MN
52H 300 ME 3743 60 MN

RIV-872T

ARCHAEOLOGICAL SITE SURVEY RECORD MAPPED

1. Site RIV-872T 2. Map Big Maria Mtns, SE-7.5'; Midland-15'; Big Maria Mtns-15' County RIVERSIDE
4. Twp. 4S Range 23E; 22E Sec. of map otherwise
5. Location Trail runs parallel to jeep trail East Northeast for 4 miles (approx), then swings South-Southeast for 1/3 mile and then due east for 2.5 miles to junction with Hiwy 95
6. On contour elevation
7. Previous designations for site SBCM report
8. Owner 9. Address
10. Previous owners, dates
11. Present tenant
12. Attitude toward excavation
13. Description of site Trail runs NW-SE along foot of Little Maria Mtns.
14. Area 9600 x 1 m 15. Depth 16. Height
17. Vegetation 18. Nearest water
19. Soil of site 20. Surrounding soil type
21. Previous excavation
22. Cultivation 23. Erosion
24. Buildings, roads, etc.
25. Possibility of destruction
26. House pits
27. Other features
28. Burials
29. Artifacts
30. Remarks
31. Published references
32. Accession No. 33. Sketch map Yes
34. Date 6-29-76 35. Recorded by SAVIO 36. Photos

AR060316

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # 33-12410
HRI #
Trinomial
NRHP Status Code
Other Listings
Review Code ____ Reviewer ____ Date DEC 20 2001

RECEIVED IN
E.I.C

Page 1 of 8 *Resource Name or #: (Assigned by recorder) NB-AF-8H Update

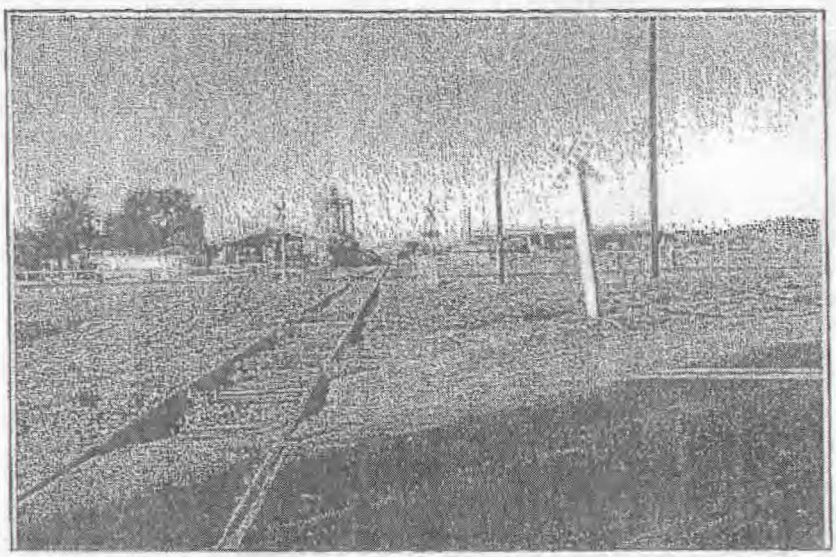
P1. Other Identifier: Atchison, Topeka and Santa Fe Railroad

*P2. Location: ■ Not for Publication □ Unrestricted *a. County Riverside
and P2c, P2e, and P2b or P2d. (Attach Location Map as necessary.)
*b. USGS 7.5' Quad Blythe Date: 1975; T 7S; R 23E: NE¼ of NE¼ of Sec. 18; SW¼ of SW¼ of Sec. 8; SB B.M.
USGS 7.5' Quad Ripley Date: 1975; T 7S; R 22E: N½ of NE¼ of Sec. 34; SB B.M.
c. Address City Zip
d. UTM: (Give more than one for large and/or linear resources) Zone: 11; A: 722520 mE/ 3717350 mN;
B: 722050 mE/ 3716125 mN; C: 716462 mE / 3713900 mN; D: 7173123 mE / 3712013 mN
*e. Other Locational Data: (E.g., parcel #, directions to resource, elevation, etc., as appropriate)
There are two segments. The northernmost begins approximately 100 feet east of the intersection of Lovekin Boulevard and 18th Avenue, and heads southwest for 2,000 feet. The southernmost segment begins at the southwest corner of 24th Avenue and Neighbors Boulevard. This segment runs east-west and is the last 1,200 feet of the terminus at Ripley.

*P3a. Description: (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries.)
The two segments are part of the Atchison, Topeka & Santa Fe Railroad (AT&SF) spur that stretches from Rice (Blythe Junction), California to its terminus in Ripley, California. The 49.4 mile AT&SF spur branches off of the Parker District branch line that runs between Cadiz, California and Parker, Arizona. Construction on this spur spanned from 1915-1920, with Ripley operations beginning October 1921. One of the rails is stamped "Colorado Sec 905 x 1912 OH" and a tie plate is marked "NES SEE-TP-3." The spur line is still in use, operated by the Arizona & California Railroad.

*P3b. Resource Attributes: (See attributes and codes) AH7. Railroad bed

*P4. Resources Present: □ Building
■ Structure □ Object □ Site □ District □ Element of District □ Other (Isolates, etc.)



P5b. Description of Photo: (View, date, accession #) Southwest, 9/28/00, 00095-AF-Roll 1, frame 2, overview as railroad crosses 18th Avenue (in foreground)

*P6. Date Constructed / Age and Sources:
■ Historic
□ Prehistoric □ Both

*P7. Owner and Address:
Southern Pacific Railroad
700 Summer Street
Bakersfield, CA 93305

*P8. Recorded by: (Name, affiliation, and address)
C. Dolan
KEA Environmental, Inc./ EDAW, Inc.
1420 Kettner Boulevard, Suite 620
San Diego, California 92101

*P9. Date Recorded: 9/28/00; 8/01

*P10. Survey Type: (Describe) Intensive pedestrian survey; evaluation

*P11. Report Citation: (Cite Survey report and other sources, or enter "none.") Cultural Resources Overview and Survey for the Proposed Alignment of the North Baja Gas Pipeline: Addendum 1 Archaeological Survey of Ancillary Facilities. Underwood 2000. Cultural Resources Evaluation for the North Baja Gas Pipeline. EDAW, Inc. 2001.

*Attachments: □ None ■ Location Map ■ Sketch Map ■ Continuation Sheet ■ Building, Structure, and Object Record
■ Linear Resource Record □ Archaeological Record □ District Record □ Milling Station Record □ Rock Art Record
□ Artifact Record □ Photograph Record □ Other (List)

DPR 523A (1/95)

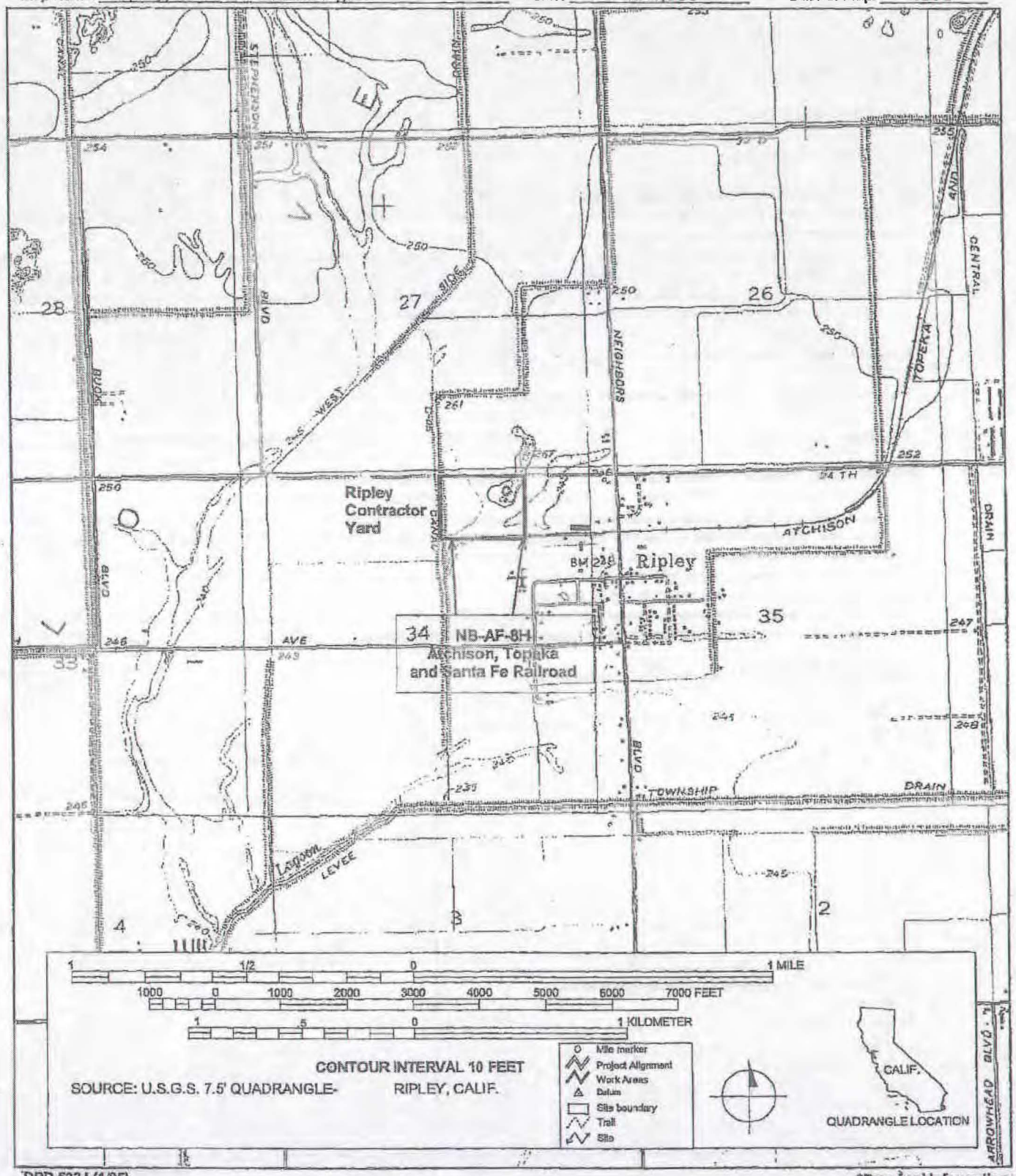
*Required Information
0K 095 NB-AF-8H.wpd

State of California - The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LOCATION MAP

Primary # 33-12410
HRI #
Trinomial

Page 3 of 8 * Resource Name or # (Assigned by recorder) NB-AF-8H Update

* Map Name: Ripley, Calif. 7.5' Quadrangle * Scale: 1:24,000 * Date of Map: 1975



DPR 523J (1/95)

*Required Information

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # 33-12419
HRI #
Trinomial

Page 5 of 8 *Resource Name or # (Assigned by recorder) NB-AF-8H Update

*Recorded by: C. Dolan *Date: 9/28/00; 8/01 ■ Continuation □ Update

*B12. References:

Byrant, Keith L. Jr. 1974 *History of the Atchison, Topeka and Santa Fe Railway.* University of Nebraska Press, Lincoln and London.

Santa Fe Railroad & Modeling Society, Curated by Russell Crump, Eastern Archivist, Shawnee, Kansas.

1915-1953	Building Record, Ripley District, Los Angeles Division, California Southern Railroad (Atchison, Topeka and Santa Fe Railroad).
n.d.	Profile Map, Ripley District, Los Angeles Division, California Southern Railroad (Atchison, Topeka and Santa Fe Railroad).
1915-1948	Distance Statement, Ripley District, Los Angeles Division, California Southern Railroad (Atchison, Topeka and Santa Fe Railroad).
c. 1960	History of The Santa Fe Coast Lines. Internal document of Atchison, Topeka and Santa Fe Railroad.

Personal communication in 2001 with Thomas Schlosser, President, Arizona and California Railroad.

B13. Remarks:

*B14. Evaluator: C. Dolan

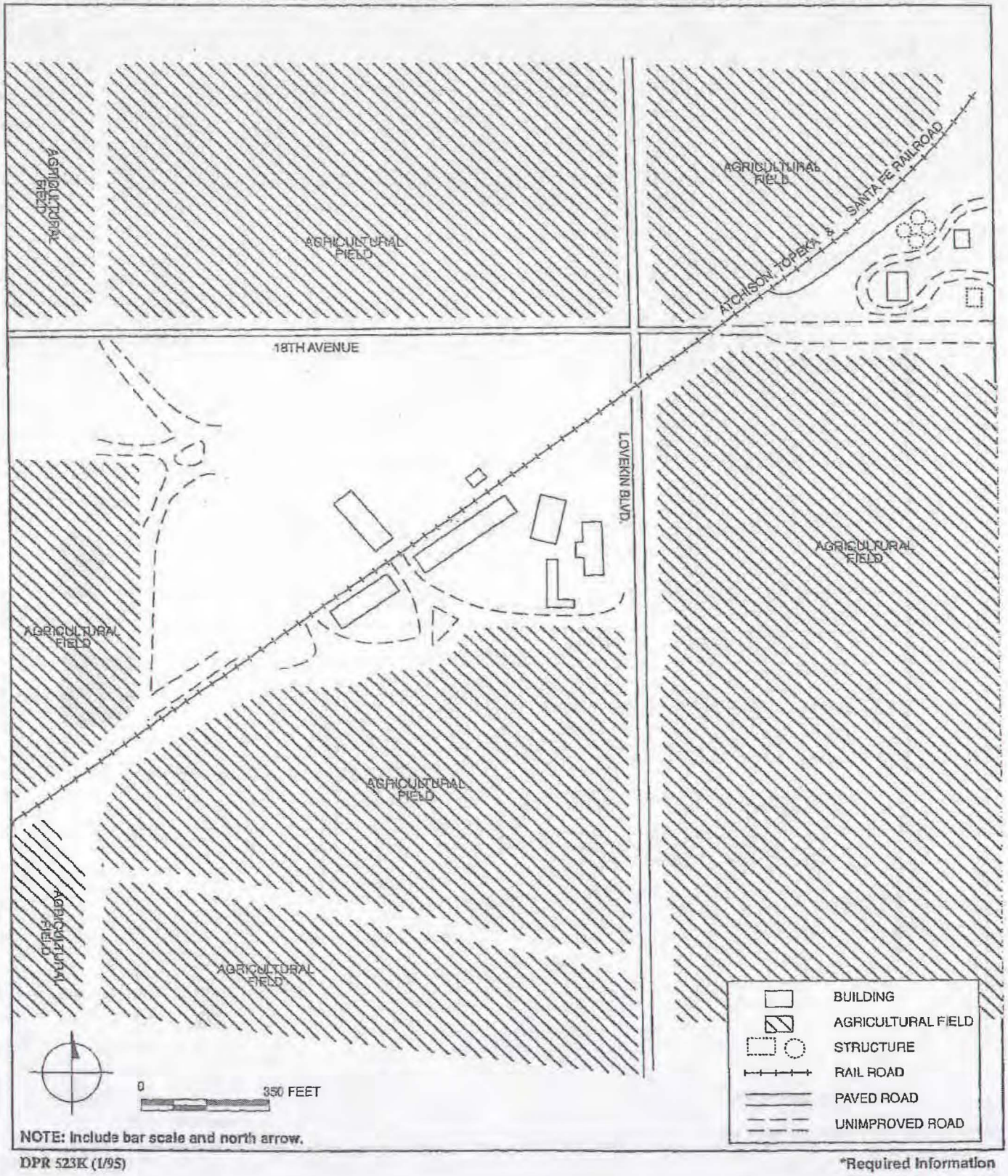
*Date of Evaluation: 8/01

State of California - The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
SKETCH MAP

Primary #
HRI#
Trinomial 33-12410

Page 7 of 8 *Resource Name or # (Assigned by recorder) NB-AF-8H Update

*Drawn By: C. Gregory 1 of 2 *Date: 9/15/01



NOTE: Include bar scale and north arrow.

DPR 523K (1/95) *Required Information

State of California - The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #: 33-12410
HRI #:
Trinomial: CA-RIV-7045H
NRHP Status Code:
Other Listings:

☐ Update or Supplement | Review Code: | Reviewer: | Date:

Page 1 of 5

RECEIVED IN
FEB 2 8 2003
EIC

*Resource Name or Number (Assigned by Recorder): Site WB-S-13

P1. Other Identifier: Arizona & California Railroad (California Southern Railroad and Atchison, Topeka, & Santa Fe Railway)

*P2. Location: ☒ Not for Publication (Styx) ☐ Unrestricted *a. County: Riverside
*b. USGS 7.5' Quad: Inca, Calif. Date: 1978; T 3S & 4S R 21E ¼ of ¼ of Sec. Various Sections San Bernardino B.M.
c. Address: N.A. City: N.A.
d. UTM: (Give more than one for large and/or linear resources) Zone: 11; 0703905 mE 3750793 (600) mN (Styx); (NAD 27)
0706790 mE 3742192 mN (Inca Siding) (see Liner Feature Record for more)
e. Other Locational Data (e.g., parcel #, directions to resource, elevation, etc., when appropriate: This segment of the Railroad is located approximately 20 miles northwest of Blythe, California and passes through Midland.

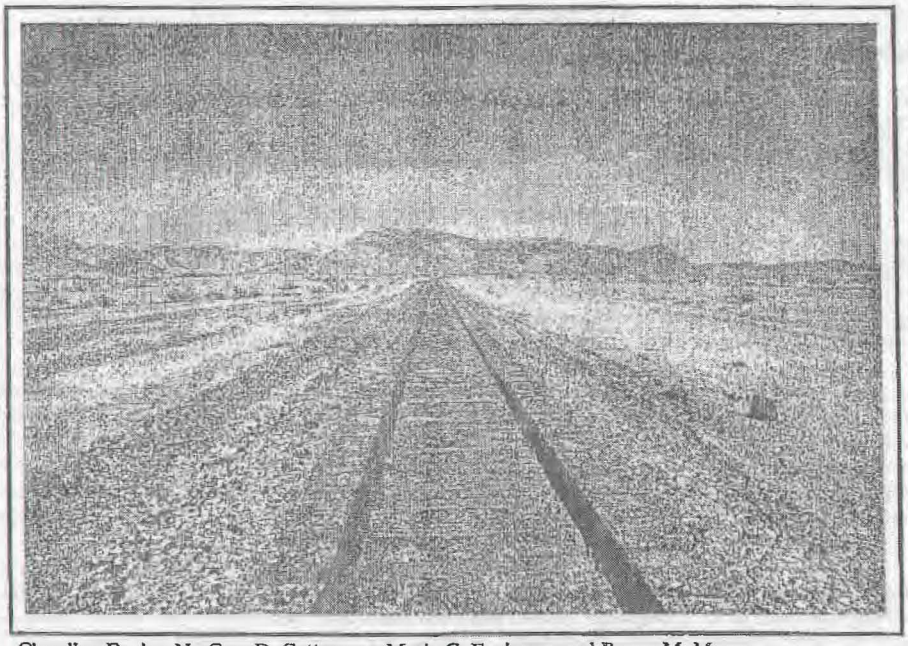
*P3a. Description (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries): This recorded segment of the Arizona & California Railroad begins at Styx and continues south through Midland and Cox Siding and ends at Inca Siding. The site consists of this 6.55-mile segment of the railroad grade and tracks.

*P3b. Resource Attributes (List Attributes and Codes): HP39 (railroad tracks); AH7 (railroad grade)

*P4. Resources Present: ☐ Building ☐ Structure ☐ Object ☒ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5b. Description of ☒ Photo ☐ Drawing (View, date, accession#): Overview of tracks, view to the north; taken 9/18/02; photo no. 64

*P6. Date Constructed/Age and Sources ☐ Prehistoric ☒ Historic ☐ Both :



*P7. Owner and Address:
U.S. Department of the Interior
Bureau of Land Management
Palm Springs/South Coast Resource Area Office
690 W. Garnet Ave., North Palm Springs, CA 92258

P8. Recorded by (Name, affiliation, address): Evelyn Chandler

Chambers Group, Inc.
302 Brookside Avenue
Redlands, CA 92373

*P9. Date ☒ Recorded ☐ Updated: September 18, 2002

*P10. Type of Study (Describe): Intensive pedestrian archaeological survey.

*P11. Report Citation (Cite survey report and other sources, or enter "none."):

Chandler, Evelyn N., Cary D. Cotterman, Maria G. Espinoza, and Roger M. Mason
2002 *Cultural Resources Survey of the Proposed Warner Brothers/Big Wheel Productions "Torque" Film Location, near Blythe, Riverside County, California.* Prepared for Warner Brothers Pictures/Big Wheel Productions, Los Angeles, California, and the Bureau of Land Management Palm Springs-South Coast Field Office, North Palm Springs, California. Prepared by Chambers Group, Inc., Redlands, California.

*Attachments: ☐ NONE ☒ Location Map ☒ Sketch Map ☐ Continuation Sheets ☐ Building, Structure, and Object Record ☒ Linear Feature Record ☐ Archaeological Site Record ☐ District Record ☐ Bedrock Grinding Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

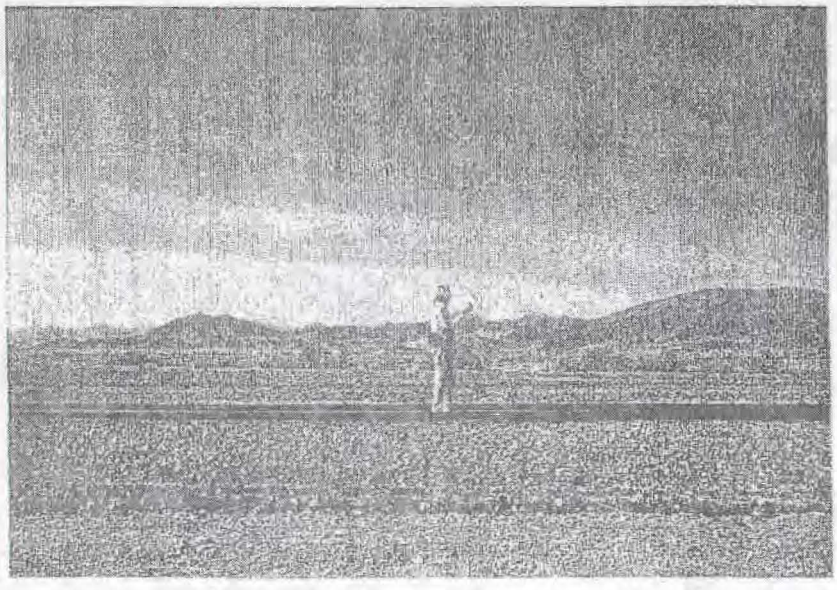
DPR 523A (1/95) *Required Information

State of California—The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LINEAR FEATURE RECORD

Primary #: 33-12410
HRI #:
Trinomial: CA-RIV-7045

Page 3 of 5 Resource Name or #: (Assigned by recorder): Arizona & California Railroad; WB-S-13

L8a. Photograph, Map or Drawing



L8b. Description of Photo, Map, or Drawing (View, scale, etc.)

Profile of railroad grade and tracks, McCoy Mountains in background, view towards southwest; taken 9/18/02; Photo #66.

L9. Remarks: The California Southern Railroad was organized in 1880, and construction of the tracks began in 1881. After 1884, the Atchison, Topeka, & Santa Fe Railway took over the California Southern Railroad as a subsidiary. The California Southern Railroad line from Cadiz, California to Matthie, Arizona was constructed in 1910. In 1915, due partially to the need for a rail line closer to mining operations north of Blythe, construction began on a branch extending south from Blythe Junction (now Rice) on the Cadiz-Matthie line to Blythe. This line was completed in 1916. The segment of railroad from Styx to Inca Siding was probably constructed in 1915 or 1916. The railroad line between Rice and Blythe was instrumental in the development of the Blythe-Midland region as a gypsum and manganese mining center in the early 20th century. On May 9, 1991, the Cadiz, California to Matthie, Arizona line, formerly of the California Southern Railroad, a subsidiary branch line of the Atchison, Topeka, & Santa Fe Railway, was purchased by the Arizona & California Railroad (Blaszak 2002; Gunther 1984; van Till Warren et al. 1981).

This branch of the railroad has not been formally evaluated for NRHP eligibility. However, given the high level of integrity of this segment and the branch's association with the California Southern and Atchison, Topeka, & Santa Fe Railroads, which played prominent roles in the historical development of transportation and mining in the Blythe-Midland region, the railroad is likely to be eligible for inclusion in the NRHP under Criteria A and C.

L10. Form Prepared by: (Name, affiliation, and address)

Evelyn N. Chandler
Chambers Group, Inc.
302 Brookside Avenue
Redlands, CA 92373

L11. Date: September 2002

L12. References:

Blaszak, Micheal W.
2002 "Santa Fe: A Chronology." *ATSF History*. www.augustweb.com/~marcc/atsfhist.html.

Gunther, Jane Davies
1984 *Riverside County, California Place Names, Their Origins and Their Stories*. Rubidoux Printing Company, Riverside, California.

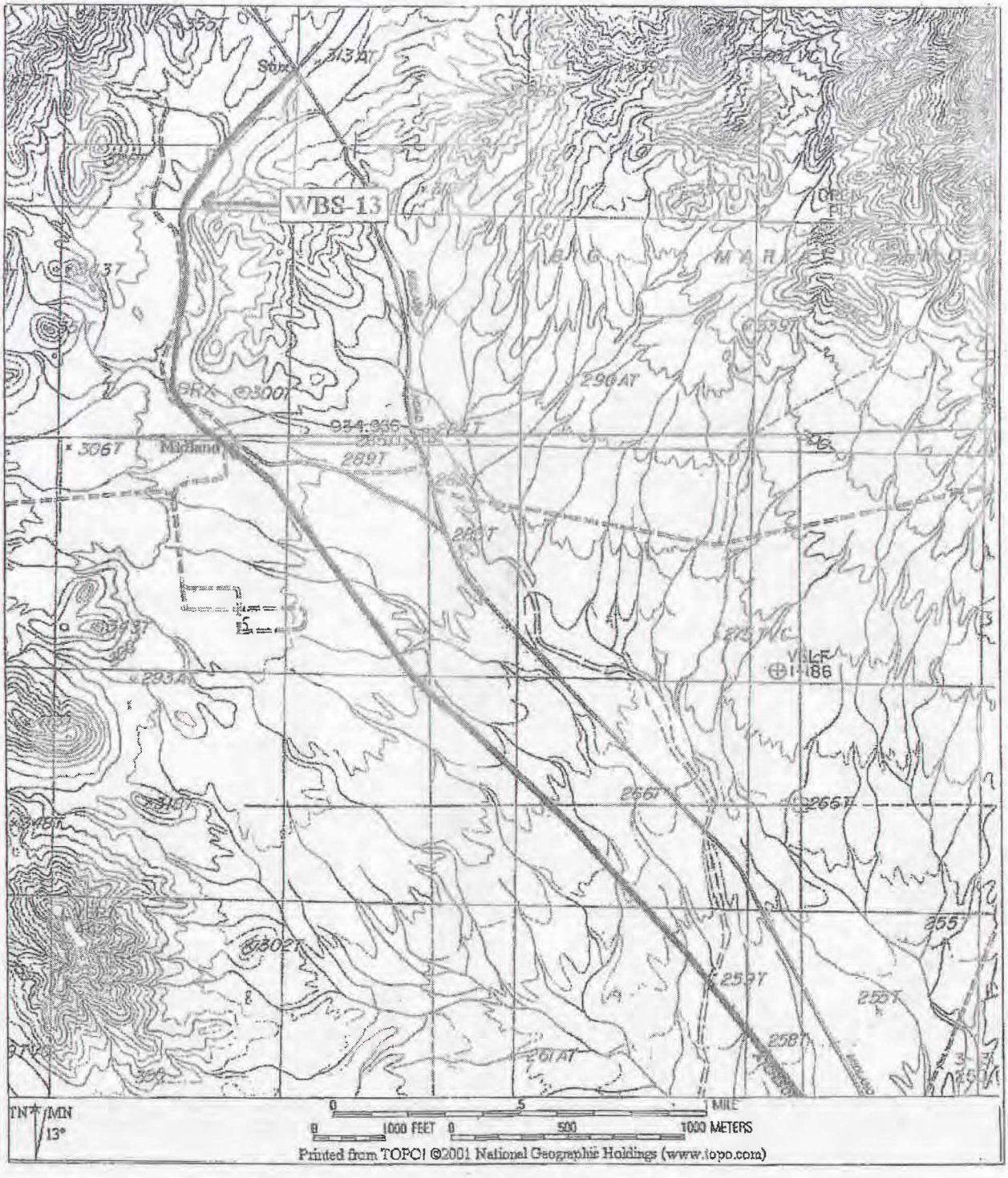
van Till Warren, Elizabeth, Robert H. Crabtree, Claude N. Warren, Martha Knack, and Richard McCarty
1981 A Cultural Resources Overview of the Colorado Desert Planning Units. Cultural Resources Publications: Anthropology—History. U.S. Department of the Interior, Bureau of Land Management, California Desert District, Riverside, California.

State of California - The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LOCATION MAP

Page 5 of 5 + Styx
*Map Name: Inca, California

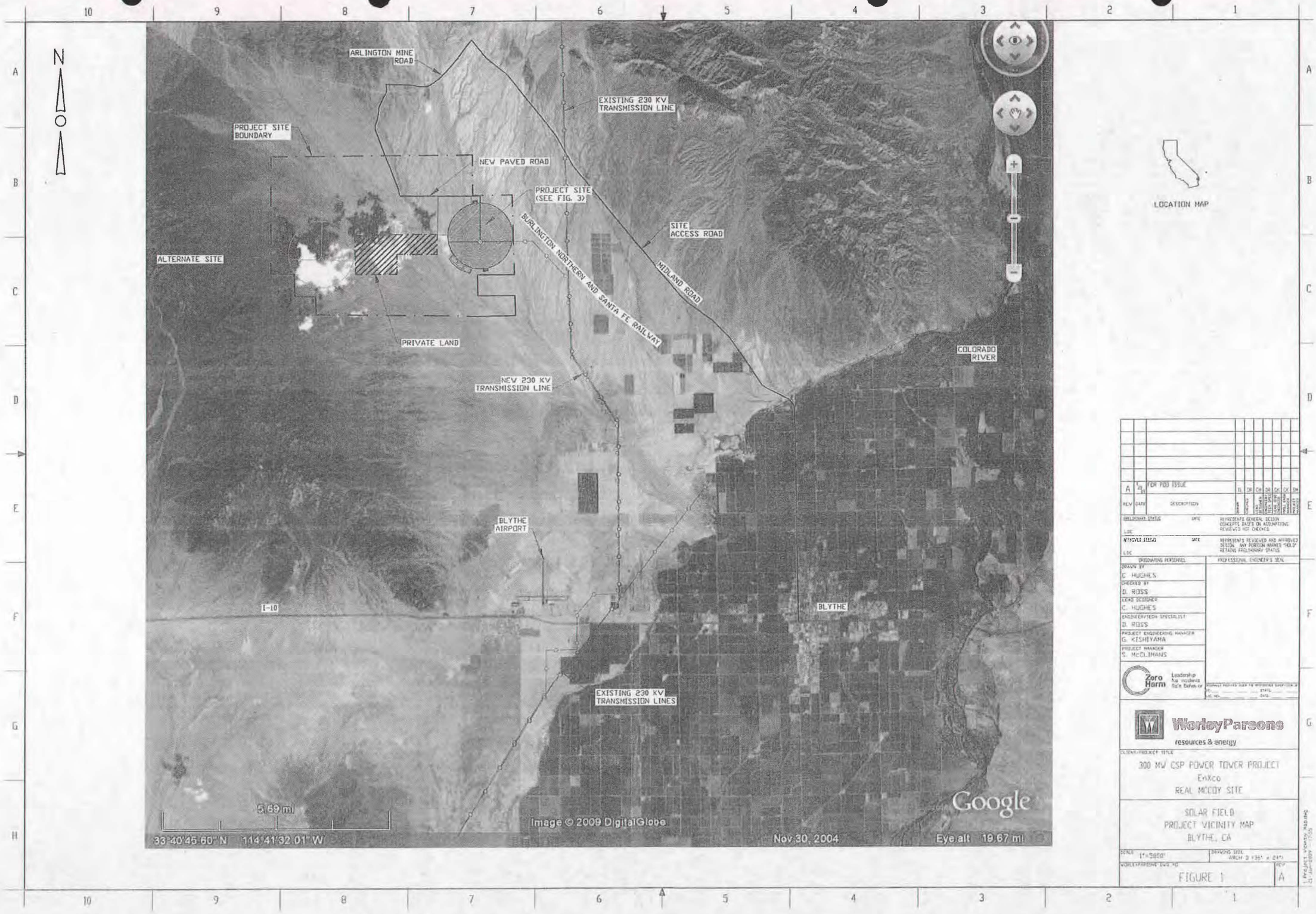
Primary #:
HRI# 33-12410
Trinomial: CA-RIV-7045

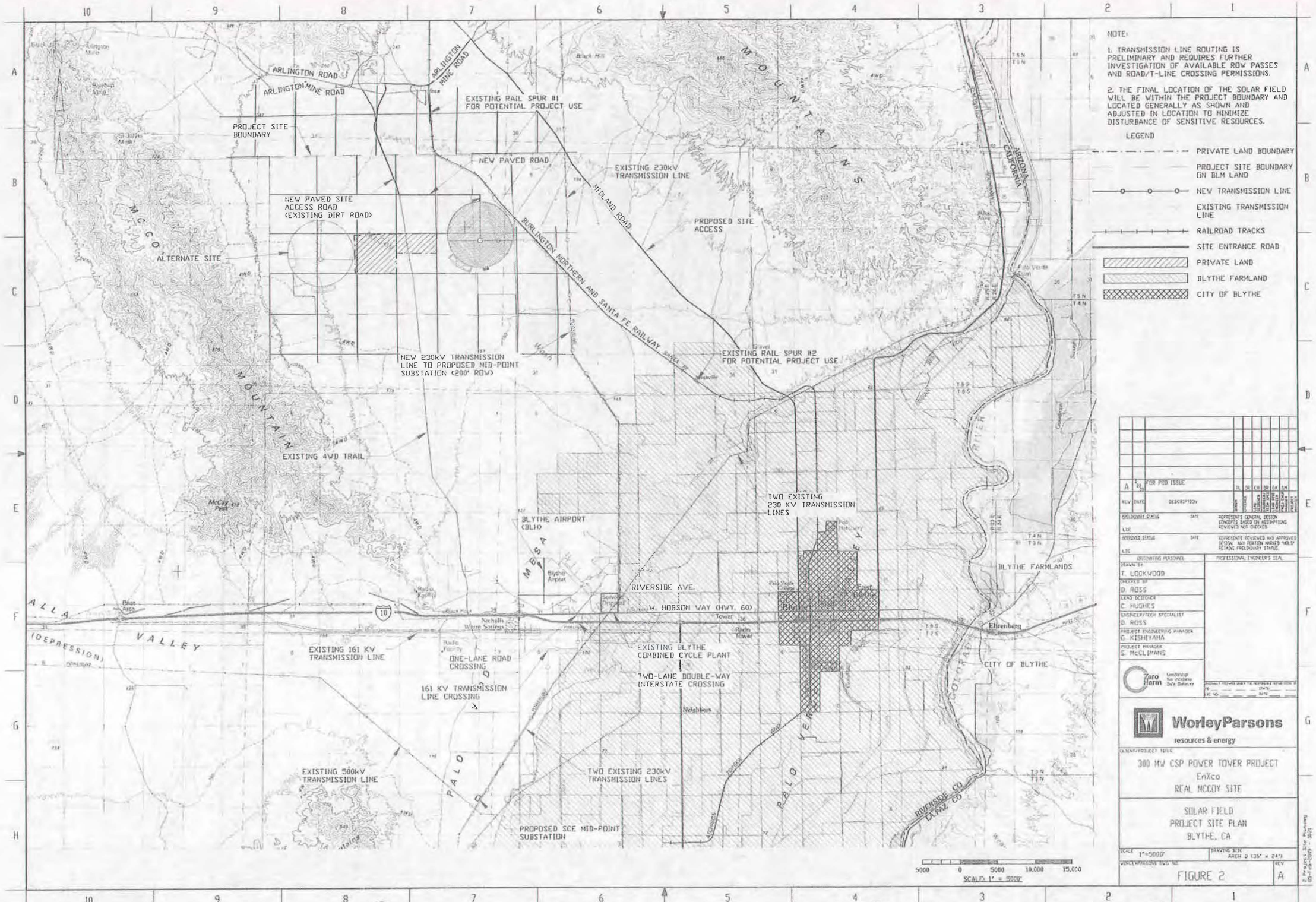
*Resource Name or Number (Assigned by recorder): WBS-13
*Scale: 1:24,000 *Date of Map: 1983



DPR 523J (1/95)

* Required information

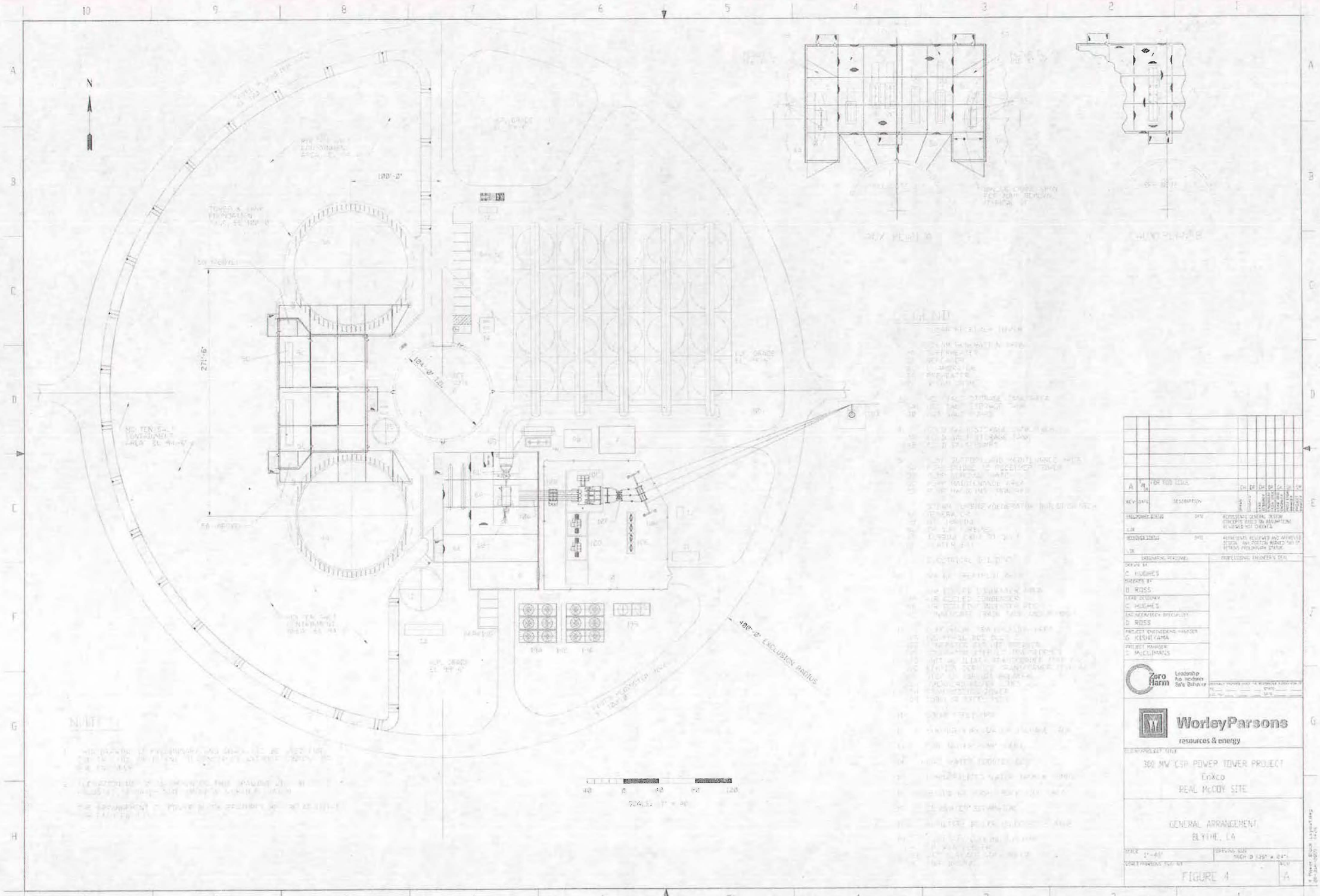

N
ARLINGTON MINE ROAD
EXISTING 230 KV TRANSMISSION LINE
PROJECT SITE BOUNDARY
NEW PAVED ROAD
PROJECT SITE (SEE FIG. 3)
SITE ACCESS ROAD
BURLINGTON NORTHERN AND SANTA FE RAILWAY
MIDLAND ROAD
ALTERNATE SITE
PRIVATE LAND
COLORADO RIVER
NEW 230 KV TRANSMISSION LINE
BLYTHE AIRPORT
I-10
BLYTHE
EXISTING 230 KV TRANSMISSION LINES
5.69 mi
Image © 2009 DigitalGlobe
Google
33°40'45.60" N 114°41'32.01" W
Nov 30, 2004
Eye alt 19.67 mi
LOCATION MAP
A FOR POD ISSUE
REV DATE DESCRIPTION
DRAWN BY C. HUGHES
CHECKED BY D. ROSS
LEAD DESIGNER C. HUGHES
ENGINEER/TECH SPECIALIST D. ROSS
PROJECT ENGINEERING MANAGER G. KISHIYAMA
PROJECT MANAGER S. McCLIMANS
Zero Harm
WorleyParsons
resources & energy
300 MW CSP POWER TOWER PROJECT
EnXco
REAL MCCOY SITE
SOLAR FIELD
PROJECT VICINITY MAP
BLYTHE, CA
FIGURE 1
A

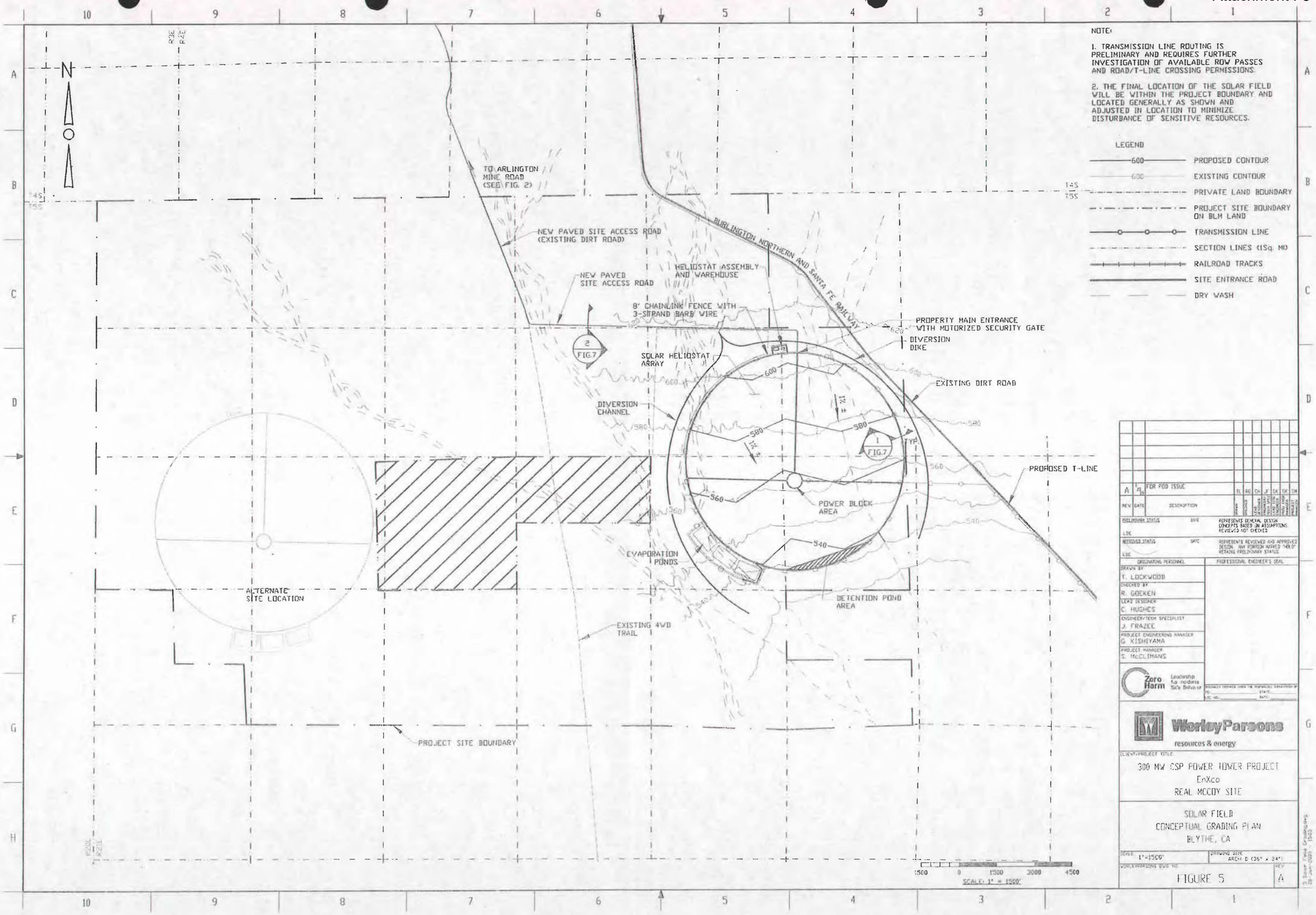

NOTE:
1. TRANSMISSION LINE ROUTING IS PRELIMINARY AND REQUIRES FURTHER INVESTIGATION OF AVAILABLE ROW PASSES AND ROAD/T-LINE CROSSING PERMISSIONS.
2. THE FINAL LOCATION OF THE SOLAR FIELD WILL BE WITHIN THE PROJECT BOUNDARY AND LOCATED GENERALLY AS SHOWN AND ADJUSTED IN LOCATION TO MINIMIZE DISTURBANCE OF SENSITIVE RESOURCES.
LEGEND
PRIVATE LAND BOUNDARY
PROJECT SITE BOUNDARY ON BLM LAND
NEW TRANSMISSION LINE
EXISTING TRANSMISSION LINE
RAILROAD TRACKS
SITE ENTRANCE ROAD
PRIVATE LAND
BLYTHE FARMLAND
CITY OF BLYTHE
ARLINGTON ROAD
ARLINGTON MINE ROAD
EXISTING RAIL SPUR #1 FOR POTENTIAL PROJECT USE
PROJECT SITE BOUNDARY
NEW PAVED ROAD
EXISTING 230kV TRANSMISSION LINE
NEW PAVED SITE ACCESS ROAD (EXISTING DIRT ROAD)
MIDLAND ROAD
PROPOSED SITE ACCESS
ALTERNATE SITE
BURLINGTON NORTHERN AND SANTA FE RAILWAY
NEW 230kV TRANSMISSION LINE TO PROPOSED MID-POINT SUBSTATION (200' ROW)
EXISTING RAIL SPUR #2 FOR POTENTIAL PROJECT USE
EXISTING 4WD TRAIL
TWO EXISTING 230 KV TRANSMISSION LINES
BLYTHE AIRPORT (BLH)
BLYTHE FARMLANDS
RIVERSIDE AVE.
W. HOBSON WAY (HWY. 60)
EXISTING 161 KV TRANSMISSION LINE
ONE-LANE ROAD CROSSING
EXISTING BLYTHE COMBINED CYCLE PLANT
TWO-LANE DOUBLE-WAY INTERSTATE CROSSING
161 KV TRANSMISSION LINE CROSSING
CITY OF BLYTHE
EXISTING 500kV TRANSMISSION LINE
TWO EXISTING 230kV TRANSMISSION LINES
PROPOSED SCE MID-POINT SUBSTATION
MOUNTAINS
MCCOY MOUNTAIN
PALO VERDE MESA
PALO VERDE VALLEY
ARIZONA
CALIFORNIA
RIVERSIDE CO
LA PAZ CO
SCALE: 1" = 5000'
FOR POD ISSUE
DRAWN BY T. LOCKWOOD
CHECKED BY D. ROSS
LEAD DESIGNER C. HUGHES
ENGINEER/TECH SPECIALIST D. ROSS
PROJECT ENGINEERING MANAGER G. KISHIYAMA
PROJECT MANAGER S. McCLIMANS
Zero Harm
WorleyParsons resources & energy
300 MW CSP POWER TOWER PROJECT
EnXco
REAL MCCOY SITE
SOLAR FIELD
PROJECT SITE PLAN
BLYTHE, CA
SCALE 1"=5000'
DRAWING SIZE ARCH D (36" x 24")
FIGURE 2
A

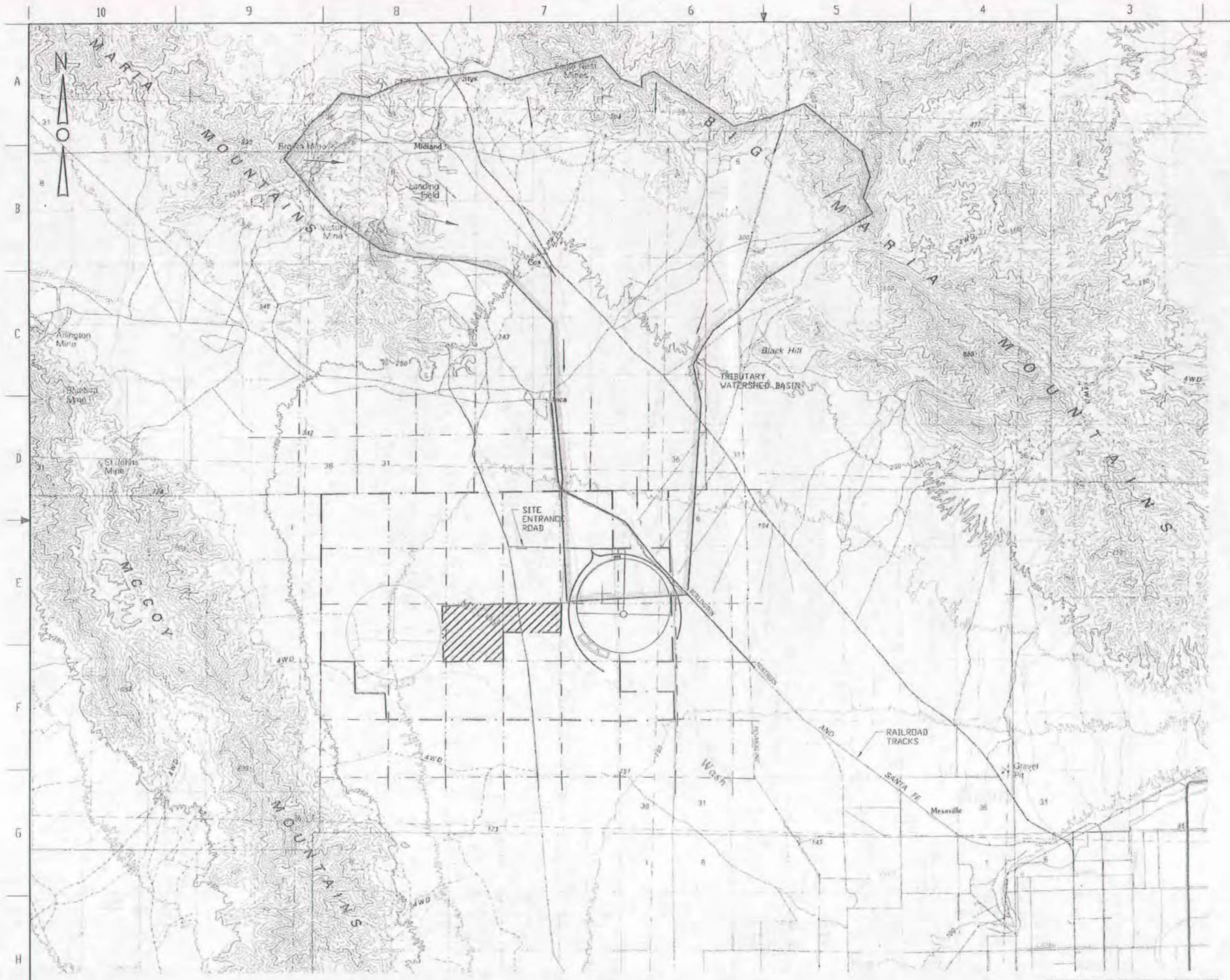
AR060325


NOTE:
1. TRANSMISSION LINE ROUTING IS PRELIMINARY AND REQUIRES FURTHER INVESTIGATION OF AVAILABLE ROW PASSES AND ROAD/T-LINE CROSSING PERMISSIONS.
2. THE FINAL LOCATION OF THE SOLAR FIELD WILL BE WITHIN THE PROJECT BOUNDARY AND LOCATED GENERALLY AS SHOWN AND ADJUSTED IN LOCATION TO MINIMIZE DISTURBANCE OF SENSITIVE RESOURCES.
LEGEND
PROJECT SITE BOUNDARY ON BLM LAND
TRANSMISSION LINE
SECTION LINES (1Sq. MI)
RAILROAD TRACKS
SITE ENTRANCE ROAD
PRIVATE LAND
EXISTING 4WD TAIL
CHAIN LINK FENCE
TO ARLINGTON MINE ROAD (SEE FIG. 2)
NEW PAVED SITE ACCESS ROAD (EXISTING DIRT ROAD)
NEW PAVED SITE ACCESS ROAD
O & M BUILDING, HELIOSTAT ASSEMBLY AND WAREHOUSE
8' CHAINLINK FENCE WITH 3-STRAND BARB WIRE
BURLINGTON NORTHERN AND SANTA FE RAILWAY
PROPERTY MAIN ENTRANCE WITH MOTORIZED SECURITY GATE
EXISTING DIRT ROAD
SOLAR HELIOSTAT ARRAY
CONSTRUCTION LOGISTICS / LAYDOWN / PARKING
SITE PERIMETER SECURITY ROAD
PROPOSED 230kV TRANSMISSION LINE ROUTE WITH 200' ROW (SEE NOTE #1)
POWER BLOCK AREA
EVAPORATION PONDS
ALTERNATE SITE LOCATION
230kV TRANSMISSION INTERCONNECTION TO PROPOSED MID-POINT SUBSTATION (SEE FIG 2)
EXISTING 4WD TRAIL
PROJECT SITE BOUNDARY
T4S
T5S
R3E
R4E
R20E
R21E
SCALE: 1" = 1500'
A FOR FOD ISSUE
REV DATE DESCRIPTION
PRELIMINARY STATUS
REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED.
REVISED STATUS
REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.
ORIGINATING PERSONNEL
PROFESSIONAL ENGINEER'S SEAL
DRAWN BY T. LOCKWOOD
CHECKED BY D. ROSS
LEAD DESIGNER C. HUGHES
ENGINEER/TECH SPECIALIST D. ROSS
PROJECT ENGINEERING MANAGER G. KISHIYAMA
PROJECT MANAGER S. McCLIMANS
Zero Harm
WorleyParsons
resources & energy
CLIENT/PROJECT TITLE
300 MW CSP POWER TOWER PROJECT
EnXco
REAL MCCOY SITE
SOLAR FIELD
GENERAL ARRANGEMENT
BLYTHE, CA
SCALE 1"=1500'
DRAWING SIZE ARCH D (36" x 24")
WORLEYPARSONS DWG NO
FIGURE 3
REV A

AR060326


N
100'-0"
271'-6"
400'-0" EXCLUSION RADIUS
LEGEND
C. HUGHES
B. ROSS
C. HUGHES
D. ROSS
G. KISHIYAMA
C. McCLIMANS
Zero Harm
Leadership
No Incidents
Safe Behavior
WorleyParsons
resources & energy
300 MW CSP POWER TOWER PROJECT
EnXco
REAL McCOY SITE
GENERAL ARRANGEMENT
BLYTHE, CA
FIGURE 4
A


NOTE:
1. TRANSMISSION LINE ROUTING IS PRELIMINARY AND REQUIRES FURTHER INVESTIGATION OF AVAILABLE ROW PASSES AND ROAD/T-LINE CROSSING PERMISSIONS.
2. THE FINAL LOCATION OF THE SOLAR FIELD WILL BE WITHIN THE PROJECT BOUNDARY AND LOCATED GENERALLY AS SHOWN AND ADJUSTED IN LOCATION TO MINIMIZE DISTURBANCE OF SENSITIVE RESOURCES.
LEGEND
PROPOSED CONTOUR
EXISTING CONTOUR
PRIVATE LAND BOUNDARY
PROJECT SITE BOUNDARY ON BLM LAND
TRANSMISSION LINE
SECTION LINES (1Sq. MI)
RAILROAD TRACKS
SITE ENTRANCE ROAD
DRY WASH
TO ARLINGTON MINE ROAD (SEE FIG. 2)
NEW PAVED SITE ACCESS ROAD (EXISTING DIRT ROAD)
NEW PAVED SITE ACCESS ROAD
HELIOSTAT ASSEMBLY AND WAREHOUSE
BURLINGTON NORTHERN AND SANTA FE RAILWAY
8' CHAINLINK FENCE WITH 3-STRAND BARB WIRE
PROPERTY MAIN ENTRANCE WITH MOTORIZED SECURITY GATE
DIVERSION DIKE
SOLAR HELIOSTAT ARRAY
EXISTING DIRT ROAD
DIVERSION CHANNEL
PROPOSED T-LINE
POWER BLOCK AREA
EVAPORATION PONDS
ALTERNATE SITE LOCATION
DETENTION POND AREA
EXISTING 4WD TRAIL
PROJECT SITE BOUNDARY
SCALE: 1" = 1500'
FOR POD ISSUE
PRELIMINARY STATUS
REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED
REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS
ORIGINATING PERSONNEL
PROFESSIONAL ENGINEER'S SEAL
DRAWN BY T. LOCKWOOD
CHECKED BY R. GOEKEN
LEAD DESIGNER C. HUGHES
ENGINEER/TECH SPECIALIST J. FRAZEE
PROJECT ENGINEERING MANAGER G. KISHIYAMA
PROJECT MANAGER S. McCLIMANS
Zero Harm
WorleyParsons resources & energy
300 MW CSP POWER TOWER PROJECT
EnXco
REAL MCCOY SITE
SOLAR FIELD
CONCEPTUAL GRADING PLAN
BLYTHE, CA
SCALE 1"=1500'
DRAWING SIZE ARCH D (36" x 24")
FIGURE 5
REV A



LOCATION MAP

LEGEND

- 1780 — PROPOSED CONTOUR
- EXISTING CONTOUR
- WATER FLOW ARROW
- PRIVATE LAND BOUNDRY
- WATERSHED AREA BOUNDRY
- SECTION LINES (1Sq. Mi)

NOTE:

1. CONTOURS INTERVAL 50 METERS.
2. THE FINAL LOCATION OF THE SOLAR FIELD WILL BE WITHIN THE PROJECT BOUNDARY AND LOCATED GENERALLY AS SHOWN AND ADJUSTED IN LOCATION TO MINIMIZE DISTURBANCE OF SENSITIVE RESOURCES.

4000 0 4000 8000 16000
SCALE: 1" = 4000'

REV	DATE	DESCRIPTION	BY
A	1/15/10	FOR POD ISSUE	CH

PRELIMINARY STATUS — DATE — REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS. REVIEWED NOT CHECKED.
REVISED STATUS — DATE — REPRESENTS REVIEWED AND APPROVED DESIGN, AND PERMITS MARKED "MUP" REFLECTS PRELIMINARY STATUS.

ENGINEERING PERSONNEL	PROFESSIONAL ENGINEER'S SEAL
DRAWN BY: C. HUGHES	
CHECKED BY: R. GOEKEN	
LEAD DESIGNER: C. HUGHES	
ENGINEER/TECH SPECIALIST: J. FRAZEE	
PROJECT ENGINEERING MANAGER: G. KISHIYAMA	
PROJECT MANAGER: S. MCELMAMS	

Zero Harm — Leadership by Incidence Safe Behavior

WorleyParsons resources & energy

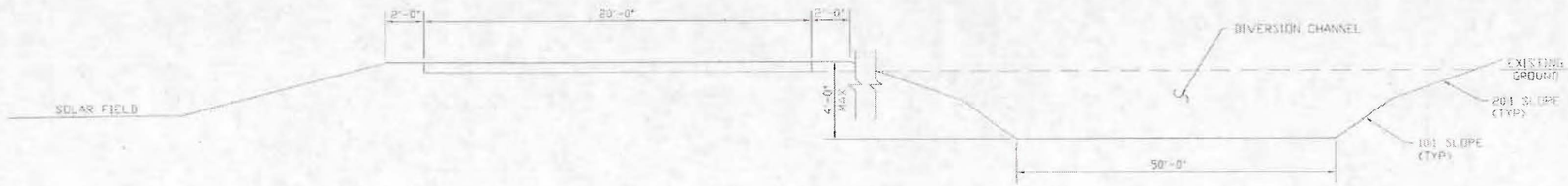
CLIENT/PROJECT TITLE

300 MW CSP POWER TOWER PROJECT
EnXco
REAL MCCOY SITE

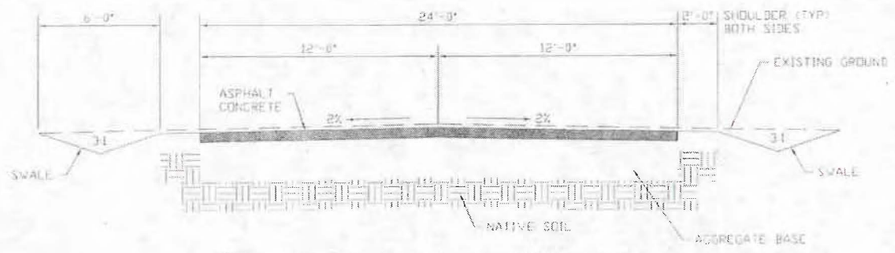
SOLAR FIELD
CONCEPTUAL DRAINAGE PLAN
BLYTHE, CA

SCALE: 1"=4000' — DRAWING SIZE: ARCH D (36" x 24")
WORLEYPARSONS DWG NO: FIGURE 6 — REV: A

G:\Solar Field Drawings\Figure 6.dwg, 1/15/2010 1:57:



1 PERIMETER ROAD- AGGREGATE SURFACE DETAIL
NOT TO SCALE



2 ACCESS ROAD SECTION (TYP)
NOT TO SCALE

REV	DATE	DESCRIPTION	DRAWN	CHECKED	CLIENT DESIGN	ENGINEERING DESIGN	DESIGN ENGINEER	DESIGN MANAGER	PROJECT MANAGER
A	7/30	FOR PDD ISSUE	TL	RG	CH	JF	GA	CA	SM

PROLIMINARY STATUS — DATE — REPRESENTS GENERAL DESIGN CONCEPTS BASED ON ASSUMPTIONS REVIEWED NOT CHECKED

APPROVED STATUS — DATE — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PROLIMINARY STATUS

ORIGINATING PERSONNEL — PROFESSIONAL ENGINEER'S SEAL

DRAWN BY: T. LOCKWOOD
CHECKED BY: R. GOEKEN
LEAD DESIGNER: C. HUGHES
ENGINEERING TECH SPECIALIST: J. FRAZEE
PROJECT ENGINEERING MANAGER: D. KISHIYAMA
PROJECT MANAGER: S. McCLIMANS

Zero Harm Leadership No Incidents Safe Behavior

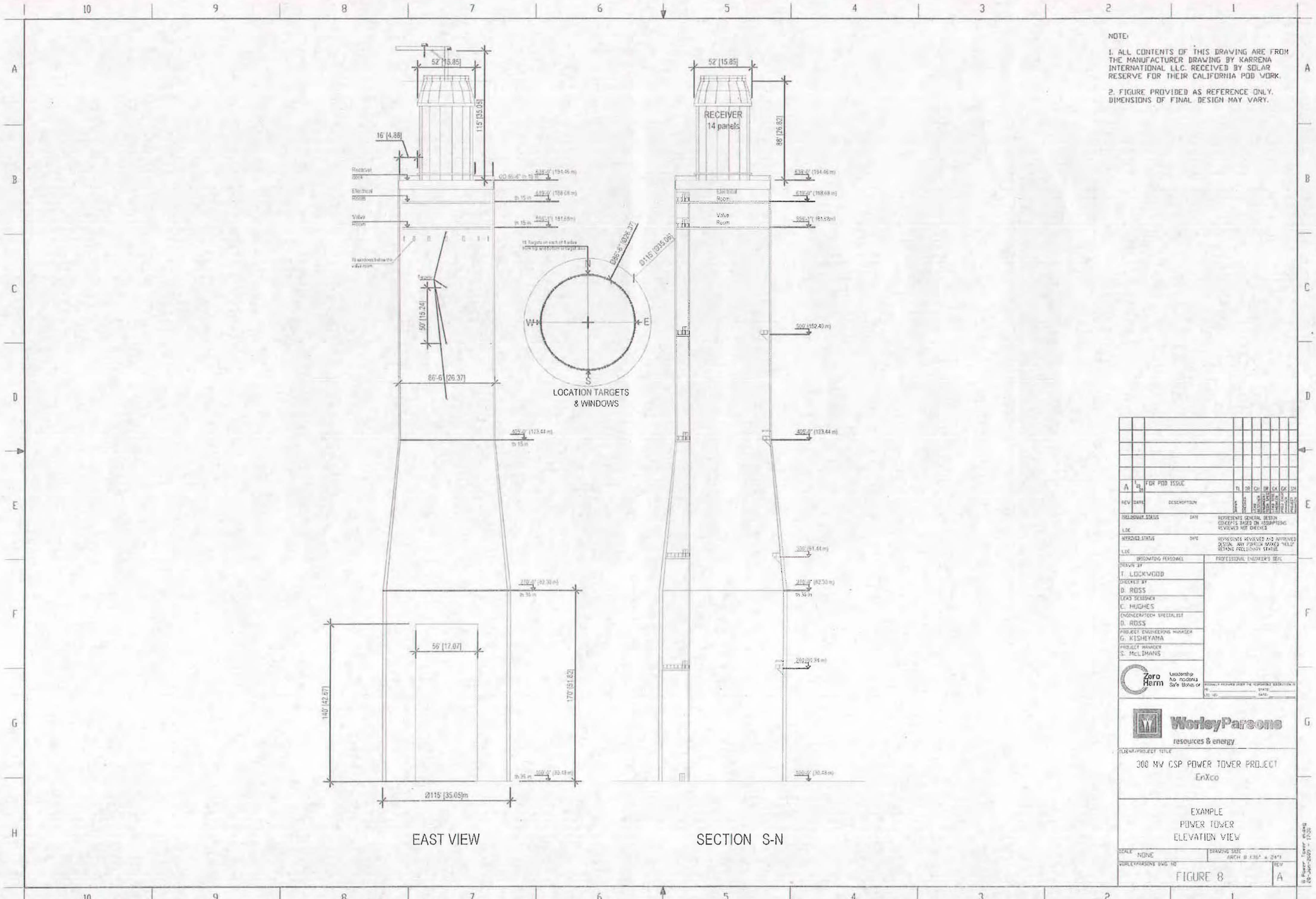
WorleyParsons resources & energy

300 MW CSP POWER TOWER PROJECT
EnXco
REAL MCCOY SITE

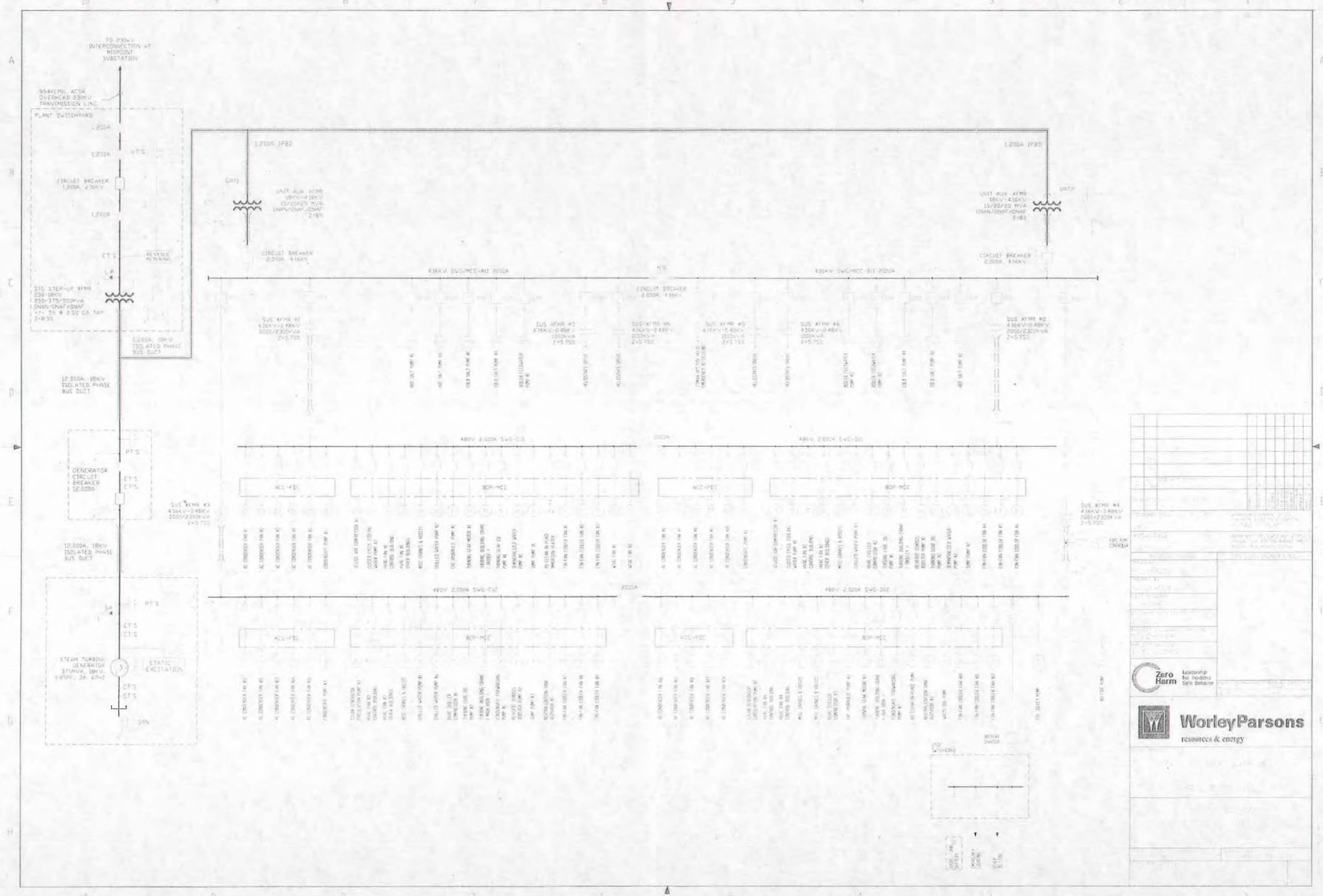
SOLAR FIELD
ROAD SECTIONS
BLYTHE, CA

SCALE: NONE — DRAWING SIZE: ARCH D (36" x 24")

FIGURE 7 — REV A


NOTE:
1. ALL CONTENTS OF THIS DRAWING ARE FROM THE MANUFACTURER DRAWING BY KARRENA INTERNATIONAL LLC. RECEIVED BY SOLAR RESERVE FOR THEIR CALIFORNIA POD WORK.
2. FIGURE PROVIDED AS REFERENCE ONLY. DIMENSIONS OF FINAL DESIGN MAY VARY.
52' [15.85]
115' [35.05]
16' [4.88]
RECEIVER
14 panels
88' [26.82]
Receiver Deck
Electrical Room
Valve Room
50' [15.24]
86'-6" [26.37]
LOCATION TARGETS
& WINDOWS
56' [17.07]
140' [42.67]
170' [51.82]
Ø115' [35.05]m
EAST VIEW
SECTION S-N
A
FOR POD ISSUE
REV
DATE
DESCRIPTION
PRELIMINARY STATUS
APPROVED STATUS
ORIGINATING PERSONNEL
PROFESSIONAL ENGINEER'S SEAL
DRAWN BY
T. LOCKWOOD
CHECKED BY
D. ROSS
LEAD DESIGNER
C. HUGHES
ENGINEERING SPECIALIST
D. ROSS
PROJECT ENGINEERING MANAGER
G. KISHIYAMA
PROJECT MANAGER
S. McLIMANS
Zero Harm
WorleyParsons
resources & energy
CLIENT/PROJECT TITLE
300 MW CSP POWER TOWER PROJECT
EnXco
EXAMPLE
POWER TOWER
ELEVATION VIEW
SCALE
NONE
DRAWING SIZE
WORLEYPARSONS DWG NO
FIGURE 8
REV
A

AR060331


TO 230KV INTERCONNECTION AT MIDPOINT SUBSTATION
954KCMIL ACSR OVERHEAD 230KV TRANSMISSION LINE
PLANT SWITCHYARD
CIRCUIT BREAKER 1,200A, 230KV
STG STEP-UP XFMR
1,200A, 18KV ISOLATED PHASE BUS DUCT
12,000A, 18KV ISOLATED PHASE BUS DUCT
GENERATOR CIRCUIT BREAKER 12,000A
STEAM TURBINE GENERATOR
STATIC EXCITATION
UNIT AUX XFMR
CIRCUIT BREAKER
ACC-PDC
BOP-MCC
Zero Harm
WorleyParsons
resources & energy

McCoy Soleil Development and Construction Schedule

	2009				2010				2011				2012				2013				2014			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Prepare and Approve POD	x																							
Detailed hydrology report					x																			
Geotechnical and Soils Analysis					x																			
Detailed Engineering & Procurement						x																		
SIS transmission study complete					x																			
Biological and Cultural Field Studies						x		x																
Installation of solar testing equipment												x												
Submit AFC to CEC								x																
BLM NEPA process							x	x	x	x	x	x												
BLM issues ROD												x												
BLM issues ROW												x												
Major Equipment Procurement, Bar & Delivery												x												
Establish laydown area(s) for materials storage/staging												x	x											
Clear and Grub												x												
Construction Site Preparation, surveying and staking												x												
Construct stormwater infiltration/evaporation area												x	x											
Assemble and erect heliostats															x	x	x	x						
Power block construction													x	x	x	x	x	x	x					
Construct reinforced concrete foundations													x	x	x	x	x	x	x					
Construct administration/warehouse bldg.																		x	x					
Transmission Distribution line & Switch yard																			x					
Start-up																			x					
Commercial Operation																				x				

CLIENT/PROJECT TITLE
300 MW CSP POWER TOWER PROJECT
EnXco

Development/Construction Schedule

SCALE NONE | DRAWING SIZE ARCH D (36" x 24")
WORK/EXPENSE DWG. NO. | REV A

Figure 10

Tannika Engelhard's email

Tannika Engelhard/CFWO/R1/FWS/DOI
06/21/2010 05:19 PM

To "Ian Black <Ian.Black@enxco.com>
cc Allison_Shaffer@blm.gov, Felicia_Sirchia@fws.gov, "Javier DeLaGarza" <Javier.DeLaGarza@enXco.com>, Jeffery_Childers@blm.gov, "Joshua Lazarus"
bcc
Subject RE: EnXco meeting

Hi Ian, I forgot to attach our Golden Eagle (GE) inventory and monitoring protocol. The FWS is also currently developing a protocol to conduct non-breeding season surveys which will send to you when it's available.

During our recent meeting, I think I mentioned that GE surveys had been conducted in Spring 2010 for several projects along the I-10 corridor, including the Blythe project, and that the results of these 2010 surveys may be applicable for EnXco's McCoy project. However, while the 2010 surveys provide valuable information about GE in the vicinity, I believe EnXco's McCoy project is outside of the area surveyed for the Blythe project. Also, per the protocol, survey results are only valid for one year since GE nesting patterns can change annually. Therefore, GE surveys should be conducted for EnXco's McCoy project following the FWS protocol. This survey effort should be coordinated through the BLM prior to initiation to maximize the effort and minimize impacts to bighorn sheep.

USFWS Interim GE Inventory and Monitoring Protocols_Feb 2010.pdf

Thanks, Tannika

****

Tannika Engelhard
Fish and Wildlife Biologist
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, CA 92011
Office 760-431-9440, ext. 202
Fax 760-431-9624
Tannika_Engelhard@fws.gov

Save paper - think before you print.

Hi Ian, we appreciate EnXco meeting with us as well. I recommend reviewing that CEC's revised staff assessments for the Blythe and Genesis projects to get an idea of the type of general and species-specific avoidance, minimization, and mitigation measures required by the CEC, BLM, CDFG and/or FWS for other large-scale solar projects along the I-10 corridor. Most, if not all, of these measures would likely be applicable for EnXco's proposed Eagle Mountain, McCoy, and Mule Mountain projects.

http://www.energy.ca.gov/2010publications/CEC-700-2010-004/CEC-700-2010-004-REV1.PDF

http://www.energy.ca.gov/2010publications/CEC-700-2010-004/CEC-700-2010-004-REV1.PDF

I also suggest reviewing the FWS' Raven Mitigation summary document available on the CEC's website.

http://www.energy.ca.gov/sitingcases/solar_millennium_blythe/documents/others/2010-06-01_USFWS_Summary_Raven_Mgmt_Plan_TN-56936.pdf

Tannika Engelhard's email

The FWS is currently finalizing guidance on desert tortoise translocation which I'll send you as soon as it's publically available. In the meantime, you can review our comments on the desert tortoise translocation plans for the Blythe and Palen projects available on the CEC's website.

http://www.energy.ca.gov/sitingcases/solar_millennium_blythe/documents/others/2010-04-29_Carlsbad_Fish_and_Wildlife_Office_Comments_on_Draft_Desert_Tortoise_Translocation_Plans_TN-56469.pdf

Also, as stated during our recently meeting, the agencies would be happy to review and discuss any proposed species survey protocols prior to their initiation.

Let me know if you need any other information regarding desert tortoise or golden eagles. Thanks, Tannika

****

Tannika Engelhard
Fish and Wildlife Biologist
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, CA 92011
Office 760-431-9440, ext. 202
Fax 760-431-9624
Tannika_Engelhard@fws.gov

Save paper - think before you print.
"Ian Black" <Ian.Black@enxco.com>



"Ian Black"
<Ian.Black@enxco.com>
06/18/2010 10:38 AM

To <Allison_Shaffer@blm.gov>, <Tannika_Engelhard@fws.gov>, <Mark_Massar@blm.gov>, <Kim_Marsden@blm.gov>, <Jeffery_Childers@blm.gov>, <Felicia_Sirchia@fws.gov>, <slee@aspeneg.com>, <swhite@aspeneg.com>, "Javier DeLaGarza" <Javier.DeLaGarza@enXco.com>, "Joshua Lazarus" <Joshua.Lazarus@enxco.com>, <mcrodriguez@dfg.ca.gov>

cc

Subject RE: EnXco meeting

Allison, et al.,

Thank you for the invitation and the opportunity to discuss our proposed BLM solar projects. We are encouraged by our biological resource team's findings on our McCoy and Eagle Mountain and appreciate the early, inclusive dialogue hosted by the BLM. We look forward to keeping that dialogue going throughout the design and permitting process. To that end, enXco would like to reiterate that we are open to thoughts from the agencies on which critical biological studies to prioritize this summer and fall, as we work through our project analysis.

Feel free to email, or call me at your convenience. Additionally, I will follow up by email individually. Thanks again Allison and Mark, for hosting us on Wednesday.

Kind Regards,

Tannika Engelhard's email

Ian Black
Solar Development
enXco - an EDF Energies Nouvelles Company
4000 Executive Parkway, Ste 100 | San Ramon, CA | 94583
t: 925.242.0168 | c: 646.287.9912
ian.black@enxco.com
www.enxco.com

-----Original Message-----
From: Allison_Shaffer@blm.gov [mailto:Allison_Shaffer@blm.gov]
Sent: Thursday, June 17, 2010 9:12 AM
To: Tannika_Engelhard@fws.gov; Mark_Massar@blm.gov; Kim_Marsden@blm.gov; Jeffery_Childers@blm.gov; Felicia_Sirchia@fws.gov; slee@aspeneg.com; swhite@aspeneg.com; Ian Black; Javier DeLaGarza; Joshua Lazarus; mcrodriguez@dfg.ca.gov
Subject: Re: EnXco meeting

All:
Here is the sign in sheet from the meeting yesterday. Thank you all again for your time and productive input/discussion.

(See attached file: enxco mtu 61610.pdf)

Allison Shaffer
Bureau of Land Management
Palm Springs/South Coast Field Office
1201 Bird Center Drive
Palm Springs, Ca 92262
t - 760.833.7104
e- allison_shaffer@blm.gov

Tannika Engelhard/CFWO/R1/FWS/DOI@FWS
06/17/2010 08:55 AM

To: Allison Shaffer/CASO/CA/BLM/DOI@BLM
cc:
Subject: EnXco meeting

Hi Allison, thanks for a good meeting yesterday. When you get a chance, can you email the meeting participant list from the EnXco meeting? Thanks, Tannika

****

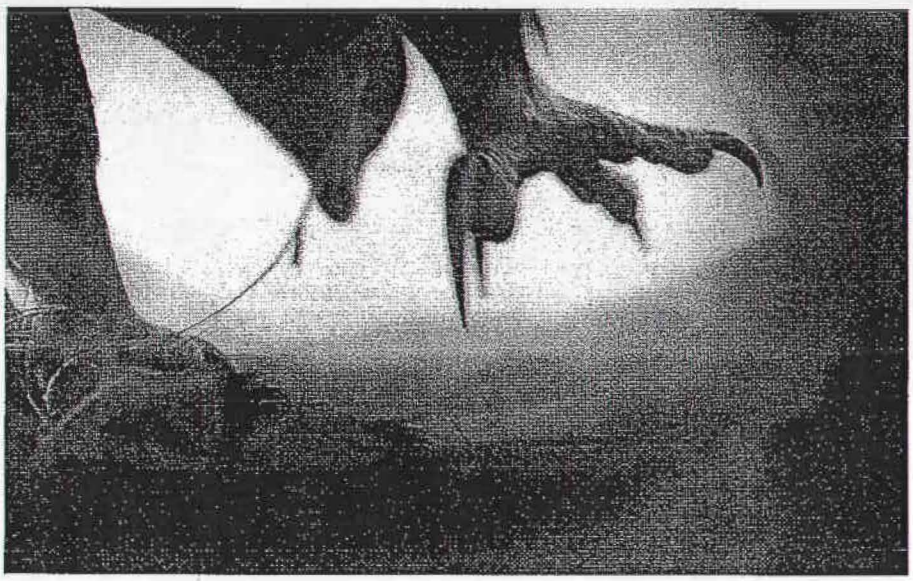
Tannika Engelhard
Fish and Wildlife Biologist
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, CA 92011
Office 760-431-9440, ext. 202
Fax 760-431-9624

Tannika Engelhard's email

Tannika_Engelhard@fws.gov

Save paper - think before you print.

Interim Golden Eagle Inventory and Monitoring Protocols; and Other Recommendations



Joel E. Pagel, Ph.D.[1],

Diana M. Whittington[1],

George T. Allen, Ph.D.[1].

U.S. Fish and Wildlife Service

February, 2010

[1] Division of Migratory Birds, U.S. Fish and Wildlife Service

Interim Golden Eagle Inventory and Monitoring Protocols; and Other Recommendations

Table of Contents:

I	Purpose	2
II	Background	2
III	Management Need	6
IV	Basic Golden Eagle Ecology	7
V	Golden Eagle Responses to Disturbance	10
VI	Overall Objectives of the Golden Eagle Survey Protocol	11
VII	Inventory Techniques	12
VIIa	Procedures for Aerial and Ground Monitoring Surveys	13
VIIb	Aerial Surveys	15
VIIc	Ground Surveys	18
VIII	Observer qualifications	20
IX	Documentation and Accepted Notation of Territory/Nest Site and Area Surveyed	21
X	Additional Considerations	23
XI	Acknowledgements	24
XII	Literature Cited	25
XIII	Glossary	29

Recommended citation:

Pagel, J.E., D.M. Whittington and G.T. Allen. 2010. Interim Golden Eagle inventory and monitoring protocols; and other recommendations. Division of Migratory Birds, U.S. Fish and Wildlife Service.

I. Purpose

This document identifies the minimum inventory and monitoring effort recommended for determining and evaluating potential Golden Eagle (*Aquila chrysaetos canadensis*) use of habitat including nest sites, roosts, and territories, as well as the rationale for identifying and evaluating foraging locations during breeding and non-breeding periods. It also outlines the minimum monitoring techniques to ascertain occupancy and reproductive success at territories. These field efforts are the mutual responsibility of agencies authorizing activities and their permittees (i.e. action agency; see Glossary). They are essential components for avoiding and minimizing disturbance and other kinds of take, including lethal take, and are a necessary component of short and long-term site specific monitoring and management of local Golden Eagles and regional Golden Eagle populations. The data gathered will provide information on the baseline circumstances for evaluation of permit applications and foundation for permit conditions, as well as assist planners so they may conduct informed impact analyses and mitigation during the National Environmental Policy Act (NEPA) process. Data collected via this effort will also help:

1. Determine the fate and reproductive trends of regional nesting populations via collating information from observed territories.
2. Document and list historical and unsurveyed habitat for future analysis to assist in determining local and regional population trajectories.
3. Provide information to document whether local Golden Eagle conservation efforts are meeting goals for improvements in the status of Golden Eagle.
4. Provide a foundation for evaluation of whether and which activities or conditions may be affecting Golden Eagle.

II. Background

Golden Eagles are protected by the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act (Eagle Act), which both Acts prohibit take. Take means *pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest,* or *disturb*. When the Bald Eagle was delisted under the Endangered Species Act (ESA), and in order to improve management of both species of eagles under the Eagle Act, the U.S. Fish and Wildlife Service (Service) undertook a series of management actions, including:

- **Codifying a regulatory definition of "disturb"** under the Eagle Act (see 72 FR 31132, June 5, 2007). *Disturb* means to agitate or bother a Bald or Golden Eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1)

injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

- **Proposing permit regulations** to (1) Create a new permit type to authorize take of Bald Eagles and Golden Eagles that is associated with, but not the purpose of, the activity; and (2) Create a second new permit type to authorize purposeful take of eagle nests that pose a threat to human or eagle safety (subsequently broadened to accommodate additional circumstances). The regulations were finalized on September 11, 2009 (74 FR 43686).

Summary of the new regulations.

Permits issued under 50 CFR § 22.26 authorize take of Bald Eagles and Golden Eagles, where the take is associated with, but not the purpose of the activity, and cannot practicably be avoided. Most take authorized under this section will be in the form of disturbance; however, permits may authorize lethal take that results from, but is not the purpose of, an otherwise lawful activity. Purposeful take will not be authorized under § 22.26.

The second new permit regulation, at 50 CFR 22.27, establishes permits for removing eagle nests where (1) necessary to alleviate a safety hazard to people or eagles, (2) necessary to ensure public health and safety, (3) the nest prevents the use of a pre-existing human-engineered structure, or (4) the activity, or mitigation for the activity, will provide a net benefit to eagles. Only inactive nests during the non-breeding season may be taken, except in the case of safety emergencies.

Regulations under § 22.27 authorize removal and/or relocation of active and inactive eagle nests in cases where genuine safety concerns for people, eagles, or both, necessitate the take. Examples include: (1) a nest tree that appears likely to topple onto a residence; (2) at airports to avoid collisions between eagles and aircraft; and (3) to relocate a nest built within a reservoir that will be flooded.

Both regulations are provided for by the Eagle Act which gives the Secretary of the Interior the authority to permit the limited take of Bald Eagles and Golden Eagles "for the protection of . . . other interests in any particular locality." Additionally, both new regulations:

- Are applicable to Golden Eagles as well as Bald Eagles.
- Authorize take only where it is compatible with the preservation of the eagle. For purposes of these regulations, "compatible with the preservation of the Bald Eagle

and the Golden Eagle" means consistent with the goal of stable or increase of breeding populations.

- Authorize take only where it cannot practicably be avoided.
- Include provisions for programmatic take. Programmatic take (take that is recurring and not in a specific, identifiable timeframe and/or location) will be authorized only where it is unavoidable despite implementation of comprehensive measures developed in cooperation with the Service to reduce the take below current levels.

Additional needs for Golden Eagle information and evaluation.

As part of an adaptive management approach to the permits and eagle management, the Service will assess, at least every five years, overall population trends along with annual report data from permittees and other information to assess how likely future activities are to result in the loss of one or more eagles, a decrease in productivity of Golden Eagles, and/or the permanent loss of a nest site, territory, or important foraging area. Therefore, implementation of the new permit regulations will entail requirements for cumulative effects analyses and identifying the impacts of an activity. We include them here to provide the context and framework for the protocols and recommendations in this document.

Cumulative effect considerations.

Whether the take is compatible with eagle preservation includes consideration of the cumulative effects of other permitted take and additional factors affecting eagle populations. Cumulative effects are defined as: *"the incremental environmental impact or effect of the proposed action, together with impacts of past, present, and reasonably foreseeable future actions"* (50 CFR 22.3). Numerous relatively minor disruptions to eagle behaviors from multiple activities, even if spatially or temporally distributed, may lead to disturbance that would not have resulted from fewer or more carefully sited activities. The accumulation of multiple land development projects or siting of multiple infrastructures that are hazardous to eagles can cumulatively reduce the availability of alternative sites suitable for breeding, feeding, or sheltering, resulting in a greater than additive risk of take to eagles.

To ensure that impacts are not concentrated in particular localities to the detriment of locally-important eagle populations, cumulative effects need to be considered at the population management level—*Service Regions* for Bald Eagles and *Bird Conservation Regions* for Golden Eagles—and, especially for project-specific analyses, at local area population levels (the population within the average natal dispersal distance of the nest or nests under consideration). Eagle take that is concentrated in particular areas can lead to effects on the larger management population because 1) disproportionate take in local populations where

breeding pairs are 'high' producers may reduce the overall productivity of the larger population; and 2) when portions of the management population become isolated from each other the productivity of the overall management population may decrease.

~~Identifying the Impacts of the Activity~~

The applicant for an Eagle Act permit (who can be a project proponent or the agency preparing the NEPA), has four subtasks to determine the likely effects of a project or activity on eagles:

a. Collection and synthesis of biological data. The applicant is responsible for providing up-to-date biological information about eagles that breed, feed, shelter, and/or migrate in the vicinity of the activity that may potentially be affected by the proposed activity. Biological information can include locations and distribution of nests, delineation of territories, prey base, general composition and relative abundance, and productivity data.

b. Identifying activities that are likely to result in take. As part of the permit application, the applicant must include a complete description of the actions that: (1) are likely to result in eagle take, and (2) for which the applicant or landowner has some form of control. For most applications, the activity will be specific and well-defined (e.g., home construction; water use development) or land use activity (e.g., forestry). For larger-scale permits, applicants will need to determine the extent of impacts they want to include in the permit authorization and, if necessary, which ones they wish to exclude.

c. Avoidance and minimization measures. Applications for a § 22.26 permit must document the measures to which the applicant will commit to avoid and minimize the impacts to eagles to the maximum degree practicable.

d. Quantifying the anticipated take. The amount of take to be authorized under a permit depends on a variety of factors, including: (1) the number of eagles that breed, feed, shelter, and or migrate within the activity area, (2) the degree to which the eagles depend on that area for breeding, feeding, or sheltering, or migration, and thus are more likely to be present and affected, (3) the potential of that type of activity in general to take eagles, (4) the scale of the activity, and (5) the measures the applicant will undertake to avoid and minimize the take.

Federal agencies have additional responsibilities to Golden Eagles under Executive Order 13186 (66 FR 3853, January 17, 2001), which reinstated the responsibilities of Federal Agencies to comply with the Migratory Bird Treaty Act of 1918. The Executive Order establishes a process for Federal Agencies to conserve migratory birds by avoiding or minimizing unintentional take and taking actions that benefit species to the extent practicable. Agencies are expected to take

reasonable steps that include restoring and enhancing habitat. Environmental analyses of Federal actions required by NEPA or other environmental review processes must evaluate the effects of actions and Federal agency plans on migratory birds, including Golden Eagles.

Golden Eagle populations are believed to be declining throughout their range in the contiguous United States (Harlow and Bloom 1989, Kochert and Steenhof 2002, Kochert et al. 2002, Good et al. 2007, Farmer et al. 2008, Smith et al. 2008, 74 FR 46836-46879). The Service has modeled current data (USFWS 2009, Appendix C), employing Moffat's equilibrium (Hunt 1998) and Millsap and Allen's (2006) analysis of anthropogenic demographic removal, and estimated that the floating (non-breeding and surplus) component of the Golden Eagle population in some areas may be limited at this time. Data from the Western EcoSystems Technology Inc. surveys from 2006 – 2009 may suggest a decline since 2006 in the total Golden Eagle population within the area covered by the surveys (Neilson et al. 2010, USFWS 2009, Appendix C). Significant Golden Eagle breeding failures have been reported in some areas of the southwestern United States (WRI 2009), and declines in counts of migratory Golden Eagles have been reported in most areas in the western United States (Farmer et al. 2008, Smith et al. 2008), although it is unclear if the latter is linked to a decrease in the number of eagles.

III. Management Need

Prior to initiating inventory and monitoring efforts, land management agencies and/or proponents of land use activities should first assess all existing recent and historical data available on eagles, including their nests, reproductive activity and chronologies, natal dispersal, pertinent data from VHF and satellite telemetry, winter roosts, migration corridors, and foraging habitats contained by and within 4 - 10 + miles of areas slated for development or authorizations for increased human activity. This background search of available information may yield few data, but is necessary to alert project proponents and regulatory staff about data gaps, and existing knowledge of Golden Eagle for that area. Inventory, monitoring, and research activities may then be identified and funded to fill in site specific information gaps to avoid take of Golden Eagle. Specific recommendations for the number of years needed for baseline data and measures to avoid take should be developed in coordination with the Service, and, to reduce redundancy between management and permitting requirements, consistent with permit requirements outlined in the Draft Implementation Guidelines for the new rules (available fall 2010).

Projects in Golden Eagle breeding home ranges on federal, state, and private land possibly will have direct, indirect, and cumulative effects associated with or exacerbated by, factors such as: recreation disturbance, electrocution, urbanization, illegal shooting, invasive species altering prey densities, lead poisoning, other contaminants, climate change, and prolonged drought

which affects predator and prey abundance and distribution. In many cases, existing data may not be adequate for NEPA, planning, or permitting purposes. Therefore, inventory and subsequent monitoring of Golden Eagles and components of their habitats are important to 1) develop a baseline prior to project planning and prior to project development in Golden Eagle habitat, 2) analyze impacts to the species, 3) continue to evaluate and report on the effects of the action and mitigation on Golden Eagles, 4) essential to adaptive management approaches, and 5) provide information that may be required for permits.

Project design, type, and siting of project footprint and infrastructure are critical to avoid disturbance and take of Golden Eagle. In the Final Environmental Assessment on the rule and in the draft Implementation Guidance, the Service recommends that when planning locations of infrastructure and project boundaries, action agencies and project proponents consider life-history components such as productivity, age-class survival, dispersal, migration, winter-concentration behavior, and foraging behavior during breeding and non-breeding seasons in a concerted effort to avoid lethal take. The Service recommends use of the best available or gathered information applicable to the location of the project or plan, but also encourages efforts to conduct further research. For permitting purposes however, and to determine the likelihood and magnitude of take, as well as effectiveness of mitigation, monitoring will need to yield productivity information.

Note: This document does not address site specific observations for transitory and wintering eagles; these protocols will be forthcoming. Although the life history for transitory and wintering eagles is not discussed at length here, that does not imply a lack importance for site-specific observations from the Service's perspective. The document provides general recommendations for factors to consider outside nesting, until more specific protocols are developed.

IV. Basic Golden Eagle Ecology

This account is not intended as a compendium of Golden Eagle natural history, biology, ethology, or ecology; please refer to Watson (1997), Palmer (1988) and Kochert et al. (2002) for more detailed information.

Where they exist, Golden Eagles are an upper-trophic aerial predator, and eat small to mid-sized reptiles, birds, and mammals up to the size of mule deer fawns and coyote pups (Bloom and Hawks 1982). They also are known to scavenge and utilize carrion (Kochert et al. 2002)

Golden Eagles nest in high densities in open and semi-open habitat, but also may nest at lower densities in coniferous habitat when open space is available, (e. g. fire breaks, clear-cuts, burned areas, pasture-land, etc.). They can be found from the tundra, through grasslands,

woodland-brushlands, and forested habitat, south to arid deserts, including Death Valley, California (Kochert et al. 2002). Historically, Golden Eagles bred in the Plains and Great Lake states. Golden Eagles currently breed in and near much of the available open habitat in North America west of the 100th Meridian, as well as in eastern United States in the northern Appalachian Mountains (Palmer 1988, Kochert et al. 2002). Lee and Spofford's (1990) review of the literature for the eastern portion of the United States suggests historical nesting Golden Eagles south of New York in the Appalachians was unlikely. Nesting of introduced Golden Eagles have been reported in Tennessee and northwestern Georgia (Kochert et al. 2002), however it is currently unknown if these territories are still extant.

A nesting territory for the purpose of this monitoring protocol has been previously defined by Steenhof and Newton (2007), i.e. an area that contains, or historically contained, one or more nests within the home range of a mated pair: a confined locality where nests are found, usually in successive years, and where no more than one pair is known to have bred at one time.

Golden Eagles avoid nesting near urban habitat and do not generally nest in densely forested habitat. Individuals will occasionally nest near semi-urban areas where housing density is low and in farmland habitat; however Golden Eagles have been noted to be sensitive to some forms of anthropogenic presence (Palmer 1988). Steidl et al. (1993) found when observers were camped 400 meters from nests of Golden Eagles, adults spent less time near their nests, fed their juveniles less frequently, and fed themselves and their juveniles up to 67% less food than when observers were camped 800 meters from nests. In studies of Golden Eagle populations in the southwest (New Mexico and Texas) and the Front Range of the Rocky Mountains (New Mexico, Colorado and Wyoming), Boeker and Ray (1971) reported that human disturbance accounted for at least 85% of all known nest losses. Breeding adults are sometimes flushed from the nest by recreational climbers and researchers, sometimes resulting in the loss of the eggs or juveniles due to nest abandonment, exposure of juveniles or eggs to the elements, collapse of the nest, eggs being knocked from the nest by startled adults, or juveniles fledging prematurely. However, Golden Eagles rarely flushed from the nest during close approaches by fixed-wing aircraft and helicopters during various surveys in Montana, Idaho, and Alaska (Kochert et al. 2002).

Golden Eagles nest on cliffs, in the upper one third of deciduous and coniferous trees, or on artificial structures (windmills, electricity transmission towers, artificial nesting platforms, etc.; Phillips and Beske 1990, Kochert et al. 2002). Golden Eagles build nests on cliffs or in the largest trees of forested stands that often afford an unobstructed view of the surrounding habitat (Beecham 1970, Menkens and Anderson 1987). Usually, sticks and soft material are

added to existing nests, or new nests are constructed to create a strong, flat or bowl shaped platform for nesting (Palmer 1988, Watson 1997, Kochert et al. 2002). Sometimes Golden Eagle will decorate multiple nests in a single year; continuing to do so until they lay eggs in the selected nest. The completed nest structure(s) can vary from large and multi-layered; or a small augmentation of sticks in caves with little material other than extant detritus (Ellis et al. 2009). Each Golden Eagle territory may have anywhere from 1 to 14 alternative nests, with 1 to 6 nests per territory being the norm (Palmer 1988, Watson 1997, Kochert et al. 2002).

Onset of courtship and nesting chronology

Courtship for Golden Eagles involves stick-carrying, display flights, and vocalization (Ellis 1979, Kochert et al. 2002). Golden Eagles partake in undulating flight, however undulating flight has been observed year- round and is thought to be associated more with aggression and territory defense than with courtship (Newton 1979, Harmata 1982, Collopy and Edwards 1989, Watson 1997).

Nesting chronologies vary however there are some generalities. In California and in Texas, courtship at territories start in mid to late December (Palmer 1988, Hunt et al. 1997, D. Bittner pers. com); in Texas eggs have been detected as early as November (Olberholser and Kincaid 1974, *in lit.*). In Utah, courtship can commence in January. In northern tier states at upper latitudes and higher elevation sites, egg laying can occur as early as February and March, before late winter snows and storms have abated (Palmer 1988).

Golden Eagles lay 1 to 4 eggs, with 4 egg clutches rare. Most nests have 2 eggs. The laying interval between eggs ranges between 3 to 5 days. Incubation commences as soon as the first egg is laid, and hatching is asynchronous and can begin as early as late January in southern California (Dixon 1937, Hickman 1968), mid April to late May in southwest Idaho (Kochert et al. 2002) and late March–early May in central and northern Alaska (McIntyre 1995, Young et al. 1995; Fig. 3). In Texas, eggs have been noted from November to June (Oberholser and Kincaid 1974, in lit.). In the northeast United States, eggs have been laid in March/April (Palmer 1988). For more detail, please refer to Kochert et al. 2002 (Appendix 2).

Migration and Wintering

Golden Eagles will migrate from the Canadian provinces and northern tier and northeastern states to areas that are milder in the winter and/or may have less snow cover. Wintering Golden Eagles have been noted in all states in the continental U.S. (Wheeler 2003, 2007). Some segments of the population are non-migratory, and can be found near their nest sites throughout the year. See Kochert et al. 2002 for detailed listing of winter range.

Roosts or gathering behavior

Golden Eagles are not known to roost communally as is common with wintering Bald Eagles in some areas of the United States, but will gather together if local food sources are abundant. A caveat to this is that Golden Eagles have perched with bald eagles where there have been large concentrations of waterfowl or carrion (Palmer 1988).

V. Golden Eagle Responses to Disturbance

Golden Eagles, as with other raptors, visibly display behavior that signifies disturbance when they are stressed by anthropogenic activities; whether it is a lone hiker walking 1000 meters or more from a nest, or extended construction or recreation activities 2000 – 5000 meters from a territory. These postures, movements and behaviors can be overt. However with Golden Eagles, disturbance behaviors are often subtle and require an experienced observer. Olendorff (1971), Fyfe and Olendorff (1976), and Olsen and Olsen (1978) identified considerations when human interactions may disturb nesting activities, and how to ascertain critical distances to avoid agitating nesting, roosting, and foraging raptors. Factors affecting critical distances included:

a. Mannerisms of intruder.

b. Size of intruder.

c. Stage of breeding cycle.

d. Topography and exposure of intruder in relation to bird.

Golden eagle behavior varies among individuals and can be affected by previous experiences. However, some behavioral generalities relative to direct and indirect disturbance include the following:

- Agitation behavior (displacement, avoidance, and defense)
- Increased vigilance at nest sites
- Change in forage and feeding behavior
- Nest site abandonment

Of the preceding behaviors, nest-site abandonment can be readily identified as constituting take under the Eagle Act, as it is specifically cited in the definition of 'disturb'. The other behaviors, when considered cumulatively, may be evidence that activities are interfering with normal breeding behavior and are likely to lead to take. Human intrusions near Golden Eagle

nest sites have resulted in the abandonment of the nest; high nestling mortality due to overheating, chilling or desiccation when young are left unattended; premature fledging; and ejection of eggs or young from the nest (Boeker and Ray 1971, Suter and Joness 1981).

VI. Overall Objectives of the Golden Eagle Survey Protocol

This survey protocol is intended to standardize procedures to inventory and monitor Golden Eagles within the direct and indirect impact area of planned or ongoing projects where disturbance or lethal take from otherwise permitted human activities is possible. This protocol will; 1) identify eagle use areas, 2) identify and minimize potential observer-related disturbance to Golden Eagles by surveys when conducted by qualified and experienced raptor biologists.

Additionally, data collected using this protocol may be used for, at a minimum, 1), sampling other geographic areas where suitable habitat may be present; 2) short and long-term analysis of Golden Eagle occupancy and productivity at known nest sites, and historical locations where observation to determine occupancy maybe necessary; 3) identification and evaluation of potential disturbance factors. If followed, this protocol will standardize data collection for potential local and regional analysis of long-term occupancy, productivity and eagle use trends. This protocol was developed as minimum standards, and as such may require additional area-specific detail if used for research purposes.

Objectives of inventory and monitoring

The first objective of these surveys is to provide methods to identify areas occupied by Golden Eagles and select factors their behavior ecology. Additional objectives of these surveys include:

1. Record and report occupancy and productivity of local Golden Eagle territories.
2. Document and list historical and unsurveyed habitat for future analysis to assist in determining local and regional population trajectories.
3. Determine nesting chronologies.
4. Provide information to document whether local Golden Eagle conservation efforts are meeting goals for improvements in the status of Golden Eagles or meeting permit conditions.
5. Provide a foundation to evaluate whether and which activities or conditions may be affecting Golden Eagles.

6. Document foraging behavior, diet and habitat use within breeding and non-breeding home ranges.

VII. Inventory Techniques

CAUTION

Golden Eagles are one of several cliff and tree dwelling species sensitive to human disturbance. Monitoring eagles in a manner that 'disturbs' them, and causes them to be 'agitated or bothered' can cause nesting failure, and permanent site abandonment, constituting take under the Eagle Act.

These monitoring protocols should facilitate observer caution and identify techniques that will minimize potential for take of Golden Eagles. For additional information regarding preventing observer disturbance while surveying raptors, please refer to Fyfe and Olendorff (1976).

Inventory

Inventories for Golden Eagles should occur if nesting, roosting, and foraging habitat are contained within the project boundary and exist within 4 – 10 air miles from the project boundary. Local and regional Golden Eagle habitat variability will dictate the distance from the project boundary where surveys will occur; distances will be greater in xeric (arid) habitat, or where local prey may not be abundant. The Service will be basing its site-specific evaluations and final determinations on local conditions, not national averages.

Nesting habitat

This account is not intended as a compendium of Golden Eagle habitat available and used in North America; please refer to Palmer (1988) and Kochert et al. (2002) for more detailed information.

Golden Eagles use a wide variety of habitat throughout North America. Small xeric mountain ranges in the Mohave and Great Basin deserts, forested habitat in the Pacific coastal, southern desert, Great Basin, Rocky, Sierra, and Cascade Mountain ranges are also key nesting areas. Local and regional variation of nesting habitat should be considered prior to surveys; however should include cliff, desert scrub, juniper woodland, and forested habitat. For example, in the northern Great Basin, Golden Eagles nest on cliff and in scrub-forest habitat; surveys of both types of substrates are urged prior to projects that have a potential to affect eagles. Identification criteria for nesting habitat at the local scale should take place in coordination with the Service, State, or Tribal wildlife agencies, and raptor experts.

VII.a. Procedures for aerial and ground inventory and monitoring surveys

Golden Eagles generally show strong fidelity to the nesting area annually. Occupancy determination is the most important goal of nest searches. Considerable suitable habitat exists in western North America which has never been adequately surveyed. Inventory surveys should examine habitat where Golden Eagles are not currently known to exist but habitat may be present, as well as previously inventoried areas to detect new activity. Monitoring surveys examine all historical and extant territories where Golden Eagles have been detected either previously or in the current survey.

A nesting territory or inventoried habitat should be designated as unoccupied by Golden Eagles ONLY after at least 2 complete aerial surveys in a single breeding season. In circumstances where ground observation occurs, at least 2 ground observation periods lasting at least 4 hours or more are necessary to designate an inventoried habitat or territory is unoccupied as long as all potential nest sites and alternate nests are visible and monitored. These observation periods should be at least 30 days apart for inventory, and at least 30 days apart for monitoring of known territories. Intervals between observations at occupied nesting territories may need to be flexible and should be based on the behavior of the adults observed, the age of any young observed, and the data to be collected (see below, Section IX). Dates of starting and continuing inventory and monitoring surveys should be sensitive to local nesting (i.e. laying, incubating, and brooding) chronologies, and would be conducted during weather conditions favorable for aerial survey and/or monitoring from medium to long range distances (+ 300 – 700 meters).

The first inventory and monitoring surveys should be conducted during courtship when the adults are mobile and conspicuous. When survey of historical territories is conducted, observers should focus their search on known alternative nests, and also carefully examine the habitat for additional nests which may have been overlooked or recently constructed. A 'decorated' nest will be sufficient evidence to indicate the probable location of a nesting attempt. If a decorated nest or pair of birds is located, the search can then be expanded to inventory likely habitat adjacent to the discovered territory to see if additional golden eagle territories can be observed.

Note: Identification of alternate nests will be required by the Service for determination of relative value of individual nests to a territory in cases of applications for permits to take 'inactive' nests, and when determining whether abandonment of a particular nest is likely to result in abandonment of a territory. The Service has determined that territory loss or permanent abandonment of a territory is a greater impact to populations than temporary abandonment of a nest.

Weather: Avoid searching potential and known nesting locations during periods of heavy rain, snow, high winds, or severe cold weather. Golden Eagles should not be induced to flush at any time during the survey period. Flushing when the adults are incubating or have small young can be particularly hazardous for successful nesting, and could constitute lethal disturbance take. High temperatures also may cause problems for successful viewing over long distances due to heat waves. Further, observer related incidences of causing flight of adults that are shading young to prevent overheating during high temperatures may cause mortality of the young. Observation for Golden Eagles during inclement weather is impractical, uncomfortable, and unsafe for Golden Eagles and observers. Weather will be recorded by the observer.

Time of day: Aerial surveys should be conducted, at the beginning of the day if winds permit. Likewise, ground surveys should be initiated, where possible, in morning hours when the air is still to avoid heat waves. Prime observation periods are around dawn, or shortly thereafter. In some cases the angle of the sun in relation to the cliff can be a more important issue, and some cliffs are better observed in afternoon light, however observations of adult behavior that are used to determine nesting chronologies may be conducted during most of the day. Observers should be aware of the angle of the sun in relation to the observation post and the nest. Some sites are plagued by afternoon winds, heat waves, or dust storms; local observation conditions should be taken into account prior to establishing viewing periods. Time of day will be recorded by the observer.

Time of year: Breeding surveys for Golden Eagles are latitude and elevation dependent; however, their nesting season ranges in the contiguous United States from 01 January to 31 August (Kochert et al. 2002). Nesting failures and seasonal variations should be considered as potential anomalies to 'normal' behavior and nesting chronologies. Dates to be used as a cut-off period for observation and reporting of nesting failures or non-nesting status will vary per region. The dates listed below are to be used as general guides, and should not be used as final nest site failure survey determination dates. Location-specific determination dates should be developed in coordination with the Service, State, or Tribal wildlife agencies, and raptor experts.

Duration of stay at observation points: Ground observers will survey from observation points for a minimum of 4 hours, unless observations yield Golden Eagle presence, or Golden Eagle behavior indicate eggs or young, or observation suggests the observer is disturbing the birds. Slowly walking and observing all potential nesting substrate can be used to completely inventory potential habitat. Observation periods may last longer as longer observation periods may be necessary to accurately determine nesting chronologies. Duration of stay at known or suspected territories during helicopter reconnaissance, or during ground observation periods will be recorded by the observer.

VII.b Aerial surveys

Helicopters are an accepted and efficient means to monitor large areas of habitat to inventory potential habitat and monitor known territories only if accomplished by competent and experienced observers. They can be the primary survey method, or can be combined with follow-up ground monitoring. Disturbance to eagles is minimal only WHEN accepted aerial practices and techniques are followed. NOTE: Ground surveys can be used when their use is more efficient, or when other circumstances (i.e. bighorn sheep lambing areas) require this method.

Coordination between state and federal agencies is an important aspect of aerial surveys to develop acceptable search criteria to be used for identifying likely suitable nesting habitat and locating nests, as well as to be become acquainted with potential hazards and air space restrictions. Survey pilots should be aware of potential ground hazards within the habitat to be examined, including marked and unmarked transmission and wires. Other hazards to surveyors include rock-fall or tree fall from above the helicopter, raptors or other birds colliding with the helicopter, and collision with other aircraft. Although pilots are often the first to note a flying raptor during surveys, some accidents involving wildlife researchers have been attributed to the pilots focusing on the survey, rather than giving their complete attention to flying the helicopter.

Helicopters used for surveying Golden Eagle habitat should be light utility, i.e. small to medium sized (e.g. MD-500/520, Eurocopter 145, Bell Jet-Ranger 206, UH-72,) capable of vertical mobility in warm temperatures and higher elevations. Inventories for raptors can be conducted with the main observer door(s) removed (which may provide more lateral and horizontal

visibility), or with the doors closed. The decision regarding observer doors should remain a personal choice, with the safety of pilots and observers as the primary determinant.

Cliffs should be approached from the front, rather than flying over from behind, or suddenly appearing quickly around corners or buttresses. Inventories should be flown at slow speeds, ca. 30 – 40 knots. However, detection of nests may require slower speeds, e.g. 20 knots, while between nest speeds can be higher (+ 60 knots). All potentially suitable nesting habitats (as identified in coordination with the Service) should be surveyed; multiple passes at several elevation bands may be necessary to provide complete coverage when surveying potential nesting habitat on large cliff complexes, escarpments, or headwalls. Hovering for up to 30 seconds no closer than a horizontal distance of 20 meters from the cliff wall or observed nests may be necessary to discern nest type, document the site with a digital photograph of the nest, and if possible, allow for the observer to read patagial tags, count young, and age young in the nest (Hoechlin 1976). Confirmation of nest occupancy may be confirmed during later flights at a greater horizontal distance.

Re-nesting is rare, but Golden Eagles may fail at their first nest attempt, and move to, or create, an alternate nest site. Multiple visits to known or potential nesting habitat may be necessary to provide complete observation and coverage of habitat.

To inventory for the purpose of documenting presence/absence of Golden Eagles in potential habitat, at least 2 aerial observation flights of habitat are necessary. These flights will be spaced no closer than 30 days apart. Additional inventory work in the territory is not necessary after nests have been located where Golden Eagles are found incubating, or where eggs or young and number of eggs or young are noted. At this point, the observation effort should switch to monitoring of the known territory. The nest location should be documented (see territory/nest naming convention, pp. 21).

Inventory and monitoring flights will be based on local knowledge of known nesting chronologies for that latitude and elevation, and should be timed to be the most efficient to reduce the number of visits to the nest site. Flights may occur preferentially during a) late courtship, b) egg-laying though hatch, and/or c) when the young are between 20 – 51+ days old. Productivity surveys are best scheduled when the young are approximately 51+ days old (prior to fledging). Aerial visits at known nests may be augmented or replaced by ground observation (see below).

Other raptors or special status species may be observed during the flight, and should be recorded/reported. Coordination with state and federal agencies will be necessary when state or federally listed Threatened, Endangered or special status (species of concern, sensitive, etc.) species are present in the flight survey area (i.e. big-horn sheep, peregrine falcons, etc.).

Bighorn sheep share the same type of cliff complexes Golden Eagles use for nesting, and are hyper-sensitive to helicopters (Weyhausen 1980, Bleich et al. 1990). Specifically for bighorn sheep lambing areas, helicopter reconnaissance and surveys for Golden Eagles are not possible as these flights will induce unpermitted take during the lambing season; all helicopter survey work for Golden Eagles should be avoided in known lambing areas. Ground observation will be necessary for inventory of cliff complexes and monitoring of potential and known Golden Eagle territories in bighorn sheep lambing areas.

Most Golden Eagle respond to fixed wing aircraft and helicopters by remaining on their nests, and continuing incubation or roosting (DuBois 1984, McIntyre 1995). Perched birds may flush. During aerial surveys, deference to flying eagles should be given at all times. Flights at nest sites should be terminated and the helicopter should bank away and move to the next location if Golden Eagles appear to be disturbed; i.e. behavior that indicates the birds are agitated by the presence of the helicopter. In short, observers should obtain their data, and leave as soon as possible.

Any disturbance behavior observed should be noted so that consecutive aerial surveys would be sensitive to Golden Eagles at that location. Aerial reconnaissance to inventory/survey for potential habitat and additional visits at known nests may be augmented/replaced by ground observation from a safe distance (see below). Ground observation may be the recommended alternative to additional survey flights due to convenience or necessitated by other sensitive wildlife species. Follow-up ground observation from a safe distance may also be the recommended alternative for additional nest site monitoring.

Observers in helicopters have specific duties. At least two observers may be best for aerial surveys; one the lead observer, the other(s) supplement survey effort. One observer is assigned to record data on a tape recorder (unless the verbal interchange can be recorded on the helicopters internal communication system), and the other briefly records data on hard-copy and with digital photographs. Aerial observation routes should be recorded, downloaded, and reported using Global Positioning System track routes or applicable software programs. Observation locations and time-on-site should be recorded on applicable maps to ascertain coverage of cliff systems and other potentially suitable habitat.

Summary:

- Qualified observer(s) (as defined in section VIII).
  No closer than 10-20 meters from cliff; no farther than 200 meters from cliff (safety dependent).
- Close approach and extended hovering is allowed when there are no birds on the nest to allow observers to count eggs, dead young, or confirm nest failure.
- Multiple passes or 'bands' (i.e. back and forth at different elevations above ground level) of observation across cliff habitat may be necessary to achieve complete coverage in large cliff complex'.
- Occupied territories and current and alternative nest sites will be documented; nests 'decorated' with fresh branches should also be delineated.
- Once a nest with eggs, young, or an incubating adult has been located, there is no need to search for other nests within the territory.
- Minimal hovering time at known or potential nest; ca < 30 seconds.
- At least 2 surveys of previously unsurveyed habitat will be spaced at least 30 days apart.

VII.c. Ground Surveys

Ground surveys of potential habitat

Ground surveys for Golden Eagles in potential habitat may be achieved without aerial support, or may be used to augment extant aerial surveys. Ground surveys to detect Golden Eagle nests and the selected nest at known territories are effective in habitat where observation points are established to observe areas on cliffs, utility towers, or in trees suspected to be nesting habitat. As with aerial surveys, identification criteria for nesting habitat should take place in coordination with the Service, State or Tribal wildlife agencies, and raptor specialists.

Observation posts (OP) are established during initial reconnaissance of potential or known nest cliffs, and are established in locations that are far enough from the potential nest site to effectively observe the behavior of the adults (if present) without disturbing nesting behavior. Well-placed OPs provide unobstructed viewing of the potential nest location or of the area to be surveyed; including a broad panorama of the surrounding habitat. Multiple OPs or walking surveys may be necessary to observe potential nest sites. OPs located in front of, and below the potential nest cliff or tree are best. Placing OPs below the potential nest cliff reduces stress if an incubating adult may be present. The distance from an OP to the potential nest site may range from 300 – 1600 meters (latter represents extreme circumstances) from the cliff base to the observer, and generally no greater than 700 meters.

Golden Eagles may use alternative nests. Detection of previously unknown alternate nests and observation of all known alternative nests will become important if Golden Eagles fail in their initial nesting attempt, or are not observed at the probable nest location.

~~Ground monitoring; known territories~~

Monitoring to document nesting success at known territories may occur solely via ground observations. Observation of known territories should use the methodology described for ground monitoring of potential habitat (see section VIIc). Dates of all visits to the nesting territory will be recorded; date of confirmation of nesting failure will be key data for site specific and regional analysis.

Nesting outcomes

Fledging success will be determined via the observation of young that are at least 51 days of age, or are known to have fledged from the observed nest. If there is whitewash (Golden Eagle defecation) and a well worn nest, young were previously observed in the nest to be > 4 weeks old during a previous visit, and the young would have been > 51 days old at the time of the visit, and no dead young are found after a thorough ground search, the nesting attempt can be deemed successful.

Nesting failure occurs when a nest where eggs were laid or where incubation behavior was observed fails to have any young reach 51 days of age. If necessary, nesting failure will be confirmed by using a spotting scope to view the nest to determine if dead young are observed. Nesting failures may also be determined if observations of the nest prior to the projected fledge date yields no young or fledglings where eggs or young were previously observed. In these instances observation periods should last 4 hours (consecutively), or are confirmed by aerial survey. If dead young are observed in the nest (i.e. all young are dead), monitoring efforts may cease. Nest failures may also be confirmed by an approach (walk-in) to the nest no more than 4 weeks after fledging was scheduled to occur. Observers will look for dead chicks at the base of the nest cliff or tree, where access is reasonable and safe.

Observers must document the criteria they use to conclude that success or failure occurred.

Summary

- Observation posts for monitoring known territories will be no closer than 300 meters for extended observations, and generally no further than 700 meters, where terrain allows. Maximum OP distance would be 1600 meters.

- To inventory and determine occupancy of cliff systems, there will be *at least* 2 observation periods per season. To determine fledging success, additional observations may (or may not) be necessary.
    - Observation periods will last at least 4 hours for known nest sites, or until territory occupancy can be confirmed.
    - Observation periods will last for at least 4 hours per 1.6 km of cliff system, based from the center point of that cliff complex.
    - Observation periods will be at least 30 days apart for monitoring efforts.
- To collect monitoring data at a known nest territory, there will be at least 2 observation periods per season.
    - Observation periods from ground observation points will last at least 4 hours for known nest sites or until nesting chronology can be confirmed per visit. Observation periods will be at least 30 days apart.

VIII. Observer qualifications

Surveyor experience affects the results of protocol-driven raptor surveys. All surveyors/observers should have the equivalent of 2 seasons of intensive experience conducting survey and monitoring of Golden Eagle and/or cliff dwelling raptors. That experience may include banding, intensive behavioral monitoring, or protocol-driven survey work. Experience should be detailed and confirmed with references, and provided to action and regulatory agencies. All surveyors should be well-versed with raptor research study design and Golden Eagle behavior and sign, including nests, perches, mutes, feathers, prey remains, flight patterns, disturbance behavior, vocalizations, age determination, etc. **Aerial surveys will be conducted by raptor specialists who have at least 3 field seasons experience in helicopter-borne raptor surveys around cliff ecosystems.**

In lieu of limited or no Golden Eagle experience, ground surveyors should attend at least a 2-day Golden Eagle training session convened with classroom and field components; trainers will be designated by the USFWS/USGS. Inexperienced or limited experience surveyors will be mentored by Golden Eagle specialists for at least 1-2 field seasons, depending on their experience level, and should assist with the preparation of at least 3 surveys and reports over at least 3 years. A Golden Eagle specialist is defined as a biologist or ecologist with 5 or more years of Golden Eagle or cliff dwelling raptor research/survey experience, possession of state/federal permit allowing capture, handling, and/or translocation of Golden Eagles and/or

cliff dwelling raptors; and/or relevant research on raptors published in the peer reviewed literature.

IX. Documentation and accepted notation of territory/nest site and area surveyed

Data for each territory/nest site(s) and area visited will be reported annually to the applicable regional office of the USFWS Division of Migratory Bird Management for collation into a national database.

Minimum data collected at known Golden Eagle territories

Observation of potential sites and known nest territories will produce data helpful to determine territory occupancy, productivity, and fate of the nesting attempt. Each observation and all site specific data collected should include at least;

a) date of observation,
b) time of observation(s),
c) weather during observation,
d) duration of observation,
e) name of observer(s),
f) location of observation,
g) description of observation.

Data collected during inventory and monitoring will include (at least) the following:

- Territory status [Unknown; Vacant; Occupied-1 eagle; Occupied-2 eagles- laying or non-laying; Breeding successful (chick observed to be at least +51 days-fledging), Breeding unsuccessful (failed-nesting attempt failed after eggs were laid)].
- Nest location (decimal degree lat/long or UTM).
- Nest elevation.
- Age class of Golden Eagles observed.
- Document nesting chronology;
    - Date clutch complete (estimated). Describe incubation behavior observed to derive this date, and/or use backdating from known nestling age).
    - Hatch date (estimated from age of nestlings).
    - Fledge date (known or estimated; see nesting outcomes, pp. 18).
    - Date nesting failure first observed and/or confirmed.

- Number of young at each visit and at >51 days of age.
- Digital photographs; a) landscape view of area inventoried, b) landscape view of territory, and c) nest(s).
- Substrate upon which the nest is placed (tree species, cliff, or structure).

Additional data that can be collected include (but are not limited to):

- Presence or absence of bands (USGS and VID), patagial tags (number and color), or telemetry unit.
- Forage location (if known).
- Prey items noted (if discerned).
- Height of nest on cliff or in tree, and description of technique used to estimate height.
- Species of tree, type of rock, or type of structure used to support the nest.
- Overall cliff or tree height, and description of technique used to estimate height.
- Nest aspect.
- Other nesting raptors present nearby.

Each area surveyed under the requirements of this protocol, including surveyed habitat, occupied nesting territory, historical territory, and suspected/alternative nests will be recorded in a standardized manner to allow local, regional, and national data analysis.

Recommended Golden Eagle Territory/site naming convention:

XX^1-XXX^2-XXXXX/XX^3-XXX^4-XX^5 Territory name

XX^1 = State (two letter alpha)

XXX^2 = County (three letter alpha)

XX^3= USGS Quad [five numeric/two letter alpha] (when the territory straddles adjacent quad maps, the quad in which the first nest was found will be used to describe the territory; XX^5 is used to document the locations of alternate nests within a territory).

XXX[4]=Assigned Territory number within USGS quad (three numeric)

XX[5]=Assigned Nest number within territory in instances of alternate nests (two numeric)

Site name=traditional site name, or if new, use local naming convention (e.g. Upper fork Amundsen Creek, Fort Peck flatland, Farmer Jane's back 40).

Example CA-KER-38512/DG-03-02 Abbot Creek

X. Additional considerations

This interim document primarily contains methods for inventorying and monitoring at nest sites, but the prohibitions against take and the new regulations apply at nest sites and foraging areas, as well as during migration and other non-breeding times. The Service will develop or adopt recommendations for surveys applicable to non-nesting in other documents.

Suitable foraging habitat

Golden Eagles forage close to and far from their nests, i.e. < 6 km from the center of their territories, but have been observed to move 9 km from the center of their territories in favorable habitat (McGrady et al. 2002). These distances may be further in xeric habitat.

Suitable wintering habitat

During winter, Golden Eagles are found throughout the contiguous United States. Inventories for wintering Golden Eagles will encompass all habitat where Golden Eagles have been known to nest, roost, and forage. Refer to Wheeler (2003, 2007) for maps elucidating suitable wintering range.

Winter surveys

Survey information gathered during the non-breeding period is needed to identify foraging areas and determine numerical estimates of use by Golden Eagles. Presence of Golden Eagles during winter surveys does not necessarily mean that breeding individuals are present; however follow-up surveys during the breeding season are necessary to denote occupancy at suspected or known territories.

Migration surveys

The location of migration routes or areas in relation to a proposal that are likely to take Golden Eagles through injury or mortality may have critical implications. Therefore, evaluations should assess whether migratory or transient Golden Eagles are likely to be present during the construction and the life of the project. Other factors to consider include numbers of Golden Eagles moving through the project area, movement patterns (including a three-dimensional spatial analysis), time of day, and seasonal patterns. In the case of wind development, surveys will need to identify the locations of migration routes and movements during migration in relation to proposed turbines and rotor-swept area.

XI. Acknowledgments.

The authors are indebted to the expertise, experience, effort and kindness expended on all phases of this protocol by Dr. Mark Fuller (USGS), Mike Kochert (USGS Emeritis), and Karen Steenhof (USGS Retired). We greatly appreciate the time they took to review multiple drafts, and provide sound advice and guidance where necessary regarding all aspects of Golden Eagle inventory and monitoring. Robert Murphy's comments on earlier drafts were also appreciated. We also appreciated Peter Bloom's input and good humor regarding his observations of Golden Eagle natural history and monitoring, and the cover photograph of a Golden Eagle taken from beneath a calf carcass while he was in a southern California pit trap.

XII Literature Cited

BEECHAM, J.J. AND M.N. KOCHERT. 1975. Breeding biology of the golden eagle in southwestern Idaho. Wilson Bull. 87:506-513.

BLEICH, V. C., R. T. BOWYER, A. M. PAULI, R. L. VERNOY, AND R. W. ANTHES. 1990. Responses of mountain sheep to helicopter surveys. Calif. Fish and Game 76(4):197-204.

BLOOM, P.H. AND S.J. HAWKS. 1982. Food habits of nesting Golden Eagles in North-east California and North-west Nevada. J. Raptor Res. 16: 110-115.

BLOOM, P.H. AND W.S. CLARK. 2001. Molt and sequence of plumages of golden eagles, and a technique for in-hand ageing. N. Am. Bird Bander 26:97-116.

BOEKER, E. L. and T .D. RAY. 1971. Golden eagle population studies in the southwest. Condor 73:463-467.

BOEKER, E.L. 1974. Status of golden eagle surveys in the western states. Wildl. Soc. Bull. 2:46-49.

COLLOPY, M.W. AND T.C. EDWARDS. 1989. Territory size, activity budget, and the role of undulation flight in nesting Golden Eagles. J. Field Ornithol. 60:43-51.

DEGROOT, D.S. 1928. Record sets of eggs of California raptores [sic]. Condor 30:360-361.

DIXON, J.B. 1937. The Golden Eagle in San Diego County, California. Condor 39:49-58.

DUBOIS, K. 1984. Rocky Mountain Front raptor survey, December 1982-November 1983, Fin. Rep. Montana Dep. Fish, Wildl., Parks, Helena.

ELLIS, D.H. 1979. Development of behavior in the golden eagle. J. of Wildlife Manage. 43: No. 4.

ELLIS, D.H., T.CRAIG, E. CRAIG, S. POSTUPALSKY, C.T. LARUE, R.W. NELSON, D.W. ANDERSON, C.J. HENNY, J. WATSON, B.A. MILSAP, J.W. DAWSON, K.L. COLE, E.M. MARTIN, A. MARGALIDA, AND P. KUNG. 2009. Unusual raptor nests around the world. J. Raptor Res. 43:175-198.

FARMER, C.J., L.J. GOODRICH, E. RUELAS INZUNZA, AND J.P. SMITH. 2008. Conservation status of North America's birds of prey. IN K.L. BILDSTEIN, J.P. SMITH, E. RUELAS INZUNZA AND R.R. VEIT (eds.). State of North America's birds of prey. Series in Ornith. # 3, Nuttall Ornith. Club and the Am. Ornith. Union.

FYFE, R.W. AND R.R. OLENDORFF. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Canadian Wildl. Serv., Occas. Paper # 23.GOOD, R.E., R.M. NIELSON, H. SAWYER, AND L.L. MCDONALD. 2007. A population estimate for golden eagles in the western United States. J. Wildl. Manage. 71:395-402.

GOOD, R.E., R.M. NIELSON, H. SAWYER AND L.L. MCDONALD. 2007. A population estimate for Golden Eagles in the western United States. J. Wildl. Manage. 71:395-402.

HARLOW, D.L. AND P.H. BLOOM. 1989. *Buteos* and the Golden Eagle. Pp. 102-110 in B.G. Pendleton, ed. Proceedings of the western raptor management symposium and workshop. Natl. Wildl. Fed. Scien. Tech. Ser. No. 12.

HARMATA, A.R. 1982. What is the function of undulating flight display in Golden Eagles? Raptor Res. 16:103-109.

HICKMAN, G.L. 1968. The ecology and breeding biology of the golden eagle in southwestern Idaho and southeastern Oregon. Draft number 2, U.S. Dept. Int. Bur. Sport Fish. and Wildl. Washington, D.C.

HOECHLIN, D.R. 1976. Development of golden eagles in southern California. Western Birds 7:137-152.

HUNT, G.W., R.E. JACKMAN, T.L. BROWN, D.E. DRISCOLL, AND L. CULP. 1997. A population study of golden eagles in the Altamont Pass Wind Resource Area; second-year progress report. Predatory Bird Research Group, Long Marine Lab., UC Santa Cruz.

HUNT, G.W. 1998. Raptor floaters at Moffats equilibrium. Oikos 82:191-197.

KOCHERT, M.N. AND K. STEENHOF. 2002. Golden eagles of the U.S. and Canada: status, trends and conservation challenges. J. Raptor Res. 36(S1):32-40.

KOCHERT, M.N. K. STEENHOF, C.L. MCINTYRE AND E.H. CRAIG. 2002. Golden Eagle (Aquila chrysaetos). In A. Poole and F. Gill (eds). The Birds of North America, # 684. The Birds of North America, Inc. Philadelphia, PA.

LEE, D.S. AND W.R. SPOFFORD. 1990. Nesting of golden eagles in the central and southern Appalachians. Wilson Bull. 102:693-698.

NIELSON, R.M., T. RINTZ, M.B. STAHL, R.E. GOOD, L.L. MCDONALD AND T.L. MCDONALD. 2010. Results of the 2009 survey of golden eagle (*Aquila chrysaetos*) in the western United States. Western Ecosystems Tech. Inc. Contract # 201818C027 for the USFWS.

NEWTON, I. 1979. Population ecology of raptors. T&AD Poyser, London.

MCINTYRE, C.L. 1995. Nesting ecology of migratory golden eagles (Aquila chrysaetos) in Denali National Park, Alaska. M.S. thesis, Univ. Alaska, Fairbanks.

MCGRADY, M.J., J.R. GRANT, I.P. BAINBRIDGE, AND D.R.A. MCLEOD. 2002. A model of golden eagle (Aquila chrysaetos) ranging behavior. J. Raptor Res. 36 (1 Supplement):62-69.

MENKENS, G.E., JR. AND S.H. ANDERSON. 1987. Nest site characteristics of a predominantly tree-nesting population of golden eagles. J. Field Ornithol. 58:22-25.

MILLSAP, B.A. AND G.T. ALLEN. 2006. Effects of falconry harvest on wild raptor populations in the United States: theoretical considerations and management recommendations. Wildl. Soc. Bull. 34:1392-1400.

OBERHOLSER, H.C. AND E.B. KINCAID, JR. 1974. The bird life of Texas. 2 Volumes. Univ. Texas Press, Austin.

OLENDORFF, R.R. 1971. Falconiform reproduction; a review. Part 1. The pre-nestling period. Raptor Res. Foundation Report # 1. Vermillion, SD.

OLSEN, P. AND J. OLSEN. 1978. Alleviating the impact of human disturbance on the breeding peregrine falcon: ornithologists. Corella 2:1-7.

PALMER, R.S. 1988. Golden eagle. IN R.S. PALMER (ed.). Handbook of north American birds. Yale Univ. Press.

PHILLIPS, R.L. AND A.E. BESKE. 1990. Distribution and abundance of golden eagles and other raptors in Campbell and Converse Counties, Wyoming. U.S. Dept. Int. Fish and Wildlife Service Tech. Rept. 27. Washington DC.

PHILLIPS, R.L., A.H. WHEELER, J.M. LOCKHART, T.P. MCENEANEY, N.C. FORRESTER. 1990. Nesting ecology of golden eagles and other raptors in southeastern Montana and northern Wyoming. U.S. Dept. Int. Fish and Wildlife Service Tech. Rept. 26. Washington DC.

SMITH, J.P., C.J. FARMER, S.W. HOFFMAN, G.S. KALTENECKER, K.Z. WOODRUFF, AND P.F. SHERRINGTON. 2008. Trends in autumn counts of migratory raptors in western North America. IN K.L. BILDSTEIN, J.P. SMITH, E. RUELAS INZUNZA AND R.R. VEIT (eds.). State of North America's birds of prey. Series in Ornith. # 3, Nuttall Ornith. Club and the Am. Ornith. Union.

STEENHOF, K. AND I. NEWTON. 2007. Assessing nesting success and productivity. IN D.M. BIRD AND K.L. BILDSTEIN (eds.). Raptor research and management techniques. Hancock House, Surrey B.C.

STEIDL, R. J., K. D. KOZIE, G. J. DODGE, T. PEHOVSKI and E. R. HOGAN. 1993. Effects of human activity on breeding behavior of golden eagles in Wrangell-St. Elias National Park and Preserve; a preliminary assessment. National Park Service, Wrangell-St. Elias National Park and Preserve, Copper Center, Alaska, WRST Research and Resource Report; no. 93-3.

USFWS [U.S. FISH AND WILDLIFE SERVICE]. 2009. Final environmental assessment; Proposal to permit take as provided under the Bald and Golden Eagle Protection Act. Division of Migratory Bird Management, USFWS, Washington, DC.

WATSON, J. 1997. The golden eagle. T&AD Poyser, London

WEHAUSEN, J.D. 1980. Sierra Nevada bighorn sheep: history and population ecology. PhD Dissertation. University of Michigan. 243pp.

WRI [WILDLIFE RESEARCH INSTITUTE, INC.]. 2009. Western Mohave 2008 raptor survey; BLM Johnson Valley and Stoddard Valley open areas and environs. WRI for U.S. Bureau of Land Mangement, Moreno Valley, CA.

WHEELER, B.K. 2003. Raptors of western North America; the Wheeler Guides. Princeton Univ. Press.

WHEELER, B.K. 2007. Raptors of eastern North America; the Wheeler Guides. Princeton Univ. Press.

YOUNG, D.D., JR., C.L. MCINTYRE, P.J. BENTE, T.R. MCCABE AND R.E. AMBROSE. 1995. Nesting by golden eagles on the north slope of the Brooks Range in northeastern Alaska. Journal of Field Ornithology 66: 373-379.

XIII Glossary

Action agency – an agency or entity authorizing an action or plan, or providing funding for actions and plans.

Active nest (from the regulations) — a Golden Eagle nest characterized by the presence of any adult, egg, or dependent young at the nest in the past 10 consecutive days immediately prior to, and including, at present. Applies only to applications for permits to take eagle nests.

Breeding home ranges - the spatial extent or outside boundary of the movement of individuals from Golden Eagle pairs during the course of everyday activities during the breeding season.

Inactive nest (from the regulations) — a Golden Eagle nest that is not currently being used by eagles as determined by the continuing absence of any adult, egg, or dependent young at the nest for at least 10 consecutive days immediately prior to, and including, at present. An inactive nest may become active again and remains protected under the Eagle Act.

Inventory –systematic observations of the numbers, locations, and distribution of Golden Eagles and eagle resources such as suitable habitat and prey in an area.

Local area population — the population within the average natal dispersal distance of the nest or nests under consideration (43 miles for bald eagles, 140 miles for golden eagles). Effects to the local area population are one consideration in the evaluation of the direct, indirect, and cumulative effects of take, and the mitigation for such take, under eagle take permits.

Migration corridors - the routes or areas where eagles may concentrate during migration. Golden Eagles begin migrating across a broad front, but tend to concentrate along leading lines (geographical features such mountain ridges) as they move between geographic locations. Golden Eagles are observed in largest numbers along north-south oriented mountain ranges where they soar on mountain updrafts. The species typically avoids lengthy water-crossings. In North America, migrating Golden Eagles concentrate along the Appalachian Mountains in the East and Rocky Mountains in the West.

Management agency - see Action Agency.

Monitoring - inventories over intervals of time (repeated observations), using comparable methods so that changes can be identified. Monitoring includes analysis of inventory data or measurements to evaluate change within or to defined metrics. Monitoring also includes repeated observations of a known nesting territory.

Occupied Nests - those nests which are used for breeding in the current year by a pair. Presence of raptors (adults, eggs, or young), freshly molted feathers or plucked down, or

current years' mute remains (whitewash) suggest site occupancy. Additionally, for the purposes of these guidelines, all breeding sites within a breeding territory are deemed occupied while raptors are demonstrating pair bonding activities and developing an affinity to a given area. If this culminates in an individual nest being selected for use by a breeding pair, then the other nests in the nesting territory will no longer be considered occupied for the current breeding season. A nest site remains occupied throughout the periods of initial courtship and pair-bonding, egg laying, incubation, brooding, fledging, and post-fledging dependency of the young.

Unoccupied Nests - those nests not selected by raptors for use in the current nesting season. Nests would also be considered unoccupied for the non-breeding period of the year. The exact point in time when a nest becomes unoccupied should be determined by a qualified wildlife biologist based upon observations and that the breeding season has advanced such that nesting is not expected. Inactivity at a nest site or territory does not necessarily indicate permanent abandonment.

Productivity — the mean number of individuals fledged per occupied nest annually.

Survey –is used when referring to inventory and monitoring combined.

Final Report

Golden Eagle Surveys Surrounding Sunrise Powerlink Project Area in San Diego and Imperial Counties, California

---

for

San Diego Gas & Electric
8315 Century Park Court, CP21G
San Diego, CA 92123-1548
(858) 636-3972

by

Wildlife Research Institute, Inc.
P.O. Box 2209
Ramona, CA 92065
(760) 789-3992
dbittner@wildlife-research.org
www.wildlife-research.org

July 14, 2010

TABLE OF CONTENTS

EXECUTIVE PROJECT SUMMARY 1
PROJECT BACKGROUND 2
GOLDEN EAGLE SURVEY AREA 4
PHASE 1 REPORT 6
ABSTRACT – PHASE 1 SURVEYS 7
METHODS AND CONSTRAINTS 8
Methods 8
Survey 8
GPS 9
Data 9
Constraints 10
RESULTS 11
All Golden Eagle Territories Surrounding the Sunrise Powerlink Project Area 15
Legend for Survey Maps 16
Barrett / Echo Mountain 17
Bell Bluff 19
Boundary Peak 20
Canebrake 21
Carrizo Gorge 23
Coyote Mountains - East 25
Coyote Mountains - West 27
El Cajon Mountain 29
Fosters 31
Hauser Canyon 33
Iron Mountain 34
Lake Moreno / Moreno Butte 36
Lyons Peak 38
Mountain Springs 39
Rock Mountain 40
San Vicente 43
Thing Valley 47
Viejas Mountain 48
DISCUSSION OF FINDINGS 50
PHASE 2 REPORT 51
ABSTRACT – PHASE 2 SURVEYS 52
METHODS AND CONSTRAINTS 53
Methods 53
Survey 53
GPS 54
Data 54
Constraints 55
RESULTS 56
Active Golden Eagle Territories Surrounding the Sunrise Powerlink Project Area 57
Legend for Survey Maps 58
Barrett / Echo Mountain 59
Canebrake 62
El Cajon Mountain 65

Iron Mountain 66
Lake Moreno / Moreno Butte 69
Lyons Peak 73
Rock Mountain 74
San Vicente 75
Thing Valley 77
DISCUSSION OF FINDINGS 78
LITERATURE CITED 79
APPENDICES 80
APPENDIX A: Waypoints and Related Data for Phase 1 & 2 Golden Eagle Surveys 80
APPENDIX B: Glossary of Golden Eagle Nest Terms 85
NEST CONDITION 85
NEST ACTIVITY 86
NEST ARRANGEMENT 87
APPENDIX C: WRI Golden Eagle Team Biographies 88

LIST OF FIGURES

Figure 1. WRI 2003 and 2008 Western Mojave Desert Golden Eagle Data from BLM Studies. 3
Figure 2. Vicinity Map. 4
Figure 3. Project Location Map. 5
Figure 4. Phase 1 Study Area with Flight Paths and Sunrise Powerlink Project Alignment. 9
Figure 5. Phase 1 2010 Golden Eagle Territory Data for the Sunrise Powerlink Project. 11
Figure 6. Overview Map of all Golden Eagle Territories Surveyed During Phase 1. 15
Figure 7. Survey Map Legend for Phase 1 Golden Eagle Territory Maps. 16
Figure 8. Barrett / Echo Mountain. 17
Figure 9. Bell Bluff. 19
Figure 10. Boundary Peak. 20
Figure 11. Canebrake. 21
Figure 12. Carrizo Gorge. 23
Figure 13. Coyote Mountains - East. 25
Figure 14. Coyote Mountains - West. 27
Figure 15. El Cajon Mountain. 29
Figure 16. Fosters. 31
Figure 17. Hauser Canyon. 33
Figure 18. Iron Mountain. 34
Figure 19. Lake Moreno / Moreno Butte. 36
Figure 20. Lyons Peak. 38
Figure 21. Mountain Springs. 39
Figure 22. Rock Mountain. 40
Figure 23. San Vicente. 43
Figure 24. Table Mountain. 45
Figure 25. Thing Valley. 47
Figure 26. Viejas Mountain. 48
Figure 27. Phase 2 Study Area with Flight Paths and Sunrise Powerlink Project Alignment. 54
Figure 28. Phase 2 2010 Golden Eagle Territory Data for the Sunrise Powerlink Project. 56
Figure 29. Overview Map of Active Golden Eagle Territories Surveyed During Phase 2. 57

Figure 30. Survey Map Legend for Phase 2 Golden Eagle Territory Maps. 58
Figure 31. Barrett / Echo Mountain. 59
Figure 32. Canebrake. 62
Figure 33. El Cajon Mountain. 65
Figure 34. Iron Mountain. 66
Figure 35. Lake Moreno / Moreno Butte. 69
Figure 36. Lyons Peak. 73
Figure 37. Rock Mountain. 74
Figure 38. San Vicente 75
Figure 39. Thing Valley. 77

LIST OF TABLES

Table 1. Phase 1 – All Wildlife Observed During Phase 1 Surveys. 12
Table 2. Phase 1 - All Golden Eagle Territories with USGS Quad Territory Names. 14
Table 3. Phase 2 - Active Golden Eagle Territories with USGS Quad Territory Names. 56

EXECUTIVE PROJECT SUMMARY

This document reports on findings of the Phase 1 and Phase 2 surveys for Golden Eagles within 4 miles of the Final Environmentally Superior Southern Route of the San Diego Gas & Electric Sunrise Powerlink Project alignment. Information from these surveys will be used in avoiding and reducing the potential for inadvertent impacts on Golden Eagles during the nesting season, including compliance with Mitigation Measure B-7h - Implement Appropriate Avoidance/Minimization Strategies for Eagle Nests. This mitigation measure is outlined in Appendix 12 of the Sunrise Powerlink Project's Environmental Impact Report/Environmental Impact Statement (California Public Utilities Commission and U.S. Department of the Interior Bureau of Land Management 2008) and the associated Biological Opinion (U.S. Fish and Wildlife Service 2009). These surveys comply with the U.S. Fish and Wildlife Service recommendations. The Wildlife Research Institute, Inc. has conducted Golden Eagle population studies in Southern California for the past 22 years and has utilized this historic data to identify and survey 19 Golden Eagle territories that fell within the recommended guidelines. Surveys for this project were conducted both by ground and helicopter to confirm activity, occupancy, breeding status of the pairs, and fledging success of the Golden Eagles. Ground surveys started in January 2010 and continued through early April 2010; helicopter surveys started on March 30, 2010 and continued with several flights through May 14, 2010. Nineteen territories were checked and 9 were confirmed to be active during 2010; 2 additional territories were considered possibly active based on nest site evidence, and 8 appeared to be inactive. Five of the active territories were seen with incubating females on the nests during the surveys. In total, 24 Golden Eagle adults and nestlings were observed in addition to 9 other species (i.e., Antelope Ground Squirrels, American Kestrels, Bighorn Sheep, Common Ravens, Great Horned Owls, Jackrabbits, Prairie Falcons, Red-tailed Hawks, and Turkey Vultures) totaling 95 wildlife documentations. All sightings have been documented with GPS locations and recorded on the attached maps and tables as recommended in the USFWS Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance (Pagel et al. 2010).

PROJECT SCOPE

The survey work reported here was conducted to record and report occupancy (Phase 1) and productivity (Phase 2) of Golden Eagles (*Aquila chrysaetos*) on and around the San Diego Gas & Electric (SDG&E) Sunrise Powerlink Project area, including a 4-mile spatial buffer from the proposed project alignment to allow for proper data interpretation of occupied territories, a U.S. Fish and Wildlife Service (USFWS) recommendation (Pagel et al. 2010).

The Sunrise Powerlink is an approximately 118-mile-long 230kV/500kV transmission line that will traverse from SDG&E's Imperial Valley Substation near El Centro, Imperial County, to SDG&E's Sycamore Canyon Substation on Marine Corps Air Station Miramar in San Diego County. One new substation (Suncrest Substation) will be constructed south of Interstate 8 and west of Japatul Valley Road in the Bell Bluff area to convert the line from 500kV to 230kV. Results of these surveys will be used by SDG&E to adjust construction activities, including helicopter flights, to avoid and reduce the potential for inadvertent impacts on Golden Eagles during the nesting season. In addition to the USFWS's existing protocol's for avoiding take of Golden Eagles under the Bald and Golden Eagle Protection Act, the Sunrise Powerlink Project is obligated to comply with Mitigation Measure B-7h, which prohibits construction or maintenance activities within 4,000 feet of an eagle nest during the eagle breeding season (December through June).

PROJECT BACKGROUND

Golden Eagles respond to environmental changes in order to survive and reproduction in Golden Eagles, as in many predators, is regulated by prey species abundance. Since 1998, Western North America has been in a prolonged drought and this has affected many species including Golden Eagles (Bittner et al. 2003). Jackrabbits, an important prey species for Golden Eagles, have also declined (L. LaPre, Bureau of Land Management [BLM] and M. Jorgenson, California State Parks pers.com.). Golden Eagle adults have persevered but reproduction rates have dropped to as low as 12% in some regions, such as the Mojave and Sonoran Deserts of the American Southwest (Bittner et al. 2003). As indicated by Figure 1, studies done by the Wildlife Research Institute (WRI) for the BLM have confirmed these unusually low reproductive levels (WRI 2002, 2003, 2009).

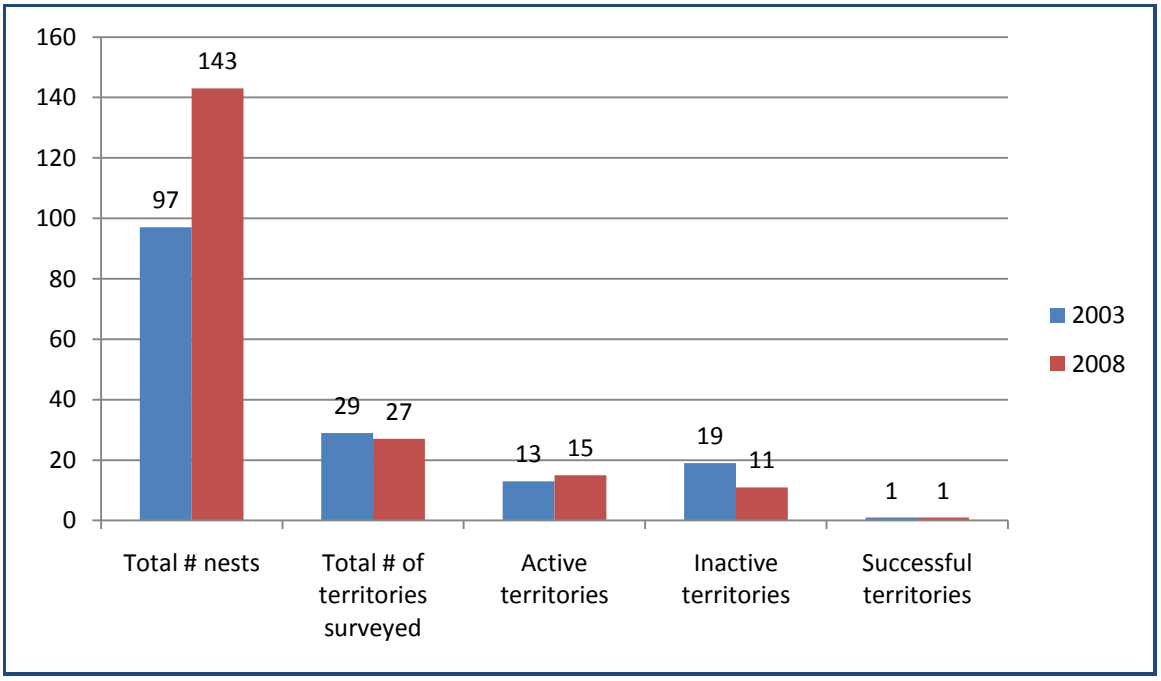


Figure 1. WRI 2003 and 2008 Western Mojave Desert Golden Eagle Data from BLM Studies.

Eagles are large predatory birds with up to 7-foot wingspans and raising young takes a large investment of time and energy. Breeding in Southern California starts in January, nest building and egg laying in February to March, and hatching and raising the young eagles occur from April through June. Once the young eagles are flying on their own, the adult eagles will continue to feed them and teach them to hunt until late November. They then repeat the nesting process. This huge investment of time and energy on the part of the adults, just to raise one or two young, causes some pairs to take a year off from breeding once in awhile even when food is abundant.

WRI has learned, based on 22 years of helicopter and ground studies on Golden Eagles, that an initial helicopter survey can successfully identify 80 to 90% of the Golden Eagle territories in a given area. Follow-up ground and helicopter surveys have indicated that some nests, and even some pairs, might be missed during the first survey. Second surveys are conducted to determine reproductive success but can also identify successful nesting attempts that were missed during initial surveys as well as reveal fledging success.

GOLDEN EAGLE SURVEY AREA

The Sunrise alignment is approximately 118 miles long, traverses from the SDG&E substation near El Centro (Imperial Valley Substation) in Imperial County to the substation on Miramar (Sycamore Canyon Substation) and crosses over BLM, private, U.S. Forest Service (USFS), County of San Diego, City of San Diego, and Department of Defense (Miramar) land.

The Golden Eagle survey area encompasses the SDG&E Sunrise Powerlink Project alignment plus a 4-mile spatial buffer on either side of the linear project. In addition to the above lands, the Golden Eagle survey area includes parts of the Anza-Borrego State Park and several Indian reservations.



Figure 2. Vicinity Map.

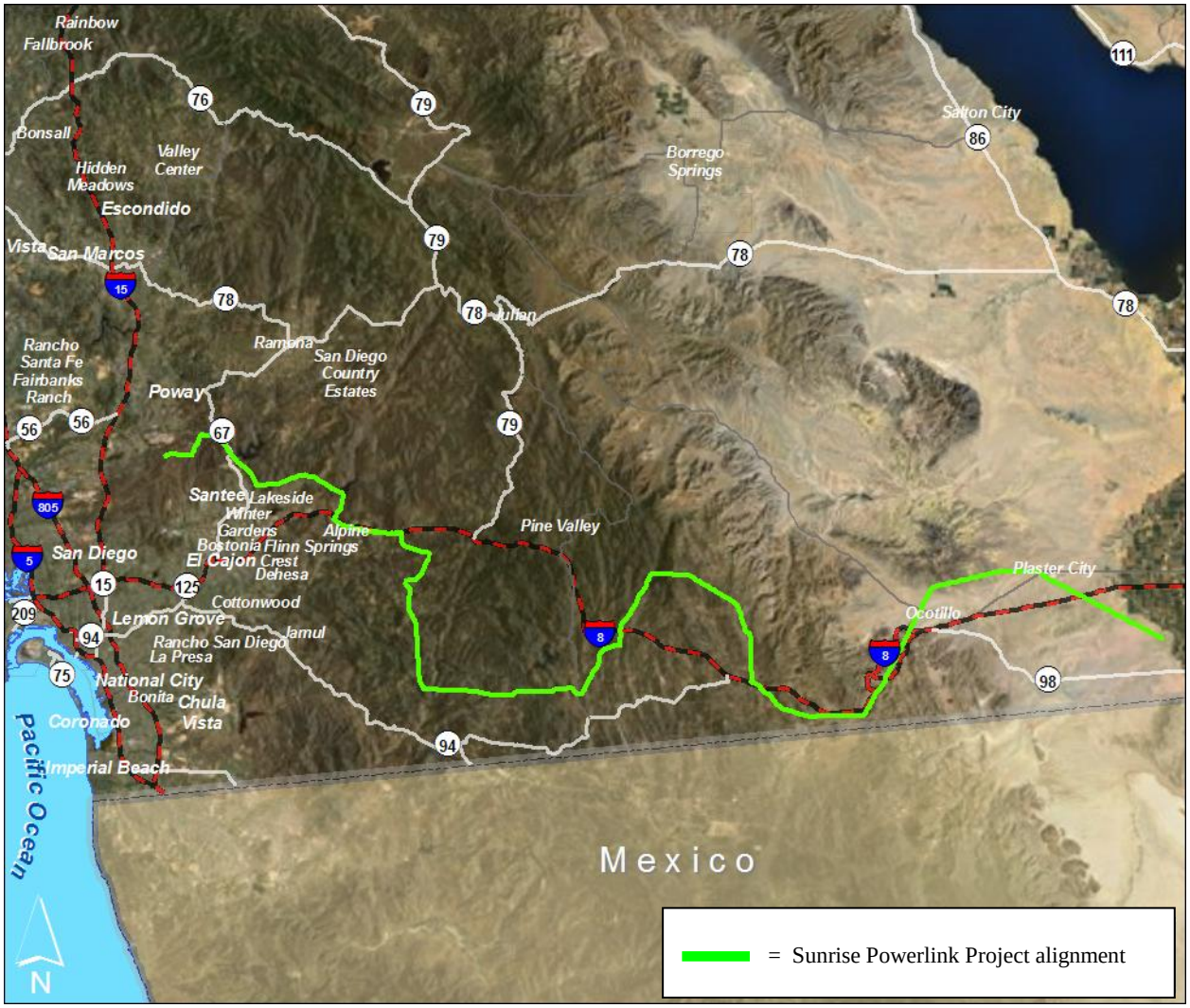


Figure 3. Project Location Map.

General alignment of Sunrise Powerlink Project Area. The surveys of this study area covered a 4-mile spatial buffer along the outer boundary of the project area.

PHASE 1 REPORT

ABSTRACT – PHASE 1 SURVEYS

This section reports on findings of the **Phase 1** surveys conducted in San Diego County, California, to record and report occupancy for Golden Eagles within 4 miles of the Sunrise Powerlink project boundary in order to comply with the U.S. Fish and Wildlife Service recommendations. Based on historical knowledge and 22 years of ongoing Golden Eagle research by the Wildlife Research Institute in San Diego County, California, 18 Golden Eagle territories were initially identified that surrounded the project boundary including the 4-mile spatial buffer. These territories were surveyed by Wildlife Research Institute biologists via helicopter and ground. Additional Phase 1 surveys of these territories occurred during annual research and monitoring conducted during January and February of 2010 by the Wildlife Research Institute in San Diego County. A total of 42 Golden Eagle nests were observed, 2 of which constituted an additional territory in the East Coyote Mountains, for a total of 19 Golden Eagle territories. Of the 19 territories, 9 were active, 2 possibly active, and 8 inactive in the 2010 breeding season; 5 were found with incubating females. Besides 24 Golden Eagles, 9 other species were seen (i.e., Antelope Ground Squirrels, American Kestrel, Bighorn Sheep, Common Ravens, Great Horned Owls, Jackrabbits, Prairie Falcons, Red-tailed Hawks, and Turkey Vultures) totaling 95 wildlife documentations. All sightings have been documented with GPS locations and recorded on the attached maps and tables as recommended in the USFWS Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance (Pagel et al. 2010).

METHODS AND CONSTRAINTS

Methods

The study area encompasses part of Southeast San Diego County, an area that has been part of the WRI's 22 year-long Golden Eagle study initiated in 1988. All territories have a known history to WRI and we utilized that data to improve the accuracy of this study. WRI also houses an archive of data dating back to the late 1800's from other researchers who studied Golden Eagles in and around San Diego County.

We contacted Dr. Larry LaPre, of the BLM, to request available historic records or reports of Golden Eagle nesting activity and/or sightings in the project area. WRI utilized the information provided by Dr. LaPre to improve our survey focus.

It should be noted that all surveying and reporting complies with the current U.S. Fish and Wildlife Service Interim Golden Eagle Inventory and Monitoring Protocols released in 2010 (Pagel et al. 2010).

Survey

We used Hughes-500 helicopters that provided seating for three investigators including 2 Golden Eagle biologists, a Bighorn Sheep biologist, and the pilot.

On March 30, 2010, April 1,2,3, and 25, 2010, WRI conducted helicopter and ground surveys (Figure 4) for the target species, Golden Eagle, specifically around the Sunrise Powerlink project area including the 4-mile spatial buffer. We spent approximately 75 person-hours of actual aerial and ground observations during the surveys for this phase. We concentrated on known or historically documented Golden Eagle territories that fell within the Sunrise Powerlink project area and 4-mile spatial buffer.

It should also be noted that, in addition to scheduled Phase 1 surveys, WRI periodically monitored active nest sites around the Sunrise Powerlink project area during our own ongoing research of Golden Eagle territories in San Diego County, California.

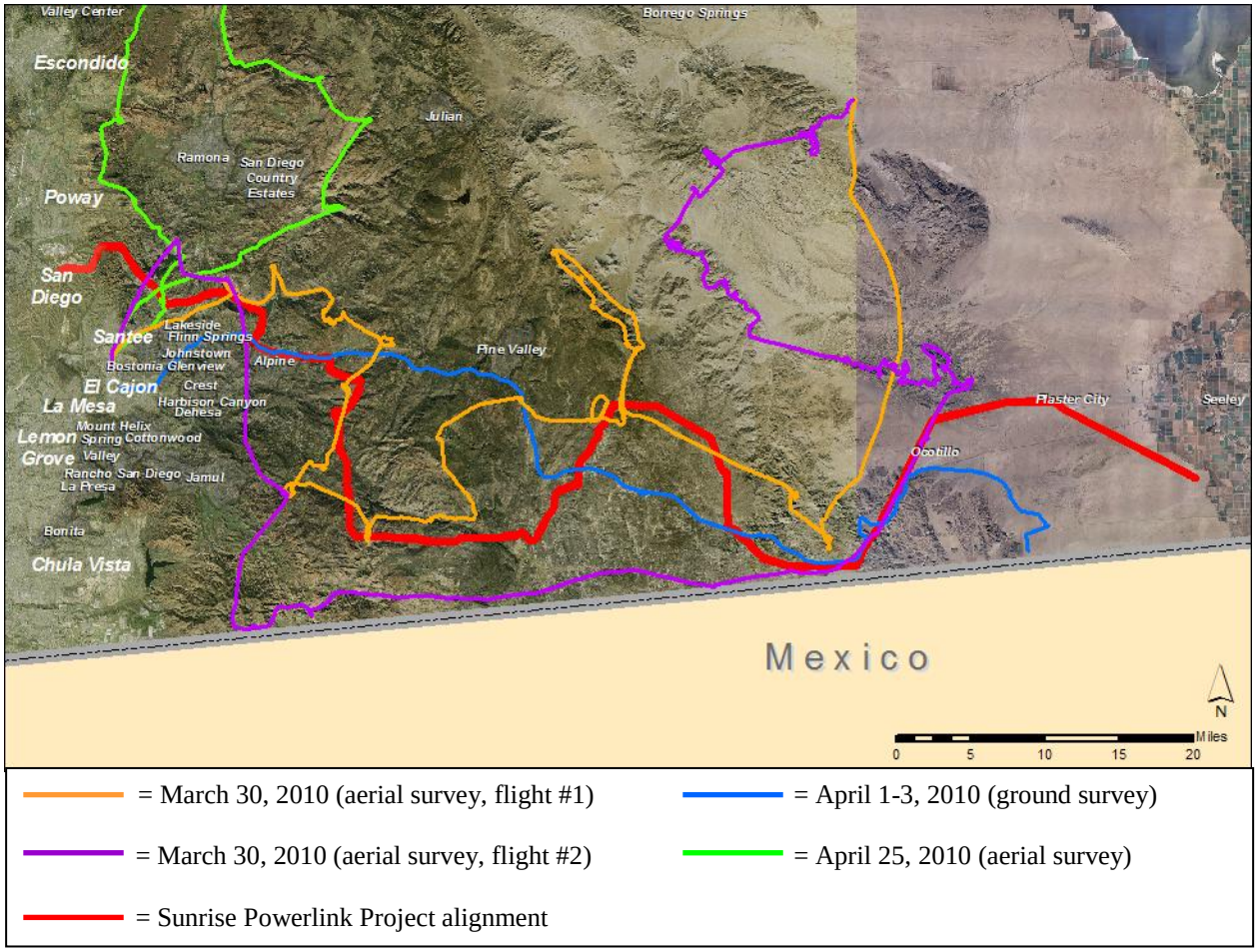


Figure 4. Phase 1 Study Area with Flight Paths and Sunrise Powerlink Project Alignment.

GPS

Nest site and other location-specific data were determined and documented using hand-held GPS units (Garmin Map60GSx). A sequential number was assigned to each observation that corresponded to the GPS waypoint. Waypoints were recorded using the UTM grid in the WGS 84 Datum. GPS was also used to track our survey routes (Figure 4). Handwritten notes were also taken that documented species and corresponded to each GPS waypoint.

Data

We photographed all active Golden Eagle nests, some other raptor nests, representations of numerous inactive Golden Eagle nest sites, and significant other wildlife species observed. The following data were also specifically collected and are on file at WRI but may not be included in all reports (Appendix A):

- Species
- Number of nests/alternative nests observed
- Condition of each nest and whether or not it was active

- Nest aspect
- Nest elevation
- Nest GPS coordinates
- Nest substrate (cliff, transmission tower, etc.)
- Age class of Golden Eagles and other species if determinable
- Behavior of species observed.

It should be noted that Red-tailed Hawks (*Buteo jamaicensis*) in particular, as well as other raptors such as Prairie Falcons (*Falco mexicanus*), sometimes utilize Golden Eagle nests for their own nesting, something observed during surveys for this project.

Constraints

In that these were diurnal surveys focused on Golden Eagles, we were less likely to observe nocturnal and crepuscular raptors (i.e., owls). Aerial surveys also tend to under-represent the smaller species, like the American kestrel (*Falco sparverius*) and burrowing owl (*Athene cunicularia*).

The release of the Interim Golden Eagle Technical Guidance in February 2010 and subsequent contracts being finalized in March 2010 resulted in survey flights being scheduled late in the Golden Eagle breeding season. Initiating surveys this late in the season may have resulted in missed observations of adult eagles on territory earlier in the year (December 2009 - February 2010) that attempted to nest but failed or that did not attempt to produce young.

RESULTS

Golden Eagles

We observed a total of 42 Golden Eagle nests in the 19 Golden Eagle territories surveyed. The nests were in various conditions and some may not have been used for many years. It is important to note that many of the nests are alternative nest sites for the same territory. We documented 9 of these territories to be active, 2 to be possibly active, and 8 inactive this year; all 8 of these inactive territories are known to have been active within the last 2-3 years (Figure 5) based on Wildlife Research Institute's Golden Eagle banding activities. Five of the active Golden Eagle territories (Barrett/Echo Mountain, Canebrake, Iron Mountain, Lake Moreno/ Moreno Butte, and San Vicente) were found with incubating females. We returned in May 2010 to conduct Phase 2 of the survey and to document if the incubating pairs were successful and also to document if any of the other active territories successfully produced young from nests not initially found.

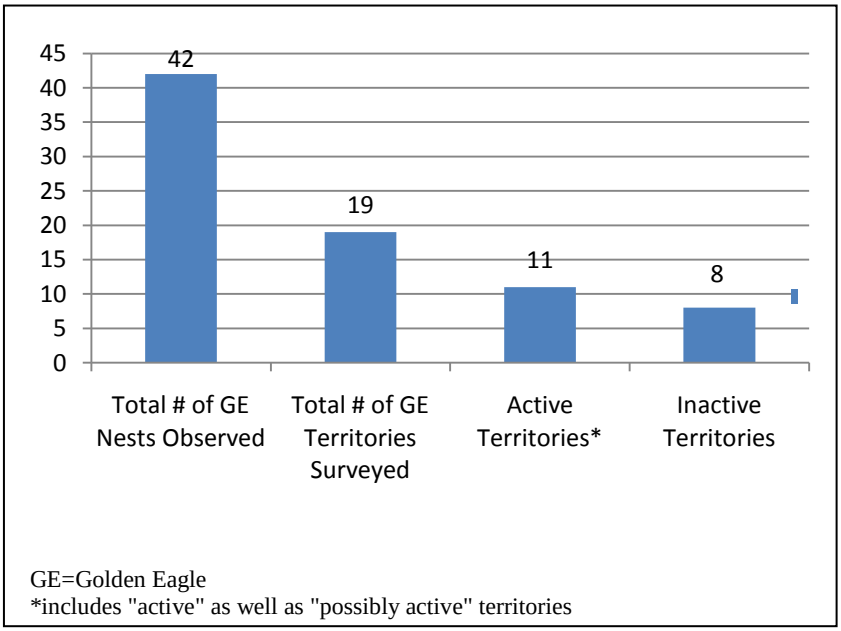


Figure 5. Phase 1 2010 Golden Eagle Territory Data for the Sunrise Powerlink Project.

Based on the USFWS Interim Golden Eagle Guidelines (Pagel et al. 2010), all wildlife observations are documented below in Table 1.

Species	Barrett/Echo Mtn	Canebrake	Carrizo Gorge	Coyote Mtns - East	Coyote Mtns - West	El Cajon	Fosters	Hauser Cyn	Iron Mtn	Lyons Pk	Moreno Butte/ Lake Moreno	Mountain Springs	Rock Mtn	San Vicente	Table Mtn	Thing Valley	Viejas Mtn	Totals
Antelope Ground Squirrel												8						8
American Kestrel				1														1
Bighorn Sheep			1	5														6
Common Raven					2							10						12
Golden Eagle	4	3				2			3	2	4	1	1	3				24
Great Horned Owl							4								3			7
Jackrabbit												2						2
Prairie Falcon				2								1						3
Red-tailed Hawk				2	2			1				7				1	1	14
Turkey Vulture				3								15						18
Totals	4	3	1	13	4	2	4	1	3	2	4	44	1	3	3	2	1	95

Table 1. Phase 1 – All Wildlife Observed During Phase 1 Surveys.

On the following two pages, Table 2 lists the waypoint identification number for each Golden Eagle nest identified, the status of Golden Eagle nest activity (i.e., whether or not it was active and whether an incubating female was observed), the territory name (incorporating the state, county, and U.S. Geological Survey [USGS] Quad; the USFWS recommended naming convention), and the geographical territory name where the nest was located. Active, and possibly active, territories are highlighted in yellow.

Territory	Trip ID	Waypoint	Species	Nest Type	# of Individuals	Active Nest	USGS Quad Name	Golden Eagle Territory
1	E	56	GE	SN	-0	N	CA-IMP-32116/g1-001-01	Coyote Mtns - East
1	E	59	GE	SN	-0	N	CA-IMP-32166/g1-001-02	Coyote Mtns - East
2	E	**22**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-001-01	Carrizo Gorge
2	E	**22**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-001-02	Carrizo Gorge
2	E	**23**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-001-03	Carrizo Gorge
2	E	**23**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-001-04	Carrizo Gorge
3	E	**24**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-002-01	Table Mtn
3	E	**25**	**GE**	**SN**	**-0**	P	CA-SD-32116/f2-002-02	Table Mtn
3	E	**26**	**GE**	**SN**	**-0**	P	CA-SD-32116/f2-002-03	Table Mtn
3	E	27	GO	SN	-3	N	CA-SD-32116/f2-002-04	Table Mtn
3	E	**28**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-002-05	Table Mtn
3	E	**28**	**GE**	**SN**	**-0**	N	CA-SD-32116/f2-002-06	Table Mtn
4	E	**11**	**GE**	**SN**	**-1**	**Y-Inc**	CA-SD-32116/f5-001-01	Moreno Butte/ Lake Moreno
5	E	10	RT	SN	-1	N	CA-SD-32116/f5-002-01	Hauser Cyn
6	E	**8**	**GE**	**SN**	**-2**	**Y-Inc**	CA-SD-32116/f6-001-01	Barrett/Echo Mtn
7	E	**7**	**GE**	**SN**	**-0**	N	CA-SD-32116/f7-001-01	Lyons Peak
7	E	**7**	**GE**	**SN**	**-0**	Y	CA-SD-32116/f7-001-02	Lyons Peak
8	E	**42**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-01	Coyote Mtns - West
8	E	**42**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-02	Coyote Mtns - West
8	E	**46**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-03*	Coyote Mtns - West
8	E	**47**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-04*	Coyote Mtns - West
8	E	**49**	**GE**	**SN**	**-0**	P	CA-SD-32116/g1-001-05*	Coyote Mtns - West
8	E	**50**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-06*	Coyote Mtns - West
8	E	**51**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-07*	Coyote Mtns - West
8	E	**52**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-08*	Coyote Mtns - West
8	E	**53**	**GE**	**SN**	**-0**	N	CA-SD-32116/g1-001-09*	Coyote Mtns - West
9	E	**16**	**GE**	**SN**	**-0**	N	CA-SD-32116/g3-001-01	Canebrake
9	E	**17**	**GE**	**SN**	**-0**	N	CA-SD-32116/g3-001-02	Canebrake
9	E	**21**	**GE**	**SN**	**-2**	N	CA-SD-32116/g3-001-03	Canebrake
9	E	**21**	**GE**	**SN**	**-0**	**Y-Inc**	CA-SD-32116/g3-001-04	Canebrake
10	E	**15**	**GE**	**SN**	**-0**	Y	CA-SD-32116/g4-001-01	Thing Valley
11	E	**4**	**GE**	**SN**	**-0**	N	CA-SD-32116/g6-001-01	Viejas Mtn
11	E	**5**	**GE**	**SN**	**-0**	N	CA-SD-32116/g6-001-02	Viejas Mtn

(*continued on next page*)

Territory	Trip ID	Waypoint	Species	Nest Type	# of Individuals	Active Nest	USGS Quad Name	Golden Eagle Territory
12	E	**1**	**GE**	**SN**	**-0**	Y	CA-SD-32116/h7-001-01	El Cajon Mtn
12	E	**68**	**GE**	**SN**	**-0**	N	CA-SD-32116/h7-001-02	El Cajon Mtn
13	E	**2**	**GE**	**SN**	**-0**	Y	CA-SD-32116/h7-002-01	Rock Mtn
13	E	**2**	**GE**	**SN**	**-0**	Y	CA-SD-32116/h7-002-02	Rock Mtn
14	F	**3**	**GE**	**SN**	**-1**	**Y-Inc**	CA-SD-32116/h8-001-01	San Vicente
14	F	**3**	**GE**	**SN**	**-0**	N	CA-SD-32116/h8-001-02	San Vicente
15	F	**4**	**GE**	**SN**	**-1**	**Y-Inc**	CA-SD-32116/h8-002-01	Iron Mtn
15	F	**4**	**GE**	**SN**	**-0**	N	CA-SD-32116/h8-002-02	Iron Mtn
16	F	2	GO	SN	**-4**	N	CA-SD-32116/h8-003-01	Fosters
17						N/A	no nest found	Bell Bluff
18						N/A	no nest found	Boundary Peak
19						N/A	no nest found	Mountain Springs

GE=Golden Eagle, GO=Great Horned Owl, Inc=Incubating, N=No, N/A=Not Applicable, P=Possibly, RT=Red-tailed Hawk, SN=Stick Nest, Y=Yes.
*Based on the USFWS recommended naming convention, the territory name is based on the location of the first nest observed. For this territory, the first 2 nests observed are in San Diego County while the remaining 7 nests are in Imperial County.

Table 2. Phase 1 - All Golden Eagle Territories with USGS Quad Territory Names.

SURVEY MAPS BY GOLDEN EAGLE TERRITORY

All Golden Eagle Territories Surrounding the Sunrise Powerlink Project Area

Overview map of all Golden Eagle territories, with an approximate 5-mile Golden Eagle territory radius (as suggested by USFWS), surrounding the Sunrise Powerlink project area in San Diego County, California (Figure 6).

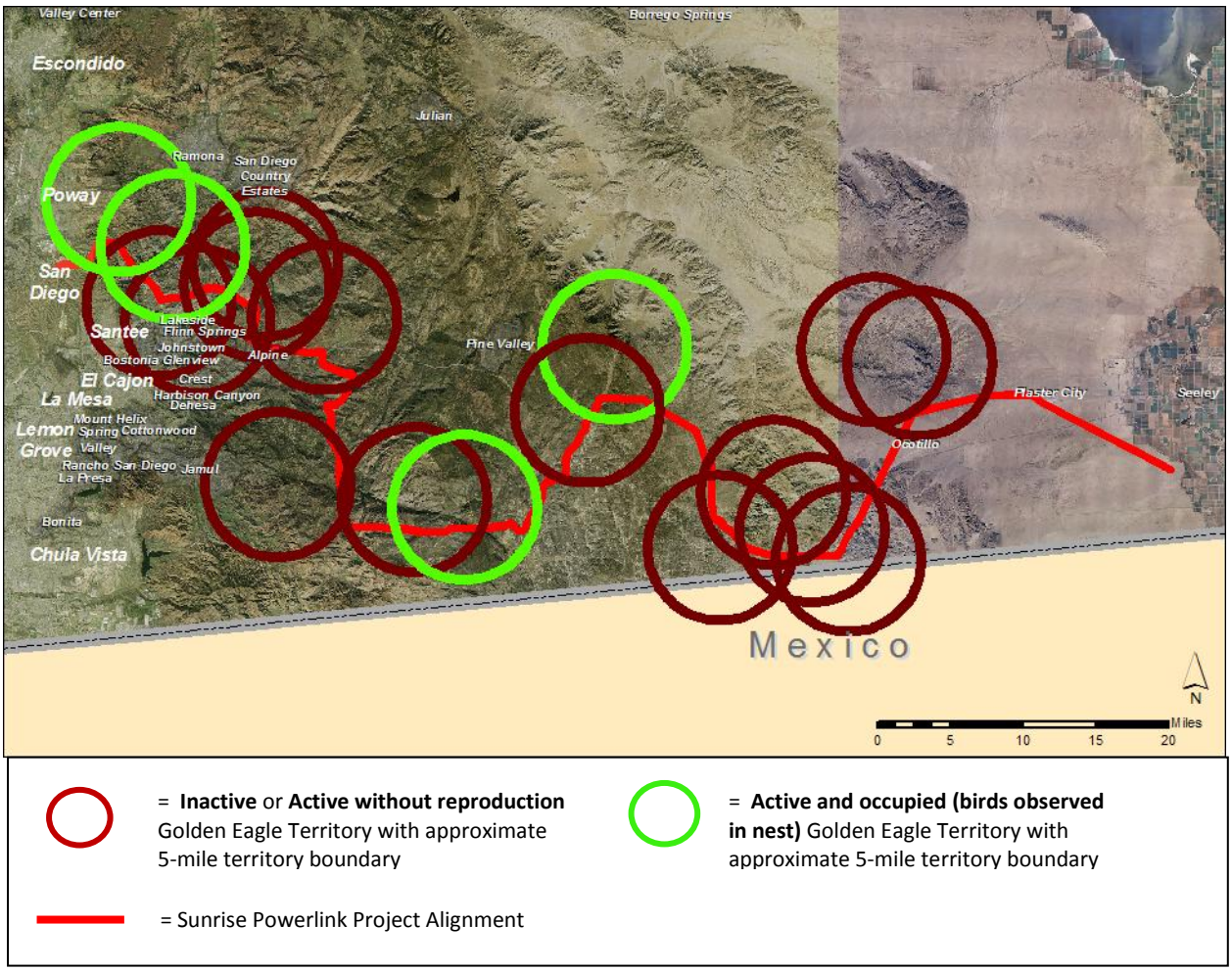


Figure 6. Overview Map of all Golden Eagle Territories Surveyed During Phase 1.

Legend for Survey Maps

Figure 7 provides a description of the waypoint labels and abbreviations noted on the following survey maps.

Map Legend	
A50GESN-1	observation ID
A =	trip ID
50 =	waypoint ID
GE =	Golden Eagle
SN =	stick nest
1 =	one bird/animal present
AG =	Antelope Ground Squirrel
AK =	American Kestrel
BS =	Bighorn Sheep
CR =	Common Raven
GE =	**Golden Eagle**
GO =	Great Horned Owl
JR =	Jackrabbit
PR =	Prairie Falcon
RT =	Red-tailed Hawk
SN =	stick nest
TV =	Turkey Vulture
U =	unidentified
Survey Paths	
=	March 30, 2010 (helicopter)
=	March 30, 2010 (helicopter)
=	April 1-3, 2010 (ground)
=	April 25, 2010 (helicopter)
=	Occupied territory with an approximate 5-mile radius
=	Inactive or active without reproduction territory with an approximate 5-mile radius

Figure 7. Survey Map Legend for Phase 1 Golden Eagle Territory Maps.

Barrett / Echo Mountain

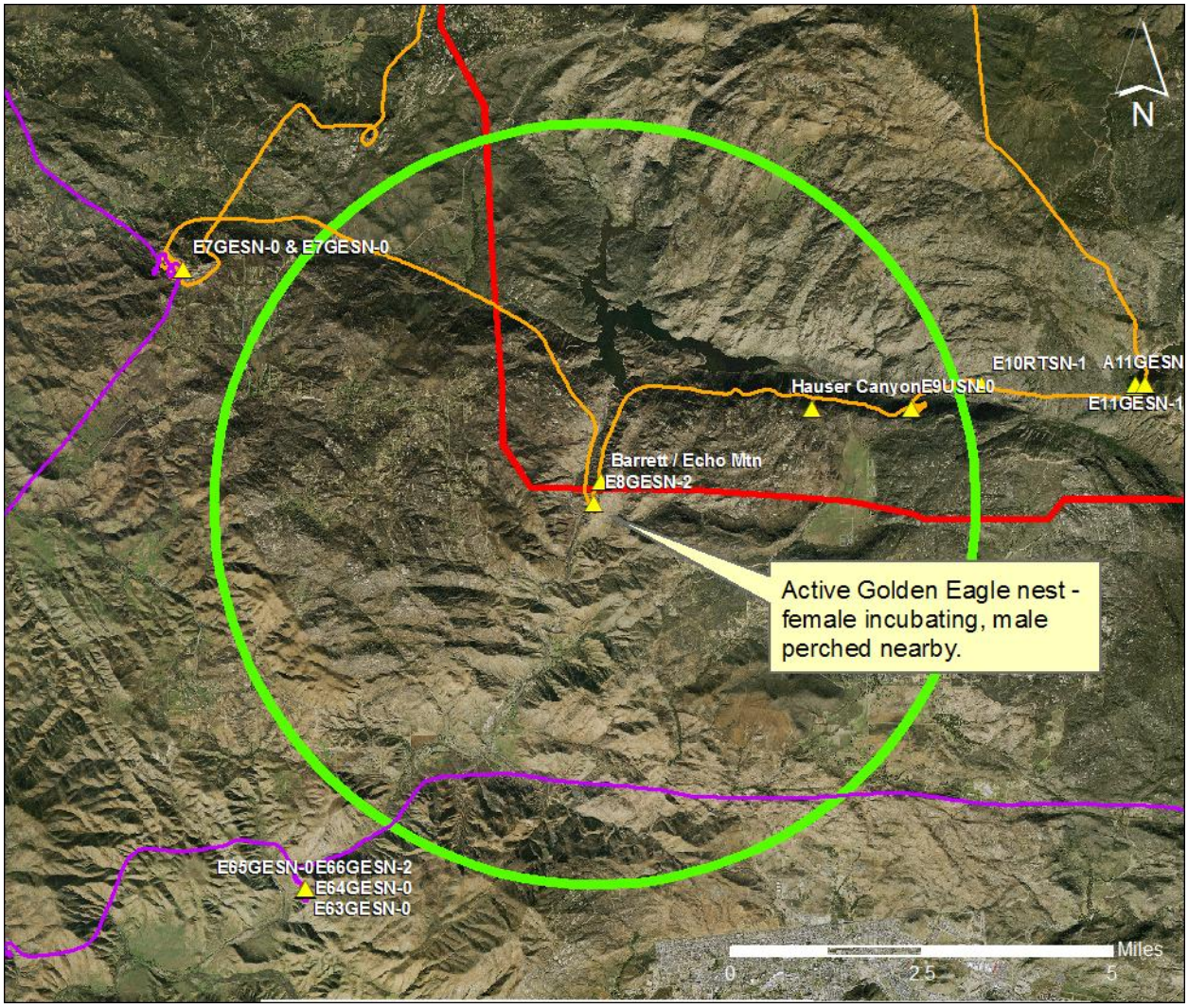


Figure 8. Barrett / Echo Mountain.

Barrett / Echo Mountain, active and occupied territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Two Golden Eagles were observed; the female was incubating and the male was perched nearby.

Barrett / Echo Mountain



An active Golden Eagle nest (E8GESN-2); good condition with incubating female. Male perched nearby.

Bell Bluff

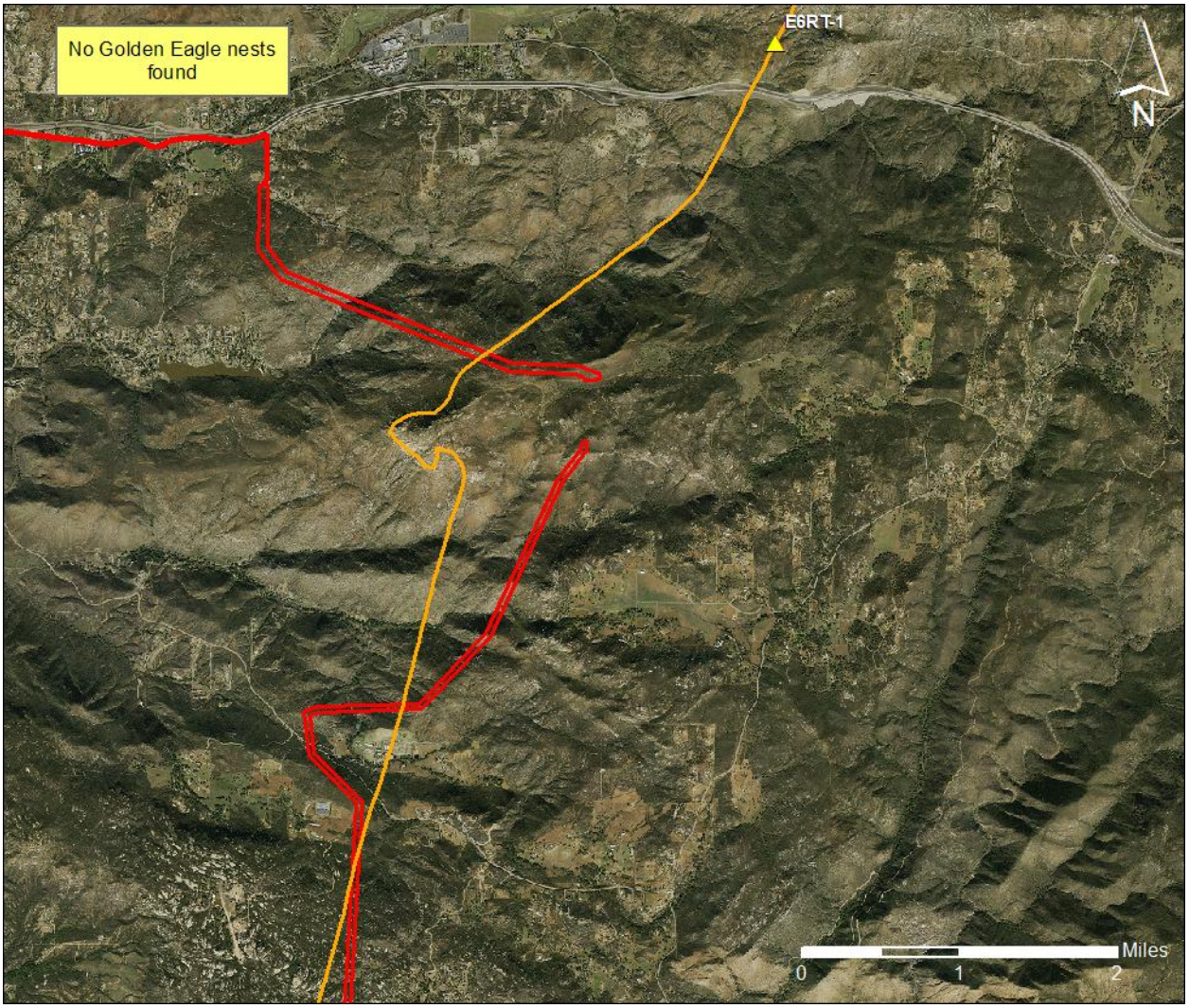


Figure 9. Bell Bluff.

Bell Bluff, inactive territory. All waypoints for species and nests observed, Project alignment, and the helicopter flight path are provided.

No Golden Eagle nests have been rediscovered in this territory since the recent (2003 and 2007) fires in San Diego County destroyed the nests previously used by the pair in this area. The eagles continue to be observed in this territory although no reproduction has been noted in the last several years.

Boundary Peak

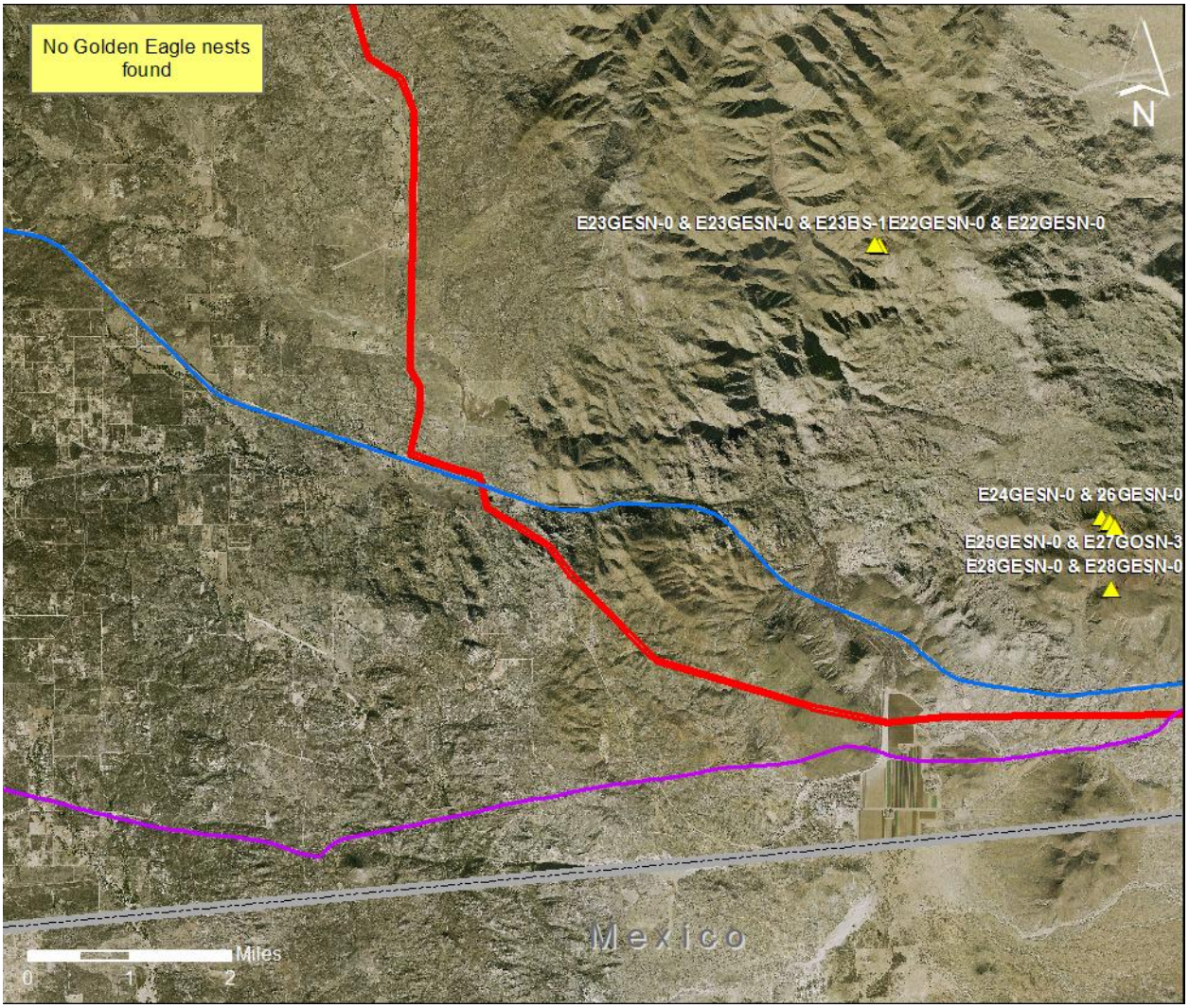


Figure 10. Boundary Peak.

Boundary Peak, inactive territory. All waypoints for species and nests observed, Project alignment, and the helicopter flight paths are provided.

This is an historically documented territory (West 1988); no Golden Eagle nests were observed during this survey.

Canebrake

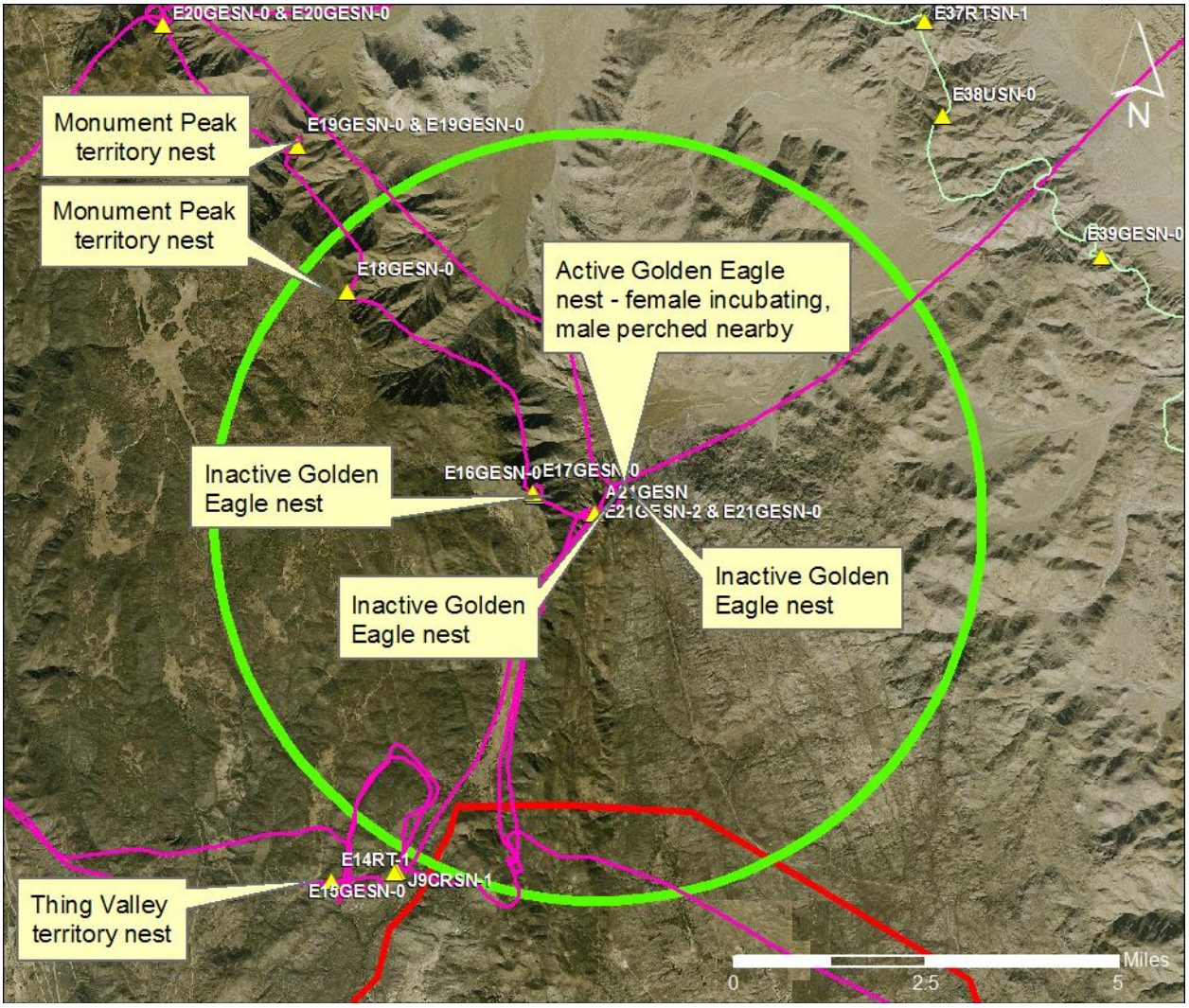


Figure 11. Canebrake.

Canebrake, active and occupied territory. All waypoints for species and nests observed, the helicopter flight path, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Two Golden Eagles were observed during this survey; the female was incubating and the male was perched nearby.

Canebrake



Active Golden Eagle nest (E21GESN-1); good condition with incubating female.



An inactive Golden Eagle nest (E16GESN-0); good condition.

Carrizo Gorge

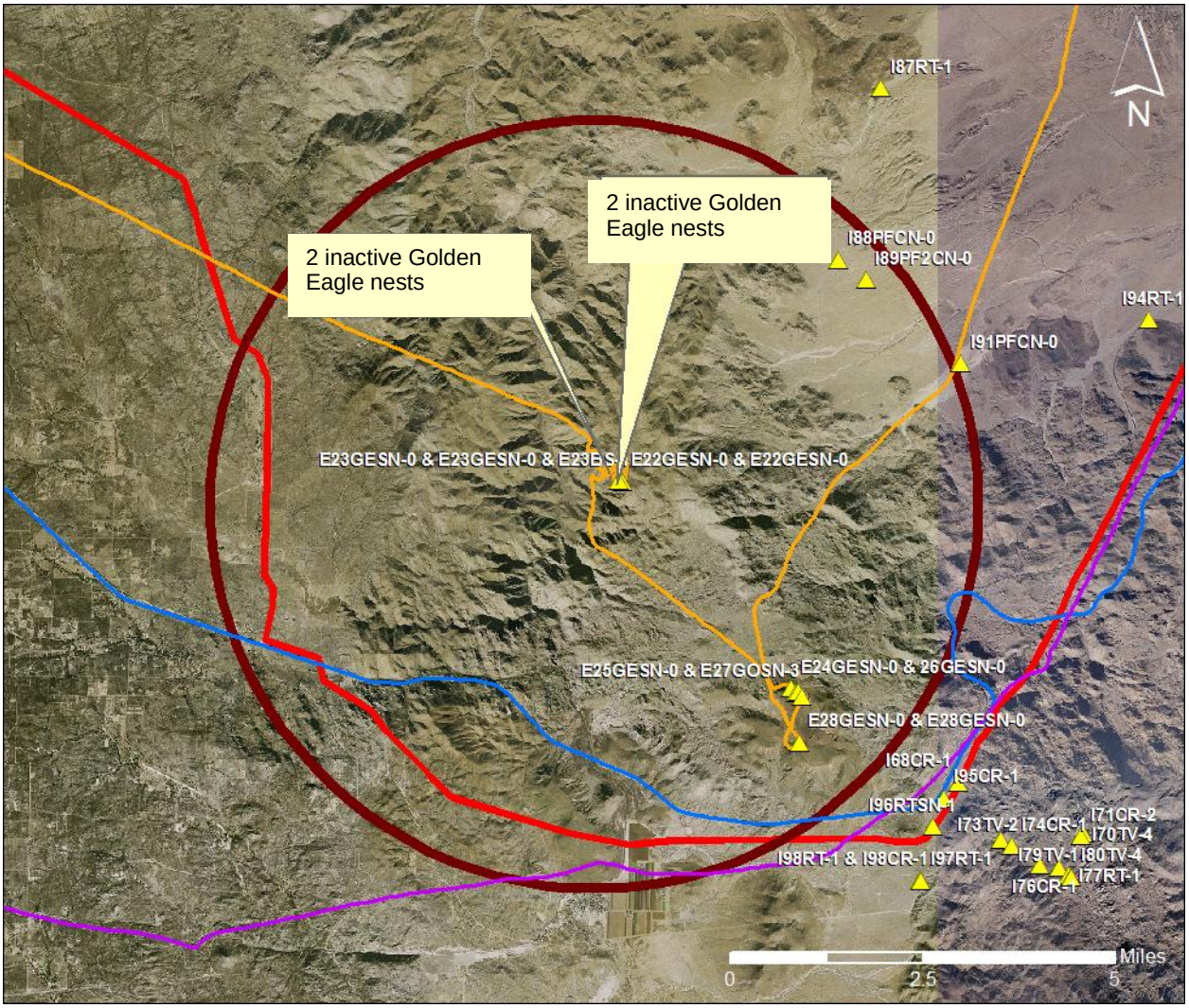


Figure 12. Carrizo Gorge.

Carrizo Gorge, inactive territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No active Golden Eagle nests were found.

Carrizo Gorge



Inactive Golden Eagle nest (E23GESN-0); fair condition. One of two nests at this waypoint.



Inactive Golden Eagle nest (E23GESN-0); poor condition, second of two nests at this waypoint.

Coyote Mountains - East

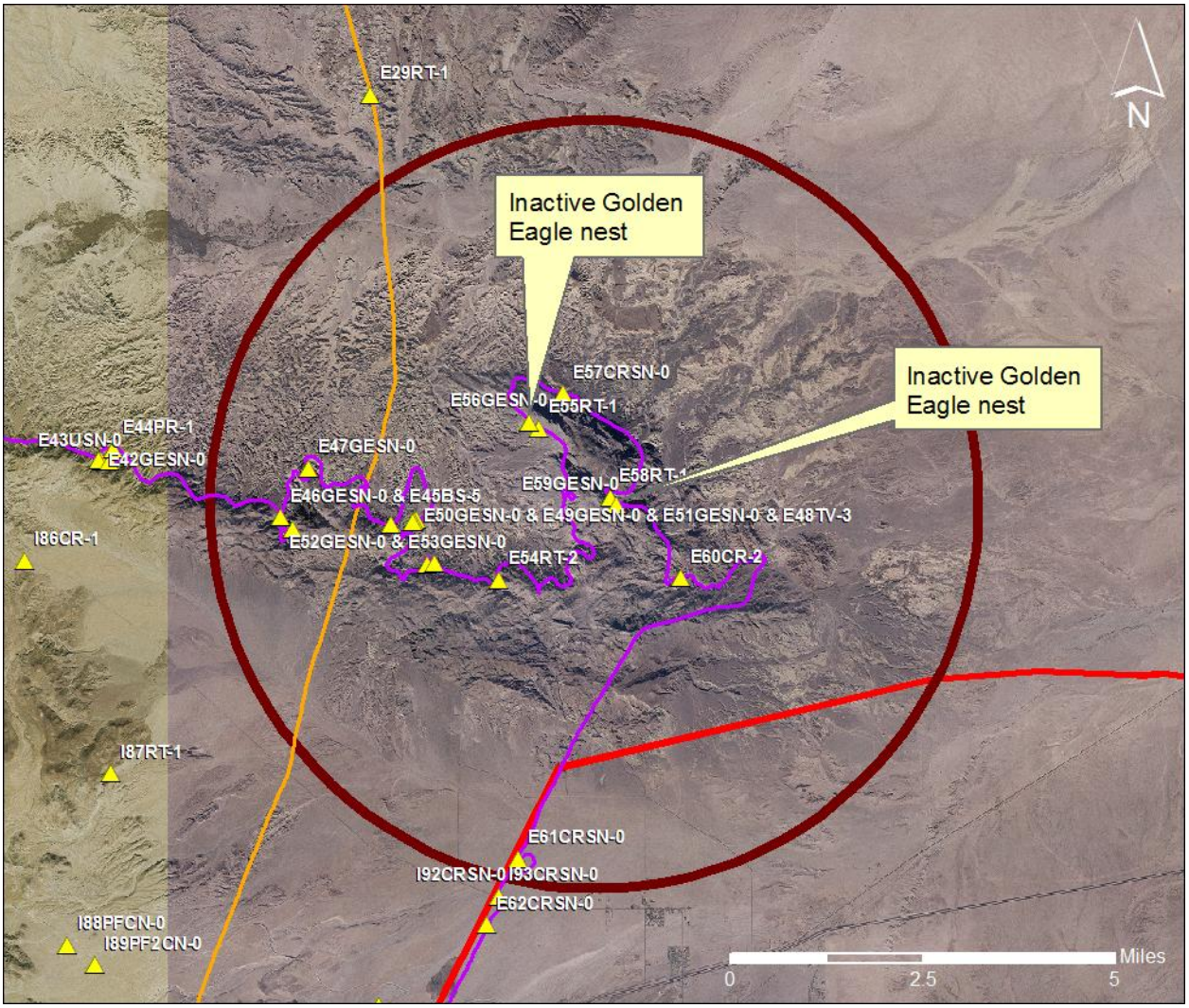


Figure 13. Coyote Mountains - East.

Coyote Mountains - East, inactive territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No active Golden Eagle nests observed.

Coyote Mountains - East



Inactive Golden Eagle nest (E59-GESN-0); poor condition, old nest, possibly the early construction of a nest that was eventually abandoned.

Coyote Mountains - West

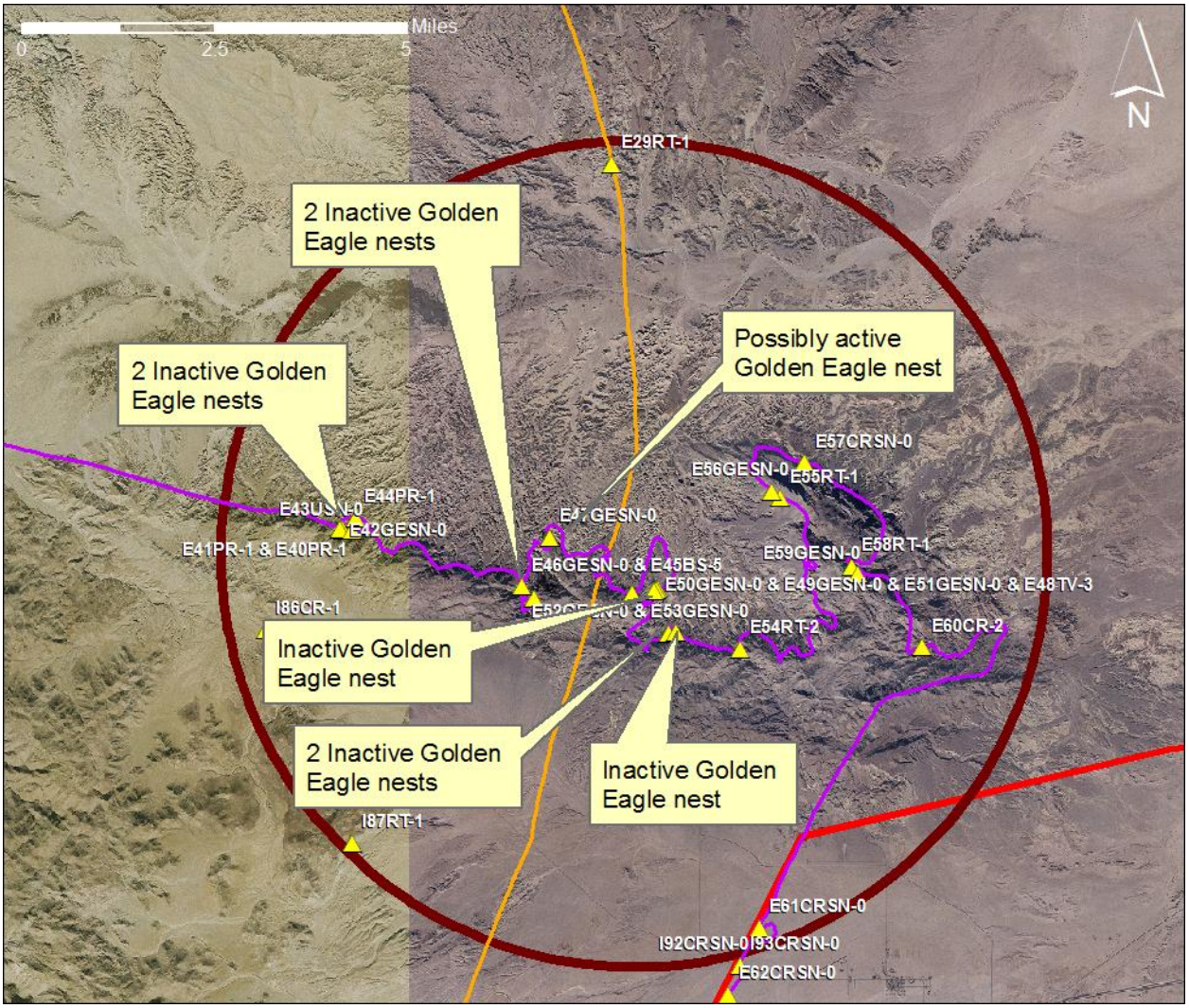


Figure 14. Coyote Mountains - West.

Coyote Mountains - West, inactive territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No active Golden Eagle nests observed.

Coyote Mountains - West



Inactive Golden Eagle nest (E42-GESN-0); fair condition, probably used in the last 2 to 3 years based on accumulation of white wash on rock wall. One of two nests at this location.

El Cajon Mountain

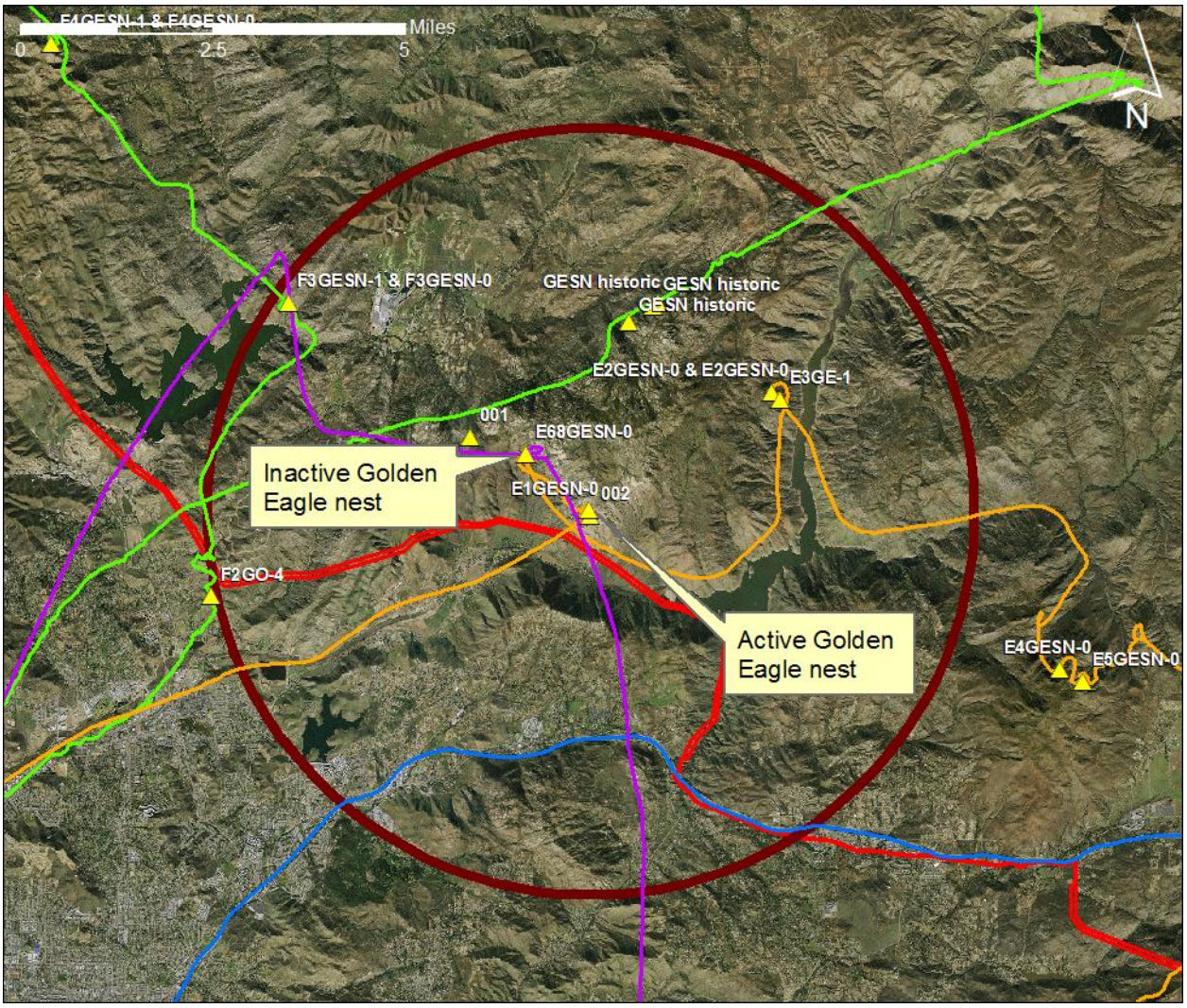


Figure 15. El Cajon Mountain.

El Cajon Mountain, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Two adult Golden Eagles observed during WRI annual ground surveys of the territory during January and February, 2010.

El Cajon Mountain



An active Golden Eagle nest (E1-GESN-0); good condition, with new material recently added in the center of the nest.

Fosters

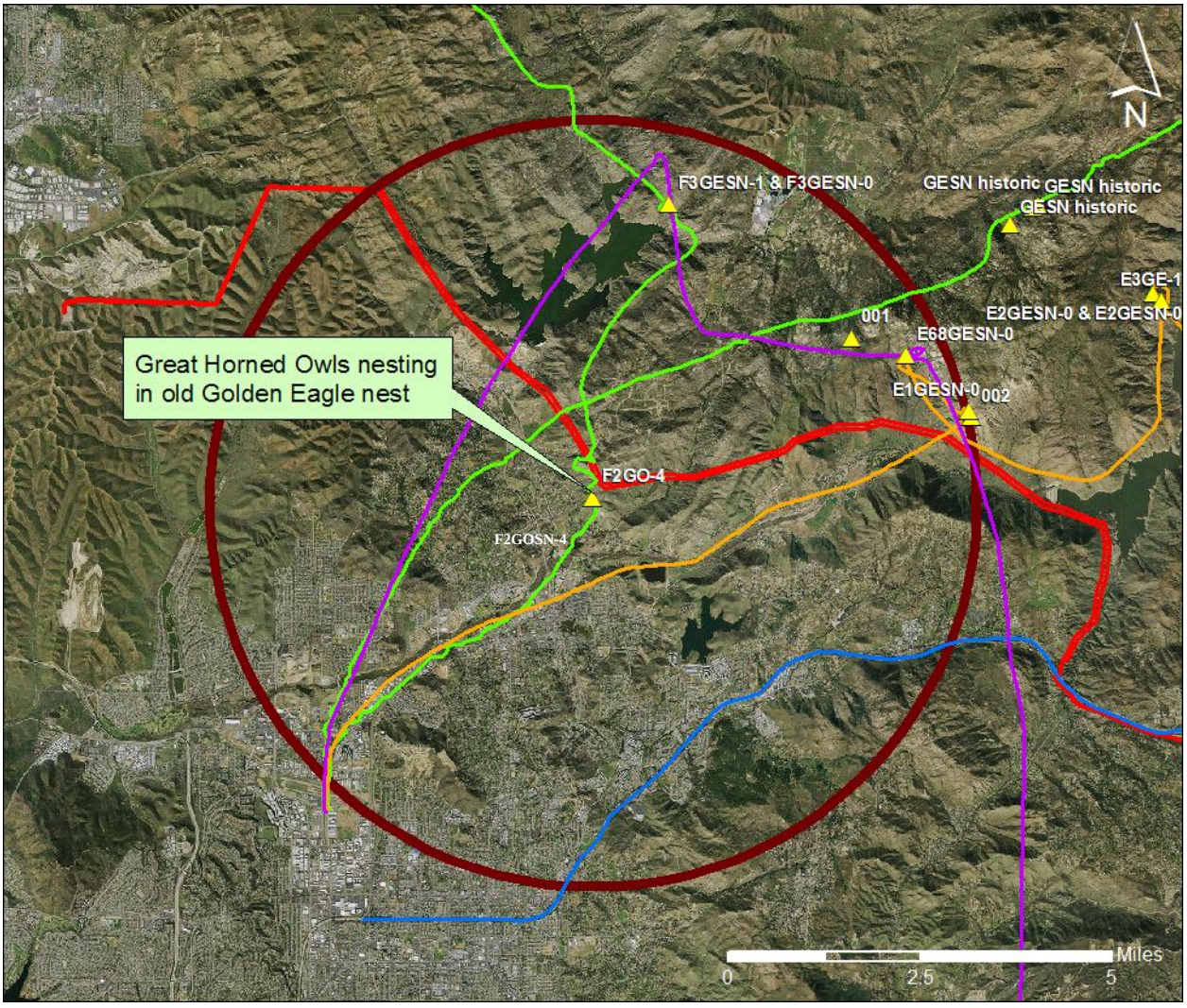


Figure 16. Fosters.

Fosters, inactive territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Old Golden Eagle nest currently being used by Great Horned Owls in 2010.

Fosters



Great Horned Owls (female with nestlings) occupying an old Golden Eagle nest (F2GOSN-4).

Hauser Canyon

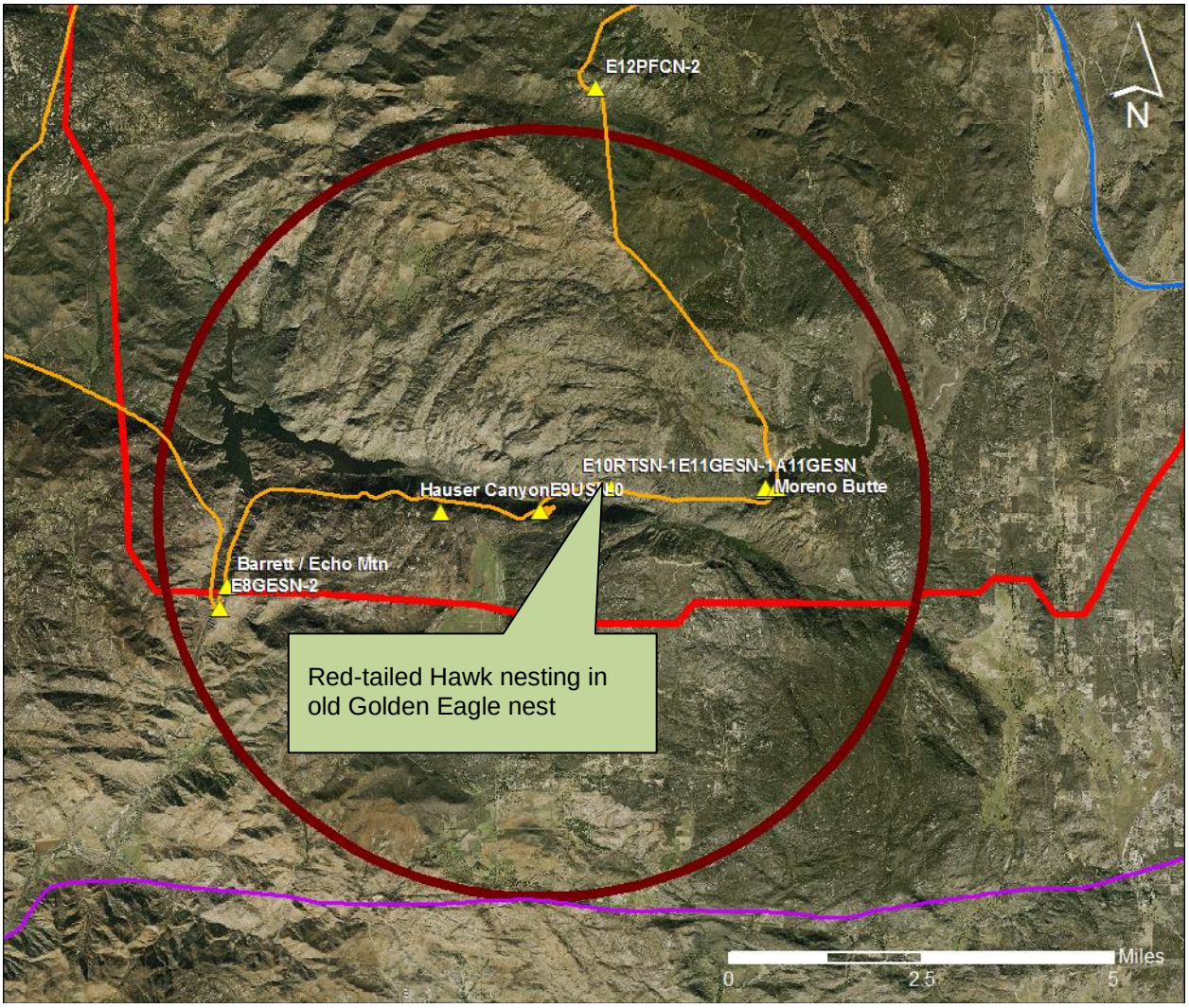


Figure 17. Hauser Canyon.

Hauser Canyon, inactive territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Old Golden Eagle nest currently being used by a Red-tailed Hawk.

Iron Mountain

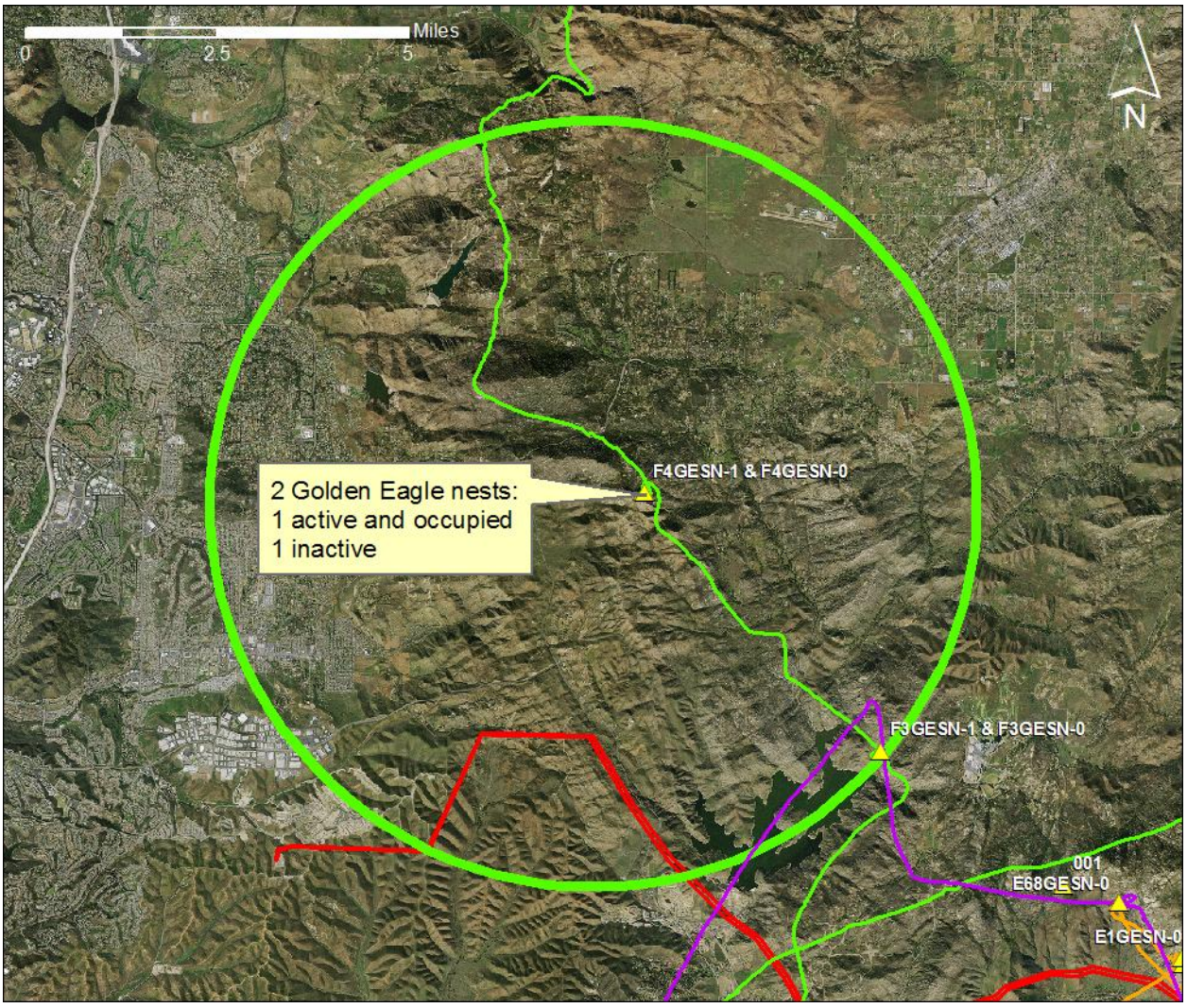


Figure 18. Iron Mountain.

Iron Mountain, active and occupied territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Incubating Golden Eagle female observed during WRI annual ground surveys of the territory during January and February, 2010.

Iron Mountain



View of Iron Mountain cliff side (Sole Peak); nest was observed during WRI ground surveys January through February. Two adults were observed building the nest and, later, the incubating female was seen.

Lake Moreno / Moreno Butte

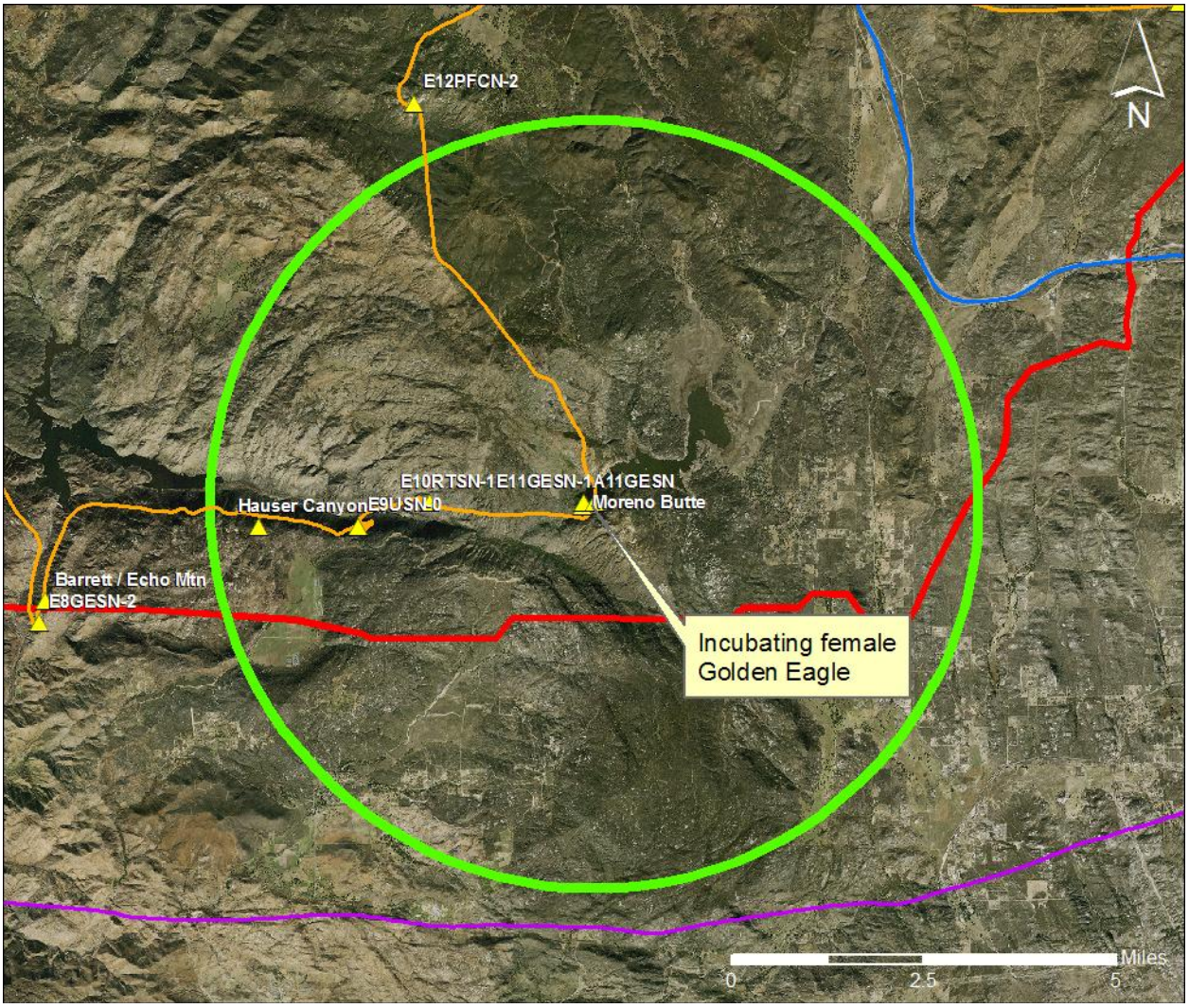


Figure 19. Lake Moreno / Moreno Butte.

Lake Moreno / Moreno Butte, active and occupied territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Incubating Golden Eagle female observed during this survey.

Lake Moreno / Moreno Butte



An active Golden Eagle nest (E11GESN-1); good condition with incubating female observed.

Lyons Peak

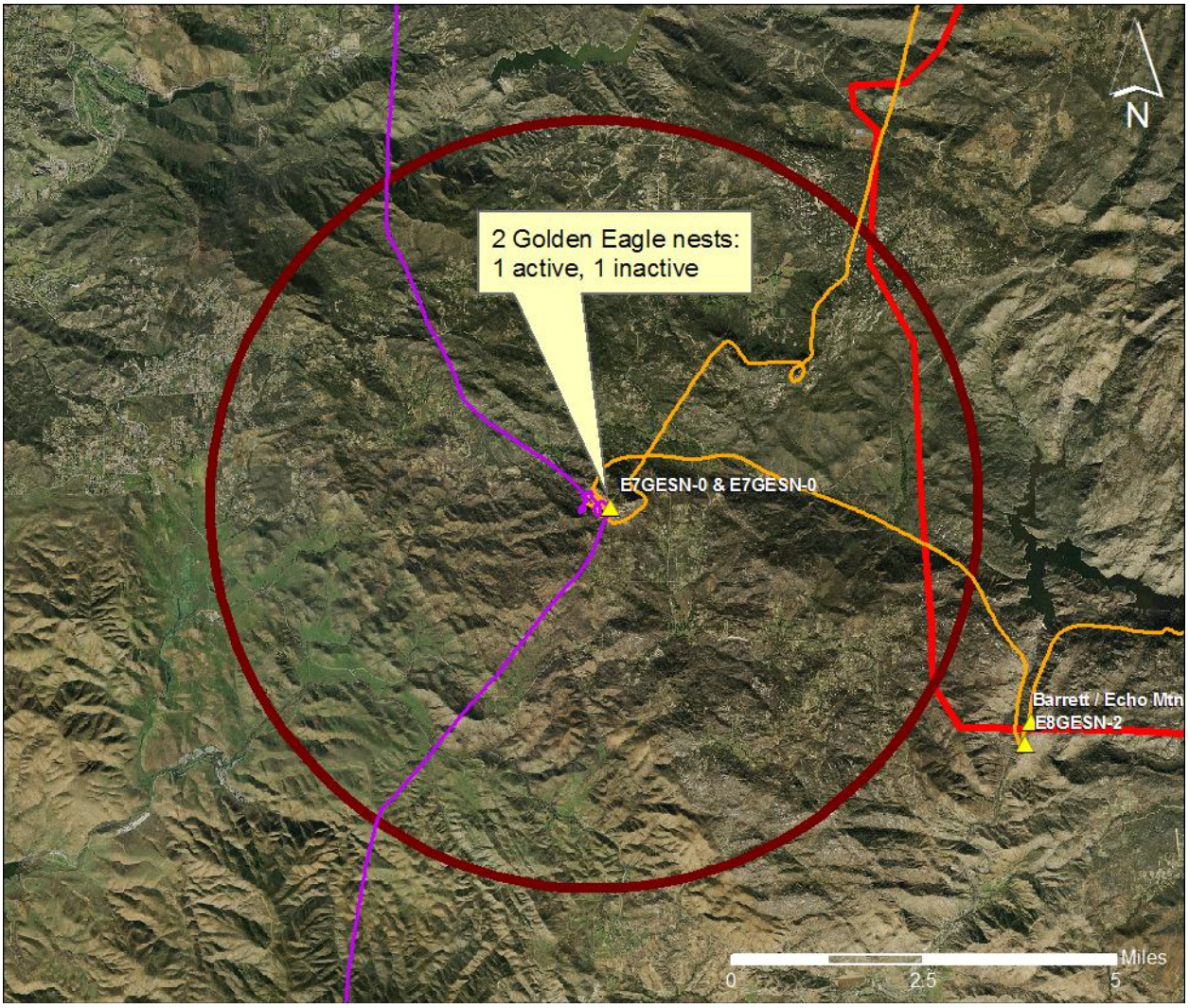


Figure 20. Lyons Peak.

Lyons Peak, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Two adult Golden Eagles observed during WRI's annual ground surveys of the territory during January and February, 2010.

Mountain Springs

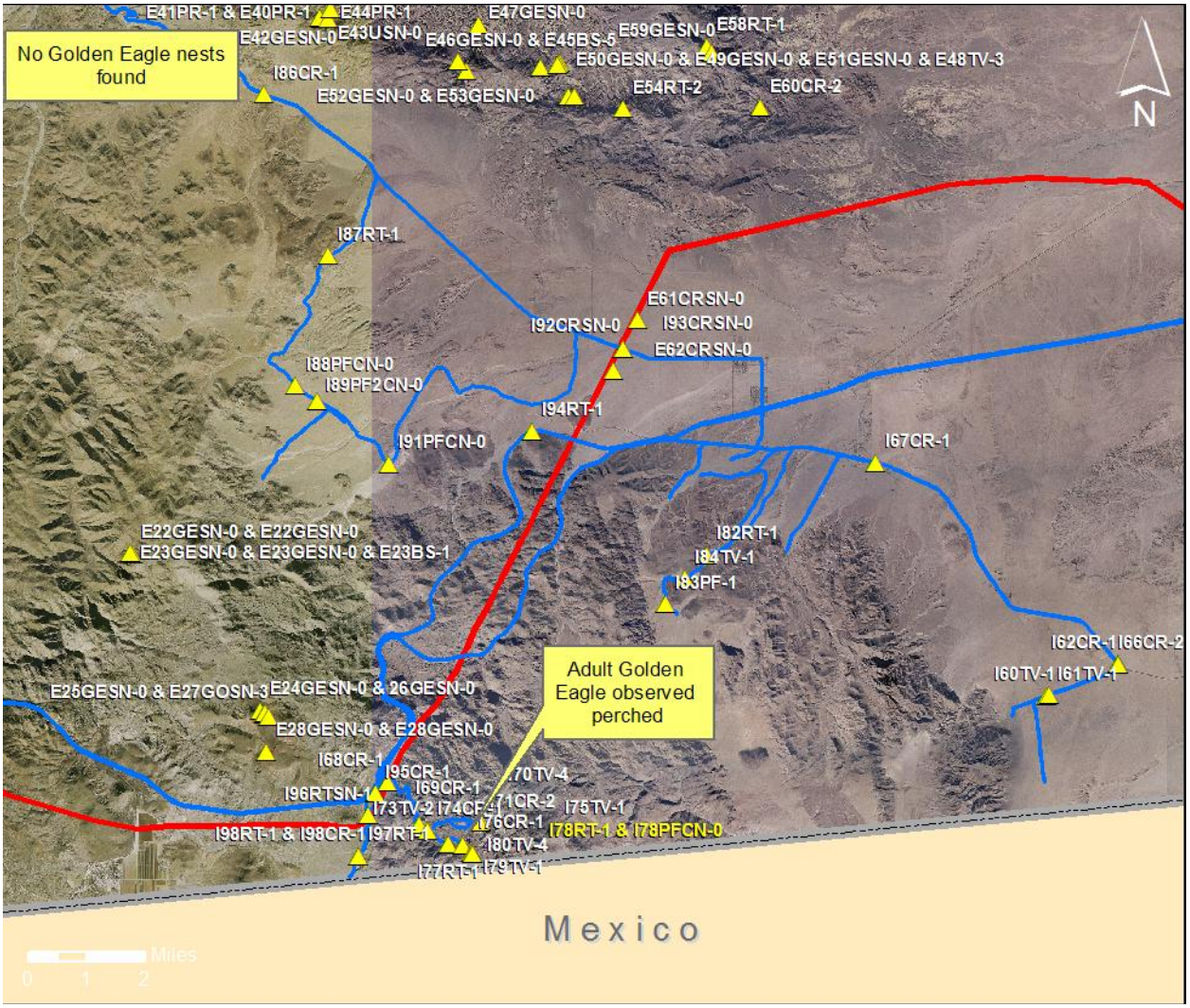


Figure 21. Mountain Springs.

Mountain Springs, inactive territory. All waypoints for species and nests observed, Project alignment, and the ground survey path are provided.

This is an historically documented territory (West 1988); no Golden Eagle nests were observed during this ground survey, however one adult Golden Eagle was seen perched in the In-Ko-Pah Mountains close to the Mexican border.

Rock Mountain

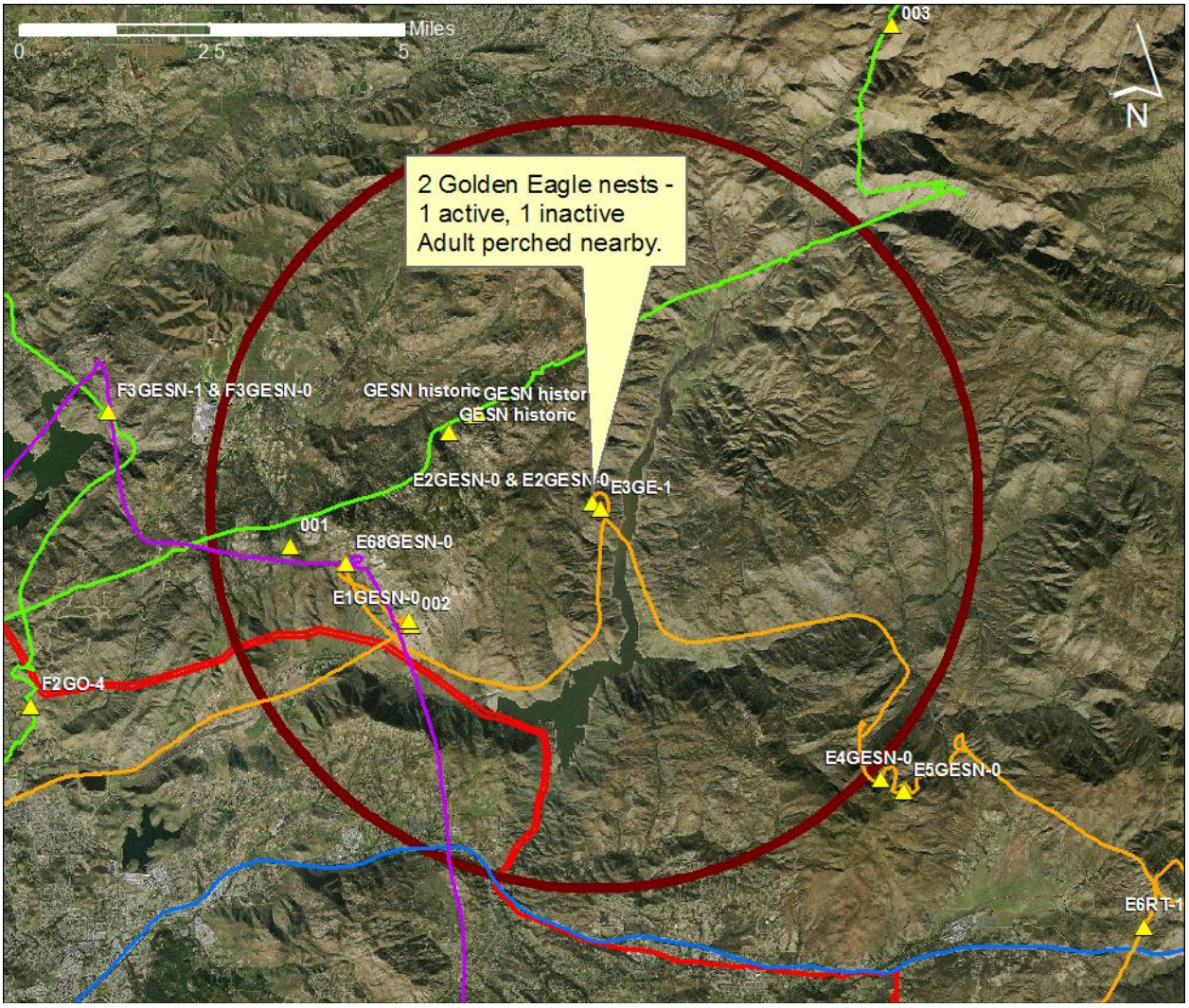


Figure 22. Rock Mountain.

Rock Mountain, active territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

One adult Golden Eagle was seen perched near the nest site.

Rock Mountain



A Golden Eagle (E3GE-1) perched near nest E2GESN-0, shown in the following photo.



An active Golden Eagle nest (E2GESN-0); good condition with new material added recently. One of two nests found at this location.

Rock Mountain



An inactive Golden Eagle nest (E2GESN-0); poor condition. The second of two nests found at this location.

San Vicente

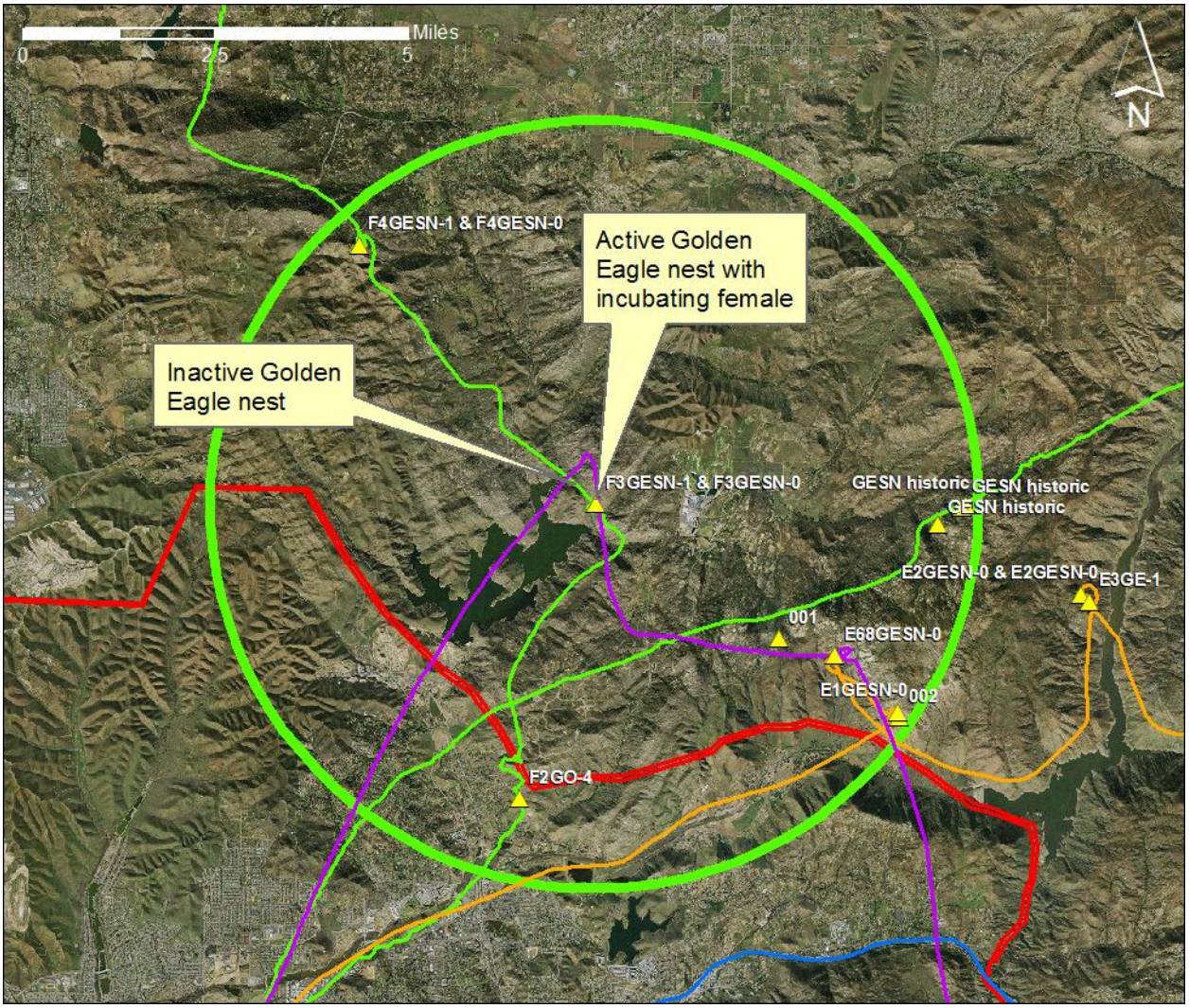
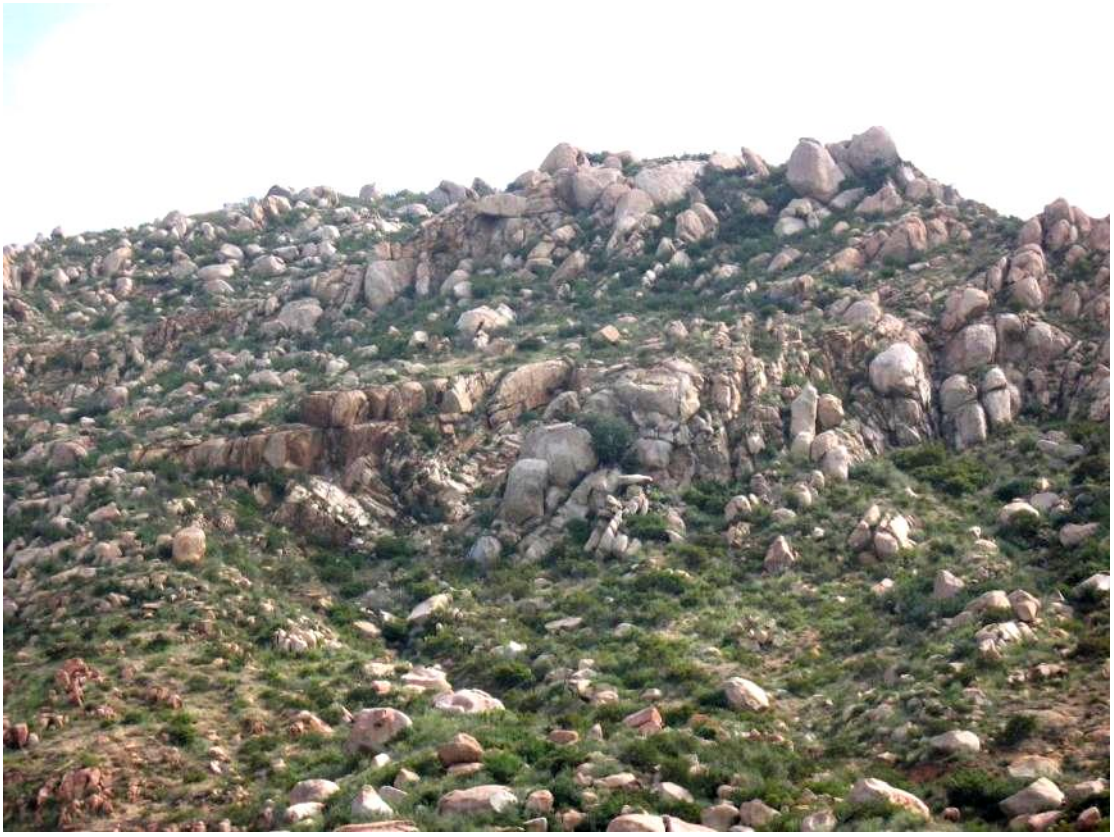


Figure 23. San Vicente.

San Vicente, active and occupied territory (incubating female observed). All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Incubating Golden Eagle female observed during WRI annual ground surveys of the territory during January and February, 2010.

San Vicente



View of San Vicente cliff containing active nest observed during 2010 surveys.

Table Mountain

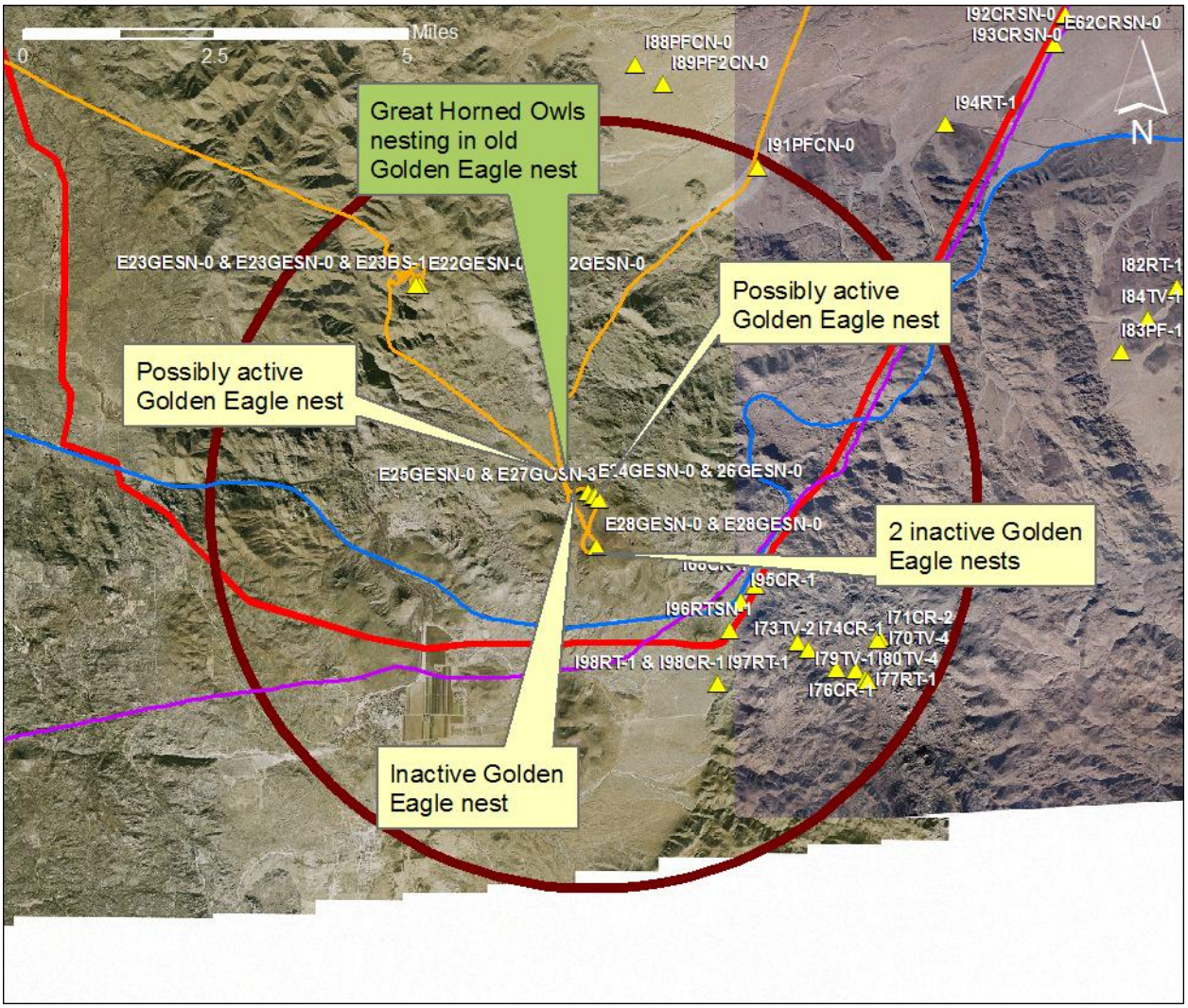


Figure 24. Table Mountain.

Table Mountain, possibly active territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Great Horned Owl occupying one of the Golden Eagle nests in this territory during the 2010 breeding season.

Table Mountain



An old Golden Eagle nest (E27GOSN-2) occupied by Great Horned Owls; white downy nestlings can be seen in the middle of the nest.

Thing Valley

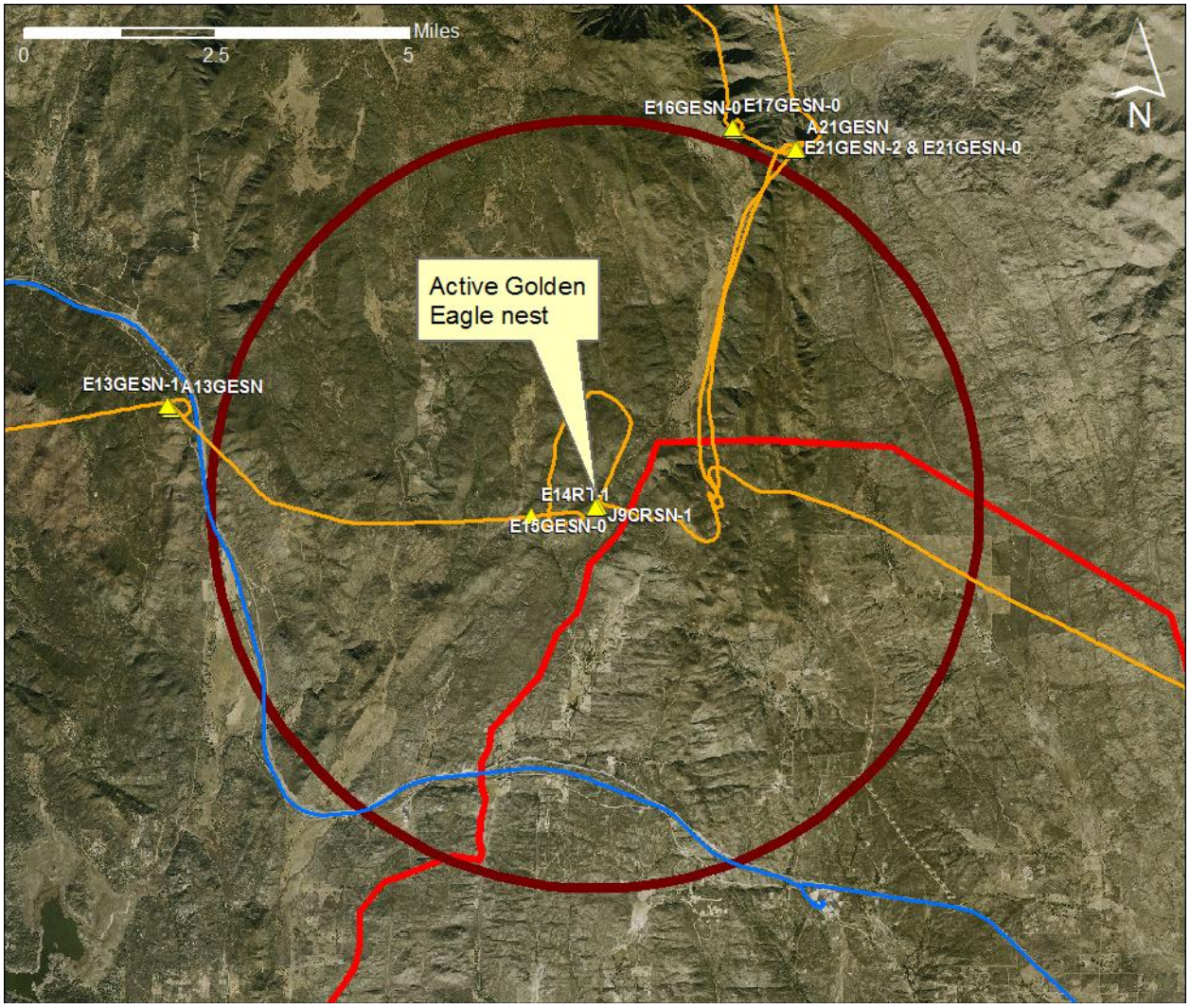


Figure 25. Thing Valley.

Thing Valley, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Active Golden Eagle nest observed but without an incubating adult (unoccupied).

Viejas Mountain

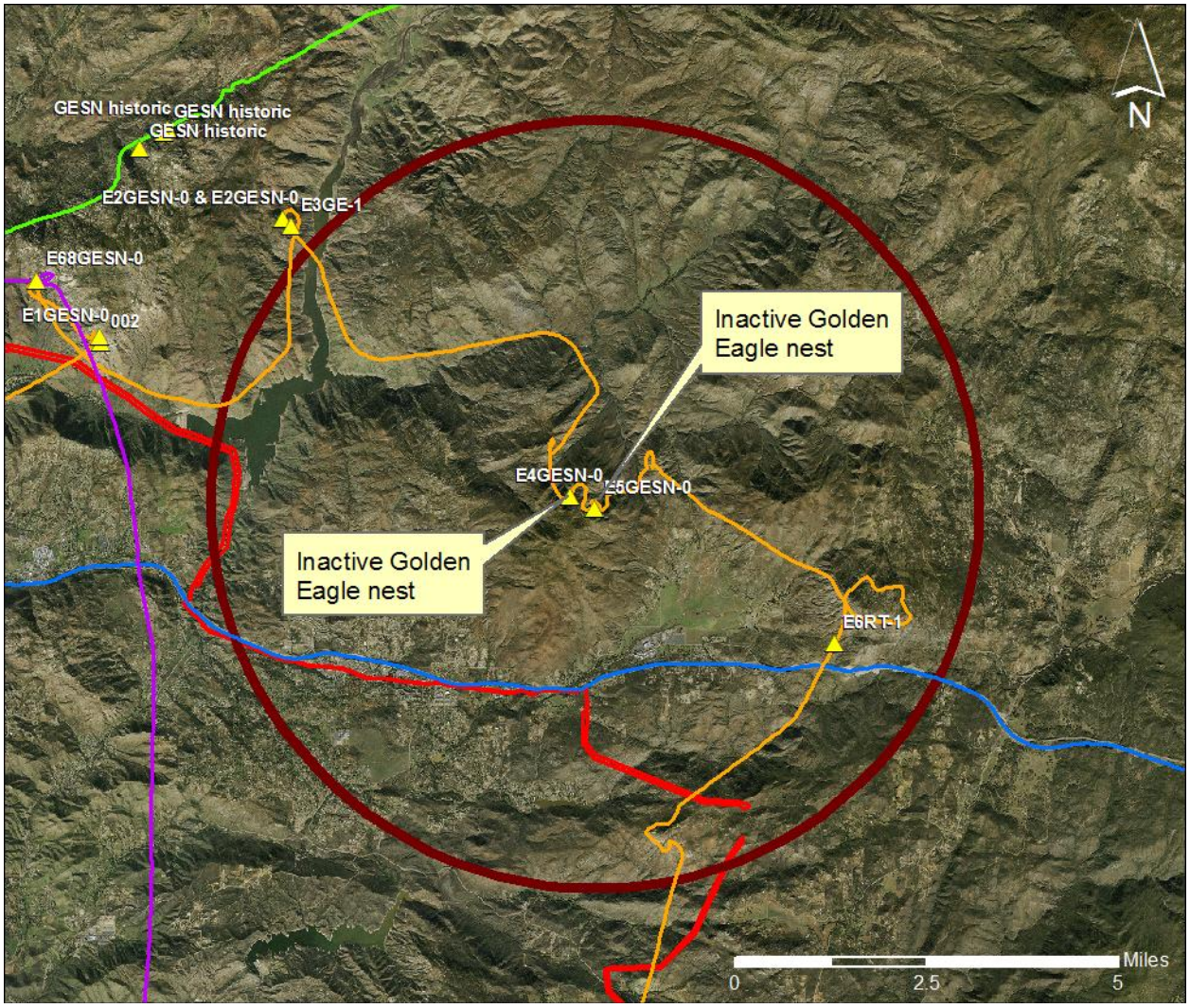


Figure 26. Viejas Mountain.

Viejas Mountain, inactive territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No active Golden Eagle nests observed.

Viejas Mountain



An inactive Golden Eagle nest (E4GESN-0); poor condition, an old nest.



An inactive Golden Eagle nest (E5GESN-0); poor condition.

DISCUSSION OF FINDINGS

While evaluating the data from this 2010 Phase 1 survey, it is important to take the recent drought and its effects on Golden Eagle reproduction into account. The California Department of Water Resources advises that the state is entering its fourth year of serious drought as a result of below average precipitation and run-off since the fall of 2006 (State of California 2010). Without the context of knowing the effects of the drought on Golden Eagle breeding, one might come to a false conclusion about the population of Golden Eagles in the study area. Because breeding in Southern California starts in January and this study was initiated in late March when only those eagles that were successful would be incubating, no opportunity was afforded to actually get a true number of pairs of Golden Eagles that attempted to reproduce but failed. Therefore, the number of active territorial pairs of Golden Eagles in the study area could be higher than those actually identified.

Because prohibition against take and the new regulations apply not only to nest sites but also includes foraging areas, a circle with an approximate 5-mile radius (approximately 78 square miles) has been placed around the Golden Eagle core nesting areas on the survey maps to reflect estimated foraging habitat. Although we have applied the approximate 5-mile radius as "suitable foraging area" in "favorable habitat", most desert-nesting Golden Eagles actually have much larger territories. Research on Golden Eagles in prime habitat indicates territories are 20 to 25 square miles in size (McGrady et al. 2002; Bittner unpublished data) but most desert-nesting Golden Eagles have much larger territories encompassing 100 to 120 square miles due to the lack of prime foraging areas (Bittner unpublished data).

During Phase 1 surveys, we observed 42 Golden Eagle nests. These nests accounted for 19 Golden Eagle territories; 9 active, 2 possibly active, and 8 inactive. Five of the active Golden Eagle territories (Barrett/Echo Mountain, Canebrake, Iron Mountain, Lake Moreno/ Moreno Butte, and San Vicente) were found with incubating females. Every territory in the study area, except for Bell Bluff, Boundary Peak, and Mountain Springs, had nest evidence of Golden Eagle breeding attempts in recent years but not all had evidence of 2010 activity. As previously noted, this is not unusual because healthy populations of Golden Eagles may average as few as 62% of pairs breeding in any one year (Kochert et al. 2002).

Numerous raptors and mammals were also observed (i.e., Antelope Ground Squirrels, American Kestrel, Bighorn Sheep, Common Ravens, Great Horned Owls, Jackrabbits, Prairie Falcons, Red-tailed Hawks, and Turkey Vultures) totaling 95 wildlife documentations, including 24 Golden Eagles and 6 Desert Bighorn Sheep.

PHASE 2 REPORT

ABSTRACT – PHASE 2 SURVEYS

This section reports on findings of the **Phase 2** surveys conducted in San Diego County, California, to record and report productivity for Golden Eagles within 4 miles of the Sunrise Powerlink project boundary in order to comply with the U.S. Fish and Wildlife Service recommendations. The 9 active Golden Eagle territories identified during Phase 1 surveys were revisited by WRI biologists via helicopter. These active territories were also surveyed throughout late April 2010 and early May 2010 by WRI during annual research and monitoring as well as during ground and aerial surveys being conducted for other projects around the area. The 5 occupied territories (Barrett/Echo Mountain, Canebrake, Iron Mountain, Lake Moreno/Moreno Butte, and San Vicente) identified during Phase 1 surveys were confirmed active and productive during Phase 2 surveys by the observation of nestlings in each of the territories. Golden Eagle nestlings in the Barrett/Echo Mountain, Iron Mountain, Lake Moreno/Moreno Butte, and San Vicente territories were banded during WRI's monitoring and research studies. The 2 nestlings at Lake Moreno/Moreno Butte were each fitted with a satellite transmitter. All sightings have been documented with GPS locations and recorded on the attached maps and tables.

METHODS AND CONSTRAINTS

Methods

The study area encompasses part of Southeast San Diego County, an area that has been part of the WRI's 22 year-long Golden Eagle study initiated in 1988. All territories have a known history to WRI and we utilized that data to improve the accuracy of this study.

Only territories identified as active during Phase 1 surveys were surveyed again during Phase 2.

It should be noted that all surveying and reporting complies with the current U.S. Fish and Wildlife Service Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance released in 2010 (Pagel et al. 2010).

Survey

We used Hughes-500 helicopters that provided seating for three investigators including 2 Golden Eagle biologists, a Bighorn Sheep biologist, and the pilot.

This final Golden Eagle surveys were conducted by ground and helicopter on May 1,2,9, 14, and 16, 2010 (Figure 27) and incurred approximately 82 person-hours of actual aerial observations. This survey focused only on revisiting active or possibly active territories that were identified during the previous, Phase 1, survey in an effort to confirm reproductive activity. Inactive territories noted during Phase 1 were not surveyed during Phase 2.

It should also be noted that, in addition to scheduled Phase 2 surveys, WRI periodically monitored active nest sites around the Sunrise Powerlink project area during our own ongoing research of Golden Eagle territories in San Diego County, California. As part of this research, WRI banded and placed satellite transmitters on the 2 Lake Moreno/Moreno Butte eaglets (data available upon request).

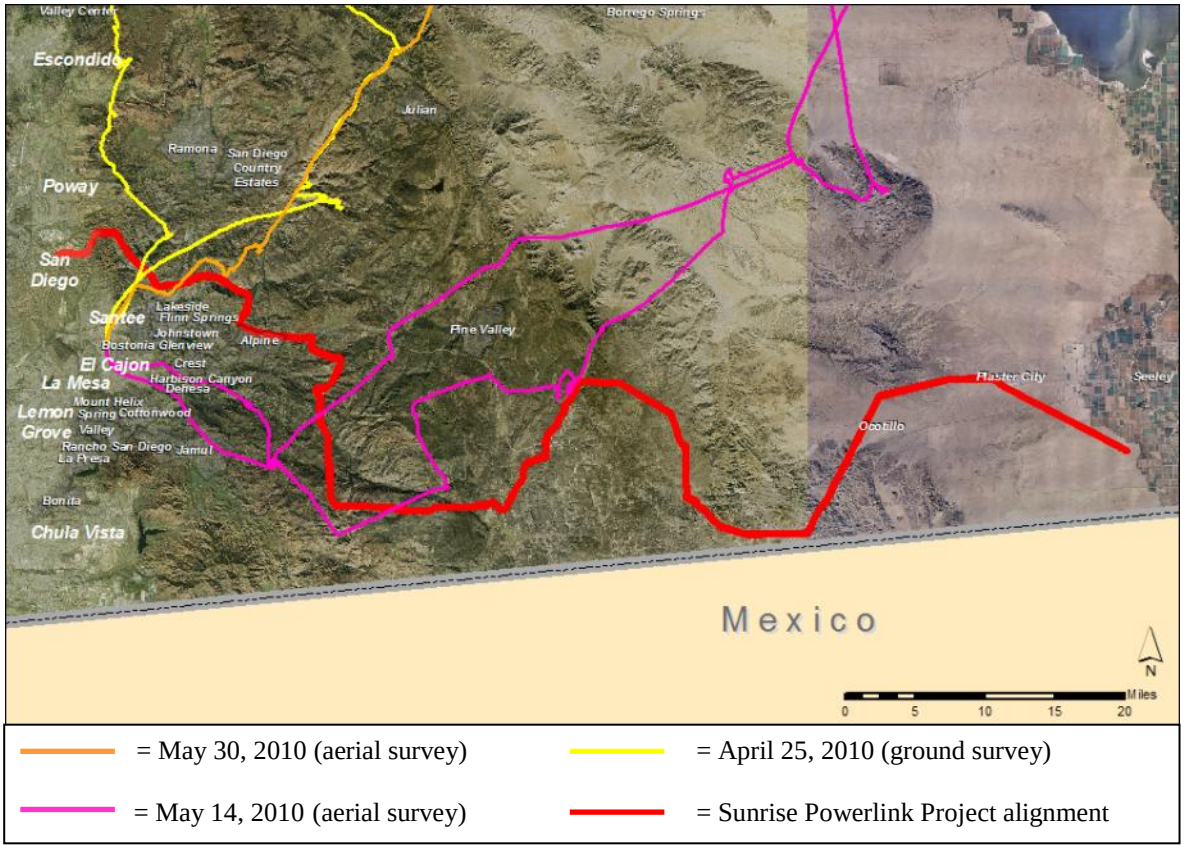


Figure 27. Phase 2 Study Area with Flight Paths and Sunrise Powerlink Project Alignment.

GPS

Nest site and other location-specific data were determined and documented during Phase 2 surveys using hand-held GPS units (Garmin Map60GSx). A sequential number was assigned to each observation that corresponded to the GPS waypoint. Waypoints were recorded using the UTM grid in the WGS 84 Datum. GPS was also used to track our survey routes (Figure 27). Handwritten notes were also taken that documented species and corresponded to each GPS waypoint.

Data

We photographed all active Golden Eagle nests, some other raptor nests, representations of numerous inactive Golden Eagle nest sites, and significant other wildlife species observed. The following data were also specifically collected and are on file at WRI but may not be included in all reports (Appendix A):

- Species
- Number of nests/alternative nests observed
- Condition of each nest and whether or not it was active
- Nest aspect
- Nest elevation

- Nest GPS coordinates
- Nest substrate (cliff, transmission tower, etc.)
- Age class of Golden Eagles and other species if determinable
- Behavior of species observed.

It should be noted that Red-tailed Hawks in particular, as well as other raptors such as Prairie Falcons, sometimes utilize Golden Eagle nests for their own nesting, something observed during some of the Phase 1 surveys for this project.

Constraints

In that this was a diurnal survey focused on Golden Eagles, we were less likely to observe nocturnal and crepuscular raptors (i.e., owls). Aerial surveys also tend to under-represent the smaller species, like the American kestrel and burrowing owl.

The release of the Interim Golden Eagle Technical Guidance in February 2010 and subsequent contracts being finalized in March 2010 resulted in survey flights being scheduled late in the Golden Eagle breeding season. Initiating surveys this late in the season may have resulted in missed observations of adult eagles on territory earlier in the year (December 2009 - February 2010) that did not attempt to produce young.

RESULTS

Golden Eagles

We surveyed a total of 9 active Golden Eagle nests during this phase of the project that represented 9 Golden Eagle territories, 5 of which were occupied and had successfully produced young (Figure 5). These nests were all in good condition.

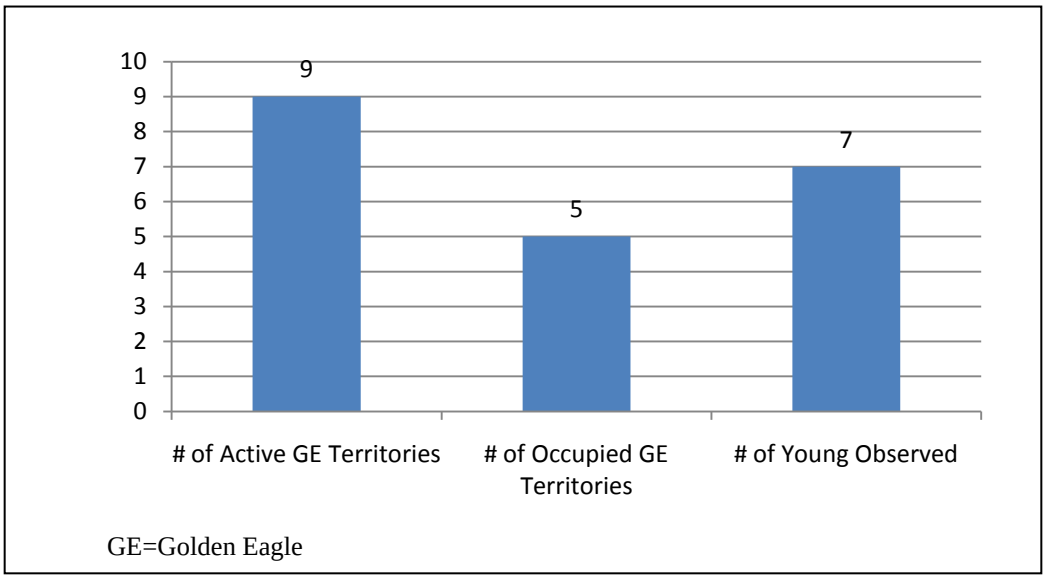


Figure 28. Phase 2 2010 Golden Eagle Territory Data for the Sunrise Powerlink Project.

Table 3 lists the waypoint identification number for each active Golden Eagle nest surveyed during Phase 2, the occupancy status of the nest (i.e., if it is occupied or not), the territory name (incorporating the U.S. Geological Survey Quad [USGS], the USFWS recommended naming convention), and the geographic territory name. Occupied territories are highlighted in yellow.

Territory	Trip ID	Waypoint	Species	Nest Type	# of Young	Occupied Nest	USGS Quad Name	Golden Eagle Territory
4	E	11	GE	SN	2	Y	CA-SD-32116/f5-001-01	Moreno Butte/ Lake Moreno
6	E	8	GE	SN	2	Y	CA-SD-32116/f6-001-01	Barrett/Echo Mtn
7	E	7	GE	SN	0	N	CA-SD-32116/f7-001-02	Lyons Peak
9	E	21	GE	SN	1	Y	CA-SD-32116/g3-001-04	Canebrake
10	E	15	GE	SN	0	N	CA-SD-32116/g4-001-01	Thing Valley
12	E	1	GE	SN	0	N	CA-SD-32116/h7-001-01	El Cajon Mtn
13	E	2	GE	SN	0	N	CA-SD-32116/h7-002-01	Rock Mtn
13	E	2	GE	SN	0	N	CA-SD-32116/h7-002-02	Rock Mtn
14	F	3	GE	SN	1	Y	CA-SD-32116/h8-001-01	San Vicente
15	F	4	GE	SN	1	Y	CA-SD-32116/h8-002-01	Iron Mtn

Table 3. Phase 2 - Active Golden Eagle Territories with USGS Quad Territory Names.

SURVEY MAPS BY GOLDEN EAGLE TERRITORY

Active Golden Eagle Territories Surrounding the Sunrise Powerlink Project Area

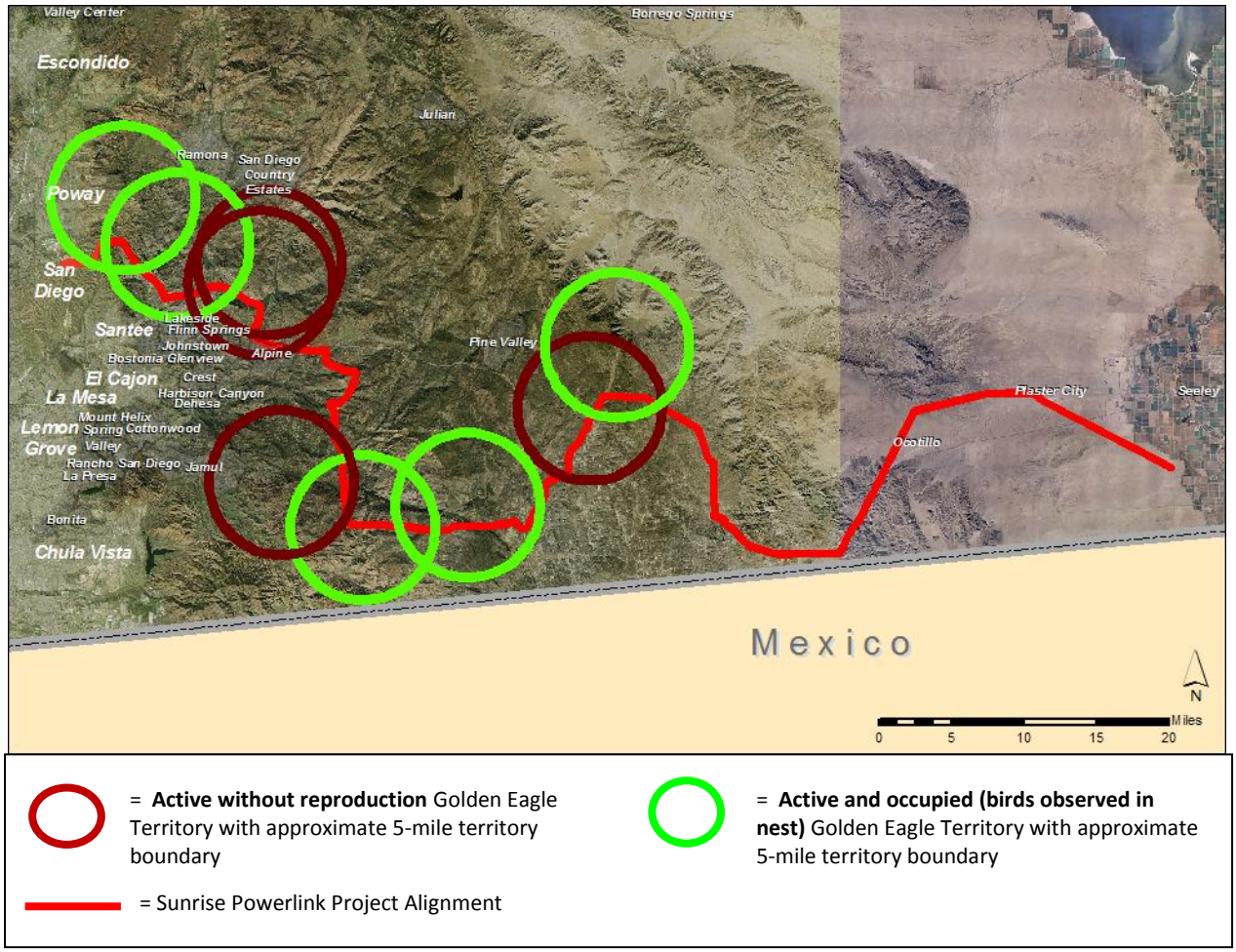


Figure 29. Overview Map of Active Golden Eagle Territories Surveyed During Phase 2.

Overview map of active Golden Eagle territories, with an approximate 5-mile Golden Eagle territory radius (as suggested by USFWS), surrounding the Sunrise Powerlink project area in San Diego County.

Legend for Survey Maps

Figure 30 provides a description of the waypoint labels and abbreviations noted on the following survey maps.

Map Legend	
A50GESN-1	observation ID
A =	trip
50 =	waypoint ID
GE =	Golden Eagle
SN =	stick nest
1 =	one bird/animal present
CR =	Common Raven
GE =	**Golden Eagle**
SN =	stick nest
Helicopter Flight Paths	
=	March 30, 2010
=	April 25, 2010
=	May 14, 2010
=	Occupied territory with An approximate 5-mile radius
=	Active without reproduction territory with An approximate 5-mile radius

Figure 30. Survey Map Legend for Phase 2 Golden Eagle Territory Maps.

Barrett / Echo Mountain

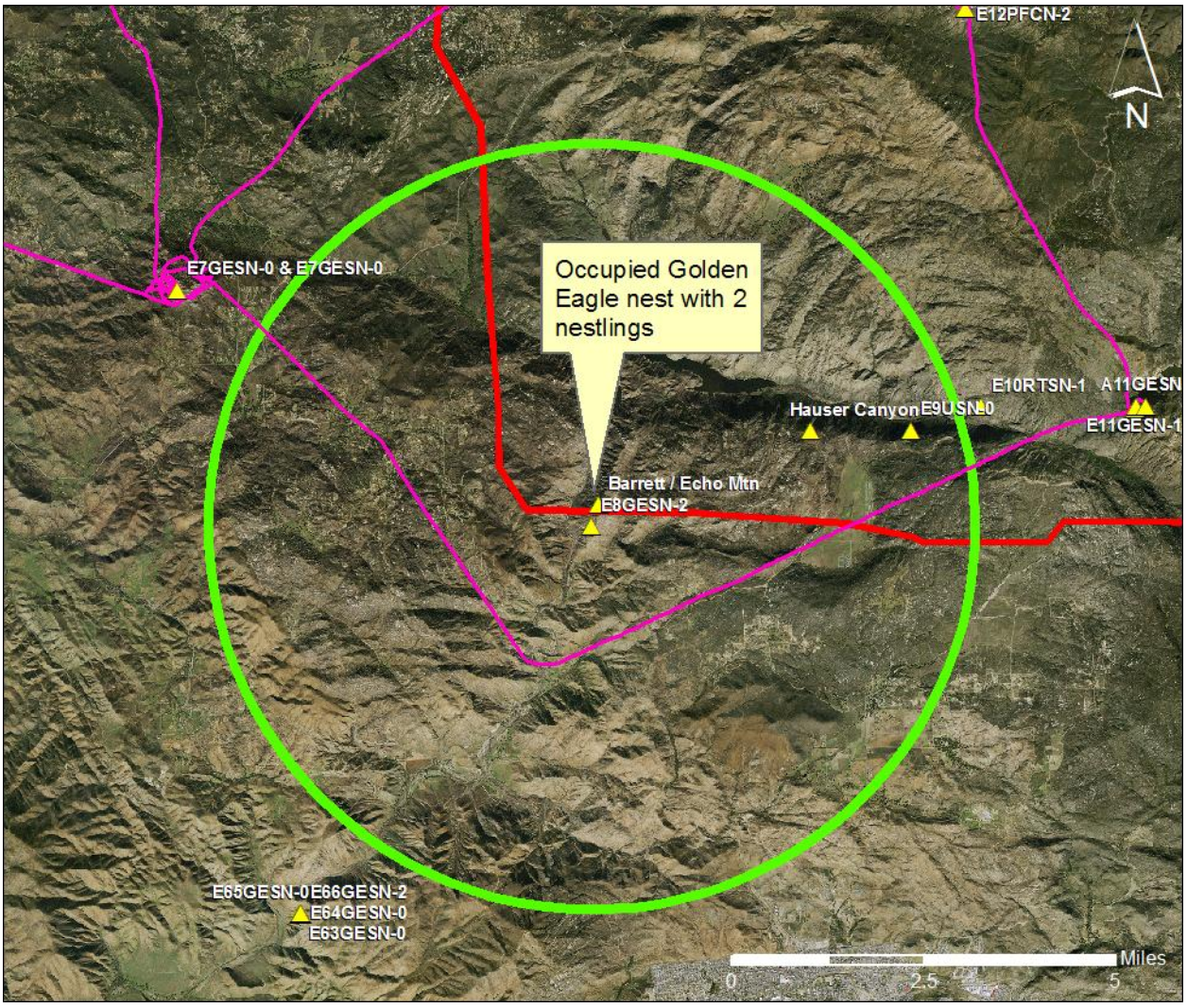


Figure 31. Barrett / Echo Mountain.

Barrett / Echo Mountain, occupied territory. All waypoints for species and nests observed, the helicopter flight path, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Two nestlings observed in nest during Phase 2 surveys. The nestlings were banded during WRI's annual monitoring and research of Golden Eagle territories in San Diego County, California.

Barrett / Echo Mountain



An active Golden Eagle nest (E8GESN-2) with incubating female observed during Phase 1 surveys, the male was perched nearby.



WRI preparing to retrieve Barrett nestlings from nest for banding (May 9, 2010).

Barrett / Echo Mountain



The older of the 2 nestlings at Barrett Mountain ready to be banded (May 9, 2010).



Collecting routine measurements for WRI's ongoing Golden Eagle research and monitoring (May 9, 2010).

Canebrake

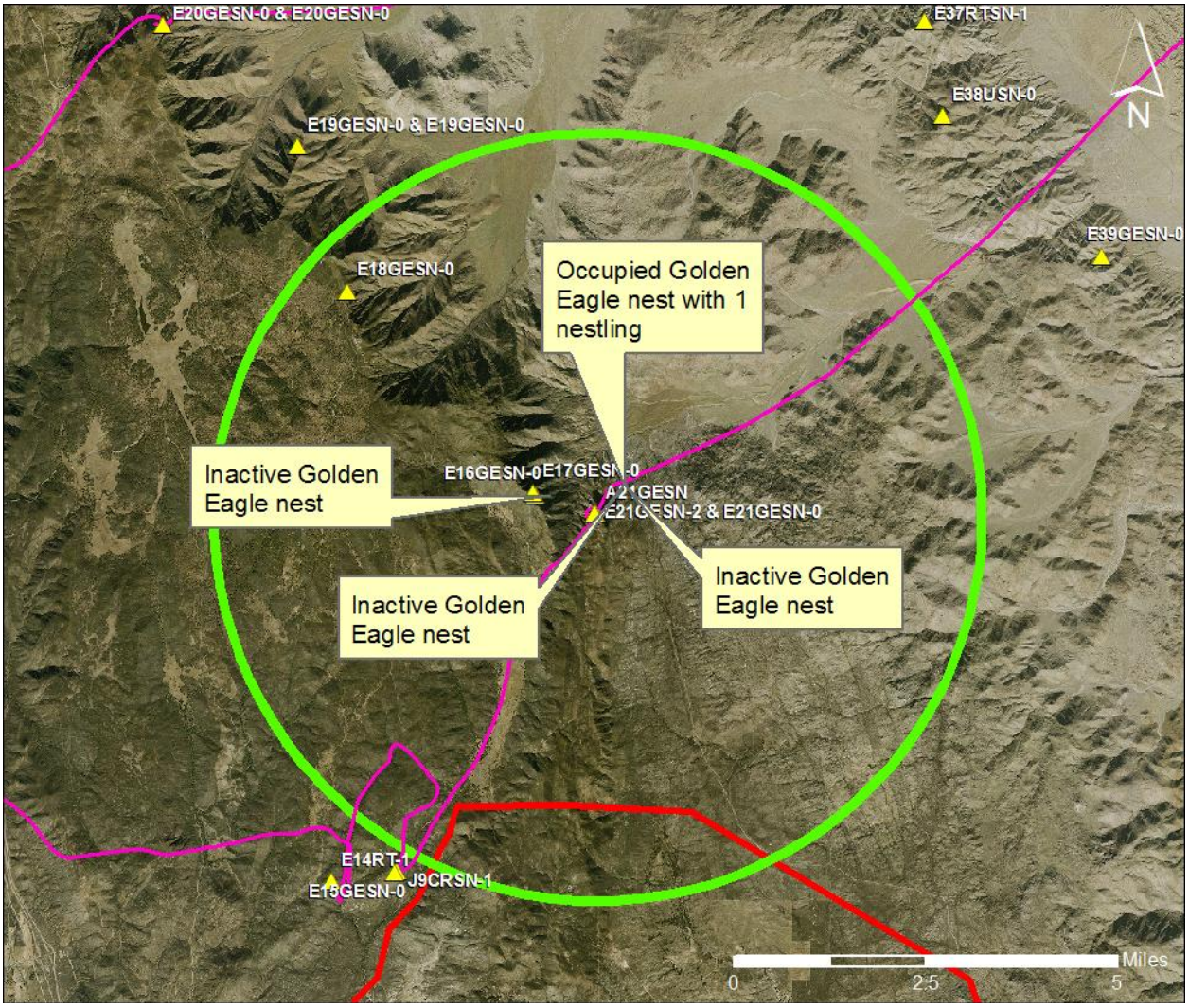


Figure 32. Canebrake.

Canebrake, occupied territory. All waypoints for species and nests observed, the helicopter flight path, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

One nestling observed in nest during Phase 2 surveys that later fledged.

Canebrake



The incubating female (E21GESN-1) observed during Phase 1 surveys on March 30, 2010.



Golden Eagle nestling, approximately 6 weeks of age, can be seen just behind the edge of the bush on right during routine aerial surveys on May 6, 2010.

Canebrake



Female Golden Eagle with nestling, approximately 7 weeks of age, during Phase 2 surveys on May 14, 2010.



View of helicopter approaching Canebrake 2010 nest site during WRI's annual surveys.

El Cajon Mountain

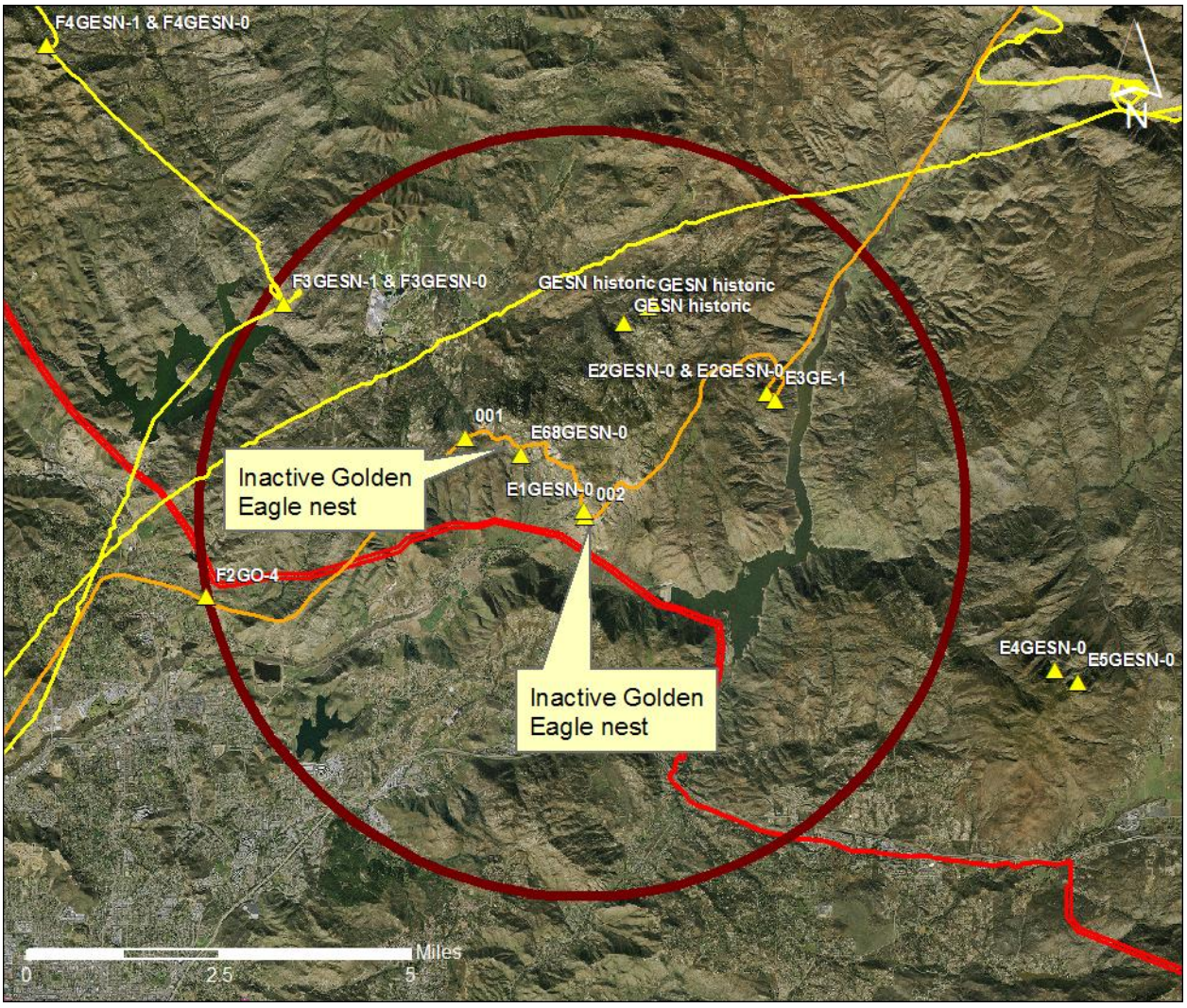


Figure 33. El Cajon Mountain.

El Cajon Mountain, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No Golden Eagles or active nests were observed during Phase 2 surveys.

Iron Mountain

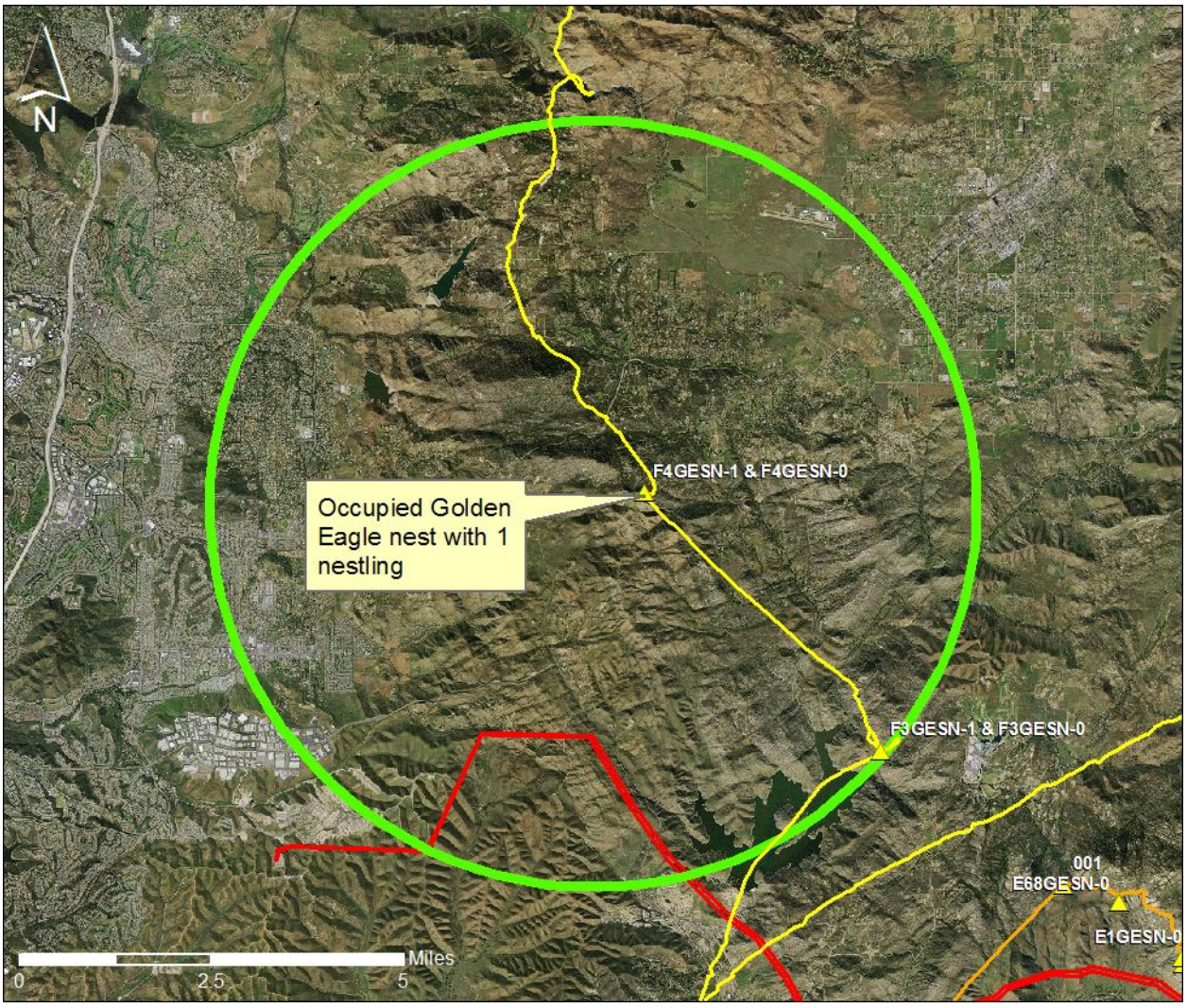


Figure 34. Iron Mountain.

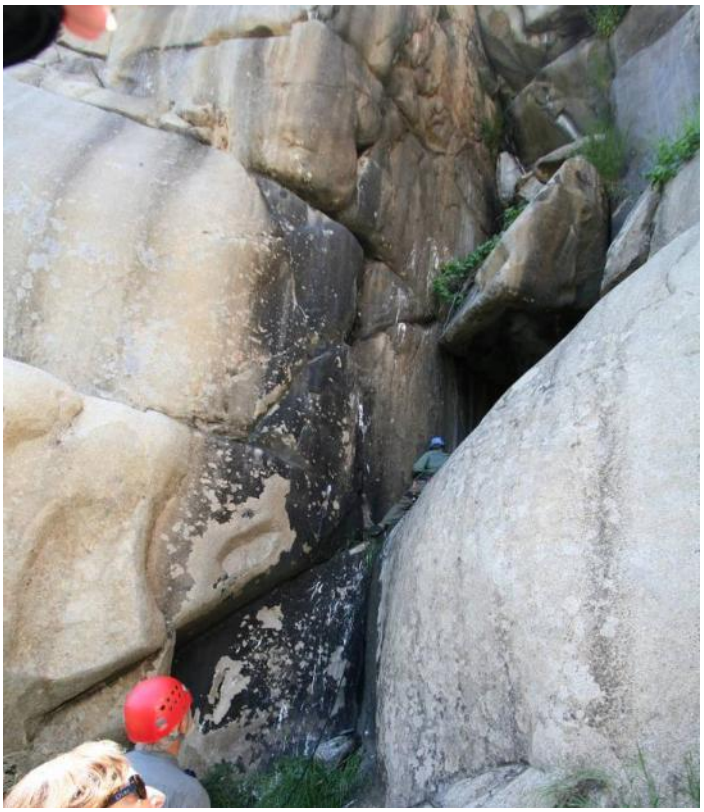
Iron Mountain, occupied territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

One nestling observed in nest during Phase 2 surveys. The nestling was banded during WRI's annual monitoring and research of Golden Eagle territories in San Diego County, California.

Iron Mountain



Golden Eagle nest (F4GESN-1) observed with a 5 week-old Golden Eagle nestling during Phase 2.



WRI biologist climbing to retrieve Iron Mountain nestling from nest for banding on May 1, 2010, during WRI ongoing research and for Phase 2 surveys.

Iron Mountain



Collecting data on Golden Eagle nestling at Iron Mountain during banding trip on May 1, 2010.

Lake Moreno / Moreno Butte

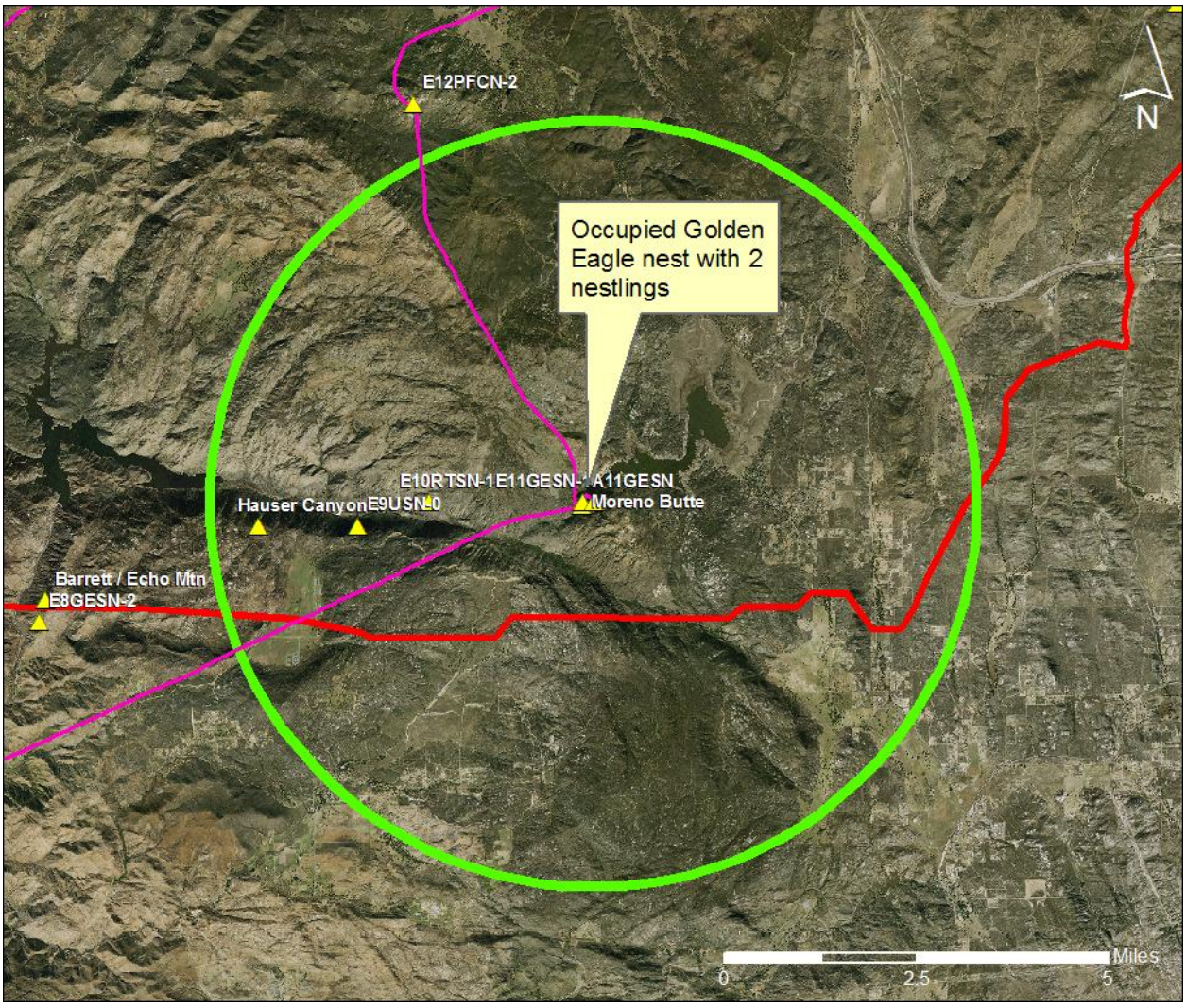


Figure 35. Lake Moreno / Moreno Butte.

Lake Moreno / Moreno Butte, occupied territory. All waypoints for species and nests observed, the helicopter flight path, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Two nestlings observed in nest during Phase 2 surveys, both were subsequently banded and fitted with satellite transmitters during WRI's annual monitoring and research of Golden Eagle territories in San Diego County, California..

Lake Moreno / Moreno Butte



Incubating female observed during Phase 1 survey on Lake Moreno nest (E11GESN-1) on March 30, 2010.



Two Golden Eagle nestlings, approximately 5 and 6 weeks of age, observed in Lake Moreno nest on May 6, 2010.

Lake Moreno / Moreno Butte



WRI climber approaching Golden Eagle nest at Lake Moreno during annual banding trip, a part of WRI's ongoing monitoring and research of San Diego Golden Eagle territories.



Golden Eagle nestling being retrieved from nest in preparation for banding.

Lake Moreno / Moreno Butte



Applying the satellite transmitter to the first of 2 Lake Moreno / Moreno Butte nestlings.

Lyons Peak

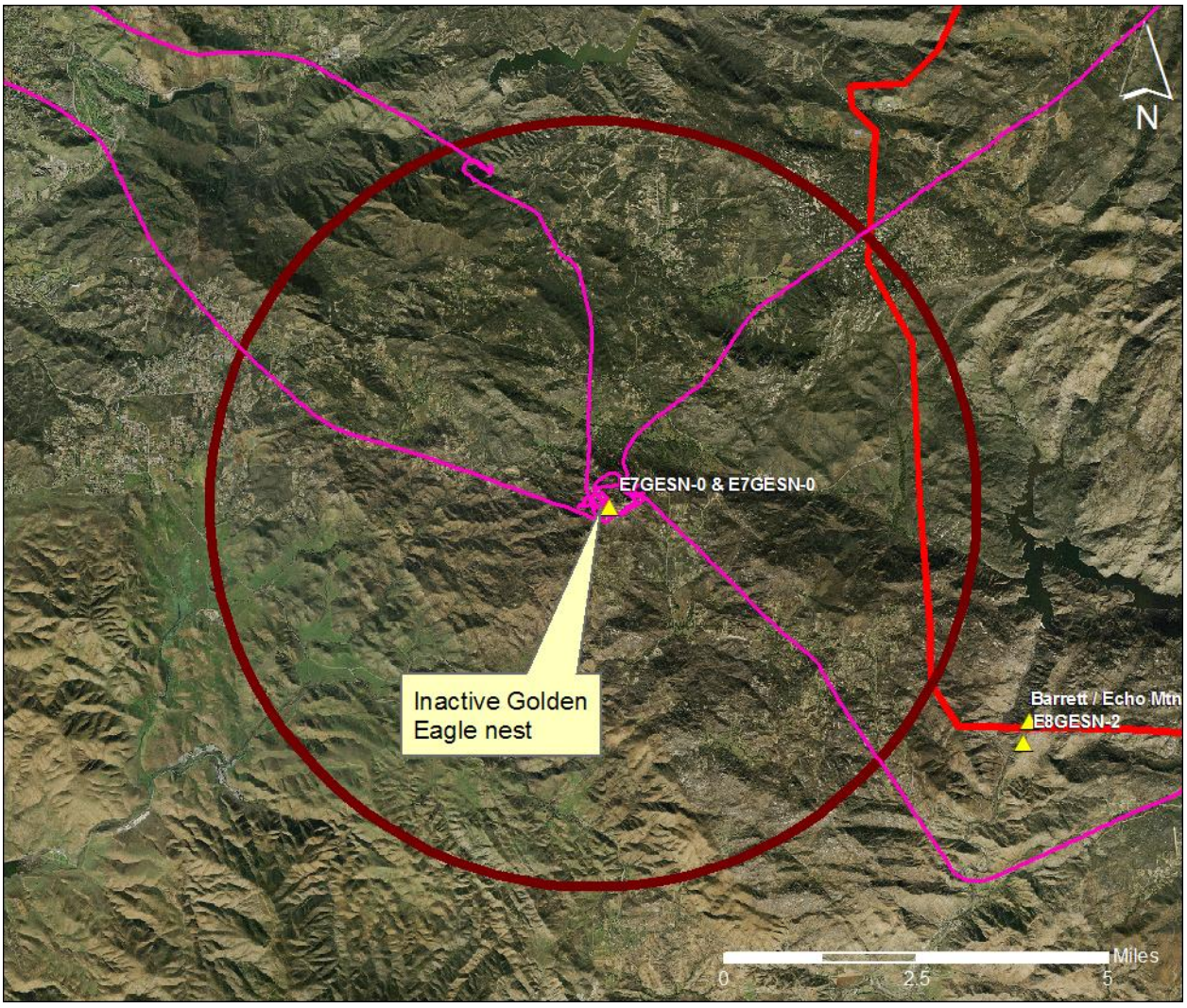


Figure 36. Lyons Peak.

Lyons Peak, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight path, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No Golden Eagles or active nests were found during Phase 2 surveys.

Rock Mountain

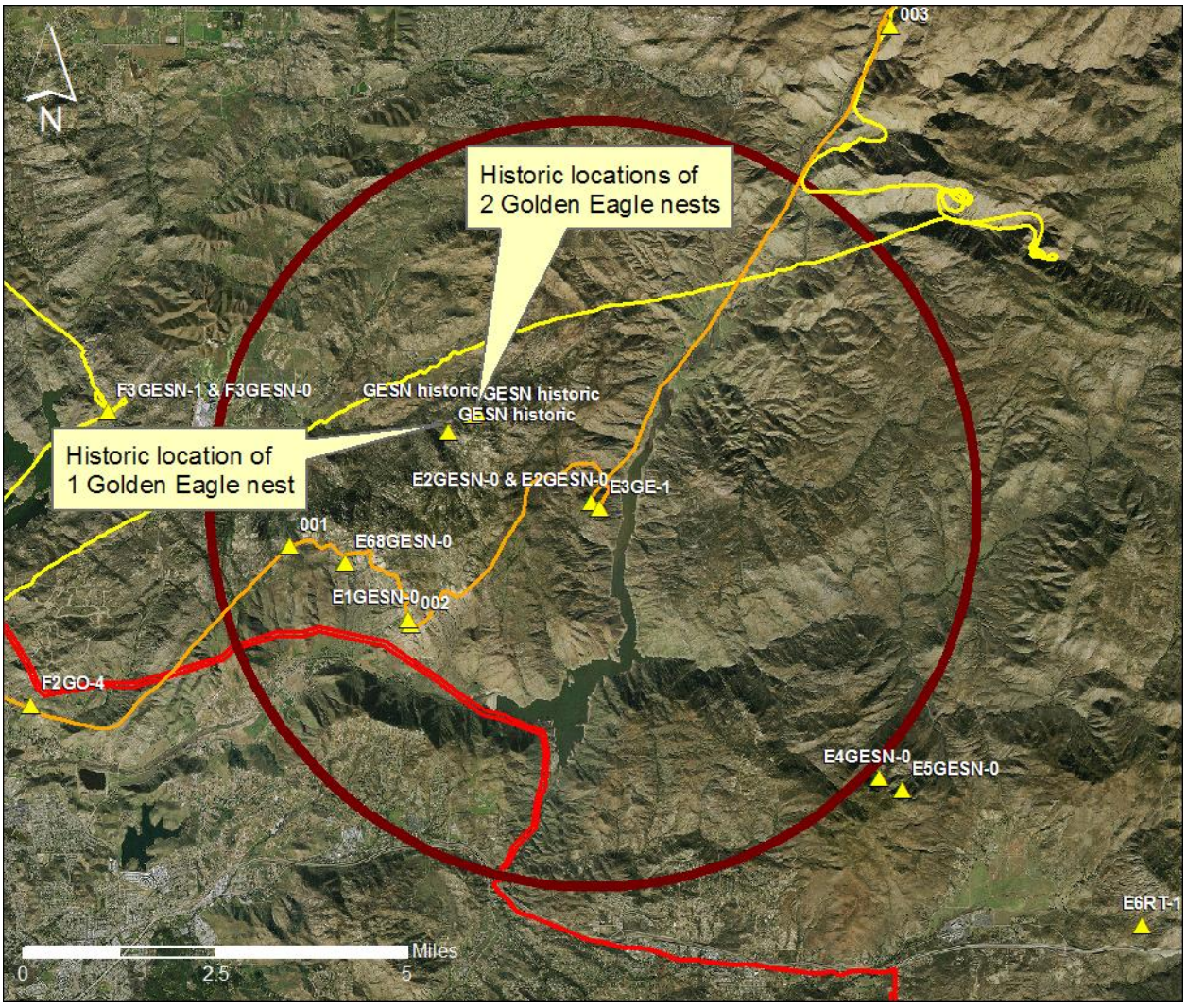


Figure 37. Rock Mountain.

Rock Mountain, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No Golden Eagles or active nests were found during Phase 2 surveys. Historic locations of 3 nests used previously by this pair, but destroyed during the 2007 fires, were surveyed to look for evidence of new activity; no new nest activity was observed.

San Vicente

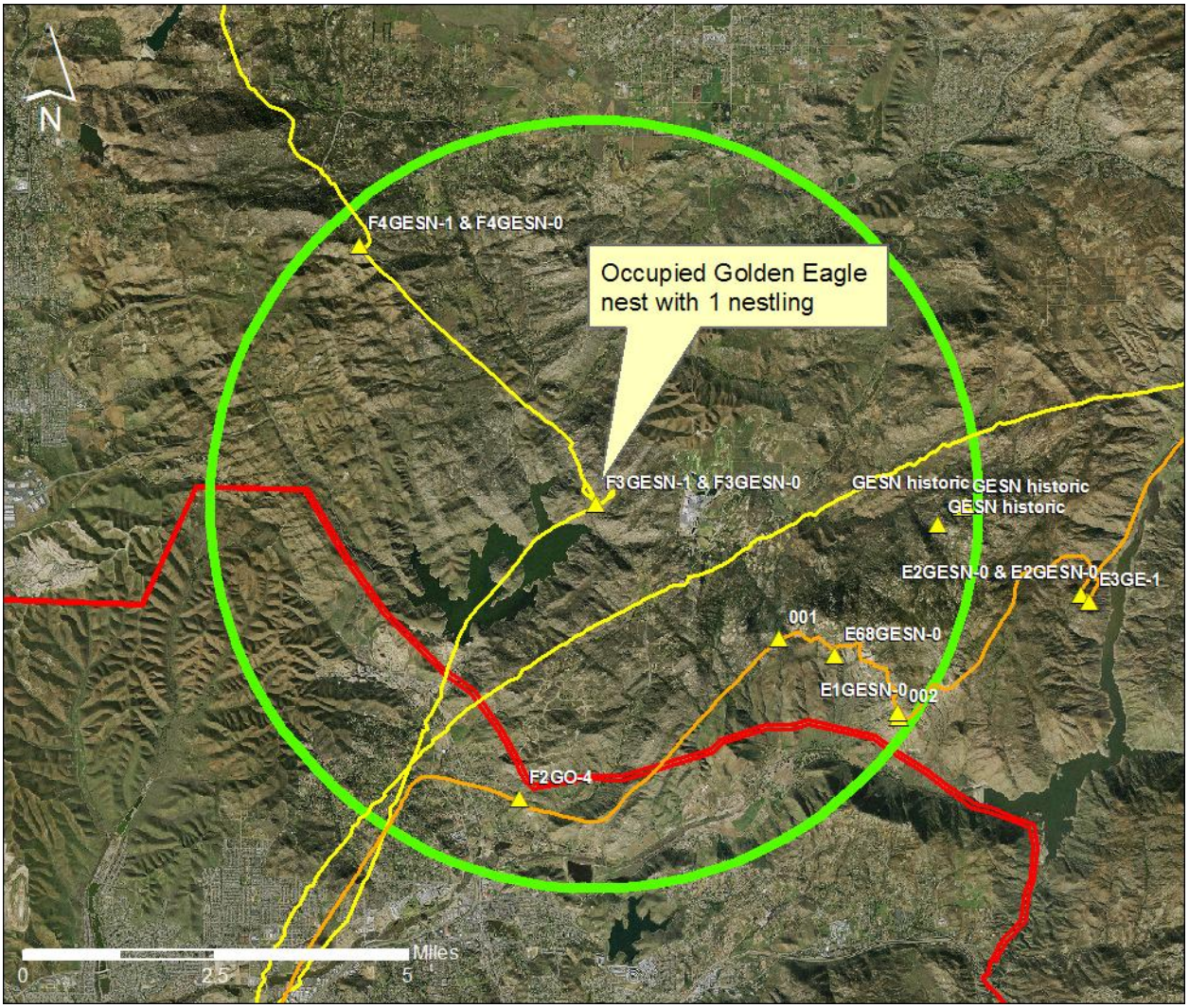


Figure 38. San Vicente.

San Vicente, occupied territory. All waypoints for species and nests observed, the helicopter flight paths, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

Incubating Golden Eagle female and nestling observed during Phase 1 and 2 surveys. The nestling was banded during WRI's annual monitoring and research of Golden Eagle territories in San Diego County, California.

San Vicente



An active Golden Eagle nest (F3GESN-1) with a 5 week-old Golden Eagle nestling observed during Phase 2 surveys on April 25, 2010.



Golden Eagle nestling from San Vicente territory (F3GESN-1) banded during Phase 2 surveys on May 2, 2010, and as part of WRI's annual research of territories in San Diego County.

Thing Valley

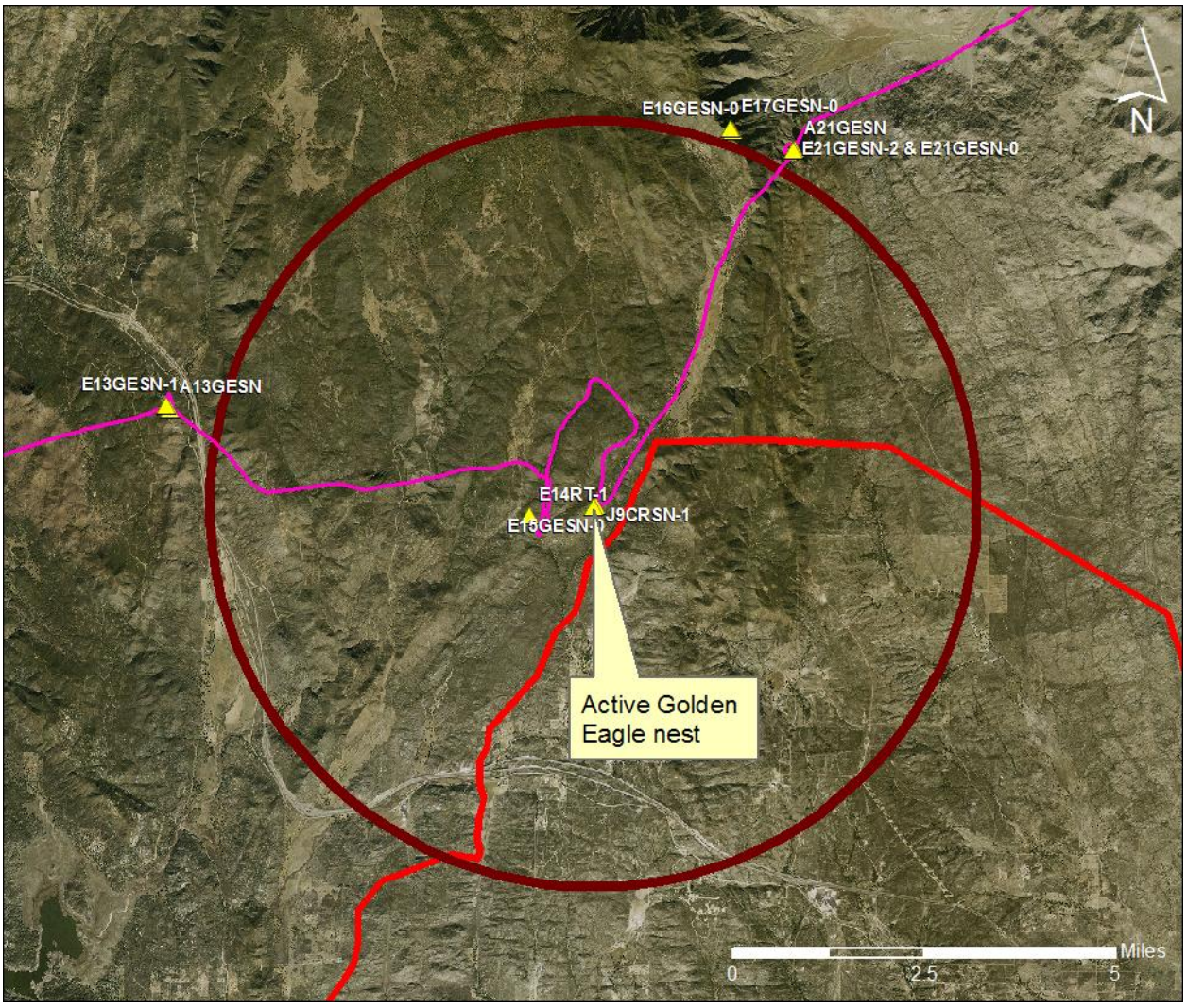


Figure 39. Thing Valley.

Thing Valley, active territory without reproduction. All waypoints for species and nests observed, the helicopter flight path, Project alignment, and an approximate 5-mile Golden Eagle territory radius are provided.

No Golden Eagles observed during Phase 2 surveys.

DISCUSSION OF FINDINGS

During Phase 2 surveys, we revisited 9 of the 19 territories because there were indications that breeding activity may be occurring in the territory during Phase 1. Five of the 9 territories resurveyed actually produced 7 baby eagles. The five productive territories were Barrett/Echo Mountain (2 young), Canebrake (1 young), Iron Mountain (1 young), Lake Moreno/Moreno Butte (2 young), and San Vicente (1 young).

Part of WRI's annual studies on San Diego's Golden Eagles includes banding and tagging the young to learn more about their behavior and survival. Six of the 7 young from these nests were banded and tagged with Very High Frequency (VHF) transmitters and 2 of these eaglets, from Moreno Butte, were also fitted with satellite transmitters. This satellite transmitter data along with the VHF data may be useful in determining the usage of the territories as it relates to energy projects.

LITERATURE CITED

Bittner J.D. Wildlife Research Institute, Inc. Unpublished data.

Bittner, J.D., J. Oakley, J. Hannan, J.L. Lincer, N. Muscolino, and R. Domenech. 2003. Reproduction of Golden Eagles in a Drought Period. Paper presented at the Raptor Research Foundation's Annual Scientific Conference. September 2-7. Anchorage, AK.

Kochert M.N., C.L. Steenhof, C.L. McIntyre and E.H. Craig. 2002. Golden Eagle(*Aquila chrysaetos*). In A. Poole and F. Gill (eds). The Birds of North America #684. The Birds of North America, Inc. Philadelphia, PA.

McGrady , M.L., J.R. Grant, I.P. Bainbridge, and D.R.A. McLeod. 2002. A model of golden eagle (*Aquila chrysaetos*) ranging behavior. Journal of Raptor Research. 36(1 Supplement): 62-29.

Pagel J.E., D.M. Whittington and G.T. Allen. 2010. Interim Golden Eagle technical guidance: Inventory and monitoring protocols; and other recommendations in support of Golden Eagle management and permit issuance. Division of Migratory Bird Management, U.S. Fish and Wildlife Service.

State of California, Department of Water Resources. 2010. Accessed at http://www.water.ca.gov/drought/ on May 30, 2010.

West R. Cuyamaca College Museum. 1988-1991. Unpublished data.

WRI (Wildlife Research Institute, Inc.). 2002. Final Report for Western Mojave Raptor Survey. Prepared for San Diego State University Foundation, Biology Department. 18 October.

WRI (Wildlife Research Institute, Inc.). 2003. Western Mojave Aerial Raptor Survey; BLM Johnson Valley and Stoddard Valley Open Areas. Prepared for Anteon Corporation-San Diego Applied Technology Group. 5 December

WRI (Wildlife Research Institute, Inc.). 2009. Western Mojave 2008 Raptor Survey; BLM Johnson Valley and Stoddard Valley Open Areas and Environs. Prepared for USDI BLM, Moreno Valley, CA. 30 June

APPENDICES

APPENDIX A: Waypoints and Related Data for Phase 1 & 2 Golden Eagle Surveys

Map coordinates (i.e., UTM, latitude/longitude) of the nests have been withheld per request of federal agencies in order to protect sensitive species, but are on file at WRI. If needed, this information is available upon request.

Trip ID	Waypoint	Species	Nest Type	# Individuals	Aspect	Nest Condition	Substrate	Active Nest	Elevation	Notes (age, sex, substrate, etc.)	Golden Eagle Territory	Survey Phase
January to February, 2010 - Ground surveys - annual WRI monitoring and research of Golden Eagle territories in San Diego County												
		GE	SN	2	SW	G	R	Y		incubating female observed (Chris Meador, WRI)	San Vicente	Phase 1
		GE	SN	2	N	G	R	Y		incubating female observed (Chris Meador, WRI)	Iron Mtn	Phase 1
		GE		2						2 adult Golden Eagles observed (Jeff Wells, USFS)	El Cajon	Phase 1
		GE		2						2 adult Golden Eagles observed (Jim Hannan, WRI)	Lyons Pk	Phase 1
March 30, 2010 - 2 flights (6.3 hrs) - sunny, 49-85F, 0-95% cloud cover (am fog), 5-20mph (gusts 25), 0% precip												
E	8	GE	SN	2	W	G	R	Y	2066 ft	female incubating, male perched nearby	Barrett/Echo Mtn	Phase 1
E	16	GE	SN	0	E	G	R	Y	5614 ft		Canebrake	Phase 1
E	17	GE	SN	0	E	G	R	Y	5549 ft	near #16	Canebrake	Phase 1
E	21	GE	SN	2	N	G	R	Y	5046 ft	incubating, male perched nearby	Canebrake	Phase 1
E	21	GE	SN	0	N	G	R	P	5046 ft	around corner to E of #21; *possibly active	Canebrake	Phase 1
E	22	GE	SN	0	NW	P	R	N	3485 ft		Carrizo Gorge	Phase 1
E	22	GE	SN	0	NW	P	R	N	3485 ft		Carrizo Gorge	Phase 1
E	23	GE	SN	0	NW	F	R	N	3406 ft		Carrizo Gorge	Phase 1
E	23	GE	SN	0	NW	P	R	N	3406 ft		Carrizo Gorge	Phase 1
E	23	BS		1					3406 ft	ram with collar	Carrizo Gorge	Phase 1
E	40	PR		1					1717 ft		Coyote Mtns - East	Phase 1
E	41	PR		1					1289 ft		Coyote Mtns – West	Phase 1
E	42	GE	SN	0	N	P	R	N	1235 ft		Coyote Mtns – West	Phase 1
E	42	GE	SN	0	S	P	R	N	1235 ft		Coyote Mtns – West	Phase 1
E	43	U	SN	0					1357 ft	small nest	Coyote Mtns – West	Phase 1
E	45	BS		5					1666 ft	2 ewes, 3 lambs	Coyote Mtns – West	Phase 1
E	46	GE	SN	0	NW	P	R	N	1131 ft	old	Coyote Mtns – West	Phase 1
E	47	GE	SN	0	N	P	R	N	991 ft		Coyote Mtns – West	Phase 1
E	47	AK		1					991 ft		Coyote Mtns – West	Phase 1

Trip ID	Waypoint	Species	Nest Type	# Individuals	Aspect	Nest Condition	Substrate	Active Nest	Elevation	Notes (age, sex, substrate, etc.)	Golden Eagle Territory	Survey Phase
E	48	TV		3					1484 ft		Coyote Mtns – West	Phase 1
E	**49**	**GE**	**SN**	**0**	**SE**	**G**	**R**	**P**	**1196 ft**	**small bowl; *possibly active**	Coyote Mtns – West	**Phase 1**
E	**50**	**GE**	**SN**	**0**	**SE**	**P**	**R**	**N**	**1175 ft**		Coyote Mtns – West	**Phase 1**
E	**51**	**GE**	**SN**	**0**	**SE**	**P**	**R**	**N**	**1182 ft**		Coyote Mtns – West	**Phase 1**
E	**52**	**GE**	**SN**	**0**	**W**		**R**		**1292 ft**		Coyote Mtns – West	**Phase 1**
E	**53**	**GE**	**SN**	**0**	**W**		**R**		**1379 ft**		Coyote Mtns – West	**Phase 1**
E	54	RT		2					1637 ft		Coyote Mtns – West	Phase 1
E	55	RT		1					1576 ft		Coyote Mtns – East	Phase 1
E	**56**	**GE**	**SN**	**0**		**P**	**R**	**N**	**1502 ft**	**old**	Coyote Mtns – East	**Phase 1**
E	57	CR	SN	0					1087 ft		Coyote Mtns – East	Phase 1
E	58	RT		1					1819 ft		Coyote Mtns – East	Phase 1
E	**59**	**GE**	**SN**	**0**	**N**	**P**	**R**	**N**	**1759 ft**	**old**	Coyote Mtns – East	**Phase 1**
E	60	CR		2					880 ft		Coyote Mtns – East	Phase 1
E	**1**	**GE**	**SN**	**0**	**W**	**G**	**R**	**Y**	**2366 ft**	**Active nest (rock), recently worked on; El Cajon**	**El Cajon Mtn**	**Phase 2**
E	**68**	**GE**	**SN**	**0**	**S**		**R**	**N**	**2167 ft**		**El Cajon Mtn**	**Phase 2**
E	9	U	SN	0					2313 ft	RT or CR	Hauser Cyn	Phase 1
E	**7**	**GE**	**SN**	**0**	**N**	**P**	**R**	**N**	**3392 ft**	**Not active (rock), old nest; Lyons Pk**	**Lyons Pk**	**Phase 1**
E	**7**	**GE**	**SN**	**0**	**N**	**P**	**R**	**Y**	**3392 ft**		**Lyons Pk**	**Phase 1**
E	**2**	**GE**	**SN**	**0**	**N**	**G**	**R**	**Y**	**1720 ft**	**Active nest (rock), new material**	**Rock Mtn**	**Phase 1**
E	**2**	**GE**	**SN**	**0**	**N**	**G**	**R**	**Y**	**1720 ft**		**Rock Mtn**	**Phase 1**
E	**3**	**GE**		**1**					**1630 ft**	**Adult, perched near nest site**	**Rock Mtn**	**Phase 1**
E	**24**	**GE**	**SN**	**0**	**W**	**P**	**R**	**N**	**3767 ft**		**Table Mtn**	**Phase 1**
E	**25**	**GE**	**SN**	**0**	**W**	**G**	**R**	**P**	**3813 ft**	***possibly active**	**Table Mtn**	**Phase 1**
E	**26**	**GE**	**SN**	**0**	**W**	**P**	**R**	**P**	**3799 ft**	***possibly active**	**Table Mtn**	**Phase 1**
E	27	GO	SN	3					3762 ft	**old GE nest**	Table Mtn	Phase 1
E	**28**	**GE**	**SN**	**0**	**W**	**F**	**R**	**N**	**3741 ft**		**Table Mtn**	**Phase 1**
E	**28**	**GE**	**SN**	**0**	**W**	**P**	**R**	**N**	**3741 ft**		**Table Mtn**	**Phase 1**
E	14	RT		1					5125 ft		Thing Valley	Phase 1
E	**15**	**GE**	**SN**	**0**	**S**	**P**	**R**	**Y**	**4786 ft**	**trying to start new nest**	**Thing Valley**	**Phase 1**
E	**4**	**GE**	**SN**	**0**	**N**	**P**	**R**	**N**	**3283 ft**	**Not active (rock), old nest; Viejas Mtn.**	**Viejas Mtn**	**Phase 1**

Trip ID	Waypoint	Species	Nest Type	# Individuals	Aspect	Nest Condition	Substrate	Active Nest	Elevation	Notes (age, sex, substrate, etc.)	Golden Eagle Territory	Survey Phase
E	**5**	**GE**	**SN**	**0**	**N**	**F**	**R**	**N**	**3260 ft**	**Not active (rock); Viejas Mtn.**	**Viejas Mtn**	**Phase 1**
E	6	RT		1					3875 ft		Viejas Mtn	Phase 1
E	**10**	**RT**	**SN**	**1**					**2396 ft**	**old GE nest**	**Hauser Cyn**	**Phase 1**
E	**11**	**GE**	**SN**	**1**	**W**	**G**	**R**	**Y**	**3226 ft**	**incubating female; same nest as last year**	**Moreno Butte/ Lake Moreno**	**Phase 1**
April 1, 2010 - Ground survey (2hrs) cloud cover 0%, wind ~10mph, vis 10+, 0% precip												
I	60	TV		1					441 ft	flying	Mountain Springs	Phase 1
I	61	TV		1					437 ft	flying	Mountain Springs	Phase 1
April 2, 2010 - Ground survey (12hrs) cloud cover 0%, wind 5-10mph, vis 10+, 0% precip												
I	67	CR		1					309 ft	flying	Mountain Springs	Phase 1
I	68	CR		1					3138 ft	perched	Mountain Springs	Phase 1
I	69	CR		1					3837 ft	hunting	Mountain Springs	Phase 1
I	70	TV		4					3688 ft	flying	Mountain Springs	Phase 1
I	71	CR		2					3655 ft	flying	Mountain Springs	Phase 1
I	73	TV		2					3736 ft	flying	Mountain Springs	Phase 1
I	74	CR		1					3733 ft	flying	Mountain Springs	Phase 1
I	75	TV		1					3758 ft	flying	Mountain Springs	Phase 1
I	76	CR		1					3770 ft	flying	Mountain Springs	Phase 1
I	77	RT		1					3925 ft	flying	Mountain Springs	Phase 1
I	**78**	**GE**		**1**					**3963 ft**	**perched on rock**	**Mountain Springs**	**Phase 1**
I	78	U	CN	**0**		N	R		3963 ft	double cavity with white wash	Mountain Springs	Phase 1
I	79	TV		1					3985 ft	flying	Mountain Springs	Phase 1
I	80	TV		4					3981 ft	flying	Mountain Springs	Phase 1
I	82	RT		1					908 ft	flying	Mountain Springs	Phase 1
I	83	PR		1					1219 ft	female flushed from feeding perch	Mountain Springs	Phase 1
I	84	TV		1					1020 ft	flying	Mountain Springs	Phase 1
I	85	JR		1					448 ft	jackrabbit running	Mountain Springs	Phase 1
I	85	AG		8					448 ft	numerous antelope ground squirrels noted in valley	Mountain Springs	Phase 1
April 3, 2010 - Ground survey (6.5hrs) cloud cover 0%, winds ~20mph, vis 10+, 0% precip												
I	86	CR		1					1200 ft	flying	Mountain Springs	Phase 1
I	87	RT		1					1226 ft	adult perched	Mountain Springs	Phase 1
I	88	U	CN	**0**		N	R		1643 ft	white wash	Mountain Springs	Phase 1

Trip ID	Waypoint	Species	Nest Type	# Individuals	Aspect	Nest Condition	Substrate	Active Nest	Elevation	Notes (age, sex, substrate, etc.)	Golden Eagle Territory	Survey Phase
I	89	U	CN	0		NW	R		1587 ft		Mountain Springs	Phase 1
I	89	U	CN	0		SE	R		1587 ft		Mountain Springs	Phase 1
I	90	JR		1					1658 ft	running	Mountain Springs	Phase 1
I	91	U	CN	0		NE	R		1405 ft		Mountain Springs	Phase 1
I	92	CR	SN	0	G		TT		584 ft	1st tower south of road	Mountain Springs	Phase 1
I	93	CR	SN	0	G		TT		585 ft	2nd tower north of road	Mountain Springs	Phase 1
I	94	RT		1					980 ft	soaring	Mountain Springs	Phase 1
I	95	CR		1					3117 ft	flying	Mountain Springs	Phase 1
I	96	RT	SN	1	G		TT	Y	3236 ft	incubating female, 400 yds from active shooting range	Mountain Springs	Phase 1
I	97	RT		1			TR		3368 ft	perched in tree, 1/2 mile behind active shooters	Mountain Springs	Phase 1
I	98	RT		1					3379 ft	soaring	Mountain Springs	Phase 1
I	98	CR		1					3379 ft	soaring	Mountain Springs	Phase 1
April 25, 2010 - 1 flight (3 hrs) - 60-70F, winds 0-10mph, visibility 10+ mi, precipitation 0%												
F	**2**	**GO**	**SN**	**4**	**W**	**G**	**R**	**Y**	**1124 ft**	**old GESN occupied by Great Horned Owl; 1 adult, 3 local**	**Fosters**	**Phase 1**
F	**3**	**GE**	**SN**	**1**	**SW**	**G**	**R**	**Y**	**1379 ft**	**new nest, 1 male 5-wks old**	**San Vicente**	**Phase 2**
F	**3b**	**GE**	**SN**	**0**	**N**	**G**	**R**	**N**	**1379 ft**	**2nd nest at this location**	**San Vicente**	**Phase 2**
F	**4**	**GE**	**SN**	**1**	**N**	**G**	**R**	**Y**	**2505 ft**	**1 young 5-wks old**	**Iron Mtn**	**Phase 2**
F	**4**	**GE**	**SN**	**0**	**N**	**G**	**R**	**N**	**2505 ft**	**2nd nest at this location**	**Iron Mtn**	**Phase 2**
May 1, 2, 9 and 14, 2010 - Ground monitoring and banding as part of WRI ongoing research												
E	**11**	**GE**	**SN**	**1**	**W**	**G**	**R**	**Y**	**3226 ft**	**adult male observed during Phase 2 aerial surveys**	**Moreno Butte/ Lake Moreno**	**Phase 2**
F	**4**	**GE**	**SN**	**1**	**N**	**G**	**R**	**Y**	**2505 ft**	**May 1, 2010 - chick banded**	**Iron Mtn**	**Banded**
F	**3**	**GE**	**SN**	**1**	**SW**	**G**	**R**	**Y**	**1379 ft**	**May 2, 2010 - chick banded**	**San Vicente**	**Banded**
E	**8**	**GE**	**SN**	**2**	**W**	**G**	**R**	**Y**	**2066 ft**	**May 9, 2010 - older chick banded**	**Barrett/Echo Mtn**	**Phase 2, Banded**
E	**8**	**GE**	**SN**	**2**	**W**	**G**	**R**	**Y**	**2066 ft**	**May 14, 2010 - younger chick banded**	**Barrett/Echo Mtn**	**Phase 2, Banded**
May 14, 2010 - 1 flight (2hr 10min) 59-84F, 100% cloud cover, 2 mile vis with haze, no wind, 0% precip												
J	**-**	**GE**	**SN**	**0**	**N**	**P**	**R**	**Y**	**3392 ft**		**Lyon's Pk**	**Phase 2**
J	**6**	**GE**	**SN**	**2**	**W**	**G**	**R**	**Y**	**3321 ft**	**2 chicks, 5 & 6 wks old (same nest as E11GESN)**	**Lake Moreno / Moreno Butte**	**Phase 2**
J	9	CR	SN	1	E	G	R	Y	4643 ft		Thing Valley	Phase 2
J	**8**	**GE**	**SN**	**1**	**S**	**P**	**R**	**Y**	**4786 ft**	**no new activity at nest (same nest as E15GESN)**	**Thing Valley**	**Phase 2**
J	**10**	**GE**	**SN**	**2**	**W**	**G**	**R**	**Y**	**5001**	**7 wk-old chick**	**Canebrake**	**Phase 2**

									ft	(same nest as E21GESN)		
Trip ID	Waypoint	Species	Nest Type	# Individuals	Aspect	Nest Condition	Substrate	Active Nest	Elevation	Notes (age, sex, substrate, etc.)	Golden Eagle Territory	Survey Phase
May 16, 2010 - Ground monitoring and banding as part of WRI ongoing research												
E	21	GE	SN	2	N	G	R	Y	5046 ft	May 16, 2010 - chick fledged	Canebrake	Fledged
E	11	GE	SN	2	W	G	R	Y	3226 ft	May 16, 2010 - chicks banded, satellites applied	Lake Moreno / Moreno Butte	Banded

APPENDIX B: Glossary of Golden Eagle Nest Terms

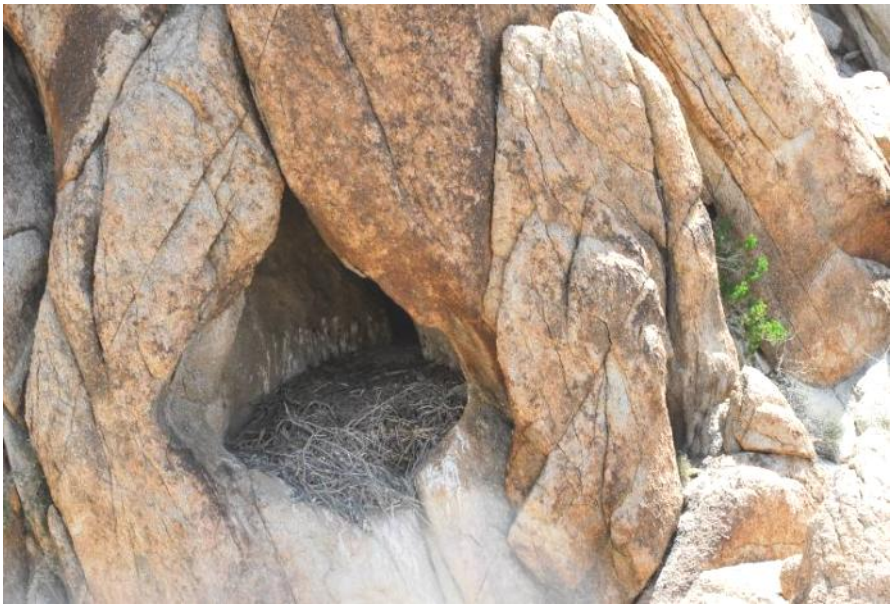
NEST CONDITION

Good condition - A Golden Eagle nest in **good condition** has been worked on in the current year or within the past 1 to 3 years; a determination made by observing the age of sticks or recent addition of other materials that make up the nest. Additionally, the presence of a bowl constructed with yucca, with or without new material, is indicative of recent activity and good condition.



Good condition

Fair condition – A Golden Eagle nest in **fair condition** has not been used for several years, shows moderate signs of weathering, and may include a rough bowl.



Fair condition

Poor condition – A Golden Eagle nest in **poor condition** shows strong signs of weathering, is in the process of deteriorating, and can often even be decomposing.



Poor condition

NEST ACTIVITY

Active nest - An **active nest** is a nest in good condition that has evidence of new material having been added during the season in which the survey has been conducted. It will include the use of yucca and often includes the construction of a bowl, used for incubation. An active nest may or may not be **occupied** by a Golden Eagle (e.g., an incubating female or a young bird) at the time of survey.

Occupied nest – An **occupied nest** is an active nest in which an adult or young Golden Eagle, or a new egg, has been observed during the survey.

NEST ARRANGEMENT

Multiple nests at one waypoint – Golden Eagles often construct nests in close proximity to one another. During surveys, these nests are often recorded at a single waypoint.



APPENDIX C: WRI Golden Eagle Team Biographies

Dave Bittner
Executive Director, WRI
Wildlife Biologist/Raptor Ecologist

Mr. Dave Bittner is a Co-founder and Executive Director of The Wildlife Research Institute, Inc. and has been a Wildlife Biologist for more than 44 years. Much of his work has been with raptors of various species but he has also studied and banded 3700 Great Blue Herons, conducted mammal research, and trapped and tagged over 3,000 mammals of various species. Dave currently coordinates an annual Golden Eagle and raptor population study throughout Southern California, including the Western Mojave Desert and the Anza-Borrego Desert State Park. He is the Primary Investigator (P.I.) for the Southern California Golden Eagle Population Study, the longest continuous running (22 years) Golden Eagle study of its kind in the Western Hemisphere, which began in 1968. Currently, he is also the P.I. for WRI's satellite and VHF telemetry-based Golden Eagle migration and habitat use study in cooperation with the US Forest Service, Montana Parks and Wildlife, and the California Department of Fish and Game. WRI, under Dave's direction, has conducted annual helicopter surveys on Golden Eagles and raptors in general since 1996. Dave has banded raptors since 1963 and has banded over 420 Golden Eagles, many with VHF and satellite telemetry. He has conducted Bighorn Sheep surveys, both aerial and ground, for Desert Bighorn Sheep in the Mojave Desert and for Peninsular Bighorn Sheep in the Anza-Borrego Desert State Park and Baja, Mexico since 1998. Dave has also surveyed Bighorn Sheep in Montana where WRI has a research Station. His education includes a B.Sc. in Zoology and Wildlife Management from Ohio State University (1968). He also conducted graduate studies in Avian Reproduction and Natural Resources (1975-1977) at Ohio State University. Dave has worked for the U.S. Fish and Wildlife Service, Cleveland Museum of Natural History, and the Ohio Department of Natural Resources and has taught at two universities and one technical college.

Jeffrey L. Lincer, Ph.D.
Research Director, WRI
Senior Scientist/Wildlife Biologist/Raptor Ecologist

Dr. Lincer is a Co-founder and Research Director of The Wildlife Research Institute, Inc. and has extensive experience surveying for raptors, including helping establish WRI's Montana Raptor Migration Station. He has actively participated in the institute's Southern California Golden Eagle project since 2000, including helicopter surveys since 2001. He has conducted numerous raptor surveys for federal, state, county, and local governments, and the private sector across desert and mountain habitat in the California Mojave and Anza-Borrego deserts, San Diego County, Nevada and the mountains of northern Baja Mexico. In addition, Jeff has over 100 hours of aerial surveying for Bald Eagles and over 50 hours for fish-eating birds. He has conducted Bighorn Sheep surveys, both aerial and ground, in the Mojave Desert and for the Anza-Borrego Desert State Park since 1998. Dr. Lincer's background includes 40 years as a scientist, scientific advisor, and administrator in the environmental research and management areas. He has taught college level courses in environmental and occupational health, environmental science, ornithology, and mangrove ecology, produced over 100 scientific publications and papers (most on raptors), authored dozens of environmental reports, and served as advisor to high-level governmental offices and national/international conservation programs. Jeff received his Bachelors and Masters degrees in Wildlife Biology/Wildlife Management

from Syracuse University and his Doctorate in Ecology and Toxicology from Cornell University. He is most well known for his work with raptors and other threatened/endangered species and his ability to manage complex interdisciplinary projects and work productively with government agencies. He is a Past-President of the Southern Chapter of The Wildlife Society. As President of the Raptor Research Foundation (RRF) from l982 to l988, he oversaw the greatest growth of that professional organization in its entire history. He chairs RRF's Leslie Brown Award Grant Committee (for research on African raptors) and chaired the First International Burrowing Owl Symposium and Workshop. He is the Co-editor for the Proceedings of the First International Symposium on Burrowing Owls, a Co-editor of the proceedings of the First California Burrowing Owl Symposium, and is a contributing Technical Editor for a recent book on California's endangered species. Dr. Lincer was the founding Director of the National Wildlife Federation's (NWF) Raptor Information Center. During his NWF tenure, he coordinated with government agencies and the private sector, developed computerized literature databases, and prioritized eagle and other raptor habitat throughout the United States for acquisition. He served as Consulting Editor for the joint RRF/Bureau of Land Management publication, "Raptor Habitat Management Multiple Use Mandate." Over the last four decades, he has worked on major projects from Alaska to Africa, addressing raptor population trends, ecological monitoring, environmental impacts, ecotoxicology, and habitat protection and acquisition.

Chris Meador
WRI Assistant Director
Wildlife Biologist

Mr. Meador is a full-time Wildlife Biologist for the Wildlife Research Institute (WRI) and has been a Wildlife Biologist for the past eight years. Chris has three years experience conducting helicopter surveys on Golden Eagles and other raptors, including over 125 hours of helicopter survey experience. He has conducted numerous raptor surveys for federal, state, county and local governments, and the private sector across desert, coastal and mountain habitats. He co-leads WRI's Southern California Golden Eagle Population Study, the longest running study of its kind in the Western Hemisphere and has participated in it for the past ten years. He currently carries out myriad tasks for various projects pertaining to the Golden Eagle. These include trapping, tagging, and affixing radio and satellite telemetry transmitters to nestling, juvenile and adult Golden Eagles in San Diego County as well as migrating Golden Eagles in Montana. He maintains and oversees much of the Wildlife Research Institute's tracking process including gathering, interpreting and publishing data and findings using GPS and GIS integration. Chris has conducted Bighorn Sheep surveys, both aerial and ground, in the Mojave Desert and for the Anza-Borrego Desert State Park since 2008. He has assisted with projects, including research, education and reintroduction on a broad range of species from endangered mammals to sensitive fish and from Burrowing Owls to Desert Tortoises. Mr. Meador also conducts educational programs on multiple topics including natural history, ecology and conservation pertaining to many different species. He is an expert in identification and ecology of North American raptors. He holds a Bachelor of Arts degree with a double major in Environmental Studies and Psychology from Prescott College in Prescott, Arizona.

Renée Rivard, Pharm.D.
Wildlife Biologist

Dr. Rivard is currently a member of the Wildlife Research Institute's Golden Eagle team; she has participated in all of WRI's 2010 Golden Eagle surveys conducted for numerous renewable energy projects across desert and mountain habitat in the California Mojave desert, San Diego County, and Nevada. Renée has over 25 hours of experience conducting Golden Eagle helicopter surveys. In addition to participating in aerial transect surveys and ground surveys to identify Golden Eagle nests and territory impacted by renewable energy projects, she has also participated in WRI's ongoing Golden Eagle research and monitoring project in San Diego County as a member of the banding and telemetry teams. She maintains the Golden Eagle Database and helps maintain Burrowing Owl artificial burrows on premises at WRI headquarters and continues to expand her knowledgebase related to these and other raptors. Renée assists with WRI's annual Hawk Watch educational program about the Ramona Grasslands and its raptor residents and migrants. Her 20+ years of database, scientific publishing, and medical research experience provide her with the background and skills to efficiently and professionally assimilate survey data for WRI, clients and agencies. Over the last 4 years, she has accumulated diverse and valuable wildlife knowledge and skills as a wildlife rescuer, rehabilitator, and veterinarian assistant for non-profit organizations in Australia and, more recently, as a field technician and laboratory technician for the San Diego Zoo's Institute for Conservation Research Applied Animal Ecology Department and Wildlife Disease Laboratory, respectively. Renée received her Bachelor's of Science in Biology from the University of South Alabama (1987), graduated *cum laude* with her Doctorate of Pharmacy from Creighton University (1995), and completed specialized post-graduate papers in medical literature evaluation from the University of Auckland in New Zealand (2001).

Leigh Bittner
Vice-President, WRI
Field Assistant

Mrs. Bittner first flew Golden Eagle helicopter surveys in 1996. She has participated in Golden Eagle nest surveys, eagle banding, tagging and tracking in California since 1991, New Mexico, 2001 and Montana since 2000. Leigh has also been involved in tagging and releasing of some of the first California Condors in California, 1992, and Arizona, 1996. Leigh is a co-founder of the Wildlife Research Institute, Inc. and has been a Board member since 1996. She is a retired Marketing Manager from Hallmark Corporation and helps coordinate office operations to support WRI's field activities.

Brittany Schlotfeldt
Wildlife Biologist

Ms. Schlotfeldt has experience with mammals and birds and field transect experience in both the marine and desert environments. Brittany has one year experience conducting helicopter surveys of Golden Eagles and other raptors. She assisted with the research on coral recruitment across various conditions in Hawaii (Donald Potts Lab, UCSC) and tracked sea otters for SORAC (Sea Otter Research and Conservation) at the Monterey Bay Aquarium. Brittany has also assisted with, and performed, a number of tasks in the upland and desert habitats for various Wildlife Research

Institute (WRI) projects. In the desert environment, she has assisted with WRI's research on golden eagles (radio telemetry and tracking), burrowing owls (transect surveys, field observations, trapping, and banding), and desert tortoises (surveyed over 100 miles of protocol transects in the Western Mojave Desert with Drs. Boarman and Lincer, and Mr. Peter Woodman). This study, which was recently completed, was a follow-up on an earlier project focused on the potential impacts of vehicular traffic, and highway fencing, on tortoise mortality (Boarman and Sazaki 2006). She has additional experience with desert tortoises on Fort Irwin, where she conducted numerous surveys and assisted with the VHF-transmittering of tortoises in an effort to relocate the individuals. Ms. Schlotfeldt received her Bachelor's of Science in Marine Biology from the University of California, Santa Cruz (2008).

James Hannan, Ph.D.
Senior Wildlife Biologist

Dr. Hannan has seven years experience with WRI conducting helicopter surveys of Golden Eagles and other raptors. Jim also helps on WRI's long running Golden Eagle Research project with rappelling to, banding and tracking Golden Eagles. He is fluent in Spanish and served as an International Environmental Consultant for the Peace Corps and United Nations Volunteer programs His professional experience includes two years as a Peace Corps Volunteer (fisheries and agriculture, in Panama), one-year Peace Crops staff (fisheries development in Puerto Rico), and one year at the Smithsonian Institution. His academic experience also includes three years as Professor of Marine Biology and Environmental Studies at Florida Institute of Technology. Jim also spent twelve years as a private environmental consultant (contracts included Mexican aquaculture, impacts to Caribbean coral reefs, deer and other game studies involving radio transmitters for the California Dept of Fish and Game). He also served as a Texas game ranch manager, naturalist for East Africa wildlife filming company, fishery management advisor for the Florida Keys and holds a NAUI diver certificate and Florida EMT certificate. Dr. Hannan, is a WRI Senior Wildlife Biologist and Professor, Mesa College. He received his BS in 1965 from Humboldt State University, his MS in 1969 from University of Oregon, and his PhD in 1973 from the University of Miami (FL).

Jeff Wells
Wildlife Biologist

Mr. Wells has been involved with WRI's Golden Eagle research since 1991 including trapping, banding and tracking. Jeff has ten years experience with WRI conducting helicopter surveys of Golden Eagles and other raptors. He has his Bachelors in Wildlife Studies from San Diego State University and has over 20 years experience as a private wildlife biologist. For the past 5 years, Jeff has been a Wildlife Biologist for the US Forest Service.

James Newland
Field Biologist

Mr. Newland has assisted WRI on Golden Eagle research for the last 4 years banding, trapping, and VHF and satellite tracking. James has also assisted trapping and tracking Golden Eagles at

WRI's migratory research center in Montana. He has one year experience conducting helicopter surveys of Golden Eagles and other raptors. James has a Bachelor's of Science in Electrical Engineering and has worked for numerous large communication corporations.

Jeff Laws
Field Biologist/Bio-climber

Mr. Laws has assisted WRI with Golden Eagle research and field work since 1995. He has also assisted trapping and tracking Golden Eagles at WRI's migratory research center in Montana. Jeff has five years experience conducting helicopter surveys of Golden Eagles and other raptors with WRI. Jeff works as a climber and field installer for San Diego Gas & Electric Company.

Mel Cain
Utility Helicopters

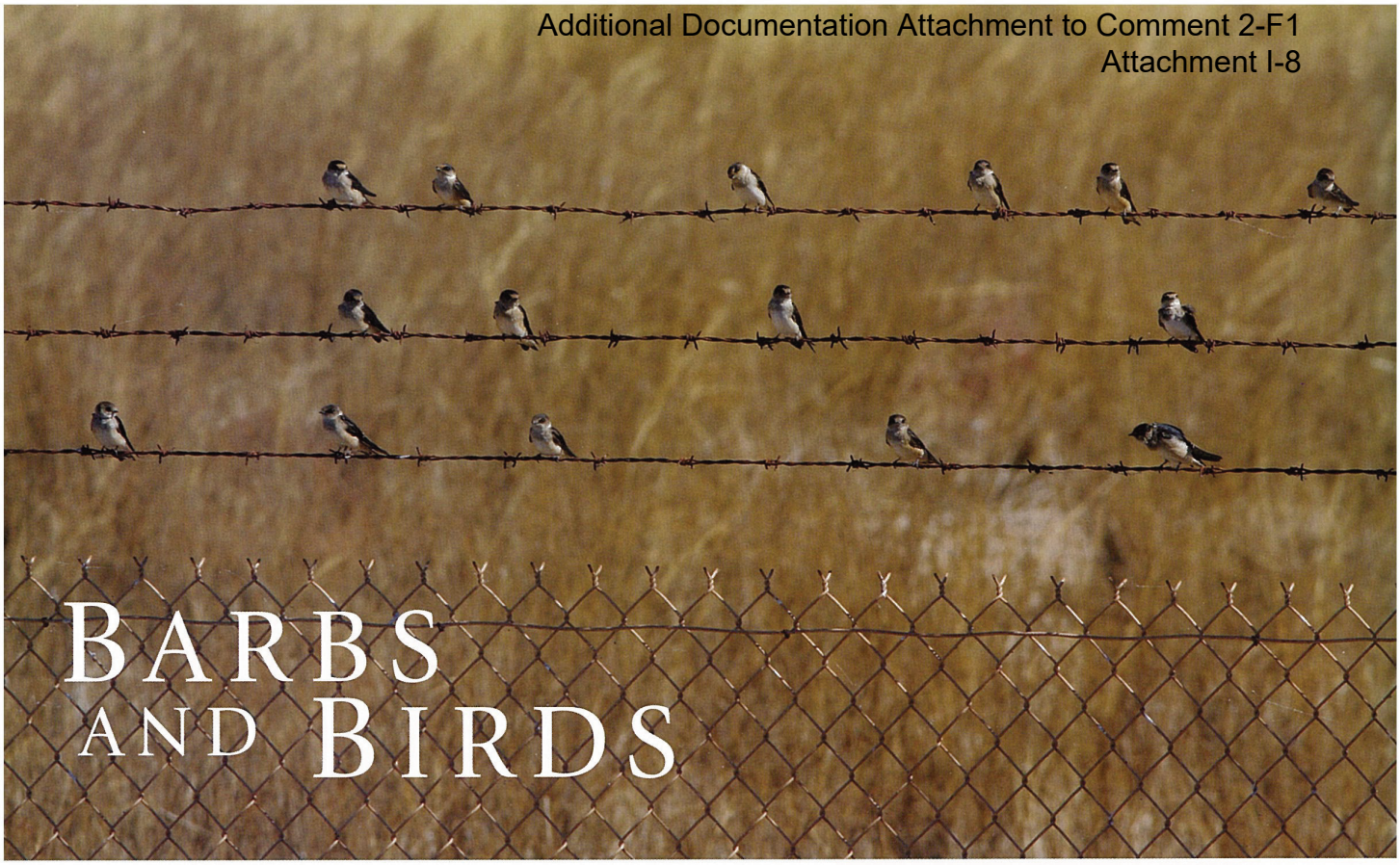
Mr. Cain has more than 55 years experience flying helicopters for wildlife surveys. Utility Helicopters, with their Hughes-500 helicopters, has assisted WRI in Golden Eagle and raptor surveys for the last 10 years in the United States and Mexico. Mel has 12 years of experience in New Zealand trapping and transporting big game including deer and elk. He has conducted hundreds of netting and translocations of Bighorn Sheep and Tule Elk in California for California Fish and Game and California State Parks. Mel works frequently in Mexico and Canada and maintains NAFTA and Mexican permits to conduct wildlife and resource surveys.

Gregg Matson, M.D.
Cherry Helicopter

Dr. Matson is a practicing physician who also started and headed a helicopter company in Hawaii to provide industrial and tourist services. Cherry Helicopter uses Hughes-500 helicopters to conduct these surveys. Gregg, WRI, and Cherry Helicopter have conducted wildlife surveys both in the United States and Mexico. He has supported WRI in aerial helicopter surveys of Golden Eagles, raptors and other wildlife for the last 8 years.

Barry Martin
Western Tracking Institute

Mr. Martin is a WRI Research Associate and Director of the Western Tracking Institute. He has a Bachelor's in Business from Fresno State and an Associate's degree in Aeronautics. He has 42 years of flying experience and 22 years in the Navy with over 300 aircraft carrier landings. Concurrent with his Navy experience, he flew for over 21 years as a pilot for American Airlines. In total, Barry has over 20,000 hours of experience in the air. In 1989, Barry started the San Diego Tracking Team and started the Western Tracking Institute in 2007 to further expand his studies in wildlife populations and movements. In 2006, he started VHF tracking from aircraft primarily for mountain lions and 2 years later, began assisting WRI in aerial VHF tracking of Golden Eagles.



BARBS AND BIRDS

Barbed wire snares many a bird, but the toll can be lessened

BY CAROL BOOTH

Clockwise from above:

Like notes on a page Tree Martins punctuate a barbed wire fence at Port Headland Sewage Works Western Australia. Birds as small as this rarely come to grief on the barbs, but they can fatally snag unlucky larger birds. Photo by **Rohan Clarke**

Barn Owls are among the most vulnerable of night flying birds to entanglement on barbed wire fences. Photo by **Rohan Clarke**

Even plain wire can be a trap for unlucky large, terrestrial animals. This photograph, taken in 1911, shows the remains of an Emu on a property in north-west New South Wales. The associated notes state: 'The unfortunate bird could not get away from this grip—it died no doubt of *thirst* and *starvation*. It will be noticed that the leg resting on the ground has made a hole underneath, through the bird kicking and struggling in its efforts to escape.' Photo by **Sidney Jackson** courtesy of the National Library of Australia

THE DEVIL'S ROPE recently snagged a rare beauty when a Night Parrot encountered something alien, barbed and final.

The discovery in September 2006 of a headless Night Parrot, killed by collision with a barbed wire fence in far western Queensland, made national news. After all, it was 17 years since the endangered bird was last definitely seen—that one also dead, hit by a vehicle. Prior to that, the survival of the Night Parrot hadn't been confirmed for 80 odd years.

The Night Parrot was a rare and famous victim of one of the cruellest hazards for wildlife. For some bats and gliders barbed wire is a recognised conservation threat. For other species, it is an occasional hazard, and a really horrible way to die. All up, there are reports of more than 70 species being found entangled in barbed wire fences in Australia, including about 50 birds.

While barbed wire was for a long time considered to be the only way to control stock, in most circumstances there are now other effective, including cost-effective, fencing choices. In this article I put the case for adopting other forms of fencing, for the sake of wildlife conservation and animal welfare. I also seek the help of birders in reporting information about wildlife entanglements, and landowners in assessing the effectiveness of wildlife-friendly fencing.

Barbed history

The invention of barbed wire was based on the well-founded principle that animals quickly learn to avoid that which inflicts pain.

Although it was invented several times, initially in France, barbed wire fencing took off on a large-scale with an 1874 patent by a US farmer. More than 600 different patents followed.

In North America, barbed wire was apparently cursed as the devil's rope (or hatband) by Native Americans cut off from traditional hunting grounds (and hindered in night raids on cattle) as well as by free-ranging cattlemen excluded from waterholes. The new barbed forms of fencing initially provoked loud protest—mainly because of injuries to horses and cattle, and the loss of access to water. In the Texas fence-cutting wars in the 1880s, gangs such as the Blue Devils and The Owls fought with cutters to keep the ranges open.

As a cost-effective way of carving up rangelands into paddocks, barbed wire fencing ushered in a rapid transformation of savannas and grasslands all over the world. By the early 1900s, for example, the Argentinean pampas was crisscrossed with enough barbed fencing to encircle the entire republic an estimated 140 times.

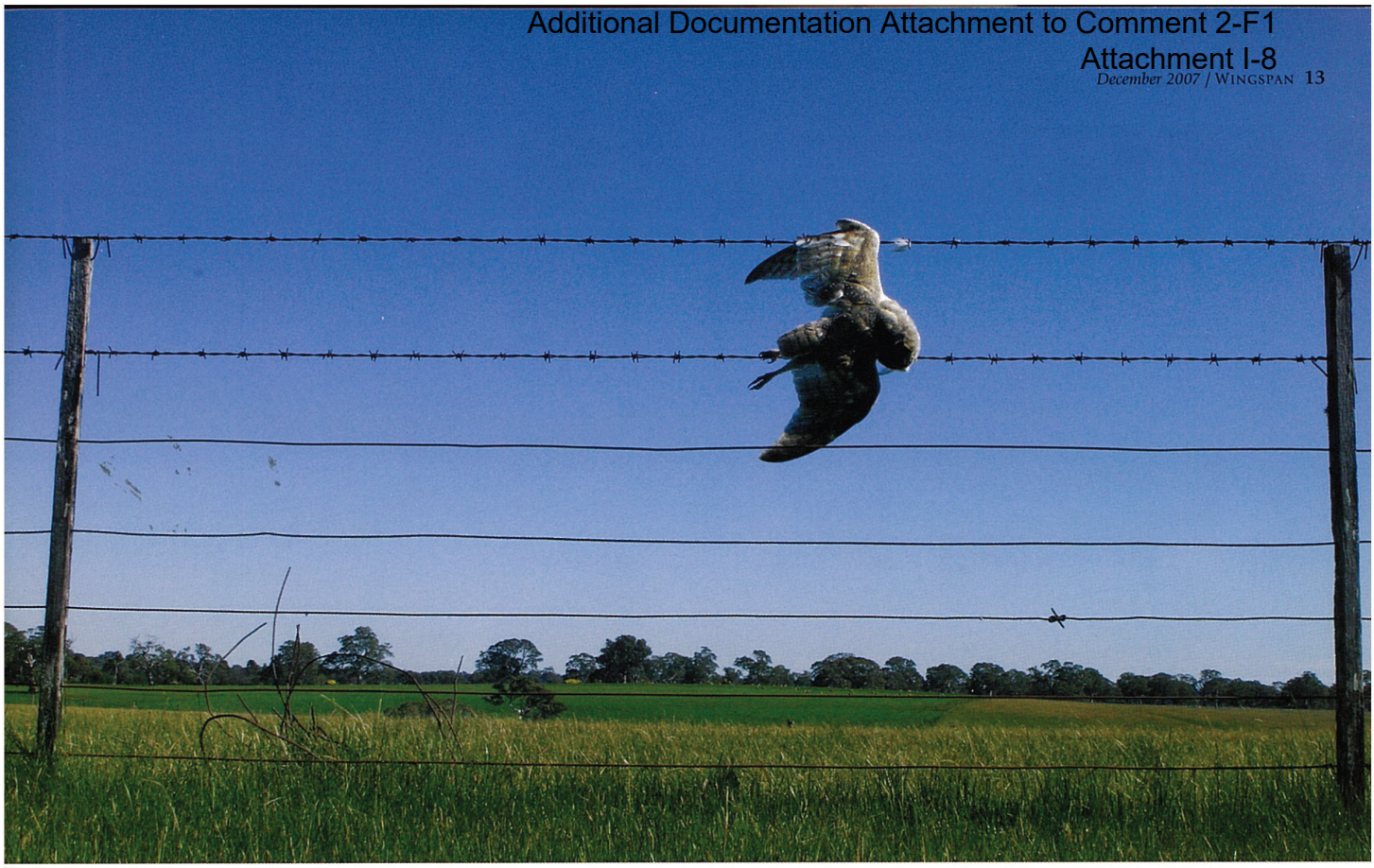
In Australia plain wire fencing had already done most shepherds out of jobs, says fencing historian John Pickard. Barbed wire became the norm soon after it became available here in the late 1800s.

By fencing off paddocks, as well as developing water points and ringbarking trees, Australian farmers were able to greatly increase stock numbers. Twenty million sheep in 1860 grew to more than 100 million just 30 years later (and peaked at 180 million in 1970).

No one can say how much fencing, let alone barbed wire fencing, exists in Australia. The last fencing census in the 1890s recorded 1.6 million kilometres of fences in New South Wales alone. According to Pickard, today 'tens of millions of kilometres of fences subdivide the landscape,' most of it barbed. In a national survey in which he recorded fence details at 3642 sites, Pickard found that 78 per cent of fences had barbed wire, and 65 per cent had barb as the top strand.

These days, much of the fencing, about 50,000 km a year, is being erected in the name of nature conservation, to keep stock away from planted trees, remnant

Additional Documentation Attachment to Comment 2-F1
Attachment I-8



vegetation, wetlands and rivers. And, fencing is not only rural—there are also barbs in the 'burbs, as the favoured method of security fencing.

Victims of barb

No one can say how many wildlife victims barbed wire claims. Most fences are not regularly checked by humans, and the thousands of animals rescued from barbs each year would represent a miniscule proportion of those caught. Predators and scavengers probably pick off most of the bodies within a day or two.

The sheer extent of barbed wire suggests a large toll—an ever-so-tentative guesstimate is 100,000 to 1 million a year.

Some bats and gliders are particularly vulnerable to barbed wire. On the Atherton Tablelands alone, 100 to 400 flying-foxes are rescued from barbs each year. In Western Australia, the loss of Ghost Bats to barbed wire fences is considered a conservation threat. And barbed wire is a significant cause of mortality for threatened Mahogany, Yellow-bellied and Squirrel Gliders.

Barbs seem to be of less conservation significance for birds. Nevertheless, poorly considered fencing around wetlands is considered an emerging threat for Brolgas and Sarus Cranes in some places (see Box) and barb entanglements (and fences in general) may be of concern with rare owls.

In the absence of data suggesting conservation threat, it is fair to say that for most birds barbed wire entanglements are mainly of welfare concern.

Which birds are the main victims and how do they become snagged?

Frogmouths, owls and raptors—perhaps swooping at or pursuing prey and failing to see a fence. Tawny Frogmouths and Southern Boobooks dominate rescue lists, but this could be due in part to their relatively greater prevalence in human-populated areas. Chris Lloyd, ornithologist with the New South Wales Wildlife Information and Rescue Service (WIRES), suggests that based on entanglement rates of these more common night birds, it would not be surprising if fences were a threat for some rarer owl species. In New South Wales, WIRES rescues dozens of raptors a year from barbs.

Emus—perhaps pursued by a dog and throwing themselves at a fence to get across, or even just quietly trying to get through and becoming entangled.

Large waterbirds, such as Brolgas and Black-necked Storks—with long legs dangling during take-off and landing, and struggling to get airborne, they may not



AR060468

Additional Documentation Attachment to Comment 2-F1
Attachment I-8





Above: Night flying bats are among the other casualties of the barbs; when found this Blossom Bat had only just died. Photo by **Jenny McLean**

Above right: An unfortunate Black-tailed Native Hen. Photo by **M. Driver**

quite clear a fence close to a wetland (see Box).

Other birds, of any sort really—with the sun in their eyes, or tired or being pursued, or at night, failing to see or clear a fence, or being unaware of a newly constructed fence. A recent story in the *Cairns Post* reported 50 Metallic Starlings ensnared by a construction site fence cutting across the flight path to their roost tree. One birder told me of rescuing an entangled Australian Magpie and a Pied Butcherbird on different occasions: each had been trailing string for their nest, which had been caught on a barb.

Lloyd notes that, barbed or not, fences are hazardous for birds such as frogmouths, owls and raptors, which may hit them at speed and break bones.

Snagging circumstances

In order to prioritise efforts to reduce the barb toll, it's important to understand the circumstances in which snagging most often occurs. Current information is that most wildlife is caught on the top strands of a fence. So, replacing the top couple of strands with plain wire would save many.

There are hotspots of entanglement—around wetlands, creeks and food trees and along ridgelines, for example. So, removing, moving or replacing barbed wire in fences in these localities is a priority.

Most entanglements occur at night, suggesting that many animals become snagged because they fail to see a fence. So, there may be strategies to make fences more visible, and various landholders are trying out used electric fence tape, old CDs, bunting, aluminium pie shells and aluminium tags to make fences more visible.

Other factors less amenable to management include inexperience (young animals are more susceptible), weather (particularly windy weather) and hard times (hungry animals are more prone to mistakes).

Fencing alternatives

The welcome news for wildlife is that barbed wire is no longer the only effective and cost-effective way to fence.

According to the farm fencing manual *Wires and Pliers*, highly tensioned plain wire fences are effective and can withstand high loads, except perhaps 'in the case of a direct collision … by a fast-moving heavy beast.' 'Plain wire works in pastoral areas' is the blunt title of the contribution to the manual by the Western Australian Department of Agriculture.

Central Queensland fencing contractor Ren Lanyon says highly tensioned plain wire is good for almost all

Rescuing wildlife entanglement

Barbed wire is a heartbreaking problem for wildlife carers. By the time an animal is found and a rescuer called, it has often been snagged for hours, sometimes days, exposed to the elements and twisting and flailing around. Typically, at least half of the animals rescued have to be euthanased because the damage is too great. The fortunate few often have to be in care for months while tissues heal.

Senior vet of the Australian Wildlife Hospital Dr Jon Hanger has the following advice for people who find entangled wildlife. Try to keep the animal calm and shaded by draping a light towel over it, and call a wildlife rescue organisation. However, if you are in a remote area or the animal is thrashing about and is likely to increase the extent of injury before help can arrive, you could try to release it from the fence. Restrain the animal with a towel, and cut the wire either side of the snagged flesh. However, *be very careful* when cutting a fence to avoid injury from wire that whips back upon release from tension.

Do not attempt to untwist the barbs from the flesh as that is likely to do more damage. Put the animal in a covered box and seek veterinary or wildlife care help.

All entangled animals should be examined under anaesthesia by a vet. Many injuries are not visible and will become apparent over time.

NOTE: Health authorities warn that people should not handle bats, because of the threat of lyssavirus infection, which is fatal for humans. If you are scratched or bitten by a bat you will need to be vaccinated.

Also note that cutting fences without permission of the landholder may be illegal.



The injuries sustained by a newly fledged Black-necked Stork when it became snagged on a barbed fence at Woodford Island, New South Wales, in 2003. It was taken to a veterinary hospital: the vet was hopeful, but the stork died. Photo by **Greg P. Clancy**

AR060469

Additional Documentation Attachment to Comment 2-F1
Attachment I-8



Left: A young Straw-necked Ibis, unable to clear the fence and fatally entangled. Photo by **Jenny McLean**

situations and cheaper than barb because it uses thinner wire, and fewer fence posts are needed, thus reducing the use of timber. It also has the benefit that is does not scar the hides of cattle, which would add value to Australia's cattle industry.

The major barrier to fencing reform seems to be habit. Lanyon says he has been trying to persuade graziers to use plain wire for a couple of decades, but there is reluctance to risk a new approach when barbed wire has worked for generations.

Changing a fencing culture

Internationally, there are moves away from barbed wire. In Europe many local and county governments have already banned barbed wire fencing for its impact on wildlife, and there are moves within the European Union animal welfare sector to have it banned Europe-wide.

In the US, some environment groups are working to remove or replace barbed wire fencing due to its impacts on birds and grazing animals. In addition, in the tradition of the fence-breachers of the late 1800s, some 'eco-guerillas' have been taking to barbed wire fences on public lands with cutters.

In Australia, the Wildlife Friendly Fencing project (see www.wildlifefriendlyfencing.com), with funding from the Threatened Species Network (WWF), is working with landholders to identify and promote alternative approaches to fencing. The project is coordinated by the Tolga Bat Hospital on the Atherton Tablelands, and supported by wildlife and welfare groups.

One of the project goals is to gather better information about fencing impacts. If you have seen entangled wildlife (dead or alive), please record it on a form accessible on the fencing website. The information will go into a database to analyse the extent and patterns of entanglements.

Another goal is to support landholder champions of wildlife-friendly fencing by assisting with fencing materials and reporting on approaches being tried. For example, project coordinator Jenny Maclean reports that one landholder in a bat entanglement hotspot is topping an existing barbed wire fence with used white electric fence tape to make it more visible. Another has replaced the top strand of barb with a glow-in-the-dark nylon fencing material. Another is moving a fence from the top of a ridge to a safer location.

The wildlife-friendly fencing website also hosts a draft action plan on barbed wire, which summarises existing information on barbed wire problems and options for mitigation and prevention. Your feedback on this plan is welcomed.

Fences are one of the prominent marks of human civilisation—you can be way out whoop-whoop in Australia, but the human stamp on the landscape is there at least in the form of a fence. When asked what he thought about British civilisation, Gandhi was said to have remarked that it would be a good idea. Taking our cue from Gandhi, it would be a very good idea to adopt a more civilised fencing culture that embodies the best of humanity—our capacity for empathy and concern for other creatures—and move on from the barbarity of barbs.

CAROL BOOTH *is the author of the* Draft Barbed Wire Action Plan *(2007), available at www.wildlifefriendlyfencing.com*

Further reading:

Casey, M. (ed.) 1994. *Wires & Pliers: The Farm Fencing Manual.* Kondinin Group, Belmont (to be re-issued on CD).

Krell, A. 2002. *The Devil's Rope: A Cultural History of Barbed Wire*. Reaktion Books, London.

van der Ree, R. 1999. Barbed wire fencing as a hazard for wildlife. *The Victorian Naturalist* 116 (6): 210–217.



Brolgas hemmed in by a barbed wire fence near Eulo, Queensland. Photo by **Glen Fergus**

Cranes and fences

Ironically, one of the emerging threats for Sarus Cranes and Brolgas in northern Australia is conservation-motivated fencing of wetlands that fails to consider how these birds use wetlands. The Australian Crane Network (see http://ozcranes.net) is urging closer consideration of fencing methods.

Cranes need plenty of room around wetlands for take-off, landing and displaying. With long legs dangling for landing and take-off and wingspans over two metres, they are vulnerable to entanglement, particularly in barbed wire fences.

Fences too close to water prevent their run-up to flight and other land-based behaviours. Fences may also prevent young from leaving a wetland until they fledge (at about 14 weeks age), and so increase risks of predation and stranding or drowning if the wetland is flooded, as well as the effort needed by parents to feed their trapped chick.

Fences that totally exclude grazing sometimes result in wetlands becoming over-grown with weeds or shrubs and thereby lost as habitat for cranes.

OzCranes Network recommends the following fencing approaches:

- **use safer materials (not barbed wire)**
- **mark the top wire near flight paths (to alert birds to its presence)**
- **fence a larger area (which could include scattered trees) well back from water**
- **install gates for management access**
- **control rank growth as part of scheduled property management (grazing, fire, chemical, or mechanical).**

AR060470

From:	Marsden, Kim
To:	Don Copeland
Cc:	Magdalena Rodriguez; Shankar Sharma; Tera Baird; Jody Fraser; Thomas Dietsch; Joel Pagel
Subject:	Agency comments on the Quartzite avian work plan
Date:	Friday, April 05, 2013 2:56:58 PM
Attachments:	Quartzite Avian Work Plan 040213_klm cmts 4_2_13 pagel comments 05 april 2013.docx Quartzite Avian Work Plan 040213_klm cmts_TVD 4_2_13 (3).docx

Don, here are the comments on the Work Plan from BLM, FWS, and FWS mig birds division. Call me Monday a.m. to arrange an agency call. Have a good weekend. -Kim

--

Kim Marsden
Natural Resource Specialist
Bureau of Land Management
California Desert District
Renewable Energy Coordinating Office
22835 Calle San Juan de los Lagos
Moreno Valley, CA 92553
951-697-5223

> *In spring at the end of the day you should smell like dirt~ Margaret Atwood*

From: Baird, Tera
To: Pete Sorensen
Cc: Jody Fraser
Subject: DRECP Mortality Reports for REAT
Date: Tuesday, May 14, 2013 4:11:45 PM
Attachments: 20130514_DPV2_mortality_events_excel.xls
20130514_MFTL_Mortality_Genesis_Reports.pdf
20130513_Genesis Avian Mortalities.pdf
20130510_Avian_Bat_Mortality_Map.pdf
20130508_Desert_Sunlight_Avian Mortality Table_Revised.docx

Pete:

I've attached the mortality reports in one email for the NEPA analyses:

DPV2 Mortality Reports
Desert Sunlight Avian Report Table/Map
Genesis Avian Report Portfolio
Genesis MFTL Report Portfolio

I've requested a kit fox mortality report for Genesis - I will forward when it get it...

Tera Keeler Baird
Biologist
777 East Tahquitz Canyon Way, Suite 208
Palm Springs, California 92262

From:	Massar, Mark
To:	Jody Fraser; Magdalena Rodriguez
Cc:	Kim Marsden; Jason Langteau
Subject:	Fwd: 2013 First Quarter report for Biological Monitoring Activities at Desert Sunlight
Date:	Monday, June 10, 2013 12:34:29 PM
Attachments:	image001.png DRAFT_Desert Sunlight 2013 1st Quarter Report.docx

---------- Forwarded message ----------
From: **Kathy Buescher Simon** <kathy@ironwoodconsultinginc.com>
Date: Mon, Jun 10, 2013 at 11:41 AM
Subject: 2013 First Quarter report for Biological Monitoring Activities at Desert Sunlight
To: mmassar@blm.gov
Cc: Amanda Beck <ABeck@firstsolar.com>, Therese Carpenter <therese.carpenter@firstsolar.com>

Here you go – might be too large to get through to you, so I will also try to get it to you on our cloud site.

Kathy Buescher Simon

Ironwood Consulting, Inc

1653 W. Cypress Ave., Redlands, CA 92373

(909) 798-0330 phone and fax

www.ironwoodconsultinginc.com

--

Mark Massar, Wildlife Biologist
Bureau of Land Management
Palm Springs-South Coast Field Office

1201 Bird Center Drive
Palm Springs, CA 92262-8001
(760) 833-7121

BIOLOGICAL RESOURCES TECHNICAL REPORT
DESERT QUARTZITE SOLAR PROJECT
BLM CASE FILE NUMBER CACA-49397
RIVERSIDE COUNTY, CALIFORNIA



Prepared for

DESERT QUARTZITE, LLC

135 Main Street, 6th floor

San Francisco, CA 94105

Prepared by:

IRONWOOD CONSULTING INC.

1040 Nevada Street, Suite 301

Redlands, CA 92374

Date

January 2014

TABLE OF CONTENTS

LIST OF ACRONYMS vii

SUMMARY ix

1.0 INTRODUCTION 1
- 1.1 PURPOSE 1
- 1.2 SITE LOCATION 1
- 1.3 SITE CHARACTERISTICS 1
- 1.4 STUDY AREA 1
- 1.5 PROJECT SUMMARY 3

2.0 METHODS 4
- 2.1 SPECIAL STATUS SPECIES DEFINITION 4
- 2.2 PRELIMINARY MAPPING 4
- 2.3 SOILS 4
- 2.4 RAINFALL ANALYSIS 6
- 2.5 STUDY PLAN 6
- 2.6 BASELINE SAMPLING 7
- 2.7 BOTANICAL STUDY 7
  - 2.7.1 Special Status Plant Species 7
  - 2.7.2 Cacti and Yucca 10
  - 2.7.3 Desert Dry Wash Woodland and Vegetation Communities 10
  - 2.7.4 Non-Native and Invasive Species 10
- 2.8 AMPHIBIANS 11
- 2.9 REPTILES 11
  - 2.9.1 Desert Tortoise Focused Surveys 11
  - 2.9.2 Mojave Fringe-Toed Lizard and Herpetofaunal Surveys 13
- 2.10 AVIAN 13
  - 2.10.1 Line Transect Sampling 15
  - 2.10.2 Burrowing Owl Surveys 16
  - 2.10.3 Golden Eagle Surveys 18
  - 2.10.4 Elf Owl Surveys 19
  - 2.10.5 Nesting Raptor/Raven Surveys 19
- 2.11 MAMMALS 20
  - 2.11.1 Small Mammal Surveys 20
  - 2.11.2 Desert Kit Foxes 20
  - 2.11.3 Bats 20

3.0 RESULTS 25
- 3.1 BOTANICAL STUDIES 25
  - 3.1.1 Special Status Plant Species 25
  - 3.1.2 Cacti and Yucca 40
  - 3.1.3 Vegetation Communities 40
  - 3.1.4 Non-Native and Invasive Species 44
- 3.2 RAINFALL ANALYSIS 47
- 3.3 AMPHIBIANS 47
- 3.4 REPTILES 47
  - 3.4.1 Desert Tortoise 47
  - 3.4.2 Mojave Fringe-Toed Lizard and Herpetofaunal 50
- 3.5 AVIAN 54

3.5.1 Migratory Bird Surveys 54
3.6 MAMMALS 65
3.6.1 Small Mammal Surveys 65
3.6.2 Desert Kit Foxes 65
3.6.3 Bats 66
3.6.4 Other Species Noted During Surveys 71
4.0 RECOMMENDED PROTECTION MEASURES 73
4.1 GENERAL MEASURES 73
4.2 BOTANICAL STUDY 75
4.2.1 Special Status Plant Species 75
4.2.2 Cactus and Yucca 75
4.2.3 Desert Dry Wash Woodland and Vegetation Communities 75
4.2.4 Non-Native and Invasive Species 75
4.3 AMPHIBIANS 76
4.4 REPTILES 76
4.4.1 Desert Tortoise 76
4.4.2 Mojave Fringe-Toed Lizard and Herptofauna 78
4.5 AVIAN 78
4.5.1 Western Burrowing Owl 79
4.5.2 Golden Eagle 79
4.5.3 Elf Owl 80
4.5.4 Nesting Raptor/Raven Surveys 80
4.6 MAMMALS 80
4.6.1 Small Mammals 80
4.6.2 Desert Kit Fox 80
4.6.3 Bats 80
4.7 COMPENSATORY MITIGATION 81
5.0 REFERENCES 82

LIST OF FIGURES

Figure 1 Regional Setting 1
Figure 2 Study Area 2
Figure 3 Soil Types 5
Figure 4 Baseline Points 8
Figure 5 Standing Water 12
Figure 6 Migration Survey Points 14
Figure 7 Line Transect Locations 17
Figure 8 Acoustic Bat Monitor Locations 22
Figure 9 Combined Rare Plants 27
Figure 10 Harwood's Milk Vetch (*Astragalus insularis* var. *harwoodii*) Distribution 30
Figure 11 Abram's Prostrate Spurge (*Chamaesyce abramsiana*) and Utah Vine Milkweed (*Funastrum utahense*) Distribution 32
Figure 12 Ribbed Cryptantha (*Cryptantha costata*) Distribution 35
Figure 13 Harwood's Eriastrum (*Eriastrum harwoodii*) Distribution 36

Figure 14 Desert Unicorn Plant (*Proboscidea althaeifolia*) Distribution 39
Figure 15 Vegetation Map 42
Figure 16 Sahara Mustard (*Brassica tournefortii*) Distribution 45
Figure 17 Desert Tortoise Sign 49
Figure 18 Mojave Fringe-Toed Lizard (*Uma scoparia*) Distribution 52
Figure 19 Burrowing Owl Sign Spring 2013 59
Figure 20 Observed BUOW Territories During Breeding Season 62
Figure 21 Active Kit Fox Burrows/Camera Locations 67

LIST OF TABLES

Table 1 Adjacent Land Use 1
Table 2 Desert Tortoise Data Recorded 13
Table 3 Migration Point Location 15
Table 4 Transect Beginning and End Points (A and B) 16
Table 5 Special Status Plants Found on Site 26
Table 6 Non-Native Plants Found on Project Site (Fall 2012 and Spring 2013) 44
Table 7 Historical Winter Rainfall Data (inches)[1] 47
Table 8 Rainfall 2012 and 2013 (inches)[1] 47
Table 9. Lizards Found on Project Site 51
Table 10. Snakes Found on Project Site 51
Table 11.Migration Point Visits-Spring 2013 54
Table 12.Migratory Birds Detected Per Visit- Spring 2013 55
Table 13 Migratory Bird Survey Results Summary- Spring 2013 55
Table 14. Summary of Line Transect Surveys Conducted 18 April Through 20 May 2013 56
Table 15 Burrowing Owl Phase II Results from Fall 2012 and Spring 2013 57
Table 16. Determination of Burrows Occupied by Burrowing Owls Prior to Breeding Season 60
Table 17.Burrows Occupied During Breeding Season 60
Table 18 Bird Nests (Including Raptor/Raven) Detected on the Project Site, Spring 2013 64
Table 19 Baseline Points: Small Mammals, April 2013 65
Table 20.Desert Kit Fox Presence, April 2013 66
Table 21.Bats Potentially Occurring Near the Project Site 70
Table 22.Minutes Per Night of Acoustic Activity by Site and Species or Acoustic Category 71

LIST OF PHOTOGRAPHS

Photograph 1 Detector 5, Microphyll Woodland 23
Photograph 2 Harwood's Milkvetch (*Astragalus insularis* var. *harwoodii*) 29
Photograph 3 Abram's Spurge (*Euphorbia amgramisana*) (R), growing next to common *Euphorbia micromeria* (L) 29
Photograph 4 Ribbed Cryptantha (*Cryptantha costata*) (L) growing alongside the common *Cryptantha angustifolia* 34

Photograph 5 Harwood's Eriastrum (*Eriastrum harwoodii*) 34
Photograph 6 Desert Unicorn Plant (*Proboscidea althaeifolia*) 38
Photograph 7 Desert Dry Wash Woodland 38
Photograph 8 Sonoran Desert Scrub 43
Photograph 9 Sand Dunes 43
Photograph 10 *Uma scoparia* Male, Captured for Identification to the species level 53
Photograph 11 Desert Kit Fox Family Captured on Camera on Project Site, April 29, 2013 68

APPENDICIES

Appendix A	Rainfall Data
Appendix B	Species Detected (Non-Avian) – Primary Study Area
Appendix C	Special Status Target Plant Species
Appendix D	Quartzite Migratory Bird Survey Protocol
Appendix E	Quartzite Avian Line-Transect Survey Protocol
Appendix F	Quartzite Fall 2012 and Spring 2013 Plant List
Appendix G	Quartzite Avian Species List, Spring 2013
Appendix H	Phase III Burrowing Owl Survey Results 2013

LIST OF ACRONYMS

ACEC	Area of Critical Environmental Concern
amsl	above mean sea level
BBCS	Bird and Bat Conservation Strategy
BLM	U.S. Bureau of Land Management
BO	Biological Opinion
BRTR	Biological Resources Technical Report
BUOW	Burrowing Owl
CAA	California Airport Authority
CDFW	California Department of Fish and Wildlife
CDNPA	California Desert Native Plant Act
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CHU	Critical Habitat Unit
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CNPSEI	California Native Plant Society's Electronic Inventory
DDWW	Dry desert Wash Woodland
Dr	Doctor
DTCC	Desert Tortoise Conservation Center
DWMA	Desert Wildlife Management Area
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FESA	Federal Endangered Species Act
ft	Feet
GBBO	Great Basin Bird Observatory
GPS	Global Positioning System
HMA	Herd Management Area
HMANA	Hawk Migration Association of North America
HMP	Habitat Management Plan
I-10	Interstate 10
IWMP	Integrated Weed Management Plan
kHz	Kilohertz

kv	Kilovolt
m	Meter
MBTA	Migratory Bird Treaty Act
MCL	Mean carapace length
mm	Millimeters
MP	Migratory Point
mph	Miles per hour
NECO	Northern and Eastern Colorado Coordination Plan
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
O&M	Operations and Maintenance
OHV	Off-Highway Vehicle
POD	Plan of Development
PST	Pacific Standard Time
PV	Photovoltaic
ROW	Right of Way
SCE	Southern California Edison
SSC	Species of Special Concern
URTD	Upper respiratory tract disease
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VRMP	Vegetation Resources Management Program
WEAP	Workers Environmental Awareness Program

SUMMARY

Desert Quartzite, LLC has requested a right-of-way grant from the Bureau of Land Management (BLM) to construct and operate a new solar photovoltaic energy generating facility in unincorporated Riverside, California near the interstate boundary of California and Arizona, just east of Blythe in Riverside County, California (Case File Number CACA-49397). The solar facility and associated generation interconnection line are collectively referred to in this report as the Desert Quartzite Solar Project (Project). The Project site is located outside the boundaries of any Area of Critical Environmental Concern, Desert Wildlife Management Area, Wilderness Area, or designated Critical Habitat Unit.

This report provides a comprehensive description of methods and results of biological resource surveys and investigations conducted in fall of 2012 and spring of 2013 within the Study Area (See Section 1.4). The purpose of the surveys was to provide information supporting consultation between BLM, United States Fish and Wildlife Service (USFWS), and California Department of Fish and Wildlife (CDFW) with respect to the California and Federal Endangered Species Acts, National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Survey standards and recommended protection measures described in this report are consistent with the Best Management Practices and Guidance Manual: Desert Renewable Energy Projects (Renewable Energy Action Team 2010).

Focused botanical surveys resulted in the documentation of six special status (California Native Plant Society list status) plant species within the Study Area including Harwood's milkvetch (*Astragulus insularis var. harwoodii*), Abram's spurge (*Chamaesyce abramsiana*), ribbed cryptantha (*Cryptantha costata*), Harwood's eriastrum (*Eriastrum harwoodii*), Utah vine milkweed (*Funastrum utahense*) and desert unicorn-plant (*Proboscidea althaeifolia*). More than 124 species of plants were identified during the surveys. Federal or state listed (endangered or threatened) plant species were not observed.

Full-coverage surveys for desert tortoise (*Gopherus agassizii*), the only animal species listed as federal and state endangered with potential to occur on site, was conducted in 2013. Tortoise sign observed during survey consisted of six carcasses, all-greater than 4 years old and disarticulated, and one set of tortoise tracks. Live desert tortoise were not observed during surveys.

Numerous Mojave fringed-toed lizards (*Una scoparis*), which is a species of concern, were found while performing surveys in the western portion of project where soils consist of much finer sand. Other special status wildlife species observed or likely to occur within the Project site included loggerhead shrike (*Lanius ludovicianus*), burrowing owl (*Athene cunicularia*), LeConte's thrasher (*Toxostoma lecontei*), American badger (*Taxidea taxus*), desert kit fox (*Vulpes macrotis arsipus*), pallid bat (*Antrozous pallidus*), small-footed myotis (*Myotis ciliolabrum*), and Townsend's big-eared bat (*Plecotus townsendii*).

1.0 INTRODUCTION

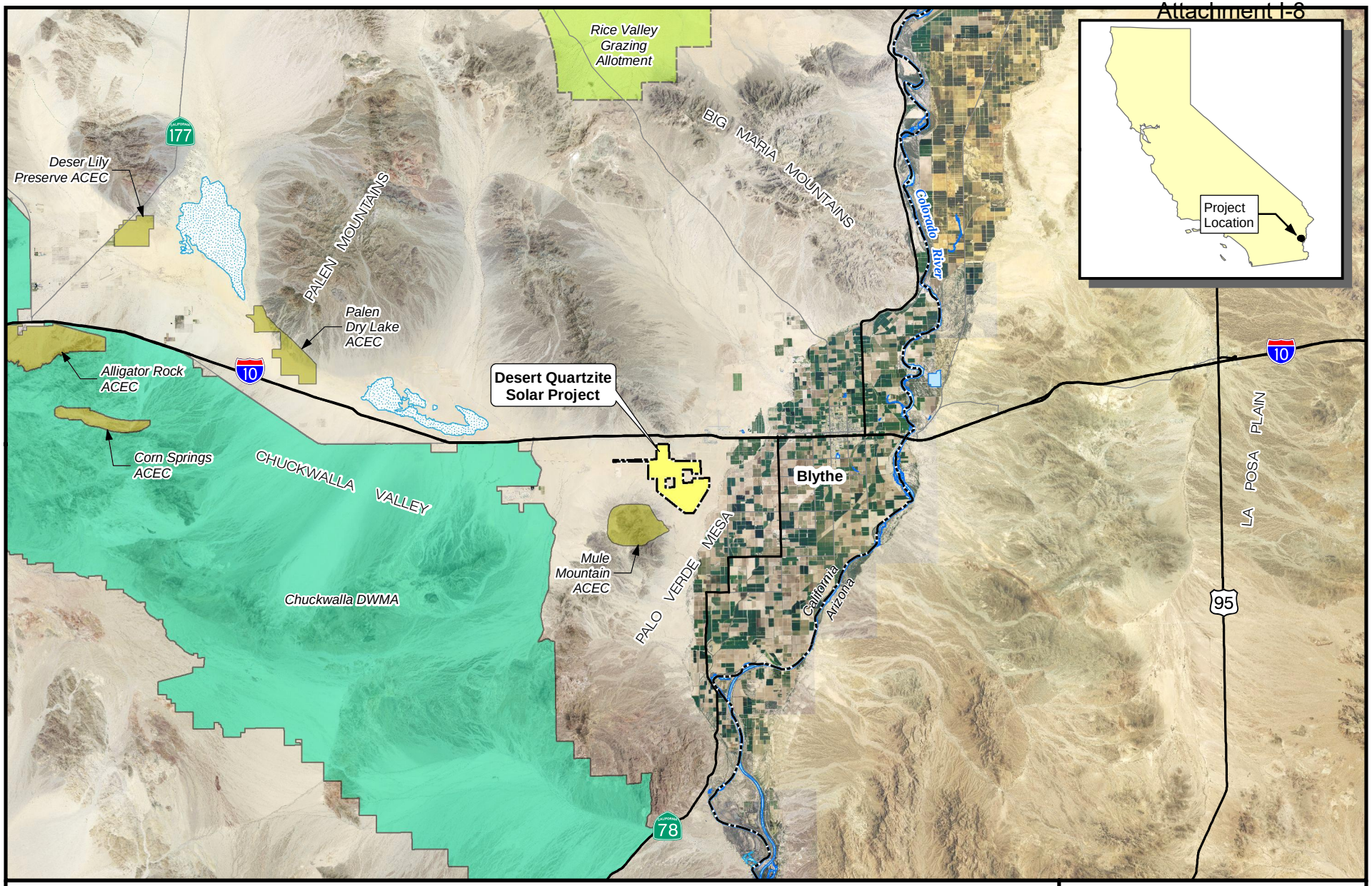
1.1 PURPOSE

This Biological Resources Technical Report (BRTR) provides a comprehensive description of methods and results of biological resource surveys and investigations conducted to date within the Study Area (See Section 1.4) for the Desert Quartzite Solar Project (Project) as proposed by Desert Quartzite, LLC. The purpose of the surveys is to support consultations between Bureau of Land Management (BLM) and United States Fish and Wildlife Services (USFWS) under Section 7 of the Federal Endangered Species Act (FESA), and any necessary incidental take authorization from the California Department of Fish and Wildlife (CDFW) with respect to the California Endangered Species Act (CESA). The data contained within this report also provides information to promote compliance with requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Survey standards and recommended protection measures described in this report are consistent with the Best Management Practices and Guidance Manual: Desert Renewable Energy Projects (Renewable Energy Action Team 2010).

1.2 SITE LOCATION

The Project site is located in unincorporated Riverside, California. It is situated south of Interstate 10 (I-10), approximately ten miles west of the City of Blythe, California (Figure 1). The Project site is located on the Ripley and Roosevelt Mine 7.5-Minute United States Geological Survey (USGS) topographic quadrangle. Elevation at the site ranges from approximately 320 to 475 feet above mean sea level (amsl). The Project is located on the Palo Verde Mesa within BLM land designated as Multiple-Use Class M (Moderate Use). The Project site is located outside the boundaries of any Area of Critical Environmental Concern (ACEC), Desert Wildlife Management Area (DWMA), BLM wilderness area, or USFWS designated critical habitat unit for desert tortoise. The Mule Mountains ACEC, which was established to manage prehistoric resources, is located less than one mile west of the Project site. The Chuckwalla DWMA for desert tortoise is located approximately twenty miles west and the current Herd Management Area (HMA) for burros is located approximately five miles south of the Project site. Please see Table 1 for additional adjacent land uses.

P:\GIS\Ironwood\Desert_Quartzite\Region.mxd



State Boundary

Proposed Desert Quartzite Site Boundary

BLM Grazing Allotment

Area of Critical Environmental Concern (ACEC)

Desert Wildlife Management Area (DWMA)

N

0 5 10
Miles

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 1

Regional Setting

AR060485

Table 1 Adjacent Land Use

Direction	Land Uses
North	McCoy Mountains; McCoy Wash; BLM Limited MUC land with interspersed privately owned land and an existing solar farm, small single family home community of Mesa Verde, Interstate 10
East	Palo Verde Valley; privately owned agricultural land; some fallow land
South	Southern extent of Palo Verde Mesa; Mule Mountains; BLM Limited MUC land with interspersed privately owned land
West	Southern California Edison's Colorado River Substation; Mule Mountains; BLM Moderate and Limited MUC land with interspersed privately owned land

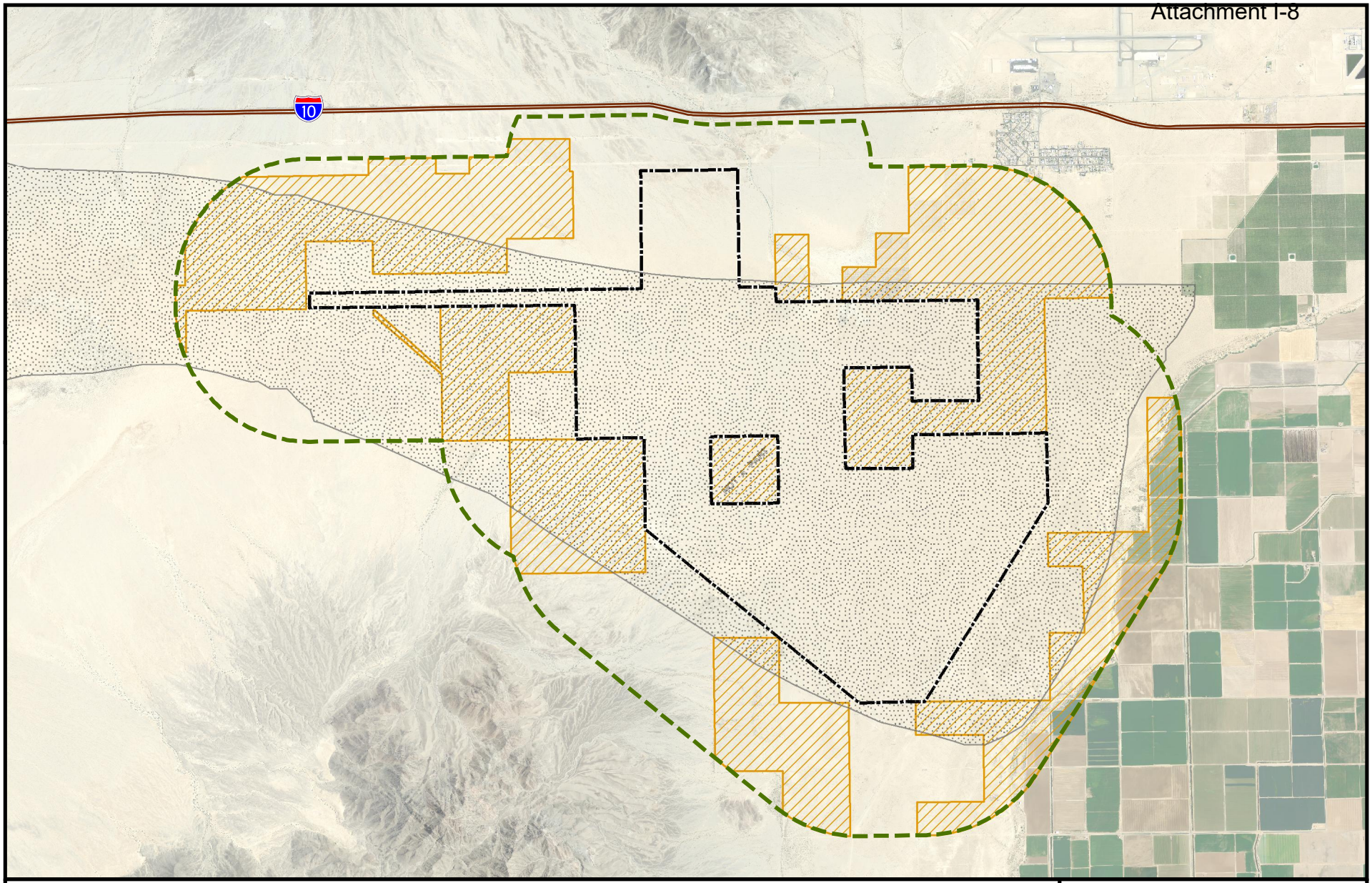
1.3 SITE CHARACTERISTICS

Based on visual observations of surface soils, soils within the Project site appear to be dominated by gravely sands and sandy loams, and ranged in texture from very fine sand to gravel. Formal site soil data from the Natural Resources Conservation Service (NRCS) is not available in the northwest portion of the Project site. Desert pavement is present in the extreme northwest and southwest limits of the Project site. Human disturbances within the Project site include off-highway vehicle (OHV) activity, existing utility corridors (i.e., overhead power transmission lines and underground petroleum pipeline), residential trash dumping and access roads for both utilities and fallow agriculture sites.

1.4 STUDY AREA

For the purposes of this report, the Project site is the area that was described in the updated Application for Transportation and Utility Systems and Facilities on Federal Lands (SF 299). This updated version decreased the size of the Project site from 7,272 acres to the current 4,885 acres. The Project site includes the electrical generation interconnection (gen-tie) transmission line to the existing Southern California Edison's (SCE) Colorado River Substation. Generally, the Study Area is the combination of the Project site and a one-mile buffer around the Project site (Figure 2). Specific species survey protocols may require a buffer larger or smaller than the one established for this project (e.g., golden eagles and bats). This buffer area will allow for adjustments to access roads and or other project related activities outside of the current proposed location. Since the gen-tie line is included as part of the Project site, the Study Area buffer was also included around this area.

P:\GIS\Ironwood\Desert_Quartzite\Study Area.mxd



1-Mile Site Boundary Buffer
Desert Quartzite Site Boundary
Sand Corridor
Private Lands

N

0 1
Miles

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 2

Study Area

AR060487

1.5 PROJECT SUMMARY

The Project, as proposed, is described in general terms below. Specific details of the Project description are included in other related documents including the Plan of Development (POD). The Project would include the solar facility (where the electrical power will be generated) and a 300-kilovolt (kV) transmission line (gen-tie Line). The solar facility would consist of several main components, all located within the Project security and permanent desert tortoise fencing:

- Main Generation Area – Photovoltaic (PV) arrays, combining switchgear, overhead lines, and access corridors;
- Operations and Maintenance (O&M) Facility;
- On-site substation; and
- Fencing and lighting.

The Project would interconnect with the regional transmission system via a 300-kV single-circuit gen-tie line that will be located on the western portion of the Project site and follow a 160-foot-wide transmission right of way (ROW) to the existing SCE's Colorado River Substation located approximately one mile west of the solar facility's western boundary. Construction of the Project would be completed in three basic phases: 1) pre-construction activities, 2) site preparation; and 3) construction and installation of the solar photovoltaic (PV) modules and electrical components, including the gen-tie line.

2.0 METHODS

2.1 SPECIAL STATUS SPECIES DEFINITION

For assessment purposes in this report, a special status species has been defined as a plant or wildlife species that meets one or more of the following criteria:

- Designated as either rare, threatened, or endangered by CDFW or the USFWS, and are protected under either CESA or FESA;
- Candidate species being considered or proposed for listing under these same Acts;
- Species of special consideration as referenced in the Northern and Eastern Colorado Coordinated Coordination Plan (NECO) and Final Environmental Impact Statement (FEIS) (Bureau of Land Management 2002) and Biological Opinion for the NECO Plan (United States Fish and Wildlife Service 2005);
- State Species of Special Concern as designated by CDFW;
- Considered endangered, threatened, or rare pursuant to CEQA Guidelines, Section 15380; or
- Considered listed under by California Native Plant Society (CNPS).

2.2 PRELIMINARY MAPPING

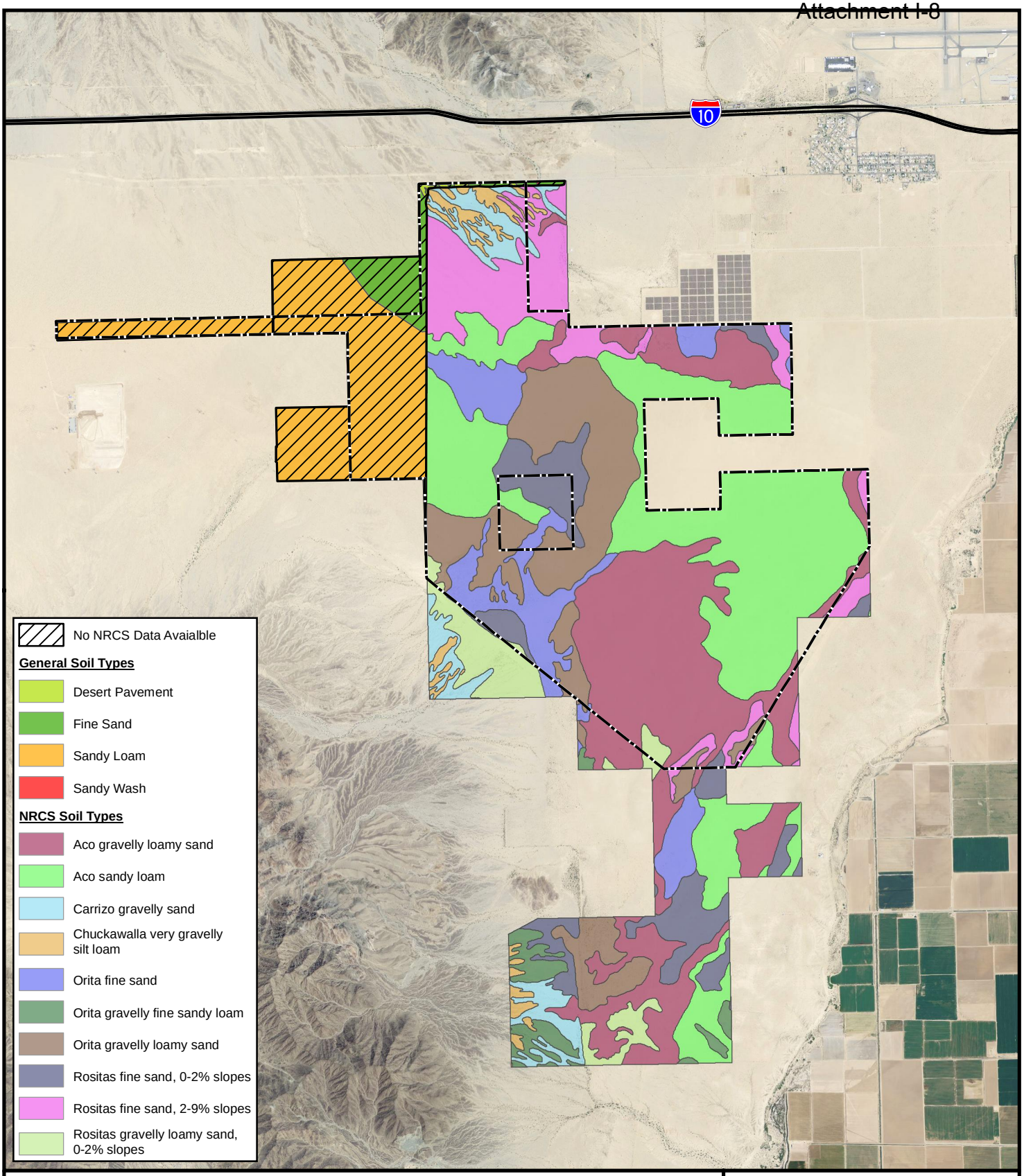
A large-scale aerial photograph of the Study Area was created and used to preliminarily map vegetation communities, soil substrates, and other areas of interest during the survey. Such areas included those that appeared to have unique plant assemblages or areas of interest under NECO including desert dry wash woodland habitat. The preliminary mapping effort allowed surveyors to focus on areas most likely to support special status species and habitats, while characterizing each type of vegetation community and soil substrate.

The 2008 mapping was for a project site approximately 7,272 acres. The current Project site is 4,885 acres. The southern portion of the original site boundary has been removed.

2.3 SOILS

Soils within the Project site are dominated by gravely sands and sandy loams, and ranged from very fine sand to gravel (Figure 3). The Natural Resources Conservation Service (NRCS) Web Survey contained data for the majority of the Project site. NCRS data is not available for the northwest portion of the Project site.

P:\GIS\Ironwood\Desert_Quartzite\Soils.mxd



Proposed Desert Quartzite Site Boundary

N

0 1
Miles

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 3

Soil Types

2.4 RAINFALL ANALYSIS

Measurements of total and average precipitation during winter periods (October through March) are important in determining the efficacy of both desert tortoise and special status plant surveys. Per the USFWS desert tortoise protocol, data was obtained from the Western Regional Climate Center (2013). The Blythe CAA Airport, California weather station (elevation 390 feet (ft) above mean sea level (amsl), approximately three miles north of the Project site and is the most proximate station. The rainfall data that was obtained and utilized for the surveys can be located in Appendix A.

2.5 STUDY PLAN

Several species of flora and fauna known to occur on or near the Project are accorded "special-status" by federal and state agencies because of their recognized rarity or potential vulnerability to extinction. These species typically have a limited geographic range and/or limited habitat and are collectively referred to as "special-status" species. Additional species protected by other regulations within the region were added to the overall species survey list and are referred to in this document as the target species. According to the NECO Plan (BLM and CDFW 2002) surveys must be completed where a project intersects the species' ranges as represented and mapped within the plan. Since, the Project site is within NECO, species covered in this document but not necessarily recognized as a "special status" species were added to the target species list. Managed big game species and burros (protected by the Wild Free-Roaming Horse and Burro Act) were also included as target species. Desert kit fox (*Vulpes macrotis*) being a protected furbearer, per California Department of Fish and Game Code (California Department of Fish and Wildlife 2013a), was also included as a target animal species.

Comprehensive biological resource surveys designed to meet all applicable USFWS, BLM, and CDFW requirements were performed in the fall of 2012 and in spring 2013. Surveys for biological resources were conducted within the Project site and up to a one-mile buffer around the proposed disturbance area. The entire 4,855-acre survey area with the buffer area will collectively be called the Study Area within this BRTR. (The Project Site Boundary and the Site Boundary Buffer depicted on Figure 2 make up the Study Area.) Any modifications to this Study Area due to specific protocol or guideline changes will be discussed for the species for which they occur. During the fall of 2012 and spring of 2013, a full focused rare plant survey was performed on the Project site. In addition to the focused rare plant surveys, project biologists completed the following surveys within the Study Area: vegetation mapping, general wildlife surveys, protocol desert tortoise surveys, protocol western burrowing owl surveys and avian point count and migration surveys. Other studies performed on site were the spadefoot and elf owl habitat assessments and the protocol golden eagle surveys. The section below details the specific methodologies and protocols utilized for the Project's biological resources surveys within the Study Area.

"Established protocols," which in this case is a species listed as threatened or endangered by the federal or state government, are guidelines promulgated by USFWS or CDFW, respectively. In an effort to gain consensus regarding the survey methodologies to be employed, the Project team initiated discussions with USFWS, BLM, and CDFW, (hereafter collectively referred to as "the agencies"). The protocols were submitted for review to the agencies and modified slightly based on input received from the agencies.

The species detected in the study area are listed in Appendix B and the special status target plant list is provided in Appendix C.

2.6 BASELINE SAMPLING

Twelve primary sampling stations (vegetation, avian, reptile, and small mammal sampling), were established (Figure 4) to provide information of species composition and provide baseline quantitative data for future monitoring associated with the Project. Ten sampling stations were established within the Project site and two offsite as controls. Sampling stations were randomly generated to obtain a sufficient representation of the area. Each sampling location represented the center or corner point of larger linear transects or grids depending on the specific survey methodology as described in the following sections.

2.7 BOTANICAL STUDY

Surveys were performed to determine the presence and distribution of special status plant species and estimates of succulent species (cacti and yucca) within the Study Area. Vegetation sampling was also performed under the baseline survey effort as described in this section.

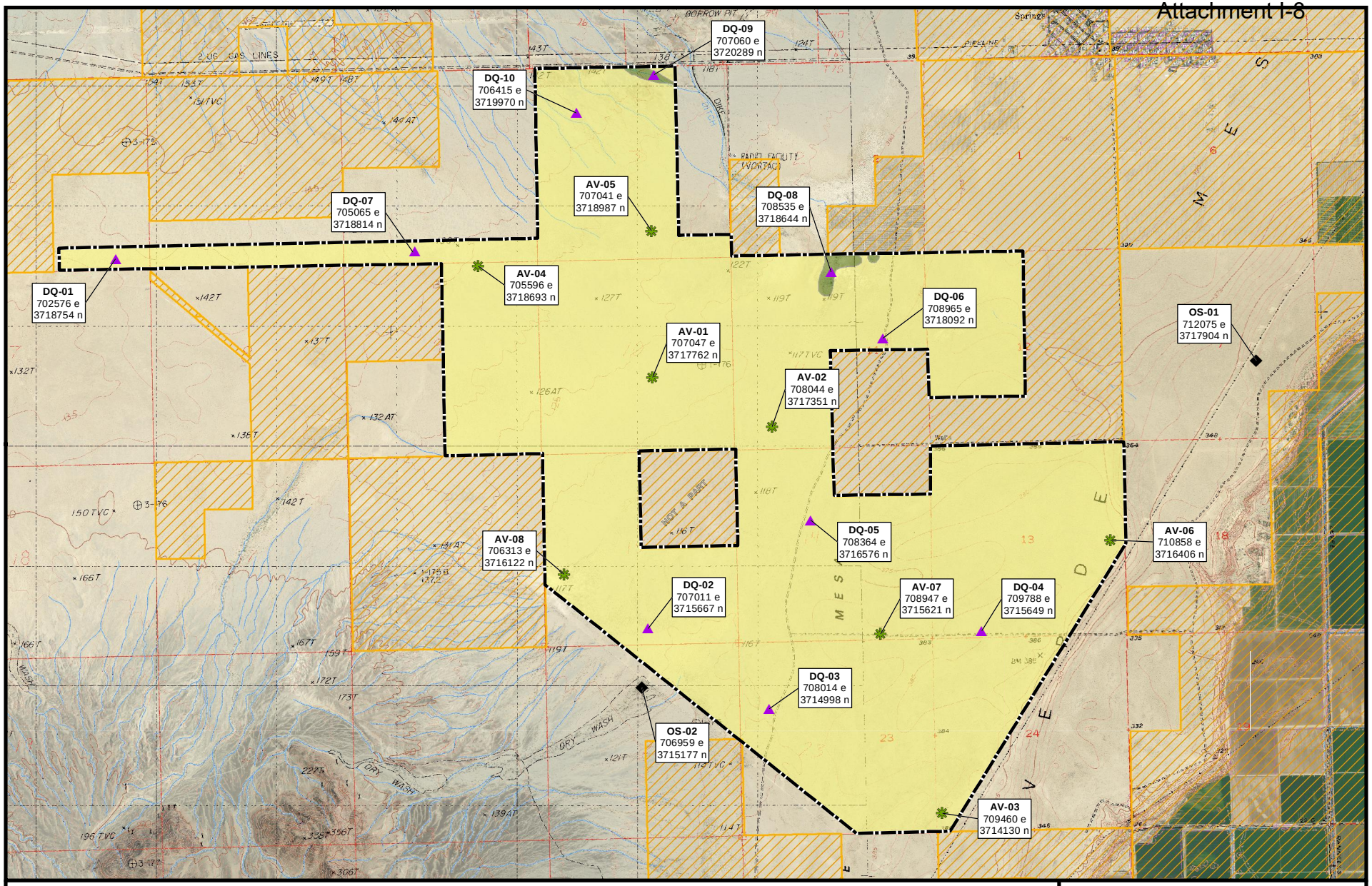
2.7.1 Special Status Plant Species

Special status plant species have been identified as potentially occurring in the vicinity of the Project site. The site specific special status target plant species list (Appendix C) was generated by searching multiple databases and reference sources for occurrence records, including:

- California Natural Diversity Database (California Department of Fish and Wildlife 2012)
- Northern and Eastern Colorado Desert Coordinated Management Plan (Bureau of Land Management 2002),
- Consortium of California Herbaria, 10,000 meter search centered at project site (Consortium of California Herbaria 2012); and
- BLM Palm Springs South Coast Field Office Sensitive Plant List: Desert Species (Bureau of Land Management 2012b).

In addition, records were reviewed from the greater southern California desert region.

P:\GIS\Ironwood\Desert_Quartzite\Baseline_Pts.mxd



Baseline Point Location
- Avian
- Off Site
- On Site

Desert Quartzite Site Boundary

Private Land

Vegetation Communities
- Desert Wash Woodland (microphyll woodland)
- Sonoran Creosote Bush Scrub

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 4

Baseline Points

AR060493

A list of special status target plants, as defined in Section 2.5, was assembled from a 12-quad CNDDB search centered on Ripley and Roosevelt Mine quads, as well as California Consortium of Herbaria records queried within a 10,000 meter (m) radius of the site. Additional information (especially on probability of occurrence and habitat) was gathered from several biologists with extensive experience in the surrounding areas. Rarity ranks conform to the CDFW CNDDB plant listing of April 2013 (California Department of Fish and Wildlife 2013).

Surveys were developed and conducted to maximize the likelihood of locating special status plant species or special status natural communities within the Project site. The primary objective was to identify all plant species to the taxonomic level (i.e., species, subspecies, or variety) necessary to determine rarity status.

Rare Plant Surveys were designed and timed to conform to protocols detailed in BLM and CDFW protocols; BLM: Survey Protocols Required for NEPA/ESA Compliance for BLM Special Status Plant Species (BLM 2009) and CDFW: Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (CDFW 2009). In summary, these protocols emphasize these major methods:

- Timing: Surveys should be conducted during the optimal season for positive identification of all target plant species, as well as justifiable on-site conditions for finding plants (adequate seasonal rainfall).
- Survey Intensity: Site coverage and surveyor spacing should be adequate for seeing and recording all potential rare plant species.
- Surveyor Qualifications: Surveyors should have experience identifying California desert rare plants, particularly Colorado Desert flora, be trained on the specific target plants through orientation meetings, specimen examples, and reference population checks prior to performing surveys on site.

Two formal Rare Plant Surveys were conducted across the Study Area detailed as follows:

- Fall 2012 (September 11 - 19) surveys were conducted after significant summer monsoon rainfall germinated abundant annuals and timing was good to observe and identify all potentially occurring fall-blooming target plants. Full coverage at 10 m spacing occurred across approximately 50 percent of the site (on loose sandy-gravelly soil in creosote bush scrub), and 20 m spacing was done on the remaining dry sandy areas where there was not significant annual germination.
- Spring 2013 (March 18 - 30) surveys were also conducted. Localized winter rainfall was enough to germinate copious annual blooms, and the timing was excellent for observing

and identifying all potentially occurring target plants. Full coverage transects were performed at 10 m spacing across the entire Study Area.

All data was recorded in triplicate form: paper data sheets, Global Positioning System (GPS) waypoints, and Pendragon handheld data collection forms. Data was proofed by Ironwood staff and periodically posted for review on Ironwood's Egnyte website.

In addition to Rare Plant Surveys, botanists also compiled and surveyed for a general Floristic Plant List with many voucher specimens, mapped vegetation communities, tracked weed infestations, and counted cacti.

In addition to Rare Plant Surveys, botanists also compiled and surveyed for a general Floristic Plant List with many voucher specimens, mapped vegetation communities, tracked weed infestations, and counted cacti.

2.7.2 Cacti and Yucca

Systematic sampling of succulents (cacti and yucca) was conducted during the fall 2012 plant surveys by botanists experienced with Colorado Desert flora. The purpose of this sampling effort was to estimate the number of individual cacti and yucca present. All species of cactus were documented and cumulative counts of the number of individual cacti were recorded. Yuccas were not observed on site.

2.7.3 Desert Dry Wash Woodland and Vegetation Communities

The science of vegetation classification is undergoing continued revision, with new nomenclature for previously described "vegetation communities." For the purposes of this report NECO common names (Bureau of Land Management 2002), with the latest nomenclature from **A Manual of California Vegetation, Second Edition** (Sawyer et al, 2009), and corresponding "Holland types" nomenclature (Holland 1986) will be used for each of these communities described below.

2.7.4 Non-Native and Invasive Species

Non-native and invasive species were documented during both the fall 2012 and spring 2013 plant survey season. During the fall season survey, the surveyors identified two invasive and two weedy non-native plants on the Project site. Due to the fact the species were found as dried up stems, the general location of these weeds were noted, but not located with a GPS or recorded. During the spring season, surveyors performed a detailed survey account of non-native and invasive plants on the Project site. The purpose of this sampling effort was to estimate the number of non-native and invasive species that were present on the site. All non-native and invasive species were documented and cumulative counts of the number of individual species were recorded.

2.8 AMPHIBIANS

There is one amphibian with the potential to be found on the project site, Couch's spadefoot (*Scaphiopus couchii*). There were 27 different points in the Study Area identified as having standing water at some time from 2008 until 2012 (Figure 5). Two locations were identified as likely to support Couch's spadefoot in the event of rains, due to the fact they were the most extant areas for having held water and exhibited a strong component of dry desert wash woodland plant species. One area was southeast of the existing solar facility and the second was south of the Project site in the Study Area buffer zone. Using this information, the surveyors monitored the areas during the monsoon season, summer of 2013, both to determine how long water was standing in these locations and to potentially identify if individuals were present.

2.9 REPTILES

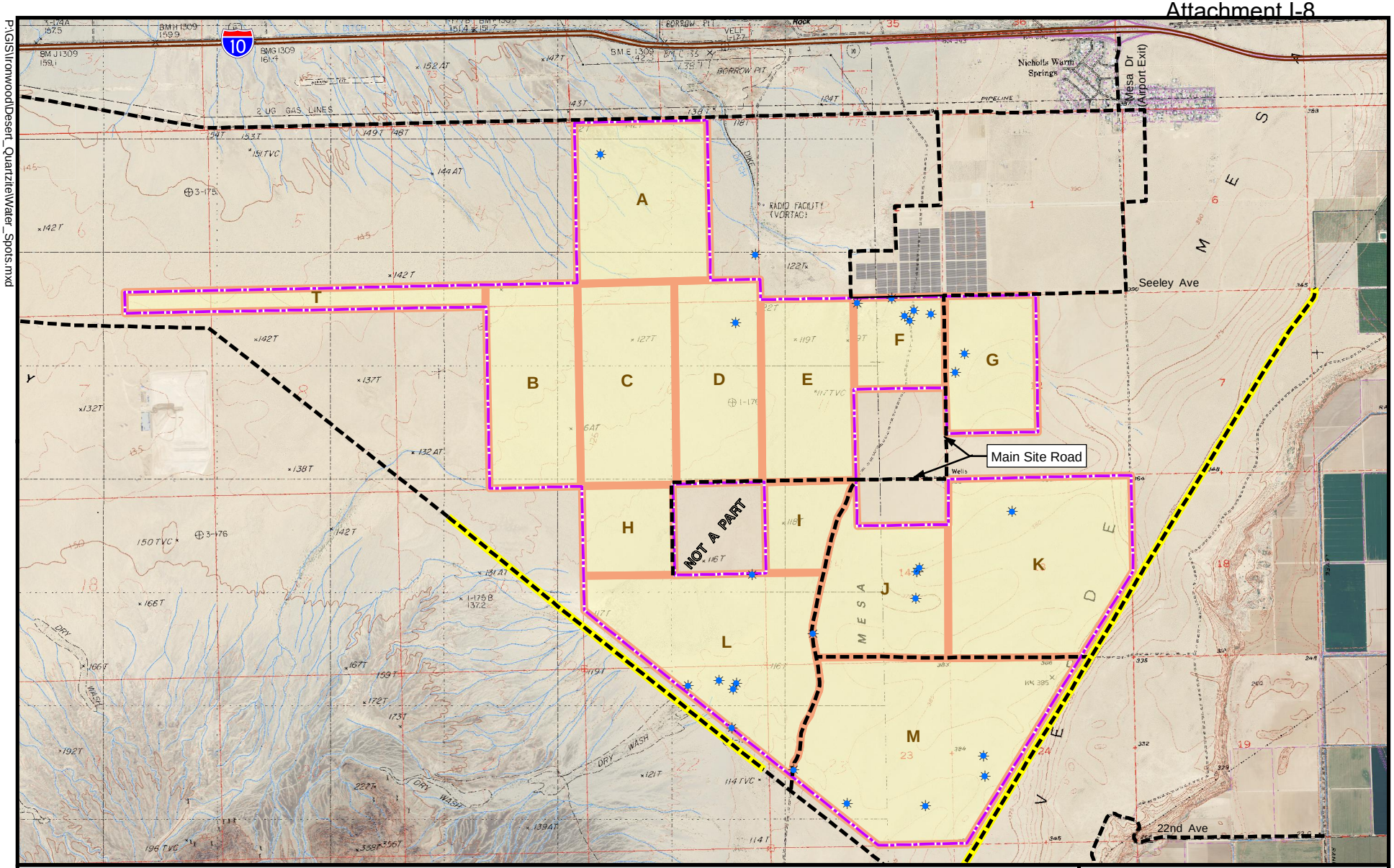
2.9.1 Desert Tortoise Focused Surveys

Full-coverage protocol desert tortoise (*Gopherus agassizii*) surveys were conducted in the spring of 2013 (March 25 –April 15, 2013) according to the most current USFWS issued survey protocols (United States Fish and Wildlife Service 2010a). The protocols also provide methods to estimate the abundance of tortoises occurring within the Study Area. These desert tortoise surveys employed belt transects approximately 10 meters (33 feet) wide in order to provide 100 percent (full) coverage of the entire Study Area.

The survey crews consisted of highly experienced desert tortoise surveyors and field technicians of varying experience who attended field and training sessions prior to conducting surveys. The desert tortoise surveyors were divided into crews of approximately 3-4 people, with one or two highly experienced desert tortoise surveyors on each crew. Each of these crews typically surveyed approximately one square-mile section until the entire surveyed portion of the Study Area was covered.

All tortoise sign [e.g., live tortoises (all age classes), shell/bone/scutes, scats, burrows/pallets, tracks, egg shell fragments, and courtship rings] were recorded (Table 2). The location of tortoise sign was recorded on a Garmin GPS unit (GPS 72, 76, or 60CSx) using a unique identification code. In addition to recording sign with the GPS unit, standardized paper datasheets were completed. Data was entered from these datasheets into a Microsoft Access database, during post processing.

P:\GIS\Ironwood\Desert_QuartziteWater_Spots.mxd



Standing Water

Site Access Road

Site Access Road (marginal conditions)

Desert Quartzite Site Boundary

Survey Area Boundary

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 5

Standing Water

Table 2 Desert Tortoise Data Recorded

Type of Sign	Measurements	Estimates	Other
Live tortoise		Sex, age class	Location, activity
Cover site (burrow, pallet)	Width, height	Depth	Condition (active [excellent], inactive [good, fair, or poor]) and location. Each burrow was investigated by using a handheld mirror and/or flashlight to detect if a tortoise was present
Shell or bone (carcass or fragments)		Sex, age class, time since death	Location
Tracks		Age	Location

2.9.2 Mojave Fringe-Toed Lizard and Herpetofaunal Surveys

Three herpetofaunal surveys were completed on the Project site. Two preliminary baseline herpetofaunal investigations (October 22-23, 2012 and March 25-April 12, 2013) and one Visual Encounter Survey (April 10 -25, 2013) were completed. Twenty-one qualified and trained field wildlife biologists took part in the surveys.

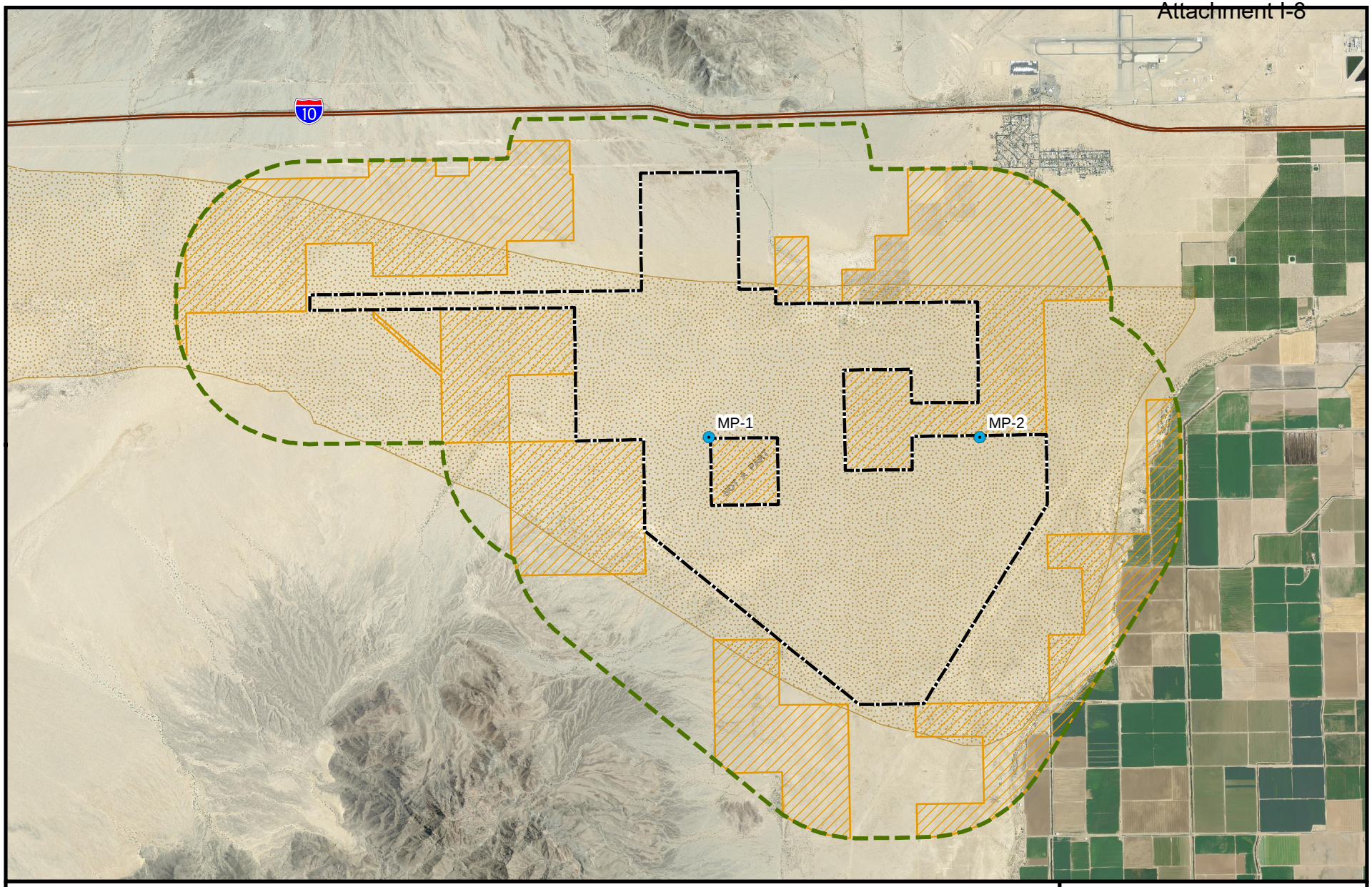
Preliminary herpetofaunal baseline investigations had two objectives; 1) to census extant squamate populations and 2) identify and determine species of concern and/or their required habitat. Sampling took place in three distinct bouts; twice during 100 percent coverage surveys. The herp surveys consisted of walking belt transects approximately 10 m (33 ft) wide to provide 100 percent (full) coverage of the entire Project site.

The Visual Encounter Survey, which is a more intensive survey, was also conducted. This survey was employed to augment the incidental data collected during the 100 percent coverage wildlife surveys. Using the 12 baseline sampling points employed by the avian, botanical, and small mammal teams, 12 transects were set up (ten on site and two in the buffer zone) and sampled using visual encounter surveys (Figure 4). Six different wildlife biologists were used to carry out these surveys across five different times of day over two weeks. Transects were intensively searched and although localized effects had been exhibited by various sampling points, when viewed on the whole, the data bore out similar data collected by the wildlife biologist crews.

2.10 AVIAN

During peak migration periods in the spring and fall of 2013, an agency-approved avian biologist conducted a survey at each MP, once per week, using unlimited-distance bird migration survey methods (Table 3). Figure 6 (below) shows the location of the MPs within the proposed Project site.

P:\GIS\Ironwood\Desert_QuartziteMigration_Survey.mxd



Avian Migration Survey Point
Project Boundary Buffer
Desert Quartzite Site Boundary
Private Lands
Sand Corridor

N

0 1,000 2,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 6

Migration Survey Points

AR060499

Table 3 Migration Point Location

Survey Point	UTM (WGS 84)	
	Easting	Northing
MP01	706914	3717172
MP02	710176	3717195

2.10.1 Line Transect Sampling

The purpose of these surveys is to depict avian use patterns at and adjacent to the Project site. Data will provide information on the following:

- Sedentary and migratory populations;
- Species richness (number of different species present);
- Species diversity (species richness combined with species evenness);
- Species use, behavior and movements; and
- Species distribution across the project.

Qualified biologists conducted surveys during the spring of 2013, recording all species observed and documenting their site use. Surveyors followed a sampling model that implemented a line-transect survey methodology. The project-specific survey protocols are available in Appendix D and Appendix E.

Survey results will be used in the development of an avian risk characterization (illustrating species use and occurrence within the proposed Project site) as part of the Bird and Bat Conservation Strategy (BBCS).

Line-transect sampling was conducted by traveling a pre-determined route and recording all bird detections (visual or aural) on either side of the transect line. The distance a bird was detected from the transect line was estimated and recorded as an absolute measure. The observer scanned the sky as well as the surrounding habitat and recorded bird use and movement data under good weather conditions, good visibility, no sustained precipitation and average wind speeds less than 15 miles per hour (mph). Each line-transect was surveyed in an effort to capture species occurrences and temporal site use through the spring season. Surveys were timed to capture migrants, breeding birds and local residents.
Information recorded during the line-transect sampling included the following:

- Transect start time;
- Species identification;
- Number of birds seen;
- Flight height;
- Time of day;

- Horizontal distance (perpendicular) to the survey line;
- Behavior during observation; and
- Transect end time.

Project-specific survey protocol were developed to ensure consistent data collection (Appendix D and Appendix E). A total of eight-2,000 meter long transects were established (Table 4). To facilitate robust data analysis, half (four) of the line-transects were situated within the Project site and half were located outside the Project site on public lands with similar habitat composition. One transect on-site and one transect off-site included sampling microphyll woodlands. The control to sample ratio is 1:1.

Transects within the Project site were aligned to promote continuity so that post-construction surveys could use the same transects and be unimpeded by installed solar panel arrays, if arrays are positioned where proposed (Figure 7). Transects surveys were conducted by alternating start and end points on subsequent surveys to avoid surveying a transect at the same time of day.

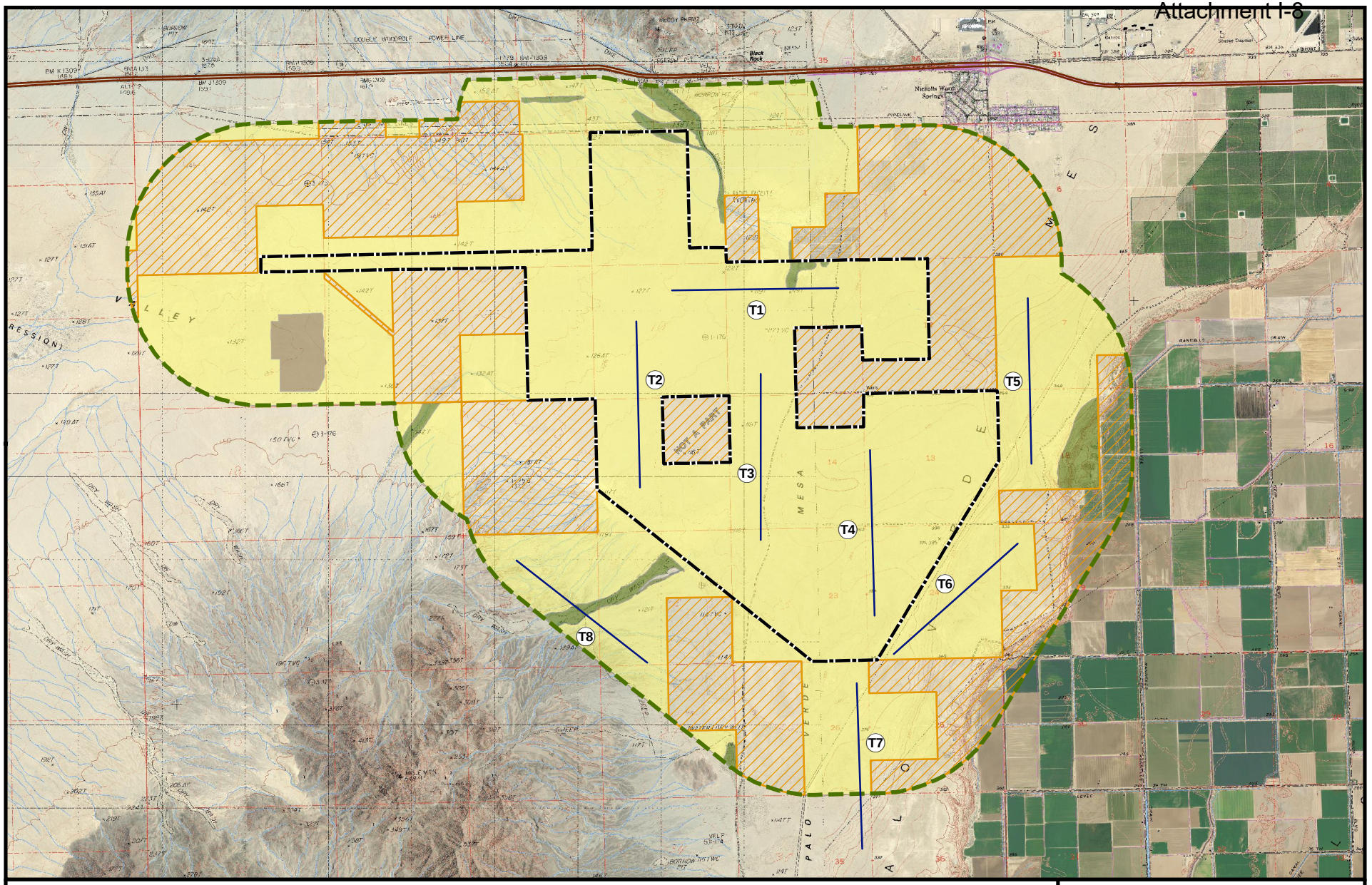
Table 4 Transect Beginning and End Points (A and B)

Transect ID	Site Name	Easting	Northing
T1-A	Project Footprint	707056	3718437
T1-B	Project Footprint	709056	3718464
T2-A	Project Footprint	706625	7318060
T2-B	Project Footprint	706666	3716060
T3-A	Project Footprint	708120	3717427
T3-B	Project Footprint	708120	3715427
T4-A	Project Footprint	709439	3716511
T4-B	Project Footprint	709494	3714512
T5-A	Project Control	711338	3718342
T6-A	Project Control	711213	3715380
T7-A	Project Control	709278	3713697
T7-B	Project Control	709344	3711698
T8-A	Project Control	705184	3715178
T8-B	Project Control	706759	3713945

2.10.2 Burrowing Owl Surveys

Burrowing owl *(Athene cunicularia)* surveys were scheduled and performed according to "Staff Report on Burrowing Owl Mitigation" (California Department of Fish and Wildlife, 2012) and the *Burrowing Owl Survey Protocols and Mitigation Guidelines* (California Burrowing Owl Consortium 1993). Phase II burrowing owl surveys (California Burrowing Owl Consortium 1993) were conducted across all portions of the Study Area.

P:\GIS\Ironwood\Desert_Quartzite\Transects.mxd



Transect Line
Site Boundary Buffer
Desert Quartzite Site Boundary
Private Lands

Vegetation Communities
Desert Wash Woodland (microphyll woodland)
Sonoran Creosote Bush Scrub
Disturbed/Developed

N

0 1,000 2,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 7

Line Transect Locations

AR060502

Wildlife crews surveyed the entire proposed Project site walking belt transects with 10 m spacing. Surveys within the 150-m buffer were conducted by walking straight-line belt transects spaced no more than 30-m apart, adjusting for vegetation height and density (Rosenberg et al. 2007). During each of these survey efforts, at the start of each transect and at least every 100 m, survey crews, using binoculars, scanned the entire visible Study Area for burrowing owls. Some burrowing owls may be detected by their calls, so crews listened for burrowing owls while conducting the survey. Care was taken not to "flush" burrowing owls from their burrows and to minimize disturbance near occupied burrows during all seasons.

Burrowing owl sightings and burrows with burrowing owl sign (including: whitewash, tracks, pellets, feathers) were mapped and recorded using standardized data forms. Burrows were recorded as used by burrowing owls if one or more burrowing owls were present, or if sign (i.e., pellets, prey remains, whitewash, or decoration is present) was detected.

Avian biologists followed up on each of the detections originally recorded by wildlife survey crews. This follow-up effort included incidental detections made by biologists during the fall of 2012 and spring of 2013 surveys. Any burrow with associated burrowing owl sign was ranked by Class (1 to 4) depending on the age and type of sign present. Burrow Class are defined as follows:

- 1=Excellent (Usable burrow with burrowing owl present);
- 2=Good (Usable burrow, fresh sign but no burrowing owl present);
- 3=Fair (Usable burrow, inactive with old sign, no burrowing owl present); and
- 4=Poor (Inactive, burrow, no burrowing owl sign).

Phase III burrowing owl surveys, extended observation surveys, were conducted on all burrows that had associated burrowing owl sign. This included all burrows ranked in Classes 1 through 3 as described by the Burrow Class conditions above. Phase III monitoring efforts were conducted from as many fixed points as necessary to provide visual coverage of the site using spotting scopes or binoculars. These surveys were performed between morning civil twilight and 10:00 AM and two hours before sunset until evening civil twilight.

2.10.3 Golden Eagle Surveys

Agency approval of the Quartzite Avian Work Plan was not granted until after the 2013 golden eagle (*Aquila chrysaetos*) breeding season ended. It is anticipated that migration surveys, scheduled for the spring 2014 season, will provide sufficient additional data points to adequately cover all bird usage.

In addition to Unlimited Distance Extended Observation Surveys, eagle surveys following the *Interim Golden Eagle Inventory and Monitoring Protocols*; and other recommendations (Pagel *et al*., 2010) were performed in the winter of 2013/2014 (December 16-20, 2013 and January 16-20, 2014). Surveys for

breeding and non-breeding bald and golden eagles were conducted within a 10-mile radius of the Project site. Occurrence of non-breeding golden eagles within at least 10 miles of the project boundary during the courtship season (*e.g.*, late December through early February) will be documented and be used to estimate potential project-related impacts to golden eagles, including: juveniles, sub-adults, adult floaters, and breeding adults.

Avian surveyors used historic nest data to model golden eagle habitat and assess the terrain for suitable nest sites within a 10-mile buffer of the proposed Project site. Surveyors have determined territory occupancy within known and potential golden eagle territories through extended observation periods (Pagel *et al*., 2010).

Golden Eagle survey data includes:

- Assign identification number;
- Record Universal Tranverse Mercator (UTM) location via GPS;
- Assess any nests for condition (fresh greens, good, fair, old and decrepit); and
- Record any birds present (species, behavior).

Surveyors utilized high-powered spotting scopes from the greatest effective distance possible during the breeding season.

2.10.4 Elf Owl Surveys

Elf Owls (*Micrathene whitneyi*) are small cavity nesters typically inhabiting desert areas overgrown with saguaro cacti, and mesquite or deciduous riparian woodlands and adjacent tablelands. They are found in ravines, canyons, plateaus, and on mountain slopes.

In July 2013, an owl-specialist biologist, Dorothy Crowe with Great Basin Bird Observatory (GBBO), toured the Project site to determine whether habitat suitable for nesting elf owls was present. Dorothy Crowe was given a comprehensive tour of the project area and a surrounding one-mile buffer zone, and examined some habitat features just outside of the one-mile buffer that merited attention. She took extensive notes on her observations, and recorded coordinates of any notable features.

2.10.5 Nesting Raptor/Raven Surveys

Nesting raptor/Raven survey efforts focused on the detection of all raptor/raven nests within 1-mile of the Project site in order to collect baseline data on the following.

- The number and distribution of raptor/raven nests prior to project development; and
- Success rates of raptor/raven nests prior to project development.

All bird nests (including the incidental detection of resident passerine species) were mapped and recorded on standardized datasheets. Monthly monitoring efforts were completed to update the datasheets to include the development stage and breeding status at each raptor/raven nest.

2.11 MAMMALS

There were three mammal surveys performed for this Project; small mammal trapping, desert kit fox and bats.

2.11.1 Small Mammal Surveys

Small mammal surveys were performed to document species types, abundance and locations. Trapping grids were established at all baseline survey locations. Narrow grids consisting of 100 Sherman large (12 inches) live-traps were set at each location. For most baseline locations, the sampling location point represented the southwest corner of the trapping grid. Depending on the width of the habitat being sampled, either a 10 by 10 configuration or a 4 by 25 configuration was used. All traps were spaced approximately 10 m apart. Trapping grids were run for three consecutive nights at all baseline locations. Traps were opened near sunset and checked and closed at sunrise. Traps were not opened if scheduled temperatures were estimated to drop below 50 degrees Fahrenheit. Traps were baited with standard small mammal bait, which consisted of a mixture of birdseed, rolled oats and peanut butter. Individuals found in the first two morning checks on each grid were marked with a colored sharpie marker to indicate recapture status.

2.11.2 Desert Kit Foxes

Surveys of the Project site were conducted by qualified biologists walking transects at 10 m spacing to ensure total visual coverage of the area. All desert kit fox single-entrance dens and canid complexes that could be occupied without modification were recorded. A camera station was set up at a total of eight dens and run for three consecutive days and nights.

A qualified biologist revisited each of these 24 dens to search for signs of activity such as lay-down spots on the entrance mounds and make a determination of active status. Up to 16 of the most active dens were monitored with cameras for three nights each. Photo images were analyzed to attempt to identify individual foxes and their sex and age group to try to determine a rough demographic index of desert kit fox presence on the Project site.

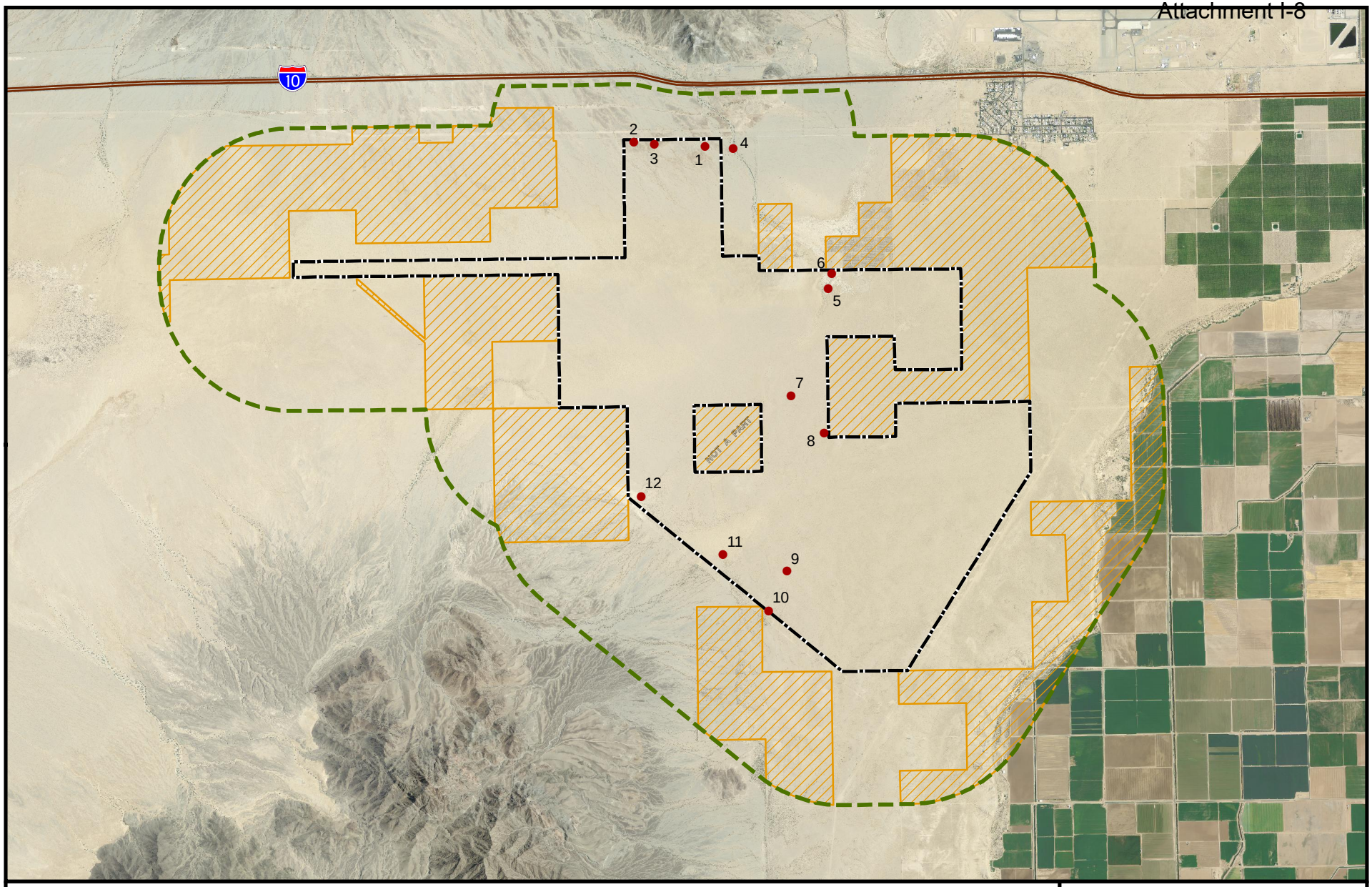
2.11.3 Bats

A bat assessment was performed by Patricia Brown, Ph.D. and William Rainey, Ph.D. (Brown-Berry Biological Consulting) to assess potential bat habitat within the Study Area. Suitable roosting and

foraging habitat for several bat species that are known to occur in the vicinity (including pallid bats, cave myotis and California leaf-nosed bats) was reviewed in the field.

Acoustic monitoring was conducted for three nights to sample bat species utilizing the Study Area (Figure 8). Passive acoustic monitors consisted of a sealed enclosure containing a battery, broadband frequency-dividing ultrasound detector and a programmable data storage device (Anabat II and CF-ZCAIM; Titley Electronics, Ballina, NSW, Australia), with an extension cable microphone in a weather shroud, flat acoustic reflector and bracket (P). The microphone and reflector assemblies were elevated approximately 3 ft above the terrain on a metal stake (Photograph 1). Recorded data were stored on compact flash cards that were programmed with sampling start and stop times (1800-0600 PST) for a sampling interval longer than the time from local sunset to sunrise. An estimate of local sunset times (ignoring local horizon topography effects) was obtained from project site coordinates and U.S. Naval Observatory web services (http://aa.usno.navy.mil/data/docs/RS_OneYear.php). Twelve monitors were deployed (Figure 8) at sites with different vegetative components to identify bat species and document activity levels at this season. Half of the monitors had standard microphones and half had low frequency microphones with higher sensitivity to sounds in the audio range (4.5 to 20 kilohertz (kHz)). This enhances recording of certain bat sounds (e.g., pallid and California leaf-nosed bat social calls, western mastiff and other free tail bat calls) along with insect and bird calls.

P:\GIS\Ironwood\Desert_Quartzite\Acoustic Bat Locs.mxd



Bat Monitoring Locations

Site Boundary Buffer

Desert Quartzite Site Boundary

Private Lands

N

0 1,000 2,000

Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 8

Acoustic Bat Monitor Locations

AR060507

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Photo 1.CDR



Photograph 1 - Detector 5, microphyll woodland.

Roost surveys were conducted of mines in the mountains adjacent to the project area during the day and at night for evidence of bats and guano. Two mines in the southern McCoy Mountains (located approximately 4.4 miles northwest of the Study Area) had previously been identified by Dr. Brown as California leaf-nosed bat maternity colonies and had been gated with bat-compatible closures by the Bureau of Land Management in 2011. These mines were monitored on May 8, 2013 at dusk by surveyors with night vision equipment to obtain accurate exit and entry counts of bats and acoustic records with additional Anabat detectors. The surveyors kept two counts, entry and exit, for at least sixty minutes after the first bat exited of how many bats entered and exited the mines. Video cameras with auxiliary infrared lights were used to remotely monitor mines and to obtain permanent records of exiting bats.

Using topographic maps and Google Earth images, ground reconnaissance was conducted of possible mine features on the north end of the Mule Mountains (1.8 miles south of the Study Area) and no underground features that could shelter bats were discovered. The closest known bat colony in the Mule Mountains is the Hodge Mine (a.k.a. Stonehouse, 33.51145, -114.79383) situated 3.4 miles south of the Study Area. This mine contains the largest winter colony of California leaf-nosed bats (*Macrotus californicus*) in the United States, as well as a maternity colony. It is also one of four maternity colonies for the cave myotis (*Myotis velifer*) in California. This mine has been a research site for Dr. Brown since 1976.

3.0 RESULTS

3.1 BOTANICAL STUDIES

Thirty-three special status plant species had been identified as potentially occurring in the vicinity of the Project site (Appendix F). This list was generated by searching multiple databases and reference sources for occurrence records.

3.1.1 Special Status Plant Species

The fall 2012 survey was conducted September 11 -19, 2012, and spring surveys were conducted March 18-30, 2013. There was very good localized winter rainfall for each of the surveys, enough to germinate abundant annual blooms, and timing was excellent for observing and identifying all potentially occurring target plants. For the fall survey, full coverage at 10 m spacing was achieved across the entire Study Area. Fall and spring surveys across the site yielded a full plant list of 124 taxa, representing 25 plant families. Of this total, 114 are native, and 10 are non-native. The floristic plant list is in Appendix F.

3.1.1.1 Special Status Plants Found on Site

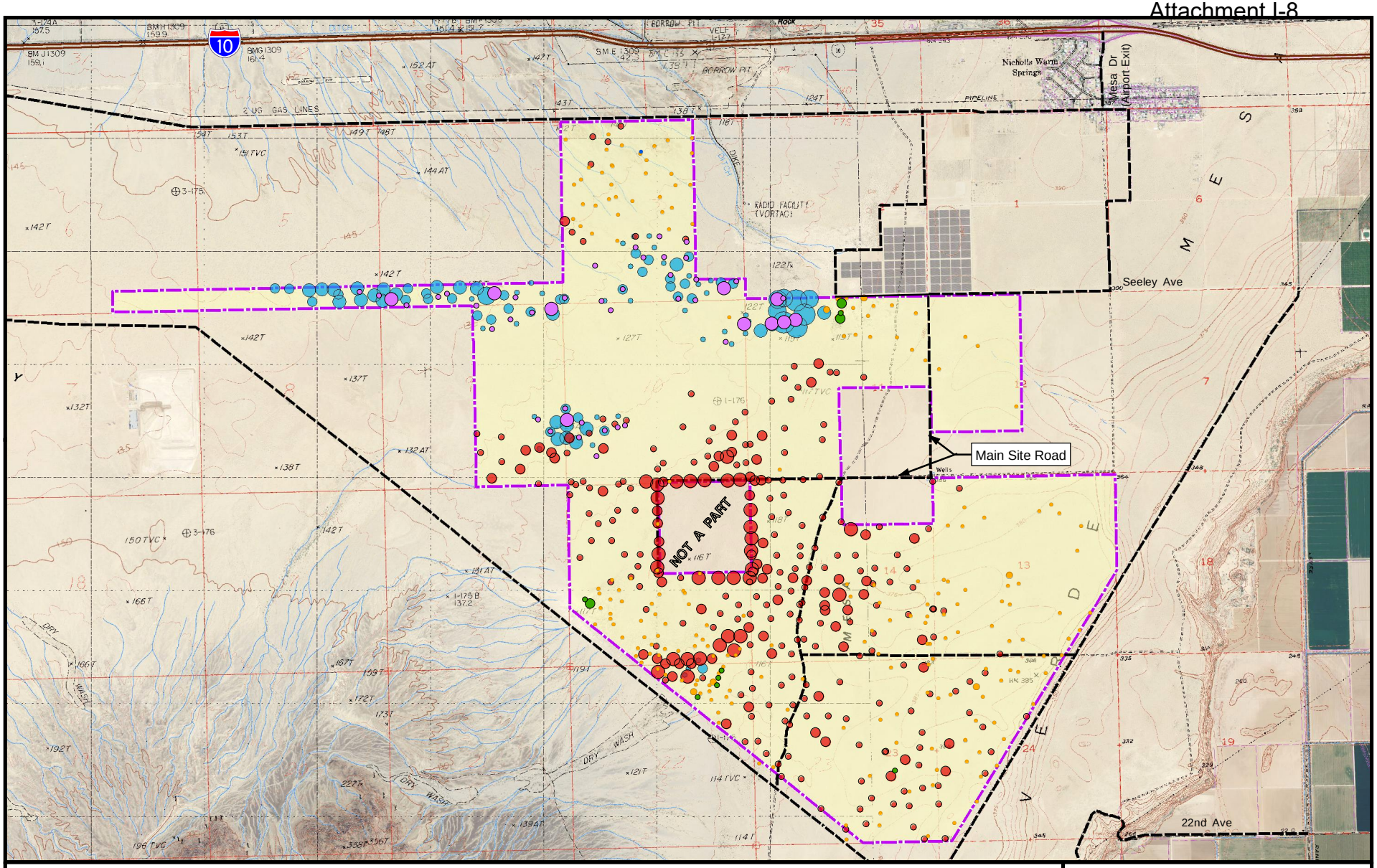
Table 5 below lists all the Special Status plants found onsite during fall and spring surveys. None of these plants are federally or State Listed, but they all qualify as Special Status to different degrees by California State-ranking and CNPS ranking.

Table 5 Special Status Plants Found on Site

Scientific Name Common Name	Status		Flowering Period	Occurrence on Site
Astragalus insularis var. *harwoodii* Harwood's milkvetch	Global: Federal Listing: State Listing: **State Rank:** **CNPS Rank:** NECO:	G5T3 none none **S2** **2.2** covered	Jan - May	**PRESENT:** 13,712 individuals estimated on site.
Euphorbia abramsiana *=Chamaesyce abramsiana* Abrams' spurge	Global: Federal Listing: State Listing: **State Rank:** **CNPS:** NECO:	G4 none none **S2S3** **2.2** not covered	Sep – Nov	**PRESENT:** appx. 2104 individuals found during Fall 2012 surveys
Cryptantha costata ribbed cryptantha	Global: Federal Listing: State Listing **State Rank:** **CNPS:** NECO:	G4G5 none none **S3.3** **4.3** not covered	Jan - May	**PRESENT:** appx. 56,748 individuals estimated on site
Eriastrum harwoodii Harwood's eriastrum	Global: Federal Listing: State Listing: **State Rank:** **CNPS:** NECO:	G3 none; BLM sensitive none **S3** **1B.2** not covered	Mar - May	**PRESENT:** appx. 882 individuals found on site
Funastrum utahense Utah vine milkweed	Global: Federal Listing: State Listing: **State Rank:** **CNPS:** NECO:	G4 none none **S3.2** **4.2** not covered	Apr - Sep	**PRESENT:** 1 individual found on site
Proboscidea althaeifolia desert unicorn-plant	Global: Federal Listing: State Listing: **State Rank:** **CNPS:** NECO:	G5 none none **S3.3** **4.3** covered	May - Aug	**PRESENT:** appx. 811 individuals estimated during Fall 2012 surveys

Ranking Source: CNPS 2012

P:\GIS\Ironwood\Desert_Quartzite\Plants_Combined.mxd



Species

- Harwood's Eriastrum
- Ribbed Cryptantha
- Adam's Prostrate Spurge
- Desert Devil's Claw
- Harwood's Milkvetch
- Utah Vine Milkweed

Plant Density

- 1 - 10
- 10 -100
- 100 - 1,000
- 1,000 - 5,000
- 5,000 - 12,200

- Site Access Roads
- Desert Quartzite Site Boundary

Note:
Dot size does not represent Area of Occurrence

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 9

Combined Rare Plants Map

AR060512

3.1.1.2 Harwood's Milkvetch

Harwood's milkvetch is a CNPS Rank 2.2 annual herb in the Fabaceae family. It is historically known to occur in desert dunes and Mojavean and Sonoran desert scrub at elevations ranging from 0 to 2,300 feet (0 to 710 meters) amsl.

Large populations of Harwood's milkvetch, were documented in the spring 2013 survey (Photograph 2) (Figure 10). It was so abundant in certain areas; the surveying botanists estimated numbers of individuals per waypoint. The total estimated count across the site was 13,712 individuals. It is distributed widely across most of south half of the Project site, with concentrated populations along the disturbed berm surrounding the existing (abandoned) Jojoba farm, and some very shallow sand dunes at the southwest corner of the site. Its mechanism for dispersal is unknown, but most likely its inflated seed pods get carried by the stiff westerly winds and deposited at some wind-breaking disturbance such as soil berms.

The majority of the plants were in fertile condition, often both flowering and fruiting, and there appeared to be a robust fruit and seed set this spring. There is certainly a significant seed bank in the soil after this spring.

Other nearby solar projects (McCoy and Bylthe) also documented large occurrences of this plant. These projects are in advanced stages of approval and share a common right-of-way with this proposed Project's gen-tie line location.

This Project's populations, however, are mostly spread across the main solar site, and the impacts may be greater. The proposed methods of site development involve intensive and comprehensive soil surface disturbance by grubbing, grading, compaction, and application of soil surface stabilizers. This type of development inhibits re-establishment of natural plant communities: essentially nothing is allowed to grow between the panels. Harwood's milkvetch has a State Rank of 2, and a CNPS Rank of 2.2, which means that it is fairly endangered in California, but more common elsewhere.

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Ch 3 Photos 2-3.CDR

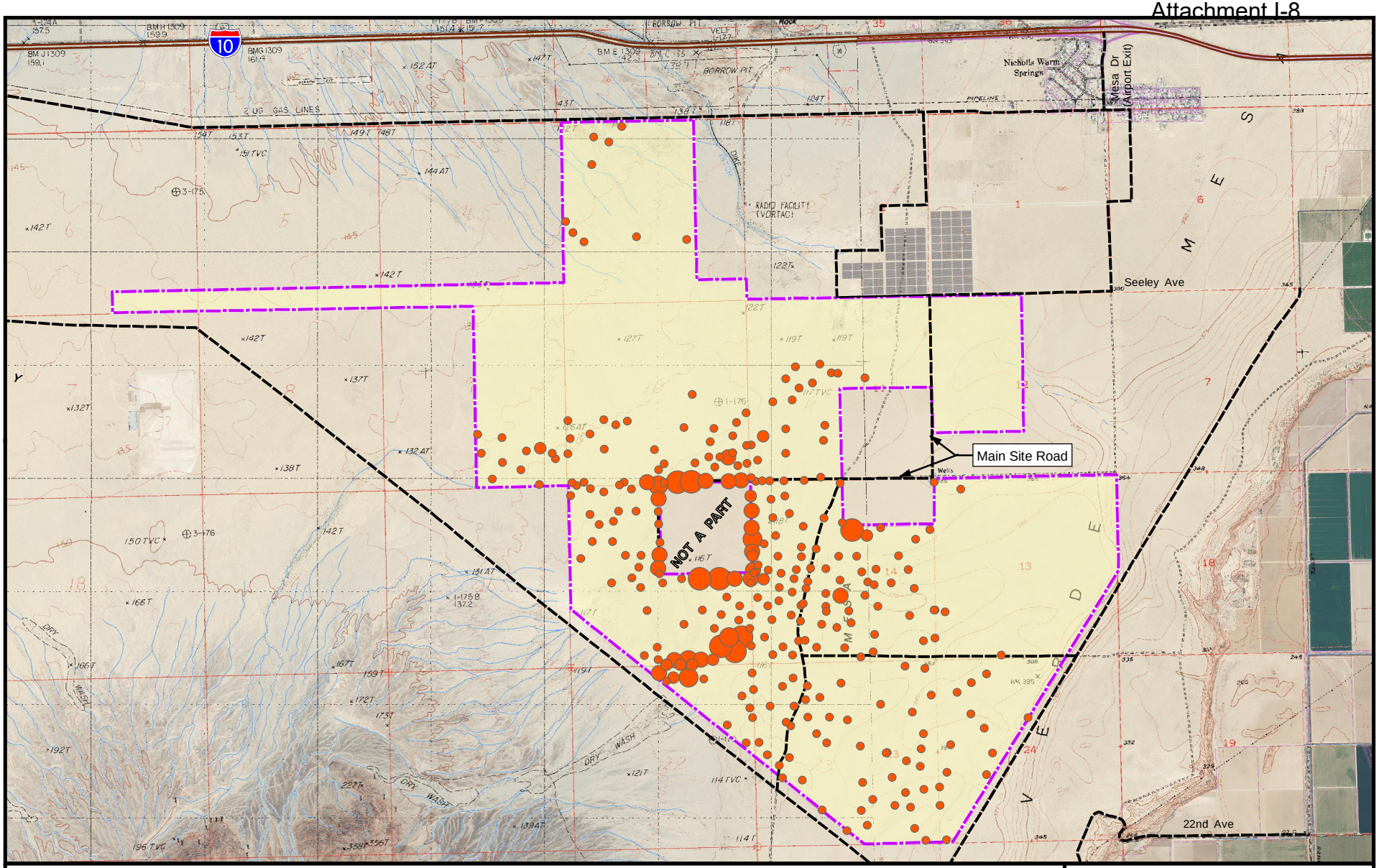


Photograph 2 - Harwood's Milkvetch (*Astragalus insularis var. harwoodii)*.



Photograph 3 - Abram's Spurge (*Euphoria amgramisana*) (R), growing next to common *Euphoribia micromeria* (L).

P:\GIS\Ironwood\Desert_Quartzite\ASTINS.mxd



Harwood's Milk Vetch
- 1 - 50
- 50 - 100
- 100 - 300
- 300 - 500
- 500 - 975

Site Access Roads

Desert Quartzite Site Boundary

Note:
Dot size does not represent Area of Occurrence

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 10

Harwood's Milk Vetch
(Astragalus insularis var. harwoodii)
Distribution

AR060515

3.1.1.3 Abram's Spurge

Abram's spurge is a CNPS Rank 2.2 annual herb in the Euphorbiaceae family. It is historically known to occur in Mojavean desert scrub, playas, and sandy/silty Sonoran desert scrubs at elevations ranging from sea level to 3,000 feet (0 to 915 meters) amsl.

It was documented as a few small occurrences and one large population during the fall 2012 surveys (Photograph 3) (Figure 11). The total number of individuals was estimated to be approximately 2,104, the majority of these existing as depauperate dwarf plants on a cracked-muddy flat at the southwest border of the site (called "population 1" in this document).

The regional distribution of Abram's spurge and its concept of rarity have been undergoing some revision lately. Recent surveys on the McCoy Solar Project have yielded over 4,000 individuals, and reports of populations in the "tens of thousands" have been observed on Ford Dry Lake and Hayfields Dry Lake (Karl, Pers. comm.). Due to its fall-blooming phenology, this plant may have been overlooked during most botanical surveys, which typically occur in the spring. Consequently, its Special Status in California is presumed to be due to under-sampling.

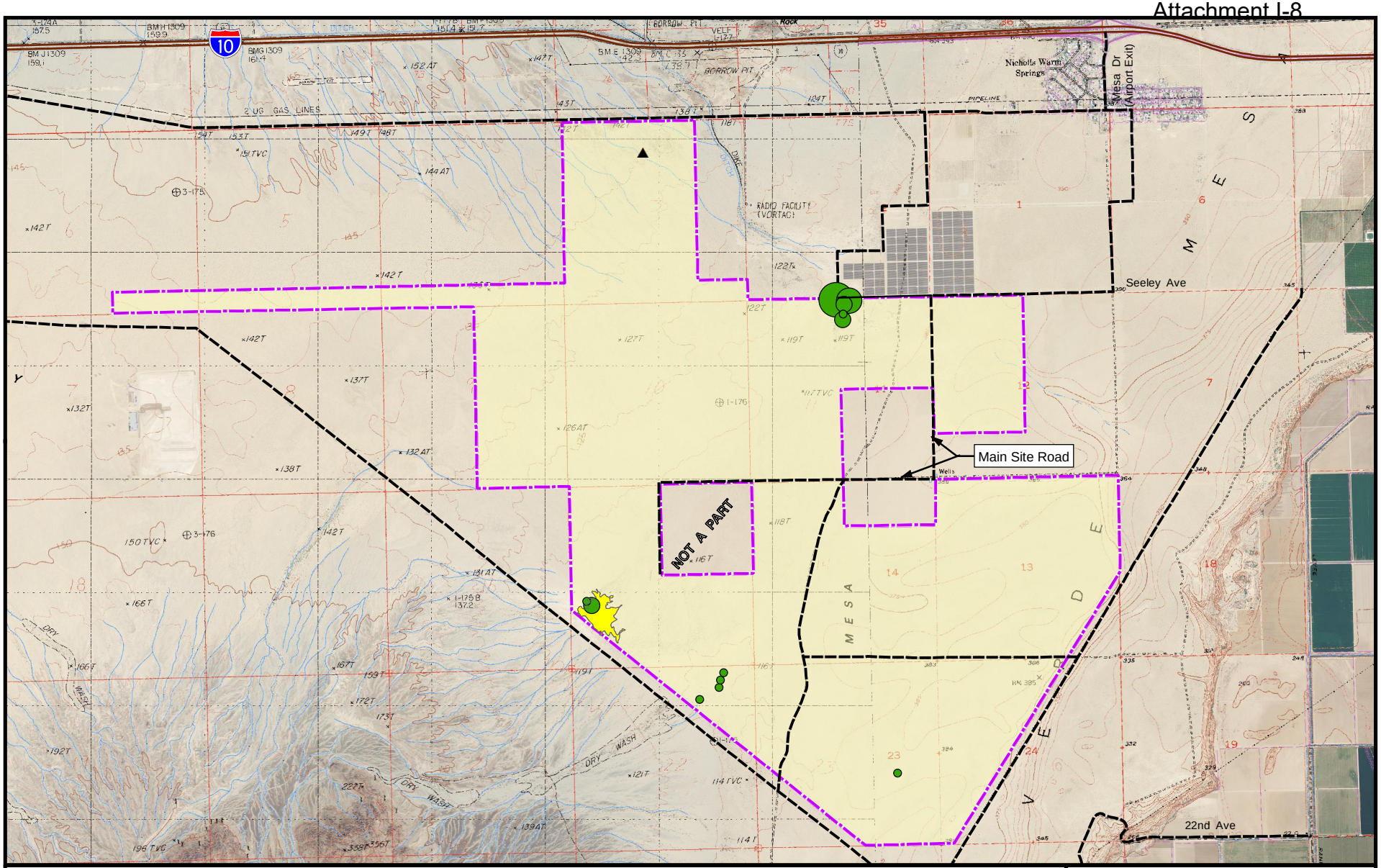
Nonetheless, because of its State Ranking of S2 and CNPS Ranking as 2.2, any unavoidable disturbance will most likely require mitigation.

3.1.1.4 Utah Vine Milkweed

Utah vine milkweed is a perennial herb in the Apocynaceae family. It typically grows along wash margins and in sandy/gravelly areas throughout the Sonoran and Mojave deserts of California, sprawling and clambering over common shrubs for support. Flowering from April to September, its elevation range is 300 to 4,700 feet (100 to 1,436 meters) amsl.

Only one small individual of Utah vine milkweed was observed onsite in the spring 2013 survey (Figure 11). It was located near the northern most border of the site in a shallow runnel margin. This is an insignificant occurrence, especially with respect to large distributed populations found on the McCoy (5,180 individuals) and Blythe Solar sites (398 individuals). Utah vine milkweed has also been widely documented during solar project surveys across California and Nevada, and appears to be much more common than previously thought.

P:\GIS\Ironwood\Desert_Quartzite\CHAABR_FUNUTA.mxd



Utah Vine Milkweed

▲ 1

Adam's Prostrate Spurge

- 1 - 5
- 5 - 10
- 10 - 20
- 20 - 40

Chamaesyce abramsiana pop #1

Desert Quartzite Site Boundary

Site Access Roads

Note:
Dot size does not represent Area of Occurrence

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 11
Abram's Prostrate Spurge *(Chamaesyce abramsina)* and Utah Vine Milkweed *(Funastrum utahense)* Distribution

3.1.1.5 Ribbed Cryptantha

Ribbed cryptantha is an annual herb in the Boraginaceae family. It occurs on fine sandy soil and shallow dunes within Sonoran and Mojavean creosote bush scrub, at an elevation range below 3,200 feet (1,000 meters) amsl. Flowering from January through May, it has been widely documented from California herbarium records, with several occurrences within five miles of the Quartzite project site, as well as a reference population near the site.

The spring 2013 surveys documented approximately 56,748 individuals of ribbed cryptantha, exclusively on sandy areas of the site (Photograph 4). Some occurrences were so dense that then numbers of individuals were estimated systematically. Very dense populations were recorded along the gen-tie line and on sandy areas southwest of the exiting solar facility (Figure 12).

From the many solar project surveys conducted throughout the region, several large populations of ribbed cryptantha have been documented. A total of 1,715 individuals, were observed at the McCoy Solar site mostly around the sandy gen-tie line alignment to be shared with both the Blythe Solar project and this Project. Blythe Solar recorded around 71,000 individuals along the same gen-tie line, but this number also includes individuals counted on the footprint of the substation (already built).

The main threats to this species are: major disturbances of sandy areas; disruption of sand transport processes and flows; and further introduction of weeds, especially Saharan mustard (*Brassica tournefortii*). Many of the sandy locations of the site are already infested with Saharan mustard, and construction of the gen-tie Line most likely will increase this weed. The large population on sandy areas just southwest of the existing solar facility is on the Project site. These areas are highly populated with Saharan mustard, but mostly at the margins of the sand dunes

3.1.1.6 Harwood's Eriastrum

Harwood's eriastrum is an annual herb in the Polemoniaceae family. It is a California endemic, distributed on sand dunes in desert areas of Riverside, San Bernardino, and San Diego counties. Typically flowering from March to May, its elevation range is 400–3,000 feet (125 - 915 meters) amsl.

Spring 2013 surveys on the Project site documented 882 individuals of this plant, exclusively on sandy areas of the gen -tie line and Survey Area (Photograph 5) (Figure 13). Harwood's eriastrum appears to co-occur sympatrically with ribbed cryptantha, with similar substrate preferences and distribution, although in fewer numbers and more sporadically dispersed. It is vulnerable to the same threats, especially weeds as discussed in Section 3.1.4.

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Photos 4-5.CDR

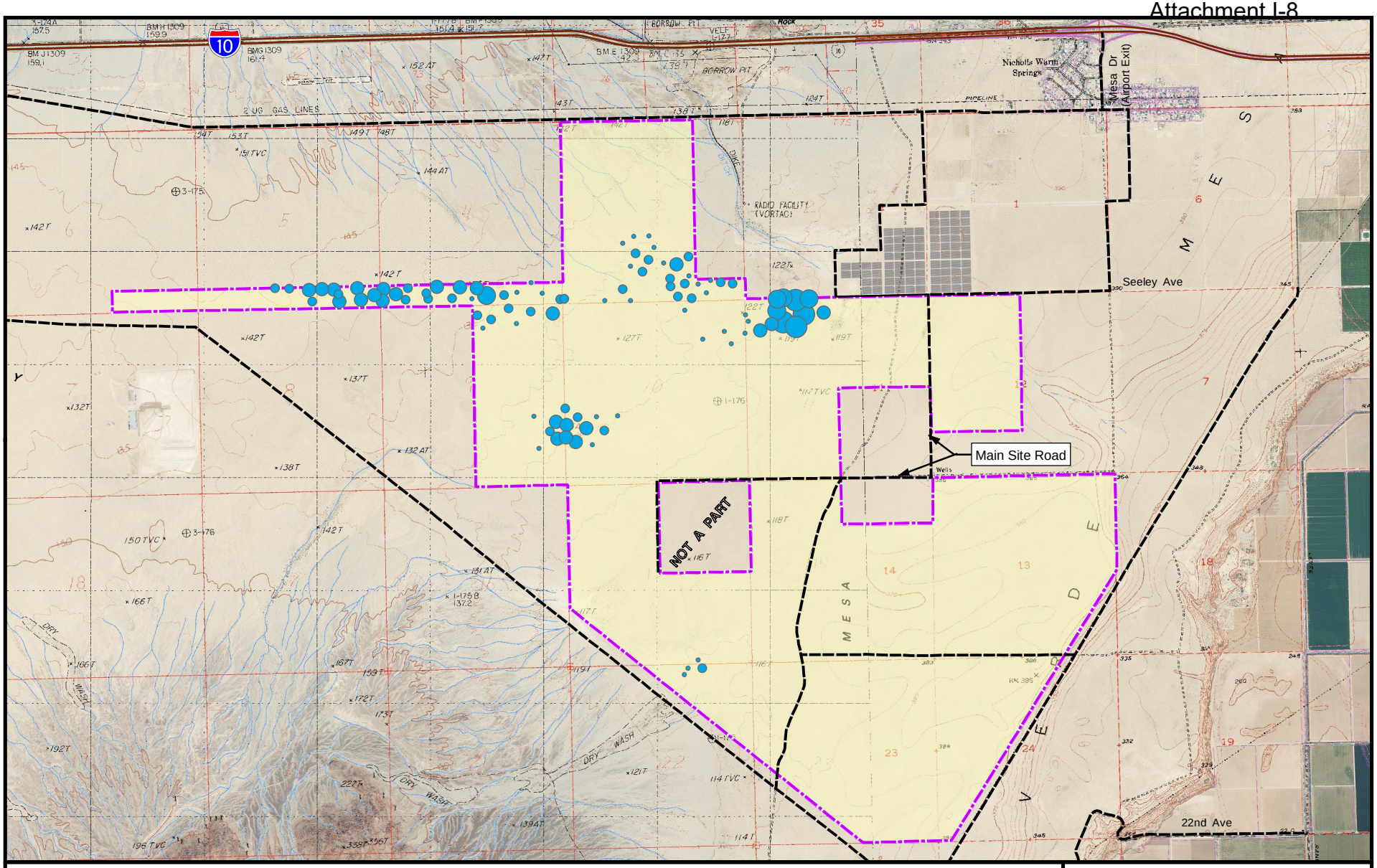


Photograph 4 - Ribed crypthantha (*Cryptantha costata*) (L), growing alongside the common *Cryptantha angustifolia.*



Photograph 5 - Harwood's Eriastrum (*Eriastrum harwoodii*).

P:\GIS\Ironwood\Desert_Quartzite\CYPCOS.mxd



Ribbed Cryptantha
- 1 - 10
- 10 -100
- 100 - 1,000
- 1,000 - 5,000
- 5,000 - 12,200

Site Access Roads

Desert Quartzite Site Boundary

Note:
Dot size does not represent Area of Occurrence

N

0 500 1,000
Meters

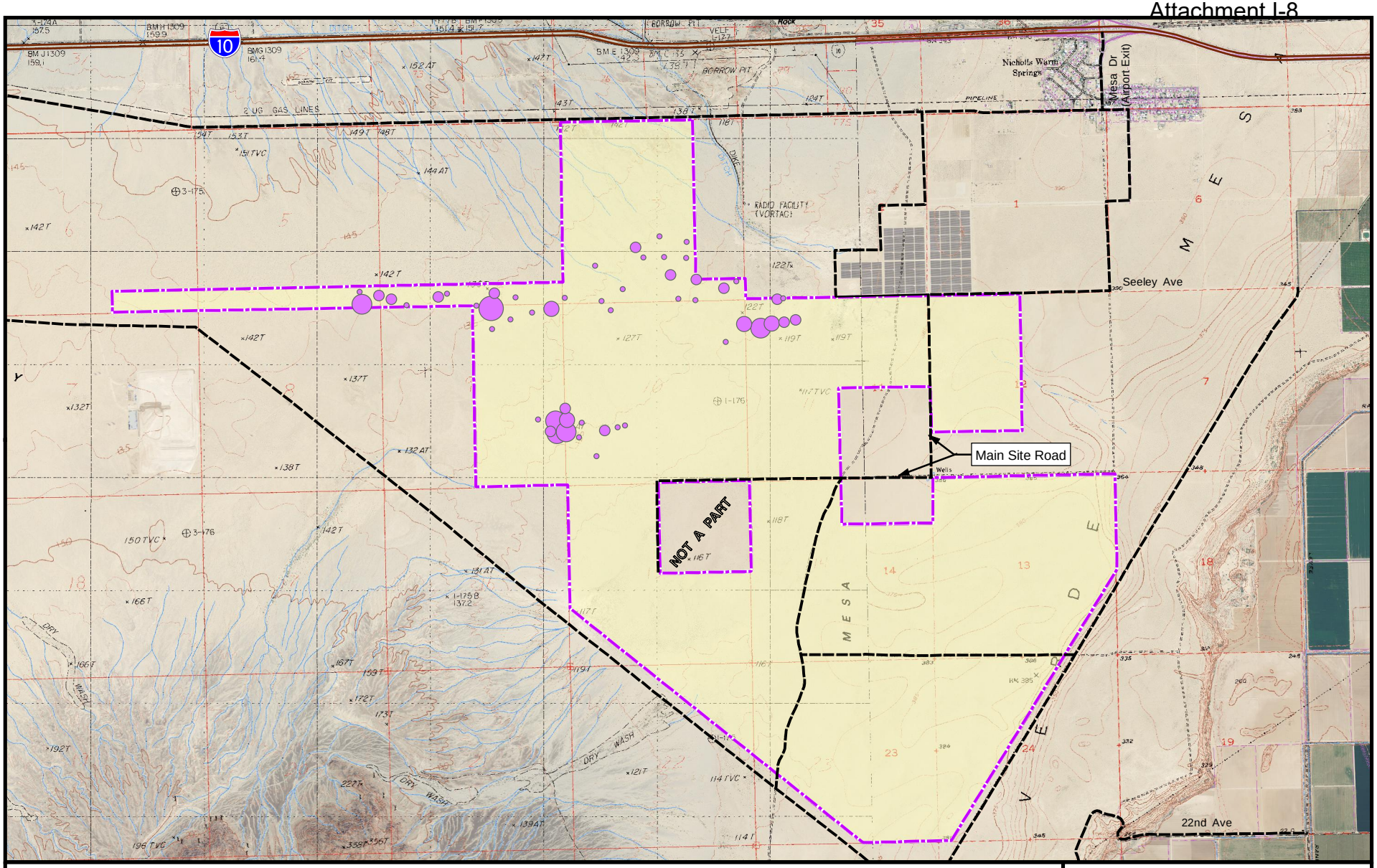
DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 12

Ribbed Cryptantha
(Cryptantha costata)
Distribution

AR060520

P:\GIS\Ironwood\Desert_Quartzite\ERIHAR.mxd



Harwood's_Eriastrum
- 1 - 5
- 5 - 20
- 20 - 50
- 50 -100
- 100 - 171

Site Access Roads

Desert Quartzite Site Boundary

Note:
Dot size does not represent Area of Occurrence

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 13

Harwood's Eriastrum
(Eriastrum harwoodii)
Distribution

AR060521

Other nearby solar projects have likewise documented populations of Harwood's eriastrum on the same sandy gen-tie line alignment. A total of 386 individuals were found on during the survey for the McCoy site. A total of 2,134 individuals were found during the survey for the Blythe Solar project that included the many found at the already-built substation.

Although Harwood's eriastrum is assigned the State Rank of S3 (apparently requiring no compensatory mitigation), its CNPS Rank is 1B.2. This is the highest Special Status ranking of any of the plants on the Project site.

3.1.1.7 Desert Unicorn Plant

Desert unicorn plant is a perennial herb belonging to the Martyniaceae family. It is historically known to occur in sandy Sonoran desert scrub at elevations ranging from 490 to 3,280 feet (150 to 1,000 meters) amsl.

811 individuals of desert unicorn plant were documented within the Study Area during fall 2012 Rare Plant Surveys (Photograph 6) (Figure 14). This is an estimate because sometimes a single root tuber might produce two to three above ground leaf rosettes, and closely spaced aboveground stems were counted as separate individuals.

Desert unicorn's distribution across the Project site followed no particular pattern. It was found occasionally on shallow sand sheets, but was mostly seen in innocuous creosote bush scrub, on both loose sandy-gravelly soils, and silty areas. It prefers shallow swales where summer monsoonal rainfall collects and soaks-down. The largest concentrations of this plant were the silty outwash flats on the southwest border of the site, and on similar silty areas near the existing solar farm.

Since fall rare plant surveys became required for desert solar projects, our knowledge of the distribution and abundance of desert unicorn has been significantly broadened. McCoy Solar surveys recorded 662 individuals distributed across its site. Blythe Solar also conducted fall surveys in 2012, documenting 1,687 individuals with many of these re-sprouting within a recently graded access road. It is presumed that this plant is much more common than believed, but has been misinterpreted as rare because of the limited number of fall surveys performed as seen with surveys not conducted at the correct time of the year for Abram's spurge noted earlier.

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Ch 3 Photo 6-7.CDR

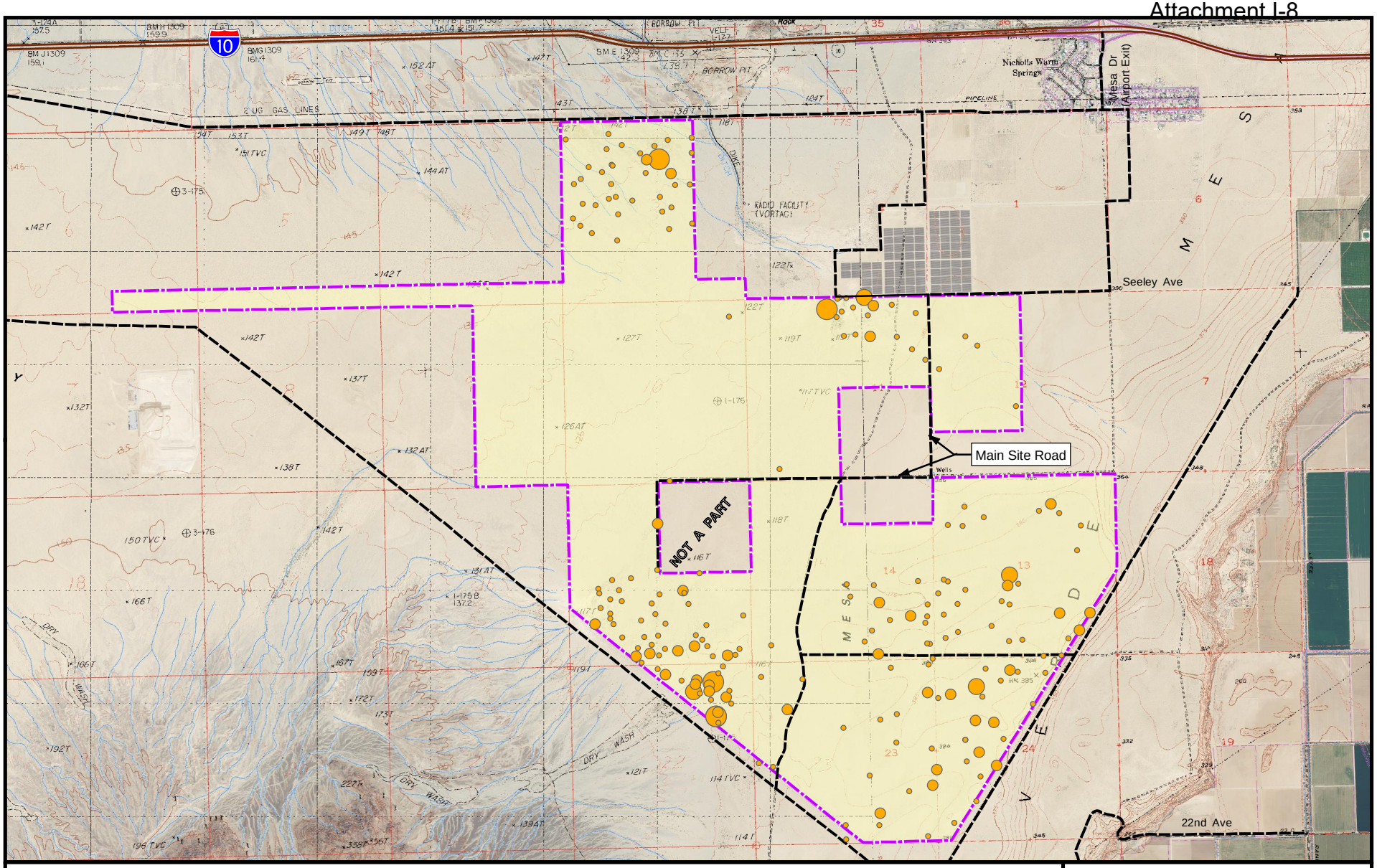


Photograph 6 - Desert Unicorn Plant (*Proboscidena athaeifolia*).



Photograph 7 - Desert Dry Wash Woodland.

P:\GIS\Ironwood\Desert_Quartzite\PROALT.mxd



Desert Unicorn Plant
- 1 - 5
- 5 - 10
- 10 - 15
- 15 - 25

Site Access Roads

Desert Quartzite Site Boundary

Note:
Dot size does not represent Area of Occurrence

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 14

Desert Unicorn Plant *(Probiscidea altheifolia)* Distribution

AR060524

3.1.2 Cacti and Yucca

Yuccas were not found on site, but three species of cactus were documented during the fall 2012 Plant Survey. Due to the fact that all cacti were already recorded, they were not documented in the spring 2013 surveys. The cacti were not recorded with GPS waypoints or in the electronic database; however, they were tallied by species on the paper datasheets by field surveyors, and represent a good census of all cacti onsite.

The estimated totals of all cacti found on site are presented as follows:

- *Cylindropuntia echinocarpa*: 106 individuals;
- *Mammillaria tetrancistra*: 11 individuals; and
- *Ferocactus cylindraceus*: 1 individual.

3.1.3 Vegetation Communities

The preliminary vegetation communities are mapped on Figure 15 and described as follows.

3.1.3.1 Desert Dry Wash Woodland

Desert Dry Wash Woodland (DDWW) is located in two distinct washes, comprising approximately 2 percent of the Project site. Desert Dry Wash Woodland habitat consists of small-leaved (microphyllous) leguminous trees, in association with sandy or gravelly washes with braided channels in active alluvial fans (Photograph 7). Dominant plants species include ironwood (*Olneya tesota*), blue palo verde (*Parkinsonia florida*), with occasional honey mesquite (*Prosopis glandulosa*). This community is considered sensitive by the California Resources Agency and BLM due its limited distribution, value to wildlife, and susceptibility to disturbance (Bureau of Land Management 2002 and Zeiner, et al., 1990). The presence of water at least on a seasonal flow regime is vital for this community to persist.

The NECO regulations consider DDWW as a sensitive resource and recommend avoidance of disturbance. There are three areas within the Study Area, which qualify as DDWW, and each of these are at the margins or borders of the proposed project. One DDWW area is just south of the existing solar facility. It is a rich woodland environment with palo verdes, ironwoods, and a few mesquites, and is good habitat for many species of avian wildlife. The second DDWW area is down by the southwest powerlines where water flows and pools from the mountains to the southwest. Fine silty soil supports a lot of unicorn plant (*Proboscidea althaeifolia*), plus a nice diversity of common native plant species. The existing project boundaries mostly avoid this area. There are, however, a few scattered palo verdes and ironwoods scattered in the scrub beyond this DDWW about one quarter to one half mile into the site. The

third DDWW is at the northern edge of the site, starting on the north border and running downstream in a southeast direction. There are palo verdes and ironwoods in this area.

3.1.3.2 Sonoran Desert Scrub

Larrea tridentata-Ambrosia dumosa Shrubland Alliance (Sawyer 2009)

Sonoran Creosote Bush Scrub (Holland Code 33100)

Sonoran Desert Scrub covers approximately 98 percent (7,160 acres) of the Study Area (Photograph 8) This alliance on the site is dominated by creosote bush (*Larrea tridentata*), burro bush (*Ambrosia dumosa*), with scattered occurrences of cheese bush (*Ambrosia salsola*), brittlebush (*Encelia farinosa*), Emory's Indigo bush (*Psorothamnus emoryi*), big galleta grass (*Hilaria rigida*), and occasional cactus species. Most of this onsite scrub is sparsely vegetated with widely scattered relatively low-growing individual shrubs.

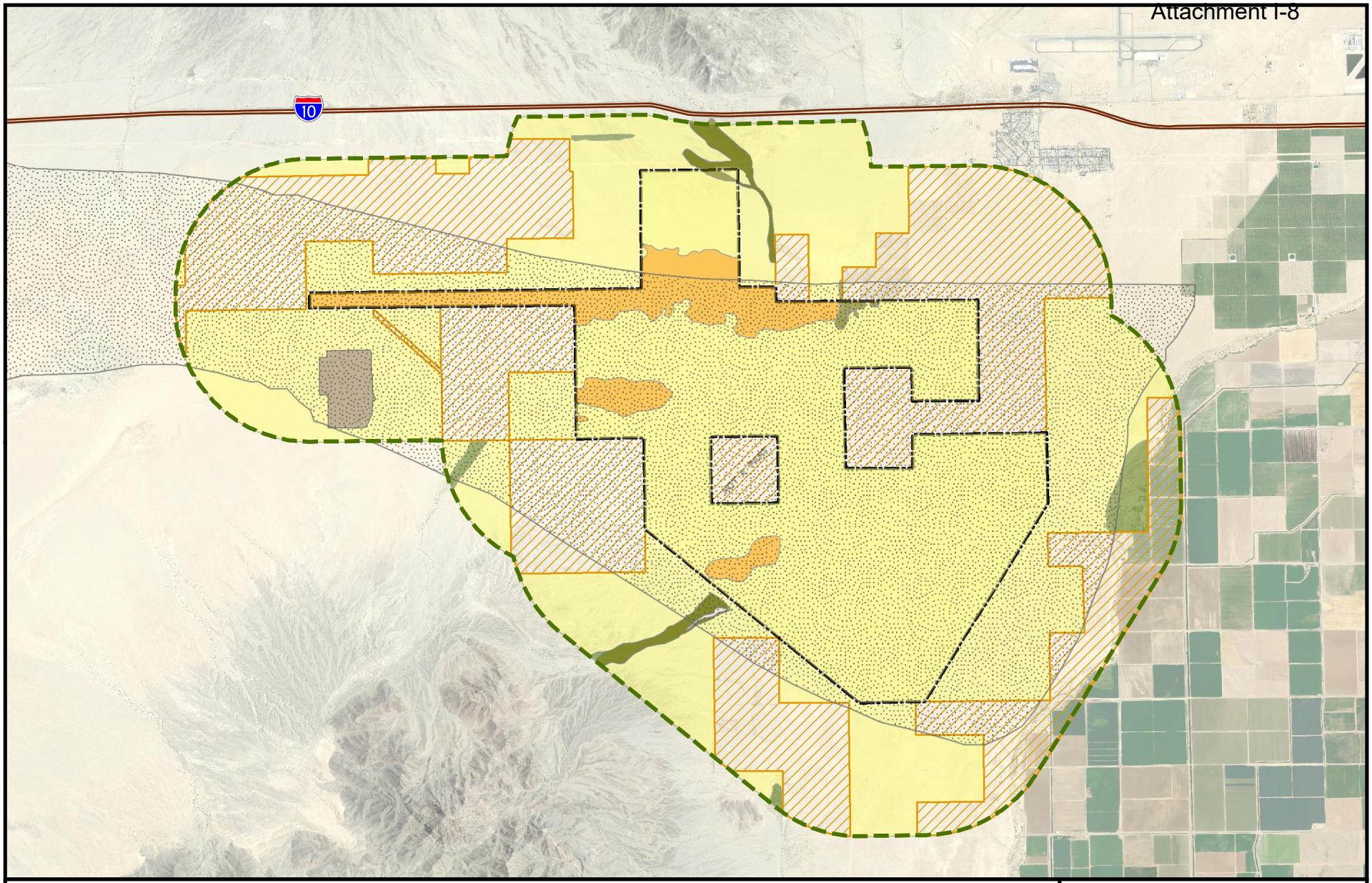
3.1.3.3 Sand Dunes

Pleuraphis (Hillaria) rigida Herbaceous Alliance (Sawyer 2009)

Stabilized and Partially Stabilized Desert Dunes (Holland Code 22200)

Sand Dunes onsite are stabilized and partially stabilized accumulations supporting an herbaceous alliance dominated by the perennial bunch grass, big galleta grass (*Hilaria rigida*) (Photograph 9). Co-dominants are widely scattered creosotes (*Larrea tridentata*), with occasional occurrences of Emory's indigo bush (*Psorothamnus emoryi*), desert wire lettuce (*Stephanomeria pauciflora*), fan-leaved tiquilia (*Tiquilia plicata*) and desert dicoria (*Dicoria canescens*). This vegetation type is present on the sandiest areas around the northwest parts of the project site and along the gen-tie alignment. It is important to note that dense infestations of the invasive weed Saharan mustard are evident on many areas of this vegetation type.

P:\GIS\Ironwood\Desert_Quartzite\VEG_20140116.mxd



Vegetation Communities

- Desert Wash Woodland (microphyll woodland)
- Sonoran Creosote Bush Scrub
- Disturbed/Developed
- Stabilized Sand Dune

- 1-Mile Site Boundary Buffer
- Sand Corridor
- Desert Quartzite Site Boundary
- Private Lands

N

0 1
Miles

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 15

Vegetation Map

AR060527

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Ch 3 Photo 8-9.CDR



Photograph 8 - Sonoran Desert Scrub.



Photograph 9 - Sand Dunes.

3.1.4 Non-Native and Invasive Species

Ten non-native plant species were observed on the Quartzite study area during the fall 2012 and spring 2013 Surveys (Table 6).

Table 6 Non-Native Plants Found on Project Site (Fall 2012 and Spring 2013)

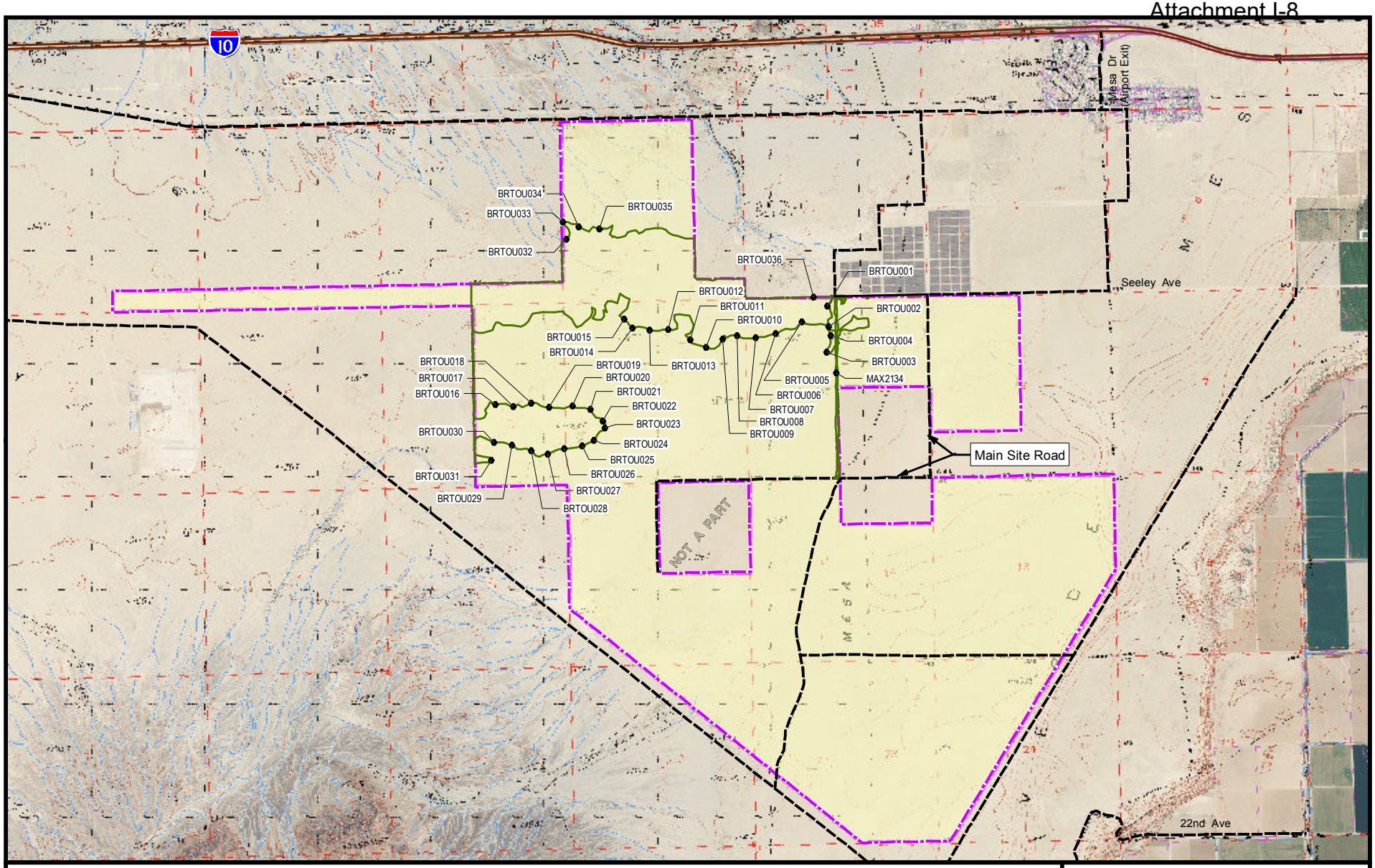
Taxon	Common Name	Abundance	Invasive Potential
**Brassica tournefortii*	Sahara mustard	Widespread, Locally abundant on sand	HIGHLY INVASIVE
**Chenopodium album*	Lamb's quarters	Scarce	Low
**Chenopodium murale*	Nettleleaf goosefoot	Scarce	Low
**Cynodon dactylon*	Bermuda grass	Scarce	Invasive but unlikely
**Eucalyptus sp.*	Eucalyptus	Scarce	Low invasivity in this situation
**Polygonum aviculare subsp. depressum*	Prostrate knotweed	Scarce	Low
**Salsola tragus*	Russian thistle	Abundant on sand	Invasive on sand and disturbed areas
**Schismus barbatus*	Mediterranean grass	Widespread	Moderately invasive with little consequence
**Tamarix ramosissima*	Tamarisk	Scarce	Non invasive in this situation
**Tribulus terrestris*	Puncture vine	Scarce	Low

Sahara mustard *(Brassica tournefortii)* is by far the most aggressive and abundant invasive plant on the Project site. It is diffusely distributed throughout the Study Area on many habitats, and locally abundant throughout the sandier areas of the Project site and along the gen-tie alignment. Millions of individuals were observed flowering and fruiting during the spring 2013 survey.

Sahara mustard infestation remains the greatest invasive weed risk of the entire site. It is already well established on most of the sandier areas, and a large seed bank is certain to exist. Minimal winter rains can germinate multiple leaf rosettes, many of which can bolt and produce seed in a short time. Potential for Sahara mustard to expand its presence across other less sandy areas of the site remains high, especially if aided by soil surface disturbance.

Figure 16 shows the heaviest infestations of Sahara mustard on the site. Although it generally invades sandy areas, the surveyors noticed that it is most abundant along the shallow margins and skirts of the major dune systems on the west portion of the Study Area. It also dominates shallow sand sheets elsewhere, as well as certain sand accumulations adjacent to abandoned agriculture fields.

X:\GIS\Ironwood\Desert_Quartzite\BRATOU.mxd



Sahara Mustard

Sand Dune Margins

Site Access Roads

Desert Quartzite Site Boundary

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 16

Sahara Mustard
(Brassica tournefortii)
Distribution

AR060530

It should be noted that Sahara mustard had very little presence on the disturbed and abandoned agriculture fields in the center of the site. This goes against the common association of disturbed areas becoming breeding grounds for weeds. In fact, both of the main agricultural fields seemed to support very few invasive weeds at all.

Control of Sahara mustard remains a challenge. It has become so widespread across southern California deserts in the last 20 years and so aggressive that control seems ineffective. Avoidance of disturbance seems the most prudent approach, but it still thrives on undisturbed areas. An Integrated Weed Plan will be designed to prevent, as much as possible, the further spread of this weed.

Russian Thistle (*Salsola tragus*) was observed mostly on the gen-tie line sand dune areas, with occasional small occurrences across disturbed areas of the site. This plant represents the second most common weed onsite after Sahara mustard. Occasional locally abundant populations are to be expected associated with soil disturbance and loose sand. Russian thistle is known to thrive on disturbed soil, so monitoring and control measures will need to be incorporated into the Integrated Weed Plan.

Mediterranean grass (*Schismus barbatus*) is widespread across the site in many habitats but never "abundant." This plant is so widespread across many California deserts that it has become the dominant annual grass in many situations. Although it is very common, it poses only a slight ecological type conversion risk in this locally harsh situation. No control is proposed.

Bermuda grass (*Cynodon dactylon*) was observed in the Desert Dry Wash Woodland along the northern part of the site adjacent to the solar farm. Two small patches were seen growing in the shade of ironwoods. They were in robust condition, flowering and fruiting. Bermuda grass' potential to spread is moderate to high, but would be limited by habitat preferences of reliably moist soil and shade.

Puncture vine (*Tribulus terrestris*) was observed on disturbed areas on the borders of the abandoned jojoba farm near the center of the site. Only a couple of individuals were seen, and its potential to become invasive and widespread is low.

Lamb's quarters (*Chenopodium album*) was seen with only a few scattered occurrences on the main solar site. Its potential for invasiveness and ecological damage is low.

Nettleleaf goosefoot (*Chenopodium murale*) was seen with only a few scattered occurrences on the main solar site. A common agriculture weed, its potential for invasiveness and ecological damage is low.

Prostrate knotweed (*Polygonum aviculare subsp. depressum*) is a common agricultural and ruderal weed. It was seen only once during spring surveys, and is not considered a major invasive threat.

Eucalyptus (*Eucalyptus* sp.) occurs only as a couple of planted individuals on the north margin of the site

on the border of the existing solar facility. Its potential for invasiveness is low due to the harsh conditions of the local landscape.

Tamarisk (*Tamarix ramosissima*) occurs as only a couple of dwarfed individuals on the north margin of the site at the border of the existing solar farm. It has a moderate potential to expand but would be limited by the lack of reliable water nearby. It should be removed promptly, in any case.

3.2 RAINFALL ANALYSIS

Available historical winter rainfall data from the Blythe CAA Airport was summarized to obtain a useful average for the Blythe area (Table 7 and 8). The historical average monthly rainfall for the Blythe area was estimated to be 0.30 inches and 0.37 for 2012.

Table 7 Historical Winter Rainfall Data (inches)[1]

	October	November	December	January	February	March	Annual Total	Monthly Average
Blythe CAA Airport[1]	0.26	0.19	0.41	0.48	0.44	0.35	3.55	0.30

[1] Western Regional Climate Center (2013)

Table 8 Rainfall 2012 and 2013 (inches)[1]

	October	November	December	January	February	March	2012 Total	2012 Monthly Average
Blythe CAA Airport[1]	0.27	0.00	0.86	0.77	0.01	0.03	4.47	0.37

[1] Western Regional Climate Center (2013)

3.3 AMPHIBIANS

Overall, there were 27 different points that were identified as having standing water at some time on the Project site (Figure 5). Of these spots, two were identified as the most likely to support Couch's spadefoot in the event of rains as they were not only the most extant areas for having held water, but because they also exhibited a strong component of dry desert wash woodland plant species.

3.4 REPTILES

3.4.1 Desert Tortoise

Desert tortoise (*Gopherus agassizii*) is a federal and state listed threatened species. Desert tortoises are well adapted to living in a highly variable, and often harsh, desert environment. They spend much of their lives in burrows, even during their seasons of activity. In late winter or early spring, desert tortoises

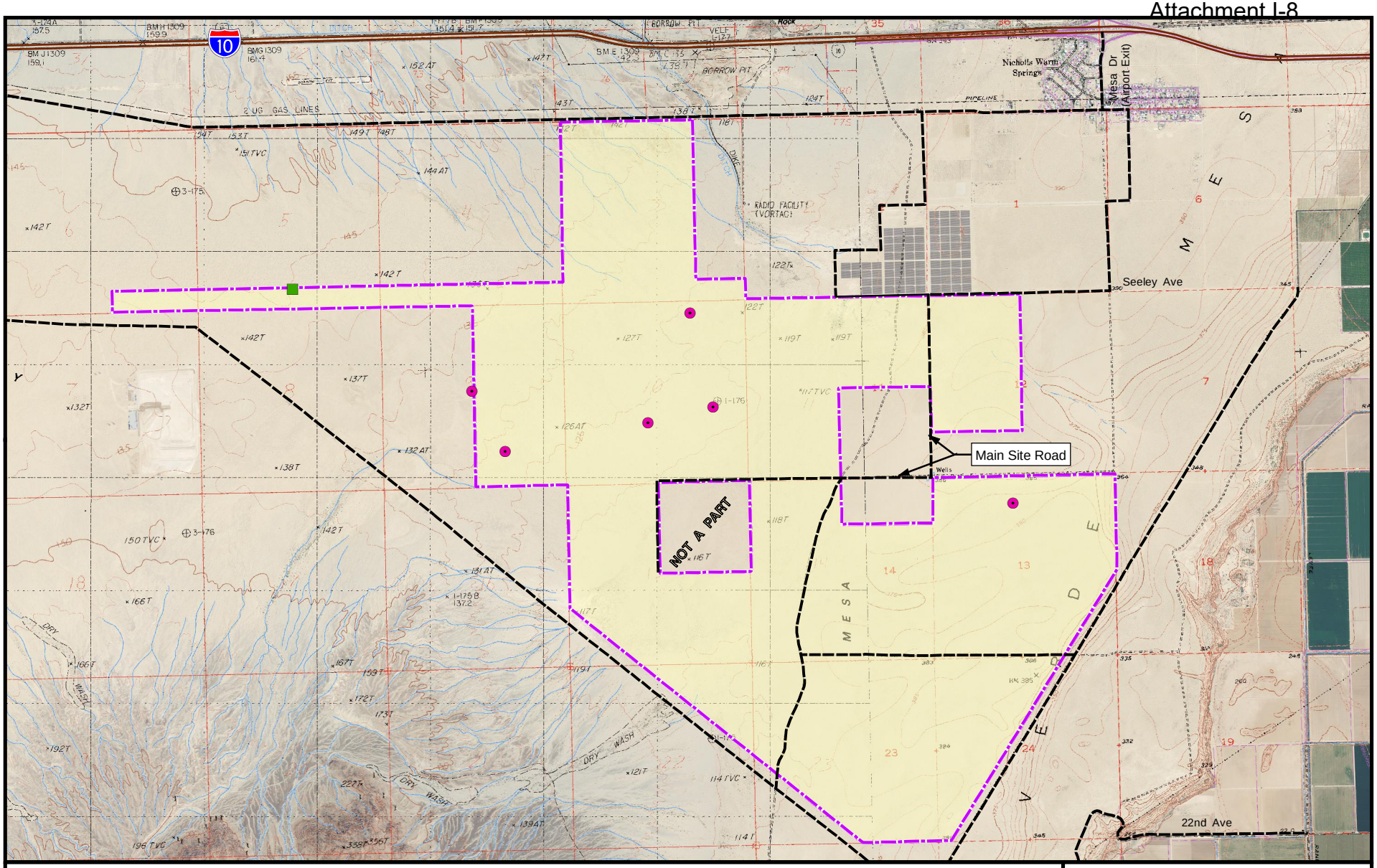
emerge from over-wintering burrows and typically remain active through fall. Activity does decrease in summer, but tortoises often emerge after summer rain storms. Activity and movement is generally influenced by temperature and precipitation, which correlate with potential food and water resources. Extreme temperatures, both high and low, and periods of drought typically result in reduced tortoise activity (Franks et. al. 2011). Mating occurs both during spring and fall. Tortoises are long-lived and grow slowly, requiring 13 to 20 years to reach sexual maturity [at approximately 180 millimeters (mm) mean carapace length (MCL)]. Eggs are generally laid in friable soil at near burrow entrances between April and June and occasionally September and October. Eggs hatch within three to four months.
Soils must be appropriately soft for digging burrows, but firm enough so that burrows do not collapse. Tortoises typically prefer habitats with abundant annual forbs, grasses and cactus, which constitute its primary food sources.

Desert tortoises occupy home ranges, which are generally defined as the area traversed while carrying out a range of normal activities (e.g., foraging and mating). The size of desert tortoise home ranges can vary with respect to sex, geographic location, substrate, topography, and year depending on climate factors such as rainfall and temperature.

2013 Results

Desert tortoise sign (i.e., live tortoises, active burrows/pallets, and recent scat, and tracks) found in the Study Area were six disarticulated carcasses and a set of tracks (Figure 17). All carcasses were disarticulated and over four years of age. No desert tortoise burrows were detected. A set of tracks was found by Alice Karl, PhD. during the botany surveys on March 22, 2013 traveling north across the dunes. Although the entire Study Area could be considered tortoise habitat, few tortoises would be expected in most of the site because of the poor cover both in and out of the washes and such low species richness and stature that the forage base may be similarly under-developed.

P:\GIS\Ironwood\Desert_QuartziteDT_Sign.mxd



Tortoise Carcass, >4 Years, Disarticulated

Tortoise Track

Site Access Roads

Desert Quartzite Site Boundary

N

0 500 1,000

Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 17

Desert Tortoise Sign

AR060534

3.4.2 Mojave Fringe-Toed Lizard and Herpetofaunal

Overall, 3,483 different individual squamates were observed over the span of all surveys undertaken (Table 9), with 98 percent of those sightings lizards. Of the lizard composition, ten different species were recorded with five species totaling over 95 percent of the total animals observed (Table 9). Western whiptail (*Aspidoscelis tigris*) was the most common lizard observed on the site with large numbers of common side-blotched lizard (*Uta stansburiana),* zebra-tailed lizard *(Callisaurus draconoides),* desert iguana *(Dipsosaurus dorsalis),* and Mojave fringe-toed lizard (*Uma scoparia)* was also observed. Six different species of snakes were encountered within the survey period with the majority comprised of the majority comprised of the species sidewinder rattlesnake (*Crotalus cerastes*) (Table 10). Due to the type of sampling methodology, the majority of observations were comprised of diurnal or day active, wide-ranging, foraging squamates.

Using species maps for Southern California squamates, there could be as many as two different California Species of Concern present upon the proposed Project site. These two species were the Mojave fringe-toed lizard and Colorado Desert fringe-toed lizard (*Uma notata*). To determine the extent of their presence on the site, waypoints were taken by survey crews upon encountering these species during all surveys (Figure 18).

Overall, members of the Uma species made up seven percent of the total squamates seen by species (Table 9). These individuals were confined to the fine sand or the sandy loam areas that occupy the northwest corner and the gen-tie area of the Project site (Figure 18). After identifying lizards as members of this genus, 13 individuals (five male and eight females) were collected briefly to identify them down to species level. According to Stebbins (2012), a good method to do this is according to inter- naris scale patterns, where the Mojave will have five scales in a pattern across the snout and the Colorado Desert fringe-toed exhibits a scale pattern of three. All individuals that were scrutinized were identified as Mojave and not Colorado Desert individuals using this method (Photograph 10).

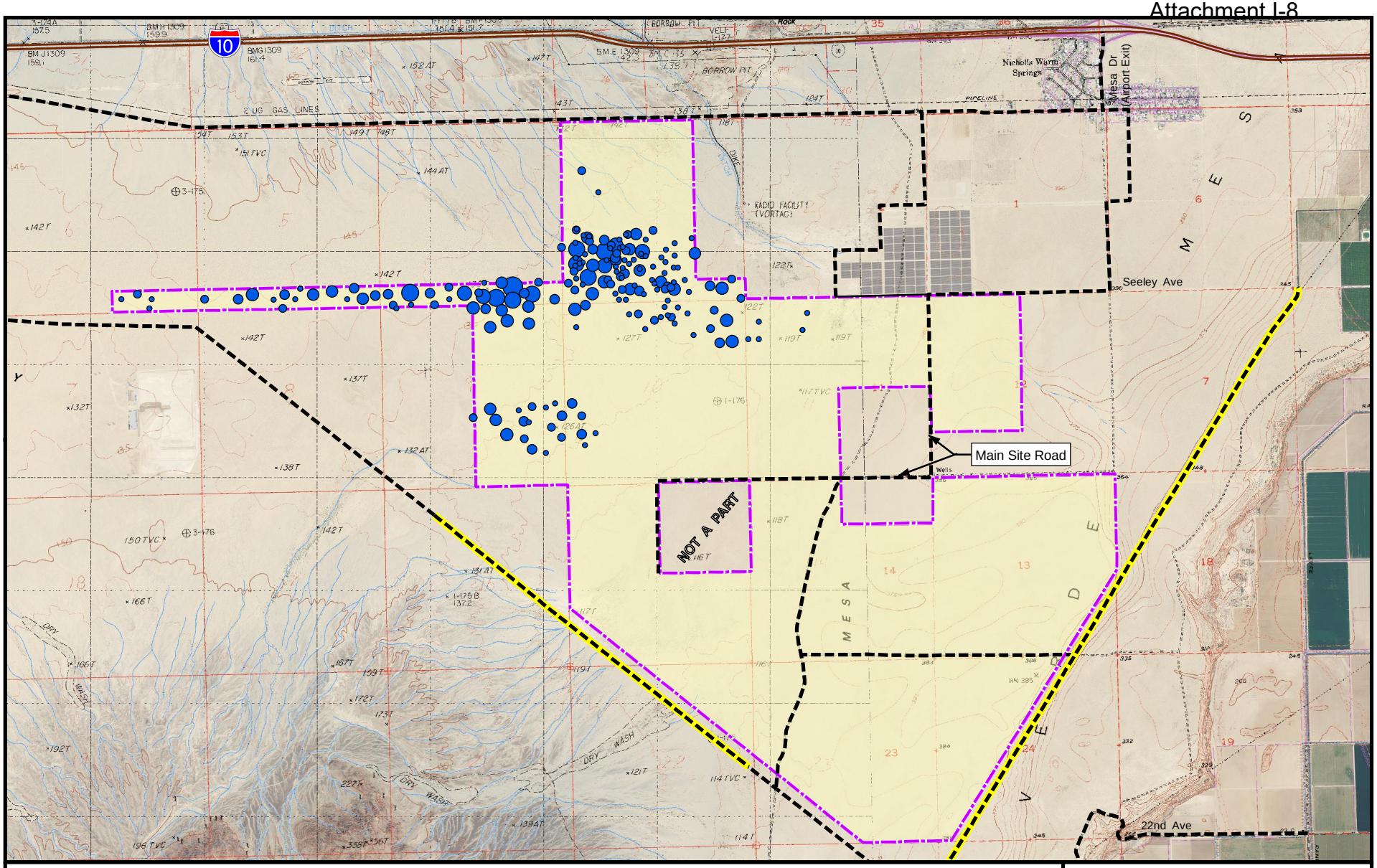
Table 9. Lizards Found on Project Site

Species	Aspidoscelis tigris	Uta stansburiana	Callisaurus draconoides	Dipsosaurus dorsalis	Uma scoparia	Phrynosoma platyrhinos calidiarum	Gambelia wislizenii	Urosaurus graciosus	Sceloporus magister	Coleonyx variegatus variegatus	Total Lizards across the site
Total Individuals	1,382	805	448	424	241	95	17	8	1	1	**3,422**
Individual species / overall species sightings	40%	23%	13%	12%	7%	3%	0.50%	0.20%	0.02%	0.02%	

Table 10. Snakes Found on Project Site

Species	Crotalus cerastes	Chionactis occipitalis	Masticophis flageiium piceus	Salvadora hexalepis	Pituophis catenifer	Arizona elegans	Total Snakes across the site	Total Squamates across the entire site
Total Individuals	44	7	6	2	1	1	**61**	**3,483**
Individual species / overall species sightings	1%	0.2%	0.2%	0.05%	0.02%	0.02%		

P:\GIS\Ironwood\Desert_QuartziteFT_Lizard_Dist.mxd



Fringe-toed Lizard Density

- 1
- 5
- 10

- Site Access Road
- Site Access Road (marginal conditions)
- Desert Quartzite Site Boundary

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 18

Mojave Fringe-toed Lizard *(Uma scoparia)* Distribution

AR060537

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Ch 3 Photo 10.CDR



Photograph 10 - *Uma Scoparia* Male, Captured for Identification to the species level.

3.5 AVIAN

3.5.1 Migratory Bird Surveys

3.5.1.1 Unlimited Distance Extended Observation Surveys

Each migration point was visited eight times between April 18th 2013 and May 30th 2013 (Table 11). The number of visits was limited during the spring migration period due to delays surrounding agency acceptance of a project-specific Avian Work Plan. However, it is anticipated that scheduled migration surveys in spring 2014 will provide sufficient additional data points to adequately illuminate a final report and/or BBCS.

Table 11.Migration Point Visits-Spring 2013

Migration Point ID	Visit Date	Visit ID	Observer
MP-2	4/18/2013	MP-2_4/18/2013	R. RADD
MP-1	4/18/2013	MP-1_4/18/2013	J. YERGER
MP-2	5/6/2013	MP-2_5/6/2013	R. RADD
MP-1	5/3/2013	MP-1_5/3/2013	R. RADD
MP-2	5/2/2013	MP-2_5/2/2013	R. RADD
MP-1	4/28/2013	MP-1_4/28/2013	R. RADD
MP-2	4/26/2013	MP-2_4/26/2013	R. RADD
MP-1	4/25/2013	MP-1_4/25/2013	R. RADD
MP-1	5/10/2013	MP-1_5/10/2013	R. RADD
MP-2	5/11/2013	MP-2_5/11/2013	R. RADD
MP-1	5/13/2013	MP-1_5/13/2013	R. RADD
MP-2	5/18/2013	MP-2_5/18/2013	R. RADD
MP-1	5/23/2013	MP-1_5/23/2013	R. RADD
MP-2	5/22/2013	MP-2_5/22/2013	R. RADD
MP-1	5/30/2013	MP-1_5/30/2013	R. RADD
MP-2	5/28/20/13	MP-2_5/20/2013	R. RADD

During the spring 2013, 97 birds were detected during 80 hours of observation (16 visits). The average number of birds detected per hour was 1.2125, this number includes five visits without any detections. Past research has shown that the peak of migration within this area occurs on April 22nd (McCrary et. al, 1982), Table 12 shows a peak in the number of birds detected on April 18th, 2013.

Table 12.Migratory Birds Detected Per Visit- Spring 2013

Visit ID	Number of Birds Detected
MP-1_4/18/2013	10
MP-1_4/25/2013	5
MP-1_4/29/2013	0
MP-1_5/10/2013	0
MP-1_5/13/2013	0
MP-1_5/23/2013	4
MP-1_5/3/2013	4
MP-1_5/30/2013	2
MP-2_4/18/2013	57
MP-2_4/26/2013	5
MP-2_5/11/2013	0
MP-2_5/2/2013	4
MP-2_5/22/2013	0
MP-2_5/28/2013	1
MP-2_5/6/2013	5

Table 13 summarizes avian detections from migratory bird surveys including species, number, flight-height and behavior.

Table 13 Migratory Bird Survey Results Summary- Spring 2013

Common Name	Scientific Name	Number Detected	Average Height	Behavior
Caracaras and Falcons (Falconidae)				
American Kestrel	*Falco sparverius*	2	2.5	FO,FL
Hawks, Kites, Eagles, and Allies (Accipitridea)				
Northern Harrier	*Circus cyaneus*	2	4	FL
Red-tailed Hawk	*Buteo jamaicensis*	6	2	FO,FL
Swainson's Hawk	*Buteo swainsoni*	3	1.67	FO,FL
Jays and Crows (Corvidae)				
Common Raven	*Corvus corax*	1	4	FL
New World Vultures (Cathartidea)				
Turkey Vulture	*Cathartes aura*	22	3.47	FL,FO
Pigeons and Doves (Columbidea)				
Mourning Dove	*Zenaida macroura*	2	1	FL,S
Shrikes (Laniidae)				
Loggerhead Shrike	*Lanius ludovicianus*	1	1	P
Swallows (Hirundinidae)				
Barn Swallow	*Hirundo rustica*	5	1.5	FL,FO

Common Name	Scientific Name	Number Detected	Average Height	Behavior
Cliff Swallow	*Petrochelidon pyrrhonota*	33	1.45	FL
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	2	2	FO
Tree Swallow	*Tachycineta bicolor*	7	1.25	FL
Unknown Swallow	-	7	3	FL
Swifts (Apodidea)				
White-throated Swift	*Aeronautes saxatalis*	2	1	FL,FO
Tyrant Flycatchers (Tyrannidea)				
Ash-throated Flycatcher	*Myiarchus cinerascens*	1	1	FL
Gray Flycatcher	*Empidonax wrightii*	1	1	FO

Behavior Codes: S=Singing, C=Calling, P=Perched, FL=Flying, FO=Foraging, O=Other.

3.5.1.2 Line Transect Sampling

Line Transect Data will be analyzed by a qualified statistician, prior to the development of a BBCS. These data will inform an Avian Risk Analysis associated with the BBCS. Appendix G contains a species list that was compiled over the course of all survey efforts during the spring 2013. Table 14 below summaries the survey time, date and surveyor of each line transect.

Table 14. Summary of Line Transect Surveys Conducted 18 April Through 20 May 2013

Transect ID	Visit Date	Visit ID	Observer	Start Time	End Time
T1-A	4/28/2013	T1-A 4/28/2013	R. Radd	6:45:00	7:40:00
T1-B	4/18/2013	T1-B 4/18/2013	J. Yerger	6:39:00	7:43:00
T1-B	5/13/2013	T1-B 5/13/2013	R. Radd	6:37:00	7:54:00
T1-B	5/2/2013	T1-B 5/2/2013	R. Radd	6:18:00	7:09:00
T2-A	4/19/2013	T2-A 4/19/2013	J. Yerger	6:28:00	7:32:00
T2-A	5/2/2013	T2-A 5/2/2013	R. Radd	7:25:00	8:06:00
T3-A	4/28/2013	T3-A 4/28/2013	R. Radd	8:32:00	9:30:00
T3-A	5/10/2013	T3-A 5/10/2013	R. Radd	7:44:00	8:48:00
T3-B	4/19/2013	T3-B 4/19/2013	J. Yerger	8:21:00	9:20:00
T3-B	5/10/2013	T3-B 5/10/2013	R. Radd	8:56:00	9:36:00
T4-B	4/22/2013	T4-B 4/22/2013	R. Radd	9:45:00	10:48:00
T4-B	5/10/2013	T4-B 5/10/2013	R. Radd	7:12:00	8:13:00
T5-A	4/22/2013	T5-A 4/22/2013	R. Radd	6:30:00	7:38:00
T5-B	5/20/2013	T5-B 5/20/2013	R. Radd	6:22:00	7:33:00
T5-B	5/3/2013	T5-B 5/3/2013	R. Radd	6:50:00	7:56:00
T6-A	5/20/2013	T6-A 5/20/2013	R. Radd	8:43:00	9:50:00
T6-A	5/3/2013	T6-A 5/3/2013	R. Radd	8:58:00	9:44:00
T6-B	4/22/2013	T6-B 4/22/2013	R. Radd	8:15:00	9:19:00
T7-A	4/26/2013	T7-A 4/26/2013	R. Radd	6:45:00	7:35:00
T7-B	5/6/2013	T7-B 5/6/2013	R. Radd	6:50:00	7:52:00
T8-B	4/25/2013	T8-B 4/25/2013	R. Radd	7:08:00	8:18:00
T8-B	5/4/2013	T8-B 5/4/2013	R. Radd	6:37:00	7:42:00

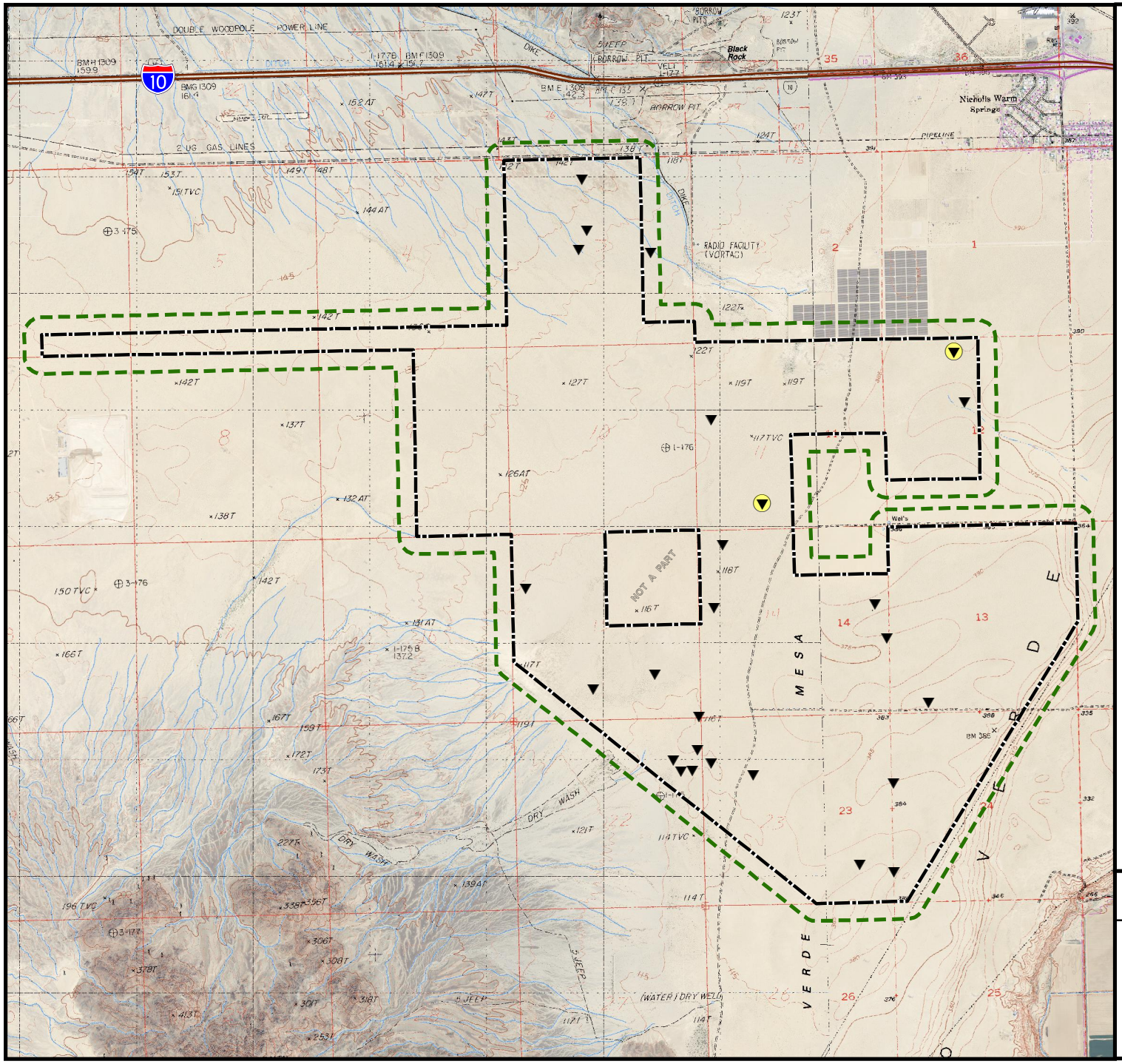
3.5.1.3 Western Burrowing Owl

During fall 2012 and spring 2013, 24 burrowing owl burrows within the Project site ranked Class I, Class II or Class III. An occupied burrow was detected incidentally during general avian survey efforts on May 13, 2013. This incidental detection involved a pair of owls utilizing a previously unoccupied rodent burrow. An additional burrow with indications of recent burrowing owl occupation was recorded during surveys of the 150 m buffer (Table 15 and Figure 19).

Table 15 Burrowing Owl Phase II Results from Fall 2012 and Spring 2013

Waypoint ID	Date	Easting	Northing	Burrow Class	Initial Burrow BUOW Sign
CVS153	10/21/2012	710018	3718263	1	Feathers;Tracks;Live Bird – Fall 2012
CVS164	10/22/2012	709353	3716229	2	Feathers;Tracks;Whitewash
PHK646	10/22/2012	706779	3719734	1	Feathers;Pellets;Tracks;Whitewash;Live Bird – Fall 2012
PHK647	10/22/2012	706738	3720171	1	Pellets;Whitewash;Live Bird
PHK648	10/22/2012	706710	3719571	2	Feathers;Pellets;Whitewash
PHK683	3/25/2013	709413	3714225	3	Whitewash
PHK684	3/25/2013	709118	3714288	2	Pellets;Whitewash
PHK701	3/27/2013	709410	3714989	2	Whitewash
PHK702	3/27/2013	708204	3715061	3	Pellets;Whitewash
DNF702	3/29/2013	707686	3715098	3	Pellets
DNF703	3/29/2013	707587	3715092	3	Pellets;Whitewash
DNF706	3/29/2013	707844	3715163	3	Whitewash
DNF707	3/29/2013	707522	3715184	3	Whitewash
JCW513	3/29/2013	707729	3715275	3	Pellets;Whitewash
PHK712	3/30/2013	707744	3715561	3	Whitewash
PHK726	3/30/2013	706837	3715796	3	Whitewash
PHK732	3/30/2013	707366	3715923	3	Whitewash
DNF717	4/1/2013	709249	3716527	3	Whitewash
PHK761	4/2/2013	706253	3716657	3	Pellets;Whitewash
PHK765	4/2/2013	707940	3717034	3	Whitewash
PHK768	4/3/2013	707869	3716491	2	Pellets;Whitewash

Waypoint ID	Date	Easting	Northing	Burrow Class	Initial Burrow BUOW Sign
PHK775	4/4/2013	709711	3715680	3	Pellets;Whitewash
PHK837	4/9/2013	708282	3717411	1	Feathers;Pellets;Whitewash; Live bird - Spring 2013
PHK842	4/11/2013	707843	3718107	3	Whitewash
RR0002	5/13/2013	709927	3718713	1	Feathers;Pellets;Tracks;Whitewash;Live Bird – Spring 2013
RR0001	5/14/2013	707327	3719545	2	Pellets



N

0 500 1,000
Meters

Burrow Status

- Sign only
- Active
- 150-meter Buffer from Project Boundary
- Desert Quartzite Site Boundary

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 19

Burrowing Owl Sign
Spring 2013

P:\GIS\Ironwood\Desert_Quartzite\BUOW_Sign.mxd

Phase III Burrowing Owl Survey Results

Observers recorded each burrow's current status and condition, and visually searched the surrounding area for live owls (Appendix H). Each of the 26 locations was visited during the intervals; 22-30 May, 19-22 June and 12-16 July.

Phase II initial surveys documented live owls at three burrows prior to breeding season surveys. All three of these burrows were determined to be vacant when Phase III surveys were conducted (Table 16).

Table 16. Determination of Burrows Occupied by Burrowing Owls Prior to Breeding Season

Waypoint ID	Phase II Survey Date	Phase II burrow classification	Phase III Survey Date	Phase III burrow classification
CVS153	21 Oct 2012	1	18 May2013	4
PHK646	22 Oct 2012	1	27 May 2013	4
PHK647	22 Oct 2012	1	27 May 2013	4

CVS153 was collapsed and no longer serviceable without re-excavation. PHK646 was an active kit fox (*Vulpes macrotis*) den, and PHK647 appeared to have been re-excavated and potentially occupied by coyote (*Canis latrans*).

Phase III surveys documented live owls at two burrows. One of these burrows was potentially occupied during Phase II surveys (Class 2); the other is believed to have been a previously undocumented rodent burrow (Table 17).

Table 17.Burrows Occupied During Breeding Season

Waypoint ID	Phase II Survey	Phase II burrow classification	Phase III Survey	Phase III burrow classification
RR0002	N.A.	N.A.	13 May 2013	1
PHK837	9 Apr 2013	2	24 May 2013	1

Burrowing owls occupying burrows during the breeding season were monitored in an attempt to determine territorial boundaries and home ranges (Figure 20).

Observations of the burrowing owl pair at RR0002, suggested dependent young were in the burrow on 15 July, although no non-adults were directly observed during a total of more than 15 hours of observation. Observations of the burrowing owl pair at PHK837 (burrow apparently re-excavated), suggested the

breeding attempt was abbreviated by a potential nest predator as the burrow was abandoned between 20 June when a pair was present, and 14 July when no owls were detected. No young-of-year were ever observed at this burrow and adults were not detected away from the burrow on a subsequent follow-up search on 15 July.

3.5.1.4 Golden Eagle Surveys

Agency approval of the Quartzite Avian Work Plan was not granted until after the 2013 Golden Eagle breeding season ended. Golden Eagle surveys will be performed between 1 December 2013 and 31 May 2014 in order to determine territory occupancy and productivity within 10 miles of the project boundary.
No potential golden eagle nesting habitat or active territories exist within the proposed project footprint. Potential golden eagle nesting habitat exists within 10 miles of the Project site boundary; in the Little Chuckwalla Mountains, the Mule Mountains and the McCoy Mountains.

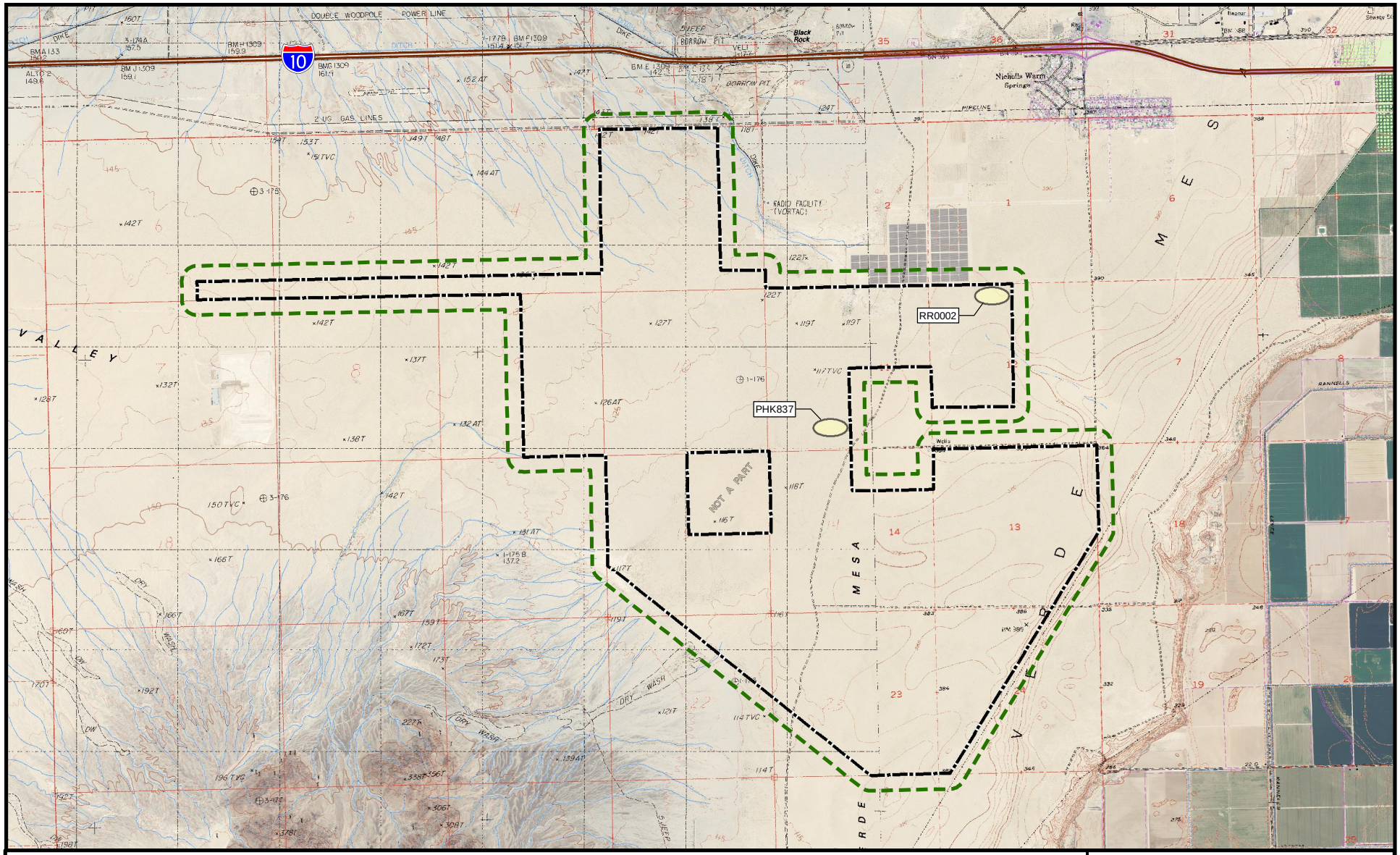
There have not been golden eagle detections during avian-focused surveys, including Avian Point Counts, Unlimited Distance Extended Observation Surveys and Line Transect surveys. There have been no reports of incidental sightings of golden eagles, which would have been reported on standardized, "General Sensitive Species" data forms that are included as required reporting for all of the various biological resource disciplines.

3.5.1.5 Elf Owl Surveys

Most of the project site and the adjoining buffer zone is comprised of scrubland dominated by creosote bush (*Larrea tridentata*), and is therefore completely unsuitable for use by elf owls.
A small patch of microphyll woodland (Lower Colorado subdivision of Sonoran desert scrub) of less than one hectare (11 S 0708580 3718750) occurs immediately south of the present solar facility and contains widely scattered ironwood, and blue palo verde trees plus several nonnative trees.

A drainage from McCoy Mountains runs north (11 S 0706925 3720960) to south (11 S 0707924 3719323). Most (97 percent) of the wash is within the one mile project buffer zone, but it also transects the most northeasterly corner of the Project site. This wash contains approximately 10 hectares of microphyll woodland with scattered ironwood and palo verde trees. It is between 30 to 70 m wide with trees spaced 15 to 60 m apart, and 7 to 9 m tall.

There are a series of braided drainages along the southwestern boundary of the project site running west to east from the foothills of the Mule Mountains. The largest drainage contains approximately 16 hectares of scattered ironwood and palo verde trees, and runs 1.6 km west (11 S 0705570 3714515) to east (11 S 0707065 3715170) across the buffer zone and ends at the powerline road. The patch is between 50-150 m wide with trees spaced 5-30 m apart, 5-8 m tall, with an open canopy and little understory.



150-meter Buffer from Project Boundary

Observed Burrowing Owl Territories

Desert Quartzite Site Boundary

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 20

Observed BUOW Territories During Breeding Season

P:\GIS\Ironwood\Desert_Quartzite\BUOW_20130620.mxd

AR060547

Scattered patches of honey mesquite occur on the slope between the upland desert scrub of the Palo Verde Mesa and the lower Colorado River floodplain, which contains extensive farmland. Mesquite trees growing along this slope were 3 to 5 m tall and found in thickets 20 to 40 m wide. There were no large trees, e.g., cottonwood (*Populus fremontii*), associated with these areas.

Assessments were made for two nearby areas that fell outside of the one-mile project buffer zone.
The Mesa Verde housing area was assessed because it superficially resembles certain trailer parks or campgrounds along the lower Colorado River where Elf Owls have been detected. It consists of trailers and small homes with yards containing native trees including palo verde, mesquite (*Prosopis* sp.), saguaro cactus (*Carnegiea gigantea,* a total of eight individuals) and nonnative columnar cacti and trees including eucalyptus, palms, African sumac (*Rhus lancea*), and pines (*Pinus* sp.). However, no cavities were observed in this area and no cottonwood trees were present.

An area of microphyll woodland north of and adjacent to the I-10 freeway corridor located along Black Rock Road was assessed. This woodland patch is approximately 1.5 km long and 30-100 m wide (about 12 hectares). This area contains palo verde and widely scattered ironwood (7-11 m tall) and is generally located between a gas station and the truck stop facilities (east end, 11 S 0710795 3721265) and a weigh station (west end, 11 S 0709305 3721290). The woodland is crossed by numerous roads and contains several disturbed areas. Trees also occur on the south side and the center strip of the freeway.

In the surveyors' judgment, none of the habitat patches assessed and discussed above met minimal standards as elf owl nesting habitat. For most patches, this lack of potential was a function of inadequate tree density and/or cavity density, combined with inadequate or marginal patch size. The mesquite patches observed within the buffer zone are much less suitable in terms of patch size and tree density than the mesquite patches within which elf owls sometimes occur along the lower Colorado River. The most promising area for elf owls that was observed occurred outside the buffer zone and adjacent to the interstate, where there were some areas of large, closely spaced palo verde trees, but even here, surveyors determined that potential for elf owls is very low, and mitigated against further by proximity of multiple disturbances, including the interstate highway itself.

3.5.1.6 Nesting Raptor/Raven Surveys

Nesting raptor/ Raven surveys were conducted monthly between May 1 and June 1, 2013. This effort focused on the detection of all raptor/raven nests within one mile of the Project site in order to collect baseline data for the following:

- The number and distribution of raptor/raven nests prior to project development; and
- Success rates of raptor/raven nests prior to project development.

All bird nests (including the incidental detection of resident passerine species) were recorded on standardized datasheets. Monthly monitoring efforts were completed to update the datasheets to include the development stage and breeding status at each raptor/raven nest.

Table 18 Bird Nests (Including Raptor/Raven) Detected on the Project Site, Spring 2013

Nest ID	Easting	Northing	Task	Observation ID	Species	Breeding Status
BH0001	708278	3718453	Incidental	BH0001_4/18/2013	RTHA	Incubation
RKR0001	704893	3716895	Nesting Raptor/ Raven Surveys	RKR0001_4/22/2013	RTHA	Incubation
RKR0001	704893	3716895	Nesting Raptor/ Raven Surveys	RKR001_5/6/2013	RTHA	Incubation
RKR0002	703684	3717850	Nesting Raptor/ Raven Surveys	RKR0002_4/22/2013	CORA	Incubation
RKR0003	709754	3714312	Nesting Raptor/ Raven Surveys	RKR0003_4/22/2013	AMKE	Hatchling/ Nestling
RKR0004	706970	3715231	Nesting Raptor/ Raven Surveys	RKR0004_5/9/2013	RTHA	Fledgling
RKR0004	706970	3715231	Nesting Raptor/ Raven Surveys	RKR0004_4/22/2013	RTHA	Hatchling/ Nestling
RKR0005	711010	3716388	Nesting Raptor/ Raven Surveys	RKR0005_4/22/2013	AMKE	Hatchling/ Nestling
RKR0006	711168	3716543	Nesting Raptor/ Raven Surveys	RKR0006_4/22/2013	RTHA	Hatchling/ Nestling
RKR0006	711168	3716543	Nesting Raptor/ Raven Surveys	RKR0006_5/9/2013	RTHA	Hatchling/ Nestling
RKR0007	712577	3719443	Nesting Raptor/ Raven Surveys	RKR0007_5/3/2013	WWDO	Nest Building
RKR0008	707682	3714578	General Avian Surveys	RKR0008_5/4/2013	NOMO	Hatchling/ Nestling
RKR0009	707816	3714548	General Avian Surveys	RKR0009_5/4/2013	CACW	Hatchling/ Nestling
RKR0010	707758	3714628	General Avian Surveys	RKR0010_5/4/2013	MODO	Incubation
RKR0011	707787	3714549	General Avian Surveys	RKR0011_5/4/2013	MODO	Incubation
RKR0012	707969	3720258	General Avian Surveys	RKR0012_4/26/2013	LOSH	Hatchling/ Nestling
RKR0013	710941	3716160	Raven Survey	RKR0013_5/9/2013	WEKI	Nest Building
RKR0014	708293	3714185	Nesting Raptor/ Raven Surveys	RKR0014_5/9/2013	CORA	Hatchling/ Nestling
RKR0015	712594	3718945	General Avian Surveys	RKR0015_5/15/2013	WEKI	Incubation
RKR0016	712579	3719532	General Avian Surveys	RKR0016_5/15/2013	MODO	Incubation

3.6 MAMMALS

3.6.1 Small Mammal Surveys

Results are summarized in Table 19. Pocket mouse (*Chaetodipus)* species were lumped due to unreliability of field identification between long-tailed and desert pocket mouse (*C. formosus* and *C. penicillatus)*. In total, seven species were found at the baseline points.

Table 19 Baseline Points: Small Mammals, April 2013

Baseline Points	DQ-01	DQ-02	DQ-03	DQ-04	DQ-05	DQ-06	DQ-07	DQ-08	DQ-09	DQ-10	OS-01	OS-02	Tot
Dipodomys merriami		23	13	43	20	24	1	20	22	23	33	35	**257**
Dipodomys deserti	16	5	2	10	5	5	19				4	6	**72**
Perognathus longimembris		6	6	3	19		1			1			**36**
Chaetodipus spp.		4	1	2	1	0	2	33	5	1	6	30	**85**
Onychomys torridus					1	1			3	1		1	**7**
Neotoma lepida								1	1			1	**3**
Spermophilus tereticaudus		1		1	1	2			1				**6**
Total Individuals	**16**	**39**	**22**	**59**	**47**	**32**	**23**	**54**	**32**	**26**	**43**	**73**	**466**

3.6.2 Desert Kit Foxes

Desert kit fox is protected by the California Code of Regulations (Title 14, CCR: §460) and Fish and Wildlife Commission Section 4000 as a fur-bearing mammal. Desert kit foxes are fossorial mammals that occur in arid open areas, shrub grassland, and desert ecosystems. Desert kit fox typically consume small rodents, primarily kangaroo rats, rabbits, lizards, insects, and in some cases immature desert tortoises. Dens typically support multiple entrances, but desert kit fox may utilize single burrows for temporary shelter.

Litters of one to seven young are typically born in February through April (Egoscue 1962; McGrew 1979). This species was detected within the Study Area. Full-coverage burrow surveys revealed 46 canid complexes and 45 single-entrance dens (91 potentially occupied dens/complexes) with some kit fox sign within the Project site. Only 24 of those had signs of recent activity, (i.e., desert kit fox tracks, or scat).

Each of these was revisited by an experienced mammal biologist for further inspection of signs of activity. Upon re-inspection, eight dens/complexes were determined to be potentially active, all of which were in the southern portion of the Project site (Figure 21). A camera station was set up at each of the eight dens and run for three consecutive days and nights (Photograph 11). Six of the eight cameras captured images of nine total individual desert kit fox as follows (Table 20):

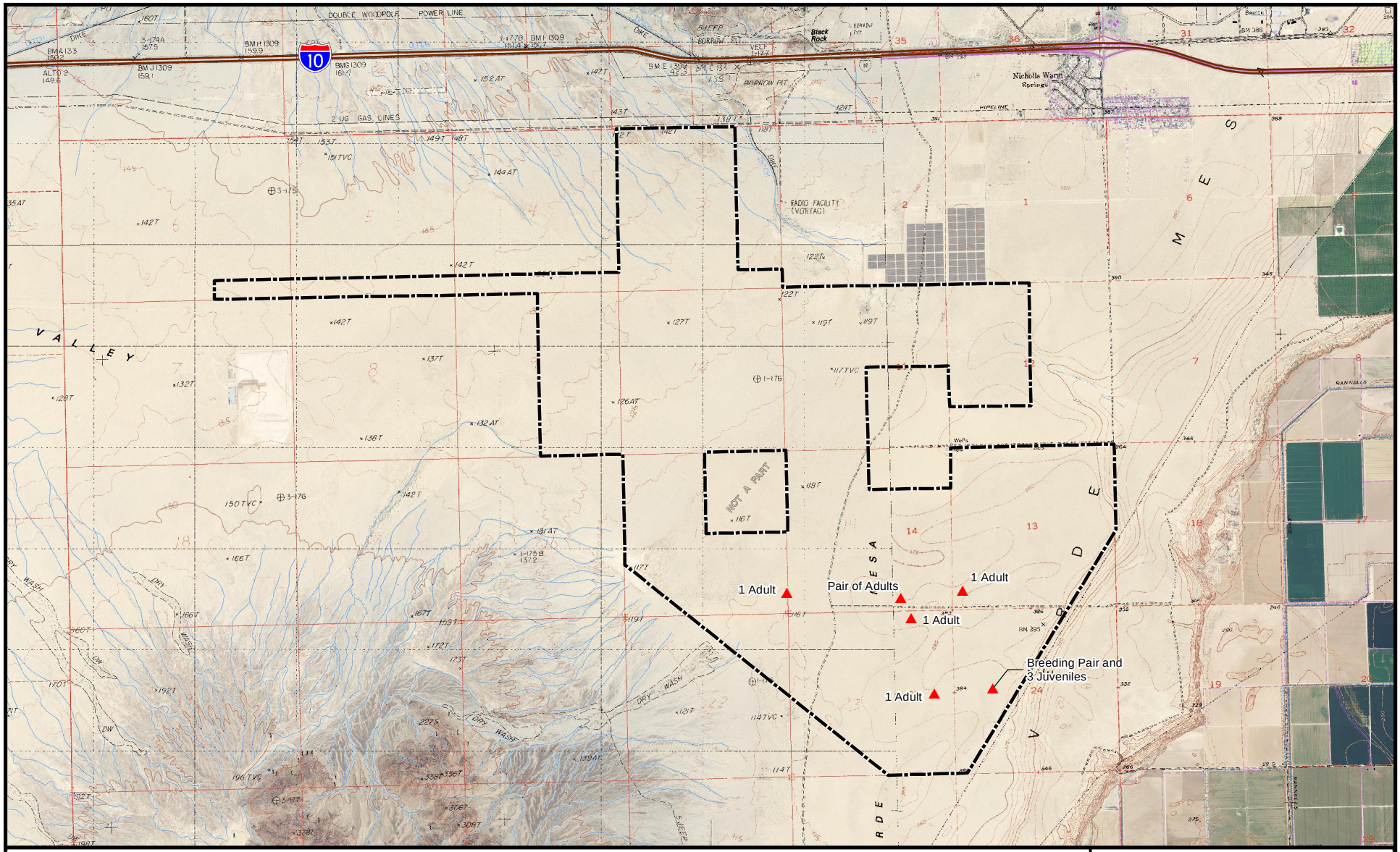
Table 20.Desert Kit Fox Presence, April 2013

Den Location UTM WGS84	Number of Individuals Photographed	Dates
11 S 707745 3715760	1 Adult	April 29- May 1, 2013.
11 S 709777 3714817	Breeding Pair and 3 Juveniles	April 29- May 1, 2013.
11 S 709201 3714768	1 Adult	April 29- May 1, 2013.
11 S 708974 3715510	1 Adult	April 29- May 1, 2013.
11 S 708873 3715704	Pair of Adults	April 29- May 1, 2013.
11 S 709479 3715780	1 Adult	April 29- May 1, 2013.

3.6.3 Bats

Roost surveys were conducted of mines in the mountains adjacent to the project area during the day and at night for evidence of bats and guano. Two mines in the southern McCoy Mountains (located approximately 4.4 miles northwest of the Study Area) had previously been identified by Dr. Brown as California leaf-nosed bat maternity colonies and had been gated with bat compatible closures by the Bureau of Land Management in 2011. These mines were monitored on May 8 at dusk by surveyors with night vision equipment to obtain accurate exit and entry counts of bats and acoustic records with additional Anabat detectors. The surveyors kept two counts for at least sixty minutes after the first bat exited of how many bats entered and exited the mines. Video cameras with auxiliary infrared lights were used to remotely monitor mines and to obtain permanent records of exiting bats. During the current survey, pallid bats were observed and recorded at the mines in addition to California leaf-nosed bats. The size and flight pattern of the two species are similar, but the echolocation and social calls are distinctive. The Uvanum Mine (33.64064,-114.82957) is closest to the Study Area, and 33 bats exited and 26 entered the mine in the hour after dark. To the west in another canyon, 71 bats exited and 44 entered the McCoy #3. Non-resident bats may enter a mine to “night-roost”, so the exiting and entering bats may not be the same individuals or species.

Using topographic maps and Google Earth images, ground reconnaissance was conducted of possible mine features on the north end of the Mule Mountains (1.8 miles south of the Study Area) and no underground features that could shelter bats were discovered.



▲ Kit Fox Burrows

Desert Quartzite Site Boundary

N

0 500 1,000
Meters

DESERT QUARTZITE SOLAR PROJECT
DESERT QUARTZITE, LLC

Figure 21

Active Kit Fox Burrows/ Camera Locations

P:\GIS\Ironwood\Desert_Quartzite\Kit Fox Burrows_20130710.mxd

AR060552

X:\GIS\Ironwood\Desert Quartzite\pdf jan 2014 steph photos\Ch 3 Photo 11.CDR



Photograph 11 - Desert Kit Fox Family Captured on Camera on Project Site, April 29, 2013.

The closest known bat colony in the Mule Mountains is the Hodge Mine (a.k.a. Stonehouse, 33.51145,-114.79383) situated 3.4 miles south of the Study Area. This mine contains the largest winter colony of California leaf-nosed bats (*Macrotus californicus*) in the United States, as well as a maternity colony. It is also one of four maternity colonies for the cave myotis (*Myotis velifer*) in California. This mine has been a research site for Dr. Brown since 1976. On the evening of May 9, a net count of 3,348 bats exited from the five portals of the Stonehouse Mine.

Bat Species

Six bat species are interpreted as detected acoustically within the Study Area (Table 21). Seven of these (pallid bat, canyon bat, California and cave myotis, Mexican and pocketed freetail bat and Western mastiff bat) yielded multiple diagnostic call sequences. For 50 kHz Myotis sequences (calls ending at this frequency) two species (*Myotis californicus* and *Myotis yumanensis*) are often not distinguishable. California myotis is far more common in open desert habitats distant from surface water, and we interpret these call sequences as this species. A small sample of 40 kHz Myotis call sequences was obtained at four monitors. There are two *Myotis* in this area that produce similar calls at this frequency, but, given the low likelihood of occurrence of the other species and the proximity to occupied cave myotis (*Myotis velifer)* roosts, surveyors conclude that these sequences represent that species. Seven additional species have the potential to occur at some time of the year (Table 21). The most likely is the California leaf-nosed bat that roosts close to the Study Area, and can hunt without emitting echolocation signals, relying solely on vision and prey-produced sounds. Four of the acoustically detected species are California State Species of Special Concern: pallid bat (*Antrozous pallidus*), cave myotis, Western mastiff bat *(Eumops perotis*) and pocketed free-tailed bat (*Nyctinomops femorosaccus*).

Table 22 shows acoustic activity by site and night for species and one sonotype or frequency category. Q25 groups non-diagnostic calls from larger mid-frequency bats (19-35 kHz) and is included to show relative activity among sites. Values in the table are counts of minutes per night with activity by a species (Miller 2001). Canyon bats (*Parastrellus hesperus*) and 50 kHz California myotis (*Myotis californicus*) were the most common species detected during echolocation surveys. Over this short sampling interval, higher bat activity (especially pallid bats) occurred at sites with more extensive woody vegetation, notably in the wash immediately east of the project north boundary (Site 4), and south of the existing solar installation (Sites 5 &6. Lower activity was detected at sites with scattered creosote bush and few or no trees (e.g., site 7).

Table 21.Bats Potentially Occurring Near the Project Site

Family/Scientific Name	Common Name	USFWS	CDFW
Chiroptera (Bats)			
Phyllostomatidae (American leaf-nosed bats)			
Macrotus californicus	California leaf-nosed bat	SC	CSC
Vespertilionidae (Vesper bats)			
Myotis yumanensis	Yuma myotis	SC	-
Myotis velifer	**Cave myotis**	SC	CSC
Myotis occultus	Arizona myotis	SC	CSC
Myotis californicus	**California myotis**	-	-
Parastrellus hesperus	**Canyon bat**	-	-
Lasiurus blossevillii	Western Red bat	-	CSC
Lasiurus xanthinus	Western yellow bat	-	-
Lasiurus cinereus	Hoary bat	-	-
Corynorhinus townsendii	Townsend's big-eared bat	SC	CSC
Antrozous pallidus	**Pallid bat**	-	CSC
Molossidae (Free-tailed bats)			
Tadarida brasiliensis	**Mexican free-tailed bat**	-	-
Nyctinomops femorosaccus	**Pocketed free-tailed bat**	-	CSC
Eumops perotis	**Western mastiff bat**	SC	CSC
USFWS	**CDFG**		
U.S. Fish and Wildlife Service	California Department of Fish and Wildlife		
Federal Species of Concern	CSC = California Species of Concern		
SC = Former Category 2 candidate			
Bold = Species detected during current survey			
Red = Special status species potentially impacted			

Table 22.Minutes Per Night of Acoustic Activity by Site and Species or Acoustic Category

Map	Night	Pahe	Myca	Myve	Anpa	Tabr	Q25	Nyfe	Eupe	Total
1	5/8/17	6	1							7
1	5/9/17	8	2		2		4	1		17
1	5/10/17	8	2				1			11
2	5/8/17	4						1		5
2	5/9/17	5				2				7
2	5/10/17	3					1			4
3	5/8/17	3	1		1			1		6
3	5/9/17	6	2		1		2			11
3	5/10/17	3	1				2			6
4	5/8/17	30	158		4		5	1		198
4	5/9/17	33	137	1	8		5			184
4	5/10/17	38	167		3		4			212
5	5/8/17	11	27		1		1	2		42
5	5/9/17	6	15	3	2	1	6			33
5	5/10/17	29	22		7	1	4	1		64
6	5/8/17	4	6		2		2			14
6	5/9/17	3	14			1	9	1		28
6	5/10/17	30	13	1	4		5			53
7	5/8/17							1		1
7	5/9/17	1	1			1	1	2	2	8
7	5/10/17									0
8	5/8/17						1			1
8	5/9/17	1	2			1	4			8
8	5/10/17	7	2				1			10
9	5/8/17	1								1
9	5/9/17	8	7				1	1		17
9	5/10/17	6	1				1			8
10	5/8/17	3	1					4	2	10
10	5/9/17	18	7				1	1		27
10	5/10/17	8	7	1	1		1			18
11	5/8/17	2	4					1	2	9
11	5/9/17	9	14			1	2	2		28
11	5/10/17	11	13							24
12	5/8/17		1		1					2
12	5/9/17	1	2				1			4
12	5/10/17	2	1				1			4
	Total	308	631	6	37	8	66	20	6	

(Pahe=*P. hesperus*, Myca=*M. californicus*, Myve=*M. velifer*, Anpa=*A. pallidus*,Tabr=*T. braziliensis*, Nyfe=*N. femorosaccus*, Eupe=*E. perotis*, Q25=non-diagnostic 19-35 kHz sequences).

3.6.4 Other Species Noted During Surveys

During various flora and fauna surveys, sign of general species were noted. A species list of general species detected on the site is in Appendix B. American badger (*Taxidea taxus*) was the only additional species of concern associated with the project.

American badger is a State Species of Special Concern associated with open grassland and desert communities. This species is associated with dry open forest, shrub, and grassland communities with an adequate burrowing rodent population; therefore, this species has high potential to occur within the Study Area. Several badger digs and scat were found on the Study Area, mostly near the southwestern perimeter. This species was not directly observed during the focused surveys or on imagery from camera stations around the site.

4.0 RECOMMENDED PROTECTION MEASURES

The following information is intended to provide the California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) document preparers an outline for general avoidance and minimization measures potentially relevant to the Desert Quartzite Solar Project. The following measures are considered standard practices for large-scale utility projects and are consistent with the *Best Management Practices and Guidance Manual: Desert Renewable Energy Projects* (Renewable Energy Action Team 2010). Due to the initial stage of the project and thus the lack of specific design and construction details, the following recommendations are non-specific and should be modified, as needed, as the project progresses.

4.1 GENERAL MEASURES

This section describes a range of design features, construction and operation best management practices (BMPs), and avoidance practices that when implemented as part of Project construction and/or operation, should collectively avoid, reduce or eliminate potential adverse effects to biological resources. Each category of features, practices and plans is described separately below.

Environmental Inspection and Compliance Monitoring Program and Plan

A comprehensive Environmental Inspection and Compliance Monitoring Program and Plan, covering both construction and operation and maintenance (O&M), should be developed. A qualified individual should be designated to serve as the Project Environmental Manager. The Environmental Manager should be responsible for the following tasks.

- Development and implementation of the overall Project compliance program;
- Communication and coordination with the applicable regulatory agencies;
- Ensuring compliance with the various conditions and requirements of permits and approvals;
- Record keeping and reporting required by permits and approvals;
- Ensuring that all applicable environmental plans are up to date;
- Advising management of actual and potential compliance issues; and
- Ensuring that Project planning takes appropriate account of compliance issues in advance.

Construction Related Plans

The following construction-related plans should be developed, as necessary. These plans have specific objectives that would indirectly help reduce potential adverse effects to biological resources.

- Storm Water Pollution Prevention Plan;
- Dust Control Plan;
- Waste Management Plan;
- Spill Prevention Control and Countermeasure Plan;
- Hazardous Materials Management Plan; and

- Fire Prevention Plan.

Construction-Related BMPs

The following general measures should be implemented during construction, which would assist with reducing potential adverse effects to biological resources,

- Construction and O&M activities should be limited to daylight hours to the extent possible;
- Water required for construction purposes should only be stored in closed containers or structures and should be transported throughout the site in enclosed water trucks;
- Water sources (such as wells) should be checked periodically by monitors to ensure they are not creating open water sources through leaking or consistently overfilling trucks;
- All vehicles leaking fuel or other liquids should be immediately removed to the staging area and repaired – all spills should be cleaned up promptly and disposed of correctly;
- All construction activities conducted outside the fenced areas should be monitored by a qualified biological monitor;
- Vegetation removal should be limited to the smallest area necessary;
- Construction traffic should remain on existing roads when possible – new roads, passing areas, and turning areas should be limited to permitted area of direct effect;
- Speed limits on all unpaved areas of the Project site should be a maximum of 15 miles per hour;
- Trash should always be contained within raven-proof receptacles and removed from the site frequently, including trash collected in vehicles in the field;
- No dogs or firearms should be allowed on the Project site during construction or O&M; and
- Plant and wildlife collection by Project staff during construction or operation should be prohibited except as allowed by the Project's permits.

Worker Environmental Awareness Program

A formal Worker Environmental Awareness Program (WEAP) should be completed for every individual working on the Project site. All individuals completing the training should sign an attendance sheet and receive wallet cards and stickers to show they have completed this training. The training should include the photographs of all environmental resources and the following information:

- Discussion of the fragile desert ecosystem, vegetation and wildlife communities within and surrounding the Project site;
- Discussion of rare plant species and other sensitive species found within and surrounding the Project site;
- Desert tortoise ecology, threats, legal protections, permitting, and penalties (including both legal and imposed by Project permits);
- Project-specific protection measures for species;
- Any safety measures personnel should be aware of as it relates to the species or environment on the Project site; and

- Worker responsibilities, communication protocol, and monitor responsibilities, including the authority for monitors to halt Project activities if warranted.

4.2 BOTANICAL STUDY

4.2.1 Special Status Plant Species

The Vegetation Resources Management Plan (VRMP) will provide details regarding the proposed salvage and transplantation of target species; the VRMP will include the following,

- Distribution of target plants within the Project site;
- Criteria for determining whether an individual plant is appropriate for salvage;
- Equipment and methods for salvage, propagation, transport, and planting;
- Procedures for marking and flagging target plants during preconstruction clearances surveys;
- Storage and/or pre-planting requirements;
- Proposed transplantation sites;
- A requirement for ten years of maintenance of the transplanted individuals, including removal of invasive species and irrigation (if necessary); and
- A requirement for ten years of monitoring to determine the percentage of surviving plants each year and to adjust maintenance activities using an adaptive management approach.

4.2.2 Cactus and Yucca

Cactus and yucca found onsite could be relocated to a nursery for future restoration areas or relocated if adjacent land was purchased for mitigation, these actions would be covered in the VRMP.

4.2.3 Desert Dry Wash Woodland and Vegetation Communities

Desert dry wash woodland is considered sensitive by the California Resources Agency and BLM due its limited distribution, value to wildlife, and susceptibility to disturbance (BLM 2002 and Zeiner, et al., 1990). The presence of water at least on a seasonal flow regime is vital for this community to persist. Due to this fact, and that the community covers very little of the project area, project boundaries could be adjusted to avoid impacts the desert dry wash woodland and add a distance buffer between this vegetation community and the project area.

4.2.4 Non-Native and Invasive Species

An Integrated Weed Management Plan (IWMP) should be prepared to reduce and/or eliminate the propagation and further spread of noxious and invasive weeds within and outside the project area due to

construction, operation and decommissioning of the Project. The objectives of the IWMP would be as follows.

- Identify weed species currently present within the Project components;
- Identify weeds not seen on the Project components that may have the potential to be present in the Project area and have the potential to invade the Project site due to construction activities;
- Identify construction and maintenance activities that may increase the presence of weeds or introduce new weed species on and adjacent to the Project components; and
- Specify steps that should be taken to ensure that the presence of weed populations on and adjacent to the Project components should not increase because of construction activities. These steps should be intended to prevent weeds not currently found on the Project site from becoming established there, and prevent weeds already present on the site from spreading to other areas.

4.3 AMPHIBIANS

There has been an on-going effort since 2008 to check the project site after heavy rains to search for ponding water that sustains itself for eight days, which is what is required for the reproduction of spade foot toads. No areas have held water for eight days. It is recommended that Project site be surveyed for ponding after heavy rains until construction.

4.4 REPTILES

4.4.1 Desert Tortoise

Due to the potential presence of desert tortoise within the Project site, formal consultation between the BLM and USFWS would be necessary. A biological assessment that fully addresses the impacts to desert tortoise would be required to initiate formal consultation. Additionally, an incidental take permit would be required from the California Department of Fish and Wildlife in compliance with the California Endangered Species Act.

The measures described in this section reflect standard requirements and may be incorporated as part of the proposed Project, which would also be included in the biological assessment. The Biological Opinion (BO) would provide specific conditions and requirements that may supersede some of the following measures. A Lead Biologist should be designated for the Project and should be responsible for all aspects of clearance surveys, monitoring, desert tortoise translocation, contacts with agency personnel, reporting, and long-term monitoring and reporting.

Exclusion Fencing

Prior to beginning clearance surveys, desert tortoise exclusion fencing should be constructed in specified areas consistent with clearance survey areas. The Project site should be completely fenced with security and desert tortoise exclusion fencing, including desert tortoise exclusion gates at access points. Fence installation should be monitored as a linear component. Exclusion fencing should be maintained over the course of construction and operations, as necessary.

Preconstruction Clearance Surveys

Clearance surveys should be conducted consistent with the USFWS Desert Tortoise Field Manual and current translocation guidance (United States Fish and Wildife Service 2009b and 2010c). If a desert tortoise or active burrow is found within a planned area of construction, surveys should stop at that time until the tortoise is translocated in the active season and per the Desert Tortoise Translocation Plan. If two complete passes are completed in a construction area (north-south and east-west) without a desert tortoise being found, construction may commence within that area outside of active season. Fencing should continue to be checked on a daily basis throughout construction.

Translocation

A Desert Tortoise Translocation Plan should be prepared for the Project. The purpose of the plan is to describe the process of translocation, minimize mortality of desert tortoises, and assess the effectiveness of the translocation effort through a long-term monitoring program. Injured tortoises should be transported to a rehabilitation facility approved by the USFWS and CDFW. Tortoises found recently killed should be salvaged and transported to a veterinary pathologist, who is familiar with desert tortoise and approved by the USFWS and CDFW. Procedures for salvaging and transport should generally follow Guidelines for the Field Evaluation of Desert Tortoise Health and Disease (Berry and Christopher 2001). Individuals approved and permitted by the USFWS and CDFW to conduct such assessments should conduct detailed health assessments on all live tortoises following current USFWS guidance. Detailed health assessments should be performed prior to translocation and repeated periodically during long-term monitoring.

Avoidance – Construction

During the construction of linear features (fencing, transmission lines, and access roads), all live tortoises and active burrows should be avoided to the extent possible. All activities should be monitored by qualified biologists. The biological monitor should instruct crews to provide approximately one hour for a live tortoise to leave an active construction area without assistance. If the tortoise does not leave the area on its own, an Authorized Biologist (listed under the BO to handle tortoises) should carefully move the

tortoise out of the construction area and into a translocation area pursuant to the conditions of the BO. Biological monitors should flag an avoidance area approximately 20 m from any active burrow to be avoided and construction activities should continue around this avoidance area while a biologist monitors the burrow. If an active burrow cannot be avoided by construction activities, the burrow should be excavated using protocols in USFWS Desert Tortoise Field Manual (United States Fish and Wildlife Service 2009b).

Avoidance – Operations and Maintenance

During the operation phase of the project, all applicable desert tortoise protection measures identified under construction should be implemented. For example, this may include the need for a biological monitor outside the fenced facility during road, fence and utility maintenance involving ground disturbance, annual WEAP refresher training, actions to take if a tortoise is encountered, etc. Additionally, a biological monitor should be designated and responsible for overseeing compliance with the desert tortoise protection measures. The biological monitor should have a copy of all measures including the BO when work is being conducted on site. The monitor should be on site during all project maintenance activities to ensure compliance with the desert tortoise measures. The monitor should have the authority to halt all non-emergency activities that are in violation of the measures. Work should proceed only after hazards to desert tortoise are removed, the species is no longer at risk, or the individual has been moved from harm's way by an Authorized Biologist. An annual compliance report should be submitted to the BLM annually.

Common Raven Management Plan

A Common Raven Management Plan will be written, see section 4.5.4.

4.4.2 Mojave Fringe-Toed Lizard and Herptofauna

The only listed species found on the project site was the Mojave fringe-toed lizard. This lizard is found in loose-sand habitats and areas that have loose sand deposits. It is recommended to construct the project with trying to avoid loose sand areas as much as possible.

4.5 AVIAN

Due to the potential presence of golden eagle, raptors, and bat species within the Project site, a BBCS should be developed. The goal of the BBCS would be to reduce the potential risks for avian and bat mortality potentially resulting from construction and operation of the Project. The objectives of this plan are as follows:

- Identify baseline conditions for raptor and bat species currently present at the Project components;

- Identify construction and operational activities that may increase the potential of adverse effects to these species on and adjacent to the Project components;
- Specify steps that should be taken to avoid, minimize and mitigate any potential adverse effects on these species; and
- Detail long-term monitoring and reporting goals.

4.5.1 Western Burrowing Owl

Burrowing Owl site use changes temporally. Survey evidence suggests greater use of the Project site by burrowing owl outside of the breeding season, with only two pairs observed remaining to attempt reproduction in 2013.

Although burrowing owls exhibit high burrow fidelity, surveys at the Project site documented dynamic occupancy of burrows in response to changing conditions. If an annual determination of site use and/or breeding success is intended, Phase II and Phase III surveys should be implemented annually across the site, beginning every spring.

If the intent of surveys is limited to the detection of burrowing owls prior to construction, it is recommended that no further action be taken until the Project nears construction. Phase II and Phase III surveys should be conducted 30-days prior to construction in an effort to confirm burrowing owl occupancy and give project managers enough time to respond to findings.

Burrowing owl Phase II and Phase III surveys should be conducted according to the methods described in, "Burrowing Owl Survey Protocol and Mitigation Guidelines" (Burrowing Owl Consortium, 1993). Burrowing owl surveys should adhere to the frequency and timing described by the "Staff Report on Burrowing Owl Mitigation" (California Department of Fish and Wildlife, 2012).

4.5.2 Golden Eagle

Agency approval of the Avian Work Plan was not granted until after the 2013 golden eagle breeding season. Golden eagle surveys will be performed between December 2013 and May 31st 2014 in order to determine territory occupancy and productivity within 10 miles of the project boundary.

Surveys for breeding and non-breeding bald and golden eagles will be conducted within a 10-mile radius of the Project. Occurrence of non-breeding golden eagles within at least 10 miles of the Project boundary during the courtship season (*e.g.,* late December through early February) will be documented and be used to estimate potential project-related impacts to golden eagles, including: juveniles, sub-adults, adult floaters, and breeding adults.

4.5.3 Elf Owl

The habitat analysis determined that the habitat within the Project site and within a one mile buffer zone surrounding the site footprint is not suitable for elf owl breeding. Although it is possible that migrating owls may occur within the area on an occasional transient basis, there are no habitat patches within the assessed area that meet minimal standards (in terms of patch size, tree density, woodland structure, or cavity density) for elf owl nesting or for a sustained foraging resource.

The habitat assessment for elf owls concluded that "the likelihood of elf owls nesting within the Desert Quartzite site or the adjacent one mile buffer zone is very small, approaching zero." Thus, no mitigation is recommended for this species.

4.5.4 Nesting Raptor/Raven Surveys

A Common Raven Management Plan should be developed for the Project. The primary objective of the plan is to protect the juvenile and hatchling desert tortoises from predation by common ravens. This should be accomplished in part by eliminating or minimizing all aspects of human impact that attract ravens (i.e., garbage, surface water, animal and plant waste materials, perching sites, nesting sites, and roosting sites). The secondary objective is to avoid lethal removal of ravens by installing passive bird deterrents. The final objective of this plan is to comply with the regional management actions of the agencies cooperating in the effort to promote tortoise recovery (USFWS 2008b). A BBCS plan will be written and approved by the agencies that will cover these issues.

4.6 MAMMALS

4.6.1 Small Mammals

No special status species were found during the trapping activities, therefore, there are no recommendations.

4.6.2 Desert Kit Fox

Six dens were found to be active on the project site. A Desert Kit Fox Management Plan should be developed, covering avoidance, exclusion and hazing methodology.

4.6.3 Bats

Due to the potential presence of bat species within the Project site, BBCS should be developed. The goal of the BBCS would be to reduce the potential risks for avian and bat mortality potentially resulting from construction and operation of the Project. The objectives of this plan are as follows.

- Identify baseline conditions for raptor and bat species currently present at the Project components;
- Identify construction and operational activities that may increase the potential of adverse effects to these species on and adjacent to the Project components;
- Specify steps that should be taken to avoid, minimize and mitigate any potential adverse effects on these species; and
- Detail long-term monitoring and reporting goals.

4.7 COMPENSATORY MITIGATION

Consistent with BLM NECO requirements and conditions likely to be imposed on the Project by CDFW and USFWS, areas of desert tortoise habitat should be acquired to partially offset the potential adverse effects of the Project. A Compensatory Mitigation Plan, or Habitat Compensation Plan, would be a valuable tool to document the details of mitigation opportunities. Land acquisition should be considered the first priority; however, it is evident that the land purchase opportunities within the Colorado Desert are limited. Supplemental mitigation actions may need to be considered and approved by the agencies. These actions could be in the form of habitat restoration and enhancement throughout the Colorado Desert. Continued coordination with the BLM, CDFW, and USFWS would be beneficial in identifying all possible compensatory mitigation opportunities as they arise.

5.0 REFERENCES

Baldwin, B.G., D.H. Goldman, D.J.Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken, editors.
2012 The Jepson manual: vascular plants of California, second edition. University of California Press, Berkeley.

Berry, K.H.
1986 Desert tortoise (*Gopherus agassizii*) relocation: Implications of social behavior and movements. Herpetologica 42:113-125.

Berry, K. H.
1989 Final Notes for Meeting on Upper Respiratory Tract Disease Syndrome in Desert Tortoises. October 12, 1989: Bureau of Land Management, Riverside, CA and October 13, 1989: Palace Station, Las Vegas, NV.

Berry, K. H and Mary M. Christopher
2001 Guidelines for the Field Evaluation of Desert Tortoise Health and Disease. Journal of Wildlife Diseases, 37(3), 2001, pp. 427–450.

Bildstein, K.L, J.P. Smith and R. Yosef
2007 Migration counts and monitoring. *In* D.M. Bird and K.L. Bildstein (eds.). Raptor research and management techniques. Hancock House Publ., Surry, BC.

Bildstein, K.L.
2006 Migrating raptors of the world. Cornell Univ. Press

Bureau of Land Management
2012b US Department of Interior, Bureau of Land Management, Palm Springs South Coast Field Office Sensitive Plant List: Desert Species.

2009 US Department of Interior, Bureau of Land Management. Survey Protocols required for NEPA/ESA Compliance for BLM Special Status Plant Species. *www.blm.gov/ca/dir/pdfs/2009/im/CAIM2009- 026ATT1.pdf*

2002 US Department of Interior, Bureau of Land Management. Proposed Northern and Eastern Colorado Desert Coordinated Management Plan and Final Environmental Impact Statement (FEIS.) July 2002. *www.blm.gov/ca/st/en/fo/cdd/neco.html*

Brown, Patricia
2011 Bat Surveys of First Solar Facility Ivanpah Valley, San Bernardino County, California. Brown-Berry Biological Consulting, Bishop, California.

Bureau of Land Management and California Department of Fish and Game
2002 Final Environmental Impact Statement. Proposed Northern & Eastern Colorado Desert Coordinated Management Plan (NECO). Bureau of Land Management, California Desert, Riverside, CA.

Bureau of Land Management and U.S. Fish and Wildlife Service
2009 Survey Protocols Required for NEPA and ESA Compliance for BLM Special Status Plant Species. Instruction Memorandum No. CA-2009-026.

California Department of Fish and Wildlife
2013 California Department of Fish and Wildlife, Natural Diversity Database. April 2013. Special Vascular Plants, Bryophytes, and Lichens List. Quarterly publication. 73 pp.

2013a California Fish and Game Code. http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=fgc

2009 Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities.

2009 Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities. November 2009. nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18959

2010 California Wildlife Habitat Relationships System. California Interagency Wildlife Task Group. California Department of Fish and Wildlife.

2012 Staff Report on Burrowing Owl Mitigation. Department of Fish and Game. March 7, 2012. http://www.dfg.ca.gov/wildlife/nongame/docs/ BUOWStaffReport.pdf2.

California Burrowing Owl Consortium

1993 Burrowing Owl Survey Protocols and Mitigation Guidelines. Prepared for the California Department of Fish and Game.

California Native Plant Society Electronic Inventory (CNPSEI)

2013 Ripley and Roosevelt Mine 7.5 minute USGS quadrangles.

2008 Inventory of rare and endangered plants of California (online edition, version 7.07c). Available from: http://www.cnps.org/inventory.

California Natural Diversity Data Base (CNDDB).

2012

2013 Ripley and Roosevelt Mine 7.5 minute USGS quadrangles. Quads searched: Roosevelt Mine, Ripley, McCoy Wash, McCoy Peak, McCoy Spring, Hopkins Well, Wiley Well, Thumb Peak, and Palo Verde. Queried 22 August 2012 and 2 October 2012. *http://www.dfg.ca.gov/biogeodata/cnddb/plants_and_animals.asp.*

CalFlora

2012 Information on California plants for education, research, conservation. Berkeley, California. Available from: http://www.calflora.org/.

Consortium of Califonria Herbaria 2012

2012 Consortium of California Herbaria. Jepson Herbarium, UC Berkeley. 10,000m radius search centered on Quartszite project site, queried 29 September 2012 and 2 October 2012. *http://ucjeps.berkeley.edu/consortium/*

CDNPA. California Native Plants Act. California Department of Fish and Game.

Chapter 5. Harvesting of Native Plants.http://www.dfg.ca.gov/habcon/plant/cadesertplantact.html

Corvus Ecological Consulting, LLC and Ironwood Consulting Inc.

2013 Quartzite Avian Work Plan. Unpublished Document. Spring 2013. Reference available upon request.

Canfield, R. H.

1949 Application of the Line Intercept Method in Sampling Range Vegetation. Journal of Forestry 39:388-394.

Christopher, M., K. Berry, I. Wallis, K. Nagy, B. Henen, and C. Peterson
1999 Reference intervals and physiologic alterations in hematologic and biochemical values of free-ranging desert tortoises in the Mojave Desert. Journal of Wildlife Diseases, 35(2), 1999, pp. 212-238.

Daubenmire, R. F.
1959 A canopy-cover method of vegetational analysis. Northwest Science 33:43–46.

Duda, J.J., A.J. Krzysik, and J.E. Freilich
1999 Effects of drought on desert tortoise movement and activity. The Journal of Wildlife Management 63:1181-1192.

Egoscue, H.J.
1962 Ecology and Life History of the Kit Fox in Tooele County, Utah. Ecology, 43(3):481–497.

Ernst C.H., J.E. Lovich, R. Barbour
1994 Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 578 pp. (682 page paperback released in 2000).

Franks, B.R., H. W. Avery, and J. R. Spotila
2011 Home range and movement of desert tortoises Gopherus agassizii in the Mojave Desert of California, USA. Endangered Species Research. Vol. 13: 191-201, 2011. Published online March 9.

Hagerty, B.E. and Tracy, C.R.
2010 Defining population structure for the Mojave desert tortoise. Conservation Genetics 11:1795-1807.

Hagerty, B.E., Nussear, K.E., Esque, T.C., and Tracy, C.R.
2010. Making molehills out of mountains: landscape genetics of the Mojave desert tortoise. Landscape Ecology. DOI 10.1007/s10980-010- 9550-6.

Hawk Migration Association of North America
2010a Data collection protocol. Available at http://hmana.org/data_entry_paper.php. Accessed 26 Nov. 2010.

2010b Use of hawkcount.org data for wind energy siting. Available at http://hmana.org/Hawkcount_Wind_Siting.php?PHPSESSID=23d2217 33b5ec31 abdf2693ffa3e4dc1. Accessed 28 Nov. 2010.

Hickman, J. (ed.)
1993 The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, California.

Holland, R.F.
1986 Preliminary Descriptions of the Terrestrial Natural Communities of California. The Resources Agency, Department of Fish and Wildlife, State of California.

Karl, Alice
2012 Personal communication by telephone, 13 October 2012.

Lovich, J.E. and K.R. Beaman.
2007 A History of Gila Monster (*Heloderma suspectum cinctu*m) Records from California with Comments on Factors Affecting their Distribution. Bull. Southern California Acad. Sci. 106(2): 39-58.

McCrary, Michael D., McKernan, Robert L., Landry, Ross E., Wagner, William D. and Schreiber, Ralph W.
1982 Nocturnal Avian Migration Assessment of the San Gorgonio Wind Resource Study Area, Spring 1982. Natural History Museum Foundations, Los Angeles, California 90007.

McGrew, J.C.
1979. Vulpes macrotis. Mammalian Species 123:1–6.

Miller, B. W.
2001 A method for determining relative activity of free flying bats using a new activity index for acoustic monitoring. Acta Chiropterologica **3**(1): 93-105

Munz, P.A.
1974 A Flora of Southern California. University of California Press, Berkeley, California.

NRCS. Natural Resources Conservation Service .
http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H.Webb.
2009 Modeling habitat of the desert tortoise (Gopherus agassizii) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

Oftedal, O.T.
2002 The nutritional ecology of the desert tortoise in the Mojave and Sonoran Deserts. Pages 194-241 *in* T.R. Van Devender (ed.), the Sonoran Desert Tortoise; Natural History, Biology and Conservation. University of Arizona Press, Tucson, Arizona.

Oftedal, O.T., S. Hillard, and D.J. Morafka
2002 Selective spring foraging by juvenile desert tortoises (*Gopherus agassizii*) in the Mojave Desert: Evidence of an adaptive nutritional strategy. Chelonian Conservation and Biology 4:341-352.

Pagel, J.E., D.M. Whittington, and G.T. Allen.
2010 Interim Golden Eagle technical guidance: inventory and monitoring protocols; and other recommendations in support of eagle management and permit issuance. Division of Migratory Bird Management, U.S. Fish and Wildlife Service.

Ralph, C. John; J. R. Sauer, S. Droege, technical editors.
1995 Monitoring Bird Populations by Point Counts. Gen. Tech. Rep. PSW-GTR-149. (p. 187) Pacific Southwest Research Station, Forest Service, US. Department of Agriculture, Albany, CA.

Randall, J.M., S.S. Parker, J. Moore, B. Cohen, L. Crane, B. Christian, D. Cameron, J. MacKenzie, K. Klausmeyer and S. Mirrison.
2010 Mojave Desert Ecoregional Assessment. Unpublished Report. The Nature Conservancy, San Francisco, California. 106 pages + appendices.

Renewable Energy Action Team (California Energy Commission, California Department of Fish and Wildlife, U.S. Department of Interior Bureau of Land Management, and Fish and Wildlife Service)
2010 Best Management Practices and Guidance Manual: Desert Renewable Energy Projects. California Energy Commission, Siting, Transmission and Environmental Protection Division. REAT-1000-2010-009-F.

Rosenberg, D. K., L. A. Trulio, D. H. Catlin, D. Chromczack, J. A. Gervais, N. Ronan, and K.A. Haley.
2007 The ecology of the burrowing owl in California, unpublished report to Bureau of Land Management.

Sawyer, J.O., T. Keeler-Wolf, J.M. Evans
2009 A Manual of California Vegetation, second edition. California Native Plant Society, Sacramento, California.

Sawyer, J.O., Jr. and T. Keeler-Wolf.
1995 A Manual of California Vegetation. California Native Plant Society, Sacramento, California.

Stebbins, R.C. and S.M. McGinnis
2012 Amphibians and Reptiles of California.University of California Press, Berkeley, CA. 538 pp.

Thien, S J.
1979 A flow diagram for teaching texture by feel analysis. Journal of Agronomic Education. 8:54-55.

US Department of Interior, Bureau of Land Management.
2011 McCoy Biological Resources Technical Reporthttp://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/palmsprings/Solar.Par.5317.File.dat/Vol2_Mc Coy%20PA-EIS_App-C.pdf

U. S. Fish and Wildlife Service
1992 Field Survey Protocol for Any Federal Action that May Occur Within the Range of the Desert Tortoise.

1994 Desert tortoise (Mojave population) recovery plan. Portland, Oregon.

2000 Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants.

2008a Draft revised recovery plan for the Mojave population of the desert tortoise (*Gopherus agassizii*). Pacific Southwest Region. Sacramento, California.

2008b Final Environmental Assessment to Implement a Desert Tortoise Recovery Plan Task: Reduce Common Raven Predation on the Desert Tortoise. March 2008.

2009a Preparing for Any Action that May Occur within the Range of the Desert Tortoise.

2009b Desert tortoise field manual.

2010a Revised pre-project survey protocols for the desert tortoise (*Gopherus agassizii*).

2010b Interim Golden Eagle technical guidance: Inventory and monitoring protocol; and other recommendations in support of Golden Eagle management and permit issuance. Division of Migratory Bird Management.

2010c Translocation of desert tortoises (Mojave Population) from project sites: plan development guidance.

2011a Draft Eagle Conservation Plan Guidance. January 2011

Western Regional Climate Center
2013 Blythe CAA Airport, California. Available from: http://www.wrcc.dri.edu/summary/Climsmsca.html.

Zeiner, D. C., W. F.Laudenslayer, Jr., K. E. Mayer, and M. White, eds.
1990. California's Wildlife. Vol. I-III. California Depart. of Fish and Game, Sacramento, California. California Wildlife Habitat Relation-ship System (CWHRS). *http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx.* Accessed October 2010.

APPENDIX A RAINFALL DATA

Appendix A: Rainfall Data

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1983	0.13	0.37	1.75	0.00	0.00	0.00	0.00	2.07	0.88	0.00	0.03	0.73	5.96
1984	0.06	0.00	0.00	0.00	0.02	0.00	2.44	0.11	0.00	0.00	0.10	3.33	6.06
1985	0.27	0.29	0.03	0.06	0.00	0.00	0.00	0.00	1.61	0.90	1.84	0.07	5.07
1986	0.07	0.40	0.19	0.02	0.00	0.00	0.11	0.05	0.90	0.50	0.69	0.75	3.68
1987	0.00	0.03	0.00	0.05	0.00	0.03	1.40	0.00	0.01	0.42	0.71	0.68	3.33
1988	0.42	0.61	0.02	0.98	0.00	0.00	0.00	0.83	0.00	0.07	0.00	0.00	2.93
1989	1.08	0.00	0.06	0.00	0.00	0.00	0.32	0.15	0.01	0.00	0.00	0.00	1.62
1990	0.14	0.01	0.21	0.00	0.02	0.00	0.22	1.47	0.13	0.06	0.00	0.00 z	2.26
1991	0.00 z	0.76	0.00 z	0.00 z	0.00	0.00	0.01	0.28	1.52	0.14	0.04	0.31	3.06
1992	0.78	1.59	2.15	0.28	0.03	0.00	0.00	1.93	0.00	0.20	0.00	2.20	9.16
1993	2.33	2.19	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.87	0.01	5.62
1994	0.01	0.29	0.68	0.02	0.12	0.00	0.69	0.14	0.00	0.00	0.06	1.23	3.24
1995	2.29	0.00 z	0.49	0.09	0.00 z	0.00	0.05	1.37	0.08	0.00	0.00	0.00	4.37
1996	0.10	0.27	0.09	0.00	0.22	0.00	0.00	0.00	0.85	0.01	0.04	0.01	1.59
1997	0.47	0.00	0.00	0.06	0.00	0.00	0.61	0.03	2.05	0.01	0.03	1.06	4.32
1998	0.28	3.03	1.29	0.01	0.01	0.00	0.05	0.47	0.52	0.04	0.16	0.21	6.07
1999	0.00	0.34	0.00	1.00	0.04	0.00	1.20	0.00	0.74	0.00	0.00	0.00	3.32
2000	0.00	0.08	0.38	0.00	0.00	0.01	0.00	1.03	0.00	0.00	0.00 b	0.00	1.50
2001	0.81	0.67	1.55	0.01	0.00	0.00	0.00	0.00 c	0.00	0.00	0.11	0.03	3.18
2002	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.75	0.04	0.03	0.00	0.86
2003	0.11	1.08	0.28	0.08	0.00	0.00	0.06	0.00	0.07	0.00	0.33	0.00	2.01
2004	0.02	0.57	0.81	0.06	0.00	0.00	0.00	0.02	0.12	1.02	0.31	0.57	3.50
2005	1.55	2.83	0.21	0.00	0.00	0.00	0.00	1.35	0.00	0.85	0.00	0.00	6.79
2006	0.00	0.00	0.25	0.00	0.00	0.20	0.15	1.46	1.44	0.04	0.00	0.00	3.54
2007	0.16	0.07	0.53	0.00	0.00	0.00	0.00	0.00	0.06	0.00	1.11	0.00	1.93
2008	0.77	0.02	0.00	0.00	0.18	0.00	0.27	0.15	0.06	0.00	0.24	0.65	2.34
2009	0.02	0.43	0.00	0.00	0.03	0.01	0.07	0.02	0.03	0.00	0.00	0.85	1.46
2010	2.12	0.90	0.67	0.01	0.00	0.00	0.00	0.03	0.00	0.26	0.00	0.54	4.53
2011	0.00	1.17	0.06	0.00	0.00	0.00	1.64	0.00	0.08	0.12	0.29	0.60	3.96
2012	0.00	0.01	0.19	0.14	0.00	0.00	1.88	1.05	0.07	0.27	0.00	0.86	4.47
2013	0.77	0.01	0.03	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.81

[1] Western Regional Climate Center (2011)
[2] Missing data

AR060574

APPENDIX B SPECIES DETECTED (NON-AVIAN)-PRIMARY STUDY AREA

Appendix B: Species Detected-(Non-Avian)-Primary Study Area

Reptiles		
Desert Tortoise	*Gopherus agassizii*	O,C
California Kingsnake	*Lampropeltis getula californiae*	O
Coachwhip	*Masticophis flagellum*	O
Desert Horned Lizard	*Phrynosoma platyrhinos*	O, S
Desert Iguana	*Dipsosaurus dorsalis*	O, S
Desert Spiny Lizard	*Sceloporus magister*	O
Glossy Snake	*Arizona elegans*	O
Gopher Snake	*Pituophis catenifer*	O
Long-nosed Leopard Lizard	*Gambelia wislizenii*	O
Long-tailed Brush Lizard	*Urosaurus graciosus*	O
Mojave Fringe Toed Lizard	*Uma scoparia*	O
Side-blotched Lizard	*Uta stansburiana*	O
Sidewinder	*Crotlus cerastes*	O
Wesertn Banded Gecko	*Coleonyx variegatus variegatus*	O
Western Patch-nosed Snake	*Salvadora hexalepis*	O
Western Shovel-nosed Snake	*Chionactis occipitalis*	O
Western Whiptail	*Cnemidophorus tigris*	O
Zebra-tailed Lizard	*Callisaurus draconoides*	O
Mammals		
Arizona Myotis	*Myotis occultus*	O
Black-tailed Jackrabbit	*Lepus californicus*	O, T, S
Burro Deer	*Odocoileus hemionus eremicus*	O, T, S
California Leaf-nose Bat	*Macrotus californicus*	O
California Myotis	*Myotis californicus*	V
Canyon Bat	*Parastrellus hesperus*	V
Cave Myotis	*Myotis velifer*	O
Coyote	*Canis latrans*	T, S, B
Desert Cottontail	*Sylvilagus audubonii*	O, T, S, B
Desert Kangaroo Rat	*Diodomys deserti*	O, B
Desert Kit Fox	*Vulpes macrotis arsipus*	B, T, S
Desert Woodrat	*Neotoma lepida*	O, B
Hoary Bat	*Lasiurus cinereus*	V
Little Pocket Mouse	*Perognathus longimembris*	O
Long-tailed Pocket Mouse	*Chaetodipus spp.*	O
Merriam's Kangaroo Rat	*Dipodomys merriami*	O, B
Mexican Free-tailed Bat	*Tadarida brasiliensis*	V
Pallid Bat	*Antrozous pallidus*	V
Palm Spring Round-tailed Ground Squirrel	*Spermophilus teriticaudus chlorus*	O
Small-footed Myotis	*Myotis ciliolabrum*	V
Southern Grasshopper Mouse	*Onychomys torridus*	O, B
Townsend's Big-eared Bat	*Corynorhinus townsendii*	O, V
Western Red Bat	*Lasiurus blossevillii*	O

Appendix B: Species Detected-(Non-Avian)-Primary Study Area

Mammals (continued)		
White-tailed Antelope Ground Squirrel	*Ammospermophilus leucurus*	O
Yuma Myotis	*Myotis yumanensis*	V

O – Observed Directly
B – Burrow
T – Tracks
V – Vocalization
S – Scat
C – Carcass

AR060577

APPENDIX C SPECIAL STATUS TARGET PLANT SPECIES

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Abronia villosa var. *aurita* chaparral sand-verbena	Global Rank: Federal Listing: State Listing: State Rank: CNPS Rank: NECO:	G5T3T4 none, BLM sensitive none S2 1B.1 not covered	Jan - Sept	Presumed absent; potential habitat present on site but not found during surveys
Acleisanthes longiflora angel trumpets	Global: Federal: State Listing: State Rank: CNPS Rank: NECO:	G5 none none S1 2.3 covered	May	Presumed absent: no suitable habitat onsite (rocky carbonate canyon bottoms).
Astragalus insularis var. *harwoodii* Harwood's milkvetch	Global: Federal Listing: State Listing: State Rank: CNPS Rank: NECO:	G5T3 none none S2 2.2 covered	Jan - May	**PRESENT:** 13,712 individuals estimated on site.
Astragalus lentiginosus var. borreganus Borrego milk-vetch	Global: Federal Listing: State Listing: State Rank: CNPS Rank: NECO:	G5T4T5 none none S3.3 4.3 covered	Feb - May	Presumed absent: potential habitat present on site but not found during surveys
Astragalus lentigunosis var. *coachellae* Coachella valley milk-vetch	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5T2 none; BLM sensitive none S2 1B.2 covered	Feb - May	Presumed absent: potential habitat present on site but not found during surveys

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Astragalus sabulonum gravel milk-vetch	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S2 2.2 not covered	Feb - July	Presumed absent: potential habitat present on site but not found during surveys
Calliandra eriophylla pink fairy-duster	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S2S3 2.3 not covered	Jan - Mar	Presumed absent: potential habitat present on site but not found during surveys
Carnegia gigantea saguaro	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S1 2.2 covered	May - June	Absent: not found during surveys, little potential habitat on site.
Castela emoryi Emory's crucifixion-thorn	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4 none none S2S3 2.3 covered	Apr - Jul	Absent; potential habitat present on site but not found during surveys
Euphorbia abramsiana =*Chamaesyce abramsiana* Abrams' spurge	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4 none none S2S3 2.2 not covered	Sep – Nov	**PRESENT:** appx. 2104 individuals found during Fall 2012 surveys

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Euphorbia parryi	Global:	G5	May - June	Presumed absent: potential habitat present on site but not found during surveys
=*Chamaesyce parryi*	Federal Listing:	none		
Parry's spurge	State Listing:	none		
	State Rank:	S1		
	CNPS:	2.3		
	NECO:	not covered		
Euphorbia platysperma	Global:	G3	Feb - Sep	Presumed absent: potential habitat present on site but not found during surveys
=*Chamaesyce platysperma*	Federal Listing:	none; BLM sensitive		
flat-seeded spurge	State Listing:	none		
	State Rank:	S1		
	CNPS:	1B.2		
	NECO:	not covered		
Colubrina californica	Global:	G4	Apr - Jun	Absent: not found during surveys; no potential habitat on site (rocky wash bottoms & margins)
Las Animas colubrina	Federal Listing:	none		
	State Listing:	none		
	State Rank:	S2S3.3		
	CNPS:	2.3		
	NECO:	not covered		
Coryphantha alversonii	Global:	G3	Apr - Jun	Absent: potential habitat present on site but not found during surveys
foxtail cactus	Federal Listing:	none		
	State Listing	none		
	State Rank:	S3.2		
	CNPS:	4.3		
	NECO:	covered		
Cryptantha costata	Global:	G4G5	Jan - May	**PRESENT:** appx. 56,748 individuals estimated on site
ribbed cryptantha	Federal Listing:	none		
	State Listing	none		
	State Rank:	S3.3		
	CNPS:	4.3		
	NECO:	not covered		

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Ditaxis clariana glandular ditaxis	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4G5 none none S1 2.2 covered	Dec - Mar	Presumed absent: potential habitat present on site but not found during surveys
Ditaxis serrata var. *californica* California ditaxis	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5T2T3 none none S2 3.2 covered	Apr - Nov	presumed absent: potential habitat present on site but not found during surveys
Eriastrum harwoodii Harwood's eriastrum	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G3 none; BLM sensitive none S3 1B.2 not covered	Mar - May	**PRESENT:** appx. 882 individuals found on site
Funastrum utahense Utah vine milkweed	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4 none none S3.2 4.2 not covered	Apr - Sep	**PRESENT:** 1 individual found on site
Helianthus niveus ssp. *tephrodes* Algodones Dunes sunflower	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4T2 none Endangered S2 1B.2 not covered	Mar - May Oct - Jan	Absent: potential habitat present on site but not found during surveys

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Hymenoxys odorata bitter hymenoxys	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S2 2 not covered	Feb - Aug	Absent: no suitable habitat on site (moist river margins and benches)
Imperata brevifolia California satintail	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G2 none none S2.1 2.1 not covered	Sep - May	Absent: no suitable habitat on site (moist river plains & canal margins)
Koeberlinia spinosa ssp. *tennuispina* Crown-of-Thorns	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4T4 none none S2.2 2.2 covered	Mar - Jul	Absent: potential habitat present on site but not found during surveys
Mammillaria grahamii var. grahamii Graham's fishhook cactus	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4T4 none none S2 2.2 not covered	Apr	Absent: potential habitat present on site but not found during surveys
Mentzelia puberula Darlington's blazing star	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4 none none S2 2.2 not covered	Mar - May	Absent: no potential habitat present on site (rocky limestone and granite slopes)

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Opuntia wigginsii Wiggins' cholla	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G3?Q none none S1? 3.3 covered	Mar - June	Absent: potential habitat occurs on site but not found during surveys. Questionable taxonomic validity.
Penstemon pseudospectabilis ssp. *speudospectabilis* desert beardtongue	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4G5T3T5 none none S3 2.2 not covered	Mar - May	Presumed absent: potential habitat present on site but not found during surveys
Physalis lobata lobed cround cherry	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S2 2.3 covered	May - Jan	Presumed absent: potential habitat present on site but not found during surveys
Portulaca halimoides desert portulaca	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S3 4.2 not covered	Sept	Presumed absent: potential habitat present on site but not found during surveys
Proboscidea althaefolia desert unicorn-plant	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5 none none S3.3 4.3 covered	May - Aug	**PRESENT:** appx. 811 individuals estimated during Fall 2012 surveys

Appendix C: Special Status Target Plant Species

Scientific Name **Common Name**	**Status**		**Flowering Period**	**Occurrence on site**
Teucrium cubense ssp. *depressum* dwarf germander	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G4G5T3T4 none none S2 2.2 not covered	Mar - Nov	Presumed absent: marginal habitat present on site but not found during surveys
Wislizenia refracta var. *refracta* jackass clover	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5T5? none none S1 2.2 not covered	Apr - Nov	Presumed absent: potential habitat present on site but not found during surveys
Wislizenia refracta var. *palmeri* Palmer's jackass clover	Global: Federal Listing: State Listing: State Rank: CNPS: NECO:	G5T2T4 none none S1 2.2 covered	Jan - Dec	Presumed absent: potential habitat present on site but not found during surveys

APPENDIX D QUARTZITE MIGRATORY BIRD SURVEY PROTOCOL

Quartzite Migratory Bird Survey Protocol

Prepared for
IRONWOOD CONSULTING INC.
20 Nevada Street, Suite 300
Redlands, CA 92373

Prepared By:
***Corvus* Ecological Consulting, LLC**
7810 Highway 89, Suite 270
Flagstaff, AZ 86004

April, 2013

I. Equipment:

Binoculars
Spotting Scope (30X or greater)
GPS
Kestrel (thermometer/ anemometer)
Clipboard
Quartzite Migratory Bird Survey Data Sheet (s)
Pen (permanent ink)
Time-keeper (e.g. watch or cell phone)
Compass

II. Migration Survey Point Explanation

The purpose of these surveys is to record the passage of birds migrating over the Desert Quartzite Solar Project (Project) and depict their activity during transit.

- Migration surveys are conducted weekly from each observation survey point from 15 March through 31 May (spring migration) and from 1 September through 15 November (fall migration).

The two Migration survey Points (MP01 and MP02) are strategically located to bisect the Project footprint along the central east-west axis and are situated with near 360 degree views of the distant horizon to maximize visual capture of migrating birds as they pass over the area.

Survey Point	UTM (WGS 84)	
MP01	710176	3717195
MP02	706914	3717170

Flapping flight is energetically expensive and therefore migratory flights are strongly correlated with advantageous weather conditions. Many birds (especially raptors) select the warmest part of the day for migratory movement. Because the Project topography is generally flat and lacking in features likely to generate orographic lift;

- Migration point surveys will be conducted from 10 a.m. through 3 p.m. when thermal lift is greatest.
- Infinite distance visual surveys

A portion of the Project avian community is resident (non-migratory). Residents and some migrants (e.g. soaring raptors) can be expected to circulate and have the potential to be tallied more than once. To reduce the influence of resident birds on the survey data;

- Birds will only be recorded as they pass the axis line and not on subsequent returns. (See IV. Migration Survey Procedures.)

III. Data Sheet Explanation:

Surveyors will use the Quartzite Migratory Bird Survey Data Sheet to record;

A. Daily Information

- Observer: First initial of the first name followed by entire last name. Example, John Doe is recorded as: J. DOE
- Date: (DD Mmm YYYY): e.g. 15 Apr 2013
- Location: Quartzite
- Point ID: Unique identifier for the survey point (MP01 or MP02)

B. Environmental Observations

Weather data is collected for correlation of migration activity with environmental conditions.

- Start Time: 10 a.m.
- Time**:** Start of hourly weather interval
- Precipitation (Yes or No)
- Visibility (in kilometers): Estimate of how far the observer can see across the landscape. Use visible landmarks to aid in this determination.
- Wind Speed (Average MPH): Record the Average Wind Speed in miles per hour. A Kestrel (or similar measuring tool) should be used to record current wind conditions.
    i. First, determine the direction from which the wind is blowing. Position the anemometer in a location that is free from wind obstruction (clear from the leeward side of a tree, shrub or vehicle; top of a wash bank rather than a drainage bottom).
    ii. Hold the anemometer above head height and turn it on. Scroll to the device's "average" setting and allow it to record for two minutes. **NOTE: These devices will begin to average the wind speed from the second they are turned on and therefore they should be in position to record accurate conditions from the moment they are turned on until the moment the value is captured*.
- Wind Direction (8-point cardinal): Direction from which the wind is emanating (e.g. SW)
- Temperature (ºC): *Temp (^oC)* = Record the Temperature in degrees Celsius.
    i. Hold the Kestrel or thermometer in a shaded location, approximately three-feet above the ground surface.

ii. Allow the temperature reading to stabilize before recording the value. With a digital thermometer (such as a Kestrel) this point can be determined by the appearance of an unchanged value for 20 seconds or when the value suddenly changes direction from which it was adjusting, such as when the value increases after a consistent downward adjustment.

- Cloud cover (%): Visually estimate the amount of the sky covered by cloud

C. Bird Observations

1. Time: Timestamp at which a bird crosses the east-west axis
2. Species Code: 4-letter Alpha code (Institute for Bird Populations 2012; http://www.birdpop.org/DownloadDocuments/Alpha_codes_eng.pdf)
3. Number of Individuals: The number of birds (of the same species) detected passing over the axis and not returning. If birds are obviously grouped together, record the number of individuals in the same-species group. If birds are separated by enough space to warrant recording significantly different distances, flight heights or behaviors for each, record those birds on separate lines (e.g. write CLSW in "Species code" on three different lines if there are three Cliff Swallows detected at three completely different height codes).
4. Flight Direction: (8-point cardinal): Direction in which the bird is flying away from the observer and travelling across the Project (e.g. NW).
5. Distance from Observer: Record (in meters) the distance of each bird from the observation point as it crosses the axis.
6. Flight Height: Record the **lowest flight height observed** with one of the following codes:

- 1 = 0-4m (height of a PV Panel)
- 2 = 4-10m (height of a 3-storey building)
- 3= 10-50m (height of a transmission tower)
- 4=50m+ (higher than a transmission tower)

7. Behavior: Record the **behavior best characterizing use of the Project area** with one of the following codes;

- F=Foraging
- FA= Flapping
- SO=Soaring
- GL=Gliding
- S=Singing
- C=Calling
- O=Other

8. Age Class: Record A=Adult or I=Immature for raptors

IV. Migration Survey Procedures:

UN-codes. Infinite distance visual surveys rely on surveyors competently combining subtle clues such as silhouetted profile, wing beat rate, and flight pattern to accurately identify distant birds under less than ideal lighting conditions. Recognizing that not all birds can be identified to species under all conditions at all distances, the Alpha abbreviations contain UN-codes;

Alpha	Bird Group
UNBI	Unidentified Bird
UNEM	Unidentified Empidonax Flycatcher
UNGU	Unidentified Gull
UNHA	Unidentified Hawk
UNHU	Unidentified Hummingbird
UNWA	Unidentified Warbler

- Use UN- codes to record birds to the highest resolution possible

Double-Counting. Care must be taken to avoid double-counting. The goal of these surveys is to account for individuals of a given species no more than one time during the migration survey period. Some birds may be expected to be residents with territories that encompass the survey point. For example, a Red-tailed Hawk may be foraging over the area even as others are passing through, so the surveyor should attempt to exclude repeat tallies of such non-migrants.

Additional Observations. There may be additional bird sightings that observers wish to record that can provide benefit to the project but are not relevant to the particular survey, e.g. breeding or wintering bird observations. These observations should be recorded and passed along to the Avian Lead to assist with the depiction of avian breeding or distributional data within the Project area. To be of maximum value, each observation should include UTMs, a date and timestamp, and thorough details.

If surveyors have any questions about this protocol, please ask them *before* conducting the survey!

APPENDIX E QUARTZITE AVIAN LINE-TRANSECT SURVEY PROTOCOL

Quartzite Avian Line-Transect Survey Protocol

Prepared for
IRONWOOD CONSULTING INC.
20 Nevada Street, Suite 300
Redlands, CA 92373

Prepared By:
***Corvus* Ecological Consulting, LLC**
7810 Highway 89, Suite 270
Flagstaff, AZ 86004

March, 2013

Materials/ Supplies:

Binoculars
GPS
Kestrel (thermometer/ anemometer)
Rangefinder
Clipboard
Data Sheet(s)
Notepad (for recording personal notes not relevant to data sheets)
Pen (permanent ink)
Watch or other portable clock (e.g. cell phone)
Compass

Line-Transect Explanation

- Check your GPS settings to insure that the Map Datum is "WGS 84;" that the Compass Heading > North Reference is set to, "Magnetic;" and that "Metric" is the selected unit of measurement for "distance/ speed."
- Line-transect will be 2000 meters in length, with a starting point and ending point (Fig. 1).

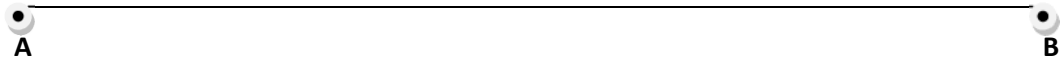


Figure 1.0. Line-transect route, 2000 meters long from point A to point B.

- Surveyors will begin the route from either point. For each line, point A should be used as a starting point 50% of the occasions it is surveyed, point B serving as starting point the other 50% of occasions it is surveyed.
- Surveyors will record distance (in meters) to each bird detected, measuring distance perpendicular (90°) to the line. Birds will not be recorded more than 90° from the line before the starting point or after the ending point. [See Methods/ Procedures for details.]
- ***Please be sure to read this entire document prior to starting your first survey***.

Data Sheet Explanation:

Surveyors will use the Quartzite Avian Line-Transect Data Sheet.

1. Line-Transect Data Sheet fields:

a. Complete the data sheet header including: Observer name, Date, Location, Transect ID, Starting point (circle A or B), Start time, and weather data prior to beginning a point count.

b. Observer(s) names: First initial of first name followed by entire last name. Example, John Doe is recorded as: J. DOE

c. Date: In DD MMM YYYY format. For example: 02 MAR 2011

d. Site Name: Locations to include: Project Footprint (within the proposed project boundary) or Project Control (outside of the proposed Project Footprint).

e. Transect ID: Unique identifier for the transect.

f. WGS 84, UTM: Provide the UTM coordinates for the starting location (A or B).

To Record Start Times and Weather Data: The purpose of collecting weather data is to provide support that environmental conditions are conducive to performing an avian line-transect survey. If conditions cause the observer to feel that results of a survey would be biased due to poor weather, the survey should be postponed until weather conditions improve. Some examples of weather conditions that are grounds for postponement include: average wind speeds greater than 15 miles per hour, visibility 2.0 miles or less, heavy rain/ fog or extreme temperatures.

1. *Record the start time.*
   i. The start time should represent the moment when observers initiate a search effort exclusive to the "transect" being surveyed; i.e. after initial information is recorded in the header of the data sheet, immediately before beginning to search for birds.
2. *Precip (Y/N)* = Precipitation, "Yes" or "No" for the entire survey period.
3. *Visibility (Miles)* = Estimate of how far the observer can see (in miles) across the landscape. Use visible landmarks to aid in this determination.
4. *Wind (AVG MPH)* = Record the Average Wind Speed in miles per hour. A Kestrel (or similar measuring tool) should be used to record current wind conditions.
   i. First, determine the direction from which the wind is blowing. Position the anemometer in a location that is free from wind obstruction (clear from the leeward side of a tree, shrub or vehicle; top of a wash bank rather than a drainage bottom).

ii. Hold the anemometer above head height and turn it on. Scroll to the device's "average" setting and allow it to record for two minutes. **NOTE: These devices will begin to average the wind speed from the second they are turned on and therefore they should be in position to record accurate conditions from the moment they are turned on until the moment the value is captured.*

5. *Temp (^oC)* = Record the Temperature in degrees Celsius.
   i. Hold the Kestrel or thermometer in a shaded location, approximately three-feet above the ground surface.
   ii. Allow the temperature reading to stabilize before recording the value. With a digital thermometer (such as a Kestrel) this point can be determined by the appearance of an unchanged value for 20 seconds or when the value suddenly changes direction from which it was adjusting, such as when the value increases after a consistent downward adjustment.
6. *Cloud Cover (%)* = A visual estimation which determines the percentage of visible sky that is covered by clouds.

- <u>Recording Data</u>

A. *Species code*: This is a bird's standardized four letter code. Appendix A contains the project related short list of codes for easy reference, if any are missing please reference: http://www.birdpop.org/DownloadDocuments/Alpha_codes_eng.pdf

B. *Detection type* (A, V): How the bird was **initially** detected; A = Audio and V = Visual. **NOTE: these codes are listed at the bottom of the data sheet.*

C. *Flight height (1, 2, 3 or 4)*: Record **lowest flight height observed** as one of the following numbers (1 through 4): 1 = 0-4m (height of a tall PV panel), 2 = 4-10m (height of a three-story building), 3 = 10-50m (height to top of transmission tower), 4 = 50m+ (higher than top of transmission tower). **NOTE: these codes are listed at the bottom of the data sheet.*

F. *Number (#) of individuals*: the number of birds detected (of the same species). If birds are obviously grouped together, record the number of individuals in the same-species group. If birds are separated by enough space to warrant recording significantly different distances for each, or if birds are located in significantly different directions, record those birds on separate lines (e.g. you can write BTSP in "Species code" on three different lines if there are three Black-throated Sparrows detected in three completely different directions; for each BTSP you

would write "1" under "# of individuals.") **Important note:** Do not count eggs or young birds that are not yet independent from their parents as "individuals."

G. *Radial distance (meters)*: perpendicular (90°) distance from the transect, in meters. If distance cannot be accurately recorded at 90° from the line-transect: record a straight line distance from the observer to the bird, AND record the size of the angle formed between the straight line to the bird and the line-transect itself. (*This is recorded in the column "Bearing (degrees)" – see below.*) **Important note:** If recording a single distance for a "cluster" of the same species, use the estimated distance to the *center of the cluster*. These are "unlimited distance surveys" and there is no limit to the perpendicular distance which detections may be made.

H. *Bearing (degrees)*: if the distance recorded to the bird(s) is made at a 90° angle, leave this field blank. Generally, this will be the case. However, if the surveyor finds it necessary to record a straight line distance to the bird - for example if writing furiously after encountering a flock of birds, or if a large obstruction such as a tree blocks the view at 90° - use this column to record the size of the angle (in degrees) formed where the surveyor is the axis, the line-transect is the adjacent side of the angle, and the straight line between the surveyor and the bird is the hypotenuse side of the angle. (The "opposite" side, which is situated 90° from the line-transect, can then be automatically calculated during data analysis.)

I. *Behavior code*: See Appendix B for a complete explanation of each behavior code. Multiple codes can be used, separated by commas (for example: C, S), but please list the *initial* behavior code first. ***NOTE: these codes are listed with brief definitions at the bottom of the data sheet.***

J. *Comments*: Observers may enter comments that they feel are relevant to any detection. It is a good idea to enter a comment such as "no data" if observers did not have a detection on the line-transect so that data checkers can keep track of progress and know that there is not data missing. If an individual bird is counted as an "incidental" and recorded again during the station survey, a comment should be made indicating such. **Note**: Any incidental sightings should be entered into pendragon, not on the transect data form.

Line-Transect Survey Methods/ Procedures:

AR060597

Once observers/ surveyors are within 200 meters of a start point they should record the initial data found in the header of the data sheet, except for Start Time. Start Time should be recorded when the surveyor arrives at the beginning of the line-transect, immediately before beginning to survey the transect.

Access the starting point and record any incidental (I) sightings while in route into pendragon. Because line-transect surveys tend to generate many more detections than a traditional point-count or point-transect, and therefore take longer to conduct, incidental sightings should be limited to noteworthy detections. Examples include: a new species for the project site list; a species not likely to be encountered again during the particular line-transect survey; a bird exhibiting breeding behavior; or any other reason the surveyor feels it necessary to document a particular incidental sighting as "data."

Once at the starting point for the line-transect, begin the count period by recording the Start Time. Birds that flush from the line-transect during approach should be included in the survey period and documented by recording the distance to the bird's initial position, prior to flushing. Detections should include a value for: "Species code," "Detection type," "Flight height," "Number (#) of individuals," "Radial distance," "Bearing," and "Behavior code" (if applicable). Observers should travel slowly or stop occasionally along the line to listen for vocalizations and to search dense areas of cover. Try to move as quietly as possible to maximize aural detections. A relatively constant pace should be maintained, but take the time needed to confidently identify every bird detected. Don't forget to scan the sky as well as the surrounding habitat, to maximize probability of detection for all upland species (especially raptors).

Once a line-transect has been completed, observers should record "End time". The surveyor should then access the next line-transect as soon as possible, if surveying a second transect that day. Any bird detection made after the "End time" has been recorded at the ending point should be recorded as an incidental detection in pendragon (even if surveyor is still at the ending point). Bird detections made between transects are recorded as incidental sightings, as well.

Care must be taken to avoid double-counting. The goal is to account for individuals of a given species no more than one time during the line-transect survey period; the exception to this rule being "incidental" detections. A bird recorded as an incidental may be recorded again during the official line-transect survey, but observers should provide a comment that indicates as much. It is important to separate incidental sightings from transect sightings for the purpose of data analysis but it is also important that we account for as many species/ individuals as possible during each survey. Once an observer has traveled more than 200 meters from the last station they should take final weather data and record any final comments on the data sheet.

There may be additional bird sightings that observers wish to record that can provide benefit to the project but are not relevant to the particular survey. Additional sighting should be recorded in the Incidental pendragon form, where they may provide beneficial migratory or distributional data.

APPENDIX F QUARTZITE FALL 2012 AND SPRING 2013 PLANT LIST

Appendix F: Quartzite Fall 2012 and Spring 2013 Plant List

Scientific Name	Family	Abundance
Abronia villosa	Nyctaginaceae	Common
Achyronchia cooperi	Caryophyllaceae	Occasional
Acmispon strigosus	Fabaceae	Common
Allionia incarnata	Nyctaginaceae	Occasional
Ambrosia dumosa	Asteraceae	Common
Ambrosia salsola	Asteraceae	Scarce
Aristida adscensionis	Poaceae	Occasional
Aristida oligantha	Poaceae	Scarce
Asclepias subulata	Apocynaceae	Scarce
Astragalus aridus	Fabaceae	Locally common
Astragalus didymocarpus	Fabaceae	Occasional
Astragalus insularis var. harwoodii	Fabaceae	Locally common
Astragalus nuttallianus var. imperfectus	Fabaceae	Locally abundant
Atriplex canescens	Chenopodiaceae	Scarce
Atriplex polycarpa	Chenopodiaceae	Scarce
Baileya pauciradiata	Asteraceae	Occasional
Bebbia juncea	Asteraceae	Scarce
Boerhavia triquetra var. intermedia	Nyctaginaceae	Locally common
Boerhavia wrightii	Nyctaginaceae	Common
Bouteloua aristidoides	Poaceae	Occasional
Bouteloua barbata	Poaceae	Occasional
**Brassica tournefortii*	Brassicaceae	Common / Locally abundant
Calocoseris wrightii	Asteraceae	Occasional
Caulanthus lasiophyllus	Brassicaceae	Occasional
Chaenactis carphoclinia	Asteraceae	Occasional
Chaenactis stevioides	Asteraceae	Abundant
**Chenopodium album*	Chenopodiaceae	Scarce

Appendix F: Quartzite Fall 2012 and Spring 2013 Plant List

Scientific Name	Family	Abundance
**Chenopodium murale*	Chenopodiaceae	Scarce
Chorizanthe brevicornu	Polygonaceae	Occasional
Chorizanthe corrugata	Polygonaceae	Occasional
Chorizanthe rigida	Polygonaceae	Occasional
Chylismia brevipes	Onagraceae	Scarce
Chylismia claviformis ssp. aurantiaca	Onagraceae	Common
Croton californicus	Euphorbiaceae	Scarce
Cryptantha angustifolia	Boraginaceae	Abundant
Cryptantha costata	Boraginaceae	Occasional
Cryptantha maritima	Boraginaceae	Occasional
Cryptantha micrantha	Boraginaceae	Occasional
Cryptantha nevadensis	Boraginaceae	Scarce
Cryptantha pterocarya var. pterocarya	Boraginaceae	Scarce
Cylindropuntia echinocarpa	Cactaceae	Scarce
**Cynodon dactylon*	Poaceae	Scarce
Dalea mollis	Fabaceae	Occasional
Dalea mollissima	Fabaceae	Occasional
Dicoria canescens	Asteraceae	Occasional
Ditaxis neomexicana	Euphorbiaceae	Scarce
Dithyrea californica	Brassicaceae	Occasional
Encelia farinosa	Asteraceae	Scarce
Encelia frutescens	Asteraceae	Scace
Eremalche exilis	Malvaceae	Occasional
Eremalche rotundifolia	Malvaceae	Scarce
Eremothera boothii	Onagraceae	Occasional
Eriastrum harwoodii	Polemoniaceae	Scarce
Eriogonum inflatum	Polygonaceae	Scarce

Appendix F: Quartzite Fall 2012 and Spring 2013 Plant List

Scientific Name	Family	Abundance
Eriogonum pusillum	Polygonaceae	Scarce
Eriogonum reniforme	Polygonaceae	Scarce
Eriogonum thomasii	Polygonaceae	Occasional
Eriogonum trichopes	Polygonaceae	Occasional
Erodium texanum	Geraniaceae	Common
Eschscholzia minutiflora	Papaveraceae	Scarce
Eschscholzia parishii	Papaveraceae	Scarce
**Eucalyptus sp.*	Myrtaceae	Scarce
Euphorbia abramsiana	Euphorbiaceae	Scarce
Euphorbia micromera	Euphorbiaceae	Common
Euphorbia polycarpa	Euphorbiaceae	Common
Euphorbia setiloba	Euphorbiaceae	Occasional
Ferocactus cylindraceus	Cactaceae	Scarce
Funastrum cynanchoides	Apocynaceae	Scarce
Funastrum hirtellum	Apocynaceae	Scarce
Funastrum utahense	Apocynaceae	Scarce
Geraea canescens	Asteraceae	Common
Hesperocallis undulata	Agavaceae	Common
Hilaria rigida	Poaceae	Locally common
Kallstroemia californica	Zygophyllaceae	Common / Locally abundant
Krameria bicolor	Krameriaceae	Occasional
Larrea tridentata	Zygophyllaceae	Common / Dominant shrub
Langloisia setosissima ssp. setosissima	Polemoniaceae	Scarce
Lepidium lasiocarpum var. lasiocarpum	Brassicaceae	Common
Loeseliastrum schottii	Polemoniaceae	Occasional
Lupinus arizonicus	Fabaceae	Scarce
Malacothrix glabrata	Asteraceae	Occasional

Scientific Name	Family	Abundance
Mammillaria tetrancistra	Cactaceae	Scarce
Marina parryi	Fabaceae	Occasional
Mentzelia albicaulis	Loasaceae	Occasional
Mentzelia longiloba	Loasaceae	Occasional
Monoptilon bellioides	Asteraceae	Occasional
Nama demissum	Boraginaceae	Scarce
Oenothera deltoides	Onagraceae	Common / Locally abundant
Oenothera primiveris	Onagraceae	Scarce
Oligomeris linifolia	Resedaceae	Occasional
Olneya tesota	Fabaceae	Scarce
Palafoxia arida	Asteraceae	Occasional
Parkinsonia florida	Fabaceae	Scarce
Pectis papposa	Asteraceae	Common / Locally abundant
Pectocarya heterocarpa	Boraginaceae	Common
Pectocarya platycarpa	Boraginaceae	Common
Pectocarya recurvata	Boraginaceae	Scarce
Perityle emoryi	Asteraceae	Scarce
Phacelia crenulata var. ambigua	Boraginaceae	Occasional
Phacelia crenulata var. crenulata	Boraginaceae	Occasional
Phacelia crenulata var minutiflora	Boraginaceae	Occasional
Phacelia ivesiana	Boraginaceae	Scarce
Plagiobothrys jonesii	Boraginaceae	Scarce
Plantago ovata	Plantaginaceae	Common
Probiscidea althaeifolia	Martyniaceae	Occasional
Prenanthella exigua	Asteraceae	Scarce
**Polygonum aviculare subsp. depressum*	Polygonaceae	Scarce
Prosopis glandulosa	Fabaceae	Scarce

Appendix F: Quartzite Fall 2012 and Spring 2013 Plant List

Scientific Name	Family	Abundance
Psathyrotes ramosissima	Asteraceae	Scarce
Psorothamnus emoryi	Fabaceae	Occasional
Rafinesquia neomexicana	Asteraceae	Common
**Salsola tragus*	Chenopodiaceae	Occasional / Locally abundant
**Schismus barbatus*	Poaceae	Common, widespread
Sphaeralcea angustifolia	Malvaceae	Scarce
Stephanomeria exigua	Asteraceae	Occasional
Stephanomeria pauciflora	Asteraceae	Occasional
Stillingia spinulosa	Euphorbiaceae	Scarce
Stipa hymenoides	Poaceae	Occasional
Streptanthella longirostris	Brassicaceae	Occasional
**Tamarix ramosissima*	Tamaricaceae	Scarce
Tidestromia suffruticosa var. oblongifolia	Amaranthaceae	Scarce
Tiquilia palmeri	Boraginaceae	Scarce
Tiquilia plicata	Boraginaceae	Locally common
**Tribulus terrestris*	Zygophyllaceae	Scarce

All nomenclature conforms to Baldwin, 2012: The Jepson Manual, 2nd edition.

*denotes non-native taxa

APPENDIX G QUARTZITE AVIAN SPECIES LIST, SPRING 2013

Quartzite Avian Species List Spring 2013

BCC = Bird of Conservation Concern, **BLM**S = BLM Sensitive, **FP** = Fully Protected, **SSC** = Species of Special Concern, **ST** = State Threatened, **MBTA** = Migratory Bird Treaty Act

Family	Common Name	Scientific Name	Federal Status	State Status	BLM Status	Other Status
New World Quail (Odontophoridae)						
	Gambel's Quail	*Callipepla gambelii*	MBTA			
Pelicans (Pelecanidae)						
	American White Pelican	*Pelecanus erythrorhynchos*	MBTA			SSC
New World Vultures (Cathartidae)						
	Turkey Vulture	*Cathartes aura*	MBTA			
Ospreys (Pandionidae)						
	Osprey	*Pandion haliaetus*	MBTA			
Hawks, Kites, Eagles, and Allies (Accipitridae)						
	Northern Harrier	*Circus cyaneus*	MBTA			SSC
	Cooper's Hawk	*Accipiter cooperii*	MBTA			
	Swainson's Hawk	*Buteo swainsoni*	MBTA			
	Red-tailed Hawk	*Buteo jamaicensis*	MBTA			
Gulls, Terns, and Skimmers (Laridae)						
	Franklin's Gull	*Leucophaeus pipixcan*	MBTA			
Pigeons and Doves (Columbidae)						
	Eurasian Collared-Dove	*Streptopelia decaocto*				
	White-winged Dove	*Zenaida asiatica*	MBTA			

Quartzite Avian Species List Spring 2013

BCC = Bird of Conservation Concern, **BLM**S = BLM Sensitive, **FP** = Fully Protected, **SSC** = Species of Special Concern, **ST** = State Threatened, **MBTA** = Migratory Bird Treaty Act

Family	Common Name	Scientific Name	Federal Status	State Status	BLM Status	Other Status
	Mourning Dove	*Zenaida macroura*	MBTA			
Cuckoos, Roadrunners, and Anis (Cuculidae)						
	Greater Roadrunner	*Geococcyx californianus*	MBTA			
Typical Owls (Strigidae)						
	Burrowing Owl	*Athene cunicularia*	MBTA		BLMS	SSC
Goatsuckers (Caprimulgidae)						
	Lesser Nighthawk	*Chordeiles acutipennis*	MBTA			
	Common Nighthawk	*Chordeiles minor*	MBTA			
Swifts (Apodidae)						
	Vaux's Swift	*Chaetura vauxi*	MBTA			SSC
	White-throated Swift	*Aeronautes saxatalis*	MBTA			
Hummingbirds (Trochilidae)						
	Costa's Hummingbird	*Calypte costae*	MBTA			
Woodpeckers and Allies (Picidae)						
	Northern Flicker	*Colaptes auratus*	MBTA			
Caracaras and Falcons (Falconidae)						

Quartzite Avian Species List Spring 2013

BCC = Bird of Conservation Concern, **BLM**S = BLM Sensitive, **FP** = Fully Protected, **SSC** = Species of Special Concern, **ST** = State Threatened, **MBTA** = Migratory Bird Treaty Act

Family	Common Name	Scientific Name	Federal Status	State Status	BLM Status	Other Status
	American Kestrel	*Falco sparverius*	MBTA			
	Peregrine Falcon	*Falco peregrinus*	MBTA, BCC	FP		
	Prairie Falcon	*Falco mexicanus*	MBTA, BCC		BLMS	
Tyrant Flycatchers (Tyrannidae)						
	Western Wood-Pewee	*Contopus sordidulus*	MBTA			
	Gray Flycatcher	*Empidonax wrightii*	MBTA			
	Dusky Flycatcher	*Empidonax oberholseri*	MBTA			
	Say's Phoebe	*Sayornis saya*	MBTA			
	Ash-throated Flycatcher	*Myiarchus cinerascens*	MBTA			
	Western Kingbird	*Tyrannus verticalis*	MBTA			
Shrikes (Laniidae)						
	Loggerhead Shrike	*Lanius ludovicianus*	MBTA, BCC			SSC
Vireos (Vireonidae)						
	Cassin's Vireo	*Vireo cassinii*	MBTA			
Jays and Crows (Corvidae)						
	Common Raven	*Corvus corax*	MBTA			
Larks (Alaudidae)						
	Horned Lark	*Eremophila alpestris*	MBTA			
Swallows (Hirundinidae)						
	Tree Swallow	*Tachycineta bicolor*	MBTA			

Quartzite Avian Species List Spring 2013

BCC = Bird of Conservation Concern, **BLM**S = BLM Sensitive, **FP** = Fully Protected, **SSC** = Species of Special Concern, **ST** = State Threatened, **MBTA** = Migratory Bird Treaty Act

Family	Common Name	Scientific Name	Federal Status	State Status	BLM Status	Other Status
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	MBTA			
	Cliff Swallow	*Petrochelidon pyrrhonota*	MBTA			
	Barn Swallow	*Hirundo rustica*	MBTA			
Verdin (Remizidae)						
	Verdin	*Auriparus flaviceps*	MBTA			
Wrens (Troglodytidae)						
	Rock Wren	*Salpinctes obsoletus*	MBTA			
	Cactus Wren	*Campylorhynchus brunneicapillus*	MBTA			
Gnatcatchers and Gnatwrens (Polioptilidae)						
	Blue-gray Gnatcatcher	*Polioptila caerulea*	MBTA			
	Black-tailed Gnatcatcher	*Polioptila melanura*	MBTA			
Mockingbirds and Thrashers (Mimidae)						
	Northern Mockingbird	*Mimus polyglottos*	MBTA			
	Le Conte's Thrasher	*Toxostoma lecontei*	MBTA, BCC			SSC
Wood-Warblers (Parulidae)						
	Orange-crowned Warbler	*Oreothlypis celata*	MBTA			
	MacGillivray's	*Geothlypis tolmiei*	MBTA			

Quartzite Avian Species List Spring 2013

BCC = Bird of Conservation Concern, **BLM**S = BLM Sensitive, **FP** = Fully Protected, **SSC** = Species of Special Concern, **ST** = State Threatened, **MBTA** = Migratory Bird Treaty Act

Family	Common Name	Scientific Name	Federal Status	State Status	BLM Status	Other Status
	Warbler					
	Common Yellowthroat	*Geothlypis trichas*	MBTA			
	Yellow Warbler	*Setophaga petechia*	MBTA, BCC			SSC
	Yellow-rumped Warbler	*Setophaga coronata*	MBTA			
	Wilson's Warbler	*Cardellina pusilla*	MBTA			
	Yellow-breasted Chat	*Icteria virens*	MBTA			SSC
Emberizids (Emberizidae)						
	Chipping Sparrow	*Spizella passerina*	MBTA			
	Brewer's Sparrow	*Spizella breweri*	MBTA, BCC			
	Black-throated Sparrow	*Amphispiza bilineata*	MBTA			
	Sage Sparrow	*Artemisiospiza belli*	MBTA			
	Lark Bunting	*Calamospiza melanocorys*	MBTA			
	Savannah Sparrow	*Passerculus sandwichensis*	MBTA			
	White-crowned Sparrow	*Zonotrichia leucophrys*	MBTA			
Cardinals, Piranga Tanagers and Allies (Cardinalidae)						
	Western Tanager	*Piranga ludoviciana*	MBTA			
Blackbirds (Icteridae)						
	Red-winged Blackbird	*Agelaius phoeniceus*	MBTA			
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	MBTA			SSC
	Brewer's Blackbird	*Euphagus*	MBTA			

Quartzite Avian Species List Spring 2013

BCC = Bird of Conservation Concern, **BLM**S = BLM Sensitive, **FP** = Fully Protected, **SSC** = Species of Special Concern, **ST** = State Threatened, **MBTA** = Migratory Bird Treaty Act

Family	Common Name	Scientific Name	Federal Status	State Status	BLM Status	Other Status
		cyanocephalus				
	Great-tailed Grackle	*Quiscalus mexicanus*	MBTA			
	Brown-headed Cowbird	*Molothrus ater*	MBTA			
	Bullock's Oriole	*Icterus bullockii*	MBTA			
Fringilline and Cardueline Finches and Allies (Fringillidae)						
	House Finch	*Haemorhous mexicanus*	MBTA			

APPENDIX H PHASE III BURROWING OWL SURVEY RESULTS, 2013

Appendix H: Phase III Burrowing Owl Survey Results, 2013

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
CVS153	5/18/2013	1	4	0		D	Collapsed burrow no longer suitable for BUOW use.
CVS164	5/25/2013	2	4	0	0	U	No BUOW sign present. Class=4.
DNF702	5/28/2013	3	4	0	0	U	Canid complex, no BUOW sign, fresh Canid excavation.
DNF702	7/12/2013	3	4	0	0	U	Well presented canid complex. Rain on 10-11 July has erased old sign. Kit fox pellets remain.
DNF703	5/30/2013	3	3	0	0	U	-No tracks or feathers observed -2 Pellets, neither fresh nor very sun-bleached -Burrow usable
DNF703	6/20/2013	3	3	0	0	U	Considerable old whitewash present. Burrow in good condition with clean entrance. No new sign observed.
DNF703	7/12/2013	3	3	0	0	U	Single canid or enlarged rodent burrow. Fair amount of old whitewash despite rain 20-11 July. No new tracks or other BUOW sign.
DNF706	5/28/2013	3	3	0	0	U	No recent BUOW sign, one old whitewash spot.
DNF706	6/19/2013	3	3	0	0	U	-No feathers, tracks or pellets -Single whitewash mark -Burrow usable
DNF706	7/15/2013	3	3	0	0	U	-No feathers, tracks or pellets -Single whitewash mark -Burrow usable
DNF707	5/28/2013	3	3	0	0	U	Single entrance canid, old whitewash, no recent BUOW sign.

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
DNF707	6/20/2013	3	3	0	0	U	Small kit fox or large rodent burrow in good condition. No recent sign but old whitewash still present.
DNF707	7/13/2013	3	3	0	0	U	Excellent single canid burrow with 2 fading whitewash spots following rain 10-11 July. No pellets or tracks of any species.
DNF717	5/29/2013	3	2	0	0	U	Clean canid complex with recent whitewash.
DNF717	6/21/2013	3	3	0	0	U	-Dozens of very sun bleached pellets around mound and borough -No feathers or tracks -Borough usable but un-kept and clearly inactive with spider webs and other materials at entrance -Single whitewash mark on sand mound in front of burrow
DNF717	7/15/2013	3	3	0	0	U	Small amount of old whitewash remain on mound. 2 burrows in good condition and many small bones adjacent.
JCW513	5/30/2013	3	3	0	0	U	- No feathers or tracks -5 Partially washed away whitewash marks -No pellets -Burrow usable
JCW513	6/20/2013	3	3	0	0	U	Enlarged rodent burrow in good condition with considerable old whitewash but no recent sign.

Appendix H: Phase III Burrowing Owl Survey Results, 2013

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
JCW513	7/15/2013	3	3	0	0	U	-6 Weathered whitewash marks -No feathers, tracks or pellets -Burrow usable
PHK646	5/27/2013	1	4	0	0	U	Active Kit fox den.
PHK647	5/27/2013	1	4	0	0	U	No BUOW sign. Class = 4.
PHK648	5/27/2013	2	4	0	0	U	Appears to have been re-excavated by mammal, end of tunnel visible. No BUOW sign. Class = 4.
PHK683	5/30/2013	3	3	0	0	U	-Pellets observed, none fresh. -White wash accumulated beneath creosote. -Burrow in usable condition
PHK683	6/21/2013	3	3	0	0	U	Pellets and whitewash still present but burrow entrance partially occluded by wind-blown vegetative debris. American Badger obs excavating 5m W did not approach this burrow.
PHK683	7/14/2013	3	3	0	0	U	-Whitewash accumulated beneath creosote and around Burrow -Multiple pellets around borough next to creosote -No feathers or tracks -Burrow usable
PHK684	5/30/2013	2	4	0	0	U	Rodent burrow observed. No whitewash or pellets observed. No sign observed.
PHK701	5/31/2013	2	3	0	0	U	Burrow in good condition with old whitewash but no other sign.

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
PHK701	6/21/2013	2	3	0	0	U	Burrow in good condition, more than 2min length. Old whitewash still present but no recent BUOW sign detected.
PHK701	7/15/2013	2	3	0	0	U	-2 Pellets -3 Whitewash marks -No feathers or tracks -Burrow usable
PHK702	5/31/2013	3	3	0	0	U	Good kit Fox burrow with many old whitewash.
PHK702	6/19/2013	3	3	0	0	U	-No feathers, tracks or pellets. -~15 weathered whitewash marks -Burrow usable
PHK712	5/25/2013	3	4	0	0	U	No sign observed. Class = 4.
PHK712	6/20/2013	3	3	0	0	U	Clean large entrance - possibly re-excavated. Sidewinder track into burrow. Owl feathers on mound.
PHK712	7/12/2013	3	3	0	0	U	-Burrow usable -No feathers, tracks or whitewash -3 weathered pellets near burrow
PHK712	7/13/2013	3	3	0	0	U	-Burrow usable -No feathers, tracks or whitewash -3 weathered pellets near burrow
PHK726	5/29/2013	3	4	0	0	U	No activity. Whitewash is old, no recent sign. Burrow inactive and in a state of decay.

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
PHK726	6/19/2013	3	3	0	0	U	Burrow in good condition, old whitewash, no recent sign. The
PHK726	7/12/2013	3	3	0	0	U	-No feathers, tracks or pellets -3 weathered whitewash marks -Burrow usable
PHK732	5/29/2013	3	3	0	0	U	No activity. Nest site looks conducive but sign (whitewash) is old.
PHK732	6/19/2013	3	3	0	0	U	One good burrow with old whitewash.
PHK732	7/13/2013	3	3	0	0	U	Canid complex with two entrances: 1 with old whitewash is partially collapsed, 1 with clean entry in excellent condition. No recent BUOW sign. Numerous canid burrows within 150m radius.
PHK761	5/31/2013	3	3	0	0	U	-12 weathered whitewash marks -No feathers, tracks or pellets -Burrow usable -Spiderwebs at entrance
PHK761	6/21/2013	3	3	0	0	U	-Burrow usable -~15 White wash marks at entrance and your burrow -No feathers, tracks or pellets
PHK761	7/15/2013	3	3	0	0	U	Considerable old whitewash at clean entry of CS but no new sign since rain event 10-11 July. No tracks pellets or pretty remains.

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
PHK765	5/31/2013	3	3	0	0	U	-No tracks, feathers or pellets observed -Three whitewash marks, not fresh -Burrow usable
PHK765	6/20/2013	3	3	0	0	U	-No feathers, tracks, pellets. -~Five weathered whitewash marks -Burrow usable
PHK765	7/13/2013	3	3	0	0	U	- 3 Weathered whitewash marks -Burrow usable -No feathers, tracks or pellets
PHK768	5/31/2013	2	3	0	0	U	-No feathers or tracks observed -One nearly washed away whitewash mark -One fox pellet
PHK768	6/20/2013	2	3	0	0	U	-Burrow usable. -Whitewash marks on rock in front of burrow nearly weathered away. -No feathers, tracks or pellets. -Kangaroo rat foot near burrow
PHK768	7/13/2013	2	3	0	0	U	-2 Weathered pellets -2 Weathered whitewash marks -No feathers or tracks -1 Kangaroo rat tail at burrow entrance

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
PHK775	5/23/2013	3	3	0	0	U	No changes since initial observation.
PHK775	6/22/2013	3	3	0	0	U	Burrow in fair condition, old whitewash and pellet. No recent sign.
PHK775	7/14/2013	3	3	0	0	U	Old whitewash at rodent burrow adjacent to old canid complex with no current viable entrances. Owl burrow in good condition. 1 disintegrating pellet and many small bones / fragments scattered near entrance.
PHK837	5/24/2013	2	1	2	Unknown	UD	One adult at burrow for 2 hrs of observation, second adult 0-150m east overlooking Brassica field.
PHK837	6/20/2013	2	1	1	Unknown	UD	Adult perched 1m agl and 1-5m from burrow entrance for duration of 2.5 hr observation
PHK837	7/14/2013	2	2	0	0	UD	-Whitewash around burrows and accumulated around creosote -Pellets -No feathers or tracks observed -Burrows usable
PHK837	7/15/2013	2	3	0	0	D	Follow up to visit 14 July. 3 burrows with large entries have debris mounds consistent with but not conclusive of predatory excavation. No owl tracks present on mounds where numerous in June. Some whitewash and pellets remain. No prey remains of any species observed.

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
PHK842	5/29/2013	3	3	0	0	U	Burrow in good condition, old BUOW sign (whitewash) but no recent indications. Class = 3.
PHK842	6/22/2013	3	3	0	0	U	-~20 sun bleached pellets around dirt mound next to burrow -~10 whitewash marks near burrow entrance -Burrow usable -No feathers or tracks
PHK842	7/16/2013	3	3	0	0	U	-Burrow usable -Sidewinder at entrance -Weathered pellets present -~ 10 weathered whitewash marks -No feathers or tracks
RR0001	5/31/2013	2	4	0	0	U	Canid complex showing recent Coyote and kit fox excavation. No BUOW sign detected.
RR0002	5/22/2013	1	1	2	0		Pale worn adult ranging to east near Brassica field with occasional forays near burrow.
RR0002	5/30/2013	1	1	2	Unknown	U	Pair observed during unrelated survey foraging on territory @ 0830. Second bird is much darker and boldly marked.

Waypoint ID	Date	Initial Burrow Class	Current Burrow Class	# of Adults	# of Juveniles	*Nest Status	Comments
RR0002	6/20/2013	1	1	2	Unknown	U	-Pair perched in same area for over 2 hours, likely guarding. -Pair in view for over two hours, however only activity observed included preening, fanning of wings, perching together, possible nest guarding and female receding occasionally into burrow for extended periods.
RR0002	7/13/2013	1	1	2	Unknown	H	Female entering burrow for 1-2 minutes every 15-20 minutes suggests young in nest. Male ranging 30-120m East of nest.
RR0002	7/15/2013	1	1	2	Unknown	H	Pale adult observed to make food drop to burrow entrance then immediately depart to guard perch, suggesting dependent young in burrow.

* Nest Status: H-Hatchling, U-Unoccupied, UD-Undetermined, D-Destroyed

DESERT QUARTZITE, LLC

A Wholly-Owned Subsidiary of First Solar Development, Inc.

PLAN OF DEVELOPMENT

Desert Quartzite Solar Project



Submitted to:
U.S. BUREAU OF LAND MANAGEMENT
California Desert District
Riverside County, California

Submitted: ~~**August 31, 2010**~~
~~**August 15, 2011**~~
~~**September 15, 2011**~~
May 23, 2014

BLM Project Number: **CACA # 049397**

Table of Contents

1.0 Introduction 1

1.1 Type of Facility, Planned Uses, and Generation Output 1

1.2 Project Background 3

1.3 Applicant's Schedule for Project Permitting, Construction, and Operation 3

1.4 Proponent's Purpose and Need for the Project 4

2.0 General Facility Description 6

2.1 Project Location, Land Ownership, and Jurisdiction 6

2.2 Legal Description 9

2.3 Project Acreage and Dimensions 10

2.4 Power Plant Facilities 10

2.4.1 First Solar Cadmium Telluride (CdTe) PV Technology 11

2.4.2 PV Arrays and Combining Switchgear 12

2.5 Number and General Dimensions of Project Components 15

2.6 Temporary Construction Facilities 16

2.7 Geotechnical Studies 16

2.8 Ancillary Facilities 16

2.8.1 Operations and Maintenance Facility 16

2.8.2 Meteorological Station 16

2.8.3 Anemometers 18

2.8.4 Other Ancillary Facilities 18

2.9 Water Uses and Sources 19

2.9.1 Groundwater Setting 19

2.9.2 Project Water Supply and Water Usage 19

2.10 Hydrological Conditions 20

2.11 Site Preparation, Erosion Control, and Storm Water Drainage 21

2.12 Vegetation Treatment and Weed Management 22

2.13 Waste and Hazardous Materials Management 22

2.14 Reusable and Recyclable Materials/PV Module Recycling 23

2.15 Fire Protection 24

2.16 Site Security and Fencing 25

2.17 Electrical Components, New Equipment, and Existing System Upgrades 25

2.18 Interconnection to Electrical Grid 25

2.19 Spill Prevention and Containment 25

2.20 Health and Safety Program 26

2.21 Other Federal, State, and Local Agency Permit Requirements 27
2.21.1 Federal Permits and Status 27
2.21.2 State Permits and Status 30
2.21.3 Local Permits and Status 31
2.22 Financial and Technical Capability of the Applicant 32

3.0 Construction of Facilities 33

3.1 Solar Field Design, Layout, Installation, and Construction Processes 33
3.2 Construction and Operations Approach 33
3.3 Access and Transportation System, Component Delivery, Worker Access 33
3.4 Construction Workforce Numbers, Vehicles, Equipment, Timeframes 33
3.4.1 Construction Workforce Numbers 33
3.4.2 Construction Equipment/Vehicles 34
3.4.3 Construction Timeframe 34
3.5 Preconstruction Surveying and Staking 34
3.6 Preconstruction Site Preparation 34
3.6.1 Desert Tortoise Exclusion Fencing and Preconstruction Surveys 34
3.6.2 Access Roads and Construction Laydown and Parking Areas 35
3.6.3 Construction Offices and Site Services 35
3.7 Site Clearing, Grading, and Compaction 35
3.7.1 Clearing 36
3.7.2 Grading 36
3.7.3 Compaction 37
3.8 Solar Array Assembly and Construction 37
3.8.1 Trenching and Cable Installation 37
3.8.2 Support Post Installation 38
3.8.3 Balance of System (BOS) Installation 38
3.9 Gravel, Aggregate, and Concrete Needs and Sources 38
3.10 Solar Module and Electrical Construction Activities 39
3.10.1 Solar Module Electrical Construction Activities 39
3.10.2 Gen-Tie Line Construction Activities 39
3.11 Aviation Lighting (Power Towers, Transmission) 40
3.12 Site Stabilization, Protection, and Reclamation Practices 40

4.0 Related Facilities and Systems 42

4.1 Transmission System Interconnect 42
4.1.1 Existing Transmission System 42
4.1.2 Proposed Transmission System 42
4.1.3 Ancillary Facilities and Substations 42
4.1.4 Status of Power Purchase Agreements 42

4.1.5 Status of Interconnection Agreements 42
4.1.6 General Design and Construction Standards 42
4.2 Gas Supply Systems 43
4.3 Other Related Systems 43
4.3.1 Communications System Requirements 43

5.0 Operations and Maintenance 44

5.1 Operation and Facility Maintenance Needs 44
5.2 Maintenance Activities 44
5.3 Operations Workforce and Equipment 44

6.0 Environmental Considerations 45

6.1 Special or Sensitive Species and Habitats 45
6.1.1 Habitat Description 45
6.1.2 Special Status Species 46
6.1.3 Jurisdictional Waters 49
6.2 Special Land Use Designations 49
6.2.1 Visual Resources 50
6.2.2 Rangeland Resources 50
6.2.3 Military and Civilian Aviation 50
6.3 Cultural and Historic Resources 51
6.4 Native American Tribal Concerns 52
6.5 Recreation, and Off-Highway Vehicle (OHV) Resources 52
6.6 Groundwater Resources 52
6.7 Mitigation 55

7.0 Supplemental Information 56

7.1 Engineering and Civil Design 56
7.1.1 Facility Survey and Design Drawing Standards 56
7.1.2 Final Engineering and Civil Design Packages 56
7.1.3 Watershed and Drainage Analysis and Calculations 56
7.1.4 Watershed Protection and Erosion Control Drawings 57
7.1.5 Final Site Grading Plans 57
7.2 Alternatives Considered by the Applicant 57
7.2.1 Alternative Site Evaluation Criteria 57
7.2.2 Alternatives Considered but Not Carried Forward by Proponent 58
Alternative Site Locations 58
Alternative Transmission and Interconnection Locations 58
7.2.3 Comparative Analysis of Proponent's Alternatives 59
7.2.4 Alternative Site Configurations 59
Solar Facility Site 59

7.3 Facility Management Plans 59
7.3.1 Storm Water Pollution Prevention Plan (SWPPP) 59
7.3.2 Spill Prevention Control and Countermeasure (SPCC) Plan 60
7.3.3 Waste Management Plan 60
7.3.4 Integrated Weed Management Plan 60
7.3.5 Health and Safety Plan 60
7.3.6 Environmental Inspection and Compliance Monitoring Plan 60
7.4 Facility Decommissioning 61
7.4.1 Reclamation and Site Stabilization Planning 61
7.4.2 Temporary Reclamation of Disturbed Areas 61
7.4.3 Removal of Power Generation and Substation Facilities 62
7.4.4 Removal and Recycling of PV Modules 62
7.4.5 Removal of Other Ancillary Facilities 62

List of Appendices

Appendix A Environmental Considerations Table
Appendix B Preliminary Biological Resources Assessment
Appendix C Site Plan Package
Appendix D Preliminary Geotechnical Investigation Report
Appendix E Drainage Report

List of Figures

Figure 1-1 Project Vicinity Map 2
Figure 2-1 Typical View of Project Site Area 6
Figure 2-2 Project Site Area 7
Figure 2-3 Devers-Palo Verde 1 Line 8
Figure 2-4 Representative Horizontal Tracker PV Array Photograph 13
Figure 2-5 Representative Power Conversion Station Photograph 14
Figure 2-6 Representative PV Combining Switchgear Photograph 14
Figure 2-7 Typical Meteorological Station Photograph 17
Figure 2-8 Typical Tracker Anemometer Tower Photograph 18
Figure 6-1 Representative Sonoran Creosote Bush Scrub at Solar Facility Site 46
Figure 6-2 Desert Dry Wash Woodland in Northern Portion of the Solar Facility Site 46
Figure 6-3 BLM-Designated Open Routes Crossing the Solar Farm Site 53

List of Tables

Table 2-1 Existing Uses and Easements within Project Site Area 8
Table 2-2 Legal Description of the Project Site Area 10
Table 2-3 Solar Facility Components, and Approximate Area 15
Table 2-4 Chemicals at Project Site During Construction 22
Table 2-5 Chemicals at Project Site During Operation 23
Table 2-6 Status of Project Federal Permits and Authorizations 27
Table 2-7 Status of Project State Permits and Authorizations 30
Table 2-8 Status of Project Local Permits and Authorizations 31
Table 5-1 Daily Vehicle Trips During Project Operation 44
Table 6-1 Special Status Plants Found On-site 47

List of Acronyms and Abbreviations

AB	Assembly Bill
AC	alternating current
ACEC	Area of Critical Environmental Concern
ADA	Americans with Disabilities Act
AF	acre feet
AFY	acre feet per year
BA	Biological Assessment
bgs	below ground surface
BLM	Bureau of Land Management
BMP	best management practice
BO	Biological Opinion
CAISO	California Independent System Operator
CalOSHA	California Occupational Safety and Health Administration
Cd	cadmium
CDCA Plan	California Desert Conservation Area Plan of 1980 as Amended
CDFW	California Department of Fish and Wildlife
CdTe	cadmium telluride
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CHU	Critical Habitat Unit
CREZ	California Renewable Energy Zone
CRSS	Colorado River Substation
CWA	Clean Water Act
DAS	data acquisition system
DOD	Department of Defense
DOE	Department of Energy
DPV	Devers-Palo Verde transmission line
DWMA	Desert Wildlife Management Area
EHS	Environmental Health and Safety
EIS	Environmental Impact Statement
ESA	Endangered Species Act
EU	European Union
FEMA	Federal Emergency Management Agency
FLPMA	Federal Land Policy Management Act of 1976
GHG	greenhouse gas
gpd	gallons per day
GW	gigawatt
I-10	Interstate 10
kV	kilovolt
LST	lattice steel tower
MOU	memorandum of understanding
MW	megawatt

MWD	Municipal Water District
NAHC	Native American Heritage Commission
NECO Plan	Northern and Eastern Colorado Desert Coordinated Management Plan
NEPA	National Environmental Policy Act of 1970 as Amended
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (formerly Soil Conservation Service)
O&M	operations and maintenance
OHV	off-highway vehicle
OSHA	Occupational Safety and Health Administration
PCS	Power Conversion Station
PEIS	Programmatic Environmental Impact Statement
POD	Plan of Development
PV	photovoltaic
PVCS	photovoltaic combining switchgear
PVMGB	Palo Verde Mesa Groundwater Basin
RETI	Renewable Energy Transmission Initiative
ROD	Record of Decision
ROW	right of way
RPS	Renewable Portfolio Standard
RWQCB	Regional Water Quality Control Board
SCE	Southern California Edison
SLF	Sacred Lands File
SPCC	Spill Prevention Control and Countermeasure
SPP	Site Plan Package
SWRCB	State Water Resources Control Board
Te	tellurium
TSP	tubular steel pole
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

1.0 Introduction

1.1 Type of Facility, Planned Uses, and Generation Output

Desert Quartzite, LLC proposes to construct and operate a 300 megawatt (MW) alternating current (AC) solar photovoltaic (PV) energy-generating project known as the Desert Quartzite Solar Project (Project). Desert Quartzite, LLC is a wholly-owned subsidiary of First Solar Development, Inc. The facility will utilize First Solar's thin-film cadmium telluride (CdTe) PV modules in order to produce clean, renewable energy for sale to one or more California utilities. The right of way (ROW) being requested for the site of the PV generating facility (solar facility) and the corridor for the Project's generation interconnection transmission line (Gen-Tie Line) will be located on lands administered by the U.S. Department of Interior, Bureau of Land Management (BLM). This Plan of Development (POD) is part of the BLM ROW grant application process and has been prepared according to the latest BLM Solar POD Outline guidance, dated December 19, 2012. This POD also includes as Appendix C a Site Plan Package (SPP) that provides preliminary engineering information for the Project.

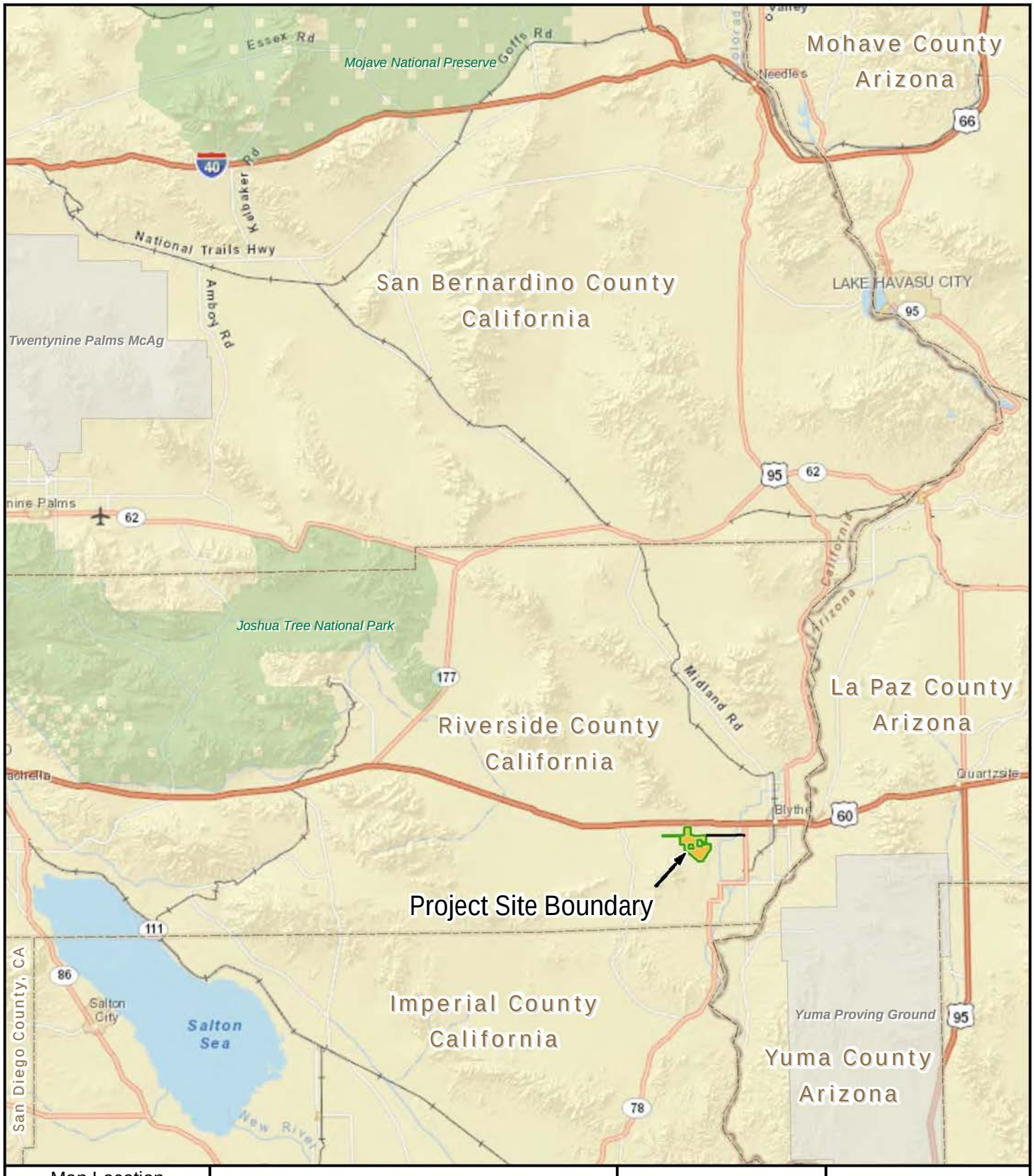
In this POD, the Solar Facility Site and the 600-foot-wide study corridor for the Gen-Tie Line are collectively referred to as the Project Site. The Project Site is located in eastern Riverside County, California, approximately 2.75 miles southwest of the western edge of the City of Blythe.

Figure 1-1 is a vicinity map of the Project Site (CACA 049397), including the Project Site and surroundings. The proposed Project includes the Solar Facility, an On-Site Substation, and the Gen-Tie Line. The Project proposes to interconnect to the regional transmission grid at Southern California Edison's (SCE's) Colorado River Substation (CRSS), . The CRSS was constructed as part of a system upgrades that are intended to serve several renewable energy projects in the region, including projects that are further along in the development process than the proposed Project. Construction of the CRSS was completed in September of 2013. Because the CRSS is already permitted, constructed, and operational, construction and operation of the CRSS is not analyzed in this POD.

The proposed Project will help California meet its Renewable Portfolio Standard (RPS) goal, which is currently 33 percent of electrical power retail sales by 2020 under Senate Bill (SB) X 1-2. The Project supports Secretary of the Interior Salazar's Orders 3283 and 3285, which make developing renewable energy a top national priority. The Project will also help the State achieve the 2006 Global Warming Solutions Act (Assembly Bill [AB] 32) greenhouse gas (GHG) reduction targets, which require California's GHG emissions to be reduced to 1990 levels by 2020.

When fully operational, the 300 MW Project will deliver over 1.5 billion kilowatt-hours of clean, renewable energy annually. This is equivalent to the amount of energy needed to serve over 90,000 California homes each year. When compared to the carbon dioxide (CO_2) emissions that would be emitted if the same amount of electricity was generated from fossil fuels, implementing the Project will avoid emissions of over 165,000 metric tons of CO_2 annually – the equivalent of taking almost 32,000 automobiles off the road. The electricity generated by the Project will be sold to one or more utilities or other retail customers.

The Project will employ best practices throughout all aspects of development. First Solar's advanced PV technology and an efficient, environmentally sensitive site layout will maximize renewable energy generation potential while minimizing disruption to the Project Site and surrounding environment.



Map Location



Legend

CACA 49397

Project Site

1:1,000,000

0 20 40 Miles

Desert Quartzite Solar Project

Figure 1-1
Project Vicinity Map

Desert Quartzite, LLC

May 2014

AR060631

Key attributes of the Project include:

- Direct conversion of sunlight to electricity without the use of water (i.e., no need for cooling water or water to generate steam) or production of wastes in the power generation process;
- 300 MW of electrical power, a typical capacity for a modern natural gas-fired combined-cycle power plant in California, generated from a renewable source and producing no carbon (or any other air pollutant) emissions and lower noise levels during power generation;
- A project sited within the Riverside East Solar Energy Zone (SEZ) as designated in the BLM 2012 Approved Resource Management Plan Amendments/Record of Decision (ROD) for Solar Energy Development in Six Southwestern States and within one of the Competitive Renewable Energy Zones (CREZ) identified by the Renewable Energy Transmission Initiative (RETI);
- Low-profile, PV arrays and no on-site structures taller than a maintenance building or electrical switchyard;
- Minimal water use during Project operation; and,
- Desert tortoise exclusion fencing along the site perimeter.

1.2 Project Background

On September 28, 2007, OptiSolar Inc. (OptiSolar) filed an application with the BLM Palm Springs Field Office for development of the Project on approximately 7,245 acres of BLM-administered land located southwest of Blythe. The Project was originally proposed as a 274 MW project using OptiSolar PV technology. OptiSolar submitted a POD for the Project on November 24, 2008, describing the Project as a 601 MW solar PV project on 7,724 acres of BLM-administered land. On April 3, 2009, First Solar, Inc. acquired OptiSolar by merger, resulting in OptiSolar becoming a wholly-owned subsidiary of First Solar, Inc. After the merger, OptiSolar changed its name to First Solar Development, Inc. In accordance with the BLM's case recordation of April 11, 2011, the acreage for CACA 049437 is 7,236 acres. On August 15, 2011, First Solar submitted a revision to the POD that refined and decreased the Project Site Boundary and redesigned the Project using First Solar PV modules. Among the areas removed in the Project Site Boundary was the portion south of the Devers-Palo Verde (DPV) transmission lines. The Project's generation capacity was revised to 300 MW, and at the same time the portion of the Project ROW to be occupied by the Project facilities (Solar Facility and Gen-Tie Line corridor) was reduced to 4,861 acres.

On September 15, 2011, First Solar submitted another revision to the POD that revised the location of the SCE Colorado River Substation and associated 230 kV Gen-Tie Line route, and provided refined Project Description details as well as provided additional figures and exhibits.

On December 13, 2013, First Solar submitted a request to substitute the Applicant/Project Development Entity on the Desert Quartzite SF-299 from First Solar Development, Inc. to Desert Quartzite, LLC. The request also included a revised map (revised Figure 2-2) and legal description of the right-of-way (ROW) application area (revised Table 2-2). The revised ROW application area is 4,843 acres.

At the request of BLM, in March of 2014, Desert Quartzite Solar submitted a minor change to the Gen-Tie Line portion of the ROW identified in the Desert Quartzite SF-299.

1.3 Applicant's Schedule for Project Permitting, Construction, and Operation

The BLM will be the lead Federal agency for approving the Project and will issue a ROW grant authorizing the Project's construction, operation, and use of BLM-administered lands. The decision regarding the issuance of the ROW grant will be based in part on an evaluation of the Project's potential environmental

effects through the National Environmental Policy Act (NEPA) review process and the requirements of the Federal Land Policy and Management Act of 1976 (FLPMA). The NEPA process will involve the preparation of an EIS detailing the Project's expected environmental impacts and mitigation measures to avoid or minimize identified impacts. The NEPA review process will commence once the BLM has deemed the POD complete, issued a Notice of Intent (NOI) to prepare an EIS, and selected a consultant to prepare the EIS. It may take 12 months or more from the formal initiation of the NEPA process to receive all final approvals for the ROW grant.

The Project Site is located within the boundaries of the area administered under the Northern and Eastern Colorado (NECO) Plan, an element of the California Desert Conservation Area Plan of 1980 as Amended (CDCA Plan). In October 2012, the BLM issued the *Approved Resource Management Plan Amendments/Record of Decision (ROD) for Solar Energy Development in Six Southwestern States*, which amends the CDCA Plan to include priority areas for utility-scale solar energy ROWs (i.e., SEZs). BLM authorization of a ROW grant for the Project is expected to require a land use Plan Amendment to the CDCA Plan for a short segment of the proposed transmission line, which is located outside of an existing transmission ROW corridor, in conformance with BLM Planning Regulations (43 Code of Federal Regulations [CFR] Part 1600), and BLM Land Use Planning Handbook (H-1601-1). The Plan Amendment process would run concurrently with the NEPA process. Desert Quartzite, LLC recognizes the importance of timely and clear communication with involved public agencies and community stakeholders. Desert Quartzite, LLC will initiate discussions and consultation processes with other involved Federal, State, and local permitting agencies in a timely manner as Project development proceeds. These include the U.S. Fish and Wildlife Service (USFWS), the U.S. Army Corps of Engineers (USACE) and the California Department of Fish and Wildlife (CDFW), and other agencies with potential jurisdiction over the Project in conjunction with the BLM's ROW grant approval process. A formal consultation process under Section 7 of the Federal Endangered Species Act (ESA) will likely take place between USFWS and the BLM with regard to the desert tortoise. Involvement of the USACE with regard to the need for a permit under Section 404 of the Clean Water Act will depend on whether the Corps ultimately chooses to take jurisdiction over drainages or waterways within the Project Site. Section 2.21 of the POD provides detail relating to the Federal, State, and local permits required for the Project.

The construction of the Project will begin once all applicable approvals and permits have been obtained, the necessary transmission upgrades are in place, and a Power Purchase Agreement has been finalized. It is expected to take 18 to 48 months from the commencement of the construction process to complete the Project. Desert Quartzite, LLC's current expectation is that Project construction will begin in late 2015. The Project is planned to be constructed sequentially in two blocks, 150 MW at a time, under separate Notices to Proceed. Once construction is completed, the Project will be in operation for 30 years or more with the possibility of a subsequent repowering of the Project for additional years of operation.

1.4 Proponent's Purpose and Need for the Project

The fundamental purpose of this Project is to construct, operate, and eventually decommission a clean, renewable source of solar electricity that helps meet California's growing demand for power and helps fulfill national and State renewable energy and GHG goals. Solar energy provides a sustainable, renewable source of power that helps reduce fossil fuel dependence and GHG emissions.

The California Energy Commission forecasts that electricity consumption in California will increase by 1.24 percent per year from 2014 to 2024[1]. Peak demand is expected to increase by 1.68 percent annually over

[1] Kavalec, C., Fugate, N., et al. 2013. *California Energy Demand 2014-2024, Revised Forecast, Volume 1: Statewide Electricity Demand, End-User Natural Gas Demand, and Energy Efficiency*. California Energy Commission. CEC-200-2013-004-SD-V1-REV.

the same period. The Project will add 300 MW of renewable generating capacity to California's energy system; in addition, this solar energy will be generated during peak hours of consumption and will help local utilities in meeting increases in peak demand.

This Project will support California in meeting the RPS mandate, which requires California's investor-owned utilities to supply 33 percent of its electricity supply from renewable energy by 2020.

In addition, the Project will help meet the goals set forth in AB 32, which requires that the State's GHG emissions be reduced to 1990 levels by 2020, a roughly 25 percent reduction compared to business-as-usual estimates. Considering the entire process, from raw material sourcing through end of life cycle collection and recycling, the Project's 300 MW of additional generating capacity will produce a tiny fraction of the GHG emissions of a similar capacity fossil fuel power plant.

Federal policy requires government agencies to facilitate the development of renewable energy sources. Executive Order 13212, issued in May 2001, mandates that Federal agencies act expediently and in a manner consistent with applicable laws to increase the "production and transmission of energy in a safe and environmentally sound manner." The Energy Policy Act of 2005 requires the Department of the Interior to approve at least 10,000 MW of renewable energy generation on public lands by 2015. In early 2009, Secretary of Interior Salazar issued Orders 3283 and 3285, making the production, development, and delivery of renewable energy top priorities for the Department of Interior.

Solar electricity generation is an important component of each of the Federal and State policy goals described above. Among other desirable attributes, the Project site provides excellent solar resource availability and contains lands that are open, generally flat and uniquely situated within a BLM-designated electrical transmission corridor and near existing transmission lines and roadways. The Project Site also is located outside of designated special management areas such as Desert Wildlife Management Areas (DWMAs), Areas of Critical Environmental Concern (ACECs), Critical Habitat Unit (CHUs), and Category I or II desert tortoise habitat (as designated in the NECO Plan). The site is located within the Riverside East SEZ designated in the Solar PEIS prepared by the BLM and U.S. Department of Energy (DOE). The site also is within one of the CREZ identified by California utilities and other stakeholders as part of the ongoing RETI process.

Specific Project objectives are:

- To construct and operate a 300 MW solar PV energy facility using First Solar's proven thin-film PV technology to provide a renewable and reliable source of electrical power to California's investor-owned utilities;
- To locate the Project on contiguous lands with high solar insolation and relatively flat terrain at sufficient scale to maximize operational efficiency while minimizing environmental impacts and water use;
- To minimize environmental impacts and land disturbance by locating the Project in proximity to an established utility corridor and good road access and by avoiding sensitive environmental areas, recreational resources and wildlife habitats (e.g., ACECs, DWMAs, CHUs, Category I and II desert tortoise habitat)
- To assist California and its investor owned utilities in meeting the State's RPS and GHG emission reduction requirements, including the requirements under SB X1-2 to increase the State's RPS to 33 percent renewable power by 2020; and
- To provide community benefits, through new jobs, spending in local businesses, and additional sales tax revenues.

2.0 General Facility Description

2.1 Project Location, Land Ownership, and Jurisdiction

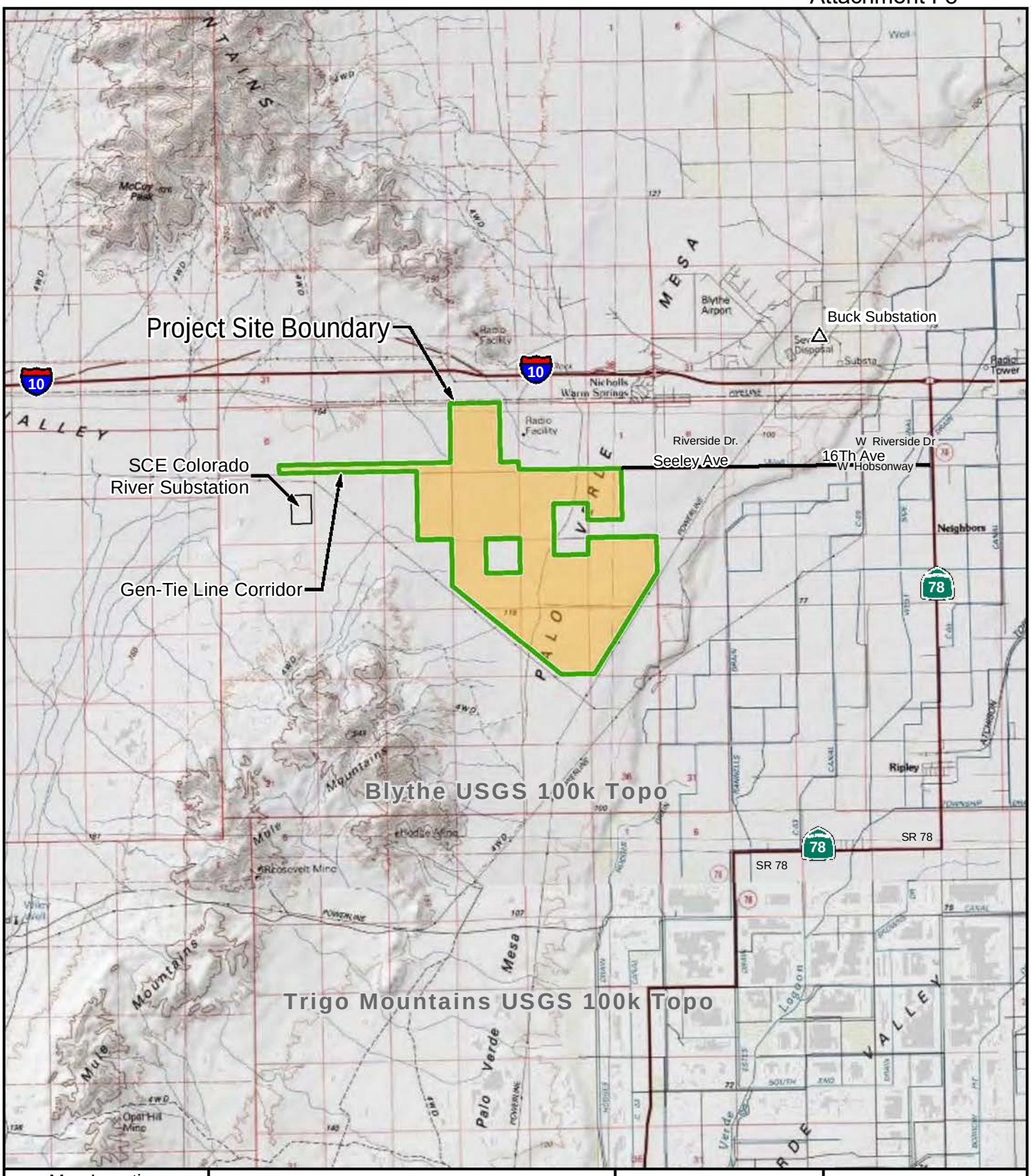
The Project Site is located in eastern Riverside County, approximately 2.75 miles southwest of the western extent of the City of Blythe, California. The Site is just south of Interstate Highway 10 (I-10) and approximately 2.5 miles to the southwest of the Blythe Airport. The community of Nicholls Warm Springs, Mesa Verde is located just to the south of the Blythe Airport, and is the closest town to the Project Site. The town of Ripley is located approximately 4.5 miles to the east. The primary access to the Project Site will be via Interstate 10 (I-10) to State Route 78 (SR 78) to S. Neighborhood Boulevard to 16th Avenue/Seeley Boulevard (see SPP Sheets 2 and 18 [Appendix C]). Secondary access (for limited large loads only) will be provided by I-10 to Mesa Drive to Orange Drive to 16th Avenue/Seeley Avenue, or I-10 to Mesa Drive to Orange Drive to 15th Avenue to Haig Drive to 16th Avenue/Seeley Avenue.

The corridor for the Gen-Tie Line will run generally west from the proposed on-site substation near the northwestern edge of the solar facility Site to the CRSS, located approximately 2.8 miles to the west of the solar facility fenceline.

The overall ROW within which the Solar Facility will be sited and a 600-foot wide study corridor for the Gen-Tie Line are collectively referred to in this POD as the Project Site. A 160-foot-wide ROW for the Gen-Tie Line will be sited within the 600-foot-wide Gen-Tie Line Study Corridor during the environmental review process. Figure 2-1 is a photograph depicting typical conditions within the Project Site Area, and Figure 2–2 shows the Project Site Area, including the 600-foot-wide Gen-Tie Line Study Corridor. As described in this POD, Desert Quartzite, LLC has refined and decreased the study area for the Project Site to exclude the portion south of the DPV transmission lines. The Project Site Area is located on a relatively flat area encompassing approximately 7.6 square miles on the Palo Verde Mesa area of Riverside County. The Palo Verde Mesa region is situated to the north of Mule Mountains; to the east of the Chuckwalla Valley; to the west of the Colorado River; and to the south of the McCoy Mountains and the Big and Little Maria Mountains.



Figure 2-1 Typical View of Project Site Area



Desert Quartzite Solar Project

Figure 2-2 Project Area

Desert Quartzite, LLC

May 2014

AR060636

As mentioned above, the Project Site is on public land administered by the BLM and designated as Moderate (M) Multiple Use Class (MUC). The CDCA Plan MUC Guidelines indicate that solar electrical generation facilities may be allowed in the M MUC.

There is a privately owned parcel in the middle of the Solar Facility ROW, previously the location of a jojoba farm, but this parcel is not part of the requested ROW and will not be part of the Project Site. The Solar Facility will be designed in such a way as to allow for continued access to this parcel.

An existing transmission line, Devers-Palo Verde Line Number 1 (DPV1), traverses from northwest to southeast adjacent to the western boundary of the Project Site, as depicted on SPP Sheet 2 (Appendix C). Figure 2-3 shows the DPV1 line in the vicinity of the Project Site. A second DPV line, Devers-Palo Verde Line Number 2 (DPV 2), has been proposed by Southern California Edison (SCE), just north of and along the same pathway as DPV1 in the Project vicinity, and has been approved for construction in California. The CRSS, the Project's transmission interconnection point, will be located along DPV1 and 2.



Figure 2-3 Devers-Palo Verde 1 Line

In addition to the DPV ROW described above, a number of other easements cross the Project Site. A list of the existing easements is provided in Table 2-1.

Table 2-1 Existing Uses and Easements within Project Site Area

Owner	Location Relative to the Preferred Project Site	Use(s)	Width (feet)	BLM Serial File Number
Bureau of Reclamation [2]	Travels southwest through T 7S, R 21E, Sections 13, 24, 26 and then south through Section 35	Access Road	50'	LA 77757

Table 2-1 Existing Uses and Easements within Project Site Area

Owner	Location Relative to the Preferred Project Site	Use(s)	Width (feet)	BLM Serial File Number
SCE [2]	Travels southeast through T 7S, R 21E, Sections 9, 15, 22, 23	Transmission - Devers-Palo Verde 1	100’	CA 04163
SCE [2]	Travels south through the NE ¼ of T 7S, R 21E, Section 3	Transmission Line	25’	CA 47307 LA 133303
IID [1, 2]	Travels southwest through T 7S, R 21E, Sections 13, 24	161 kV Transmission	50’	CA 17905
Verizon California, Inc.[2]	Travels southwest through T 7S, R 21E, Sections 13, 24	Underground Telephone Line	10’	CA 21597
FPL Energy Cabazon Wind, LLC [2]	Travels southeast through T 7S, R 21E, Sections 9, 15, 22, 23	Transmission Line	50’	CA 46331
Mesa Date Ranch LLC[2]		Water pipeline and access road	50’	CA 49208
Gas Transmission Northwest/North Baja Pipeline LLC [2]		30 in. Oil and Gas Pipeline		CA 42662
Palo Verde Land and Water Co. [1, 2]	Blanket easement in T 7S, R 21E	Build, construct, maintain telephone line and irrigation ditches	N/A	CA 106688
California Electric Power Company [1]	NW ¼ of T 7S, R 21E, Section 13	Transmission Line		

[1] Title Report ordered from Stewart Title Co.

[2] BLM LR2000 database at http://www.blm.gov/lr2000/ and BLM Public Room Maps.

In addition to the existing easements discussed in Table 2-1, a 225-foot wide ROW for the planned transmission interconnection route for the Blythe Solar Energy Project crosses the northern portion of the Project Site, running roughly in parallel with the alignment for 16th Avenue (along the southern edge of Sections 3 and 4, T 7S, R 21E).

2.2 Legal Description

A legal description of the Project Site/CACA #049397 is provided in Table 2-2. Figure 2–2 shows the Project Site Boundary in relation to the Public Land Survey System. SPP Sheet 6 (Appendix C) shows the land ownership of the Project Site.

Table 2-2 Legal Description of the Project Site Area

Township Range and Section	
T 7S, R 21E	
Section 3	W ½ and W ½ of E ½ and S ½ of SE ¼ of SE ¼
Section 4	S ½ of S ½ of S ½
Section 5	S ½ of S ½ of S ½
Section 6	S ½ of S ½ of SE ¼
Section 7	NE ¼
Section 9	E ½
Section 10	All
Section 11	N ½ and SW ¼
Section 12	NW ¼ and N ½ of the SW ¼
Section 13	All the area west of CA 08974
Section 14	S ½ of the NE ¼ and W ½ and SE ¼
Section 15	W ½ east of CA 04163 and SE ¼
Section 22	N ½ east of CA 04163
Section 23	All that area east of CA 04163
Section 24	W ½ west of CA 08974 and NE ¼ west of CA 08974

2.3 Project Acreage and Dimensions

As shown on Figure 2–2, the current configuration of the Solar Facility Site and Gen-Tie Line study corridor encompasses the approximately 4,843 acre ROW for CACA # 49397. Within the Solar Facility Site area, the facility footprint (i.e., areas within the fenceline) will occupy approximately 2,453 acres, and the 600-foot-wide Gen-Tie Line study corridor occupies approximately 205 acres. The Gen-Tie Line is approximately 2.8 miles long (portion outside solar facility fenceline up to near northern boundary of SCE Colorado River Substation) and will occur within a 160-foot wide operational ROW corridor occupying approximately 55 acres.

The 600-foot-wide Gen-Tie Line study corridor (205 acres) that is located primarily west of the solar facility boundary consists of substantially more acreage than will ultimately be needed for the Project in order to allow necessary flexibility in adjusting the final routing of the Gen-Tie Line with consideration of environmental conditions to be addressed further in the forthcoming EIS.

2.4 Power Plant Facilities

The Project will involve the installation of First Solar PV modules with the capacity to generate a total of 300 MW of power under peak solar conditions. First Solar has an active Research & Development program that seeks to increase PV module efficiency and design new, more efficient ways to install the PV modules and reduce the footprint of installed energy on a per acre basis. This POD is based on current technology and installation methodology. Inverter hardware will be located in each PCS, which will convert the DC electric input into grid-quality AC electric output.

2.4.1 First Solar Cadmium Telluride (CdTe) PV Technology

The principal materials incorporated into the PV arrays include glass, steel, and various semiconductor metals. First Solar's module production process is designed to minimize waste generation and maximize the recyclability and reusability of component materials. At the end of their useful life, the Project materials will be removed from the site and many will be fully recycled, including the steel tables and posts, wiring, and PV modules themselves.

The First Solar modules used in the Project employ the compound CdTe as the semiconductor material. The unique advantages of CdTe PV technology include:

- Superior light absorption properties, compared to traditional silicon modules, resulting in higher output under cloudy and diffuse light conditions such as dawn and dusk;2
- Better performance at the high temperatures that modules are subject to under direct sunlight compared to traditional silicon modules;3
- Enhanced suitability for production of modules – high volume and low cost;
- Effective sequestration of cadmium in a stable compound between two protective sheets of glass for the lifetime of the module; and
- The smallest carbon footprint and fastest energy payback time of all existing PV technologies.4

Cadmium telluride is a stable compound of cadmium (Cd) and tellurium (Te). Cadmium, Cd, produced primarily as a byproduct of zinc refining, is a human carcinogen as an independent element, but when combined with Te, a byproduct of copper refining, forms the stable, non-hazardous compound CdTe. In module manufacturing, First Solar effectively takes a hazardous material, Cd, and safely sequesters it in the form of CdTe in a module for the over 30-year lifetime of the module, after which it can be recycled for use in new solar modules or other new products. In addition, CdTe's physical properties, including its extremely low vapor pressure and high melting point, along with its insolubility in water, limit its mobility. Furthermore, the very thin layer of CdTe in PV modules is encapsulated between two protective sheets of glass. As a result, the risk of health or environmental exposure in fires, from accidental breakage, or from leaching is de minimus. The exposure routes to CdTe in modules are limited; furthermore, recent toxicological testing indicates that CdTe is significantly less toxic than elemental Cd. First Solar offers an industry-leading collection and recycling program that is designed to recover approximately 95 percent of the semiconductor material and 90 percent of the glass. The remaining materials (e.g., glass fines, dust) are collected in HEPA filters and are disposed of properly. Commercial scale recycling facilities are currently in operation at each of First Solar's manufacturing facilities to recycle materials.

In 2009, an in-depth assessment of the environmental, health and safety aspects of First Solar's CdTe PV systems and manufacturing operations was carried out under the authority of the French Ministry of Ecology, Energy, Sustainable Development, and the Sea. It concluded that, "During standard operation of CdTe PV systems, there are no cadmium emissions – to air, to water, or to soil. In the exceptional case of accidental fires or broken panels, scientific studies show that cadmium emissions remain negligible.

---

[2] Mohring, H.D., et al., "Outdoor Performance of Polycrystalline Thin Film PV Modules in Different European Climates," European project PYTHAGORAS.

[3] Ibid.

[4] de Wild-Scholten, M., 'Solar as an environmental product: Thin-film modules – production processes and their environmental assessment,' presented at the Thin Film Industry Forum, Berlin, April, 2009.Fthenakis, V. M, Alsema, E., "Photovoltaics Energy Payback Times, Greenhouse Gas Emissions and External Costs: 2004 –Early 2005 status," Progress in Photovoltaics: Research and Applications, 2006; 14: 275-280.

Accordingly, large-scale deployment of CdTe PV can be considered safe to human health and the environment."[5]

A 2005 peer review of three major published studies on the environmental profile of CdTe PV organized by the European Commission, Joint Research Center and sponsored by the German Environment Ministry concluded "…CdTe used in PV is in an environmentally stable form that does not leak into the environment during normal use or foreseeable accidents, and therefore can be considered the environmentally safest current use of cadmium." This review also concluded that "Large scale use of CdTe photovoltaic modules does not present any risks to public health and the environment."[6]

Independent analysis also indicates that CdTe modules do not pose a risk during fires. CdTe has an extremely low vapor pressure, high boiling and melting points and is almost completely encapsulated by molten glass when exposed to fire. Exposure of pieces of CdTe PV modules to flame temperatures from 1,400°F to 2,000°F illustrated that CdTe diffuses into glass, rather than being released into the atmosphere. Higher temperatures produce further CdTe diffusion into the glass.[7]

2.4.2 PV Arrays and Combining Switchgear

The Project will be constructed using cadmium telluride thin-film solar modules mounted on single-axis, horizontal tracker structures or fixed-tilt mounting systems, or a combination thereof. The mounting system for the modules is proposed to be supported by steel posts driven into the ground. Based on the general soil and drainage characteristics of the surrounding area, preliminary estimates are that the posts will be driven between 4 and 7 feet into the ground for fixed-tilt structures, and up to 12 feet for tracker structures. Tilt-brackets, which establish the plane of the fixed-tilt arrays (tilt angle), are bolted onto the posts (fixed tilt). Steel table frames (tabletops) are then bolted to the tilt-brackets or tracker structures, and the modules are mechanically fastened to the tables.

If the results of detailed geotechnical investigations indicate that driven steel posts are not an optimal foundation, then other embedded foundation designs may be utilized. Concrete foundations will be required for other Project components, including power conversion stations (PCSs) (which house the inverters), photovoltaic combining switchgear (PVCS) and transformers, weather stations, and substation equipment.

Fixed-tilt arrays, which do not track the sun, are positioned in a south-facing orientation at a tilt between 20 and 25 degrees from horizontal (ground surface) to receive optimal solar energy throughout the year. The rows in each array are oriented in an east-west direction. The maximum height for fixed-tilt arrays is 13 feet above the ground surface for the Ten High System design (see Sheet 7A in Appendix C).

On the single-axis horizontal trackers, the PV modules are mounted horizontally (not tilted to the south). The tracking units are arranged into north-to-south-oriented rows, and are powered by a drive motor to track the east-west path of the sun on a single axis throughout the day. The highest point for a horizontal tracker occurs during the early morning and evening hours and is approximately 13 feet maximum above the ground surface. The tracking systems will be bolted onto posts. If the results of detailed geotechnical

---

[5] Summary Report, "Environmental, Health, and Safety (EHS) Aspects of First Solar Cadmium Telluride (CdTe) Photovoltaic (PV) Systems," carried out under the authority of the French Ministry of Ecology, Energy, Sustainable Development, and the Sea, July 2009.

[6] Summary Report, "Peer Review of Major Published Studies on the Environmental Profile of Cadmium Telluride (CdTe) Photovoltaic (PV) Systems," European Commission, Joint Research Centre

[7] Fthenakis, V., Fuhrmann, M., Heiser, J., Lanzirotti, A., Fitts, J., and Wang, W., "Emissions and Encapsulation of Cadmium in CdTe PV Modules During Fires," *Progress in Photovoltaics: Research and Applications*, 6, 99-103 (1998).

investigations indicate that driven steel posts are not an optimal foundation, then other embedded foundation designs including concrete footings may be utilized.

These assemblies will be organized into arrays (see Figure 2–4, and SPP Sheet 7 [Appendix C] for typical horizontal tracker details, and Sheet 7A [Appendix C] for typical fixed-tilt configuration details). Placement of arrays within the Project Site will be based on constraints including topography, biological, and geotechnical considerations.



Figure 2-4 Representative Horizontal Tracker PV Array Photograph

The PV modules will be electrically connected by wire harnesses and combiner boxes that collect power from several rows of modules and feed a Power Conversion Station (PCS) (see Figure 2-5 and SPP Sheet 8 [Appendix C]) via underground direct current (DC) cables. Inverter hardware located in each PCS converts the DC electric input into grid-quality alternating current (AC) electric output. A transformer then steps up the voltage of the array output for on-site transmission of the power to the PV Combining Switchgear (PVCS). Overhead lines then take the electricity to the On-Site Substation where the voltage is stepped up and routed to CRSS via the Gen-Tie Line. The PCS and transformer will be located within each PV block, and housed on concrete vaults.



Figure 2-5 Representative Power Conversion Station Photograph

The PVCS (see Figure 2–6) will collect the power from a group of arrays for transmission to the On-Site Substation. The PVCS cabinets will be dispersed amongst the arrays. High-capacity collection system lines will connect the power output from the PVCS to the On-Site Substation. The on-site electrical collection system is designed to minimize electrical losses within the Solar Facility Site prior to delivery to the On-Site Substation.



Figure 2-6 Representative PV Combining Switchgear Photograph

The On-Site Substation facility will be located in an approximately 6.5-acre area located in the northwest portion of the Solar Facility Site. At the On-Site Substation, the voltage of the Solar Facility-generated electricity will be stepped up to interconnect with the SCE regional transmission grid at the CRSS.

2.5 Number and General Dimensions of Project Components

Table 2-3 below provides a list of major Project components along with the approximate acreage they will require. In addition to the PV areas and conversion equipment, which take up the vast majority of the Project acreage, the largest permanent land uses on the Solar Facility Site are access roads, the O&M facility, and the On-Site Substation. Less than one percent of the total footprint will be covered with at-grade facilities (e.g., O&M facility, On-Site Substation, inverter pads), and approximately 50 percent of the Solar Facility Site will typically be covered or shaded by solar modules.

Table 2-3 Solar Facility Components, and Approximate Area[1]

Project Facility or Component	Length or Number of Components	Approx. Area (acres)	Percent of Project Site[2]
Transmission Corridor[3]	2.8 miles (total)	55	1.1
PV Arrays	302	2,896	60%
On-site Project Substation	1	6.5	0.1%
O&M facility	1	5	.1%
Temporary Construction Staging Areas[4]	3	83	1.7%
Access Roads (on-site)[5]	109.9 miles	268	5.5%
Graded Area Including Roads	NA	3,574	73.8%
Area Covered by At-Grade Items (inverter pads, substation, O&M facility)	NA	14.8	0.3%
Area Shaded by PV Modules (at solar noon)	NA	2,226	46%
Area Shaded by PV Modules (scenario-Dec 21, 9:00am)	NA	2,769	57.2%
Total Number of Piles	325,984	0.1	<0.1%
Security Fencing	18.4 miles	NA	NA

[1] Data provided is based on horizontal tracker design which represents worst-case disturbance compared to fixed-tilt designs.

[2] Percentages based on 4,843 acre Project Site (includes 4,660 acre Solar Facility Site, and 183 acre Gen-Tie Line study corridor [600 feet wide]).

[3] Acreage based on a 160-foot transmission ROW width.

[4] Includes three construction staging areas and area for construction offices and parking.

[5] Includes roads (1.1 miles graveled [4.2 acres] and108.8 miles compacted earth/native soil [263.8 acres]) within the Solar Facility Site.

2.6 Temporary Construction Facilities

Included within the Solar Facility Site will be several temporary construction staging areas and an area for construction worker parking. These areas will be utilized throughout the approximately 18- to 48-month Project construction period and then decommissioned and/or replaced by arrays.

The staging areas will include material laydown and storage areas and an equipment assembly area. The Project is not expected to require an on-site cement batch plant. During construction, the area near the location of the O&M facility will also contain a guard shack, construction trailers, construction worker parking and portable toilet facilities that will serve the Project's sanitation needs during construction. Temporary construction fencing will surround this area and the guard shack will be manned to provide security during construction. Refer to SPP Sheet 10 (Appendix C).

Graded all-weather roads will be required in selected locations on the Project Site during construction to bring equipment and materials from the staging areas to the construction work areas, and for long-term Project operation and maintenance. SPP Sheet 18 (Appendix C) shows the locations of the planned access roads. Also see POD Section 3.0, Construction of Facilities.

2.7 Geotechnical Studies

Preliminary geotechnical assessments of the area's soils will be conducted and incorporated into the Project's design. As part of the preliminary geotechnical assessment, a consulting geologist will visit the Project Site to check and evaluate the mapped geologic units and to collect exploratory borings from various locations across the site. Before construction commences, Desert Quartzite, LLC will commission another design-level geotechnical investigation of the Project Site to further explore the consultant's preliminary findings and to determine the best foundation types for the Project structures and facilities.

According to Natural Resources Conservation Service (NRCS) information, soils within the Project area vary across the site and consist of gravelly loamy sands, sandy loam, gravelly sands, and fine sands. Refer to Appendix D, Figure 4, showing the NRCS soil types within the Project Site. A map of surface geology within the Project Site is included as SPP Sheet 13 (Appendix C).

A Preliminary Geotechnical Investigation Report (URS 2011) (based on literature review) is presented in Appendix D of this POD. The Preliminary Geotechnical Investigation Report findings indicate that geotechnical-related conditions and constraints at the Site can be mitigated through field investigation and appropriate design measures.

2.8 Ancillary Facilities

2.8.1 Operations and Maintenance Facility

The Operations and Maintenance (O&M) facility, located adjacent to the On-Site Substation, will be designed for parts storage, plant security systems, and Project monitoring equipment. The O&M facility will consist of offices, a restroom, and a storage area. A septic system and leach field will be located at the O&M building, as shown on SPP Sheet 9 (Appendix C), and will serve the Project's sanitary wastewater treatment needs.

2.8.2 Meteorological Station

One or more meteorological stations will be installed prior to construction in order to track weather patterns. Figure 2-7 depicts a typical meteorological station. The meteorological station(s) will be attached to the data acquisition system (DAS) to collect data for analysis and system monitoring. The DAS involves a network of data loggers and programmable logic controllers at each PCS enclosure. These will, in turn, be connected

to a Wide Area Network and monitored on-site in the O&M facility, as well as in a remote Network Operations Center.



Figure 2-7 Typical Meteorological Station Photograph

2.8.3 Anemometers

Anemometer towers, which measure and communicate wind speed data to the facility control room for solar array panel tracker positioning in the event of high winds, would be installed around the site perimeter. Each tower would typically measure approximately 20 feet in height, but could range up to 30 feet maximum.. An estimated 9 anemometer tower structures are currently proposed as part of the proposed Site layout (refer to SPP Sheet 3 in Appendix C for locations). Refer to Figure 2-8 showing a typical tracker anemometer tower.



Figure 2-8 Typical Tracker Anemometer Tower Photograph

2.8.4 Other Ancillary Facilities

A guard shack will be constructed at the entrance to the Project Site for use by security personnel during Project construction and operations phases. It is expected that the guard shack will be manned 24 hours a day throughout the construction phase of the Project.

2.9 Water Uses and Sources

2.9.1 Groundwater Setting

The Project Site is located in the northwestern Colorado Desert, which is part of the greater Colorado Desert Geomorphic Province. The Colorado Desert Geomorphic Province is characterized by isolated mountain ranges separated by broad alluvium-filled basins of Cenozoic-age sedimentary and volcanic materials overlying older rocks. Much of the Colorado Desert lies at low elevations, with some areas below sea level.

The Project Site is located in the alluvial-filled basin of the Palo Verde Mesa in eastern Riverside County, California, approximately 2.75 miles west of the western border of the City of Blythe. Beneath the Palo Verde Mesa lies the Palo Verde Mesa Groundwater Basin (PVMGB), which is bounded by non-water-bearing rocks of the Big Maria and Little Maria mountains to the north, the McCoy and Mule Mountains to the west, and the Palo Verde Mountains to the south. The Big Maria Mountains and the McCoy Mountains are the contributing watersheds to the Palo Verde Mesa. The groundwater storage capacity is estimated at 6,840,000 acre-feet (AF) with the groundwater in storage currently unknown[8]. It is likely that recharge of the basin is primarily from percolation of runoff from the surrounding mountains, and percolation of precipitation to the valley floor and subsurface inflow may be additional sources of recharge (DWR 2004). Natural recharge in the basin is estimated at about 800 acre-feet per year (AFY), and recharge by underflow from Chuckwalla Valley is estimated to be 400 AFY[9].

The groundwater movement is southeasterly to the Palo Verde Valley[10]. It is observed from surface conditions that groundwater elevations would decrease in a southeasterly direction to ultimately outfall in an agricultural drain to the east of the Project Site[11].

The project is located in the Riverside East SEZ, which contains portions of the Chuckwalla Valley and Palo Verde Mesa groundwater basins and covers approximately 150,000 acres along an east-west corridor along I-10 between the towns of Desert Center and Blythe. A recent groundwater model was assembled for the BLM to assess the potential impacts of groundwater pumping within the Riverside East SEZ associated with full build out of utility scale solar projects within the SEZ[12]. The intent is that this model be updated as large scale solar projects are initiated.

2.9.2 Project Water Supply and Water Usage

Construction water usage rates and total requirements would vary depending on the length and intensity of construction activities. The construction timeframe is estimated to vary from 18 to 48 months. Although an 18-month construction timeframe (minimum) is much shorter than a 48-month construction timeframe (maximum), the Project's water needs are directly related to the intensity of construction activities such as water for fugitive dust control and soil compaction associated with site preparation and grading activities. It is currently estimated that the maximum water usage for an 18-month construction timeframe would total

---

[8] California Department of Water Resources (DWR). 2004. California's Groundwater – Bulletin 118. Basin Descriptions: Palo Verde Groundwater Basin. (http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/7-39.pdf)

[9] Ibid.

[10] Ibid.

[11] Stone and Webster Engineering Corporation. 1976. Evaporation Basin Report, SunDesert Nuclear Plant, San Diego Gas & Electric Company, San Diego, California. June.

[12] Argonne National Laboratory. 2013. A Groundwater Model to Assess Water Resource Impacts at Riverside East Solar Energy Zone. ANL/EVS/R-13/8. December.

about 1,300 acre feet (AF)(i.e., approximately 867 AF per year on average) whereas a 48-month construction timeframe would require a maximum total of approximately 1,800 AF (i.e., approximately 450 AF per year on average). During construction, water will be needed for primarily dust control and soil compaction, with small amounts used for sanitary and other purposes.

During operations, the Project will use no water for electricity generation. The operational phase of the Project is expected to require up to 38 AFY of water. Of this volume, approximately 20 AFY would be used for process water, fire protection, dust control, vegetation management, and at the O&M building, and 18 AFY would be used for up to two annual panel washings. This annual demand during Project operation is a small fraction of the most recent California Energy Commission information for a similar-sized solar thermal generation facility. An aboveground process water/firewater storage tank will be included on the site, as shown on SPP Sheet 9 (Appendix C). The tank size and dimensions will be determined based on Riverside County Fire Department requirements for firewater storage.

Although a water supply investigation has not yet been conducted for the Project, Desert Quartzite, LLC plans to utilize groundwater from either existing local well(s) or via installation of two groundwater wells (one temporary and one permanent) as the water supply source for the Project during both construction and operations. A study will be performed to establish the feasibility of obtaining the needed supplies either from groundwater well(s) developed on the Project Site or from existing groundwater wells that may be identified in the immediate vicinity. In the event that new wells are to be installed on-site, one permanent well would be installed at the O&M facility area. Refer to SPP Sheet 9 (Appendix C) showing the permanent well location and associated water line (on-site only) to the proposed aboveground water storage tank. One temporary construction well would be installed in the southeast or southwest portion of the site (refer to SPP Sheet 3 [Appendix C] for well locations).

Although no site-specific data has yet been obtained, Desert Quartzite, LLC is considering use of local groundwater because of its recent experience in constructing a 21-MW PV project in the near vicinity (i.e., adjacent to the Project Site to the north) of the Project Site. For the 21-MW project (now owned and operated by NRG Solar), adequate water supply for construction was successfully obtained from an on-site well. Given the proximity of the two sites, this suggests that local groundwater may be feasible for Project use. However, as noted, additional study is needed to determine whether this is a viable option.

If Desert Quartzite, LLC decides to install a groundwater well or wells on the Project Site, Desert Quartzite, LLC will perform the necessary studies and secure the necessary permissions to install the well(s). An analysis of impacts of Project water consumption on water availability in the Palo Verde Groundwater Basin will be conducted as part of the EIS process.

2.10 Hydrological Conditions

A hydrological study (drainage report) of the proposed Project Site has been completed and is presented in Appendix E of this POD. The 2011 hydrological study considered the current site boundary, but with a smaller facility footprint. The study includes the results of a hydrologic analysis and hydraulic model of the Site for existing (i.e., pre-Project) conditions. The study includes the results of a watershed analysis that encompasses areas immediately upstream and downstream of the Site to determine and evaluate the Site's potential peak flows and off-site peak flows during 100-year storm event. The preliminary results of the hydrologic and hydraulic modeling of storm water flow rates and sediment transport rates will be considered in the final Project design. The conclusions in the 2011 Drainage Report are presented in Section 7.1.3 and Appendix E.

The Project is located in an existing drainage alluvial fan area which receives drainage from off-site mountains and off-site alluvial fan areas. The off-site downstream areas consist of alluvial fan areas with drainage flows that ultimately drain over bluffs east of the Project Site.

There are two mountain areas that drain into and through portions of the Project Site; sediment from these areas created the alluvial fan area that occupies the Project Site. One area is north of I-10. This shed consists of a portion of the McCoy Mountains and a portion of an alluvial fan that has been blocked and diverted to the southeast by channelization and I-10. This shed consists of 3,343-acres and ranges in elevation from 1,670 feet above mean sea level (amsl) at the northwest corner to 470 feet amsl at the I-10 bridge crossing. The area drains under an I-10 bridge into an area south of the I-10 bridge and into the alluvial shed area in and around the northern portion of the Project Site.

The other mountain area is towards the southwest side of the Project Site. These sheds consist of a portion of the Mule Mountains that drain into the alluvial fan area in and around the western portion of the Project Site. These sheds have a cumulative acreage of 2,043-acres and range in elevations from 1,750 feet amsl to 395 feet amsl where they enter into the alluvial fan.

The alluvial fan drainage area studied consists of the off-site and on-site areas in the Palo Verde Mesa. The area consists of 15,695 off-site acres and an assumed 4,769 Project on-site acres for a total of 20,464-alluvial fan acres. The total alluvial fan area ranges in elevation from the highest elevation in the northwest of 525 feet amsl to a lowest elevation of 320 feet amsl in the southeast. The straight line length between these elevations is approximately 6.92-miles and yields a slope of 0.0056 feet/foot.

The area is undeveloped except for the First Solar-constructed, 200 acre, 21 MW, NRG-owned solar project abutting the northeast side of the Project; a portion of a developed subdivision located south of I-10 at the northeast side of the drainage shed studied; and overhead power line facilities that cross the drainage sheds studied. There are some areas in the alluvial fan area south of I-10 that were cultivated in the past but are currently not active. There also are some bermed areas in the alluvial fan that have evidently been constructed to divert drainage flows away from the internal areas protected by the berms. One of these bermed areas consists of a 160-acre parcel (previously used as a jojoba farm) near the middle of and completely surrounded by the proposed Project. The Project does not propose removal or disturbance of any existing berms.

2.11 Site Preparation, Erosion Control, and Storm Water Drainage

First Solar (EPC contractor) would utilize site preparation techniques that adequately prepare the site for safe and efficient and operation of PV arrays while allowing water to sheet flow across the Site with negligible impact on surface water flow upstream and downstream of the Site. The planned approach to Project Site preparation, which involves the use of “disc and roll” and micrograding techniques, reflects the results of the First Solar’s field testing of various site preparation techniques at an off-site location near the Project Site, as well as their experience with construction of similar solar PV projects in other desert locations in Southern California and Nevada. First Solar has been using this experience to adjust and optimize its site preparation and construction methods.

Based on the hydrologic evaluation described in Section 2.10, the Applicant will implement site design and protective erosion and drainage control design measures during construction and operation to achieve the above objectives. Storm water flow will be managed to prevent downstream erosion and channelization.

Contour grading, erosion control design features, storm water mitigation measures and other protective measures (including avoiding the placement of PV module tables and piles within significant drainages and minimizing disturbance and compaction to the extent possible), will enable historic levels of runoff off-site to be maintained at the Project Site and in downstream areas.

SWPPPs would be prepared as applicable to discharges to Waters of the U.S. The Applicant will design erosion control plans and implement SWPPP Best Management Practices (BMPs) under the direction of a Qualified SWPPP Practitioner (QSP) for storm water management and control. Preliminary erosion control

BMPs are shown on Sheets 16 and 17 in Appendix C. The BMPs to be implemented would manage storm water on the site to both protect the site and to minimize downstream erosion and sedimentation.

Several erosion control measures are planned during construction including stabilization of the heavily-used construction entrance area, employing a concrete wash-out area, as needed, and tire washes near the entrance to existing roadways. Silt fences are proposed for erosion control along neighboring properties.

The approximate percentage of the Project Site that will be covered with impervious surfaces (inverter foundations, etc.) will constitute a fraction of one percent of the total surface area of the Project Site. The final Site Plan will be based on a detailed topographic survey of the Project Site, as well as detailed hydrologic and topographic studies that will be performed as a part of the permitting and engineering design process. A Project Drainage Shed Map is shown on SPP Sheet 11 (Appendix C). No Federal Emergency Management Agency- (FEMA-) designated flood zones exist within the vicinity of the Project; the Project Site Area and vicinity are classified by FEMA as Zone D – Not Studied (see FEMA Flood Hazard Map, SPP Sheet 12, Appendix C).

2.12 Vegetation Treatment and Weed Management

Desert Quartzite, LLC will develop a plan for vegetation management at the Project Site. Desert Quartzite, LLC will coordinate with the BLM, USFWS, and CDFW to determine the best methods and species to employ in the vegetation plan. Further details relative to this vegetation management plan will be provided during the NEPA process. An Integrated Weed Management Plan also will be developed and implemented to control invasive exotic weeds. The plan will comply with existing BLM plans and permits including the *Vegetation Treatments Using Herbicides* (2007) and *Vegetation Treatment Final EIS* (2007).

2.13 Waste and Hazardous Materials Management

The Project will generate minimal wastes during operation. There also will be limited amounts of chemicals and petroleum products stored or used on-site as shown in the tables below. A Spill Prevention, Control, and Countermeasure (SPCC) Plan will be implemented during operation, as required. Appropriate spill containment and clean-up kits will be kept on-site during construction and maintained during the operation of the Project. The primary chemicals/petroleum products expected to be present on the Project Site during construction and operation are listed in Table 2-4 and Table 2-5, respectively.

Table 2-4 Chemicals at Project Site During Construction

Product	Use
Diesel Fuel	Vehicles
Gasoline	Vehicles
Motor Oil	Vehicles
Hydraulic Fluids and Lube Oils	Vehicles and Equipment
Solvents and Adhesives	PV Module Assembly
Soil Stabilizers	Roads and PV Table Areas

Table 2-5 Chemicals at Project Site During Operation

Product	Use
Diesel Fuel	Vehicles
Gasoline	Vehicles
Motor Oil	Vehicles

First Solar PV modules and other products used during construction and operation of the Project are generally not hazardous and are not subject to Federal hazardous material management regulations. First Solar's end-of-life CdTe PV modules are currently characterized as federal non-hazardous waste, and as a California-only hazardous waste. Solar equipment and infrastructure will be recycled as practical or disposed of in compliance with applicable laws. Electrical generating activities will not produce hazardous or other industrial waste. Desert Quartzite, LLC will utilize biodegradable oil in transformers rather than mineral oil.

During construction of the Project, the only wastes produced will be typical construction wastes, such as broken PV modules, wood, concrete, and miscellaneous packaging materials. Construction wastes will be disposed of in accordance with local, State and Federal regulations. Any modules damaged or broken during construction are considered retrograde material and will be returned to First Solar's manufacturing facility in Ohio, where they will be recycled into new modules or other new products (also see Section 2.14 below).

Portable toilets will be used during construction and will be regularly pumped out, hauled away, and disposed of by appropriately licensed organizations. An on-site septic system and leach field near the on-site O&M facility will be used to manage sanitary waste during Project operation. Because of the small operational work force (up to 15 full time workers), volumes of sanitary waste discharged to the septic system and leach field will be no more than a few hundred gallons per day during operation.

Permits for the septic system will be obtained from Riverside County, as needed. Soil percolation tests will be performed in order to demonstrate that an on-site septic system and leach field is feasible at the planned location. Additional testing may be performed in accordance with Riverside County test procedures prior to final leach field design. The specific location of the leach field and septic system may be adjusted based on the results of preliminary percolation tests.

2.14 Reusable and Recyclable Materials/PV Module Recycling

As discussed in Section 2.13, the PV modules and inverters would produce no waste during operation of the proposed solar facilities. However, end-of-life PV modules are considered to be a California-only hazardous waste. Solar equipment and infrastructure will be recycled as practical or disposed of in compliance with applicable laws. The PV module manufacturer (First Solar) offers CdTe module collection and recycling services. The PV module manufacturer pioneered the first global and comprehensive module collection and recycling program in the PV industry in 2005. The Project facilities include numerous recyclable materials, including glass, semiconductor material, steel, and wiring. As the Project approaches the end of its useful life, the component parts will be dismantled and recycled, as practical. First Solar offers a pre-funded recycling program for all of its solar modules as described in the following paragraphs.

As manufacturer and supplier of the PV modules to the Project, First Solar is committed to the philosophy of extended product responsibility and to improving the global environment, and as such offers a Collection and Recycling Program to promote the collection and recycling of PV modules. The program enables

substantially all components of the modules, including the glass and the encapsulated semiconductor material, to be collected and recycled into new modules or other products.

Under this program, First Solar offers its customers the ability to set aside funds, at the time of module sale to meet estimated collection and recycling costs, including all packaging, transportation, and recycling costs. Some key elements of the First Solar recycling Program include:

- Funding: With the sale of each module, First Solar sets aside the funds required for the collection and recycling in a restricted account controlled by a third-party insurance company;
- Registration: The site location of each module installation is registered with First Solar;
- Notice: Individual modules are labeled with Web site and telephone contact information in six languages, along with instructions for the user to return the product free of charge;
- Collection: First Solar manages the logistics of collecting each module and provides packaging and transportation to the recycling center;
- Recycling: All recycling processes are monitored to ensure compliance with local regulations regarding health, safety, and waste management; and
- Improvement: Results of the program are audited for continuous improvement.

Managing the product lifecycle, from raw material sourcing through end-of-life collection and recycling, enables First Solar to create a perpetually sustainable cycle that strives to provide the most environmental benefits.

2.15 Fire Protection

There is limited potential for wildfire on the Project Site. The Project is not located adjacent to either urbanized areas or wild lands. Vegetation is sparse and the facility footprint itself will be cleared, so that fire risk from vegetation will be minimized. The Project will coordinate with Riverside County to ensure that appropriate measures will be taken to control the risk of fire. During operations, one aboveground water storage tank will be installed adjacent to the O&M facility. The tank will be sized to meet Riverside County Fire Department requirements to supply sufficient fire suppression water during operations. Additional fire protection measures will include: sprinkler systems in the O&M building; a FM200 fire suppression system, or equivalent, in the facility control room at the O&M building; and portable carbon dioxide (CO_2) fire extinguishers mounted at the power conversion system units.

Project facilities will be designed, constructed, and operated in accordance with applicable fire protection and other environmental, health and safety requirements. Effective maintenance and monitoring programs are vital to productivity as well as to fire protection, environmental protection, and worker protection.

Desert Quartzite, LLC will have a Project fire prevention plan in place for construction and operation. This plan will comply with applicable Riverside County regulations and will be coordinated with the Riverside County Fire Department. During construction, the following steps will be taken to identify and control fires and similar emergencies:

- Electrical equipment that is part of the Project will only be energized after the necessary inspection and approval, so there is minimal risk of any electrical fire during construction.
- Project staff will monitor fire risks during construction and operation to ensure that prompt measures are taken to mitigate identified risks.
- Transformers located on-site will be equipped with coolant that is non-flammable, biodegradable and contains no polychlorinated biphenyls or other toxic compounds.

2.16 Site Security and Fencing

The proposed Project Site boundary, which excluding the off-site Gen-Tie Line study corridor encompasses approximately 4,660 acres,will be fenced to facilitate Project and equipment security. Within the Project Site area, the facility area contained within the fenceline would occupy approximately 3,516 acres. Security at the Project Site will be achieved by fencing, lighting, security patrols, and electronic security systems. The Project Site will be monitored on a 24-hour-per-day, 7-day-per-week basis. Site security will be provided through a combination of on-site staffing and security patrols, remote monitoring, or electronic security systems. Surveillance methods such as security cameras, motion detectors, or heat sensors may be installed at locations along the Project boundary. Gates will be installed at the roads entering or exiting the Solar Facility Site. Limiting access to the Project will be necessary both to ensure the safety of the public and to protect the equipment from potential theft and vandalism. The perimeter of the Solar Facility Site will be fenced with an approximately six-foot tall chain-link fence topped with barbed wire for security purposes. In addition, six-foot chain-link fencing will surround the Project's on-site substation, switching station, O&M facility, and the temporary construction staging areas. The perimeter fence will include tortoise exclusion fencing, as appropriate, to prevent desert tortoises from entering the Solar Facility Site. Refer to SPP Sheet 19 (Appendix C). The Solar Facility Site will be designed, operated, and maintained so that channelization will not occur under the desert tortoise fencing which could undermine its integrity as exclusion fencing.

Shielded area-specific lighting for security purposes will be limited to the O&M facility, the On-Site Substation, the temporary construction staging areas, and possibly on or near each PCS station. The level and intensity of lighting will be the minimum needed for security and safety reasons. These lights will be turned on either by a local switch, as needed, or by motion sensors that will be triggered by movement at a human's height during maintenance or emergency activities. In order to minimize the Project's visual impact on surrounding receptors and roads, there will be no lights around the Project perimeter. Sensors on the security fencing will alert security personnel of possible intruders. Exterior lights will be shielded and focused downward and toward the interior of the site to minimize lighting impacts to the night sky and neighboring areas.

2.17 Electrical Components, New Equipment, and Existing System Upgrades

An On-Site Substation (owned and operated by Desert Quartzite, LLC) will be constructed in the northwestern portion of the Solar Facility Site. As shown on Figure 2–2 and SPP Sheet 3 (Appendix C), the Project's Gen-Tie Line will run north from the On-Site Substation and then turn to the west along the planned utility corridor that crosses the Project site in an east- west direction along the 16th Avenue alignment. The Project Gen-Tie Line runs primarily in a western direction approximately 2.8 miles from the Solar Facility fenceline until it reaches the proposed CRSS. The Project's electrical transmission system is discussed further in Section 4.1, below.

2.18 Interconnection to Electrical Grid

Interconnection to the CAISO Grid via the SCE-operated transmission system will be at the CRSS. The Project's electrical transmission system is discussed further in Section 4.1, below.

2.19 Spill Prevention and Containment

A SPCC Plan will be implemented during operation, as required. BMPs will be employed in the use and storage of all hazardous materials within the Project, including the use of containment systems in appropriate locations. Appropriately sized and supplied spill containment kits will be maintained on-site in the O&M area, and Desert Quartzite, LLC employees will be trained on spill prevention, response, and containment procedures. In addition, in accordance with the Emergency Planning & Community Right to Know Act, Desert Quartzite, LLC will supply the local emergency response agencies with a Hazardous Materials Management Plan and an associated emergency response plan and inventory.

The small quantities of chemicals to be stored at the Solar Facility Site during construction include equipment and facilities maintenance chemicals such as those listed in Table 2-4. These materials will be stored in their appropriate containers in an enclosed and secured location such as portable outdoor hazardous materials storage cabinets equipped with secondary containment to prevent contact with rainwater. The portable chemical storage cabinets may be moved to different locations around the site as construction activity locations shift. The chemical storage area will not be located immediately adjacent to any drainage. Disposal of excess materials and wastes will be performed in accordance with local, State and Federal regulations; excess materials/waste will be recycled or reused to the maximum extent practicable.

Additional construction period BMPs will include:

- Keeping materials in their original containers with the original manufacturer's label and resealed when possible;
- Avoiding excessive on-site inventories of chemicals; procure and store only the amounts needed for the job;
- Following manufacturer's recommendation for proper handling and disposal;
- Conducting routine inspections to ensure that all chemicals on-site are being stored, used, and disposed of appropriately;
- Performing timely maintenance on vehicles/equipment that are leaking oil or other fluids, and placing drip plans under the leak when the vehicle/equipment is parked prior to the maintenance event;
- Performing fueling of vehicles and equipment in locations that are protected from spillage onto exposed ground surface:
- Ensuring that all personnel dealing with hazardous materials are properly trained in the use and disposal of these materials in accordance with local, State and Federal regulations;
- Maintaining Material Safety Data Sheets available on the site for use during Project construction and operation.

As noted earlier in Section 2.13, the Project will not involve the use or storage of large quantities of chemicals compared to other large industrial facilities. Facilities will be appropriately designed and as previously described, a SPCC Plan will be prepared if needed.

Spill response plans will be developed prior to Project construction and operation, and personnel will be made aware of the procedures for spill cleanup and the procedures to report a spill. Spill cleanup materials and equipment appropriate to the type and quantity of chemicals and petroleum products expected will be located on-site and personnel shall be made aware of their location. Key employees will be trained in conducting spill response activities in accordance with appropriate procedures. Spill response materials will include, but are not limited to, brooms, dust pans, mops, rags, gloves, absorbent pads/pillows/socks, sand/absorbent litter, sawdust, and plastic and metal containers.

2.20 Health and Safety Program

First Solar has established "Safety First" as a core value. Safety First is included in all aspects of manufacturing and for engineering design, procurement and construction of a solar array project. First Solar will develop an Environmental Health and Safety Plan in conjunction with Desert Quartzite, LLC to ensure it includes all activities and compliance to all local, State and Federal regulatory requirements. The plan is customized as needed for the specific project based on location, scope and hazards. The Project will comply with all Occupational Safety and Health Administration (OSHA) and California OSHA (CalOSHA)

requirements in construction and operation. Illness and Injury Prevention Programs will be developed for construction and operation. For construction activities, all subcontractors are screened to review their safety performance. Safety orientation will be provided to all contractors working on the site to make them aware of all the project safety hazards and requirements and procedures. Tool box safety meetings will be held daily to discuss site conditions, pre-task plans and any new hazards.

First Solar's manufacturing processes include comprehensive and conservative environmental health and safety (EHS) protocols and processes. First Solar has full time Environmental Health and Safety resources working to ensure a safe work environment and compliance to all EHS regulations and standards. First Solar uses state of the art engineering controls, operational procedures, housekeeping methods, and personal protective equipment to ensure the health and safety of employees as well as the community. First Solar has integrated environmental responsibility into every aspect of the product lifecycle. From raw material sourcing through end of life collection and recycling, First Solar has created a sustainable cycle that protects and minimizes impacts to the environment. The Perrysburg, Ohio, manufacturing facility is certified to OSHA's 18001 for Health and Safety Management Systems and ISO14001:2004 environmental standards. Manufacturing in Germany and Malaysia are certified to ISO14001:2004 environmental standards.

2.21 Other Federal, State, and Local Agency Permit Requirements

2.21.1 Federal Permits and Status

Table 2-6 provides a list of the Federal permits anticipated to be required for the Project, as well as the status of relevant permit applications.

Table 2-6 Status of Project Federal Permits and Authorizations

Permit	Lead Agency	Status
FLPMA ROW Grant	BLM	The original FLPMA Standard Form 299 ROW application was submitted to BLM in September 2007. The original POD was submitted in November 2008, revised in August 2010, and revised most recently as of September 2011. This POD is an update to the September 2011 POD. On December 13, 2013 First Solar submitted a letter amendment of the filing area boundary and change of applicant from First Solar to Desert Quartzite, LLC. The ROW Grant is subject to NEPA review and terms and conditions as set forth under FLPMA and BLM's implementing regulations. BLM will issue a ROW grant and Record of Decision (ROD) at the end of the NEPA process.
BLM ROW Permits	BLM, Palm Springs – South Coast Field Office	Desert Quartzite, LLC will apply for and obtain applicable BLM ROW Permits for pre-construction activities involving vegetation/ground disturbance and/or subsurface excavations such as for geotechnical field investigations, groundwater monitoring well installation, and meteorological tower placement.

Table 2-6 Status of Project Federal Permits and Authorizations

Permit	Lead Agency	Status
Section 404 Clean Water Act (CWA) Permit	U.S. Army Corps of Engineers (USACE)	Desert Quartzite, LLC will conduct a delineation to determine if any of the ephemeral washes on-site are subject to Federal jurisdiction under the CWA. Desert Quartzite, LLC will seek concurrence with this delineation from the USACE and obtain a Section 404 permit, if required. Based on a preliminary biological resources assessment, it is expected that most of the washes on-site will not be jurisdictional under the CWA (see POD Section 6.1.3).
Endangered/Threatened Species Consultation and Incidental Take Statement under the Federal ESA	USFWS	Desert Quartzite, LLC and the BLM will engage the USFWS in the ESA Section 7 consultation process concurrently with the NEPA review process and will obtain incidental take statement authority, as necessary. Informal meetings, e-mail discussions, and phone calls will be conducted to streamline this process by familiarizing USFWS with the Project and eliciting agency concerns to be addressed throughout the process. Biological surveys for federally-listed species for the Project Site are in progress.
Bald and Golden Eagle Protection Act Permit	USFWS	Based on site conditions, the Project Site does not support nesting habitat for golden eagles, but is suitable for foraging by this species. Suitable nesting habitat may be present in the nearby mountainous areas south and west of the site. Desert Quartzite, LLC will coordinate with the BLM and USFWS to determine what effects on golden eagles are likely to result from Project-related losses of foraging habitat. If it is determined that the loss of foraging habitat would be likely to result in the "take" of golden eagles by precipitating decreases in eagle productivity, Desert Quartzite, LLC will obtain the required take permit from the USFWS.
National Historic Preservation Act Section 106 Compliance	BLM	Desert Quartzite, LLC will conduct cultural resources investigations for the Project's Area of Potential Effects. BLM will initiate consultation with the State Historic Preservation Office after Class I and Class III cultural resource inventories have been completed and approved. Section 106 compliance requirements will be met prior to the completion of NEPA analysis.
Archaeological Resources Protection Act, Cultural Resource Use Permit	BLM, State Office	As required based on the planned cultural resources investigations, a BLM Cultural Resource Use Permit will be obtained for the purposes of testing to determine the National Register of Historic Places significance of identified sites and to conduct data recovery on sites adversely affected by project construction and operation.

Table 2-6 Status of Project Federal Permits and Authorizations

Permit	Lead Agency	Status
Fieldwork Authorization	BLM, Palm Springs-South Coast Field Office	A BLM Fieldwork Authorization will be obtained prior to conducting Class III cultural resource inventories.
Native American Consultation	BLM	Desert Quartzite, LLC will coordinate with BLM to support BLM's consultation with Native American tribes for the purpose of identifying sacred sites and other places of traditional religious and cultural importance. Consultation with tribes will continue throughout the NEPA and Section 106 compliance processes.
CDCA Plan Amendment	BLM	The Project Site is located within the boundaries of the area administered under the NECO Plan, an element of the CDCA Plan. The Project will require a CDCA Plan Amendment (e.g., to address utility corridor encroachments and roads) to address the segment of the proposed gen-tie line located outside of the existing transmission ROW. The Plan Amendment will be addressed as part of the FLPMA and NEPA processes as provided for in the BLM Planning Regulations (43 CFR Part 1600), and BLM Land Use Planning Handbook (H-1601-1).
Department of Defense (DoD) Review	DoD	Desert Quartzite, LLC will request a review of the project by DoD for its potential impact on military overflights and operations.
Bureau of Reclamation Coordination for Draft Groundwater Accounting Surface	Bureau of Reclamation (USBR)	Desert Quartzite, LLC will request coordination with USBR regarding the draft Groundwater Accounting Surface, as applicable, following completion of further groundwater study and analysis for the potential Project drawdown

As described in Table 2-6, the Project, which is located on BLM-administered lands, will require a FLPMA ROW grant, thereby triggering the need for NEPA review. BLM will prepare an EIS to comply with NEPA. BLM will issue the necessary ROW grant through its ROD following completion of the Final EIS. The CDCA Plan Amendment required for the Project transmission line will also be addressed through the FLPMA and NEPA process.

Based on biological resources research conducted to date, Desert Quartzite, LLC expects there may be potential impacts to a species listed under the Federal ESA (desert tortoise). Desert Quartzite, LLC and the BLM expect to participate in formal consultations with USFWS pursuant to Section 7 of the ESA. A Biological Assessment (BA) will be submitted to USFWS, which will issue a Biological Opinion and Incidental Take Statement following completion of the consultation process. Desert Quartzite, LLC biologists conducted protocol biological surveys in the Project area in the fall of 2012 and the spring of 2013 and have provided the findings in a draft report to the BLM. The results of these studies will be considered in the EIS and be taken into account in designing the Project through the incorporation of measures to avoid, minimize, and, where necessary, mitigate impacts to the species.

Based on site conditions, the Project Site does not support nesting habitat for golden eagles, but is suitable for foraging by this species. Suitable nesting habitat may be present in the nearby mountainous areas south and west of the site. Desert Quartzite, LLC will coordinate with the BLM and USFWS to determine what effects on golden eagles are likely to result from Project-related losses of foraging habitat. If it is determined that the loss of foraging habitat would be likely to result in the "take" of golden eagles by precipitating decreases in eagle productivity, Desert Quartzite, LLC will obtain the required take permit from the USFWS.

Based on preliminary reconnaissance, most of the ephemeral drainages located on the Project Site are expected to be non-jurisdictional under Section 404 of the CWA because the drainages are neither navigable themselves nor hydrologically connected to navigable waters (see POD Section 6.1.3). If washes on the Project Site are connected with the Colorado River which is considered a navigable water they would be subject to Federal jurisdiction under Section 404 of the Clean Water Act. A formal delineation will be conducted to determine the federal jurisdiction (if any) of the washes on the Project Site. Consultation with the USACE will be required in order to obtain the agency's concurrence with the findings of the delineation and, if necessary, a Section 404 permit.

2.21.2 State Permits and Status

Table 2-7 provides a list of the State permits anticipated to be required for the Project, as well as the status of relevant permit applications. As currently proposed, the Project Site is located on BLM-administered lands. The proposed Project includes approximately 5 miles of upgrades (widening and graveling) to off-site roads to the east of the Project Site, including unincorporated Riverside County lands, in order to improve access. To the extent that the Project triggers State or County jurisdiction, compliance with the California Environmental Quality Act (CEQA) will be required. CEQA compliance would typically require a CEQA Initial Study and then preparation of a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report.

Table 2-7 Status of Project State Permits and Authorizations

Permit	Lead Agency	Status
Endangered/Threatened Species Take Authorization under CESA and Sections 2050 (general provision for endangered species) and 2080 (take of endangered species) of the California Fish and Game Code	CDFW	The desert tortoise, listed as threatened under CESA, has potential to occur on-site and CESA review and approval is likely to be required. Focused biological surveys for sensitive species will be conducted for the Solar Facility Site (CDFW is expected to be a full participant in agency discussion between Desert Quartzite, LLC/BLM and the USFWS so that CDFW can complete a Consistency Determination with the project Biological Opinion issued by the USFWS. Informal meetings, e-mail discussions, and phone calls will be undertaken to streamline this process by familiarizing CDFW with the Project and eliciting agency concerns to be addressed throughout the process.
Section 1600-1602 Streambed Alteration Agreement process under the California Fish and Game Code	CDFW	Further assessment is needed to determine if drainage areas located on the Solar Facility Site are jurisdictional under the Fish and Game Code Sections 1600-1602. Desert Quartzite, LLC will work with CDFW to determine the applicability of Fish and Game Code Sections 1600-1602 and to prepare a Streambed Alteration Notification, if required.

Table 2-7 Status of Project State Permits and Authorizations

Permit	Lead Agency	Status
Construction and Operations Phase Storm Water Permits under California Water Code/CWA	California State Water Resources Control Board (SWRCB)	A SWPPP would be prepared as applicable to discharges to Waters of the U.S. The Applicant will design erosion control plans and implement SWPPP Best Management Practices under the direction of a Qualified SWPPP Practitioner (QSP) for storm water management and control. Preliminary BMPs are shown on Sheets 16 and 17 in Appendix C.
Section 401 Certification under CWA	Regional Water Quality Control Board (RWQCB)	CWA Section 401 certification would only be required in the event that a USACE Section 404 permit is required. If certification is required, Desert Quartzite, LLC will apply to the RWQCB to obtain certification.
Interconnection Agreement	CAISO	See Section 4.1.5 for the status of the Interconnection Agreement.
Fugitive Dust Control Plan	Mojave Desert Air Quality Management District	A fugitive dust control plan will be developed in accordance with Mojave Desert Air Quality Management District requirements prior to construction
Consultation on sacred areas to comply with State requirements.	Native American Heritage Commission (NAHC)	The NAHC will be contacted prior to beginning the NEPA analysis.

The Mojave Desert Air Quality Management District will be consulted before construction and during final Project design regarding fugitive dust emissions and the control of such emissions through adoption of a fugitive dust control plan.

Desert Quartzite, LLC specialists will conduct an assessment of potential waters within the Project Site subject to CDFW jurisdiction under the CGFC Section 1602. If the Project cannot avoid adversely affecting State jurisdictional drainages, a Streambed Alteration Agreement from CDFW would be required and applied for as needed. Desert Quartzite, LLC will consult with CDFW regarding any potential for State jurisdiction at the Project Site.

2.21.3 Local Permits and Status

Table 2-8 provides a list and status of the local permits anticipated to be required for the Project, as well as the status of these permit applications.

Table 2-8 Status of Project Local Permits and Authorizations

Permit	Lead Agency	Status
Land Use Review	Riverside County Airport Land Use Commission	Coordination and compatibility review to be conducted during environmental review process.

Construction Permits (e.g., Grading, Building, Electrical)	Riverside County and/or BLM	If such permits are required, they will be secured before construction activities commence.
Encroachment Permit	Riverside County, and/or BLM	Permit will be secured before construction activities commence, as necessary.

2.22 Financial and Technical Capability of the Applicant

First Solar (parent company of Desert Quartzite, LLC) is a recognized worldwide leader in solar PV manufacturing and development with a substantial track record. First Solar is a U.S.-based corporation with offices in Tempe, Arizona; Perrysburg, Ohio; San Francisco, California; and Bridgewater, New Jersey. First Solar also has 28 manufacturing lines worldwide, including locations in Perrysburg, Ohio, and Malaysia, with a total manufacturing capacity of 2.2 gigawatts (GW) in 2013. First Solar's current market capitalization is approximately $6.75 billion, and is one of the largest companies in the solar power industry.

The Project will utilize First Solar's proven thin film cadmium telluride (CdTe) PV technology, which is readily scalable to the Project's size. First Solar has developed and is continually refining manufacturing technologies that drive down the cost of its modules in order to offer reliable solar power at a price that is cost-competitive with other forms of non-renewable power generation. At the same time, the firm has continued to emphasize methods and programs for manufacturing and construction that are environmentally sustainable, such as its end-of-life management program for module collection and recycling. First Solar has installed over 8 gigawatts (GW) worldwide, and has multiple large-scaled project nearing construction completion, and/or in the early stages of operation, including the 550 MW Desert Sunlight Solar Farm Project in Riverside County, 550 MW Topaz Solar Farm in San Luis Obispo County, 230 MW AV Solar Ranch One Project in Los Angeles County, 400 MW Silver State Solar in Nevada, 300 MW Stateline Solar Farm in San Bernardino County, and 290 MW Agua Caliente Solar Project in Arizona.

3.0 Construction of Facilities

The construction of the Project will begin once all applicable approvals and permits have been obtained. It will take approximately 18 to 48 months from the commencement of the construction process to complete construction of the 300 MW Solar Facility and 230 kV Gen-Tie Line. The following sections provide detail about the Project timeline and process for the construction.

3.1 Solar Field Design, Layout, Installation, and Construction Processes

Appendix C, Site Plan Package, includes engineering design plans that depict the design and layout of the Project. The installation and construction processes for the Project are described in the following subsections.

3.2 Construction and Operations Approach

After the preconstruction surveys, construction mobilization, and site preparation are completed, construction of the Solar Facility and Gen-Tie Line will begin. Work will be completed in two, 150 MW blocks moving across the site so that completion of one block is closely followed by the beginning of the next.

3.3 Access and Transportation System, Component Delivery, Worker Access

A preliminary access road map is provided as SPP Sheet 18 (Appendix C). Proposed primary access to the Project Site will be provided from the I-10 freeway to SR 78 to S. Neighborhood Boulevard to 16th Avenue/Seeley Boulevard (see SPP Sheets 2 and 18 [Appendix C]). Secondary access (for limited large loads only) will be provided by I-10 to Mesa Drive to Orange Drive to 16th Avenue/Seeley Avenue, or I-10 to Mesa Drive to Orange Drive to 15th Avenue to Haig Drive to 16th Avenue/Seeley Avenue. The perimeter of the occupied portions of the Solar Facility will be fenced to limit public access. The entrance to the Facility will be gated and restricted to unauthorized entry. Permanent six-foot tall gated chain-link security fences with barbed wire will be constructed around the Solar Facility.

Desert Quartzite, LLC is considering shuttle buses as an option for transporting the construction workforce to the Project Site. A traffic study for the Project will be prepared as a part of the NEPA process.

3.4 Construction Workforce Numbers, Vehicles, Equipment, Timeframes

3.4.1 Construction Workforce Numbers

The typical construction work schedule is expected to be from 7:00 a.m. to 5:00 p.m., Monday through Friday. However, to meet schedule demands, it may be necessary to work early morning, evening, or nights and on weekends during certain construction phases. The work schedule may be modified throughout the year to account for changing weather conditions (e.g., starting the workday earlier in the summer months to avoid work during the hottest part of the day for health and safety reasons). In the event that construction work takes place outside these typical hours, activities will comply with Riverside County standards for construction noise levels. For safety reasons, certain construction tasks, including final electrical terminations, must be performed after dark when no energy is being produced. The Project will use restricted nighttime task lighting during construction. No more lighting will be used than is needed in order to provide a safe workplace, and lights will be focused downward, shielded, and directed toward the interior of the site to minimize light exposure to areas outside the construction area.

During Project construction, the workforce is expected to average approximately 600 employees over the 18- to 48-month construction period, with a peak workforce of approximately 1,000 employees. The Project

construction workforce will be recruited from within Riverside County and elsewhere in the surrounding region to the extent practicable.

3.4.2 Construction Equipment/Vehicles

Most construction equipment and vehicles will be brought to the Project Site at the beginning of the construction process during construction mobilization and will remain on-site throughout the duration of the construction activities for which they were needed. Generally, the equipment and vehicles will not be driven on public roads while in use for the Project. In addition to construction worker commuting vehicles, as discussed above, construction traffic will include periodic truck deliveries of materials and supplies, recyclables, trash and other truck shipments.

Truck access to the site will be from I-10 to Route 78 south via Exit 236, and then west on 16th Avenue/Seeley Avenue to the site access gate. Approximately 20,000 truck deliveries are expected over the Project construction period. Construction truck deliveries and shipments will typically avoid the peak traffic hours in the morning and evening, so it is unlikely that Project deliveries will represent a substantial increase in traffic volumes during peak commuting hours. Materials will typically be delivered starting two weeks before the start of the associated task with the exception of electrical gear (PCSs, PVCs, etc.), which will be drop shipped just prior installation.

3.4.3 Construction Timeframe

The construction of the Project will begin once all applicable approvals and permits have been obtained. Desert Quartzite, LLC plans to construct the Project beginning in late-2015 over an 18- to 48-month schedule depending on market conditions. Construction of the Gen-Tie Line would take place concurrently with the construction of the Solar Facility.

3.5 Preconstruction Surveying and Staking

Surveying includes two main objectives: 1) obtaining detailed topographic information for supporting the storm water modeling and grading design, and 2) construction layout surveying with staking. Desert Quartzite, LLC will complete detailed (one-foot interval accuracy) topographic information for the Solar Facility ROW using photogrammetry and field cross sections. Concurrent with the acquisition of topographic data, aerial photographs will be obtained and analyzed to determine changes in land use and stream channel configurations. The final Site Plans for the Project will be based on the detailed topographic survey of the site that is being performed as a part of the permitting and engineering design process.

Road corridors, buried electrical lines, PV array locations, and the locations of other facilities will be located and staked in order to guide construction activities. Preconstruction survey work will consist of staking and flagging the following: 1) ROW and construction area boundaries, 2) work areas (permanent and short term), 3) cut and fill, 4) access and roads, 5) transmission structure centers, 6) foundation structure, and 7) desert tortoise or endangered plant offsets. Staking and flagging will be maintained until final cleanup.

3.6 Preconstruction Site Preparation

Preconstruction activities will include installation of desert tortoise fencing and pre-construction surveys; installation of access roads and construction laydown and parking areas; and setting up offices and site services. A brief description of each of these activities is provided below.

3.6.1 Desert Tortoise Exclusion Fencing and Preconstruction Surveys

Prior to beginning pre-construction surveys, desert tortoise exclusion fencing will be constructed in specified areas. Pre-construction activities will include clearance surveys for desert tortoise and other sensitive species (e.g., Mojave fringe-toed lizard); relocation for desert tortoise; seasonal avoidance of nesting birds,

including burrowing owls; passive relocation of burrowing owls, as necessary; and possible transplantation of sensitive plant species including foxtail cactus.

Pre-construction survey work will also consist of staking and flagging the following: 1) ROW and construction area boundaries, 2) construction laydown, parking, and work areas, 3) final grade, 4) access and roads, and 5) foundation structures for facilities. Staking and flagging will be maintained until final cleanup.

3.6.2 Access Roads and Construction Laydown and Parking Areas

The proposed main access route to the Project Site will be from I-10 to Route 78 south via Exit 236, and then west on 16th Avenue/Seeley Avenue to the site entrance gate at the northern Project Site boundary. Additional Solar Facility access may be identified, as needed. Approximately five miles of the off-site access roads will need to widened and graveled. Graded, graveled, all-weather roads will also be required in selected locations within the Solar Facility during construction to bring equipment and materials from the staging areas to the construction work areas. These roads will be maintained for long-term Project operation and maintenance. The area of disturbance required for these roads is included in Table 2-3. The off-site access road route to the Project Site is depicted on SPP Sheet 18 (Appendix C).

Three temporary on-site construction staging areas, totaling approximately 83 acres, will be utilized throughout the Project construction period. The staging areas within the Solar Facility Site will include material laydown and storage areas and an equipment assembly area. The staging areas will be un-paved and un-graveled but will be treated with dust palliative and water periodically to control dust. The staging areas within the Solar Facility Site will be replaced with PV arrays once the areas are no longer needed for staging.

Construction materials in the laydown areas will be stored in uncovered rows grouped according to the type of material: steel piles, PV modules, table frames, tilt brackets, hardware, electrical cables etc. Electrical equipment such as transformers, PVCSs, and PCSs will be drop shipped shortly before installation to the locations where they will be installed, rather than stored in the laydown areas. Aggregate will be delivered at a rate proportional to spreading for access roads, building foundations, and other equipment foundations.

3.6.3 Construction Offices and Site Services

Desert Quartzite, LLC will construct the main construction site offices and services area in the northern portion of the Solar Facility Site. This area will be fenced with temporary construction fencing and will include temporary construction trailers, the safety office, field offices, recycling areas, and employee and visitor parking. Access to the construction area will be controlled by site security. A guard shack will be located near the entrance to the Project Site for site security.

3.7 Site Clearing, Grading, and Compaction

Construction grading and compaction techniques will be used to prepare the Project Site for safe and efficient installation and operation of the PV arrays. The discussion below provides preliminary detail relative to the site preparation techniques that may be employed at the Site; however, First Solar is conducting off-site tests of various site preparation and revegetation techniques. First Solar in conjunction with Desert Quartzite, LLC is currently exploring the use of agricultural methods for vegetation removal such as disking and compaction of vegetation, in order to minimize impacts from clearing and grading. First Solar will use the results of the off-site field testing to potentially adjust site preparation and construction methods, if appropriate, to minimize impacts to vegetation and facilitate site stabilization. However, at the time of the preparation of this POD, in order to be conservative in analyzing potential impacts from site preparation, it is assumed that the entire Solar Facility Site would be cleared and graded.

Site preparation techniques would be used to prepare the site for safe and efficient construction and operation of PV arrays while allowing water to sheet flow across the site with negligible impact on surface water flow upstream and downstream of the site. The planned approach to Project Site preparation, which involves the use of "disc and roll" and micrograding techniques, reflects the results of field testing of various site preparation techniques at an off-site location near the Project Site, as well as experience with construction of solar PV projects in other desert locations in Southern California and Nevada. First Solar has been using this experience to adjust and optimize its site preparation and construction methods. The disc and roll site preparation method does not involve removal of topsoil. Topsoil removed during limited grading activities at buildings (e.g., Operations and Maintenance facility) would be utilized for post-construction reclamation of disturbed areas or for balanced cut-and-fill needs at the site.

During Project decommissioning and reclamation, the Project Site soil and vegetation will be restored to its preconstruction condition with native vegetation similar to plants in the surrounding vicinity. Refer to Section 7.4 for additional details on Project decommissioning and reclamation.

3.7.1 Clearing

The Applicant prioritizes providing a safe working environment for construction personnel. In addition, construction vehicles would need to access the site for site preparation and array installation. For these reasons, the surface vegetation may need to be removed from the site. Vegetation would not be removed until the onset of a given construction phase. Within the solar field, facility roadways, and areas around the operations and maintenance building, vegetation would be disked under, mulched or composted, and retained on-site to assist in erosion control and limit waste disposal. In some areas to be graded outside of the solar field, native vegetation may be harvested for replanting to augment soil stabilization.

Vegetation would be cleared from roadways, access ways, and where concrete foundations are used for inverter equipment, substations, and the operations and maintenance building. Vegetation would be cleared for construction of the drainage controls. Organic matter would be mulched and redistributed within the construction area (except in trenches and under equipment foundations). Plant root systems would be left in place to provide soil stability except where grading and trenching are required for placement of solar module foundations, underground electric lines, inverter and transformer pads, road and access ways, and other facilities.

During the site clearing process, the site would also be cleared of refuse, as necessary. Refuse materials encountered would be recycled or disposed.

3.7.2 Grading

The cut and fill depths across the Site will be minimized, and it is expected that no import or export of soil material will be required, as the amount of cut and fill would be balanced on-site.

Areas that make up more than half of the solar field would be prepared using conventional farming equipment including tractors with disking equipment and vibratory rollers. This technique is referred to as "disc and roll" or Type 3 grading. With this approach, rubber-tired farming tractors towing disc harrow equipment would disc the top 5 to 7 inches of soil. A water truck would follow closely alongside the tractor to moisten the soil to hold fugitive dust emissions to acceptable levels. The tractor may make several passes to fully disc the vegetation into the topsoil, preserving the underground root structure, topsoil nutrients and seed base; once the soil has been wetted on the first pass, additional water would not be needed for subsequent passes. A drum roller would then be used to flatten the surface and return the soil to a compaction level similar to the preconstruction stage. The intent of the roller would be to level the soil under the solar field area and even out the surface after the disking is complete.

In dispersed sections of the solar array field, there would be limited use of scrapers to perform micrograding. This technique is referred to as "isolated cut/fill and roll" or Type 2 grading. In general,

portions of the site would be contour graded level; the macro-level topography and stormwater drainage would remain unchanged, but within each solar array, “high spots” would be graded and the soil cut from these limited areas used to fill “low spots” within the same array. Limited use of scrapers for micrograding would be employed only where needed to produce a more level surface than can be produced by the disc and roll technique.

Standard cut and fill techniques would be used in areas of the site where soil conditions do not lend themselves to disking. The overall objective of the earth moving would be to produce a consistent grade in each solar field area. Standard cut and fill techniques would be utilized within specific arrays to limit slope to within 3 percent. Essentially, the Solar Facility site would be graded to a sufficiently level topography using the least practicable amount of conventional cut and fill grading. The grading plan would utilize hydrology analysis to identify and protect areas that are susceptible to scour from stormwater runoff, and otherwise manage stormwater runoff to maintain plant facilities and safety and to ensure that off-site drainage conditions upstream and downstream of the site are as close as practicable to preexisting conditions. Work over the site preparation period would be paced so that grading of an area takes place shortly before trenching and post installation are ready to begin. This would minimize the area of open, uncovered ground present at any one time during construction, and thereby minimize dust and erosion issues.

Work over the grading period would be paced so that grading of an area takes place shortly before trenching and post installation are ready to begin. This would minimize the area of open, uncovered ground present at any one time during construction, and thereby minimize dust and erosion issues. Refer to SPP Sheet 15 (Appendix C) for the facility preliminary grading and compaction details.

3.7.3 Compaction

The Solar Facility construction process would require moving equipment across the site, including delivery trucks, pile driving equipment, and cranes. Soil would be compacted to a level that allows this equipment to move across the site. After grading and underground work, most areas would be compacted to approximately 85 percent. Dust palliative and water would also be applied to graded areas, as needed. Access roads would be treated with palliative and sprayed with water as needed during construction. Refer to SPP Sheet 15 (Appendix C) for the facility preliminary grading and compaction details.

3.8 Solar Array Assembly and Construction

The assembly, construction and installation phase involves assembly and installation of the PV solar modules and all the necessary electrical equipment to make the Project operational. After surveying and clearing, leveling, and compaction are conducted, construction and installation activities will include post installation; trenching and installation of underground cables; and installation of the Balance of System. Construction will also include installation of the Gen-Tie Line including tie-in to the CRSS. In general, the work tasks will follow in close sequence across the site, moving from south to north.

3.8.1 Trenching and Cable Installation

After the array areas have been surveyed, cleared and graded, trenches will be dug for the underground AC and DC cabling. Underground DC cables will connect rows of arrays with the PCS. Underground AC cables will connect the PCSs, transformers, and PVCSs. Trenches are dug for the underground AC and DC cabling, and the foundations for the inverter enclosures and transformers are prepared. Trenching will occur within each array to bury the AC and DC electrical cables. Trenching will also occur between the PCS and transformer locations. The trenched areas will be backfilled once the cables are buried and previous contours restored. During construction, desert tortoises and other wildlife may become entrapped within open trenches. This potential impact would be avoided, minimized or mitigated by implementing Desert Tortoise Exclusion Fencing and Translocation Plan. Additionally, the trenches would be excavated with slope inclines at 50-foot intervals, which would allow egress and prevent entrapment of wildlife.

Electrical cables are laid in the trenches and combiner boxes are also installed. Underground cables connect the PCSs to the on-site AC electric infrastructure, and also connect the PCS to the PVCS. Overhead lines connect the electrical output from the PVCS to the On-Site Substation. Refer to SPP Sheet 20 (Appendix C) for the facility preliminary electrical collection system details.

3.8.2 Support Post Installation

The next task to occur after trenching is complete in a work area is to drive the vertical support posts into the ground. These posts will hold the support structures, or tables, on which PV modules will be mounted. First Solar is evaluating various post installation equipment in the field, such as use of a small tracked-vehicle-mounted post driver to install the vertical support posts.

3.8.3 Balance of System (BOS) Installation

Approximately one week after posts are installed, crews will begin to install components comprising the balance of the system. These will include the PV modules and module framing assemblies. PV modules and module framing assemblies will arrive at the construction staging area in containers on tractor-trailers. The tractor trailers will utilize the gravel access roads to deliver the modules and the framing assemblies to the array areas. PV modules and the assemblies will be lifted from the tractor-trailers and placed adjacent to the array locations. Prefabricated tilt brackets attach the tables to the vertical support posts. Brackets also attach the PV modules to the tables and wire harnesses connect the PV modules to the electrical collection system. Vertical steel support posts are driven into the ground. The module framing assemblies, or tables, are then attached to the support posts using tilt brackets. Modules are manually carried from shipping containers to the location of installation. They will be placed on the tables and fastened with brackets at the top and bottom of the module.

The PCS enclosures are prefabricated structures mounted on prefabricated foundations or vaults. They will be installed at predetermined central locations within each block and then connected to incoming lines from the combiner boxes. After the blocks are installed in a particular area, traffic is expected to be limited to infrequent low-impact traffic in the aisle ways between PV blocks for inspection, maintenance, and repair purposes.

During the final system validation and commissioning process, the DAS and monitoring systems will be brought online, the equipment tested, and operational readiness verified. Once commissioning is complete, the Project will be brought online and connected to the grid. Section 4.0, Related Facilities and Systems, provides a detailed discussion of the existing and proposed electrical transmission system.

3.9 Gravel, Aggregate, and Concrete Needs and Sources

Prior to construction, approximately 1.1 miles of site on-site access roads would be stabilized with gravel, and approximately 108.8 miles of on-site access roads would be compacted native soil material. The stabilization materials will be obtained locally to the extent possible. Concrete will be used to create foundations and pads for the On-Site Substation equipment, the O&M facility, and other Solar Facility structures, fence footings, and transmission structures. While both pre-cast and poured-in-place concrete pads/foundations will be used, inverter enclosures and transformers are placed on poured or pre-cast concrete foundations/vaults.

For the gravel access roads at the Solar Facility Site, gravel needs are based on two assumptions for the thickness of aggregate required. The access road from the main entrance to the construction trailers and laydown areas of the site will be surfaced with aggregate. Aggregate may be processed on-site from native materials using the power screener or may be obtained from a local vendor. Concrete will likely be obtained from local sources, as much as practicable.

3.10 Solar Module and Electrical Construction Activities

The following section describes those activities associated with solar module electrical construction and construction activities associated with installation of the Gen-Tie Line.

3.10.1 Solar Module Electrical Construction Activities

Groups of glass PV modules are installed onto the tables as described in Sections 2.4 and 3.8, and are wired to the PCS using wiring harnesses with touch-safe connectors. Modules are manually carried from shipping containers to the location of install. They are placed on the tables and fastened with brackets at the top and bottom of the module.

Once all the modules are installed in a block, they can be electrically connected. The modules are built with standard touch-safe wiring connectors. Workers walk behind each row and plug the wires from each module into a wiring harness that collects all power from each table.

An electrician connects all wiring harness to a combiner box. Each combiner box links the connections from the PV modules. All combiner boxes are wired via underground DC cables to the PCS enclosure. An electrician connects these wires to the inverters and other electrical equipment inside the PCS enclosure. The inverter converts the DC power to three-phase AC power which is fed into a step-up transformer.

Transformers are connected via underground AC cables to the PVCS. Each PCS combines the power output from multiple arrays. Power is then transferred via overhead lines that route all power to the On-Site Substation. The On-Site Substation will step the power up for transmission via the Gen-Tie Line to the SCE CRSS.

Certified electricians in the construction workforce will perform appropriate Project electrical construction activities starting with combiner box connections. Utility journeymen may be required to perform or supervise the higher-voltage electrical construction activities for the On-Site Substation and Gen-Tie Line.

During the final system validation and commissioning process, the DAS and monitoring systems will be brought online, the equipment tested, and operational readiness verified. Once commissioning is complete, the Project will be brought online and connected to the grid.

3.10.2 Gen-Tie Line Construction Activities

The Gen-Tie Line structures would be constructed of either tubular steel monopoles or lattice structures. Construction of the Gen-Tie Line will cause temporary disturbance within a construction corridor estimated at a width of 160 feet. However, the long term disturbance associated with the Gen-Tie Line will be limited to the foundations of the transmission structures and the footprint of the access roads.

Pre-construction activities for the Gen-Tie Line will consist of surveying and marking the ROW and structure locations and mobilization of equipment and materials. A laydown yard (within the Project Site) will be prepared for storage of materials.

Access roads will be developed to access the Gen-Tie Line facilities. This will include the permanent roads to the new transmission structure locations and temporary roads for construction. Temporary work areas around the transmission structures will be necessary during construction to accommodate pole assembly and erection. Clearing and grading will also be needed for wire setup sites. Puller and tensioner sites will require a large relatively level area to safely accommodate all the equipment required on a wire stringing operation. These sites will be determined once the wire pulls have been planned. During the construction period, no disturbance is expected beyond the 600-foot-wide study corridor and permanent disturbance will be limited to areas within the 160-foot-wide Gen-Tie corridor.

During erection of the Gen-Tie Line, transmission structures will be picked up from the material storage yard, hauled to various structure sites or marshalling yards and unloaded. Structures will be assembled in sections on cribbing that will provide for the proper alignment of the steel members. Steel sections will be laid out with hydraulic cranes. The pole base and top sections will be assembled at each structure site. Insulators and hardware may be placed on the structure prior to erection.

Foundations will be constructed at each transmission structure location. Various foundation types are being considered, including drilled-shaft anchor-bolted foundations, drilled-shaft embedded foundations, and vibrated steel casings. A crane will be used for pole erection to set the pole base sections on foundations. The grounding crew will follow behind the erection crew, installing the grounding. The crew will test the ground resistance after installation.

For this Project, conventional wire stringing using tension stringing equipment has been assumed. After stringing, wires will be sagged in accordance with specified sagging data, corrections, and offsets. After sagging, the wires will be dead-ended on the dead-end structures and clipped-in on the tangent and angle structures. Final inspection, testing, will need to be coordinated with functional checkout and commissioning of the substation equipment at each end of the line.

3.11 Aviation Lighting (Power Towers, Transmission)

The nearest airport to the Project Site is the Blythe Airport, located approximately 2.5 miles northeast of the northernmost portion of the proposed Project Site. There is also a small, privately owned airstrip operated by a crop protecting service (Cyr Aviation) located in Blythe approximately 7.5 miles directly east of the proposed Project Site in Blythe, and another small privately owned airport (W.R. Byron) located approximately 8.3 miles northeast of the Project Site, also in Blythe.

The Solar Facility itself is a low-profile facility; the arrays are a maximum of approximately 13-feet tall above the ground surface. Project transmission structures will be less than 200 feet tall and will be located at least 2.5 miles from the Blythe Airport. If it is determined to be required, aviation lighting will be installed on Project structures in conformance with FAA requirements.

There is essentially no potential for light interference from the solar arrays to local aviation: the PV modules used in the installation are black and absorb over 90 percent of the light received; as a result, glare from reflected sunlight is not an issue. These type of PV modules have been installed at numerous airports, including Denver International Airport and Nellis Air Force Base, and studies have found that the reflection from PV array installations do not cause problems for airplanes in the vicinity of these solar facilities.

3.12 Site Stabilization, Protection, and Reclamation Practices

Before Project construction begins, Desert Quartzite, LLC will determine the appropriate site stabilization measures to be utilized on the Project. A Preliminary Geotechnical Investigation (based on literature review) is presented in Appendix D of this POD, and a detailed geotechnical study is planned to support detailed project design. The detailed geotechnical study will provide valuable input with respect to soil conditions and needed stabilization measures.

After Project construction is completed, relatively minimal operations and maintenance activities are required during operations. Access roads and aisle ways will need to be maintained, but the project areas covered by panels can support revegetation. Therefore, Desert Quartzite, LLC is exploring options to allow for revegetation of the Project Site post-construction.

Desert Quartzite, LLC will have a Project fire prevention plan in place during construction. This plan will comply with applicable Riverside County regulations and will be coordinated with the local Fire Department. During construction, the following steps will be taken to identify and control fires and similar emergencies:

- A network of access roads will be constructed for adequate fire control and emergency vehicle access to the site.
- Electrical equipment that is part of the Project will only be energized after the necessary inspection and approval, so there is minimal risk of any electrical fire during construction.
- Project staff will monitor fire risks during construction and operation to ensure that prompt measures are taken to mitigate identified risks. The Applicant's staff vehicles will be equipped with fire extinguishers.
- Transformers located on-site will be equipped with non-toxic, mineral-oil-based coolant that is non-flammable, biodegradable and contains no polychlorinated biphenyls or other toxic compounds.
- Non-native species will be managed per an Integrated Weed Management Plan prepared for the Project Site.

At the end of the Project's useful life, Desert Quartzite, LLC will decommission the facility and remove aboveground facilities including the PV arrays and supporting electrical and facility systems. Following facility decommissioning and removal, the area will be reclaimed according to applicable regulations in effect at the time of decommissioning. Please see Section 7.4 for a discussion of the Project facility decommissioning plans.

4.0 Related Facilities and Systems

4.1 Transmission System Interconnect

The Project is proposed to interconnect to the grid at the existing SCE CRSS.

4.1.1 Existing Transmission System

The primary transmission system of adequate capacity to accept the proposed Solar Facility output and which is located in the vicinity of the proposed Project, is SCE's 500-kV DVP2 line, which runs from the Harquahala Substation (in Arizona, near the Palo Verde nuclear power plant) to SCE's Devers Substation (in North Palm Springs, California) along the same pathway as the existing DPV1. In the area near the Project Site, the DPV transmission corridor runs from the northwest to the southeast adjacent to the southwestern portion of the Solar Facility ROW and then due east (see SPP Sheet 4, Appendix C).

4.1.2 Proposed Transmission System

The medium-voltage collection system lines transmitting power from each PV block will be buried underground from the PCS to the PVCS and will be connected on overhead lines from the PVCS to the On-Site Substation. At the On-Site Substation, the Project's output will be stepped up to the voltage required for interconnection. The Gen-Tie Line will connect the On-Site Substation to the CRSS, where it will be connected to the existing grid.. The Project's Gen-Tie Line would run north from the On-Site Substation, located in the northwest portion of the Solar Facility Site, to the proposed utility corridor running east-west along the 16th Avenue alignment, due west along the proposed utility corridor, and then south to the CRSS (see Figure 2–2 and SPP Sheet 3, Appendix C).

The transmission of the high voltage power produced by the Project would use overhead construction. Under this method of construction, the transmission conductor would be strung overhead on the supporting transmission structures. Heights of structures for the Project would vary depending on the electrical clearances required but would be less than 200 feet in all cases.

4.1.3 Ancillary Facilities and Substations

Other than the On-Site Substation, Gen-Tie Line, and CRSS, which have been described previously, there are no further ancillary transmission facilities necessary for the Project.

4.1.4 Status of Power Purchase Agreements

Desert Quartzite, LLC is pursuing the sale of power from the Project to utilities and other retail purchasers.

4.1.5 Status of Interconnection Agreements

The Project CAISO interconnection request was submitted on December 15, 2010 2 with a CAISO Interconnection queue date of March 31, 2011. Phase 1 and Phase II cluster studies have been completed The CAISO interconnection process is being reviewed by stakeholder groups for possible tariff modifications that may impact future process timelines.

4.1.6 General Design and Construction Standards

The specific engineering design for the above described facilities will be negotiated between Desert Quartzite, LLC, SCE, and CAISO once the Final Facilities Studies are complete. The Project will comply with Riverside County, State of California, and International Building Codes. Additionally, the Project will be designed in conformance with the National Electrical Code.

4.2 Gas Supply Systems

The Project will not utilize natural gas for power production.

4.3 Other Related Systems

4.3.1 Communications System Requirements

For transmission of operational data and to support employees working on-site, Desert Quartzite, LLC expects to utilize existing wired or wireless telecommunications facilities. In the event that these facilities are not available in the Project vicinity, Desert Quartzite, LLC would supplement with small aperture (less than one meter) satellite communications gear.

As described in Section 2.8.3, the solar facility would be installed with an estimated nine tracker anemometer towers around the site perimeter, which measure and communicate wind speed data to the facility control room for tracker positioning in the event of high winds.

In addition, the Solar Facility Site will be routinely patrolled by pickup trucks and all-terrain vehicles. These vehicles will be operated by supervisors and foremen and equipped with communications devices (cell phones and/or radios) to coordinate any emergency or fire-fighting issues internally and with the local fire department.

5.0 Operations and Maintenance

5.1 Operation and Facility Maintenance Needs

The Project is designed to have minimal moving parts, no thermal cycle, and no water use for electricity generation. This simple Project design will require only limited maintenance throughout its lifetime. Section 5.2 provides a discussion of anticipated maintenance activities.

5.2 Maintenance Activities

Project maintenance activities will generally include all-weather road maintenance; vegetation restoration and management; scheduled maintenance of inverters, transformers, and other electrical equipment; and occasional replacement of faulty modules or other site electrical equipment. The Project's all-weather access roads will be regularly inspected, and any degradation due to weather or wear and tear will be repaired. Dust palliatives will be applied on dirt access roads as necessary. This is expected to be needed only once every two to five years. Washing of solar panels is expected to occur up to twice per year.

5.3 Operations Workforce and Equipment

After the construction period, the workforce for operations and maintenance (O&M) and security purposes is estimated to be up to 15 full time workers. Typical work schedules are expected to be in two 12-hour shifts. During operations, potable water will be trucked into the site (one truck a week from Blythe) or on-site groundwater will be utilized, including treatment, as necessary. The O&M workforce will generate small amounts of sanitary wastewater that will be handled by an on-site septic system and leach field.

Only limited deliveries will be necessary for replacement PV modules and equipment during Project operation. Table 5-1 details the expected daily traffic to the Solar Facility Site during operations.

Table 5-1 Daily Vehicle Trips During Project Operation

Purpose	Operations Traffic
Employees (daily round trips)	up to 15
Deliveries (daily round trips)	up to 10

6.0 Environmental Considerations

The Project Site is located outside the boundaries of any Area of Critical Environmental Concern, Desert Wildlife Management Area, Wilderness Area, or designated Critical Habitat Unit.

Environmental considerations are summarized for the Project in Appendix A, Environmental Considerations Table. This table provides a list of the potential environmental impacts of the Project as well as environmental protection and mitigation measures that are proposed to avoid and reduce the Project's impacts. Particular environmental resources are also discussed in the following sections.

6.1 Special or Sensitive Species and Habitats

6.1.1 Habitat Description

A preliminary biological resources assessment was conducted for the Solar Facility Site in the fall of 2008 and the results of that assessment were provided previously to the BLM. Supplemental biological surveys and assessment were conducted in the fall of 2012 and the spring of 2013 and the results were provided to the BLM for review in 2014 in a draft report dated January 2014. Once the BLM's comments are received, the draft report (Biological Resources Technical Report, Desert Quartzite Solar Project, BLM Case File CACA-43937, Riverside County, California) prepared by Ironwood Consulting , Inc. will be revised and reissued. Key biological resource information from the January 2014 report is summarized herein.

Based on the biological surveys and assessments performed to date by Ironwood Consulting, Inc. for the Project, the Project Site area supports two primary vegetation communities: Sonoran Creosote Bush Scrub[13] (analogous to Creosote Bush-White Bursage Series[14]) and Desert Dry Wash Woodland[15] (analogous to Blue Palo Verde-Ironwood-Smoke Tree Series[16] [Sawyer and Keeler-Wolf 1995]) Sonoran Creosote Bush Scrub covers approximately 98% (7,160 acres) of the Project study area utilized for biological resources which encompasses a 1-mile-wide buffer around the outside of the proposed Project Site. Sonoran creosote bush scrub is dominated by creosote (*Larrea tridentata*) and white-bursage (*Ambrosia dumosa*). Within the Project Site Area, this vegetation community is characterized by sparse, relatively low-growing individual shrubs (see Figure 6-1).

Desert Dry Wash Woodland is located in three distinct wash systems within the expanded study area for biological resources (one originating from the McCoy Mountains in the northwest and the two originating from the Mule Mountains in the southwest), comprising approximately 2% (112 acres) of the expanded study area for biological resources. Desert Dry Wash Woodland is characterized by drought-deciduous, microphyllous trees, including palo verde (*Cercidium* sp.), and is associated with ephemeral watercourses (see Figure 6-2). Wildlife species richness is typically higher in Desert Dry Wash Woodland than other desert vegetation communities because it often contains increased shade, vegetation refuge for birds, available water, and wildlife migration opportunities on a local and regional scale. This community is considered a sensitive plant community by the BLM and the California Resources Agency. The three areas

[13] Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. The Resources Agency, Department of Fish and Wildlife, California.

[14] Sawyer, J.O., Jr. and T. Keeler-Wolf. 1995. A Manual of California Vegetation. California Native Plant Society, Sacramento, California.

[15] Holland 1986, *op. cit*.

[16] Sawyer 1995, *op. cit*.



Figure 6-1 Representative Sonoran Creosote Bush Scrub at Solar Facility Site



Figure 6-2 Desert Dry Wash Woodland in Northern Portion of the Solar Facility Site

within the expanded study area for biological resources that contain desert dry wash woodland may serve as movement corridors for large mammal species including mountain lion (*Felis concolor*) and burro deer (*Odocoileus hemionus eremicus*).

6.1.2 Special Status Species

The potential for occurrence of special status species on the Project Site was assessed through a search of the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB)

and the California Native Plant Society's (CNPS) Online Inventory of Rare and Endangered Plants, and intensive biological surveys of the Project Site in the fall of 2012 and the spring of 2013.

Special Status Plants

Six special status (California Native Plant Society list status) plant species were observed during the focused botanical surveys of the Project Site that were conducted in the fall of 2012 and the spring of 2013. The six plant species are: Harwood's milkvetch (Astragulus insularis var. harwoodii), Abram's spurge (Chamaesyce abramsiana), ribbed cryptantha (Cryptantha costata), Harwood's eriastrum (Eriastrum harwoodii), Utah vine milkweed (Funastrum utahense) and desert unicorn plant (Proboscidea althaeifolia). More than 124 species of plants were identified during the surveys. Table 5-1 presents a summary of the special status plant species found to be present on the Project Site, including their status. These plant species will be considered in the environmental review and threatened and endangered species consultation processes for the Project.

Table 6-1 Special Status Plants Found On-site[1]

Scientific Name Common Name	Status		Flowering Period	Occurrence On-site
Astragalus insularis var. *harwoodii* Harwood's milkvetch	Global: Federal Listing: State Listing: **State Rank:** **CNPS Rank:** NECO:	G5T3 None None **S2** **2.2** Covered	Jan – May	**PRESENT** .
Euphorbia abramsiana = *Chamaesyce abramsiana* Abrams' spurge	Global: Federal Listing: State Listing: **State Rank:** **CNPS Rank:** NECO:	G4 None None **S2S3** **2.2** Not covered	Sep – Nov	**PRESENT** s
Cryptantha costata Ribbed cryptantha	Global: Federal Listing: State Listing: **State Rank:** **CNPS Rank:** NECO:	G4G5 None None S3.3 4.3 Not covered	Jan – May	**PRESENT**
Eriastrum harwoodii Harwood's eriastrum	Global: Federal Listing: State Listing: **State Rank:** **CNPS Rank:** NECO:	G3 Sensitive – BLM None **S3** **1B.2** Not covered	Mar – May	**PRESENT**
Funastrum utahense Utah vine	Global: Federal Listing: State Listing:	G4 None None	Apr – Sep	**PRESENT**

Table 6-1 Special Status Plants Found On-site[1]

Scientific Name Common Name	Status		Flowering Period	Occurrence On-site
milkweed	**State Rank:** **CNPS Rank:** NECO:	**S3.2** **4.2** Not covered		
Proboscidea althaeifolia Desert unicorn-plant	Global: Federal Listing: State Listing: **State Rank:** **CNPS Rank:** NECO:	G5 None None **S3.3** **4.3** Covered	May – Aug	**PRESENT**

[1] Source: preliminary results of fall 2012 and spring 2013 field surveys performed by Ironwood Consulting, Inc. Final Biological Resources Technical Report is in progress.

No plant species that are federal- or state-listed as endangered or threatened have been recorded as occurring on or near the Project Site.

Special Status Animals

There is one federal-listed (threatened) and state-listed (threatened) animal species likely to inhabit the Project Site: the desert tortoise (*Gopherus agassizii*).

The USGS has developed a model for assessing the relative value of an area's potential as habitat for desert tortoise[17], and this model was used to assess the potential for desert tortoise habitat within the Project Site. The model is based on a comparison between known desert tortoise presence/absence data with ten environmental criteria that define or influence desert tortoise habitat, including soil characteristics, perennial and annual plant cover, elevation and topographic variables, and seasonality and variability of precipitation. The model provides output on the statistical probability of habitat potential, which can be used for mapping potential areas of desert tortoise habitat. Of note, however, the model does not account for anthropogenic changes that may have decreased habitat suitability in an area.

The results of the USGS habitat model ranking for the Project Site indicate that desert tortoise habitat potential varies across the Site from low to medium-low. The eastern portions of the Site have the lowest habitat potential score and the northwestern portions of the site have the highest (though still only moderate) habitat potential. In general, the model shows that the areas close to the Colorado River, including the Project Site, have lower potential for desert tortoise habitat than areas further to the east and west.

Full-coverage surveys for desert tortoise (Gopherus agassizii), the only animal species listed as federal and state endangered with potential to occur on-site, were conducted in 2013. Tortoise sign observed during the

[17] Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H. Webb. 2009. Modeling Habitat of the Desert Tortoise (Gopherus agassizii) in the Mojave and Parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

surveys consisted of six carcasses, all-greater than 4 years old and disarticulated, and one set of tortoise tracks. Live desert tortoise were not observed during surveys.

Numerous Mojave fringed-toed lizards (Una scoparis), which is a species of concern, were found while performing surveys in the western portion of the Project Site, including the 230 kV Gen-Tie Line corridor, where soils consist of much finer sand.

Other special status wildlife species observed or likely to occur within the Project Site included loggerhead shrike (Lanius ludovicianus), burrowing owl (Athene cunicularia), LeConte's thrasher (Toxostoma lecontei), American badger (Taxidea taxus), desert kit fox (Vulpes macrotis arsipus), pallid bat (Antrozous pallidus), small-footed myotis (Myotis ciliolabrum), and Townsend's big-eared bat (Plecotus townsendii).

These special status animal species, as well as others such as golden eagles (Aquila chrysaetos) will be considered in the environmental review and threatened and endangered species consultation processes for the Project.

6.1.3 Jurisdictional Waters

The majority of washes on the Project Site drain towards the center of the site where they fan out and lack hydrological characteristics. Because these washes are not contiguous with a navigable or relatively permanent water (RPW), and thus would be considered "isolated waters", it is expected that they are not subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE) under Clean Water Act (CWA) Section 404 or the Regional Water Quality Control Board (RWQCB) under CWA Section 401. Based on the preliminary assessment, the wash system located in the far southwestern extent of the study area appear to drain into the Palo Verde Valley and potentially connect with agricultural drainages. These agricultural drainages may be hydrologically connected with the Colorado River, which is considered a navigable water and subject to USACE and RWQCB jurisdiction. A formal delineation will be conducted to determine the federal jurisdiction (if any) of all washes on the Project Site.

Several washes on-site may fall under the jurisdiction of the CDFW under Section 1602 of the California Fish and Game Code, which regulates all changes to the natural flow, bed or bank, of any river, stream, or lake that supports fish or wildlife resources. Under Section 1602, a stream is defined broadly as a body of water that flows at least periodically, or intermittently, through a channel that has banks and that supports fish or other aquatic biota. Several washes with bed and bank and intermittent flow occur on-site. These systems also support Desert Dry Wash Woodland, which is considered a riparian community subject to CDFW jurisdiction. The largest wash system originates to the northwest of the Project Site at the base of the McCoy Mountains and flows diagonally across the northern sections of the site before exiting the eastern boundary and terminating at an existing agricultural field located adjacent to the site. Another prominent wash system flows northeast from the northeastern reaches of the Mule Mountains. This wash system extends to the DPV1 corridor then fans out onto the flat mesa within the Project Site. The final wash is located in the far southern portion of the site. This wash is a tributary to a larger drainage feature located off-site to the south, which flows into the Palo Verde Valley.

6.2 Special Land Use Designations

Several Areas of Critical Environmental Concern (ACEC) are located within the region. The Chuckwalla Valley Dune Thicket ACEC is located approximately eight miles to the west of the Project site. The Mule Mountains ACEC is near the southwestern border of Project Site. The Project design will provide a buffer between the ACEC and the Project Site. The Palen McCoy Wilderness Area is located approximately 12 miles to the northwest of the Project Site.

The entire Project Site, including Gen-Tie Line corridor are on BLM-administered land. This land is administered by the BLM pursuant to the CDCA Plan. The Project Site lies within the planning area designated under a 2002 amendment to the CDCA Plan, known as the Northern and Eastern Colorado Desert Coordinated Management Plan (NECO Plan). According to the NECO Plan, the Solar Facility Site and Gen-tie Line are located on land classified as Multiple Use Class M (Moderate Use), which are lands managed to provide for a wide variety of uses including mining, grazing, recreation, utilities and energy development, while conserving desert resources and mitigating damage to those resources caused by permitted uses. The CDCA management plan further designates utility-scale solar development as an allowable use within the Eastern Riverside SEZ.

6.2.1 Visual Resources

The Project Site is located within the Chuckwalla Valley within the Mojave Basin and Range physiographic province, which is typified by small, rocky mountain ranges with jagged peaks alternating with talus slopes and desert floor. Visually prominent mountain ranges near the Project Site include the Big Maria Mountains to the north, McCoy Mountains to the northwest, and Mule Mountains and Palo Verde Mountains to the south. Although the Eastern Riverside SEZ is generally natural appearing, cultural modifications within the SEZ detract somewhat from the SEZ's scenic quality. In addition to I-10 north of the Project Site, several dirt roads cross the SEZ, including through the Project Site. Additionally, the Project Site is bordered by the CDD Utility Corridor, which contains multiple high-voltage transmission lines. The BLM conducted a Visual Resource Inventory (VRI) in 2010, and designated the Project area SEZ as Class II, which is the highest rating for lands without special designation.

However, site-specific impact assessment would be needed to systematically and accurately assess visual impact levels for the proposed Project. Once appropriate visual impacts have been identified for the Project, implementation of the programmatic design features intended to reduce visual impacts from the Solar Energy Development in Six Southwestern States PEIS, Appendix A, would be expected to reduce visual impacts associated with utility-scale solar energy development.

A Visual Impact Assessment will be performed to support the EIS for the Project.

6.2.2 Rangeland Resources

No livestock grazing is authorized within the East Riverside SEZ, including the Project area. As a result, the Project would have no impacts on livestock grazing. The closest BLM Herd Management Area (HMA) is the Cibola-Trigo HMA, which is located in Arizona and is approximately 9 miles east of the Project Site. The closest wild horse and burrow territory is located within the San Bernardino National Forest, and is more than 70 miles northwest of the Project area. The Project would result in no impacts to wild horse and burrow HMAs and territories.

6.2.3 Military and Civilian Aviation

The Project Site does not appear to be located within a Military Operations Area (MOA), but may potentially be located within the path of Military Training Route(s) (MTRs), based on preliminary review of the Riverside County Airport Land Use Compatibility Plan (Riverside County Airport Land Use Commission [RCALUC] 2004). Therefore, consultation with the Department of Defense (DoD) would be expected prior to approval of Project activities that may adversely affect the use of the MTRs.

The Project Site is located approximately 2.5 miles southwest of Blythe Airport, which is a municipal public located on the north side of I-10. The Project Site is not located within the airport influence area, as defined by the outer edge of the Federal Aviation Regulations (FAR) Part 77 conical surface. Two northern portions of the Project Site are located within the airport Compatibility Zone E. According to the Riverside County Airport Land Use Compatibility Plan (RCALUC 2004), power plants are considered generally compatible in

Zone E, and airspace review would be required for objects over 100 feet tall, objects located on high ground, or solitary objects (i.e., antenna) more than 35 feet above the ground.

6.3 Cultural and Historic Resources

The following paragraphs provide a very brief overview of the cultural resources context for the Project. A Class I cultural resources records search and literature review has been completed and a Class III field survey of the Project Site will be performed in the future. No other site-specific cultural resources investigations have yet been conducted to date. The information presented below is based on the results of the records search and literature review, along with the personal experience of Project cultural resources consultants.

The Project Site is in an area known to be rich with cultural resources. Studies of other nearby planned energy projects (e.g., Blythe Solar Power Project and Genesis Solar Energy Project, north and northwest of the Project Site, respectively) have demonstrated that a wide variety of cultural resources from the prehistoric and historical periods are found in the region. The high density of cultural resources can be attributed to the proximity of the Colorado River and other natural resources. Prehistoric occupation of this area began several millennia ago and is largely found along the relic channel of the Colorado River and in the floodplains and bajadas of the north-south trending mountain ranges that border the Project area to the southwest and north.

Prehistoric materials are especially prevalent along the western edge of the relic channel of the Colorado River where people collected tool stone from the elevated cobble terraces that were created by flooding episodes of the Colorado River prior to its settling in its current location to the east. Areas along the bajada slopes of the small mountain ranges bordering the Project area to the west and north are deeply incised by seasonal drainages. These washes that are home to several species of trees and plants that would have provided food resources to prehistoric travelers moving through this portion of the desert. These same locations also often contain outcrops of minerals such as quartz that were valued as tool stone, and quarried by people in prehistory for this purpose.

Historically, the Project region was widely used for civilian mining and agricultural pursuits and also as a training area by General George Patton during World War II. Patton's Desert Training Center, California-Arizona Maneuver Area (DTC-CAMA), covered large portions of the desert in California, Arizona, and Nevada, and has left its mark on the landscape in this area. Throughout the region, remnant archaeological signatures from the DTC-CAMA are readily visible. Foxhole features, refuse dumps, camp areas, and other features related to various practice maneuvers are common. In addition to the DTC-CAMA, the area was subjected to military maneuvers for two weeks in 1964 during Operation Desert Strike. Because of the use of military surplus, the archaeological signature of Operation Desert Strike would be much the same as that from the DTC-CAMA with some technological variations (e.g., transition from C-rations to MCI rations). Failed attempts at agricultural and ranching pursuits dot the landscape in this region as well, and are identifiable archaeologically as the remnants of small homesteads. Along the mountainous areas, small mining sites are common and archaeologically evident through the presence of refuse deposits and long-abandoned mines or adits. There are also many "wildcat" refuse dumps related to the development of the town of Blythe dating as far back as the late 19th century.

The location of the proposed Project is within areas that are likely to include a number of the resources discussed above. As noted above, and the records search has demonstrated that prehistoric and historical-period cultural resources are located in the Project area and the planned Class III cultural resources survey of the Project Site is expected to determine the presence and extent of these resources on-site.

6.4 Native American Tribal Concerns

A search of Sacred Lands File (SLF) from the Native American Heritage Commission (NAHC) in Sacramento was requested to determine if there are any known resources of traditional, religious, or historical importance to local Native American groups. Information letters were sent to all of the tribal contacts on a list provided by the NAHC, and responses have been received from several of them. The BLM will conduct government-to-government consultation with Native American tribes as part of the NEPA and National Historic Preservation Act compliance processes.

6.5 Recreation, and Off-Highway Vehicle (OHV) Resources

The Project Study Area is not designated by BLM as special recreation management areas and are managed for extensive recreation. Extensive recreation management areas typically experience light to moderate dispersed recreational use, including camping, hiking, hunting, and OHV and other vehicle travel along BLM-designated open routes. Several BLM roads that are considered Designated Open OHV Routes are located within the Project area, and are shown on Figure 6-3. Open BLM routes crossing areas granted ROWs for solar facilities would be redesignated as closed, and replacement of access lost for OHV use would be considered as part of the analysis of project-specific impacts, and recreational impacts would require consideration of developing alternative routes that would retain a similar level of access across and to public lands.

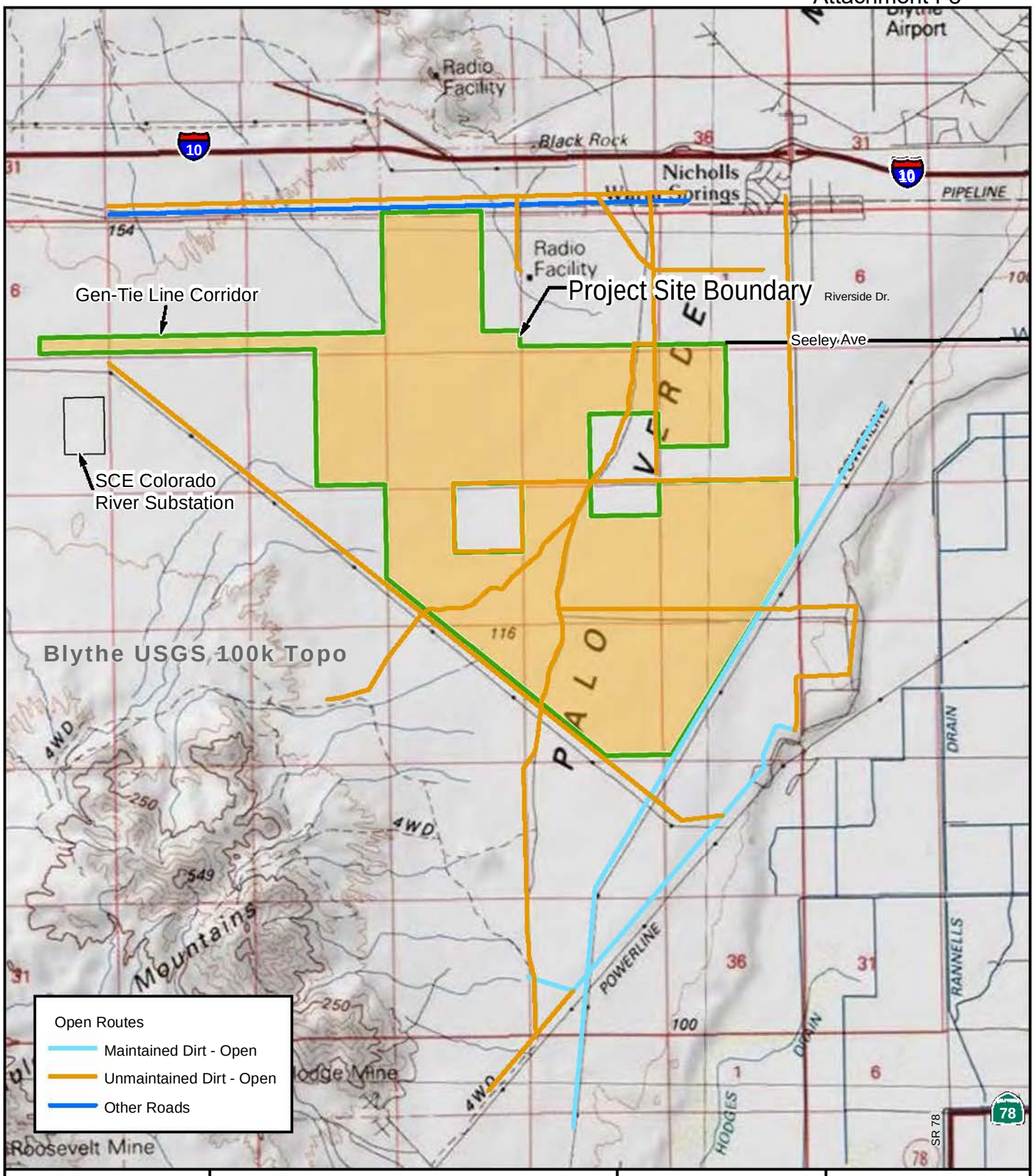
The primary routes crossing through the site include Blythe Way (which crosses the northern portion of the Solar Facility ROW) and several maintained dirt routes crossing the southern portion of the Solar Facility ROW. It is expected that these routes will remain open during and after construction of the Project, as will the routes accessing the private in-holding in the center of the ROW and the access roads along the transmission lines crossing the site. Construction of the Project may affect public access via some of the other unmaintained dirt roads that cross the area to be occupied by the Solar Facility. If this is the case, Desert Quartzite, LLC will work with the BLM and the OHV community to reroute existing routes where necessary to minimize impacts to public access. Rerouting of existing routes would comply with applicable regulations.

6.6 Groundwater Resources

The primary consideration for groundwater management within the Riverside East SEZ (including the PVMGB) relates to managing the allocations of water from the Colorado River, which is managed by an assemblage of compacts, federal laws, court decrees, and contracts that comprise the "Law of the River."[18] According to the "Law of the River" consumptive use of Colorado River water can occur through direct diversions of surface water, as well as through withdrawal of water from the river by underground pumping. To enable the United States Bureau of Reclamation (USBR) to properly account for the use of lower Colorado River water, and to ensure that existing and future use of the water is consistent with federal law, the United States Geological Survey (USGS), in cooperation with USBR, is developing a rule that establishes procedures for making determinations of unlawful use of lower Colorado River water. The proposed rule will:

- Adopt an " Accounting Surface" defined by groundwater levels that would occur if the Colorado River were the only source and sink for water in an aquifer that is hydraulically connected to the Colorado River floodplain;

[18] Ibid.



Map Location



Legend

CACA 49397

Project Site

1 in = 1 miles

0 1 2 Miles

Desert Quartzite Solar Project

Figure 6-3
BLM-Designated Open Routes Crossing the Project Site

Desert Quartzite, LLC

May 2014

AR060682

- Address under what circumstances an entitlement would be required for water pumped from underground wells near the Colorado River in order to identify groundwater wells outside the lower Colorado River floodplain that yield water that will be replaced by water from the Colorado River;
- Provide options for unlawful users to legitimize their lower Colorado River water use;
- Establish the criteria water users must satisfy to demonstrate that their wells do not pump water that would be replaced by lower Colorado River water;
- Establish a process for water users to appeal USBR determinations that specific wells pump Colorado River water; and
- Provide for public review and comment on the rule and methodology.

Currently, the "Accounting Surface," which is the static groundwater elevation in contributing basins that replenish the Colorado River, is used to determine if proposed pumping may fall under the "Law of the River." USGS defines static water-level as the level to which water will rise in a tightly cased well under its full pressure head when it is not being affected by groundwater withdrawal[19]. Wells that have a static water-level elevation above the "Accounting Surface" are presumed to yield water that will be replaced by water from precipitation and inflow from tributary valleys. Wells that have static water-levels equal to or below the "Accounting Surface" are presumed to yield water that will be replaced by water from the Colorado River, and therefore are subject to accounting and require an entitlement to use or divert river water. In general, if groundwater elevations go below the "Accounting Surface" elevation, then subsequent groundwater withdrawals are considered Colorado River extractions and may infringe on water rights established in the "Law of the River"[20] (Argonne, 2013).

The "Accounting Surface" extends to the margins of the Colorado River Aquifer which currently includes the PVMGB. The "Accounting Surface" elevation within the Project Site ranges from approximately 236 to 239 feet (National Geodetic Vertical Datum of [NGVD] 1929). Groundwater levels within the PVMGB are approximately 150 feet below ground surface and static water levels in groundwater wells in the vicinity of the site are at approximately 245 feet (NGVD 1929)[21]. Based on the Project's proposed groundwater use, it is anticipated that the Project groundwater pumping during operations would likely not result in drawdown that would affect the groundwater flow into the Colorado River, however this will need to be substantiated by further groundwater study and analysis to determine potential drawdown based on proposed withdrawal rates. The applicability of the "Accounting Surface" to the current Project has not currently been established.

A notice of the proposed "Accounting Surface" rule was published in the Federal Register on August 18, 2006, and the draft rule was published in the Federal Register on July 16, 2008. However, the Accounting Surface Method was withdrawn and has neither been acted upon, nor included as part of the Law of the River. The processes related to this action are continuing, but in general, coordination with USBR is required if it is anticipated that groundwater levels within the Project Site will be drawn down below the "Accounting Surface" groundwater elevation during groundwater pumping.

[19] Weile, S.M., Leake, .A. Owen-Joyce, S.J. and McGuire, E.H., 2009, Update of the accounting surface along the lower Colorado River: U.S. Geological Survey (USGS) Scientific Investigation Report 2008-5113, version 1.1, 16p. 3 plates in pocket.

[20] Argonne 2013, *op. cit*.

[21] U.S. Geological Survey (USGS). 2010-2011. National Water Information System Web Interface. http://maps.waterdata.usgs.gov/mapper/. Accessed January 29, 2014.

6.7 Mitigation

In addition to the environmental protection measures identified in Appendix A, the Project will adopt the applicable desert tortoise protection measures prescribed by the NECO Plan and subsequent amendments, including the BLM 2012 Approved Resource Management Plan Amendments for Solar Energy Development in Six Southwestern States, and applicable measures adapted to the Project from the BMPs and mitigation measures prescribed by BLM, USWFS, and CDFW for renewable energy projects on public land.

As necessary, compensatory mitigation for loss of tortoise habitat may be part of the Project, at a ratio determined as part of the formal consultation with the USFWS under Section 7 of the Federal ESA and with CDFW under Section 2080 of CESA. In addition, mitigation may be provided for impacts to sensitive species as prescribed in NECO, and its appendices. Specific Project impacts to desert tortoise and its habitat, as well as mitigation for those impacts, will be addressed in during the EIS process and through the formal endangered species consultation process.

The Project will implement the general mitigation measures as set forth in the Desert Tortoise Mitigation Measures for the CDCA Plan of 1980 as amended by the NECO Plan and subsequent amendments, as applicable to the Project, as well as the Terms and Conditions of the Project BO and Incidental Take Permit.

Desert tortoise exclusion fencing will be installed around the Solar Facility Site prior to construction. Desert tortoise relocation will occur as described in the Project BO, Incidental Take Permit, and associated CDFW permitting, and will also be discussed in the Project Desert Tortoise Relocation Plan, which will be prepared and provided as an appendix to the Project EIS.

7.0 Supplemental Information

Desert Quartzite, LLC understands that supplemental information will be required from the Applicant in order to prepare the NEPA analysis and complete the review process, although it is not required to be submitted with the POD. Some of this information has already been developed and is readily available, and Desert Quartzite, LLC is summarizing this information below. Additional data will be developed and provided in the future, as more information is obtained during the Project design development phase.

7.1 Engineering and Civil Design

7.1.1 Facility Survey and Design Drawing Standards

The Project will comply with applicable survey, inspection, and design drawing codes and standards as designated by Riverside County, State of California, the Federal government, and International Building Codes. First Solar is a leader in the development of large-scale solar energy systems and, as such, has technical expertise in conducting facility surveys and preparing drawings and sketches using AutoCAD based on appropriate engineering specifications, design criteria and technical manuals. First Solar ensures conformance with applicable codes and standards as well as company policies and procedures and conforms to appropriate CAD, ANSI, and ISO drafting standards in both 2D and 3D formats.

7.1.2 Final Engineering and Civil Design Packages

First Solar has developed preliminary and conceptual engineering and civil design information, which are included in this POD as part of the SPP (Appendix C). The engineering and civil designs will be updated during development of the Project and will be finalized during EIS development prior to Project construction.

7.1.3 Watershed and Drainage Analysis and Calculations

A preliminary hydrological study of the proposed Solar Facility Site has been completed and is presented in Appendix E of this POD (TLA 2011). The study includes the results of a hydrologic analysis and hydraulic model of the Site for existing (i.e., pre-Project) conditions. The study includes the results of a watershed analysis that encompasses areas immediately upstream and downstream of the Site to determine and evaluate the Site's potential peak flows and off-site peak flows during 100-year storm event. The preliminary results of the hydrologic and hydraulic modeling of storm water flow rates and sediment transport rates will be considered in the final Project design.

The conclusions in the 2011 Drainage Report are presented below; refer to Appendix E for more information.

The proposed Project will cause minor impacts to the existing drainage shed area. The potential impacts will be minimized due to the relatively flat terrain and presence of large natural depressions that range from one to five feet deep. These large depressions store significant volumes of water which attenuate the increased runoff.

The post-Project impacts during the 100-year storm event are estimated as follows:

- Average Flow Depth increase of 0.03-feet
- Average Flow Velocity increase of 0.04 feet/second
- Total Outflow increase of 20 acre-feet (2.6%)

The nominal post-Project increases in flow depth, velocity and outflow can be mitigated with on-site retention basins sized with at least 20 acre-feet of combined storm water storage capacity.

The unmitigated post-Project sediment transport will be less than the pre-Project conditions due to soil compaction. The Project Site experiences relatively shallow and slow flows, so the nominal increases in post-Project flow depths and velocities do not overcome the decreased erosion potential due to compaction.

The maximum potential pier scouring at the solar array pedestal supports is 1.22 feet. The structural design and embedment depth of the solar panel pedestal piers should account for the maximum potential scour plus a factor of safety. Monitoring after large storm events should be implemented to detect piers with significant scouring.

7.1.4 Watershed Protection and Erosion Control Drawings

A map depicting the existing hydrological conditions in the vicinity of the Project is provided on SPP Sheet 11 (Appendix C). After the hydrologic assessment and design, described in Section 7.1.3, is complete, Desert Quartzite, LLC will provide a plan depicting post-construction hydrologic conditions. Desert Quartzite, LLC intends to design the Project, so that the post-construction storm run-off from the Project Site will be essentially the same as existing storm run-off conditions.

7.1.5 Final Site Grading Plans

Preliminary (30 percent) design grading and erosion control plans and details will be developed and provided to BLM based on the results of planned hydrologic modeling analyses described above. These Site Grading Plans will be finalized during EIS development and prior to Project construction.

7.2 Alternatives Considered by the Applicant

7.2.1 Alternative Site Evaluation Criteria

NEPA regulations (40 CFR § 1502.14 [c]) identify the need to consider reasonable alternatives. NEPA requires consideration of all aspects that may be relevant and important to decision-makers, including factors that are not related to environmental quality. NEPA requires substantial treatment of each alternative, including the proposed action, so that reviewers may evaluate their comparative merits (40 CFR Section 1502.14). The process of evaluating and selecting a suitable site for the Project involved application of a number of specific criteria.

Evaluation criteria included the following:

- High levels of solar insolation, as well as a contiguous area with reasonably flat topography that is large enough (several thousand acres minimum) for a 300 MW PV facility;
- Avoidance of areas that are highly pristine or biologically sensitive, such as an ACEC, DWMA, designated wilderness areas, National Park, etc. The site also should not be within a military facility or a park;
- Avoidance of high quality (Category I or II) desert tortoise habitat, or important habitat for other sensitive species or habitats (desert woodland wash habitat, dune habitat);
- Proximity to existing high voltage transmission facilities (230 kV or higher) with sufficient capacity for Project output and with suitable interconnection locations;

- Within a priority area for utility-scale solar energy ROWs (i.e., SEZs) identified by the Federal government[22];
- Good highway access and available for sale or lease/ROW at a reasonable cost; and
- Located in an area that has a history of development including transmission and road infrastructure and nearby industrial facilities.

7.2.2 Alternatives Considered but Not Carried Forward by Proponent

During the initial phases of Project planning, alternatives were identified that clearly did not meet the Project objectives, were technically disadvantageous, or had greater environmental impacts than the currently proposed Project. These alternatives were eliminated from further consideration. The alternatives that were considered, but not carried forward due to various constraints include those described below. These alternatives and possibly others will be analyzed in greater detail in the Project EIS.

Alternative Site Locations

Consideration was given to other areas along the I-10 corridor in reasonable proximity to the designated utility corridor that runs along I-10. However, much of the area is precluded from development by designation as ACEC, DWMA, wilderness, etc. Many potentially suitable areas outside these designated areas are precluded because they are in use or are proposed for energy projects (primarily solar). Private lands were considered as well as public lands. However, the potential for private land use is limited by the lack of large contiguous parcels of suitable size with a small number of owners (so that site control could be obtained relatively easily and at reasonable cost).

Alternative Transmission and Interconnection Locations

Southern California Edison (SCE) recently completed the CRSS at a site approximately 2 miles west of the Solar Facility Site; this substation was developed as part of SCE's upgrade of its transmission system to serve a number of renewable energy projects planned along the I-10 corridor in the Project vicinity. These planned projects include Solar Millennium's Blythe Solar Energy Project, NextEra's Genesis Solar Energy Project and Solar Reserve's Rice Solar Energy Project. Environmental documentation for the CRSS was developed as part of the environmental review process for these other projects (e.g., the environmental documentation for the Blythe Solar Energy Project includes environmental survey data for the CRSS site), although the CRSS has been developed and is owned by SCE.

The Project will interconnect with the SCE system at the SCE CRSS. Because of the proximity of the proposed Solar Facility Site to the CRSS site, the Applicant is not currently considering other interconnection locations. As shown on Figure 2–2 and SPP Sheet 3 (Appendix C), Desert Quartzite, LLC's plan is for the Project's Gen-Tie Line to run north from the On-Site Substation to the nearest point where it intersects with the planned utility corridor that crosses the Project Site in an east-west direction along the 16th Avenue alignment, which will contain the 230-kV interconnection transmission line extending from Solar Millennium's Blythe Solar Power Project north of I-10 to the CRSS. The Project Gen-Tie Line will follow the same path due west that is planned for the Solar Millennium line, and then south, until it reaches the CRSS, approximately 2 miles west of the Solar Facility Site boundary. The precise position of the proposed Gen-Tie Line relative to the planned Blythe Solar Power Project line has not yet been established; this will be worked out among Desert Quartzite, LLC, Solar Millennium, and SCE. Similarly the location where the Project Gen-Tie Line will enter the CRSS site and where within the CRSS facility the Gen-Tie Line interconnection

[22] BLM. 2012. Approved Resource Management Plan Amendments/ROD for Solar Energy Development in Six Southwestern States. October.

facilities will be located have not yet been determined but will be worked out between Desert Quartzite, LLC and SCE.

7.2.3 Comparative Analysis of Proponent's Alternatives

Through the Project impact analysis process, a number of alternative sites for the Solar Facility Site were evaluated, although as noted above because of the Project's proximity to the recently completed CRSS where the Project will interconnect with the SCE transmission system, alternative interconnection points or transmission routes are not being considered. A description and comparative analysis of the alternative Project configurations previously carried forward is provided in Section 7.2.4.

7.2.4 Alternative Site Configurations

Alternative sites for the main Project generation facilities and the Gen-Tie Line within the proposed Project Site area will be analyzed in greater detail by a BLM-selected consultant in the Draft EIS. SCE considered alternate sites for the CRSS. The preferred alternative for the Project Site includes the Solar Facility Site and Gen-Tie Line corridor as defined previously in this POD. Desert Quartzite, LLC is prepared to present further detailed data concerning Project alternatives during the NEPA process so that the EIS contractor can perform a sufficient level of analysis for the reasonable range of alternatives. Alternatives considered are described in the following paragraphs.

Solar Facility Site

As discussed throughout the POD, the original application to BLM for a ROW (approximately 7,236 acres) was larger than would be needed for the Project facilities themselves (the Solar Facility Site is now 4,660 acres). This was done to provide flexibility to configure the Project in a manner that is technically and operationally sound and also minimizes the potential for impacts on-site environmental and other resources. As discussed earlier, the Project Site area is traversed by a number of desert washes and includes topographic features (depressions) and other areas of environmental sensitivity. Also, the Mule Mountain ACEC is located near the southwestern border of the Project ROW. There were a variety of possible layouts for a 300 MW facility within the original 7,236-acre Solar Facility ROW area. The preferred Solar Facility Site is now focused on the more northerly portions of the ROW in order to provide a buffer between Project facilities and the Mule Mountain ACEC. The preliminary Site Plan for the Project also is laid out to minimize impacts on sensitive resources (e.g., desert washes). The NEPA process will further evaluate Project sites/configurations.

7.3 Facility Management Plans

7.3.1 Storm Water Pollution Prevention Plan (SWPPP)

A SWPPP would be prepared as applicable to discharges to Waters of the U.S. A formal delineation will be conducted to determine the federal jurisdiction (if any) of all washes on the Project Site. The Applicant will design erosion control plans and implement SWPPP Best Management Practices (BMPs) under the direction of a Qualified SWPPP Practitioner (QSP) for storm water management and control. Preliminary erosion control BMPs are shown on Sheets 16 and 17 in Appendix C. The BMPs to be implemented would manage storm water on the site to both protect the site and to minimize downstream erosion and sedimentation. Hazardous Materials Management Plan

Several methods will be used to properly manage and dispose of hazardous materials, petroleum products and hazardous wastes. Waste lubricating oil will be recovered and recycled by a waste oil recycling contractor. Chemicals will be stored in appropriate chemical storage facilities. Bulk chemicals are not expected to be used on-site. Most other chemicals will be stored in smaller returnable delivery containers. All chemical storage areas will be designed to contain leaks and spills in containment areas or containment

plans. A more detailed hazardous waste management plan indicating types, quantities, storage and management procedures, etc., will be prepared by Desert Quartzite, LLC for use in the Draft EIS.

7.3.2 Spill Prevention Control and Countermeasure (SPCC) Plan

If required, Desert Quartzite, LLC will prepare an SPCC Plan.

7.3.3 Waste Management Plan

All construction operational wastes produced at the Project Site will be properly collected, recycled (if possible), treated (if necessary), and disposed of in an appropriate manner and in full compliance with all regulatory requirements. Project wastes will include sanitary wastewater, non-hazardous waste, and potentially small quantities of hazardous waste, primarily liquid. Domestic waste streams such as showers and toilets will be treated using a septic tank and leach field. Heavy solids will settle to the bottom of the septic tank to undergo anaerobic decomposition and slight compaction, and will be removed, as necessary. Liquid effluent from the septic tanks will be distributed to a leach field. It is expected that the leach field will satisfy the needs of the Project for its entire service life. The leach field will be constructed of open tile drains laid in trenches filled with gravel or crushed stone. The trenches permit downward percolation or upward evaporation and transpiration.

Additional data on Project waste streams (quantities, types, storage, handling, and disposal procedures, etc.) will be prepared by Desert Quartzite, LLC for use in the Project EIS.

7.3.4 Integrated Weed Management Plan

Noxious weed control practices for the Project have been developed from existing Integrated Weed Management Plans contained in other PODs for Arizona, Nevada and California. Desert Quartzite, LLC will coordinate with the BLM, the CDFW and other jurisdictional agencies to identify target weed species for the Project. In addition, Desert Quartzite, LLC will coordinate with Caltrans to ensure that noxious weed controls for the Project area are in conformance with road management plans.

7.3.5 Health and Safety Plan

The Project will follow OSHA and CalOSHA requirements in its construction and operating activities. A safety and compliance director will be assigned to the Project to ensure that safety is given the highest priority. A site-specific Health and Safety Plan will be developed, identifying the roles and responsibilities of every employee with respect to safety on the Project.

7.3.6 Environmental Inspection and Compliance Monitoring Plan

Desert Quartzite, LLC will develop an Environmental Inspection and Compliance Monitoring program and plan for the Project, covering both construction and operation. A qualified individual will be designated to serve as the Project's Environmental Manager. The Environmental Manager will be responsible for development and implementation of the Project's compliance program. They will be responsible for communication and coordination with the applicable regulatory agencies and ensuring compliance with the various conditions and requirements of the full range of Project permits and approvals. The Environmental Manager will be responsible for the necessary record keeping and reporting required by Project permits. They will ensure that all applicable plans are up to date (e.g., Project SWPPP, Integrated Weed Management Plan). The Environmental Manager's role will include advising Project management of actual and potential compliance/non-compliance issues and for ensuring that Project planning takes appropriate account of compliance issues in advance.

A cultural resources monitoring and mitigation plan will be developed prior to construction that will identify areas to be monitored during construction by a qualified archaeologist. A discovery plan will be included in

the monitoring and mitigation plan that describes procedures to be followed in the event that subsurface archaeological materials are encountered during construction. The monitoring and mitigation plan will also include provisions for the education of construction workers about the importance of preserving significant cultural properties, and a process will be established for the workers to report and protect suspected discoveries. Curation of recovered archaeological materials will be arranged with an accredited curation facility.

Similarly, a monitoring and mitigation plan will be developed prior to construction that identifies areas to be monitored by a qualified paleontological professional. The plan will include measures to be followed in the event that fossil materials are encountered during construction. The plan will include worker awareness training to ensure that the construction personnel understand requirements and procedures to be followed in the event of suspected fossil discoveries. Curation of recovered fossils will be arranged with an appropriate curation facility.

7.4 Facility Decommissioning

The Project has a minimum expected lifetime of 30 years or more, with an opportunity for a lifetime of 50 years or more with equipment replacement and repowering. When the Project concludes operations, much of the wire, steel, and modules of which the system is comprised will be recycled to the extent feasible. The Project components will be deconstructed and recycled or disposed of safely, and the Solar Facility Site could be converted to other uses in accordance with applicable land use regulations in effect at the time of closure. Consistent with BLM and NEPA requirements, a detailed Decommissioning and Reclamation Plan (Decommissioning Plan) will be developed in a manner that both protects public health and safety and is environmentally acceptable.

7.4.1 Reclamation and Site Stabilization Planning

Conditions are likely to change over the course of a Project lifespan of 30 years or more, and a final Decommissioning Plan will be developed in the future prior to facility closure based on conditions as they occur at that time. The reclamation measures provided in the Decommissioning Plan will be developed to ensure protection of the environment and public health and safety and to comply with applicable laws, ordinances, regulations, and standards.

In general, the Project Decommissioning Plan will address:

- Proposed decommissioning and reclamation measures for the Project and associated facilities;
- Activities necessary for site restoration/re-vegetation, if removal of equipment and facilities is needed;
- Procedures for reuse, recycling, or disposal of facility components; collection and disposal of hazardous wastes; and use or disposal of unused chemicals;
- Costs associated with the planned decommissioning activities and the source of funding for these activities; and
- Conformance with applicable laws, ordinances, regulations, and standards.

The Decommissioning Plan will be developed in coordination with the BLM and submitted to the BLM for review and approval prior to final closure of the facility.

7.4.2 Temporary Reclamation of Disturbed Areas

After closure, measures will be taken to stabilize disturbed areas once equipment and structures are decommissioned and removed from the Project site. These measures will be outlined fully in the Decommissioning Plan. If and when Project structures are removed upon facility closure, the resulting

disturbed soil will be stabilized using standard erosion control BMPs (e.g., use of mulch, fiber rolls, silt fences, reseeding, etc., as applicable) until final reclamation measures may be implemented. Only a small portion of the Solar Facility Site contains structures that are in direct contact with the ground and thus would create surface disturbance during removal; these include access roads, the O&M facility, septic system and leach field, and associated parking areas; removal of the solar arrays will create minimal ground disturbance due to the small footprint of their pile foundation design. Final reclamation measures will be implemented as soon as practicable after facility closure. Desert Quartzite, LLC understands that some measures that support permanent reclamation may need to be taken prior to construction. For example, the reclamation plan may need to include stockpiling and maintaining a nursery for desert cacti, so that an ample supply is available for reclamation during facility decommissioning.

7.4.3 Removal of Power Generation and Substation Facilities

While there are no power generation facilities involved in the Project other than the PV modules, there will be several PCSs, PV Combing Switchgear cabinets, a Gen-Tie Line, and an On-Site Substation. As required, these facilities will be de-energized, decommissioned, dismantled, and removed in accordance with all Federal, State, and local regulatory requirements. Where feasible, Project components will be recycled or reused.

7.4.4 Removal and Recycling of PV Modules

As described in Section 2.14, First Solar is committed to philosophy of extended producer responsibility and improving the global environment, and as such has established a Collection and Recycling Program to offer its customers that promotes the collection and recycling of PV modules. The program enables substantially all components of the modules, including the glass and the encapsulated semiconductor material, to be treated and processed into new modules or other products. Under the program, First Solar funds, at the time of module sale, the estimated costs of collection and recycling including, packaging, transportation, and recycling costs for their PV modules.

7.4.5 Removal of Other Ancillary Facilities

The Project's ancillary facilities will include the O&M facility, parking areas, septic system and leach field, water storage tank, access roads, fencing, lighting, and related infrastructure. When the Project site is removed from power generation service, the Project's ancillary facilities will be reused, recycled, removed, or abandoned based on the desired subsequent use and in compliance with applicable Federal, State, and local regulations. Procedures for reuse, recycling, removal, or abandonment will be fully outlined in the final Decommissioning Plan. Where feasible, Project components will be reused or recycled. If the site is not planned for industrial, commercial, or residential development after Project decommissioning, ancillary facilities will be removed and the site will be restored to a condition that allows it to be utilized for natural habitat and as rural open space.

Appendix A Environmental Considerations Table

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Special or sensitive species and habitats		
Listed Species - Desert Tortoise (*Gopherus agassizii*)	There is one federal- and state-listed (threatened) animal species with known potential to inhabit the Project Site: the desert tortoise. Full-coverage surveys for desert tortoise (Gopherus agassizii), the only animal species listed as federal and state endangered with potential to occur on the Project Site, was conducted in 2013. Tortoise sign observed during the surveys consisted of six carcasses, all-greater than 4 years old and disarticulated, and one set of tortoise tracks. Live desert tortoise were not observed during surveys. The USGS habitat model ranking indicate that desert tortoise habitat potential within the Project Site ranks as low to low-medium and is relatively lower than areas further to the west and across the Colorado River to the east. The Solar Facility Site will be developed and fenced with desert tortoise exclusion fencing and therefore will no longer be available as habitat to desert tortoise. Development of the Gen-Tie Line will also impact small areas of potential desert tortoise habitat (permanent transmission impacts will be limited to the footprint of the transmission towers and the access road).	The Project will adopt and implement the general mitigation measures as set forth in the *Desert Tortoise Mitigation Measures* for the CDCA Plan as amended by the NECO Plan and subsequent amendments, as applicable to the Project. A desert tortoise mitigation plan and, if necessary, a translocation plan will be developed in consultation with the USFWS and CDFW. Mitigation ratios and strategies adopted will be proportional to and consistent with the quality of habitat, which is very low, and with the identified and projected tortoise densities on the site. If it is determined that there are desert tortoises inhabiting the Project Site, clearance surveys will be conducted prior to Project construction. All tortoises found above-ground during clearance surveys would be fitted with transmitters and moved to a relocation area to be chosen in consultation with USFWS and CDFW. The Solar Facility Site would be fenced with desert tortoise exclusion fencing.
Candidate Species	There are no Candidate species known to occur in the Project area. Mountain plover and western yellow-billed cuckoo records were identified through a CNDDB search but habitat for these species was not detected within the Project area and these candidate species are therefore considered absent from the Project Site.	No environmental protection measures are expected to be necessary. If candidate species are discovered on-site during focused surveys, coordination and conference between the Desert Quartzite, LLC/BLM team and USFWS and CDFW will determine any necessary minimization and/or mitigation measures for these species.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Other Special Status Species--Wildlife	Numerous Mojave fringed-toed lizards (Una scoparis), which is a species of concern, were found while performing the fall 2012 and spring 2013 surveys in the western portion of the Project Site, including the 230 kV Gen-Tie Line corridor, where soils consist of much finer sand. Other special status wildlife species observed or likely to occur within the Project Site included loggerhead shrike (Lanius ludovicianus), burrowing owl (Athene cunicularia), LeConte's thrasher (Toxostoma lecontei), American badger (Taxidea taxus), desert kit fox (Vulpes macrotis arsipus), pallid bat (Antrozous pallidus), small-footed myotis (Myotis ciliolabrum), and Townsend's big-eared bat (Plecotus townsendii). These special status animal species, as well as others such as golden eagles (Aquila chrysaetos) will be considered in the environmental review and threatened and endangered species consultation processes for the Project.	Focused surveys for special status wildlife species have been conducted and will be considered as part of the environmental review and threatened and endangered species consultation processes in the EIS for the Project. Desert Quartzite, LLC is designing the Project facilities to provide the minimum level of disturbance necessary in order to complete the proposed Project. Desert Quartzite, LLC will work with the BLM to develop environmental protection measures to minimize impacts to sensitive wildlife species.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Other Special Status Species--Plants	Six special status (California Native Plant Society list status) plant species were observed during the focused botanical surveys of the Project Site that were conducted in the fall of 2012 and the spring of 2013. The six plant species are: Harwood's milkvetch (Astragulus insularis var. harwoodii), Abram's spurge (Chamaesyce abramsiana), ribbed cryptantha (Cryptantha costata), Harwood's eriastrum (Eriastrum harwoodii), Utah vine milkweed (Funastrum utahense) and desert unicorn plant (Proboscidea althaeifolia). More than 124 species of plants were identified during the surveys. These plant species will be considered in the environmental review and threatened and endangered species consultation processes for the Project. No plant species that are federal- or state-listed as endangered or threatened have been recorded as occurring on or near the Project Site.	Focused surveys for special status plant species have been conducted and the results of the surveys will be considered as part of the environmental review and threatened and endangered species consultation processes for the Project. Desert Quartzite, LLC will design the Project facilities to provide, to the extent practicable, the maximum avoidance of disturbance to special status plant species. Facilities (including transmission structures) will be designed to avoid and minimize impacts to these species. Desert Quartzite, LLC will work with the BLM to develop environmental protection measures to minimize impacts to sensitive plant species within the EIS.
Federal and State Jurisdictional Waters	The majority of the washes on the Project Site do not appear drain to a navigable or relatively permanent water, and thus would be considered “isolated waters” and would not be subject to the jurisdiction of the USACE under CWA Section 404 or the RWQCB under CWA Section 401. At least one wash system may be contiguous with agricultural channels and thus contiguous with the Colorado River, which is considered a navigable water and subject to USACE and RWQCB jurisdiction. Some of the washes on-site may fall under the jurisdiction of the CDFW under Section 1602 of the California Fish and Game Code under Section 1602. Several ephemeral washes with bed and bank occur on site that may be subject to State jurisdiction and may require a Streambed Alteration Agreement.	A formal delineation will be conducted to determine the federal jurisdiction (if any) of the washes on the Project Site. To the extent practicable, siting of the Project facilities will avoid jurisdictional waters. Attempts will be made to fully avoid likely jurisdictional drainages, however, if necessary, the Project will apply for a Section 404 permit and/or Streambed Alteration Agreement. If necessary, mitigation measures for impacts to jurisdictional waters would be determined in consultation with USACE related to Section 404 of the CWA and CDFW under Section 1602 of the Fish and Game Code.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Desert Dry Wash Woodland	Desert Dry Wash Woodland vegetation is associated with three desert wash systems located within the Project Site area.	To the extent practicable, siting of the Project facilities will avoid jurisdictional waters. If necessary, mitigation measures for impacts to desert dry wash woodland would be determined in consultation with BLM and CDFW and in keeping with requirements of the NECO Plan.
Desert Scrub Vegetation	Desert scrub vegetation occurs over approximately 98% of the Project Site area. Existing vegetation will be cut within all occupied portions of the Project area over the active life of the Project.	Cutting or removal of desert scrub wildlife habitat will be restricted to the occupied and fenced portions of the Project area. Desert Quartzite, LLC is evaluating via test site construction methods the minimum level of disturbance necessary in order to complete the proposed Project.
Wild or Scenic rivers	There are no wild or scenic rivers in or near the Project area, and none will be directly or indirectly affected by the Project.	Not Applicable
Introduction of Invasive, Nonnative Species	Soil disturbance and construction and operational activities could introduce invasive nonnative species to the Project area.	Applicant will develop an Integrated Weed Management Plan and provided in support of the Project EIS. The Plan will be implemented during all Project phases.
Migratory birds	The burrowing owl (*Athene cunicularia*) is protected by the federal Migratory Bird Treaty Act. Other native bird species, also protected by the federal Migratory Bird Treaty Act, may occur on the Project Site and could be affected by Project activities.	Nesting bird locations will be temporarily avoided during construction. To the extent practicable, burrowing owls will be avoided by siting of Project components. Mitigation for unavoidable impacts to burrowing owls will be mitigated in consultation with CDFW and will comply with the latest CDFW and California Burrowing Owl Consortium guidelines.
Special Land Use Designations		
Areas of Critical Environmental Concern (ACEC)	Mule Mountain ACEC is located approximately one mile southwest of the Project Area. The Chuckwalla Valley Dune Thicket ACEC is located 8 miles directly west of the Project. There will be no direct impacts from the Project on these ACECs.	The Solar Facility has been sited in the northern portion of the originally applied for ROW in order to establish a reasonable buffer zone between the Project and Mule Mountain ACEC.
Desert Wildlife Management Areas	The Chuckwalla DWMA for desert tortoise is located approximately 20 miles west of the site. No effects on the Chuckwalla DWMA are expected from the Project.	Not Applicable

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Critical Habitat	No critical habitat will be directly or indirectly affected by the Project.	Not Applicable
Prime or Unique Farmlands	No prime or unique farmlands will be directly or indirectly affected by the Project.	Not Applicable
Wilderness Areas	There are no wildernesses or wilderness study areas in the Project area. The nearest Wilderness Areas are the Big Maria Mountains Wilderness 12 miles to the northeast, and the Palen McCoy Wilderness located about 10 miles to the northwest, both of which are north of Interstate 10.	None
Cultural and Historic Resource Sites and Values		
Cultural and Historic Resources	Historic cultural resources may occur within the Project area.	A Class I cultural resources records search and literature review has been completed and a Class III field survey of the Project area will be completed prior to completion of the Project EIS in conformance with BLM requirements. To the extent practical, Project facilities will be constructed in a manner that avoid potentially eligible cultural resource sites. Other measures will be implemented to mitigate potential adverse effect on identified cultural resources that cannot be avoided in conformance with BLM and State Historic Preservation Office (SHPO) requirements.
Native American Tribal Concerns		
Native American Tribal Concerns	No specific Native American concerns have been identified to date.	Desert Quartzite, LLC's consultant has requested a search of Sacred Lands File from the NAHC in Sacramento to determine if there are any known resources of traditional, religious, or historical importance to local Native American groups. The BLM will conduct government-to-government consultation with Native American tribes as part of the NEPA and National Historic Preservation Act compliance processes.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Paleontological Resources		
Paleontological Resources	No specific Paleontological Resource concerns have been identified to date.	A paleontological resource survey of the Project area will be conducted prior to site construction or surface disturbance in conformance with BLM requirements.
Recreation and OHV Conflicts		
OHV Recreation	There are no developed OHV recreation facilities in or near the Project area, but several BLM-designated open routes cross the Project Site. OHV use within the developed portions of the Project area will not be permitted for safety reasons.	Only developed and occupied portions of the Project area will be fenced. Designated open routes will either be re-routed or remain open to public access to the extent practicable. Desert Quartzite, LLC will work with the BLM and the OHV community to re-route any routes that are affected by the Project.
Other Recreation	There are no developed recreation facilities in or near the Project Study Area.	Desert Quartzite, LLC is designing the Project facilities to provide the minimum level of disturbance necessary in order to complete the proposed Project. Only developed portions of the Project Site will be fenced, thus minimizing limitations to existing recreational uses in the Project vicinity.
Other Environmental Considerations		
Air Quality		
Fugitive Dust Emissions	Approximately 4,682 acres[RR1] will be disturbed during Solar Facility site preparation. Small amounts of grading will also be required for construction of the Gen-Tie Line (limited to access roads, the footprints of the transmission structures, and some temporary work areas; acreage to be determined), and associated with upgrading of approximately 5 miles of off-site access roads.. Limited vehicle access will occur on unpaved roads and access corridors over the operational life of the Project.	A Fugitive Dust Suppression Plan will be developed and implemented, in conformance with Mojave Desert Air Quality Management District requirements, that will detail control measures to reduce fugitive emissions from construction and operational activities, including but not limited to watering of unpaved roads and other disturbed surface areas, vehicle speed limits, transport container covers, and cleaning and maintenance procedures.
Vehicle Emissions	An estimated 20,000 truckloads of solar modules and other construction materials will be delivered to the Project Site area during the construction period for the Project.	The potential impact from construction vehicle emissions will be evaluated during the NEPA process.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Hydrology and Water Quality		
Floodplains	FEMA has not mapped floodplains in the Project area. Periodic rain events in the Project vicinity could result in sediment-laden runoff onto or from floodplains in the Project area, especially during Project construction activities.	Any major floodplains demarcated by scouring or other hydrologic criteria in the Project area would be avoided during Project siting.
Desert Washes and other Surface Water	The Project site is located in a desert environment. Several desert washes exist within the Project site boundary. Although some surface water collects within the Project area, Desert Quartzite, LLC is exploring site preparation methods that will contain water draining onto the site, and fill the primary low areas if necessary, to avoid flooding hazard in limited portions of the site area. The Project area also contains washes that periodically contain water during infrequent events. An agricultural ditch surrounding an offsite jojoba farm also periodically contains water.	The Project will avoid the major desert washes and the agricultural ditch near the jojoba farm in its placement of PV arrays and other structures, to the extent practicable. If the Project cannot avoid adversely affecting these drainages, then a Streambed Alteration Agreement from CDFW will be obtained. Best Management Practices (BMP) will be developed and implemented for construction, post-construction, and operational phases to maintain the integrity of the desert washes in the area.
Storm water	The Project area is located in a large alluvial fan area with several washes that periodically collect runoff water during infrequent rain events. Site preparation studies will also evaluate the option of creating more of a sheet flow regime in lieu of the numerous washes which now drain the site. To the extent that washes are left intact, it may be necessary to construct unpaved roads that cross the washes in several places.	The Project will conform to the California State Water Resource Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges (General Permit) for both construction and industrial (if applicable) activities regulations regarding runoff and erosion control, as well as applicable regional, county, and local requirements. This will include preparing a Storm Water Pollution Prevention Plan (SWPPP) for any discharges to Waters of the U.S., and implementing appropriate storm water BMP. BMPs will consist of control measures such as swales and ditches, stabilized construction entrances, gravel-covered construction staging area, and silt fencing. The industrial SWPPP (if necessary) will include appropriate BMPs (such as secondary containment structures around mineral oil-filled transformers).

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Ground Water	If available, ground water may be used for the Project.	Use of groundwater resources, if available, will be designed, so that there are no adverse impacts to groundwater levels or concentrations.
Surface Discharge	Project surface flows will remain similar to the existing natural surface flows. .	None
Water Supply/Water Use (Construction)	It is expected that water will be collected from on-site wells to meet water needs during construction (e.g., concrete foundations, equipment pads, and dust control).	Use of groundwater resources, if available, will be designed, so that there are no significant impacts to groundwater levels or concentrations.
Water Supply/Water Use (Operational)	During operation, the Project will consume small amounts of water, which are expected to come from on-site wells.	None
Visual Resources		
Lighting	Lights may periodically be used at nighttime in occupied portions of the Project area for security purposes.	Lighting on the Project Site will be limited to areas required for operations or safety, will be directed on site to avoid backscatter, and will be shielded from public view to the extent practical. Lighting that is not required to be on during nighttime hours will be controlled with sensors or switches operated such that lighting will be on only when needed.
Color and Reflection	The Project will introduce new man-made facilities to the viewshed.	A paint color acceptable to the BLM will be used on all Project facilities that can be painted where appropriate to blend more naturally with the existing setting. Any necessary fencing will be constructed of non-reflective materials or will be treated or painted to reduce visual effects on sensitive viewing areas. The reflectivity of surfaces will be reduced by using non-reflective elements where appropriate and possible.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Profile	The Project's PV blocks will cover an extensive ground area with dark PV panels, which will result in a visual impact. As the Project will be situated on nearly flat land on only slightly elevated terrain, only portions of the Project area will be visible at middle distances from the major roads in the area. Because the Project will be located near I-10 some visual buffer setback will be provided, the distance to be determined in the NEPA process	The Project area will use low profile PV panel structures that should not extend higher than approximately 6 feet above the ground surface. Project facilities will be set back approximately ½ mile from I-10. Visual Impact Analyses of the potential visual impact of the project will be conducted as part of the Project EIS.
Geological, Soils, & Mineral Resources		
Geologic Hazards	The Project buildings and other facilities will be constructed in a seismically active area.	The development facilities would be built in accordance with Riverside County Building Code requirements applicable to Seismic Zone 4. No human occupied structures will be placed across the trace of an active fault, and no human occupied structure will be placed within fifty feet of the trace of an active fault or within a seismic special studies zone without a geologic report, satisfactory to the State Geologist, demonstrating that no undue hazard would be created by the construction or placement of the structure.
Minerals	No commercial quantities of saleable or leasable minerals are known to exist within the Project Site.	None
Soils	Soils will be disturbed during site construction and along access ways during normal operations.	See air quality fugitive dust control measures.
Public Health and Safety		
Hazardous Waste	No hazardous wastes will be used or generated by the Project during normal operations.	Not Applicable
Petroleum Hydrocarbon Waste	Bulk containers of petroleum hydrocarbon fuels may be located in the construction staging area and used during site construction to fuel vehicles.	Bulk fuel containers will be stored in secondary containment to catch any potential fuel spills. Spilled petroleum hydrocarbon wastes will be collected and transported to an offsite disposal facility authorized to accept the wastes.

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Solid Waste	Solid wastes will be generated during the construction phases of the Project. Minimal amounts of solid waste will be generated during the operational phase of the Project.	Solid wastes generated by the Project will be temporarily stored in wind- and wildlife-secure containers on site. Solid wastes generated by the Project will be transported to an offsite disposal facility authorized to accept the wastes.
Sanitary Waste	Sanitary waste will be generated during both construction and operational phases of the Project.	During site construction portable sanitary facilities will be located in the Project area and maintained by a local contractor. During the operational phase of the Project either portable sanitary facilities will continue to be used and/or a septic system will be constructed for the Operations and Maintenance facility.
Socioeconomics and Environmental Justice		
Socioeconomics (During Construction)	During Project construction, the workforce is expected to average approximately 600 employees over the 18 to 48 month construction period, with a peak workforce of approximately 1,000 employees. The Project construction workforce will be recruited from within Riverside County and elsewhere in the surrounding region as much as practicable. A temporary increased demand for services from local businesses, employment opportunities, and increased demand for temporary housing will likely occur.	None
Socioeconomics (During Operations)	During the operational phase of the Project, the social and economic effects are likely to be minimal. The Project will employ up to 15 maintenance and security workers and have minimal demand on local services. The Project will generate approximately 300 MW of renewable energy for sale to California utilities.	None

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS
Desert Quartzite Solar Project

Resources	Project Effects on the Resource	Environmental Protection Measures
Environmental Justice	There are no known minority groups or disadvantaged populations living within or adjacent to Project area that would be disproportionately affected by the Project.	None
Rangeland and Livestock		
Rangeland and Livestock	No public rangelands are known to occur in the Project vicinity and no range allotments have been issued by the BLM for lands within or near the Project area.	Not Applicable
Noise		
Noise	The Project will generate noise during construction; however, the closest noise sensitive resources are located more than one mile from the Project site. The Project should not generate noise during normal operations that would adversely affect dispersed recreation in the Project vicinity.	None

Appendix B Preliminary Biological Resources Assessment

A draft Biological Resources Technical Report for the Desert Quartzite Solar Project has been prepared and submitted to the BLM in 2014 for review as discussed in Section 6.1 of the POD. Once the BLM's review is completed, the report will be finalized and considered in the EIS and permitting for the Project, as appropriate.

Appendix C Site Plan Package

AR060705

DESERT QUARTZITE, LLC.

DESERT QUARTZITE SOLAR PROJECT

PLAN OF DEVELOPMENT

SITE PLAN PACKAGE

SUBMITTED TO: BUREAU OF LAND MANAGEMENT, CALIFORNIA DESERT DISTRICT

DESERT QUARTZITE SOLAR PROJECT
RIVERSIDE COUNTY, CA

PROJECT OWNER-OPERATOR:
DESERT QUARTZITE, LLC, A WHOLLY-OWNED SUBSIDIARY OF
FIRST SOLAR DEVELOPMENT, LLC

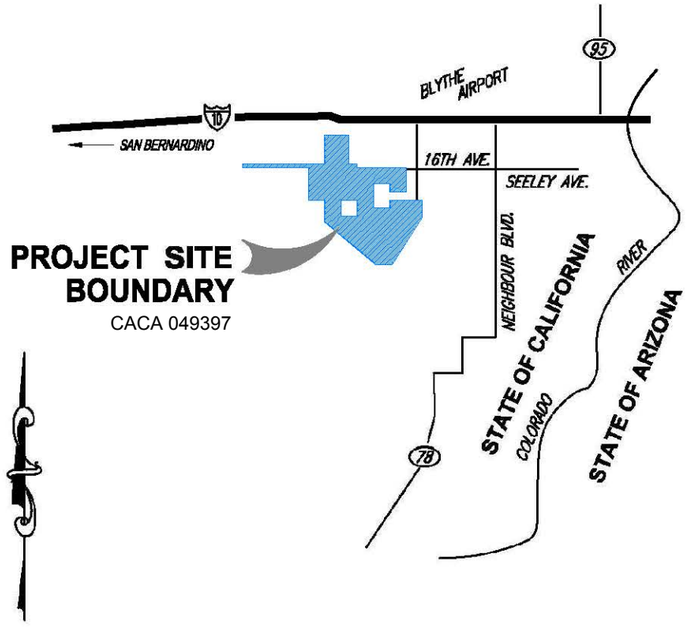
PROJECT SITE DESCRIPTION:
4,843 ± ACRE PROJECT AREA
LATITUDE 33° 33' 59.50" N
LONGITUDE 114° 45' 28.09" W
ELEVATION 99-145 ft.

PROJECT DESIGN DATA:

SNOW LOAD	0 PSF
WIND LOAD	85 MPH, EXPOSURE C
SEISMIC LOAD	Ss = 0.374g, S1 = 0.215g

PROJECT INTERCONNECTION:
PROPOSED FIRST SOLAR PROJECT SUBSTATION WITH
GEN-TIE TO SOUTHERN CALIFORNIA EDISON COLORADO RIVER SUBSTATION

SOLAR PV PRODUCTION:
TRACKER MOUNTING SYSTEM
358°51'34" NW AZIMUTH
1000 VOLT dc PV SYSTEM DESIGN
34.5 kV DISTRIBUTION SYTEM



SHEET INDEX	
SHEET NO.	DESCRIPTION
1	COVER SHEET
2	VICINITY MAP & PROJECT STUDY AREA
3	PRELIMINARY SITE PLAN
4	EXISTING SITE CONDITIONS - PROJECT STUDY AREA
5	LAND USES - PROJECT STUDY AREA
6	OWNERSHIP MAP
7	TYPICAL ARRAY CONFIGURATION
7A	TYPICAL MOUNTING SYSTEMS
8	POWER CONVERSION SYSTEM
9	CONCEPTUAL OPERATION AND MAINTENANCE (O&M) FACILITY PLAN
10	PRELIMINARY MOVE-ON AREA PLAN
11	PROJECT DRAINAGE SHED MAP
12	FEMA FLOOD HAZARD MAP
13	GEOLOGIC MAP
14	PRELIMINARY EXISTING GROUND SLOPE ANALYSIS
15	PRELIMINARY GRADING AND COMPACTION PLAN
16	PRELIMINARY EROSION CONTROL PLAN
17	PRELIMINARY EROSION CONTROL DETAILS
18	PRELIMINARY ACCESS ROAD PLAN
19	PRELIMINARY FENCE PLAN
20	PRELIMINARY AC ELECTRICAL COLLECTION SYSTEM
21	PRELIMINARY PERMANENT LIGHTING PLAN
22	PRELIMINARY ONSITE SUBSTATION PLAN

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	PDD RESUBMITTAL			
B	09-15-11	PDD RESUBMITTAL			
C	04-07-14	PDD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR, INC.

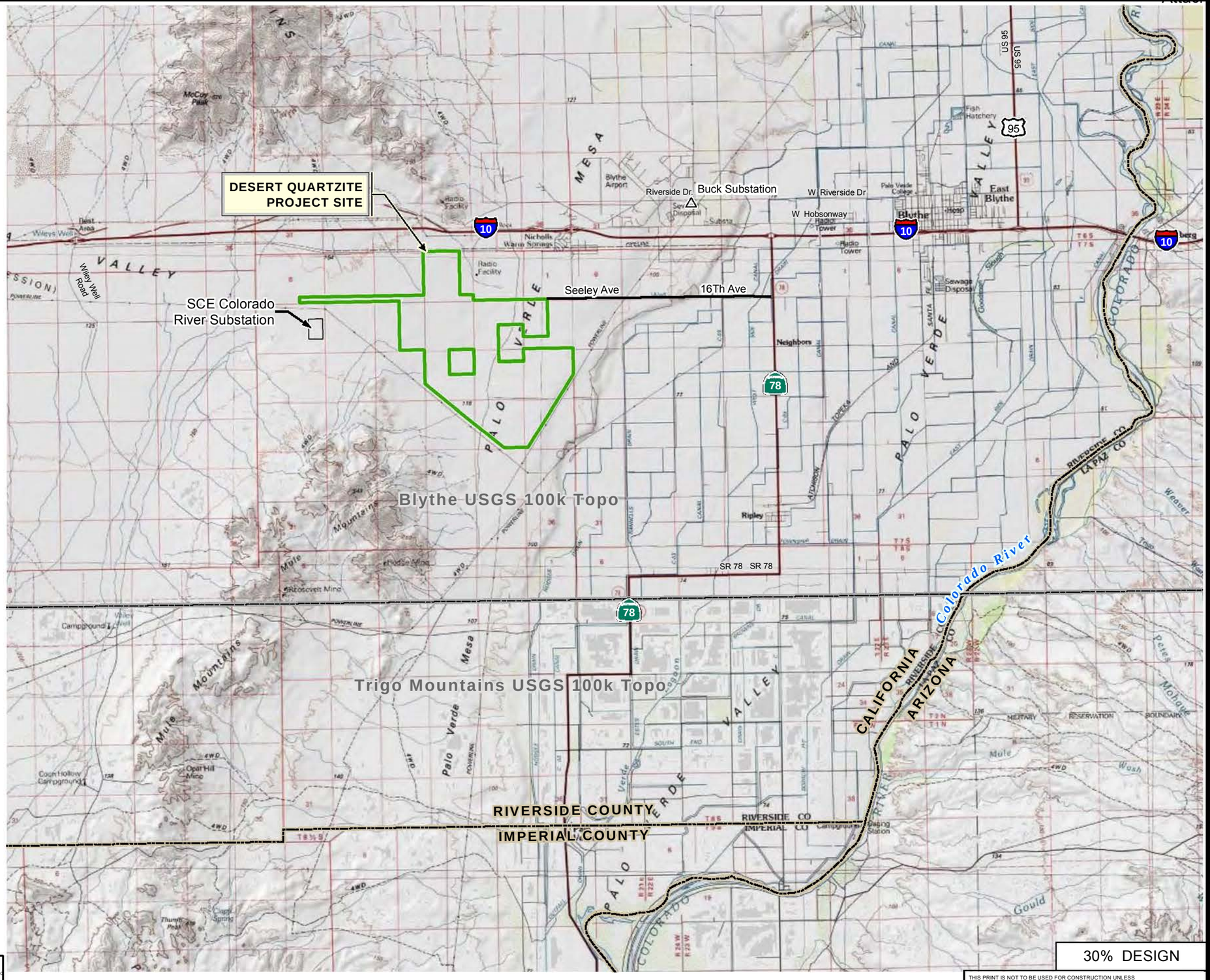
SHEET TITLE
COVER SHEET

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

COPYRIGHT © 2011-2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

T:\Application Engineering\Projects\2010\6017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th T-001-TL-QUART.dwg FS104849 May 07, 2014 - 6:29am



Legend

- Project Site
- SCE Colorado River Substation
- USGS 100k Topo Map Boundaries

Base map; Seamless, scanned images of United States Geological Survey (USGS) paper topographic 1:100,000-scale maps: Blythe, CA ('82) & Trigo Mountains, AZ ('82), Copyright:© 2013 National Geographic Society, i-cubed.

0 0.5 1 1.5 2 Miles

0 1 2 3 4 Kilometers

N

V:\Projects\GIS_Proj\FirstSolar\DesertQuartziteSite\deliverables\May2014\Sheet2_VicinityMap&ProjectStudyArea.mxd

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

First Solar.
FIRST SOLAR DEVELOPMENT, INC.
1111 BROADWAY ST., 4TH FLR.
OAKLAND, CALIFORNIA 94607
PHONE: (510) 625-7400
WWW.FIRSTSOLAR.COM

PROFESSIONAL ENGR.

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV.	DATE	DESCRIPTION	BY	CHK'D	APP'D
A	07/28/11	ISSUED FOR POD RESUBMITTAL			

6017-0100-23

RH

JT

VICINITY MAP &
PROJECT STUDY AREA

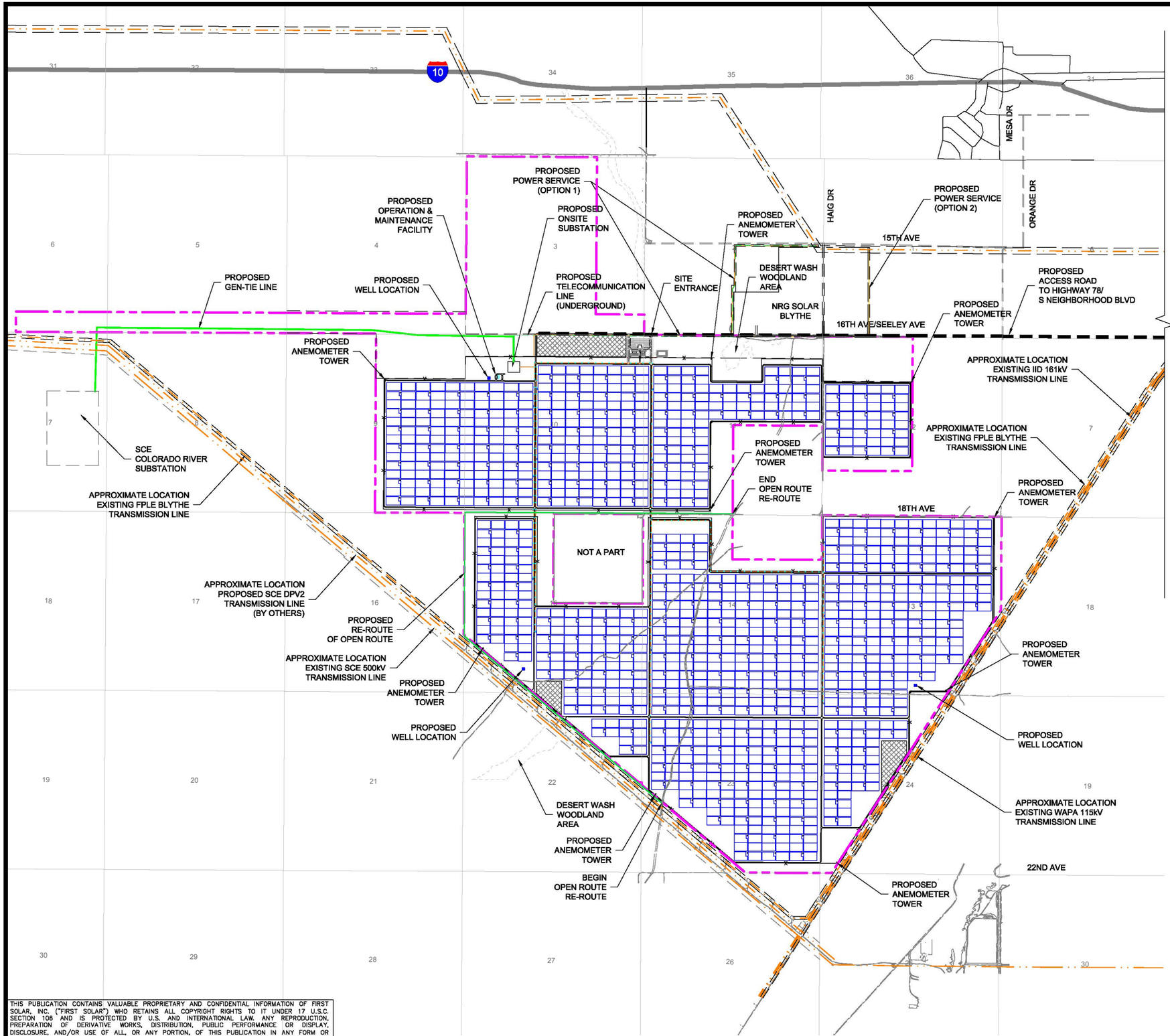
30% DESIGN

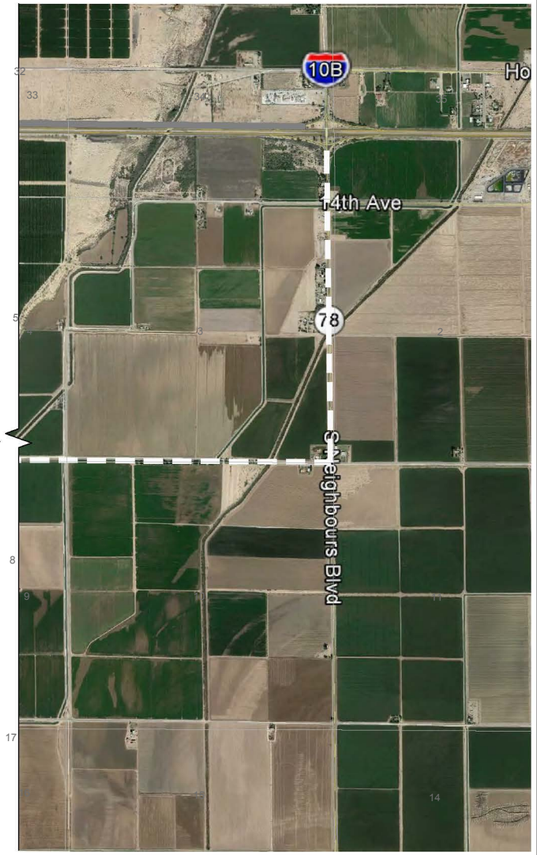
THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

SHEET 2 OF 22

COPYRIGHT © 2013 FIRST SOLAR, INC. ALL RIGHTS RESERVED

AR060707





LEGEND

- PROPOSED PROJECT SITE BOUNDARY
- PROPOSED GEN-TIE
- PROPOSED PERIMETER FENCE
- PROPOSED ACCESS ROAD
- PROPOSED WELL LOCATION (GROUNDWATER)
- TYPICAL PV ARRAY
- CONSTRUCTION STAGING AREA
- EXISTING ROADS
- EASEMENTS/RIGHT-OF-WAY BY OTHERS
- EXISTING/PROPOSED TRANSMISSION LINE

PROJECT NORTH
(358°51'34" TRUE NORTH)

3000' 1500' 0 3000'

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: 1"=3000' @ 11"x17" SHEET
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

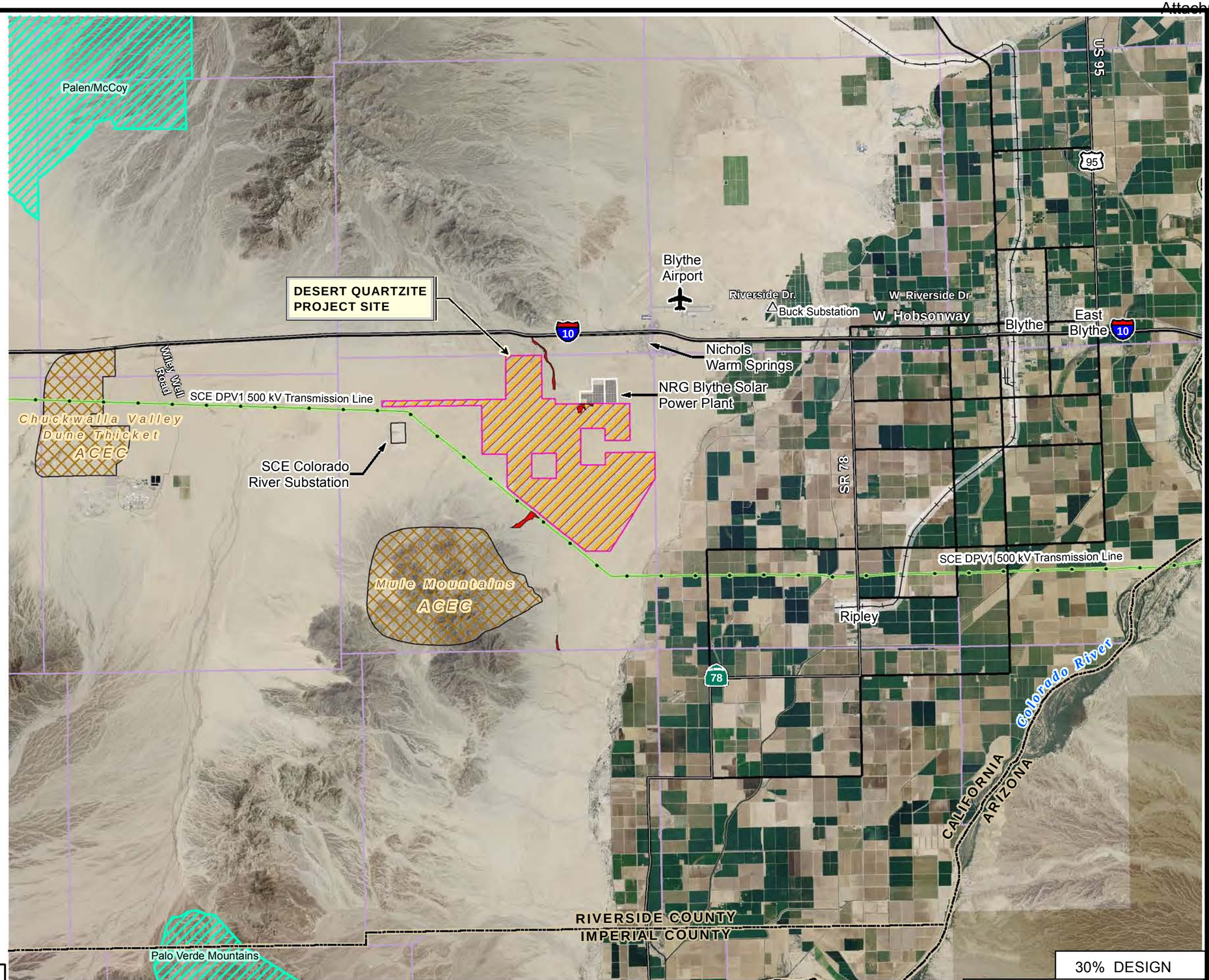
PRELIMINARY SITE PLAN

SHEET 3 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

C:\Desert Quartzite\POD\Site Plan Package\C-100-SP-QUART.dwg FS104849 May 02, 2014 - 2:21pm



Legend

- NLCS Wilderness Areas
- Interstate, US or State Highways
- Secondary State/County Routes
- Railroads
- Dry Wash Woodland (DWW)
- Existing Transmission Lines
- Project Site
- SCE Colorado River Substation
- BLM Areas of Critical Environmental Concern/Desert Wildlife Management Areas
- BLM Sections

Base map; USDA-FSA Aerial Photography Field Office; National Agriculture Imagery Program (NAIP) 2012-04-23 ArcGIS Image Service, USDA-FSA-APFO: http://gis.apfo.usda.gov/arcgis/services.

0 0.5 1 1.5 2 Miles

0 1 2 3 4 Kilometers

V:\Projects\GIS_Proj\FirstSolar\DesertQuartziteSite\deliverables\May2014\Sheet4_ExistingSiteConditionsProjectStudyArea.mxd

First Solar.
FIRST SOLAR DEVELOPMENT, INC.
1111 BROADWAY ST., 4TH FLR.
OAKLAND, CALIFORNIA 94607
PHONE: (510) 625-7400
WWW.FIRSTSOLAR.COM

PROFESSIONAL ENGR.

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	07/26/11	ISSUED FOR POD RESUBMITTAL			

6017-0100-23

RH

JT

EXISTING SITE CONDITIONS - PROJECT STUDY AREA

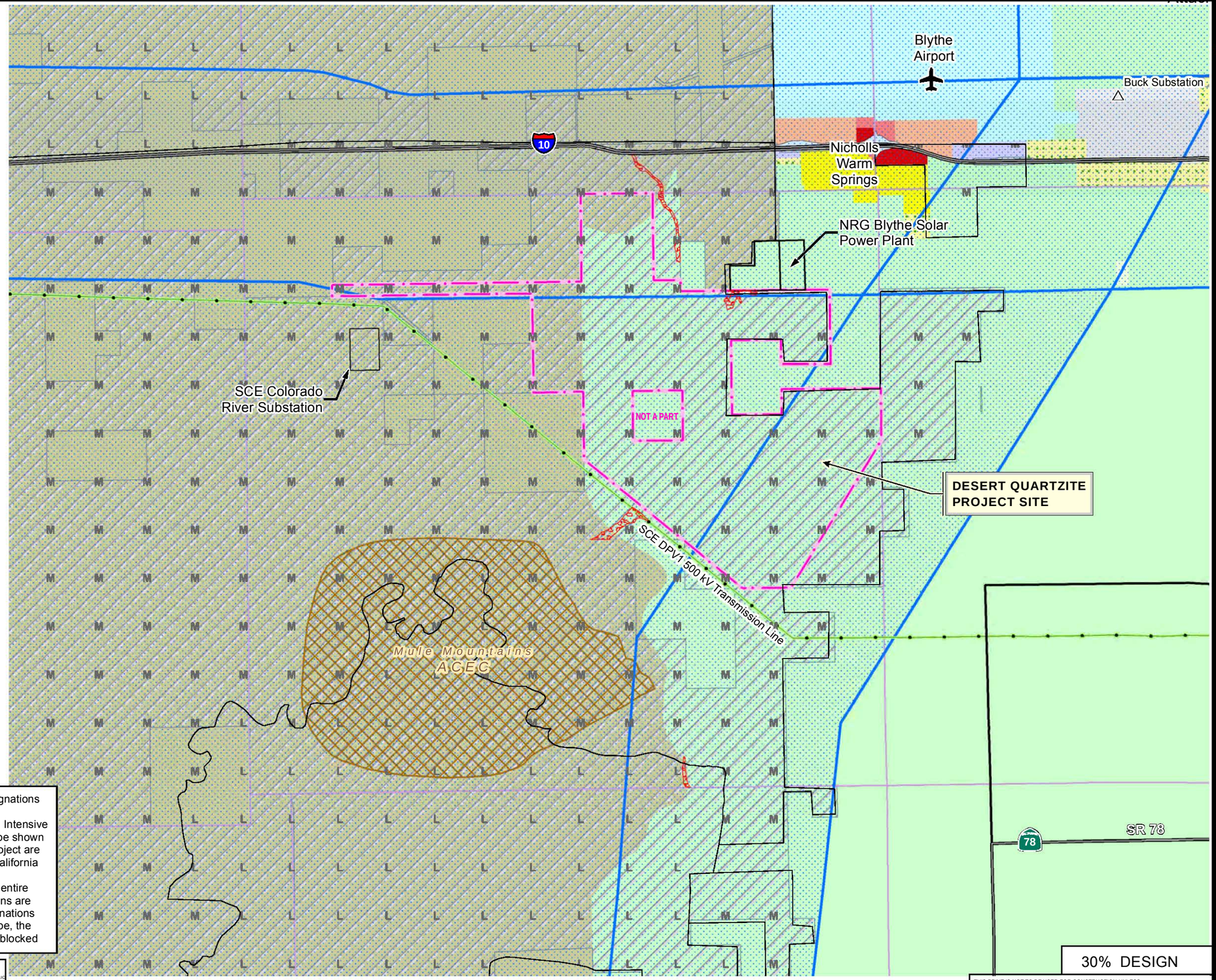
30% DESIGN

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

SHEET 4 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

COPYRIGHT © 2010 FIRST SOLAR, INC. ALL RIGHTS RESERVED



Legend

- Existing Transmission Lines
- Interstate, US or State Highways
- Secondary State/County Routes
- Project Site
- SCE Colorado River Substation
- Dry Wash Woodland (DWW)
- BLM Energy Corridor

BLM Multiple Use Classes

- M Moderate
- L Limited
- BLM Areas of Critical Environmental Concern/Desert Wildlife Management Areas
- BLM Sections
- Bureau of Land Management (BLM)

Riverside County General Plan Land Use

- RC-Very Low Density Residential
- Medium Density Residential
- Commercial Retail
- Commercial Tourist
- Light Industrial
- Business Park
- Public Facilities
- Rural Residential
- Agriculture
- Open Space Rural
- CITY
- Freeway

0 0.25 0.5 0.75 1 Miles

0 0.5 1 1.5 2 Kilometers

N

IMPORTANT NOTE: Are the BLM land use designations (also called "Multiple-Use Class" available (e.g., Controlled Use, Limited Use, Moderate Use, and Intensive Use)? There are the key land uses that need to be shown in the Study Area. These designations for the Project are would likely be found associated with the BLM California Desert Conservation Area (CDCA) Plan.
Within the BLM jurisdictional areas including the entire Project Study Area, the BLM land use designations are only applicable (i.e., the County's land use designations have no worth on BLM land). Therefore, if need be, the County's LU designations in these areas can be blocked

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

First Solar.
FIRST SOLAR DEVELOPMENT, INC.
1111 BROADWAY ST., 4TH FLR.
OAKLAND, CALIFORNIA 94607
PHONE: (510) 625-7400
WWW.FIRSTSOLAR.COM

PROFESSIONAL ENGR.

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV.	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	07/26/11	ISSUED FOR POD RESUBMITTAL			

6017-0100-23

RH

JT

LAND USES -
PROJECT STUDY AREA

30% DESIGN

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

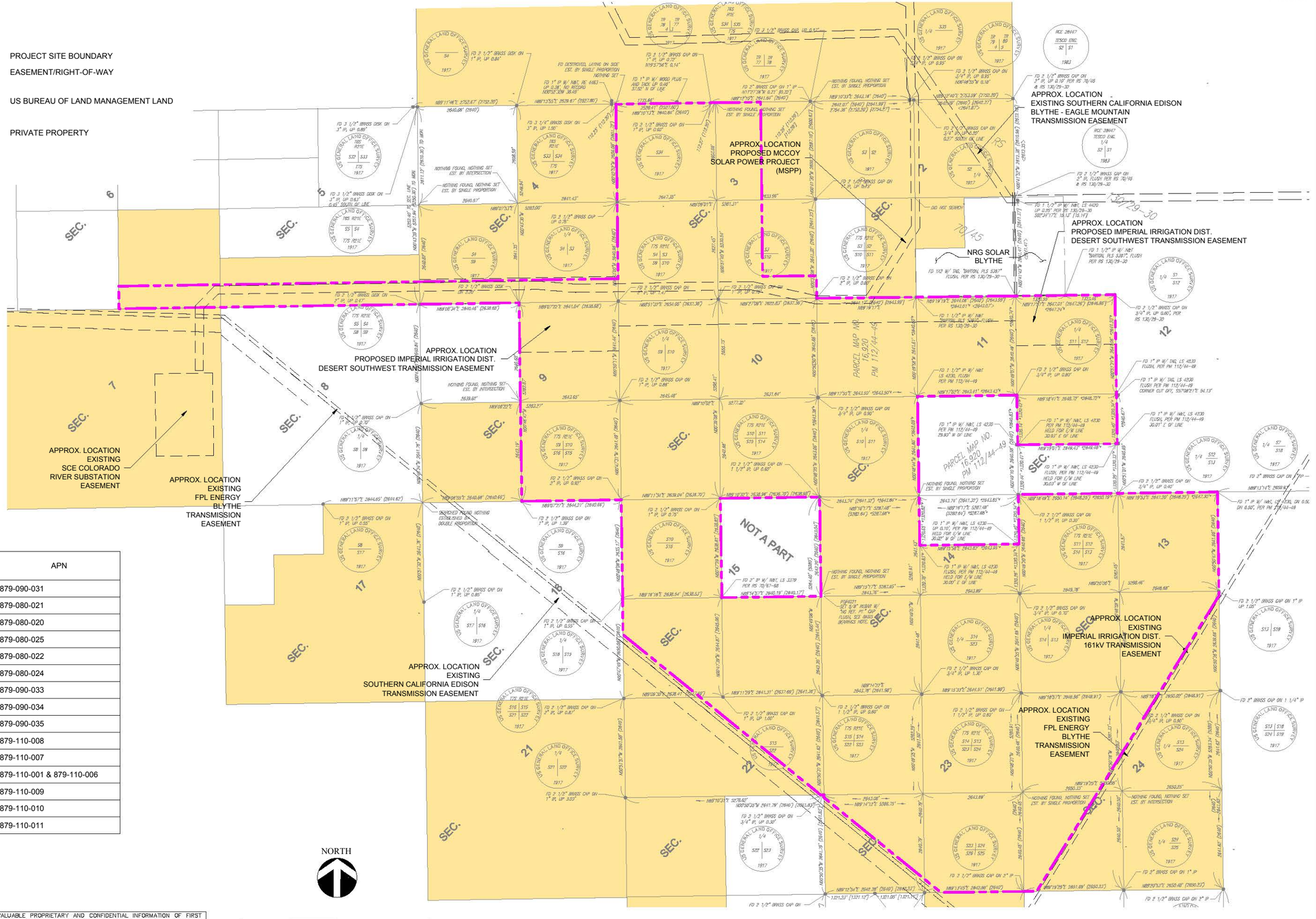
SHEET 5 OF 22

COPYRIGHT © 2011 FIRST SOLAR, INC. ALL RIGHTS RESERVED

V:\Projects\GIS_Proj\FirstSolar\DesertQuartziteSite\deliverables\May2014\Sheet5_LandUsesProjectStudyArea.mxd

LEGEND

- PROJECT SITE BOUNDARY
- EASEMENT/RIGHT-OF-WAY
- US BUREAU OF LAND MANAGEMENT LAND
- PRIVATE PROPERTY



T7S R21E SECTION	APN
3	879-090-031
4	879-080-021
5	879-080-020
6	879-080-025
7	879-080-022
9	879-080-024
10	879-090-033
11	879-090-034
12	879-090-035
13	879-110-008
14	879-110-007
15	879-110-001 & 879-110-006
22	879-110-009
23	879-110-010
24	879-110-011

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: 1"=2500' @ 11"x17" SHEET
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

OWNERSHIP
MAP

30% DESIGN

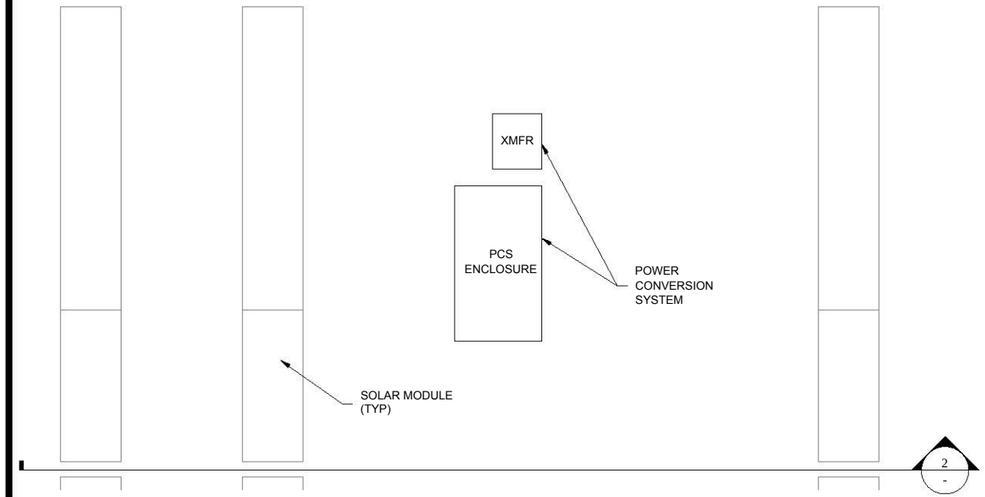
SHEET 6 OF 22

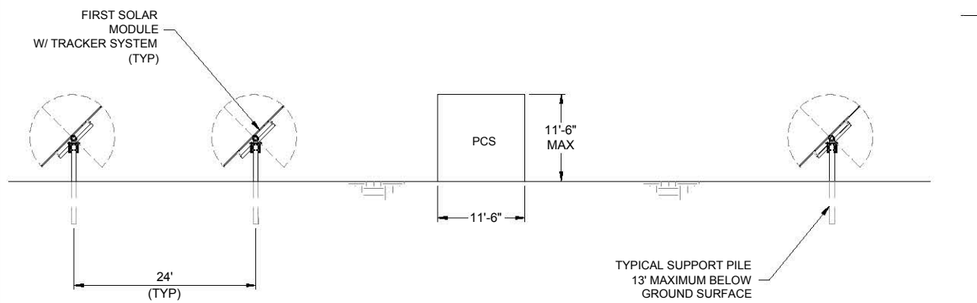
THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

COPYRIGHT © 2011 FIRST SOLAR, INC. ALL RIGHTS RESERVED

T:\ApplicationEngineering\Projects\2010\6017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th V-100-OM-QUART.dwg FS104849 Apr 29, 2014 - 12:09pm

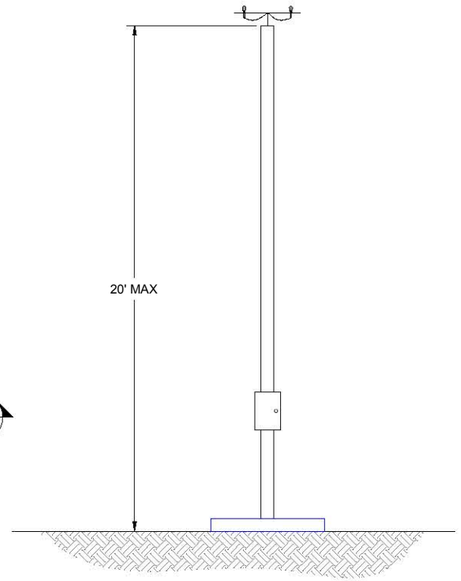




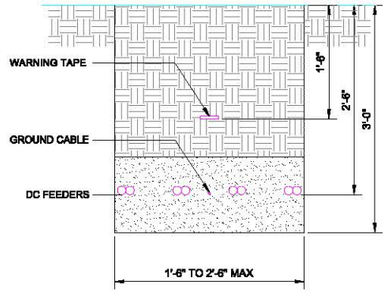
2 ARRAY ELEVATION SIDE VIEW
Scale: NTS

NOTES

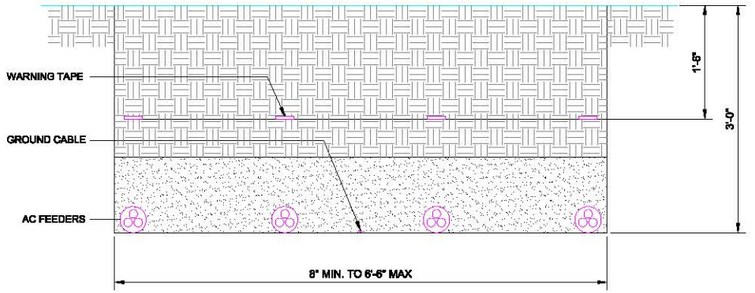
1. DIMENSIONS MAY CHANGE PENDING FINAL DESIGN.



6 ANEMOMETER TOWER AT PERIMETER
Scale: NTS



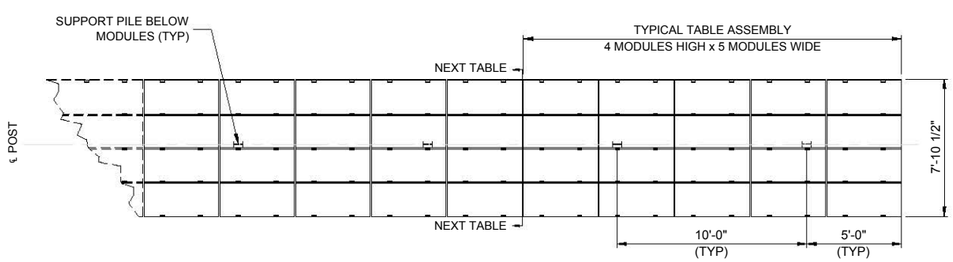
4 TYPICAL DC TRENCH
Scale: NTS



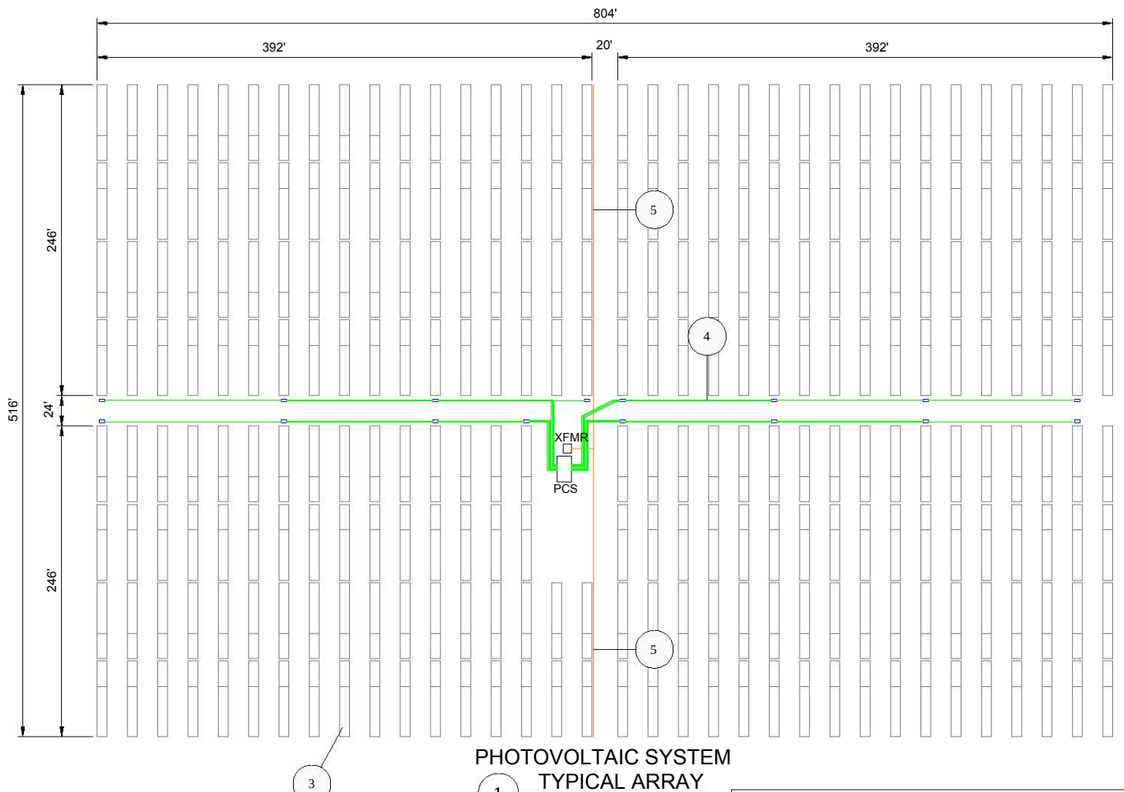
5 TYPICAL AC TRENCH
Scale: NTS

LEGEND

- DIRECT CURRENT (DC) TRENCH
- ALTERNATING CURRENT (AC) TRENCH
- NATIVE SOIL
- CLEAN FILL



3 MODULE ASSEMBLY
Scale: NTS



PHOTOVOLTAIC SYSTEM
1 TYPICAL ARRAY
Scale: NTS

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

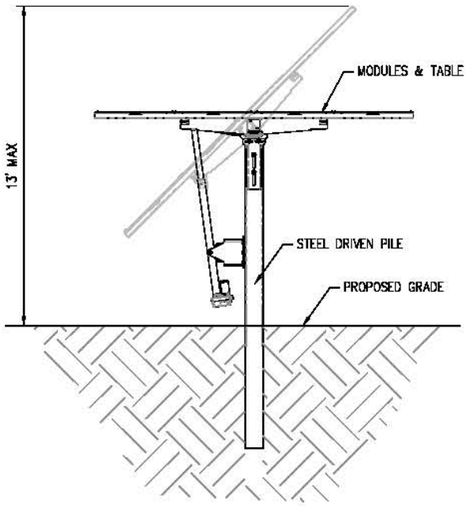
REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	PDD RESUBMITTAL			
B	09-15-11	PDD RESUBMITTAL			
C	04-07-14	PDD RESUBMITTAL			

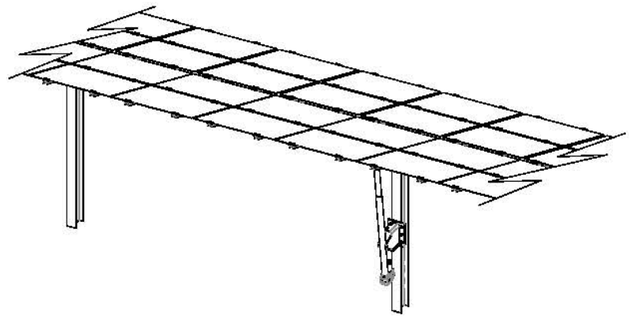
FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE
TYPICAL ARRAY CONFIGURATION

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

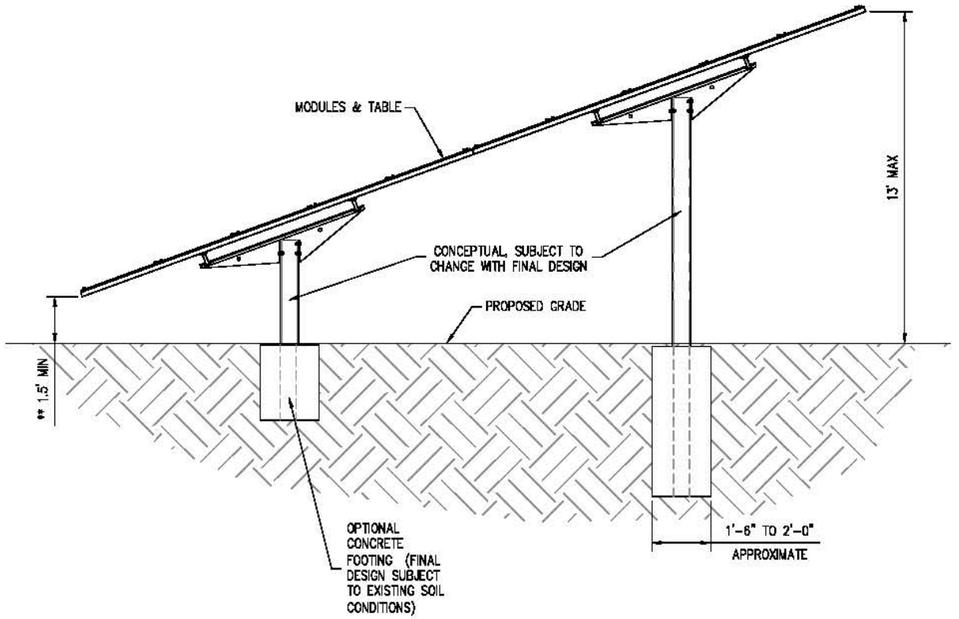
T:\Application\Engineering\Projects\20100617-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th C-200-BC-QUART.dwg FS104849 Apr 29, 2014 - 10:51am



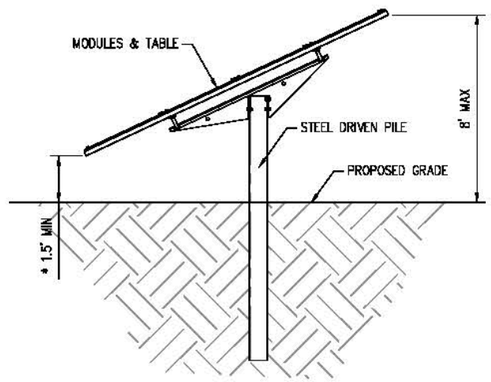


SINGLE AXIS TRACKER

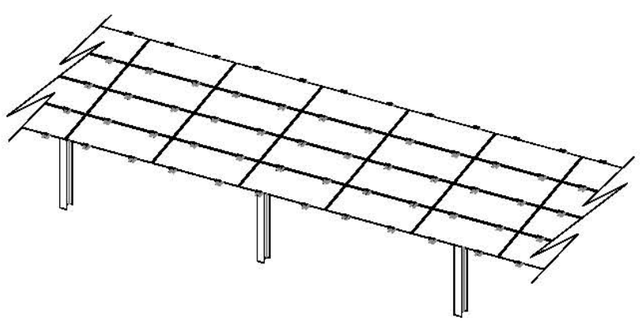
NOT TO SCALE



** NOTE: MINIMUM HEIGHT MAY VARY DUE TO FLOOD CONDITIONS.



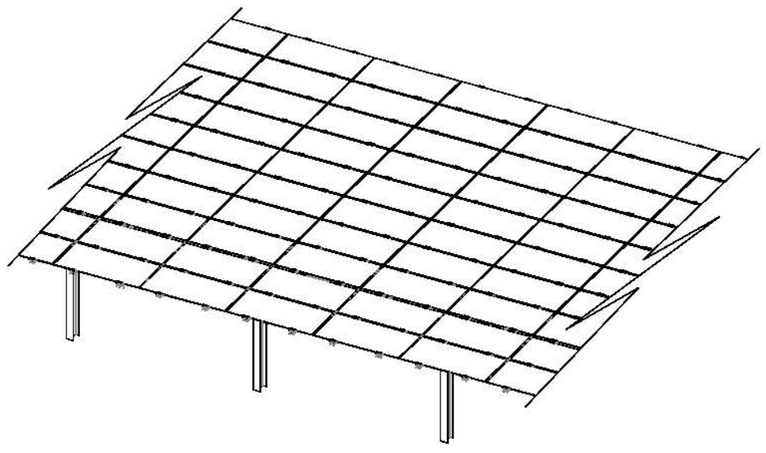
* NOTE: MINIMUM HEIGHT MAY VARY DUE TO FLOOD CONDITIONS.



FOUR HIGH SYSTEM
FIXED TILT

NOT TO SCALE

TABLE SYSTEM INFORMATION		
TYPE	ROW SPACING	ROW ORIENTATION
FIXED	14'-0" TO 16'-0"	EAST-WEST
TRACKER	16'-0" TO 22'-0"	NORTH-SOUTH
TEN HIGH	22'-0"	EAST-WEST



TEN HIGH SYSTEM
FIXED TILT

NOT TO SCALE

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

First Solar.
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	06-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

TYPICAL
MOUNTING SYSTEMS

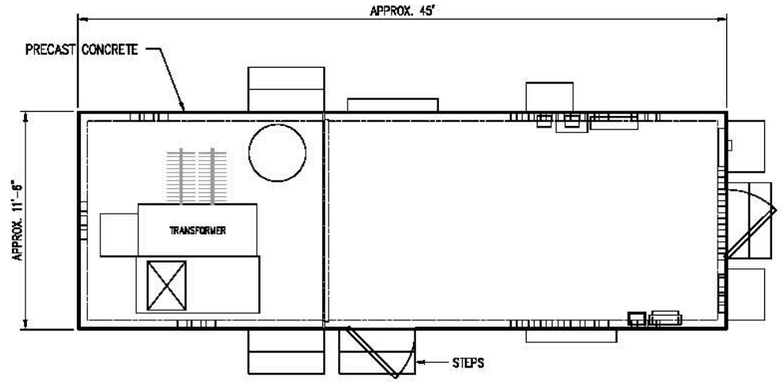
THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

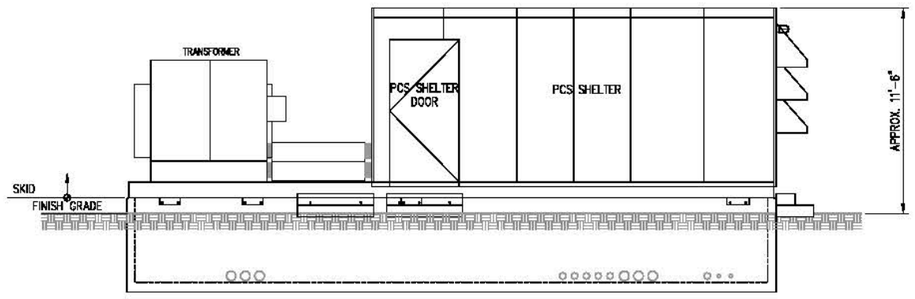
T:\Application\Engineering\Projects\2010\09017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th C-102-M6-QUART.dwg FS9104648 May 07, 2014 - 9:24am

NOTES

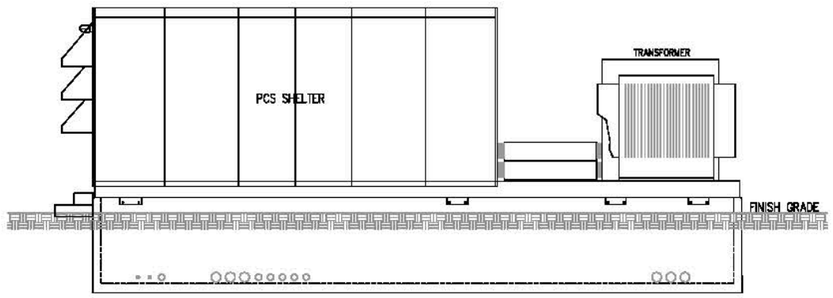
1. DIMENSIONS MAY CHANGE PENDING FINAL DESIGN.
2. PAD ELEVATION TO VARY BASED ON EXISTING WATER SURFACE ELEVATION.



1 TYPICAL PCS FLOOR PLAN
Scale: NONE



2 FRONT VIEW SECTION
Scale: NONE



3 REAR VIEW SECTION
Scale: NONE

First Solar.
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE
POWER CONVERSION SYSTEM

SHEET 8 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

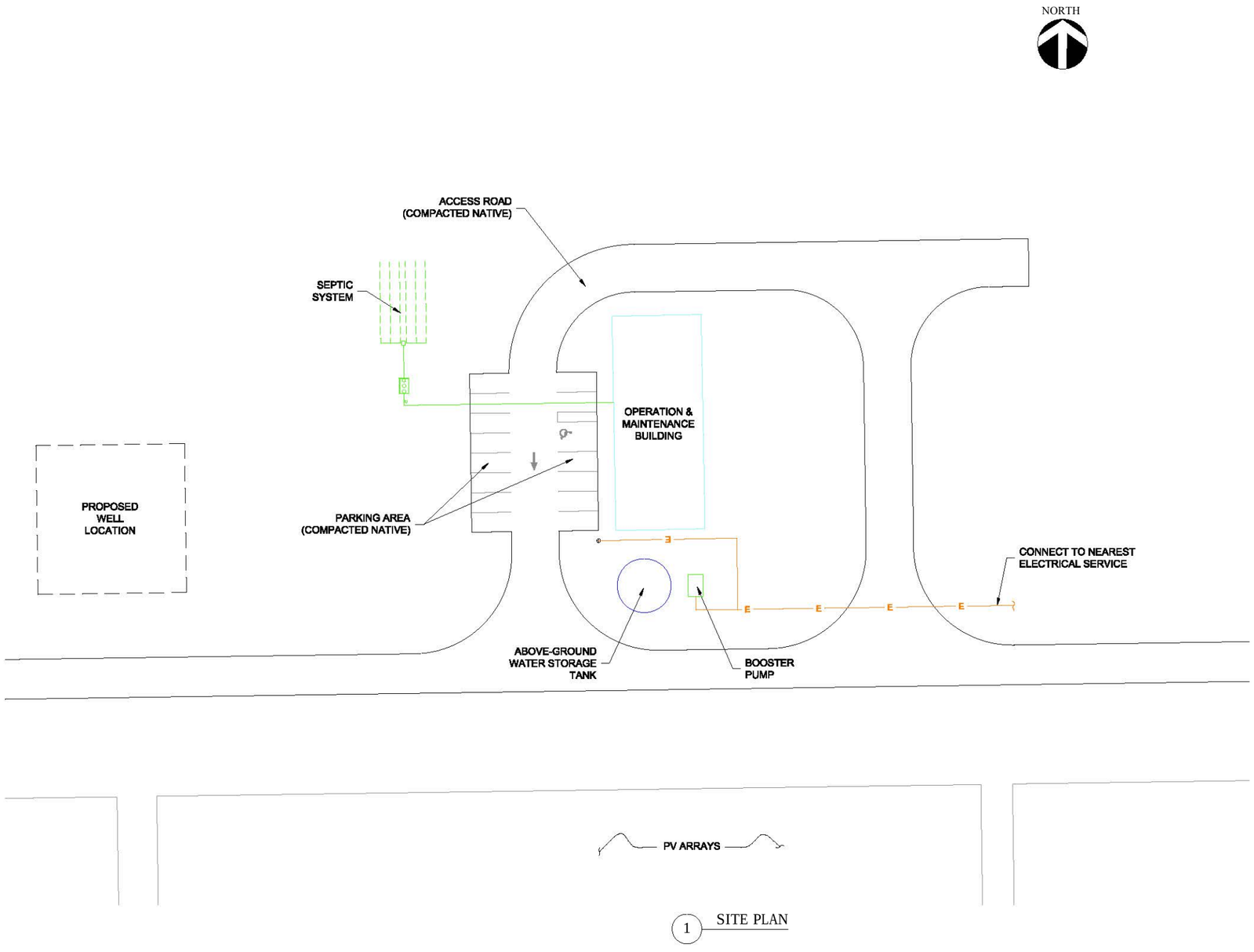
THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

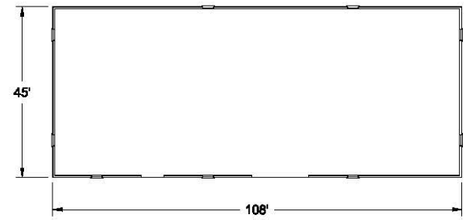
C:\Desert Quartzite\POD\Site Plan Package\4C-201 PC-QUART.dwg FS104349 May 01, 2014 - 4:39pm

NOTES

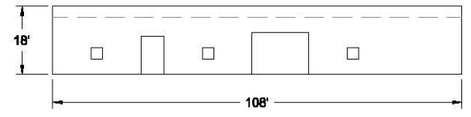
1. DIMENSIONS MAY CHANGE PENDING FINAL DESIGN.



1 SITE PLAN



OPERATION & MAINTENANCE BLDG.
2 CONCEPTUAL FLOOR PLAN



3 SECTION

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE
CONCEPTUAL OPERATION AND MAINTENANCE (O&M) FACILITY

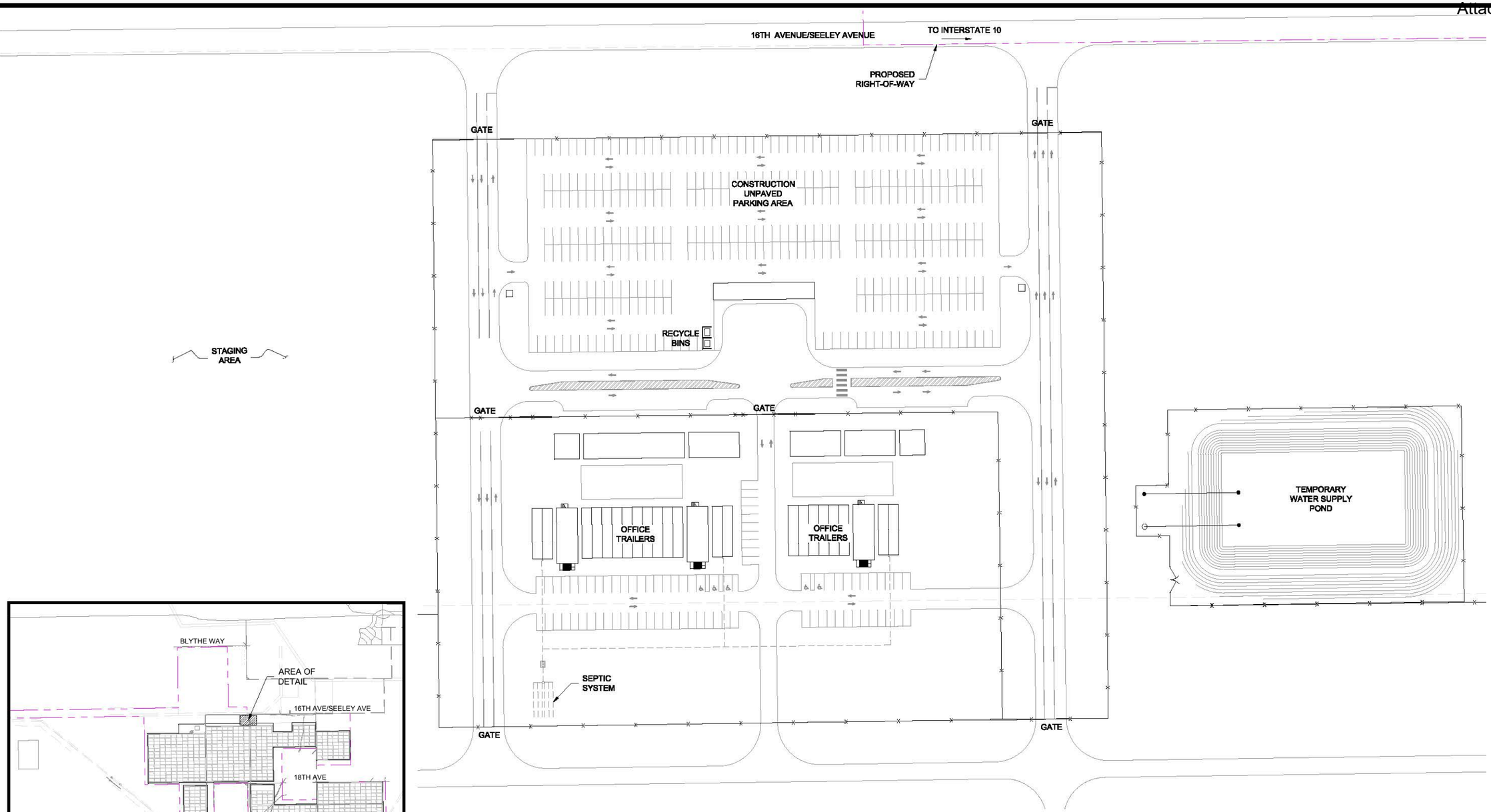
SHEET 9 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

T:\ApplicationEngineering\Projects\20100\6017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th C-202-OM-QUART.dwg FS104849 Apr 29, 2014 - 10:54am



KEY MAP

NOT TO SCALE

NORTH

240' 120' 0 240'

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

First Solar

FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV.	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:

PROJ. DEVT. ENGR: RH

PROJ. MGR:

SCALE: AS SHOWN

COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

PRELIMINARY
MOVE-ON AREA
PLAN

SHEET 10 OF 22

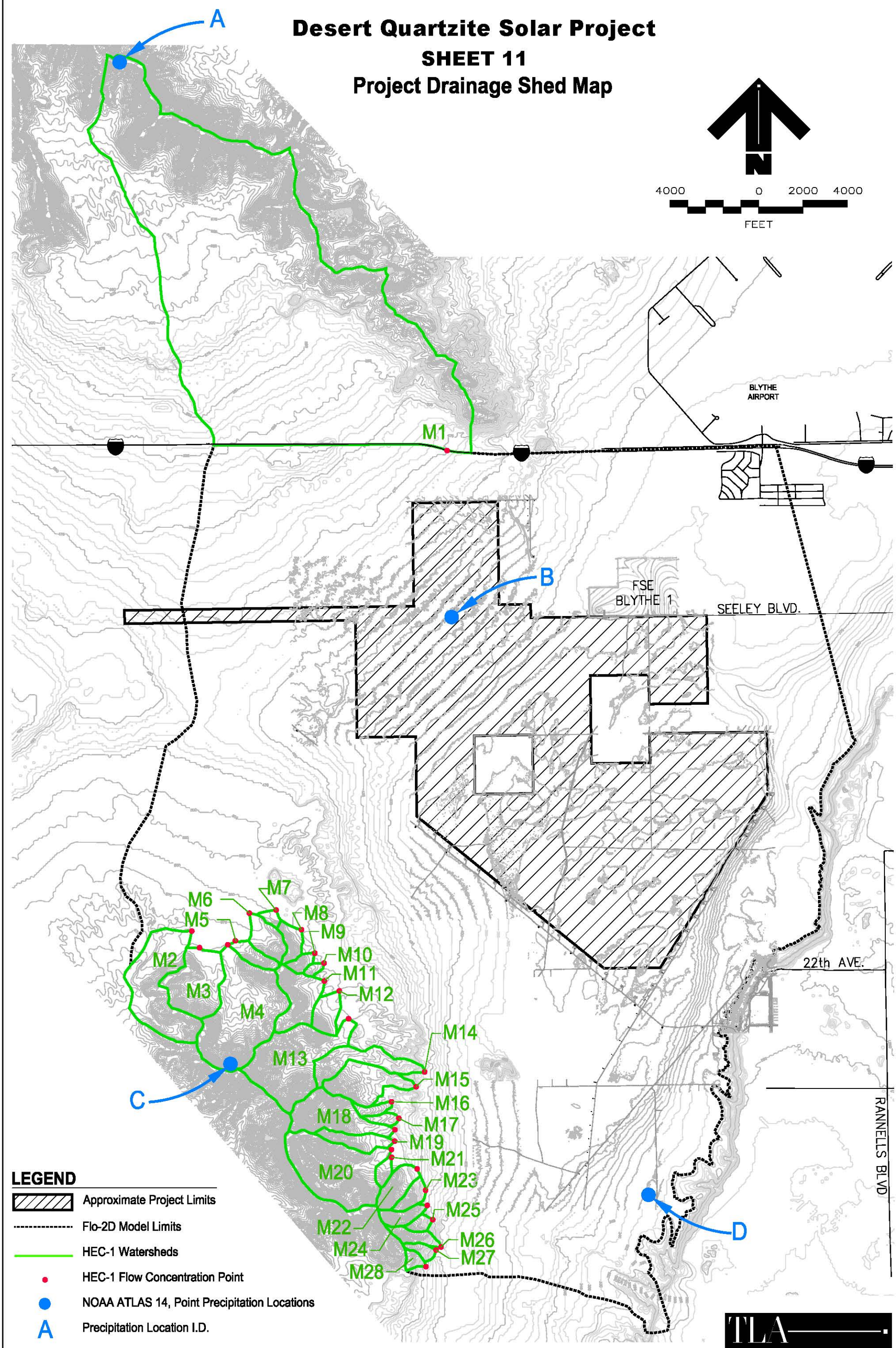
COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

T:\Application\Engineering\Projects\20106017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th C-501-CP-QUART.dwg FS104849 Apr 29, 2014 - 10:56am

Desert Quartzite Solar Project

SHEET 11

Project Drainage Shed Map



TLA ENGINEERING & PLANNING

AR060717

File: K:\1pro\14XX\1468\Drainage\2011 Riverside Method Report\Exhibits\Fig-03 Project Drainage Shed Map.dwg Aug 04, 2011 - 12:52pm jhenderson

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A Cross section line

23 — 23 Transect line

97°07'30", 32°22'30" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

$^{42}75^{000m}$N 1000-meter Universal Transverse Mercator grid ticks, zone 13

6000000 FT 5000-foot grid ticks: South Dakota State Plane coordinate system, south zone (FIPSZONE 4002), Lambert Conformal Conic

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

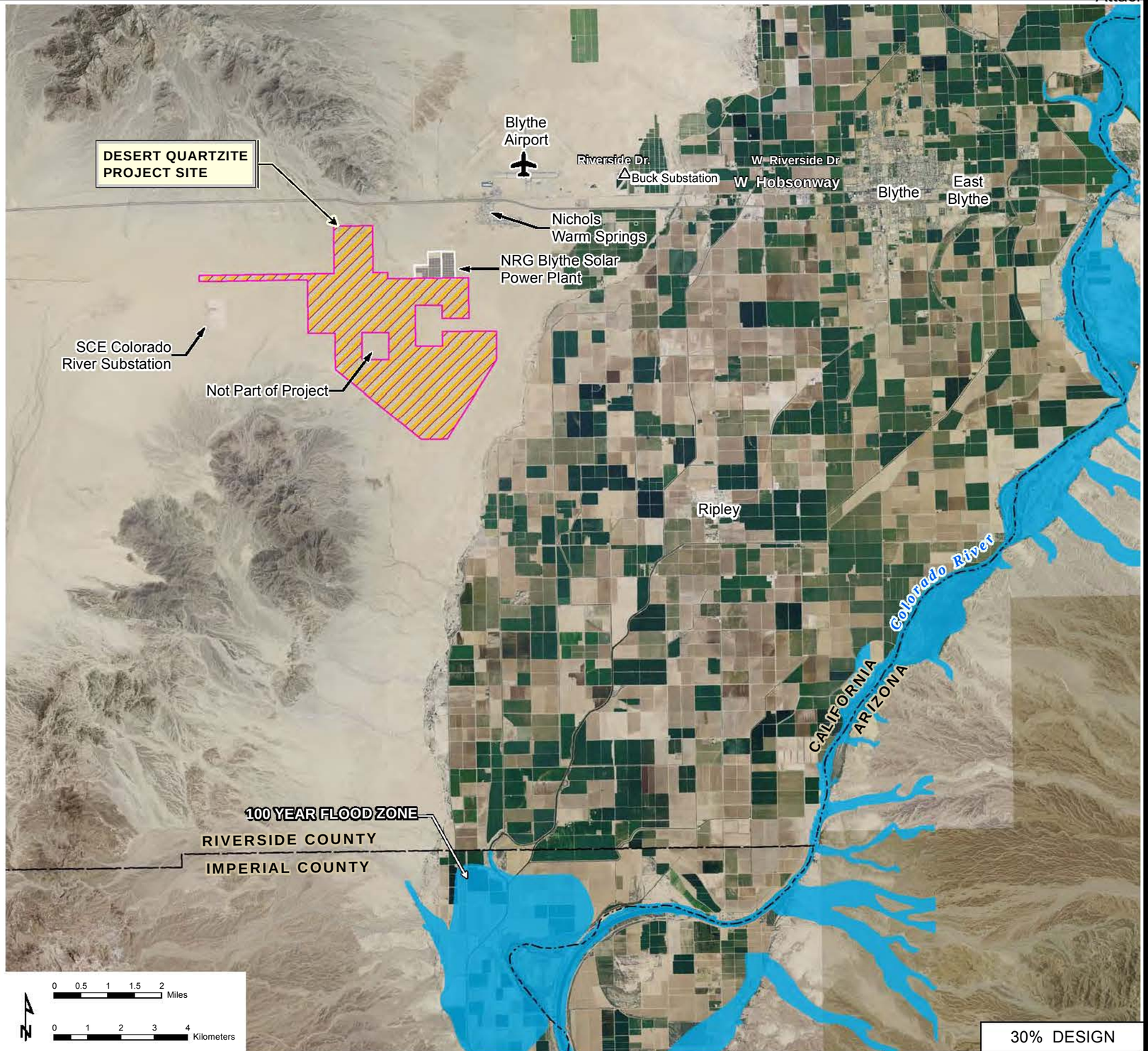
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.



First Solar.
FIRST SOLAR DEVELOPMENT, INC.
1111 BROADWAY ST., 4TH FLR.
OAKLAND, CALIFORNIA 94607
PHONE: (510) 625-7400
WWW.FIRSTSOLAR.COM

PROFESSIONAL ENGR.

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	ASP
A	07/29/11	ISSUED FOR POD RESUBMITTAL			

6017-0100-23

RH

JT

FEMA FLOOD HAZARD MAP

30% DESIGN

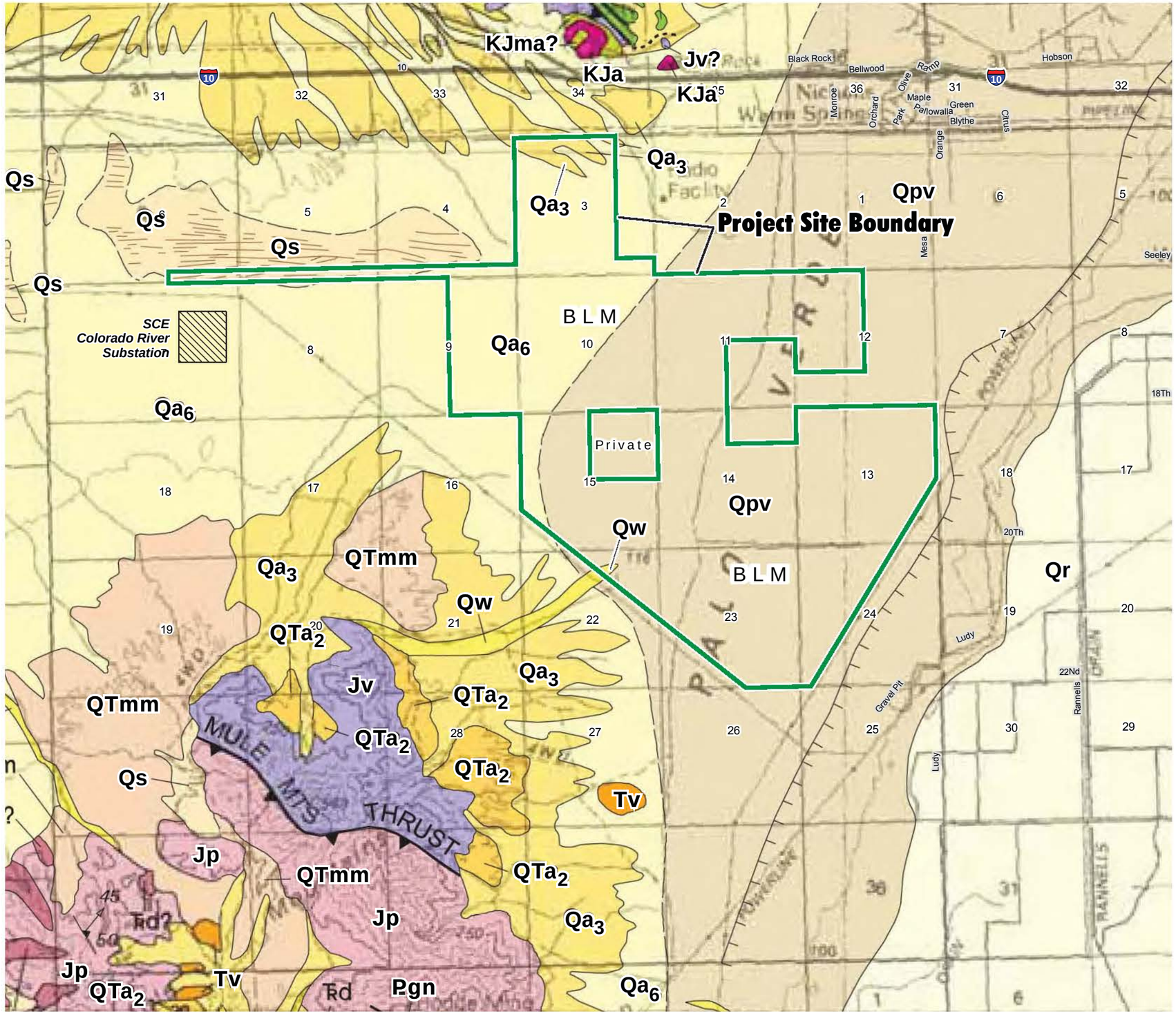
THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

SHEET 12 OF 22

COPYRIGHT © 2011 FIRST SOLAR, INC. ALL RIGHTS RESERVED

V:\Projects\GIS_Proj\FirstSolar\DesertQuartziteSite\deliverables\May2014\Sheet12_FEMA_FloodHazardMap.mxd

T:\Ladd\FirstSolar\DesertQuartzite\811-278B



Legend

Project site boundary

List of Project Site Map Units

Qw – Alluvium of modern washes (Holocene)

Qs – Eolian sand (Holocene)(brown lines mark dune crests)

Qa_3 – Alluvial fan and valley deposits (Unit 3) (Holocene to Pleistocene)

Qa_6 - Alluvial fan and alluvial valley deposits (Unit 6) (Holocene)

Qpv – Alluvial deposits of Palo Verde Mesa (Pleistocene)

Note:
See Sheet 13A for a complete list of map units

Source:
U.S.G.S 1:100,000 Geologic Map of the West Half of the Blythe 30'x60' quadrangle, Riverside Co., CA & La Paz Co., AZ, dated 1988-1990 & 2004. Digital basemap by Techni Graphic Systems, Inc., and Paul Stone.

0 0.25 0.5 0.75 1 Miles

0 1,000 2,000 3,000 4,000 5,000 Feet

NORTH

First Solar.
FIRST SOLAR DEVELOPMENT, INC.
1111 BROADWAY ST., 4TH FLR.
OAKLAND, CALIFORNIA 94607
PHONE: (510) 628-7400
WWW.FIRSTSOLAR.COM

PROFESSIONAL ENGR.

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

DEV. DATE	DESIGN DESCRIPTION	BY CHK APP

FS JOB No: 6017-0100-23
DRAWN BY: LP DESIGN BY:
PROJ. ENG: CB PROJ. MGR: JB
CHECKED BY: RH PROJ. DIR: JT
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR
SHEET TITLE

GEOLOGIC MAP

V-102

SHEET 13 OF 22

30% DESIGN

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT (UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DRIVATIVE WORKS, DISRTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

COPYRIGHT © 2009 FIRST SOLAR, INC. ALL RIGHTS RESERVED

T:\Ladd\FirstSolar\DesertQuartzite\811-288

List of Map Units

Qw	Alluvium of modern washes (Holocene)
Qr	Alluvium of the modern Colorado River flood plain (Holocene)
Qp	Playa lake deposits (Holocene)
Qs	Eolian sand (Holocene)—Brown lines mark dune crests
	Alluvial-fan and alluvial-valley deposits (Holocene to Miocene)
Qa_6	Unit 6 (Holocene)
Qa_5	Unit 5 (Holocene)
Qa_4	Unit 4 (Holocene and Pleistocene)
Qa_3	Unit 3 (Holocene and Pleistocene)
QTa_2	Unit 2 (Pleistocene to Miocene)
Ta_1	Unit 1 (Miocene)
	Alluvial deposits of the ancestral Colorado River (Pleistocene and Pliocene)
Qpv	Alluvial deposits of Palo Verde Mesa (Pleistocene)
Qbm	Alluvial deposits east of the Big Maria Mountains (Pleistocene)
Qbmg	Gravel-dominated deposits
Qbms	Sand-dominated deposits
QTmm	Alluvial deposits of the Mule Mountains (Pleistocene or Pliocene)
QTmw	Alluvial deposits of the McCoy Wash area (Pleistocene and/or Pliocene
QTe	Alluvial deposits of the Ehrenberg area (Pleistocene and/or Pliocene)
QTes	Sand-dominated deposits
	Bouse Formation (Pliocene and/or Miocene)
Tbs	Fine-grained clastic sedimentary rocks
Tbl	Limestone
Tbx	Sedimentary breccia (Miocene and Oligocene?)
Tsb	Slide blocks (Miocene and Oligocene?)
Tfbx	Fanglomerate, sedimentary breccia, and slide blocks, undivided (Mioc and Oligocene?)
Ti	Felsic intrusive rocks (Miocene and Oligocene?)
Tv	Volcanic rocks (Miocene and Oligocene?)
Kgp	Gneissic porphyritic granite (Cretaceous)
Ka	Andesite (Cretaceous or Jurassic)
	McCoy Mountains Formation (Cretaceous and Jurassic?)
Kml	Member L (Cretaceous)
Kmk	Member K (Cretaceous)
Kmj	Member J (Cretaceous)
Kmi	Member I (Cretaceous)
Kmh	Member H (Cretaceous)
Kmg	Member G (Cretaceous)
Kmf	Member F (Cretaceous)
Kme	Member E (Cretaceous)
Kmd	Member D (Cretaceous)
Kmc	Member C (Cretaceous)
KJmb	Member B (Cretaceous or Jurassic)
KJma	Member A (Cretaceous or Jurassic)
JTu	Volcanic and sedimentary rocks, undivided (Jurassic and Triassic)
Jv	Volcanic rocks (Jurassic)
Jp	Plutonic rocks (Jurassic)
Jpgd	Foliated granodiorite and diorite
Jpgb	Hornblende gabbro
JTrs	Sedimentary rocks (Jurassic and Triassic)
Trqm	Quartz monzonite and monzodiorite (Triassic)
Trd	Diorite and gabbro (Triassic?)
PzS	Sedimentary rocks, undivided (Paleozoic)
P€s	Sedimentary rocks (Permian to Cambrian)
PIPs	Sedimentary rocks (Permian and Pennsylvanian)
M€s	Sedimentary rocks (Mississippian to Cambrian)
Xpg	Porphyritic granite and augen gneiss (Proterozoic)
Xgn	Gneiss and amphibolite (Proterozoic)
	UNITS OF MIXED OR UNCERTAIN AGE
MzPgn	Gneissic rocks, undivided (Mesozoic and Proterozoic)
MzPs	Schist (Mesozoic or Proterozoic)
MzPfg	Fine-grained gneiss (Mesozoic or Proterozoic)

Source:
U.S.G.S 1:100,000 Geologic Map of the West Half of the Blythe 30'x60' quadrangle, Riverside Co., CA & La Paz Co., AZ, dated 1988-1990 & 2004. Digital basemap by Techni Graphic Systems, Inc., and Paul Stone.

First Solar.
FIRST SOLAR DEVELOPMENT, INC.
1111 BROADWAY ST., 4TH FLR.
OAKLAND, CALIFORNIA 94607
PHONE: (510) 628-7400
WWW.FIRSTSOLAR.COM

PROFESSIONAL ENGR.

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP

FS JOB No: 6017-0100-23
DRAWN BY: LP DESIGN BY:
PROJ. ENG: GB PROJ. MGR: JB
CHECKED BY: RH PROJ. DIR: JT
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR
SHEET TITLE

GEOLOGIC MAP UNITS

V-102

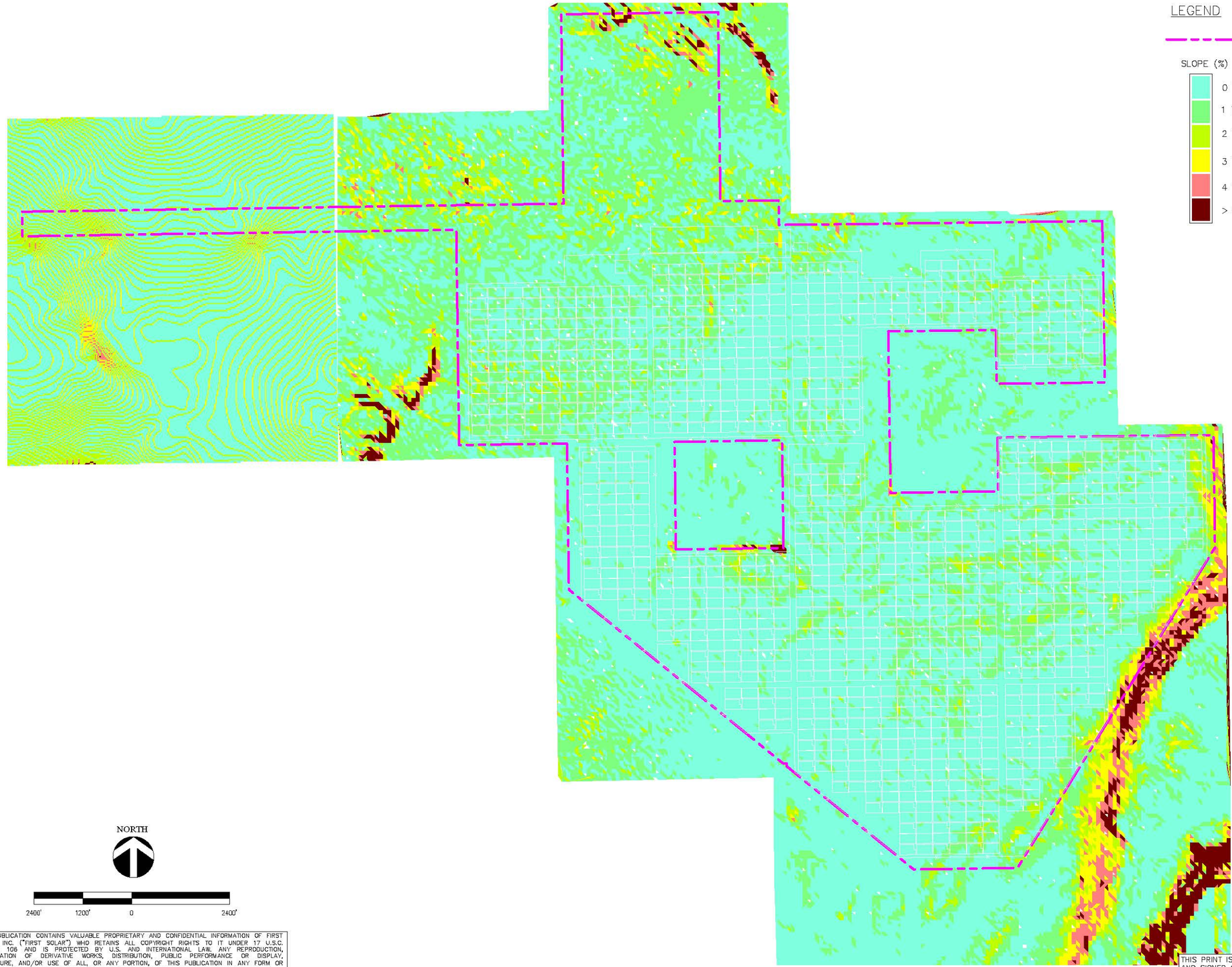
SHEET 13A OF 22

30% DESIGN

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT (UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DRIVATIVE WORKS, DIRSTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL , OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

COPYRIGHT © 2010 FIRST SOLAR, INC. ALL RIGHTS RESERVED



First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: 1"= 2400' @ 11"X17" SHEET
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

PRELIMINARY
EXISTING
GROUND SLOPE
ANALYSIS

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

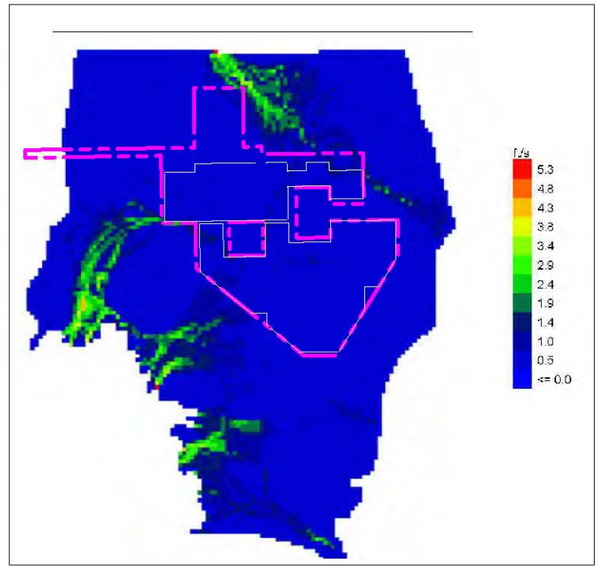
AR060721
COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

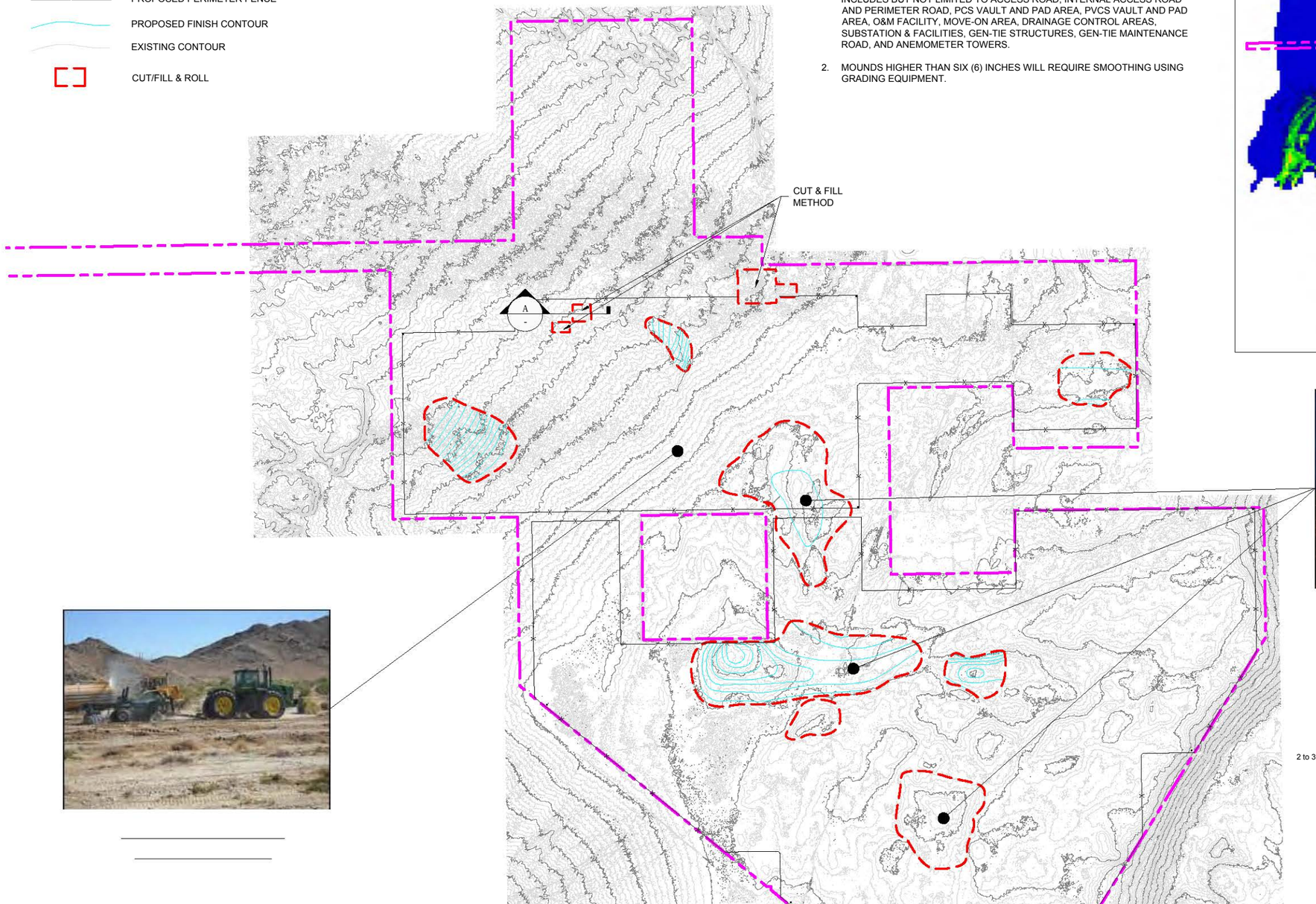
T:\Application\Engineering\Projects\20106017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th C-400-GD-QUART.dwg FS104849 Apr 29, 2014 - 11:00am

LEGEND

- PROPOSED PROJECT SITE BOUNDARY
- PROPOSED PERIMETER FENCE
- PROPOSED FINISH CONTOUR
- EXISTING CONTOUR
- CUT/FILL & ROLL

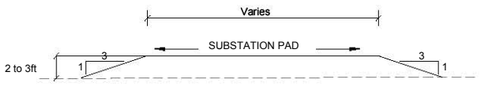
1. PROJECT INFRASTUCTURE SHALL BE CONVENTIONALLY GRADED AND COMPACTED PER ENGINEERING SPECIFICATIONS. INFRASTRUCTURE INCLUDES BUT NOT LIMITED TO ACCESS ROAD, INTERNAL ACCESS ROAD AND PERIMETER ROAD, PCS VAULT AND PAD AREA, PVCS VAULT AND PAD AREA, O&M FACILITY, MOVE-ON AREA, DRAINAGE CONTROL AREAS, SUBSTATION & FACILITIES, GEN-TIE STRUCTURES, GEN-TIE MAINTENANCE ROAD, AND ANEMOMETER TOWERS.
2. MOUNDS HIGHER THAN SIX (6) INCHES WILL REQUIRE SMOOTHING USING GRADING EQUIPMENT.







CUT AND FILL METHOD



NOTE:

PAD ELEVATION TO VARY BASED ON EXISTING WATER SURFACE ELEVATION.

NORTH

2400' 1200' 0 2400'

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: 1"=2400' @ 11"x17" SHEET
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

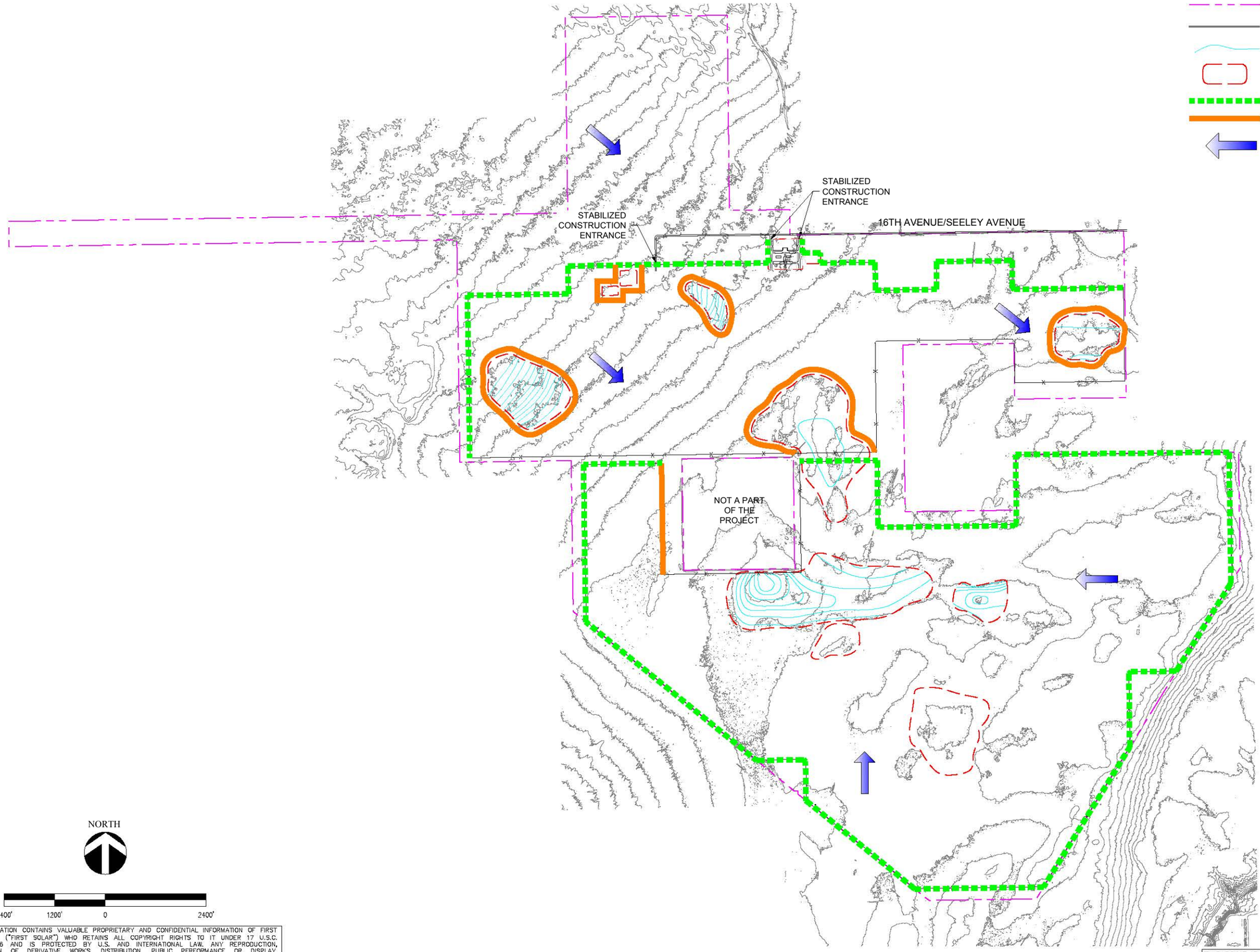
PRELIMINARY GRADING AND COMPACTION PLAN

SHEET 15 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

C:\Desert Quartzite\POD\Site Plan Package\C-401-GD-QUART.dwg FS104949 May 01, 2014 - 2:00pm



First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: 1"=2400' @ 11"x17" SHEET
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE

PRELIMINARY EROSION CONTROL PLAN

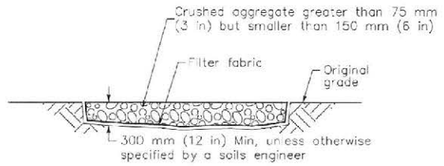
THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

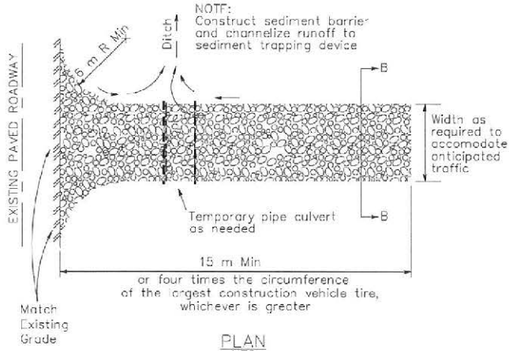
COPYRIGHT © 2011 FIRST SOLAR, INC. ALL RIGHTS RESERVED

C:\Desert Quartzite\POD\Site Plan Package\C-402-EC-QUART.dwg FS104849 May 01, 2014 - 1:44pm

Stabilized Construction Entrance/Exit TC-1



SECTION B–B
NTS



PLAN
NTS

Stabilized Contraction Entrance/Exit (Type 1)

Caltrans Storm Water Quality Handbooks
Construction Site Best Management Practices Manual
March 1, 2003

Section 6
Stabilized Construction Entrance/Exit TC-1
3 of 4

1 STABILIZED CONSTRUCTION ENTRANCE

NOT TO SCALE

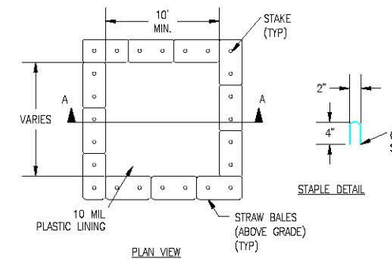
NOTES:
CONCRETE WASHOUT AREA SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT ON–SITE.

THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

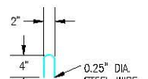
ACTUAL LAYOUT DETERMINED IN FIELD.

THE CONCRETE WASHOUT AREA SHALL BE REPAIRED AND ENLARGED OR CLEANED OUT AS NECESSARY TO MAINTAIN CAPACITY FOR WASTED CONCRETE.

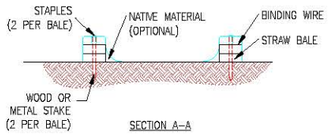
WHEN CONCRETE WASHOUT AREA IS REMOVED, THE DISTURBED AREA SHALL BE SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER ACCEPTED BY RIVERSIDE COUNTY.



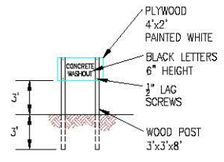
PLAN VIEW



STAPLE DETAIL



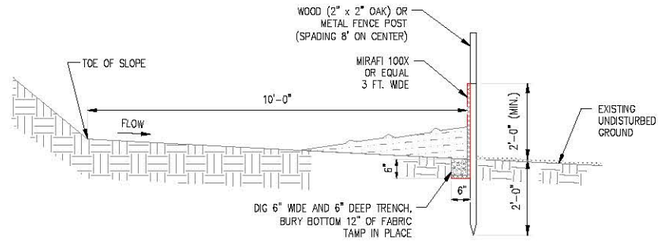
SECTION A–A



CONCRETE WASHOUT SIGN DETAIL

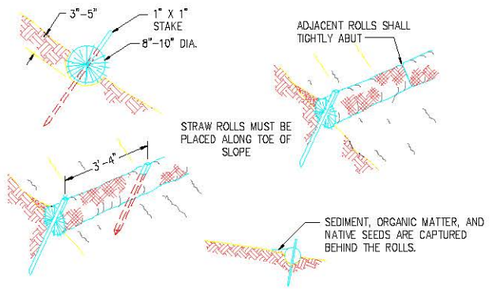
2 CONCRETE WASHOUT AREA
(CONTRACTOR TO DETERMINE LOCATION ON SITE)

NOT TO SCALE



3 SILT FENCE

NOT TO SCALE



NOTES:

1. PREPARE THE SLOPE BEFORE THE WATTLING PROCEDURE IS STARTED.
2. DIG SMALL TRENCHES ACROSS THE SLOPE ON CONTOUR, TO PLACE ROLLS IN. THE TRENCH SHOULD BE DEEP ENOUGH TO ACCOMMODATE HALF THE THICKNESS OF THE ROLL, WHEN THE SOIL IS LOOSE AND UNCOMPACTED, THE TRENCH SHOULD BE DEEP ENOUGH TO BURY THE ROLL 2/3 OF ITS THICKNESS BECAUSE THE GROUND WILL SETTLE.
3. INSTALL ROLLS PERPENDICULAR TO WATER MOVEMENT.
4. START AT THE BOTTOM OF THE SLOPE AND WORK UP.
5. CONSTRUCT TRENCH AT CONTOUR INTERVALS OF 12 FEET APART.
6. USE STRAIGHT BAR TO DRIVE HOLES THROUGH THE WATTLE AND INTO THE SOIL.
7. MAKE SURE NO GAPS EXIST BETWEEN THE SOIL AND THE STRAW WATTLE.
8. DRIVE THE STAKE THROUGH THE PREPARED HOLE INTO THE SOIL. LEAVE ONLY 1 OR 2 INCHES OF STAKE EXPOSED ABOVE ROLL. INSTALL STAKE EVERY 4 FEET APART THROUGH THE WATTLE. ADDITIONAL STAKES MAY BE DRIVEN ON THE DOWNSLOPE SIDE OF THE TRENCHES ON HIGHLY EROSIVE OR VERY STEEP SLOPES.
9. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.

4 FIBER ROLL

NOT TO SCALE

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: NONE
COPYRIGHT BY: FIRST SOLAR, INC.

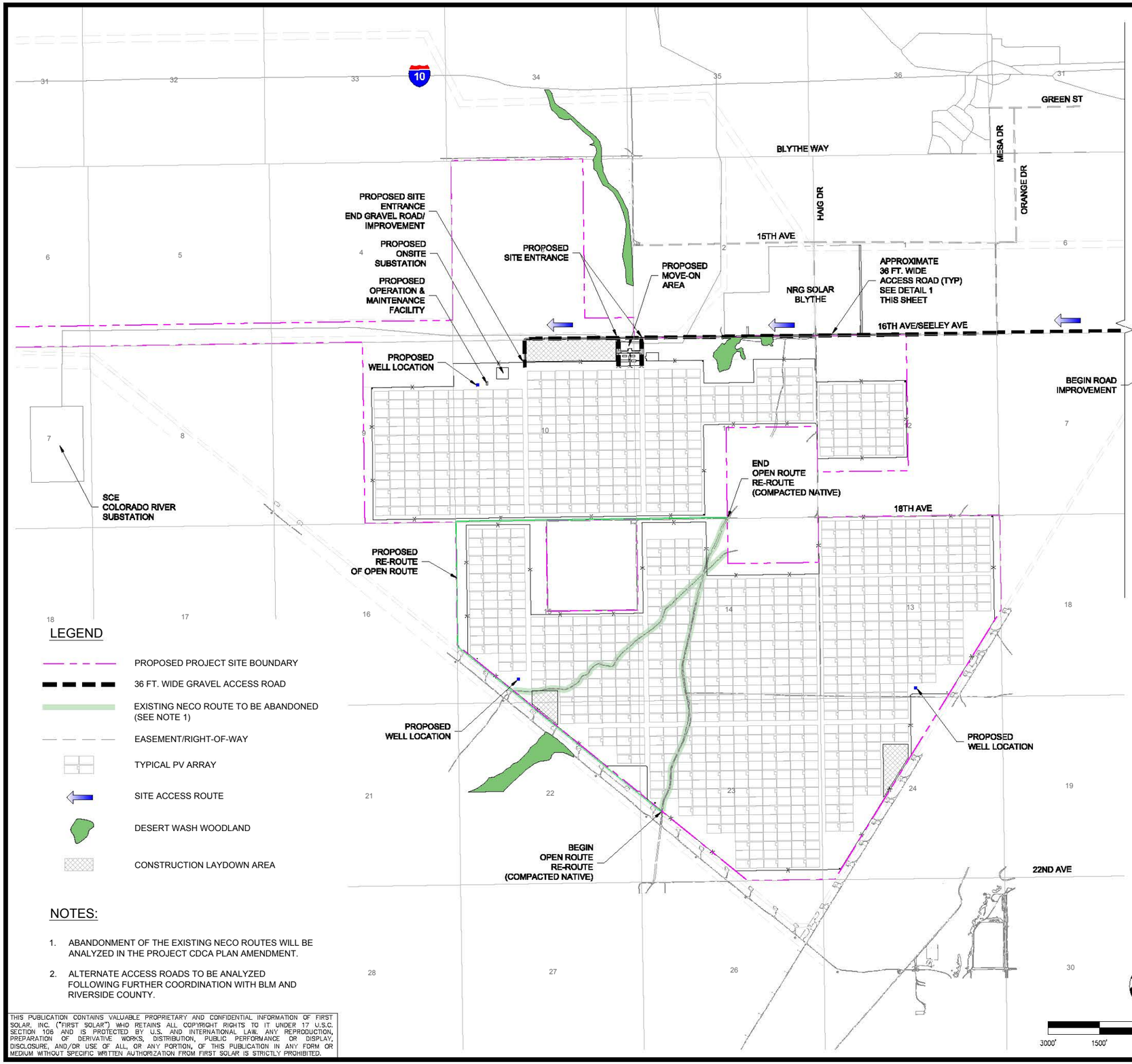
SHEET TITLE
PRELIMINARY EROSION CONTROL DETAILS

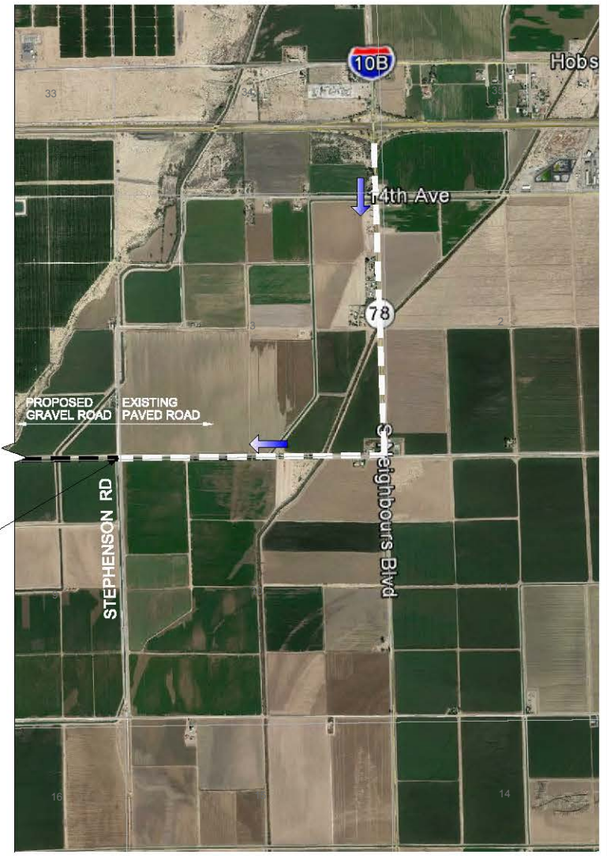
SHEET 17 OF 22

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

T:\Application\Engineering\Projects\20100617-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\Sht C-403-EC-QUART.dwg FS104849 Apr 29, 2014 - 11:10am



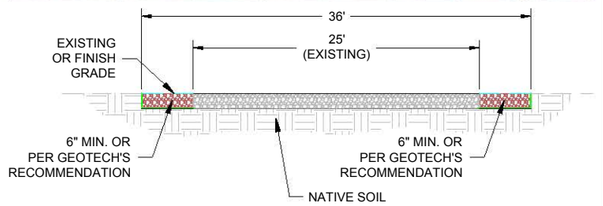


LEGEND

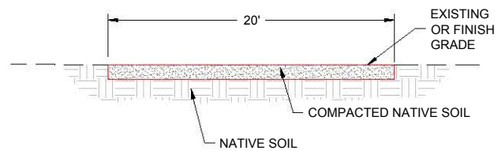
- PROPOSED PROJECT SITE BOUNDARY
- 36 FT. WIDE GRAVEL ACCESS ROAD
- EXISTING NECO ROUTE TO BE ABANDONED (SEE NOTE 1)
- EASEMENT/RIGHT-OF-WAY
- TYPICAL PV ARRAY
- SITE ACCESS ROUTE
- DESERT WASH WOODLAND
- CONSTRUCTION LAYDOWN AREA

NOTES:

1. ABANDONMENT OF THE EXISTING NECO ROUTES WILL BE ANALYZED IN THE PROJECT CDCA PLAN AMENDMENT.
2. ALTERNATE ACCESS ROADS TO BE ANALYZED FOLLOWING FURTHER COORDINATION WITH BLM AND RIVERSIDE COUNTY.



GRAVEL ACCESS ROAD
CROSS SECTION WHERE APPLICABLE (1)
Scale: NONE



NATIVE SOIL ONSITE ROAD
CROSS SECTION WHERE APPLICABLE (2)
Scale: NONE

NORTH

3000' 1500' 0 3000'

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 108 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

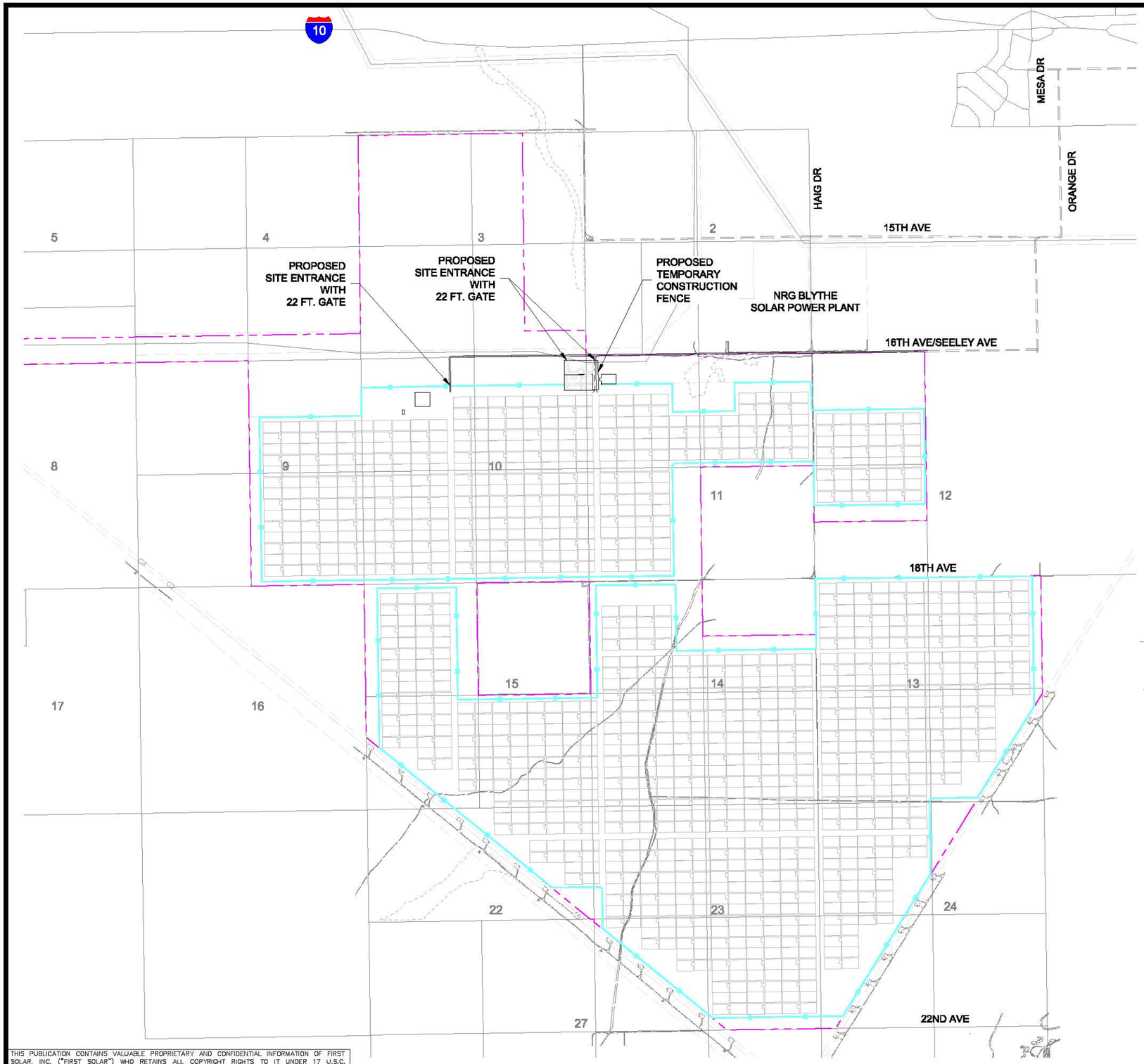
FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: AS SHOWN
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE
PRELIMINARY ACCESS ROAD PLAN

SHEET 18 OF 22

C:\Desert Quartzite\POD\Site Plan Package\C-600-RL-QUART.dwg FS104849 May 02, 2014 - 2:12pm

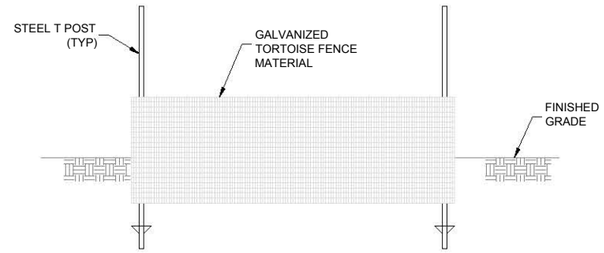
COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED



LEGEND

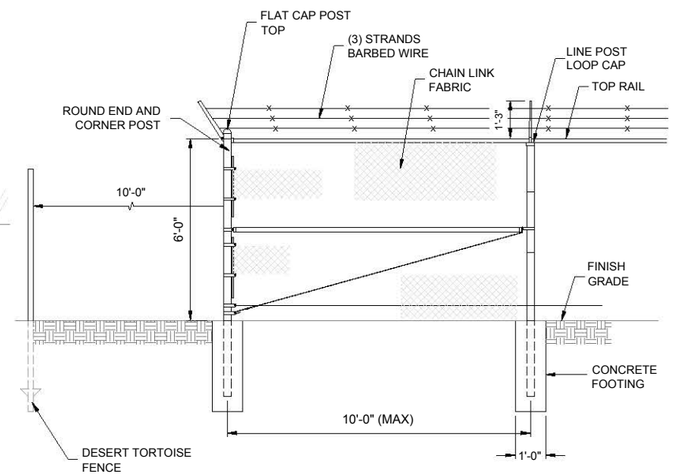
PROPOSED PROJECT SITE BOUNDARY

CHAIN LINK FENCE



DESERT TORTOISE EXCLUSION FENCE

SCALE: N.T.S



6 FT. HIGH CHAIN LINK FENCE W/ BARBED WIRE TOP

SCALE: N.T.S

NORTH

2500' 1250' 0 2500'

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

First Solar

FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:

PROJ. DEVT. ENGR: RH

PROJ. MGR:

SCALE: AS SHOWN

COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE:

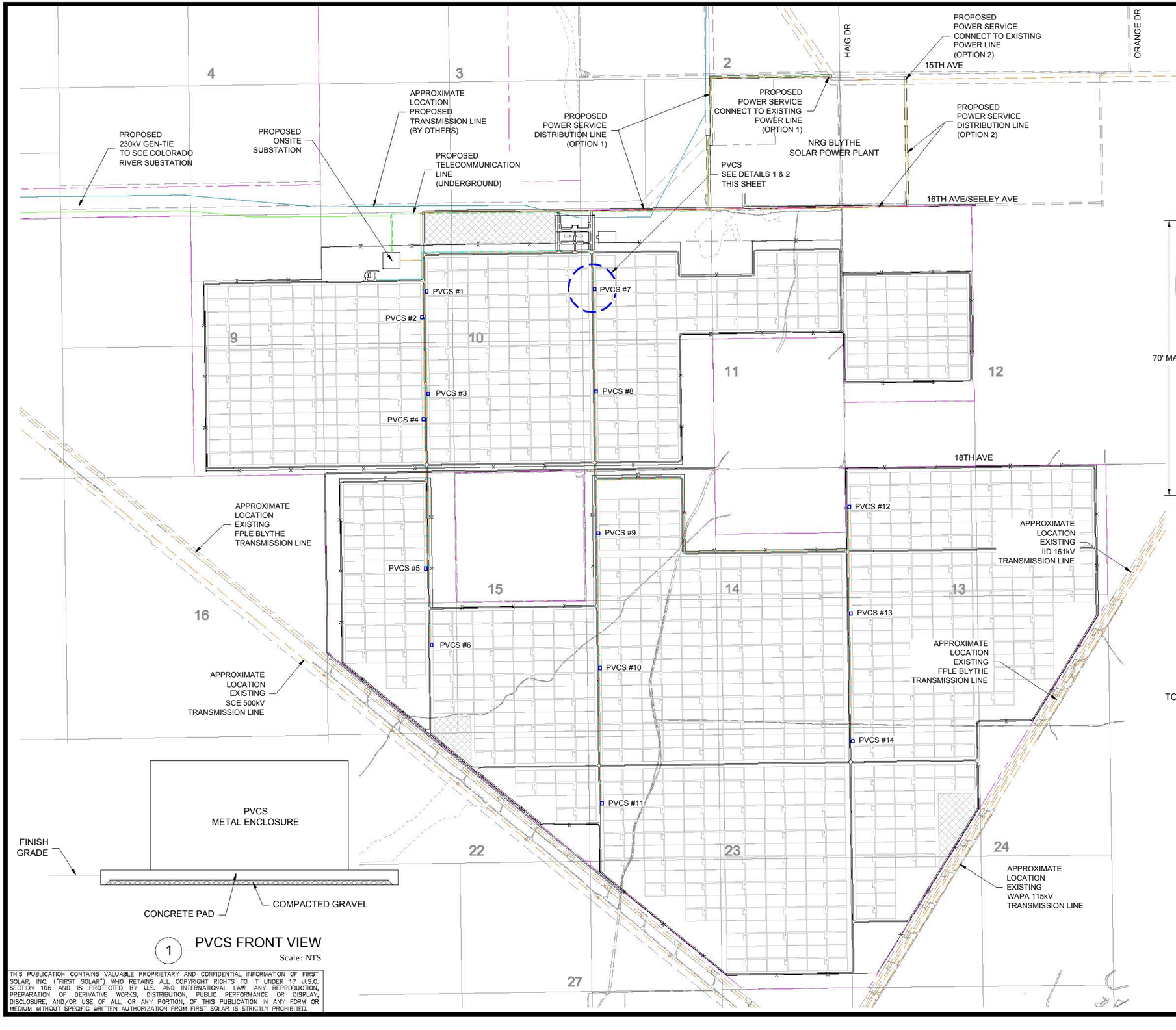
PRELIMINARY FENCE PLAN

SHEET 19 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

COPYRIGHT © 2011-2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

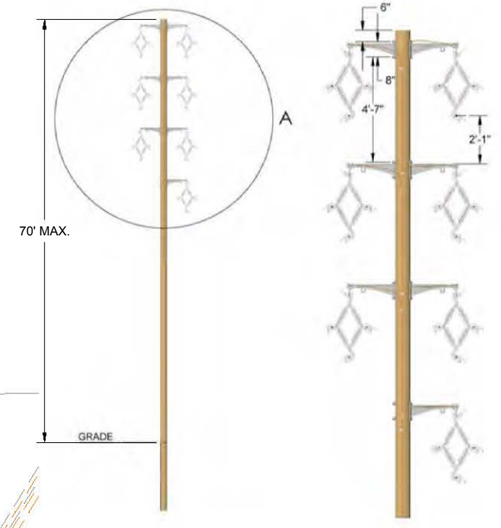
T:\Application\Engineering\Projects\2010\6017-0100-23 Desert Quartzite\Entitlements\02 Project Development\Active Drawing Files\5th C-700-FP-QUART.dwg FS104849 Apr 29, 2014 - 11:24am



LEGEND

- PROPOSED PROJECT SITE BOUNDARY
- PROPOSED OVERHEAD ELECTRICAL LINE
- EXISTING TRANSMISSION LINE
- TYPICAL PV ARRAY
- PHOTOVOLTAIC COMBINING SWITCHGEAR (PVCS) (NOT TO SCALE)

1 PVCS FRONT VIEW
Scale: NTS

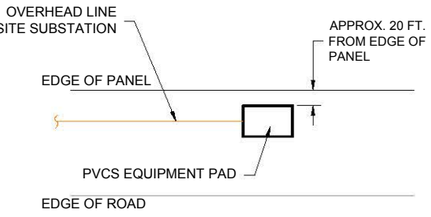


NOTE:

1. H-FRAME CONFIGURATION MAY BE USED FOR COLLECTOR POLE.
2. COLLECTOR POLE MAY BE WOOD OR STEEL.

DETAIL A

3 OVERHEAD COLLECTOR POLE
Scale: NTS



2 PVCS LAYOUT DETAIL
Scale: NTS

NORTH

2000' 1000' 0 2000'

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

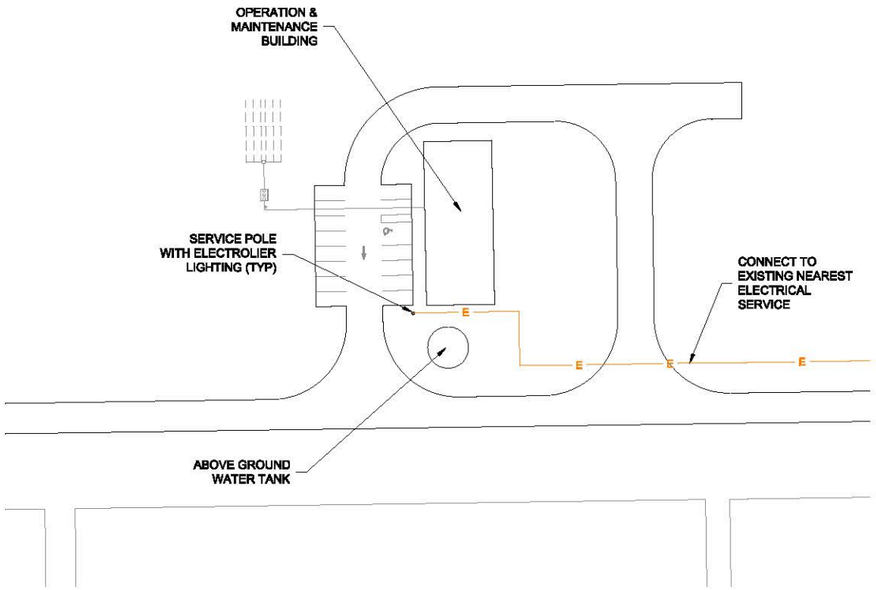
FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: AS SHOWN
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE
PRELIMINARY
AC ELECTRICAL
COLLECTION SYSTEM

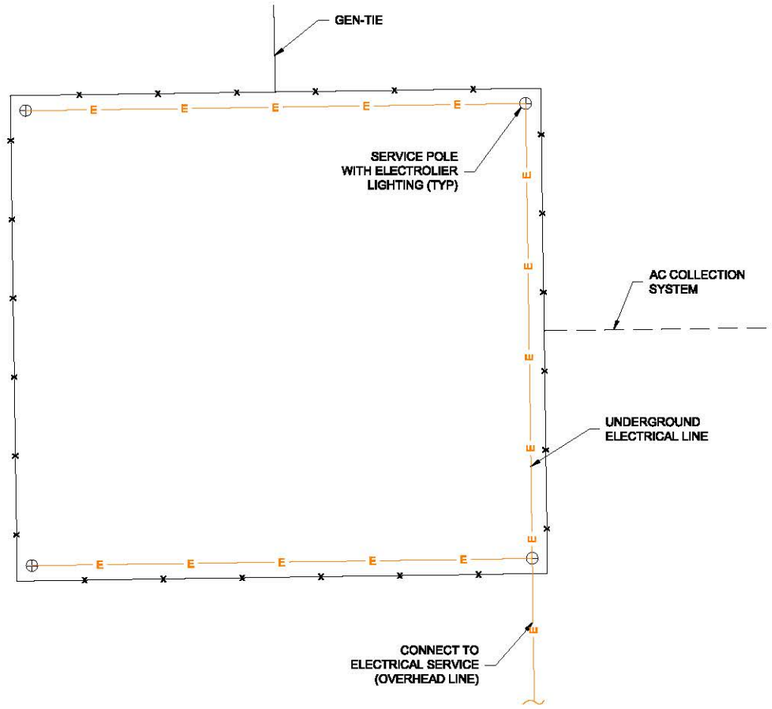
COPYRIGHT © 2011 FIRST SOLAR, INC. ALL RIGHTS RESERVED

AR060727

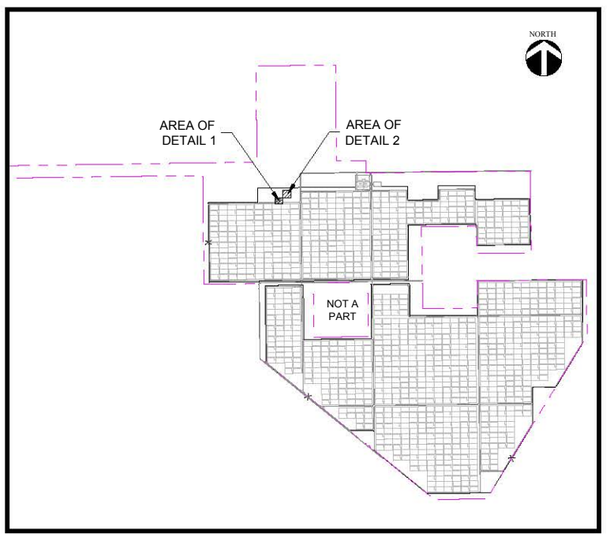
C:\Desert Quartzite\POD\Site Plan Package\E-100-CS-QUART.dwg FS104849 May 02, 2014 - 2:11pm



1 OPERATION & MAINTENANCE FACILITY
Scale: 1"=100'



2 ONSITE SUBSTATION
Scale: 1"=100'



4 KEY MAP
Scale: NTS

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	09-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: AS SHOWN
COPYRIGHT BY: FIRST SOLAR, INC.

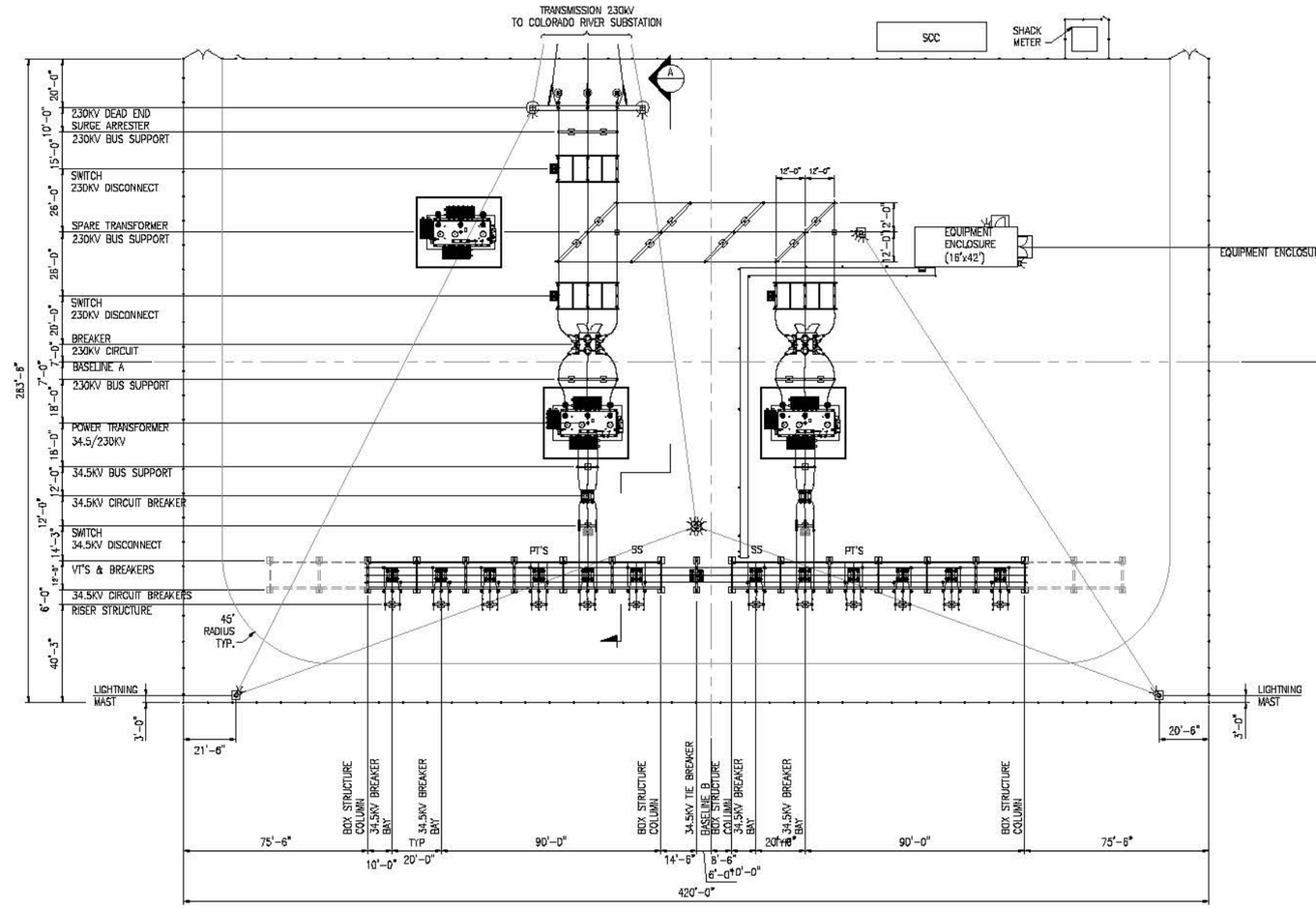
SHEET TITLE
PRELIMINARY
PERMANENT
LIGHTING PLAN

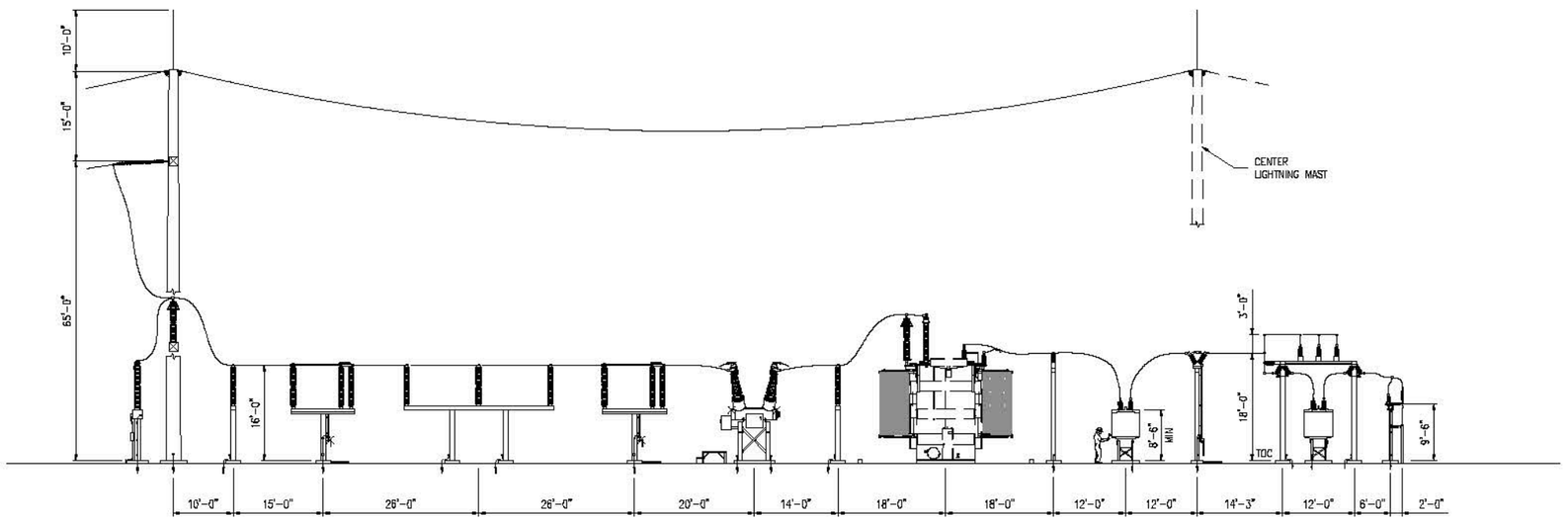
THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

C:\Desert Quartzite\POD\Site Plan Package\E-200-LP-QUART.dwg FS104849 May 02, 2014 - 1:49pm





A-A SECTION
SCALE: NTS

NOTES:

1. DIMENSIONS MAY CHANGE PENDING FINAL DESIGN.

First Solar
FIRST SOLAR, INC.
135 MAIN STREET, 6TH FLOOR
SAN FRANCISCO, CALIFORNIA 94105
PHONE: (415) 935-2500
WWW.FIRSTSOLAR.COM

DESERT QUARTZITE
SOLAR PROJECT
RIVERSIDE COUNTY
CALIFORNIA

REV	DATE	REVISION DESCRIPTION	BY	CHK	APP
A	08-15-11	POD RESUBMITTAL			
B	06-15-11	POD RESUBMITTAL			
C	04-07-14	POD RESUBMITTAL			

FS JOB #:
PROJ. DEVT. ENGR: RH
PROJ. MGR:
SCALE: AS SHOWN
COPYRIGHT BY: FIRST SOLAR, INC.

SHEET TITLE
PRELIMINARY
ONSITE SUBSTATION
PLAN

SHEET 22 OF 22

THIS PUBLICATION CONTAINS VALUABLE PROPRIETARY AND CONFIDENTIAL INFORMATION OF FIRST SOLAR, INC. ("FIRST SOLAR") WHO RETAINS ALL COPYRIGHT RIGHTS TO IT UNDER 17 U.S.C. SECTION 106 AND IS PROTECTED BY U.S. AND INTERNATIONAL LAW. ANY REPRODUCTION, PREPARATION OF DERIVATIVE WORKS, DISTRIBUTION, PUBLIC PERFORMANCE OR DISPLAY, DISCLOSURE, AND/OR USE OF ALL, OR ANY PORTION, OF THIS PUBLICATION IN ANY FORM OR MEDIUM WITHOUT SPECIFIC WRITTEN AUTHORIZATION FROM FIRST SOLAR IS STRICTLY PROHIBITED.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

COPYRIGHT © 2014 FIRST SOLAR, INC. ALL RIGHTS RESERVED

C:\Desert Quartzite\POD\Site Plan Package\E-300-SL-QUART.dwg FS104849 May 01, 2014 - 3:01pm

Appendix D Preliminary Geotechnical Investigation Report

PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT

FOR THE

FIRST SOLAR DEVELOPMENT, INC.
DESERT QUARTZITE SOLAR PROJECT
CACA-049397

RIVERSIDE COUNTY, CALIFORNIA
Township 7 South, Range 21 East, San Bernardino Baseline and Meridian

Prepared for:

First Solar Development, Inc.
1111 Broadway, Suite 400
Oakland, California 94607-4165

Prepared by:

URS
130 Robin Hill Road, Suite 100
Santa Barbara, California 93455
(805) 692-00600 ◆ Fax: (805) 739-1135

URS Project No. 28907270

August 2011

URS

August 8, 2011

Mr. James Cook
First Solar Development, Inc.
1111 Broadway, Suite 400
Oakland, CA 94607-4165

Re: Preliminary Geotechnical Investigation Report
Desert Quartzite Solar Project (CACA 04937)
Riverside County, California
Township 7 South, Range 21 East, San Bernardino Baseline and Meridian

Dear Mr. Cook:

URS Corporation (URS) is pleased to present the results of our preliminary geologic/geotechnical investigation performed for the proposed site development at the Desert Quartzite Solar Project, located in Riverside County, California. The preliminary conclusions and recommendations contained in this report are based on the findings of our literature review and our interpretation of the site geologic and geotechnical conditions based upon this literature review. The purpose of this investigation was to evaluate the geologic/geotechnical constraints to the development of the property. Further site-specific geotechnical investigation, including field investigation, will be required for the final design phase of the project.

Should you have any questions or require additional information, please do not hesitate to contact Robert Urban at 805-361-1109.

Sincerely,
URS Corporation

Robert J. Urban, P.G. #7842, C.E.G. #2428
Exp. 1/31/13
Senior Engineering Geologist

Natalie Evans, G.I.T. #286
Geologist

URS Corporation
130 Robin Hill Road, Suite 100
Santa Barbara, CA 93117
Tel: 805.692.0600
Fax: 805.964.0259

TABLE OF CONTENTS

Section **Page**

EXECUTIVE SUMMARY ES-1
1.0 INTRODUCTION 1-1

1.1 BACKGROUND 1-1
1.2 SCOPE OF WORK 1-1
1.3 SITE LOCATION AND DESCRIPTION 1-1
1.4 PROPOSED DEVELOPMENT 1-2

2.0 GEOLOGIC SETTING 2-1

2.1 REGIONAL GEOLOGIC AND SEISMIC SETTING 2-1
2.2 GENERAL SITE GEOLOGY 2-1

2.2.1 Quaternary Non Marine (Qpv) 2-2
2.2.2 Quaternary Alluvium (Qa_6) 2-2
2.2.3 Quaternary Dune Sand (Qs) 2-2
2.2.4 Quaternary Dune Sand ($Q\ a_3$) 2-2
2.2.5 Quaternary Alluvium (Qs) 2-3

2.3 FAULTS 2-3
2.4 NRCS SURFACE SOILS INFORMATION 2-4
2.5 GROUNDWATER CONDITIONS 2-5

3.0 GEOLOGIC AND SEISMIC HAZARDS 3-1

3.1 FLOODING 3-1
3.2 SLOPE INSTABILITY/LANDSLIDES 3-1
3.3 SUBSIDENCE 3-1
3.4 POOR SOIL CONDITIONS (EXPANSIVE OR COLLAPSIBLE SOILS) 3-2
3.5 EXCESSIVE SETTLEMENT (ARTIFICIAL FILL) 3-2
3.6 FAULT HAZARDS 3-2

3.6.1 Surface Fault Rupture 3-2
3.6.2 Seismic Ground Shaking 3-3

3.7 LIQUEFACTION 3-3
3.8 TSUNAMIS AND SEICHES 3-5

3.9 GENERAL SOIL EROSION AND STABILITY CONSIDERATIONS..... 3-5

Section **Page**

4.0 SUMMARY 4-1

4.1 CONCLUSIONS AND RECOMMENDATIONS 4-1
4.2 LIMITATIONS..... 4-1

5.0 REFERENCES..... 5-1

List of Tables **Page**

Table 1 Summary of Potential Seismic Sources – Faults in Proximity to Site..... 2-3
Table 2 NRCS Surface Soils Properties and Description 2-3
Table 3 Summary of Potential Seismic Sources – Parameters and Estimated Earthquakes for Regional Faults..... 3-4

List of Figures

Figure 1 Topographic Map of Desert Quartzite Solar Project Site
Figure 2 Aerial Map of Desert Quartzite Solar Project Site
Figure 3 Geologic Map of Desert Quartzite Solar Project Site
Figure 4 Regional Fault and Epicenter Map of Desert Quartzite Solar Project Site
Figure 5 Soils Map of Desert Quartzite Solar Project Site

List of Appendices

Appendix A EQFAULT Seismic Parameters

EXECUTIVE SUMMARY

This geotechnical assessment executive summary has been prepared to provide a general overview of the report. The executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the sections discussed herein.

The Desert Quartzite Solar Project (Site) is located in eastern Riverside County approximately 8 miles southwest of the town of Blythe, California. First Solar Development, Inc. (First Solar) proposes to construct and operate a solar photovoltaic energy-generating project at the Site. The proposed project will include the solar facility, an on-site substation, and an interconnection transmission line (gen-tie) to Southern California Edison's (SCE) Colorado River Substation to the west of the site.

The primary objective of this preliminary geotechnical investigation was to identify potential geologic and geotechnical issues for the Project development. The scope of work performed by URS included a review of readily available information and data on the geotechnical and geological conditions of the project area and preparation of this report.

Based on information obtained from the preliminary review, the Site appears to be suitable for development for the proposed project. A comprehensive geotechnical report should be prepared prior to construction with recommendations to be incorporated into the final design.

The most significant geologic hazard to the project identified in this preliminary study is the potential for moderate seismic shaking likely to occur during the design life of the proposed development. The project Site is located in the seismically active Southern California region within the influence of several fault systems considered to be potentially active. Structures should be designed in accordance with the values and parameters provided in the 2007 California Building Code (CBC) and ASCE 7-05. The preliminary seismic design parameters are provided within the report.

A comprehensive design-level geotechnical investigation should be performed prior to construction. Earthwork on the project should be observed and evaluated by a licensed engineer practicing in the field of geotechnical engineering. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during construction.

.

SECTION 1.0
INTRODUCTION

1.1 BACKGROUND

First Solar Development, Inc. (First Solar) is considering development of the Desert Quartzite Solar Project (Site), located in eastern Riverside County approximately 10 miles southwest of the town of Blythe, California. Consequently, First Solar retained URS to conduct a preliminary geotechnical investigation to support planning and permitting activities relative to this project. The primary objective of the preliminary investigation was to identify potential geologic and geotechnical issues for the Project development, and to provide geologic/geotechnical information to support the Bureau of Land Management's permitting process for the project.

1.2 SCOPE OF WORK

This investigation is based on a review of readily available information and data on the geotechnical and geological conditions of the project area. The tasks performed for this investigation included the following:

- Review of First Solar's development plans
- Review of available pertinent literature and reports
- Preparation of this report

The primary information available for this study included published regional geologic maps and reports.

1.3 SITE LOCATION AND DESCRIPTION

The Site is approximately 7.5 square miles in size and is located south of U.S. Interstate 10 (I-10), approximately 10 miles southwest of the town of Blythe, California (Figure 1). The Site comprises approximately 4,769 acres located within Sections 3, 4, 9 through 15, 22, 23, and 24, Township 7 South, Range 21 East, San Bernardino Baseline and Meridian.

The Site is situated on the Palo Verde Mesa located within the Mojave Desert geomorphic province of Southern California. The Site is located on a relatively flat area and ranges in elevation from approximately 330 feet above mean sea level (MSL) at the southeast corner to 475 feet MSL in the northwest (USGS 1983). The Palo Verde Mesa is located south of the McCoy Mountains, west of the Palo Verde Valley, north of the Palo Verde Mountains, and northeast of the Mule Mountains.

1.4 PROPOSED DEVELOPMENT

First Solar proposes to construct and operate an approximately 300 megawatt (MW) solar photovoltaic energy facility at the Site. The proposed project includes the following key structures: solar field arrays, an on-site operation and maintenance facility, an on-site substation, and an interconnection transmission line (gen-tie) to SCE's Colorado River Substation. The proposed project Site boundary, including the proposed gen-tie corridor, is shown on Figure 1 (topographic map) and Figure 2 (aerial map). URS understands that the development plans are preliminary in nature and subject to refinement.

SECTION 2.0
GEOLOGIC SETTING

2.1 REGIONAL GEOLOGIC AND SEISMIC SETTING

The project site is located on the Palo Verde Mesa within the Mojave geomorphic province of southern California. The Mojave Desert is a broad interior fault-bounded wedge consisting of pre-Cambrian gneisses, metamorphosed sedimentary rocks, plutonic rocks, scattered Mesozoic-age volcanics and metavolcanics, and sedimentary strata. The Mojave Desert is bounded by the right-lateral San Andreas fault on the south, the left-lateral Garlock fault on the northwest, and the Colorado River on the east (DMG 1954) and is characterized by isolated mountain ranges separated by vast expanses of desert plains. Dominant northwest-southeast trending faults control topography in this region.

The area surrounding the site is characterized by faults and seismicity driven by movement along the boundary between the North American and Pacific crustal plates. These two plates are passing by each other horizontally, in a right lateral sense (i.e., the North American plate is moving southeastward relative to the Pacific plate) at a rate of about 40 to 50 millimeters (mm)/year. Most of this stress is accommodated by movement on the San Andreas fault, which extends from north of San Francisco to the Gulf of California and marks the southern boundary of the Mojave Desert geomorphic province. The San Andreas fault presents significant seismic risk to California with a high potential for large earthquakes.

The remaining portion of the crustal stress is accommodated by the numerous shorter active faults that flank the San Andreas fault. These shorter faults are also considered to be significant seismic sources. The geoseismic characteristics of these seismic sources are summarized in Section 2.3, including an estimate of the maximum earthquake magnitude that might be generated by each fault. A geologic map is depicted on Figure 3. The location of the site with respect to known active or potentially active faults and epicenters of earthquakes with magnitudes of 4 or greater is shown on the Regional Fault and Epicenter Map, Figure 4.

2.2 GENERAL SITE GEOLOGY

The Palo Verde Mesa is characterized by the nearly level morphology of the mesa and gently to moderately sloping alluvial fans. Fluvial erosion and deposition are the major geomorphic processes in the immediate area. According to the regional geologic mapping of Jennings (CGS 1967), the northern portion of the project site is underlain by metamorphosed sedimentary bedrock of Pre-Cretaceous age. The Cretaceous Period is a geologic period extending from approximately 145 to 65.6 million years ago (Ma). Southwest of the Site, the metamorphosed sedimentary bedrock of Pre-Cretaceous age (greater than 145 Ma) abuts Precambrian age (4,600 to 542 Ma) granitic bedrock. Based on the Jennings' fault activity mapping (CGS 1994), this unconformity is a pre-Quaternary age (2.6 Ma to present) thrust

fault system trending northwest immediately southwest of the Site. Stone (USGS 2006) identifies the bedrock types as Jurassic age (199 to 145 Ma) volcanics north of the thrust fault and Jurassic age (199 to 145 Ma) plutonic rocks to the south (USGS 2006). Both Jennings (CGS 1994) and Stone (USGS 2006) map a thrust fault in the same place; however, Jennings' map includes additional fault traces. The Jennings 1994 CGS map identifies a Tertiary age (65 to 2.6 Ma) fault southwest of the site; however, a recent map developed by the USGS depicts detailed Quaternary age (2.6 Ma to present) terrace mapping which identifies terraces of varying ages rather than an offset single terrace that has been offset due to faulting (USGS 2006).

Overlying the Precambrian to Mesozoic age bedrock immediately southwest of the Site are Tertiary age (65 to 2.6 Ma) volcanics of rhyolitic composition (CSG 1994; USGS 2006). These volcanics are of Oligocene age (34 to 23 Ma) to Miocene age (23 to 5.3 Ma), indicating the depositional event(s) took place between 5.3 and 34 million years before present, coinciding with a period of intense plate tectonic activity. In the southeastern corner of the Site, the bedrock is overlain by Pleistocene age (2.6 Ma to 11,700 years before present [BP]) non-marine sediments. Holocene age (11,700 BP to present) alluvium overlays the older units across most of the Site; according to Stone (USGS 2006), the alluvium overlying the western portion of the Site is of Pleistocene age (2.6 Ma to 11,700 BP). Deposits of Holocene age dune sand are present in the northwestern portion of the Site (11,700 BP to present), including along the off-site portion of the gen-tie corridor. The distribution of these various units is depicted on the attached Geologic Map (Figure 2). The general characteristics of each of these geologic map units are described below in the relative order of predominance on the Site, including the proposed gen-tie corridor.

2.2.1 Quaternary Non Marine (Qpv)

Pleistocene age (2.6 Ma to 11,700 BP) alluvial deposits of the ancestral Colorado River comprised of moderately indurated, poorly graded sand, gravel, boulders, silt, and clay.

2.2.2 Quaternary Alluvium (Qa_6)

Holocene age (11,700 BP to present) alluvial fan and alluvial valley deposits comprised of unconsolidated sand, gravel, silt, and clay.

2.2.3 Quaternary Dune Sand (Qs)

Holocene Age (11,700 BP to present) dune sand comprised of actively drifting sand.

2.2.4 Quaternary Alluvium (Qa_3)

Holocene and Pleistocene age (2.6 Ma to present) alluvial fan deposits comprised of unconsolidated sand, gravel, silt, and clay.

2.2.5 Quaternary Alluvium (Qw)

Holocene Age (11,700 BP to present) alluvium of modern washes comprised of unconsolidated sand and gravel derived from local mountain ranges.

2.3 FAULTS

There are no known faults active during the Quaternary located in the Palo Verde Mesa area. The Jennings (CGS 1994) map identifies a Tertiary age (65 to 2.6 Ma) fault southwest of the Site; however, a recent map developed by the USGS depicts detailed quaternary terrace mapping which identifies terraces of varying ages rather than an offset single terrace (CGS 1994; USGS 2006).

The approximate distances of active fault zones from the Site are listed in Table 1.

TABLE 1
SUMMARY OF POTENTIAL SEISMIC SOURCES –
FAULTS IN PROXIMITY TO SITE

Fault Name	Approximate Distance from Site (Miles)
Brawley Seismic Zone	58.8
Elmore Ranch	59.2
San Andreas – Southern	59.7
San Andreas – Coachella	59.7
Imperial	66.7
Superstition Hills (San Jacinto)	71.0
Superstition Mountain (San Jacinto)	73.8
Pinto Mountain	81.7
San Jacinto – Borrego	82.3
San Jacinto – Anza	84.1
Pisgah-Bullion Mountain – Mesquite LK	84.6
Laguna Salada	89.0
San Jacinto – Coyote Creek	89.2
Elsinore – Coyote Mountain	92.3
Emerson So. – Copper Mountain	94.3

Eureka Peak	97.9
Burnt Mountain	99.7

2.4 NRCS SURFACE SOILS INFORMATION

Based on review of the U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) (previously Soil Conservation Service) soil survey of the Palo Verde Area, the Site is characterized by multiple soil types, generally consisting of silty sands and gravels (USDA 1969). The NRCS mapped soil types at the Site are listed in Table 2. Figure 5 depicts the distribution of soils at the Site.

TABLE 2
NRCS SURFACE SOILS PROPERTIES AND DESCRIPTION

Soil Series	Slope (% Grade)	Depth (Inches)	Classification USCS[1]	Classification AASHTO[2]	Description
Aco	0–1	0–60	SM	A-1, A-2	The Aco series comprises deep, well-drained soil formed in mixed alluvium on terraces above the flood plain.
Carrizo	0–2	0–60	SW-SM, GM	A-1	The Carrizo series comprises deep, well-drained soils formed in mixed sandy and gravelly alluvium on arroyos.
Chuckwalla	0–1	0–60	GC-GM	A-1, A-2, A-4	The Chuckwalla series comprises deep, well-drained soils formed in mixed stratified alluvium on alluvial fan terraces.
Orita	0–1	0–80	SM, GM	A-1, A-2, A-4, A-6	The Orita series comprises deep, well drained soils formed in alluvium on alluvial fan remnants and terraces.
Rositas	0–9	0–72	SM, SP-SM	A-1, A-2, A-3	The Rositas series comprises deep, well-drained soils formed in sandy eolian soils from recent alluvium on sand dunes.

1 USCS: United Soils Classification System.

2 AASHTO: American Association of State Highway and Transportation Officials classification.

The Aco series is present throughout the Site and is the predominant soil type on the Site. All of the soils mapped on Site have low potential for expansive soil characteristics, according to the Palo Verde Area soil map (USDA 1969).

As shown on Figure 5, other soil series prevalent on the Site include the Orita and Rositas series as well as the Carrizo series. The mapped soil series on the Site are considered to have high risk of corrosion for uncoated steel and low to moderate risk of corrosion for concrete. Based on the USDA report, there is a low to moderate potential for water- and wind-induced erosion for soil series throughout the Site (USDA 1969).

The USDA report provides an interpretation of soil limitations for septic suitability. Using these interpretations, all of the soil series mapped on the Site are classified as somewhat limited with respect to septic suitability with one exception; the Orita series is classified as very limited suitability for septic system disposal fields (USDA 1969).

2.5 GROUNDWATER CONDITIONS

The depth to groundwater in the Site vicinity is believed to be greater than 100 feet below ground surface (bgs) based on relative site elevation difference above the Colorado River and floodplain (Palo Verde Valley) and measured depth to groundwater at adjacent sites (DWR 1978; Metzger et al 1973). Groundwater levels may fluctuate seasonally with precipitation, regional pumping from wells, irrigation, drainage, and site grading.

SECTION 3.0
GEOLOGIC AND SEISMIC HAZARDS

Geologic and seismic hazards are those hazards that could impact the project due to the surrounding geologic and seismic conditions. Geological hazards include slope instability (landslides), erosion, subsidence, poor soil conditions, excessive settlement, and flooding. Seismic hazards include phenomena that occur during an earthquake such as surface fault rupture, seismic ground shaking, liquefaction, and tsunami waves. The potential impact of these hazards to the Site has been *assessed* and is summarized in the following sections.

3.1 FLOODING

The Site is located in an area designated Zone D within the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, indicating an area where there are possible but undetermined flood hazards (FIRM map 06065C Panel *06065C3200G). In areas designated Zone D, no analysis of flood hazards has been conducted.

The project Site is located in an arid environment and on relatively high ground northeast of the Mule Mountains, which drain into and through portions of the Site. Based on the TLA site drainage report (TLA 2011), the potential for flooding on the Site is considered moderate.

3.2 SLOPE INSTABILITY/LANDSLIDES

The potential for slope instability is insignificant based on the relatively flat terrain that characterizes the Site (USGS 1975; 1983). Therefore, the potential for hazards related to slope instability, landslides, or debris flows is considered low; however, considering the potential for flooding on Site, the hazard of episodic debris flows may be present based on Site hydraulic analysis (TLA 2011).

3.3 SUBSIDENCE

Land subsidence can be caused by various natural phenomena, including tectonic movement, hydro compaction, or consolidation. The extraction of water or petroleum from sedimentary source rocks can also cause the permanent collapse of the pore space previously occupied by the removed fluid. Sufficient subsidence resulting from these phenomena may cause damage to nearby engineered structures.

Based on review of available literature, subsidence has not been documented within the vicinity of the project site (USGS 2002; DWR 1978) and available literature does not indicate significant quantities of fluids being extracted in the project area. Subsidence is therefore not anticipated to pose a significant hazard to the proposed project.

3.4 POOR SOIL CONDITIONS (EXPANSIVE OR COLLAPSIBLE SOILS)

Expansive soils are fine-grained soils (clay) that can undergo a significant increase in volume with an increase in water content. Changes in the water content of an expansive soil can result in severe distress to structures constructed upon the soil. Based on USDA, NRCS soil maps and descriptions, the on Site surface and near-surface soils are expected to exhibit low expansive potentials. As expansive soils may impact a project, testing should be conducted to identify the degree to which onsite soils may expand.

Collapsible soils are those that undergo settlement upon wetting, even without the application of additional load. The process of collapse with the addition of water is known as hydrocompaction. Hydrocompaction occurs when water weakens or destroys the bonds between soil particles and severely reduces the bearing capacity of the soil. Typical collapsible soils are lightly colored, are low in plasticity and have relatively low densities. Collapsible soils are typically associated with alluvial fans, windblown materials, or colluvium. Because the project Site is largely covered in alluvium and windblown materials, the potential for collapsible soils may exist at the project Site. If collapsible soils are found to occur at the Site, as part of the design level geotechnical investigation mitigation measures may be necessary to reduce or eliminate the hazard. Traditional methods of construction grading generally would employ removal of collapsible soils and replacement with engineered fill. Provided that these mitigation methods are incorporated into the design of the project, collapsible soils are not expected to have a significant impact upon the project.

3.5 EXCESSIVE SETTLEMENT (ARTIFICIAL FILL)

A risk of excessive settlement can be associated with improperly placed and substandard artificial fills. With regard to this potential hazard, based on aerial photograph review and available literature there is no evidence at this time of previous site disturbance which would entail artificial fill; therefore, it is unlikely that excessive settlement of artificial fill would have a negative impact on this project.

3.6 FAULT HAZARDS

3.6.1 Surface Fault Rupture

The “Alquist-Priolo Earthquake Fault Zoning Act” is a state law that regulates development projects near active faults to mitigate the hazard of surface fault rupture. The Act requires that development permits for projects within “Earthquake Fault Zones” be withheld until geologic investigations demonstrate that the sites are not threatened by surface displacement from future fault rupture. To be zoned under the Alquist-Priolo Fault Zoning Act, a fault must be considered active or both sufficiently active and well-defined (CGS 1997). CGS defines an active fault as one that has had surface displacement within Holocene time (about the last 11,000 years), and a sufficiently active fault as one that has evidence of Holocene

surface displacement along one or more of its segments or branches (CGS 1997). The CGS considers a fault to be well defined if its trace is clearly detectable as a physical feature at or just below the ground surface.

The State of California has not yet completed mapping the region in which the Site is located for Seismic Hazard Zones. No known active, sufficiently active, or well-defined fault traces have been recognized as crossing the proposed project Site, and the CGS does not delineate any part of the proposed project as being within an Earthquake Fault Zone.

3.6.2 Seismic Ground Shaking

As indicated by the numbers and distribution of recorded earthquake epicenters and the proximity of faults in the region (Figure 3), it is anticipated that the site will be subjected to seismic shaking during the lifetime of the development. The degree of shaking that is felt at a given site depends on the distance from the earthquake source, the type of subsurface material on which the project is situated, and topography. Based on the California Geological Survey interactive Seismic Hazard map (CGS 2008), the Peak Ground Acceleration with a 10 percent chance of exceedance in 50 years would be less than 0.1g. The effect of seismic ground motion to the planned development should be mitigated by proper building design, in accordance to 2007 California Building Code (CBC) and its current amendments. Building codes are designed to limit the degree of damage that would otherwise occur to an un-reinforced building. Additional geotechnical studies should be performed to develop final seismic design recommendations.

The Site is located in Southern California, a seismically active area. The magnitude and type of seismic hazard which may potentially affect the Site is dependent on both proximity to causative faults, and magnitude of seismic event. Table 3 presents distance of fault zones from the Site and the maximum credible earthquake (MCE), calculated using the EQFAULT program, which nearby seismic events may produce.

Based on these calculations, the peak ground acceleration at the Site for a 10 percent Probability of Exceedance in 50 years is estimated to be approximately 0.0373g.

3.7 LIQUEFACTION

Liquefaction is defined as significant and relatively sudden reduction in stiffness and shear strength of saturated sandy soils caused by a seismically induced increase in pore water pressures. Potential for seismically induced liquefaction exists whenever relatively loose, sandy soils exist with high groundwater level and/or potential for long duration, high seismic shaking. The susceptibility of a site to liquefaction is relative to water content, depth, and density of granular sediments as well as the frequency and magnitude of earthquakes in the surrounding area. When liquefaction occurs, the site can experience damage induced by permanent ground movements resulting in differential settlement.

TABLE 3
SUMMARY OF POTENTIAL SEISMIC SOURCES – PARAMETERS AND ESTIMATED EARTHQUAKES FOR REGIONAL FAULTS

		Estimated Maximum Credible Earthquake Event		
Fault Name	Approximate Distance from Site (Miles)	Maximum Earthquake Magnitude (MM[1])	Peak Site Acceleration (g[2])	Estimated Site Intensity (Mod. Merc.[3])
Brawley Seismic Zone	58.8	6.4	0.016	IV
Elmore Ranch	59.2	6.6	0.019	IV
San Andreas – Southern	59.7	7.4	0.037	V
San Andreas – Coachella	59.7	7.1	0.029	V
Imperial	66.7	7.0	0.022	IV
Superstition Hills (San Jacinto)	71.0	6.6	0.014	III
Superstition Mountain (San Jacinto)	73.8	6.6	0.013	III
Pinto Mountain	81.7	7.0	0.015	IV
San Jacinto – Borrego	82.3	6.6	0.010	III
San Jacinto – Anza	84.1	7.2	0.018	IV
Pisgah-Bullion Mountain – Mesquite LK	84.6	7.1	0.016	IV
Laguna Salada	89.0	7.0	0.013	III
San Jacinto – Coyote Creek	89.2	6.8	0.011	III
Elsinore – Coyote Mountain	92.3	6.8	0.010	III
Emerson So. – Copper Mountain	94.3	6.9	0.011	III
Eureka Peak	97.9	6.4	0.006	II
Burnt Mountain	99.7	6.4	0.006	II

1 MM: moment magnitude.

2 g: acceleration due to earth's gravity.

3 Mod. Merc.: Modified Mercalli Intensity Scale.

Mitigation methods for liquefaction may include identifying potentially liquefiable soils and then either avoiding placing structures within the limits of liquefiable soils, or applying in-situ soil improvement, and using a deep foundation system. In-situ soil improvement methods for liquefiable soil include vibro-replacement, compaction grouting and deep soil mixing. A deep foundation system may consist of driven pre-cast piles or cast-in-drilled-hole piers or caissons. The results of the forthcoming detailed geotechnical investigation relative to liquefaction potential at the site should be incorporated into the final project design.

Based on the relatively deep water table underlying the Site, which is elevated over 100 feet above the floodplain of the Colorado River, the potential for liquefaction is considered to be low (USGS 1983; Metzger et al 1973).

3.8 TSUNAMIS AND SEICHES

A tsunami is a great sea wave (commonly called a tidal wave) produced by a significant undersea disturbance, such as tectonic displacement of the sea floor associated with large, shallow earthquakes. A seiche is a wave generated in an enclosed body of water such as a lake or reservoir. Based on the fact that the Site is situated inland, far from oceans or large, land-locked water bodies, the potential for seismically induced tsunamis or seiches is considered to be low (CGS 1977).

3.9 GENERAL SOIL EROSION AND STABILITY CONSIDERATIONS

The soils present at the Site have a low to moderate susceptibility to wind and water erosion (USDA 1969). Preventative measures to reduce seasonal flooding and erosion should be incorporated into site grading and drainage plans. Dust control should be implemented during construction, and soil stabilization measures should be implemented, where necessary.

The upper soils at the Site are expected to be relatively loose to medium-dense and may be unsuitable in their present condition to support structures in the vicinity of the operations and maintenance facility and the on-site substation. The soils within the building and structural areas may require moisture conditioning, over-excavation, and recompaction to improve bearing capacity and to reduce the potential for differential settlement from static loading. It is expected that these potential issues will be investigated as part of the forthcoming detailed geotechnical investigation and addressed, as applicable, in the final project design.

SECTION 4.0
SUMMARY

4.1 CONCLUSIONS AND RECOMMENDATIONS

The geology and seismic conditions of the project site have been evaluated in terms of their impact on the proposed project. Based on the findings of the preliminary site investigation, the project Site is generally suitable for the proposed development. Provided that standard geotechnical practices are followed and standard mitigation methods are incorporated into the final design of the development, it is anticipated that geologic hazards will not significantly impact the project. The primary geotechnical consideration for the project is the potential for moderate seismic shaking likely to occur during the design life of the proposed development. The project Site is located in the seismically active Southern California region within the influence of several fault systems considered to be potentially active. Structures should be designed in accordance with the values and parameters provided in the 2007 California Building Code (CBC) and ASCE 7-05. The seismic design parameters are provided within the report.

The published literature clearly indicates that the mapped faults near the Site are not active. Therefore, from a fault rupture hazard standpoint there is no requirement to establish a development setback zone for these faults.

Finally, URS notes that this is a preliminary assessment of engineering geologic/geotechnical conditions of the Site. For any given aspect of the development, final geotechnical conclusions and recommendations should be provided in a separate report after specific, final project plans are developed, and on-site geotechnical explorations and testing are performed.

4.2 LIMITATIONS

This report presents preliminary interpretations and recommendations pertaining to the subject site based on the assumption that surface and subsurface conditions do not deviate appreciably from those indicated by the available literature and reports (as cited in this preliminary report). The scope of this preliminary engineering geology and geotechnical investigation did not include any field investigations. The potential for encountering conditions different from those assumed cannot be discounted. Professional judgments presented in this report are based on evaluations of the available literature gathered, on our understanding of the proposed project construction, and on our general experience in the geotechnical engineering and engineering geology field. The judgments presented meet the standard of care of our profession at this time and location in work performed under similar circumstances.

SECTION 5.0
REFERENCES

California Building Standards Commission. 2007. *2007 California Building Code, Based on the 1997 UBC.*

California Department of Water Resources (DWR). 2004. *California's Groundwater Bulletin 118, Palo Verde Groundwater Basin*, 2004.

1978. *Water Wells and Springs in Palo Verde Valley, Riverside and Imperial Counties, California.* Bulletin 91-23. Sacramento, CA.

California Geologic Survey (CGS; formerly the California Division of Mines and Geology). 2008. Interactive Probabilistic website at http://www.consrv.ca.gov.cgs/rghm.

2003. *The Revised California Probabilistic Seismic Hazard Maps,* http://www.consrv.ca.gov/cgs/rghm/psha/fault_parameters/pdf/2002_CA_Hazard_Maps.pdf, June 2003.

2002. *California's Geomorphic Provinces, Note 36*. 2002.

1997. *Fault Rupture Hazard Zones in California,* Special Publication 42, Revised 1997.

1994. *Fault Activity Map of California and Adjacent Areas, California Division of Mines and Geology,1:750,000-Scale Map*.

1977. *Geologic Map of California, Scale 1:750,000.*

1967. *Geologic Map of California, Salton Sea Sheet, Scale 1:250,000.*

1954. *Geology of Southern California, Bulletin 170*, 1954.

First Solar. 2010. *Plan of Development, Desert Quartzite Project,* August 31, 2010.

Metzger, D.G. et al. 1973. *Geohydrology of the Parker-Blythe-Cibaloa Area, Arizona and California. U.S. Geological Survey Professional Paper 486-G*.

TLA Engineering & Planning, Inc. 2011. *Desert Quartzite Solar Project -- Drainage Report*, August 10.

University of California, Santa Barbara (UCSB). 2008, online aerial photograph database, accessed August, 2011, from website http://www.sdc.ucsb.edu/holdings/.

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) (formerly Soil Conservation Service). 1969. *Soil Survey of Palo Verde Area, California*.

U.S. Geological Survey (USGS), Working Group on Earthquake Probabilities. 2010. *Groundwater Quality in the Colorado River Basins, California*. 2010.

2006. *Geologic Map of the West Half of the Blythe 30' by 60' Quadrangle, Riverside County, California and La Paz County, Arizona, 1:100,000, Map 2922*, 2006.

2002. *Detection and Measurement of Land Subsidence Using Global Positioning and Interferometric Synthetic Aperture Radar, Coachella Valley, California, Report 02-4239*, 2002.

1988. *Probabilities of Large Earthquakes Occurring in California on the San Andreas Fault, USGS Open File Report 88-398.*

1986. *30x60 Minute Series Topographic Map, Blythe, California-Arizona, Scale 1: 100,000.*

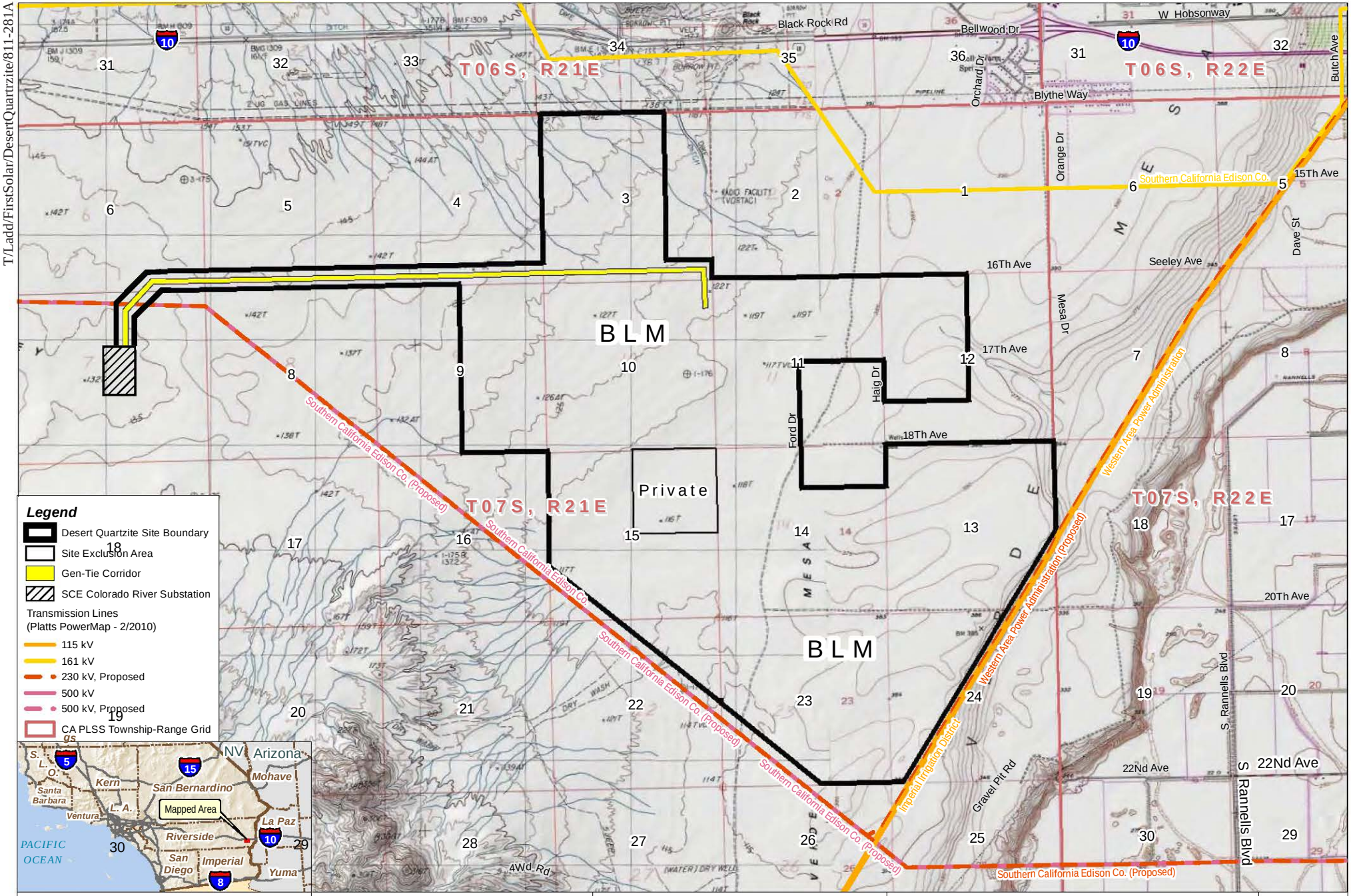
1983. *7.5 Minute Series Topographic Quadrangle Map, Roosevelt Mine Quadrangle, Scale 1: 24,000*.

1975. *7.5 Minute Series Topographic Quadrangle Map, Ripley Quadrangle, Scale 1: 24,000.*

Wells, D.L. and K.J. Coppersmith. 1994. *New Empirical Relationships Among Magnitude, Rupture Length, Rupture Width, Rupture Area, and Surface Displacement, Bulletin of The Seismological Society of America, Vol. 84, No. 4*, pp. 974–1002.

FIGURES

T/Ladd/FirstSolar/DesertQuartzite/811-281A



First Solar - Desert Quartzite Solar Project, Riverside County, CA

URS Corporation

0 0.25 0.5 0.75 1 Miles

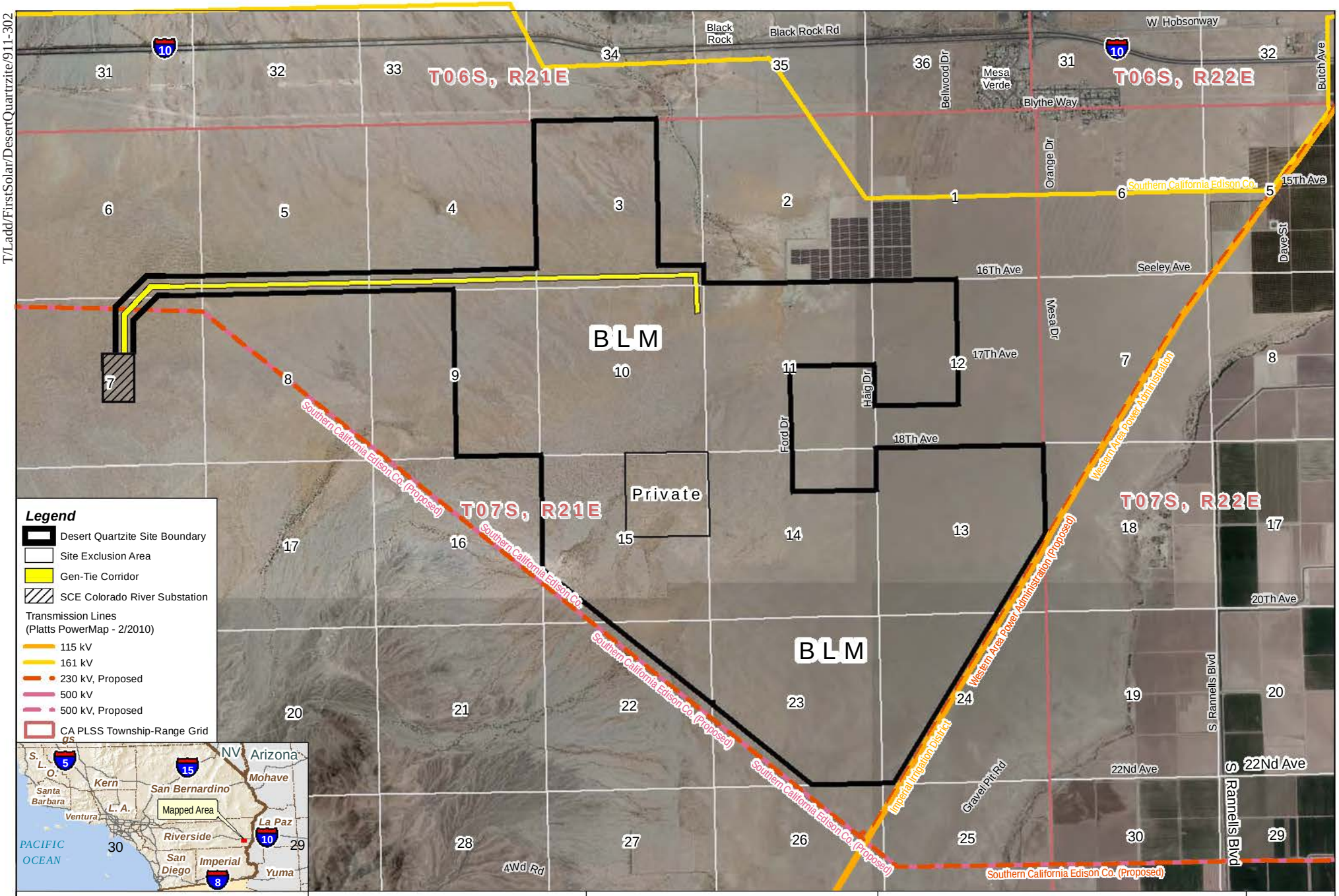
0 1,000 2,000 3,000 4,000 5,000 Feet

Source: [1] USGS 1:24,000-scale topographic map created with TOPO!, [2] California Geospatial Information Library PLS, [3] ESRI StreetMap USA (2007), [4] Platts PowerMap for power infrastructure.

Figure 1. Topographic Map of Desert Quartzite Solar Project Site **AR060752**

2011

T:/Ladd/FirstSolar/DesertQuartrzite/911-302



First Solar - Desert Quartzite Solar Project, Riverside County, CA

URS Corporation

0 0.25 0.5 0.75 1 Miles

0 1,000 2,000 3,000 4,000 5,000 Feet

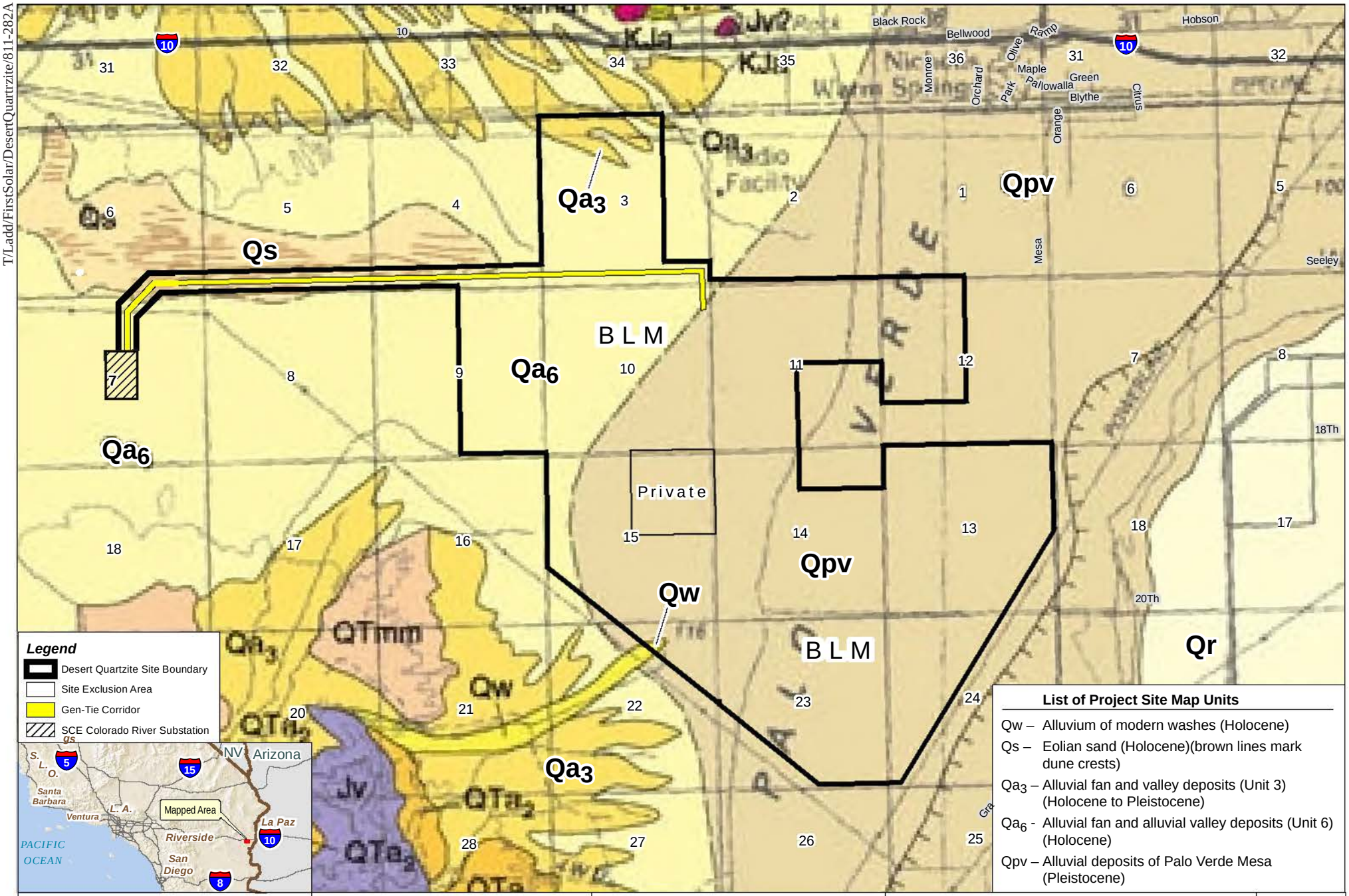
Source: [1] National Agriculture Imagery Program (NAIP) Orthoimagery for Zone 11 California State Quarter Quadrangles, Aerial Photography Field Office (2010-04-28 image date, 1m res.), [2] California Geospatial Information Library PLS, [3] ESRI StreetMap USA (2007), [4] Platts PowerMap for power infrastructure.

Figure 2. Aerial Map of Desert Quartzite Solar Project Site

2011

AR060753

T/Ladd/FirstSolar/DesertQuartzite/811-282A



List of Project Site Map Units

- Qw – Alluvium of modern washes (Holocene)
- Qs – Eolian sand (Holocene)(brown lines mark dune crests)
- Qa_3 – Alluvial fan and valley deposits (Unit 3) (Holocene to Pleistocene)
- Qa_6 - Alluvial fan and alluvial valley deposits (Unit 6) (Holocene)
- Qpv – Alluvial deposits of Palo Verde Mesa (Pleistocene)

First Solar - Desert Quartzite Solar Project, Riverside County, CA

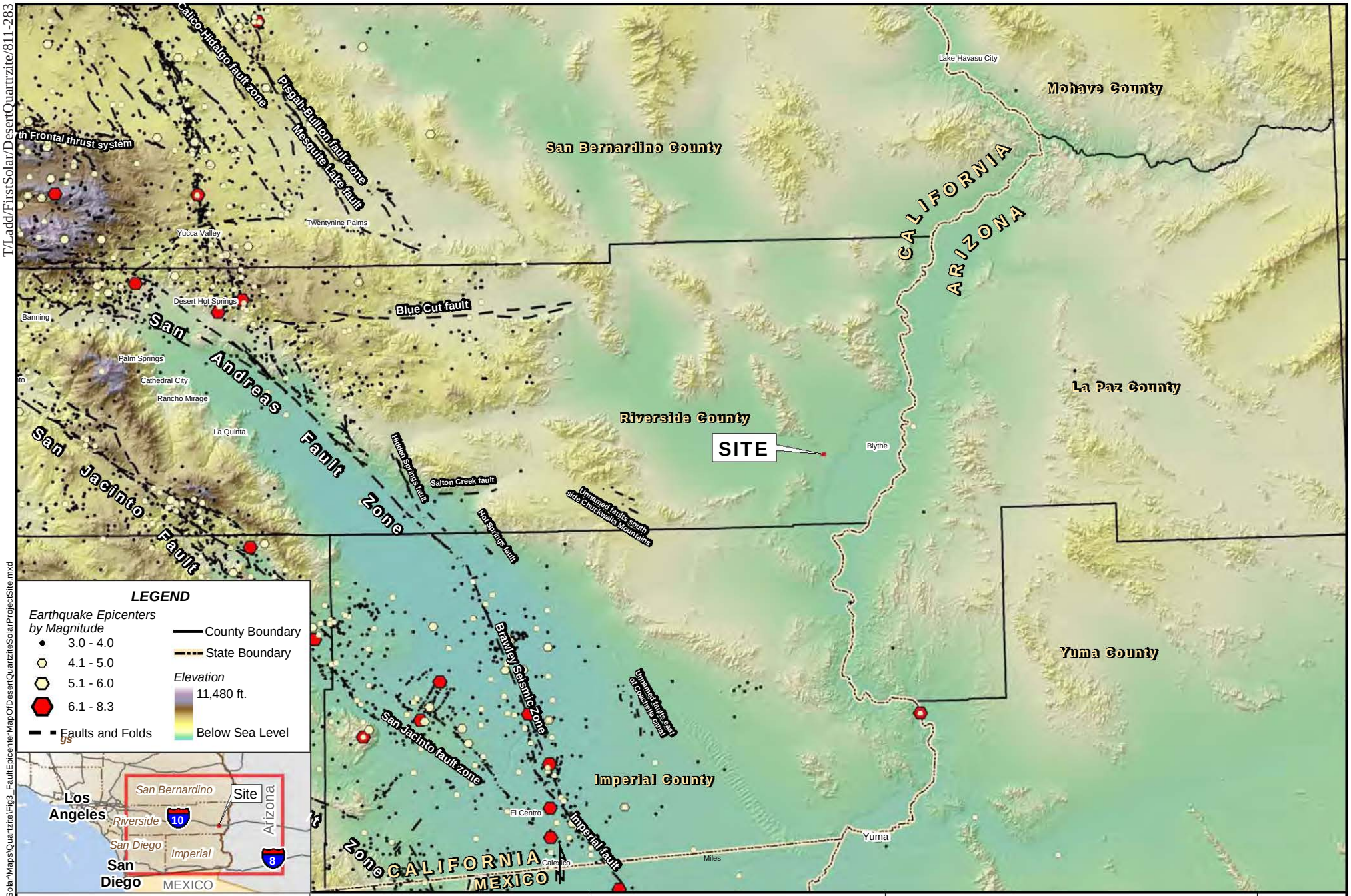
URS Corporation

Source:
U.S.G.S 1:100,000 Geologic Map of the West Half of the Blythe 30'x60' quadrangle, Riverside Co., CA & La Paz Co., AZ, dated 1988-1990 & 2004. Digital basemap by Techni Graphic Systems, Inc., and Paul Stone.

Figure 3. Geologic Map of Desert Quartzite Solar Project Site

2011

T:\Ladd\FirstSolar\DesertQuartrzite\811-283



T:\PROJECTS\First Solar\Maps\Quartzite\Fig3_FaultEpicenterMapOfDesertQuartziteSolarProjectSite.mxd

First Solar - Desert Quartzite Solar Project, Riverside County, CA

URS Corporation

0 5 10 15 20 Miles

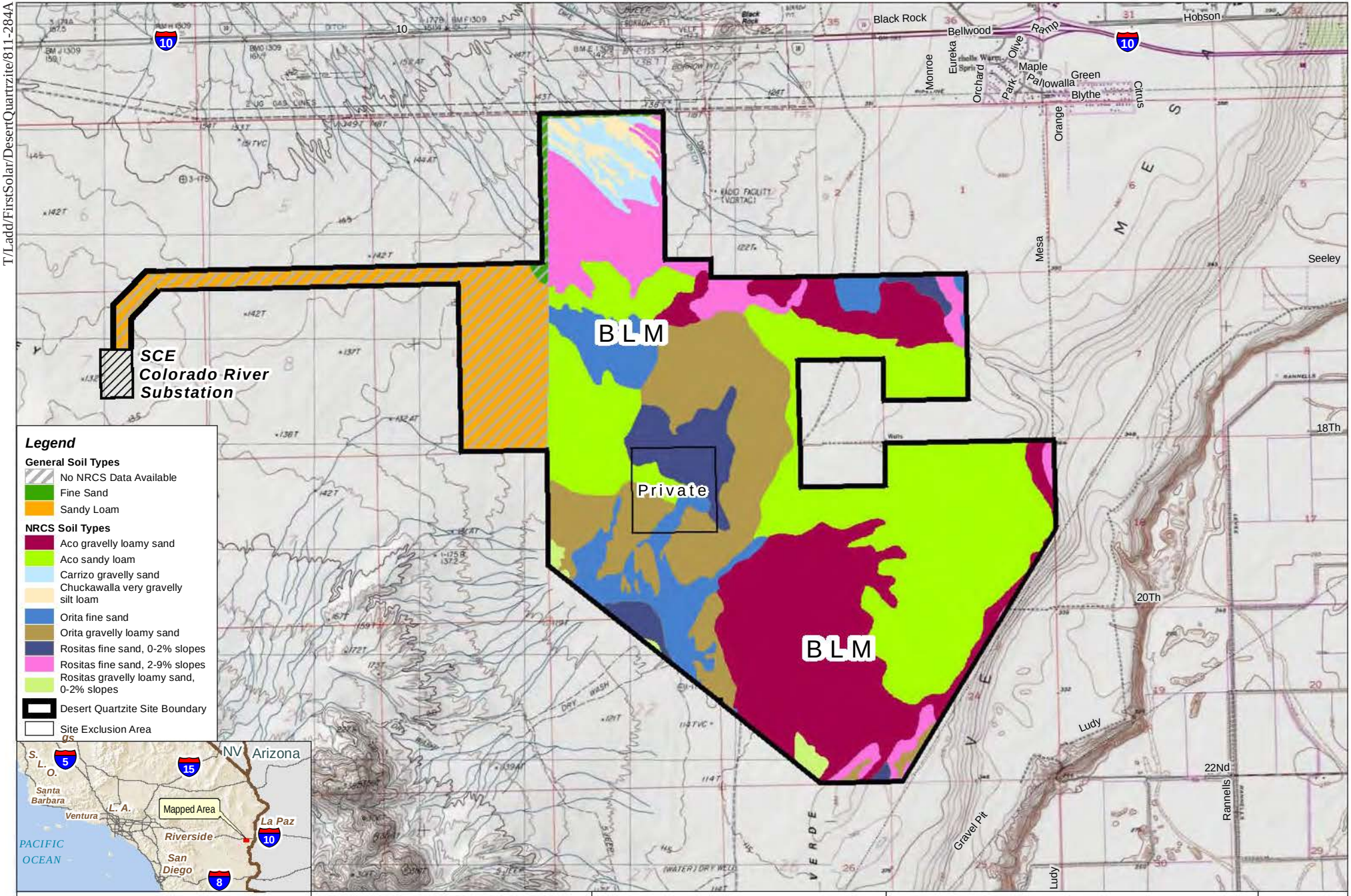
0 50,000 100,000 Feet

Fault Source: CGS CD 2000-006
Epicenter Source: CGS 1800-2000 Earthquake Catalog and California Earthquake Data Center (SCEDC)
Source: U.S. Geological NASA Survey Shuttle Radar Topography Mission (SRTM) 2 Arc Seconds, Tele Atlas North America, Inc, ESRI.

Figure 4. Regional Fault and Epicenter Map of Desert Quartzite Solar Project Site

2011

T/Ladd/FirstSolar/DesertQuartzite/811-284A



First Solar - Desert Quartzite Solar Project, Riverside County, CA

URS Corporation

0 0.25 0.5 0.75 1 Miles

0 1,000 2,000 3,000 4,000 5,000 Feet

Source: [1] USGS 1:24,000-scale topographic map created with TOPO!, [2] USDA-NRCS Soil Survey of the Palo Verde Area (USDA, 1969).

Figure 5. Soils Map of Desert Quartzite Solar Project Site

2011

AR060756

APPENDIX A
EQFAULT SEISMIC PARAMETERS

\Project\First Solar\SAh - First Solar.grf

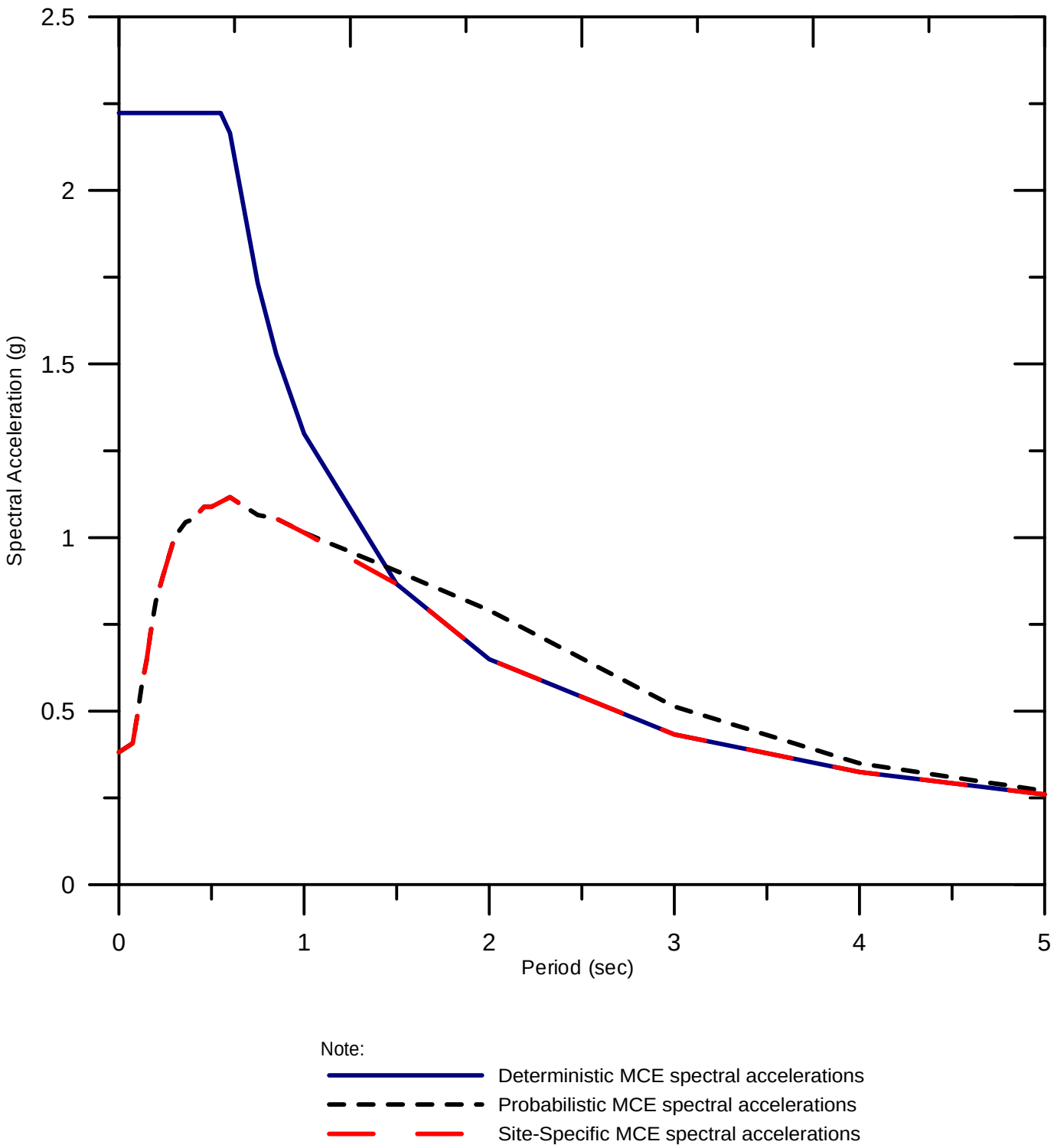


Figure 1 - MAXIMUM CREDIBLE EARTHQUAKE (MCE) ACCELERATION RESPONSE SPECTRUM FIRST SOLAR DESERT QUARTZITE

\Project\First Solar\SAh - First Solar.grf

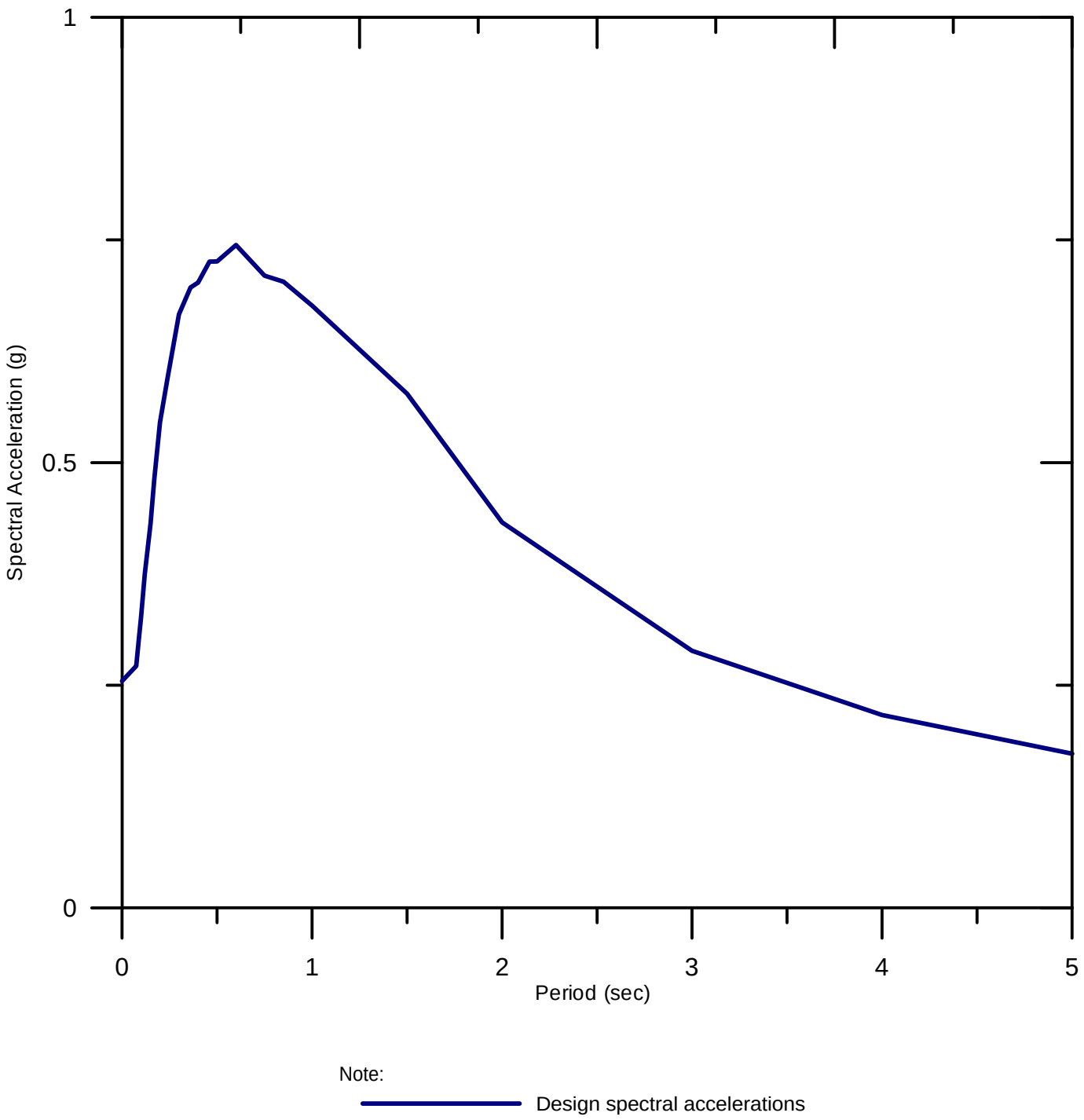


Figure 2 - SITE-SPECIFIC DESIGN RESPONSE SPECTRUM - FIRST SOLAR DESERT QUARTZITE

First Solar EQFault.txt

```
**********************
*                    *
*    E Q F A U L T   *
*                    *
*    Version 3.00    *
*                    *
**********************

      DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER:
                                                  DATE: 08-01-2011

JOB NAME: First Solar Desert Quartzite

CALCULATION NAME:

FAULT-DATA-FILE NAME: CDMGFLTE.DAT


SITE COORDINATES:
   SITE LATITUDE:  33.5620
   SITE LONGITUDE:  114.7069

SEARCH RADIUS:   100  mi

ATTENUATION RELATION:  21) Sadigh et al. (1997) Horiz. - Rock
   UNCERTAINTY (M=Median, S=Sigma): M       Number of Sigmas:  0.0
   DISTANCE MEASURE:  clodis
   SCOND:   0
   Basement Depth:  5.00 km     Campbell SSR:        Campbell SHR:
   COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED:  CDMGFLTE.DAT


MINIMUM DEPTH VALUE (km):  0.0
```

First Solar EQFault.txt

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
BRAWLEY SEISMIC ZONE	58.8(94.6)	6.4	0.016	IV
ELMORE RANCH	59.2(95.3)	6.6	0.019	IV
SAN ANDREAS - Southern	59.7(96.1)	7.4	0.037	V
SAN ANDREAS - Coachella	59.7(96.1)	7.1	0.029	V
IMPERIAL	66.7(107.4)	7.0	0.022	IV
SUPERSTITION HILLS (San Jacinto)	71.0(114.3)	6.6	0.014	III
SUPERSTITION MTN. (San Jacinto)	73.8(118.8)	6.6	0.013	III
PINTO MOUNTAIN	81.7(131.5)	7.0	0.015	IV
SAN JACINTO - BORREGO	82.3(132.5)	6.6	0.010	III
SAN JACINTO-ANZA	84.1(135.3)	7.2	0.018	IV
PISGAH-BULLION MTN.-MESQUITE LK	84.6(136.2)	7.1	0.016	IV
LAGUNA SALADA	89.0(143.2)	7.0	0.013	III
SAN JACINTO-COYOTE CREEK	89.2(143.5)	6.8	0.011	III
ELSINORE-COYOTE MOUNTAIN	92.3(148.6)	6.8	0.010	III
EMERSON So. - COPPER MTN.	94.3(151.7)	6.9	0.011	III
EUREKA PEAK	97.9(157.5)	6.4	0.006	II
BURNT MTN.	99.7 (160.5)	6.4	0.006	II

-END OF SEARCH- 17 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE BRAWLEY SEISMIC ZONE FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 58.8 MILES (94.6 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.0373 g

Project: First Solar Quartzite Site
Project No. 28907270
By: NS

Subject: Site-specific MCE Motion

Solution:

1. Site coefficients Fa and Fv per Table 11.4-1 and Table 11.4.2, respectively:
   Site F= No
   F_a= 1.5
   F_v= 2.2
2. Adjusted MCE spectral response acceleration parameters for Site F:
   S_{MS}= 0.59 S_{M1}= 0.34
   T_0= 0.12 sec. T_S= 0.58 sec. T_L= 8 sec.
3. Scaling factor Q= 0.67

T (sec.)		MCE SA (g) PSHE	MCE SA (g) DSHE	Site-Specific MCE	Design SA per Mapped Method	Design SA (5% Damping)		S_{DS}	S_{D1}
0		0.38	2.22	0.38	0.16	0.25		0.67	0.87
0.075		0.41	2.22	0.41	0.31	0.27			
0.09		0.46	2.22	0.46	0.34	0.30		S_{MS}	S_{M1}
0.1		0.49	2.22	0.49	0.36	0.33		1.00	1.30
0.12		0.56	2.22	0.56	0.39	0.37			
0.15		0.65	2.22	0.65	0.39	0.43			
0.17		0.72	2.22	0.72	0.39	0.48			
0.2		0.82	2.22	0.82	0.39	0.55			
0.24		0.89	2.22	0.89	0.39	0.59			
0.3		1.00	2.22	1.00	0.39	0.67			
0.36		1.04	2.22	1.04	0.39	0.70			
0.4		1.05	2.22	1.05	0.39	0.70			
0.46		1.09	2.22	1.09	0.39	0.73			
0.5		1.09	2.22	1.09	0.39	0.73			
0.6		1.12	2.17	1.12	0.38	0.74			
0.75		1.06	1.73	1.06	0.31	0.71			
0.85		1.05	1.53	1.05	0.27	0.70			
1		1.01	1.30	1.01	0.23	0.68			
1.5		0.90	0.87	0.87	0.15	0.58			
2		0.79	0.65	0.65	0.11	0.43			
3		0.51	0.43	0.43	0.08	0.29			
4		0.35	0.32	0.32	0.06	0.22			
5		0.27	0.26	0.26	0.05	0.17			

Appendix E Drainage Report

AR060763

DESERT QUARTZITE SOLAR PROJECT

DRAINAGE REPORT

Prepared For:

First Solar Development, Inc.
1111 Broadway, Suite 400
Oakland, CA 94607

Prepared by:

TLA Engineering and Planning, Inc.
1528 Eureka Road, Suite 100
Roseville, CA 95661
(916) 786-0685

August 10, 2011

Copyright © 2011 by TLA Engineering & Planning, Inc.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 1

2 INTRODUCTION 2

3 PROJECT SITE DESCRIPTION 3
3.1 Proposed Development 3
3.2 Climate 3
3.3 Geology 4
3.4 Soil Type 4
3.5 Drainage Area 4

4 HYDROLOGIC ANALYSIS 6
4.1 Precipitation 6
4.2 Infiltration 6

5 HYDRAULIC ANALYSIS 8
5.1 Pre to Post Project Characteristics 8
5.2 Results 9

6 SEDIMENT TRANSPORT ANALYSIS 11
6.1 Methodology 11
6.2 Results 11

7 PIER SCOUR ANALYSIS 12
7.1 Methodology 12
7.2 Results 12

8 CONCLUSIONS 13

9 REFERENCES 14

TABLES

TABLE 1 HYDRAULIC ANALYSIS SUMMARY 10

TABLE 2 SEDIMENT TRANSPORT ANALYSIS SUMMARY 11

TABLE 3 PIER SCOUR ANALYSIS SUMMARY 12

TABLE OF CONTENTS

FIGURES

FIGURE 1 VICINITY MAP 16

FIGURE 2 POST PROJECT SITE MAP 17

FIGURE 3 DRAINAGE SHED MAP 18

FIGURE 4 EXISTING PRE PROJECT DEPRESSION AREAS 19

FIGURE 5 MAXIMUM FLOW DEPTH
5a Pre Project 20
5b Post Project 20
5c Difference 21

FIGURE 6 MAXIMUM VELOCITY
6a Pre Project 22
6b Post Project 22
6c Difference 23

FIGURE 7 MAXIMUM SEDIMENT SCOUR
7a Pre Project 24
7b Post Project 24

FIGURE 8 POST PROJECT PIER SCOUR DEPTHS 25

AR060766

1 EXECUTIVE SUMMARY

First Solar proposes to construct and operate a 300 Megawatt alternating current (MWac) solar photovoltaic energy generating facility known as Desert Quartzite Solar Project (Project). The Project is located on 5,000 acres in an unincorporated area of eastern Riverside County, south of Interstate 10 and west of Blythe, California. See Figure 1 for the Project vicinity map, Figure 2 for the Post Project site map and Figure 3 for the Project drainage shed map.

The purposes of this Report are to evaluate the Project's potential impact to drainage runoff depth, velocity, volume and sediment transport; determine the potential solar panel pedestal pier scour depths; and if necessary, propose mitigation measures for the identified Post Project drainage impacts.

The primary drainage criteria and methods follow the Riverside County Hydrology Manual. U.S Army Corps of Engineers HEC-1 modeling software was used to determine the mountain shed runoff hydrographs. FLO-2D modeling software was used to determine the alluvial fan area rainfall, flow depths, velocities, and sediment transport. HEC-18 method was used to determine the solar pedestal pier scour depths.

Based on the results of this Report, the proposed Desert Quartzite Solar Project will cause minor impacts to the existing drainage shed area. The impacts have been minimized due to the relatively flat terrain and presence of large natural depressions that range from one to five feet deep. These large depressions store significant volumes of water which attenuate the increased outflow. See Figure 4 for existing depression areas.

The unmitigated Post Project impacts during the 100-year storm event are as follows:

- Average Flow Depth increase of 0.03-feet
- Average Flow Velocity increase of 0.04 feet/second
- Total Outflow increase of 20 acre-feet (2.6%)

See Figures 5 and 6 for the maximum flow depth and velocity. The nominal Post Project increases in flow depth, velocity and outflow can be mitigated with onsite retention basins sized with at least 20 acre-feet of combined storm water storage capacity.

The unmitigated Post Project sediment transport will be less than the pre project conditions due to soil compaction. The Project site experiences relatively shallow and slow flows, so the nominal increases in Post Project flow depths and velocities do not overcome the decreased erosion potential due to compaction. See Figure 7 for maximum sediment scour depths.

The maximum potential pier scouring at the solar array pedestal supports is 1.22-feet. The structural design and embedment depth of the solar panel pedestal piers should account for the maximum potential scour plus a factor of safety. Monitoring after large storm events should be implemented to detect piers with significant scouring. See Figure 8 for pier scour depths.

AR060767

2 INTRODUCTION

First Solar proposes to construct and operate a 300 Megawatt alternating current (MWac) solar photovoltaic energy generating facility known as Desert Quartzite Solar Project (Project). The Project is located in an unincorporated area of eastern Riverside County, south of Interstate 10 and west of Blythe, California. The Project will be located on federal lands managed by the U.S. Department of Interior, Bureau of Land Management (BLM), Palm Springs Field Office. See Figure 1 for the Project vicinity map and Figure 2 for the Post Project site map.

The Project boundary encompasses 5,310 acres and will ultimately develop approximately 2,500 acres of solar panels. The Project facilities will consist of: fixed tilted solar panels mounted above ground on supports consisting of wide flange pedestals; access roads; underground electrical wires from solar panels, transformer pads; maintenance and control buildings and facilities; water well for potable water supply and onsite sewage disposal system for the maintenance building; electrical interconnect equipment; overhead phone line; and a transmission line and facilities.

The Project is located in an existing drainage alluvial fan area which receives drainage from offsite mountains and offsite alluvial fan areas. The offsite downstream areas consist of alluvial fan areas with drainage flows that ultimately drain over bluffs east of the Project site.

The drainage areas, including the Project, are located in ungauged watershed runoff areas.

FIRM maps for all of the drainage studied area, including the Project area, are designated in The FIRM Riverside County panel index sheet 06065CIND2A, dated August 28, 2008 as “Zone D”, “Areas in which flood hazards are undetermined”.

The purposes of this Report are:

1. Evaluate the Project’s potential impact to drainage runoff depth, velocity, volume and sediment transport;
2. Determine the potential solar panel pedestal pier scour depths; and
3. If necessary, propose mitigation measures for the identified Post Project drainage impacts.

AR060768

3 PROJECT SITE DESCRIPTION

The Project is located on largely undeveloped and relatively flat land on the Palo Verde Mesa in eastern Riverside County, approximately nine miles west of the City of Blythe and one mile south of the Interstate-10 freeway. See Figure 1 for the Project vicinity map.

The Project area is undeveloped except for the First Solar Electric Blythe 1 200-acre solar project abutting the northeast side of the Project; a portion of a developed subdivision located south of I-10 at the northeast side of the drainage shed studied; and overhead power line facilities that cross the drainage sheds studied. There are some areas in the alluvial fan area south of I-10 that were cultivated in the past. There also are some bermed areas in the alluvial fan that have evidently been constructed to divert drainage flows away from the internal areas protected by the berms. One of these bermed areas consists of a 160-acre parcel near the middle of and completely surrounded by the proposed Project.

3.1 Proposed Development

The Project will be a 300 Megawatt alternating current (MWac) solar photovoltaic energy generating facility. The Project will construct solar arrays, access roads, an on-site electrical substation, and maintenance facilities.

The photovoltaic (PV) modules are mounted on framing assemblies made of steel, each holding 16 modules and measuring approximately eight feet wide by sixteen feet long. The PV module assemblies are attached at an angle to vertical steel piers that are spaced eight feet center-to-center and are driven into the ground to a depth of four to seven feet below grade. Each steel pier is a single W6x7.2 “I” beam. Once mounted, the front of each PV module assembly will be approximately 1.5 feet above grade, while the rear will be approximately five to six feet above grade.

The PV modules are electrically connected by wiring harnesses running along the bottom of each assembly to combiner boxes that collect power from several rows of modules. The combiner boxes feed DC power from the modules to the Power Conversion Station (PCS) via underground cables. The inverters in the PCS convert the DC electric input into AC electric output and the isolation transformer steps the current up for on-site transmission of the AC power to the PV combining switchgear (PVCS). The PVCS collects the power for transmission to the substation.

3.2 Climate

The Riverside County Hydrology Manual describes the desert areas as extremely hot and dry during the summer months, with moderate temperatures occurring during the winter. The mean seasonal precipitation in the eastern desert region is three inches.

The region experiences three types of storms: general winter storms, general summer storms and high intensity thunderstorms. General winter storms generate most of the precipitation. As these

storms move toward the eastern end of the County, beyond the Santa Ana Mountains, little moisture remains and precipitation decreases rapidly over the desert areas.

3.3 Geology

The Project is located in an alluvial fan area with the Mule Mountains located immediately to the southwest and the McCoy Mountains located north of I-10. As discussed in the Riverside County Hydrology Manual, mountain areas have extremely shallow soil depths and on many of the steepest slopes soil cover is virtually non-existent with bedrock exposed. These areas without soil cover have extremely low infiltration capacity.

The alluvial cones and fans near the mountains have coarse soils and are extremely porous. The soils further downstream tend to become finer and less porous.

3.4 Soil Type

A geotechnical investigation by Earth Systems Southwest was performed on the First Solar Electric Blythe 1 200-acre solar project abutting the northeast side of the Project. This report indicates the soil conditions consist generally of medium dense to dense, dry to damp, fine to course grained Silty Sands and Sands with Some Silt (Unified Soils Classification System symbols SM and SP-SM).

Additionally, soil maps from the U.S. Department of Agriculture Natural Resources Conservation Service were obtained and evaluated to determine the various soil types within the alluvial fan area. These soils maps were used to calculate a composite runoff index number from the Riverside County Hydrology Manual Plate E-6.1.

3.5 Drainage Area

The existing drainage areas surrounding the Project were determined from a combination of USGS topographic maps and a project specific topographic survey performed by Hillwig-Goodrow, Inc. in 2009. Hillwig-Goodrow's survey utilized aerial Lidar scanning, ground survey control and conventional photogrammetry to generate one-foot elevation contours within the Project boundary. The drainage basins are shown on Figure 3.

There are two mountain areas that drain into and through portions of the Project that created the alluvial fan area.

One area is north of Interstate 10, and is designated as drainage shed M1 on Figure 3. This shed consists of a portion of the McCoy Mountains and a portion of alluvial fan that has been blocked and diverted to the southeast side of shed M1 by channelization and I-10. This shed consists of 3,343-acres and ranges in elevation from 1670-feet at the northwest corner to 470-feet at the southeast and the I-10 bridge crossing. The area drains under an I-10 bridge into an area south of the I-10 bridge and into the alluvial shed area north of the Project.

The other mountain area is towards the southwest side of the Project and consists of 27 sheds designated as sheds M2 through M28 on Figure 3. These sheds consist of a portion of the Mule Mountains that drain into the alluvial fan area west of the Project site. These 27 sheds have a cumulative acreage of 2,043-acres and range in elevations from 1750-feet to 395-feet where they enter into the alluvial fan.

The alluvial fan drainage area studied consists of the offsite and onsite areas and is located in the Palo Verde Mesa. The area consists of 14,847 offsite acres and 5,310 Project onsite acres for a total of 20,157-alluvial fan acres. The total alluvial fan area ranges in elevation from the highest elevation near the northwest of 525-feet to a lowest elevation of 320-feet near the southeast. The straight line length between these elevations is approximately 6.92-miles and yields a slope of 0.0056 feet/foot.

The northern portion of the alluvial fan can be considered inactive because of the construction of I-10 and the diversion of mountain shed's M1 and alluvial fan drainage to the I-10 bridge as a concentrated flow under the bridge. This concentrated flow eventually becomes braided south of I-10 and reenters the alluvial fan drainage area near the north side of the Project.

4 HYDROLOGIC ANALYSIS

The primary drainage criteria and methods follow the Riverside County Hydrology Manual for precipitation, soil infiltration, and runoff index numbers. The drainage shed areas that affect the Project upstream and that the Project may affect downstream are shown on Figure 3.

The total drainage shed area studied is approximately 25,543 acres (39.91 square miles) and consists of:

1. Mountain shed M1, north of the Project and I-10: 3,343 acres
2. Mountain sheds M2-M28 southwest of the Project: 2,043 acres
3. Alluvial fan area south of I-10:
   a. Outside of Project 14,847 acres
   b. Project area 5,310 acres

4.1 Precipitation

The Riverside County Hydrology Manual relies on the National Oceanic and Atmospheric Administration (NOAA) for precipitation. NOAA Atlas 14 was utilized for determining point precipitation frequency estimates for the 100-year event.

Point precipitation for four representative locations throughout the total drainage shed areas studied were obtained. The unadjusted point frequencies for the four locations were tabulated and found to have very little difference by location. Thus, the average of the four locations was calculated for each time period within the 24-hour rainfall event.

A rainfall distribution is not specified in the Riverside County Hydrology Manual; therefore, the point precipitation was adjusted per the San Bernardino County Hydrology Manual by the respective drainage shed areas. Lag times were calculated using the curve number method (i.e. runoff index number).

The resultant 100-year, 24-hour rainfalls for the drainage sheds are:

- mountain shed M1 = 3.47” (adjusted for area)
- mountain sheds M2-M28 = 3.50” (unadjusted because shed areas are less than 1 sq. mile)
- alluvial fan = 3.40” (adjusted for area).

4.2 Infiltration

The Riverside County Hydrology Manual estimates infiltration rates based on the watershed’s soil-cover complex. This estimation is expressed as an index of runoff potential or “runoff index” number ranging from zero to 100. High runoff index numbers indicate a high runoff potential with low infiltration.

AR060772

Riverside County specifies an antecedent moisture condition II for 100-year design storm events. Accordingly, Riverside County Plate E-6.1 provides the associated runoff index numbers.

The mountain shed areas have the following drainage shed characteristics:

1. Are undeveloped with Barren ground cover conditions;
2. For AMC II condition have a composite runoff index number:
    a. For mountain shed M1: RI = 88.5
    b. For mountain sheds M2-M28: RI = 93.0
3. Have a basin surface roughness coefficient "n" = 0.04;

The existing alluvial fan shed area has the following drainage characteristics:

1. Is mostly undeveloped with Barren ground cover conditions;
2. For AMC II condition has a composite runoff index number of 83.0;
3. Has a basin surface roughness coefficient "n" = 0.05;
4. Soil grading curve (using FSE Blythe1 geotechnical report) provides the following:
    a. D10 = 0.070 mm
    b. D50 = 0.270 mm
    c. D60 = 0.297 mm
    d. D95 = 2.700 mm
    e. Uniformity coefficient = D60/D10 = 4.24
    f. Specific gravity = 2.65
    g. Dry weight = 104 pounds/cubic feet

5 HYDRAULIC ANALYSIS

Because the proposed Project is located in ungauged watersheds with a large alluvial fan area, ephemeral drainages, and for most of the site not well defined drainage outlet channels, it is necessary to utilize several types of drainage technologies and methods in order to provide the information, results, and develop mitigation measures if needed.

U.S Army Corps of Engineers HEC-1 modeling software was used to determine the mountain shed runoff hydrographs. FLO-2D modeling software was used to determine the alluvial fan area rainfall, flow depths, velocities and sediment transport.

The hydrographs from the HEC-1 calculations were entered into the FLO-2D model and used along with the other parameters developed above for the alluvial fan area to calculate: maximum flow depths, maximum velocities and sediment aggregation/degradation depths. The FLO-2D model grid cells were set to dimensions of 300-feet by 300-feet.

FLO-2D output for maximum depths, velocities, and pier scour calculations are those that occurred at any time during the 36-hour runoff calculation period in each grid and they do not necessarily occur at the same time. Sediment aggregation/degradation amounts are those final amounts that result from the 100-year, 24-hour storm at the end of the 36-hour calculation period.

5.1 Pre to Post Project Characteristics

The Project will alter the soil's hydraulic characteristics within the solar arrays due to vegetation removal and grading as follows:

> Vegetation would not be removed from the Proposed Project site until the onset of construction of a given phase. Vegetation would be Disked under, mulched or composted and retained on site to assist in erosion control and limit waste disposal. In some areas to be graded outside of the solar field, native vegetation would possibly be harvested for replanting to augment soil stabilization.
>
> Area's comprising the solar array field will be prepared using conventional farming equipment including tractors with Disking equipment and vibratory rollers with limited use of scrapers to perform micrograding within sections of the solar array field. This method improves construction worker safety by eliminating trip hazards. The site will be contour graded level; the macro level topography will remain unchanged, but within each solar array, the vegetation will be disked into the top soil and then flattened with a drum roller.
>
> Under this approach, rubber-tired farming tractors towing Disking equipment will disc the top 5-7 inches of soil. A water truck will follow along the tractor to moisten the land and keep dust below acceptable levels. The tractor may make several passes to fully disc the vegetation into the top soil, preserving the underground root structure, top soil

AR060774

nutrients and seed base. A drum roller will then be used to flatten the surface and return the soil compaction to a compaction level similar to the preconstruction compaction. The intent of the roller is to compact the soil under the solar field area, simply to even out the surface after the Disking is complete.

Lastly, limited use of scrapers for micrograding will be employed to even out areas of the ground to maintain a consistent grade in each solar field area. Hydrology analysis will evaluate these areas that are susceptible to scour from storm water runoff. The ground will be graded to a level topography using micrograding only where necessary.

Vegetation would be cleared from roadways, access ways, and where concrete foundations would be used for inverter equipment, substations, and the O&M facilities. Vegetation would be cleared for construction of the drainage controls, including berms. Organic matter would be mulched and redistributed within the construction area (except in trenches and under equipment foundations). Plant root systems would be left in place, except where grading and trenching would be required for placement of solar module foundations, underground electric lines, inverter and transformer pads, road and access ways, and other facilities to provide soil stability.

To account for the above described grading approach and the other facilities and impervious surfaces discussed in the Project Site Description, the Post Project soil characteristics were adjusted as follows:

	Pre Project	Post Project	Change
1. Composite runoff index number	83.0	88.0	+5.0
2. Surface roughness coefficient “n”	0.05	0.04	-0.01

Theoretically these soil characteristic changes will result in higher runoff potential with less infiltration.

The Project terrain is relatively flat with large natural depressions scattered across the southeast portion. The natural depressions range in depth from one to five feet, and are shown on Figure 4. These depressed areas trap and hold large volumes of runoff which will help attenuate increases in peak flow and volume associated with the Project.

5.2 Results

The Pre and unmitigated Post Project hydraulic analysis results are summarized in Table 1 below. Total rainfall volume from the mountain sheds and alluvial fan shed remained constant at a total of 6,679 acre-feet.

The total rainfall volume simulated over the alluvial fan shed area resulted in infiltration, storage in the natural depressions and outflow. The unmitigated Post Project infiltration decreased by 91 acre-feet or 3.4%; storage increased by 71 acre-feet or 2.2%; and outflow increased by 20 acre-feet or 2.6%.

AR060775

The Pre and unmitigated Post Project flows have relatively shallow depths and low velocities due to the flat terrain. The maximum depth results are somewhat miss leading due to the natural depressions that are approximately five-feet deep. On average the majority of the Project site will experience flow depths less than half a foot (see Figure 5a & 5b). The unmitigated Post Project onsite flow depths increased by an average of 0.03-feet or 7.5% (see Figure 5c).

The maximum velocities occur on the fringe of the Project boundary where the mountain sheds enter the alluvial fan area. On average the majority of the Project site will experience flow velocities less than half a foot per second (see Figure 6a and 6b). The unmitigated Post Project onsite flow velocities increased by an average of 0.04 feet per second or 17.4% (see Figure 6c).

The unmitigated Post Project increases to depth, velocity and outflow are minimal as an order of magnitude to the drainage area studied. The flat terrain with natural depressions helped to attenuate the Post Project effects of decreasing the infiltration capability of the soil.

Mitigation for the Project's nominal increases can be achieved by constructing retention basins at the upstream and/or downstream edges of the Project. The retention basins should be sized with at least 20 acre-feet of combined storm water storage capacity.

TABLE 1: Hydraulic Analysis Summary

Item Description		Pre Project	Unmitigated Post Project	Post - Pre	Percent Change
Rainfall Volume					
Mountain Sheds	acre-feet	1,097	1,097	0	0.0%
Alluvial Fan Shed	acre-feet	5,582	5,582	0	0.0%
Total	acre-feet	6,679	6,679	0	0.0%
Alluvial Fan Flow Volume					
Infiltration	acre-feet	2,671	2,580	-91	-3.4%
Storage	acre-feet	3,245	3,316	71	2.2%
Outflow	acre-feet	763	783	20	2.6%
Total	acre-feet	6,679	6,679	0	0.0%
Onsite Flow Depth					
Maximum Depth	feet	5.23	5.63	0.40	7.6%
Average Depth	feet	0.40	0.43	0.03	7.5%
Onsite Flow Velocity					
Maximum Velocity	feet/sec	1.85	2.12	0.27	14.6%
Average Velocity	feet/sec	0.23	0.27	0.04	17.4%

6 SEDIMENT TRANSPORT ANALYSIS

Sediment transport occurs through the scour or deposition of soil based on storm event flow rates and soil characteristics. Hydrologic, hydraulic and soil data discussed earlier in this report were utilized for the sediment transport analysis.

6.1 Methodology

FLO-2D has a sediment transport component that can compute sediment scour or deposition for nine different methodologies. The FLO-2D user's manual identifies the Zeller and Fullerton methodology as appropriate for alluvial floodplain conditions.

Within each FLO-2D grid element, the sediment transport capacity is computed for overland flow based on the flow hydraulics. The sediment transport capacity is then compared with the sediment supply and the resulting sediment excess or deficit is uniformly distributed over the grid element.

6.2 Results

The Pre and unmitigated Post Project sediment transport analysis results are summarized in Table 2 below. On average the majority of the Pre and unmitigated Post Project site will experience sediment scour and deposition depths of plus or minus half a foot.

The unmitigated Post Project average onsite sediment scour depth (degradation) decreased by 0.07-feet or 15.9% and the deposition depth (aggradation) decreased by 0.03-feet or 5.0%. These decreases are attributable to the increase in the soil compaction which reduces the erosion potential.

The Project site experiences relatively shallow and slow flows, so the nominal increases in Post Project flow depths and velocities do not overcome the decreased erosion potential due to compaction.

TABLE 2: Sediment Transport Analysis Summary

Item Description			Pre Project	Unmitigated Post Project	Post - Pre	Percent Change
Onsite Sediment Transport						
Average Degradation Depth (-)		feet	-0.44	-0.37	0.07	-15.9%
Average Aggradation Depth (+)		feet	0.60	0.57	-0.03	-5.0%
Average Site Depth (+ or -)		feet	0.12	0.11	-0.01	-8.3%

7 PIER SCOUR ANALYSIS

As discussed earlier in this report, the solar panel pedestals will be supported by vertical steel piers. Each pier is a single W6x7.2 "I" beam. As storm water flow encounters the piers, turbulent flow will occur. The turbulent flow will cause increased local scour around the piers.

7.1 Methodology

The pier scour analysis followed the Federal Highway Administration's Hydraulic Engineering Circular No. 18 (HEC-18), "Evaluating Scour at Bridges" (4th Edition). Flow depth and velocity outputs from the FLO-2D model were used to calculate the pier scour depths at each grid element. The local scour equation and the various parameters and assumed values are as follows:

$$\frac{y_s}{a} = 2.0 K_1 K_2 K_3 K_4 \left(\frac{y}{a}\right)^{0.35} Fr^{0.43}$$

Where: y_s = Local scour depth (ft)
K_1 = 1.1 (correction factor for pier nose shape)
K_2 = 1.29 (correction factor for angle of attack of flow)
K_3 = 1.1 (correction factor for bed condition)
K_4 = 1.0 (correction factor for armoring)
a = 0.33 (pier width in feet)
y = FLO-2D average flow depth (ft);
Fr = Froude number:

$$Fr = \frac{V}{\sqrt{gy}}$$

Where: V = FLO-2D average velocity (ft/s)
g = Acceleration due to gravity (32.2 ft/s^2)

7.2 Results

The pier scour analysis results are summarized in Table 3 below. The maximum pier scour depth is 1.22-feet and the average depth is 0.39-feet (see Figure 8). The structural design and embedment depth of the solar panel pedestal piers should account for the maximum potential scour plus a factor of safety. Monitoring after large storm events should be implemented to detect piers with significant scouring.

TABLE 3: Local Pier Scour Analysis Summary

Item Description			Unmitigated Post Project
Local Pier Scour			
	Maximum Depth	feet	1.22
	Average Depth	feet	0.39

AR060778

8 CONCLUSIONS

The proposed Desert Quartzite Solar Project will cause minor impacts to the existing drainage shed area. The impacts have been minimized due to the relatively flat terrain and presence of large natural depressions that range from one to five feet deep. These large depressions store significant volumes of water which attenuate the increased runoff.

The unmitigated Post Project impacts during the 100-year storm event are as follows:

- Average Flow Depth increase of 0.03-feet
- Average Flow Velocity increase of 0.04 feet/second
- Total Outflow increase of 20 acre-feet (2.6%)

The nominal Post Project increases in flow depth, velocity and outflow can be mitigated with onsite retention basins sized with at least 20 acre-feet of combined storm water storage capacity.

The unmitigated Post Project sediment transport will be less than the pre project conditions due to soil compaction. The Project site experiences relatively shallow and slow flows, so the nominal increases in Post Project flow depths and velocities do not overcome the decreased erosion potential due to compaction.

The maximum potential pier scouring at the solar array pedestal supports is 1.22-feet. The structural design and embedment depth of the solar panel pedestal piers should account for the maximum potential scour plus a factor of safety. Monitoring after large storm events should be implemented to detect piers with significant scouring.

AR060779

9 REFERENCES

1. "Hydrology Manual", Riverside County (California) Flood Control and Water Conservation District, April 1978, John W. Bryant, Chief Engineer

2. Flood Insurance Rate Map (FIRM). FIRM maps for the all of the drainage area and Project area consist of four Panels as follows: Panel Numbers *06065C2550G, *06065C2575G, *06065C3200G, and *06065C3225G. These panels are not printed by NFIP and for the areas are designated in the FIRM Index Sheet 2 for Riverside County, California as "Zone D", "Areas in which flood hazards are undetermined".

   Thus, flood plains in the area have not been determined and no flood plain elevations or flows have been developed.

3. "Geotechnical Engineering Report, Proposed Solar Field Facility, North of 16th Avenue on both sides Haig Road, Blythe, Riverside county, CA", March 27, 2008 by Earth Systems Southwest for First Solar Electric.

   This report is for an approximately 240 acre site abutting and near the northeast side of the Project.

4. "Web Soil Survey, National Cooperative Soil Survey", by USDA, Natural Resources Conservation Service. (See Appendix I for applicable excerpts).

5. "Point Precipitation Frequency Estimates from the National Oceanic & Atmospheric Administration (NOAA) Atlas 14". 2006, National Weather Service, Silver Spring, Maryland.

6. "San Bernardino County, Hydrology Manual", August 1986 (SBCHM).

7. "HEC-1", US Army Corps of Engineers, Hydraulic Engineering Center.

   This is a computer program that allows runoff and hydrographs to be computed utilizing various input data. This program is used for the Project offsite Mountain Shed areas.

8. FLO-2D, Version 2007.06.

   FLO-2D is a two-dimensional surface-water-flow and sediment-transport model computer drainage calculation program used for the Projects alluvial fan drainage areas.

9. "Evaluating Scour at Bridges, 4th Edition", May/Sept 2001, Publication No. FHWA NHI 01-001, Hydraulic Engineering Center No. 18 (HEC-18).

   Chapter 6 of this document provides the background methods used to calculate scour depths at the solar support pedestals.

10. "Drainage Calculations for x1-Riv-64-D,E", April 1964, by California Department of Public Works-Division of Highways.

The calculations include information relative to I10 and DOH station 927+50 and shown as the Palowalla Ditch. This is the ditch and area that drains to the southeast and under the I10 bridge which drainage is directed towards the northeast side of the Project site.

11. "Desert Quartzite Field Visit" 1 page email of August 14, 2009 from Crystal Eggers.

This email provides a general description of soil conditions in the Project site.

12. "Sedimentation Engineering", ASCE Manuals and Reports on Engineering Practice No. 54, 2006 originally published 1975 and republished as Classic Edition, 2006

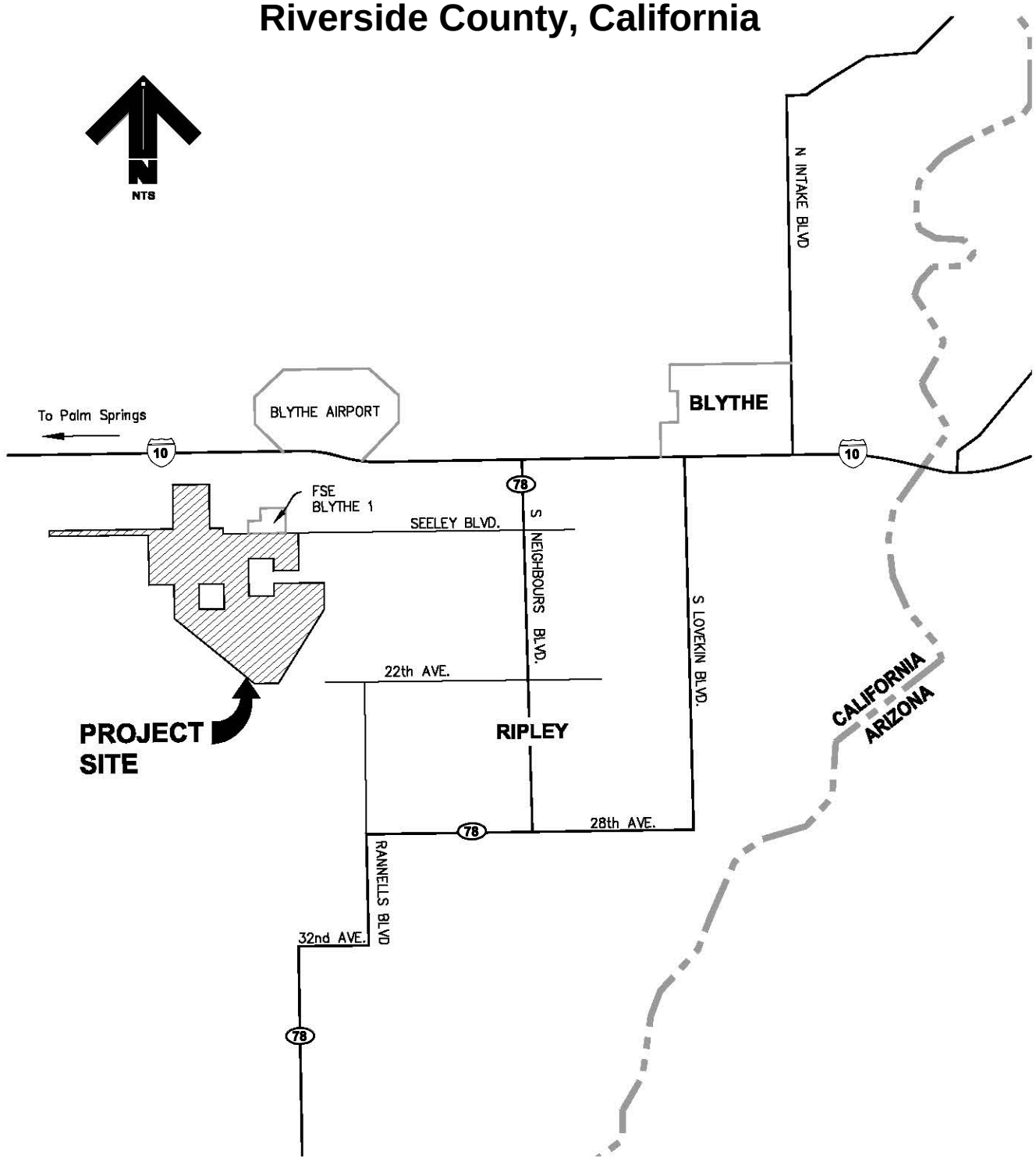
13. "Sedimentation Engineering, Processes, Measurements, Modeling, and Practice", ASCE Manuals and Reports on Engineering Practice No. 110, 2007

14. "Sediment Yield Computed with Universal Equation", December 1972, Journal of the Hydraulics Division, Proceedings of ASCE, by Jimmy R. Williams and Harold D. Berndt.

15. 'Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE)", January 1997, USDA, Agricultural Research Service, Agriculture Handbook Number 703

16. "Draft, User's Reference Guide, Revised Universal Soil Loss Equation, Version 2 (RUSLE@), May 15, 2008, prepared for USDA-Agricultural Research Service, Washington, D.C.

First Solar
Desert Quartzite Solar Farm
Figure 1
General Project Vicinity Map
Riverside County, California



TLA
ENGINEERING & PLANNING

AR060782

First Solar
Desert Quartzite Solar Farm
FIGURE 2
Post Project Site Map

N

4000 0 2000 4000

FEET

BLYTHE AIRPORT

PROPOSED ELECTRIC SUBSTATION

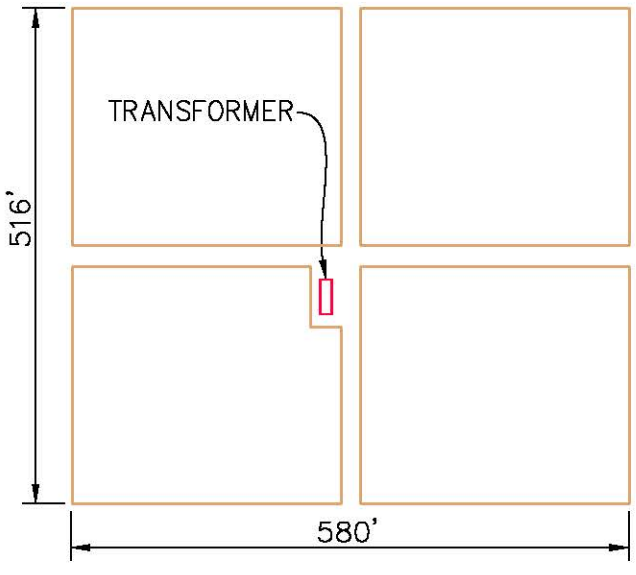
FSE BLYTHE 1

SEELEY BLVD.

PROPOSED SOLAR PANEL ARRAY (SEE DETAIL BELOW)

22th AVE.

RANNELLS BLVD



Typical 1 Megawatt Array Layout
NTS

LEGEND

Approximate Project Limits

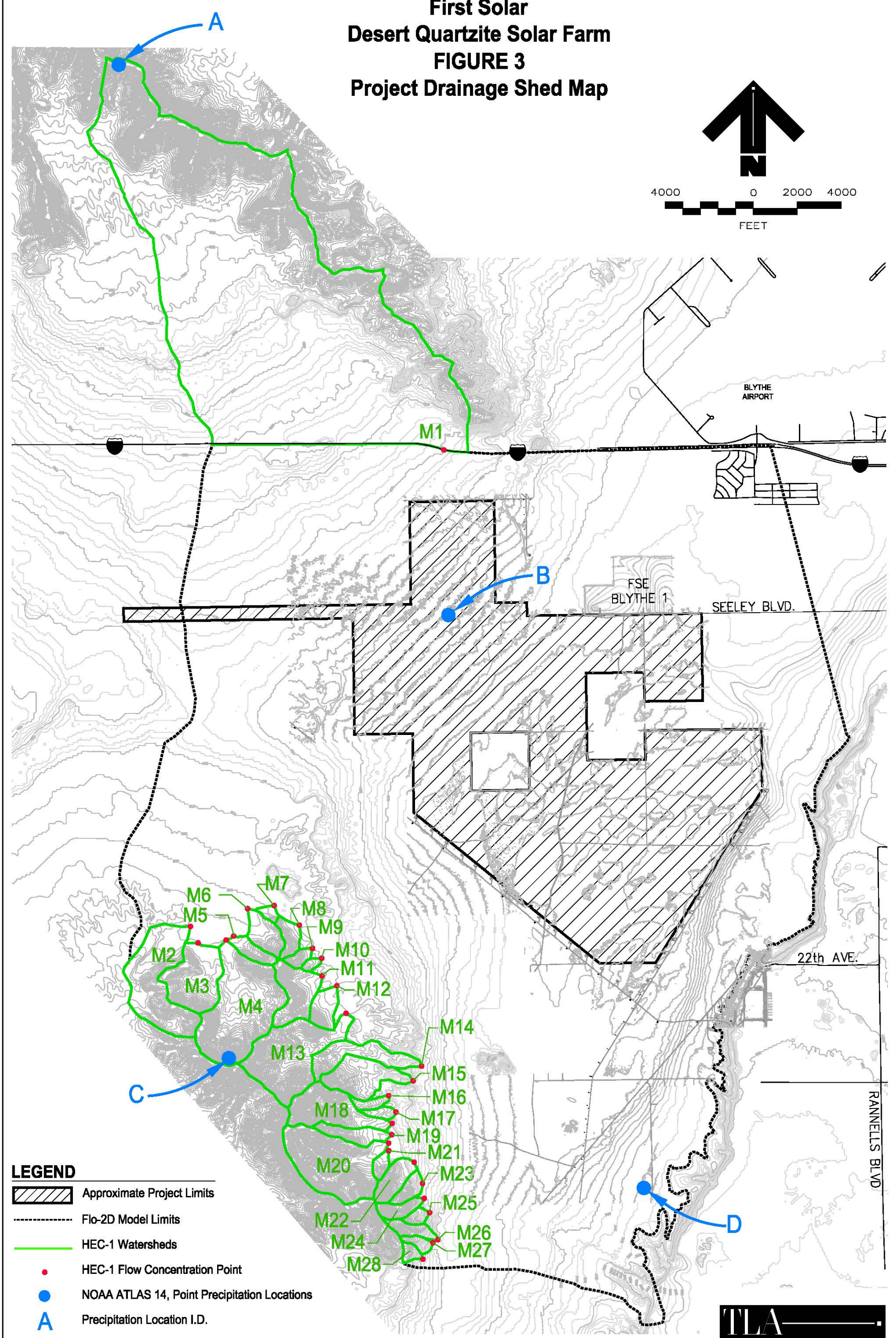
1 Megawatt Array (Typ)
(See Array Layout above)

TLA ENGINEERING & PLANNING

AR060783

File: K:\1proj\14XX\1468\Drainage\2011 Riverside Method Report\Exhibits\Fig-2_Post-Project Site Map.dwg Aug 04, 2011 - 9:59am jhenderson

First Solar
Desert Quartzite Solar Farm
FIGURE 3
Project Drainage Shed Map



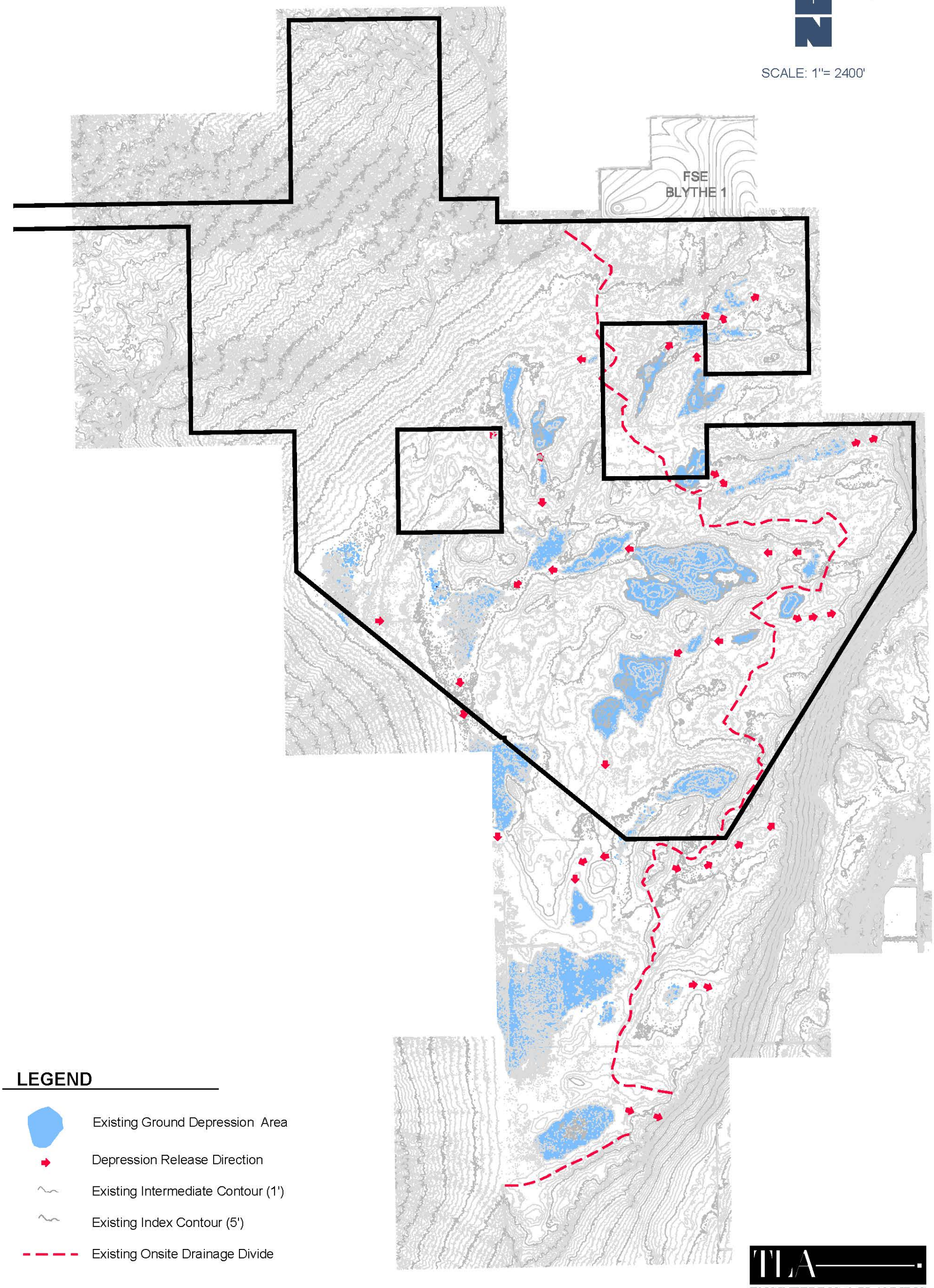
TLA ENGINEERING & PLANNING

File: K:\1pro\14XX\1468\Drainage\2011 Riverside Method Report\Exhibits\Fig-03 Project Drainage Shed Map.dwg Aug 04, 2011 - 12:52pm jhenderson

AR060784

First Solar
Desert Quartzite Solar Farm
FIGURE 4
Existing Ground Depression Areas

SCALE: 1"= 2400'



LEGEND

- Existing Ground Depression Area
- Depression Release Direction
- Existing Intermediate Contour (1')
- Existing Index Contour (5')
- Existing Onsite Drainage Divide

TLA ENGINEERING & PLANNING

AR060785

File: K:\1proj\14XX\1468\Drainage\2011 Riverside Method Report\Exhibits\Fig-04_Ex-Depression Areas.dwg Aug 04, 2011 - 1:05pm jhenderson

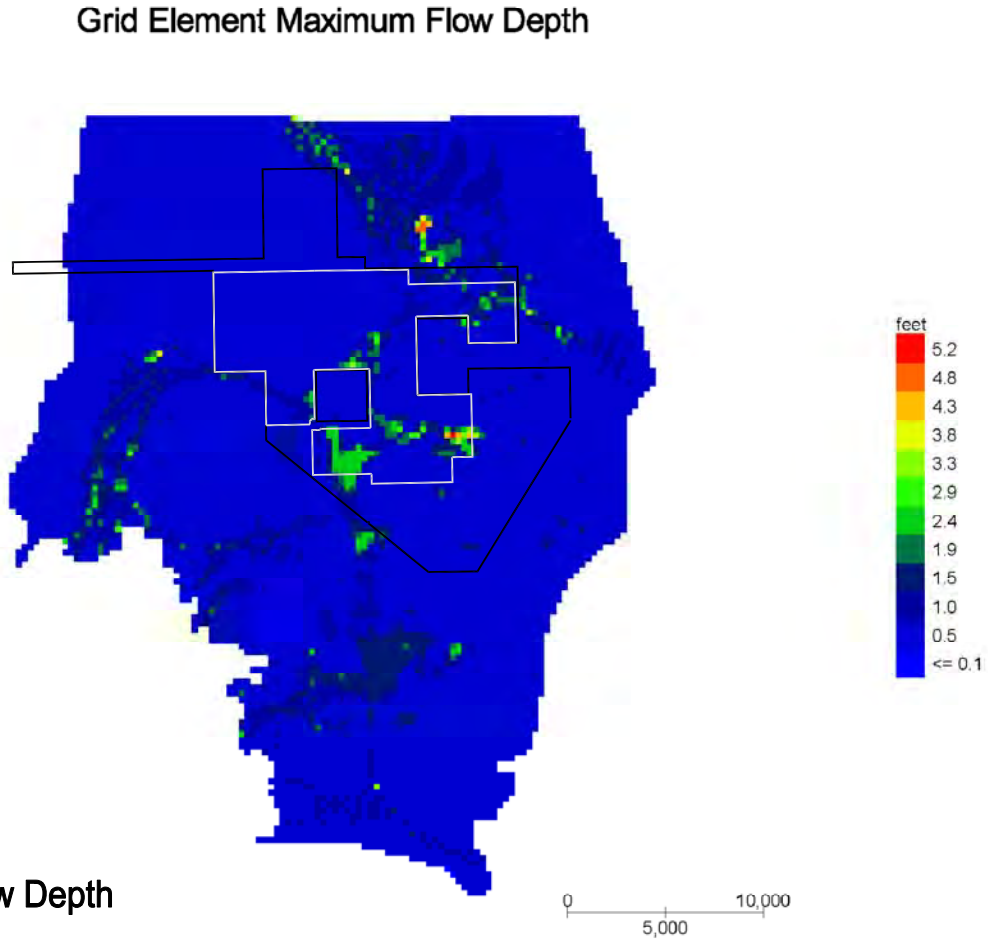


Figure 5a
Pre Project Flow Depth

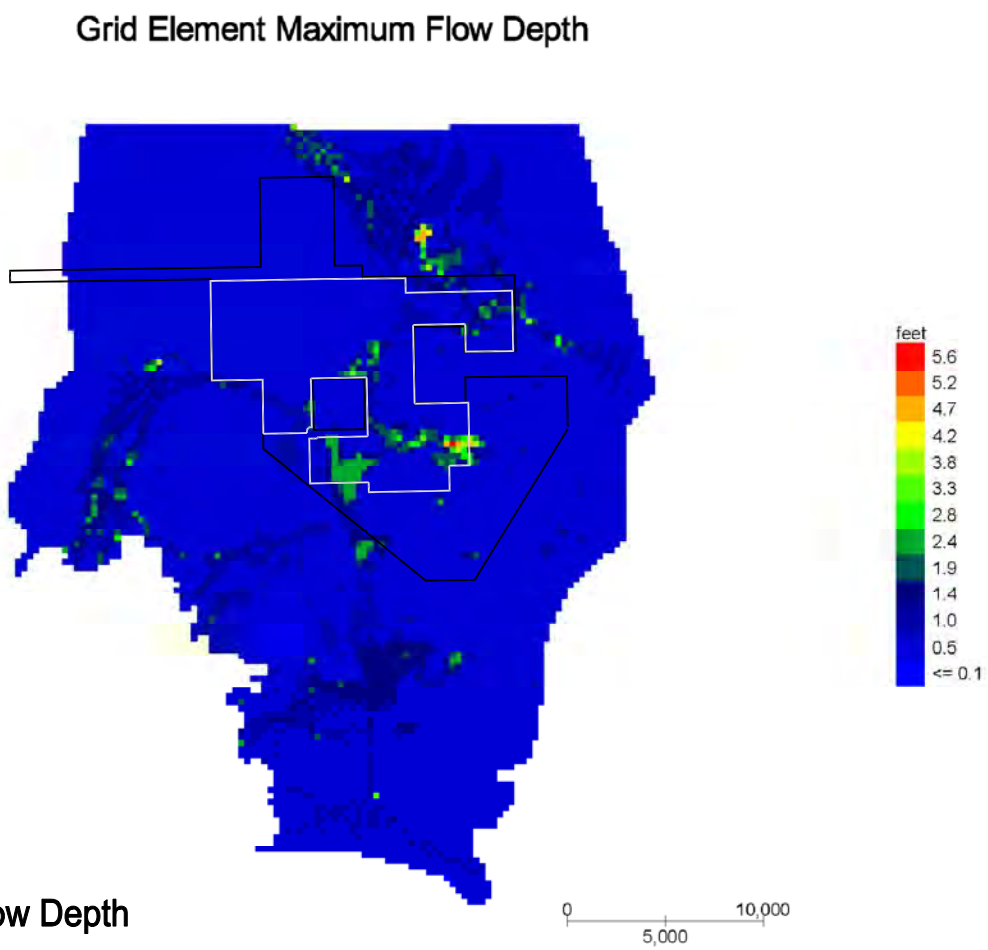


Figure 5b
Post Project Flow Depth

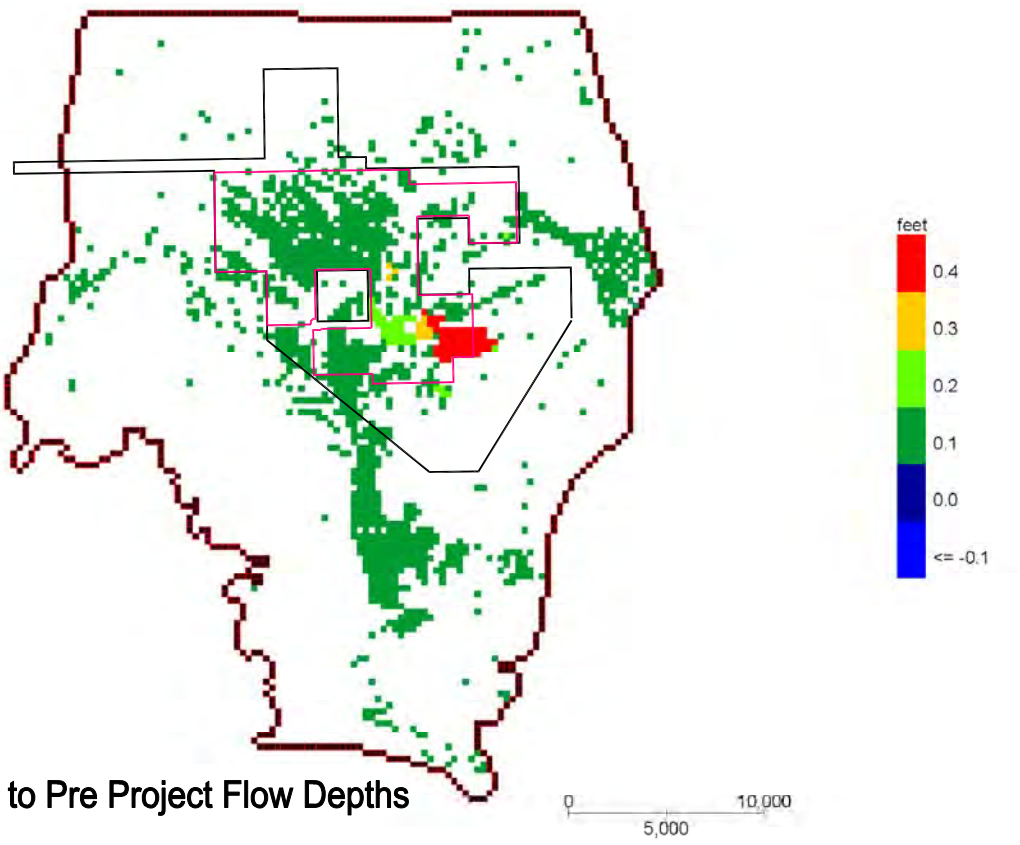


Figure 5c
Difference Post to Pre Project Flow Depths

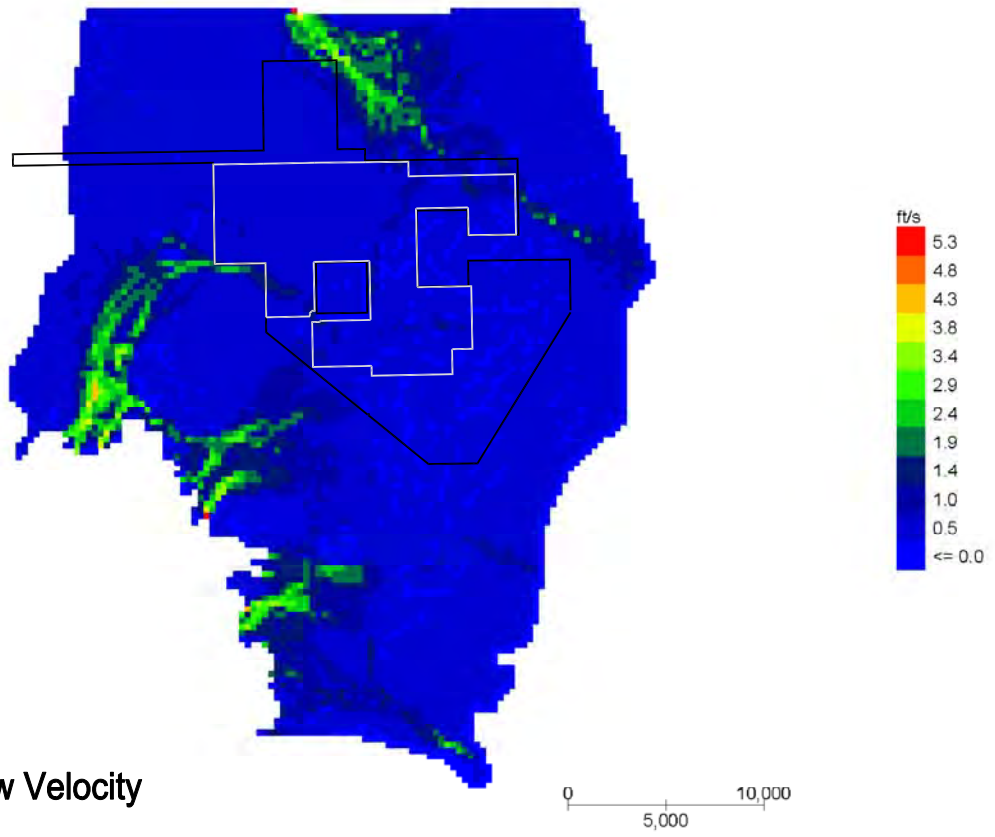


Figure 6a
Pre Project Flow Velocity

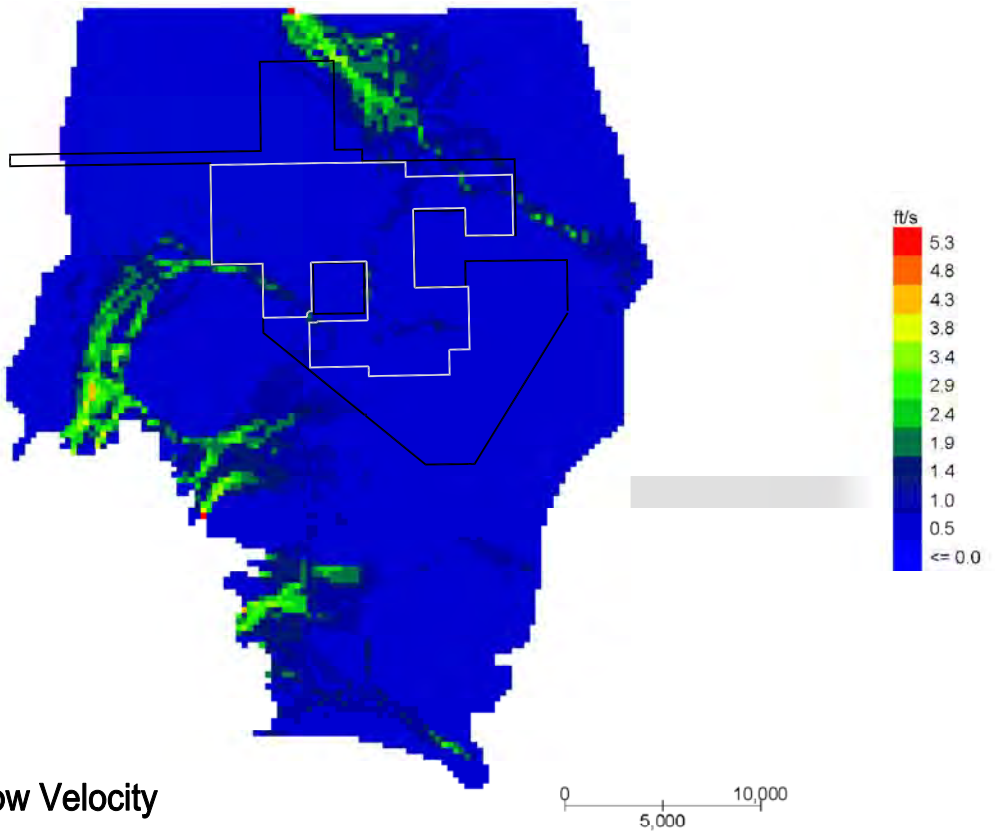


Figure 6b
Post Project Flow Velocity

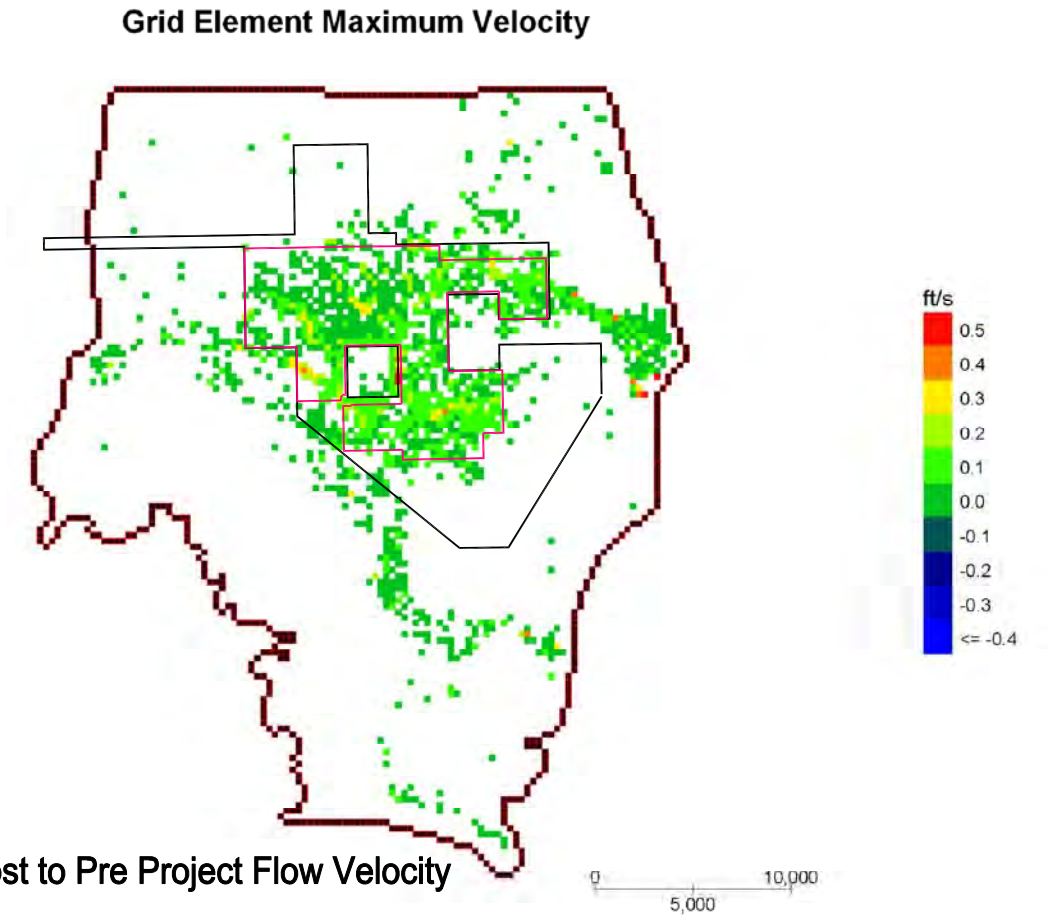


Figure 6c
Difference Post to Pre Project Flow Velocity

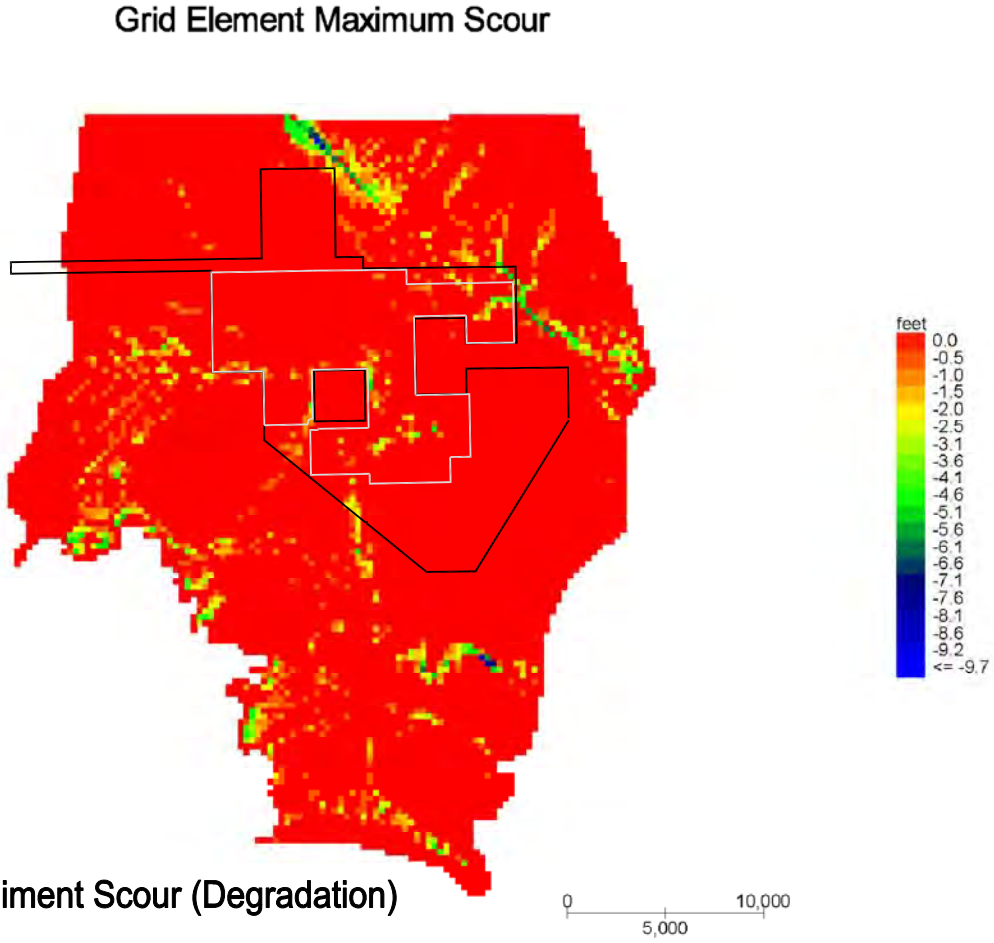


Figure 7a
Pre Project Sediment Scour (Degradation)

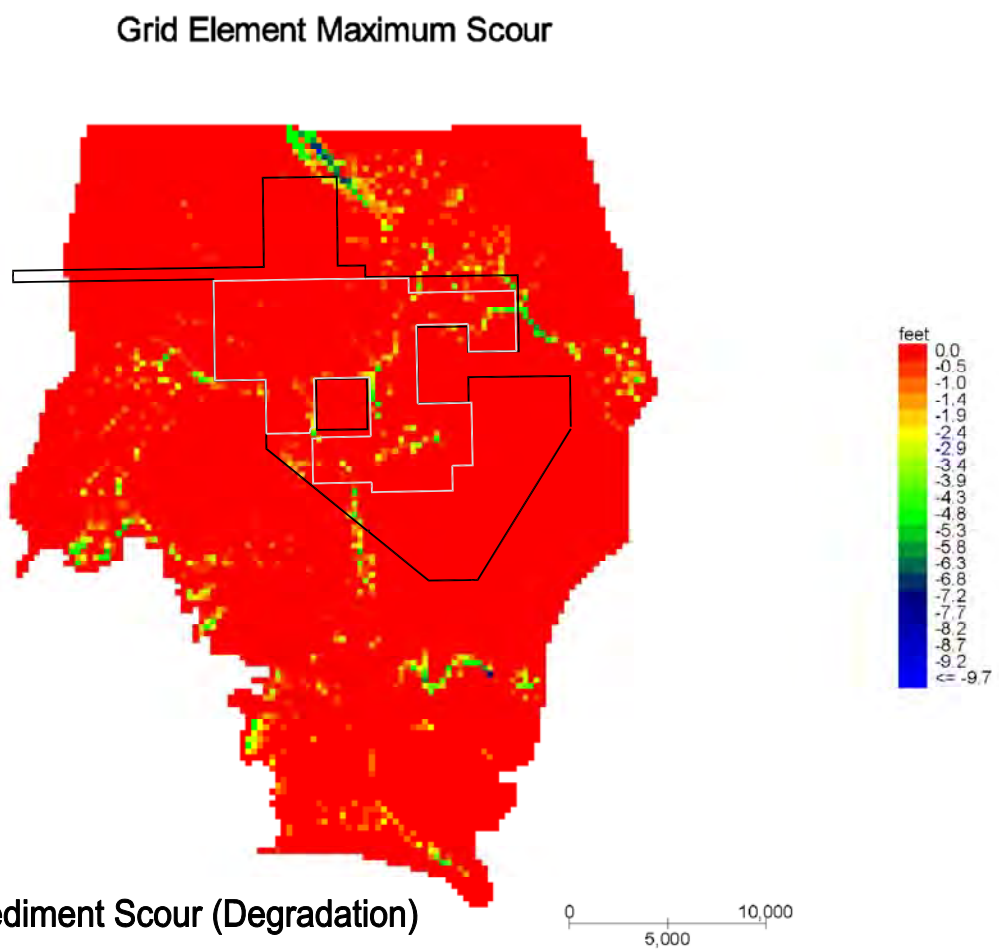


Figure 7b
Post Project Sediment Scour (Degradation)

Grid Element Maximum Pier Scour

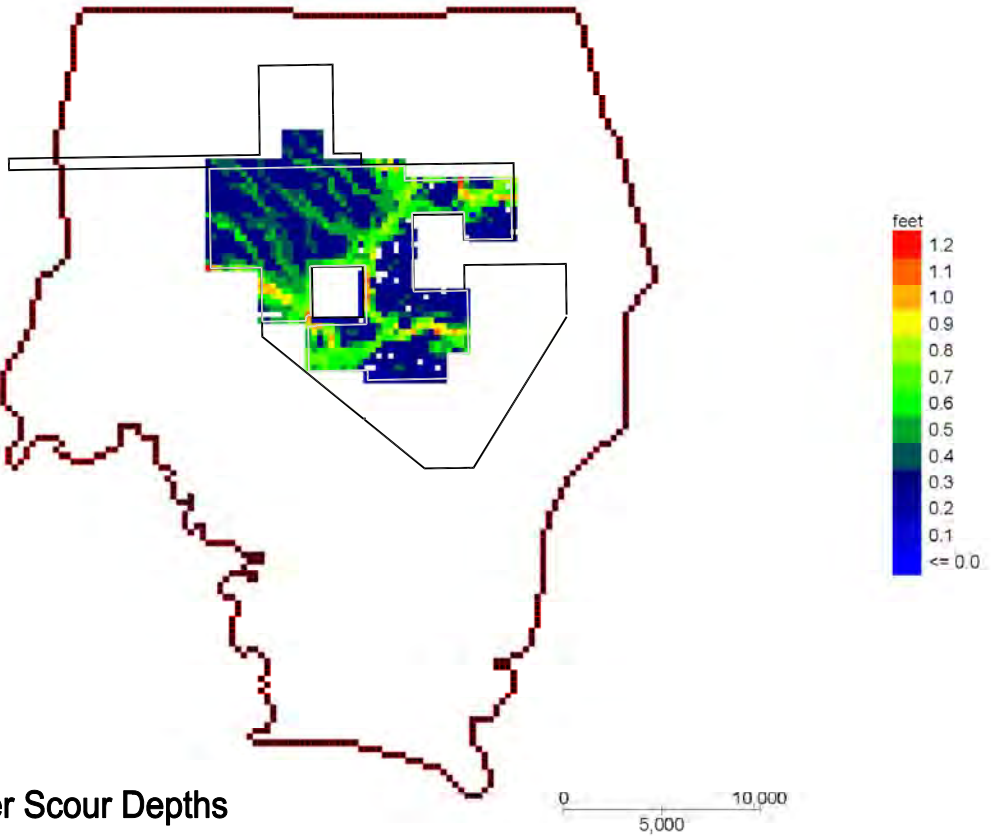
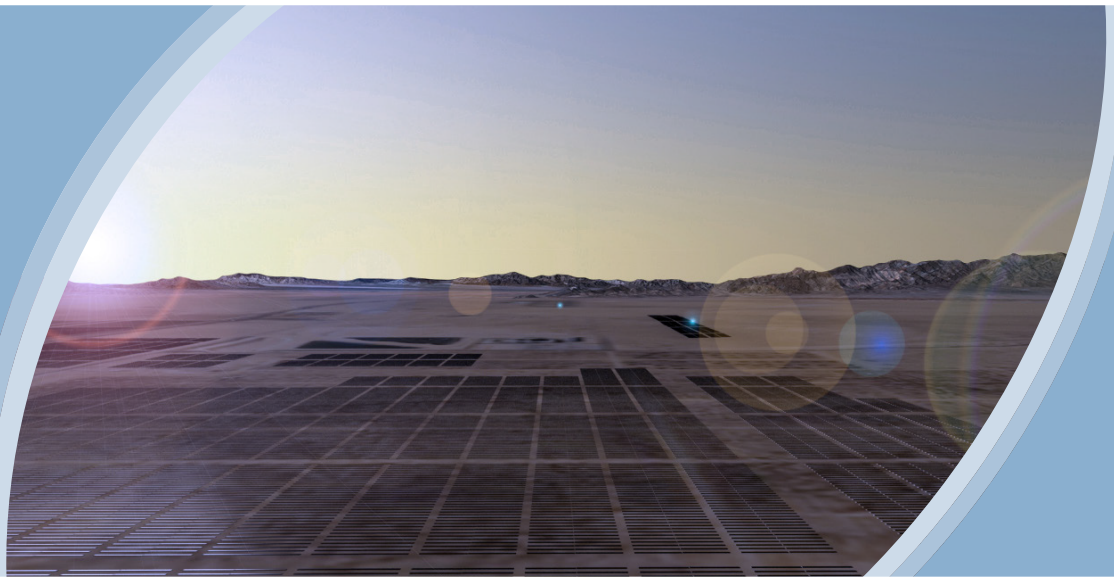


Figure 8
Post Project Pier Scour Depths

BLYTHE MESA SOLAR PROJECT



Draft Environmental Impact Report/Environmental Assessment

Volume I

EIR No. 529
EA No. 0021
SCH No. 2011111056

June 2014

CEQA/NEPA Lead Agencies:

RIVERSIDE COUNTY
PLANNING DEPARTMENT

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

THIS PAGE INTENTIONALLY LEFT BLANK

Draft
Environmental Impact Report/
Environmental Assessment

Blythe Mesa Solar Project

EIR No. 529
EA No. 0021
SCH No. 2011111056

Volume I
(Chapters 1, 2, and 3)

Project Proponent:

Renewable Resources Group
113 S. La Brea Ave., 3rd Floor
Los Angeles, CA 90036

Prepared by:

POWER Engineers, Inc.
731 East Ball Road, Suite 100
Anaheim, CA 92805

June 2014

THIS PAGE INTENTIONALLY LEFT BLANK

MASTER TABLE OF CONTENTS

Volume I

Executive Summary

Chapter 1: Introduction

Chapter 2: Alternatives Including the Proposed Project

Chapter 3: Affected Environment

Volume II

Chapter 4: Environmental Consequences

Chapter 5: Other NEPA/CEQA Considerations

Chapter 6: Coordination and Consultation

Chapter 7: References

Volume III

Appendix A:	Notice of Preparation
Appendix B:	Air Quality and Global Climate Change Technical Report
Appendix C1:	Biological Resources Technical Report
Appendix C2:	230 kV Transmission Line Alternatives Habitat Assessment Report
Appendix C3:	Western Burrowing Owl Survey Report
Appendix C4:	Avian and Bat Protection Plan
Appendix C5:	Review of Federal Waters

Volume IV

Appendix D1:	Archaeological Resource and Built Environment Survey Final Report
Appendix D2:	Archaeological Resource and Built Environment Survey Transmission Line Alternatives Supplemental Report
Appendix E:	Limited Geotechnical Evaluation
Appendix F:	EDR Data Map
Appendix G:	Water Supply Assessment
Appendix H:	Wash Feature Summary of Findings
Appendix I:	Paleontological Resources Survey Report
Appendix J:	Traffic Impact Study Report
Appendix K:	Glare and Reflection Study
Appendix L:	Land Evaluation and Site Assessment
Appendix M:	Fish and Wildlife Service Informal Consultation Memo
Appendix N:	Airport Land Use Commission Development Review

THIS PAGE INTENTIONALLY LEFT BLANK

ACRONYMS AND ABBREVIATIONS

˚C	Degrees Celsius
˚F	Degrees Fahrenheit
µT	microtesla
3D	three-dimensional
A	Agriculture
A.D.	Anno Domini
A-1	Light Agriculture
A-1-10	Light Agriculture
A-1-2 ½	Light Agriculture
A-2	Heavy Agriculture
A-2-10	Heavy Agriculture
A-2-2 ½	Heavy Agriculture
AB	Assembly Bill
AC	Alternating current
ACEC	Area of Critical Environmental Concern
Ac-ft/yr	Acre-feet per year
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACM	asbestos-containing materials
A-D	Agriculture-Dairy
AF	Acre-feet
AG	Agriculture
AGR	Agricultural Supply
AIA	Airport Influence Area
ALUC	Airport Land Use Commission
amsl	Above mean sea level
A-P	Light Agriculture with Poultry
APE	Area of Potential Effects
Applicant	Renewable Resources Group
AQ	air quality
AQUA	Aquaculture
AST	Aboveground storage tank
BAAB	Blythe Army Air Base
BBCS	Bird and Bat Conservation Strategy
BEA	Bureau of Economic Analysis
BLM	Bureau of Land Management
BMPs	Best Management Practices
BMSP	Blythe Mesa Solar Project
BP	Before present
BPD	Blythe Police Department
BRMIMP	Biological Resources Mitigation Implementation and Monitoring Plan
BSPP	Blythe Solar Power Project
BUOW	western burrowing owl
C	Circulation
C-1/C-P	General Commercial
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CAD	Computer aided design
CAISO	California Independent System Operator
Cal EPA	California Environmental Protection Agency
CAL FIRE	California Department of Forestry and Fire Protection
Cal/OSHA	California Occupational Safety and Health Administration
Caltrans	California Department of Transportation
CAPCOA	California Air Pollution Control Officer's Association

CARB	California Air Resources Board
CBC	California Building Code
CCAA	California Clean Air Act
CCR	California Code of Regulations
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game (now known as CDFW)
CDFW	California Department of Fish and Wildlife (formerly CDFG)
CDP	Census Designated Place
CEC	California Energy Commission
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CESA	California Endangered Species Act
CFGC	California Fish and Game Code
CFR	Code of Federal Regulations
C-G	General Commercial
CH_4	Methane
CHL	California Historic Landmarks
CHMIRS	California Hazardous Material Incident Report System
CHP	California Highway Patrol
CHRIS	California Historical Resources Information System
CHWMP	Riverside County Hazardous Waste Management Plan
CMP	Congestion Management Program
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	CO_2 equivalent
CORRACTS	Corrective Action
County	County of Riverside
C-P-S	Scenic Highway Commercial
CPUC	California Public Utilities Commission
C-R	Rural Commercial
CRHR	California Register of Historic Resources
CRMP	Cultural Resources Management Plan
CRPR	California Rare Plant Ranking System
CSA	Community Service Area
C-T	Tourist Commercial
CUP	Conditional Use Permit
CUPA	Certified Unified Program Agency
CVC	California Vehicle Code
CWA	Clean Water Act
dB	Decibels
dBA L_{max}	maximum sound level
dBA	A-weighted decibel scale
DC	Direct current
DDT	Dichlorodiphenyltrichloroethane
DOC	California Department of Conservation
DOF	California Department of Finance
DOT	California Department of Transportation
DRECP	Desert Renewables Energy Conservation Plan
DTC/C-AMA	Desert Training Center/California-Arizona Maneuver Area
DTM	Digital terrain mapping
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources

EA	Environmental Assessment
EDD	Employment Development Department
EDR	Environmental Data Resources, Inc.
EDR-RC	Estate Density Residential-Rural Community
EIR /EA	Environmental Impact Report/Environmental Assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMF	Electric and magnetic fields
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FCR	Field Contact Representative
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FINDS	Facility Index System
FLPMA	Federal Land Policy and Management Act
FMMP	Farmland Mapping and Monitoring Program
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FR	Federal Register
ft	feet
GC	Government Code
gen-tie	generation interconnection
GHG	Greenhouse gas
GIS	Geographic information systems
GPS	Global positioning system
GWR	Ground Water Recharge
HFCs	Hydrofluorocarbons
HFE	Hydrofluorinated ethers
HI	Hazard Index
HIST CORTESE	Hazardous Waste and Substances Sites
HIST UST	Historical underground storage tank
hp	horsepower
HPOW	Hydropower Generation
H_sS	Hydrogen Sulfide
Hz	hertz
I-10	Interstate 10
IBA	important bird area
IBC	International Building Code
ICC	International Code Council
ICNIRP	International Commission on Non Ionizing Radiation Protection
IEEE	Institute of Electric Engineers
I-G	General Industrial
IM	Instruction Memorandum
in/sec	inches per second
IND	Industrial Service Supply
I-P	Industrial Park
IPCC	United Nations Intergovernmental Panel on Climate Change
I-S	Service Industrial
KOPs	Key Observation Points
kV	kilovolt
kWh	kilowatt-hours
kWh/m^2/day	kilowatt-hours per square meter per day
LBP	lead-based paint
lbs/day	pounds per day
L_{dn}	day-night average sound level

L_{eq}	Equivalent level
LESA	Land Evaluation and Site Assessment
L_{max}	maximum sound level
LOS	Level of Service
LTVA	long term visitor areas
LU	Land use
LUST	Leaking underground storage
MBTA	Migratory Bird Treaty Act
MDAB	Mojave Desert Air Basin
MDAQMD	Mojave Desert Air Quality Management District
Medevac	Medical evacuation
M-H	Manufacturing-Heavy
M-M	Medium Manufacturing
mm	millimeters
Mmax	Maximum moment magnitude
MMRP	Mitigation Monitoring and Reporting Program
MMT	Millions of metric tons
MOA	Memorandum of Agreement
mph	Miles per hour
M-R	Mineral Resources
M-R-A	Mineral Resource and Related Manufacturing
MRZ	Mineral Resources Zone
M-SC	Manufacturing-Service Commercial
MSHCP	Multiple Species Habitat Conservation Plan
MT	Metric tons
MUN	Municipal and Domestic Supply
MW	megawatt
MWh	megawatt-hour
n/a	not available
N_2O	Nitrous oxide
N-A	Natural Assets
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission
NECO	Northern and Eastern Colorado Desert Coordinated Management
NEPA	National Environmental Policy Act
NESC	National Electric and Safety Code
NF_3	Nitrogen trifluoride
NFRAP	No Further Remedial Action Planned
NHPA	National Historic Preservation Act
NLR	Noise Level Reduction
NO_2	Nitrogen dioxide
NOC	Notice of Completion
Non-Gen	Non-Generators
NOP	Notice of Preparation
NO_x	Oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O&M	Operation and maintenance
O_3	Ozone
OEHHA	California Office of Environmental Health Hazard Assessment
OHP	California State Office of Historic Preservation

OHV	off-highway vehicle
OHWM	Ordinary High Water Mark
OS	Open Space
OSHA	Occupational Safety and Health Act
PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
Pb	Lead
PCE	Passenger car equivalent
PEIS	Programmatic Environmental Impact Statement
PFCs	Perfluorocarbons
PFM	Protected furbearing mammal
PFYC	Potential Fossil Yield Classification System
pH	a measure of acid and base properties
PLP	polarized light pollution
PM10	Particulate Matter with an Aerodynamic Diameter of 10 microns or less
PM2.5	Particulate Matter with an Aerodynamic Diameter of 2.5 microns or less
PMP	Paleontological Mitigation Program/Plan
POM	polycyclic organic matter
POWs	Palustrine open-water wetlands
ppm	Parts per million
PPV	peak particle velocity
PRC	Public Resources Code
Project	Blythe Mesa Solar Project
PUP	Public Use Permit
PV	Photovoltaic
PVID	Palo Verde Irrigation District
PVVAP	Palo Verde Valley Area Plan
PVVTA	Palo Verde Valley Transit Agency
R-A-5	Residential Agriculture
RARE	Rare, Threatened, or Endangered Species
RCALUCP	Riverside County Airport Land Use Compatibility Plan
RCFD	Riverside County Fire Department
RCGP	Riverside County General Plan
RCRA	Resource Conservation and Recovery Act
RCTC	Riverside County Transportation Commission
R-D	Regulated Development Areas
REAT	Renewable Energy Action Team
REC-1	Water Contact Recreation
REC-2	Non-Contact Water Recreation
RMP	Resource Management Plan
RMS	Room mean square
ROG	Reactive organic gases
ROW	Right-of-way
RPS	Renewable Portfolio Standard
R-R	Rural Residential
RTP	Regional Transportation Plan
R-T-R	Mobile Home Subdivision-Rural
RWQCBs	Regional Water Quality Control Boards
SB	Senate Bill
SBCM	San Bernardino County Museum
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCGC	Southern California Gas Company
SCH	State Clearinghouse
SCHWMA	Southern California Hazardous Waste Management Authority

SEZ	Solar Energy Zone
SF_6	Sulfur hexafluorite
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SLIC	Spills, Leaks, Investigation and Cleanup
SO_2	Sulfur dioxide
SO_x	Oxides of Sulfur
SPRR	Southern Pacific Rail Road
sq ft	square feet
SVP	Society of Vertebrate Paleontology
SWAT	Solid Waste Assessment Test
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State of California Water Resources Control Board
TACs	Toxic air contaminants
TDS	Total dissolved solids
THPO	Tribal Historic Preservation Officer
TMDL	Total Maximum Daily Load
tpy	tons per year
U.S.C.	U.S. Code
UCBMP	University of California, Berkeley Museum of Paleontology
USA	Underground Service Alert
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage
V/M	volts per meter
VdB	Decibel notation
VOCs	Volatile organic compounds
VRI	Visual resource inventory
VRM	Visual Resource Management
W/m^2	Watts per square meter
W-1	Waterways and Watercourses
W-2	Controlled Development
W-2-10	Controlled Development Areas
W-2-2 ½	Controlled Development
W-2-5	Controlled Development Areas
W-2-M	Controlled Development with Mobile Homes
WARM	Warm Freshwater Habitat
W-E	Wind Energy Resource Zone
WEAP	Worker Environmental Awareness Program
WHMA	Wildlife Habitat Management Area
WILD	Wildlife Habitat
WMUDS	Waste Management Unit Database System

TABLE OF CONTENTS – VOLUME I

EXECUTIVE SUMMARY ES-1

ES-1: INTRODUCTION ES-1

ES-2: PROJECT OBJECTIVES/PURPOSE AND NEED ES-1

ES-2.1 County and Applicant's Project Objectives ES-1

ES-2.2 Federal Purpose and Need ES-2

ES-3: PUBLIC SCOPING ES-3

ES-3.1 CEQA Public Scoping ES-3

ES-3.2 Draft EIR/EA Informational Meetings ES-3

ES-3.3 BLM Public Scoping ES-3

ES-4: ALTERNATIVES DEVELOPMENT ES-3

ES-4.1 Alternatives Description ES-4

ES-5: ALTERNATIVES CONSIDERED BUT ELIMINATED ES-7

ES-5.1 Solar Power Tower Technology ES-7

ES-5.2 Distributed Solar Photovoltaic Alternative ES-7

ES-5.3 Conservation and Energy Demand Reduction ES-8

ES-5.4 Alternative Site on BLM-managed Lands ES-9

ES-5.5 Palo Verde Valley Floor Alternative ES-9

ES-6: ENVIRONMENTAL IMPACTS ES-9

ES-6.1 Impact Assessment Methodology ES-10

ES-6.2 Areas of Known Controversy ES-11

ES-6.3 Construction, Operation, Maintenance, and Decommissioning Impacts ES-12

ES-6.4 Applicable Best Management Practices ES-12

ES-6.5 Mitigation Measures ES-12

ES-7: MAJOR CONCLUSIONS UNDER CEQA ES-13

ES-8: ALTERNATIVES COMPARISON ES-14

ES-8.1 Action Alternative Resource Summary (Alternatives 1, 3, 4, and 5) ES-14

ES-8.2 No Project/ No Action Alternative (Alternative 2) ES-15

ES-9: FEDERAL LEAD AGENCY PREFERRED ALTERNATIVE AND CEQA ENVIRONMENTALLY SUPERIOR ALTERNATIVE ES-15

CHAPTER 1: INTRODUCTION 1-1

1.1 OVERVIEW 1-1

1.1.1 Project Overview 1-1

1.1.2 Project Location 1-2

1.1.3 Regional Setting 1-3

1.1.4 Local Setting and Surrounding Land Uses 1-3

1.1.5 Zoning 1-4

1.1.6 BLM Land Use Plan Conformance 1-9
1.2 PURPOSE AND NEED/PROJECT OBJECTIVES 1-9
1.2.1 Federal Purpose and Need 1-9
1.2.2 Decisions to be Made by County of Riverside 1-10
1.2.3 County and Applicant's Project Objectives 1-15
1.3 JOINT CEQA/NEPA DOCUMENT 1-17
1.3.1 CEQA Environmental Impact Report 1-17
1.3.2 NEPA Environmental Assessment 1-17
1.4 DRAFT EIR/EA FORMAT AND CONTENT 1-18
1.4.1 Volumes I and II 1-18
1.4.2 Volumes III and IV: Technical Appendices 1-20
1.5 SCOPE OF THE DRAFT EIR/EA AND KNOWN AREAS OF INTEREST 1-21
1.5.1 CEQA Scoping 1-21
1.5.2 Water Resources BLM Scoping 1-21
1.5.3 Areas of Interest 1-22
1.6 AGENCIES RELYING ON THE DRAFT EIR/EA; ANTICIPATED PERMITS AND APPROVALS 1-22
1.6.1 Related State and Local Review and Consultation Requirements 1-23
1.6.2 Related Federal Review and Consultation Requirements 1-24
1.7 CONTACT PERSONS 1-26

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED PROJECT 2-1
2.1 OVERVIEW 2-1
2.1.1 Overview of Solar Technology 2-1
2.1.2 Insolation 2-1
2.2 ALTERNATIVE 1: PROPOSED PROJECT 2-1
2.2.1 Project Facilities 2-5
2.2.2 Construction 2-12
2.2.3 Operation and Maintenance 2-19
2.2.4 Best Management Practices 2-21
2.3 ALTERNATIVES ANALYZED IN DETAIL 2-32
2.3.1 CEQA and NEPA Requirements for Alternatives 2-32
2.3.2 Alternative 2: No Project/No Action Alternative 2-33
2.3.3 Alternative 3: Northern Alternative 230 kV Gen-tie Line 2-33
2.3.4 Alternative 4: Southern Alternative 230 kV Gen-tie Line 2-33
2.3.5 Alternative 5: Reduced Acreage Alternative 2-34
2.4 ALTERNATIVES COMPARISON SUMMARY 2-40
2.4.1 Action Alternative Resource Summary (Alternatives 1, 3, 4, and 5) 2-40
2.4.2 No Project/No Action Alternative (Alternative 2) 2-45

2.5 ALTERNATIVES CONSIDERED AND ELIMINATED FROM FURTHER ANALYSIS..... 2-45
2.5.1 Solar Power Tower Technology 2-46
2.5.2 Distributed Solar Photovoltaic Alternative 2-47
2.5.3 Conservation and Energy Demand Reduction 2-49
2.5.4 Alternative Site on BLM-managed Lands 2-50
2.5.5 Palo Verde Valley Floor Alternative 2-51

CHAPTER 3: AFFECTED ENVIRONMENT 3-1
3.1 INTRODUCTION 3-1
3.2 REGIONAL SETTING 3-2
3.2.1 Aesthetics, Visual Resources, and Reflection 3-2
3.2.2 Agriculture 3-17
3.2.3 Air Quality 3-31
3.2.4 Biological Resources 3-43
3.2.5 Cultural Resources 3-77
3.2.6 Geology and Soils 3-95
3.2.7 Greenhouse Gas Emissions 3-102
3.2.8 Hazards and Hazardous Materials 3-107
3.2.9 Hydrology and Water Quality 3-126
3.2.10 Land Use and Planning 3-136
3.2.11 Noise 3-149
3.2.12 Paleontological Resources 3-156
3.2.13 Population, Housing, Public Services, Utilities, and Socioeconomics 3-163
3.2.14 Recreation 3-183
3.2.15 Traffic and Transportation 3-195

FIGURES

Figure 1-1 Project Area 1-5
Figure 1-2 Regional Area 1-7
Figure 1-3 Zoning 1-11
Figure 1-4 BLM Multiple-Use Classes and Energy Corridors 1-13
Figure 2-1 Site Plan 2-3
Figure 2-2 Typical 1.5 mw Solar Array 2-5
Figure 2-3 Tracker Specifications 2-6
Figure 2-4 PV Panels to Proposed Substation 2-7
Figure 2-5 Equipment Pad containing Inverter and Transformer 2-8
Figure 2-6 Medium Voltage Overhead Poles 2-9
Figure 2-7 Internal Substation Arrangement 2-10
Figure 2-8 Gen-tie Line Poles 2-11
Figure 2-11 Fence Details 2-12
Figure 2-9 Conceptual O&M Building Plan 2-13
Figure 2-10 Conceptual O&M Layout and Elevation 2-15
Figure 2-12 Proposed Zoning Changes 2-23

Figure 2-13 Agricultural Preserve Enrollment 2-25
Figure 2-14 Reduced Acreage Alternative 2-35
Figure 3.2.1-1 Residences withing the Study Area 3-7
Figure 3.2.1-3 Existing View from KOP 1 (Residences on Mesa) 3-9
Figure 3.2.1-2 KOP Locations and Camera Views 3-11
Figure 3.2.1-4 View from KOP 2 (I-10 Freeway) 3-13
Figure 3.2.1-5 View from KOP 3 (Nicholls Warm Springs/Mesa Verde) 3-14
Figure 3.2.2-1 Important Farmland 3-23
Figure 3.2.2-2 Soils 3-25
Figure 3.2.4-1 Vegetation Communities Within the Study Area 3-49
Figure 3.2.4-2 Special-Status Plants inventory results 3-51
Figure 3.2.4-3 Wildlife inventory results 3-59
Figure 3.2.4-4 Special-Status Mojave Fringe-Toed Lizard inventory results 3-61
Figure 3.2.6-1 Site Geology 3-97
Figure 3.2.8-1 Hazardous Sites 3-109
Figure 3.2.8-2 Airport Compatibility Zones 3-115
Figure 3.2.9-1 Floodplain Delineation 3-127
Figure 3.2.9-2 Jurisdictional Waters 3-131
Figure 3.2.9-3 Potential Ordinary High Water Mark Within the Project Limits 3-133
Figure 3.2.13-1 Population And Housing Study Area 3-165
Figure 3.2.13-2 Median Income by Census Tract 3-169
Figure 3.2.14-1 BLM-Administered Recreational Areas 3-185
Figure 3.2.14-2 NECO Plan Route Designations 3-189
Figure 3.2.14-3 Regional Recreational Areas 3-193

TABLES

Table ES-1 Alternatives Comparison Summary ES-17
Table 1-1 Assessor's Parcel Numbers for Solar Facility 1-3
Table 1-2 Assessor's Parcel Numbers for Gen-tie Lines 1-4
Table 1-3 Recommended EA Sections and Required EIR Elements 1-19
Table 1-4 Anticipated Permits and Approvals 1-23
Table 2-1 Duration and Number of Workers of Each Construction Phase* 2-18
Table 2-2 Construction Equipment by Construction Phase 2-19
Table 2-3 Best Management Practices 2-27
Table 2-4 Duration and Number of Workers of Each Construction Phase: Alternative 5 2-37
Table 2-5 Disturbance Estimates 2-39
Table 2-6 Alternatives Comparison Summary 2-41
Table 3.2.1-1 Visibility Thresholds Used in Visual Analysis 3-6
Table 3.2.2-1 Riverside County Agricultural Land Conversion 2008 to 2010 3-19
Table 3.2.2-2 Palo Verde Irrigation District Crop Report 2011 3-19
Table 3.2.3-1 Monthly Average Temperatures and Precipitation, Blythe Meteorological Station 3-31
Table 3.2.3-2 Ambient Air Quality Standards and Health Effects 3-34
Table 3.2.3-3 Toxic Air Contaminants and Health Effects 3-36
Table 3.2.3-4 Summary of Available Air Quality Data for the Project Area (2006-2011) 3-37
Table 3.2.4-1 Vegetation Communities and Cover Types 3-46
Table 3.2.4-2 Special-Status Plant Species Relevant to the Proposed Project Potentially Occurring in the Study Area 3-53
Table 3.2.4-3 Special-Status Wildlife Species with the Potential to Occur in the Study Area 3-63
Table 3.2.5-1 Cultural Resources within the APE[1] 3-86
Table 3.2.6-1 Principal Active Faults 3-96
Table 3.2.7-1 State of California GHG Emissions by Sector 3-103
Table 3.2.7-2 Global Warming Potentials and Atmospheric Lifetimes of GHGs 3-103
Table 3.3.8-2 Approximate Tower Heights for Transmission Lines in the Blythe AIA 3-113
Table 3.3.8-1 Basic Compatibility Criteria 3-122
Table 3.3.8-3 ICNIRP EMF Limits 3-126

Table 3.2.9-1	Beneficial Uses of Surface Waters in the Project Area*	3-130
Table 3.2.10-1	Surrounding Land Uses, General Plan, and Zoning Designations	3-138
Table 3.2.10-2	Existing and Proposed ROWS within Utility Corridors J And K	3-141
Table 3.2.11-1	Typical Noise Sources and Noise Environments	3-149
Table 3.3.11-2	Residences within 0.25-mile of the Proposed Project	3-151
Table 3.2.12-1	Combined PFYC and SVP ratings	3-159
Table 3.2.13-1	Population Estimates, Projections, and Average Annual Growth Rates	3-167
Table 3.2.13-2	Study Area Communities Population Growth	3-167
Table 3.2.13-3	2010 Study Area Housing Characteristics	3-171
Table 3.2.13-4	2010 Employment by Industry Sector for Riverside and Imperial County and State of California	3-172
Table 3.2.13-5	2010 Employment by Industry Sectors for La Paz County, Arizona	3-173
Table 3.2.13-6	Riverside and San Bernardino County Industry Employment Projections	3-174
Table 3.2.13-7	Imperial County (El Centro MSA) Industry Employment Projections	3-175
Table 3.2.13-8	California Industry Employment Projections	3-175
Table 3.2.13-8	Summary of Schools and Enrollment in Palo Verde Unified School District, 2009 to 2010	3-176
Table 3.2.13-12	Hospitals and Clinics Serving the Project Area	3-178
Table 3.2.13-13	Environmental Justice Characteristics	3-180
Table 3.2.14-1	BLM-Administered Recreational Areas and Opportunities in the Project Vicinity	3-184
Table 3.2.14-1	Intersection Levels of Service Definitions	3-196
Table 3.2.14-2	Existing Intersection Conditions	3-197
Table 3.2.14-3	School Bus Characteristics in the Project Vicinity	3-198

THIS PAGE INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

ES-1: INTRODUCTION

Renewable Resources Group (Applicant) proposes to construct the Blythe Mesa Solar Project (Project), a solar photovoltaic (PV) electrical generating facility of up to 485 megawatt (MW) and 8.4-mile generation interconnection (gen-tie) line that would together occupy a total of 3,660 acres. It would be located in the Palo Verde Mesa region of Riverside County—3,587 acres for the solar facility component and 73 acres for the 230 kilovolt (kV) gen-tie line. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison (SCE) Colorado River Substation, an approved new substation under construction south of Interstate 10 (I-10) and approximately five miles west of the Project site. The Project has secured a California Independent System Operator (CAISO) interconnection queue position. The Project would produce enough energy to power approximately 180,000 households and advance the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state.

In compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), Riverside County (County) and the Bureau of Land Management (BLM) have prepared this Draft Environmental Impact Report (EIR)/Environmental Assessment (EA) to inform the public about the proposed Project and to meet the need of federal, state, and local permitting agencies in considering the proposed Project. This Draft EIR/EA was further designed and intended to satisfy the requirements in the BLM's land use planning regulations applicable to the request for a right-of-way (ROW) grant to use federal lands under the Federal Land Policy and Management Act (FLPMA). The information contained in this Draft EIR/EA will be considered by the County when evaluating the Applicant's Conditional Use Permit (CUP No. 3685) and Public Use Permit (PUP No. 913), Development Agreement (DA No. 79), Change of Zone application (CZ No. 7831), establishment of an agricultural preserve and Williamson Act Contract (Agricultural Preserve Case No. 1045), and potential future cancellation of the Williamson Act Contract and Agricultural Preserve. Together, these permits and applications are collectively being considered by the County as the Project. The information in this Draft EIR/EA will also be considered by the BLM in its deliberations regarding approval of the ROW grant, and by other federal, state, and local agencies with regard to their respective permit approvals, if any.

ES-2: PROJECT OBJECTIVES/PURPOSE AND NEED

ES-2.1 County and Applicant's Project Objectives

The objectives for the Project are as follows:

- Construct a solar energy facility in order to help meet State and federal renewable energy standards and goals.
- Assist with Greenhouse Gas (GHG) reduction objectives to the maximum extent possible.
- Locate the Project facilities as near as possible to electrical transmission facilities with anticipated capacity and reserved CAISO interconnection position.
- Site the Project in an area with excellent solar energy resource, in order to maximize energy productivity from the PV panels.
- To the extent feasible, site the Project on previously disturbed land with compatible topography in a manner that minimizes environmental impacts.
- Use a proven and available solar PV technology to provide cleanly generated electricity at a competitive price for California electric ratepayers.
- Eventual decommissioning of the 485 MW solar PV electrical generating facility and associated infrastructure at the end of the energy sales contract term, if the energy buyer is not available for extension or another energy buyer does not emerge.

California has one of the most ambitious renewable energy standards in the country, and mandates have been issued to significantly increase renewable energy generation, including utility scale solar facilities like the proposed Project. In 2002, California established its Renewable Portfolio Standard (RPS) Program, with the goal of increasing the percentage of renewable energy in the state's electricity mix to 20 percent of retail sales by 2017. The state's Energy Action Plan supported this goal and required retail sellers of electricity to increase renewable energy purchases by at least one percent per year with a target of 20 percent renewables by 2010. On November 17, 2008, former Governor Arnold Schwarzenegger signed Executive Order S-14-08 requiring that "….[a]ll retail sellers of electricity shall serve 33 percent of their load with renewable energy by 2020." The following year, Executive Order S-21-09 directed the California Air Resources Board (CARB), under Assembly Bill (AB) 32 authority, to enact regulations to achieve the goal of 33 percent renewables by 2020. In recognition of the important role played by large-scale solar projects, California's Clean Energy Jobs Plan calls for the development of 8,000 MW of utility scale renewable energy projects by 2020.

California is committed to a significant and substantial increase in reliance on renewable resources for electrical power, the reduction of fossil-fuel based pollutants, and promoting the green economy, consistent with protection of the environment. Former Governor Arnold Schwarzenegger issued Executive Order S-03-05 on climate change to advance renewable energy and other solutions to lower California's GHG emissions. The California Global Warming Solutions Act of 2006 (AB 32) directed CARB to develop regulations, market mechanisms, and other actions to reduce California's GHG emissions, such as carbon dioxide, to 1990 levels by 2020.

ES-2.2 Federal Purpose and Need

In accordance with the FLPMA (Section 102(a)(7), 43 United States Code [U.S.C.] §1701(a)(7)), public lands are to be managed for multiple uses that take into account the needs of future generations for renewable and non-renewable resources. The Secretary of the Interior is authorized to grant ROWs on public lands for systems for generation, transmission, and distribution of electric energy (Section 501(a)(4), 43 U.S.C. §1761(a)(4)). The purpose and need for the proposed action is to respond, in a manner that takes into account the BLM's multiple use mandate, to a FLPMA ROW application submitted by the Applicant to construct, operate, maintain, and decommission a gen-tie line on public lands administered by the BLM, which would serve a solar energy generation facility and associated infrastructure, in compliance with FLPMA, BLM ROW regulations, other applicable federal laws and policies, and the management objectives referenced below.

The proposed action would, if approved, assist the BLM in addressing the following management objectives:

- Executive Order 13212, dated May 18, 2001, which mandates that agencies act expediently and in a manner consistent with applicable laws to increase the "production and transmission of energy in a safe and environmentally sound manner."
- Department of the Interior Secretarial Order 3285A1, dated March 11, 2009, and amended on February 22, 2010, which "establishes the development of renewable energy as a priority for the Department of the Interior."
- BLM Instruction Memorandum 2011-061, dated February 7, 2011, which prioritizes the development of solar facilities on, inter alia, "[l]ands specifically identified for solar or wind energy development in BLM land use plans; [p]reviously disturbed sites or areas adjacent to previously disturbed or developed sites; [l]ocations that minimize construction of new roads and/or transmission lines; [and l]ands adjacent to designated transmission corridors…"
- President Obama's Climate Action Plan, dated June 2013, which set a goal to double renewable electric generation by 2020. "In 2012 the President set a goal to issue permits for 10 gigawatts of renewables on public lands by the end of the year. The Department of the Interior achieved this goal ahead of schedule and the President has directed it to permit an additional 10 gigawatts by 2020."

ES-3: PUBLIC SCOPING

Consistent with CEQA and NEPA requirements, public participation and agency consultation was completed for this Project. This included meetings, and formal and informal consultation with agencies, stakeholders, landowners, and Native American Tribes. The consultation and coordination process helped to determine and focus the scope of the Draft EIR/EA and identify a range of alternatives and mitigation measures. Three sets of meetings were held for the Project: (1) CEQA Public Scoping, (2) Draft EIR/EA Informational Meetings, and (3) BLM Public Scoping.

ES-3.1 CEQA Public Scoping

In compliance with California Code of Regulations (CCR) Title 14, Section 15082(c) (CEQA Guidelines), Riverside County conducted the first public scoping meeting on December 12, 2011. The purpose was to inform the public about the Project; describe the purpose and need of the Project; provide information regarding the environmental review process; and gather public input regarding the scope and content of the Draft EIR/EA. The issues and comments that were raised by the commenters were in regard to impacts to air quality, public services and utilities, socioeconomics, hazardous materials/soils, cultural resources, and water resources.

ES-3.2 Draft EIR/EA Informational Meetings

On May 10, 2012, two informational meetings were conducted for the Project. In the morning, the BLM convened the pre-application meeting with several resource agencies who have an interest in the Project. The afternoon meeting was attended by the Project Applicant to provide Project information to Native American groups. The purpose of these meetings was to present information about Project alternatives; describe the purpose and need of the Project; provide information regarding the environmental review process; and gather input regarding the preliminary alternatives.

ES-3.3 BLM Public Scoping

On October 4, 2012, the BLM conducted a public scoping meeting in Blythe, California. The BLM and Applicant presented information about the Project, alternatives, environmental review process, and potential impacts. A question and answer session was held after the presentation. At the conclusion of the question and answer session, the open house continued and staff members were available to answer questions and gather input.

ES-4: ALTERNATIVES DEVELOPMENT

CEQA and NEPA both require consideration of a reasonable range of alternatives to the proposed Project that would feasibly attain most of the basic objectives of the Project. In addition, CEQA requires the consideration of how to avoid or substantially lessen any of the significant or adverse effects caused by the Project.

Regulation 40 CFR 1508.9(b) of the Council on Environmental Quality requires an EA to study, develop, and describe alternatives to the proposed action involving unresolved resource conflicts.

To determine which alternatives would be analyzed in this Draft EIR/EA, alternatives were evaluated as to whether they would:

1) Attain the purpose and need of the Project, as well as most of the basic objectives of the Project;
2) Have the potential to avoid or substantially lessen any of the significant or adverse effects of the Project; and
3) Be considered feasible.

ES-4.1 Alternatives Description

The following were identified as a reasonable range of alternatives to the Project that would feasibly meet the basic objectives of the Project, attain the purpose and need of the Project, but avoid or substantially lessen any of the significant or adverse effects of the Project. The Project Alternatives and the No Action Alternative are described below.

ES-4.1.1 Alternative 1: Proposed Project

The proposed up to 485 MW PV solar energy generation facility and 8.4-mile gen-tie line would occupy a total of 3,660 acres. The Project would be located on lands under the jurisdiction of the County of Riverside, the BLM, and the City of Blythe. A majority of the Project would be located within the County of Riverside and within the area governed by the County of Riverside's General Plan and the Palo Verde Valley Area Plan. The Project would likely be developed in phases that extend over several years. Pending commencement of each phase of construction, the existing agricultural lands likely would remain in agricultural production. The initial use of the Project site to be permitted under the conditional use permit will be active agricultural production. Agricultural uses are allowed uses under the entire site, but part of the site is not in an agricultural zone. To encourage agricultural use of the site to continue pending construction of solar facilities, approximately 1,249 acres would be rezoned from W-2-5 and N-A to A-1-10 (light agricultural), which would make zoning consistent throughout the solar facility site (refer to Figure 2-12 in Chapter 2). Approximately 1,485 acres, all south of I-10 and representing the land not planned to be developed immediately, would be placed into an agricultural preserve and in a Williamson Act contract (refer to Figure 2-13). As each portion of the site is developed for solar use, any Williamson Act Contract for that portion of the site and the agricultural preserve would be cancelled.

This Draft EIR/EA evaluates a construction schedule that assumes construction of the entire site within a three-year period, to ensure a conservative analysis of the most intense and concentrated construction activities reasonably possible. A longer construction duration would not result in an increase in impacts, nor would continuation of agricultural uses of the site.

A portion of the solar facility site would be within the area of the City of Blythe, within the area governed by the City's General Plan. A portion of the 230 kV gen-tie line would traverse BLM-managed lands, and that area would be governed by the California Desert Conservation Area (CDCA) Plan. The portion of the gen-tie line that would traverse BLM-managed lands that are within the area governed by the CDCA Plan, designated Multiple-Use Class M (Moderate). Within the CDCA Plan area, the proposed gen-tie lines would be located within BLM's Utility Corridor K, which is also designated as Section 368 Federal Energy Corridor 30-52 (BLM 2009). The proposed Project would produce enough energy to power approximately 180,000 households and would consist of two primary components:

- **Solar Facility Site (3,587 total acres)**
    - Solar array field that would utilize single-axis solar PV trackers (295 feet long and 140 feet wide). Six trackers with 18 north-south oriented rows of PV panels would be configured into 1.5 MW blocks (600 feet long by 470 feet wide).
    - System of interior collection power lines located between inverters and substations.
    - Up to three on-site substations (each approximately 90,000 square feet).
    - Up to two operation and maintenance (O&M) buildings (approximately 3,500 square feet each).
    - Associated communication facilities and site infrastructure.
    - Two primary off-site access roads and several interior access roads.
- **Approximately 8.4 miles of 230 kV Gen-tie Transmission Line**
    - Approximately 3.6 miles would be located within the solar facility, which would connect all on-site substations.

- Approximately 4.8 miles would extend outside of the solar facility and would be placed within a 125-foot-wide ROW and occupy 73 acres. Of this, 3.8 miles would traverse BLM-managed lands with 53 acres within the Riverside East Solar Energy Zone (SEZ).At the end of the energy sales contract term (20-year term) of Alternative 1, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled within the Project area. Following decommissioning and dismantling of the solar facility and gen-tie line, the site would be made available for reversion to agricultural use.

ES-4.1.2 Alternative 2: No Action/Project Alternative

The No Action/Project Alternative is required by NEPA and CEQA. Under the No Action/Project Alternative, the construction of a solar generating facility and associated infrastructure would not occur. This alternative discusses existing conditions as well as what would be reasonably expected to occur in the foreseeable future if the Project was not approved and does not take place.

ES-4.1.3 Alternative 3: Northern Alternative 230 kV Gen-tie Line

Similar to Alternative 1 (proposed Project), Alternative 3 would include the interim agriculture-related actions described above, and construction, operation, and potential decommissioning of an up to 485 MW PV solar energy generation facility and associated infrastructure. It would occupy a total of 3,665 acres and would utilize the same solar array field as the proposed Project. The primary difference between Alternatives 1 and 3 is the location of the 230 kV gen-tie line that extends outside of the solar array field to the Colorado River Substation; the same 230 kV gen-tie alignment within the solar array field would be utilized for both Alternatives 1 and 3. The gen-tie alignment for Alternatives 1 and 3 would also be located within or adjacent to the same BLM utility corridor; however, Alternative 3 would be located on the north side of the Alternative 1 gen-tie alignment and within a 125-foot ROW entirely on BLM-managed lands. Like Alternative 1, the gen-tie in this alternative would be entirely within the Riverside East SEZ where it is on BLM-managed land. Under this alternative, the total length of the 230 kV gen-tie line both on-site and off-site would be 8.8 miles; 3.6 miles would be located on private lands within the array site boundary and 5.2 miles would be located off-site on BLM-managed lands. The BLM portion of the ROW would contain 78 acres. Similar to Alternative 1, at the end of the energy sales contract term of Alternative 3, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled within the Project area. Following decommissioning and dismantling of the solar facility and gen-tie, the Alternative 3 site would be made available for reversion to agricultural use.

ES-4.1.4 Alternative 4: Southern Alternative 230 kV Gen-tie Line

Similar to Alternative 1, Alternative 4 would include the construction, operation, maintenance, and decommissioning of an up to 485 MW PV solar energy generation facility and associated infrastructure. Alternative 4 would occupy a total of 3,647 acres and would utilize the same solar array field location as the proposed Project. The primary difference between Alternatives 1 and 4 is the location of the 230 kV gen-tie line that extends from the solar array field (proposed Substation 3) to the Colorado River Substation. Alternative 4 would exit the southwestern portion of the solar array field and extend approximately four miles west to the Colorado River Substation within a 125-foot ROW. To facilitate this alignment, an additional 10,000 feet of 230 kV gen-tie line would need to be built within the solar array field extending south from the proposed Substation 3 and angling west to the site boundary. The gen-tie line would continue westerly off-site across 3.4 miles of BLM-managed lands and 0.6 mile of private lands before reaching the Colorado River Substation. Under this alternative, the total length of the 230 kV gen-tie line both on-site and off-site would be 9.5 miles; 5.5 miles would be located on private lands within the array site boundary and 4.0 miles would be located off-site. The total area of the gen-tie off-site would be about 60 acres (50 acres of BLM-managed land and 10 acres of private land). The gen-tie under this alternative would be entirely within the Riverside East SEZ where it is on BLM-managed land. Similar to Alternative 1, at the end of the energy sales contract term of Alternative 4, if the utility buyer is not

available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled within the Project area. Following decommissioning and dismantling of the solar facility and gen-tie, the Alternative 4 site would be made available for reversion to agricultural use.

ES-4.1.5 Alternative 5: Reduced Acreage Alternative

Similar to Alternative 1, Alternative 5 would include the interim agriculture-related actions described above, and construction, operation, and potential decommissioning of a PV solar energy generation facility and associated infrastructure; however, Alternative 5 would eliminate development north of I-10. In comparison to the proposed Project, Alternative 5 would reduce electrical generation from a 485 MW down to a 315 MW alternating current solar PV facility located on a footprint of approximately 2,476 acres, reduced from 3,660 acres. The Reduced Acreage Alternative would include approximately 2,403 acres for the solar facility and 73 acres for the 230 kV gen-tie line. Components of the Reduced Acreage Alternative that differ from the proposed Project would include the following:

- **Solar Facility Site (2,403 total acres)**
  - Up to two on-site substations (each approximately 90,000 square feet).
  - One O&M building (approximately 3,500 square feet).
  - One primary off-site access road and several interior access roads.
- **Approximately 7.8 miles of 230 kV Gen-tie Transmission Line**
  - Approximately three miles would be located within the solar facility, which would connect all on-site substations.
  - Approximately 4.8 miles would extend outside of the solar facility and would be placed within a 125-foot-wide ROW and occupy 73 acres.

The fenced-in solar PV electric generation facility would occupy approximately 2,403 acres on privately-owned land (all within the County of Riverside). Similar to the proposed Project, the portion of the gen-tie line outside the solar facility site, from the southernmost substation to the Colorado River Substation, would traverse 3.8 miles of BLM-managed lands (approximately 58 acres) and approximately one mile of private land (approximately 15 acres). A comparison to the other alternative gen-tie alignments can be found below in ES.8.1. Similar to Alternative 1, at the end of the energy sales contract term of Alternative 5, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled within the Project area. Following decommissioning and dismantling of the solar facility and gen-tie, the Alternative 5 site would be made available for reversion to agricultural use.

ES-5: ALTERNATIVES CONSIDERED BUT ELIMINATED

CEQA and NEPA require an Draft EIR/EA to consider a reasonable range of alternatives to the Project that would feasibly attain most of the basic objectives of the Project. In addition, CEQA requires the consideration of how to avoid or substantially lessen any adverse effects of the proposed Project. Under CEQA, the proposed Project has the potential to have significant adverse effects to aesthetics, agriculture, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, paleontological resources, and traffic and transportation. With implementation of Best Management Practices (BMPs) and mitigation measures, impacts in these issue areas would be less than significant.[1]

Alternatives to the proposed Project were identified through the scoping process, informational public meetings, and preliminary studies. A number of alternatives to the proposed Project were identified. Some of these alternatives did not meet the Project objectives, purpose and need or provide the potential to avoid or minimize adverse environmental effects, or were considered infeasible through additional study and evaluation. Alternatives considered but eliminated from detailed analysis include:

- Solar Power Tower Technology
- Distributed Solar Photovoltaic Alternative
- Conservation and Energy Demand Reduction
- Alternative Site on BLM-Managed Lands
- Palo Verde Valley Floor Alternative

ES-5.1 Solar Power Tower Technology

Solar power tower technology uses a flat mirror "heliostat" system that tracks the sun and focuses solar energy on a central receiver at the top of a high tower. The focused energy is used to heat a transfer fluid (to 800 to 1,000 degrees Fahrenheit [˚F]) to produce steam and run a center power generator. The transfer fluid is super-heated before being pumped to heat exchangers that transfer the heat to boil water and run a conventional steam turbine to produce electricity. Although concentrated, solar power systems can store heated fluids to deliver electricity even when the sun is not shining. In areas of high solar insolation potential (i.e., desert environments), the land required to develop a concentrated solar energy power tower facility is comparable to that required for a PV project—approximately five acres per MW of installed capacity (NREL 2012).

ES-5.1.1 Alternative Conclusions

The use of a solar power tower technology would meet most of the basic Project Objectives; however, use of this technology would result in potentially significant glare impacts to the operations at Blythe Airport, which is located to the north and west of the proposed solar facility site's operations. Therefore, a solar power tower system alternative was not considered further.

ES-5.2 Distributed Solar Photovoltaic Alternative

There is no single accepted definition of distributed solar technology. The 2011 Integrated Energy Policy Report defines distributed generation resources as "(1) fuels and technologies accepted as renewable for purposes of the Renewables Portfolio Standard; (2) sized up to 20 MW; and (3) located within the low-voltage distribution grid or supplying power directly to a consumer." Distributed solar facilities vary in size

[1] Under NEPA, "significance" is defined in 40 CFR 1508.27, and requires federal agencies to consider the context and intensity of a proposed action and its alternatives. The BLM will determine whether this action has significant effects under NEPA using the final version of this Draft EIR/EA, following which it will either prepare a Finding of No Significant Impacts (FONSI), or initiate an Environmental Impact Statement (EIS).

from kilowatts to tens of megawatts but do not require transmission to get to the areas in which the generation is used.

A distributed solar alternative would consist of PV panels that would absorb solar radiation and convert it directly to electricity. The PV panels could be installed on residential, commercial, or industrial building rooftops or in other disturbed areas like parking lots or disturbed areas adjacent to existing structures such as substations. To create a viable alternative to the proposed Project, there would have to be sufficient newly installed panels to generate up to 485 MW of capacity. According to the 2012 CEC renewable energy acreage calculator, it would take approximately 3,464 acres to construct a 485 MW distributed solar PV alternative (0.4 MW per acre), nearly the size of the proposed Project.

ES-5.2.1 Alternative Conclusions

Although there is potential to achieve up to 485 MW of distributed solar energy, the limited number of existing facilities makes it unlikely to be feasible or present environmental benefits. The proposed Project would utilize single-axis PV trackers with high efficiency, monocrystalline, silicon solar panels. The panel design minimizes shading, and by grouping trackers close together, the technology requires 20 percent less land than conventional crystalline fixed tilt systems and 60 percent less land than thin film systems. Rooftop systems typically consist of less efficient fixed-tilt systems that may not be oriented optimally towards the sun, meaning that developers would need to obtain more surface area for the Project if constructed on a rooftop instead of on the ground. The transaction costs of obtaining multiple rooftops, the complexity of mobilizing construction crews across multiple projects including the transporting and deployment of construction materials in a less efficient manner, and the need to develop the deals to secure the same amount of PV-produced electricity can make this type of alternative infeasible.

To the extent that distributed generation projects might have fewer impacts on certain resources because they do not utilize substations and transmission facilities, this illustrates that distributed generation projects cannot meet one of the fundamental objectives of a utility-scale solar project: to provide renewable energy to utility off-takers and their customers. Rooftop systems that are not connected to the utility side of the electric grid only generate power for on-site consumption. At the same time, the difficulties in supplying a comparable amount of megawatts of clean energy to the public through the utility sector has its own set of impacts due to failure to offset the impacts of counterpart fossil fuel energy sources.

Because of the challenges associated with the implementation of a distributed solar technology, which include widely varying codes, standards, and fees; environmental requirements and permitting concerns; interconnection of distributed generation; inefficiencies; and integration of distributed generation. As a result, this technology was eliminated from detailed analysis as an alternative to the proposed Project.

ES-5.3 Conservation and Energy Demand Reduction

Conservation and demand reduction consist of a variety of approaches for the reduction of electricity use, including energy efficiency and conservation, building and appliance standards, and load management and fuel substitution.

ES-5.3.1 Alternative Conclusions

This alternative is not technically feasible as a replacement for the proposed Project, because California utilities are required to achieve aggressive energy efficiency goals. Additional energy efficiency beyond that occurring in the baseline condition may be technically possible, but it is speculative to assume that energy efficiency alone would achieve the necessary greenhouse gas reduction goals. With population growth and increasing demand for energy, conservation and demand management alone is not sufficient to address all of California's energy needs. Additionally, as stated in the California Energy Commission's 2011 Integrated Energy Policy Report, California's renewable energy goals are based on a percentage of retail sales of electricity, and reducing overall electricity demands means fewer retail sales and therefore

less renewable energy that must be generated. Furthermore, it states that conservation and demand-side management mean fewer renewable plants will need to be built. However, conservation and demand-side management would not by themselves provide the renewable energy required to meet the California renewable energy goals. Therefore, this alternative would not meet Project objectives pertaining to renewable energy goals.

ES-5.4 Alternative Site on BLM-managed Lands

Similar to the proposed Project, the Alternative Site on BLM-managed lands would involve the construction, operation, maintenance, and decommissioning of an up to 485 MW solar facility and 230 kV gen-tie line. This alternative would be located within the Developable Areas within the Riverside East (SEZ) that was identified by the BLM and Department of Energy (BLM 2012). Wilderness areas and areas of critical environmental concern (ACECs) were precluded from solar development. Additionally, the Alternative Site on BLM-managed lands would be located approximately 20 miles from the Colorado River Substation. It is also assumed that this alternative would require a BLM ROW grant and CUP approvals to allow for the construction and operation of solar facilities within BLM-managed lands.

ES-5.4.1 Alternative Conclusions

The Alternative Site on BLM-managed lands would avoid significant impacts to Agricultural Resources; however, it may not be feasible to find an Alternative Site on BLM-managed lands, because most of the land within the Developable Areas of the Riverside East SEZ is in use, proposed for other solar energy projects, or within mountainous areas. This alternative would likely have impacts similar to those of the proposed site for many resource elements, such as air quality and traffic. However, it is likely to have more severe biological, cultural, and visual resource impacts, as it would likely be located on undisturbed lands. This alternative would also be sited closer to wilderness areas and ACECs. The Alternative Site on BLM-managed lands would not present significant environmental advantages over the proposed Project.

ES-5.5 Palo Verde Valley Floor Alternative

Similar to the proposed Project, the Palo Verde Valley Floor Alternative would involve the construction, operation, maintenance, and decommissioning of an up to 485 MW solar facility and 230 kV gen-tie line. The solar facility would be situated on private lands within the Palo Verde Valley (between the Palo Verde Mesa to the west and the Colorado River to the east), instead of the Palo Verde Mesa, as well as on BLM-managed lands. It is also assumed that this alternative would require a BLM ROW grant for the 230 kV gen-tie line and CUP approvals to allow for the construction and operation of solar facilities.

ES-5.5.1 Alternative Conclusions

Similar to the proposed Project, the Palo Verde Valley Floor Alternative would also impact agricultural land. This Alternative would also be farther away from the Colorado River Substation, which would increase ground disturbance and impacts to aesthetics, air quality, biological resources, hydrology and water quality, and traffic and transportation. The proximity to the Colorado River could pose adverse impacts related to migratory birds, water resources, and the risk of flooding, which would not result from implementation of the proposed Project. As a result, this alternative was not analyzed in further detail.

ES-6: ENVIRONMENTAL IMPACTS

Impacts that would result from constructing and operating the Proposed Action and Alternatives were assessed using a methodology that documents the existing environmental conditions, then classifies and quantifies the various types of impacts that could occur. The potential impacts are compared to impact thresholds and assigned significance based on the extent of change from existing conditions. Mitigation measures are proposed as necessary to alleviate significant adverse effects. The methodology employed is discussed below.

ES-6.1 Impact Assessment Methodology

This Draft EIR/EA is a joint federal/State document prepared to comply with the requirements of both CEQA and NEPA. CEQA requires an EIR to identify the significant environmental effects of a project. An EIR presents criteria that are used to determine whether or not an adverse impact is significant under CEQA. An EIR must also describe potentially feasible mitigation measures that could minimize each significant adverse impact. Potentially feasible mitigation measures that could minimize impacts determined significant under CEQA are specifically identified in this Draft EIR/EA as "mitigation measures." This Draft EIR/EA also states whether the impact deemed significant under CEQA would remain significant after implementation of the mitigation measure(s). A CEQA significance determination is provided at the end of each resource section.

Under NEPA, "[t]he EA must describe and provide the analysis of environmental effects of the proposed action and each alternative analyzed in detail (40 [Code of Federal Regulations] CFR Part 1508.9(b)). The EA must also identify and analyze mitigation measures, if any, which will be taken to avoid or reduce potentially significant effects (see Question 39, Council on Environmental Quality [CEQ], *Forty Most Asked Questions Concerning CEQ's NEPA Regulations*, March 23, 1981)" (BLM NEPA Handbook Section 8.3.6). The analyses contained in this Draft EIR/EA provide quantitative and qualitative measures with which to review the context and intensity of the effects. These two components assist the decision-makers in determining whether to prepare an EIS or make a FONSI in instances where an EIS is not normally required or categorically exempt (40 CFR Part 1501.4(a)-(c)).

The impact assessment methodology for each resource in Chapter 4 was used to determine the significance of identified impacts, as required by CEQA. The impact locations and intensity were recorded and the impacted area described. To determine impact intensity (i.e., the severity of the potential impact), an "impact model" was developed for each resource classification using the same criteria, as applicable:

- Resource sensitivity—the probable impact(s) to a particular resource as a result of Project-related activities
- Resource quality—the pre-Project condition of the resource potentially affected
- Resource quantity—the amount of the resource potentially affected
- Duration of impact—the period of time over which the resource would be affected, measured as short-term (up to a few years) or long-term (life of the Project and beyond)
- Time of year—the season or period of time in which the resource would be affected
- Setting—consideration of the Project location, the affected region, and interests
- Expressed public concern—the amount of concern expressed by the land management agencies and the public

Pursuant to NEPA, the intent of the environmental impact analysis is to ensure that environmental information is available to public officials and the public before decisions are made and actions are taken (40 CFR Part 1500.1 [b]). In addition, the NEPA process is to be used to identify and assess reasonable alternatives to proposed actions that will avoid or minimize adverse effects of the action upon the quality of the human environment (40 CFR Part 1500.2 [e]). Environmental effects include direct, indirect, and cumulative impacts. Cumulative effects of Project implementation are discussed under each resource area.

The term *significant* as used in NEPA requires considerations of both context and intensity (40 CFR Part 1508.27). *Context* requires the BLM to analyze the significance of an action in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action (40 CFR Part 1508.27 [a]). *Intensity* refers to the severity of effect. 40 CFR Part 1508.27(b) includes the following ten considerations for evaluating intensity:

- Impacts that may be both beneficial and adverse;
- The degree to which the proposed action affects public health or safety;

- Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas;
- The degree to which the effects on the quality of the human environment are highly uncertain or involve unique or unknown risks;
- The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts;
- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific cultural, or historical resources;
- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined critical under the Endangered Species Act of 1973;
- Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

To determine the severity of effect on a particular resource, the BLM must look at direct, indirect, and cumulative effects on that resource (BLM NEPA Handbook H-1790-1, Section 7.3).

An EA may be used to demonstrate that a proposed action would have effects that are significant but could be reduced or avoided through mitigation. The BLM may use a mitigated FONSI rather than an EIS if decision-makers are able to reasonably conclude, based on the EA analysis, that the mitigation measures would be effective in reducing effects to nonsignificance.

The BLM will make a determination about the significance of impacts for this Project and either initiate an EIS or issue a FONSI once the EA process is complete.

The intent of the environmental impact analysis is to provide a scientific and analytic basis for comparing the Alternatives. The analysis also identifies any adverse environmental effects that cannot be avoided should the Project be implemented, and presents mitigation measures to minimize adverse environmental impacts. Analyses for each resource area consider direct, indirect, and cumulative effects of the proposed Project and Alternatives, including short-term effects during construction and decommissioning and long-term effects during operations and maintenance.

ES-6.2 Areas of Known Controversy

Based on internal and external scoping, and input received from agencies, organizations, Native American Tribes, and members of the general public, the following environmental resources had a potential to be affected by activities related to construction, operation, maintenance, and decommissioning of the proposed Project and Alternatives and are evaluated in this Draft EIR/EA:

- Aesthetics, Visual Resources, and Reflection
- Agriculture
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Greenhouse Gas Emissions
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Noise
- Paleontological Resources
- Population, Housing, Public Services, Utilities, and Socioeconomics

- Recreation
- Traffic and Transportation

Forestry and Mineral Resources are not discussed in detail in this Draft EIR/EA, because there are no forestry or mineral resources within the Project area or vicinity of the Project area.

ES-6.3 Construction, Operation, Maintenance, and Decommissioning Impacts

The implementation of the proposed Project or Alternatives has the potential to result in the following basic types of impacts to environmental resources. These impact types include the following:

Construction and decommissioning impacts associated with the short-term presence of Project construction and decommissioning activities resulting in impacts such as ground disturbance, noise, and air emissions;

Increased access-related impacts associated with enhanced accessibility by persons, such as through use of Project access roads into areas that are currently remote or inaccessible; and

Operational and maintenance related impacts associated with the long-term presence of Project facilities and improvements, such as inspections, maintenance checks, and repairs, and the long-term operation of facilities and improvements.

Construction, operation, maintenance, and decommissioning of the Project would result in a number of permanent and temporary impacts. The temporary impacts would cease upon completion of the construction phase. Many of the impacts can be minimized by implementing BMPs and specifically recommended mitigation measures.

ES-6.4 Applicable Best Management Practices

For the purposes of this Draft EIR/EA, the applicable Best Management Practices (BMPs) are: 1) requirements of existing policies, practices, and measures required by law, regulation, or local policy and 2) ongoing, regularly occurring practices. In other words, the BMPs identified in this Draft EIR/EA are inherently part of the proposed Project and Alternatives. They are not additional mitigation measures proposed as a result of the significance findings from the CEQA environmental review process. The list of BMPs may be found in Chapter 2 of this Draft EIR/EA. Applicable BMPs are referenced in each resource topic discussion of Chapter 4 of this Draft EIR/EA analysis.

ES-6.5 Mitigation Measures

Mitigation measures were examined to see if they could be effective in reducing the intensity of impacts. If analysis concluded the possibility of a potentially significant impact even after BMPs are considered, then specific mitigation was applied to lessen the impact or potentially reduce it to a less than significant level. Both 40 Code of Federal Regulations [CFR] Part 1508.20 of the Council on Environmental Quality regulations for implementing NEPA and CEQA Guidelines Section 15370 define “mitigation” as:

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected [“impacted” under CEQA] environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- Compensating for the impact by replacing or providing substitute resources or environments.

Mitigation is required for significant impacts under CEQA. In addition, in order to forego the preparation of an Environmental Impact Statement (EIS) under NEPA notwithstanding the potential for a project to have adverse impacts, a federal agency must find that the mitigation measures would render any environmental impact resulting from the permit activity insignificant. NEPA furthermore encourages mitigation for all of the adverse impacts of a project (40 CFR Part 1502.16(h)), and for this reason, some mitigation measures described in this document are wholly appropriate under NEPA, although the impacts they address may not be considered significant under CEQA.

Resource analysis determined **that impacts would be less than significant** with applicable BMPs to: Aesthetics, Visual Resources, and Reflection; Air Quality; Greenhouse Gases; Land Use and Planning; Recreation; and Population, Housing, Public Services, Utilities, and Socioeconomics. No additional compensatory mitigation would be required for any impacts the Project might have on these resources.

Regarding the remaining resource categories (listed below), mitigation measures are proposed for the respective resource topics in this Draft EIR/EA to avoid or reduce potentially significant impacts associated with the proposed Project. These mitigation measures can be found in Chapter 4 of this document.

- Agriculture
- Biological Resources
- Cultural Resources
- Geology and Soils
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Noise
- Paleontological Resources
- Traffic and Transportation

ES-7: MAJOR CONCLUSIONS UNDER CEQA

A discussion of the proposed Project and alternatives is included in Chapter 1 (Introduction) and Chapter 2 (Alternatives including the proposed Project) of this Draft EIR/EA. Together these chapters detail the Project objectives, the purpose and need for the Project, the proposed Project, and the identification and selection of potentially feasible alternatives, and fully address the Project's specific design. The environmental setting of the proposed Project is detailed in Chapter 3 (Affected Environment). The potential environmental effects of the proposed Project or Alternatives, implementation of BMPs, and mitigation measures to reduce or avoid these effects are described in detail in Chapter 4 along with the cumulative effects (Environmental Consequences Including Cumulative Impacts). Based on the environmental analysis conducted, it was determined that with implementation of BMPs the proposed Project and Alternatives would not result in significant impacts under CEQA to the following resources:

- Aesthetics, Visual Resources, and Reflection
- Air Quality
- Greenhouse Gas Emissions
- Land Use and Planning
- Population, Housing, Public Services, Utilities, and Socioeconomics
- Recreation

Even with implementation of BMPs some environmental resources listed below would sustain significant impacts under CEQA. However, with implementation of mitigation measures, these impacts would be reduced to less-than-significant levels under CEQA.

- Agriculture
- Biological Resources
- Cultural Resources

- Geology and Soils
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Noise
- Paleontological Resources
- Traffic and Transportation

Therefore, with implementation of BMPs and mitigation measure, the proposed Project and Alternatives would not result in significant impacts or adverse environmental effects that cannot be avoided under CEQA.

The BLM will determine whether the proposed Project and Alternatives have the potential for significant impacts using the final version of this Draft EIR/EA, after which it will either document a FONSI, or initiate an EIS.

ES-8: ALTERNATIVES COMPARISON

A comparison of the potential environmental impacts associated with the five Project Alternatives (No Project/No Action Alternative and four action Alternatives) are summarized below and in Table ES-1. The solar facility site and interior components (solar panels, substations, O&M buildings, and 34.5 kV distribution lines) are the same for each of the action Alternatives 1, 3, and 4 and would result in the same associated impacts (the solar facility site and interior components of Alternative 5 would result in fewer impacts compared to Alternatives 1,3 and 4); therefore, this discussion focuses on the impacts of the proposed gen-tie line corridor for each action Alternative.

ES-8.1 Action Alternative Resource Summary (Alternatives 1, 3, 4, and 5)

The primary difference between the proposed Project (Alternative 1) and Alternative 3 is the location of the 230 kV gen-tie line that extends outside of the solar array field to the Colorado River Substation; the same 230 kV gen-tie alignment within the solar array field would be utilized for both Alternatives 1 and 3. The gen-tie alignment for Alternatives 1 and 3 would also be located within or adjacent to the same BLM utility corridor; however, Alternative 3 would be located on the north side of the Alternative 1 gen-tie alignment and within a 125-foot ROW entirely on BLM-managed lands. As such, Alternative 3 is also referred to as the *Northern Alternative*. The primary difference between the proposed Project (Alternative 1) and Alternative 4 is the location of the 230 kV gen-tie line that extends from the solar array field (proposed Substation 3) to the Colorado River Substation. Alternative 4 would exit the southwestern portion of the solar array field and extend approximately four miles west to the Colorado River Substation within a 125-foot ROW. As such, Alternative 4 is also referred to as the *Southern Alternative*.

Among the action alternatives, the proposed gen-tie line for the Reduced Acreage Alternative (Alternative 5) is the shortest at 7.8 miles and traverses the least amount of private lands inside the solar facility (approximately 3.0 miles). Alternative 4's gen-tie line is the longest at 9.5 miles. Alternative 5 would occupy the least acreage of the action alternatives: 2,476 acres (1,184 acres less than Alternative 1; 1,189 acres less than Alternative 3; and 1,171 acres less than Alternative 4). Alternative 1, Alternative 3, and Alternative 5's gen-tie lines would parallel existing and approved transmission lines and access roads. However, approximately 3.0 miles of Alternative 4's gen-tie line would not parallel existing transmission lines or access roads and would require approximately 3.0 miles of new access roads.

As development of the solar facility under Alternative 5 would occur south of I-10, it would avoid conversion of agricultural resources to non-agricultural resources, as compared to Alternatives 1, 3, and 4. Alternative 5 would have less annual air emissions and lower impact to vegetation communities such as areas of disturbed creosote bush scrub, bajada community, irrigated alfalfa, non-irrigated wheat. The remaining direct and indirect impacts to vegetation communities under Alternative 5 would be similar to the proposed Project analyzed under Alternative 1. Alternative 1 and Alternative 5's gen-tie line would cross 22.9 acres of Desert Riparian Woodland Wash, the same as Alternative 3 but more than Alternative 4 (11.4 acres). No records or survey results indicated the presence of State- or federal-listed plants or

wildlife on Alternative 1, Alternative 3 or Alternative 5. However, based on recent survey records, the desert tortoise has a high potential to occur on the Alternative 4 gen-tie line ROW.

Action Alternatives 1, 3, and 4's solar facility site does not contain cultural resources that are eligible or assumed eligible to be listed on the National Register of Historic Places. During the cultural surveys on the alternative gen-tie lines, Alternative 1 and Alternative 5 had two unique cultural sites, Alternative 3 had five unique cultural sites, and Alternative 4 had 16 unique cultural sites. The documented unique cultural sites located on all the action Alternatives are not eligible for inclusion in either the National Register of Historic Places or the California Register of Historical Resources.

The action Alternatives would use approximately 1,354 acre-feet (AF) of water (about 451 AF per year) for construction, which would be provided by the Palo Verde Irrigation District. The Alternative 1, Alternative 3, and Alternative 5 gen-tie line corridor portions would cross one ephemeral channel; in contrast, Alternative 4 gen-tie line corridor portion would cross one ephemeral channel twice.

All the action Alternatives would promote General Plan and Area Plan and CDCA Plan policies favoring solar development. The County and City would continue to promote agricultural uses in conformity with the Agricultural Preservation Policy of the Palo Verde Valley Area Plan and the City of Blythe Open Space Guiding Policies 1 and 9, but construction of the Project and the other action Alternatives would halt agricultural use of the Project Site.

ES-8.2 No Project/ No Action Alternative (Alternative 2)

Under the No Project/ No Action Alternative, ongoing activities would continue, but new impacts associated with the implementation of the No Project/No Action Alternative are not anticipated. Relative to Alternatives 1, 3, 4, and 5, all impacts associated with the construction, operation, and maintenance of the Blythe Mesa Solar Project would be avoided. As such, there would be no effects related to GHG emissions beyond those that already occur on the Project site as a result of existing agricultural operations (zero net increase in GHG emissions). However, the beneficial impacts of the proposed Project associated with providing renewable energy in accordance with the State's adopted RPS policy would also not occur under this Alternative. That is, under the No Project/No Action Alternative, renewable energy would not be available to offset the use of energy from other sources, including fossil fuels. Consequently, the No Project/No Action Alternative would not achieve the GHG reduction associated with the proposed Project, which was estimated to range from 371,116 to 1,061,829 metric tons of carbon dioxide equivalent (CO_2e) per year.

ES-9:FEDERAL LEAD AGENCY PREFERRED ALTERNATIVE AND CEQA ENVIRONMENTALLY SUPERIOR ALTERNATIVE

CEQA requires analysis of a reasonable range of alternatives to the proposed Project to foster informed decision making and public participation (14 CCR § 15126.6(a)). The EIR shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project [or plan]. A matrix displaying the major characteristics and significant environmental effect of each alternative may be used to summarize the comparison. If an alternative would cause one or more significant effects in addition to those that would be caused by the project as proposed, the significant effects of the alternative shall be discussed, the in less detail that the significant effects of the project as proposed (*County of Inyo v. City of Los Angeles*, 124 Cal. App.3d 1). (CEQA Guidelines § 15126.6(d)).

For NEPA, EAs shall " include brief discussions … of alternatives as required by section 102(2)(E)…" (40 CFR Part 1508.9(b)). Section 102(2)(E) of the NEPA provides that agencies of the Federal Government shall "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources."

A comparison of the potential environmental impacts associated with the five Project Alternatives (No Project/No Action Alternative and four action Alternatives) are summarized in Table ES-1. The impacts,

mitigation measures, and residual impacts after mitigation of the proposed Project and Alternatives are detailed in Chapter 4 of this Draft EIR/EA. After comparing and weighing the benefits and impacts of all of the feasible alternatives, the BLM (NEPA Federal Agency) and the County (CEQA Lead Agency) have identified Alternative 1 (proposed Project) as the preferred/environmentally superior alternative, subject to public review.

Final identification of a preferred/ environmentally superior alternative will occur after the public review and comment period.

TABLE ES-1 ALTERNATIVES COMPARISON SUMMARY

ISSUES OR CONCERNS		ALTERNATIVE 1 PROPOSED ACTION	ALTERNATIVE 2 NO PROJECT/NO ACTION	ALTERNATIVE 3 NORTHERN ALTERNATIVE 230KV GEN-TIE LINE	ALTERNATIVE 4 SOUTHERN ALTERNATIVE 230KV GEN-TIE LINE	ALTERNATIVE 5 REDUCED ACREAGE ALTERNATIVE
Total acreage of the solar facility site	*Private*	3,587 acres	0	3,587 acres	3,587 acres	2,476 acres
Jurisdiction crossed (miles) by gen-tie line ROW	*Private (inside solar facility)*	3.6 miles	0	3.6 miles	5.5 miles (3.6 + 1.9)	3.0 miles
	Private (outside solar facility)	1.0 miles (15 acres)	0	0.0 miles	0.6 mile (9 acres)	1.0 miles (15 acres)
	Bureau of Land Management (outside of solar facility)	3.8 miles (58 acres)	0	5.2 miles (78 acres)	3.4 miles (51 acres)	3.8 miles (58 acres)
	TOTAL	8.4 miles	0	8.8 miles	9.5 miles	7.8 miles
Total acreage (solar facility and gen-tie line)		3,660 acres	0	3,665 acres	3,647 acres	2,549
Gen-tie line	**Percentage of new 230 kV gen-tie line parallel to existing and approved transmission lines**	100%	0	100%	68%	100%
	Miles of 230 kV gen-tie line requiring new access roads (unpaved)	4.8	0	5.2	3.0	4.8
Disturbance Estimates	Solar Facility Site	2,336 acres (temporary) 2,316 acres (permanent)	0 acres	2,336 acres (temporary) 2,316 acres (permanent)	2342 acres (temporary) 2,320 acres (permanent)	1,579 acres (temporary) 1,567 acres (permanent)
	Gen-tie Line	22.7 acres (temporary) 9.8 acres (permanent)	0 acres	24.6 acres (temporary) 10.6 acres (permanent)	17.5 acres (temporary) 6.73 acres (permanent)	22.7 acres (temporary) 9.8 acres (permanent)
Aesthetics, Visual Resources and Reflection	*Designated Scenic Vista*	No	No	No	No	No
	Designated areas of natural beauty or scenic recreational areas	No	No	No	No	No
	Miles of new gen-tie line that would not parallel existing or proposed transmission lines	0.0	0.0	0.0	3 miles	0.0
Agriculture	*Acres of designated Farmland converted to non-agricultural use; cancellation of Williamson Act Contracts and agricultural preserve*	(Land Evaluation Subscore: 27.2) (Site Assessment Subscore 26.1) Total LESA Score: 53.3 1,681 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve	0.0 acres	(Land Evaluation Subscore: 27.2) (Site Assessment Subscore 26.1) Total LESA Score: 53.3 1,681 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve	(Land Evaluation Subscore: 27.2) (Site Assessment Subscore 26.1) Total LESA Score: 53.3 1,681 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve	(Land Evaluation Subscore: 25.9) (Site Assessment Subscore 22.4) Total LESA Score: 48.3 1,279 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve
Air Quality	*Conformance with the Mojave Desert Air Quality Management District (MDAQMD)*	Yes	Yes. The air quality of the site is not expected to change noticeably from existing conditions and, as such, the No Project/No Action Alternative would not result in the air quality impacts or benefits described for Alternative 1.	Yes. However, on an annual basis, the additional construction required for the longer 230 kV gen-tie line (8.8 miles versus 8.4 miles) would have greater air emissions than Alternative 1.	Yes. However, on an annual basis, the additional construction required for the longer 230 kV gen-tie line (9.5 miles versus 8.4 miles) would have greater air emissions than Alternatives 1 and 3.	Yes. However, on an annual basis, the reduced number of workers required under the Reduce Acreage Alternative would result in fewer annual air emissions than Alternatives 1, 3 and 4.
	Estimated annual construction emissions	ROG = 4.12 NO_x = 18.44 CO = 34.58 SO_x = 0.39 PM_{10} = 6.16 $PM_{2.5}$ 2.02	No new emissions	ROG = 4.12 NO_x = 18.52 CO = 34.62 SO_x = 0.39 PM_{10} = 6.17 $PM_{2.5}$ 2.03	ROG = 4.12 NO_x = 18.65 CO = 34.70 SO_x = 0.39 PM_{10} = 6.16 $PM_{2.5}$ 2.03	ROG = 4.12 NO_x = 18.44 CO = 34.58 SO_x = 0.39 PM_{10} = 6.16 $PM_{2.5}$ 2.02
	Federal Conformity Determination requirement	Annual construction emissions for the portion of Alternative 1 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD	The air quality of the site is not expected to change noticeably from existing conditions and, as such, the No Project/No Action Alternative would not result in the air quality impacts or benefits described for Alternative 1.	Annual construction emissions for the portion of Alternative 3 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD	Annual construction emissions for the portion of Alternative 4 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD	Annual construction emissions for the portion of Alternative 5 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD

ISSUES OR CONCERNS		ALTERNATIVE 1 PROPOSED ACTION	ALTERNATIVE 2 NO PROJECT/NO ACTION	ALTERNATIVE 3 NORTHERN ALTERNATIVE 230KV GEN-TIE LINE	ALTERNATIVE 4 SOUTHERN ALTERNATIVE 230KV GEN-TIE LINE	ALTERNATIVE 5 REDUCED ACREAGE ALTERNATIVE
Biological Resources	*Vegetation communities crossed by the solar facility site and transmission line*	540 acres creosote bush scrub 3,294 acres of agricultural and fallow fields 18 acres bajada	0	565 acres Creosote bush scrub 3,294 acres of agricultural and fallow fields 18 acres bajada	494 acres Creosote bush scrub 3,294 acres of agricultural and fallow fields 18 acres bajada	427 acres creosote bush scrub 3,086 acres of agricultural and fallow fields
	State- or federal-listed plants detected	No	No	No	No	No
	State- or federal-listed wildlife detected	No	No	No	Desert Tortoise	No
	Conflict with local policies or ordinances protecting biological resources	No	No	No	No	No
	Designated USFWS or CDFW wildlife habitats	No	No	No	No	No
	Acres of riparian habitat crossed	22.9 acres of Desert Riparian Woodland Wash	0.0	22.9 acres of Desert Riparian Woodland Wash	11.4 acres of Desert Riparian Woodland Wash	22.9 acres of Desert Riparian Woodland Wash
Cultural Resources	*NRHP- or CRHR-listed, NRHP- or CRHR--eligible, or unevaluated resources*	No. Portion of proposed Blythe Army Air Base Historic District within the Project APE does not retain integrity and is not eligible.	N/A	No. Portion of proposed Blythe Army Air Base Historic District within the Project APE does not retain integrity and is not eligible.	2. 2 unevaluated archaeological sites. Portion of proposed Blythe Army Air Base Historic District within the Project APE does not retain integrity and is not eligible.	No
	Cultural Resources within each gen-tie line corridor	3 isolated finds (1 prehistoric/historic, 1 prehistoric, and 1 historic). All 3 resources are not eligible for the NRHP or CRHR.	N/A	2 historic archaeological sites (refuse scatters) and 3 isolated finds (2 historic and 1 prehistoric). All 5 resources are not eligible for the NRHP or CRHR.	12 archaeological sites (6 prehistoric, 5 historic, and 1 prehistoric/historic) and 4 isolated finds (2 prehistoric and 2 historic). 10 archaeological sites and all 4 isolated finds have been determined not eligible for the NRHP or CRHR. 2 archaeological sites are unevaluated.	3 isolated finds were documented (1 prehistoric/historic, 1 prehistoric, and 1 historic). All 3 resources are isolated sites and have been determined not eligible for the NRHP or CRHR
Paleontological Resources	*Resource sensitivity crossed*	Quaternary Alluvium, Eolian Sand (Qs)	No	Quaternary Alluvium, Eolian Sand (Qs)	Quaternary Alluvium	Quaternary Alluvium, Eolian Sand (Qs)
Geology and Soils	*Distinctive geologic features*	None	None	None	None	None
	Miles crossed of high levels of earthquake ground shaking	No	N/A	No	No	No
	Liquefaction hazard zones crossed	Moderately susceptible to liquefaction	N/A	Moderately susceptible to liquefaction	Moderately susceptible to liquefaction	Moderately susceptible to liquefaction
	Potential landslides	No	N/A	No	No	No
	Susceptible to soil and wind erosion	Moderate to High	N/A	Moderate to High	Moderate to High	Moderate to High
	Mineral production	No	N/A	No	No	No
Greenhouse Gas	*Generate greenhouse gas emissions*	Construction emissions: 183 metric tons of CO_2e (amortized over the life of the Project); Operations emissions: 271 metric tons per year of CO_2e Project emissions due to construction would not exceed CAPCOA thresholds	No new emissions. Existing emissions do not exceed CAPCOA thresholds.	The total GHG emissions are estimated to be slightly greater than Alternative 1 during construction and would not exceed CAPCOA thresholds	The total GHG emissions are estimated to be slightly greater than Alternative 1 during construction and would not exceed CAPCOA thresholds	Construction emissions: less than 183 metric tons of CO_2e (amortized over the life of the Project); Operations emissions: less than 271 metric tons per year of CO_2e for solar facility Project emissions due to construction would not exceed CAPCOA thresholds
Hazards and Hazardous Materials	*Located on-site that is included on a list of hazardous materials site complied pursuant to Gov. Code Section 65962.5*	One aboveground storage tank located within solar facility site, however, will be removed in compliance with rules, laws, and regulations.	N/A	One aboveground storage tank located within solar facility site; however, will be removed in compliance with rules, laws, and regulations.	One aboveground storage tank located within solar facility site; however, will be removed in compliance with rules, laws, and regulations.	N/A
	Create hazards	No	No	No	No	No
Hydrology and Water Resources	*Water supply needs from Palo Verde Valley Irrigation District*	Up to 500 AF/year during construction Up to 302 AF/year during operation, resulting in a net reduction of 2,903 to 3,101 AF/year.	No increase in existing demand. Irrigation for agriculture approximately 3,403 AF/year	Up to 500 AF/year during construction Up to 302 AF/year during operation	Up to 500 AF/year during construction Up to 302 AF/year during operation	Less than 500 AF/year during construction Less than 302 AF/year during operation, resulting in a net reduction of more than 2,903 to 3,101 AF/year
	Number of ephemeral channel crossings	2 ephemeral	N/A	2 ephemeral	3 (one ephemeral channel crossed twice)	2 ephemeral
	Potential impact from flooding	Yes, but solar facility would be designed outside of floodplain	No	Yes, but solar facility would be designed outside of floodplain	Yes, but solar facility would be designed outside of floodplain	Yes, but solar facility would be designed outside of floodplain

ISSUES OR CONCERNS		ALTERNATIVE 1 PROPOSED ACTION	ALTERNATIVE 2 NO PROJECT/NO ACTION	ALTERNATIVE 3 NORTHERN ALTERNATIVE 230KV GEN-TIE LINE	ALTERNATIVE 4 SOUTHERN ALTERNATIVE 230KV GEN-TIE LINE	ALTERNATIVE 5 REDUCED ACREAGE ALTERNATIVE
	Change in absorption rates, surface runoff, or drainage patterns	No; however, the Project would result in the creation of minimal additional impervious surface.	N/A	No; however, the Project would result in the creation of minimal additional impervious surface.	No; however, the Project would result in the creation of minimal additional impervious surface.	No; however, the Project would result in the creation of minimal additional impervious surface.
Land Use Planning	*Conflict with regional/local land use plans, policies, and regulations*	No	No	No	No	No
	Miles of 230 kV gen-tie within federal jurisdiction and within an agency-designated Utility Corridor	3.8 miles	N/A	5.3 miles	4.0 miles*	3.8 miles
Noise	*Closest residence*	260 feet	N/A	260 feet	260 feet	580 feet
	Residences within 1 mile of solar facility (no residences within 1,000 feet for gen-tie)	377	N/A	377	377	372
Recreation	*Impact existing parks or other recreational facilities*	No	N/A	No	No	No
	Located within a Community Service Area	No	N/A	No	No	No
Socioeconomics	*Increase population*	Not substantial / temporary during construction	N/A	Not substantial / temporary during construction	Not substantial / temporary during construction	Not substantial / temporary during construction
Traffic and Transportation	*Roads that may require improvement for emergency access*	Seeley Avenue and Riverside Drive	N/A	Seeley Avenue and Riverside Drive	Seeley Avenue and Riverside Drive	Seeley Avenue
	Miles of new gen-tie line requiring new access roads	0.0	0.0	0.0	3.0 miles	0.0

* Plan Maintenance would expand the utility corridor from two to five miles wide.

AF = acre-feet
CAPCOA = California Air Pollution Controls Officers Association
CDFG = California Department of Fish and Game
CO = Carbon monoxide
CRHR = California Register of Historical Resources
MDAQMD = Mojave Desert Air Quality Management District
N/A = not applicable
NO_x = Nitrogen oxides
NRHP = National Register of Historic Places
PM_{10} = Particulate matter 10 microns in diameter or larger
$PM_{2.5}$ = Particulate matter 2.5 microns in diameter or larger
ROG = Reactive organic gases
SO_x = Sulfur oxides
USFWS = U.S. Fish and Wildlife Service

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 1: INTRODUCTION

1.1 Overview

In accordance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), the County of Riverside (County) and the United States Department of the Interior, Bureau of Land Management (BLM) have prepared this joint Draft Environmental Impact Report/Environmental Assessment (Draft EIR/EA) for the proposed Blythe Mesa Solar Project (Project). This action is in response to the Renewable Resources Group's (Applicant) application to: (1) the County for a Conditional Use Permit and Public Use Permit; (2) the City of Blythe for a Conditional Use Permit; and (3) the BLM for a right-of-way (ROW) grant.

This Draft EIR/EA analyzes the impacts of the proposed action, a solar photovoltaic (PV) facility of up to 485 megawatts (MW) and associated infrastructure (power collection system, communication cables, overhead and underground transmission and collection lines, electrical switchyards, and operations and maintenance [O&M] buildings). The Draft EIR/EA is an informational disclosure document that:

1) informs agency decision-makers and the public of environmental impacts that are expected to result from construction, operation, maintenance, and decommissioning of the proposed Project and each agencies' respective actions;
2) presents recommended mitigation measures that, if adopted, would avoid or minimize many of the environmental impacts identified; and
3) identifies alternatives to the proposed Project that would avoid or minimize significant environmental impacts associated with the Project, and evaluates the environmental impacts associated with these alternatives.

A majority of the solar facility would occupy 3,587 acres on privately owned land under the jurisdiction of the County, approximately 334 acres of which are within the City of Blythe. The Project would be located on lands under the jurisdiction of the County of Riverside, the BLM, and the City of Blythe. A majority of the Project would be within the County of Riverside and governed by the County of Riverside's General Plan and the Palo Verde Valley Area Plan (PVVAP). A portion of the solar facility would be within the area of the City of Blythe General Plan. The County is the "lead agency" responsible for preparation of the EIR in compliance with CEQA. As the CEQA lead agency, the County is responsible for conducting the CEQA review and has final approval of the Project. The County is responsible for coordinating with the Applicant, public, and associated agencies during the CEQA process. When more than one agency is involved in a project, the agency with primary responsibility for approving a project is the lead agency for purposes of following the CEQA protocol. Other agencies with discretionary approval power over the project are called "responsible agencies." The City of Blythe is a responsible agency that has actively participated in the NEPA/CEQA process and review of this Draft EIR/EA.

A portion of the 230 kilovolt (kV) generation interconnection (gen-tie) line would traverse BLM-managed lands. The BLM is the lead federal agency responsible for preparation of the EA in compliance with NEPA. The information contained within this Draft EIR/EA will be considered by all applicable decision-makers in determining whether to grant the approvals the Applicant requests.

1.1.1 Project Overview

The proposed Project encompasses 3,660 acres and consists of two primary components:

- **Solar facility site (3,587 total acres)**
    - Solar array field that would utilize single-axis solar PV trackers (295 feet long and 140 feet wide). Six trackers with 18 north-south oriented rows of PV panels would be configured into 1.5 MW blocks (600 feet long by 470 feet wide).
    - System of interior collection power lines located between inverters and substations.

- Up to three on-site substations (each approximately 90,000 square feet).
- Up to two O&M buildings (approximately 3,500 square feet each).
- Associated communication facilities and site infrastructure.
- Two primary off-site access roads and several interior access roads.

- **Approximately 8.4 miles of 230 kV gen-tie transmission line**

    - Approximately 3.6 miles would be located within the solar facility, which would connect all on-site substations.
    - Approximately 4.8 miles would extend outside of the solar facility and would be placed within a 125-foot-wide ROW and occupy 73 acres. Of this, 3.8 miles would traverse BLM-managed lands with 53 acres within the Riverside East Solar Energy Zone (SEZ). At the end of the energy sales contract term (20-year term) of Alternative 1, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled within the Project area. Following decommissioning and dismantling of the solar facility and gen-tie line, the site would be made available for reversion to agricultural use.

The fenced-in solar PV electric generation facility would occupy approximately 3,587 acres on privately owned land (approximately 3,253 acres are within the County of Riverside and approximately 334 acres are within the City of Blythe). The portion of the gen-tie line outside the solar facility site, from the southernmost substation to the Colorado River Substation, would traverse 3.8 miles of BLM-managed lands (approximately 58 acres) and approximately one mile of private land (approximately 15 acres). Figure 1-1, illustrates the solar facility site, gen-tie line location, and jurisdictions within the Project vicinity. The term "Project area" is used in this document to refer to the proposed 485 MW solar PV facility and associated infrastructure (3,587 acres), as well as the proposed 230 kV transmission line (gen-tie line) corridor (73 acres). The proposed solar facility would be considered a non-federal connected action because the solar facility must interconnect to the electrical grid via a gen-tie line; without a gen-tie line on BLM-managed land the solar facility site would be stranded.

Two alternative gen-tie line corridors are considered in this Draft EIR/EA—the Northern Alternative (Alternative 3) and Southern Alternative (Alternative 4). The proposed solar facility site would be the same for Alternatives 3 and 4; however, the main difference between the Alternatives is the location of the 230 kV gen-tie line corridor that extends outside the solar facility site. The Northern Alternative gen-tie line corridor would occupy 95 acres and the Southern Alternative gen-tie line corridor would occupy 60 acres. The Reduced Acreage Alternative's (Alternative 5) solar facility site would be within the boundary of the proposed Project; however, it would occupy a smaller footprint than the proposed Project. The solar facility development for Alternative 5 would occur south of Interstate 10 (I-10). Refer to Chapter 2 (*Alternatives Including the Proposed Project*) for a detailed description of the proposed Project, Alternatives, and regulatory permits needed for construction and implementation.

The initial use of the Project site to be permitted under the conditional use permit will be active agricultural production. To encourage agricultural uses to continue on the site until solar facility development occurs, approximately 1,249 acres of the solar facility site would be rezoned to an agricultural zone (refer to Figure 2-12 in Chapter 2). Approximately 1,485 acres would be placed in an agricultural preserve and potentially placed in a Williamson Act Contract (refer to Figure 2-13 in Chapter 2). The solar facilities in the areas subject to these Williamson Act protections would be constructed later, in accordance with market demand and public interest, and such development would necessitate cancellation of the applicable Williamson Act Contract and preserve.

1.1.2 Project Location

The proposed Project is located in east Riverside County, approximately five miles west of central Blythe and 40 miles east of Desert Center (refer to Figure 1-1); more specifically, the proposed Project is located north and south of I-10, west of Neighbors Boulevard and Arrowhead Boulevard, and south and east of the Blythe Airport.

1.1.3 Regional Setting

The proposed Project is located in the Palo Verde Valley along the western edge of the City of Blythe, near the Colorado River. The Project area is situated on Palo Verde Mesa and is part of the Colorado Desert. The topography of the site is relatively flat, sloping toward the southeast, and elevations range from 260 to 400 feet above mean sea level. An ephemeral stream bisects the solar facility site and the transmission line would traverse an ephemeral stream. The Project area is generally bounded by the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert. Urban development near and adjacent to the Project area consists of agricultural fields and groves, residences, the Blythe Airport, the Blythe Generating Plant, electrical transmission lines, and commercial businesses. The Project area also includes undeveloped open desert that is managed by the BLM and illustrated by the yellow shaded areas in Figure 1-2.

The subtropical climate of the Colorado Desert is characterized by dry, mild winters averaging 45 degrees Fahrenheit (°F) and dry, hot summers averaging 104°F. Summer highs have been known to reach 120°F. Precipitation ranges between two and ten inches per year, mostly occurring between November and March. Although rainfall is primarily in the winter months, the region is periodically influenced by tropical weather conditions including sudden monsoonal summer storms.

1.1.4 Local Setting and Surrounding Land Uses

The Project area is primarily characterized by both active and previously farmed agricultural land uses. Active agricultural uses include a citrus grove and wheat and alfalfa fields. Jojoba was previously grown for commercial purposes. Existing vacant land consists of either fallow farmland or creosote bush scrub.

The Project area is situated on the urban fringe of the City of Blythe. Urban development near and adjacent to the Project area includes the community of Nicholls Warm Springs/Mesa Verde, Blythe Airport, the 520-MW natural gas-fired Blythe Generating Plant, an existing solar facility site (Blythe Solar Project, owned by NRG), electrical substations, electrical transmission lines, ancillary agricultural facilities, dirt roads, and commercial businesses. I-10 crosses through the study area in an east-west alignment. Refer to Figure 1-1.

The solar facility site includes the assessor's parcel numbers listed in Table 1-1. The parcels that would be traversed by the proposed and Alternative gen-tie lines are listed in Table 1-2.

TABLE 1-1 ASSESSOR'S PARCEL NUMBERS FOR SOLAR FACILITY

RIVERSIDE COUNTY				CITY OF BLYTHE
821110004	824102015	863040015	863100010	824101014
821120025	824102016	863040017	863100011	824101015
821120026	824130006	863040020	863100012	824101016
821120027	824130007	863040021	863100016	824101017
821120028	863030002	863050004	879090036	824102020
821120029	863030003	863050007	879090027	824102023
821120038	863030004	863050008	879090038	824102024
821120039	863030005	863050009	879090039	824102026
821120040	863030006	863060015	879090040	824102027
821120042	863030007	863060016	879090041	824110035
821120043	863030008	863060017	879090042	824110036

RIVERSIDE COUNTY				CITY OF BLYTHE
821120044	863030009	863060018	879090043	824110037
821120048	863030010	863070018	879090044	824110038
824080003	863030013	863070019	879090045	824122013
824080005	863030014	863070022	879090048	
824090009	963030015	863100005	879090049	
824090024	863030016	863100006	879090050	
824102013	863030017	863100008	879090051	
824102014	863040001	863100009	879110013	
			879110014	

TABLE 1-2 ASSESSOR'S PARCEL NUMBERS FOR GEN-TIE LINES

ALTERNATIVE 1 (PROPOSED)		ALTERNATIVE 3 (NORTHERN)	ALTERNATIVE 4 (SOUTHERN)	
Riverside County	BLM	BLM	BLM	Riverside County
879080013	879080022	879080020	879080022	879080034
879080014	879080024	879080021	879080023	
879080028	879080026	879080022	879080024	
879080032	879080027	879080025	879090033	
879090048	879090028	879090031	879090034	
	879090033	879090033		
	879090034	879090034		
	879090035	879090035		

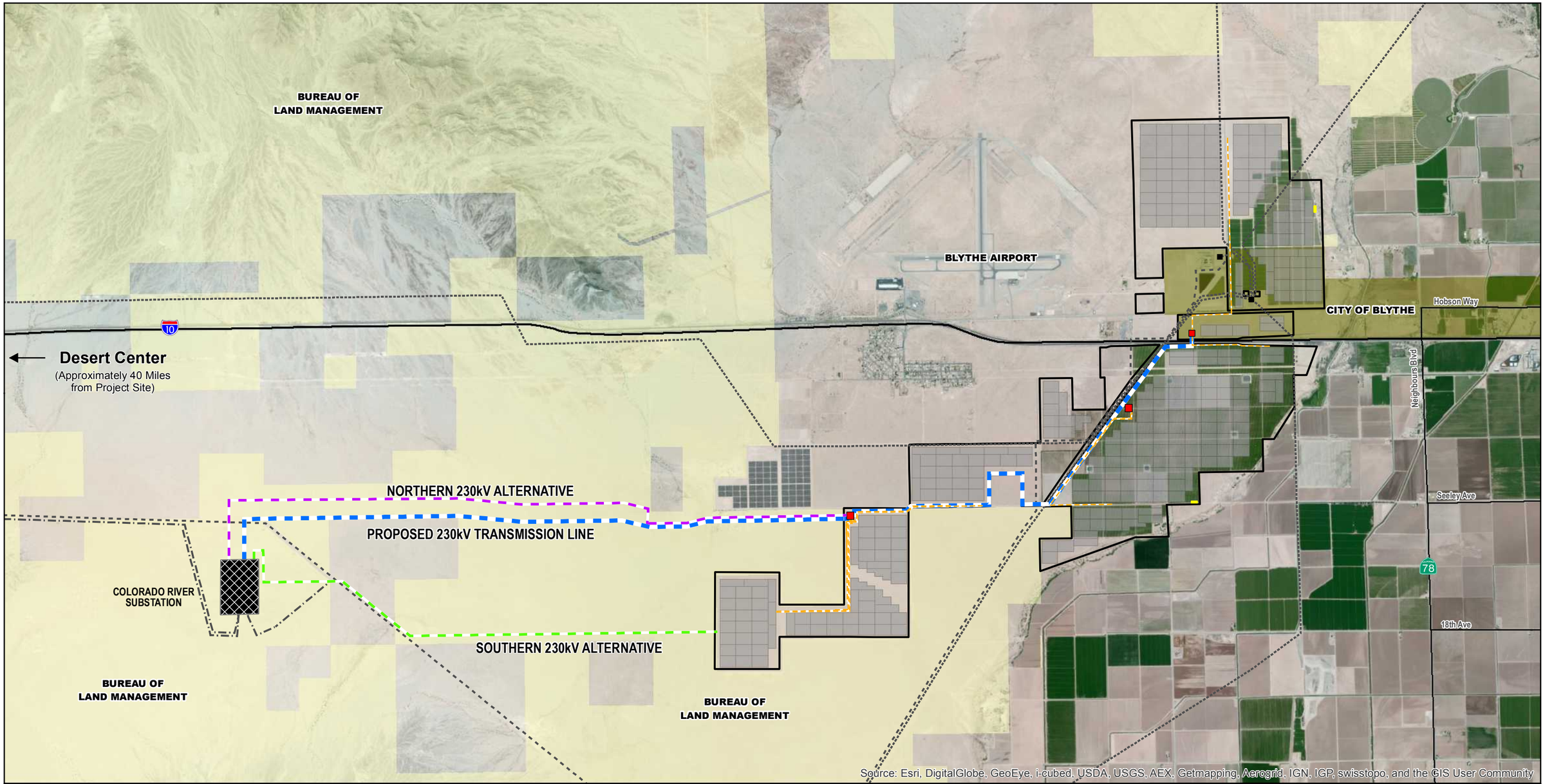
1.1.5 Zoning

The Project would be located on lands under the jurisdiction of the County of Riverside, the BLM, and the City of Blythe. A majority of the Project would be located within the County of Riverside and within the area governed by the County of Riverside's General Plan and the Palo Verde Valley Area Plan. A portion of the solar facility site would be within the area of the City of Blythe, within the area governed by the City's General Plan. A portion of the 230 kV gen-tie line would traverse BLM-managed lands, and that area would be governed by the California Desert Conservation Area (CDCA) Plan.

Figure 1-3 illustrates the zoning for the County of Riverside and City of Blythe. Portions of the Project located within area governed by the Palo Verde Valley Area Plan are currently zoned as follows:

- Controlled Development Areas (W-2-10) (10-acre minimum)
- Controlled Development Areas (W-2-5)
- Light Agriculture (A-1-10)
- Heavy Agriculture (A-2-10)

AR062289



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Solar Array Location
- Project Substation
- Operations and Maintenance Building
- Proposed Blythe Mesa 230 kV Line
- Proposed Blythe Mesa 34.5 kV Line
- Northern 230kV Alternative
- Southern 230kV Alternative

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Jurisdiction
- Bureau of Land Management
- City of Blythe

N

0 4,000 8,000
Feet
1:48,000



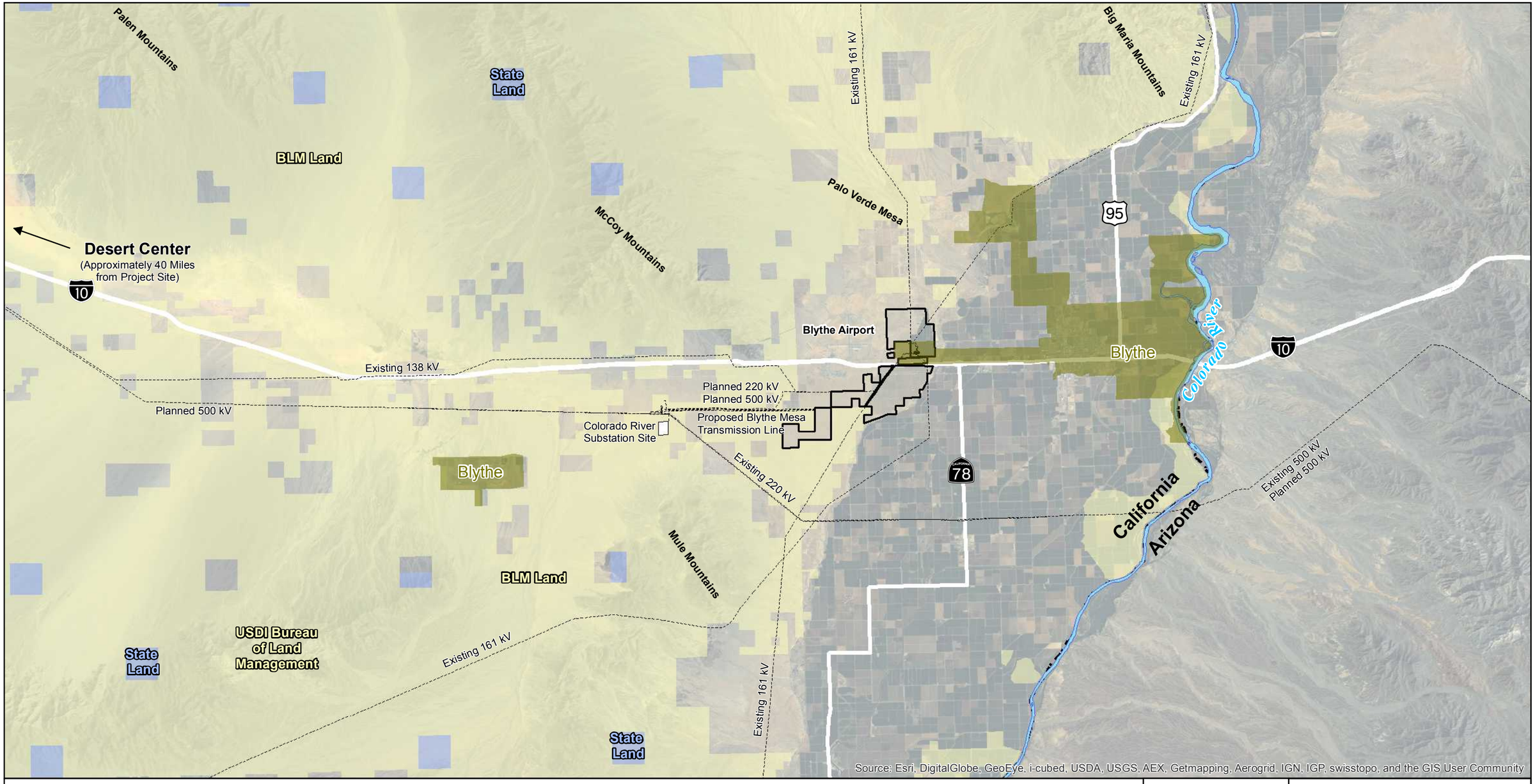
FIGURE 1-1
PROJECT AREA

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062290

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Blythe Mesa Solar Project Boundary

N

0 3 6

Miles

1:190,080



FIGURE 1-2
REGIONAL AREA

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062292

THIS PAGE INTENTIONALLY LEFT BLANK

Zoning designations adjacent to and surrounding the Project area within the Palo Verde Valley Area Plan area consist of the following:

- Rural Residential (R-R)
- Light Agriculture (A-1-2 1/2 and A-1-10)
- Controlled Development Areas (W-2-10 and W-2-2 1/2)
- Residential Agricultural (R-A-5)
- Manufacturing-Service Commercial (M-SC)
- Controlled Development with Mobile Homes (W-2-M)
- Tourist Commercial (C-T)
- Scenic Highway Commercial (C-P-S)
- Industrial Park (I-P)
- Manufacturing-Heavy (M-H)
- Mobile Home Subdivision-Rural (R-T-R)
- Heavy Agriculture (A-2-10 and A-2-2 1/2)
- Not Applicable (N-A)

Portions of the Project located within the City of Blythe are currently zoned:

- Agriculture (A)
- Service Industrial (I-S)

The adjacent and surrounding City of Blythe zoning consists of the following:

- Agriculture (A)
- Rural Residential (R-R)
- General Commercial (C-G)
- General Industrial (I-G)

1.1.6 BLM Land Use Plan Conformance

Figure 1-4 illustrates the portion of the gen-tie line for the proposed action (and alternatives) that would traverse BLM-managed lands. These lands are within the area governed by the CDCA Plan, as amended and within the Riverside East Solar Energy Zone (SEZ). The Riverside East SEZ was designated through the Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern States (Western Solar Plan) (BLM 2012a). A SEZ is defined by the BLM as “an area within which the BLM will prioritize and facilitate utility-scale production of solar energy and associated transmission infrastructure development” (BLM 2012b).

The CDCA Plan requires that sites associated with power generation or transmission not identified in the Plan or outside of transmission corridors be considered through the plan amendment process. The Western Solar Plan amended the CDCA Plan to “identify all SEZ lands within the CDCA as sites associated with power generation or transmission” (BLM 2012b). Because the Western Solar Plan has satisfied the requirement of the CDCA Plan for a plan amendment, any ROW issued by BLM for the proposed action (or alternatives) would be in conformance with the CDCA Plan, as amended.

1.2 Purpose and Need/Project Objectives

1.2.1 Federal Purpose and Need

In accordance with the Federal Land Policy and Management Act (FLPMA) (Section 103(c), 43 United States Code [U.S.C.] §1702(c)), public lands are to be managed for multiple uses that take into account the needs of future generations for renewable and non-renewable resources. The Secretary of the Interior is authorized to grant ROWs on public lands for systems for generation, transmission, and distribution of

electric energy (Section 501(a)(4), 43 U.S.C. §1761(a)(4)). The purpose and need for the proposed action is to respond, in a manner that takes into account BLM's multiple use mandate, to a FLPMA ROW application submitted by the Applicant to construct, operate, maintain, and decommission a gen-tie line on public lands administered by the BLM, which would serve a solar energy generation facility and associated infrastructure, in compliance with FLPMA, BLM ROW regulations, other applicable federal laws and policies, and the management objectives referenced below.

The proposed action would, if approved, assist the BLM in addressing the following management objectives:

- Executive Order 13212, dated May 18, 2001, which mandates that agencies act expediently and in a manner consistent with applicable laws to increase the "production and transmission of energy in a safe and environmentally sound manner."
- Department of the Interior Secretarial Order 3285A1, dated March 11, 2009 and amended on February 22, 2010, which "establishes the development of renewable energy as a priority for the Department of the Interior."
- BLM Instruction Memorandum (IM) 2011-061, dated February 7, 2011, which prioritizes the development of solar facilities on, inter alia, "[l]ands specifically identified for solar or wind energy development in BLM land use plans; [p]reviously disturbed sites or areas adjacent to previously disturbed or developed sites; [l]ocations that minimize construction of new roads and/or transmission lines; [and l]ands adjacent to designated transmission corridors…"
- President Obama's Climate Action Plan, dated June 2013, which set a goal to double renewable electric generation by 2020. "In 2012 the President set a goal to issue permits for 10 gigawatts of renewables on public lands by the end of the year. The Department of the Interior achieved this goal ahead of schedule and the President has directed it to permit an additional 10 gigawatts by 2020."

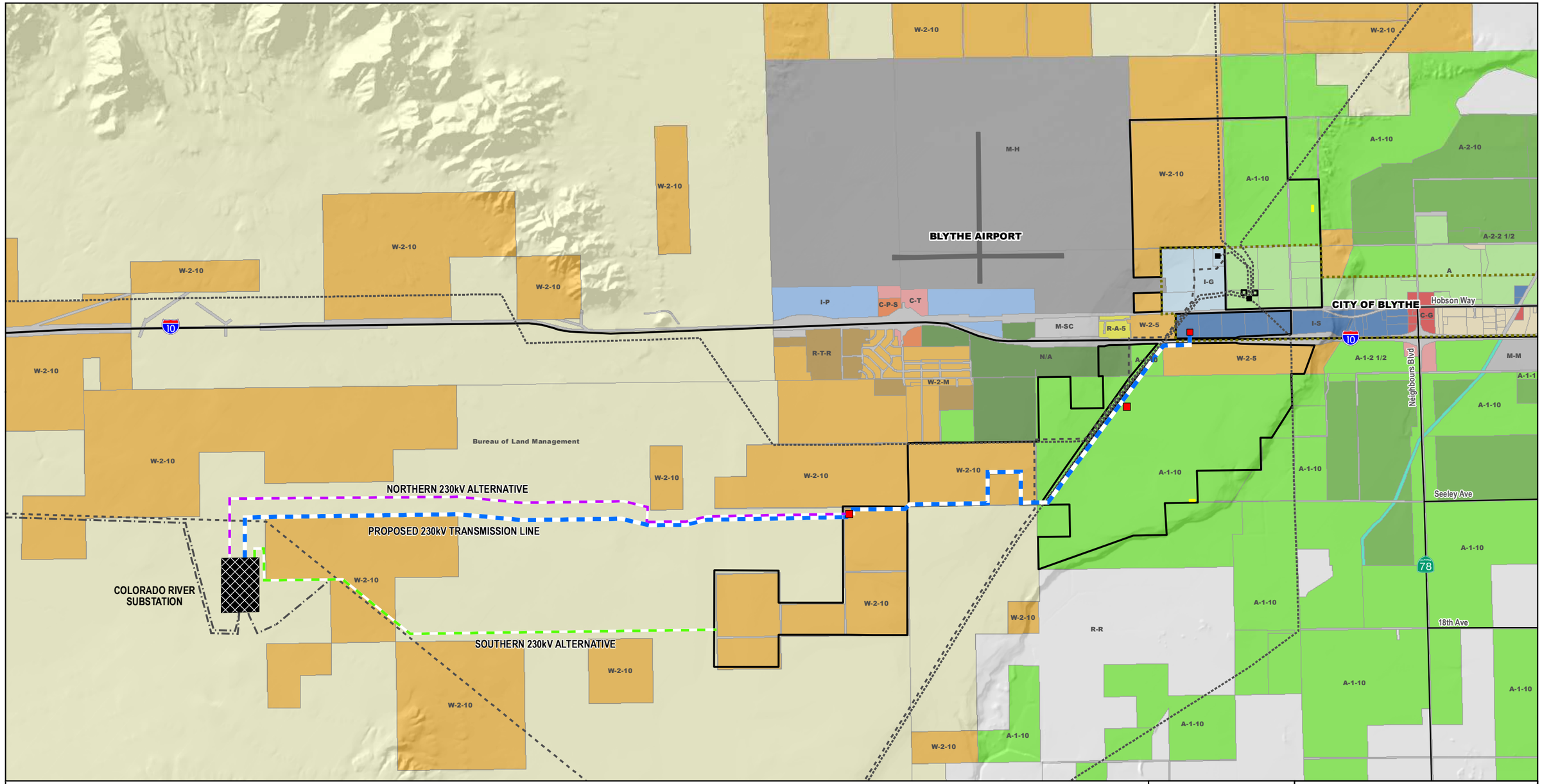
For NEPA purposes, the purpose and need statement must describe the BLM's purpose and need for action, not the applicant's interests and objectives (BLM NEPA Handbook (H-1790-1), Section 6.2). The applicant's interests and objectives, including any constraints or flexibility with respect to their proposal, help inform the BLM's decision and cannot be ignored in the NEPA process (BLM IM 2011-059).

Decisions to be Made by BLM

The BLM will decide whether to deny the proposed ROW, grant the ROW, or grant the ROW with modifications. The BLM may include any terms, conditions, and stipulations it determines to be in the public interest, which may include modifying the proposed use or changing the route or location of the proposed facilities (43 CFR Part 2805.10(a)(1)). The decisions to be made by the BLM will not require a land use plan amendment because such an amendment has previously occurred upon the Department's issuance of the Western Solar Plan in October 2012 (see section 1.1.6).

1.2.2 Decisions to be Made by County of Riverside

This Draft EIR/EA will be used by the County, in conjunction with other information developed in the County's formal administrative record for the Project, when considering whether to approve the Conditional Use Permit (CUP) and Public Use Permit (PUP) for the construction, operation, maintenance, and decommissioning of the proposed Project on lands subject to County jurisdiction. Pursuant to CEQA requirements, the County will determine the adequacy of the Final EIR and, if determined adequate, will certify the document as complying with CEQA.



Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Project Substation
- Operations and Maintenance Building

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Zoning - County of Riverside

A-1-1	I-P	R-T-R	
A-1-10	M-H	W-1	
A-1-2 1/2	M-M	W-2-10	
A-2-10	M-SC	W-2-2 1/2	
A-2-2 1/2	N/A	W-2-5	
C-P-S	R-A-5	W-2-M	
C-T	R-R		

Zoning - City of Blythe
- A
- C-G
- I-G
- I-S
- R-R

Jurisdiction
- City of Blythe
- Bureau of Land Management

N

0 4,000 8,000
Feet
1:48,000

CALIFORNIA
SITE LOCATION

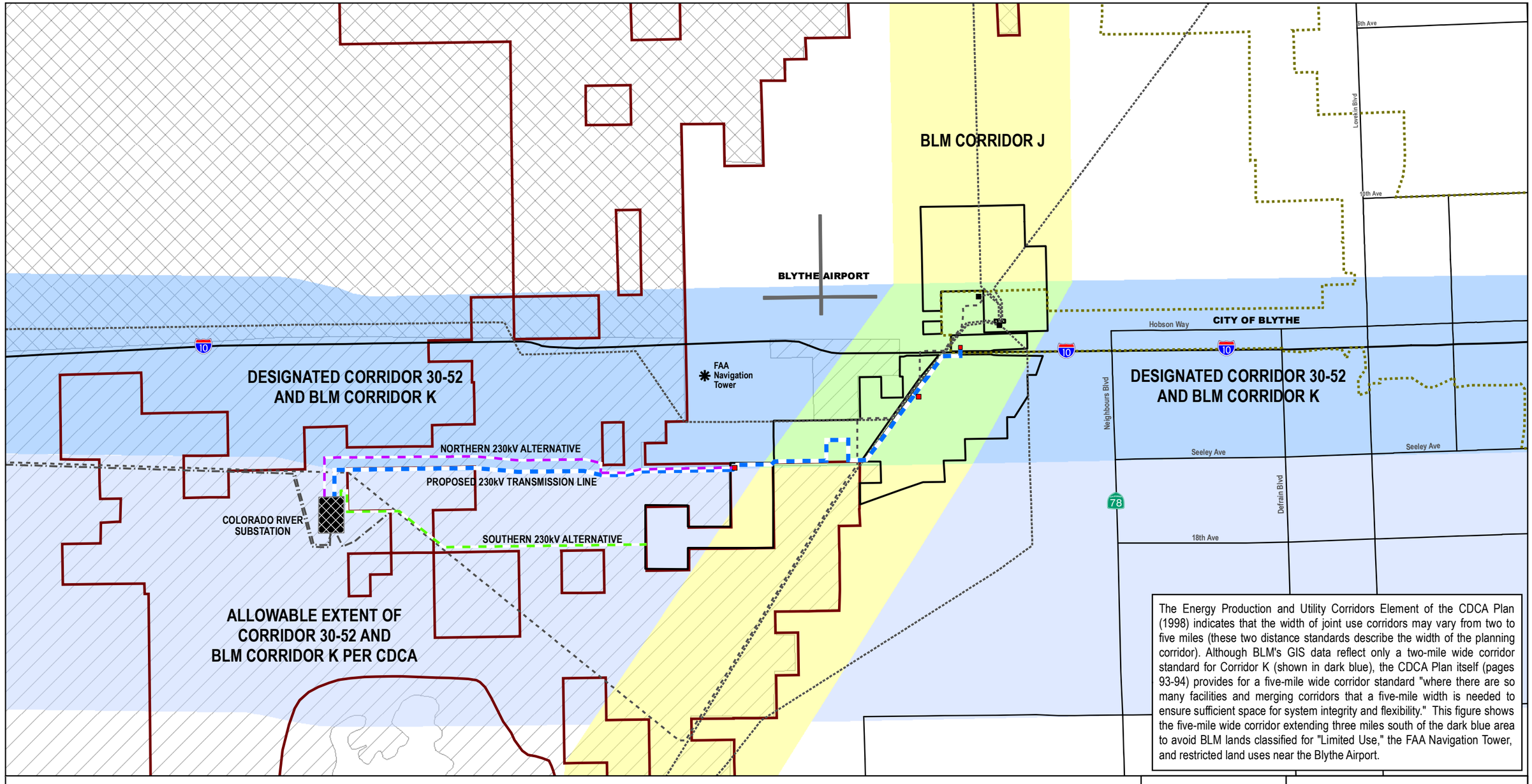
FIGURE 1-3
EXISTING ZONING

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062296

THIS PAGE INTENTIONALLY LEFT BLANK



The Energy Production and Utility Corridors Element of the CDCA Plan (1998) indicates that the width of joint use corridors may vary from two to five miles (these two distance standards describe the width of the planning corridor). Although BLM's GIS data reflect only a two-mile wide corridor standard for Corridor K (shown in dark blue), the CDCA Plan itself (pages 93-94) provides for a five-mile wide corridor standard "where there are so many facilities and merging corridors that a five-mile width is needed to ensure sufficient space for system integrity and flexibility." This figure shows the five-mile wide corridor extending three miles south of the dark blue area to avoid BLM lands classified for "Limited Use," the FAA Navigation Tower, and restricted land uses near the Blythe Airport.

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed Blythe Mesa 230 kV Line
- Northern 230 kV Alternative
- Southern 230 kV Alternative
- Project Substation

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Jurisdiction
- City of Blythe

Utility Corridors
- BLM Utility Corridor J
- BLM Utility Corridor J and K
- BLM Utility Corridor K
- Allowable Extent of BLM Utility Corridor K per CDCA

BLM Multiple-Use Classes
- Limited
- Moderate

Solar Energy Zone
- Riverside East Solar Energy Zone

N

0 3,000 6,000 9,000 12,000
Feet
1:72,000



FIGURE 1-4
BLM MULTIPLE-USE CLASSES AND ENERGY CORRIDORS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS RENEWABLE RESOURCES GROUP

THIS PAGE INTENTIONALLY LEFT BLANK

1.2.3 County and Applicant's Project Objectives

The County and Project Applicant have set forth the following objectives for the proposed Project:

- Construct a solar energy facility in order to help meet State and federal renewable energy standards and goals.
- Assist with greenhouse gas (GHG) reduction objectives to the maximum extent possible.
- Locate the Project facilities as near as possible to electrical transmission facilities with anticipated capacity and reserved California Independent System Operator interconnection position.
- Site the Project in an area with excellent solar energy resource, in order to maximize energy productivity from the PV panels.
- To the extent feasible, site the Project on previously disturbed land with compatible topography in a manner that minimizes environmental impacts.
- Use a proven and available solar PV technology to provide cleanly generated electricity at a competitive price for California electric ratepayers.
- Eventual decommissioning of the 485 MW solar PV electrical generating facility and associated infrastructure at the end of the energy sales contract term, if the energy buyer is not available for extension or another energy buyer does not emerge.

California's Renewable Energy Standards and Goals

California's Renewable Portfolio Standard (RPS) required California's investor-owned electric utilities to obtain 20 percent of the electricity that they supply from renewable sources by 2010. Executive Order S-14-08 mandated that "all retail sellers of electricity shall serve 33 percent of their load with renewable energy by 2020." State government agencies have been directed to take all appropriate actions to implement this target in all regulatory proceedings, including siting, permitting, and procurement for renewable energy power plants and transmission lines. California's three large investor-owned utilities (Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison) collectively served 19.6 percent of their 2012 retail electricity sales with renewable power (CPUC 2013).

California policy has mandated significant increases in renewable energy generation, including utility scale solar facilities like the proposed Project, and requires that California utilities meet their electrical supply needs from both large central station power sources, and from distributed generation. "Utility scale power plants can take advantage of economies of scale early in the growth of new technologies. In recognition of the important role played by large-scale solar projects, California's Clean Energy Jobs Plan calls for the development of 8,000 megawatts of utility scale renewable energy projects by 2020" (http://www.jerrybrown.org/sites/default/files/6-15%20Clean_Energy%20Plan.pdf).

Greenhouse Gas Reduction

California is committed to a significant and substantial increase in reliance on renewable resources for electrical power, the reduction of fossil-fuel based pollutants, and promoting the green economy, consistent with protection of the environment. The RPS embodies this commitment, but it is evident in other statutes and policies as well, in particular those policies that aim to reduce California's contribution of approximately 6.2 percent of the total United States GHG.

Former Governor Arnold Schwarzenegger issued Executive Order S-03-05 on climate change to advance renewable energy and other solutions to lower California's GHG emissions. Further, in enacting the California Global Warming Solutions Act of 2006 (Assembly Bill 32), the Legislature found that global warming poses a serious threat to California's economic well-being, public health, natural resources, and environment. Aspiring to exercise a global leadership role, Assembly Bill 32 directed the California Air Resources Board (CARB) to develop regulations, market mechanisms, and other actions to reduce California's greenhouse gas emissions, such as carbon dioxide, to 1990 levels by 2020 (see Health and Safety Code, § 38501).

In fulfilling its duties under Assembly Bill 32, CARB determined that electricity generation accounts for approximately 22 percent of carbon dioxide (CO_2) emissions in California due to the burning of fossil fuel energy sources such as coal and natural gas. Renewable energy power plants are urgently needed to address the emissions and enable the State to meet its GHG reduction objectives and RPS standard. The Project is anticipated to produce approximately 1,410,000,000 kilowatt hours (kWh) of electrical energy per year with corresponding operational GHG emissions of approximately 271 metric tons of CO_2 equivalent (CO_2e), or 806 metric tons of CO_2e if the amortized construction and operational emissions are added (refer to the Air Quality Technical Report). In comparison, gas turbine and coal-fired power plants of the same electrical energy output are estimated to produce approximately 371,922 and 1,062,635 metric tons of CO_2e, respectively. The net GHG emission displacement or offset of the Project's solar facility in place of a conventional fossil-fuel combustion power plant is estimated to range from 371,116 to 1,061,829 CO_2e per year.

Proximity to Electrical Transmission Facilities

A major impediment to meeting the RPS is transmission line capacity and availability. California Independent System Operator (CAISO) manages the high-voltage transmission system and controls the process of obtaining rights to interconnect to the statewide grid. To obtain permission to interconnect with transmission facilities, an electric generator must submit an interconnection application to CAISO, which then places the electric generator into the "interconnection queue" and evaluates and apportions the cost of any associated transmission facility upgrades. Accordingly, a key driver in achieving the State's RPS is to locate renewable energy power plants where transmission capacity is expected to be available and sufficient queue position has been reserved by the electric generator, such that interconnection approvals can be granted within the near term.

The Project would be located within five miles of Southern California Edison's Colorado River Substation, a component of the Devers-Palo Verde 2 Transmission Line project, which received its approval from the California Public Utilities Commission (CPUC) in July 2011 (Decision D.11-07-011) and is under construction. The portion of the proposed 230 kV gen-tie line that is outside of the solar facility would also be collocated in a utility corridor with three approved transmission lines (Blythe Solar Power Project 220 kV gen-tie line, Devers-Palo Verde 2 500 kV Transmission Line, and McCoy Solar Energy Project 230 kV gen-tie line). A portion of the proposed gen-tie line within the solar facility would be collocated within the existing Western Area Power Administration's 161 kV transmission line and existing Blythe 230 kV transmission line.

High Potential Solar Resource Area

The Blythe area receives anywhere between 6.0 and 7.0 kilowatt hours per square meter per day ($kWh/m^2/day$) of solar radiation energy, giving it a higher degree of solar radiation than most areas within the United States (NREL 2012). The BLM and Department of Energy prepared a Solar Energy Development Programmatic Environmental Impact Statement identified the Riverside East study area (of which Blythe is a part) as having a high potential for solar resources (BLM and DOE 2012). Also, there are a number of proposed and approved solar projects that may be constructed in close proximity to the Blythe area (refer to the Cumulative Project Map found in Chapter 3, Section 3.3). As such, the Project would be sited in an area with excellent solar energy resources in order to maximize productivity from the PV panels.

Site the Project on Disturbed Land and Minimize Adverse Environmental Impacts

To minimize adverse environmental impacts, such as impacts to biological, cultural, and water resources, the solar Project would be sited on land with flat topography that has been previously disturbed by ongoing agricultural activities. It would also be adjacent to the 520 MW natural gas-fired Blythe Generating Plant and would be located one mile east of the Blythe Airport. The solar facility site is bisected by I-10 and has two existing 161 kV transmission lines traversing the site.

Proven and Available Solar PV Technology

The Project would use proven and available ground mounted, tracked, solar PV technology that provides efficient solar energy at a cost-effective utility scale. Solar PV technology has been commercially used for over 40 years. According to the U.S. Solar Market Insight Report, in 2011, 1,855 MW of photovoltaic solar systems were installed in the United States and the cumulative PV capacity operating in the County now stands at 3,954 MW (Solar Energy Industries Association 2011).

1.3 Joint CEQA/NEPA Document

This Draft EIR/EA was prepared as a joint state/federal environmental document (State Clearinghouse Number 2011111056 and EA Number 0021). This document analyzes the effects of the proposed Project (solar facility site and gen-tie line corridor) and Alternatives.

1.3.1 CEQA Environmental Impact Report

Under CEQA, as amended (Public Resources Code Section 21080(a)), an environmental review document must be prepared, reviewed, and certified by the decision-making body before action is taken on any non-exempt discretionary project proposed to be carried out or approved by a State or local public agency in California. This EIR serves as the environmental review document that evaluates the potential environmental effects associated with implementation of the proposed Project. The County is the lead agency responsible for preparation of this EIR in compliance with CEQA. This EIR has been prepared pursuant to CEQA (California Public Resources Code Section 21000 et seq.) and the CEQA Guidelines (California Code of Regulations, Title 14, Section 15000 et seq.).

The EIR will serve as an informational disclosure document for the County, responsible agencies, and other interested parties. The County will consider the conclusions of the Final EIR, in light of the entire administrative record, before certifying the Final EIR and taking action on the Project. The following are included among the stated purposes of an EIR in the CEQA Guidelines:

- Disclose significant environmental impacts that are expected to result from the construction, operation, and maintenance of the proposed Project;
- Indicate ways in which significant impacts can be avoided or mitigated;
- Identify any unavoidable adverse impacts that cannot be mitigated; and
- Identify feasible alternatives to the Project that would substantially lessen or eliminate significant adverse impacts.

1.3.2 NEPA Environmental Assessment

NEPA requires the preparation of an Environmental Impact Statement (EIS) for all “major Federal actions significantly affecting the quality of the human environment” 42 U.S.C. §4332(2)(C). Where, as here, an agency's regulations do not plainly require the preparation of an EIS for a particular type of project, however, the agency must first prepare an EA to determine whether the action will have a significant effect on the environment and whether an EIS must consequently be prepared. See 40 CFR Part 1501.4. If the agency’s analysis determines that the action, with or without mitigation measures, will not have a significant effect on the environment, then the agency may issue a Finding of No Significant Impact (FONSI) in lieu of preparing an EIS (40 CFR Parts 1501.4 and 1508.9). The FONSI must be accompanied by ‘a convincing statement of reasons’ to explain why a project’s impacts are insignificant.” *Blue Mountains Biodiversity Project*, 161 F.3d 1208, 1212 (9th Cir. 1998), *cert den.*, 1999 U.S. LEXIS 4045 (1999).

Identifying a significant effect on the environment involves consideration of the context and intensity of the proposed action. Agencies consider context (whether it be “society as a whole (human, national), the affected region, the affected interests, [or] the [affected] locality”) because “[s]ignificance varies with the setting of the proposed action.” 40 CFR Part 1508.27(a). To evaluate intensity, agencies consider the

degree to which the effects of the action are highly uncertain, affect public health or safety, are likely to be highly controversial, or involve unique or unknown risks. Whether the geographic area of the action has "unique characteristics," such as "proximity to historic or cultural resources, park lands, prime farmlands, wetlands . . . or ecologically critical areas," whether the Project "may cause loss or destruction of significant scientific, cultural, or historic resources," and the likelihood of cumulative impacts are additionally relevant. Finally, agencies must consider whether the decisions made in an EA might "establish a precedent for future actions with significant effects" 40 CFR Part 1508.27(b)(1)-(10).

Notwithstanding the fact that an EA is intended to be a concise document (40 CFR Part 1508.9), courts have allowed agencies to consider the effect of mitigation measures in determining whether preparation of an EIS is necessary. *Preservation Coalition, Inc. v. Pierce*, 667 F.2d 851, 860 (9th Cir. 1982). A mitigated EA can consequently be rather lengthy, especially when combined with the requirements of an EIR. An agency decides whether or not an EIS is warranted based on the aforementioned factors and whether significant measures are undertaken as needed to mitigate the effects of the action below levels of significance – not the length of the analysis.

The gen-tie line for the proposed solar facility would traverse BLM-managed lands and trigger the need for environmental review with BLM as the NEPA lead agency. In accordance with NEPA (42 U.S.C. § 4321 et seq.); CEQ's NEPA regulations (40 CFR Parts 1500-1508); the Department of the Interior's NEPA regulations, 43 CFR Part 46; the BLM NEPA Handbook, H-1790-1; FLPMA Sections 201, 202, and 206, (43 U.S.C. §§ 1711, 1712, 1716; 43 CFR Part 1600); and the BLM Land Use Planning Handbook, H-1601-1, this joint Draft EIR/EA (1) describes the affected environment relevant to potential impacts of the proposed action, action alternatives, and no action alternative; (2) evaluates the environmental impacts that are expected to result from construction, operation, maintenance, and decommissioning of the proposed gen-tie line and its alternatives in the BLM ROW; (3) evaluates the indirect impacts of a non-federal connected action (the proposed solar facility); and (4) identifies and characterizes cumulative impacts that could result from the proposed action (and its action alternatives) in relation to other ongoing or reasonably foreseeable activities within the surrounding area. Additionally, this Draft EIR/EA presents recommended mitigation measures that, if adopted, would avoid, minimize, or mitigate the direct and indirect environmental impacts identified. The information contained in this Draft EIR/EA will be considered by the BLM in its deliberations regarding approval of the ROW grant, and may also be considered by other federal agencies for use in decision-making to protect, preserve, and enhance the human environment and natural ecosystems.

As previously described, the solar facility must interconnect to the electrical grid via a gen-tie line; without a gen-tie line on BLM-managed lands, the solar facility site would be stranded. There is no private land alternative for a gen-tie line to connect the solar facility to the Colorado River Substation. The solar facility is a non-Federal connected action. Connected actions are those actions that are "closely related" and "should be discussed" in the same NEPA document (40 CFR Part 1508.25(a)(1)). Actions are connected if they automatically trigger other actions that may require an EIS; cannot or will not proceed unless other actions are taken previously or simultaneously; or are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR Part 1508.25(a)(i, ii, iii). If a non-federal connected action and its effects can be prevented by BLM decision-making, then the effects of the non-federal action are properly considered indirect effects of the BLM action and must be analyzed as effects of the BLM action (40 CFR Parts 1508.7 and 1508.25). Because it can be difficult to distinguish between direct and indirect effects, BLM policy does not require NEPA documents to differentiate between the terms (BLM NEPA Handbook (H-1790-1), Section 6.8.2 (2008)). This EA analyzes the direct, indirect, and cumulative effects of the entire Project.

1.4 Draft EIR/EA Format and Content

1.4.1 Volumes I and II

This is a joint Draft EIR/EA document in compliance with both CEQA and NEPA. The document is longer and more complex than would be typical if the document were an EIR or EA only.

The CEQA Guidelines provide that each EIR contain essential elements of discussion. Table 1-3 identifies each CEQA element that must be described in an EIR along with a reference to the corresponding section(s) in the Draft EIR/EA where the elements are discussed.

According to the CEQ NEPA Regulations, an EA must briefly discuss the following: the need for the proposed action; the proposed action and alternatives as required by NEPA Section 102(2)(E), 42 U.S.C. § 4332(2)(E); the environmental impacts of the proposed action and alternatives; and the agencies and persons consulted during preparation of the EA (40 CFR 1508.9(b)). Table 1-1 identifies each NEPA element with a reference to the corresponding section(s) in the Draft EIR/EA where the elements are discussed. The format and content of this Draft EIR/EA are consistent with the BLM NEPA Handbook (H-1790-1) as listed in Table 1-3.

TABLE 1-3 RECOMMENDED EA SECTIONS AND REQUIRED EIR ELEMENTS

DRAFT EIR/EA SECTION	CEQA REQUIRED ELEMENT/CEQA GUIDELINES	RECOMMENDED NEPA EA SECTIONS
Table of Contents	Table of Contents (Section 15122)	n/a
Executive Summary	Summary (Section 15123)	n/a
Chapter 1	Project Description (Section 15124) Regional Map Project Objectives List of Agencies Expected to Use EIR List of Required Permits and Approvals List of Related Review and Consultation Requirements	Introduction Identifying Information Location of Proposal Purpose and Need for Action and Decision to be Made Scoping and Public Involvement Issues
Chapter 2	Project Description (Section 15124) Precise location and boundaries of the Project Project's Characteristics Alternatives to the Proposed Project (Section 15126)	Proposed Action and Alternatives Description of Proposed Action Description of Alternatives Analyzed in Detail Alternatives Considered but not Analyzed in Detail
Chapter 3	Environmental Setting (Section 15125) Effects Found Not to Be Significant (Section 15128)	Affected Environment
Chapter 4	Environmental Impact Analysis (Section 15126) Significant Environmental Effects Significant Environmental Effects that Cannot Be Avoided Mitigation Measures Cumulative Impacts (Section 15130) Alternatives (15126.6)	Environmental Effects Direct and Indirect Effects Cumulative Effects Residual Effects Identify and analyze mitigation measures, if any
Chapter 5	Long-Term Implications of the Proposed Project (Section 15126.2) Significant Irreversible Environmental Changes Growth-Inducing Impacts	n/a
Chapter 6	List of Organizations, Agencies, and Persons Consulted and List of Preparers (Section 15129)	Tribes, Individuals, Organizations, or Agencies Consulted List of Preparers
Chapter 7	References (Section 15129)	n/a

n/a = not applicable

The contents of this Draft EIR/EA are organized in the following manner:

Volume I

- **Executive Summary**—The Executive Summary is provided to afford the casual reader an opportunity to understand the entire Project and its implications. The Executive Summary includes: a brief description of the Project Applicant; lead agency and responsible agency data; a narrative summary of each significant effect with proposed mitigation measures and alternatives that would

reduce that effect; areas of interest known to the lead agencies; and issues to be resolved including the choice among alternatives and whether or how to mitigate the significant effects.

- **Chapter 1**. **Introduction—**The Introduction briefly describes the purpose and need, and Project objectives; location and characteristics of the Project and Alternatives; purpose of NEPA and CEQA and the Draft EIR/EA; and the format and content of the Draft EIR/EA. The Introduction also identifies agencies expected to use the Draft EIR/EA; permits and other discretionary actions required for the Project; related review and consultation requirements; and contact persons for the Draft EIR/EA.
- **Chapter 2**. **Alternatives Including the Proposed Project—**This chapter provides detailed descriptions of the proposed Project and Alternatives. Construction details, operational aspects, and relevant background information are also included.
- **Chapter 3**. **Affected Environment—**This chapter of the Draft EIR/EA describes the existing environmental setting for the Project and the surrounding study area. It also identifies the regulatory framework for each environmental resource topic. Please see Section 1.5 below for a list of the resource topics covered in this Draft EIR/EA.

Volume II

- **Chapter 4. Environmental Consequences Including Cumulative Impacts—**This chapter describes the environmental consequences (direct and indirect impacts) associated with implementation of the proposed Project and Alternatives. It analyzes the potential significant impacts and provides mitigation measures that reduce the magnitude of significant impacts. Residual impacts (impact after mitigation) are also discussed. A discussion of past, present, and reasonably foreseeable future projects and their combined impact with the proposed Project and Alternatives is also included. Please see Section 1.5 below for a list of the resource topics covered in this Draft EIR/EA.
- **Chapter 5. Other CEQA Considerations—**Analyses of significant irreversible environmental changes, growth-inducing impacts, and unavoidable significant environmental impacts (under CEQA) are provided.
- **Chapter 6. Coordination and Consultation—**Organizations and persons consulted during preparation of the Draft EIR/EA. This Chapter identifies persons involved in the preparation of the document.
- **Chapter 7. References**

1.4.2 Volumes III and IV: Technical Appendices

The technical reports that were prepared for the environmental review of the proposed Project are listed below and are provided on the attached CD of this Draft EIR/EA. These reports are referenced at the beginning of each environmental issue area and within the relevant environmental analysis sections of this document. In addition, the Project-specific technical reports included in the appendix and other documents and reference sources that have been used in preparation of this Draft EIR/EA are listed in Chapter 7 (References). The baseline physical conditions as analyzed in these reports are the conditions that existed at the time of the issuance of the Notice of Preparation (NOP) for the Draft EIR/EA (CEQA Guidelines Section 15125(a)) in November 2011. For analytical purposes, the NEPA analysis also uses the November 2011 baseline data.

- Air Quality and Global Climate Change Report
- Biological Technical Report
- 230 kV Transmission Line Alternatives, Habitat Assessment Report
- Western Burrowing Owl Survey Report
- Bird and Bat Conservation Plan
- Review of Federal Waters
- Archeological Resource and Built Environment Survey
- Archeological Resource and Built Environment Survey, Transmission Line Alternative Supplemental Report
- Limited Geotechnical Reconnaissance Evaluation
- Water Supply Assessment

- Blythe Mesa CUP 03685 Wash Feature Summary of Findings
- Paleontological Resource Survey Report
- Traffic Impact Study
- Glare Study

1.5 Scope of the Draft EIR/EA and Known Areas of Interest

1.5.1 CEQA Scoping

Scoping was conducted for this Project to identify the scope of the environmental analysis. An NOP of a Draft EIR/EA for the Project was issued by the County on November 16, 2011. Copies of the NOP were provided to the Office of Planning and Research (State Clearinghouse) for issuance to State agencies. Seventy-five copies of the NOP were distributed to federal, State, and local agencies, responsible and trustee agencies, local governments, private organizations, Native American tribes, and other interested parties. A Scoping Session Notice was sent to 120 property owners within 2,400 feet of the Project boundary. The comment period for the NOP began on November 16, 2011, and ended on December 21, 2011. In compliance with California Code of Regulations (CCR) Title 14, Section 15082(c) (CEQA Guidelines), Riverside County conducted the first public scoping meeting on December 12, 2011. The purpose was to inform the public about the Project; describe the purpose and need of the Project; provide information regarding the environmental review process; and gather public input regarding the scope and content of the Draft EIR/EA. A total of ten comments were received during scoping, all from agencies (one of the ten comments was a courtesy notice from the State Clearinghouse to comment in a timely manner). The comment letters in response to the NOP raised the issue topics listed below. The Scoping Report that contains the comment letters can be found in Appendix A.

- Air Quality
- Public Services and Utilities
- Socioeconomics
- Hazardous Materials/Soils
- Cultural Resources

1.5.2 Water Resources BLM Scoping

On October 4, 2012, the BLM conducted a scoping meeting in Blythe, California. The BLM and Applicant presented information about the Project, alternatives, environmental review process, and potential impacts. A question and answer session was held after the presentation. At the conclusion of the question and answer session, the open house continued and staff members were available to answer questions and gather input. A total of ten individuals attended the meeting. A Public Meeting announcement was mailed to 139 recipients, which included agencies, Native American tribes, organizations, and interested individuals. A newspaper advertisement in the *Palo Verde Valley Times* was published on September 28, 2012, that announced the public meeting date, time, and location.

In addition to the oral comments received at the BLM scoping meeting on October 4, 2012, a total of three comments were received. One comment was made by a concerned citizen on a public comment card. The other two were both from the same individual from a Native American organization. All three copies of the original comments may be found in Appendix A. The issue topics raised by the commenters included:

- Public Services and Utilities
- Socioeconomics
- Cultural Resources
- Hazards

1.5.3 Areas of Interest

The following environmental resources had a potential to be affected by activities related to the proposed Project and Alternatives and are evaluated in this Draft EIR/EA:

- Aesthetics, Visual Resources, and Reflection
- Agriculture
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Greenhouse Gas Emissions
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Noise
- Paleontological Resources
- Population, Housing, Public Services, Utilities, and Socioeconomics
- Recreation
- Traffic and Transportation

The following environmental resources are either not present or not impacted by the proposed Project or its alternative, and therefore not discussed in detail in this Draft EIR/EA:

- Forestry
- Mineral Resources
- Livestock Grazing
- Wild Horses and Burros

The Project area and surrounding area do not house any forestry or mineral resources. Accordingly, impacts to these resources are clearly unlikely to occur.

1.6 Agencies Relying on the Draft EIR/EA; Anticipated Permits and Approvals

The table below provides a list of the anticipated federal, State, and local permits and approvals that would be required for the proposed Project and the agencies that are anticipated to rely on the Draft EIR/EA. Other relevant laws, regulations, plans, and policies applicable to the proposed Project are summarized in the resource- and issue-specific sections in Chapter 3. Please refer to Chapter 6, Coordination and Consultation, for a detailed discussion on consultations and persons consulted for the proposed Project and Alternatives.

TABLE 1-4 ANTICIPATED PERMITS AND APPROVALS

ACCEPTING AUTHORITY/ APPROVING AGENCY	PERMIT/APPROVAL	TRIGGERING ACTION	STATUTORY REFERENCE
Federal			
BLM	Grant of ROW and Temporary Use Permit	Proposed gen-tie line construction and operation would occur, in part, on lands under BLM management	Federal Land Policy and Management Act of 1976 (PL 94-579), 43 U.S.C. §§1761-1771; 43 CFR Part 2800. National Environmental Policy Act of 1969 as amended (PL 91-190), 42 U.S.C. §4332, and related statutes
United States Army Corps of Engineers	Nationwide Permit 12	Proposed gen-tie line construction and operation would occur, in part, within waters of the United States	Clean Water Act, Section 404
State of California			
California Department of Fish and Wildlife	Lake or Streambed Alteration Agreement	Proposed construction and operation may potentially impact sensitive biological resources	California Fish and Game Code, Section 1601
State Water Resources Control Board – California Water Quality Control Boards for Colorado River Region	The Applicant must demonstrate compliance with General Discharge Permits for Storm Water Associated with Construction Activity	Proposed construction may involve storm water discharges to surface Waters of the State	Clean Water Act, Section 401
California Department of Transportation, District 8	Encroachment Permit	Proposed construction and operations would occur within and across a California highway ROW	The California Streets and Highways Code, Sections 660 to 734
County of Riverside			
County of Riverside	Conditional Use Permit Public Use Permit Development Agreement	Proposed construction and operation of the Project is located within County jurisdiction	County of Riverside Zoning Ordinance (Ordinance No. 348; CEQA, California Public Resources Code, Sec. 21000 et seq.
	Rezoning, Designation of Agricultural Preserve, Williamson Act Contract Cancellation of Williamson Act Contract and agricultural preserve	Actions taken to encourage agricultural production until all or portions of the site are developed as solar facilities	California Government Code sections 51200 et seq. ; California Government Code section 51282
City of Blythe			
City of Blythe	Conditional Use Permit	Proposed construction and operation of the Project is located within the City limits	City of Blythe, Code of Ordinances, Title 17, Zoning

1.6.1 Related State and Local Review and Consultation Requirements

Ancillary permits, including encroachment permits, grading and construction permits, and certificates of occupancy, are anticipated from the County and the City. These permits and approvals are local ministerial actions that are parallel to or follow CEQA compliance. Other State and local agencies or regulatory entities that could exercise authority over specific elements of the proposed Project include:

- Riverside County Airport Land Use Commission (ALUC): On April 12, 2012, the ALUC reviewed the proposed solar facility layout, transmission components, glint and glare analysis, and ancillary facilities and found the Project consistent with the 2004 Blythe Airport Land Use Compatibility Plan subject to a number of conditions.

- California Department of Transportation, District 8: An encroachment permit would be needed for any Project construction and operations that occur within or across a California highway ROW.

- California Department of Fish and Wildlife (CDFW): Informal consultation has occurred with the CDFW, Inland Desert Region, concerning the scope of biological resource studies and species of interest relative to the proposed Project on private lands.

- Mojave Desert Air Quality Management District (MDAQMD): Permits regulating air pollutant emissions during Project construction, operation, maintenance, and decommissioning are anticipated to be issued by the MDAQMD upon demonstration that the Project will comply with local air regulations.

- Palo Verde Irrigation District (PVID)/County Service Area #22: The Applicant has consulted with the PVID regarding the availability of water supplies to serve the proposed Project, including preparation of Water Supply Assessment pursuant to State law. The Applicant has consulted with and received a will-serve letter from the potable water purveyor, County Service Area #22.

- Native American Heritage Commission (NAHC): In April 2011, prior to the commencement of archeological field surveys of the Project area, the Applicant submitted a letter to the NAHC. The letter requested a list of Native American tribes that should be contacted for information about cultural resources that may occur on or in close proximity to the proposed Project area, as well a Sacred Lands File search. Information requests were submitted to the listed Tribes via United States mail.

- California Independent System Operator (CAISO): The Applicant has applied for and been granted a reservation by CAISO for a secured interconnection queue position sufficient for the size of the Project at the Colorado River Substation. This is a necessary element of being able to transmit generated power to the statewide electric grid.

Additional legislative enactments may be sought from Riverside County by the Applicant, but these would not change the physical aspects of the Project or its impacts. The Project is being pursued pursuant to land use amendments recently adopted by Riverside County. These include General Plan Amendment 1080, which added Land Use Policy LU-15.15, stating: “Permit and encourage, in an environmentally and fiscally responsible manner, the development of renewable energy resources and related infrastructure, including but not limited to, the development of solar power plants in the County of Riverside.” In connection with GPA 1080, Riverside also enacted Ordinance No. 348.4705, which amended the zoning code to allow a solar power plant on a lot 10 acres or larger in certain zoning districts,[2] upon issuance of a use permit.

1.6.2 Related Federal Review and Consultation Requirements

In addition to complying with NEPA, the BLM will comply with other federal regulations and authorizations and conduct necessary consultations regarding the resources potentially affected by the proposed Project. Such consultations include but are not limited to:

[2] The zoning districts are: General Commercial (C-1/C-P), Commercial Tourist (C-T), Scenic Highway Commercial (C-P-S), Rural Commercial (C-R), Industrial Park (I-P), Manufacturing Servicing Commercial (M-SC), Medium Manufacturing (M-M), Heavy Manufacturing (M-H), Mineral Resources (M-R), Mineral Resource and Related Manufacturing (M-R-A), Light Agriculture (A-1), Light Agriculture with Poultry (A-P), Heavy Agriculture (A-2), Agriculture-Dairy (A-D), Controlled Development (W-2) , Regulated Development Areas (R-D), Natural Assets (N-A), Waterways and Watercourses (W-1), and Wind Energy Resource Zone (W-E).

- United States Fish and Wildlife Service (USFWS): The USFWS has jurisdiction to protect threatened and endangered species under the Endangered Species Act (ESA) (16 U.S.C. § 1531 et seq.). Under Section 7 of the ESA, the BLM is obligated to conduct informal and, if necessary, formal consultation with the USFWS relative to federal actions that may adversely affect a federally listed species. BLM conducted informal consultation, which resulted in the USFWS issuing a determination letter that the Project would not likely adversely affect federally listed desert tortoise (see Appendix M of this Draft EIR/EA). Therefore, an ESA Section 7 formal consultation is not required.

- Section 106 of the National Historic Preservation Act (NHPA), as amended, 16 U.S.C. §470f, (36 CFR Part 800), requires federal agencies to take into account the effects of a proposed undertaking on historic properties and to afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment (36 CFR Part 800.1(a)). The Section 106 process seeks to accommodate historic preservation concerns with the needs of federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess the undertaking's effects, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties (36 CFR Part 800.1). As required by Section 106, the BLM sent a consultation letter to the ACHP on August 7, 2013, summarizing its determinations of NRHP eligibility for cultural resources within the area of potential effect and its findings of effect.

    - On August 7, 2013, the BLM notified the State Historic Preservation Officer (SHPO) about the Project and requested initiation of formal consultation regarding the undertaking, which follows the procedures of 36 CFR Part 800.2(c)(1)). The letter also summarized the BLM's determinations of eligibility for cultural resources within the area of potential effect and its findings of effect.
    - Tribal Consultation: As part of the Section 106 process of the NHPA (36 CFR Part 800.2(c)(2)), the BLM has consulted directly with Native American tribes regarding properties of cultural or religious significance that may be affected by the proposed action.

- Government-to-Government Consultation: In addition to the requirements of the NHPA and NEPA, the BLM is required to consult with Native American tribes according to *Executive Order 13175, Consultation and Coordination with Indian Tribal Governments*, which directs federal agencies to establish regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Native American tribes, and to reduce the imposition of unfunded mandates upon Native American tribes. Also, the Presidential *Memorandum for the Heads of Executive Departments and Agencies Regarding Government-to-Government Relations with Native American Tribal Governments,* issued November 5, 2009, directs executive departments and agencies to engage in regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, and to strengthen the government-to-government relationship between the United States and Native American tribes. Government-to-government consultation between the BLM and tribal governments is an on-going process that will continue even after the Section 106 process for the proposed Project has been completed.

- Federal Aviation Administration (FAA), Objects Affecting Navigable Airspace: In conjunction with ALUC project review, the Applicant submitted tower structure locations and other relevant Project features to the FAA for formal hazard determination under 49 U.S.C. §1501; 13 CFR Part 77, Objects Affecting Navigable Airspace. In April 2012, the FAA conducted aeronautical studies (Aeronautical Study Nos. 2012-AWP-551-OE, 2012-AWP-552-OE, 2012-AWP-562-OE, 2012-AWP-566-OE through 2012-AWP-571-OE, 2012-AWP-573-OE, 2012-AWP-1712-OE through 2012-AWP-1725-OE) and issued "No Hazard to Air Navigation" Determinations for the 230 kV gen-tie line structures (see Appendix N of this Draft EIR/EA). Prior to construction, the Applicant must submit a Notice to Construct (FAA Form 7460-2) and receive authorization from FAA.

- United States Army Corps of Engineers (USACE) Jurisdictional Waters: The USACE has jurisdiction to protect the aquatic ecosystem, including water quality and wetland resources, under Section 404 of

the Clean Water Act (CWA). Under that authority, the USACE regulates the discharge of dredged or fill material into waters of the United States, including wetlands, by reviewing proposed projects to determine whether they may impact such resources and, thereby, are subject to a Section 404 permit. The Applicant has informally consulted with the USACE to assist the agency in making a determination regarding its jurisdiction and the need for a Section 404 permit. The determination is pending.

1.7 Contact Persons

Please contact the following individuals regarding questions and concerns about the Project:

CEQA Lead Agency:
Larry Ross, Principal Planner
Riverside County Planning Department
4080 Lemon Street, 12th Floor
P.O. Box 1409
Riverside, CA 92502-1409

NEPA Lead Agency:
Frank McMenimen, Project Manager
Bureau of Land Management
Palm Spring South Coast Field Office
1201 Bird Center Drive
Palm Springs, CA 92262

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED PROJECT

2.1 Overview

The California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) both require consideration of a reasonable range of alternatives to the proposed Blythe Mesa Solar Project (Project) that would attain most of the basic objectives of the Project or meet the United States Department of the Interior, Bureau of Land Management's (BLM's) purpose and need. CEQA requires that decision-makers adopt mitigation measures or alternatives that would avoid or substantially lessen any of the significant effects of the Project, and the Environmental Impact Report (EIR) must contain sufficient information to allow them to do so. Under NEPA, the analysis of alternatives in an Environmental Assessment (EA) need not be as comprehensive and detailed as the alternatives analysis required for an Environmental Impact Statement (40 Code of Federal Regulations [CFR] Part 1508.9(b)). Chapter 1 describes the purpose and need for the Project and Project objectives. This chapter addresses the development of the range of alternatives considered; provides a detailed description of the proposed Project and alternatives, selected for detailed study, and describes the alternatives considered and eliminated from further analysis.

2.1.1 Overview of Solar Technology

Solar cells, also called photovoltaic (PV) cells, convert sunlight directly into electricity. PV gets its name from the process of converting light (photons) to electricity (voltage), which is called the *PV effect.* PV cells are located on panels, which are mounted at a fixed angle facing south or on a tracking device that follows the sun, allowing them to capture more sunlight than a fixed mount system. Many solar panels on multiple rows combined together and controlled by a single motor create one system called a solar tracker. For large electric utility or industrial applications, hundreds of solar trackers are interconnected to form a large utility-scale PV system.

2.1.2 Insolation

Insolation is a measure of solar radiation energy received on a given surface in a given time. It is commonly expressed as an average irradiance in watts per square meter (W/m^2) or kilowatt-hours per square meter per day ($kWh/m^2/day$). The Blythe area receives anywhere between 6.0 and 7.0 $kWh/m^2/day$ of solar radiation energy, giving it a higher degree of solar radiation than most areas within the United States (NREL 2012).

The amount of the sun's heat absorbed by a solar panel is similar to the amount of the sun's heat absorbed by the earth. Solar panels, however, store less heat than the earth. A solar panel is thin—the glass is approximately 3.0 millimeters (0.12 inch) in thickness—lightweight, and surrounded by airflow (because it is mounted above the ground). Therefore, heat dissipates quickly from a solar panel. The normal operating condition temperature for solar panels would be 20 degrees Celsius (°C) or 68 degrees Fahrenheit (°F) above ambient temperature, and so a typical summer day at 40°C (104° F) results in panel temperatures of approximately 60°C (140°F). When accounting for irradiance, wind, and module type, it is expected that the peak module temperatures would be between 35°C and 40°C (95°F and 104°F). Although the panels would be hot to the touch, the temperature below the panels would be nearly the same as ambient temperatures in the ordinary shade.

2.2 Alternative 1: Proposed Project

The Project would consist of the construction, operation, maintenance, and decommissioning of an up to 485 megawatt (MW) alternating current solar PV electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid.

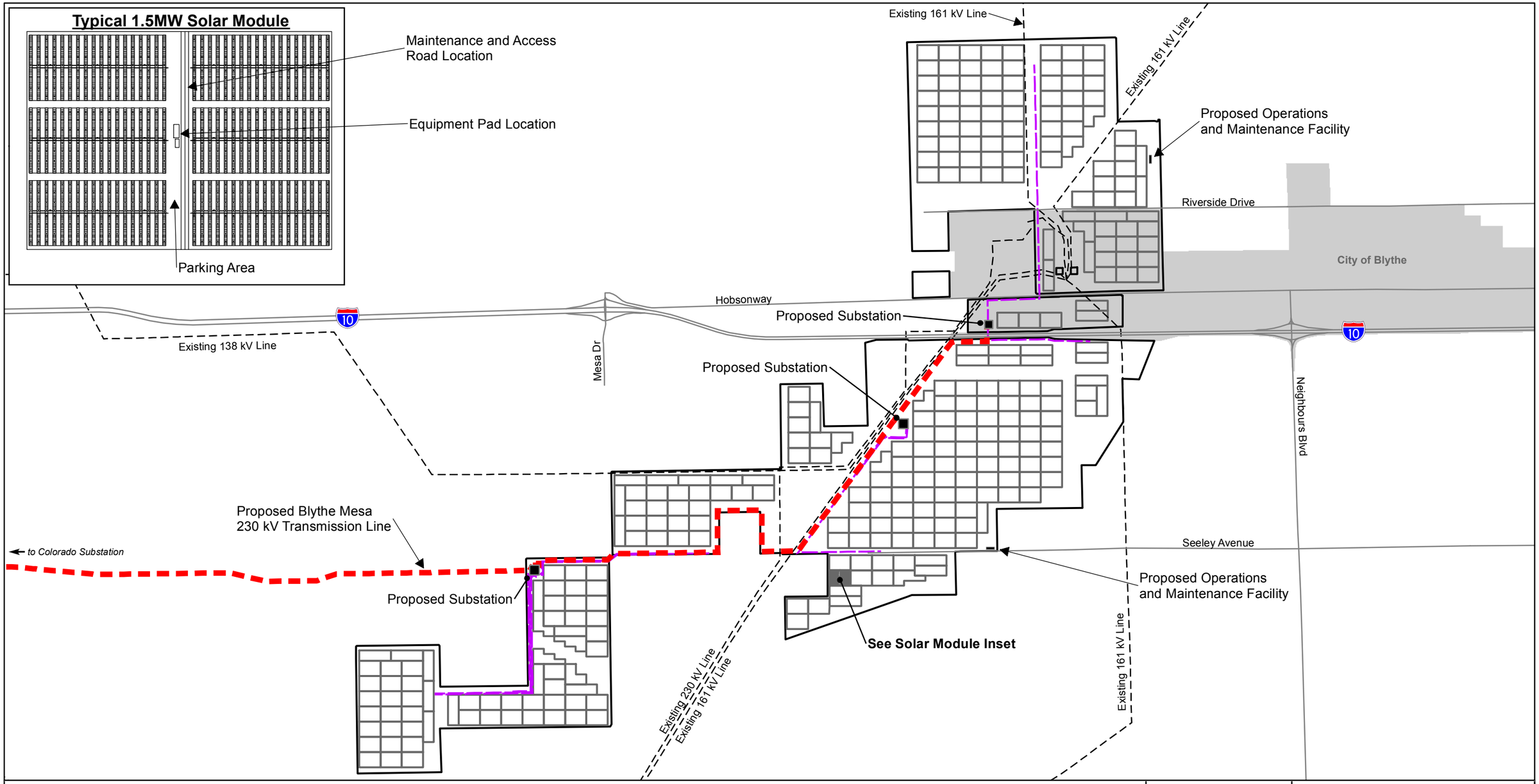
The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—approximately 3,587 acres for the solar field and 73 acres for the 230 kilovolt (kV) generation interconnection (gen-tie) line. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison (SCE) Colorado River Substation, an approved new substation located south of Interstate 10 (I-10) and approximately four miles west of the Project site. The Project has secured a California Independent System Operator (CAISO) interconnection queue position sufficient for the size of the Project. The Project would produce enough energy to power approximately 180,000 households and progress the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state. The Project would also assist in meeting President Obama's Climate Action Plan, which set a goal of issuing an additional 10 gigawatts of renewable electric generation on public lands by 2020.

The proposed Project would consist of the following components (see Figure 2-1):

- **Solar facility site (3,587 total acres)**
    - Solar array field that would utilize single-axis solar PV trackers (295 feet long and 140 feet. wide). Six trackers with 18 north-south oriented rows of PV panels would be configured into 1.5 MW blocks (600 feet long by 470 feet wide).
    - System of interior collection power lines (34.5 kV) located between inverters and substations.
    - Up to three on-site substations (each approximately 90,000 square feet).
    - Up to two operations and maintenance (O&M) buildings (approximately 3,500 square feet each).
    - Associated communication facilities and site infrastructure.
    - Two primary off-site access roads and several interior access roads.
- **Approximately 8.4 miles of 230 kV gen-tie transmission line**
    - Approximately 3.6 miles would be located within the solar facility, which would connect all on-site substations.
    - Approximately 4.8 miles would extend outside of the solar facility and would be placed within a 125-foot-wide right-of-way (ROW) and occupy 73 acres.

The fenced-in solar PV electric generation facility would occupy approximately 3,587 acres on privately owned land (approximately 3,253 acres are within the County of Riverside and approximately 334 acres are within the City of Blythe). The portion of the gen-tie line outside the solar facility site, from the southernmost substation to the Colorado River Substation, would traverse 3.8 miles of BLM-managed lands (approximately 58 acres) and approximately one mile of private land (approximately 15 acres). The term "Project area" is used in this document to refer to the proposed 485 MW solar PV facility and associated infrastructure (3,587 acres), as well as the proposed 230 kV transmission line (gen-tie line) (73 acres).

The BLM's action options would be to deny the proposed ROW grant, grant the ROW, or grant the ROW with modifications. The BLM may include any terms, conditions, and stipulations it determines to be in the public interest, and may include modifying the proposed use or changing the route or location of the proposed facilities (43 CFR Part 2805.10(a)(1)).



Legend

- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Proposed 34.5 kV Transmission Line
- Existing Transmission Line
- 1.5 MW Solar Module
- City of Blythe

N

0 3,000 6,000

Feet

1:36,000



FIGURE 2-1
SITE PLAN

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062314

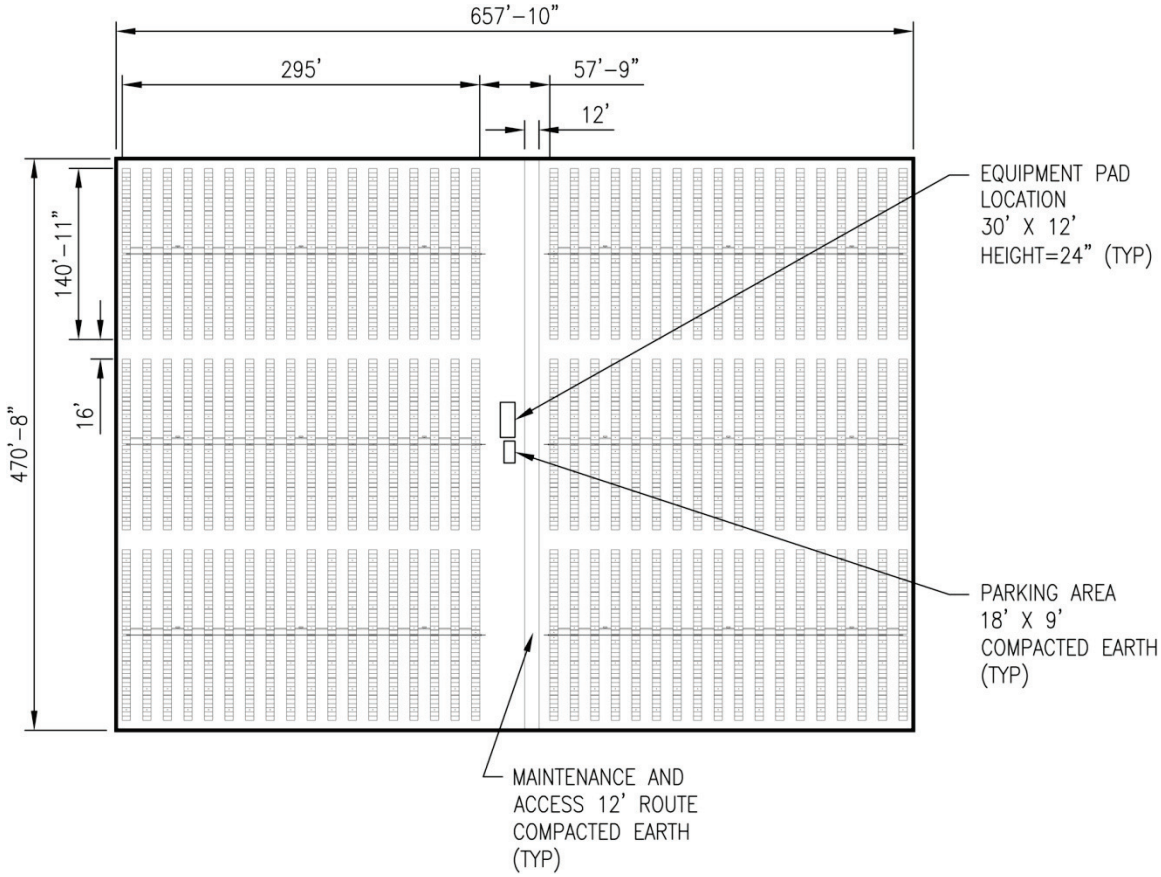
THIS PAGE INTENTIONALLY LEFT BLANK

2.2.1 Project Facilities

Solar Array Field

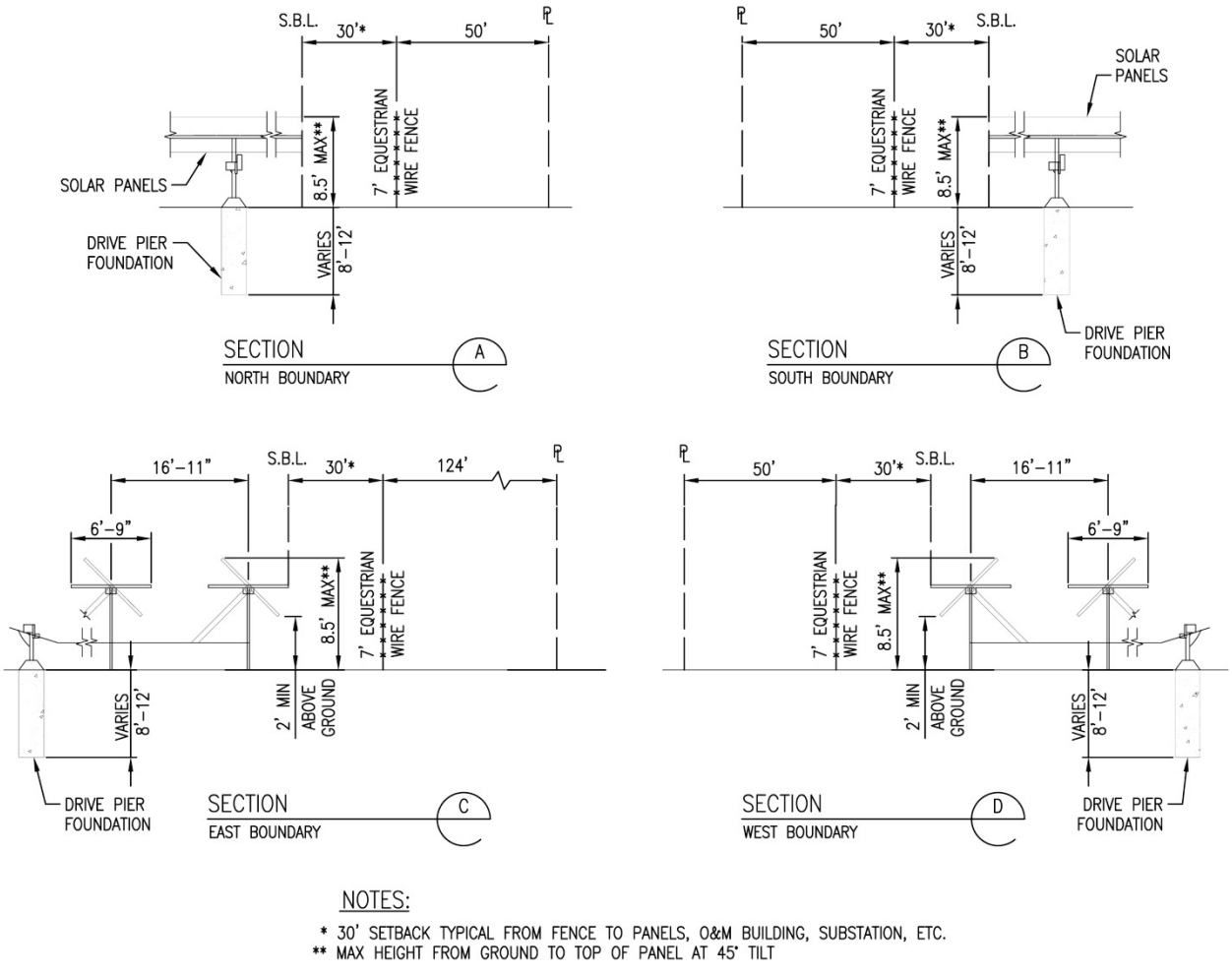
The Project would utilize single-axis PV trackers with approximately 1,425,600 high-efficiency, monocrystalline, silicon solar panels. The panels would be configured into trackers, and the trackers configured into blocks approximately 660 feet wide and 470 feet long (refer to Figure 2-2). Each block comprises six trackers with 18 north-south oriented rows of PV panels (295 feet long and 140 feet wide) that rotate up to 45 degrees from east to west to track the sun (total number of rows is 35,640), with the center of rotation being approximately four to eight feet above grade (refer to Figure 2-3). Solar panels at an upright position would have a minimum clearance of 24 inches above the highest adjacent ground. Within each tracker, the rows of PV panels would be linked by a steel drive strut (295 feet long), which would be oriented perpendicular to the axis of rotation. Each row would be connected to the drive strut by a torque arm, which acts as a lever, enabling the drive strut to rotate the rows in unison. A small 0.5-horsepower electric drive motor would move the drive strut back and forth and is typically mounted in the center of a block. The drive motor would be placed on a concrete foundation that is approximately 2.5 feet in diameter and a minimum of 1.5 feet above ground level. Torque tubes act as the horizontal support for the PV panels and are in turn supported by micro piles (15 to 20 feet long and having a 4.5-inch outer diameter), which are driven directly into the ground (i.e., no concrete footings are used) and are able to withstand high-wind conditions as required under International Building Code (IBC) occupancy classification U. The metal structural elements would be constructed of corrosion-resistant galvanized steel.

FIGURE 2-2 TYPICAL 1.5 MW SOLAR ARRAY



AR062316

FIGURE 2-3 TRACKER SPECIFICATIONS



Combiners, Inverters, and Transformers

Individual PV panels would be connected together in series to create a "string" to carry direct current (DC) electricity. Multiple DC strings would be brought together into an above-ground combiner box to merge the strings into a single high-current cable and provide overcurrent protection. From the combiner boxes, the cabling would run in raceways and underground to inverters (5.0 feet wide and 10.5 feet tall) mounted on small concrete pads (minimum 0.5 foot above grade) distributed across the site. The inverters would take the DC output from the combiner boxes and convert it to alternating current (AC) electricity. Figure 2-4 illustrates the process from PV panels to the proposed substation.

Installation of the electrical collection system would require excavations to a depth of about three feet for underground electrical circuits.

Next, the AC electricity would be increased to medium voltage (34.5 kV) with a standard "step-up" transformer. The medium-voltage collection lines would begin at the inverter/transformer pads and would be located in trenches about three feet deep until the output from 10 to 15 blocks is gathered and transferred at risers to a system of overhead medium-voltage collection lines for transmission to the substations (Figure 2-5). The medium-voltage collection circuits would be mounted above-ground on poles 35 to 60 feet tall, have an average tower to tower span of approximately 200 feet, and carry 20 to 30 MW of electricity (see Figure 2-6). To the extent possible, the poles would be located along the northern edge of the blocks.

FIGURE 2-4 PV PANELS TO PROPOSED SUBSTATION

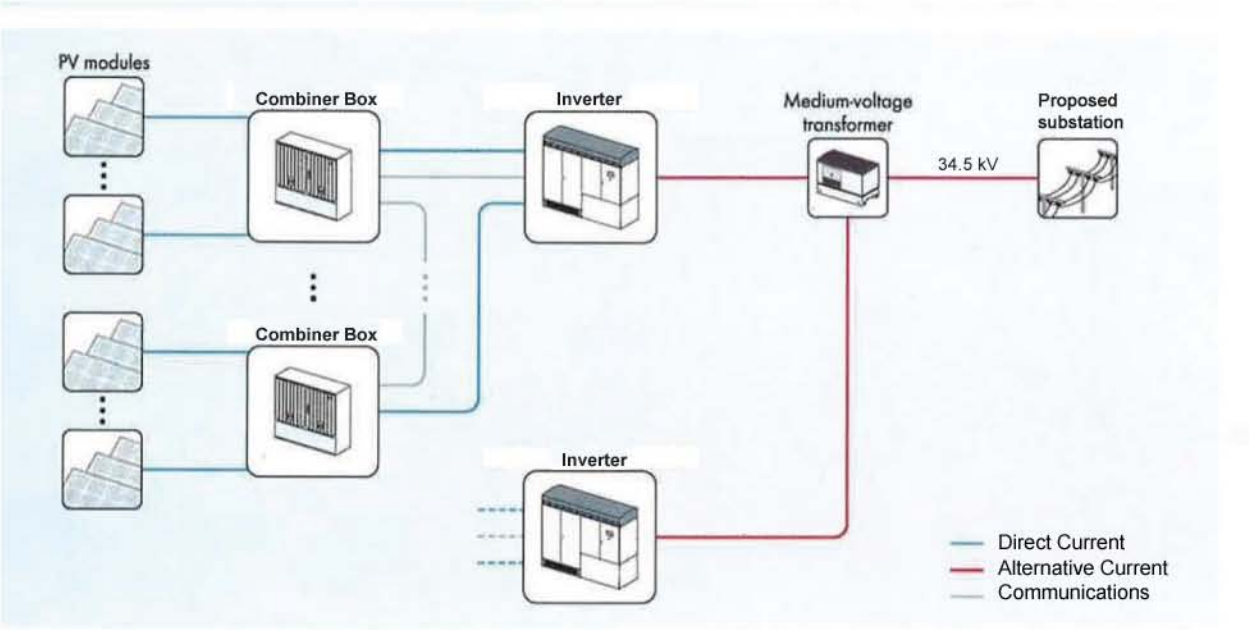
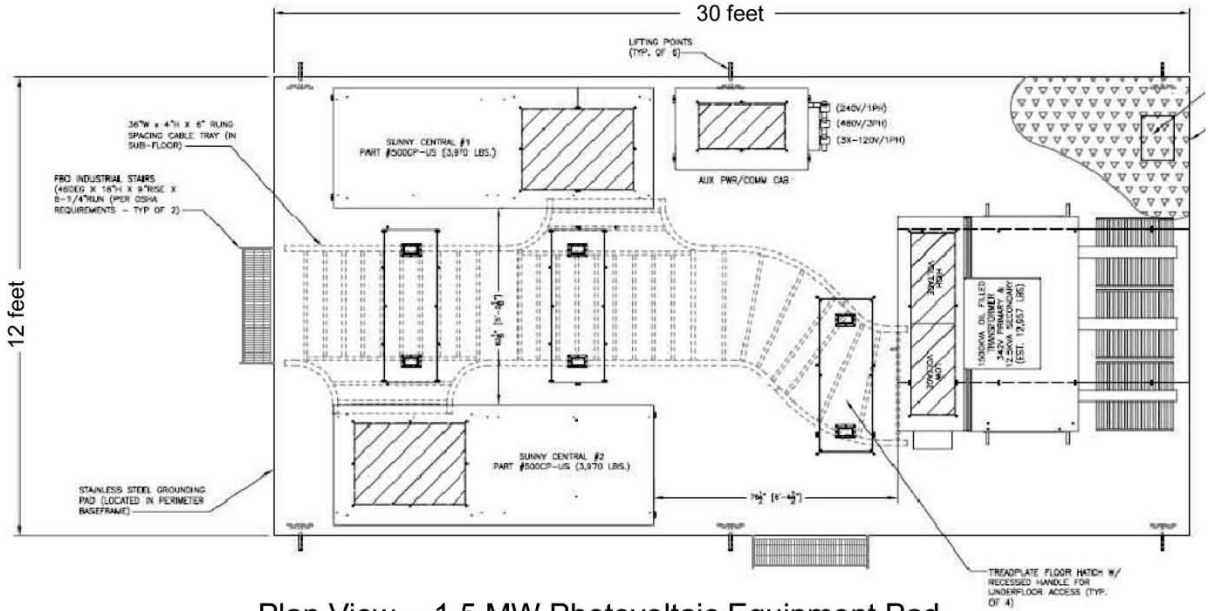
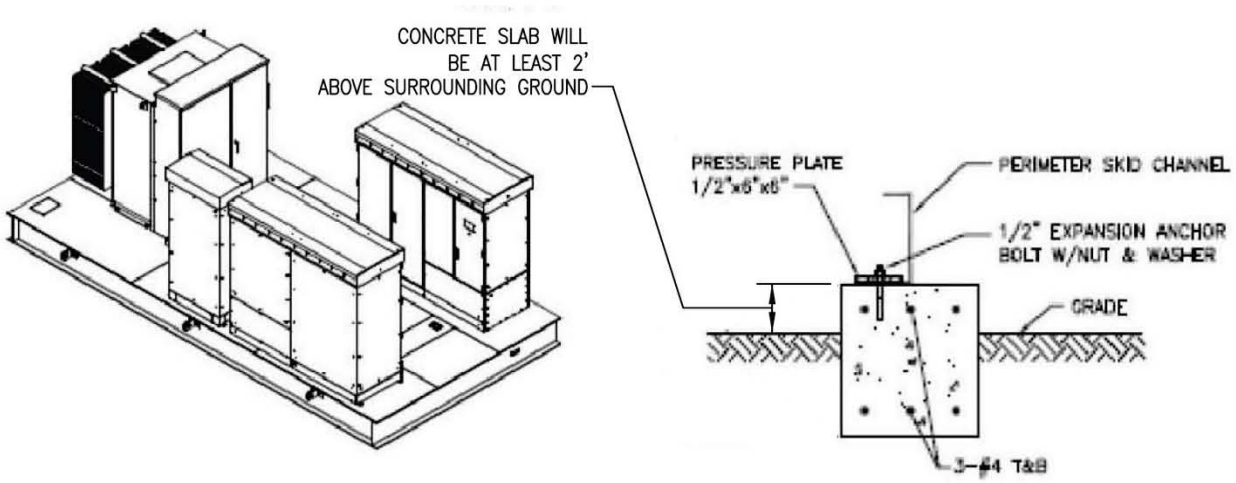


FIGURE 2-5 EQUIPMENT PAD CONTAINING INVERTER AND TRANSFORMER

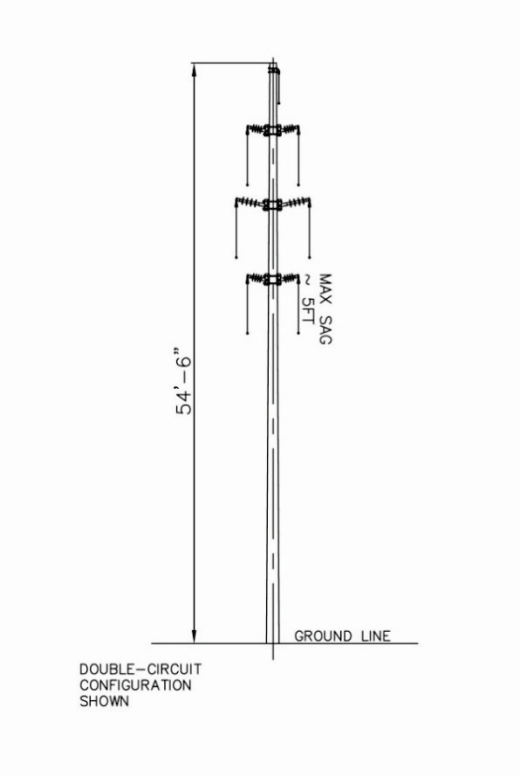


Plan View -- 1.5 MW Photovoltaic Equipment Pad



INVERTER/TRANSFORMER EQUIPMENT PAD

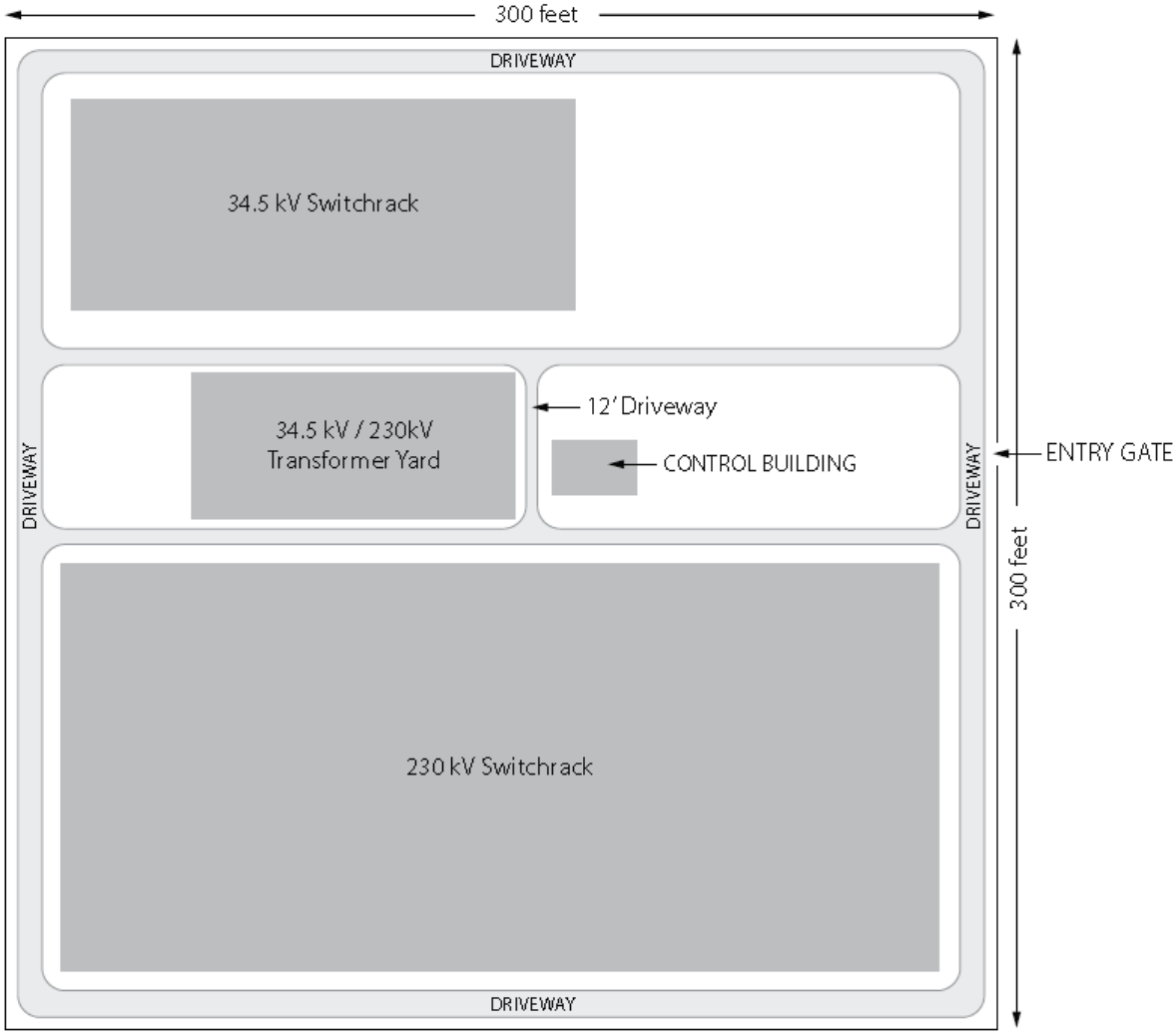
FIGURE 2-6 MEDIUM VOLTAGE OVERHEAD POLES



Substation and Switchgear Pads

The three Project substations (each approximately 300 feet long by 300 feet wide) would collect all the medium-voltage circuits and step up the voltage to 230 kV. The internal arrangement for the substations would include a 34.5 kV switchrack and outdoor breaker assemblies, 230 kV outdoor breakers and switches, a 34.5 kV / 230 kV transformer yard, and a control building (see Figure 2-7). The substation foundations would be a minimum of 24-inches above the highest adjacent ground.

FIGURE 2-7 INTERNAL SUBSTATION ARRANGEMENT



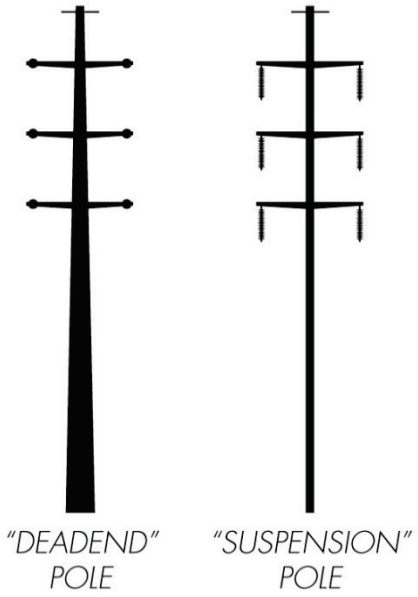
Substation and Switchgear Pads

The Applicant proposes to construct an approximately 8.4-mile-long, 230 kV overhead gen-tie line from the proposed on-site substation located just north of I-10 to the Colorado River Substation that is currently under construction. Approximately 3.6 miles of the gen-tie line would be located within the solar facility. From the southernmost substation to the Colorado River Substation, the gen-tie line would extend another 4.8 miles within a 125-foot-wide ROW (3.8 miles would traverse BLM-managed lands and one mile would traverse private land). The gen-tie line would run parallel to and immediately south of the 500 kV Desert Southwest Transmission Line corridor.

The gen-tie line facilities would include a set of double-circuit tubular steel poles (only one circuit would be strung and the other circuit would be vacant) that are 85 to 125 feet tall with an average tower-to-tower span length of 500 to 800 feet (see Figure 2-8). Structure heights and corresponding span lengths meet Federal Aviation Administration (FAA) requirements for the nearby Blythe Airport. The suspension poles would typically be four to six feet in diameter. At angle or dead-end points along the gen-tie path, larger poles would be required that would be approximately six to ten feet in diameter. The poles would be directly embedded in the soil or set in concrete foundations approximately 20 to 30 feet deep. Concrete foundations, if used, would typically extend one foot laterally beyond the base of the poles, adding up to

two feet to the overall diameter of the permanent footprint of each pole location. Temporary access roads to each structure would be 12 to 16 feet wide, covered with eight inches of gravel over compacted sub-grade, and located within the proposed ROW.

FIGURE 2-8 GEN-TIE LINE POLES



Operation and Maintenance Buildings

Up to two O&M buildings (approximately 3,500 square feet each, enclosed, and no more than 20 feet tall) would provide work space for maintenance staff and storage space for spare parts. The locations of the buildings are shown in Figure 2-1 with the layout and elevations illustrated in Figures 2-9 and 2-10. The buildings shall be constructed with the finished floor a minimum of 24-inches above the highest adjacent ground. The building would include bathroom facilities serviced by a private septic system and would be designated occupancy classification U. A covered outdoor temporary assembly and storage area (80,000 square feet, 25 feet tall) would be directly adjacent to the O&M building(s).

Access Roads

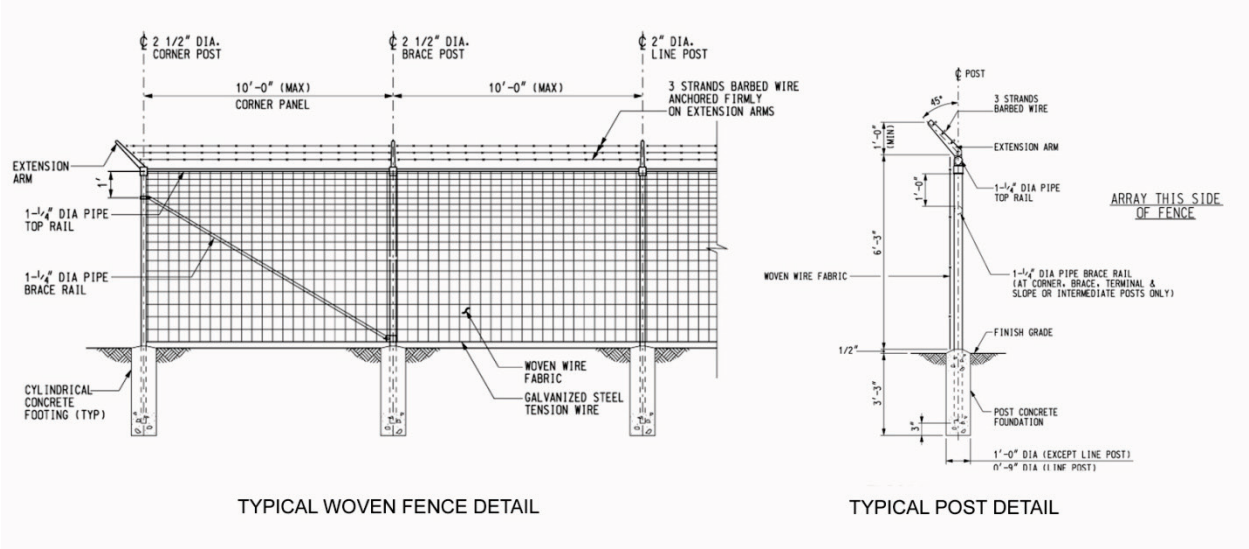
Two access points to the solar facility are planned on Seeley Avenue and Riverside Drive; both accessible from the Neighbors Boulevard off-ramp from I-10 (see Figure 2-1). The primary access roads would be improved at the entrance to the site for 100 feet and would be 16 to 20 feet wide.

Unpaved access roads within the solar field would be 12 feet wide and constructed approximately every 200 to 400 feet to allow access to and maintenance of the solar panels.

Other Infrastructure

The solar facility would be enclosed with fencing that meets National Electric and Safety Code (NESC) requirements for protective arrangements in electric supply stations, such as a seven-foot-tall, equestrian-type wire fence along the perimeter (see Figure 2-11). This type of fence allows smaller wildlife to enter and exit the solar facility site, as well as allows water to flow through. The fence would typically be set 30 feet from the edge of the solar array.

FIGURE 2-11 FENCE DETAILS



2.2.2 Construction

Site Preparation

Since most of the site has nearly level to gently sloping topography, no mass grading would be required. Some of the parcels where facilities and arrays would be located would require light grubbing for leveling and trenching. Access roads would require minimal grading. After grubbing and light grading, construction of staging areas would occur. On-site pre-assembly of trackers would take place in the assembly area.

The PV system proposed for the site can operate on slopes up to nine percent in all directions. Fine grading would only be required for the development of site access. During construction, it is anticipated that a total of up to approximately 1,354 acre-feet (AF) of water (451 AF per year) would be utilized for soil moisture conditioning and dust control (final use numbers will be further refined pre-construction).

Minor demolition of existing site structures (e.g., storage buildings in citrus grove, three on-site residences) would be required.

Installation of the electrical collection system would require excavations to a depth of about three feet for underground electrical circuits, inverter and switchgear enclosure foundations, and transformer foundations. The O&M building foundations would also be excavated to a depth of about three feet.

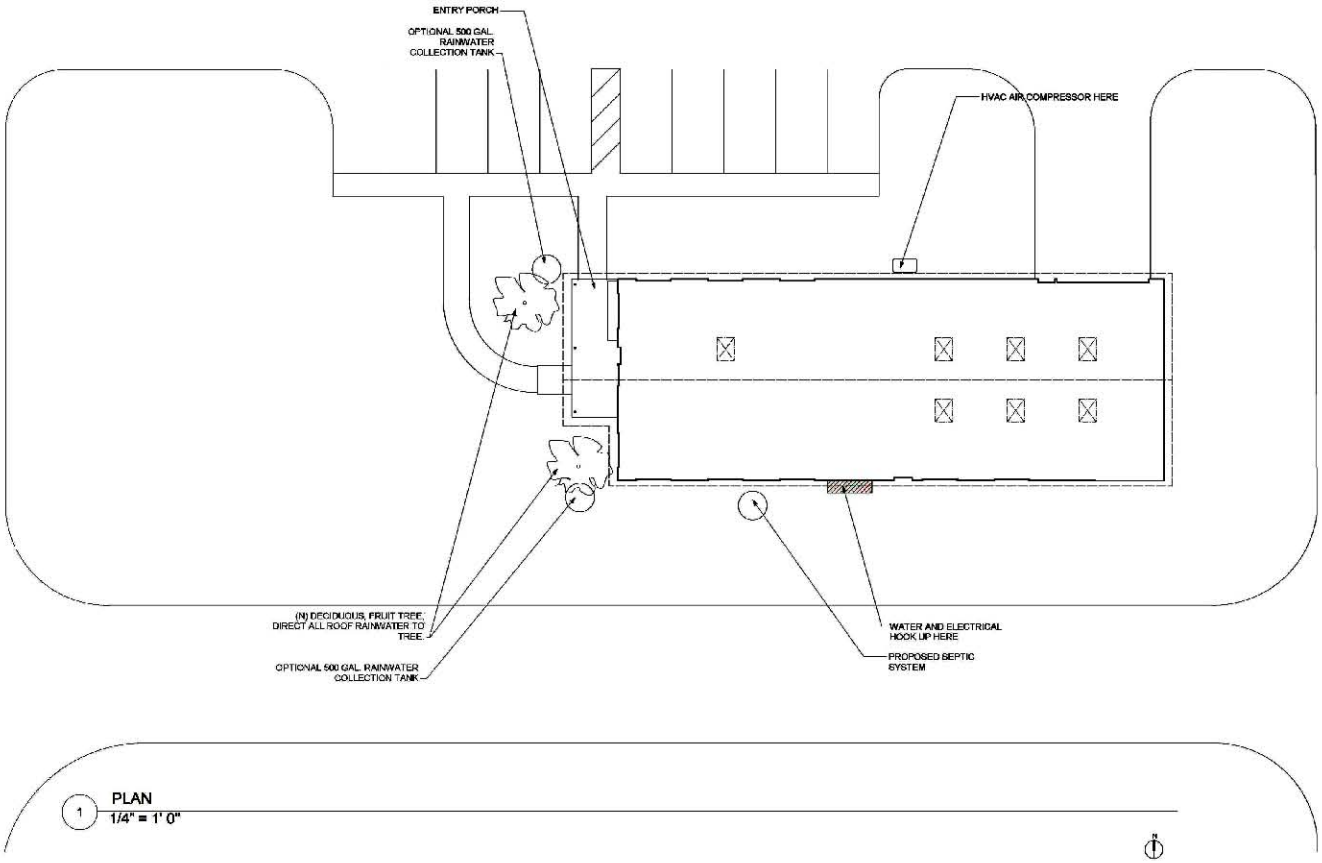


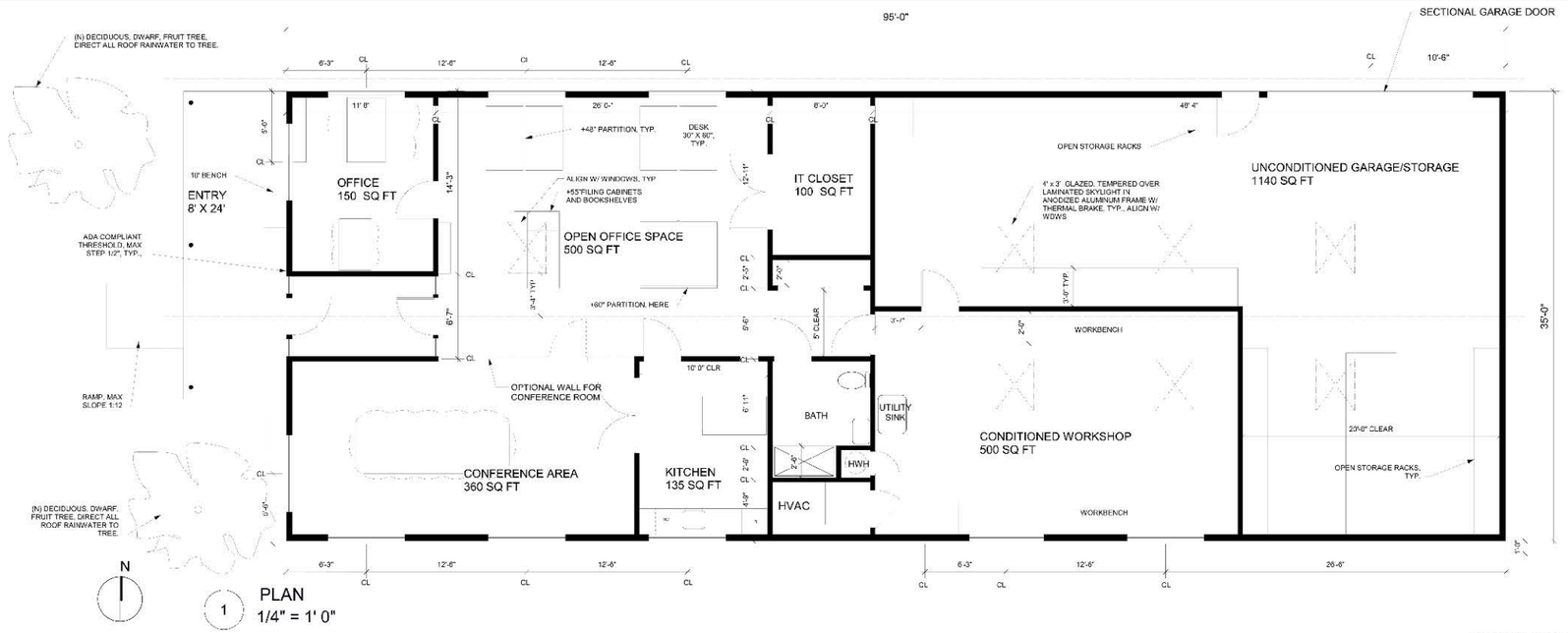
FIGURE 2-9
CONCEPTUAL O&M BUILDING PLAN

BLYTHE MESA SOLAR PROJECT

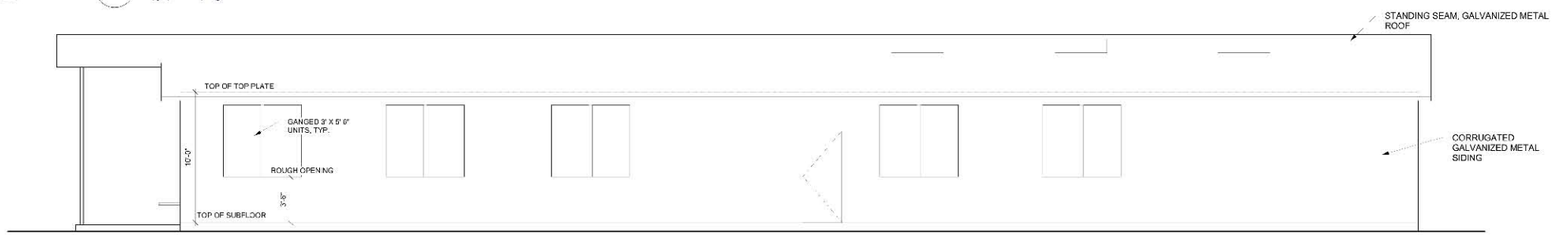
POWER ENGINEERS RENEWABLERESOURCESGROUP

AR062324

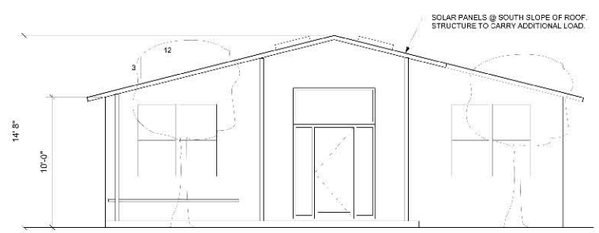
THIS PAGE INTENTIONALLY LEFT BLANK



1 PLAN
1/4" = 1' 0"



2 SOUTH ELEVATION
1/4" = 1' 0"



3 WEST ELEVATION
1/4" = 1' 0"

FIGURE 2-10
CONCEPTUAL O&M LAYOUT AND ELEVATION

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: Sunpower Corp, 2011.

THIS PAGE INTENTIONALLY LEFT BLANK

Construction Activities

To ensure study of the maximum intensity of construction impacts, the Project is studied based upon an assumption that there would be continuous construction activity over a period of approximately three years, which represents the shortest reasonable construction period. The Project may in fact be constructed in several phases at several different times over a longer time frame.

For purposes of the Draft EIR/EA, it is assumed that the Project would be constructed in the following phases, which would occur simultaneously on different portions of the site:

- Development of staging areas and assembly areas, and grading of site access roads.
- Construction of arrays including pile installation, assembly of trackers, mounting of PV panels, and trenching and installation of electrical equipment for arrays.
- Construction of electrical transmission facilities including the construction of three substations, the 230 kV gen-tie line, and up to two O&M buildings.

Staging Areas, Assembly Areas, and Access Roads

Construction staging and material lay-down would be distributed across the solar facility evenly to allow for efficient distribution of components to different parts of the Project. One staging and material lay-down area would typically be set up for every 100 acres of the Project site. These lay-down areas would be temporarily fenced and would cover approximately five acres each. Lay-down areas would be converted to solar arrays as work is completed in the general area. Within the solar field, 12-foot-wide access roads would also be constructed approximately every 200 to 400 feet to allow access to and maintenance of the solar panels.

Array Assembly

Tracker assembly may include up to 25 small gas-powered generators to power welding machines to assemble trackers and construct tracker arrays. Support piles up would be driven into the ground to a depth of eight to twelve feet using a vibration technology to reduce noise impacts. Torque tubes, electrical wire trays, and panels would then be installed on the piles. Concrete foundations for the drive motors would be poured in place, and electrical equipment for the array would be set in place. A tracked backhoe would drive piles. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would place trackers on support tiles. Tracker installation would include small all-terrain vehicles to transport materials and workers on access roads and array aisles.

Substations

Construction of the substations would involve site preparation, clearing of the switchrack sites, and installation of substructures and electrical equipment. Each site would first be cleared and graded, and then security-fenced for the duration of substation construction. Underground Service Alert would be contacted to mark the locations of existing buried utilities in the vicinity. Substation materials and equipment would be delivered to, and stored at, the substation site, as required, during construction. The sites would be graded to maintain current drainage patterns as much as possible.

Each substation would be constructed with conventional grading and construction equipment. Grading would establish the desired site grade, and minor excavation would provide concrete footings for the substation equipment. The substation sites would be graveled with crushed rock for grounding and employee safety purposes.

O&M Buildings

The O&M building areas would be surveyed and staked. A concrete slab would be poured to the dimensions of each building. The prefabricated steel building structures would then be assembled. The

exterior finish would be constructed as the mechanical and electrical systems are built inside. Interior finishing would follow, and final fixtures and equipment would be installed.

Gen-tie Line

The gen-tie line construction would involve the following activities: (1) construction of staging areas for trailers, office personnel, equipment, material staging, lay-down, and employee parking; (2) construction of access roads to the structure locations; (3) pole erection; (4) conductor installation; (5) tension and pulling sites of conductors; and (6) installation of overhead ground/fiber optic communications systems.

Construction Sequence, Equipment, and Workforce

For the purposes of the Draft EIR/EA, construction is anticipated to occur over a three-year period with the construction activities described above occurring simultaneously; peak construction would occur over 24 months. The solar field would be developed in six-month phases, with six blocks constructed at a time (each block 100 acres, for a total of 600 acres at a time). Construction of the substations, gen-tie line, switchyard, and up to two O&M buildings would occur as the arrays are being assembled. The timing and workforce used for each construction activity/phase is illustrated in Table 2-1. After the common facilities (e.g., substations, switchyards, O&M building(s)) are completed in the earlier stages, the workforce would be devoted more to array construction in the later stages.

Approximately 500 daily workers would be present on-site during peak construction. Workers would gain primary access to the site using Seeley Avenue and Riverside Drive off of Neighbors Boulevard. Worker construction traffic would consist of approximately 400 daily vehicle roundtrips (300 employees would travel alone, and 200 employees would carpool). It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region. Anticipated average daily material deliveries would consist of about 20 truck deliveries per day for 24 months. Workers and delivery trucks would access the site using the Neighbors Boulevard off-ramp from I-10. Typical on-site work hours would be from 7:00 a.m. to 6:00 p.m. During the installation period, construction workers are projected to be on-site five days per week, year-round. Due to weather or other major-type delays, times may shift to start as early as 5:00 a.m. and end as late as 8:00 p.m., as well as continue into the weekends. However, in compliance with Noise Ordinance 847, construction within 0.25-mile from a residence would be prohibited during non-typical work hours. Security would be on-site 24 hours per day.

TABLE 2-1 DURATION AND NUMBER OF WORKERS OF EACH CONSTRUCTION PHASE*

CONSTRUCTION ACTIVITY/PHASE	DURATION	WORKERS
Site Preparation/Clearing/Grading	6 months	20
Staging and Assembly Areas (including access roads)	6 months	20
Construction of Solar Array, Substations, O&M Building(s)	24 months	200-500
Installation of 230 kV Gen-tie Line and Fiber Optic Cable	12 months	30
Testing	3 months	20
Clean up/restoration	1 month	20

*Construction would occur over a three-year period with construction activities occurring simultaneously.

During construction, a variety of equipment and vehicles would be operating on the site. Table 2-2 provides a list of the types of equipment and vehicles expected to be involved in each construction phase.

TABLE 2-2 CONSTRUCTION EQUIPMENT BY CONSTRUCTION PHASE

EQUIPMENT	CONSTRUCTION PHASES					
	Site Preparation	Construction of Solar Array	Installation of Gen-tie Line Poles	Fiber Optic Cable	Substation & O&M Building	Clean up & Restoration
Backhoe		X	X		X	
Cranes		X	X	X	X	
Vibratory Post Drivers		X				
Fork Lifts	X	X	X	X	X	
Dozers	X				X	
Excavator	X				X	
Grader	X				X	X
Loaders, Rubber-Tired	X	X	X	X		
Rollers	X				X	
Scrapers	X					
Trenchers		X				
Dump Truck	X	X				
Water Truck	X	X			X	
Concrete Truck	X	X	X			
Flatbed Truck		X	X	X	X	
Light-weight Truck	X	X	X	X	X	
ATV Gator Carts	X	X			X	

2.2.3 Operation and Maintenance

Operation and Maintenance Activities

After the construction phase, the O&M building(s) would serve the Project's approximately 12 permanent full-time employees, which would include one plant manager, five engineers/technicians, and six security staff. Project facilities would be monitored during operating (daylight) hours, even though the Project facilities would be capable of automatic start up, shutdown, self-diagnosis, and fault detection.

The Project would require the use of a water supply to maintain the facility. The solar panels may be cleaned up to two times per year, if necessary to optimize output. Water would also be used to provide fire protection, maintain vegetation, and serve the up to two O&M buildings. No chemicals would be used during cleaning of the solar panels. It is estimated that operational non-potable water requirements would be approximately up to 345 AF/year (with a significant portion going to dust control), as well as less than one AF/year of groundwater for potable use in the up to two O&M buildings (final use numbers will be further refined pre-construction). The Project would coordinate with Gila Farm Land, LLC (landowner) and the Palo Verde Irrigation District to secure water service and supply during operation.

No heavy equipment would be used during normal operation. O&M vehicles would include trucks (pickup and flatbed), forklifts, and loaders for routine and unscheduled maintenance and water trucks for solar panel washing. Large heavy-haul transport equipment may be brought to the solar facility infrequently for equipment repair or replacement.

Maintenance schedules would be developed to arrange periodic maintenance and equipment replacement in accordance with manufacturer recommendations for the life-term of the Project. Solar panels are warranted for 25 years or longer and are expected to have a life of 30 or more years, with a degradation rate of 0.5% per year. Moving parts, such as motors and tracking module drive equipment, motorized circuit breakers and disconnects, and inverter ventilation equipment, would be serviced on a regular basis, and unscheduled maintenance would be performed as necessary.

The solar facility would be secured 24 hours per day by on-site private security personnel and remote security services with motion-detection cameras.

Fire Safety

Solar arrays and PV modules are fire-resistant, as they are constructed largely out of steel, glass, aluminum, or components housed within steel enclosures. As the tops and sides of the panels are constructed from glass and aluminum, PV modules are not vulnerable to ignition from firebrands from wildland fires. In a wildfire situation, the panels would be rotated and stowed in a panel-up noon time position. The rotation of the tracker rows would be controlled remotely via a wireless local area network. All trackers could be rotated simultaneously in a hazard situation. During construction, standard defensible space requirements would be maintained surrounding any welding or digging operations. Fire safety and suppression measures, such as smoke detectors and extinguishers, would be installed and available at the O&M facilities, per code. Interior access roads within the solar facility would be 12 feet wide, which allows sufficient access for fire trucks.

A Fire Management and Protection Plan and Emergency Action Plan would be prepared in coordination with the Riverside County Fire Department or other emergency response organizations to identify the fire hazards and response scenarios that may be involved with operating the solar facility. This would include information on response to accidents involving downed power lines or accidents involving damage to solar arrays and facilities.

Interconnection with Statewide Grid

Power produced by the Project would be conveyed to the statewide electricity grid via a new 230 kV gen-tie line from the Project facilities to the Colorado River Substation approximately 4.5 miles west of the solar facility. The Project has secured an interconnection queue position sufficient for the size of the Project at the Colorado River Substation and has made the necessary reservation deposits to CAISO.

Decommissioning and Repowering

At the end of the energy sales contract term, if the energy buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled. Accordingly, this Draft EIR/EA analyzes the impacts of potential decommissioning and dismantling. If the Project continues to operate, the impacts described in this Draft EIR/EA as the impacts of operation and maintenance would continue indefinitely.

Decommissioning activities would require similar equipment and workforce as construction, but would be less intense. The following activities would be involved:

- Dismantling and removal of all above ground equipment (solar panels, track units, transformers, inverters, substations, O&M building(s), switchyard, etc.)
- Excavation and removal of all above-ground cables
- Removal of solar panel posts
- Removal of roads (both gravel and paved, including the aggregate base)
- Break-up and removal of concrete pads and foundations
- Removal of septic system and leach field
- Dismantling of 34.5 kV distribution lines
- Dismantling of 230 kV gen-tie line
- Scarification of compacted areas

The panels could be sold into a secondary solar PV panel market. It is expected that a robust market for used PV panels will exist in the future because the panels can be used in various configurations and at various scales. Electricity demand is expected to continue to rise and electricity prices are projected to continue their steady increase. Demand for solar energy is rapidly accelerating and is expected to grow for decades to come.

The module's component materials lack toxic metals such as mercury, lead, cadmium telluride, or gallium, and the majority of the components of the solar installation are made of materials that can be readily recycled. A Waste Recycling Plan will be developed for the Project, which will identify: materials that will be generated by construction and development; projected amount of materials; measures and methods that will be taken to recycle, reuse, and or reduce the amount of materials; facilities and haulers; and the target recycling or reduction rate. If the panels can no longer be used in a solar array, the silicon can be recovered, the aluminum resold, and the glass recycled. Other components of the solar installation, such as the tracker structures and mechanical assemblies, can be recycled, as they are made from galvanized steel. Equipment such as drive controllers, inverters, transformers, and switchgear can be either reused or their components recycled. The equipment pads are made from concrete, which can be crushed and recycled. Underground conduit and wire can be removed by uncovering trenches and backfilling when done. The electrical wiring is made from copper and/or aluminum and can be reused or recycled, as well. Following decommissioning and dismantling of the solar facility, the Project site would be made available for reversion to agricultural use.

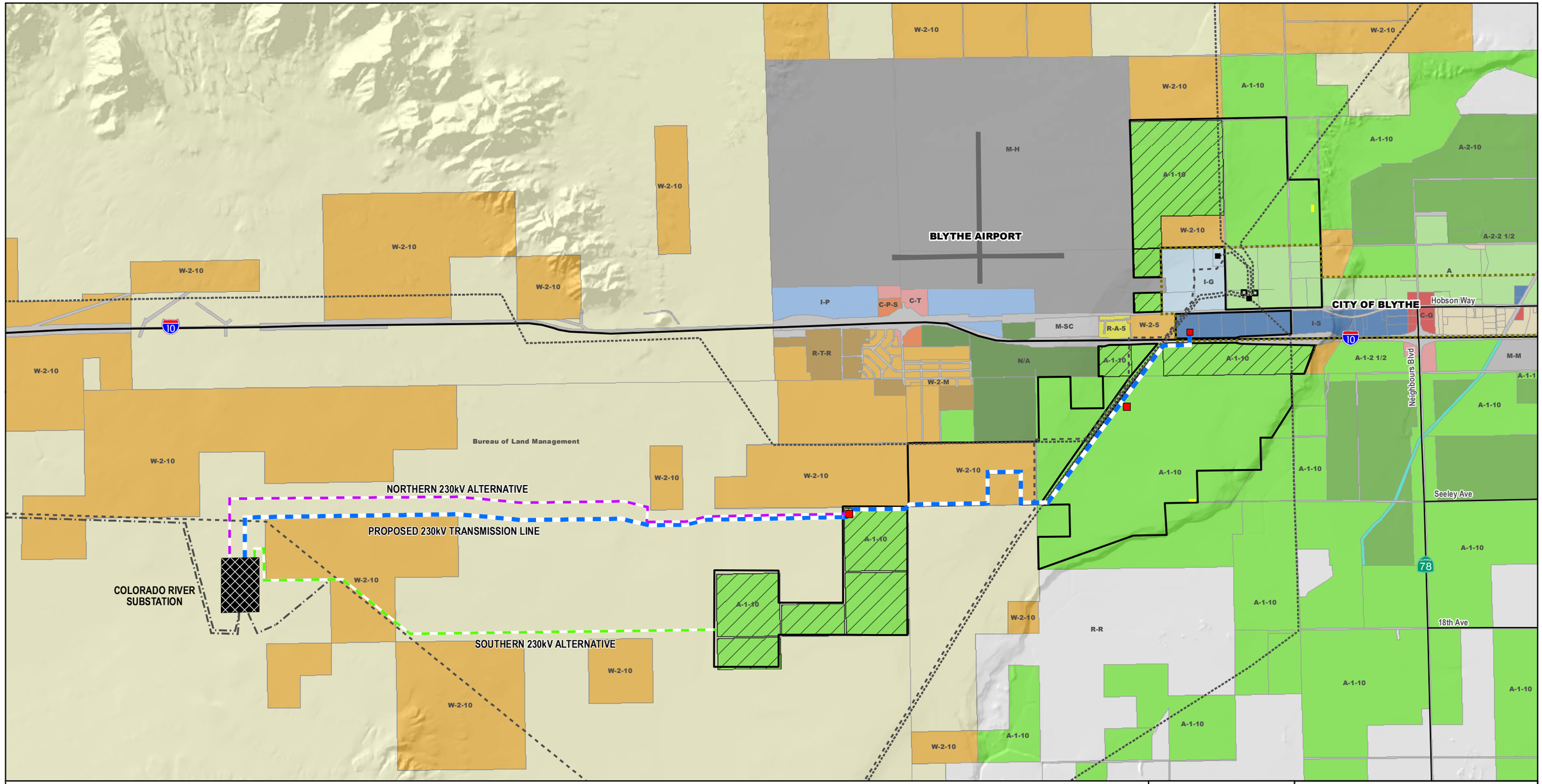
Interim Agricultural-Related Actions

The initial use of the Project site to be permitted under the conditional use permit will be active agricultural production. The Project proposes a unique approach to encouraging continued agricultural use of the site pending construction of the solar plant. The Project proposes (a) to rezone approximately 1,249 acres from W-2-5 (controlled development areas) and N-A to A-1-10 (light Agriculture) (refer to Figure 2-12). This will make zoning on these parcels consistent with the zoning on the rest of the solar facility site (refer to Figure 1-3, *Existing Zoning*, in Chapter 1). Approximately 1,485 acres, all south of I-10 and representing the land not planned to be developed immediately, would be placed in an agricultural preserve and put in a Williamson Act contract (refer to Figure 2-13). These actions are intended to help ensure the continued economic viability of agricultural production until construction of solar facilities. Because these actions would facilitate continued agricultural uses of existing agricultural lands, they would not cause new significant impacts and therefore are not addressed in detail in this Draft EIR/EA. However, as a result of the interim actions, the Project includes potential cancellation of the Williamson Act Contract and agricultural preserve, which is addressed in the Agricultural Resources section of this Draft EIR/EA.

2.2.4 Best Management Practices

For the purposes of this Draft EIR/EA, the Best Management Practices (BMPs) listed in Table 2-3 below would reduce the environmental impacts associated with the proposed Project. Although BMPs lessen potential impacts by avoiding, minimizing, or reducing/eliminating impacts, BMPs are distinguished from mitigation measures in this Draft EIR/EA because BMPs are: 1) requirements of existing policies, practices, and measures required by law, regulation, or local policy; 2) ongoing, regularly occurring practices; and 3) not specific to this proposed Project. In other words, the BMPs identified in this Draft EIR/EA are inherently part of the proposed Project and are not additional mitigation measures proposed as a result of the CEQA significance findings. The BMPs listed are measures that would lessen environmental impacts and are referenced throughout Chapter 4 of this Draft EIR/EA.

THIS PAGE INTENTIONALLY LEFT BLANK



Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Project Substation
- Operations and Maintenance Building

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Zoning - County of Riverside
- Proposed Zoning Change (to A-1-10)
- A-1-1
- A-1-10
- A-1-2 1/2
- A-2-10
- A-2-2 1/2
- C-P-S
- C-T
- I-P
- M-H
- M-M
- M-SC
- N/A
- R-A-5
- R-R
- R-T-R
- W-1
- W-2-10
- W-2-2 1/2
- W-2-5
- W-2-M

Zoning - City of Blythe
- A
- C-G
- I-G
- I-S
- R-R

Jurisdiction
- City of Blythe
- Bureau of Land Management

N

0 4,000 8,000
Feet
1:48,000



FIGURE 2-12
PROPOSED ZONING CHANGES

BLYTHE MESA SOLAR PROJECT

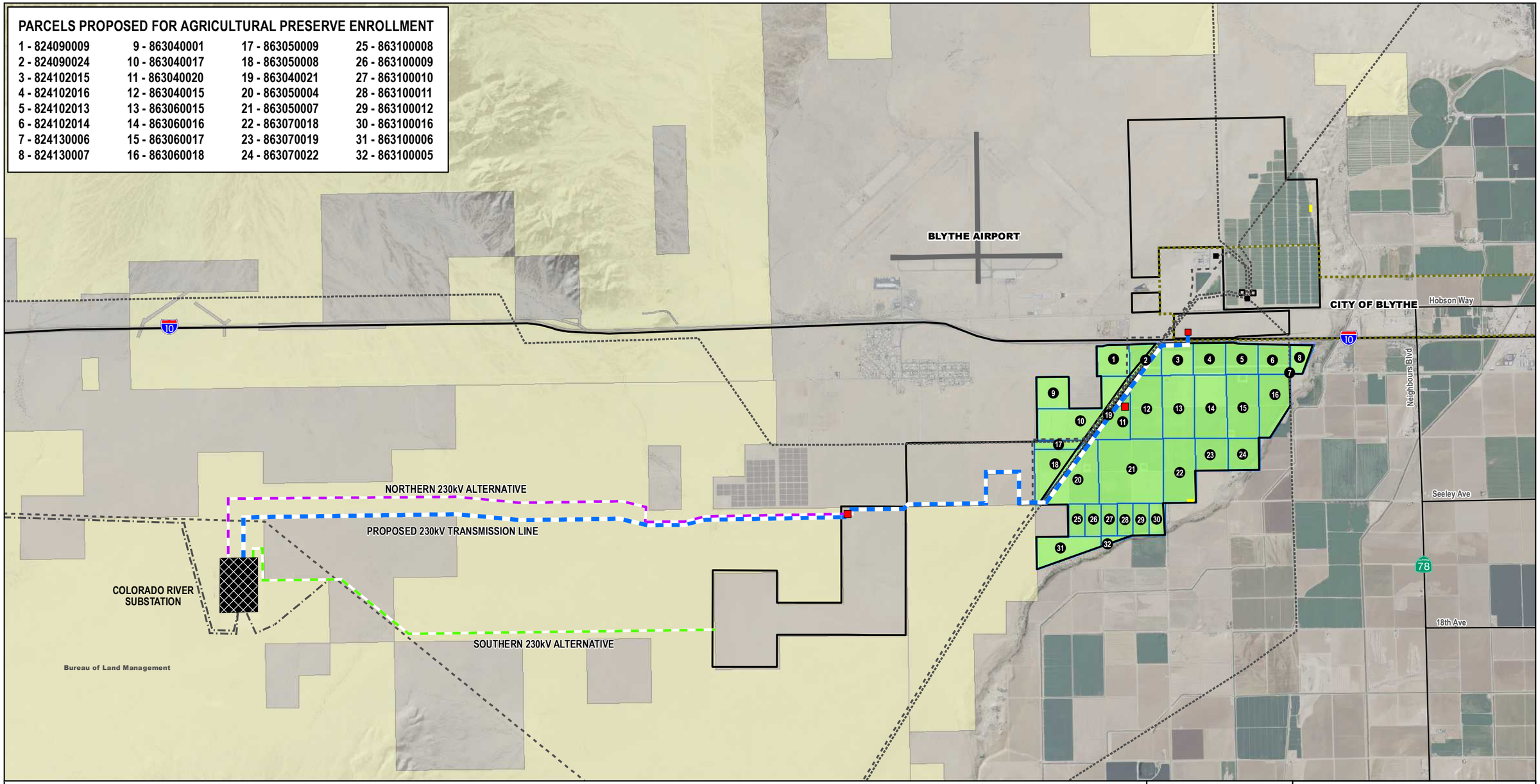
POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062334

THIS PAGE INTENTIONALLY LEFT BLANK

PARCELS PROPOSED FOR AGRICULTURAL PRESERVE ENROLLMENT

1 - 824090009	9 - 863040001	17 - 863050009	25 - 863100008
2 - 824090024	10 - 863040017	18 - 863050008	26 - 863100009
3 - 824102015	11 - 863040020	19 - 863040021	27 - 863100010
4 - 824102016	12 - 863040015	20 - 863050004	28 - 863100011
5 - 824102013	13 - 863060015	21 - 863050007	29 - 863100012
6 - 824102014	14 - 863060016	22 - 863070018	30 - 863100016
7 - 824130006	15 - 863060017	23 - 863070019	31 - 863100006
8 - 824130007	16 - 863060018	24 - 863070022	32 - 863100005



Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Project Substation
- Operations and Maintenance Building

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Agricultural Preserve
- Agricultural Preserve Enrollment
- Agricultural Preserve Enrollment Parcel Boundary

Jurisdiction
- City of Blythe
- Bureau of Land Management

N

0 4,000 8,000
Feet
1:48,000



FIGURE 2-13
AGRICULTURAL PRESERVE ENROLLMENT

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062336

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 2-3 BEST MANAGEMENT PRACTICES

BMP	DESCRIPTION
BMP-1	**Drainage, Erosion, and Sedimentation Control Plan**. As part of the County of Riverside's Conditional Use Permit (CUP) requirements, a Drainage, Erosion, and Sedimentation Control Plan would be developed for the Project. The plan would address the drainage, erosion, and sediment control requirements to support all activities associated with construction, operation, maintenance, and decommissioning of the Project. For example, any stockpiles created would be kept on-site, with an upslope barrier in place to divert runoff. Stockpiles would be sprayed with water, covered with tarpaulins, and/or treated with appropriate dust suppressants, especially in preparation for high wind or storm conditions. Certified weed-free straw bale barriers would be installed to control sediment in runoff water; straw bale barriers would be installed only where sediment-laden water can pond, thus allowing the sediment to settle out. Topsoil from the site would be stripped, stockpiled, and stabilized before excavating earth for facility construction. Topsoil would be segregated and spread on freshly disturbed areas to reduce color contrast and aid rapid revegetation.
BMP-2	**Stormwater Pollution Prevention Plan.** In compliance with requirements of the National Pollutant Discharge Elimination System (NPDES) permit, a Stormwater Pollution Prevention Plan (SWPPP) would be developed and prepared for the Project to ensure that protection of water quality and soil resources is consistent with County and State regulations. The plan would identify site surface water runoff patterns and include measures that prevent excessive and unnatural soil deposition and erosion throughout and downslope of the Project site and Project-related construction areas, and would also include measures for non-stormwater discharge and waste management. The SWPPP would cover all activities associated with the construction of the Project, including clearing, grading, and other ground disturbance such as stockpiling or excavation erosion control. The plan would prevent off-site migration of contaminated stormwater, changes in pre-Project storm hydrographs, or increased soil erosion.
BMP-3	**Fugitive Dust Abatement Plan.** As required by the Mojave Desert Air Quality Management District Rule 403, a Fugitive Dust Abatement Plan would be prepared to address fugitive dust emissions during Project construction, operation, maintenance, and decommissioning. The plan would include measures to minimize fugitive dust emissions from wrecking, excavation, grading, clearing of land, and solid waste disposal operations, and would take every reasonable precaution to prevent visible particulate matter from being deposited upon public roadways as a direct result of operations. During construction, all unpaved roads, disturbed areas (e.g., areas of scraping, excavation, backfilling, grading, and compacting), and loose materials generated during Project construction activities would be watered as frequently as necessary to minimize fugitive dust generation. However, the amount of water will be minimized each time to prevent temporarily ponding water that may occur as a result of the fugitive dust plan. In water-deprived locations, water spraying would be limited to active disturbance areas only, and non-water-based dust control measures would be implemented in areas with intermittent use or use that is not heavy, such as stockpiles or access roads. Alternatively, chemical dust suppressants or durable polymeric soil stabilizers could be used. The dust suppression measures would consider the sensitivity of wildlife to the windborne dispersal of fugitive dust containing dust suppressants and the potential impact on future reclamation.
BMP-4	**Fire Management and Protection Plan.** As required by existing law (Title 8 California Code of Regulations [CCR] Section 3221), a Fire Management and Protection Plan would be developed in consultation with the Riverside County Fire Department to identify potential hazards and accident scenarios that would exist at the facility during construction, operation, maintenance, and decommissioning of the Project. The Plan would include the identification of the following: potential fire hazards and ignition sources; proper handling and storage of potential fire hazards; control of potential ignition sources; persons responsible for equipment and systems maintenance; location of portable fire extinguishers; automatic sprinkler fire suppression system; water-spray fire system; coordination with local fire department; and recordkeeping requirements.

BMP	DESCRIPTION
BMP-5	**Emergency Action Plan.** As required by Title 8 CCR Section 3220, the Project would develop a site-specific operations phase Emergency Action Plan. The operations Emergency Action Plan would address potential emergency situations requiring emergency response and/or planned evacuation. The plan would describe accident scenarios, evacuation routes, alarm systems, points of contact, assembly areas, responsibilities, and other actions to be taken in the event of an emergency. In particular, the plan would describe arrangements with local emergency response agencies.
BMP-6	**Lighting Plan.** A lighting plan would be prepared that documents how lighting will be designed and installed to minimize night-sky impacts during facility construction and operations. Lighting for facilities will not exceed the minimum number of lights and brightness required for safety and security and will not cause excessive reflected glare. Light fixtures will not spill light beyond the Project boundary. Where feasible, vehicle-mounted lights will be used for night maintenance activities. Wherever feasible, consistent with safety and security, lighting will be kept off when not in use. The lighting plan will include a process for promptly addressing complaints about lighting.
BMP-7	**Trash Abatement Plan**. A Trash Abatement Plan shall be developed that focuses on containing trash and food in closed and secure sealable containers, with lids that latch, and removing them periodically to reduce their attractiveness to opportunistic species, such as common ravens, coyotes, and feral dogs, that could serve as predators of native wildlife and special-status animals. The Plan would also establish a regular litter pick-up procedure within and around the perimeter of the Project site, and removal of construction-related trash containers from the Project site when construction is complete.
BMP-8	**Cleanup and Restoration.** Upon completion of construction activities, all unused materials and equipment shall be removed from the Project site. All construction equipment and refuse including, but not limited to, wrapping material, cables, cords, wire, boxes, rope, broken equipment parts, twine, strapping, buckets, and metal or plastic containers shall be removed from the site and disposed of properly after completion of construction. Any unused or leftover hazardous products shall be properly disposed of off-site.
BMP-9	**Hazardous materials.** As required by the Clean Air Act, Section 401 of the Clean Water Act, the Toxic Substance Control Act, and the Hazardous Materials Transportation Act, all vehicles and equipment must be in proper working condition to ensure that there is no potential for fugitive emissions or accidental release of motor oil, fuel, antifreeze, hydraulic fluid, grease, or other hazardous materials. Equipment must be checked for leaks prior to operation and repaired as necessary. Refueling of equipment must take place on existing paved roads, where possible, and not within or adjacent to drainages. Hazardous spills must be cleaned up immediately. Contaminated soil would be disposed of at an approved off-site landfill, and spills reported to the permitting agencies. Service/maintenance vehicles should carry appropriate equipment and materials to isolate and remediate leaks or spills, and an on-site spill containment kit for fueling, maintenance, and construction will be available. Cleaning of construction vehicles at commercial car washes should be considered rather than washing vehicles on the Project site so that dirt, grease, and detergents are treated effectively at existing facilities designed to handle those types of wastes.

BMP	DESCRIPTION
BMP-10	**Integrated Weed Management Plan.** In compliance with the Federal Noxious Weed Act and the Plant Protection Act, a Project-specific integrated weed management plan for the control of noxious weeds and invasive plant species would be prepared. The plan would identify presence, location, and abundance of weed species in the Project area and surrounding area adjacent to the Project, as well as identify suppression and containment measures to prevent the spread of weed species and introduction of weed species. Prevention techniques would include: limiting disturbance areas during construction to the minimum required to perform work; limiting ingress and egress to defined routes; maintaining vehicle wash and inspection stations; and closely monitoring the types of materials brought on-site to minimize the potential for weed introduction. During operations, noxious and invasive weed management will be incorporated as a part of mandatory site training for groundskeepers and maintenance personnel. Training will include weed identification and the impacts on agriculture, wildlife, and fire frequencies. Training will also cover the importance of preventing the spread of noxious weeds and of controlling the proliferation of existing weeds.
BMP-11	**Project structures, gen-tie line, and building surfaces.** Project facilities would be sited to ensure that there is adequate space (i.e., setbacks of no less than 100 feet) between solar facilities and natural washes. These setbacks would preserve and maintain the natural washes' hydrological functions. The color and finish of Project structure and building surfaces that are visible to the public will be designed to ensure minimal visual intrusion, contrast, and glare. Grouped structures will be painted the same color to reduce visual complexity and color contrast. Solar panel backs will be color-treated to reduce visual contrast with the landscape setting. Materials, coatings, or paints having little or no reflectivity will be used wherever possible. The visual color contrast of graveled surfaces will be reduced with approved color treatment practices.
BMP-12	**Gen-tie lines.** Gen-tie line support structures and other facility structures shall be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This design would also reduce the potential for increased predation of special-status species, such as the desert tortoise. Mechanisms to visually warn birds (permanent markers or bird flight diverters) shall be placed on gen-tie lines at regular intervals to prevent birds from colliding with the lines (APLIC 2006 and USFWS 2010). To the extent practicable, the use of guy wires shall be avoided because they pose a collision hazard for birds and bats. Necessary guy wires shall be clearly marked with bird flight diverters to reduce the probability of collision. Shield wires shall be marked with devices that have been scientifically tested and found to significantly reduce the potential for bird collisions. Gen-tie lines shall utilize non-specular conductors and non-reflective coatings on insulators.
BMP-13	**Ground and surface disturbance.** Construction boundaries would be clearly delineated to minimize areas of ground and surface disturbance. Ground-disturbing activities shall be minimized, especially during the rainy season. To the maximum extent possible, construction-related activities (such as vehicle and foot traffic) would avoid areas with intact biological soil crusts. For cases in which impacts cannot be avoided, soil crusts would be salvaged and restored on the basis of recommendations by the County of Riverside and BLM once construction has been completed. Existing rocks, vegetation, and drainage patterns shall be preserved to the maximum extent possible. No paint or permanent discoloring agents shall be applied to rocks or vegetation (to indicate surveyor construction activity limits or for any other purpose). All stakes and flagging shall be removed from the construction area and disposed of in an approved facility. Where feasible, brush-beating, mowing, or use of protective surface matting rather than removing vegetation shall be employed. Clearing and disturbing of sensitive areas (e.g., steep slopes and natural drainages) and other areas shall be avoided outside the construction zone. Surface disturbance would be minimized by utilizing undulating surface disturbance edges; stripping, salvaging, and replacing topsoil; using contoured grading; controlling erosion; using dust suppression techniques; and restoring exposed soils to their original contour and vegetation.

BMP	DESCRIPTION
BMP-14	**Travel and traffic.** Vehicular traffic on-site shall be confined to existing or designated travel routes and designated work areas. Access to the construction site and staging areas shall be limited to authorized vehicles and only through the designated roads. The extent of habitat disturbance during construction shall be reduced by keeping vehicles on access roads and minimizing foot and vehicle traffic through undisturbed areas. To the extent practical, travel shall be limited to stabilized roads. Road maintenance activities shall avoid blading existing forbs and grasses in ditches and adjacent to roads. Abandoned roads and roads no longer needed shall be subsoiled to increase infiltration and reduce soil compaction, then recontoured and revegetated. Construction traffic shall avoid unpaved surfaces to the extent practical (to reduce the risk of compaction) and reduce speed to lessen fugitive dust emissions. On unpaved or unstabilized surfaces within the construction site, speed limits (e.g., 20 miles per hour [mph]) shall be posted with visible signs and enforced to minimize airborne fugitive dust. Project vehicle speeds shall be limited in areas occupied by special-status animal species. Traffic shall stop to allow wildlife to cross roads. Shuttle vans or carpooling shall be used to reduce the amount of traffic on access roads. Workers shall be trained to comply with the speed limit, use good engineering practices, minimize the drop height of materials, and minimize the number and extent of disturbed areas. The Project developer shall enforce these requirements.
BMP-15	**New access roads and parking lots.** New access roads shall be designed and constructed to the appropriate road design standards, such as those described in BLM Manual 9113 or County standards, whichever is applicable. New access roads shall be designed to follow natural land contours in the Project area and avoid existing desert washes. The specifications and codes developed by the United States Department of Transportation (DOT) and County of Riverside Transportation Department are also to be taken into account. Primary access roads and parking lots shall be surfaced with aggregate that is hard enough that vehicles cannot crush it and thus cause dust or compacted soil conditions. Paving may also be used on access roads and parking lots. Alternatively, chemical dust suppressants or durable polymeric soil stabilizers would be used on these locations.
BMP-16	**Diesel engines.** All diesel engines used in the facility would be fueled only with ultra-low sulfur diesel with a sulfur content of 15 parts per million (ppm) or less. The Project would require use of construction diesel engines with a rating of 50 horsepower (hp) or higher that meet, at a minimum, the Tier 2 California Emission Standards for Off-Road Compression Ignition Engines, as specified in the California Code of Regulations, Title 13, Section 2423(b)(1), unless such engines are not available. Equipment meeting Tier 3 standards shall be used as feasible. If a Tier 2 engine is not available for off-road equipment larger than 100 hp, an engine equipped with retrofit controls to reduce exhaust emissions of nitrogen oxides (NO_x) and diesel particulate matter to no more than Tier 2 levels, may be used; however documentation discussing attempts to utilize Tier 3 vehicles must be provided to the County. Regulatory agencies may determine that use of such devices is not practical when: There is no available retrofit control device verified by either the California Air Resources Board (CARB) or the United States Environmental Protection Agency (EPA) to control engines in question to Tier 2 equivalent emission levels and the retrofitted or Tier 1 engines use the highest level of available control technology. The construction equipment is intended to be on-site for five days or less. It can be demonstrated there is a good faith effort to comply with the recommendation and that compliance is not practical. The idling time of diesel equipment would be limited to no more than 10 minutes, unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).

BMP	DESCRIPTION
BMP-17	**High wind conditions.** In compliance with Mojave Desert Air Quality Management District (MDAQMD) Rule 403 criteria, all soil-disturbing activities and travel on unpaved roads must be suspended during periods of high winds, with the exception of those trips necessary to maintain the facility and prevent property damage. A 25 mph wind speed has been determined on the basis of soil properties identified during site characterization. Monitoring of the wind speed would be required at the site during construction, operation, maintenance, and decommissioning.
BMP-18	**Noise.** The Project would minimize construction- and operation-related noise levels to minimize impacts to wildlife and nearby residents.
BMP-19	**Plants and wildlife.** In compliance with the California Fish and Game Code while on the Project property, workers or visitors would be prohibited from: feeding wildlife; moving live, injured, or dead wildlife off roads, ROWs, or the Project site; bringing domestic pets to the Project site; collecting native plants; and harassing wildlife. Areas where wildlife could hide or be trapped (e.g., open trenches, sheds, pits, uncovered basins, and laydown areas) would be covered. If the trenches or excavations cannot be covered, a ramp that will sufficiently allow wildlife to escape shall be placed into the trench or excavated area, or exclusion fencing (i.e., silt fencing) shall be installed around the trench or excavation to prevent entrapment of wildlife. Open trenched, or other excavations that could entrap wildlife, shall be inspected by the qualified biologists daily and immediately before backfilling. For example, an uncovered pipe that has been placed in a trench should be capped at the end of each workday to prevent animals from entering the pipe. If a special-status species is discovered inside a component, that component must not be moved, or, if necessary, moved only to remove the animal from the path of activity, until the animal has escaped. As open trenches could impede the seasonal movements of large game animals and alter their distribution, they would be backfilled as quickly as possible. Open trenches could also entrap smaller animals; therefore, escape ramps would be installed along open trench segments at distances identified in the applicable land use plan or by the best available information and science. If traffic is being unreasonably delayed by wildlife in roads, personnel would contact the Project biologist, who will take any necessary action. Any vehicle-wildlife collisions would be immediately reported to the Project biologist. Observations of potential wildlife problems, including wildlife mortality, would be immediately reported to the BLM or other appropriate agency authorized officer.
BMP-20	**Waste Recycling Plan**. Prior to issuance of a grading and building permit, a Waste Recycling Plan shall be submitted to the Riverside County Water Management Department for approval. The plan shall identify: materials (i.e., cardboard, concrete, asphalt, wood) that will be generated by construction and development; projected amounts of materials; measures/methods that will be taken to recycle, reuse, and/or reduce the amount of materials; the facilities and/or haulers; and the target recycling or reduction rate. During Project construction, the construction site shall have, at a minimum, two bins: one for waste disposal and the other for recycling of construction and demolition materials. An accurate record keeping system of recycling construction and demolition recyclable materials and solid waste disposal shall also be established.

2.3 Alternatives Analyzed in Detail

2.3.1 CEQA and NEPA Requirements for Alternatives

CEQA and NEPA both require consideration of a reasonable range of alternatives to the proposed Project that have the potential to feasibly attain most of the basic objectives of the Project or meet the federal purpose and need. In addition, CEQA requires the consideration of how to avoid or substantially lessen any of the significant or adverse effects caused by the Project. The CEQA and NEPA requirements for the identification of project alternatives are described below.

CEQA Guidelines (Section 15126.6) state the following:

(a) An EIR [Environmental Impact Report] shall describe a range of reasonable alternatives to the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives.

(b) The discussion of alternatives shall focus on alternatives to the project or its location which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives would impede to some degree the attainment of the project objectives, or would be more costly.

(c) The EIR should briefly describe the rationale for selecting the alternatives to be discussed. The EIR should also identify any alternatives that were considered by the lead agency but were rejected as infeasible during the scoping process and briefly explain the reasons underlying the lead agency's determination. Among the factors that may be used to eliminate alternatives from detailed consideration in an EIR are: (i) failure to meet most of the basic project objectives, (ii) infeasibility, or (iii) inability to avoid significant environmental impacts.

(d) The EIR shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project.

(e) The EIR shall include the evaluation of the "No project" alternative.

(f) The alternatives shall be limited to ones that would avoid or substantially lessen any of the significant effects of the project. Of those alternatives, the EIR need examine in detail only the ones that the lead agency determines could feasibly attain most of the basic objectives of the project. The range of feasible alternatives shall be selected and discussed in a manner to foster meaningful public participation and informed decision making.

Under NEPA, a federal agency undertaking a "major Federal action" significantly affecting "the quality of the human environment" must prepare an EIS. 42 United States Code [U.S.C.] § 4332(2)(C). As an initial matter, however, an agency can prepare a less detailed EA to assess the need for an EIS (40 CFR Part 1501.4(b)). Based on the conclusions in the EA, the reviewing agency may determine that in lieu of an EIS, it should issue a finding of no significant impact ("FONSI")." *Id.* § 1501.4(e). The Council on Environmental Quality (CEQ) regulations (40 CFR Part 1508.9(b)) further require that an EA shall include brief discussions of the need for the proposal; of alternatives as required by Section 102(2)(E); of the environmental impacts of the proposed action and alternatives; and a listing of agencies and persons consulted. Additionally, BLM NEPA Handbook H-1790-1 Section 8.3.4.2, *Alternatives in an EA,* provides guidance on developing a range of alternatives to permit a reasoned choice among alternatives that meet the purpose and need for the action.

The federal and State lead agencies identified the alternatives below to be carried forward and analyzed in this Draft EIR/EA. Figure 1-1 illustrates the proposed Project and alternative 230 kV gen-tie line alignments.

To provide for a direct comparison to the Project, each action alternative incorporates the Best Management Practices applicable to the Project, and the interim agricultural-related actions that are

proposed by the Project, resulting in potential Williamson Act Contract and future agricultural preserve and Williamson Act Contract cancellation before construction would occur. Also, each of the action alternatives proposes a similarly condensed construction schedule, to ensure that the most intense level of construction-related impacts is studied.

2.3.2 Alternative 2: No Project/No Action Alternative

The No Project/No Action Alternative must be evaluated under CEQA and NEPA. Under the No Project/No Action Alternative, the construction of a solar generating facility and associated infrastructure would not occur. This alternative discusses existing conditions as well as what would be reasonably expected to occur in the foreseeable future if the Project was not approved and did not take place. The construction of a new gen-tie line and the addition of solar array facilities would not occur. Other transmission lines would likely be constructed in or near the transmission corridor. Current, ongoing operation and maintenance activities associated with the agricultural use of the Project site would continue.

2.3.3 Alternative 3: Northern Alternative 230 kV Gen-tie Line

Similar to Alternative 1 (proposed Project), Alternative 3 would include the interim agricultural-related actions, and the construction, operation, maintenance, and potential decommissioning of an up to 485 MW solar PV electrical generating facility and associated infrastructure. It would occupy a total of 3,665 acres and would utilize the same solar facility site as the proposed Project. The fenced-in solar PV electric generation facility would occupy approximately 3,587 acres on privately-owned land under the jurisdiction of the County, and approximately 334 acres located within the City of Blythe. The primary difference between Alternatives 1 and 3 is the location of the 230 kV gen-tie line that extends outside of the solar facility site to the Colorado River Substation; the same 230 kV gen-tie alignment within the solar facility site would be utilized for both Alternatives 1 and 3. Both Alternatives 1 and 3 would be located within the Riverside East SEZ; however, Alternative 3 would be located to the north and within a 125-foot ROW entirely on BLM-managed lands. Under this alternative, the total length of the 230 kV gen-tie line both on-site and off-site would be 8.8 miles; 3.6 miles would be located on private lands within the solar facility site boundary and 5.2 miles would be located entirely off-site on BLM-managed lands. The BLM portion of the ROW would total 78 acres. Similar to Alternative 1, at the end of the energy sales contract term of Alternative 3, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled. Following decommissioning and dismantling of the solar facility, the Alternative 3 site would be made available for reversion to agricultural use.

2.3.4 Alternative 4: Southern Alternative 230 kV Gen-tie Line

Also similar to Alternative 1, Alternative 4 would include the interim agricultural-related actions, and the construction, operation, maintenance, and potential decommissioning of an up to 485 MW solar PV electrical generating facility and associated infrastructure. Alternative 4 would occupy a total of 3,647 acres and would utilize the same solar facility site location as the proposed Project. The fenced-in solar PV electric generation facility would occupy approximately 3,587 acres on privately-owned land under the jurisdiction of the County, and approximately 334 acres located within the City of Blythe. The primary difference between Alternatives 1 and 4 is the location of the 230 kV gen-tie line that extends between the solar facility site and the Colorado River Substation. Under Alternative 4, the gen-tie line would exit the southwestern portion of the solar facility site and extend approximately four miles west to the Colorado River Substation within a 125-foot ROW. To facilitate this alignment, an additional 10,000 feet of 230 kV gen-tie line would need to be built on the solar facility site extending south from the proposed substation 3 and angling west to the site boundary. As illustrated on Figure 1-1, Project Area, the gen-tie line would continue westerly off-site across 3.4 miles of BLM-managed lands and 0.6 mile of private lands before reaching the Colorado River Substation. Under this alternative, the total length of the 230 kV gen-tie line both on-site and off-site would be 9.5 miles; 5.5 miles would be located on private lands within the array site boundary and 4.0 miles would be located off-site. The total area of the ROW off-site would be about 60 acres (50 acres of BLM-managed land and 10 acres of private land). Similar to Alternative 1, at the

end of the energy sales contract term of Alternative 4, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled. Following decommissioning and dismantling of the solar facility, the Alternative 4 site would be made available for reversion to agricultural use.

2.3.5 Alternative 5: Reduced Acreage Alternative

Similar to Alternative 1, Alternative 5 would include the interim agricultural-related actions, and the construction, operation, maintenance, and potential decommissioning of a solar PV electrical generating facility and associated infrastructure; however, Alternative 5 would eliminate development north of I-10 (see Figure 2-14). In comparison to the proposed Project, Alternative 5 would reduce electrical generation from a maximum of 485 MW to a maximum of 315 MW. The alternating current solar PV facility would be located on a footprint of approximately 2,476 acres, reduced from 3,660 acres. The Reduced Acreage Alternative would include approximately 2,403 acres for the solar facility and 73 acres for the 230 kV gen-tie line. Components of the Reduced Acreage Alternative that differ from the proposed Project would include the following:

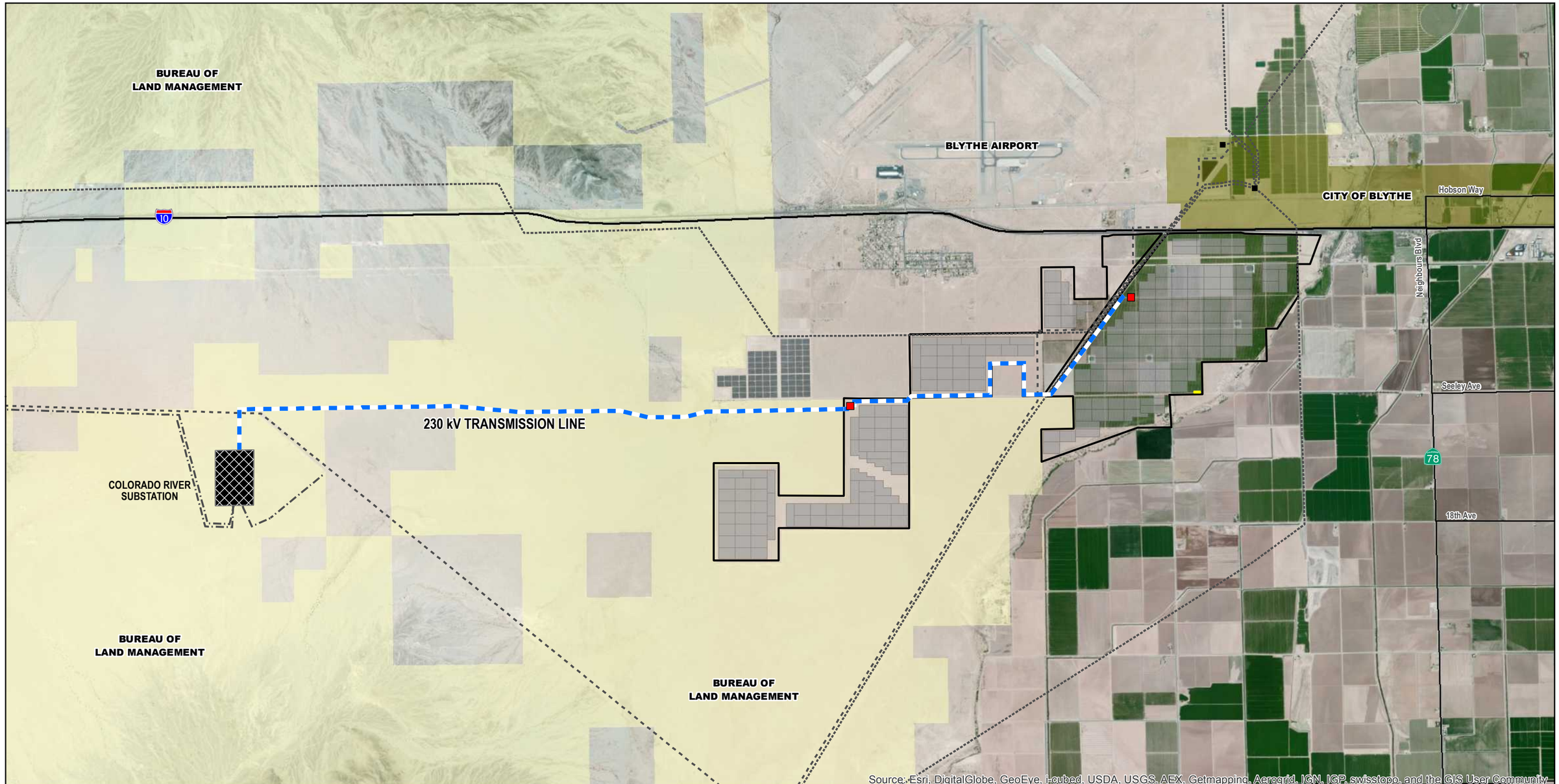
- **Solar facility site (2,403 total acres)**
  - Up to two on-site substations (each approximately 90,000 square feet)
  - One O&M building (approximately 3,500 square feet)
  - One primary off-site access roads and several interior access roads
- **Approximately 7.8 miles of 230 kV gen-tie transmission line**
  - Approximately three miles would be located within the solar facility, which would connect all on-site substations
  - Approximately 4.8 miles would extend outside of the solar facility and would be placed within a 125-foot-wide ROW and occupy 73 acres

The fenced-in solar PV electric generation facility would occupy approximately 2,403 acres on privately owned land (all within the County of Riverside). Similar to the proposed Project, the portion of the gen-tie line outside the solar facility site, from the southernmost substation to the Colorado River Substation, would traverse 3.8 miles of BLM-managed lands (approximately 58 acres) and approximately one mile of private land (approximately 15 acres). Similar to Alternative 1, at the end of the energy sales contract term of Alternative 5, if the utility buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled. Following decommissioning and dismantling of the solar facility, the Alternative 5 site would be made available for reversion to agricultural use.

Reduced Acreage Alternative Project Facilities

230 kV Gen-tie Lines

The Reduced Acreage Alternative would no longer extend a 230 kV overhead gen-tie line from an on-site substation located north of I-10, as this alternative would eliminate all development north of I-10. Therefore, the approximately 8.4-mile-long line associated with the proposed Project would be reduced under this alternative. The Reduced Acreage Alternative would construct an approximately 7.8-mile-long 230 kV overhead gen-tie line from the proposed on-site substation located south of I-10 to the Colorado River Substation, which is currently under construction. Approximately three miles of the gen-tie line would be located within the solar facility. Similar to the proposed Project, the Reduced Acreage Alternative 230 kV gen-tie line would also extend another 4.8 miles within a 125-foot-wide ROW from the southernmost substation to the Colorado River Substation (3.8 miles would traverse BLM-managed



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Solar Array Location
- Project Substation
- Operations and Maintenance Building

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Jurisdiction
- City of Blythe
- Bureau of Land Management

N

0 4,000 8,000
Feet
1:48,000



FIGURE 2-14
REDUCED ACREAGE ALTERNATIVE

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062346

THIS PAGE INTENTIONALLY LEFT BLANK

lands and one mile would traverse private land). The gen-tie line would run parallel to and immediately south of the 500 kV Desert Southwest Transmission Line corridor. The gen-tie line poles and foundations associated with the Reduced Acreage Alternative would be identical to those of the proposed Project.

Access Road

Under the Reduced Acreage Alternative, one access point to the solar facility is planned on Seeley Avenue, accessible from the Neighbours Boulevard off-ramp from I-10 (see Figure 2-14). The primary access road would be improved at the entrance to the site for 100 feet and would be 16 to 20 feet wide. Similar to the proposed Project, unpaved access roads within the solar field would be 12 feet wide and constructed approximately every 200 to 400 feet to allow access and maintenance of the solar panels.

Construction

Site Preparation

Site preparation under the Reduced Acreage Alternative would be similar to the proposed Project, only it would exclude the area north of I-10. During Alternative 1 construction, it is anticipated that up to approximately 1,354 AF of water would be utilized for soil moisture conditioning and dust control over the entire construction period (451 AF per year). Under Alternative 5, it is anticipated that water demand will be less, as there would be a reduced solar development footprint and less associated construction. Similar to the proposed Project, Alternative 5 would require minor demolition of existing site structures (e.g., storage buildings in citrus grove, three on-site residences).

Construction Activities

The Reduced Acreage Alternative would be constructed in similar fashion and in the same phases as the proposed Project (simultaneously on different portions of the site), with the difference of one less substation and O&M building.

Construction Sequence, Equipment, and Workforce

Construction for the Reduced Acreage Alternative is anticipated to be similar to the proposed Project; however, under this alternative, construction would require a reduced workforce. The solar field would be developed in six-month phases, with six blocks constructed at a time (each block 100 acres, for a total of 600 acres at a time). Approximately 400 daily workers (compared to 500 under the proposed Project) would be present on-site during peak construction. Workers would gain primary access to the site using Seeley Avenue off of Neighbours Boulevard. Worker construction traffic would consist of approximately 400 daily vehicle roundtrips (240 employees [compared to 300 under the proposed Project] would travel alone, and approximately 160 employees [compared to 200 under the proposed Project] would carpool). Anticipated average daily material deliveries would consist of about 20 truck deliveries per day for 24 months.

TABLE 2-4 DURATION AND NUMBER OF WORKERS OF EACH CONSTRUCTION PHASE: ALTERNATIVE 5

CONSTRUCTION ACTIVITY/PHASE	DURATION	WORKERS
Site Preparation/Clearing/Grading	6 months	15
Staging and Assembly Areas (including access roads)	6 months	15
Construction of Solar Array, Substations, O&M Building	24 months	200-400
Installation of 230 kV Gen-tie Line and Fiber Optic Cable	12 months	30
Testing	3 months	20
Clean up/restoration	1 month	20

*Construction would occur over a three-year period with construction activities occurring simultaneously.

During construction of the Reduced Acreage Alternative, a similar variety of equipment and vehicles as the proposed Project would be operating on the site. Table 2-2 provided a list of the types of equipment and vehicles expected to be involved in each construction phase.

Table 2-5 lists the estimated disturbance that would occur from the proposed Project and Alternatives. The table separates the disturbance by Project component—solar facility site and gen-tie line corridor. The temporary disturbance within the solar facility site would include: the construction of the solar arrays; fencing; on-site substations; O&M building; main access road; distribution line construction areas; gen-tie line pole construction areas, gen-tie maintenance road; pulling and tensioning sites; sleeving and miscellaneous stringing operations; and guard structure. Permanent disturbance, which is assumed for the life of the Project, within the solar facility site would include the solar arrays; fencing; on-site substation; O&M building; distribution line pole foundations; gen-tie line pole foundations, and gen-tie maintenance road. The temporary disturbance for the gen-tie line corridor includes: the gen-tie line construction areas; gen-tie line poles; pulling and tensioning sites; and sleeving and miscellaneous stringing operations. The permanent disturbance for the gen-tie line corridor includes the gen-tie line pole foundations, and access and spur roads. Table 2-6, Alternatives Comparison Summary, lists the total temporary and permanent disturbance from the proposed Project and Alternatives.

Operation

Operation and Maintenance Activities

Implementation of the Reduced Acreage Alternative would result in the same operation and maintenance activities as the proposed Project. After the construction phase, however, the O&M building would serve the Project's approximately seven permanent full-time employees. It is estimated that operational non-potable water requirements would be less than the estimates for the proposed Project, as well as less than one AF/year of groundwater for potable use in the one O&M building.

Interconnection with Statewide Grid

Power produced by the Reduced Acreage Alternative would also be conveyed to the statewide electricity grid via a new 230 kV gen-tie line from the Project facilities to the Colorado River Substation approximately 4.5 miles west of the solar facility.

Decommissioning and Repowering

At the end of the energy sales contract term, if the energy buyer is not available for extension or another energy buyer does not emerge, the solar arrays and gen-tie line could be decommissioned and dismantled under Alternative 5, similar to the proposed Project. Accordingly, this Draft EIR/EA analyzes the impacts of potential decommissioning and dismantling. If the Reduced Acreage Alternative continues to operate, the impacts described in this Draft EIR/EA as the impacts of operation would continue indefinitely. Similar to the proposed Project, decommissioning activities would require similar equipment and workforce as construction, but would be less intense.

TABLE 2-5 DISTURBANCE ESTIMATES

DISTURBANCE DESCRIPTION	DISTURBANCE DIMENSIONS	AVERAGE DISTURBANCE	ALTERNATIVE 1	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
Solar Facility Site						
1.5 MW solar array (panels, trackers, equipment pad, access roads between solar arrays)	660 ft X 470 ft	7.12 acres/1.5 MW array	310 solar arrays 2,207 acres	310 solar arrays 2,207 acres	310 solar arrays 2,207 acres	210 solar arrays 1,495 acres
perimeter fence/maintenance road	20 ft wide	2.42 acres/mile	34.8 miles 84.2 acres	34.8 miles 84.2 acres	34.8 miles 84.2 acres	21.6 miles 52.3 acres
on-site substations	300 ft X 300 ft each	2.07 acres each	3 substations 6.21 acres	3 substations 6.21 acres	3 substations 6.21 acres	2 substations 4.14 acres
O&M building	3,500 sq ft building 10,000 sq ft parking area	0.31 acre	Up to 2 O& M Buildings 0.62 acre	Up to 2 O& M Buildings 0.62 acre	Up to 2 O& M Buildings 0.62 acre	1 O&M building 0.31 acre
	80,000 sq ft temporary	1.84 acres	3.68 acres	3.68 acres	3.68 acres	1.84 acres
distribution line poles	25 ft X 25 ft temporary	0.014 acre/pole	208 poles 2.98 acres	208 poles 2.98 acres	208 poles 2.98 acres	155 poles 2.22 acres
	3 ft X 3 ft permanent	0.0002 acre/pole	0.04 acre	0.04 acre	0.04 acre	0.03 acre
gen-tie poles	100 ft X 100 ft temporary	1.6 acres/mile	3.6 miles 5.76 acres	3.6 miles 5.76 acres	5.5 miles 8.8 acres	3.0 miles 4.8 acres
	10 ft X 10 ft permanent	0.014 acre/mile	0.05 acre	0.05 acre	0.08 acre	0.04 acre
gen-tie line maintenance road	12 ft wide	1.45 acres/mile	5.22 acres	5.22 acres	7.98 acres	4.35 acres
pulling and tensioning sites	200 ft X 500 ft; one site every 2.5 miles	0.9 acre/mile	3.24 acres	3.24 acres	4.95 acres	2.7 acres
sleeving and miscellaneous stringing operations	100 ft X 200 ft; one site every 2.5 miles	0.2 acre/mile	0.72 acre	0.72 acre	1.1 acres	0.6 acre
guard Structure at freeway crossing	(200 ft x 300 ft)	1.4 acres	1.4 acres	1.4 acres	1.4 acres	n/a
Gen-tie Line Corridor						
Gen-tie poles	100 ft X 100 ft temporary	1.6 acres/mile	4.8 miles; 7.68 acres	5.2 miles 8.32 acres	4.0 miles 6.4 acres	4.8 miles 7.68 acres
	10 ft X 10 ft permanent	0.014 acre/mile	0.07 acres	0.07 acre	0.06 acre	0.07 acre
gen-tie line maintenance road	12 ft wide	1.45 acres/mile	6.96 acres	7.54 acres	4.35 acres	6.96 acres
Gen-tie line spur road	12 ft wide and 2,100 ft long	0.58 acres/mile	2.78 acres	3.016 acres	5.2.32 acres	2.78 acres
pulling and tensioning sites	200 ft X 500 ft; one site every 2.5 miles	0.9 acre/mile	4.32 acres	4.68 acres	3.6 acres	4.32 acres
sleeving and miscellaneous stringing operations	100 ft X 200 ft; one site every 2.5 miles	0.2 acre/mile	0.96 acres	1.04 acres	0.8 acre	0.96 acres

Notes: ft = feet/foot; sq ft = square feet; n/a = not available

2.4 Alternatives Comparison Summary

The following sections offer a comparison of the potential environmental impacts associated with the five Project Alternatives (the proposed Project three other action Alternatives, and the No Project/No Action Alternative), which are summarized in Table 2-6. The solar facility site and interior components (solar panels, substations, O&M buildings, and 34.5 kV distribution lines) are the same for Alternatives 1, 3, and 4 and would result in the same associated impacts. The distinctions among these alternatives focus on the impacts of distinct gen-tie lines. The analysis also considers a reduced solar facility project, which would rely on the same gen-tie line as in Alternative 1 (proposed Project).

2.4.1 Action Alternative Resource Summary (Alternatives 1, 3, 4, and 5)

Among the action alternatives, the proposed gen-tie line for the Reduced Acreage Alternative (Alternative 5) is the shortest at 7.8 miles and traverses the least amount of BLM-managed lands (approximately 3.8 miles). Alternative 4's gen-tie line is the longest at 9.5 miles. Alternative 5 would occupy the least acreage of the action alternatives: 2,476 acres (1,184 acres less than Alternative 1; 1,189 acres less than Alternative 3; and 1,171 acres less than Alternative 4). Alternative 1, Alternative 3, and Alternative 5's gen-tie lines would parallel approved and existing transmission lines and access roads. The gen-tie line would require a maintenance road; however, because of the flat desert landscape no grading would be required. Trucks would access the gen-tie lines poles by crushing over existing vegetation. Alternative 1 and Alternative 5 would require 4.8 miles of new gen-tie line maintenance roads. Alternative 3 would require 5.2 miles of maintenance roads. Alternative 4's gen-tie line would parallel an existing transmission line for approximately one mile; however, approximately three miles would not parallel existing transmission lines and would require approximately three miles of new access roads.

Alternative 5's total gen-tie line length is the shortest of the action alternatives. Alternative 5 would have marginally less annual air emissions and lower impact to vegetation communities such as areas of disturbed creosote bush scrub, bajada community, irrigated alfalfa, non-irrigated wheat. The remaining direct and indirect impacts to vegetation communities under Alternative 5 would be similar to the proposed Project analyzed under Alternative 1. Alternative 1 and Alternative 5's gen-tie line would cross 22.9 acres of Desert Riparian Woodland Wash, the same as Alternative 3 but more than Alternative 4 (11.4 acres). No records or survey results indicated the presence of State- or federal-listed plants or wildlife on Alternative 1, Alternative 3, or Alternative 5. However, based on recent survey records, the desert tortoise has a high potential to occur on the Alternative 4 gen-tie line corridor.

Action Alternatives 1 and 3, and 5 would have no cultural resources eligible for listing on the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR). Alternative 4 contains two archaeological sites along the gen-tie line that are unevaluated and avoided by Project design. Alternatives 1, 3, and 4 all contain portions of Site 33-018837, the Blythe Army Air Base (BAAB), but the BLM and County agree that the elements of BAAB within the Project area of potential effects (APE) no longer retain integrity and are not themselves eligible to the NRHP or CRHR. As development under Alternative 5 would occur south of I-10, cultural resources found north of I-10, including BAAB, as analyzed under Alternative 1, would be avoided under Alternative 5 construction. None of the gen-tie alternatives contain eligible cultural resources except possibly the Alternative 4 gen-tie line, which contains two unevaluated archaeological sites that would be avoided by Project design.

None of the action Alternatives would use groundwater during construction; rather, they would utilize water provided by the Palo Verde Irrigation District. An ephemeral stream would bisect the solar facility site for Alternative 1, Alternative 3, and Alternative 5 and the gen-tie lines for these Alternatives would also cross one ephemeral stream; an ephemeral stream would bisect Alternative 4 and its gen-tie line would cross one ephemeral stream twice.

TABLE 2-6 ALTERNATIVES COMPARISON SUMMARY

ISSUES OR CONCERNS		ALTERNATIVE 1 PROPOSED ACTION	ALTERNATIVE 2 NO PROJECT/NO ACTION	ALTERNATIVE 3 NORTHERN ALTERNATIVE 230 KV GEN-TIE LINE	ALTERNATIVE 4 SOUTHERN ALTERNATIVE 230 KV GEN-TIE LINE	ALTERNATIVE 5 REDUCED ACREAGE ALTERNATIVE
Total acreage of the solar facility site	*Private*	3,587acres	0	3,587acres	3,587 acres	2,476 acres
Jurisdiction crossed (miles) by gen-tie line ROW	*Private (inside solar facility)*	3.6 miles	0	3.6 miles	5.5 miles (3.6 + 1.9)	3.0 miles
	Private (outside solar facility)	1.0 miles (15 acres)	0	0.0 mile	0.6 mile (9 acres)	1.0 mile (15 acres)
	BLM (outside of solar facility)	3.8 miles (58 acres)	0	5.2 miles (78 acres)	3.4 miles (51 acres)	3.8 miles (58 acres)
	TOTAL	8.4 miles	0	8.8 miles	9.5 miles	7.8 miles
Total acreage (solar facility and gen-tie line)		3,660 acres	0	3,665 acres	3,647 acres	2,549
Gen-tie line	*Percentage of new 230 kV gen-tie line parallel to existing and approved transmission lines*	100%	0	100%	68%	100%
	Miles of 230 kV gen-tie line requiring new access roads (unpaved)	4.8	0	5.2	3.0	4.8
Disturbance Estimates	*Solar Facility Site*	2,336 acres (temporary) 2,316 acres (permanent)	0	2,336 acres (temporary) 2,316 acres (permanent)	2342 acres (temporary) 2,320 acres (permanent)	1,579 acres (temporary) 1,567 acres (permanent)
	Gen-tie Line	22.7 acres (temporary) 9.8 acres (permanent)	0	24.6 acres (temporary) 10.6 acres (permanent)	17.5 acres (temporary) 6.73 acres (permanent)	22.7 acres (temporary) 9.8 acres (permanent)
Aesthetics, Visual Resources and Reflection	*Designated Scenic Vista*	No	No	No	No	No
	Designated areas of natural beauty or scenic recreational areas	No	No	No	No	No
	Miles of new gen-tie line that would not parallel existing or proposed transmission lines	0.0	0.0	0.0	3.0	0.0
Agriculture	*Acres of designated Farmland converted to non-agricultural use; cancellation of Williamson Act Contracts and agricultural preserve*	(Land Evaluation Subscore: 27.2) (Site Assessment Subscore 26.1) Total Land Evaluation and Site Assessment (LESA) Score: 53.3 1,681 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve	0	(Land Evaluation Subscore: 27.2) (Site Assessment Subscore 26.1) Total LESA Score: 53.3 1,681 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve	(Land Evaluation Subscore: 27.2) (Site Assessment Subscore 26.1) Total LESA Score: 53.3 1,681 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve	(Land Evaluation Subscore: 25.9) (Site Assessment Subscore 22.4) Total LESA Score: 48.3 1,279 acres of Prime Farmland 16 acres of Unique Farmland 10 acres of Farmland of Statewide Importance Cancellation of Williamson Act Contracts and agricultural preserve
Air Quality	*Conformance with the Mojave Desert Air Quality Management District (MDAQMD)*	Yes	Yes. The air quality of the site is not expected to change noticeably from existing conditions and, as such, the No Project/No Action Alternative would not result in the air quality impacts or benefits described for Alternative 1.	Yes. However, on an annual basis, the additional construction required for the longer 230 kV gen-tie line (8.8 miles versus 8.4 miles) would have greater air emissions than Alternative 1.	Yes. However, on an annual basis, the additional construction required for the longer 230 kV gen-tie line (9.5 miles versus 8.4 miles) would have greater air emissions than Alternatives 1 and 3.	Yes. However, on an annual basis, the reduced number of workers required under the Reduce Acreage Alternative would result in fewer annual air emissions than Alternatives 1, 3 and 4.
	Estimated annual construction emissions	ROG = 4.12 NO_x = 18.44 CO = 34.58 SO_x = 0.39 PM_{10} = 6.16 $PM_{2.5}$ = 2.02	No new emissions	ROG = 4.12 NO_x = 18.52 CO = 34.62 SO_x = 0.39 PM_{10} = 6.17 $PM_{2.5}$ = 2.03	ROG = 4.12 NO_x = 18.65 CO = 34.70 SO_x = 0.39 PM_{10} = 6.16 $PM_{2.5}$ = 2.03	ROG = 4.12 NO_x = 18.44 CO = 34.58 SO_x = 0.39 PM_{10} = 6.16 $PM_{2.5}$ = 2.02
	Federal Conformity Determination requirement	Annual construction emissions for the portion of Alternative 1 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD.	The air quality of the site is not expected to change noticeably from existing conditions and, as such, the No Project/No Action Alternative would not result in the air quality impacts or benefits described for Alternative 1.	Annual construction emissions for the portion of Alternative 3 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD.	Annual construction emissions for the portion of Alternative 4 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD.	Annual construction emissions for the portion of Alternative 5 on federal lands would be less than the *de minimis* thresholds for all pollutants in the MDAQMD.

ISSUES OR CONCERNS		ALTERNATIVE 1 PROPOSED ACTION	ALTERNATIVE 2 NO PROJECT/NO ACTION	ALTERNATIVE 3 NORTHERN ALTERNATIVE 230 KV GEN-TIE LINE	ALTERNATIVE 4 SOUTHERN ALTERNATIVE 230 KV GEN-TIE LINE	ALTERNATIVE 5 REDUCED ACREAGE ALTERNATIVE
Biological Resources	*Vegetation communities crossed by the solar facility site and transmission line*	540 acres creosote bush scrub 3,294 acres of agricultural and fallow fields 18 acres bajada	0	565 acres Creosote bush scrub 3,294 acres of agricultural and fallow fields 18 acres bajada	494 acres Creosote bush scrub 3,294 acres of agricultural and fallow fields 18 acres bajada	427 acres creosote bush scrub 3,086 acres of agricultural and fallow fields
	State- or federal-listed plants detected	No	No	No	No	No
	State- or federal-listed wildlife detected	No	No	No	Desert Tortoise	No
	Conflict with local policies or ordinances protecting biological resources	No	No	No	No	No
	Designated USFWS or CDFW wildlife habitats	No	No	No	No	No
	Acres of riparian habitat crossed	22.9 acres of Desert Riparian Woodland Wash	0.0	22.9 acres of Desert Riparian Woodland Wash	11.4 acres of Desert Riparian Woodland Wash	22.9 acres of Desert Riparian Woodland Wash
Cultural Resources	*NRHP- or CRHR-listed, NRHP- or CRHR--eligible, or unevaluated resources*	No. Portion of proposed Blythe Army Air Base Historic District within the Project APE does not retain integrity and is not eligible.	n/a	No. Portion of proposed Blythe Army Air Base Historic District within the Project APE does not retain integrity and is not eligible.	2 unevaluated archaeological sites. Portion of proposed Blythe Army Air Base Historic District within the Project APE does not retain integrity and is not eligible.	No
	Cultural Resources within each gen-tie line corridor	3 isolated finds (1 prehistoric/historic, 1 prehistoric, and 1 historic). All 3 resources are not eligible for the NRHP or CRHR.	n/a	2 historic archaeological sites (refuse scatters) and 3 isolated finds (2 historic and 1 prehistoric). All 5 resources are not eligible for the NRHP or CRHR.	12 archaeological sites (6 prehistoric, 5 historic, and 1 prehistoric/historic) and 4 isolated finds (2 prehistoric and 2 historic). 10 archaeological sites and all 4 isolated finds have been determined not eligible for the NRHP or CRHR. 2 archaeological sites are unevaluated.	3 isolated finds were documented (1 prehistoric/historic, 1 prehistoric, and 1 historic). All 3 resources are isolated sites and have been determined not eligible for the NRHP or CRHR.
Paleontological Resources	*Resource sensitivity crossed*	Quaternary Alluvium, Eolian Sand (Qs)	No	Quaternary Alluvium, Eolian Sand (Qs)	Quaternary Alluvium	Quaternary Alluvium, Eolian Sand (Qs)
Geology and Soils	*Distinctive geologic features*	None	None	None	None	None
	Miles crossed of high levels of earthquake ground shaking	No	n/a	No	No	No
	Liquefaction hazard zones crossed	Moderately susceptible to liquefaction	n/a	Moderately susceptible to liquefaction	Moderately susceptible to liquefaction	Moderately susceptible to liquefaction
	Potential landslides	No	n/a	No	No	No
	Susceptible to soil and wind erosion	Moderate to High	n/a	Moderate to High	Moderate to High	Moderate to High
	Mineral production	No	n/a	No	No	No
Greenhouse Gas	*Generate greenhouse gas emissions*	Construction emissions: 183 metric tons of CO_2e (amortized over the life of the Project); Operations emissions: 271 metric tons per year of CO_2e. Project emissions due to construction would not exceed CAPCOA thresholds.	No new emissions. Existing emissions do not exceed CAPCOA thresholds.	The total GHG emissions are estimated to be slightly greater than Alternative 1 during construction and would not exceed CAPCOA thresholds.	The total GHG emissions are estimated to be slightly greater than Alternative 1 during construction and would not exceed CAPCOA thresholds.	Construction emissions: less than 183 metric tons of CO_2e (amortized over the life of the Project); Operations emissions: less than 271 metric tons per year of CO_2e for solar facility. Project emissions due to construction would not exceed CAPCOA thresholds.
Hazards and Hazardous Materials	*Located on-site that is included on a list of hazardous materials site complied pursuant to Gov. Code Section 65962.5*	One aboveground storage tank located within solar facility site, however, will be removed in compliance with rules, laws, and regulations.	n/a	One aboveground storage tank located within solar facility site; however, will be removed in compliance with rules, laws, and regulations.	One aboveground storage tank located within solar facility site; however, will be removed in compliance with rules, laws, and regulations.	N/A
	Create hazards	No	No	No	No	No
Hydrology and Water Resources	*Water supply needs from Palo Verde Valley Irrigation District*	Up to 500 AF/year during construction Up to 302 AF/year during operation, resulting in a net reduction of 2,903 to 3,101 AF/year.	No increase in existing demand. Irrigation for agriculture approximately 3,403 AF/year	Up to 500 AF/year during construction Up to 302 AF/year during operation	Up to 500 AF/year during construction Up to 302 AF/year during operation	Less than 500 AF/year during construction Less than 302 AF/year during operation, resulting in a net reduction of more than 2,903 to 3,101 AF/year.
	Number of ephemeral channel crossings	2 ephemeral	N/A	2 ephemeral	3 (one ephemeral channel crossed twice)	2 ephemeral
	Potential impact from flooding	Yes, but solar facility would be designed outside of floodplain.	No	Yes, but solar facility would be designed outside of floodplain.	Yes, but solar facility would be designed outside of floodplain.	Yes, but solar facility would be designed outside of floodplain.

ISSUES OR CONCERNS		ALTERNATIVE 1 PROPOSED ACTION	ALTERNATIVE 2 NO PROJECT/NO ACTION	ALTERNATIVE 3 NORTHERN ALTERNATIVE 230 KV GEN-TIE LINE	ALTERNATIVE 4 SOUTHERN ALTERNATIVE 230 KV GEN-TIE LINE	ALTERNATIVE 5 REDUCED ACREAGE ALTERNATIVE
	Change in absorption rates, surface runoff, or drainage patterns	No; however, the Project would result in the creation of minimal additional impervious surface.	n/a	No; however, the Project would result in the creation of minimal additional impervious surface.	No; however, the Project would result in the creation of minimal additional impervious surface.	No; however, the Project would result in the creation of minimal additional impervious surface.
Land Use Planning	*Conflict with regional/local land use plans, policies, and regulations*	No	No	No	No	No
	Miles of 230 kV gen-tie within federal jurisdiction and within an agency-designated Utility Corridor	3.4	n/a	5.3	4.0	3.4
Noise	*Closest residence*	260 feet	n/a	260 feet	260 feet	580 feet
	Residences within 1 mile of solar facility (no residences within 1,000 feet for gen-tie)	377	n/a	377	377	372
Recreation	*Impact existing parks or other recreational facilities*	No	n/a	No	No	No
	Located within a Community Service Area	No	n/a	No	No	No
Socioeconomics	*Increase population*	Not substantial / temporary during construction	n/a	Not substantial / temporary during construction	Not substantial / temporary during construction	Not substantial / temporary during construction
Traffic and Transportation	*Roads that may require improvement for emergency access*	Seeley Avenue and Riverside Drive	n/a	Seeley Avenue and Riverside Drive	Seeley Avenue and Riverside Drive	Seeley Avenue
	Miles of new gen-tie line requiring new access roads	0.0	0.0	0.0	3.0 miles	0.0

AF = acre-feet
CAPCOA = California Air Pollution Controls Officers Association
CDFW = California Department of Fish and Wildlife
CO = Carbon monoxide
CRHR = California Register of Historical Resources
MDAQMD = Mojave Desert Air Quality Management District
n/a = not applicable
NO_x = Nitrogen oxides
NRHP = National Register of Historic Places
PM_{10} = Particulate matter 10 microns in diameter or larger
$PM_{2.5}$ = Particulate matter 2.5 microns in diameter or larger
ROG = Reactive organic gases
SO_x = Sulfur oxides
USFWS = U.S. Fish and Wildlife Service

THIS PAGE INTENTIONALLY LEFT BLANK

All the action Alternatives would promote General Plan and Area Plan policies favoring solar development. The County and City would continue to promote agricultural uses in conformity with the Agricultural Preservation Policy of the Palo Verde Valley Area Plan and the City of Blythe Open Space Guiding Policies 1 and 9, but the Project and the other action Alternatives would cease agricultural use of the Project Site once construction begins.

2.4.2 No Project/No Action Alternative (Alternative 2)

Under the No Project/No Action Alternative, ongoing activities would continue, but new impacts associated with the implementation of the No Project/No Action Alternative are not anticipated. Relative to Alternatives 1, 3, 4, and 5, all impacts associated with the construction, operation, maintenance, and decommissioning of the Blythe Mesa Solar Project would be avoided. As such, there would be no effects related to greenhouse gas (GHG) emissions beyond those that already occur on the Project site as a result of existing agricultural operations (zero net increase in GHG emissions). However, the beneficial impacts of the proposed Project associated with providing renewable energy in accordance with the State's adopted RPS and President Obama's Climate Action Plan would also not occur under this Alternative. That is, under the No Project Alternative, renewable energy would not be available to offset the use of energy from other sources, including fossil fuels. Consequently, the No Project Alternative would not achieve the GHG reduction associated with the proposed Project, which was estimated to range from 371,116 to 1,061,829 metric tons of carbon dioxide equivalent (CO_2e) per year.

2.5 Alternatives Considered and Eliminated from Further Analysis

CEQA and NEPA require an EIR/EA to consider a reasonable range of alternatives to the Project that have the potential to feasibly attain most of the basic objectives of the Project (see list below) or meet the federal purpose and need. In addition, CEQA requires the consideration of how to avoid or substantially lessen any adverse effects of the proposed Project. The proposed Project has the potential to have significant adverse effects on Agriculture, Biological Resources, Cultural and Paleontological Resources, Geology and Soils, Hydrology and Water Quality, Noise, and Traffic and Transportation, but would be reduced to less than significant levels with implementation of mitigation measures.

The Applicant's objectives for the Project are as follows:

- Construct a solar energy facility in order to help meet State and federal renewable energy standards and goals.
- Assist with GHG reduction objectives to the maximum extent possible.
- Locate the Project facilities as near as possible to electrical transmission facilities with anticipated capacity and reserved CAISO interconnection position.
- Site the Project in an area with excellent solar energy resource, in order to maximize energy productivity from the PV panels.
- To the extent feasible, site the Project on previously disturbed land with compatible topography in a manner that minimizes environmental impacts.
- Use a proven and available solar PV technology to provide cleanly generated electricity at a competitive price for California electric ratepayers.
- Eventual decommissioning of the 485 MW solar PV electrical generating facility and associated infrastructure at the end of the energy sales contract term, if the energy buyer is not available for extension or another energy buyer does not emerge.

Alternatives to the proposed Project were identified through the scoping process, informational public meetings, and preliminary studies. A number of alternatives to the proposed Project were identified. Some of these alternatives did not have the potential to meet most of the Project objectives, to meet the federal purpose and need, or to avoid or minimize adverse environmental effects, or were considered infeasible through additional study and evaluation. The sections below provide a brief description of each alternative, the alternative's ability to meet the screening criteria, and the rationale for elimination of the alternative from full analysis in this Draft EIR/EA. The alternatives considered but eliminated from further analysis included:

- Solar Power Tower Technology
- Distributed Solar Photovoltaic Alternative
- Conservation and Energy Demand Reduction
- Alternative Site on BLM-managed Land
- Palo Verde Valley Floor Alternative

2.5.1 Solar Power Tower Technology

The solar power tower technology uses a flat mirror "heliostat" system that tracks the sun and focuses solar energy on a central receiver at the top of a high tower. The focused energy is used to produce steam and run a center power generator. The transfer fluid is super-heated before being pumped to heat exchangers that transfer the heat to boil water and run a conventional steam turbine to produce electricity. Although concentrated, solar power systems can store heated fluids to deliver electricity even when the sun is not shining. In areas of high solar insolation potential (i.e., desert environments), the land required to develop a concentrated solar energy power tower facility is comparable to that required for a PV project—approximately five acres per MW of installed capacity (NREL 2012).

Project Objectives

A solar power tower system has the potential to meet most of the Project objectives, depending on whether its location is in conformity with guiding principles of local General Plans.

A solar power tower system, if located at least partially on public lands under BLM management, could also meet the BLM's purpose and need.

Feasibility

Concentrated solar power tower systems are typically not compatible with airports (FAA Solar Guide). Blythe Airport's Runway 26 is approximately 2,900 feet from the Project boundary. The proximity of the Project area to the airport could result in significant impacts due to glint and glare caused by heliostats associated with development of a concentrated solar power tower system, which could cause temporary flash blindness to pilots on arrival or departure or to Air Traffic Control Personnel; electromagnetic interference with on- and off-airport radar systems; and thermal plumes emitted in the airport environs by steam turbine generator cooling systems. In addition, approximately 3,300 acres of the solar facility site would be located within the Blythe Airport Influence Area (Airport Compatibility Zones B1, C, D, and E). According to FAA Regulations, Part 77, Section 77.23 (a)(2), objects greater than 200 feet tall from the ground surface, or 200 feet above the elevation of the airport (whichever is higher) that are within three nautical miles (3.45 linear miles) of an airport could be considered an obstruction to aviation activities (refer to Sections 3.2.8 and 4.2.8, *Hazards and Hazardous Materials*, for a detailed discussion regarding the Airport Operations and regulatory information regarding the Riverside County Airport Land Use Compatibility Plan). A concentrated solar power tower which could be up to 750 feet tall and located within the Blythe Airport Influence Area would penetrate the navigable airspace and obstruct aviation activities; therefore, the Solar Power Tower Technology Alternative would be infeasible.

Environmental Advantages

The footprint required for a solar power tower facility would be equivalent to that of a PV solar system; therefore, the impacts relating to land disturbance would be similar to that of the proposed Project.

Environmental Disadvantages

The environmental disadvantages would occur to visual resources, land use, and water supply/quality. The solar power towers are generally taller than a PV system; therefore, it would be seen from greater distances. Solar power tower systems typically use conventional steam plants to generate electricity, which typically consume water for cooling. In arid settings, such as the Palo Verde Mesa, any increase in

water demand would strain available water resources. Solar power tower facilities would also adversely impact the operations at the Blythe Airport and the Airport Land Use Commission compatibility requirements.

Alternative Conclusions

The use of a solar power tower technology appears to have the ability to meet most of the basic Project Objectives and would have similar impacts as the proposed Project with respect to biology, cultural resources, paleontology, and geology. However, use of this technology would result in comparatively greater impacts to the Blythe Airport's operations. This alternative would be more visible than the proposed Project due to the height of the power tower and creation of cooling system vapor plumes, and the alternative would not avoid impacts to agricultural resources. Therefore, a solar power tower system alternative was not considered further.

2.5.2 Distributed Solar Photovoltaic Alternative

There is no single accepted definition of distributed solar technology. The California Energy Commission's (CEC) 2011 *Integrated Energy Policy Report* defines distributed generation resources as "(1) fuels and technologies accepted as renewable for purposes of the Renewables Portfolio Standard; (2) sized up to 20 MW; and (3) located within the low-voltage distribution grid or supplying power directly to a consumer." Distributed solar facilities vary in size from several kilowatts to tens of megawatts but do not require transmission to get to the areas in which the generated power is used.

A distributed solar alternative would consist of PV panels that would absorb solar radiation and convert it directly to electricity. Under this Alternative, the PV panels would be installed on residential, commercial, or industrial building rooftops or in other disturbed areas like parking lots or disturbed areas adjacent to existing structures such as substations. To create a viable alternative to the proposed Project, there would have to be sufficient newly installed panels to generate up to 485 MW of capacity. According to the 2012 CEC renewable energy acreage calculator, it would take approximately 3,464 acres to construct a 485 MW Distributed Solar Photovoltaic Alternative (0.4 MW/acre), nearly the size of the proposed Project.

Rooftop PV systems and parking lot systems exist in small areas throughout California. Larger distributed solar PV installations are becoming more common. Examples of different distributed PV systems are:

- Nellis Air Force Base, Nevada: Over 72,000 solar panels, generating 14 MW of energy, were constructed in 2007 by SunPower Corp. on 140 acres of Nellis Air Force Base land (Whitney 2007). Energy generated is used at the base.
- SCE, Ontario, CA and Redlands, CA: SCE's newest solar PV installations have a combined peak generating capacity of 12.5 MW. The Ontario installations involved four solar stations on 1.8 million square feet of leased warehouse roofs owned by ProLogis. The 32,950 solar PV panels are capable of generating 5.5 MW. In Redlands, SCE built three installations, with 34,600 panels spread over 1.5 million square feet of ProLogis warehouse roofs, which can generate 7 MW of power (allvoices 2011).
- Metrolink Industry Station, City of Industry, CA; Metrolink's Industry Station was outfitted with approximately 8,000 PV solar panels covering 940 parking spaces that is capable of generating two MW (Velasco 2012).
- FedEx, Oakland, CA: The FedEx Express hub at Oakland International Airport has 5,769 solar PV panels installed on 81,000 square feet that produce approximately 904 kW (SunPower 2014).

Project Objectives

A distributed solar technology alternative, if constructed at 485 MW, has the potential to meet some of the Project objectives. However, this solar power would be distributed throughout California and thus not subject to the same local planning policies. The distributed solar technology would not necessarily meet the objective to locate the facility in areas of high solar resource, because the distributed technology

would be located throughout the state. An implemented distributed generation system would not achieve RPS as efficiently, since scattered, individual solar installations are likely to be less efficient in producing energy because they do not enjoy economies of scale and are less likely to be subjected to rigorous, regular maintenance. Additionally, while 485 MW of rooftop solar has the potential to meet some the Project objectives, contributions from all commercially available renewable technologies are needed to meet California's RPS requirements and to achieve the statewide RPS target for 2020. To meet the 33 percent by 2020 RPS target, CEC staff estimates that the state will need renewable generation in the range of 35,000 to 47,000 gigawatt hours in addition to generation expected from existing facilities (CEC 2011). To meet this goal, Governor Brown's Clean Energy Job Plan calls for adding 20,000 MW of new renewable capacity by 2020 (including 8,000 MW of large-scale wind, solar and geothermal and 12,000 MW of distributed generation).

Distributed solar projects would be located on rooftops and ancillary existing facilities. Consequently, few, if any, of such projects would be located on BLM-managed property. A distributed solar technology alternative could not meet the federal purpose and need to consider the ROW application for the Project in a manner that takes account of the BLM's multiple use mandate for BLM-managed land, and takes account of management objectives to take actions that increase the production and transmission of energy in a safe and environmentally sound manner, to approve non-hydropower renewable energy projects on public lands, and to treat development of renewable energy as a priority for the Department of the Interior.

Feasibility

The rate of PV manufacturing and installation is expected to continue to grow very quickly. In 2011, 311 MW of customer-sited solar was installed, a growth of 60 percent from 2010 (CPUC 2013). Through April 2012, 97 MW of new distributed solar was installed through the California Solar Initiative (CPUC 2012). The addition of a further 485 MW to eliminate the need for the proposed Project cannot be guaranteed. This would require an even more aggressive deployment of PV than the California Solar Initiative program currently employs. As discussed in *Renewable Power in California: Status and Issues* (CEC 2011), challenges to an accelerated implementation of distributed solar PV include:

- **Widely varying codes, standards, and fees.** Local governments with jurisdiction over these projects have widely varying codes, standards, and fees that are a challenge for developers trying to meet permitting requirements.
- **Environmental requirements and permitting.** Distributed generation projects must comply with a number of environmental requirements including permits and approvals from multiple local entities like fire departments, building and electric code officials, and local air districts. Many local jurisdictions do not have energy elements in their general plans or zoning ordinances to provide guidance to renewable development, and developers must request general plan amendments and/or rezoning of developable parcels.
- **Interconnection.** Physical interconnection to the local distribution system may be complicated, depending on the electricity infrastructure in each community. Upgrades to the distribution system can require local permits.
- **Integration of distributed generation.** California utilities need to balance maintaining system reliability and dealing with aging distribution infrastructure. There are issues with integration of large amounts of renewable distributed generation into the distribution system, which brings power from substations to consumers. The increasing amounts of distributed PV solar power generated may exceed load at different times of the day and flow backwards into the circuit or substation. The distribution system needs to be modernized and use technologies that easily allow for two-way flow of electricity as well as improved communication technologies.

Environmental Advantages

Installation of 485 MW of distributed solar PV could require approximately the same acreage as the proposed Project; however, distributed solar PV is assumed to be located on already existing structures or disturbed areas, so little to no new ground disturbance would be required, and there would be few associated biological and cultural impacts. This alternative would also avoid impacts to agricultural resources and air quality impacts resulting from construction activities.

Environmental Disadvantages

None of the environmental impacts of the proposed Project would occur with the Distributed Solar Photovoltaic Alternative. However, the individualized nature of the solar panel installations would compare unfavorably to a utility scale solar project in terms of ability to regulate visual impacts, ability to regulate use of materials containing hazardous substances, control over potential decommissioning, dismantling and disposal of solar panels, and the applicability and enforceability of other environmentally protective mitigation measures and laws.

Alternative Conclusions

Although there is potential to achieve 485 MW of distributed solar energy, the limited number of existing facilities makes it unlikely to be feasible or present environmental benefits. The proposed Project would utilize single-axis PV trackers with high efficiency, monocrystalline, silicon solar panels. The panel design minimizes shading, and by grouping trackers close together, the technology requires 20 percent less land than conventional crystalline fixed tilt systems and 60 percent less land than thin film systems. Rooftop systems typically consist of less efficient fixed-tilt systems that may not be oriented optimally towards the sun, meaning that developers would need to obtain more surface area for the Project if constructed on a rooftop instead of on the ground. The transaction costs of obtaining multiple rooftops, the complexity of mobilizing construction crews across multiple projects including the transporting and deployment of construction materials in a less efficient manner, and the need to develop the agreements to secure the same amount of PV-produced electricity can make this type of alternative infeasible.

To the extent that distributed generation projects might have fewer impacts on certain resources because they do not utilize substations and transmission facilities, the discussion here illustrates that distributed generation projects cannot meet one of the fundamental objectives of a utility-scale solar project: to provide renewable energy to utility off-takers and their customers. Rooftop systems that are not connected to the utility side of the electric grid only generate power for on-site consumption. At the same time, the difficulties in supplying a comparable amount of megawatts of clean energy to the public through the utility sector has its own set of impacts due to failure to offset the impacts of counterpart fossil fuel energy sources.

There are a number of challenges associated with the implementation of a distributed solar technology, which include widely varying codes, standards, and fees; environmental requirements and permitting concerns; interconnection of distributed generation; inefficiencies; and integration of distributed generation into the electrical grid. As a result, this technology was eliminated from detailed analysis as an alternative to the proposed Project.

2.5.3 Conservation and Energy Demand Reduction

Conservation and demand reduction consist of a variety of approaches for the reduction of electricity use, including energy efficiency and conservation, building and appliance standards, and load management and fuel substitution.

Project Objectives

The alternative would not meet the objectives of constructing a solar energy facility to meet renewable energy standards and goals. It would assist with GHG reduction objectives. However, this alternative likely would not meet the projected demand for energy. This alternative would not help BLM achieve its management objectives or multiple use mandate.

Feasibility

Energy efficiency in general is feasible and would assist with GHG reduction. However, energy efficiency alone would not meet State and federal renewable energy standards and goals. The CEC's 2011 *Integrated Energy Policy Report* takes energy efficiency and conservation into account when determining the RPS assumptions and goals, and concludes that additional sources of renewable energy are required in addition to implementation of conservation measures.

Environmental Advantages

All impacts of the proposed Project would be avoided.

Environmental Disadvantages

Impacts are unknown. Because this alternative would not meet demands, and if no additional power generation facilities were built, it is likely that demand would remain unsatisfied. It is not possible to predict, reasonably, neither what consequences would result from the unmet demand nor where those consequences would occur.

Alternative Conclusions

This alternative is not technically feasible as a replacement for the proposed Project, because California utilities are required to achieve aggressive energy efficiency goals. Additional energy efficiency beyond that occurring in the baseline condition may be technically possible, but it is speculative to assume that energy efficiency alone would achieve the necessary GHG reduction goals. With population growth and increasing demand for energy, conservation and demand management alone is not sufficient to address all of California's energy needs. Therefore, this alternative would not meet Project objectives pertaining to renewable energy goals.

2.5.4 Alternative Site on BLM-managed Lands

Similar to the proposed Project, an Alternative Site on BLM-managed Lands would involve the construction, operation, maintenance, and decommissioning of a 485 MW solar facility and 230 kV gen-tie line. This alternative would be located within the Developable Areas within the Riverside East Solar Energy Zone (SEZ) that was identified by the BLM and Department of Energy (BLM and DOE 2012). Wilderness areas and areas of critical environmental concern (ACECs) were precluded from solar development. Additionally, to achieve the Project objectives, the Alternative Site on BLM-managed Lands would need to be located approximately 20 miles from the Colorado River Substation. It is also assumed that this alternative would require a BLM ROW grant to allow for the construction and operation of solar facilities within BLM-managed lands.

Project Objectives

The construction and operation of a solar facility on an Alternative Site on BLM-managed Lands has the potential to meet the basic Project Objectives. It also has the potential to meet BLM's purpose and need.

Feasibility

Most of the land that would be located in close proximity to the Colorado River Substation and within the Developable Areas of the Riverside East SEZ are in use or proposed for other solar energy projects (see Figure 4.1-1) or within a mountainous area that is not ideal for solar development. It is very unlikely that there would be enough acreage within BLM's Developable Area of the Riverside East SEZ to support a 485 MW solar facility in close proximity to the Colorado River Substation.

Environmental Advantages

This Alternative would avoid adverse impacts to agricultural resources that would result from the implementation of the proposed Project. An Alternative Site would likely be sited farther away from Palo Verde Valley residents and avoid potential less-than-significant impacts to their views.

Environmental Disadvantages

An Alternative Site on BLM-managed Lands would likely be sited closer to wilderness areas and in areas that are generally more natural in appearance compared to lands in the proposed Project; therefore, this Alternative would increase the visual contrast in the area and impacts to visual resources. Also, most of the BLM-managed lands in these areas are undisturbed and would likely experience more severe impacts to biological and cultural resources than the proposed Project, which is located on previously disturbed land. BLM-managed land would likely require more extensive grading because the land has not been previously disturbed, and construction of more or longer access roadways. These activities are likely to result in greater air quality, biological, and cultural impacts.

Alternative Conclusions

The Alternative Site on BLM-managed Lands would avoid impacts to agricultural resources; however, it may not be feasible to find an Alternative Site on BLM-managed Lands, because most of the land within the Developable Areas of the Riverside East SEZ is in use, proposed for other solar energy projects, or within mountainous areas. This alternative would likely have impacts similar to those of the proposed Project for many resource elements, such as air quality and traffic. However, it is likely to have more severe biological, cultural, and visual resource impacts, as it would likely be located on undisturbed lands. This alternative would also be sited closer to wilderness areas and ACECs, which border the developable SEZ areas. The Alternative Site on BLM-managed Lands would not present significant environmental advantages over the proposed Project.

2.5.5 Palo Verde Valley Floor Alternative

Similar to the proposed Project, the Palo Verde Valley Floor Alternative would involve the construction, operation, maintenance, and decommissioning of a 485 MW solar facility and 230 kV gen-tie line. The solar facility would be situated on private lands within the Palo Verde Valley (between the Palo Verde Mesa to the west and the Colorado River to the east), instead of the Palo Verde Mesa, as well as on BLM-managed lands. It is also assumed that this alternative would require a BLM ROW grant for the 230 kV gen-tie line and CUP approvals to allow for the construction and operation of solar facilities.

Project Objectives

The alternative has the potential to meet the Project objectives of constructing a solar energy facility to meet renewable energy standards and goals, which would assist with GHG reduction objectives. If this Alternative were sited at least partially on BLM-managed lands, it would have the potential to meet the federal purpose and need.

Feasibility

Among the factors that may be taken into account when addressing the feasibility of alternatives (as described in CEQA Guidelines Section 15126.6(f)(l)) are environmental impacts, site suitability, economic viability, availability of infrastructure, general plan inconsistency, regulatory limitations, jurisdictional boundaries, and whether the proponent could reasonably acquire, control, or otherwise have access to the alternative site.

While it would be feasible to construct a solar facility and gen-tie lines on the Palo Verde Valley Floor, the possibility of finding a contiguous area sufficient for siting a 485 MW facility is unlikely. To have the potential to meet most of the Project objectives, an alternative site would need to be of sufficient size to accommodate the 485 MW solar facility. There are no suitable sites that are available or within the control of the Project Applicant. Given the size of the proposed Project, the Project objectives, and the need to arrange a suitable assemblage of parcels, it is impractical and infeasible to propose the Project on an alternative site within Palo Verde Valley Floor and still proceed within a reasonably similar timeframe.

In addition, the Palo Verde Valley Floor contains large areas of land classified as Prime Farmland, Farmland of Statewide Importance, and Unique Farmland. Purchasing and converting these prime farmlands, to nonagricultural use would increase the timeframe, effort, and cost of obtaining site control. This alternative has effects that cannot be reasonably ascertained, and its implementation is speculative. Therefore, an alternative site on the Palo Verde Valley Floor has been eliminated from further consideration because it is not considered to be potentially feasible.

Environmental Advantages

In comparison with the Palo Verde Valley Floor Alternative, the proposed Project would be located on the larger contiguous area of designated Prime Farmland. By contrast, the Palo Verde Valley Floor has a mixture of Prime Farmland, Farmland of Statewide Importance, and Unique Farmland. Impacts to agricultural resources would be transferred from the Palo Verde Mesa to the Palo Verde Valley Floor with implementation of the Palo Verde Valley Floor Alternative, but agricultural impacts would not be reduced.

Environmental Disadvantages

The Palo Verde Valley Floor is one of the richest agricultural regions in California. The soils, deposited by the Colorado River, are classified as Prime Farmland, Farmland of Statewide Importance, and Unique Farmland. The proposed Project is located on the Palo Verde Mesa The Palo Verde Irrigation District is committed to keeping the Palo Verde Valley lands in agriculture and is likely to oppose solar energy development (BrightSource 2011). Maintaining viable agricultural land for future generations is also an important aspect of Riverside County's Palo Verde Valley Area Plan.

The Palo Verde Valley Floor Alternative is also farther away from the Colorado River Substation and would require a longer gen-tie line, which would increase the amount of ground disturbance and potential impacts to aesthetics, air quality, biological resources, cultural resources, hydrology and water quality, and traffic and transportation. This alternative would also be closer to more populated areas than the proposed Project, which would further increase impacts to visual resources. The alternative's proximity to the Colorado River has a potential to increase impacts to migratory birds.

Alternative Conclusions

Similar to the proposed Project, the Palo Verde Valley Floor Alternative would also impact agricultural land. This Alternative would also be farther away from the Colorado River Substation, which would increase ground disturbance and impacts to aesthetics, air quality, biological resources, hydrology and water quality, and traffic and transportation. The proximity to the Colorado River could pose adverse impacts related to migratory birds, water resources, and the risk of flooding, which would not result from implementation of the proposed Project. As a result, this alternative was not analyzed in further detail.

CHAPTER 3: AFFECTED ENVIRONMENT

3.1 Introduction

Chapter 3 describes the affected environment and the existing environmental conditions, or "baseline conditions," associated with the construction, operation, and decommissioning of the Blythe Mesa Solar Project (Project) and Alternatives. The baseline conditions are used for comparison to establish the type and extent of the potential environmental effects of the Project. In the following sections, the environmental setting is described within a defined Project area and a regional vicinity context, with a focus on the particular environmental impacts being discussed. The term "Project area" refers to the proposed 485 megawatt (MW) solar photovoltaic (PV) facility and associated infrastructure (3,587 acres), as well as the proposed 230 kilovolt (kV) transmission line (generation interconnection [gen-tie] line) (73 acres). As discussed in Chapter 2, this Draft Environmental Impact Report/Environmental Assessment (Draft EIR/EA) analyzes four Alternatives—the No Project (Alternative 2) and three action Alternatives (the Northern Alternative, the Southern Alternative and the Reduced Acreage Alternative). The proposed solar facility site would be the same for Alternative 1 (proposed Project), Alternative 3 (Northern Alternative), and Alternative 4 (Southern Alternative). Alternative 5's (Reduced Acreage Alternative) solar facility site would occupy the same area as proposed Project; however, it would only include development south of the Interstate 10 (I-10) freeway, which would occupy 2,476 acres instead of 3,600 acres. The main difference between the Alternative 3 and 4 is the location of the 230 kV gen-tie line corridor that extends outside the solar facility site. The Northern Alternative gen-tie line corridor would occupy 95 acres and the Southern Alternative gen-tie line corridor would occupy 60 acres. The proposed Project (Alternative 1) and Alternative 5's gen-tie line corridor would have the same alignment and occupy 73 acres. The environmental setting and impacts analysis for the proposed Project and Alternatives utilizes a study area approach, which may vary based on the resource being evaluated and the predicted locations of direct and indirect effects of the proposed Project.

This chapter also includes a discussion of the regulatory framework for each of the environmental resource topics that present regulations, plans, goals, policies, and standards that may be applicable to the proposed Project and Alternatives. The following environmental topics are addressed in detail in this Draft EIR/EA:

- 3.2.1 Aesthetics, Visual Resources, and Reflection
- 3.2.2 Agriculture
- 3.2.3 Air Quality
- 3.2.4 Biological Resources
- 3.2.5 Cultural Resources
- 3.2.6 Geology and Soils
- 3.2.7 Greenhouse Gas Emissions
- 3.2.8 Hazards and Hazardous Materials
- 3.2.9 Hydrology and Water Quality
- 3.2.10 Land Use and Planning
- 3.2.11 Noise
- 3.2.12 Paleontological Resources
- 3.2.13 Population, Housing, Public Services, Utilities, and Socioeconomics
- 3.2.14 Recreation
- 3.2.15 Traffic and Transportation

The information and data used to prepare this chapter were obtained from several sources including the City of Blythe General Plan, County of Riverside General Plan, and the California Desert Conservation Area (CDCA) Plan. In addition, information was obtained from various U.S. Department of the Interior, Bureau of Land Management (BLM) planning documents, National Environmental Policy Act (NEPA) documents, California Energy Commission (CEC) documents, research publications prepared by various federal and State agencies, and private sources pertaining to key resource conditions found within the

Project area, Alternatives, and surrounding areas. The discussions in this chapter were also informed by the surveys and studies conducted for the Project, as noted throughout this chapter.

3.2 Regional Setting

The Project would be located in eastern Riverside County, approximately five miles west of the city center of Blythe (refer to Figure 1-2, in Chapter 1); portions of the solar array facility would be within the City of Blythe. The proposed Project and Alternatives are situated on the Palo Verde Mesa, which comprises a series of ancient raised river terraces. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (amsl). The following geographic features are located in proximity to the solar facility site and gen-tie lines: the Big Maria Mountains to the northwest; the McCoy Mountains to the west; the Mule Mountains to the southwest; and the Colorado River to the east. These mountain ranges, which trend northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert.

Land uses in the regional area consist of agricultural fields and groves, residences, Blythe Airport, Blythe Energy Center, Blythe Solar Project (owned by NRG), electrical transmission lines, and commercial businesses. Existing open desert lands consist of creosote bush scrub. The proposed solar arrays would be situated primarily within agricultural land, and the gen-tie line within private, disturbed lands and open public lands.

3.2.1 Aesthetics, Visual Resources, and Reflection

Visual resources are the elements of the landscape that contribute to the aesthetic and/or scenic character and quality of the environment. These elements can be either natural or human-made. This section describes the environmental setting and regulatory framework in regards to aesthetics, visual resources, and reflection for the proposed Project and Alternatives. The visual resources inventory describes the existing landscape character and scenic quality of the Project area, identifies sensitive viewpoints and corridors within the visual resources study area, and describes sensitive views in the Project area.

Methodology

The Project area includes private lands for the solar facility and the gen-tie line that would traverse both BLM and private lands. The methodology used to establish baseline environmental conditions includes the inventory of existing visual conditions (visual setting, scenic quality, sensitive viewpoints, visibility and distance zones, key observation points) and incorporation of BLM's policies and guidelines for managing visual resources.

The assessment of aesthetic resources included a review of the proposed Project development plans, regional and local regulatory guidelines, and current land use data. Existing regional landform, vegetation, and water features were reviewed with aerial photography interpretation. Documentation of existing regional physiography was reviewed to determine broad landscape patterns and regionally significant natural features. Land use was determined to identify potential sensitive viewers, viewpoints, and corridors to be evaluated.

A visual resources study area was developed for the Project based on potential for significant impacts. This was based on the scale of the Project and its visual influence on viewers and the landscape. Solar electrical generating facilities may be visible for long distances due to their large scale and contrast with the landscape, particularly from elevated viewpoints that have open views that may encompass an entire facility. Because the Project would be located on flat agricultural land and potential viewers are located at the same elevation as the Project or at a lower elevation, views of the Project would be generally limited to the edges of the solar facility. Because of the low profile of the solar panels, the flat topography, limited development on the mesa on which the Project would be located, and lack of potentially sensitive viewpoints in the mountain ranges around the desert plain, the study area for the solar facility was defined as a 1.0-mile area around the perimeter of the solar facility. For the 230 kV gen-tie line, a 1.5-mile area on

each side (total of a three-mile-wide study corridor) of the centerline was inventoried for visual setting and sensitive viewpoints. The distance threshold for the gen-tie line was based on previous experience with the assessment of visual impacts on transmission lines and previous studies conducted on the visibility of transmission lines in the landscape (Jones and Jones 1976).

Key observation points (KOPs) were selected from the identified sensitive viewpoints and corridors that are representative of views of the Project that would occur during construction, operation, maintenance and decommissioning. Additional viewpoints, such as the residential areas on the Palo Verde Valley floor, were not selected as KOPs because visibility of the Project would be limited. Several mountain ranges with wilderness areas are located around the edges of the desert plain where the Project would be located. However, they do not contain developed trails, parking/trailheads, or other visitor use facilities. See Section 3.2.14, *Recreation*, for a detailed discussion regarding recreational facilities within the Project vicinity. The closest recreational areas to the Project area are the Palo Verde Municipal Golf Course (approximately three miles away) and Midland Long-Term Visitors Areas (approximately seven miles away). These recreational areas would have very distant views of the site that would be difficult to perceive and, therefore, were not selected as KOPs.

BLM Visual Resource Management System

The BLM's Visual Resource Management (VRM) system, as detailed in the 8400 Series Manuals (BLM 1986, 1986a), was also utilized to assess the Project's aesthetic effects. The BLM must consider the scenic values of BLM-administered public lands before allowing uses that may have negative visual impacts. The BLM's VRM system accomplishes this by inventorying scenic values on BLM lands, establishing VRM objectives, and evaluating proposed activities to determine whether they are compatible with the VRM objectives. VRM classes are assigned based on the management decisions made in Resource Management Plans (RMPs). The applicable RMP for the Project is the CDCA Plan. The CDCA Plan does not contain a visual resource element and has not established VRM Classes. Interim VRM Classifications are typically established when a project is proposed and there are no RMP- or Management Framework Plan-approved VRM Classifications. The portion of the Project's gen-tie line corridor that would traverse BLM lands would be in an area of Interim VRM Class III, which was assigned to the area by the McCoy Solar Energy Project Final Environmental Impact Statement (EIS). The objectives of each VRM classification are as follows:

> **VRM Class I**. The objective is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
>
> **VRM Class II**. The objective is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
>
> **VRM Class III**. The objective is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate or lower. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
>
> **VRM Class IV**. The objective is to provide for management activities, which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements in the predominant natural features of the characteristic landscape.

Environmental Setting

Existing Visual Setting

The Project would be located in the Colorado Desert in the Great Basin section of the Basin and Range Physiographic Province (Fenneman 1931). The topography of the basin is relatively flat with occasional desert washes and slopes toward the southeast; elevations range from 260 to 400 feet amsl. The steeply rising, barren-sloped McCoy Mountains visually dominate the mesa. The mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert. Developed lands in the Project vicinity include agricultural fields (both active and fallow) and groves, residences, the Blythe Airport, the Blythe Energy Center, the Blythe Solar Project, electrical transmission lines, and commercial businesses. I-10, which is a Riverside County Eligible Scenic Corridor, crosses through the study area in an east-west alignment. Undeveloped lands surrounding the Project include open desert and creosote bush scrub. Views of the surrounding mountains provide the most significant scenic vistas and backdrops in the study area. Areas of similar visual character present within the visual resources study area include the following:

I. Open Desert/Fallow Agriculture: These areas are open, sparsely vegetated landscapes that are not developed or actively cultivated for agriculture. Based on the Biological Report vegetation mapping, approximately 24 percent of the solar facility was previously disturbed by agricultural or military activities and six percent remains undisturbed (POWER 2012). The gen-tie line corridors would traverse open desert land mainly comprising desert scrub habitat and disturbed lands associated with existing infrastructure. Several utility lines and maintenance roads run through or parallel the gen-tie line corridors. Additionally, the visual resources study area has been previously disturbed by off-highway vehicle (OHV) use, trash dumping, and historic use for military training during World War II.

II. Cultivated Agriculture: These areas are vegetated, irrigated agricultural areas that include actively cultivated fields and orchards, as well as non-irrigated wheat fields. Based on the Biological Report vegetation mapping, approximately 70 percent of the solar facility area is actively cultivated agricultural land, which includes drip-irrigated citrus orchards, flood-irrigated alfalfa, non-irrigated winter wheat, and abandoned jojoba orchards (POWER 2012).

III. Development: These areas have a wide variety of architectural styles and development patterns, with secondary structures, such as garages and barns, or occasional commercial operations. Along Hobson Way, to the west and east of the Project boundary, are a number of industrial and commercial businesses.

IV. Blythe Airport: The airport landscape includes the runways, associated structures, and open areas within the airport complex. The Project boundary is approximately 0.5 mile from Blythe Airport's Runway 26.

V. Electrical Facilities: Electrical facilities include power plants, substations, and transmission and distribution lines. The Project area surrounds the Blythe Energy Center, a 507 MW natural gas-fired facility, which includes the Buck Substation. The Blythe Substation is located on the solar facility site, just north of Hobson Way. There are a number of high voltage transmission lines (161 kV and 230 kV) that enter and exit the Buck and Blythe substations, which bisect the proposed solar facility site. The Blythe Solar Project, owned and operated by NRG, is an existing 21 MW utility-scale photovoltaic solar array that is approximately 0.5 mile from the proposed solar facility site and adjacent to the 230 kV gen-tie line. The proposed gen-tie line would be collocated with other existing and proposed transmission lines through private and BLM-managed lands. The portion of the Project gen-tie line that would cross BLM lands would be located within the CDCA's Multiple-Use Class M. Multiple-Use Class M allows energy and utility development (BLM 1980). The gen-tie would also be within or adjacent to BLM's designated Utility Corridor K and Section 368 Federal Energy Corridor 30-52, which overlap, and within the Riverside East Solar Energy Zone (SEZ).

Scenic Quality

Scenic quality is a measure of the visual appeal of an area created by the features of the landscape, including both natural landscape features (landform, vegetation, water, color, adjacent scenery, and scarcity) and man-made features (roads, structures, and agriculture). The scenic quality of the landscape was assessed based on the criteria used in the BLM VRM system's Visual Resource Inventory (VRI) scenic quality rating system, described in BLM Manual H-8410-1, Visual Resource Inventory (BLM 1986). Criteria including distinctiveness, contrast, variety, harmony, and balance are assessed and scenic quality classes A, B, or C are assigned. Scenic quality classes are defined as follows:

> **Class A:** Areas have outstanding diversity or interest; characteristic features of landform, water, and vegetation are distinctive or unique in relation to the surrounding region. These areas contain considerable variety in form, line, color, and texture.
>
> **Class B:** Areas have above-average diversity or interest, providing some variety in form, line, color, and texture. The natural features are not considered rare in the surrounding region but provide adequate visual diversity to be considered valuable.
>
> **Class C:** Areas have minimal diversity or interest; representative natural features have limited variation in form, line, color, or texture in the context of the surrounding region. Discordant cultural modifications (e.g., substations, transmission lines, other cultural modifications) can be highly noticeable, which can reduce the inherent value of the natural setting.

While all lands have scenic value, areas with the most variety and most harmonious composition have the greatest scenic value. The scenic quality of the Project area and the visual resources study area was assessed as being Class C, which is common to the region. The flat desert landscape, with its sparse vegetation cover areas, has a low level of variety and distinctiveness and a limited color palette that is common to the region. Agricultural fields and groves add vibrant greens and some visual variety to the landscape. Cultural modifications in the visual resources study area include existing transmission lines and other electrical facilities, the Blythe Energy Center, the Blythe Solar Project, and the Blythe Airport, as well as residential development and commercial facilities associated with the City of Blythe on the west end of the visual resources study area, which reduce the inherent value of the natural setting.

Sensitive Viewpoints Analysis

Potentially sensitive viewpoints and corridors within the study area were identified from investigation of agency websites, geographic information system (GIS) shapefiles, aerial photo interpretation, and land use data. Viewpoints and corridors considered include residences, developed recreation areas, and transportation corridors. Viewing context and visual sensitivity level were assessed using the criteria of concern level (expectations for maintaining the existing visual condition), duration of view (static, fixed views or short-duration views), and use volume (number of individual viewers).

Sensitive viewpoints and corridors within the study area that were determined to be highly sensitive to scenery alterations included residences and I-10. Residences generally have a low level of use (relatively few occupants), a high user attitude (high expectations for maintaining existing landscape conditions), and a long duration of view (reoccurring, potentially continuous views). I-10 has a high level of use (many travelers), a high user attitude (expectations for maintaining existing landscape conditions are high because it is a Riverside County Eligible Scenic Corridor), and moderate or intermediate duration views (open highway views).

The Project would be located on the broad and relatively flat Palo Verde Mesa. The majority of residences with views of the solar array are located in the Nicholls Warm Springs/Mesa Verde subdivision south of the Blythe Airport and I-10 (see Figure 3.2.1-1). The residences closest to the Project are located just east of the Project on the mesa. Residences on the Palo Verde Valley floor and outskirts of Blythe are scattered within the eastern half of the visual resources study area. These residences generally do

not have views of the Project due to screening from the 30- to 50-foot bluff that descends to the Palo Verde Valley floor.

Visibility and Distance Zones

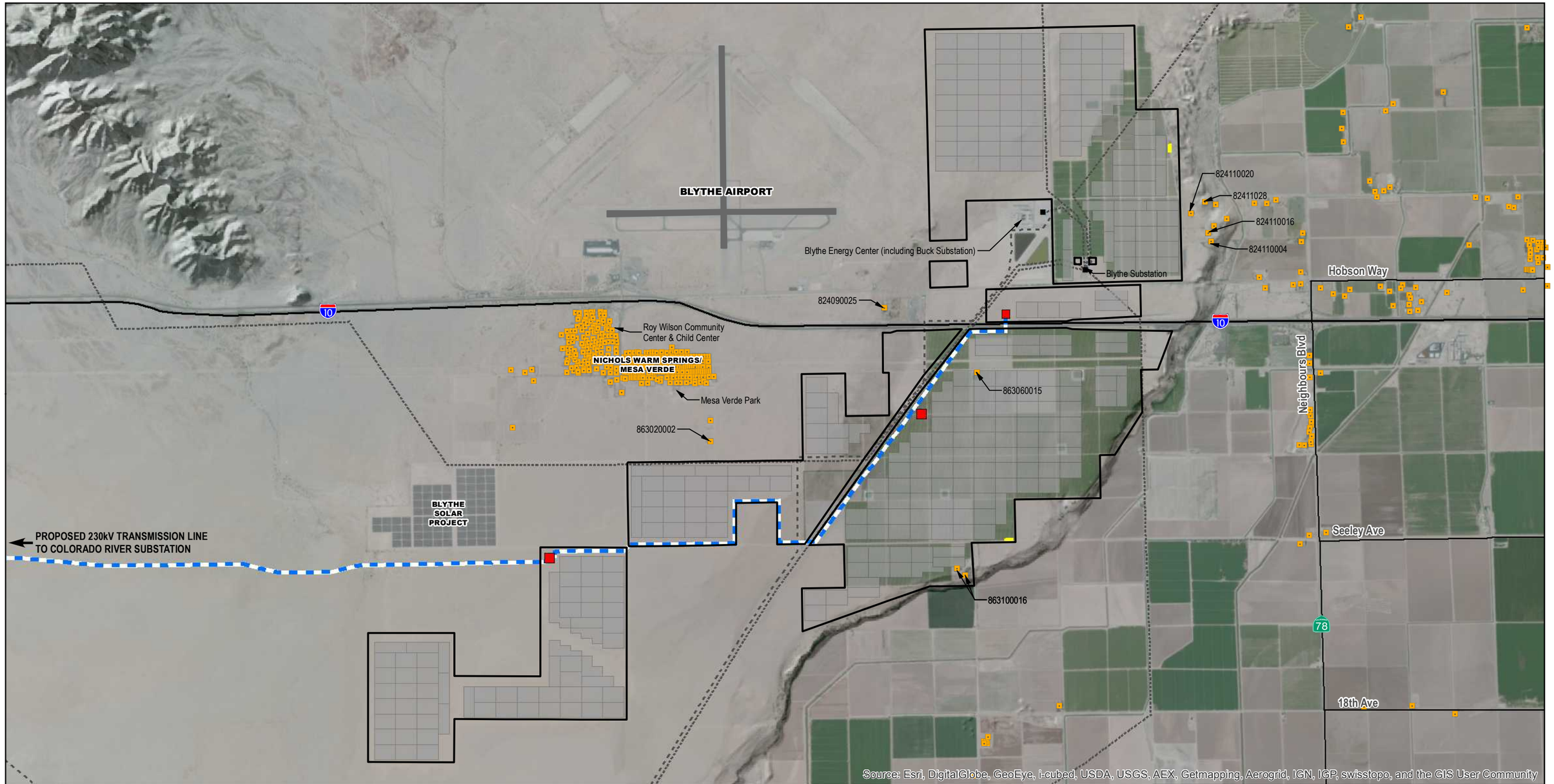
Distance zones, or visibility thresholds, for this Project were based on review of distance zones used by the BLM for VRI assessment (BLM 1986) and previous studies in similar geographical, topographical, and environmental settings, and reflect the scale and natural landscape of the objects being viewed. Table 3.2.1-1 provides the visibility thresholds and distance zones used for the Project. Because the components of the solar facility would be much shorter than the 230 kV gen-tie line structures and would become indistinct at a shorter distance, the distance zones for the solar facility are composed of shorter distances than those used for the gen-tie line.

TABLE 3.2.1-1 VISIBILITY THRESHOLDS USED IN VISUAL ANALYSIS

VISIBILITY THRESHOLD	PROJECT COMPONENT	
	Solar Facility	**230 kV Gen-tie Line**
Immediate Foreground	0 to 300 feet	0 to 500 feet
Foreground	300 to 1,500 feet	500 feet to 0.5 mile
Middleground	1,500 feet to 0.5 mile	0.5 mile to 1.5 miles
Background/Seldom Seen	Beyond 0.5 mile	Beyond 1.5 miles

Source: POWER 2012.

Visibility from sensitive viewpoints were generated by GIS using digital terrain data from the U.S. Geological Survey (USGS) and the viewpoints mapped for this study and identified as sensitive (i.e., residences and I-10). Visibility was mapped using ground visibility for the solar facility and a 105-foot uniform height for the centerline of the proposed 230 kV gen-tie line.



Legend

- Blythe Mesa Solar Project Boundary
- Solar Array Location
- Substation
- Operations & Maintenance Facility
- Proposed 230 kV Transmission Line
- Existing 230 kV Line
- Existing 500 kV Line
- Existing 138-161 kV Line
- Residence

N

0 3,000
Feet
1:36,000



FIGURE 3.2.1-1
RESIDENCES WITHIN THE STUDY AREA

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

THIS PAGE INTENTIONALLY LEFT BLANK

Key Observation Points

The analysis described in this section determined that three KOPs would be sufficient to capture the various types of views of the Project that might be impacted during construction, operation, maintenance, and/or decommissioning. These three KOPs were selected to be representative of the sensitive viewpoints that were identified within the visual resources study area from which the proposed Project would be seen, and were used to evaluate visual impacts.

Photographs were taken at the KOPs with a Canon DSLR Rebel XSI 12-megapixel digital camera fitted with an 18-55 millimeter (mm) zoom lens. The photos were taken with an approximate focal length of 50 mm to represent approximate human viewing conditions. The camera was held at eye-level (approximately five feet from the ground). The date, time of day, global positioning system (GPS) coordinates (latitude/longitude), and weather conditions were documented for each photo location.

The existing visual setting for each KOP is described in the following sections. Figure 3.2.1-2 illustrates the photo locations and views for each KOP's existing condition.

KOP 1: View West from West Riverside Drive

This KOP is located near the residences on the mesa, east of the Project. The view is toward the northwest and encompasses agricultural fields that stretch over the broad, flat landscape of the mesa. See Figure 3.2.1-3 for a photograph of the existing condition. The McCoy Mountains extend across the horizon, with the Big Maria Mountains visible at the northern edge of the view. An existing low voltage distribution line crosses the view in the immediate foreground while additional, higher voltage transmission lines are visible farther away. The Blythe Energy Center is a prominent feature on the southern edge of the view. This view is representative of views from the residences on the mesa and public views along Hobson Way and is a high sensitivity viewpoint. The residences in this area would be the closest residences to the solar facility.

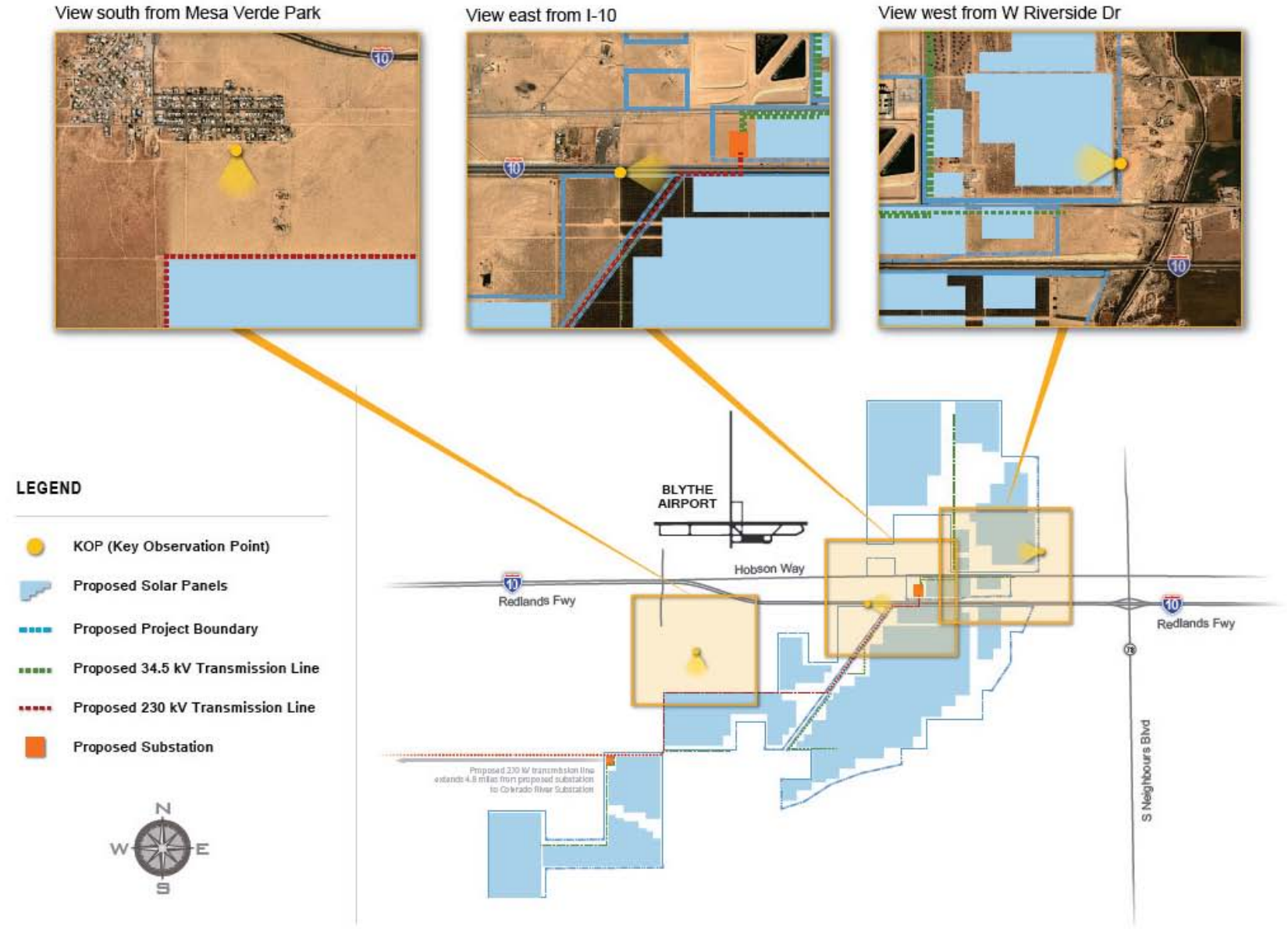
FIGURE 3.2.1-3 EXISTING VIEW FROM KOP 1 (RESIDENCES ON MESA)



THIS PAGE INTENTIONALLY LEFT BLANK

AR062373

FIGURE 3.2.1-2 KOP LOCATIONS AND CAMERA VIEWS



THIS PAGE INTENTIONALLY LEFT BLANK

KOP 2: View from Interstate 10

This KOP is located along I-10, which is a Riverside County Eligible Scenic Corridor and was therefore considered to be a scenic highway. The KOP is representative of views for eastbound and westbound motorists on I-10. See Figure 3.2.1-4 for a photograph of the existing condition.

The photographed view is toward the east and encompasses undeveloped, unvegetated areas and creosote bush scrub, the interstate, several transmission lines, and an agricultural citrus grove. The Sawtooth Mountains are visible on the horizon. Large native shrubs are scattered along the interstate and limit the view on the south side of the roadway.

The view to the west would be similar and would also encompass undeveloped, unvegetated areas and creosote bush scrub, the interstate, and transmission lines. The view to the west would also include the Blythe Airport, the Blythe Energy Center, and the community of Nicholls Warm Springs/Mesa Verde. The Big Maria Mountains to the northwest, the McCoy Mountains to the west, and the Mule Mountains to the southwest provide a backdrop.

FIGURE 3.2.1-4 VIEW FROM KOP 2 (I-10 FREEWAY)



KOP 3: View South from Mesa Verde Park

This KOP is located at a playground on the south end of the community of Nicholls Warm Springs/Mesa Verde. The view is toward the south and encompasses the flat desert landscape of undeveloped, unvegetated areas and creosote bush scrub. An existing transmission line extends across the view. The KOP is representative of views from residences in the Nicholls Warm Springs/Mesa Verde community, which are high-sensitivity viewpoints. See Figure 3.2.1-5 for a photograph of the existing condition.

FIGURE 3.2.1-5 VIEW FROM KOP 3 (NICHOLLS WARM SPRINGS/MESA VERDE)



Palo Verde Valley Residences

Although all residences in the visual resources study are identified as high sensitivity viewpoints, the residences on the Palo Verde Valley floor and outskirts of Blythe were not selected as KOPs because of the limited potential for views of the Project due to topographic screening and distance. However, because some residences may have background views of the Project area, they have been included in the Aesthetics, Visual Resources, and Reflection Affected Environment and Impact Analysis discussions.

Existing Light and Glare

Based on the relatively undeveloped nature of the surrounding landscape, very little light is generated in, or in the vicinity of, the Project area. The primary source of light and glare in the area is motor vehicles traveling on surrounding roadways. During daytime hours, roadways generate glare from the sun's reflection off cars and paved surfaces. Likewise, at night, vehicle headlights on surrounding roadways generate light and glare. Lighting is also located on the Blythe Energy Center site; at the Blythe Airport to alert aircraft of potential hazards in their flight path; and at Palo Verde College.

Regulatory Setting

Federal

BLM VRM System

BLM uses the VRM System to inventory and manage scenic values on lands under its jurisdiction. Guidelines for applying the system are described in the BLM Manual Section 8400 et seq. VRM classes are assigned through RMP). The assignment of VRM classes is based on the management decisions made in RMPs. The applicable RMP for the Project is the CDCA Plan; however, the VRM inventory and management class mapping were not prepared for the CDCA by the BLM and, therefore, VRM Classes

were not established for the proposed Project and Alternatives area. Interim VRM Classifications are typically established when a project is proposed and there are no RMP- or Management Framework Plan-approved VRM Classifications. The portion of the Project gen-tie line that would cross BLM lands would be located within a federally designated Section 368 Energy Corridor (BLM 2009).

Federal Land Policy and Management Act

Section 102(a)(8) of the Federal Land Policy and Management Act of 1976 (FLPMA), 43 United States Code (U.S.C.) § 1701(a)(8), states that "...the public lands [are to] be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values." Section 103(c) of the Act, 43 U.S.C. § 1702(c), identifies "scenic values" as one of the resources for which public land should be managed. Section 201(a), 43 U.S.C. § 1711(a), states that "[t]he Secretary shall prepare and maintain on a continuing basis an inventory of all public lands and their resources and other values (including . . . scenic values)." Section 505(a)(ii) requires that "each right-of-way shall contain terms and conditions which will… minimize damage to scenic and esthetic values." 43 U.S.C. § 1765(a) (ii).

CDCA Plan and the Northern and Eastern Colorado Desert Coordination Management Plan

The Recreation Element of the CDCA Plan specifies that VRM objectives and the contrast rating procedure be used to manage visual resources (BLM 1980). VRM is the process the BLM uses to inventory visual resources (inventory of scenic quality, sensitivity levels, and distance zones), prescribe land use visual standards, and guide Project design to meet the established visual standards. VRM objectives provide the visual management standards for future projects and for rehabilitation of existing projects. Activities within the landscape are designed or evaluated using contrast ratings (BLM 1986).

Local

The Project would be subject to visual policies from the following: Riverside General Plan, the Palo Verde Valley Area Plan, and the City of Blythe General Plan.

Riverside County General Plan

The Riverside County General Plan (adopted October 2003) is applicable to all unincorporated lands within Riverside County. Countywide policies that seek to preserve visual quality are located in the Land Use Element, Open Space Element, and Circulation Element of the County General Plan, and include:

Land Use Element (LU)

Policy LU 6.4. *Retain and enhance the integrity of existing residential, employment, agricultural, and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing, and traffic.*

Policy LU 8.1. *Provide for permanent preservation of open space lands that contain important natural resources, hazards, water features, watercourses, and scenic and recreational values.*

Policy LU 13.1. *Preserve and protect outstanding scenic vistas and visual features for the enjoyment of the traveling public.*

Policy LU 13.3. *Ensure that the design and appearance of new landscaping, structures, equipment, signs or grading within Designated and Eligible State and County Scenic Highways corridors are compatible with the surrounding scenic setting or environment.*

Policy LU 13.4. *Maintain at least a 50-foot setback from the edge of the right-of-way for new development adjacent to Designated and Eligible State and County Scenic Highways.*

Policy LU 13.5. *Requires "new or relocated electric or communication distribution lines, which would be visible from Designated and Eligible State and County Scenic Highways, to be placed underground."*

Policy LU 13.8. *Avoid the blocking of public views by solid walls.*

Policy LU 24.8. *Require that industrial development be designed to consider the surroundings and visually enhance, not degrade, the character of the surrounding area.*

Policy LU-25.5. Requires that *"public facilities be designed to consider their surroundings and visually enhance, not degrade the character of the surrounding area."*

Open Space and Circulation Element (OS)

The Public Facilities area plan land use designation provides for the development of private uses with similar characteristics to public uses and includes utility facilities such as public and private electric generating station and corridors. Privately held uses with public facility characteristics are not required to be designated as Public Facilities, but are eligible to be so designated based on site-specific reviews of the characteristics of the use in question.

Policy OS-20.2. Seeks to *"[p]revent unnecessary extension of public facilities, services, and utilities, for urban uses, into Open Space-Conservation designated areas."*

Policy OS-21.1. *Identify and conserve the skylines, view corridors, and outstanding scenic vistas within Riverside County.*

Policy C-19.1. *Preserve scenic routes that have exceptional or unique visual features in accordance with Caltrans'* [the California Department of Transportation's] *Scenic Highways Plan.*

Policy C-25.2. *Locate new and relocated utilities underground when possible. All remaining utilities shall be located or screened in a manner that minimizes their visibility by the public.*

Scenic Corridors

I-10 is not a State- or county-designated scenic highway; however, it has been identified by the County of Riverside in its Circulation Element as eligible for designation as a scenic corridor. The County has indicated in its General Plan Land Use Element that I-10 should be designated a scenic highway and has developed General Plan scenic corridor policies. These policies seek to maintain resources in corridors along scenic highways. Policies for Scenic Corridors include:

- Preserve and protect outstanding scenic vistas and visual features for the enjoyment of the traveling public.
- Incorporate riding, hiking, and bicycle trails and other compatible public recreational facilities within scenic corridors.
- Ensure that the design and appearance of new landscaping, structures, equipment, signs, or grading within Designated and Eligible State and County Scenic Highway corridors are compatible with the surrounding scenic setting or environment.
- Maintain at least a 50-foot setback from the edge of the right-of-way (ROW) for new development adjacent to designated and eligible State and County Scenic Highways.
- Require new or relocated electric or communication distribution lines that would be visible from Designated and Eligible State and County Scenic Highways to be placed underground.
- Prohibit off-site outdoor advertising displays that are visible from Designated and Eligible State and County Scenic Highways.
- Require that the size, height, and type of on-premise signs visible from Designated and Eligible State and County Scenic Highways be the minimum necessary for identification.

The design, materials, color, and location of the signs shall blend with the environment, utilizing natural materials where possible.

- Avoid the blocking of public views by solid walls.

Palo Verde Valley Area Plan

Palo Verde Valley Area Plan (RCTLMA 2008) policies that address visual quality are located in the Local Circulation Policies, Scenic Highways, and include:

PVVAP 10.1. Protect the scenic highways in the Palo Verde Valley planning area from change that would diminish the aesthetic value of adjacent properties in accordance with the Scenic Corridors sections of the General Plan Land Use, Multipurpose Open Space, and Circulation Elements.

PVVAP 10.2. *Encourage the designation of Interstate 10 and US Highway 95 as eligible and subsequently Official Scenic Highways in accordance with the California State Scenic Highway Program.*

City of Blythe General Plan

City policies in the City of Blythe General Plan 2025 (2007) that seek to preserve visual quality are located in the Land Use Element, Open Space Element, Guiding Policies of the City General Plan, and include:

Open Space and Conservation Element

Policy 1: *Maintain hillsides and visible agricultural lands as open space for resource conservation and preservation of views*.

Policy 3: *Maintain existing views of the Mesa and Colorado River from roadways and public uses and other rights-of-way on the valley floor whenever feasible.*

3.2.2 Agriculture

This section describes the environmental setting and regulatory framework in regards to agriculture for the proposed Project and Alternatives. The Project would be located primarily on land zoned for agricultural production. Although timber production is an allowable activity within an agricultural zone, the Project area is not used for timber production, nor is it forested. Because of the arid climate of the area surrounding Project and Alternatives, it is unlikely that the land could support 10 percent native tree cover under natural (i.e., non-irrigated) conditions; therefore, the Project does not meet the definition of “forest land” (Public Resources Code [PRC] Section 12220(g)). The same land is not considered timberland (PRC Section 4526) because the land is not zoned Timberland Production Zone (PRC Section 51104(g)).

The information contained in this section is based on the following resources: Riverside County General Plan; soil classifications by the United States Department of Agriculture’s (USDA) Natural Resources Conservation Service’s (NRCS) Web Soil Survey; California Department of Conservation (DOC) Farmland Monitoring and Mapping Program (FMMP) data; Palo Verde Irrigation District Crop Report; aerial photography; and a study prepared by URS for the Project, applying the Land Evaluation Site Assessment methodology.

The California DOC FMMP produces Important Farmland Maps that document resource quality and land use information. The USDA soil survey information and the corresponding Important Farmland candidacy recommendations are used for assessing local land. The FMMP is intended to assist decision-makers in assessing present status, reviewing trends, and planning for the future of California’s agricultural land resources. The FMMP uses eight land classifications, described below.

Prime Farmland: Farmland with the best combination of physical and chemical features able to sustain long-term agricultural production. This land has the soil quality, growing season, and moisture supply

needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.

Farmland of Statewide Importance: Farmland similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.

Unique Farmland: Farmland of lesser-quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include non-irrigated orchards or vineyards, as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.

Farmland of Local Importance: Land of importance to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee. Farmland of Local Importance in Riverside County is defined as:

- Lands with soils that would be classified as Prime or Statewide Important Farmlands but lack available irrigation water.
- Lands planted in 1980 or 1981 in dry land grain crops such as barley, oats, and wheat.
- Lands producing major crops for Riverside County that are not listed as Unique Farmland crops. Such crops are permanent pasture (irrigated), summer squash, okra, eggplant, radishes, and watermelon.
- Dairylands, including corrals, pasture, milking facilities, and hay and manure storage areas, if accompanied with permanent pasture or hayland of 10 acres or more.
- Lands identified by the County with Agriculture land use designations or contracts.
- Lands planted with jojoba that are under cultivation and are of producing age.

Grazing Land. Land on which the existing vegetation is suited to the grazing of livestock. This category was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities.

Urban and Built-up Land. Land occupied by structures with a building density of at least one unit to 1.5 acres, or approximately six structures to a 10-acre parcel. This land is used for residential, industrial, commercial, construction, institutional, public administration, railroad and other transportation yards, cemeteries, airports, golf courses, sanitary landfills, sewage treatment, water control structures, and other developed purposes.

Other Land. Land not included in any other mapping category. Common examples include low density rural developments; brush, timber, wetland, and riparian areas not suitable for livestock grazing; confined livestock, poultry or aquaculture facilities; strip mines and borrow pits; and water bodies smaller than forty acres. Vacant and non-agricultural land surrounded on all sides by urban development and greater than 40 acres is mapped as Other Land.

Land Committed to Nonagricultural Use. Land Committed to Nonagricultural Use is land that is permanently committed by local elected officials to nonagricultural development by virtue of decisions which cannot be reversed simply by a majority vote of a city council or county board of supervisors.

Environmental Setting

Riverside County

Agriculture remains a strong component in Riverside County's economy, and Riverside County agriculture competes successfully in the global agricultural market. According to the annual Riverside County Agricultural Production Report (2011), agriculture production accounted for an estimated $1,282,256,116 in 2011. The primary agricultural products from Riverside County include nursery stock, milk, table grapes, hay, bell peppers, and eggs. Nursery stock ranked as the top-valued crop in Riverside County.

The most recent agricultural land conversion data available for Riverside County is for the 2008 to 2010 period. Land converted in this period is shown below in Table 3.2.2-1.

TABLE 3.2.2-1 RIVERSIDE COUNTY AGRICULTURAL LAND CONVERSION 2008 TO 2010

LAND USE CATEGORY	TOTAL ACRES INVENTORIED		2008 TO 2010 ACREAGE CHANGES		
	2008	2010	Acres Lost (-)	Acres Gained (+)	Net Acreage Changed
Prime Farmland	122,935	119,635	5,655	2,355	-3,300
Farmland of Statewide Importance	44,653	44,086	1,463	896	-567
Unique Farmland	37,133	35,391	2,780	1,038	-1,742
Farmland of Local Importance	229,156	229,877	7,012	7,733	721
Grazing Land	111,219	110,841	410	32	-378
Agricultural Land Subtotal	**545,096**	**539,830**	**17,320**	**12,054**	**-5,266**

Source: California DOC 2010b.

For the two-year period from 2008 to 2010, Riverside County had a decrease of 5,266 acres in the total amount of active agricultural land mapped by the FMMP. (For comparison, during the 2006 to 2008 period, Riverside County had a net decrease in irrigated farmland of approximately 11,173 acres.) This included a decrease of 4,888 acres of Important Farmland (including Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance) and a decrease of 378 acres of Grazing Land. The largest decrease was in Prime Farmland, with 3,300 acres converted to non-agricultural uses. There were also decreases in Farmland of Statewide Importance (a net decrease of 567 acres) and Unique Farmland (a net decrease of 1,742 acres) during the 2008 to 2010 period.

Site Description and Vicinity

Palo Verde Valley

The Project would be located on the Palo Verde Mesa, which is west of the Palo Verde Valley area, and a small portion of the solar facility would be within the City of Blythe. The Palo Verde Valley floor is one of the richest agricultural regions in California. The soils, deposited by the Colorado River, are classified as Prime Farmland, Farmland of Statewide Importance, and Unique Farmland, some of which are under Williamson Act contracts. Based on Sheet 3 of the Riverside County Important Farmland 2010 map, approximately 198,000 acres of Important Farmland are within the Palo Verde Valley. The Palo Verde Valley supports agricultural lands that include alfalfa; cotton: wheat and barley; and Sudan grass and Bermuda grass (Barrows 2007). With its long, hot growing season, the Palo Verde Valley is ideal for agriculture; crops are grown and harvested year-round. Mild winters, with a minimum of frost, permit growing of many crops not suitable for production in other areas. Primary agricultural uses in the City of Blythe include alfalfa, cotton, hay, orchards, and field crops. Land to the north and south of I-10 and east of the Mesa are considered suitable for seasonal livestock (sheep) grazing (City of Blythe 2007).

Colorado River water is supplied through the Palo Verde Irrigation District (PVID) canals and laterals. There are also a number of irrigation ditches that are owned and operated by the water users in the PVID. The PVID contains approximately 131,298 acres, 26,798 acres of which are on the Palo Verde Mesa (PVID 2011). Table 3.2.2-2 details the field crops grown in the entire PVID.

TABLE 3.2.2-2 PALO VERDE IRRIGATION DISTRICT CROP REPORT 2011

DISTRICT CROPS	ACREAGE
Field Crops	
Alfalfa	44,974
Barley	308
Bermuda Grass	1,922

DISTRICT CROPS	ACREAGE
Citrus	1,984
Corn	113
Cotton	16,620
Golf Course	137
Klein Grass	1,939
Milo	134
Multi-Species Conservation Program Habitat	812
Oats	610
Orchard	40
Palm Trees	186
Rye	177
Sudan	2,101
Timothy Grass	5
Wheat	1,645
	Subtotal: 73,707 Acres
Vegetables	
Broccoli	1,242
Cabbage	72
Garlic	0
Lettuce - Spring	478
Lettuce - Fall	885
Mixed Vegetables	25
Onions	0
Squash	30
	Subtotal: 2,732 Acres
Melons	
Cantaloupe	738
Honeydew	683
Watermelon	126
Mixed Melons	804
	Subtotal: 2,351 Acres
Other	
Fish Ponds	81
Fallow	35,626
Idle or Diverted	1,491
	Subtotal: 37,198 Acres
	GROSS ACRES: 115,988 Acres

Source: PVID 2011.

Palo Verde Mesa

The proposed Project is located on the Palo Verde Mesa, generally west of the Palo Verde Valley. Palo Verde Mesa has a higher elevation in comparison to the Palo Verde Valley. Water supplied from the PVID is lifted onto the Mesa by private pumps to irrigate agricultural lands. The PVID provides water to approximately 26,798 acres on the Palo Verde Mesa (PVID 2011).

According to the 2010 FMMP, the solar facility site would occupy 1,707 acres of Important Farmland (1,681 acres of Prime Farmland, 16 acres of Unique Farmland, and 10 acres of Farmland of Statewide Importance) and 1,880 acres of Farmland of Local Importance designated by Riverside County on Palo Verde Mesa. No Williamson Act contract lands are currently located within the Project boundary. Figure 3.2.2-1 illustrates the Important Farmland Classifications in the Project area and includes a 0.25-mile buffer around the solar facility site. The portion of the proposed 230 kV gen-tie line corridor that extends outside the solar facility site is also located on Palo Verde Mesa; however, it does not contain designated agricultural resources.

The predominant crop on Palo Verde Mesa is citrus (refer to the *Biological Resources Technical Report* in Appendix C1). Approximately 24 percent of the solar facility site was previously disturbed by agricultural or military activities. Based on biological vegetation mapping (Table 3.2.4-1), approximately 75 percent of the proposed solar facility site is actively cultivated agricultural land, which includes:

- Drip-irrigated citrus orchards (1,188.4 acres)
- Flood-irrigated alfalfa (404 acres)
- Non-irrigated winter wheat (1,088.2 acres)

The USDA survey identified 15 soil types on the solar facility site (see Figure 3.2.2-2). These include: Aco gravelly loamy sand; Aco sandy loam; badland; Carrizo gravelly sand; Cibola silty clay loam; duneland; Imperial silty clay; Meloland fine sandy loam; Orita fine sand; Orita gravelly fine sandy loam; Ripley very fine sandy loam; Rositas fine sand 0 to 2 percent slopes and 2 to 9 percent slopes; Rositas fine sand, wet, 0 to 2 percent slopes; and Rositas gravelly loamy sand, 0 to 2 percent slopes.

Within an area that includes the solar facility site and a surrounding 0.25-mile buffer of the solar facility site, most of the lands used for agricultural production are located in the Palo Verde Valley to the east and south. Approximately 7,377 acres are within this area, 1,951 acres of which are in agricultural production (URS 2012). Parcels intersected by the line comprising the outside edge of the 0.25-mile buffer are accounted for in their entirety in the acreage calculations. There are 282.2 acres of Williamson Act contracted lands are within this area (URS 2012).

In the 1970s, large-scale development of irrigated agricultural production was attempted on the Palo Verde Mesa. Groundwater supplies were utilized as the primary water source for the newly developed agricultural crops. However, agricultural development was unsuccessful during these years and the acreage was subsequently abandoned and left without irrigation for an extended period of time. Because of the previous agricultural efforts of the 1970s, 1,319 acres (approximately) of land proposed for the solar facility has been previously irrigated. It is estimated, though, that much of the fertile topsoil has likely eroded away since that time. As a result, the future agricultural suitability of this area has been reduced (Burton 2012).

PVID reports that there were 3,911 acre-feet (AF) of groundwater provided to irrigate 768 acres on the Palo Verde Mesa in 2010; however, this groundwater did not support agricultural operations on the Project area. Instead, based on the 2010 PVID report, the agricultural operations on Project area utilized approximately 12,000 AF of water from the PVID surface delivery system to irrigate crops on approximately 1,592 acres. This surface delivery system would also be available to the proposed solar facility. Please refer to Section 3.2.9, *Hydrology and Water Quality*, for a detailed discussion regarding groundwater and water supply.

Regulatory Framework

Federal

Farmland Protection Policy Act (7 U.S.C. § 4201)

The purpose of the Farmland Protection Policy Act (FPPA) is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses.

It additionally directs federal programs to be compatible with state and local policies for the protection of farmlands. Congress passed the Agriculture and Food Act of 1981 (Public Law 97-98) containing the FPPA—Subtitle I of Title XV, Section 1539-1549. The final rules and regulations were published in the Federal Register on June 17, 1994.

The FPPA was implemented to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses, and to ensure that federal programs are administered in a manner compatible with state and local programs and policies to protect farmland. To fulfill these objectives, the USDA has promulgated criteria and guidelines to assess the effects of the conversion of farmland. The FPPA ensures that, to the extent possible, federal programs are administered to be compatible with state, local units of government, and private programs and policies to protect farmland. Federal agencies are required to develop and review their policies and procedures to implement the FPPA every two years. Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to non-agricultural use and are completed by a federal agency or with assistance from a federal agency. The FPPA does not authorize the federal government to regulate the use of private or nonfederal land or, in any way, affect the property rights of owners.

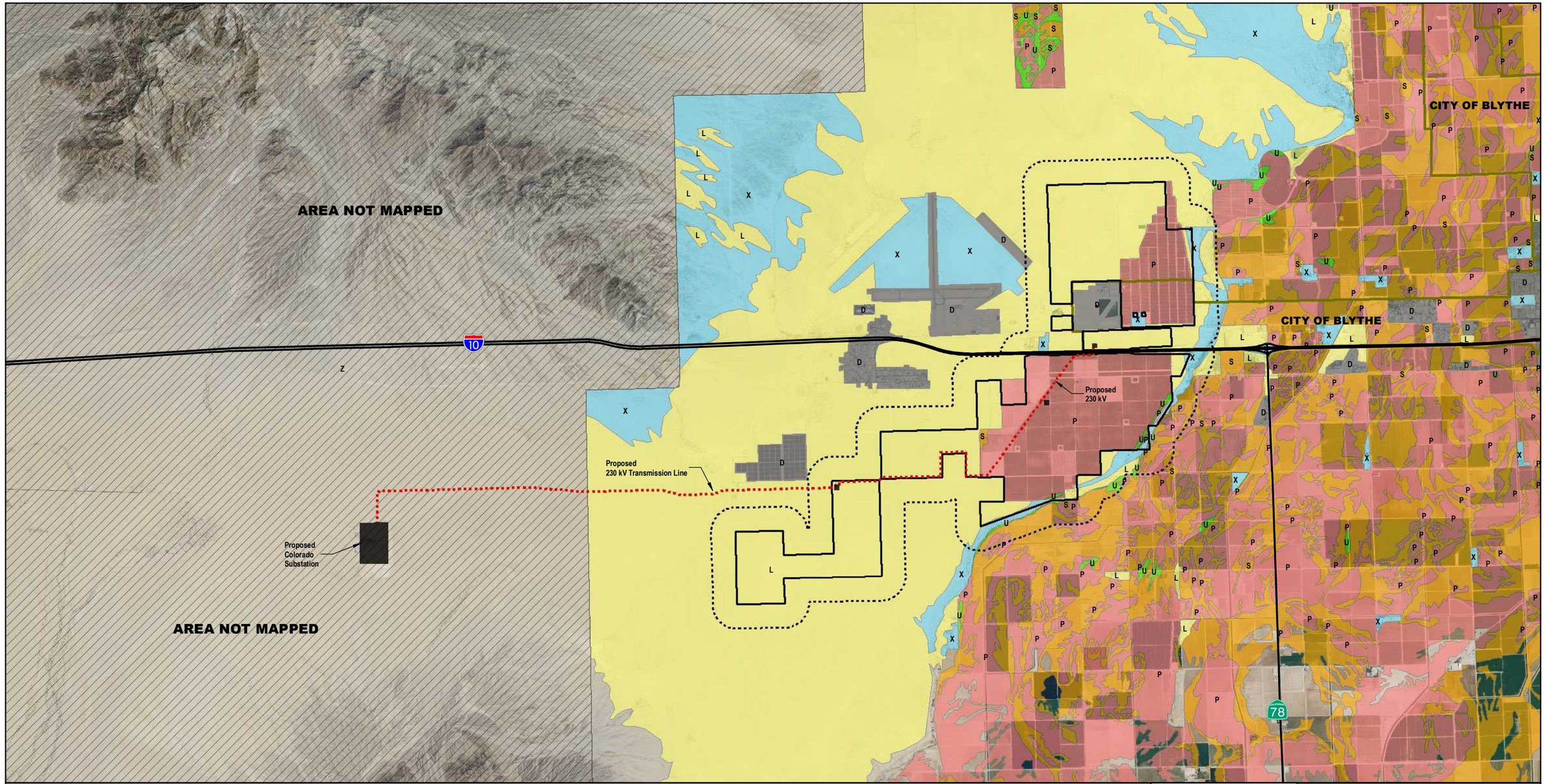
For the purpose of FPPA, farmland includes prime farmland, unique farmland, and farmland of statewide or local importance. The USDA has developed definitions for Prime Farmland and Unique Farmland that are used for purposes of the FPPA. The federal definitions are similar to the California definitions, which are set forth below. The primary distinction between the State and federal definitions is that Prime Farmland must be irrigated to satisfy the State definitions, while irrigation is not required under the federal regulations. Under the federal regulations, Prime Farmland could be cropland, pastureland, rangeland, forest land, or other land (but not urban built-up land or water), so long as the land meets required physical and chemical criteria. In its FPPA regulations, the USDA recommends that federal agencies use a Land Evaluation and Site Assessment (LESA) system to evaluate prospective farmland conversion for projects in states that have approved LESA models.

State

California Department of Conservation, Division of Land Resource Protection

The California DOC applies the NRCS soil classifications to identify agricultural lands, and these agricultural designations are used in planning for the present and future of California's agricultural land resources. Pursuant to the California DOC's FMMP, these designated agricultural lands are included in the Important Farmland Maps used in planning for the present and future of California's agricultural land resources. The FMMP was established in 1982 to assess the location, quality, and quantity of agricultural lands and the conversion of these lands. The FMMP provides analysis of agricultural land use and land use changes throughout California. The California DOC has a minimum mapping unit of 10 acres, with parcels that are smaller than 10 acres being absorbed into the surrounding classifications.

The California DOC FMMP produces Important Farmland Maps that document resource quality and land use information. The USDA soil survey information and the corresponding Important Farmland candidacy recommendations are used for assessing local land. The FMMP is intended to assist decision-makers in assessing present status, reviewing trends, and planning for the future of California's agricultural land resources. The FMMP uses eight land classifications: (1) Prime Farmland, (2) Farmland of Statewide



Legend

- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- City of Blythe
- 1/4-Mile Project Buffer

Farmland Mapping and Monitoring Program

- Prime Farmland (P)
- Farmland of Statewide Importance (S)
- Farmland of Local Importance (L)
- Unique Farmland (U)
- Other Land (X)
- Urban and Built-Up Land (D)
- Area not mapped (Z)

N

0 1 2

Miles

1:63,360



FIGURE 3.2.2-1
IMPORTANT FARMLAND

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program, 2010. USDA NAIP Imagery, 2012.

THIS PAGE INTENTIONALLY LEFT BLANK

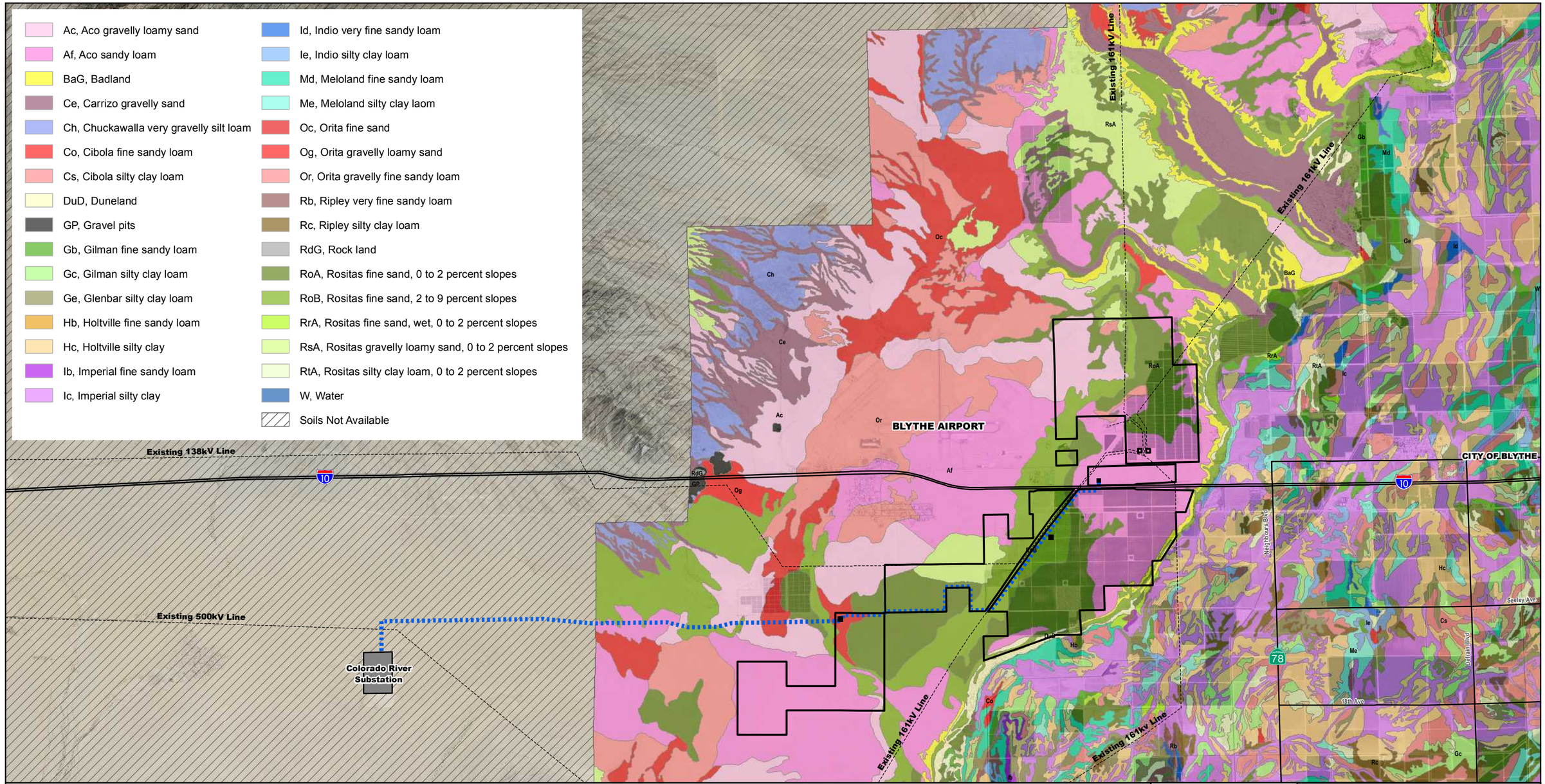


FIGURE 3.2.2-2
SOILS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: USDA, NRCS, Digital General Soil Map of U.S., 2006. USDA NAIP Imagery, 2012.

THIS PAGE INTENTIONALLY LEFT BLANK

Importance, (3) Unique Farmland, (4) Farmland of Local Importance, (5) Grazing Land, (6) Urban and Built-up Land, (7) Other Land, and (8) Land Committed to Nonagricultural Use.

Public Resources Code

PRC Section 21060.1 defines agricultural land for the purposes of assessing environmental impacts using the FMMP. Sections 21061.2 and 21095; and California Environmental Quality Act (CEQA) Guidelines Appendix G, identify the California LESA Model as an optional methodology to access impacts on agriculture and farmland.

The LESA model allows for rating the quality of land for agricultural uses by rating soil resources, project size, water availability, surrounding agricultural lands, and surrounding protected resource lands. The factors are weighted relative to one another, resulting in a numeric score that is measured against thresholds established by the California DOC. Both Riverside County and the BLM have used the LESA model for assessing impacts. The LESA model allows a more precise characterization of the specific attributes of the Project area than an application of the more generalized farmland categories used in the FMMP.

California Land Conservation Act (Williamson Act)

The California Land Conservation Act of 1965, commonly referred to as the Williamson Act, is promulgated in California Government Code Section 51200-51297.4, and therefore is applicable only to specific land parcels within the state of California. The Williamson Act enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space uses in return for reduced property tax assessments. Private land within locally designated agricultural preserve areas is eligible for enrollment under Williamson Act contracts. However, an agricultural preserve must consist of no less than 100 acres; in order to meet this requirement, two or more parcels may be combined if they are contiguous, or if they are in common ownership.

The Williamson Act program is administered by the California DOC in conjunction with local governments, which administer the individual contract arrangements with landowners. The landowner commits the parcel to a 10-year period wherein no conversion out of agricultural use is permitted. Each year the contract automatically renews unless a notice of non-renewal or cancellation is filed. In return, the land is taxed at a rate based on the actual use of the land for agricultural purposes, as opposed to its unrestricted market value. An application for immediate cancellation can also be requested by the landowner, provided that the proposed immediate cancellation application is consistent with the cancellation criteria stated in the California Land Conservation Act and those adopted by the affected county or city. Non-renewal or immediate cancellation does not change the zoning of the property. Participation in the Williamson Act program is dependent on county adoption and implementation of the program and is voluntary for landowners. Riverside County implements the Williamson Act and has adopted Rules and Regulations Governing Agricultural Preserves.

As defined by the Williamson Act, prime agricultural land includes: (1) Class I and II soils as classified by the NRCS; (2) land that qualifies for rating 80 through 100 in the Storie Index Rating by the University of California, Division of Agricultural Sciences; (3) land that supports livestock used for the production of food and fiber and with a carrying capacity of at least one animal unit per acre; (4) land planted with fruit or nut-bearing crops that have a nonbearing period of less than five years and that will normally yield not less than $200 per acre annually during commercial bearing periods; or (5) land that has returned from the production of unprocessed agricultural plant products an annual gross value of not less than $200 per acre for three of the previous five years (Government Code, Section 51201(c)(1)-(5)). The Williamson Act states that a board or council by resolution shall adopt rules governing the administration of agricultural preserves. The rules of each agricultural preserve specify the uses allowed in the preserve. Owners of land within a preserve may then opt to enter into Williamson Act contracts, which restrict the valuation of the property used for property tax purposes in exchange for a long-term commitment to agricultural and compatible uses. Generally, any commercial agricultural use will be permitted within any agricultural preserve and on contracted lands. In addition, local governments may identify compatible uses permitted with a use permit.

California Government Code Section 51238 states that, unless otherwise decided by a local board or council, the erection, construction, alteration, or maintenance of electric and communication facilities, as well as other facilities, are determined to be compatible uses within any agricultural preserve. Section 51238 also states that boards of supervisors may impose conditions on lands or land uses to be placed within preserves to permit and encourage compatible uses in conformity with Section 51238.1.

Further, California Government Code Section 51238.1 allows a board or council to allow as compatible any use that without conditions or mitigations would otherwise be considered incompatible. However, this may occur only if that use meets the following conditions:

- The use will not significantly compromise the long-term productive agricultural capability of the subject contracted parcel or parcels on other contracted lands in agricultural preserves.
- The use will not significantly displace or impair current or reasonably foreseeable agricultural operations on the subject contracted parcel or parcels or on other contracted lands in agricultural preserves. Uses that significantly displace agricultural operations on the subject contracted parcel or parcels may be deemed compatible if they relate directly to the production of commercial agricultural products on the subject contracted parcel or parcels or neighboring lands, including activities such as harvesting, processing, or shipping.
- The use will not result in the significant removal of adjacent contracted land from agricultural or open-space use.

Farmland Security Zone Act

The Farmland Security Zone Act is similar to the Williamson Act and was passed by the California State Legislature in 1999 to ensure that long-term farmland preservation is part of public policy. Farmland Security Zone Act contracts are sometimes referred to as “Super Williamson Act Contracts.” Under the provisions of this act, a landowner already under a Williamson Act contract can apply for Farmland Security Zone status by entering into a contract with the county. Farmland Security Zone classification automatically renews each year for an additional 20 years. In return for a further 35 percent reduction in the taxable value of land and growing improvements (in addition to Williamson Act tax benefits), the owner of the property promises not to develop the property into non-agricultural uses.

Project lands are not under a Farmland Security Act Contract.

Local

Riverside County General Plan

The Riverside County General Plan Land Use Element includes the Agricultural Foundation Component, which contains the agriculture area plan. The Agriculture land use designation has been established to help conserve productive agricultural lands within the county. The intent of the Agriculture Foundation Component and its associated policies is to identify and preserve areas where agricultural uses are the long-term desirable use, as stated in the general plan principles: “Provide for the continued and even expanded production of agricultural products by conserving areas appropriate for agriculture and related infrastructure and supporting services.” In addition, the intent of these policies is to minimize the conflicts between agricultural and urban or suburban uses.

Land Use Element (LU)

Policy LU 6.4. *Retain and enhance the integrity of existing residential, employment, agricultural and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing and traffic*.

Policy LU 16.1. *Encourage retaining agriculturally designated lands where agricultural activity can be sustained at an operational scale, where it accommodates lifestyle choice, and in locations where impacts to and from potentially incompatible uses, such as residential uses, are minimized, through incentives such as tax credits*.

Policy LU 16.2. *Protect agricultural uses, including those with industrial characteristics (dairies, poultry, hog farms, etc.) by discouraging inappropriate land division in the immediate proximity and allowing only uses and intensities that are compatible with agricultural uses*.

Policy LU 16.4. *Encourage conservation of productive agricultural lands. Preserve prime agricultural lands for high-value crop production*.

Multipurpose Open Space Element

The Riverside County General Plan Multipurpose Open Space Element (OS) includes the following policies with respect to agricultural land and describes Farmland of Local Importance as follows:

- These farmlands are not covered by the above categories but are of locally significant economic importance. They include the following:
- Lands with soils that would be classified as Prime or Statewide Important Farmlands but lack available irrigation water.
- Lands planted in 1980 or 1981 in dry land grain crops such as barley, oats, and wheat.
- Lands producing major crops for Riverside County but that are not listed as Unique Farmland crops. Such crops are permanent pasture (irrigated), summer squash, okra, eggplant, radishes, and watermelon.
- Dairylands including corrals, pasture, milking facilities, hay and manure storage areas if accompanied with permanent pasture or hayland of 10 acres or more.
- Lands identified by the County with Agriculture land use designations or contracts.
- Lands planted with jojoba that are under cultivation and are of producing age.

Policy OS 7.3. *Encourage conservation of productive agricultural lands and preservation of prime agricultural lands*.

Riverside County General Plan – Palo Verde Valley Area Plan

The majority of the planning area within the Palo Verde Valley is devoted to agriculture and is regulated through the Palo Verde Valley Area Plan (PVVAP). The PVVAP provides for agricultural land use designations along with residential densities and uses. The applicable policy related to agricultural lands included with the PVVAP is provided below.

PVVAP 4.1. *Protect farmland and agricultural resources in Palo Verde Valley through adherence to the Agriculture sections of the General Plan Multipurpose Open Space and Land Use Elements*.

Riverside County Agricultural Preserve Ordinance – Ordinance 509

The Riverside County Agricultural Preserve Ordinance provides for the administration of lands placed in agricultural preserves, including procedures for initiating, filing, and processing requests to establish, enlarge, disestablish, or diminish agricultural preserves, pursuant to the California Land Conservation Act. In establishing the rules under this ordinance, the County found that:

- the preservation of the maximum amount of the limited supply of agricultural land is necessary to the conservation of the County's economic resources, and is necessary not only for the maintenance of agricultural economy of the County, but also for the assurance of adequate, healthful and nutritious food for future residents of the County;
- the discouragement of premature and unnecessary conversion of agricultural land to urban uses is a matter of public interest and will be of benefit to urban dwellers

themselves in that it will discourage discontinuous urban development patterns which unnecessarily increase costs of community services to community residents; and

- in a rapidly urbanizing society agricultural lands have a definite public value as open space, and the preservation in agricultural production of such lands, constitutes an important physical, social, aesthetic and economic asset to existing and pending urban or metropolitan development.

There are no locally designated agricultural preserves affected by the Project.

Riverside County Ordinance 348.4705

Zoning ordinance 348.4705 permits a solar power plant in several districts, including agricultural districts, with a use permit. Ordinance 348.4705 was enacted at the same time as and implements General Plan Policy LU-15.15, which states: "Permit and encourage, in an environmentally and fiscally responsible manner, the development of renewable energy resources and related infrastructure, including but not limited to, the development of solar power plants in the County of Riverside."

Riverside County Ordinance 625, the "Right to Farm" Ordinance

Ordinance 625 factors into Riverside County's standard significance thresholds. It was enacted to conserve, protect, and encourage the development, improvement, and continued viability of agricultural land. The intent of the ordinance is to reduce the loss to the County of its agricultural resources by limiting the circumstances under which agricultural operations may be deemed to constitute a nuisance. Nothing in the ordinance is to be construed to limit the right of any owner of real property to request that the county consider a change in the zoning classification.

City of Blythe General Plan 2025

Policies related to agricultural lands included with the City of Blythe General Plan 2025 are provided below.

Open Space and Conservation Elements

Open Space

Policy 1: *Maintain hillsides and viable agricultural lands as open space for resource conservation and preservation of views*.

Policy 2: *Minimize conflicts between urban and agricultural uses by requiring buffers and greenbelts.*

Agriculture

Policy 9: *Promote continued agricultural use of important farmland outside the urban area*.

Policy 10: *Minimize conflicts between agricultural and urban uses by requiring buffers or use restrictions or using roads or canals to separate these uses*.

City of Blythe Zoning

The City of Blythe Zoning Code lists utility operations facilities among the uses permitted through obtaining a conditional use permit in the Agricultural zoning district. Utility operations facilities are permitted uses in the Service Industrial zoning district.

3.2.3 Air Quality

This section provides an overview of the technical methodology used in collecting baseline conditions, examines the affected environment, and presents the regulatory framework with respect to air quality. Recent regulatory actions on both the federal and State levels address emissions of greenhouse gases and potential global climate change impacts. Under CEQA guidelines, global climate change is addressed as a cumulative impact. Greenhouse gas emissions are discussed in Section 3.2.7. Recent regulatory action on both the federal and State level addresses emissions of greenhouse gases and potential global climate change impacts.

The information in this section is based on the *Air Quality and Global Climate Change Technical Report*, prepared by Scientific Resources Associated (SRA 2013) (provided in Appendix B of this Draft EIR/EA). While this section presents a summary of the findings of the Air Quality and Global Climate Change Technical Report, please refer to that report for more detailed information on the proposed Project and Alternatives' effects on air quality and climate change.

Environmental Setting

Regional Climate

The Project would be located in eastern California in the Colorado Desert. The climate in the Blythe area is categorized as a high desert climate, with dry, hot summers and cool winters. The region is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. January is the coldest month, with a mean low temperature of 37.4 degrees Fahrenheit (°F). July is the hottest month, with a mean high temperature of 108.4°F.

In late winter and early spring, the wind is a prominent feature, with dry winds blowing in the afternoon and evening. Winds in excess of 25 miles per hour (mph), with gusts of 75 mph or more, are not uncommon. Although it is windy during all months, November, December, and January are the calmest. During 2010, the predominant wind direction was from the south approximately 21 percent of the time, with overall average speed of 7.2 mph (SRA 2013). The humidity is below 40 percent most of the year. During most winter nights, and during and after summer rains, the humidity can rise above 50 percent.

Data from the Western Regional Climate Center (WRCC 2010) indicate that temperature and precipitation data have been measured at Blythe from January 1913 through the present. The mean temperature for the Blythe station is 71.6°F, and the mean annual precipitation is 3.8 inches. More than half of the precipitation occurs between November and March. Although rainfall occurs primarily in the winter months, the region is periodically influenced by tropical weather conditions including sudden monsoonal late summer storms. Monthly average temperatures and precipitation for the area are summarized in Table 3.2.3-1.

TABLE 3.2.3-1 MONTHLY AVERAGE TEMPERATURES AND PRECIPITATION, BLYTHE METEOROLOGICAL STATION

MONTH	MONTHLY AVERAGE TEMPERATURES, °F			PRECIPITATION, INCHES
	Maximum	Minimum	Mean	Mean
January	67.6	37.4	52.5	0.51
February	73.0	41.8	57.4	0.46
March	79.4	46.5	57.4	0.34
April	87.4	52.7	70.0	0.12
May	95.5	59.9	77.7	0.03
June	104.2	67.4	85.8	0.05
July	108.4	76.1	92.3	0.19

MONTH	MONTHLY AVERAGE TEMPERATURES, °F			PRECIPITATION, INCHES
	Maximum	Minimum	Mean	Mean
August	106.8	75.4	91.1	0.61
September	101.8	67.3	84.6	0.39
October	90.5	54.8	72.6	0.27
November	76.7	43.4	60.0	0.27
December	67.7	37.6	52.7	0.57
Annual	75.8	49.9	62.9	3.80

Source: www.wrcc.dri.edu.

Overview of Air Quality Parameters

Air quality is defined by ambient air concentrations of specific pollutants determined by the U.S. Environmental Protection Agency (EPA) to be of concern with respect to the health and welfare of the general public. Seven major pollutants of concern, called "criteria pollutants," are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb) (see Table 3.2.3-2). The EPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. Areas that violate a federal air quality standard are designated as non-attainment areas.

Ambient air quality refers to the atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) that occurs at a particular geographic location. The ambient air quality levels measured at a particular location are determined by the interactions of emissions, meteorology, and chemistry. Emission considerations include the types, amounts, and locations of pollutants emitted into the atmosphere. Meteorological considerations include wind and precipitation patterns affecting the distribution, dilution, and removal of pollutant emissions. Chemical reactions can transform pollutant emissions into other chemical substances. Ambient air quality data are generally reported as a mass per unit volume (e.g., micrograms per cubic meter [$\mu g/m^3$] of air) or as a volume fraction (e.g., parts per million [ppm] by volume).

Pollutant emissions typically refer to the amount of pollutants or pollutant precursors introduced into the atmosphere by a source or group of sources. Pollutant emissions contribute to the ambient air concentrations of criteria pollutants, either by directly affecting the pollutant concentrations measured in the ambient air or by interacting in the atmosphere to form criteria pollutants. Primary pollutants, such as CO, SO_2, Pb, and some particulates, are emitted directly into the atmosphere from emission sources.

Secondary pollutants, such as O_3, NO_2, and some particulates, are formed through atmospheric chemical reactions that are influenced by meteorology, ultraviolet light, and other atmospheric processes. PM_{10} and $PM_{2.5}$ are generated as primary pollutants by various mechanical processes (for example, abrasion, erosion, mixing, or atomization) or combustion processes. However, PM_{10} and $PM_{2.5}$ can also be formed as secondary pollutants through chemical reactions or by gaseous pollutants condensing into fine aerosols. In general, emissions that are considered "precursors" to secondary pollutants in the atmosphere (such as reactive organic gases [ROG] and oxides of nitrogen [NO_x], which are considered precursors for O_3) are the pollutants for which emissions are evaluated to control the level of O_3 in the ambient air.

Toxic air contaminants (TACs) are substances that have the potential to be emitted into the ambient air that have been determined to present some level of acute or chronic health risk (cancer or non-cancer) to the general public. These pollutants may be emitted in trace amounts from various types of sources, including combustion sources. TACs that may be produced by construction and operation of the proposed Project are listed in Table 3.2.3-3, including the most relevant health effects.

Existing Air Quality

The proposed Project and Alternatives are located within the Mojave Desert Air Quality Management District (MDAQMD), which collects ambient air quality data from several air quality monitoring stations within its jurisdiction. The closest monitoring site to the Project is located at 445 West Murphy Street in Blythe and measures O_3. The nearest monitoring station that measures $PM_{2.5}$ is located in Victorville; measurements in Victorville are not likely to be representative of conditions in the Project area (solar facility site and gen-tie line). The nearest monitoring station that measures CO, NO_2, and PM_{10} is located in Barstow, which may also be substantially different from conditions in Blythe. According to the Northern and Eastern Colorado Desert Coordinated Management (NECO) Plan, the ozone standard is exceeded due to long-distance transport of pollutants from the Los Angeles Basin, while the PM_{10} exceedance is due to natural sources found in a desert environment and various land uses. These uses include OHV use, mining, agricultural use, and livestock grazing. The PM_{10} concentrations are from fugitive dust emission sources, rather than from combustion particulate or secondary particulate emission sources. Table 3.2.3-4 provides a summary of available ambient air quality data for the Project region.

Areas that do not meet the NAAQS or California Ambient Air Quality Standards (CAAQS) for a given criteria pollutant are designated as “non-attainment areas” by the EPA and/or the California Air Resources Board (CARB). Further classifications are given to non-attainment areas to identify the severity and number of violations experienced, and the year in which attainment is anticipated based on implementation of attainment plans. In circumstances where there is not enough ambient data available to support designation as either attainment or non-attainment, the area can be designated as unclassified. An unclassified area is normally treated by the EPA the same as an attainment area for regulatory purposes. The air basin for the Project area is considered an unclassified/attainment area for all of the NAAQS. The air basin is considered a moderate non-attainment area for the CAAQS for O_3 and a non-attainment area for the CAAQS for PM_{10}. The air basin is considered unclassified/attainment for all other CAAQS (refer to Table 3.2.3-3 for air quality in relation to standards).

TABLE 3.2.3-2 AMBIENT AIR QUALITY STANDARDS AND HEALTH EFFECTS

POLLUTANT	CALIFORNIA STANDARDS	NATIONAL STANDARDS [A]		MOST RELEVANT HEALTH EFFECTS
		Primary [b,c]	Secondary [b,d]	
Ozone (O_3)	0.070 ppm, 8-hour average; (137 µg/m^3)	0.075 ppm, 8-hour average; (147 µg/m^3)	Same as primary	O_3 is considered a respiratory irritant and prolonged exposure can reduce lung function, aggravate asthma and increase susceptibility to respiratory infections. Exposure to levels of ozone above the current ambient air quality standard can lead to human health effects such as lung inflammation, tissue damage, impaired lung function, coughing, chest tightness, shortness of breath, and the worsening of asthma symptoms. Harmful health effects are associated with outdoor workers, athletes, children and others who spend greater amounts of time outdoors during smoggy periods.
	0.09 ppm, 1-hour average; (180 µg/m^3)	—	—	
Carbon monoxide (CO)	9.0 ppm, 8-hour average; (10 mg/m^3)	9 ppm, 8-hour average; (10 mg/m^3)	—	Exposure to CO near the levels of the ambient air quality standards can lead to fatigue, headaches, confusion, and dizziness. CO interferes with the blood's ability to carry oxygen. Exposure to CO is especially harmful to those with heart disease and has been associated with aggravation of angina pectoris and other aspects of coronary heart disease, decreased exercise tolerance in people with peripheral vascular disease and lung disease, impairment of central nervous system functions, and possible increased risk to fetuses.
	20 ppm, 1-hour average; (23 mg/m^3)	35 ppm (40 mg/m^3)	—	
Nitrogen dioxide (NO_2)	0.030 ppm, Annual Arithmetic Mean; (56 µg/m^3)	0.053 ppm (100 µg/m^3)	Same as primary	NO_2 is a respiratory irritant and may affect those with existing respiratory illness, including asthma. Exposure to NO_2 along with other traffic-related pollutants, is associated with respiratory symptoms, episodes of respiratory illness and impaired lung functioning.
	0.18 ppm, 1-hour average, 1-hour average; (338 µg/m^3)	0.100 ppm (188 µg/m^3)	—	
Sulfur dioxide (SO_2)	0.04 ppm, 24-hour average (105 µg/m^3)	—	—	Effects from SO_2 exposures at levels near the one-hour standard include bronchoconstriction accompanied by symptoms, which may include wheezing, shortness of breath and chest tightness, especially during exercise or physical activity. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) are most susceptible to these symptoms. SO_2 is a respiratory irritant that can cause narrowing of the airways leading to wheezing and shortness of breath. Long-term exposure to SO_2 can cause respiratory illness and aggravate existing cardiovascular disease.
	----	—	0.5 ppm, 3-hour average (1,300 µg/m^3)	
	0.25 ppm, 1-hour average; (655 µg/m^3)	0.075 ppm (196 µg/m^3)	—	

POLLUTANT	CALIFORNIA STANDARDS	NATIONAL STANDARDS [A]		MOST RELEVANT HEALTH EFFECTS
		Primary [b,c]	Secondary [b,d]	
PM_{10}	Annual Arithmetic Mean; 20 µg/m^3,	—	—	(a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children.
	24-hour average, 50 µg/m^3	150 µg/m^3	Same as primary	
$PM_{2.5}$ [(e)]	Annual Arithmetic Mean; 12 µg/m^3	12.0 µg/m^3	Same as primary	(a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease; (b) Excess seasonal declines in pulmonary function, especially in children
	—	35 µg/m^3, 24-hour average	Same as primary	
Lead	—	0.15 µg/m^3, rolling 3-month average	Same as primary	Because lead is only slowly excreted, exposures to small amounts of lead from a variety of sources can accumulate to harmful levels. Effects from inhalation of lead near the level of the ambient air quality standard include impaired blood formation and nerve conduction. Lead can adversely affect the nervous, reproductive, digestive, immune, and blood-forming systems. Symptoms can include fatigue, anxiety, short-term memory loss, depression, weakness in the extremities, and learning disabilities in children. Lead is also classified as a probable human carcinogen.
	—	1.5 µg/m^3, calendar quarter	Same as primary	
	30-day average; 1.5 µg/m^3	—	—	
Hydrogen Sulfide (H_2S)	0.03 ppm, 1-hour average; (42 µg/m^3)	—	—	Breathing H_2S at levels above the standard would result in exposure to a very disagreeable odor. The California Air Resources Board (CARB) has concluded that the ambient standard for H_2S is adequate to protect public health.

Source: SRA 2013

Notes: µg/m3 = micrograms per cubic meter; ppm = parts per million

(a) Standards other than the 1-hour ozone, 24-hour PM_{10}, 24-hour $PM_{2.5}$, and those based on annual averages are not to be exceeded more than once a year. The 8-hour ozone national standard has replaced the 1-hour ozone national standard.

(b) Concentrations are expressed first in units in which they were promulgated. Equivalent units given in parenthesis.

(c) Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the EPA.

(d) Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

(e) The NAAQS for $PM_{2.5}$ was lowered to 12 µg/m^3 in December, 2012.

TABLE 3.2.3-3 TOXIC AIR CONTAMINANTS AND HEALTH EFFECTS

CONTAMINANT	CHARACTERISTICS	MOST RELEVANT HEALTH EFFECTS
Sulfates	A fully oxidized ionic form of sulfur primarily derived from combustion of petroleum based fuels.	Effects of sulfate exposure at levels above the standard include a decrease in ventilatory function, aggravation of asthmatic symptoms and an increased risk of cardio-pulmonary disease.
Vinyl Chloride	A chlorinated hydrocarbon that is a colorless gas with a mild, sweet odor.	Short-term exposure to high levels of vinyl chloride in air causes central nervous system effects, such as dizziness, drowsiness and headaches. Long-term exposure through inhalation and oral exposure causes liver damage. Cancer is a major concern from exposure via inhalation.
Visibility Reducing Particles	Suspended particulate matter, which is a complex mixture of tiny particles that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid.	No specific health effects noted.
Benzene	Benzene is found in the air from emissions from burning coal and oil, gasoline service stations, and motor vehicle exhaust.	Short-term inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Long-term inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings. Reproductive effects and increased incidences of leukemia have been observed in humans occupationally exposed to benzene. A Group A human carcinogen.
Formaldehyde	Formaldehyde exposure may occur by breathing contaminated indoor air, tobacco smoke, or ambient urban air.	Short-term and long-term inhalation exposure to formaldehyde in humans can result in respiratory symptoms, and eye, nose, and throat irritation. Short-term high exposure may lead to eye, nose and throat irritation, and in the respiratory tract, nasal obstruction, pulmonary edema and dyspnea. Prolonged or repeated exposures have been associated with allergic sensitization, respiratory symptoms, and decrements in lung function. A Group B1 probable human carcinogen.
Diesel Particulate Matter	Diesel particulate matter is emitted from both mobile and stationary sources of diesel powered on-road and off-road equipment.	Occupational exposures to diesel exhaust particles have been associated with significant cross-shift decreases in lung function. Increased cough, labored breathing, chest tightness, and wheezing have been associated with exposure to diesel exhaust in bus garage workers. A number of adverse long-term non-cancer effects have been associated with exposure to diesel exhaust. Occupational studies have shown that there may be a greater incidence of cough, phlegm and chronic bronchitis among those exposed to diesel exhaust than among those not exposed. Reductions in pulmonary function have also been reported following occupational exposures in chronic studies. Exposure to diesel exhaust has also shown cellular changes in laboratory animals.
Acrolein	Acrolein is a powerful irritant.	Short-term exposures to levels above 1.0 ppm result in mucous hypersecretion and exacerbation of allergic airway response in animal models. Moderately higher exposures may result in severe lacrimation, and irritation of the mucous membranes of the respiratory tract. Death due to respiratory failure has been associated with high level exposures. Long term exposure to acrolein may result in structural and functional changes in the respiratory tract, including lesions in the nasal mucosa, and pulmonary inflammation.

CONTAMINANT	CHARACTERISTICS	MOST RELEVANT HEALTH EFFECTS
1,3–Butadiene	Motor vehicle exhaust is a constant source of 1,3-butadiene. Although 1,3-butadiene breaks down quickly in the atmosphere, it is usually found in ambient air at low levels in urban and suburban areas.	Short-term exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. The EPA has classified 1,3-butadiene as carcinogenic to humans by inhalation.
Naphthalene	Naphthalene is used in the production of phthalic anhydride; it is also used in mothballs.	Short-term exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion. Long-term exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy. A Group C, possible human carcinogen.
Polycyclic Organic Matter (POM)	The term polycyclic organic matter (POM) defines a broad class of compounds that includes the polycyclic aromatic hydrocarbon compounds (PAHs), of which benzo[a]pyrene is a member. POM compounds are formed primarily from combustion and are present in the atmosphere in particulate form. Sources of air emissions are diverse and include cigarette smoke, vehicle exhaust, home heating, laying tar, and grilling meat.	Cancer is the major concern from exposure to POM. Epidemiologic studies have reported an increase in lung cancer in humans exposed to coke oven emissions, roofing tar emissions, and cigarette smoke; all of these mixtures contain POM compounds. Animal studies have reported respiratory tract tumors from inhalation exposure to benzo[a]pyrene and forestomach tumors, leukemia, and lung tumors from oral exposure to benzo[a]pyrene. The EPA has classified seven PAHs (benzo[a]pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as Group B2, probable human carcinogens.

Source: SRA 2013

TABLE 3.2.3-4 SUMMARY OF AVAILABLE AIR QUALITY DATA FOR THE PROJECT AREA (2006-2011)

AIR QUALITY INDICATOR	2006	2007	2008	2009	2010	2011
Ozone (O_3)[1,3]						
Peak 1-hour value (ppm)	0.073	0.092	0.074	0.072	0.072	0.066
Days above state standard (0.09 ppm)	0	0	0	0	0	0
Peak 8-hour value (ppm)	0.059	0.075	0.071	0.066	0.067	0.061
Days above state standard (0.070 ppm)	0	1	1	0	0	0
Days above federal standard (0.075 ppm)[1,2]	0	0	0	0	0	0
Particulate matter less than or equal to 10 microns in diameter (PM_{10})[4]						
Peak 24-hour value ($\mu g/m^3$)	80	202	93	76	38	108
Days above state standard (50 $\mu g/m^3$)	2	5	2	2	0	2
Days above federal standard (150 $\mu g/m^3$)	0	1	0	0	0	0
Annual Arithmetic Mean (ppm)	21.9	29.8	26.1	26.8	18.8	21.5
Carbon Monoxide[4]						
Peak 8-hour value ($\mu g/m^3$)	1.19	0.70	1.23	0.89	0.89	1.35
Days above state and federal standard (9 ppm)	0	0	0	0	0	0

AIR QUALITY INDICATOR	2006	2007	2008	2009	2010	2011
Peak 8-hour value (μg/m³)	3.5	1.4	1.4	1.2	1.1	4.3
Days above state standard (20 ppm)	0	0	0	0	0	0
Days above federal standard (35 ppm)	0	0	0	0	0	0
Nitrogen Dioxide (NO_2)[4]						
Peak 1-hour value (ppm)	0.082	0.073	0.081	0.060	0.062	0.072
Days above state standard (0.18 ppm)	0	0	0	0	0	0
Annual Arithmetic Mean (ppm))	0.022	0.020	0.019	0.016	0.017	0.017

Notes: [1] The federal O_3 standard was revised downward in 2008 to 0.075 ppm.
[2] The federal eight-hour ozone standard was previously defined as 0.08 ppm (1 significant digit). Measurements were rounded up or down to determine compliance with the standard; therefore, a measurement of 0.084 ppm is rounded to 0.08 ppm. The 8-hour ozone ambient air quality standards are met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to the standard.
[3] Data from the Blythe monitoring station.
[4] Data from the Barstow monitoring station. Data for 1-hour CO concentrations unavailable.
ppm = parts per million; μg/m³ = micrograms per cubic meter; * = not available
Source: http://www.arb.ca.gov/adam/php_files/aqdphp/topfourdisplay.php

Sensitive Receptors

Sensitive receptors are people who are considered to be more sensitive than others to air pollutants. The reasons for greater than average sensitivity include pre-existing health problems, proximity to emissions sources, or duration of exposure to air pollutants. Schools, hospitals, and convalescent homes are considered to be relatively sensitive to poor air quality because children, elderly people, and the infirm are more susceptible to respiratory distress and other air quality-related health problems than the general public. Residential areas are considered sensitive to poor air quality because people usually stay home for extended periods of time, with associated greater exposure to ambient air quality. Recreational uses are also considered sensitive due to the greater exposure to ambient air quality conditions because vigorous exercise associated with recreation places a high demand on the human respiratory system.

The site is located in proximity to rural agricultural lands, undeveloped lands, uses associated with the Blythe Airport, power generation, local roads, and interstate highway and other non-sensitive uses. However, some sensitive air quality receptors are located within one mile of the site. There are approximately 369 residences within one mile of the proposed solar facility site, nine of which are individual residences located within 1,000 feet of the site (see Figure 3.2.1-1). The closest residence is located approximately 260 feet away. In addition, the Project would be approximately 0.4 mile (2,200 feet) from the Mesa Verde Park and approximately 0.8 mile (4,400 feet) from the Roy Wilson Community and Child Center. No schools, hospitals, or convalescent homes are located within one mile of the proposed Project.

Regulatory Setting

Air quality in the Project area's air basin is regulated by federal, State, and local regulatory agencies with the responsibility for maintaining ambient air quality within federal and State standards. The EPA is the federal agency responsible for establishing air quality regulations on a federal level. The federal Clean Air Act (CAA) and its subsequent amendments establish air quality regulations and the NAAQS and delegate the enforcement of these standards to the states. In California, the CARB is responsible for enforcing air pollution regulations. The CARB has in turn delegated the responsibility of regulating stationary emission sources to regional air agencies. In the Project area's air basin, which is located in eastern Riverside County, the MDAQMD has this responsibility.

The following sections summarize the air quality rules and regulations that apply to the Project.

Federal

The federal CAA applies to all air emission sources and to all areas within the United States. Regulations adopted under the CAA that would apply to the Project would include the NAAQS as well as other requirements that have been adopted as part of the MDAQMD's federally approved plans and programs.

As indicated in Federal Register Volume 75, No. 11, Page 2938, the EPA is considering lowering the 8-hour O_3 standard from 0.075 ppm, which is its current level, to a lower level within the range of 0.060 and 0.070 ppm. The lower level is proposed to provide increased protection for children and other "at risk" populations against O_3 health effects.

Federal Emission Standards. The EPA has also adopted on-road and off-road engine emission reduction requirements, including Federal Exhaust and Evaporative Emission Standards for Light-Duty Vehicles and Light-Duty Trucks, Federal Emission Standards for Heavy-Duty and Non-road Engines, and other emission control programs that affect the Project's potential impacts to air quality through the phase-in of clean fuel and engine requirements.

General Conformity Rule. The General Conformity Rule (40 Code of Federal Regulations [CFR] Part 93) requires that federal agencies demonstrate that federal actions conform with the applicable State Implementation Plan (SIP) in order to ensure that federal activities do not hamper local efforts to control air pollution. The EPA general conformity rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The *de minimis* emission thresholds are based on the attainment status of each air basin. Since the Project is located in an air basin that is designated attainment for all federal criteria pollutants, it is not subject to the General Conformity emissions thresholds.

State

The California Clean Air Act (CCAA) was signed into law in 1988 and, for the first time, clearly spelled out in statute California's air quality goals, planning mechanisms, regulatory strategies, and standards of progress. The CCAA provides the State with a comprehensive framework for air quality planning regulation. Prior to passage of the CCAA, federal law contained the only comprehensive planning framework. As part of its authority within the state of California, and as allowed under the federal CAA, CARB has established the CAAQS. The CAAQS are at least as stringent as the NAAQS. Both the NAAQS and CAAQS are shown in Table 3.2.3-4.

The CARB has oversight over air quality in the state of California. The CARB is responsible for the development of the SIP, which provides a framework for attaining and maintaining the NAAQS within the state of California. In turn, development of individual inputs to the SIP is the responsibility of local air pollution control agencies. Regulation of individual stationary sources has been delegated to local air pollution control agencies.

The CARB is responsible for developing programs designed to reduce emissions from non-stationary sources, including motor vehicles and off-road equipment. The CARB and the California Office of Environmental Health Hazard Assessment (OEHHA) are also responsible for developing regulations governing TACs. TACs include air pollutants that can cause serious illnesses or increased mortality, even in low concentrations. The CARB and OEHHA identify specific air pollutants as TACs, develop health thresholds for exposure to TACs, and develop guidelines for conducting health risk assessments for sources of TAC emissions.

Local

As discussed above, the Project would be located in the jurisdiction of the MDAQMD. The MDAQMD is responsible for regulating stationary sources of air emissions in the Project area's air basin. Stationary

sources that have the potential to emit air pollutants into the ambient air are subject to the Rules and Regulations adopted by the MDAQMD. The following MDAQMD rules are applicable to the Project.

Rule 401 – Visible Emissions. Rule 401 states that a person shall not discharge into the atmosphere, from any single source of emissions whatsoever, any air contaminant for a period or periods aggregating more than three minutes in any one hour which is:

As dark or darker in shade as that designated as No. 1 on the Ringelmann Chart, as published by the U.S. Bureau of Mines, or
Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in Subsection A [of the Rules].

Rule 402 - Nuisance. Rule 402 prohibits a person from discharging from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

Rule 403 – Fugitive Dust. Rule 403 requires control of fugitive dust emissions during activities such as construction that have the potential to generate dust. The provisions of Rule 403 include the following:

1) A person shall not cause or allow the emissions of fugitive dust from any transport, handling, construction or storage activity so that the presence of such dust remains visible in the atmosphere beyond the property line of the emission source. (Does not apply to emissions emanating from unpaved roadways open to public travel or farm roads. This exclusion shall not apply to industrial or commercial facilities).
2) A person shall take every reasonable precaution to minimize fugitive dust emissions from wrecking, excavation, grading, clearing of land and solid waste disposal operations.
3) A person shall not cause or allow particulate matter to exceed 100 micrograms per cubic meter when determined as the difference between upwind and downwind samples collected on high volume samplers at the property line for a minimum of five hours.
4) A person shall take every reasonable precaution to prevent visible particulate matter from being deposited upon public roadways as a direct result of their operations. Reasonable precautions shall include, but are not limited to, the removal of particulate matter from equipment prior to movement on paved streets or the prompt removal of any material from paved streets onto which such material has been deposited.
5) Subsections (a) and (c) shall not be applicable when the wind speed instantaneously exceeds 40 kilometers (25 miles) per hour, or when the average wind speed is greater than 24 kilometers (15 miles) per hour. The average wind speed determination shall be on a 15 minute average at the nearest official air-monitoring station or by wind instrument located at the site being checked.
6) The provisions of this rule shall not apply to agricultural operations.

Rule 403.2 – Fugitive Dust. Rule 403.2 applies to construction sites, and requires the owner or operator of any Construction/Demolition source to:

1) Use periodic watering for short-term stabilization of Disturbed Surface Area to minimize visible fugitive dust emissions. For purposes of this Rule, use of a water truck to maintain moist disturbed surfaces and actively spread water during visible dusting episodes shall be considered sufficient to maintain compliance;
2) Take actions sufficient to prevent project-related Trackout onto paved surfaces;
3) Cover loaded haul vehicles while operating on Publicly Maintained paved surfaces;
4) Stabilize graded site surfaces upon completion of grading when subsequent development is delayed or expected to be delayed more than thirty days, except when such a delay is due to precipitation that dampens the disturbed surface sufficiently to eliminate Visible Fugitive Dust emissions;

5) Cleanup project-related Trackout or spills on Publicly Maintained paved surfaces within twenty-four hours; and
6) Reduce non-essential Earth-Moving Activity under High Wind conditions. For purposes of this Rule, a reduction in Earth-Moving Activity when visible dusting occurs from moist and dry surfaces due to wind erosion shall be considered sufficient to maintain compliance.

Rule 403.2 also requires that the owner/operator of a Construction/Demolition source disturbing 100 or more acres shall, in addition to the provisions of subsection (2):

7) Prepare and submit to the MDAQMD, prior to commencing Earth-Moving Activity, a dust control plan that describes all applicable dust control measures that will be implemented at the project;
8) Provide Stabilized access route(s) to the project site as soon as is feasible. For purposes of this Rule, as soon as is feasible shall mean prior to the completion of Construction/Demolition activity;
9) Maintain natural topography to the extent possible;
10) Construct parking lots and paved roads first, where feasible; and
11) Construct upwind portions of project first, where feasible.

Rule 404 – Particulate Matter Concentration. Rule 404 restricts emissions of particulate matter from any source based on the concentrations specified in Table 404(a).

Rule 405 – Solid Particulate Matter Weight. Rule 405 restricts emissions of particulate matter from any source based on the concentrations specified in Table 405(a).

Rule 406 – Specific Contaminants. Rule 406 restricts emissions of sulfur compounds to 500 ppm or less, and restricts emissions of halogens, which are not generally emitted from construction projects.

Rule 407 – Liquid and Gaseous Air Contaminants. Rule 407 restricts emissions of carbon monoxide to 2,000 ppm or less.

Rule 408 – Circumvention. Rule 408 restricts the building, erection, installation or use of any equipment, the use of which, without resulting in a reduction in the total release of air contaminants to the atmosphere, reduces or conceals an emission which would otherwise constitute a violation of Chapter 3 (commencing with Section 41700) of Part 4, of Division 26 of the Health and Safety Code or of the MDAQMD Rules.

Rule 409 – Combustion Contaminants. Rule 409 restricts discharge into the atmosphere from the burning of fuel, combustion contaminants exceeding 0.23 gram per cubic meter (0.1 grain per cubic foot) of gas calculated to 12 percent of carbon dioxide (CO_2) at standard conditions averaged over a minimum of 25 consecutive minutes.

Rule 431 – Sulfur Content of Fuels. Rule 431 restricts the use of any gaseous fuel containing sulfur compounds in excess of 800 ppm calculated as hydrogen sulfide at standard conditions, or any liquid or solid fuel having a sulfur content in excess of 0.5 percent by weight.

Rule 442 – Usage of Solvents. Rule 442 restricts the emission of volatile organic compounds (VOCs) from any solvent material to 1,190 pounds per month, and requires proper storage and handling of VOC-containing solvents.

Riverside County General Plan

The Riverside County General Plan Air Quality Element (AQ) includes policies that limit emissions within the County boundaries. The goal is to support efforts to decrease region-wide pollution emissions, as surrounding jurisdictions significantly impact Riverside County's air quality. Policies were designed to establish a regional basis for improving air quality. The Riverside County General Plan's Air Quality Element (AQ) discusses the following applicable policies regarding air quality within Riverside County:

countywide policies that address air quality within the County boundaries are also located in the Land Use Element (LU) of the County General Plan, and include:

Air Quality Element

Policy AQ 1.1. *Promote and participate with regional and local agencies, both public and private, to protect and improve air quality.*

Policy AQ 1.4. *Coordinate with the South Coast Air Quality Management District (SCAQMD) and MDAQMD to ensure that all elements of air quality plans regarding reduction of air pollution emissions are being enforced.*

Policy AQ 1.5. *Establish and implement air quality, land use and circulation measures that improve not only the County's environment but the entire region.*

Policy AQ 2.1. *The County land use planning efforts shall assure that sensitive receptors are separated and protected from polluting point sources to the greatest extent possible.*

Policy AQ 2.2. *Require site plan designs to protect people and land uses sensitive to air pollution through the use of barriers and/or distance from emissions sources when possible.*

Policy AQ 2.3. *Encourage the use of pollution control measures such as landscaping, vegetation and other materials, which trap particulate matter or control pollution.*

Policy AQ 4.1. *Encourage the use of building materials/methods which reduce emissions.*

Policy AQ 4.5. *Require stationary pollution sources to minimize the release of toxic pollutants through:*

- *Design features;*
- *Operating procedures;*
- *Preventive maintenance;*
- *Operator training; and*
- *Emergency response planning*

Policy AQ 4.6. *Require stationary air pollution sources to comply with applicable air district rules and control measures.*

Policy AQ 4.7. *To the greatest extent possible, require every project to mitigate any of its anticipated emissions which exceed allowable emissions as established by the SCAQMD, MDAQMD, SCAB* [South Coast Air Basin]*, the Environmental Protection Agency and the California Air Resources Board.*

Policy AQ 4.9. *Require compliance with SCAQMD Rules 403 and 403.1, and support appropriate future measures to reduce fugitive dust emanating from construction sites.*

Policy AQ 4.10. *Coordinate with the SCAQMD and MDAQMD to create a communications plan to alert those conducting grading operations in the County of first, second, and third stage smog alerts, and when wind speeds exceed 25 miles per hour. During these instances all grading operations should be suspended.*

Policy AQ 5.1. *Utilize source reduction, recycling and other appropriate measures to reduce the amount of solid waste disposed of in landfills.*

Policy AQ 16.1. *Cooperate with local, regional, state and federal jurisdictions to better control particulate matter.*

Policy AQ 16.2. *Encourage stricter state and federal legislation on bias belted tires, smoking vehicles, and vehicles that spill debris on streets and highways, to better control particulate matter.*

Policy AQ 16.3. *Collaborate with the SCAQMD and MDAQMD to require and/or encourage the adoption of regulations or incentives to limit the amount of time trucks may idle.*

Policy AQ 16.4. *Collaborate with the EPA, SCAQMD, MDAQMD, and warehouse owners and operators to create regulations and programs to reduce the amount of diesel fumes released due to warehousing operations.*

Policy AQ 17.3. *Identify and create a control plan for areas within the County prone to wind erosion of soil.*

Policy AQ 17.4. *Adopt incentives, regulations and/or procedures to manage paved and unpaved roads and parking lots so they produce the minimum practicable level of particulates.*

Policy AQ 17.8. *Adopt regulations and programs necessary to meet state and federal guidelines for diesel emissions.*

Land Use Element

Policy LU 6.2(a). *The facility is compatible in scale and design with surrounding land uses, and does not generate excessive noise, traffic, light, fumes, or odors that might have a negative impact on adjacent neighborhoods.*

Policy LU 6.4. *Retain and enhance the integrity of existing residential, employment, agricultural, and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing, and traffic.*

City of Blythe General Plan

City policies in the City of Blythe General Plan 2025 (2007) related to air quality are located in the Open Space Element, Guiding Policies of the City General Plan, and include:

Open Space and Conservation Element

Policy 11: *Strive to meet all regional and federal ambient air quality standards and reduce the generation of air pollutants.*

Policy 14: *Whenever feasible, coordinate air quality, transportation, and land use planning efforts with other jurisdictions and public agencies responsible for air quality management.*

3.2.4 Biological Resources

This section describes the environmental setting and regulatory framework in regards to biological resources for the proposed Project and Alternatives.

The information in this section is based on the *Blythe Mesa Solar Project Biological Resources Technical Report,* prepared by POWER Engineers, Inc. 2013 (Appendix C1 of this Draft EIR/EA), the *Blythe Mesa Solar Project 230 kV Transmission Line Alternative Habitat Assessment Report,* prepared by POWER Engineers, Inc. 2013 (Appendix C2 of this Draft EIR/EA), the *Western Burrowing Owl Survey Report* prepared by POWER Engineers, Inc. 2013 (Appendices C3 of this Draft EIR/EA), the *Bird and Bat Conservation Plan* prepared by POWER Engineers, 2013 (Appendix C4 of this Draft EIR/EA), and the *Review of Federal Waters* prepared by POWER Engineers, Inc. 2013 (Appendices C5 of this Draft EIR/EA).

Environmental Setting

The Project Area is in the Palo Verde Valley, which is along the western edge of the Colorado River. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet amsl. The study area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert.

Approximately 70 percent of the solar array area is actively cultivated agricultural land, 24 percent is previously disturbed by agricultural or military activities, and six percent remains undisturbed. Agricultural land use within the solar array site includes drip-irrigated citrus orchards, flood-irrigated alfalfa, non-irrigated winter wheat, abandoned jojoba orchards, and fallow fields. The gen-tie line corridors would pass through BLM lands and other private lands mainly comprised of desert scrub habitat and disturbed lands associated with existing infrastructure. Several utility lines and maintenance roads run through or parallel the gen-tie line corridors. Additionally, the Project Area has been previously disturbed by off-road vehicle use, trash dumping, and historic use for military training during World War II. The Project area is located in the Colorado Desert in gently rolling open terrain dominated by desert scrub vegetation. The Colorado Desert is a part of the larger Sonoran Desert, which extends across the southwest United States and into Mexico. The climate is very hot and dry in the summer months, and cool in the winter.

Surface water is minimal on Palo Verde Mesa and consists of limited seasonal and perennial sources. Perennial water comes from McCoy Springs in the McCoy Mountains west of the Project Area and the Colorado River, which lies eight miles east of the eastern edge of the Project Area. The Colorado River is the source of irrigation water for agriculture in the area.

No designated critical habitat, special management areas, wilderness study areas, or Areas of Critical Environmental Concern (ACEC) are located within the solar array site or gen-tie line corridors.

Methodology

The following sections provide an overview of the biological resources evaluation methods that were used in conducting the biological resources assessment for this Project. The study area refers to the solar facility site, the gen-tie line and additional areas to be affected directly or indirectly by the proposed Project. From here on, the study area is defined as the solar facility site and a 500-foot-wide gen-tie line corridor (250 feet on each side of the gen-tie centerline).

Prior to initiating the biological surveys, available data was reviewed from resource management plans and other relevant documents to determine the locations and types of biological resources that have the potential to exist within and adjacent to the biological resources survey area. Database and literature searches included review of numerous biological databases including the California Natural Diversity Database (CDFW 2011c and 2012), California Native Plant Society Inventory (CNPS 2011), U.S. Fish and Wildlife Service (USFWS) Critical Habitat Portal (USFWS 2011a), California Gap Analysis Program (USGS 2011), and National Wetland Inventory (USFWS 2011b). A quad-based search was conducted to provide information on listed species that may occur in the vicinity and to identify potential biological resource concerns in the Project vicinity. The following USGS 7.5-minute quadrangles were reviewed, Roosevelt Mine, Ripley, McCoy Spring, McCoy Peak, McCoy Wash, Blythe NE, Blythe, Mule Wash, Palo Verde, Thumb Peak, Wiley Well, and Hopkins. These search parameters encompass an approximately 10-mile buffer around the study area. This buffer accounts for the home ranges of all species that could occur, may migrate through, or forage in the Project area. Certain species have larger home ranges, such as the golden eagle (*Aquila chrysaetos*), and their home ranges may occur primarily outside of this buffer; however, species such as these are expected to readily migrate into and out of the study area based on their habitat needs. The database search, then, was assumed to account for all species that are known to occur near the study area and that are not restricted from migrating or foraging through the study area. However, species that may have more restrictive habitat requirements or home ranges and would be

unlikely to be present near the study area based on vegetation, disturbance, soil substrates, or other factors were excluded.

Examinations of aerial photographs and other sensitive species accounts for Riverside County were also conducted. Regional resource planning documents prepared by federal, State, and local agencies were reviewed, including the California Desert Conservation Area Plan (BLM 2005), the Northern and Eastern Colorado Desert Coordinated Management Plan (BLM and CDFG 2002), the Riverside County General Plan (Riverside County 2003), and the USFWS Recovery Plan for the desert tortoise (*Gopherus agassizii*) (USFWS 2011c).

Information gathered from the literature review was used to help identify habitat for all threatened and endangered plant and wildlife species with potential to occur within the study area during the reconnaissance surveys and habitat mapping. The habitat mapping survey was conducted to assess general and dominant vegetation types, community sizes, habitat types, and species present within communities. Community types were based on observed dominant vegetation composition and density. Vegetation communities were classified based on Holland (1986), Sawyer and Keeler-Wolf (1995), and California Department of Fish and Wildlife (CDFW) classifications were used to provide additional detail when needed, such as denoting special vegetation communities that are either known or believed to be of high priority for inventory in California Natural Diversity Database (CNDDB) due to significance or rarity. Plants of uncertain identity were collected and subsequently identified from taxonomic keys (Hickman 1993) and field guides (Stuart and Sawyer 2001). Scientific and common species names were recorded according to The Jepson Manual: Higher Plants of California.

The reconnaissance survey assess the presence of a wildlife species based on direct observation, wildlife sign (e.g., tracks, burrows, nests, scat), or vocalization. Field data compiled for wildlife included the species scientific name, common name, and evidence of sign when no direct observations were made. Wildlife were identified and named based on field guides and other related literature (Burt and Grossenheider 1980; Elbroch 2003; Sibley 2000; and Stebbins 2003).

Prior to conducting focused field surveys, BLM, USFWS and the County were consulted to determine survey needs and appropriate survey time frames. Based on the habitat mapping, reconnaissance surveys and input from the wildlife agencies protocol surveys were conducted for special status plants and the burrowing owl (*Athene cunicularia hypugaea)*.

For the purposes of this document, “special-status” is being defined as species that are:

Listed, proposed for listing, or candidates for listing as threatened or endangered under the Endangered Species Act (ESA) (50 CFR Part 17.12 [listed plants], 50 CFR Part 17.11 [listed animals], 67 Federal Register [FR] 40657 [candidate species], and various notices in the FR [proposed species]]);

- Listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (CESA) (CDFW 2011a);
- Identified by the California Department of Fish and Wildlife (CDFW) as species of concern or fully protected species, including fish and wildlife that do not have state or federal threatened or endangered status but may still be threatened with extinction (CDFW 2011b);
- California Species of Special Concern, vertebrate species that have been designated as “species of special concern” by the CDFW because declining population levels, limited range, and/or continuing threats have made them vulnerable to extinction (CDFW 2011b);
- On BLM land with the potential to be affected, species that are listed by the BLM as Sensitive (BLM 2010);
- Species that are listed by the California Rare Plant Ranking System (CRPR) as List 1A (presumed extirpated in California), 1B (rare, threatened, and endangered in California and elsewhere), or 2A (presumed extirpated in California, but more common elsewhere), or 2B (rare, threatened, and endangered in California, but more common elsewhere).

CRPR List 1A, 1B, 2A and 2B species are considered special-status plant species if they fall within any of these categories as defined in the Native Plant Protection Act, California Fish and Game Code (CFGC) Section 1901, or the CESA, CFGC Sections 2050 through 2098 (CNPS 2001, 2011); or

- Covered as a State-protected furbearing mammal (PFM).

The term "special-status species" excludes those avian species solely identified under Section 10 of the Migratory Bird Treaty Act (MBTA) for federal protection. Nonetheless, protected species under MBTA (50 CFR Part 10.13) are afforded avoidance and minimization measures per federal and State requirements.

Under the CEQA review process, only CRPR List 1 and 2 species are considered since these are the only CRPR species that meet CEQA's definition of "rare" or "endangered" (14 CCR §15380). Impacts to the species listed under the old ranking of CNPS List 3 and 4 are not regarded as significant pursuant to CEQA. Surveys and database and literature searches were also conducted to determine presence or of absence of resources protected by the NECO plan and burros, which are protected under the Wild Free-Roaming Horse and Burro Act (Public Law 92-195).

Results

The following sections describe the results of the biological inventory. The results reflect both the data collected from the literature, database reviews, and physical surveys conducted in the study area. Acreages provided in Table 3.2.4-1 below for the gen-tie line and its Alternatives include a 500-foot survey corridor (250 feet on either side of the centerline) in addition to the area that is part of the Project area. In comparison to the numbers below, which already include a buffer, the proposed gen-tie line by itself is 73 acres, the Northern Alternative is 95 acres, and the Southern Alternative is 60 acres.

Vegetation Communities

Eleven vegetation communities and other cover types were identified within the study area during the field surveys (Table 3.2.4-1; Figure 3.2.4-1). Vegetation communities were mapped according to the second edition of *A Manual of California Vegetation, Second Edition* (Sawyer et al. 2009). Community classifications were based on dominant species comprising approximately 50 percent or more of the total cover within the mapped unit relative to the list of dominant species for a given vegetation community.

TABLE 3.2.4-1 VEGETATION COMMUNITIES AND COVER TYPES

VEGETATION COMMUNITIES AND OTHER COVER TYPES	ACREAGE ON THE SOLAR ARRAY SITE PROJECT BOUNDARY	ACREAGE ON THE PROPOSED GEN-TIE LINE*	ACREAGE ON THE NORTHERN ALTERNATIVE GEN-TIE LINE*	ACREAGE ON THE SOUTHERN ALTERNATIVE GEN-TIE LINE*	ACREAGE ON THE REDUCED ACREAGE ALTERNATIVE SOLAR ARRAY SITE
Bajada	18.1	0.0	0.0	0.0	0.0
Creosote Bush Scrub	41.9	278.8	303.6	232.3	41.9
Desert Riparian Woodland Wash	0.0	22.9	22.9	11.4	0.0
Disturbed Creosote Scrub	220.1	0.0	0.5	0.3	107.1
Disturbed/Ruderal	31.2	0.5	0.0	0.0	31.2
Fallow Agriculture	249.7	0.0	0.0	0.0	41.7
Irrigated Alfalfa	404	0.0	0.0	0.0	0.0
Irrigation Pond	17.2	0.0	0.0	0.0	13.3

VEGETATION COMMUNITIES AND OTHER COVER TYPES	ACREAGE ON THE SOLAR ARRAY SITE PROJECT BOUNDARY	ACREAGE ON THE PROPOSED GEN-TIE LINE*	ACREAGE ON THE NORTHERN ALTERNATIVE GEN-TIE LINE*	ACREAGE ON THE SOUTHERN ALTERNATIVE GEN-TIE LINE*	ACREAGE ON THE REDUCED ACREAGE ALTERNATIVE SOLAR ARRAY SITE
Mixed – Drip-irrigated Jojoba and Disturbed Creosote Scrub	347	0.0	0.0	0.0	347
Non-irrigated Wheat	1,088.2	0.0	0.0	0.0	610.2
Orchard	1,188.4	0.0	0.0	0.0	1,188.4
Total Acreage	**3,605.8 acres †**	**302.1 acres**	**327 acres**	**244.1 acres**	**2,380.8 acres**

Source: POWER 2012a.
*500-foot corridor (250 feet on either side of the gen-tie centerline) takes into account potential indirect and direct impacts to biological resources
†While Riverside County's estimate of the parcels within the solar facility is 3,587 acres, the GIS-calculated number listed in this table is 3,605.8 acres.

Bajada. Bajadas are essentially alluvial fans or desert washes. This community is present in the northeastern corner of the study area and is typically characterized as the shallow, sandy, braided bottoms of wide canyons. This community most closely resembles Holland's "Mojave Desert Wash Scrub," Code 63700 (Holland 1986).

Creosote Bush Scrub/Disturbed Creosote Scrub. Within the study area, this community is characterized by sandy soils with a shallow clay pan on a broad gentle southeast-trending slope. Dominant plants within the study area for this community include creosote bush (*Larrea tridentata*), burro bush (*Ambrosia dumosa*), brittlebush (*Encelia farinosa*), and cheesebush (*Hymenoclea salsola)*. This is the most common plant community consisting of non-agricultural plants within the study area. This plant community intergrades into the desert riparian woodland wash. Within the creosote scrub habitat in the study area, there are areas of desert pavement that are covered with rounded cobbles that range in size from one to three inches. Typically, these areas are higher than the surrounding landscape by three to 15 feet. These areas are within creosote bush scrub, though the plant density is lower. Sonoran creosote bush scrub is designated by Holland as Code 33100 and Sawyer Keeler-Wolf and Evens as the Ocotillo Series (Holland 1986; Sawyer et al. 2009).

Within the gen-tie line corridors, the creosote bush scrub is relatively undisturbed, except for occasional vehicle tracks. In these areas, fine sand drifts are interspersed within this community type; the Emory's indigo bush occurs in stands and is more prevalent than in other portions of the creosote bush scrub.

There are more areas of disturbed creosote bush scrub in the solar array area compared to the gen-tie line. Past disturbances in these areas consist of military training and agricultural use, including cultivation of jojoba (*Simmondsia chinensis*). These disturbances occurred in the past, and the Sonoran creosote bush scrub within the solar array area has been recovering through natural recruitment. Two invasive plant species, Russian thistle (*Salsola tragus*) and Sahara mustard (*Brassica tournefortii*), can be found in disturbed areas throughout the study area, especially near roads and fallow and active agricultural areas. Another exotic plant, Mediterranean grass (*Schismus* sp.), is prevalent throughout the creosote bush scrub.

Desert Riparian Woodland Wash. This vegetation community consists of open, drought-deciduous, riparian scrub woodland and is made up of three primary components: wash-dependent vegetation, vegetated ephemeral dry wash, and islands of Sonoran creosote bush scrub (e.g., riparian interfluves). Dominant and indicator plants of this community within the study area include honey mesquite (*Prosopis glandulosa*), palo verde (*Cercidium floridum*), desert ironwood (*Olneya tesota*), cat-claw acacia (*Acacia greggii*), and rush milkweed (*Asclepias subulata*). Creosote bush and burro brush were scattered throughout the canopy. The herbaceous layer is dominated by desert plantain (*Plantago ovata*), *Cryptantha* spp., and Mediterranean grass (*Schismus barbatus*). Of the vegetation communities listed in

Table 3.2.4-1, the CDFW considers desert riparian woodland wash to be a sensitive habitat/biological resource. In addition, desert riparian woodland wash is a special community type (i.e., high priority for inventory in the CNDDB) per the CDFW's Vegetation and Mapping Program. Desert riparian woodland wash is equivalent to Holland's desert dry wash woodland (Code 62200) and Sawyer, Keeler-Wolf and Evens' Catclaw Acacia Series (Holland 1986; Sawyer et al. 2009).

Irrigated Cropland/Irrigation Pond/Orchard/Jojoba/Wheat. These community types fall into the broader category of agriculture. The majority of agricultural land within the proposed solar array disturbance area is fallow and active agriculture. It includes lands that are currently under cultivation and those that are abandoned (e.g., fallow). Within abandoned agriculture areas, native vegetation is growing back; Russian thistle, Sahara mustard, and other exotic plants were observed interspersed with the native vegetation and are indicative of past agricultural disturbance.

Disturbed/Ruderal. Disturbed/Ruderal communities have been previously disturbed and have been converted to mostly non-native, weedy areas. Ruderal vegetation is that which grows quickly in disturbed areas and may consist of native species, such as fire-following plants, or non-native species, such as invasive grasses or forbs. Examples of invasive species that would occur in these areas include redstem filaree (*Erodium cicutarium*), Sahara mustard, and Mediterranean grass. Ruderal areas in the study area are primarily concentrated within the proposed solar array area.

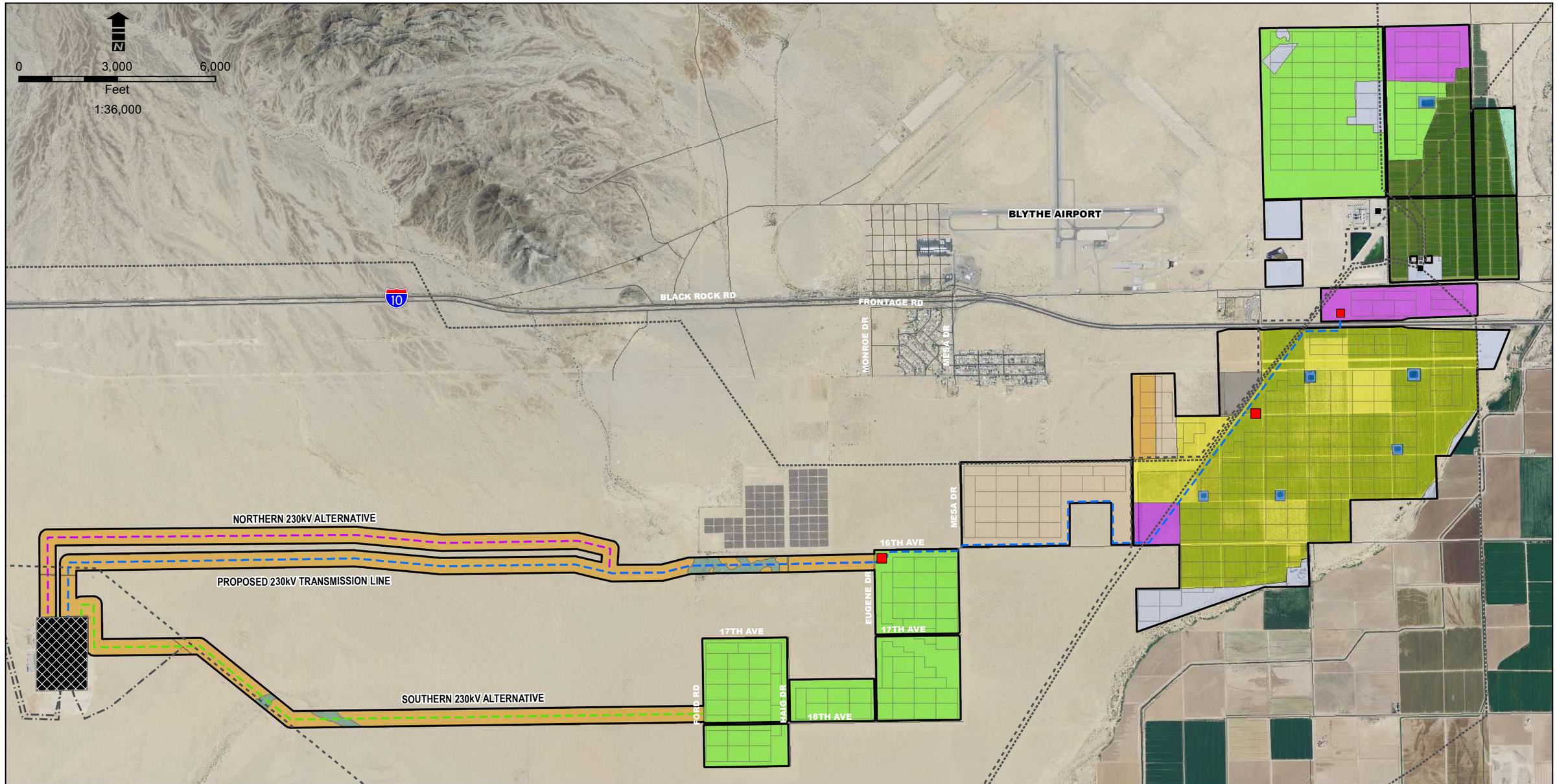
Flora

In total, 79 plant species were detected in the Project Area during vegetation mapping, including 15 non-native plant species. Data was collected on plant species during the database search and protocol-level special-status plant surveys conducted in the Spring of 2011 (refer to the *Biological Resources Technical Report* in Appendix C1 and the *Blythe Mesa Solar Project 230 kV Transmission Line Alternative Habitat Assessment Report* in Appendix C2 of this Draft EIR/EA). It should be noted that spring 2011 was a dry year and therefore the survey data was supplemented by a records search from surrounding projects that overlapped with the study area (AECOM 2010; CH2M Hill 2010). In addition to the supplemented data conducted in wet years (2009-2010) additional pre-construction surveys shall be conducted for State and federally listed Threatened and Endangered, Proposed, Petitioned, and Candidate plants in a 250-foot radius around all areas subject to ground-disturbing activity.

Of the 79 species recorded, a total of 15 special-status plant species have potential to occur within the study area (Table 3.2.4-2). No federally listed or State-listed plant species was observed within the study area during the protocol-level surveys or during surveys that crossed the study area (POWER 2012a; CH2M Hill 2010; AECOM 2010). Two of the special-status species detected are CRPR List 1B or List 2 (rare) and therefore require consideration under CEQA: Harwood's woollystar (*Eriastrum harwoodii*) and Harwood's milkvetch (*Astragalus insularis* var. *harwoodii*). The remaining species are formally listed as CNPS List 4 (watch-list) and no longer tracked by the CRPR System; they include desert unicorn (*Proboscidea althaeifolia*) and winged cryptantha (*Cryptantha holoptera*). In addition to no longer being tracked, they are also not considered special- status by, CEQA standards, the County or by the BLM. Species accounts are provided in the Biological Technical Report for special-status plant species that occur or have potential to occur in the study area. Table 3.2.4-2 provides a summary of the special-status plant species with the potential to occur within the study area.

State-listed Plant Species. Based on site-specific habitat evaluations conducted by Project biologists and a literature and database review, including a CNDDB record search, no State-listed plant species have been recorded near the study area or have potential to occur in the study area.

Other Special-Status Plant Species. Harwood's woollystar was observed within the study area. Harwood's woollystar, a CRPR 1B.2 (rare, threatened, or endangered in California and elsewhere) species, was detected in all three Alternative gen-tie line corridors. Forty-nine individuals were observed in flower within the survey area. These individuals are displayed as point locations on Figure 3.2.4-2.



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Solar Array
- Colorado River Substation
- Substation

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Vegetation Communities
- Disturbed/Ruderal
- Non-irrigated Wheat
- Fallow
- Irrigated Alfalfa
- Orchard
- Irrigation Pond
- Mixed - Drip-irrigated Jojoba and Disturbed Creosote Bush Scrub
- Bajada
- Creosote Bush Scrub
- Desert Riparian Woodland Wash
- Disturbed Creosote Bush Scrub



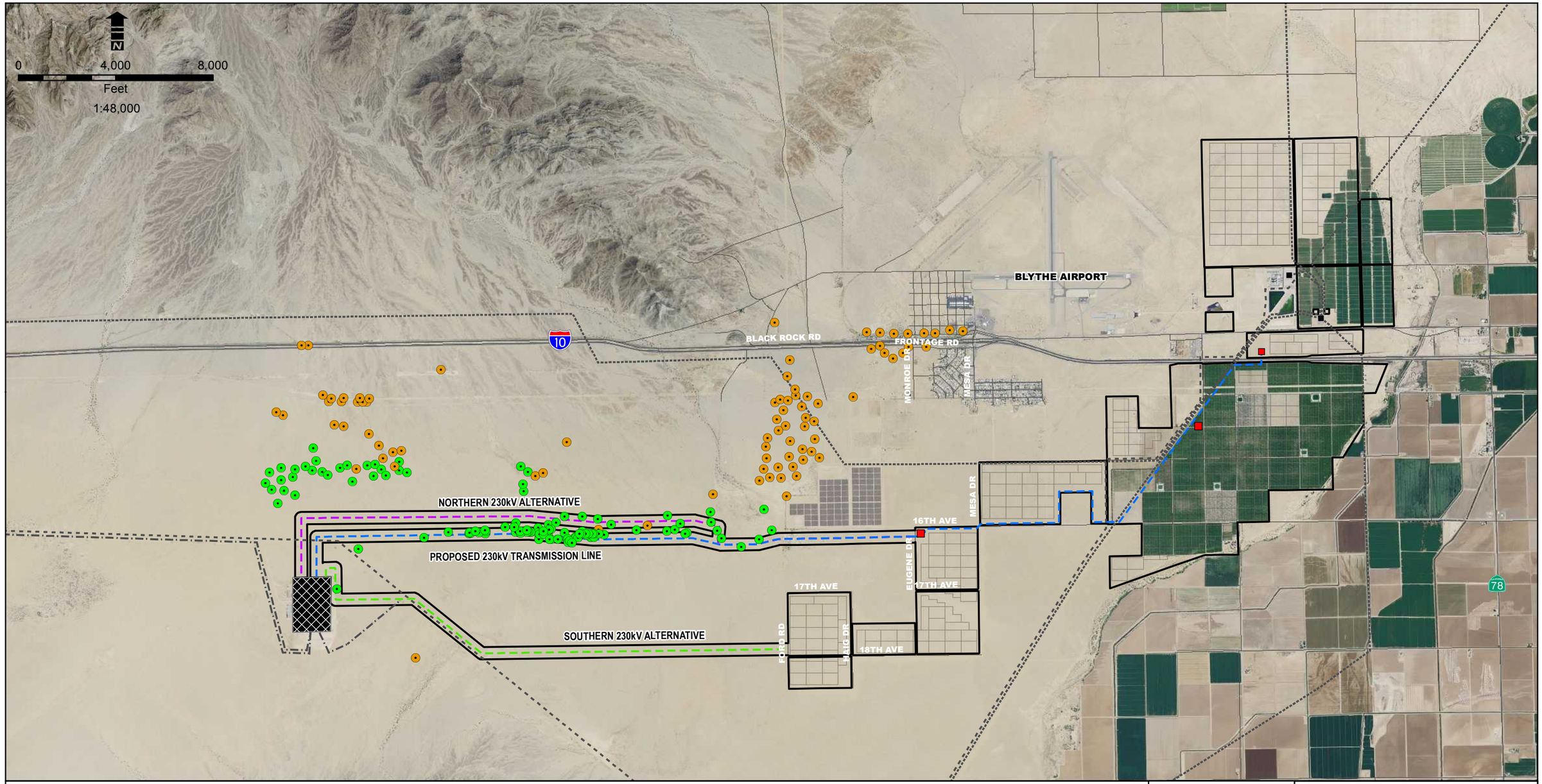
FIGURE 3.2.4-1
VEGETATION COMMUNITIES WITHIN THE STUDY AREA

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

AR062412

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Solar Array
- Colorado River Substation
- Substation

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Special Status Plant Inventory Results
- Harwood's Woolystar
- Harwood's Milkvetch



FIGURE 3.2.4-2
SPECIAL STATUS PLANTS INVENTORY RESULTS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR062414

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 3.2.4-2 SPECIAL-STATUS PLANT SPECIES RELEVANT TO THE PROPOSED PROJECT POTENTIALLY OCCURRING IN THE STUDY AREA

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1,3]	PLANT HABIT AND GENERAL HABITAT DESCRIPTION (CNPS 2012)	FLOWERING PERIOD (CNPS 2012)	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Angel trumpets (Acleisanthes longiflora)	CRPR 2.3 NECO Plan	Prostrate to ascending perennial stems less than three feet. Occurs in dry places, generally on carbonate or limestone derived soils in mountainous areas 30 to 8,000 feet.	May	The closest record of this species is in the Big Maria Mountains.	Low	Low	Low	Low
Coachella Valley Milkvetch (Astragalus lentiginosus var. coachellae)	ESA: Endangered CRPR 1B.2 BLM: Sensitive	Sonoran Desert, in sandy areas growing at elevations of 0 to 1,150 feet.	Annual or perennial herb that flowers February to May.	Habitat for this species occurs within sandy washes. Most populations are restricted to the Coachella Valley, approximately 50 miles west of the Study Area.	Low	Low	Low	Low
Harwood's milkvetch (Astragalus insularis var. harwoodii)	CRPR 2.2 NECO Plan	Annual plant. Occurs in the Sonoran Desert in sandy to gravely areas 0 to 1,000 feet.	January to May	This species was detected in the Project vicinity toward the northwestern limits in 2009 (CEC).	Moderate	High	High	High
Gravel milkvetch (Astragalus sabulonum)	CRPR 2.2	Annual and perennial herb. Occurs in desert dunes and Mojavean and Sonoran desert scrub in sandy or gravelly areas. Also in washes or along roadsides. Occurs between 195 and 3,050 feet.	February to June	The nearest CNDDB record is approximately 1.5 miles north of the Study Area in a "best guess" location.	Low	Moderate	Moderate	Moderate

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1,3]	PLANT HABIT AND GENERAL HABITAT DESCRIPTION (CNPS 2012)	FLOWERING PERIOD (CNPS 2012)	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Pink fairyduster (Calliandra eriophylla)	CRPR 2.3 NECO Plan	Shrubs less than one foot in height. Occurs in Sonoran Desert, sandy washes, slopes, and mesas typically between 390 and 5,000 feet.	January to March	Some suitable habitat is present. Species most often occurs at sites above 500 feet.	Low	Low	Low	Low
Saguaro (Carnegiea gigantea)	CRPR 2.2 NECO Plan	Perennial stem succulent. Occurs in Sonoran desert scrub in rocky areas, typically between 165 and 4,920 feet.	May to June	The only CNDDB record is approximately 15 miles south of the Study Area.	None	None	None	None
Crucifixion horn (Castela emoryi)	CRPR 2.3 NECO Plan	Shrub less than 10 feet in height. Occurs in Mojavean and Sonoran desert scrub on dry, gravelly washes from 295 to 3,000 feet.	April to May	This large shrub was not observed in the surveys, which were conducted within the appropriate blooming period.	None	None	None	None
Abrams' spurge (Chamaesyce abramsiana)	CRPR 2.2	Annual herb. Occurs in Mojavean and Sonoran desert scrub on sandy soils up to 3,000 feet.	September to November	37 records totaling over 2,000 individuals within a 10 mile radius recorded by CNDDB (2013). Nearest location approximately 0.6 miles north of the west end of the solar array (CNDDB EO Index 88392)	Moderate	Moderate	Moderate	Moderate
Las Animas colubrine (Colubrina californica)	CRPR 2.3 NECO Plan	Perennial, deciduous shrub generally less than three feet in height. Occurs in Sonoran creosote bush scrub less than 3,500 feet.	April to June	According to CEC 2009 data, specimens were observed in flower during April, an early blooming period for this species. Similar habitat is expected to occur in the Study Area.	Low	Moderate	Moderate	Moderate

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1,3]	PLANT HABIT AND GENERAL HABITAT DESCRIPTION (CNPS 2012)	FLOWERING PERIOD (CNPS 2012)	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Harwood's woollystar (Eriastrum harwoodii)	CRPR 1B.2 BLM: Sensitive	Annual herb. Occurs in desert dunes and Sonoran Desert scrub on sandy soils from 400 to 3,000 feet.	March to June	Observed in abundance in an area between the northern and southern alternatives in 2011. Not observed in 2012 possibly due to below average precipitation.	Low	Present	Present	Present
Bitter hymenoxys (Hymenoxys odorata)	CRPR 2	Annual herb. Occurs in chaparral, coastal scrub, Mojavean Desert scrub, and meadows and seeps, often in alkali soils, and riparian scrub with mesic soils. Most often found on sandy sites from 145 to 490 feet.	February to November	Habitat for this species is limited to the desert riparian woodland wash located in the easternmost portion of the proposed transmission line.	Low	Low	Low	Low
California satintail (Imperata brevifolia)	CRPR 2.1	Perennial grass. Occurs in San Bernardino Mountains and Mojave Desert in cultivation. Found near wet springs, meadows, stream sides and flood plains up to 1,700 feet.	September to May	The habitat for this species (wet springs, meadows, stream sides, and flood plains) does not occur within the Study Area.	None	Low	Low	Low
Darlington's blazing star (Mentzelia puberula)	CRPR 2.2	Perennial herb. Occurs in sandy or rocky areas of Mojavean and Sonoran desert scrub, between 295 and 4,200 feet.	March to May	The only CNDDB record is approximately 14.5 miles south of the Study Area.	Low	Low	Low	Low
Orocopia sage (Salvia greatae)	CRPR 1B.3 NECO Plan	Southeast Sonoran Desert (Orocopia, Chocolate Mtns.) on alluvial slopes between 100 to 800 feet.	Evergreen shrubs less than 3 feet in height with white blooms from March to April.	Nearest known occurrence near Desert Center, 35 miles west of the Project.	Low	Low	Low	Low

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1,3]	PLANT HABIT AND GENERAL HABITAT DESCRIPTION (CNPS 2012)	FLOWERING PERIOD (CNPS 2012)	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Desert spikemoss (Selaginella eremophila)	CRPR 2.2	Eastern Peninsular Ranges to the Sonoran Desert at elevations less than 3,000 feet. Shaded sites among rocks, in crevices and gravelly soils.	Rhizomatous mat-forming non-flowering herb.	The habitat for this species (shaded gravel soil in crevices and rocks) is limited in the Study Area.	Low	Low	Low	Low
Dwarf germander (Teucrium cubense ssp. depressum)	CRPR 2.2	Annual plant up to six inches tall. Occurs in sandy soils, washes, and fields in the Sonoran Desert below 1,200 feet.	March to November	Habitat for this species is present within the Study Area and vicinity.	Low	High	High	Moderate
Jackass clover (Wislizenia refracta ssp. refracta)	CRPR 2.2 NECO Plan	Sandy washes, roadsides, alkaline flats in the Mojave Desert, and northern Sonoran Desert between 1,600 to 2,000 feet.	Annual; flowers between April and November.	Habitat is not present based on elevation criteria.	None	None	None	None
Orcutt's woodyaster (Xylorhiza orcuttii)	CRPR 1B.2 BLM Sensitive	Arid canyons between 60 and 1,000 feet.	Shrubs less than 5 feet in height; blooms March to April.	According to CEC data, one plant recorded north of the San Diego / Imperial County border in Indio (Riverside County).	Low	Low	Low	Low

[1]Sensitivity Status Key
ESA Federal Endangered Species Act
CRPR California Rare Plant Rank
1A: Plants presumed extirpated in California and either rare or extinct elsewhere.
1B: Considered rare, threatened, or endangered in California and elsewhere.
2A: Plants presumed extirpated in California, but more common elsewhere
2B: Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
Threat Ranks/ Decimal notations: ACNPS extension added to the CRPR
- Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
- Moderately threatened in California (20-80% occurrences threatened / moderate degree and immediacy of threat)
– Not very threatened in California (<20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

[2]Species Potential for Occurrence
Low Potential – low potential to occur because suitable habitat is of marginal quality.
Moderate Potential – has moderate potential to occur because suitable habitat was expected to be present but was not found during focused plant surveys
High Potential – has high potential to occur because suitable habitat was expected to be present, and species is known to occur within the vicinity but was not found during focused plant surveys
Present – detected during surveys or recorded in previous surveys

[3]Only CRPR 1 and 2 are included in the rare plant table for Blythe Mesa
BLM Sensitive Plants: plant species found on public lands administered by the Bureau of Land Management whose survival is of concern due to limited distribution, low number of individuals and/or populations, and potential threats to habitat.
NECO Plan: Northern and Eastern Colorado Desert Coordinated Management Plan special-status species

Based on a CNDDB search, Harwood's milk-vetch (*Astragalus insularis* var. *harwoodii*), a CNDDB List 2.2 species, has a high potential to occur within the proposed gen-tie line disturbance area. Additional species have lower potentials to occur as reflected in Table 3.2.4-2. There are numerous records in the vicinity and several that are just outside the survey corridor area. Ribbed cryptantha and winged cryptantha are both CNPS List 4.3 and were detected within the study area. Both species are not discussed in detail and are not considered special-status due to being on CNPS List 4.3; refer to the methodology section for a description of special-status species.

Fauna

In total, 57 wildlife species were detected during general reconnaissance and protocol wildlife surveys (refer to the biological resources technical reports in Appendix C1 and C2 of this Draft EIR/EA), as well as reported in the database search. Of the wildlife species detected during the survey work and literature review, seven special-status wildlife species or their sign were observed within the study area (Table 3.2.4-3), including Mojave fringe-toed lizard (*Uma scoparia*) (Figure 3.2.4-4), western burrowing owl (*Athene cunicularia hypugaea*), Le Conte's thrasher *(Toxostoma lecontei*), loggerhead shrike (*Lanius ludovicianus*), Nelson's bighorn sheep (*Ovis canadensis nelson*), American badger (*Taxidea taxus*), and desert kit fox *(Vulpes macrotis arsipus*). In total, 11 insect, nine reptile, 28 bird, and nine mammal species were detected during biological surveys. Figure 3.2.4-3 illustrates the special-status wildlife inventory results.

Wildlife species observed during the reconnaissance and focused surveys conducted for this Project are listed in the Biological Technical Report. The species most commonly observed during biological surveys included lizards, such as the common side-blotched lizard (*Uta stansburiana*), desert iguana (*Dipsosaurus dorsalis*), and western whiptail (*Aspidoscelis tigris*), along with desert ironclad beetle (*Asbolus verrucosus*), common raven (*Corvus corax*), great-tailed grackle (*Quiscalus mexicanus*), and white-tailed antelope squirrel (Ammospermophilus leucurus). Species accounts are provided in the *Biological Resources Technical Report* and the *230 kV Transmission Line Alternatives Habitat Assessment Report* (Appendix C1 and C2, respectively) for the special-status species that could occur within the study area. This includes species that both were and were not detected during surveys. Razorback sucker, while federally- and State-listed with a record in CNDDB (CDFW 2011a), is expected to be absent due to a lack of habitat within the study area and is not discussed. Table 3.2.4-3 provides a summary of the species accounts and potential to occur.

Federally Listed Wildlife Species

No federally listed wildlife species were detected within the study area during spring 2011 or 2012 survey work. However, despite no detection during the survey effort there is a moderate potential for one federally listed threatened wildlife species, the desert tortoise (Gopherus agassizii), to occur within Alternatives 1, 3, and 5. The moderate potential is based on consultation with USFWS and review of surrounding Project data and a CNDDB records search (USFWS 2012; CDFW 2012a). Along Alternative 4 the species has a high potential to occur based on existing records, sign and potential habitat that was found to support the desert tortoise during the survey effort (POWER 2012a, POWER 2012b, CDFW 2013).

State-listed Wildlife Species

No State-listed wildlife species were detected within the study area during spring 2011 or 2012 survey work. There is a potential for the Swainson's hawk (*Buteo swainsoni*) to forage within the study area; however, the species was not detected during the survey effort. Based on existing records and potential habitat, Alternative 4 has the potential to support the desert tortoise. Based on existing records and potential habitat, Alternative 4 has the potential to support the desert tortoise.

Non-listed Special-Status Wildlife Species

Seven non-listed special-status wildlife species or their sign were detected on-site, including the Mojave fringe-toed lizard, western burrowing owl, Le Conte's thrasher, loggerhead shrike, desert kit fox, Nelson's

bighorn sheep, and American badger. These detections are discussed in detail in the biological resources technical reports (Appendix C1 and C2, respectively).

The golden eagle (*Aquila chrysaetos*) is a CDFW Fully Protected Species and Watch List Species and a USFWS Bird of Conservation Concern. Golden eagles or their nests were not observed during surveys for this Project and there are no known golden eagle nests in the general vicinity of the Project area (AECOM 2010; Tetra Tech 2011). The golden eagle does not have any nesting habitat within the study area and there are no active nests known to be present within 10 miles (CDFW 2013). However, abundant foraging habitat is present in and around the study area, particularly south of I-10, and it may enter into the study area while foraging away from its nesting sites.

Jurisdictional Waters

A hydrology study was performed in 2012 to review potential jurisdictional waters (provided in Appendix C5, *Review of Federal Waters,* of this Draft EIR/EA). POWER found that there are two discontinuous ephemeral channels within the Project area. The discontinuous ephemeral channels consist of swales and erosional features including gullies and potential small washes characterized by low volume, infrequent or short duration flow. Based on the data collected the two discontinuous ephemeral channels are considered potential federal waters. For additional discussion on jurisdictional waters, refer to Section 3.2.9, Hydrology and Water Quality. There are 29.2 acres of Desert Riparian Woodland Wash, considered potential waters of the State (POWER 2012a). There is an agricultural irrigation ditch running close to the eastern edge of the proposed solar array, but it does not cross the study area and is approximately 75 to 90 feet below the edge of the study area. There are several palustrine open-water wetlands, likely stock ponds, located in a block in an area that is surrounded by the Project east of the Blythe Airport and north of I-10, but there are no palustrine open-water wetlands within the Project boundaries.

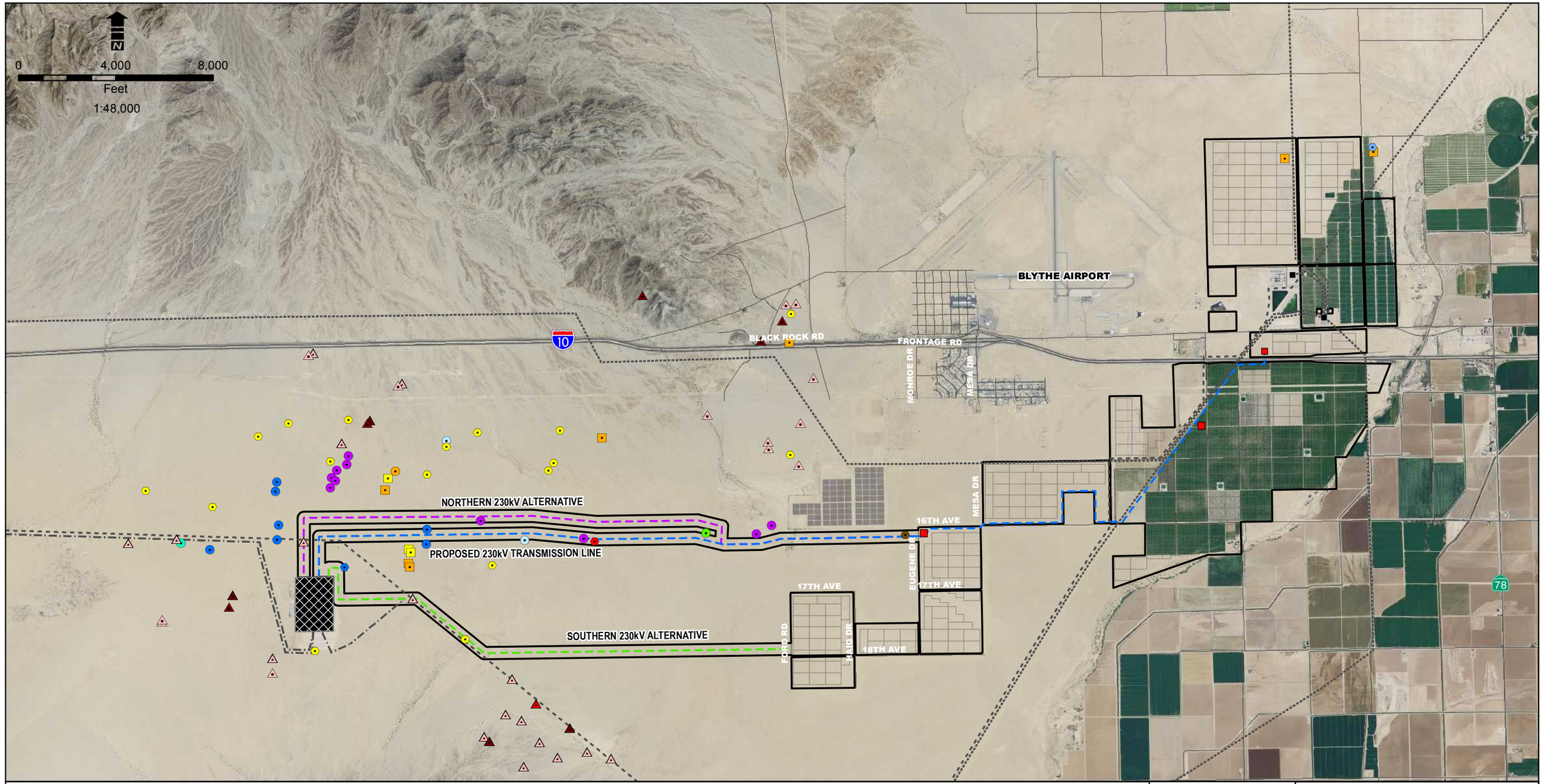
Wildlife Movement

The solar array site and gen-tie line corridors could be used by a variety of wildlife species for movement purposes. Wildlife movement activities typically fall into one of three movement categories: 1) dispersal (e.g., juvenile animals from natal areas, or individuals extending range distributions); 2) seasonal migration; and 3) movements related to home range activities (foraging for food or water, defending territories, or searching for mates, breeding areas, or cover).

Local movement for wildlife across the proposed solar array site and gen-tie line corridors is currently limited by the existing agriculture use and paralleling existing transmission lines. Habitat exists outside of both the solar array site and gen-tie line corridors that would facilitate movement around the site for species.

Critical and Designated Habitat

The study area does not include any designated critical habitat for special-status plant or wildlife species. The Chuckwalla Unit, an area of designated critical habitat for the desert tortoise (59 FR 5820, 5866), is approximately 15 miles west of the study area. The NECO Plan addresses conservation of the bighorn sheep through the designation of Bighorn Sheep wildlife-habitat management areas. The two closest Bighorn Sheep wildlife-habitat management areas, McCoy Mountains and Mule Mountains, are currently listed as unoccupied range (BLM and CDFG 2002). No special management areas, wilderness study areas, or ACECs are located within the solar array site or gen-tie line corridors.



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Solar Array
- Colorado River Substation
- Substation

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Wildlife Inventory Results
- Adult Desert Tortoise
- Desert Tortoise Sign
- Desert Tortoise Burrow
- Kit Fox Burrow
- Potential Coyote or Kit Fox Den
- Coyote/Badger Burrow
- Coyote Burrow
- Burrow
- Ferruginous Hawk
- Le Conte's Thrasher
- Loggerhead Shrike
- Northern Harrier
- Swainson's Hawk
- Unknown Raptor Nest
- Burrowing Owl
- Burrowing Owl Burrow

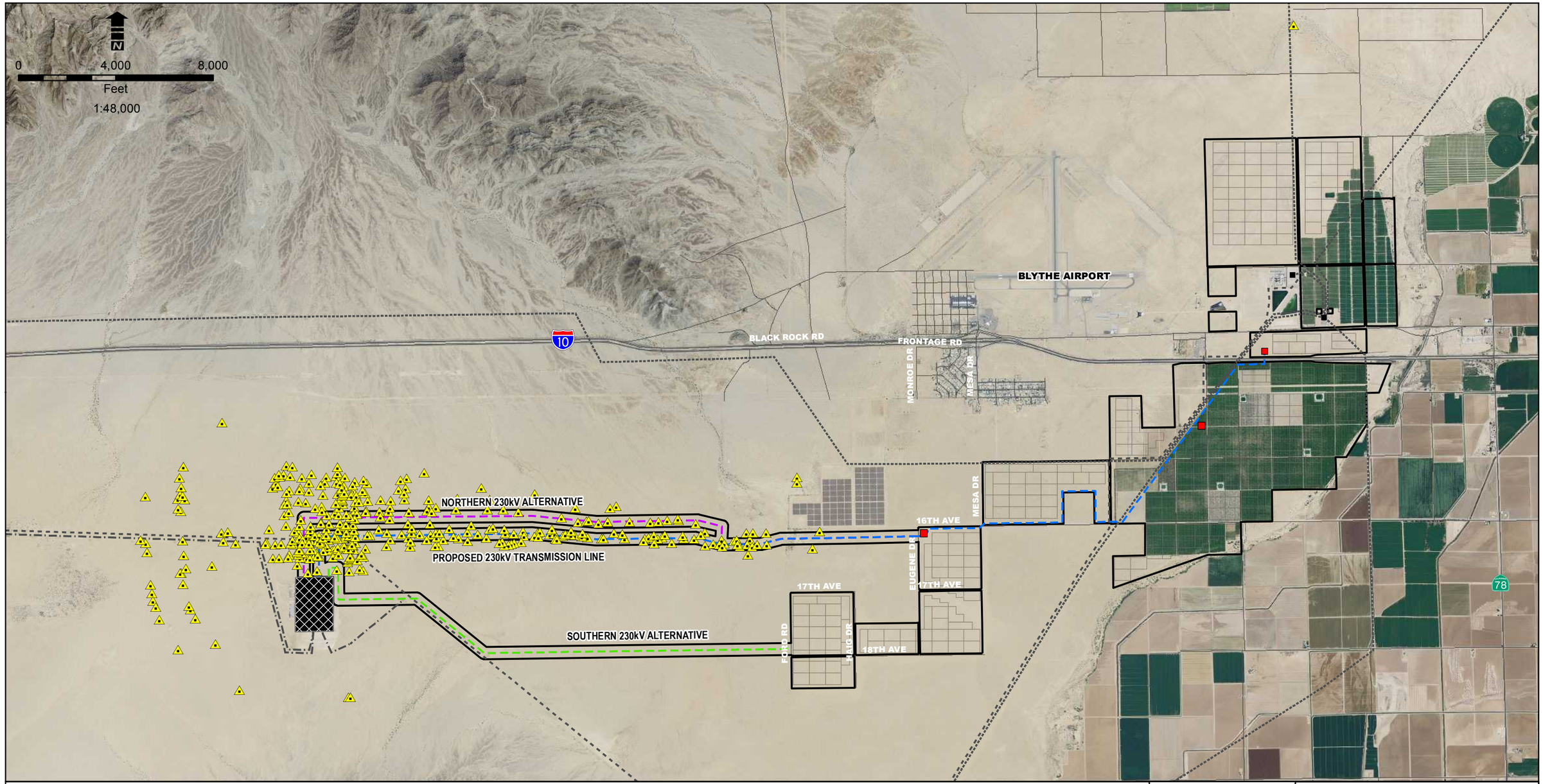


FIGURE 3.2.4-3
WILDLIFE
INVENTORY RESULTS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230kV Transmission Line
- Northern 230kV Alternative
- Southern 230kV Alternative
- Solar Array
- Colorado River Substation
- Substation

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Mojave Fringed-toed Lizard Inventroy Results
- Mojave Fringe-toed Lizard



FIGURE 3.2.4-4
MOJAVE FRINGED-TOED LIZARD INVENTORY RESULTS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 3.2.4-3 SPECIAL-STATUS WILDLIFE SPECIES WITH THE POTENTIAL TO OCCUR IN THE STUDY AREA

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Amphibians							
Couch's spadefoot toad (*Scaphiopus couchii*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Various arid and semiarid environments. Breeds in desert ponds quickly following rainfall.	Suitable habitat is not known to be present, but some areas may still support ponded water after rain events. There is a 2012 CNDDB record located approximately three miles southwest of the Colorado River Substation (CDFW 2013).	Low	Low	Low	Low
Reptiles							
Desert tortoise (*Gopherus agassizii*)	ESA: Threatened CESA: Threatened NECO Plan	Various desert scrubs and desert washes up to about 5,000 feet, but not including playas.	Desert tortoise was documented approximately 0.5 mile south of the southern alignment (CH2M Hill 2010) and sign was scattered around the Colorado River Substation (AECOM 2010). There was a high number of desert tortoise sightings in 2011 and 2012 in the washes spreading out from Mule Mountain, south of the Colorado River Substation (CDFW 2013). POWER walked transects along both alternatives in suitable habitat but did not observe desert tortoise or its sign.	Low	Moderate	Moderate	High
Mojave fringe-toed lizard (*Uma scoparia*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Fine, wind-blown sand in creosote bush scrub of the Mojave and northern Colorado Deserts. From below sea level to 2,952 feet.	Species detected in the northern alternative and proposed gen-tie line during habitat mapping. This species was detected in 2011 within 50 feet of the southern alternative's survey corridor (CDFW 2013).	High	Present	Present	Present

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Birds							
Western burrowing owl (*Athene cunicularia hypugaea*)	CDFW: Species of Special Concern BLM: Sensitive USFWS: Bird of Conservation Concern NECO Plan	Found mainly in grassland and open scrub from the seashore to foothills. Also found in deserts and scrublands.	Habitat marginally suitable for this species within the gen-tie line corridors. May be occasionally present as foragers but unlikely to be present as residents. Suitable habitat and the species were detected within the solar array site during the survey work. High number of sightings in the general region (AECOM 2010, CDFW 2013).	Present	Moderate	Moderate	Moderate
Golden Eagle (*Aquila chrysaetos)*	CDFW: Fully Protected Species USFWS: Bird of Conservation Concern	Golden Eagles favor partially or completely open country, especially around mountains, hills, and cliffs. Also found in desert, shrublands, grasslands, farmland, and areas along rivers and streams.	The golden eagle does not have any nesting habitat within the study area and there are no active nests known to be present within 10 miles (AECOM 2010, Tetra Tech 2011, CDFW 2013). However, abundant foraging habitat is present in and around the study area, particularly south of I-10, and it may enter into the study area while foraging away from its nesting sites.	Low (foraging only)	Low (foraging only)	Low (foraging only)	Low (foraging only)
Ferruginous hawk (*Buteo regalis*)	CDFW: Watch List (wintering)	Open country, primarily plains, prairies, badlands, sagebrush, shrubland, desert.	The species is known to winter in the Colorado River Valley. They are most often seen in agricultural fields around Blythe, but occasionally in the open desert as well. There is no breeding habitat on-site. This species was detected just north of the northern gen-tie line during surveys for the Blythe Mesa Solar Project (AECOM 2010).	Low (non-breeding only)	Present (non-breeding only)	Present (non-breeding only)	Present (non-breeding only)

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Swainson's hawk (*Buteo swainsoni*)	CESA: Threatened, USFWS: Bird of Conservation Concern, USFS: Sensitive	Nesting habitat consists of open habitats with trees, either isolated, scattered or in windrows.	Migrants more frequently occur near western edge of desert such as Borrego and Morongo valleys, as reflected in annual data from the various regional hawk-watch reports. No suitable breeding habitat exists on-site. However, this species was detected just north of the northern gen-tie line during surveys for the Blythe Mesa Solar Project (AECOM 2010).	Low (non-breeding only) High (foraging)	Present (non-breeding only) High(foraging)	Present (non-breeding only) High (foraging)	Present (non-breeding only) High(foraging)
Northern harrier (*Circus cyaneus*)	CDFW: Species of Special Concern	Typically occurs in grasslands around coastal salt or freshwater marshes. Nests are constructed on the ground in shrubby vegetation, usually near the edges of marshes.	This species was not detected during Project surveys but was detected in and around the Project during surveys for the Blythe Mesa Solar Project (AECOM 2010). There is foraging habitat around the transmission line alternatives but limited or no nesting habitat. The solar array presents limited habitat, as it consists of large cleared areas or areas with sparse vegetation.	Low	Present	Present	High
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	ESA: Candidate CESA: Endangered USFWS: Bird of Conservation Concern	Nests along large river systems, typically in areas dominated by willows and cottonwoods.	No suitable habitat observed in study area. Records in the vicinity of the Colorado River (CDFW 2013).	None	None	None	None

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Sonoran yellow warbler (*Dendroica petechia sonorana*)	CDFW: Species of Special Concern USFWS: Bird of Conservation Concern NECO Plan	Occurs in riparian deciduous habitat, such as cottonwood and willow areas, nesting in understories. Summer resident of the Colorado River Valley.	The only suitable habitat for this species is close to where the proposed and northern gen-tie alternatives diverge, where there is a desert dry wash woodland. Historic records located around the Colorado River (CDFW 2013). This species was detected in a wash adjacent to the proposed and northern gen-tie alternatives in 2011 (Tetra Tech 2011a).	None	Present	Present	None
Southwestern willow flycatcher (*Empidonax traillii extimus*)	ESA: Endangered CESA: Endangered NECO Plan	Riparian woodlands.	No suitable habitat observed in study area. Records in the vicinity of the Colorado River (CDFW 2013).	None	None	None	None
Yellow-breasted chat (*Icteria virens*)	CDFW: Species of Special Concern	Inhabits riparian willow thickets near watercourses. Nests in low, dense riparian areas. Summer resident.	No suitable habitat observed in study area. Records in the vicinity of the Colorado River (CDFW 2013).	None	None	None	None
Loggerhead shrike (*Lanius ludovicianus*)	CDFW: Species of Special Concern USFWS: Bird of Conservation Concern	Occurs in semi-open country with utility posts, wires, and trees to perch on.	Pair detected just north of the northern alternative. This species was detected in 2012 just west of the Colorado River Substation, approximately 0.75 mile from the southern alternative (CDFW 2013), and in 2010 in areas overlapping all three gen-tie line boundaries (AECOM 2010).	High	Present	Present	Present
Gila woodpecker (*Melanerpes uropygialis*)	CESA: Endangered USFWS: Bird of Conservation Concern NECO Plan	Nests in cottonwoods or other desert riparian trees, shade trees, or date palms.	Limited suitable habitat available in the study area. Nearest occupied habitat is near Blythe on the Colorado River.	Low	Low	Low	Low

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Gila woodpecker (*Melanerpes uropygialis*)	CESA: Endangered, USFWS: Bird of Conservation Concern	Requires live tree-size cactus or dead trees (Winkler et al. 1995).	Nearest occupied habitat is near Blythe on the Colorado River.	Low	Low	Low	Low
Elf owl (*Micrathene whitneyi*)	CESA: Endangered USFWS: Bird of Conservation Concern NECO Plan	In California, nests only in cottonwood-willow and mesquite riparian areas along the Colorado River.	No suitable nesting habitat in study area. May forage in or near the study area. Historic records along the Colorado River (CDFW 2013).	Low	Low	Low	Low
Summer tanager (*Piranga rubra*)	CDFW: Species of Special Concern	Requires cottonwood-willow riparian forests for nesting and foraging. Summer resident on the Colorado River.	No suitable habitat present in the study area. Historic records along the Colorado River (CDFW 2013).	None	None	None	None
Vermilion flycatcher (*Pyrocephalus rubinus*)	CDFW: Species of Special Concern NECO Plan	Open farmlands, shrubby grasslands, streamsides, and small wooded ponds in desert habitat. Found in diverse areas near open water.	Limited suitable habitat within the proposed alternatives. No recent records. Closest record is from 1919, approximately 2.2 miles away (CDFW 2013).	Moderate	Low	Low	Low
Yuma clapper rail (*Rallus longirostris yumanensis*)	ESA: Endangered CESA: Threatened CDFW: Fully Protected	Nests in freshwater marshes surrounded by tules and cattails. Found along the Colorado River.	No suitable habitat within the study area. Local occurrences primarily constrained to the Colorado River (CDFW 2013).	None	None	None	None

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Crissal thrasher (*Toxostoma crissale*)	CDFW: Species of Special Concern NECO Plan	Occurs in dense riparian and mesquite scrub, microphyll woodland, and riparian washes with a dense understory of shrubs	Some habitat present that could support species foraging but not typical for nesting. Riparian wash present south of the southern alternative. An unidentified thrasher was heard calling during the survey on the northern alternative. This species was identified in 2012 within 500 feet of the southern alignment centerline (CDFW 2013).	Low	Moderate	Moderate	Present
Le Conte's thrasher (*Toxostoma lecontei*)	USFWS: Bird of Conservation Concern NECO Plan	Arid and open plains that are sparsely vegetated and dominated by saltbush and creosote bush	This species was previously detected in 2011 in an area between the northern and southern alternatives. Suitable habitat for this species is present mainly in the creosote bush areas of the Project. An unidentified thrasher was heard calling during the survey on the northern alternative. This species was identified in 2012 west of the Colorado River Substation within one mile of all three alternatives (CDFW 2013).	High	Present	Present	Present
Arizona bell's vireo (*Vireo bellii arizonae*)	CESA: Endangered USFWS: Bird of Conservation Concern	Summer resident along the Colorado River. Nests in willow, mesquite, or small trees and shrubs, but typically in willow thickets with an understory of marsh baccharis.	No suitable habitat present in the study area. Recent (2012) record along the Colorado River (CDFW 2013).	None	None	None	None
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)	CDFW: Species of Special Concern	Nests along the borders of lakes, ponds, or freshwater marshes and wetlands. Found in areas of dense vegetation.	This species was detected several times by POWER in 2013 within three miles of the solar array during surveys of the adjacent Palo Verde Mesa Solar Project. It has a high potential to occur in any vegetated wet basins in the area.	High	Low	Low	Low

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Mammals							
Pallid bat (*Antrozous pallidus*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	This gregarious species usually roosts in small colonies in rock crevices and buildings, but may nest in caves, mines, rock piles, and tree cavities.	Roosting habitat for pallid bats is present in tree cavities in desert riparian woodland wash in the southeastern portion of the survey area. The closest documented occurrence in the CNDDB is from 1992, approximately 30 miles to the southwest of the airport near Corn Springs. The only CNDDB records within 10 miles are both from 1919 (CDFW 2013).	Low	Low	Low	Low
Burro (*Equus asinus)*	BLM: Wildlife Free Roaming Horse and Burro Act	This species is found in the vicinity of the Colorado River, below 7,800 ft. Habitats include sagebrush, bitterbrush, Joshua tree, and pinyon-juniper.	Potential habitat is not documented within the study area, although south of the Project area BLM has documented a BLM Herd Area (HA) where species are known to roam. The HA is approximately 3 miles south of the study area.	Low	Low	Low	Moderate
Pallid San Diego pocket mouse (*Chaetodipus fallax pallidus*)	CDFW: Species of Special Concern	Along desert borders in eastern San Diego County in desert washes, desert scrub, desert succulent scrub, and pinyon-juniper areas. Usually in rocky or gravelly areas.	Very little habitat observed within the study area. Closest CNDDB occurrence is from 1957 approximately 11 miles southwest (CDFW 2013).	Low	Low	Low	Low
Townsend's big-eared bat (*Corynorhinus townsendii*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Occurs in a wide variety of habitats but most commonly in mesic areas. Roosts in open areas.	Suitable foraging habitat within the study area but limited roosting habitat. The closest CNDDB record is from 1919 and is approximately seven miles southeast of the surveyed areas (CDFW 2013).	Low	Low	Low	Low

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Western yellow bat (*Lasiurus xanthinus*)	CDFW: Species of Special Concern	Occurs in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats. Roosts in trees and forages over water and in trees.	Limited roosting habitat available in the study area; no water observed during surveys. The only CNDDB record is from 1980 and is mapped in Blythe.	Low	Low	Low	Low
California leaf-nosed bat (*Macrotus californicus*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Lowland desert scrub, desert riparian and wash areas, alkali scrub, or palm oases. Requires rugged or rocky terrain with mines or caves for roosting.	Suitable foraging habitat is present throughout the study area, although roosting habitat is limited in the immediate region, due to lack of a rugged or rocky terrain. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low	Low	Low
Arizona myotis (*Myotis occultus*)	CDFW: Species of Special Concern	Lowlands of the Colorado River and adjacent desert mountain ranges. Roosts in tree hollows, rock crevices, and similar areas.	The closest documented occurrence in the CNDDB is from 1942, approximately five miles south of the Project (CDFW 2013).	Low	Low	Low	Low
Cave myotis (*Myotis velifer*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Low elevation arid regions near the Colorado River and in adjacent mountains. Requires caves or mines for roosting.	Suitable foraging habitat is present throughout the study area, although roosting habitat is limited in the immediate region. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present (CDFW 2013).	Low	Low	Low	Low

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
Yuma myotis (*Myotis yumanensis*)	BLM: Sensitive	Prefers open forests and woodlands. Requires water for foraging. Roosts in mines, caves, buildings, and crevices.	No roosting or foraging habitat available within the study area. Local CNDDB records are on the Colorado River (CDFW 2013).	None	None	None	None
Colorado Valley woodrat (*Neotoma albigula venusta*)	NECO Plan	Low-lying deserts in southeastern California, particularly those with beavertail cactus (*Opuntia basilaris*) and mesquite (*Prosopis* sp.).	While there is ample foraging habitat for this species, there is very little rocky habitat for constructing middens into. There were no obvious signs of woodrat at the burrows that were observed. The closest CNDDB record is from 1919, approximately 2.25 miles east of the solar array (CDFW 2013).	Low	Low	Low	Low
Pocketed free-tailed bat (*Nyctinomops femorosaccus*)	CDFW: Species of Special Concern NECO Plan	Occurs in rocky areas with high cliffs in pine-juniper woodland, desert scrub, palm oasis, desert wash, and desert riparian habitat.	No suitable habitat in study area.	None	None	None	None
Nelson's bighorn sheep (*Ovis canadensis nelson*)	BLM: Sensitive NECO Plan	Mountain slopes with sparse growth of trees above the desert floor in California.	Nelson's bighorn sheep is known within the region. While the species is generally associated with mountainous areas, desert floor areas are important for dispersal and seasonal movement. However, no records were found within the study area. In addition, the survey work conducted in 2011 and 2012 did not detect the species or sign that it utilizes this area.	Low	Low	Low	Low
Colorado River cotton rat (*Sigmodon arizonae plenus*)	CDFW: Species of Special Concern	Occurs in alluvial areas along the Colorado River in areas supporting marshy vegetation.	No suitable habitat in study area.	None	None	None	None

COMMON NAME SCIENTIFIC NAME	SENSITIVITY STATUS[1]	HABITAT REQUIREMENTS	DISCUSSION	POTENTIAL FOR OCCURRENCE WITHIN THE SOLAR ARRAY PROJECT BOUNDARY[2]	POTENTIAL FOR OCCURRENCE WITHIN THE PROPOSED GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE NORTHERN GEN-TIE LINE (BLM JURISDICTION)[2]	POTENTIAL FOR OCCURRENCE WITHIN THE SOUTHERN GEN-TIE LINE (BLM JURISDICTION)[2]
American badger (*Taxidea taxus*)	CDFW: Species of Special Concern	Coastal sage scrub, mixed chaparral, grassland, oak woodland, chamise chaparral, mixed conifer, pinyon-juniper, desert scrub, desert wash, montane meadow, open areas, and sandy soils.	Suitable badger habitat occurs throughout the vicinity in undeveloped areas. Some large burrows were observed within the study area but were likely kit fox and/or coyote. A live badger was found in 2012 three miles west of the Colorado River Substation (CDFW 2013).	High	High	High	High
Desert kit fox (*Vulpes macrotis arsipus*)	Calif. Code of Regulations: PFM	Suitable habitat for this fossorial mammal consists of arid open areas, shrub grassland, and desert ecosystems.	Suitable kit fox habitat occurs throughout the vicinity in undeveloped areas. A kit fox den was detected on the southern alternative.	High	High	High	Present
Fish							
Razorback sucker (*Xyrauchen texanus*)	ESA: Endangered CESA: Endangered CDFW: Fully Protected	Colorado River. Uses both quiet and swift waters and spawns in shallow water where there is abundant sand, gravel, and rocks.	There is no suitable habitat to support this species within the study area. This species occurs along the Colorado River (CDFW 2013).	None	None	None	None

Source: POWER 2012a.

[1]Sensitivity Status Key
Federal
Endangered Species Act (ESA)
U.S. Fish and Wildlife Service (USFWS)
State
California Department of Fish and Game (CDFW)
California Endangered Species Act (CESA)
California Code of Regulations PFM: Protected furbearing mammal
BLM
Sensitive

[2] Species Potential for Occurrence
Low Potential–low potential to occur because suitable habitat present, but of marginal quality
Moderate Potential–moderate potential to occur because suitable habitat present; not found during surveys
High Potential–high potential to occur because suitable habitat present, and species known to occur within the vicinity; not found during surveys
Present–Species detected during Project surveys on adjacent areas.

Regulatory Framework

The Project must comply with various federal, State, and local laws. While some laws and policies provide constraints, others provide intent and direction for certain actions to occur. The following is a general overview of such guidance, which gives intent or direction for the proposed Project relevant to biological resources.

Federal

Endangered Species Act of 1973; 16 U.S.C. § 1531 et seq.; 50 CFR Parts 17, 222, and 402

The ESA includes provisions for protection and management of species that are federally listed as threatened or endangered or proposed for such listing and of designated critical habitat for these species. The administering agency for the above authority for non-marine species is the USFWS.

Migratory Bird Treaty Act: 16 U.S.C. § 703-711; 50 CFR Subchapter B

The Migratory Bird Treaty Act (MBTA) includes provisions for protection of migratory birds, including basic prohibitions against any taking not authorized by federal regulation. The administering agency for the above authority is the USFWS. The law contains no requirement to prove intent to violate any of its provisions. Wording in the MBTA makes it clear that most actions that result in "taking" or possession (permanent or temporary) of a protected species can be a violation of the act. The word "take" is defined as "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect (including nests, eggs, and feathers)."

Bald and Golden Eagle Protection Act

Bald eagle protection began in 1940 with the passage of the Eagle Protection Act, which was later amended to include golden eagle and was renamed. The Bald and Golden Eagle Protection Act makes it unlawful to import, export, take, sell, purchase, or barter any bald eagle or golden eagle, their parts, products, nests, or eggs. Take includes pursuing, shooting, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing. Exceptions may be granted by USFWS for scientific or exhibition use, or for traditional and cultural use by Native Americans. However, no permits may be issued for import, export, or commercial activities involving eagles.

Clean Water Act (33 U.S.C. § 1251 et seq.)

The Clean Water Act (CWA) is the principal federal statute protecting navigable waters and adjoining shorelines from pollution. The Clean Water Act is administered by the EPA and the United States Army Corps of Engineers (USACE). The USACE is responsible for regulating the discharge of fill material into waters of the United States. Waters of the United States include lakes, rivers, streams and their tributaries, as well as wetlands. Since its enactment, the CWA prohibits the discharge of pollutants into waters of the United States without a permit. Section 404 of the CWA provides that whenever any person discharges dredged or clean fill material into Waters of the United States including, without limitation, wetlands, streams, and bays (e.g., while undertaking road construction, bridge construction, or streambed alteration), a permit is required from the USACE. Through field reconnaissance surveys and analyses of National Wetlands Inventory (NWI) and watershed data, it is unlikely that there are any jurisdictional waters of the United States.

Northern and Eastern Colorado Desert Coordinated Management Plan

The NECO Plan (BLM and CDFG 2002) is a landscape-scale, multi-agency planning effort that protects and conserves the natural resources of the California portion of the Sonoran Desert while also managing its use for humans. This plan was prepared under the same regulations that implement the FLPMA of 1976. The NECO planning area of the CDCA spans 5.5 million acres in the southeastern California Desert, and covers the Project area. The NECO Plan, which was adopted in December 2002, provides

management direction for a variety of sensitive species and habitats on BLM and National Park Service land, as well as the U.S. Marine Corps Chocolate Mountain Aerial Gunnery Range.

The NECO Plan primarily addresses recovery of the desert tortoise (*Gopherus agassizii*), conservation of a variety of other species, and modification of management of wild burro herds in the planning area, and updates policies regarding OHV use and public lands access and use. As part of its focus on desert tortoise recovery and sensitive species protection, the NECO Plan has established several Desert Wildlife Management Areas, which cover much of the designated critical habitat for the desert tortoise. Specifically, these Wildlife Management Areas consist of a system of integrated ecosystem management for special-status species and natural communities on federal lands, and regional standards and guidelines for public land health on BLM lands. The NECO Plan also establishes several Wildlife Habitat Management Areas, which include habitat for desert bighorn sheep and other sensitive species in the planning area (BLM and CDFG 2002).

California Desert Conservation Area Plan

The CDCA Plan guides the management of all BLM-administered lands in the Mojave, Sonoran, and a small portion of the Great Basin Deserts. In total, the CDCA Plan includes an area of approximately 25 million acres, 12 million of which are public lands. The primary goal of the CDCA Plan is to provide guidance for the overall maintenance of the land while simultaneously planning for multiple uses and balancing the human needs with the need to protect the natural environment.

The CDCA Plan includes 12 elements: Cultural Resources; Native American; Wildlife; Vegetation; Wilderness; Wild Horse and Burro; Livestock Grazing; Recreation; Motorized Vehicle Access; Geology, Energy and Mineral Resources; Energy Production and Utility Corridors; and Land-Tenure Adjustment. Each of the elements contains goals and specific actions for the management, use, development, and protection of the resources and public lands within the CDCA, and is based on the concepts of multiple use, sustained yield, and maintenance of environmental quality. In addition, each element provides both a desert-wide perspective of the planning decisions for one major resource or issue of public concern as well as more specific interpretation of multiple-use class guidelines for a given resource and its associated activities.

Wild Horse and Burro Act of 1971, as amended

Herd Areas are those geographic areas where wild horses and/or burros were found at the time of the passage of the Wild Horse and Burro Act in 1971. Herd Management Areas are those areas within Herd Areas where the decision has been made, through Land Use Plans, to manage for populations of wild horses and/or burros. Herd Areas boundaries may only be changed when it is determined that areas once listed as Herd Areas are later found to be used only by privately owned horses or burros, or the Herd Area boundary does not correctly portray where wild horses and burros were found in 1971. Chocolate Mule Mountains Herd Area is located approximately 1,000 feet away from the Southern Alternative's gen-tie line.

Executive Order 11312

This Executive Order from 1999 requires all federal agencies to prevent and control the introduction of invasive non-native species in cost-effective and environmentally sound manners. It established a nationwide Invasive Species Council and Invasive Species Advisory Committee to oversee and facilitate the implementation of the Executive Order.

State

California Endangered Species Act of 1984, California Fish and Game Code § 2050-2098

The CESA includes provisions for the protection and management of species listed by the State as endangered or threatened, or designated as candidates for such listings. CESA includes a requirement

for consultation "to ensure that any action authorized by a state lead agency is not likely to jeopardize the continued existence of any endangered or threatened species… or result in the destruction or adverse modification of habitat essential to the continued existence of the species" (§ 2090). Plants of California declared to be endangered, threatened, or rare are listed at 14 California Code of Regulations (CCR) § 670.2. Animals of California declared to be endangered, threatened, or rare are listed at 14 CCR § 670.5. The administering agency for the above authority is the CDFW.

California Fish and Game Code Section 3503, 3511, 4700, 5050, and 5515

These California Fish and Game Codes (CFGC) list bird (primarily raptor), mammal, amphibian, and reptile species that are classified as fully protected in California. Fully protected species are prohibited from being taken or possessed except under specific permit requirements. These Codes also prohibit the take, possession, or needless destruction of the nests or eggs of any bird, including birds of prey or their nests or eggs, except as otherwise provided by the code or any regulation made pursuant thereto.

Native Plant Protection Act (CFGC Section 1900 et seq.)

The California Native Plant Protection Act prohibits importation of rare and endangered plants into California, "take" of rare and endangered plants, and sale of rare and endangered plants. CESA defers to the California Native Plant Protection Act, which ensures that State-listed plant species are protected when State agencies are involved in projects subject to CEQA. In this case, plants listed as rare under the California Native Plant Protection Act are not protected under CESA but rather under CEQA.

California Fish and Game Code Sections 1600-1616 – Streambed Alteration Agreement

This Code requires that any person, State or local government agency, or public utility notify the CDFW and obtain a streambed alteration agreement before they begin any construction project that will divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake, use materials from a streambed, or result in the disposal or disposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake. In general, CDFW jurisdiction extends to the top of the stream or bank, or to the outer edge of riparian vegetation, whichever is wider.

Porter-Cologne Water Quality Control Act of 1969 (California Water Code Section 13000 et seq.)

The Porter-Cologne Water Quality Control Act provides State coordination with the CWA, which is described above. It provides a mechanism by which the Regional Water Quality Control Boards certify that federal actions that result in a discharge to waters, including federally issued CWA permits to ensure the compatibility of federal and State water quality guidelines, are in compliance with Section 401 of the CWA, which requires such federal actions to comply with state water quality standards. The act provides for the development and periodic review of water quality control plans (basin plans) that designate beneficial uses of California's major rivers and groundwater basins and establish narrative and numerical water quality objectives for those waters. Basin plans are primarily implemented by using the National Pollution Discharge Elimination System permitting system to regulate waste discharges to ensure that water quality objectives are met. Waste discharges may include fill, any material resulting from human activity, or any other "discharge" that may directly or indirectly impact Waters of the State relative to the implementation of Section 401 of the CWA.

California Desert Renewables Energy Conservation Plan

The California Desert Renewables Energy Conservation Plan (DRECP) is a Natural Community Conservation Plan being developed by a joint federal and State Renewable Energy Action Team (REAT) to provide for effective protection and conservation of desert ecosystems while allowing for the appropriate development of renewable energy projects. The REAT consists of the CEC, CDFW, BLM, USFWS, and counties impacted by the DRECP. The DRECP is intended to provide long-term endangered species permit assurances, facilitate the review and approval of renewable energy projects in the Mojave and Colorado deserts in California, and provide a process for conservation funding to

implement the DRECP. It is anticipated that the DRECP also would serve as the basis for one or more habitat conservation plans under the federal ESA and provide biological information necessary for consultation under ESA Section 10. The proposed Project would be located within the DRECP planning area. The DRECP is not yet final, and no decision has been made for the DRECP.

Local Ordinances

Riverside County General Plan

The Riverside County General Plan includes policies that address biological resources within the County boundaries. Countywide policies that seek to preserve biological resources are located in the Land Use Element and Open Space Element of the County General Plan, and include:

Land Use Element (LU)

Policy LU 8.1. *Provide for permanent preservation of open space lands that contain important natural resources, hazards, water features, watercourses, and scenic and recreational values.*

Policy LU 8.2. *Require that development protect environmental resources by compliance with the Multipurpose Open Space Element of the General Plan and Federal and State regulations such as CEQA, NEPA, the Clean Air Act, and the Clean Water Act.*

Policy LU 18.2. *Cooperate with the* [former] *California Department of Fish and Game (CDFG)* [now California Department of Fish and Wildlife (CDFW)]*, United States Fish and Wildlife Service (USFWS), and any other appropriate agencies in establishing programs for the voluntary protection, and where feasible, voluntary restoration of significant environmental habitats.*

Multipurpose Open Space Element (OS)

Policy OS 18.1. *Preserve multi-species habitat resources in the County of Riverside through the enforcement of the provisions of applicable MSHCPs* [Multiple Species Habitat Conservation Plans]*, if adopted.*

City of Blythe General Plan

Policies that seek to preserve biological resources are located in the Open Space Element of the City General Plan, and include:

Open Space and Conservation Element

Policy 15*: Protect habitats that are sensitive, rare, declining, unique or represent valuable biological resources in the Planning Area.*

Policy 16: *Preserve and protect populations and supporting habitat of special status species within the Planning Area, including species that are State or federally-listed as Rare, Threatened, or Endangered, all federal "candidate" species for listing and other species on officially adopted federal and/or State listings, and all California Species of Special Concern.*

Policy 17: *Minimize impacts to sensitive natural habitats throughout the Planning Area. In new developments, emphasis should be placed on protecting and preserving valuable and sensitive natural habitats, the comprehensive habitat mapping and biological resource inventory prepared, as part of Plan preparation, shall be consulted when reviewing development applications.*

Policy 18: *Preserve and protect areas determined to function as regional wildlife corridors, particularly those areas that provide natural connections permitting wildlife movement between designated sensitive habitats and all areas being considered for future conservation because of their high value.*

3.2.5 Cultural Resources

Cultural resources were inventoried and are described for the proposed Project and Alternatives. This section summarizes the results of a literature review, records searches, archaeological resource and historic built environment survey, and communications with Native American representatives regarding cultural resources that could potentially be impacted by the Project. The information in this section is based on the *Blythe Mesa Solar Project Archaeological Resource and Built Environment Survey, prepared by* POWER Engineers, Inc. (2013a) and the *Blythe Mesa Solar Project Archaeological Resource and Built Environment Survey, Transmission Line Alternatives Supplemental Report*, prepared by POWER Engineers, Inc. (2013b) (provided in Appendix D1 and D2, respectively, of this Draft EIR/EA). This section describes the affected environment and regulatory setting for cultural resources.

Environmental Setting

Prehistory

Paleoindian Period (San Dieguito) (12,000 to 7,000 before present [BP])

The Paleoindian period experienced profound environmental changes, as the cool, moist conditions of the Pleistocene (from 2.5 million to 12,000 years ago) gave way to the warmer, drier climate of the Holocene (from 12,000 years ago to present). The earliest record of habitation in eastern Riverside County occurred during the Paleoindian Period. Settlement patterns of this period suggest that habitation occurred along prehistoric lakeshores and on mesas near springs and washes. Away from the Colorado River, the Palo Verde Mesa area was not conducive to settlement due to the limited water resources available and was likely used as a travel corridor between the mountains and river (von Werlhof 2004). Within the larger Riverside County region, Paleoindian sites may be found on stable landforms, in protected caves above floodplains and valley/riparian environments, and along ridge systems and in mountain passes that may have served as travel routes.

The Paleoindian inhabitants were nomadic large-game hunters whose tool assemblage included choppers; percussion-flaked scrapers and knives; large, well-made, fluted, leaf-shaped, or stemmed projectile points (e.g., Lake Mojave, Silver Lake); crescents; heavy core/cobble tools; hammerstones; bifacial cores; and scraper planes (Rogers 1939, 1966; Warren 1968). The subsistence strategy used during the San Dieguito period focused primarily on hunting both large and small game as well as gathering plants throughout the seasons. Near the end of this period the climate began to warm, which caused the lakes and marshes to dry, resulting in the need for different subsistence and settlement strategies (Moratto 1984).

Archaic Period (Pinto and Amargosa) (7,000 to 1,500 BP)

The climatic patterns of the late Paleoindian period continued into the early Archaic period. The beginning of the late Archaic coincides with a period of increased moisture in the region. Research suggests the California desert environment was unstable during these periods, forcing the hunter-gatherers towards more hospitable regions (Crabtree 1981; Schaefer 1994; Weide 1974). However, late Archaic sites have been recorded in more southern portions of Riverside County's low desert near the Peninsular Ranges, where water was more available.

Late Archaic site types include residential bases with large, diverse artifact assemblages, abundant faunal remains, and cultural features; temporary bases; temporary camps; and task-specific activity areas. Diagnostic projectile points of this period include more refined notched (Elko), concave base (Humboldt), and small-stemmed (Gypsum) forms (Warren 1984). The mortar and pestle were used to process acorns, an important storable resource. *Haliotis* and *Olivella* shell beads and ornaments and split-twig animal figurines indicate that interior California occupants were in contact with populations on the California coast and in the southern Great Basin (Warren 1984).

Late Prehistoric (Patayan Complex) (1,500 to 150 BP)

A period of even more persistent drought began by 1,500 years ago, and conditions became significantly warmer and drier (Jones et al. 1999; Kennett and Kennett 2000). The dry period continued until 750 years ago (Spaulding 2001).

The Patayan Complex is marked by strong regional cultural development relative to the economic system and settlement patterns. In the Southern California desert regions, cultural development was heavily influenced by the Patayan culture of the lower Colorado River area (Warren 1984). This period includes a pre-ceramic transitional phase ranging between 1,500 and 1,200 years BP. The Patayan complex is distinguished from the transitional phase by the introduction of pottery using the paddle-and-anvil technique as well as the use of bow-and-arrow technology. Also noted is the use of floodplain agriculture (Rogers 1945). These technological advancements are believed to be from Mexico or the ancestral Pueblo cultures of the Southwest deserts (McGuire and Schiffer 1982; Rogers 1945; Schroeder 1979).

Diagnostic artifacts include Saratoga Springs projectile points, small triangular projectile points, mortars and pestles, steatite ornaments and containers, perforated stones, circular shell fishhooks, numerous and varied bone tools, and bone and shell ornaments (Schaefer 1994). Elaborate mortuary customs and extensive trade networks are also characteristic of this period. Additionally, abundant amounts of obsidian were being imported into the region from the Obsidian Butte source that had been exposed by the desiccation of Lake Cahuilla (Warren 1984).

According to Schaefer and Laylander (2007), the preponderance of evidence suggests that pottery was not introduced or was rarely used in the California desert area before *Anno Domini* (A.D.) 870 to 1010. Two ceramic types have been identified as the most prevalent for the Palo Verde Valley area, Lower Colorado Buffware and Tizon Brown Ware. Harner (1957) observed that in the Chuckwalla Valley (20 miles west of the Project) the frequency of Lower Colorado Buff was double that of Tizon Brown. When this pottery was compared and cross-dated with a collection from the Bouse Site in Arizona, Harner (1957) found that the pottery from the Chuckwalla Valley could date between A.D. 1300 and 1900. However, Griset (1996), cited in Schaefer and Laylander (2007), also saw evidence of pottery in the region as early as A.D. 800.

Lower Colorado Buffware is made from riverine and lacustrine clay, usually with fine grains of subangular to sub-round quartz, feldspars, and other opaque spars. Most vessels are highly oxidized due to the firing process. The surface finish is typically smoothed with faint wipe marks left by mops. The larger vessels may display anvil marks on the interior surfaces. A thick cream-colored scum coat is common in the desert regions, and stucco treatment is also common along the Colorado River and in the desert. The surface color is usually tan with pink tones. Recurved rims are common, polish is rare, and decorations often include fingernail impressions, in casing and punched holes. Colorado Buff dates to Patayan III (A.D. 1500 to post-1900) (Waters 1982).

Tizon Brown Ware is made from clays from decomposing granite outcrops in the California-Colorado desert regions, and usually contains higher iron content. The vessels are typically reddish brown and contain little to no temper. Both Tizon Brown and Lower Colorado Buff were usually made using coils, smoothed and shaped by a paddle and anvil (Lyneis 1988).

By the late Prehistoric period there appears to have been a transition to more mobile patterns of travel and trade between the Colorado River and Lake Cahuilla (Pendleton 1984). Long-range travel for resource procurement and trade resulted in a system of trails through the Colorado Desert. The increased mobility along the trail system allowed the opportunity for interaction between neighboring tribes. As the Spanish began to explore the area, native trails and trade routes were used and expanded.

In an ongoing study, Laylander and Schaefer (2010) have applied a regional perspective to evaluate and treat cultural resources within a broad landscape approach. The current Project falls within their Prehistoric Trails Network Cultural Landscape area, which includes the Palo Verde Valley and McCoy Wash and Palen Valley. No historic trails are documented within the proposed Project solar facility site or alternative gen-tie line ROWs. For this reason and because of the extensive past military-related and

agricultural disturbance of the Project area, the Prehistoric Trails Network Cultural Landscape is not analyzed in detail in this Draft EIR/EA.

Three prehistoric trails are outside the Project boundaries but in the Project vicinity; these were likely used to travel to and from springs and other water sources. McCarthy (1993) explained that trails in the McCoy Springs region are un-bordered and do not indicate evidence of deliberate construction.

Early research in the area noted recognizable trail types, including major long distance, minor long distance, and subsidiary trails between settlements and resource areas (Rogers 1941). McCarthy (1993) defines two types of trails, primary and secondary. Primary trails are based around a destination that is fixed on the landscape, such as a spring. McCoy Springs was the destination spot for all of the trail segments in the current Project vicinity. Secondary trails branch off from primary trails. McCarthy identified CA-RIV-53 (known as the Halchidhoma Trail), east and northwest of the Project, as the predominant trail that leads to McCoy Springs. The trails along the southern flank of the McCoy Mountains probably emanate from the Colorado River (Palo Verde Valley) and lead toward the Chuckwalla Valley. Between the McCoy and the Chuckwalla Mountains, several springs (McCoy, Chuckwalla, and Corn Springs), tanks (Palen and Mule Tanks), and dry lake beds (Ford Dry Lake and Palen Lake) were linked with a network of trails. The trails that were found within the desert pavement setting were in excellent condition. These trails include CA-RIV-53; CA-RIV-885, less than a mile southwest of the Project; and CA-RIV-3673, less than a mile northeast of the Project. The historic Bradshaw trail, discussed below, followed ancient Native American trails that linked water sources across the Colorado Desert. These trails passed through the San Gorgonio Pass, turned south and ran to the Salton Sink and between the Orocopia and Chocolate mountains, skirted the southern edge of the Chuckwalla Range, crossed through the Mule Mountains, and reached the Palo Verde Valley.

Other trails lead toward canyons containing temporary water sources. Petroglyph sites have been documented in these canyons; two short trail segments that lead to a large canyon southeast of McCoy Peak have been documented outside the Project but within the Project vicinity. In addition to water sources, other resource areas would include lithic quarries and assay areas. A line of pebble terraces line the southern flank of the McCoy Mountains. Several extremely large prehistoric lithic sources and assay sites have been recorded in these terraces. Trail segments between these sites have been documented. One segment, CA-RIV-3671, is within one mile of the Project (von Werlhof 1987). McCarthy speculates shorter trail segments in the area of McCoy Wash were used to connect specialized activity areas within larger habitation areas (McCarthy 1993).

Trails were also used for trade routes. Trade between Southern California and the Southwest may have begun more than 9,000 years ago (Ruby 1970), but the predominant trading activity ranged between A.D. 900 and A.D. 1300. Exchange items included California marine shell and Southwestern pottery. Johnston and Johnston (1957) found segments of trails from the Colorado River through the San Gorgonio Pass and into Riverside County. The system connected the Palo Verde Valley to the McCoy Mountains through the Chuckwalla Valley into the Chuckwalla Mountains. Trails are also discussed in Warren and Roske (1981) and Johnston (1980).

Trails are also a significant element in the Native American sacred landscape; they link the spiritual world to the natural landscape. Trails have been marked with rock shrines and artifacts such as pottery drops and flaked stone scatters, particularly white quartz. Songs and stories contain named places such as mountains, water sources, valleys, and other geographical locations along known trails (Fowler 2009).

Ethnography

The Colorado Desert area of Riverside County is within the ethnographic boundaries of several different eighteenth and nineteenth century Native American groups.

Colorado River Peoples: the Quechan, Halchidhoma, and Mojave

The first Europeans to encounter and document the traditional inhabitants of the Lower Colorado River area were the Spanish, followed by American explorers. Kroeber (1920, 1925) conducted extensive

fieldwork at the turn of the twentieth century; in particular, he studied the Mojave tribe in the Needles area. Spanish missionary influence did not reach the desert cultures, which enabled them to retain much of their language, religion, and cultural practices. Early ethnographers were able to conduct fieldwork and documented many details about oral histories, ritual and burial practices, and life-ways practiced prior to contact and those during the first half of the twentieth century. Malcolm Rogers studied the Colorado River tribes in the 1930s and documented information that included the lithic and ceramic technologies.

After A.D. 1000, the Colorado River tribes appear to have become more mobile and extended their travel between the river and Lake Cahuilla, and consequently expanded their resource procurement patterns (Pendleton 1984). This resulted in the development of an extensive trail network throughout the Colorado Desert. Evidence of travel and trade is noted by the presence of pottery drops and shrines lining the trails (McCarthy 1993). The trails network was also a major component of the tribes' belief system, interconnecting important geographical locations and ceremonial sites with song cycles and rituals.

Lithic quarries along various mountain ranges were used for tool material; springs within these mountains provided water. Several springs are located within a day's travel of the Project area; in addition to McCoy Springs, Corn and Chuckwalla springs are less than 30 miles to the west.

The lower Colorado River region, including the Project area, was inhabited by numerous tribes at the time of the first Spanish contact. Alarcon and Diaz were the first to travel up the Colorado River in 1540; their description of the interaction between tribes indicates shifting boundaries and inter-tribal hostilities. (Forbes 1965). A later expedition by Oñate in 1605 documents several tribes, including the Halchidhoma, the Quechan, and the Mojave, at various points along the river. By 1774, the Anza Expedition noted the Halchidhoma living between the Mojave and Quechan territories near Parker, Arizona. Historical accounts describe constant conflict among the tribes, with the Quechan and Mojave against the Halchidhoma. Ultimately, the Halchidhoma left the area and resettled in the mid-1800s in the Gila River area.

Settlement was determined primarily by proximity to permanent water sources. Villages and camp sites were most often in the foothills and less frequently on the open areas of the desert floor and mesas, depending on the availability of water. Tribal boundaries and territories were dynamic as a result of interactions and warfare between tribes (Dobyns et al. 1963; Kroeber 1925).

Like some of the other river Yuman tribes, the Mojave focused on agriculture, producing close to half of their dietary needs from crops, including maize, squash, melons, beans, and a variety of grasses (Bee 1983; Castetter and Bell 1951). Similarly, the Quechan also relied on agriculture as well as fish from the Colorado River. In addition, both small game and large game were hunted, adding important dietary protein.

The Colorado River tribes share similar beliefs that are strongly linked to dreaming and ritual songs that apply to daily life and personal knowledge. These beliefs are based on real places that are visited physically or in dreams (Kroeber 1925). Forbes noted that religion, cultural identity, various aspects of daily life, and the landscape on which the tribes lived were intricately intertwined. Important ceremonial locations include intaglios, petroglyphs, lithic scatters, and cleared circles along the Colorado River and in the surrounding hills. As previously mentioned, one key component of the cultural landscape is the regional trail system (Forbes 1965).

Chemehuevi

The Chemehuevi tribe is the southernmost group of the Southern Paiutes (Kelly and Fowler 1986). Their territory included the western side of the Colorado River into the Palo Verde Mountains and north toward Cadiz Dry Lake.

The Chemehuevi share many cultural elements with the Mojave, including habitation structures, ground stone tool types, and spiritual beliefs. The Chemehuevi were organized in small mobile groups who traveled widely, interacting with neighboring tribes. They subsisted on small game, hunting as far west as San Bernardino, and on harvesting seasonal plant resources throughout the region. They hunted with the Quechan in Arizona and the Serrano in Tehachapi, and were reported to have collected abalone in the

Santa Barbara Channel and to have journeyed east to the Hopi villages (Kelly and Fowler 1986). They were not known to have used pottery but rather chose basketry and other woven implements, often decorated. The Chemehuevi who settled along the Colorado River lived in relatively permanent structures and utilized agriculture to a greater extent than related groups to the west (Laird 1976). Historically, they grew a variety of crops including vegetables, beans, winter wheat, and grasses.

Chemehuevi spiritual beliefs include a sacred landscape that incorporates both the spirit world and the natural world. These rituals include songs and dreams that are the basis of their daily lives, linking their beliefs, material existence, and the cultural landscape. Kroeber states that knowledge is acquired by each man according to his dreams (Kroeber 1925). The "Salt Song" describes a ceremonial trail that traverses through three states and explains the significance of the mountains and the medicines found in them.

Cahuilla

The Cahuilla are one of several groups that migrated into California from the Great Basin; although the specific time, duration, and process is unclear, it is estimated to have taken place around 1,500 BP (Kroeber 1925; Laylander 1985). The Cahuilla's traditional territory encompassed diverse topography ranging from 273 feet below sea level at the Salton Sink to 11,000 feet amsl in the San Bernardino Mountains. The Cahuilla's territory extended from the summit of the San Bernardino Mountains in the north to the Chocolate Mountains and Borrego Springs in the south. Its eastern border included the Colorado Desert west of Orocopia Mountain, and its western border included the San Jacinto Plain near Riverside and the eastern slopes of Palomar Mountain (Bean 1978).

Numerous land-holding clans claim territory within this area, each of which ranged from the desert to the mountain areas. Clans could include more than one lineage, each of which had independent community areas that were owned within the larger clan area (Wilke and Lawton 1975).

Cahuilla villages usually were in canyons or along alluvial fans near adequate sources of water and food plants. The immediate village territory was owned in common by a lineage group or band. The other lands were divided into tracts owned by clans, families, or individuals. Trails used for hunting, trading, and social interaction connected the villages. Each village was near numerous sacred sites (places of importance such as locations of traditional ceremonies or activities) that included rock art panels (Bean and Shipek 1978).

Cahuilla belief system and oral tradition indicate that when Lake Cahuilla dried up, the desert floor was settled; 17 or more rancherias have been identified in Coachella Valley. These rancheria locations are associated with hand-dug wells, springs, or palm oases. Water collection and conveyance features and associated agricultural fields have been documented from the early 1800s (Wilke and Lawton 1975).

Euro-American History

European presence in the Colorado River region began with explorations in the sixteenth century. Permanent settlement occurred in the mid-nineteenth century as a result of the development of transportation and water conveyance. Exploration was primarily for travel routes in search of interior waterways and from Mexico north toward Monterey for the establishment of the California missions by the Spanish. The end of the Mexican War of 1846 to 1848, the discovery of gold in California in 1849, and the establishment of California as a state on September 9, 1850 all contributed to a steady influx of non-Hispanic settlers into the area. Later, mining, agriculture, and military training brought settlement to the Riverside County area.

Transportation

Prior to the European presence in the Colorado Desert area, transportation was limited to foot trails used by the Native Americans. As the Spanish began to explore the area, these native trails and trade routes were further used and expanded. One of the more important routes, known as the Bradshaw Trail, was developed as the result of the search for gold in the region, specifically in the area of La Paz, along the

eastern side of the Colorado River (Gunther 1984; Johnston 1972, 1987) and north of the Project area. William D. Bradshaw, a forty-niner working in the San Bernardino County area, was determined to find an overland route from the Pacific Ocean to the Colorado River, where gold had been recently discovered in what is now Ehrenberg. Bradshaw had previously mined for gold in Sutter's Mill in 1849, and anticipated La Paz to become a gold strike boom-town. To accommodate the expected influx of miners headed toward La Paz, Bradshaw recruited a group of eight men to scout out a direct route.

Bradshaw worked with Chief Cabazon, the leader of the Desert Cahuilla, and a Coco Maricopa Indian mail runner to map a route using an ancient native trail. The Bradshaw Trail passed through the San Gorgonio Pass through Palm Springs, then turned south and ran through Martinez to the north side of the Salton Sink and between the Orocopia and Chocolate Mountains ranges. The route then skirted the southern edge of the Chuckwalla range crossed through the Mule Mountains and reached the Palo Verde Valley. Bradshaw also established a ferry service to cross the Colorado River and proceeded to promote his new trail and ferry enterprise (Gunther 1984; Johnston 1972, 1987). The Bradshaw Trail is 5.5 miles south of the Project area.

Also paramount to the development of the Colorado Desert was the arrival of the Southern Pacific Rail Road (SPRR), a transcontinental railroad system. The SPRR was founded as a land holding company in 1865 and acquired various smaller railroad companies that would eventually link New Orleans, Texas, New Mexico, Arizona, and California through Los Angeles and then north into San Francisco through to Portland, Oregon. Numerous communities sprang up along the route and greatly accommodated the mining boom in the local area (Vredenburgh et al. 1981). The railroad was instrumental in settlement of the Colorado Desert areas by providing access to immigrants as well as shipping consumer goods and produce between the east and west coasts (Fickewirth 1992). The SPRR reached Yuma, Arizona in 1877, and links north on the river were provided by commercial river boat traffic (Vredenburgh et al. 1981). Later, to facilitate the mining activities in the Blythe area, a spur was constructed to the Atchison, Topeka, and Santa Fe Blythe-Ripley Line in 1916.

Mining

With the signing of the Treaty of Guadalupe-Hidalgo in 1848, the southwest came under the control of the United States. The Colorado Desert was the scene of prolonged mining from 1850, with the beginning of the gold rush in California. The small town of La Paz, 45 miles northeast of Blythe on the eastern bank of the Colorado River, was a boomtown in the 1860s (Wilson 1961). The mid-1860s saw the town of La Paz swell in population to over 5,000, but by 1870 the miners had gleaned most of the gold-bearing ore from this site.

Mining and prospecting were primarily focused in the mountains and high desert north of Blythe, and small-scale mining occurred from the 1860s until after the Great Depression in the 1930s (Morton 1977). Although gold was found only in small amounts, mining of gypsum and manganese were more successful ventures. To the north in the McCoy Mountains, several significant manganese mines provided ore for armaments during both World Wars I and II (Butler 1998). Other minerals that were mined from the areas in the Project vicinity include fluorite, copper and uranium (Warren et al. 1981).

Homesteading and Agriculture

The passage of the Homestead Act in 1862 and the Desert Land Act in 1877 were instrumental in the settlement of the Lower Colorado River area. The Homestead Act offered the opportunity for United States citizens to file a claim on 160 acres or less of land for $1.25 per acre. The Act stipulated that the claim be for purposes of actual settlement and cultivation, and the claimant was required to "improve" the plot by building a dwelling and cultivating the land. After five years on the land, the original filer was entitled to the property, free and clear (National History Day n.d.).

The Desert Land Act was similar to the Homestead Act in that it was enacted to encourage and promote economic development of the desert lands of the western states. This act also required the filer to irrigate and cultivate the land within three years. A married couple could pay $1.25 per acre for a maximum of 640 acres, whereas a single man would receive half the land but pay the same price. Proof of irrigation

was required for the filer to obtain title. This act was revised to offer a maximum of 320 acres with proof of irrigation required within four years (Library of Congress n.d.).

Agriculture in the Palo Verde Valley was made possible by the construction of canals and pipelines as well as the securing of water appropriations. Thomas Blythe came to the lower Colorado River area and established water rights along the Colorado River. His efforts in irrigation and cultivation of the land were successful. The first irrigation project was not completed until 1883, after his death (Warren 1981), but eventually 40,000 acres were irrigated as a result of his diverting water from the Colorado River (Blythe Chamber of Commerce 2011). The valley was still subject to flooding, however, until after the completion of Boulder Dam in the 1930s.

World War II Desert Training Center/California-Arizona Maneuver Area

Soon after the United States entered World War II, General George S. Patton, Jr. was assigned the task of developing a training center to prepare Army troops for combat against German forces in North Africa. Patton identified an area in the California desert that offered realistic terrain and combat conditions to train the troops. The lack of water, extreme heat, and difficult terrain as well as the remote location would assist preparing troops for mobilization and combat tactics. Ultimately, training missions were both ground and air; all manner of equipment and battle strategies were tested and perfected there (Bischoff 2000).

Patton established base operations headquarters at Camp Young, near Indio, and began training troops in April 1942. The Desert Training Center (DTC) facility extended from Desert Center in California to the Colorado River, as far north as Searchlight, Nevada and as far south as Yuma, Arizona. To accommodate the massive number of troops brought to the region, several desert airfields were taken over by the Army in 1942, including the airfield that was to become Blythe Army Air Base (BAAB). The name of the DTC was changed to the California-Arizona Maneuver Area (C-AMA) in October 1943, and the mission of the C-AMA was expanded to include simulation of large-scale operations and logistics beyond exclusively desert warfare tactics.

The DTC/C-AMA consisted of 11 major camps, seven in California and four in Arizona. The larger camps included Camp Iron Mountain, Camp Granite, and Camp Coxcomb, north of Desert Center. All of the facilities were connected by railroads and major roads (Vrendenburgh et al. 1981).

The DTC/C-AMA was where actual battle simulation was first used. The training offered in surviving the elements, tactical mobility, and mastering ordinance and engagement provided unparalleled experience for troops and commanding officers. In April 1944, the facilities began evacuations and closing, eventually being turned back to the United States Department of the Interior and private landowners (Bischoff 2000).

Blythe Army Air Base

The Project area is on the eastern side of BAAB that, beginning in 1942, supported the military training missions associated with the DTC/C-AMA and later provided aerial bombardment training between 1942 and 1944. As a cultural resource, BAAB was documented in 2010 as P-33-18837 and evaluated for the National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR); a brief summary based on Mitchell (2010a, 2010b) and information provided by Art Wilson (2008, personal communication 2011), a local historian, is provided below.

Under the Civil Aeronautics Act of 1938, the Civil Aeronautics Administration was charged with developing civilian airfields throughout California that could be used for defense. BAAB had humble beginnings in 1940 as a private, unpaved airstrip, originally known as Intermediate Flying Field Site 21. In addition, Site 21 was intended for emergency landings for flights between Los Angeles and Phoenix. The following year (1941) the Works Progress Administration provided funds to upgrade the airfield to two paved runways as part of the National Defense Program, with Riverside County sponsoring the project and maintaining the airfield.

In February 1942, General Patton was tasked to identify a location suitable for training troops in desert warfare as preparation for deployment to North Africa. The selected location became the DTC.

Construction was planned for DTC airfields at Thermal, Desert Center, Rice, and Shaver's Summit (now Chiriaco Summit). Because construction for the Site 21 airfield outside Blythe was already underway, it was incorporated into General Patton's DTC operation and used immediately for air support until the four new airfields became operational.

On April 7, 1942, approval was given for Site 21 to become BAAB, and improvements were begun in preparation for the arrival of the 46th Bombardment Group, whose initial mission was to provide medium bomber crews in support of Patton's rigorous desert warfare training. This group was joined by the 3rd Observation Squadron to perform observation missions in support of the army ground forces on maneuvers at the DTC. For five months, General Patton oversaw the operations of the DTC, including BAAB. In September 1942, General Henry "Hap" Arnold and Lt. Col. Richard Lee took over command of the base from General Patton; by the end of that year the base population was 800 officers and 5,400 enlisted men (Wilson 2008).

Construction continued on the base throughout 1942; by December a deep water well, a small hanger, an engineering building, the base theater, four warehouses and 60 barracks had been completed, and four runways with aprons had been paved and were in use. However, by the end of 1942, DTC airfields were operational at Thermal, Rice and Desert Center and support from BAAB was no longer needed. At that point, BAAB was relieved of its DTC air support role and changed to heavy bomber training under the 2nd Air Force. The 34th Bombardment Group was assigned to BAAB; its mission was training in B-17 Flying Fortress and B-24 Liberator aircraft (Wilson 2008). In total, BAAB's direct association with the DTC lasted eight months, from April 1942 to the end of the same year, and its association with General Patton lasted only five months.

In 1943, the base hospital, an officer's club, and the pool were opened for use. Also, a mess hall, a base chapel, a barber shop, and additional hangars were completed. Numerous bombardment groups trained at the base for the next two years. Included in the troops assigned to the base for short periods were the Women's Army Auxiliary Corps and the 99th Fighter Squadron, also known as the Tuskegee Airmen (Wilson 2008).

By March 1944, the training mission at BAAB began to gear down. Most of the troops had completed training and were deployed to new assignments; no new crews were being assigned to BAAB for training. The DTC/C-AMA was closed in 1944; BAAB became an alternative landing site for March Field in Riverside. BAAB remained staffed for providing emergency landing for airplanes unable to land at their designated home fields due to weather. By October 1945, BAAB was downgraded to an airfield, being closed and surplus government property the following year. It continued to be used for various training purposes until 1948 when the government transferred the property to the County of Riverside, which currently operates a portion of the property as the Blythe City Airport. Farming on the airfield property during the 1970s and 1980s destroyed most of the original buildings and features (Wilson 2008).

City of Blythe

Thomas Blythe, an Englishman, arrived in the area in 1882 in search of gold and real estate development possibilities. Having been successful in real estate investments in San Francisco, Blythe came to the lower Colorado River area and established water rights along the Colorado River. His efforts in irrigation and cultivation of the land were successful (Blythe Chamber of Commerce 2011). Further development of the desert lands into fertile agricultural fields continued. Most noteworthy was the formation of the Palo Verde Land and Water Company by Frank Murphy, Ed Williams and W.A. Hobson.

The City of Blythe was incorporated in 1916. In that same year, the California Southern Railroad built a railroad to the community. Even with the railroad and despite the development of irrigation, growth was limited because of the threat of flooding from the Colorado River. An especially devastating flood occurred in 1922. Development of Hoover Dam and other structures in the 1930s stabilized the flow of the Colorado River, leading to an improved economy and population growth.

Historic Background and Records Search

Records searches were conducted at the Eastern Information Center, housed at the University of California, Riverside on April 7, 2011 and May 31, 2012. California Historical Resources Information System records were reviewed to determine the location of previously recorded archaeological and historic architectural resources and the locations of prior cultural resource surveys within one mile of the area of potential effects (APE). The APE is defined for this Project as the land within the boundaries of the proposed solar facility site and land within a 300-foot corridor along each of the gen-tie alternatives. In this section, APE is used interchangeably with "Project area." Also consulted were the NRHP, National Park Service (NPS) Focus CRHR, California Historic Landmarks (CHL) lists, and California Points of Historic Interest. In addition, the online BLM General Land Office patent information was consulted. Also consulted were Art Wilson, a local historian, the General George S. Patton Memorial Museum and the Palo Verde Historical Museum and Society.

The records searches conducted at the Eastern Information Center indicated that 34 cultural resource studies were previously conducted within one mile of the solar facility site and the collective area covered by a one mile buffer on each side of the three gen-tie route alternatives). Fourteen of the previous surveys occurred entirely or partly within the APE, but only nine percent (360 acres) of the APE had been surveyed.

A total of 250 cultural resources were previously recorded within one mile of the Project area (see Appendices C1 and C2, respectively, for information about cultural resources identified in the records searches). Twenty cultural resources were previously recorded within the Project APE.

Of the 250 resources identified during the record searches, 163 are archaeological sites, 75 are isolated finds, four are historic built resources (transmission lines), and eight have missing information. Of the archaeological sites, 60 had prehistoric components, 82 had historic components, and 21 had both prehistoric and historic components. Of the isolated finds, 45 had prehistoric artifacts, 24 had historic artifacts, four had both prehistoric and historic artifacts, and two inventory forms lacked descriptions of the artifacts. The prehistoric sites are predominantly lithic and ceramic scatters. The historic sites are primarily refuse deposits, many related to World War II training in the area, but also include survey markers, fence lines, and roads.

Field Inventory

An intensive BLM Class III archaeological and historic built environment survey was conducted of the area that could potentially experience direct impacts from construction and operation of the proposed Project and Alternatives. The survey covered the APE, defined as the solar array site boundary and a 150-foot area on each side of the centerline of the proposed and alternative gen-tie routes. The APE included privately owned lands and public lands managed by the BLM. During the surveys, archaeologists walked parallel transects, using 15-meter (50-foot) intervals, to locate archaeological and architectural resources within the APE. The ground surface was visually examined for evidence of prehistoric or historic archaeological materials and historical structures. Ground visibility was excellent. Visible ground surfaces were examined, including fence lines, drainage channels, and other exposures. No subsurface surveys (e.g., shovel test pits) were conducted. A sub-meter GPS was used to document the location of each cultural resource.

The archaeological field survey was conducted in five sessions between April and June, 2011, and between June and July, 2012. Isolated finds were recorded at the time of discovery by collecting GPS data, photographs, and measurements of the artifact. The archaeological sites were point-located when discovered and later recorded during a later session. Overview photographs of survey areas and comprehensive field notes were also taken. In addition, a site visit of selected areas of the solar generation site was conducted by County Archaeologist Leslie Mouriquand and Riverside County Historic Preservation Officer Keith Herron on November 22, 2011.

The records search results, existing and new archaeological sites and isolated finds within the solar facility site and gen-tie line corridor alternatives, and other details of the surveys are described in detail in Appendices C1 and C2, respectively. There are a total of 55 resources within the APE. There are seven prehistoric archaeological sites, 12 historic archaeological sites, one multi-component site with prehistoric and historic artifacts, two historic architectural resources (transmission lines), one proposed historic district that includes archaeological remains plus a single standing building, and 32 isolated finds (nine are prehistoric, 21 are historic, and two have both prehistoric and historic artifacts). The survey results for existing and new cultural resources with eligibility recommendations within the APE are summarized in Table 3.2.5-1 and discussed below.

Solar Generation Site: The field survey resulted in the identification of five newly recorded archaeological sites and 23 isolated finds. Of the five archaeological sites, one is prehistoric (P-33-020001) and four are historic (P-33-019996; P-33-019997; P-33-019999; P-33-020000). Of the isolated finds, 16 are historic and seven are prehistoric (five contain ceramic sherds and two contain flakes). During the field survey, four previously documented historic resources were revisited and their site records updated. The previously documented historic sites consist of one refuse scatter (P-33-009186); two architectural resources (P-33-012532; P-33-014083); and the BAAB Historic District (P-33-018837).

Proposed Gen-tie Route: Two isolated finds were identified, one of which is prehistoric (P-33-021136) and the other historic (P-33-021137). During the field survey, one previously documented cultural resource (P-33-019770) was revisited but not re-recorded because it was recorded in 2011 and conditions had not changed.

Northern Alternative Gen-tie Route: One newly recorded historic archaeological site (P-33-021133), one historic isolated find (P-33-021135), and one prehistoric isolated find (P-33-021134) were identified. Two previously documented cultural resources (P-33-017319, a historic refuse scatter; and P-33-019612, a historic isolated find) were revisited but not re-recorded because they were recorded in 2008 and 2011, respectively; and the site conditions had not changed.

Southern Alternative Gen-tie Route: One newly recorded historic archaeological site (P-33-021132); two newly recorded prehistoric archaeological sites (P-33021130, and P-33-021131); and one prehistoric isolated find (P-33-021134) were identified. Twelve previously recorded resources were within this alternative alignment: four historic archaeological sites (P-33-014150, P-33-019682, P-33-019703, and P-33-019736); four prehistoric archaeological sites (P-33-019733, P-33-019737, P-33-019739, and P-33-019760); one multi-component site with prehistoric and historic artifacts (P-33-019714); and three isolated finds (two historic: P-33-019704, P-33-019712; and one prehistoric: P-33-020317). These previously recorded sites were revisited but not re-recorded because they were recorded as recently as 2011 and site conditions have not changed.

TABLE 3.2.5-1 CULTURAL RESOURCES WITHIN THE APE[1]

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	LAND OWNERSHIP	AGE	NRHP / CRHR ELIGIBILITY DETERMINATION
Within Solar Facility Site APE					
P-33-009186	--	Refuse scatter – 10x30 meters – WW II dump containing food cans, miscellaneous metal pieces, and other debris.	Private	Historic	Not Eligible
P-33-012532	--	Transmission line – 100 feet x 2.5 miles (within the APE). 161 kV transmission line with wooden pole, H-frame structures.	Private	Historic	Not Eligible
P-33-014083	--	Transmission line – 125 feet x 1.9 miles (within the APE). 161 kV transmission line with wooden pole, H-frame structures.	Private	Historic	Not Eligible

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	LAND OWNERSHIP	AGE	NRHP / CRHR ELIGIBILITY DETERMINATION
P-33-018837	--	Blythe Army Air Base (BAAB) Historic District. Remains of the former military are base in the vicinity of the Blythe Municipal Airport. A portion of the BAAB (approx. 383 acres) extends into the Project APE, including one standing utility building; remains of demolished warehouses, barracks, and hospital; other infrastructure (fire hydrants, manholes); and three clusters of refuse.	Private	Historic	Elements within APE – Not Eligible
P-33-019996	CA-RIV-10165	Refuse scatter – 66x42 meters – Sparse scatter of bottles, jars, cans, and miscellaneous metal debris.	Private	Historic	Not Eligible
P-33-019997	CA-RIV-10166	Refuse scatter – 50x10 meters – Two concentrations of debris, primarily cans and glass.	Private	Historic	Not Eligible
P-33-019999	CA-RIV-10168	Refuse scatter – 67x58 meters – Cans, porcelain fragments, bottles, and whiteware, mixed with modern trash.	Private	Historic	Not Eligible
P-33-020000	CA-RIV-10169	Refuse scatter – 36x70 meters – Sparse scatter of cans, bottles, and glass, mixed with modern trash.	Private	Historic	Not Eligible
P-33-020001	CA-RIV-10170	Ceramic scatter – 17x17 meters – 16 sherds	Private	Prehistoric	Not Eligible
P-33-020003	--	Isolated find - 1 bottle	Private	Historic	Not Eligible
P-33-020004	--	Isolated find - 1 hole-in-top can	Private	Historic	Not Eligible
P-33-020005	--	Isolated find - 1 hole-in-top can	Private	Historic	Not Eligible
P-33-020006	--	Isolated find - 1 hole-in-top can	Private	Historic	Not Eligible
P-33-020007	--	Isolated find - 1 hole-in-top can	Private	Historic	Not Eligible
P-33-020008	--	Isolated find - 3 hole-in-top cans, 2 sanitary cans	Private	Historic	Not Eligible
P-33-020009	--	Isolated find - 1 bottle fragment	Private	Historic	Not Eligible
P-33-020010	--	Isolated find - 2 hole-in-cap cans, 1 tin, 2 glass fragments	Private	Historic	Not Eligible
P-33-020011	--	Isolated find - 1 hole-in-top can, 1 tin, 1 lid	Private	Historic	Not Eligible
P-33-020012	--	Isolated find - 2 hole-in-top cans, 1 tobacco tin	Private	Historic	Not Eligible
P-33-020013	--	Isolated find - 1 sherd, 1 hole-in-top can	Private	Prehistoric/ Historic	Not Eligible
P-33-020014	--	Isolated find - 2 sherds	Private	Prehistoric	Not Eligible
P-33-020015	--	Isolated find – 1 hammerstone	Private	Prehistoric	Not Eligible
P-33-020016	--	Isolated find - 1 sherd	Private	Prehistoric	Not Eligible

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	LAND OWNERSHIP	AGE	NRHP / CRHR ELIGIBILITY DETERMINATION
P-33-020017	--	Isolated find - 1 sherd	Private	Prehistoric	Not Eligible
P-33-020020	--	Isolated find - 1 tobacco tin	Private	Historic	Not Eligible
P-33-020021	--	Isolated find - 1 bottle	Private	Historic	Not Eligible
P-33-020022	--	Isolated find - 1 oil can	Private	Historic	Not Eligible
P-33-020023	--	Isolated find - 1 hole-in-top can	Private	Historic	Not Eligible
P-33-020024	--	Isolated find - 1 tested cobble	Private	Prehistoric	Not Eligible
P-33-020025	--	Isolated find - 1 hole-in-top can	Private	Historic	Not Eligible
P-33-020026	--	Isolated find - 1 bottle	Private	Historic	Not Eligible
Within Proposed Gen-tie Line Corridor APE					
P-33-019770		Isolated find – 1 flake, 1 hole-in-top can	BLM	Prehistoric/ Historic	Not eligible
P-33-021136		Isolated find – 3 sherds	BLM	Prehistoric	Not eligible
P-33-021137		Isolated find – 3 key-opened cans	BLM	Historic	Not eligible
Within Northern Alternative Gen-tie Line Corridor APE					
P-33-017319	CA-RIV-9009	Refuse scatter – 3x5 meters -- a small scatter of cans, glass, and metal associated with WW II military use	BLM	Historic	Not eligible
P-33-019612	--	Isolated find – 1 can	BLM	Historic	Not eligible
P-33-021133	--	Refuse Scatter – 15x10 meters – 10 WW II K-ration cans.	BLM	Historic	Not eligible
P-33-021134	--	Isolated find – 3 sherds	BLM	Prehistoric	Not eligible
P-33-021135	--	Isolated find – 3 hole-in-top cans, 1 beer can	BLM	Historic	Not eligible
Within Southern Alternative Gen-tie Line Corridor APE					
P-33-014150	CA-RIV-9100	Road – 6 feet x 2 miles (in 9 segments) -- Two-track road.	BLM	Historic	Determined not eligible by SHPO 2/11/09
P-33-019682	CA-RIV-9997	Refuse scatter – 6x22 meters – 30 cans and more than 100 can fragments related to military use.	BLM	Historic	Not eligible
P-33-019703	CA-RIV-10018	Military feature and refuse scatter – 8x11 meters -- WW II fighting hole and food cans.	BLM	Historic	Not eligible
P-33-019704	CA-RIV-10019	Isolated find – 1 wire, 1 can, 1 metal disk.	BLM	Historic	Not eligible
P-33-019712	--	Isolated find – Survey marker	BLM	Historic	Not eligible
P-33-019714	CA-RIV-10028	Refuse scatter and isolated stone tool – 5x10 meters – Scatter of WW II-related food cans, 1 piece of lumber, 1 quartzite core	BLM	Prehistoric/ Historic	Unevaluated and avoided

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	LAND OWNERSHIP	AGE	NRHP / CRHR ELIGIBILITY DETERMINATION
P-33-019733	CA-RIV-10047	Lithic scatter – 162x70 meters – Sparse lithic assay site with chert and quartzite flakes and cobbles.	BLM	Prehistoric	Not eligible
P-33-019736	CA-RIV-10050	Wood debris –30x15 meters -- Over 50 fragments of wooden boards next to an abandoned two-track road.	BLM	Historic	Not eligible
P-33-019737	CA-RIV-10051	Lithic scatter – 54x44 meters -- Sparse scatter of about 24 y flakes and 1 core.	BLM	Prehistoric	Not eligible
P-33-019739	CA-RIV-10053	Lithic scatter – 40x27 meters -- Sparse scatter of 3 cores and two dozen quartzite and chert flakes.	BLM	Prehistoric	Not eligible
P-33-019760	CA-RIV-10073	Lithic scatter – 7x57 meters -- Small scatter of 4 chert flakes and 1 piece of shatter	BLM	Prehistoric	Unevaluated and avoided
P-33-020317	--	Isolated find – 1 hammerstone.	BLM	Prehistoric	Not eligible
P-33-021130	CA-RIV10962	Ceramic scatter – 2x2 meters – Small concentration of 22 sherds, probably a pot drops.	BLM	Prehistoric	Not eligible
P-33-021131	CA-RIV-10963	Ceramic Scatter – 6x2 meters – 10 sherds, probably a pot drop	BLM	Prehistoric	Not eligible
P-33-021132	CA-RIV-10964	Refuse scatter – 3x3 meters – Debris scatter with cans and bottles	BLM	Historic	Not eligible
P-33-021134	--	Isolated Find – 3 sherds	BLM	Prehistoric	Not eligible

Source: POWER 2013a, 2013b.
[1] Some cultural resources described in the survey report (POWER 2013a, 2013b) are not included in this table because the sites are no longer within the APE as a result of changes in Project design.

Native American and Agency Coordination

In the course of developing information about the archaeological and historic resources that could be affected by the Project, contacts were made with Native American tribes and relevant public agencies, including representatives of the Agua Caliente Band of Cahuilla Indians, Augustine Band of Cahuilla Indians, Cabazon Band of Mission Indians, Cahuilla Band of Mission Indians, Chemehuevi Indian Tribe, Cocopah Indian Tribe, Colorado River Indian Tribes, Fort Mojave Indian Tribe, Fort Yuma Quechan Tribe, Morongo Band of Mission Indians, Ramona Band of Mission Indians, San Manuel Band of Mission Indians, Soboba Band of Luiseño Indians, Torres-Martinez Desert Cahuilla Indians, and Twenty-Nine Palms Band of Mission Indians. Contacts also included the cultural resource representatives of relevant public agencies including the Native American Heritage Commission (NAHC), State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation (ACHP) and the County of Riverside. Please refer to Chapter 6 of this Draft EIR/EA for more information about this coordination.

Regulatory Setting

Federal

Regulations Relating to Archaeological and Architectural Resources

NEPA (42 U.S.C. §§ 4321-4346) establishes national policy for the protection and enhancement of the environment. Part of the function of the federal government in protecting the environment is to “preserve important historic, cultural, and natural aspects of our national heritage.” The act is implemented by the Council on Environmental Quality (CEQ) regulations at 40 CFR Parts 1500-1508. Refer to Sections 1.3 and 1.4 for more information regarding NEPA as it relates to this Project.

National Historic Preservation Act

The National Historic Preservation Act (NHPA), as amended (16 U.S.C. § 470f), is the principal federal law in the United States protecting cultural resources. Section 106 of the NHPA directs all federal agencies to take into account the effects of their undertakings (i.e., actions, financial support, and authorizations) on properties included in or eligible for inclusion in the NRHP and to allow the ACHP an opportunity to comment. ACHP regulations at 36 CFR Part 800 implement Section 106 of the NHPA. These regulations establish the NRHP as a planning tool to help federal agencies evaluate cultural resources in consultation with the SHPO, Native American tribes, and other interested parties. The criteria for determining whether cultural resources are eligible for listing in the NRHP is provided in 36 CFR Part 60.4. These criteria are:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

A) Are associated with events that have made a significant contribution to the broad patterns of our history;
B) Are associated with the lives of persons significant in our past;
C) Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; or
D) Have yielded, or may be likely to yield, information important in prehistory or history.

A cultural resource that is eligible for the NRHP is called a historic property regardless of the time period to which it dates. To be listed in, or determined eligible for, the NRHP a cultural resource must meet one or more of the above criteria and possess integrity. Integrity is defined as the authenticity of a resource's historic identity as evidenced by the survival of physical characteristics that existed during the prehistoric or historic period of use. The NRHP recognizes seven aspects, which in various combinations define integrity: location, design, setting, materials, workmanship, feeling, and association. Integrity of location means that the resource has not been moved from its historic location. Integrity of design, materials, and workmanship mean that the resource's original building materials, plan, shape, and design elements remain intact. Integrity of setting means that the surrounding landscape has changed very little since the period of importance for the resource. Integrity of feeling and association means the resource retains a link to an earlier time and place and is able to evoke that era. Historic properties must generally be at least 50 years old; however, a younger resource may be considered eligible if it is of exceptional importance.

An undertaking results in adverse effects, or impacts, to a historic property (i.e., a cultural resource eligible to or listed in the NRHP) when it alters the resource's characteristics, including relevant features of its environment or use, that qualify it for inclusion in the NRHP. Potential effects could include (36 CFR Part 800.5(a) (2)):

- Physical destruction, damage, or alteration of all or part of the property;
- Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR Part 68);
- Removal of the property from its historic location;
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
- Neglect of a property resulting in its deterioration or destruction; and
- Transfer, lease, or sale of the property.

Compliance with Section 106 is required whenever a project has a federal nexus, meaning that the project is on federal land, uses federal funds, or is permitted by a federal agency. The BLM is reviewing an application for and will make a decision on issuing a new ROW grant for the proposed gen-tie line. This activity constitutes an undertaking as defined in 36 CFR Part 800.16(y) and requires compliance with Section 106.

The BLM considers the development of the proposed solar generation site to be a connected action, even though the solar facility would not be on federal land. The BLM's 8100 manual series on cultural resources explains BLM's Section 106 responsibility on non-federal lands. Factors taken into consideration include the degree of federal involvement; the nature and extent of potential effects on historic properties; the likely nature and the location of historic properties in the APE; and the views of the SHPO, Native American tribes, and interested public. However, the primary factor is the extent to which BLM's authorization (in this case of the proposed gen-tie line) could result in effects to historic properties, including properties within the proposed solar facility.

Antiquities Act

The Antiquities Act of 1906 (16 U.S.C. § 431-433) was the first law to protect and preserve cultural resources on federal lands. It makes it illegal to remove cultural resources from federal lands without a permit and establishes penalties for illegal excavation and looting. The Archaeological Resources Protection Act (see below) reinforces and replaces portions of the Antiquities Act as the authority for special use permits regarding archaeological investigations.

Federal Land Policy and Management Act

The FLPMA (43 U.S.C. § 1701) requires the BLM to manage its lands on the basis of multiple use in a manner that will "protect the quality of…historical…resources and archaeological values." FLPMA is a comprehensive law that provides for the periodic inventory of public lands and resources, for long-range, comprehensive land use planning, for permits to regulate the use of public lands, and for the enforcement of public land laws and regulations. FLPMA compels agencies to manage all cultural resources on public lands through the land management planning process.

Archaeological Resources Protection Act

The Archaeological Resources Protection Act of 1979 (16 U.S.C. § 470 aa-mm) establishes civil and criminal penalties for the unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources; prohibits trafficking in resources from public lands; and directs federal agencies to establish educational programs on the importance of archaeology. The act also establishes permit requirements for removal or excavation of archaeological resources from federal lands. The law applies to archaeological resources more than 100 years old found on public lands. No distinction is made regarding NRHP eligibility.

American Indian Religious Freedom Act

The American Indian Religious Freedom Act of 1978 requires federal agencies to consult Native American groups when a proposed land use might conflict with traditional Indian religious beliefs or practices; to avoid interference with these beliefs to the extent possible; and to maintain access to religious or sacred areas whenever feasible.

Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 U.S.C. § 3001) provides a process for federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, or objects of cultural patrimony—to lineal descendants and culturally affiliated Indian tribes. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional excavation and unanticipated discovery of Native American cultural items on federal lands, and penalties for noncompliance and illegal trafficking. Permits for the excavation

or removal of cultural items protected by the act require Tribal consultation, as do discoveries of cultural items made during activities on federal lands. The Secretary of the Interior's implementing regulations are at 43 CFR Part 10.

Executive Order 11593, Protection and Enhancement of the Cultural Environment

Issued in 1971, Executive Order 11593 directs land-holding federal agencies to identify and nominate historic properties to the NRHP and requires that these agencies avoid damaging historic properties that might be eligible to the NRHP. It also directs agencies to treat resources eligible for listing in the NRHP as if they were already listed.

Executive Order 13007, Indian Sacred Sites

Executive Order 13007, issued in 1996, directs federal agencies responsible for managing federal lands to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners; avoid adversely affecting the physical integrity of such sacred sites; and maintain the confidentiality of sacred sites.

Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

Executive Order 13175, issued in 2000, directs federal agencies to establish regular and meaningful consultation and collaboration with Tribal officials in the development of federal policies that have Tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

Executive Order 13287, Preserve America

This Executive Order, issued in 2003, encourages the federal government to take a leadership role in the protection, enhancement, and contemporary use of historic properties and establishes new accountability for agencies with regard to inventories and stewardship.

Memorandum for the Heads of Executive Departments and Agencies Regarding Government-to-Government Relations with Native American Tribal Governments

The Presidential memorandum, issued in 2009, directs each federal agency to operate within a government-to-government relationship with federally recognized Tribal governments; consult with Tribal governments; assess the impact of plans, projects, programs, and activities on Tribal trust resources; and ensure that Tribal rights are taken into account during consideration of such plans, projects, and activities.

State

The principal State law relevant to the protection of cultural resources within the solar generation site and gen-tie Alternatives is CEQA, with particular reference to California PRC 21083.2 to 21084.1, which addresses historical resources, unique archaeological resources, and Native American human remains.

Section 5097.5 of the PRC specifies that any unauthorized disturbance or removal of archaeological and historical resources located on public lands is a misdemeanor. This Section also prohibits the knowing destruction of objects of antiquity without a permit (expressed permission) on public lands, and provides for criminal sanctions. In addition, Section 30244 of the PRC requires reasonable mitigation for adverse impacts on archaeological resources as identified by the SHPO. Further, California Penal Code, Section 622.5, provides misdemeanor penalties for willfully injuring or destroying objects of historic or archaeological interest located on public or private lands, but specifically excludes the landowner.

Historical Resources

Lead agencies are required to identify historical resources that may be affected by any undertaking involving State or county lands, funds, or permitting. Also, the significance of such resources that may be affected by the undertaking must be evaluated using the criteria for listing in the CRHR (PRC §5024.1, Title 14 CCR, Section 4852). Under CEQA, a resource is considered historically significant if the resource satisfies any of the following criteria:

1) A resource listed in, or determined to be eligible by the State Historical Resources Commission for listing in, the CRHR (PRC §5024.1, Title 14 CCR, Section 4850 et seq.).

2) A resource included in a local register of historical resources, as defined in Section 5020.1(k) of the PRC or identified as significant in an historical resource survey meeting the requirements section 5024.1(g) of the PRC, shall be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.
3) Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be an historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record. Generally, a resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing on the CRHR (PRC §5024.1, Title 14 CCR, Section 4852) including the following:

   A) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
   B) Is associated with the lives of persons important in our past;
   C) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or
   D) Has yielded, or may be likely to yield, information important in prehistory or history.

4) The fact that a resource is not listed in, or determined to be eligible for listing in, the CRHR, not included in a local register of historical resources (pursuant to section 5020.1(k) of the PRC), or identified in an historical resources survey (meeting the criteria in Section 5024.1(g) of the PRC) does not preclude a lead agency from determining that the resource may be an historical resource as defined in PRC Sections 5020.1(j) or 5024.1.

Resources already listed or determined eligible for the NRHP and CHL (No. 770 and above) are by definition eligible for the CRHR. Historical resources included in resource inventories prepared according to California State Office of Historic Preservation (OHP) guidelines or designated under county or city historic landmark ordinances may be eligible.

For a resource to be eligible for the CRHR, it must satisfy each of the following three standards:

- A property must be significant at the local, state or national level, under one or more of the following criteria:

1) It is associated with events or patterns of events that have made a significant contribution to the broad patterns of the history and cultural heritage of California and the United States.
2) It is associated with the lives of persons important to the nation or California's past.
3) It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
4) It has yielded, or may be likely to yield, information important to the prehistory or history of the state or the nation:

- A resource must retain enough of its historic character or appearance to be recognizable as a historic property, and to convey the reasons for its significance; and
- It must be fifty years old or older (except for rare cases of structures of exceptional significance).

Integrity is defined as the authenticity of a historical resource's physical identity, evidenced by the survival of characteristics that existed during the resource's period of significance. CRHR regulations specify that integrity is a quality that applies to historical resources in seven ways: location, design, setting, materials, workmanship, feeling, and association.

Unique Archaeological Resources

Lead agencies must also determine whether a proposed project will have a significant effect on unique archaeological resources. PRC 21083.2(g) states:

> "…a 'unique archaeological resource' means an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:
>
> Contains information needed to answer important scientific research questions and that there is demonstrable public interest in that information.
> Has a special and particular quality such as being the oldest of its type or the best available example of its type.
> Is directly associated with a scientifically recognized important prehistoric or historic event or person."

A non-unique archaeological resource does not meet these criteria and does not need to be given further consideration other than simple recording, unless it happens to qualify as a historical resource.

Native American Human Remains

The CEQA Guidelines (Section 15064.5 (d)) provide that when an initial study identifies the existence of, or probable likelihood of, Native American human remains within the Project, a lead agency will work with the appropriate Native Americans as identified by the NAHC.

Native American Consultation

Pursuant to Senate Bill (SB) 18 (California Government Code §65352.3), local governments are required to consult with California Native American tribes identified by the NAHC for the purpose of protecting and/or mitigating impacts to cultural places. SB 18 requires formal consultation with Native American tribes as part of a project that enacts or amends a general plan or specific plan. The proposed Project would not require a general plan or specific plan amendment; therefore, SB 18 does do not apply to the proposed Project. However, as described above, Native American Coordination has been initiated with Native American groups with historic ties to, and interest in, the proposed Project area.

Local

Riverside County General Plan- Multipurpose Open Space Element

The Multipurpose Open Space Element of the Riverside County General Plan (amended March 22, 2011) outlines policies intended to promote the preservation of cultural resources in the County of Riverside, as follows:

OS 19.2 -The County of Riverside shall establish a cultural resources program in consultation with Tribes and the professional cultural resources consulting community. Such a program shall, at a minimum, address each of the following: application processing requirements; information database(s); confidentiality of site locations; content and review of technical studies; professional consultant

qualifications and requirements; site monitoring; examples of preservation and mitigation techniques and methods; and the descendant community consultation requirements of local, state, and federal law. (AI-A)

OS 19.3 - Review proposed development for the possibility of cultural resources and for compliance with the cultural resources program.

OS 19.4 - To the extent feasible designate as open space and allocate resources and/or tax credits to prioritize the protection of cultural resources preserved in place or left in an undisturbed state, (AI-B)

OS 19.5 - Exercise sensitivity and respect for human remains form both prehistoric and historic time periods and comply with all applicable laws concerning such remains.

City of Blythe General Plan

The City of Blythe General Plan Open Space and Conservation Element addresses archaeological, historic, and paleontological resources. The purpose of the Open Space and Conservation Element is to identify those areas located within the City's Planning Area boundary that merit recognition or preservation because of their location use and/or natural, topographic, or aesthetic features. The applicable policy related to archaeological and paleontological resources is provided below.

Open Space and Conservation Element

Policy 25. Protect archaeological, historic, and paleontological resources for their aesthetic, scientific, educational, and cultural value.

3.2.6 Geology and Soils

This section describes the existing regional and local geology, soil conditions, and mineral resources, as well as regulatory framework in regards to geology, soils, and mineral resources for the proposed Project and Alternatives. Though the impact of the existing environment on the Project or Alternatives is not an impact encompassed by CEQA or NEPA, this section also identifies seismic hazards that could potentially affect structures associated with the Project to assist decision-makers in addressing regulatory concerns. The study area relevant to geology, soils, and geologic hazards is the physical footprint of Project construction, operation and maintenance, and decommissioning. The study area relevant to faulting and seismic hazards includes the larger Southern California region, because distant faults can produce ground shaking and secondary seismic hazards at the Project area. The information in this section is based on the *Limited Geological Reconnaissance Evaluation: Blythe Mesa Solar Project, Blythe, California*, prepared by Ninyo & Moore Geotechnical and Environmental Sciences Consultants, 2012 (provided in Appendix E of this Draft EIR/EA).

Environmental Setting

Regional Geology and Seismicity

The Project and Alternatives would be located on the eastern edge of the Colorado Desert Geomorphic Province in Riverside County, California. Within California, this geomorphic province encompasses an area that extends from the Colorado River on the east, the eastern Transverse Ranges on the north, the Mexican border on the south, and the Peninsular Ranges on the west. The Colorado Desert province is generally characterized by broad alluvial valleys separated by steep, discontinuous, sub-parallel mountain ranges that generally trend northwest-southeast.

The Project and Alternatives would be located in a seismically active region of Southern California. Based on data compiled by the California Geological Survey, there are no known active faults that intersect the Project area, nor is the site located within a State of California Earthquake Fault Zone, formerly known as an Alquist-Priolo Special Studies Zone (Ninyo & Moore 2012). Specifically, the Project area is situated within the Sonoran zone, which is a relatively more stable tectonic region than areas further west. The

California Geological Survey defines an active fault as one that has had surface displacement during the Holocene age (roughly the last 11,000 years). Potentially active faults are those that show evidence of surface displacement during the Quaternary age (roughly the last 1.6 million years) but for which evidence of Holocene movement has not been established. An inactive fault is one that has not shown evidence of surface displacement during the Quaternary age. The nearest faults to the Project and Alternatives are inactive and located in the McCoy Mountains, approximately three miles east of the solar facility site and approximately two miles from the gen-tie line. The inactive faults are illustrated as bold black lines on Figure 3.2.6-1. Table 3.2.6-1 lists principal known active faults within 60 miles of the Project area, the approximate fault-to-site distances, and the maximum moment magnitudes[3] (Mmax).

TABLE 3.2.6-1 PRINCIPAL ACTIVE FAULTS

FAULT	APPROXIMATE FAULT-TO-SITE DISTANCE (MILES)	MAXIMUM MOMENT MAGNITUDE (MMAX)
Brawley Seismic Zone	57.9	6.4
Elmore Ranch	58.4	6.6
San Andreas (Coachella)	58.4	7.2

Source: Ninyo & Moore 2012.

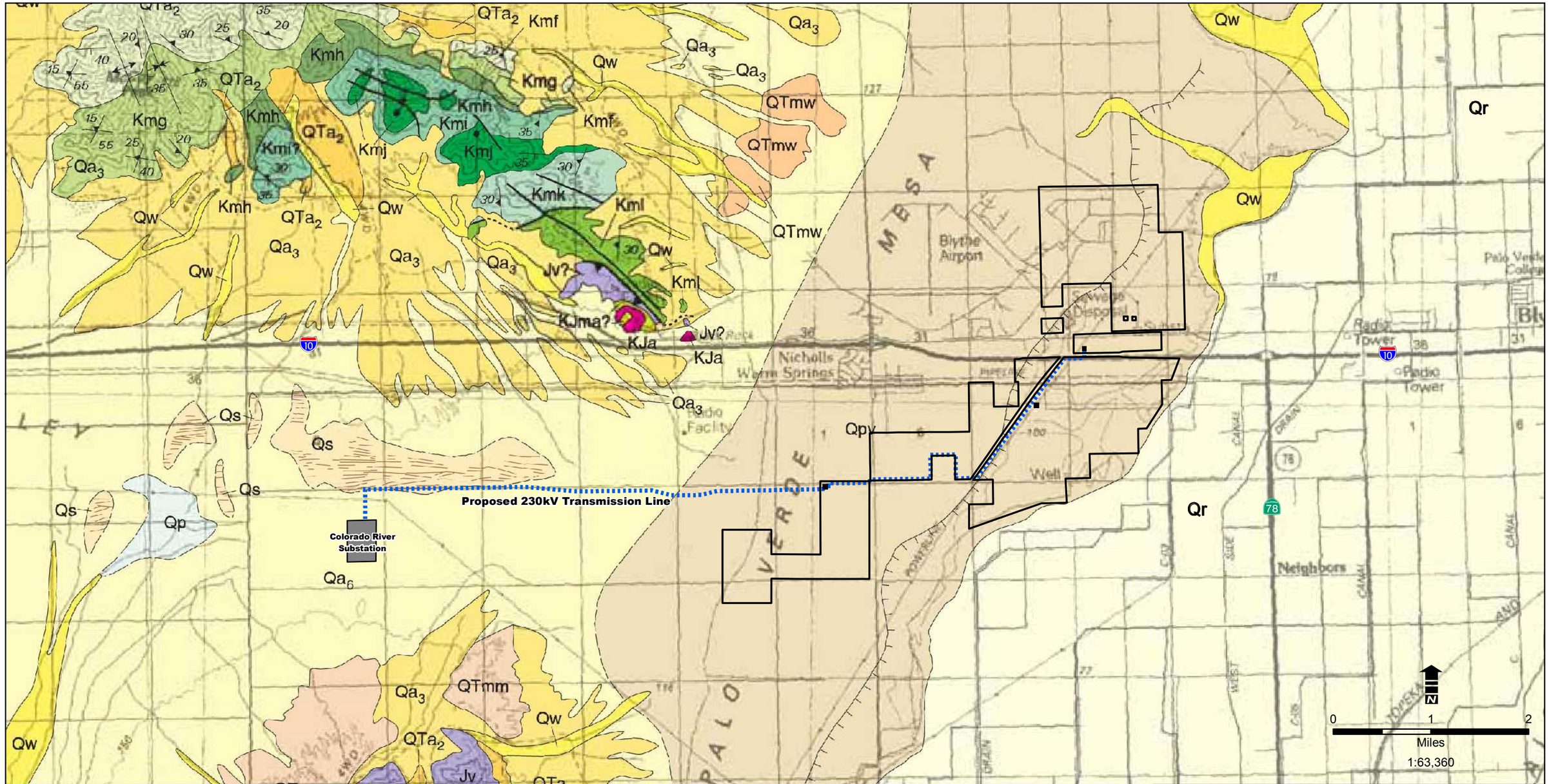
Site Geology

Soils

According to the geotechnical study prepared for the proposed Project, the site is generally underlain by Quaternary age alluvium consisting of unconsolidated to weakly consolidated sand, silt, and gravel. Surficial deposits of aeolian sand (blow sand), gravels, and minor fill are also present across portions of the Project area. Generalized descriptions of the units encountered are described below. Generalized descriptions of the units encountered are described below and shown on Figure 3.2.6-1.

- Holocene age alluvium associated with modern washes (designated Qw) has been mapped near the northeastern portion of the Project area. These deposits are the result of erosion, transport, and deposition of sediments caused by winter storm systems or intense summer thunderstorms. The alluvial materials generally consist of fine to coarse sand with scattered to abundant gravel to cobble-size clasts.
- Holocene age alluvium of the modern Colorado River flood plain (designated Qr) has been mapped near the eastern boundary of the Project area. These deposits are associated with flood events associated with the Colorado River and are expected to consist of fine to coarse sand, silt, and clay.
- Holocene age aeolian sand (designated Qs) has been mapped near the western portion of the solar facility under the western portion of the Project's proposed gen-tie line, and consists of unconsolidated sand dunes and sheets. The dunes are partially stabilized by vegetation.
- Holocene age alluvial-fan and alluvial-valley deposits (designated Qa6) have been mapped under portions of the Project's proposed gen-tie line. This unit is characterized by sand, pebbly sand, sandy gravel, and occasional aeolian sand deposits. These sediments lack desert varnish, a dark coating on exposed rock surfaces in arid environments.

[3] The *moment magnitude scale* is used by seismologists to measure the size of earthquakes in terms of the energy released.



Legend

- Blythe Mesa Solar Project Boundary
- Proposed 230kV Transmission Line
- Colorado River Substation

Qw	Alluvium of Modern Washes (Holocene)
Qr	Alluvium of Modern Colorado Rive Flood Plain (Holocene)
Qp	Playa Lake Deposits (Holocene)
Qs	Eolian Sand (Holocene)
Qa_6	Alluvial-fan and Alluvial-Valley Deposits Unit 6 (Holocene)
Qa_3	Alluvial-fan and Alluvial-Valley Deposits Unit 3 (Holocene and Pleistocene)
QTa_2	Alluvial-fan and Alluvial-Valley Deposits Unit 2 (Pleistoene to Miocene)
Qpv	Alluviul Deposits of Palo Verde Mesa (Pleistocene)
QTmw	Alluvial Deposits of the McCoy Wash Area (Pleistocene and/or Pliocene)
QTmm	Alluvial Deposits of the Mule Mountains (Pleistocene and/or Pliocene)
KJa	Bouse Formation Andesite (Cretaceous or Jurassic)
Kml	McCoy Mountains Formation Member L (Cretaceous)
Kmj	McCoy Mountains Formation Member J (Cretaceous)
Kmi	McCoy Mountains Formation Member I (Cretaceous)
Kmh	McCoy Mountains Formation Member H (Cretaceous)
Kmg	McCoy Mountains Formation Member G (Cretaceous)
KJma	McCoy Mountains Formation Member A (Cretaceous or Jurassic)
Jv	McCoy Mountains Formation Volcanic Rocks (Jurassic)



FIGURE 3.2.6-1
SITE GEOLOGY

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: Geologic map of the west half of the Blythe 30' by 60' quadrangle, Riverside County, California and La Paz County, Arizona, 2006.

THIS PAGE INTENTIONALLY LEFT BLANK

- Pleistocene age alluvial deposits in Palo Verde Mesa (designated Qpv) have been mapped across the majority of the solar facility. This unit consists of generally loose to very dense, silty, fine to medium sand with scattered interlayers of gravel.

Topsoil and alluvium (surficial soils) are also present in the Project vicinity; the boundaries of these soils are depicted on Figure 3.2.2-2 (see Section 3.2.2 above), with a legend that list regional and site-specific soils. Much of the site has been or is currently being utilized for agricultural purposes and it is expected that the upper one to two feet of soil have been disturbed as a result of agricultural activities.

Groundwater Conditions

According to the geotechnical report prepared for the proposed Project, the static groundwater table is anticipated to be below the depth of the proposed excavations. Based on previous borings performed by Ninyo & Moore at the Blythe Energy Center (located adjacent to the northern portion of the proposed solar facility), the static water table is in excess of 90 feet below the existing ground surface or at an elevation of approximately 245 feet amsl. Shallow perched groundwater or groundwater seepage may also be present at the Project area, particularly in or near areas of active citrus groves or other agricultural activities. Groundwater levels near the City of Blythe were reported at approximately 250 feet amsl (Ninyo & Moore 2012). It should be noted that groundwater levels are influenced by seasonal variations, variations in ground surface topography, precipitation, irrigation practices, soil/rock types, groundwater pumping, and other factors and are subject to fluctuations. For a more detailed description of hydrology and water resources, refer to Section 3.2.10, *Hydrology and Water Quality*.

Minerals

Riverside County contains diverse mineral resources, which include extensive deposits of clay, limestone, iron, sand, and aggregates. Geologic factors restrict mining operations to the relatively few locations where mineral deposits are feasible for extraction. MRZs (Mineral Resources Zones) within Riverside County are depicted on Figure OS-5, Mineral Resources, of the *Riverside County General Plan Multipurpose Open Space Element* (Riverside County 2003). The Project area is not used for mineral production, nor is it under claim, lease, or permit for the production of locatable, leasable, or salable minerals or mineral materials. However, the Project area is underlain by sand and gravel, which could potentially represent a source of saleable minerals or mineral materials if there is a sufficient local demand for construction aggregate. However, the Project area and vicinity have been classified as MRZ-4 for mineral resources (areas of unknown mineral resource significance) and is not designated as being of regional or state-wide importance (Ninyo & Moore 2012).

According to the geotechnical report prepared for the proposed Project, there are no past or present mines and no locatable mineral activity located on the Project area. Sand and gravel deposits are ubiquitous throughout the Quaternary geologic deposits in the vicinity of the Project area and the region. There are several past producers and one current producer of sand and gravel on the west side of the McCoy Wash, approximately five miles east of the Project area. In addition, there is one former producer of sand and gravel immediately to the east of the access road. None of the past or current producers of sand and gravel intersects the Project area.

According to review of the Mineral Resources Data System online database, metallic resources and occurrences (such as gold, silver, manganese, and copper) are restricted to the surrounding mountains, including the McCoy, Big Maria, and Mule Mountains, located outside of the Project area (USGS 2011). Numerous land sections within the mountainous areas have active mining claims, and there are two sites listed in the Mineral Resources Data System as mineral producers. However, none of these resources occurs within the vicinity of the Project area and they are unlikely to be found within the geologic units that underlie the Project area.

The California DOC, Division of Oil, Gas, and Geothermal Resources, indicates that there are no oil, gas, or geothermal resources present within or in the vicinity of the Project area (DOGGR 2013).

Regulatory Setting

Federal

International Building Code

The International Building Code (IBC) is published by the International Code Council (ICC) and is the national model building code. The 2012 IBC is the most recent edition of the International Building Code, and applies to all structures currently being constructed in California (ICC 2012). The national model codes are incorporated by reference into the building codes of local municipalities, such as the California Building Code (CBC) and County of Riverside Building Code as discussed below.

California Desert Conservation Area Plan

The CDCA Plan defines multiple-use classes for BLM-managed lands within the CDCA, which includes land area encompassing the Project area. With respect to mineral resources, the CDCA Plan aims to maintain the availability of mineral resources on public lands for exploration and development. A portion of the Project's gen-tie line extends through BLM-managed lands designated Class L, or limited use. Mineral exploration and development is allowed on Class L lands provided that NEPA requirements are met.

State

California Building Code

The CBC is promulgated under the CCR, Title 24, Parts 1 through 12 (also known as the California Building Standards Code), and is administered by the California Building Standards Commission. The Project is subject to the applicable sections of the CBC. The Riverside County Building Department is responsible for implementing the CBC for the Project. The Project would comply with applicable seismic design and construction criteria of the most recent CBC.

State Surface Mining and Reclamation Act of 1975

The Surface Mining and Reclamation Act of 1975 (PRC §2710 et seq.) mandated the initiation by the State Geologist of mineral land classification in order to help identify and protect mineral resources in areas within the State subject to urban expansion or other irreversible land uses that would preclude mineral extraction. The Surface Mining and Reclamation Act also allowed the State Mining and Geology Board, after receiving classification information from the State Geologist, to designate lands containing mineral deposits of regional or statewide significance. Mineral lands are mapped according to jurisdictional boundaries (i.e., counties), mapping all mineral commodities at one time in the area, using the California Mineral Land Classification System.

The objective of classification and designation processes is to ensure, through appropriate lead agency policies and procedures, that mineral deposits of statewide or of regional significance are available when needed. The State Mining and Geology Board, based on recommendations from the State Geologist and public input, prioritizes areas to be classified and/or designated. Areas that are generally given highest priority are those areas within the state that are subject to urban expansion or other irreversible land uses that would preclude mineral extraction.

Classification is completed by the State Geologist in accordance with the State Mining and Geology Board's priority list, into MRZs, as defined below. Classification of these areas is based on geologic and economic factors without regard to existing land use and land ownership. As stated above, the Project area and vicinity have been classified as MRZ-4 for mineral resources and are not designated as being of regional or state-wide importance (Ninyo & Moore 2012). The following MRZ categories are used by the State Geologist in classifying the state's lands:

***MRZ-1*:** Areas where adequate geologic information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence. This zone is applied where well developed lines of reasoning, based on economic-geologic principles and adequate data, indicate that the likelihood for occurrence of significant mineral deposits is nil or slight.

***MRZ-2a*:** Areas underlain by mineral deposits where geologic data show that significant measured or indicated resources are present. Areas classified MRZ-2a contain discovered mineral deposits that are either measured or indicated reserves as determined by such evidence as drilling records, sample analysis, surface exposure, and mine information. Land included in the MRZ-2a category is of prime importance because it contains known economic mineral deposits.

***MRZ-2b*:** Areas underlain by mineral deposits where geologic information indicates that significant inferred resources are present. Areas classified MRZ-2b contain discovered deposits that are either inferred reserves or deposits that are presently sub-economic as determined by limited sample analysis, exposure, and past mining history.

MRZ-3a: Areas containing known mineral deposits that may qualify as mineral resources. Further exploration work within these areas could result in the reclassification of specific localities into the MRZ-2a or MRZ-2b categories. MRZ-3a areas are considered to have a moderate potential for the discovery of economic mineral deposits.

***MRZ-3b*:** Areas containing inferred mineral deposits that may qualify as mineral resources. Land classified MRZ-3b represents areas in geologic settings that appear to be favorable environments for the occurrence of specific mineral deposits. MRZ-3b is applied to land where geologic evidence leads to the conclusion that it is plausible that economic mineral deposits are present.

***MRZ-4*:** Areas where geologic information does not rule out either the presence or absence of mineral resources. It must be emphasized that MRZ-4 classification does not imply that there is little likelihood for the presence of mineral resources, but rather there is a lack of knowledge regarding mineral occurrence.

Local

Riverside County General Plan – Palo Verde Valley Area Plan

Portions of the Palo Verde Valley planning area may be subject to seismic hazards. Threats from seismic events include ground shaking, fault rupture, liquefaction, and landslides. In the Palo Verde Valley planning area, liquefaction poses the most significant threat from a seismic event. Generally, the use of building techniques and practical avoidance measures help mitigate potentially dangerous seismic events. The PVVAP provides the policy related to seismic hazards below.

PVVAP 15.1. *Protect life and property from seismic related incidents through adherence to the Seismic Hazards section of the General Plan Safety Element.*

Riverside County contains diverse mineral resources, which include extensive deposits of clay, limestone, iron, sand, and aggregates. Geologic factors restrict mining operations to the relatively few locations where mineral deposits are feasible for extraction. MRZs within Riverside County are depicted on Figure OS-5, Mineral Resources, of the Riverside County General Plan Multipurpose Open Space Element (Riverside County 2003). The solar facility currently consists of undeveloped and agricultural land. A portion of the Project's gen-tie line extends through BLM-managed lands. The Project area appears to contain no mineral resources, and no mining activities occur in the vicinity of the Project.

City of Blythe General Plan

The City of Blythe General Plan Safety Element addresses hazards and disasters, and sets forth the policy basis for the City's response to potential seismic hazards. Applicable policies related to seismic hazards are included in the City of Blythe General Plan 2025 and are provided below.

Safety Element

Policy 5: *Maintain and enforce appropriate building standards and codes to avoid and/or reduce all risks associated with geologic constraints.*

Policy 6: *Ensure through available engineering solutions that buildings designed for human habitation will not be adversely impacted by geological hazards*.

Policy 7: *Educate the public about potential geologic hazards in Blythe and maintain emergency response policies*.

3.2.7 Greenhouse Gas Emissions

This section describes the environmental setting and regulatory framework in regards to greenhouse gas (GHG) emissions for the proposed Project and Alternatives. Emissions and impacts associated with criteria air pollutants were addressed in Section 3.2.3.

Environmental Setting

Characteristics and Definition

Global climate change refers to changes in average climatic conditions on Earth as a whole, including temperature, wind patterns, precipitation, and storms. Global temperatures are moderated by naturally occurring atmospheric gases, including water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), which are known as GHGs. These gases allow solar radiation (sunlight) into the Earth's atmosphere, but prevent radiative heat from escaping, thus warming the Earth's atmosphere. Gases that trap heat in the atmosphere are often called greenhouse gases, analogous to a greenhouse, and are emitted by both natural processes and human activities. GHGs in the atmosphere influence regulation of the Earth's temperature. Emissions from human activities, such as burning fossil fuels for electricity production and vehicle use, have elevated the concentration of these gases in the atmosphere.

Scientific evidence indicates a trend of increasing global temperature over the past century, which a number of scientists attribute to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

Recent observed changes due to global warming include shrinking glaciers, thawing permafrost, a lengthened growing season, and shifts in plant and animal ranges (IPCC 2007). Generally accepted predictions of long-term environmental impacts due to global warming include sea level rise, changing weather patterns with increases in the severity of storms and droughts, changes to local and regional ecosystems, including the potential loss of species, and a significant reduction in winter snowpack.

The State of California has been at the forefront of developing solutions to address global climate change. Global climate change refers to any significant change in measures of climate, such as average temperature, precipitation, or wind patterns over a period of time. Global climate change may result from natural factors, natural processes, and/or human activities that change the composition of the atmosphere and alter the surface and features of land.

The United Nations Intergovernmental Panel on Climate Change (IPCC) developed several emission trajectories of GHGs needed to stabilize global temperatures and climate change impacts. The IPCC concluded that a stabilization of GHGs at 400 to 450 ppm CO_2 equivalent concentration is required to keep global mean warming below 3.6ºF (2º Celsius [2ºC]), which is assumed to be necessary to avoid dangerous climate change (AEP 2007).

The State of California has been at the forefront of developing solutions to address global climate change. State law defines greenhouse gases as any of the following compounds: CO_2, CH_4, N_2O,

hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (California Health and Safety Code Section 38505(g)). CO_2, CH_4, and N_2O are the most common GHGs that result from human activity.

GHG Inventory

The State of California GHG Inventory performed by the CARB, compiled statewide anthropogenic GHG emissions and sinks. It includes estimates for CO2, CH4, N2O, SF6, HFCs, and PFCs. The current inventory covers the years 1990 to 2009, and is summarized in Table 3.2.7-1. Data sources used to calculate this GHG inventory include California and federal agencies, international organizations, and industry associations. The calculation methodologies are consistent with guidance from the IPCC. The 1990 emissions level is the sum total of sources and sinks from all sectors and categories in the inventory. The inventory is divided into seven broad sectors and categories in the inventory. These sectors include: Agriculture; Commercial; Electricity Generation; Forestry; Industrial; Residential; and Transportation.

Total GHG emissions from a source are often reported as a CO2 equivalent (CO2e). The CO2e is calculated by multiplying the emission of each GHG by its global warming potential and adding the results together to produce a single, combined emission rate representing all GHGs. GHG emissions are typically quantified in metric tons (MT) or millions of metric tons (MMT).

TABLE 3.2.7-1 STATE OF CALIFORNIA GHG EMISSIONS BY SECTOR

SECTOR	TOTAL 1990 EMISSIONS (MMT CO_2E)	PERCENT OF TOTAL 1990 EMISSIONS	TOTAL 2009 EMISSIONS (MMT CO_2E)	PERCENT OF TOTAL 2009 EMISSIONS
Agriculture	23.4	5%	32.13	7%
Commercial	14.4	3%	13.41	3%
Electricity Generation	110.6	26%	103.68	23%
Forestry (excluding sinks)	0.2	<1%	0.19	<1%
Industrial	103.0	24%	81.38	18%
Residential	29.7	7%	28.61	6%
Transportation	150.7	35%	172.92	38%
Recycling and Waste			7.32	2%
High Global Warming Potential Gases			16.32	4%
Forestry Sinks	(6.7)		(3.80)	

Source: CARB 2011a.

GHGs have varying global warming potential. The global warming potential is the potential of a gas or aerosol to trap heat in the atmosphere; it is the "cumulative radiative forcing effect of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas" (EPA 2006). The global warming potential rating system is standardized to CO2, which has a value of one. For example, CH4 has a global warming potential of 21, which means that it has a global warming effect 21 times greater than CO2 on an equal-mass basis. Table 3.2.7-2 presents the global warming potential and atmospheric lifetimes of common GHGs.

TABLE 3.2.7-2 GLOBAL WARMING POTENTIALS AND ATMOSPHERIC LIFETIMES OF GHGS

GHG	FORMULA	100-YEAR GLOBAL WARMING POTENTIAL	ATMOSPHERIC LIFETIME (YEARS)
Carbon Dioxide	CO_2	1	Variable
Methane	CH_4	21	12 ± 3
Nitrous Oxide	N_2O	310	120
Sulfur Hexafluoride	SF_6	23,900	3,200

Source: EPA 2006.

Human-caused sources of CO2 include combustion of fossil fuels (coal, oil, natural gas, gasoline, and wood). Data from ice cores indicate that CO2 concentrations remained steady prior to the current period for approximately 10,000 years. Concentrations of CO2 have increased in the atmosphere since the industrial revolution.

CH4 is the main component of natural gas and also arises naturally from anaerobic decay of organic matter. Human-caused sources of natural gas include landfills, fermentation of manure, and cattle farming. Human-caused sources of N2O include combustion of fossil fuels and industrial processes such as production of nylon or nitric acid.

Other GHGs are present in trace amounts in the atmosphere and are generated from various industrial or other uses.

Regulatory Setting

On a national scale, federal agencies are addressing emissions of GHGs by reductions mandated in federal laws and Executive Orders; most recently, Executive Order 13423 Strengthening Federal Environmental, Energy, and Transportation Management (January 24, 2007) was enacted. Several states have promulgated laws as a means to reduce statewide levels of GHG emissions. In particular, the California Global Warming Solutions Act of 2006 directs the State of California to reduce statewide GHG emissions to 1990 levels by the year 2020.

Federal

Recent actions by the EPA have allowed for the regulation of GHGs. On April 17, 2009, the EPA issued its proposed endangerment finding for GHG emissions. On December 7, 2009, the EPA Administrator signed and finalized two distinct findings regarding greenhouse gases under Section 202(a) of the Clean Air Act:

> **Endangerment Finding:** The Administrator finds that the current and projected concentrations of the six key well-mixed greenhouse gases—carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—in the atmosphere threaten the public health and welfare of current and future generations.
>
> **Cause or Contribute Finding:** The Administrator finds that the combined emissions of these well-mixed greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution which threatens public health and welfare.

These findings do not themselves impose any requirements on industry or other entities. However, this action was a prerequisite to finalizing the EPA's proposed GHG emission standards for light-duty vehicles, which were jointly proposed by the EPA and the Department of Transportation's National Highway Safety Administration on September 15, 2009 and adopted on April 1, 2010. As finalized in April 2010, the emissions standards rule for vehicles will improve average fuel economy standards to 35.5 miles per gallon by 2016. In addition, the rule will require model year 2016 vehicles to meet an estimated combined average emission level of 250 grams of CO_2 per mile.

On March 10, 2009, in response to the FY2008 Consolidated Appropriations Act (H.R. 2764; Public Law 110–161), the EPA proposed a rule that requires mandatory reporting of GHG emissions from large sources in the United States. On September 22, 2009, the Final Mandatory Reporting of Greenhouse Gases Rule was signed, and it was published in the Federal Register on October 30, 2009. The rule became effective on December 29, 2009. The rule will collect accurate and comprehensive emissions data to inform future policy decisions.

The EPA is requiring suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions to submit annual reports to

the EPA. The gases covered by the proposed rule are CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and other fluorinated gases, including nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFE).

State

The State of California enacted some of the first legislation in the United States to regulate GHGs. The following subsections describe regulations and standards that have been adopted by the State of California to address GHG emissions.

Assembly Bill 32, the California Global Warming Solutions Act of 2006

In September 2006, Governor Schwarzenegger signed Assembly Bill (AB) 32 into law. AB 32 required that, by January 1, 2008, the CARB determine what the statewide GHG emissions level was in 1990, and approve a statewide GHG emissions limit that is equivalent to that level, to be achieved by 2020. The CARB adopted its Scoping Plan, which provided estimates of the 1990 GHG emissions level and identified sectors for the reduction of GHG emissions, in December 2008. The CARB has estimated that the 1990 GHG emissions level was 427 MMT net CO_2e (CARB 2007). The CARB estimates that a reduction of 173 MMT net CO_2e emissions below business-as-usual would be required by 2020 to meet the 1990 levels (CARB 2007). This amounts to roughly a 30 percent reduction from projected business-as-usual levels in 2020 (CARB 2008).

Senate Bill 97

Senate Bill (SB) 97, enacted in 2007, amends the CEQA statute to clearly establish that GHG emissions and the effects of GHG emissions are appropriate subjects for CEQA analysis. SB 97 directed the Governor's Office of Planning and Research to develop draft CEQA guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions" by July 1, 2009, and directed the California Natural Resources Agency to certify and adopt the CEQA guidelines by January 1, 2010.

The Office of Planning and Research published a technical advisory on CEQA and climate change on June 19, 2008. The guidance did not include a suggested threshold, but stated that the Office of Planning and Research had asked the CARB to "recommend a method for setting thresholds which will encourage consistency and uniformity in the CEQA analysis of greenhouse gas emissions throughout the state." The Office of Planning and Research technical advisory does recommend that CEQA analyses include the following components:

- identification of greenhouse gas emissions;
- determination of significance; and
- mitigation of impacts, as needed and as feasible.

On December 31, 2009, the California Natural Resources Agency adopted the proposed amendments to the CEQA Guidelines. These amendments became effective on March 18, 2010.

Executive Order S-3-05

Executive Order S-3-05, signed by Governor Schwarzenegger on June 1, 2005, calls for a reduction in GHG emissions to 1990 levels by 2020 and for an 80 percent reduction in GHG emissions below 1990 levels by 2050. Executive Order S-3-05 also calls for the California EPA to prepare biennial science reports on the potential impact of continued global climate change on certain sectors of the California economy. The first of these reports, "Our Changing Climate: Assessing Risks to California," and its supporting document, "Scenarios of Climate Change in California: An Overview," were published by the California Climate Change Center in 2006.

Executive Order S-21-09

Executive Order S-21-09 was enacted by the Governor on September 15, 2009. Executive Order S-21-09 requires that the CARB, under its AB 32 authority, adopt a regulation by July 31, 2010 that sets a 33 percent renewable energy target. Under Executive Order S-21-09, the CARB will work with the Public Utilities Commission and California Energy Commission to encourage the creation and use of renewable energy sources, and will regulate all California utilities. The CARB will also consult with the Independent System Operator and other load balancing authorities on the impacts on reliability, renewable integration requirements, and interactions with wholesale power markets in carrying out the provisions of the Executive Order. The order requires the CARB to establish highest priority for those resources that provide the greatest environmental benefits with the least environmental costs and impacts on public health.

California Code of Regulations Title 24

Although not originally intended to reduce GHG emissions, Title 24 of the California Code of Regulations, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings, was first established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow for the consideration and possible incorporation of new energy efficiency technologies and methods. Energy efficient buildings require less electricity, natural gas, and other fuels. Electricity production from fossil fuels and on-site fuel combustion (typically for water heating) results in GHG emissions. Therefore, increased energy efficiency results in decreased GHG emissions.

The GHG emission inventory was based on Title 24 standards as of October 2005; however, Title 24 has been updated as of 2008 and standards are currently being phased in.

Senate Bill 1078, Senate Bill 107, and Executive Order S-14-08

SB 1078 initially set a target of 20 percent of energy to be sold from renewable sources by the year 2017. The schedule for implementation of the renewable portfolio standard (RPS) was accelerated in 2006 with the Governor's signing of SB 107, which accelerated the 20 percent RPS goal from 2017 to 2010. On November 17, 2008, the Governor signed Executive Order S-14-08, which establishes a goal of having all retail sellers of electricity to serve 33 percent of their load with renewable energy by 2020. The Governor signed Executive Order S-21-09 on September 15, 2009, which directs the CARB to implement a regulation consistent with the 2020 33 percent renewable energy target by July 31, 2010.

State Standards Addressing Vehicular Emissions

California Assembly Bill 1493 (Pavley), enacted on July 22, 2002, required the CARB to develop and adopt regulations that reduce GHGs emitted by passenger vehicles and light duty trucks. Regulations adopted by the CARB would apply to 2009 and later model year vehicles. The CARB estimated that the regulation would reduce climate change emissions from light duty passenger vehicle fleet by an estimated 18 percent in 2020 and by 27 percent in 2030 (AEP 2007). Overall within the state of California, implementation of the Pavley standards are anticipated to reduce GHG emissions by 17.23 percent (CARB 2011).

The CARB has adopted amendments to the Pavley regulations that reduce GHG emissions in new passenger vehicles from 2009 through 2016. The amendments, approved by the CARB Board on September 24, 2009, are part of California's commitment toward a nationwide program to reduce new passenger vehicle GHGs from 2012 through 2016, and prepare California to harmonize its rules with the federal rules for passenger vehicles.

Executive Order S-01-07

Executive Order S-01-07 was enacted by the Governor on January 18, 2007, and mandates that: 1) a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least

AR062469

10 percent by 2020; and 2) a Low Carbon Fuel Standard for transportation fuels be established for California. On April 23, 2009, the CARB adopted regulations to implement the Low Carbon Fuel Standard.

Senate Bill 375

SB 375 finds that GHG from autos and light trucks can be substantially reduced by new vehicle technology, but even so, "…it will be necessary to achieve significant additional greenhouse gas reductions from changed land use patterns and improved transportation. Without improved land use and transportation policy, California will not be able to achieve the goals of AB 32." Therefore, SB 375 requires that regions with metropolitan planning organizations adopt sustainable community strategies, as part of their regional transportation plans, which are designed to achieve certain goals for the reduction of GHG emissions from mobile sources.

Local

To date, the MDAQMD has not enacted regulations governing GHGs. Likewise, Riverside County and the City of Blythe have not adopted policies or regulations addressing greenhouse gas emissions or climate change.

3.2.8 Hazards and Hazardous Materials

This section describes the environmental setting and regulatory framework in regards to hazards and hazardous materials for the proposed Project and Alternatives. The affected environment for public health and safety includes evaluation of several program areas, including aircraft operations, hazardous materials, public health, and electric and magnetic field exposure (EMF). The affected environment related to flooding or seismic hazards is discussed in Section 3.2.7, *Geology and Soils* and Section 3.2.10, *Hydrology and Water Quality*.

Environmental Setting

A consideration for hazardous materials analyses is the proximity of residential and other sensitive receptors, such as schools, daycare centers, emergency response facilities, and long-term care facilities. The Project's solar array field and gen-tie line would be located within Riverside County and portions of the proposed site would be located within the City of Blythe.

There are 369 residences within one mile of the solar facility site. The three existing residences (two residences on APN 863060015 and one residence on APN 863100016) on the solar facility site would be removed as part of the Project and therefore would not be considered sensitive receptors of the Project. Seven individual residences are located within 1,000 feet of the solar facility site. The closest residence (APN 824110004) is approximately 260 feet away from the property boundary and adjacent to an area of the Project that is proposed to contain solar arrays. In addition, the Project is approximately 0.4 mile (2,200 feet) from the Mesa Verde Park and approximately 0.8 mile (4,400 feet) from the Roy Wilson Community and Child Center. Outside the solar facility site boundary, the closest occupied residence to the Project's proposed gen-tie line is approximately 0.7 mile (3,670 feet); the closest unoccupied mobile home is approximately 0.4 mile (1,960 feet). No schools, hospitals, or long-term care facilities are located within one mile of the proposed Project.

Environmental Site Assessment

Environmental Data Resources, Inc. (EDR) prepared the EDR DataMap™ Area Study, which contains a summary of environmentally affected sites and other sites that are within a one-mile radius surrounding the Project area (refer to Appendix F). The EDR report includes descriptions of each agency database, site names and addresses, and status, with some repetition existing among the different databases. Figure 3.2.8-1 illustrates the location of hazardous sites.

Federal Database Records

The following provides discussion of the federal databases reviewed in the EDR.

Comprehensive Environmental Response Compensation Liability Information System (CERCLIS) and No Further Remedial Action Planned Report (CERC-NFRAP)

CERC-NFRAP contains information on archived sites that have been removed from the inventory of CERCLIS sites. CERCLIS contains information on sites identified by the EPA as abandoned, inactive, or uncontrolled hazardous waste sites that may require cleanup. CERCLIS sites are in the evaluation stage to determine whether these sites are to be included on the federal NPL (priority for clean up under the Superfund program). Archived status indicates that, to the best of the EPA's knowledge, assessment has been completed and the EPA has determined no further steps will be taken to list the site on the NPL, unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time.

The EDR database indicates no sites are listed within the Project area; however, two sites within the one-mile search radius of the Project area do appear on the CERC-NFRAP list:

- Farmer Air Service, 17500 W. Hobson Way, Blythe.
- West Coast Flying Service, 13-400 W. 14th Save, Blythe.

Resource Conservation and Recovery Act (RCRA) and Corrective Action (CORRACTS) List

The CORRACTS list contains information concerning RCRA facilities that have conducted or are currently conducting corrective action. The EDR database indicates that no sites are listed within the Project area; however, two sites appear on the RCRA and the CORRACTS list as located within one mile of the solar facility site:

- Farmer Air Service, 17500 W. Hobson Way, Blythe.
- West Coast Flying Service, 13-400 W. 14th Ave., Blythe.

RCRA and Non-Generators (NonGen)

The RCRA-NonGen is an EPA comprehensive information system, providing access to data supporting the RCRA of 1976 and the Hazardous and Solid Waste Amendments of 1984. The database includes selective information on sites that generate, transport, store, treat, and/or dispose of hazardous waste as defined by the RCRA. Non-Generators do not presently generate hazardous waste.

The EDR database indicates that no sites are listed within the Project area; however, two sites appear on the RCRA-NonGen list as located within the one-mile search radius of the Project area:

- Farmer Air Service, 17500 W. Hobson Way, Blythe.
- West Coast Flying Service, 13-400 W. 14th Ave., Blythe.

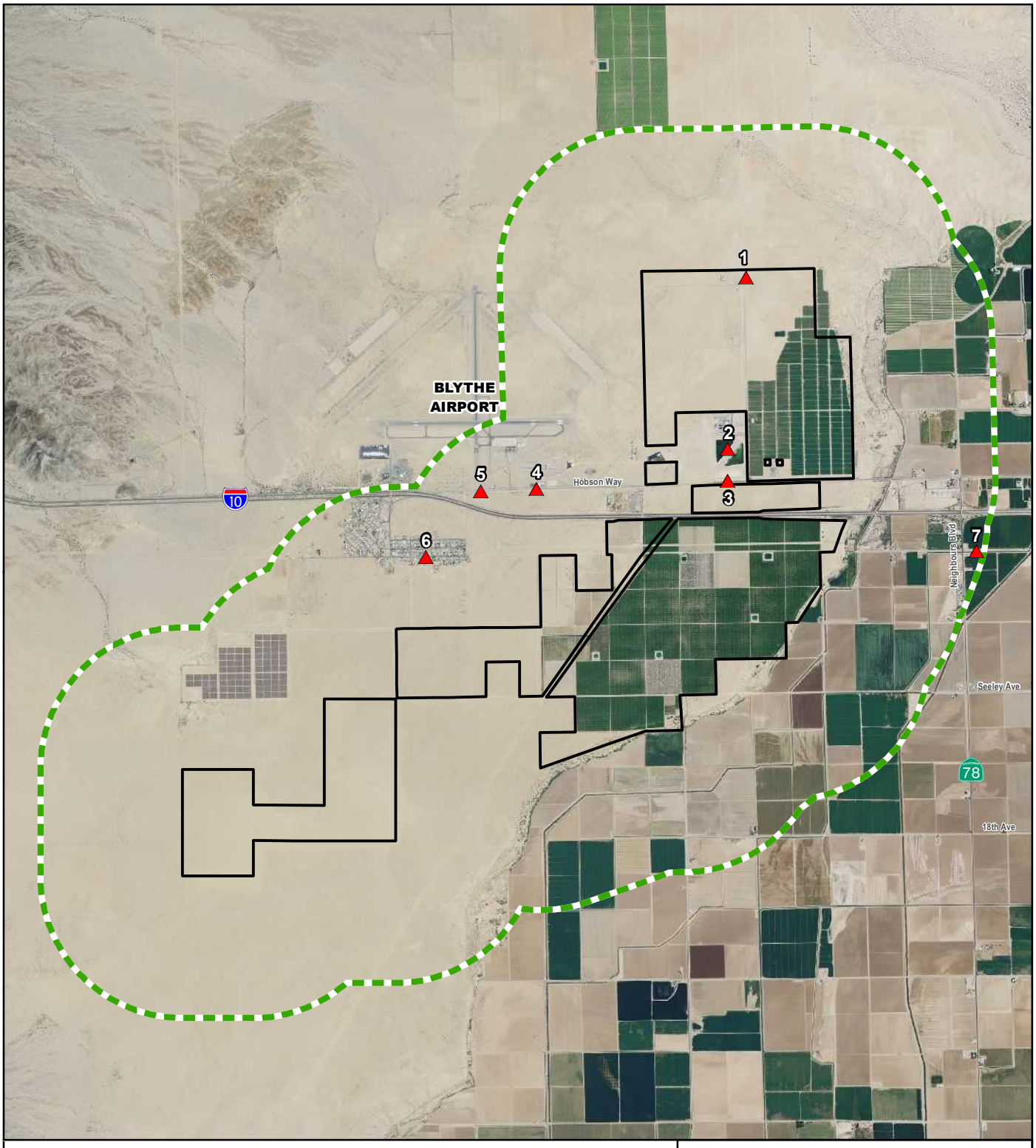
The Facility Index System (FINDS)

The FINDS contains both facility information and "pointers" to other sources of information that contain more detail. The EDR database indicates that no sites are listed within the Project area; however, two sites appear on the FINDS list as located within the one-mile search radius of the Project area:

- Farmer Air Service, 17500 W. Hobson Way, Blythe.
- West Coast Flying Service, 13-400 W. 14th Ave., Blythe.

State and Local Database Records

The following provides discussion of the State and local data bases reviewed in the EDR.



Legend

- Blythe Mesa Solar Project Boundary
- Listed Site
- 1-Mile Search Boundary

1. Blythe Lemon Ranch
2. Blythe Airport Dump
3. Sunworld #1, Blythe Lemon Ranch #41
4. Blythe Airport
5. Farmer Air Service
6. Woten Aviation - Blythe
7. West Coast Flying Service

N

0 1

Miles

1:63,360

FIGURE 3.2.8-1
HAZARDOUS SITES

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

THIS PAGE INTENTIONALLY LEFT BLANK

The Waste Management Unit Database System/Solid Waste Assessment Test (WMUDS/SWAT)

WMUDS/SWAT is used for program tracking and inventory of waste management units. The EDR database indicates that no sites are listed within the Project area; however, one site appears on the FINDS list, located within the one-mile search radius of the Project area:

- Blythe Airport Dump, Blythe Airport.

Hazardous Waste and Substances Sites (HIST CORTESE)

The HIST CORTESE list identifies sites designated by the State Water Resources Control Board, integrated Waste Board (SWF/LS), and the Department of Toxic Substances Control (CALSITES) as those that have had documented leaking underground storage tanks. The EDR database indicates that two sites are listed within the Project area and one site is listed on the CORTESE database as located within the one-mile search radius of the Project area.

On-Site:

- Sunworld #1: 15550 West Hobson Way, Blythe. The EDR indicates this is a leaking underground storage tank (LUST) clean-up site with the status as Completed – Case Closed.
- Blythe Lemon Ranch #41: 15550 West Hobson Way, Blythe.

Off-site:

- Blythe Airport: 17240 Blythe Airport, Blythe. The EDR indicates this is a LUST clean-up site with the status as Completed – Case Closed.

Leaking Underground Storage Tank (LUST)

The LUST database tracks all of the known leaking underground storage tanks. The database also provides some information on the status of the remedial action on those sites. The EDR database indicates three sites listed on the LUST database within the Project area, and one within the one-mile search radius of the Project area. The locations are as follows:

On-Site:

- Sunworld #1: 15550 West Hobson Way, Blythe. The EDR indicates this is a LUST clean-up site with the status as Completed – Case Closed.
- Sunworld: 15550 West Hobson Way, Blythe. The EDR indicates the status of this listing as Site Closed 10/23/93 – Case referred to the Regional Water Board.
- Sunworld Facility: The EDR indicates this is a LUST clean-up site with the status as Completed – Case Closed.

Off-Site:

- Blythe Airport: 17240 Blythe Airport, Blythe. The EDR indicates this is a LUST clean-up site with the status as Completed – Case Closed.

Spills, Leaks, Investigation and Cleanup (SLIC)

SLIC database (has been replaced by Geotracker) is the California Regional Water Quality Control Board's data management system for managing sites that impact groundwater, especially those that require groundwater cleanup (Underground Storage Tanks [USTs], Department of Defense, Site Cleanup Program) as well as permitted facilities such as operating USTs and land disposal sites The EDR database revealed that there is one SLIC site within the one-mile search radius (not located on the Project area):

- Woten Aviation, Blythe AFSFO: 17798 Blythe Way, Blythe.

Historical Underground Storage Tank (HIST UST)

The HIST UST is a database of historical listings of underground storage tanks. The EDR database revealed that there is one HIST UST site within the one-mile search radius (not located on the Project area):

- Blythe RCAG, Blythe AFSFO.

California Hazardous Material Incident Report System (CHMIRS)

CHMIRS contains information on reported hazardous material (e.g., accidental releases of spills). The EDR database revealed that there is one CHMIRS site within the one-mile search radius (not located on the Project area):

- Blythe Airport Dump, Blythe Airport.

Aboveground Storage Tank (AST)

The AST database contains registered ASTs. The data comes from the State Water Resources Control Board's Hazardous Substance Storage Container Database. The EDR database revealed that there is one 3,500 gallon AST registered on the Project area:

- Blythe Lemon Ranch, 10151 Buck Blvd., Blythe (referenced as Listed Site #1 on Figure 3.2.8-1).

Airport Operations

The Blythe Airport is to the north and west of the proposed solar facility site. The 8.4 miles of gen-tie line would be located to the west and south of the Blythe Airport. The airport is a public facility, owned by Riverside County. The 3,094-acre facility is the largest airport serving eastern Riverside County and serves primarily general aviation demand in the Blythe area. The Airport is classified in the National Plan of Integrated Airport Systems as a general aviation transport airport, designed to accommodate business jets, cargo-type aircraft, light private planes, and flight school training activities. The Blythe Airport currently has two runways (8/26 and 17/35). The primary runway is Runway 8/26, which is oriented generally east-west. Aircraft operations average 69 flights per day (AirNav 2012). The airport is often used as a base for crop spraying operations, flight rental, and flight instruction (County of Riverside 2003-2008).

The proposed Project would be located within the area covered by the Riverside County Airport Land Use Compatibility Plan (RCALUCP), which was adopted by the Riverside County Airport Land Use Commission (ALUC) in 2004 and replaced the compatibility plans for individual airports. The RCALUCP identifies Airport Influence Areas (AIAs) to protect the public from the adverse effects of aircraft noise, ensure that facilities and people are not concentrated in areas susceptible to aircraft accidents, and ensure that no structures or activities adversely affect or encroach upon the use of navigable airspace (ALUC 2012).

The proposed Project would be located within the Blythe AIA. According to the RCALUCP (Appendix D, Compatibility Guidelines for Specific Land Uses), electrical facilities (such as power plants, electrical substations, and transmission lines) located in airport land use compatibility zones must meet the restrictions designated for each zone so that they are generally compatible or potentially compatible. This is to ensure that electrical facilities do not create obstructions to the navigable air space and safe operations at the airport. Land uses, concentrations of population, and height of proposed development within this airport influence area are restricted in certain areas of the AIA and listed in Table 3.3.8-2 under the RCALUCP discussion. Airport land use compatibility zones within the Project area are illustrated in Figure 3.2.8-2.

The proposed Project would fall within airport Compatibility Zones B1, C, D, and E. The majority of the proposed Project's PV panel structures would be located within Zones D and E, with a smaller portion located within Zone C; no solar panels are proposed in Zone B1. A portion of the solar array field would be partially outside of the Blythe AIA. The gen-tie lines (poles would be approximately 85 to 120 feet in height) would traverse Zones D and E, and would proceed generally from I-10 in a southwesterly direction and then in a westerly direction, ultimately terminating at the planned Colorado River Substation located outside the Blythe AIA.

Table 3.3.8-2 below lists the approximate tower heights by voltage for existing and planned transmission lines within Blythe AIA.

TABLE 3.3.8-2 APPROXIMATE TOWER HEIGHTS FOR TRANSMISSION LINES IN THE BLYTHE AIA

TRANSMISSION LINE VOLTAGE	APPROXIMATE TOWER HEIGHT
Planned 500 kV	125 to 200 feet
Existing 220 kV/230 kV	75 to 135 feet
Planned Blythe Mesa Solar Project 230 kV	85 to 125 feet
Existing 161 kV	60 to 80 feet
Existing 138 kV	60 to 80 feet

Source: POWER, LIDAR data from Blythe 230 kV Transmission Line and Devers-Palo Verde No. 2 Transmission Project Final EIR/EIS

Electric and Magnetic Fields

EMFs are invisible lines of force that surround any electrical device. Both fields occur together whenever electricity flows, hence the general practice of describing exposure together as EMF exposure. Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of current through wires or electrical devices and increase in strength as the current increases. Most electrical equipment has to be turned on, i.e., current must be flowing, for a magnetic field to be produced. Electric fields, on the other hand, are present even when the equipment is switched off, as long as it remains connected to the source of electric power. Both electric and magnetic fields decrease as the distance from the source increases.

Regulatory Setting

Federal

Resource Conservation and Recovery Act of 1976 (42 U.S.C. § 6901 et seq.)

The RCRA grants authority to the EPA to control hazardous waste from start to finish. This covers the production, transportation, treatment, storage, and disposal of hazardous waste. The RCRA also sets forth a framework for the management of non-hazardous solid waste. The 1986 amendments to the RCRA enabled the EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances.

Federal Water Pollution Control Act (Clean Water Act)

The CWA is a comprehensive statute focused on restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. Originally enacted in 1948, the CWA was amended numerous times until it was reorganized and expanded in 1972. It continues to be amended almost on an annual basis.

Primary authority for the implementation and enforcement of the CWA rests with the EPA. The CWA authorizes water quality programs, requires federal effluent limitations and state water quality standards, requires permits for the discharge of pollutants into navigable waters, provides enforcement mechanisms, and authorizes funding for wastewater treatment works construction grants and state revolving loan

programs, as well as funding to states and Tribes for their water quality programs. Provisions have also been added to address water quality problems in specific regions and specific waterways. The Project would be subject to a National Pollutant Discharge Elimination System (NPDES) Construction General Permit during construction and a General Industrial Permit during operations and maintenance to address water quality.

Occupational Safety and Health Act

Congress passed the Occupational Safety and Health Act (OSHA) to ensure safe and healthful working conditions for working men and women. OSHA authorized enforcement of the standards developed under the Act and assisted states in their efforts to ensure safe and healthful working conditions. OSHA also provides for research, information, education, and training in the field of occupational safety and health. The Project would be subject to OSHA requirements during construction, operations and maintenance, and decommissioning.

Federal Aviation Administration Regulations Part 77

Federal Aviation Administration (FAA) regulations, 14 CFR Part 77, establish standards and notification requirements for objects affecting navigable airspace. This notification serves as the basis for evaluating the effects of construction or alteration on operating procedures; determining the potential hazardous effect of the proposed construction on air navigation; identifying mitigation measures to enhance safe air navigation; and charting of new objects.

These regulations apply to the following:

- Any construction or alteration exceeding 200 feet above ground level;
- Any construction or alteration:

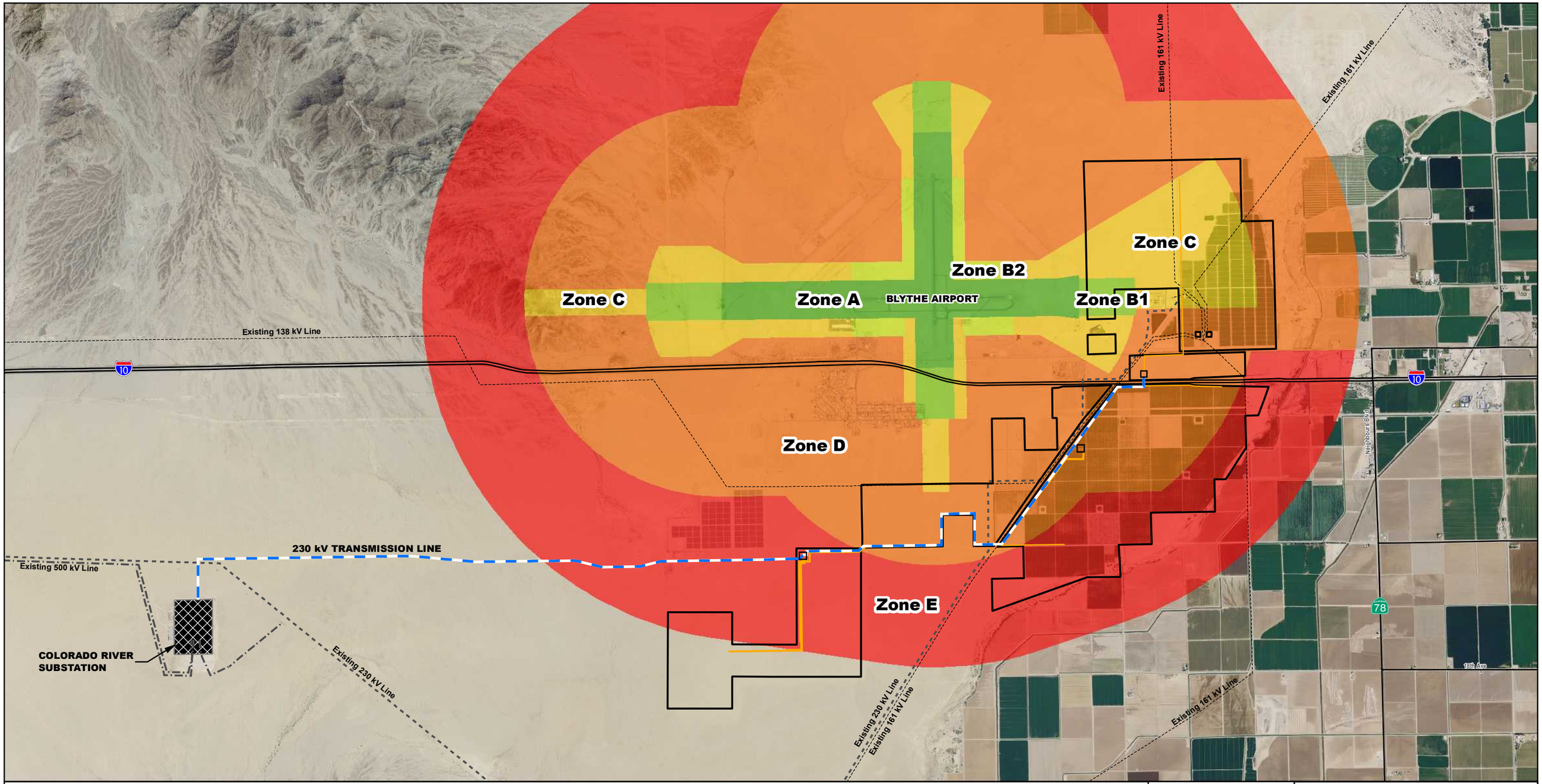
- within 20,000 feet of a public use or military airport that exceeds a 100:1 surface from any point on the runway of each airport with at least one runway more than 3,200 feet long
- within 10,000 feet of a public use or military airport that exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 feet long
- within 5,000 feet of a public use heliport that exceeds a 25:1 surface;
- Any highway, railroad or other traverse way whose prescribed adjusted height would exceed the above-noted standards:
- when requested by the FAA; and
- any construction or alteration located on a public use airport or heliport regardless of height or location.

FAA Advisory Circular No. 70/7460-1G

FAA Advisory Circular No. 70/7460-1G, “Proposed Construction and/or Alteration of Objects that May Affect the Navigation Space,” identifies the need to file the “Notice of Proposed Construction or Alteration” form (Form 7640) with the FAA in cases of potential for an obstruction hazard. The proposed Project includes towers to support the gen-tie line that could be between 85 and 125 feet in height.

Title 47 CFR Part 15.2524, Federal Communications Commission

Title 47 CFR Part 15.2524, Federal Communications Commission (FCC) prohibits operation of devices that can interfere with radio-frequency communication. The proposed gen-tie line, as a high-voltage gen-tie line, represents a potential source of radio-frequency communication interference.



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Proposed 34.5 kV Transmission Line

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

Blythe Airport Zoning
- Zone A
- Zone B1
- Zone B2
- Zone C
- Zone D
- Zone E

N

0 4,000 8,000
Feet
1:48,000



FIGURE 3.2.8-2
AIRPORT COMPATIBILITY ZONES

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: USDA NAIP Imagery, 2012.

THIS PAGE INTENTIONALLY LEFT BLANK

State

California Environmental Protection Agency

The California Environmental Protection Agency (Cal EPA) and the State Water Resources Control Board establish rules governing the use of hazardous materials and the management of hazardous waste. Applicable State and local laws include the following:

- Public Safety/Fire Regulations/Building Codes
- Hazardous Waste Control Law
- Hazardous Substances Information and Training Act
- Air Toxics Hot Spots and Emissions Inventory Law
- Underground Storage of Hazardous Substances Act
- Porter-Cologne Water Quality Control Act

Department of Toxic Substances Control

The Department of Toxic Substances Control (DTSC) has primary regulatory responsibility for the management of hazardous materials and the generation, transport, and disposal of hazardous waste under the authority of the Hazardous Waste Control Law. Enforcement is delegated to local jurisdictions that enter into agreements with the DTSC.

California's Secretary of Environmental Protection established a unified hazardous waste and hazardous materials management regulatory program as required by Health and Safety Code Chapter 6.11. The unified program consolidates, coordinates, and makes consistent portions of the following six existing programs:

- Hazardous Waste Generations and Hazardous Waste On-site Treatment
- Underground Storage Tanks
- Hazardous Material Release Response Plans and Inventories
- California Accidental Release Prevention Program
- Aboveground Storage Tanks (spill control and countermeasure plan only)
- Uniform Fire Code Hazardous Material Management Plans and Inventories

The statute requires all counties to apply to the Cal EPA Secretary for the certification of a local unified program agency. Qualified cities are also permitted to apply for certification. The local Certified Unified Program Agency (CUPA) is required to consolidate, coordinate, and make consistent the administrative requirements, permits, fee structures, and inspection and enforcement activities for these six program elements within the county. Most CUPAs have been established as a function of a local environmental health or fire department.

The Office of the State Fire Marshal participates in all levels of the CUPA program including regulatory oversight, CUPA certifications, evaluations of the approved CUPAs, training, and education. The Riverside County Department of Environmental Health serves as the CUPA in Riverside County.

Hazardous Waste Control Act

The Hazardous Waste Control Act created the State hazardous waste management program, which is similar to but more stringent than the federal RCRA program. The act is implemented by regulations contained in Title 26 of the CCR, which describes the following required aspects for the proper management of hazardous waste:

- identification and classification;
- generation and transportation;
- design and permitting of recycling, treatment, storage, and disposal facilities;

- treatment standards;
- operation of facilities and staff training; and
- closure of facilities and liability requirements.

These regulations list more than 800 materials that may be hazardous and establish criteria for identifying, packaging, and disposing of such waste. Under the Hazardous Waste Control Act and Title 26, the generator of hazardous waste must complete a manifest that accompanies the waste from generator to transporter to the ultimate disposal location. Copies of the manifest must be filed with the DTSC.

California Occupational Safety and Health Administration

The California Occupational Safety and Health Administration (Cal/OSHA) is the primary agency responsible for worker safety in the handling and use of chemicals in the workplace. Cal/OSHA standards are generally more stringent than federal regulations. The employer is required to monitor worker exposure to listed hazardous substances and notify workers of exposure (8 CCR 337-340). The regulations specify requirements for employee training, availability of safety equipment, accident-prevention programs, and hazardous substance exposure warnings.

Title 8, California Code of Regulations, Section 2700 et seq. "High Voltage Safety Orders"

Title 8 of the CCR specifies requirements and minimum standards for safety when installing, operating, working around, and maintaining electrical installations and equipment. The proposed Project would be subject to Title 8.

National Electrical Safety Code

The National Electrical Safety Code specifies grounding procedures to limit nuisance shocks and specifies minimum conductor ground clearances. The proposed Project would be subject to this code and would be designed with a grounding system providing an adequate path to ground to permit the dissipation of current created by lightning and ground faults.

14 California Code of Regulations, Sections 1250 – 1258, "Fire Prevention Standards for Electric Utilities"

14 CCR provides specific exemptions from electric pole and tower firebreak. 14 CCR also provides conductor clearance standards and specifies when and where standards apply. These standards address hazards that could be caused by sparks from conductors of overhead lines, or that could result from direct contact between the line and combustible objects. The proposed Project would be subject to these standards.

Local

Riverside County General Plan

The Riverside County General Plan Safety Element provides policies for development of the Project area within Riverside County. In compliance with State law, the primary objective of the Safety Element is to "reduce death, injuries, property damage, and economic and social impact from hazards." Countywide policies that address health and safety within the County boundaries are also located in the Land Use Element of the County General Plan.

Safety Element (S)

Fire Hazards – Building Code and Performance Standards

Policy S 1.1. *Mitigate hazard impacts through adoption and strict enforcement of current building codes, which will be amended as necessary when local deficiencies are identified.*

Policy S 5.1. *Develop and enforce construction and design standards that ensure that proposed development incorporates fire prevention features through the following:*

1) *All proposed construction shall meet minimum standards for fire safety as defined in the County Building or Fire Codes, or by County zoning, or as dictated by the Building Official or the Transportation Land Management Agency based on building type, design, occupancy, and use.*
2) *In addition to the standards and guidelines of the Uniform Building Code and Uniform Fire Code fire safety provisions, continue additional standards for high-risk, high occupancy, dependent, and essential facilities where appropriate under the Riverside County Fire Protection Ordinance. These shall include assurance that structural and nonstructural architectural elements of the building will not:*

    - impede emergency egress for fire safety staffing/personnel, equipment, and apparatus; nor
    - hinder evacuation from fire, including potential blockage of stairways or fire doors.

3) *Proposed development in Hazardous Fire areas shall provide secondary public access, unless determined otherwise by the County Fire Chief.*
4) *Proposed development in Hazardous Fire areas shall use single loaded roads to enhance fuel modification areas, unless otherwise determined by the County Fire Chief.*

Hazardous Waste and Materials – Hazardous Waste Management Plan

Policy S 6.1. *Enforce the policies and siting criteria and implement the programs identified in the County of Riverside Hazardous Waste Management plan, which includes the following: (AI 98)*

1) *Comply with federal and state laws pertaining to the management of hazardous wastes and materials.*
2) *Ensure active public participation in hazardous waste and hazardous materials management decisions in Riverside County.*
3) *Coordinate hazardous waste facility responsibilities on a regional basis through the Southern California Hazardous Waste Management Authority (SCHWMA).*
4) *Encourage and promote the programs, practices, and recommendations contained in the County Hazardous Waste Management Plan, giving the highest waste management priority to the reduction of hazardous waste at its source.*

Policy S 7.2. *Require commercial businesses, utilities, and industrial facilities that handle hazardous materials to:*

- Install automatic fire and hazardous materials detection, reporting and shut-off devices; and
- Install an alternative communication system in the event power is out or telephone service is saturated following an earthquake.

Land Use Element (LU)

Policy LU 6.2(b). *The location of the proposed use will not jeopardize public health, safety, and welfare, or the facility is necessary to ensure the continual public safety and welfare.*

Policy LU 14.7. *Ensure that no structures or activities encroach upon or adversely affect the use of navigable airspace.*

Palo Verde Valley Area Plan

PVVAP 14.1. *Protect life and property from wildfire hazards through adherence to the Fire Hazards section of the General Plan Safety Element.*

Riverside County Airport Land Use Compatibility Plan

The proposed Project would be located within the area covered by the RCALUCP. The RCALUCP sets forth the criteria and policies that the Riverside County ALUC uses in assessing the compatibility between the principal airports in Riverside County and proposed land use development in the areas surrounding them. The RCALUCP primarily deals with review of local general plans, specific plans, zoning ordinances, and other land use documents covering broad geographic areas. Certain individual land use development proposals also may be reviewed by the ALUC as provided in the policies identified in the RCALUCP. The ALUC does not have authority over existing incompatible land uses or the operation of any airport.

The ALUC adopts Airport Land Use Compatibility Plans for the areas surrounding the airports within its jurisdiction. Local development approvals must be found consistent with the RCALUCP unless approved by a 4/5th supermajority vote. The RCALUCP identifies AIAs to protect the public from the adverse effects of aircraft noise, ensure that facilities and people are not concentrated in areas susceptible to aircraft accidents, and ensure that no structures or activities adversely affect or encroach upon the use of navigable airspace (ALUC 2012). The Compatibility Plan for Blythe Airport is based upon the Airport Master Plan adopted by the Riverside County Board of Supervisors in 2001.

The following RCALUCP county-wide policies are applicable to the proposed Project:

Policy 1.5.3. Major Land Use Actions: The scope or character of certain major land use actions, as listed below, is such that their compatibility with airport activity is a potential concern. Even though these actions may be basically consistent with the local general plan or specific plan, sufficient detail may not be known to enable a full airport compatibility evaluation at the time that the general plan or specific plan is reviewed. To enable better assessment of compliance with the compatibility criteria set forth herein, ALUC review of these actions may be warranted. The circumstances under which ALUC review of these actions is to be conducted are indicated in Policy 1.5.2 above.

1) Actions affecting land uses within any compatibility zone.

   Any proposed expansion of the sphere of influence of a city or special district.
   Proposed pre-zoning associated with future annexation of land to a city.
   Proposed development agreements or amendments to such agreements.
   Proposed residential development, including land divisions, consisting of five or more dwelling units or lots.
   Any discretionary development proposal for projects having a building floor area of 20,000 square feet or greater unless only ministerial approval (e.g., a building permit) is required.
   Major capital improvements (e.g., water, sewer, or roads) which would promote urban uses in undeveloped or agricultural areas to the extent that such uses are not reflected in a previously reviewed general plan or specific plan.
   Proposed land acquisition by a government entity for any facility accommodating a congregation of people (for example, a school or hospital).
   Any off-airport, non-aviation use of land within Compatibility Zone A of any airport.
   Proposals for new development (including buildings, antennas, and other structures) having a height of more than:

   - 35 feet within Compatibility Zone B1, B2, or a Height Review Overlay Zone;
   - 70 feet within Compatibility Zone C; or

- 150 feet within Compatibility Zone D or E.

Any obstruction reviewed by the Federal Aviation Administration in accordance with Part 77 of the Federal Aviation Regulations that receives a finding of anything other than "not a hazard to air navigation."

Any project having the potential to create electrical or visual hazards to aircraft in flight, including:

- Electrical interference with radio communications or navigational signals;
- Lighting which could be mistaken for airport lighting;
- Glare in the eyes of pilots of aircraft using the airport; and
- Impaired visibility near the airport.

Projects having the potential to cause attraction of birds or other wildlife that can be hazardous to aircraft operations to be increased within the vicinity of an airport.

2) Proposed non-aviation development of airport property if such development has not previously been included in an airport master plan or community general plan reviewed by the Commission. (See Policy 1.2.5 for definition of aviation-related use.)
3) Regardless of location within Riverside County, any proposal for construction or alteration of a structure (including antennas) taller than 200 feet above the ground level at the site. (Such structures also require notification to the Federal Aviation Administration in accordance with Federal Aviation Regulations, Part 77, Paragraph 77.13(a) (1).)
4) Any other proposed land use action, as determined by the local planning agency, involving a question of compatibility with airport activities.

Policy 3.1.4. *Nonresidential Development: The compatibility of nonresidential development shall be assessed primarily with respect to its usage intensity (the number of people per acre) and the noise-sensitivity of the use. Additional criteria listed in Table 2A shall also apply.*

1) The total number of people permitted on a project site at any time, except for rare special events, must not exceed the indicated usage intensity times the gross acreage of the site.

Usage intensity calculations shall include all people (e.g., employees, customers/ visitors, etc.) who may be on the property at any single point in time, whether indoors or outside.

Rare special events are ones (such as an air show at an airport) for which a facility is not designed and normally not used and for which extra safety precautions can be taken as appropriate.

No single acre of a project site shall exceed the number of people per acre indicated in Policy 4.2.5(b) and listed in Table 2A unless special risk reduction building design measures are taken as described in Policy 4.2.6.

The noise exposure limitations cited in Policy 4.1.4 and listed in Table 2B shall be the basis for assessing the acceptability of proposed nonresidential land uses relative to noise impacts. The ability of buildings to satisfy the interior noise level criteria noted in Policy 4.1.6 shall also be considered.

Policy 3.1.5. *Prohibited Uses: Regardless of usage intensity, certain types of uses are deemed unacceptable within portions of an airport influence area. See Policy 4.2.3 and Table 2A. In addition to these explicitly prohibited uses, other uses will normally not be permitted in the respective compatibility zones because they do not meet the usage intensity criteria.*

TABLE 3.3.8-1 BASIC COMPATIBILITY CRITERIA

ZONE	LOCATIONS	MAXIMUM DENSITIES/INTENSITIES (PEOPLE PER ACRE)[1]		REQUIRED OPEN LAND[4]	PROHIBITED USES[5]	OTHER DEVELOPMENT CONDITIONS[6]
		Average[2]	Single Acre[3]			
B1	Inner Approach/Departure Zone	25	50	30%	• Children's schools, day care centers, libraries • Hospitals, nursing homes • Places of worship • Buildings with >2 aboveground habitable floors • Highly noise-sensitive outdoor nonresidential uses • Aboveground bulk storage of hazardous materials • Critical community infrastructure facilities • Hazards to flight	• Locate structures maximum distance from extended runway centerline • Minimum noise level reduction (NLR) of 25 decibels (dB) in residences (including mobile homes) and office buildings • Airspace review required for objects >35 feet tall • Avigation easement dedication
C	Extended Approach/Departure Zone	75	150	20%	• Children's schools, day care centers, libraries • Hospitals, nursing homes • Buildings with >3 aboveground habitable floors • Highly noise-sensitive outdoor nonresidential uses • Hazards to flight	• Minimum of NLR of 20 dB in residences (including mobile homes) and office buildings • Airspace review required for objects >70 feet tall • Avigation easement dedication
D	Primary Traffic Patterns and Runway Buffer Area	100	300	10%	• Highly noise-sensitive outdoor nonresidential uses • Hazards to flight	• Airspace review required for objects >70 feet tall • Children's schools, hospitals nursing homes discouraged • Deed notice required
E	Other Airport Environs	No Limit	No Limit	No Requirement	• Hazards to flight	• Airspace review required for objects>100 feet tall • Major spectator-oriented sports stadiums, amphitheaters, concert halls discouraged beneath principal flight tracks

Source: Riverside County Airport Land Use Compatibility Plan Policy Document Table 2A, October 2004.

Notes:

1) Usage intensity calculations shall include all people (e.g., employees, customers/visitors) who may be on the property at a single point in time, whether indoors or outside.
2) The total number of people permitted on a project site at any time, except rare special events, must not exceed the indicated usage intensity times the gross acreage of the site. Rare special events are ones (such as an air show at the airport) for which a facility is not designed and normally not used and for which extra safety precautions can be taken as appropriate.
3) Clustering of nonresidential development is permitted. However, no single acre of a project site shall exceed the indicated number of people per acre.
4) Open land requirements are intended to be applied with respect to an entire zone. This is typically accomplished as part of a community general plan or a specific plan, but may also apply to large (10 acres or more) development projects.
5) The uses listed here are ones that are explicitly prohibited regardless of whether they meet the intensity criteria. In addition to these explicitly prohibited uses, other uses will normally not be permitted in the respective compatibility zones because they do not meet the usage intensity criteria.
6) As part of certain real estate transactions involving residential property within any compatibility zone (that is, anywhere within an airport influence area), information regarding airport proximity and the existence of aircraft overflights must be disclosed. This requirement is set by state law.

Policy 3.1.6. *Other Development Conditions: All types of proposed development shall be required to meet the additional conditions listed in Table 2A* [Table 3.3.8-1 above] *for the respective compatibility zone where the development is to be located. Among these conditions are the following:*

1) *Aviation Easement Dedication: See Policy 4.3.5.*
2) *Deed Notice: See Policy 4.4.3.*
3) *Real Estate Disclosure: See Policy 4.4.2.*
4) *Noise Level Reduction: See Policy 4.1.6.*
5) *Airspace Review: See Policy 4.3.3.*

Riverside County Hazardous Waste Management Plan

The Riverside County Hazardous Waste Management Plan (CHWMP) uses a framework of 24 existing and recommended programs. The CHWMP serves as the County's primary planning document for the management of hazardous substances. Although the title refers only to hazardous waste, the CHWMP is a comprehensive document containing all of the County programs for managing both hazardous materials and waste.

Southern California Hazardous Waste Management Authority

The SCHWMA was formed through a joint powers agreement between Santa Barbara, Ventura, San Bernardino, Orange, San Diego, Imperial, and Riverside Counties and the Cities of Los Angeles and San Diego. Each SCHWMA county has agreed to take responsibility for the treatment and disposal of hazardous waste in an amount that is at least equal to the amount generated within that county. This responsibility can be met by siting hazardous waste management facilities (transfer, treatment, and/or repository) capable of processing an amount of waste equal to or larger than the amount generated within the county, or by creating intergovernmental agreements between counties to provide compensation to a county for taking another county's waste, or through a combination of both facility siting and intergovernmental agreements. When and where a facility is to be sited is primarily a function of the private market. However, once an application to site a facility has been received, the county will review the requested facility and its location against a set of established siting criteria to ensure that the location is appropriate, and may deny the application based on the findings of this review. The County of Riverside does not presently have any of these facilities within its jurisdiction and therefore must rely on intergovernmental agreements to fulfill its fair share responsibility to SCHWMA.

Riverside County Department of Environmental Health

The Riverside County Department of Environmental Health, under the Health and Safety Code, is responsible for oversight of activities pertaining to the generation, storage, handling, disposal, treatment, and recycling of hazardous waste. Ordinance No. 615.3 has been implemented for the purpose of monitoring establishments where hazardous waste is generated, stored, handled, disposed, treated, or recycled and to regulate the issuance of permits and the activities of establishments where hazardous waste is generated. The Department of Environmental Health also contains a Hazardous Materials Management Branch, which is the CUPA for the entire County, and oversees all hazardous materials and hazardous waste-related activities.

Riverside County Brush Clearance

County of Riverside Ordinance No. 695 provides brush clearance requirements on unincorporated County land that are designed to reduce risks from wildland fires. The code requires that every owner, occupant, and person in control of any unimproved parcel of land clear vegetation on a 100-foot-wide strip of land at the boundary of the parcel adjacent to a roadway and/or a 100-foot-wide strip of land around any structures located on an adjacent improved parcel. The Riverside County Fire Department can require different clearance distances based upon a visual inspection of the parcel and factors including local weather conditions, fuel types, topography, and the environment where the property or adjoining structures are located.

City of Blythe General Plan 2025

Policies related to hazards included with the City of Blythe General Plan 2025 are provided below.

Safety Element

Policy 18: *Identify facilities utilizing, storing, or transporting hazardous materials in Blythe.*

Policy 19: *Ensure that new facilities involved with handling hazardous materials are located at a safe distance from other land uses that may be adversely affected by this activity.*

Policy 20: *Apply, as appropriate, provisions of the Riverside County Hazardous Waste Management Plan to decisions involving hazardous materials in Blythe.*

Policy 21: *Coordinate enforcement of the Hazardous Materials Disclosure Law with the City of Blythe Fire Department.*

Policy 23: *Minimize the impact of transportation related accidents involving hazardous materials.*

Policy 25: *Ensure that hazardous obstructions to the navigable airspace do not occur.*

Policy 27: *Minimize the risks associated with visual hazards including distracting lights, glare and sources of smoke.*

EMF Recommendations and Standards

Several entities have developed guidelines for EMF exposure, including individual states, the FCC, the Institute of Electrical and Electronics Engineers (IEEE), and the American Conference of Governmental Industrial Hygienists (ACGIH). Neither the national nor state governments have regulations limiting EMF exposure from power transmission lines. However, the California EMF Program has been established by the California Public Utilities Commission's (CPUC) Decision 93-11-013. The program is a research, education, and technical assistance program concerned with the possible health effects of EMF from power lines, appliances, and other uses of electricity. The California EMF Program's goal is to find a rational and fair approach to dealing with the potential risks, if any, of exposure to EMF (CaEMF 2012).

The IEEE has developed guidelines for EMF exposure. The IEEE levels are recommendations only, not regulations. The IEEE Standard C95.6 recommends limits on exposures to magnetic fields, electric fields, and contact currents in the frequency range of 0 to 3000 hertz (Hz). Exposure limits are derived for both controlled (occupational, live-line workers) and uncontrolled (publicly accessible) environments, for uniform and non-uniform fields, and for whole-body and extremity exposures. The FCC's standards are mandatory for occupational exposure to EMF for FCC licensees and grantees and only cover the frequency range from 300 kHz to 100 GHz (FCC 1999). The ACGIH provides that occupational exposures should not exceed 10 Gauss (G) (10,000 mG). The ACGIH guideline level is intended to prevent effects, such as induced currents in cells or nerve stimulation. However, the ACGIH guidelines are for occupational exposure, not general public exposure (AIHA 2002).

The United States does not have any regulations on EMF exposure; however, the European Union has developed EMF guidelines based on recommendations by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP has made a series of recommendations for limiting EMF exposure to humans based on the epidemiological data available from verifiable research studies (ICNIRP 1998). Based on the ICNIRP's work, the EU has adopted these same standards for EMF exposure (Council Recommendation 1999). While the guidelines are voluntary, the levels are designed to prevent undue health risks associated with EMF exposure.

TABLE 3.3.8-3 ICNIRP EMF LIMITS

FREQUENCY	ELECTRIC FIELD STRENGTH (V/M)	MAGNETIC FIELD (µT)
Occupational: 60 Hz	10,000	1
Public: 60 Hz	5,000	200

Source: ICNIRP 1998.
V/M = volts per meter, Hz = frequency in Hertz
µT= microtesla

3.2.9 Hydrology and Water Quality

The purpose of this section is to inventory and describe existing water resources in the vicinity of the proposed Project and Alternatives. In addition to describing the existing conditions, this analysis presents the regulatory framework and examines the affected environment within the Project footprint and vicinity, where appropriate. This section utilizes information from the *Water Supply Assessment for the Blythe Mesa Solar Project,* prepared by POWER Engineers, Inc. 2013 (provided in Appendix G of this Draft EIR/EA), as well as the *Blythe Mesa CUP 03685 Wash Feature Summary of Findings*, prepared by POWER Engineers, Inc. 2013 (provided in Appendix H of this Draft EIR/EA).

Existing Setting

The proposed Project and Alternatives are located in the Colorado Desert, which is part of the greater Colorado Desert Geomorphic Province. The physiography of the area consists of mountains, alluvial fans, alluvial fan remnants, and alluvial valleys, including active drainages and fluvial terraces, and internally drained basins (USDA 2006). Elevations in the Project vicinity range from 260 feet near the Colorado River to 2,054 feet on McCoy Peak. The Project area is characterized by rural development intermixed with agricultural and undeveloped lands. Extensive areas to the north and east are preserved open space, set aside for recreation, wildlife, and protected species.

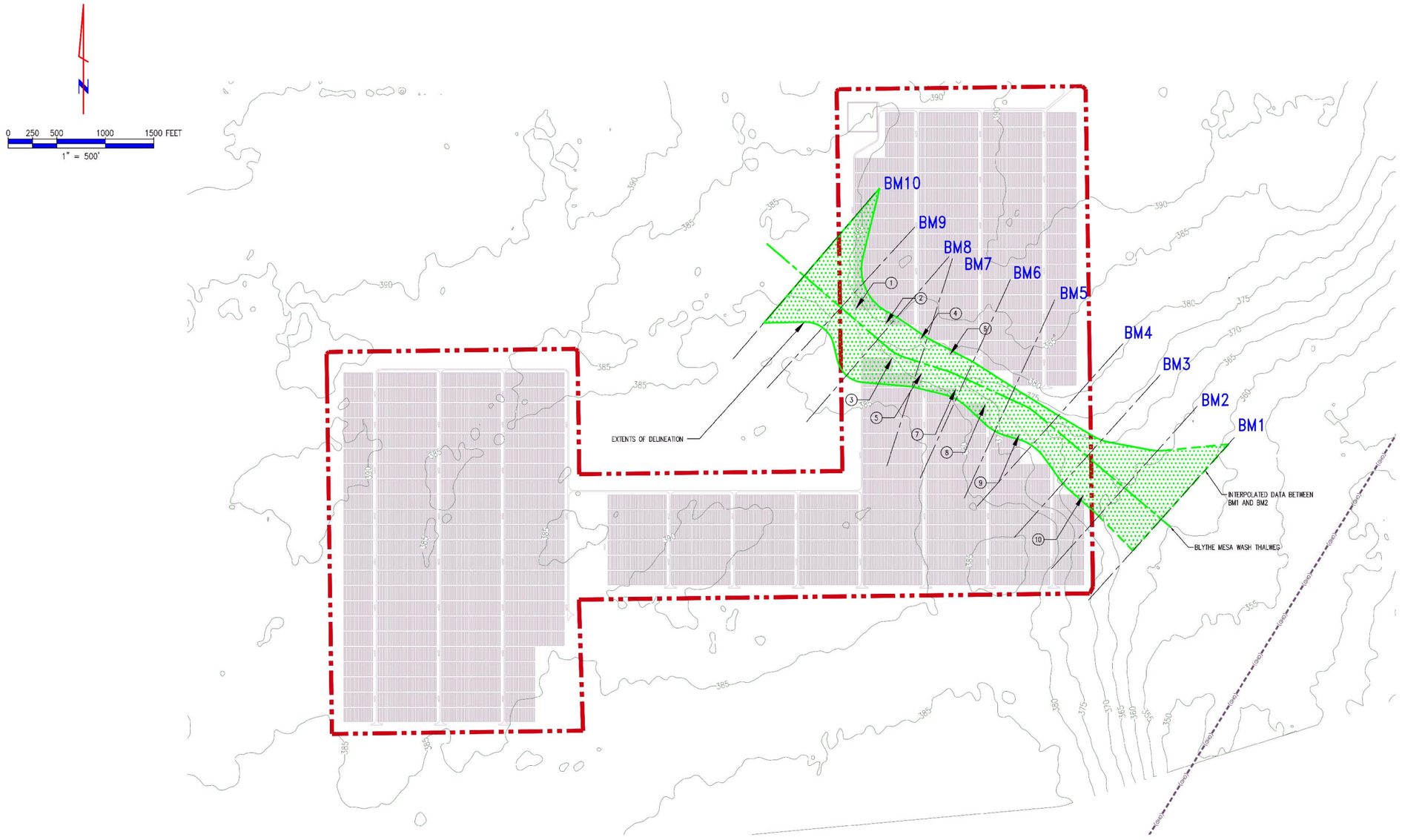
The Colorado Desert has the lowest annual precipitation and highest temperatures in North America. In the Blythe area, temperatures range from average summer highs of 108.5°F (42.5°C) to average winter highs of 67.6°F (19.8°C). Precipitation occurs in the form of rainfall; the average annual rainfall for Blythe is 3.83 inches, primarily from late summer thunderstorms moving north from Mexico (Colorado RWQCB 2006).

Surface Waters

The Project is located in an undefined Hydrologic Sub-Area (HSA 715.40) of the Palo Verde Hydrologic Area (Palo Verde Mesa) within the Colorado (River) Hydrologic Unit in eastern Riverside County, California. The Colorado River is the largest river in the region, with a watershed encompassing approximately 244,000 square miles in portions of seven states (Wyoming, Utah, Colorado, Nevada, New Mexico, Arizona, and California), and provides water to over 25 million people and approximately 3.5 million acres of agricultural lands in the United States and Mexico. In addition, hydroelectric generation facilities in the Colorado River Basin provide approximately 12 billion kilowatt hours of energy annually (MSCP 2004).

Due to the low precipitation rates, surface water is generally minimal on the Palo Verde Mesa, limited to ephemeral and intermittent drainages with the exception of the Colorado River. [4] The Project would be located near the eastern edge of the Palo Verde Mesa, above the Palo Verde Valley and west of the 100-year floodplain of the Colorado River. Lands in this area that are not utilized for agriculture are crossed by a number of small ephemeral drainages, generally flowing from northwest to southeast toward the Colorado River, either dissipating prior to reaching the edge of the Mesa or flowing into the valley. An ephemeral drainage bisects the southern portion of the proposed Project and transmission line. This

[4] An ephemeral drainage has flowing water only during, and for a short duration after, precipitation events in a typical year whereas an intermittent drainage has regular flows during certain times of the year.



POINT	WATER DEPTH (FT)	VELOCITY (FT/S)	SCOUR (IN)
1	2.66	7.0	16
2	1.62	2.2	9
3	2.77	4.6	14
4	0.49	1.6	7
5	2.64	6.1	15
6	0.42	3.2	9
7	1.83	3.4	11
8	2.65	6.2	15
9	0.91	2.0	8
10	0.41	1.4	6

FIGURE 3.2.9-1
FLOODPLAIN DELINEATION

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: POWER Engineers, 2013.

THIS PAGE INTENTIONALLY LEFT BLANK

drainage originates in the McCoy Mountains northwest of the proposed Project, and flows southeast, partially contained by a berm. Approximately one mile south of highway I-10 the dike ends and the drainage continues as a broad, shallow channel beneath the proposed gen-tie line and through the proposed solar array field. During larger storm events flow from this ephemeral drainage eventually connects with the Colorado River, as described below.

Precipitation in the form of sheet flow typically flows overland toward the edge of the Mesa. In areas used for agriculture, flow may be diverted by earthen berms or irrigation ditches. Sheet flow eventually reaches the edge of the Mesa and flows into the canal and drain system of the Palo Verde Valley south of 10th Street. This system eventually returns water to the Colorado River via the Outfall Drain, located approximately 18 miles south of the Project area. Water supplies for the Project area comes from the Colorado River, which lies eight miles east and is the primary source of irrigation water for the existing agriculture in the area. In 2010, the PVID reported that the Project area used approximately 12,000 ac-ft/yr of surface water to irrigate the agricultural fields.

Floodplains

The Palo Verde Mesa is located above the 100-year floodplain of the Colorado River (FEMA 2013). Within the Project area, a 100-year floodplain is associated with the ephemeral drainage discussed above. This floodplain was delineated based on site topography and predicted flow elevations and illustrated in Figure 3.2.9-1. The majority of this floodplain lies within the setback for this ephemeral drainage; however, due to the relatively flat topography of the area and lack of defined bed and bank, small portions of this floodplain may lie outside the limits of the setback (POWER 2013b).

Jurisdictional Waters

During large storm events, many of the ephemeral streams and washes in the Project area flow across the mesa and into the canal and drain system of the Palo Verde Valley; from this system, stormwater eventually flows into the Colorado River via the Outfall Drain, as described previously. As the Colorado River is a Traditional Navigable Water of the United States, tributaries that drain into it are likewise considered Waters of the United States as defined in Section 404 CWA. Stormwater within the ephemeral channel that crosses the southern portion of the Project eventually reaches the canal and drain system as sheet flow (see Figure 3.2.9-2). The USACE delineated the potential Ordinary High Water Mark (OHWM) of this drainage within Project limits, as illustrated in Figure 3.2.9-3. The potential OHWM lies within the Project area setback with exception of one gen-tie line pole.

Water Quality

The Project area lies within the East Colorado River Basin Planning Area of the Water Quality Control Plan (Basin Plan) for the Colorado River Regional Water Quality Control Board (RWQCB). This Basin Plan describes surface and groundwater quality objectives for the Planning Area; the objectives were established to protect the existing and potential beneficial uses of surface and groundwater in the region. Beneficial are reasonable uses of a water body as specified in the Basin Plan, and may include existing, proposed, or intermittent uses. Beneficial uses for water bodies in the Project area (solar facility site and gen-tie line) are listed in Table 3.2.9-1, and include the following: Municipal and Domestic Supply (MUN), Agricultural Supply (AGR), Aquaculture (AQUA), Industrial Service Supply (IND), Ground Water Recharge (GWR), Water Contact Recreation (REC-1), Non-Contact Water Recreation (REC-2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), Hydropower Generation (POW), and Preservation of Rare, Threatened, or Endangered Species (RARE).

Water quality is the physical, chemical, and biological characteristics of water, when assessed according to standards related to ecosystem health, the safety of drinking water, and the safety of human contact. The State of California Water Resources Control Board (SWRCB) and the nine RWQCBs are responsible for setting policies and developing regulations for the implementation of water quality control programs mandated by federal and State water quality statutes and regulations. Basin Plans, developed and

implemented by the RWQCBs, consider regional beneficial uses, water quality characteristics, and water quality problems.

TABLE 3.2.9-1 BENEFICIAL USES OF SURFACE WATERS IN THE PROJECT AREA*

	MUN	AGR	AQUA	IND	GWR	REC-1	REC-2	WARM	WILD	POW	RARE
Colorado River and associated lakes and reservoirs	E	E	E	E	E	E	E	E	E	E	E
Palo Verde Valley Canals	P	E	E		E	E	E	E	E		
Palo Verde Drains						E	E	E	E		
Palo Verde Lagoon and Outfall drain						E	E	E	E		E
Washes (Ephemeral Streams)					I		I	C	I		

*Adapted from the Water Quality Control Plan for the Colorado River Basin – Region 7 (RWQCB 2006).
E – Existing use
P – Potential Use
I – Intermittent Use
C – Conditional use, to be determined on a case-by-case basis

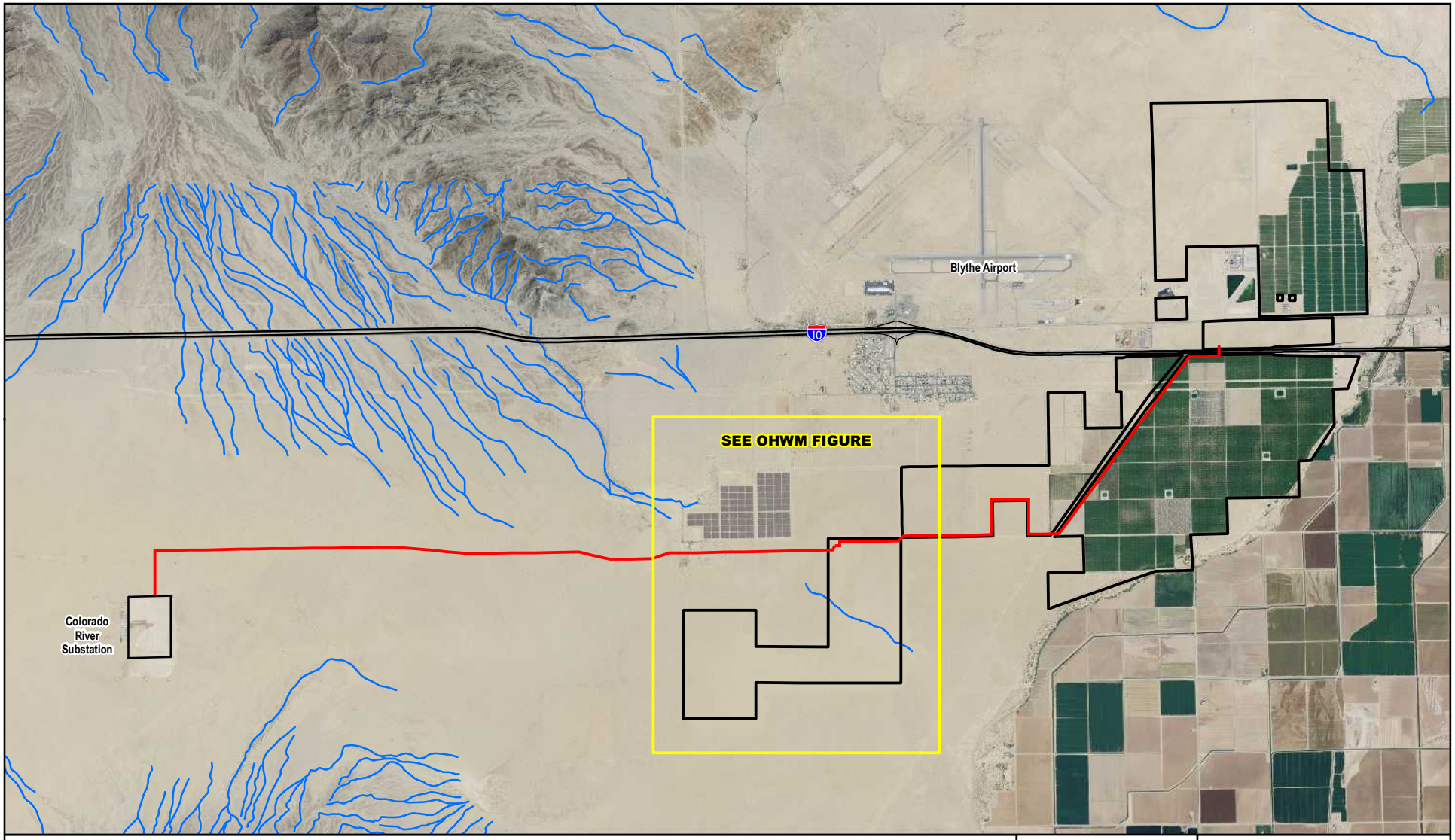
Under Section 303(d) of the CWA, states, territories, and authorized Tribes are required to develop a list of surface waters with impaired water quality. These waters on the list do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for surface waters on the lists and develop action plans, called Total Maximum Daily Loads (TMDLs), to improve water quality.

On June 28, 2007, the EPA gave final approval to California's 2006 Section 303(d) List of Water Quality Limited Segments. Section 303(d)-listed or impaired streams and completed TMDL requirements are identified as part of the resource inventory of the Project area. Impaired streams are considered sensitive resources in the routing of transmission lines and are protected from water quality impacts.

Within the Project region, one water body is listed as impaired on the Section 303(d) list. The Palo Verde Outfall Drain and Lagoon are listed as impaired by dichlorodiphenyltrichloroethane (DDT) and pathogens, both from unknown sources.

Groundwater

The Project area is located within the Palo Verde Mesa Groundwater Basin (Groundwater Basin Number 7-39), which has a drainage area of approximately 353 square miles. Groundwater in this basin is located in alluvial deposits with no known barriers that inhibit groundwater flow. Groundwater in this basin is likely recharged from percolation of runoff from the surrounding mountains; percolation of precipitation to the valley floor and subsurface inflow from the adjacent Chuckwalla Valley Groundwater Basin (Groundwater Basin Number 7-5 and adjacent irrigation canals and drains may be additional sources of recharge). According to groundwater level data provided by the California Department of Water Resources (2011), depth-to-groundwater near the Project area ranges from approximately 148 feet below the surface, just north of the Blythe Airport, to approximately 83 feet below the surface near the intersection of Hobson Way and Keim Boulevard. It should be noted that groundwater levels are influenced by seasonal variations, variations in ground surface topography, precipitation, irrigation practices, soil/rock types, groundwater pumping, and other factors and are subject to fluctuations. The storage capacity of the Palo Verde Mesa Groundwater Basin is estimated to be approximately 6,840,000 acre-feet (AF) (DWR 1975). Groundwater quality in this basin is calcium-sodium chloride or calcium-sodium sulfate in character, and is impaired by arsenic, selenium, fluoride, chloride, boron, sulfate, and total dissolved solids (TDS) content (DWR 2004).



Legend

- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- Jurisdictional Waters

N

0 1

Miles

1 in=1 miles



FIGURE 3.2.9-2
JURISDICTIONAL WATERS

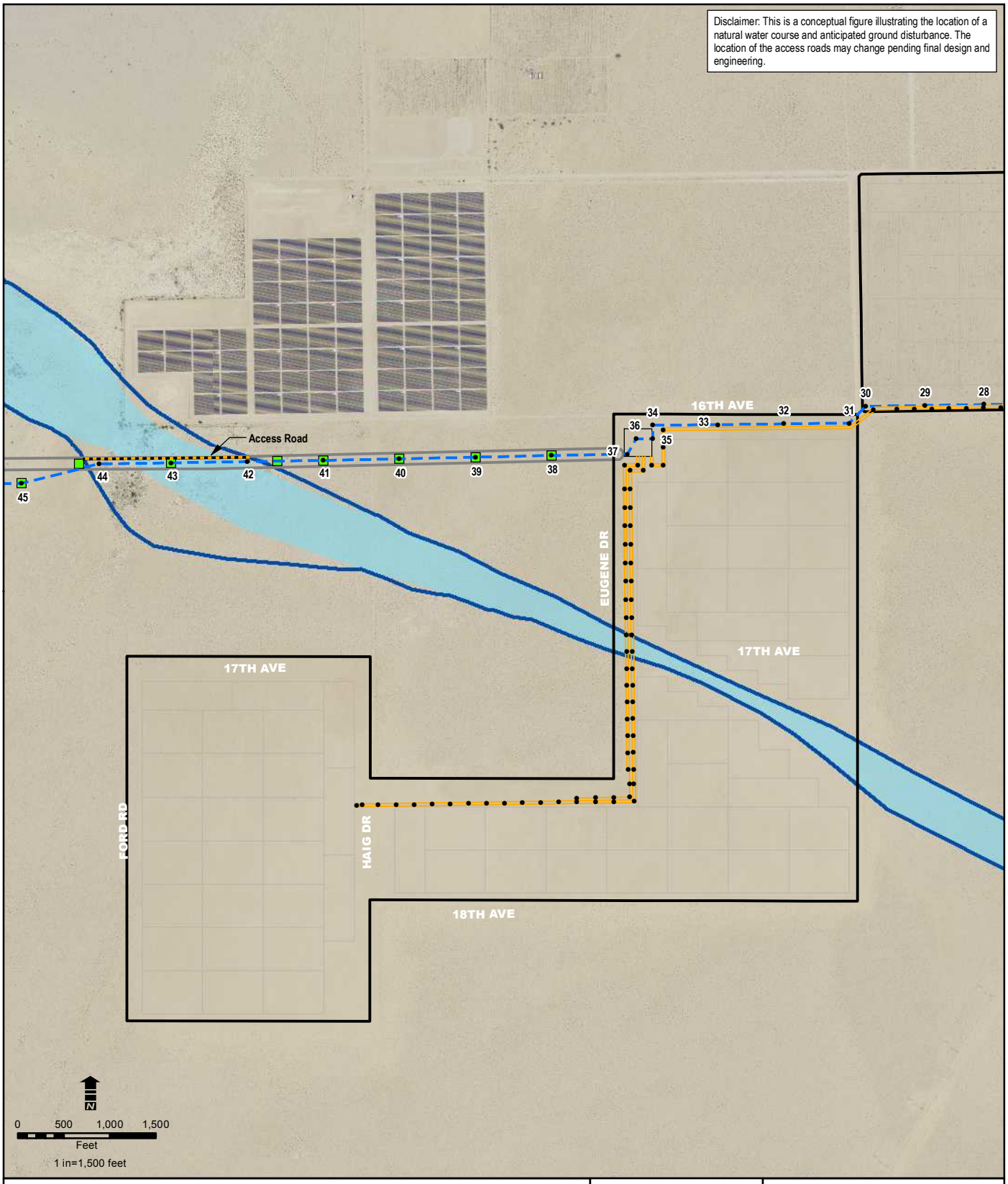
BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: USDA NAIP Imagery, 2012.

AR062494

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Proposed Project

- Blythe Mesa Solar Project Boundary
- Proposed 230kV Transmission Line
- Proposed 35.4 kV Transmission Line
- Transmission Line 125-foot Corridor
- Proposed Tower Location
- Temporary Conventional Construction Disturbance for Transmission Line Poles
- Conceptual Access Road (12 ft wide)

Hydrologic Feature

- Ephemeral Channel
- Estimated Ordinary High Water Mark (per June 6 2013 Corps field visit)



FIGURE 3.2.9-3
ORDINARY HIGH WATER MARK WITHIN PROJECT LIMITS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

THIS PAGE INTENTIONALLY LEFT BLANK

A water budget for the Palo Verde Mesa Groundwater Basin estimates an inflow of approximately 817 AF per year (ac-ft/yr), based on inflow estimates from the surrounding groundwater basins irrigation return flow, infiltration from precipitation events, and infiltration from canal seepage. Recharge by underflow from Chuckwalla Valley is estimated to be 400 af/yr (DWR 2004).

Regulatory Setting

Federal

Section 404 CWA. Waters of the United States including wetlands are subject to USACE jurisdiction under Section 404 of the CWA. A Section 404 permit is required for the discharge of dredged or fill material into Waters of the United States. The Los Angeles District of the USACE would provide review and permitting services for this Project. Field reconnaissance surveys, analyses of NWI and watershed data have determined the presence of one jurisdictional water of the United States within the Project area, as discussed previously

Section 401 CWA. Pursuant to Section 401 of the CWA, a water quality certification (Certification) is required from the Colorado River RWQCB if a federal agency proposes to license or permit a discharge into waters of the United States, to ensure such discharge does not violate state water quality standards. The is generally understood to apply to, but is not limited to, Section 404 permits. The Colorado River RWQCB certifies that discharges to Waters of the United States or Waters of the State complies with State water quality standards and ensures that there is no net loss of wetlands through impact avoidance, minimization, and mitigation. Most Certifications are issued in connection with USACE CWA Section 404 permits; however, the RWQCB regulates isolated waters under Section 401(c) of the CWA as Waters of the State regardless of USCAE jurisdiction.

Section 303(d) CWA. Section 303(d) unites the water quality management strategies of the CWA. Section 303(d) requires that states make a list of waters that exceed the minimum level of pollutants put in place by the CWA. For waters on this list, the states must develop TMDLs that account for all sources of the pollutants that caused the water to be listed. The TMDLs must account for contributions from both point sources and nonpoint sources, as defined by Section 502 of the CWA. In California, the SWRCB has interpreted State law (see Porter-Cologne Water Quality Control Act below) to require that implementation of TMDLs be addressed when incorporated into Basin Plans.

State

Construction Stormwater Program. The SWRCB and the nine RWQCBs implement water quality regulations under the federal CWA and the California Porter-Cologne Water Quality Control Act. Existing water quality regulations require compliance with the NPDES for discharges of stormwater runoff associated with construction activity.

Dischargers are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction and Land Disturbance Activities (Construction General Permit, 2009-0009-DWQ). Construction activity subject to this permit includes clearing, grading, and disturbances to the ground, such as stockpiling or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP should contain a site map(s) that shows the construction site perimeter, existing and proposed structures, lots, roadways, stormwater collection and discharge points, general topography both before and after construction, and drainage patterns across the Project. The SWPPP must list Best Management Practices (BMPs) the discharger will use to protect stormwater runoff and the placement of those BMPs. Additionally, the SWPPP must contain a monitoring program for visible and non-visible pollutants and changes in water quality, such as substantial alteration in pH (a measure of acid and base properties).

Lake or Streambed Alteration Agreement. Sections 1601-1603 of the CDFW Fish and Game Code protect the natural flow, bed, channel, and bank of any river, stream, or lake designated by the CDFW, in which there is at any time an existing fish or wildlife resource, or from which these resources derive benefit. General Project plans must be submitted to the CDFW in sufficient detail to indicate the nature of a project for construction, if the project would:

- Divert, obstruct, or change a streambed, bank, or riparian zone.
- Use material from the streambeds.
- Result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into a stream.

The Inland Deserts Region of the CDFW serves Riverside County.

Porter-Cologne Water Quality Control Act. The Porter-Cologne Water Quality Control Act defines "water quality objectives" as the allowable "limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area." Thus, water quality objectives are intended to protect the public health and welfare, and to maintain or enhance water quality in relation to the existing and/or potential beneficial uses of the water. Water quality objectives apply to both Waters of the United States and Waters of the State.

Basin Plans. The SWRCB requires individual RWQCBs to develop Basin Plans (water quality control plans) designed to preserve and enhance water quality and protect the beneficial uses of all Regional waters. Specifically, Basin Plans designate beneficial uses for surface waters and groundwater, set narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the State's antidegradation policy, and describe implementation programs to protect all waters in the Regions. In addition, Basin Plans incorporate by reference all applicable State and Regional Board plans and policies, and other pertinent water quality policies and regulations. The Project is under the jurisdiction of the Basin Plan of the Colorado River Regional Water Quality Control Board.

Regional and Local

City of Blythe General Plan

Portions of the Project fall within the jurisdiction of the City of Blythe. The Open Space and Conservation Element of the City of Blythe General Plan 2025 (2007) sets forth guiding policies for the preservation of water quality within the zoning area of the City.

Open Space and Conservation Element

Policy 20: *Enhance the quality of surface water resources of the Planning Area and prevent their contamination.*

Policy 21: *Comply with the Regional Water Quality Control Board's regulations and standards to maintain and improve groundwater quality in the Planning Area.*

Policy 22: *Where feasible, given flood control requirements, maintain the natural condition of waterways and flood plains and protect watersheds to ensure adequate groundwater recharge and water quality.*

3.2.10 Land Use and Planning

This section describes the environmental setting and regulatory framework in regards to land use and planning for the proposed Project and Alternatives. Applicable local land use plans include the General Plans and Zoning Ordinances/Codes for Riverside County and the City of Blythe and the Riverside County Airport Land Use Compatibility Plan. Approximately 3.8 miles of the 230 kV gen-tie line would

traverse public lands managed by the BLM. The gen-tie line is located within or adjacent to CDCA Utility Corridor K and Section 368 Federal Energy Corridor 30-52, which overlap, and is within the Riverside East (SEZ). BLM-administered lands are not zoned, and may be encumbered by easements, ROWs, mining claims, and permits. Information regarding BLM ROW authorizations and easements were obtained from the Land & Mineral Legacy Rehost 2000 System of automated records (LR2000). Applicable federal land use plans include, the CDCA Plan (BLM 1980), as amended, and the Northern and Eastern Colorado Desert Coordinated Management Plan. The CDCA Plan was amended by the Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern States (Western Solar Plan) (2012) to identify all SEZ lands within the CDCA as sites associated with power generation or transmission (at p. 36). The Project area is also encompassed within the Blythe Airport Land Use Compatibility Plan. Please see Section 3.2.8, Hazards and Hazardous Materials above for a discussion of compatibility with the ALUCP.

Environmental Setting

Regional Setting

The Project area is located in the Palo Verde Valley along the western edge of the Colorado River in the Colorado Desert. Palo Verde Valley consists of the valley floor and the Palo Verde Mesa. The proposed Project and Alternatives are on Palo Verde Mesa. The topography on the Palo Verde Mesa is relatively flat and slopes toward the southeast. Elevations range from 260 to 400 feet amsl. The Project area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert. Development in the surrounding area consists of agricultural fields and groves, residences, the Blythe Airport, the Blythe Generating Plant, electrical transmission lines, and commercial businesses. The Project area also includes undeveloped open desert that is managed by the BLM (refer to Figure 1-1, in Chapter 1). The Project area would be located in eastern Riverside County, approximately five miles west of the Colorado River and 40 miles east of Desert Center (refer to Figure 1-2, in Chapter 1). The Project would be located north and south of I-10 and west of State Route 89 and Highway 95.

On-Site Land Uses

The Project is located within unincorporated Riverside County, City of Blythe Sphere of Influence, the City of Blythe, and on BLM-managed lands. The proposed 485 MW PV electrical generating facility and 8.4-mile gen-tie line would occupy a total of 3,660 acres. The fenced-in solar PV electric generation facility would occupy 3,587 acres on privately owned land—3,253 acres under the jurisdiction of the County and 334 acres under the jurisdiction of the City of Blythe. The solar facility would be located on the Palo Verde Mesa. Within the solar facility site, the 230 kV gen-tie line would connect all three proposed on-site substations, extending a distance of approximately 3.6 miles on-site. From the southernmost on-site substation to the Colorado River Substation, the gen-tie line would extend another 4.8 miles within a 125-foot-wide ROW (or 73 acres), traversing 3.8 miles of BLM-managed lands (58 acres) and one mile of private land (15 acres). The gen-tie line situated on BLM land would traverse open access roads (i.e., access by motorized vehicles is allowed).

Agriculture is the predominant land use on-site. The proposed solar facility includes both active and previously farmed agricultural lands. Active agricultural uses include a citrus grove, wheat, and alfalfa fields. Jojoba was previously grown for commercial purposes. Two existing occupied housing units are located on the proposed solar facility. The Project would be situated on both the north and south sides of I-10, a major regional transportation corridor extending east-west through the area. The site is located generally west of Neighbors Boulevard, north of 20th Avenue, and south of 10th Avenue. The zoning for the Project area is illustrated in Figure 1-3 in Chapter 1.

Portions of the Project located within the Palo Verde Valley Area Plan are currently zoned as follows:

- Controlled Development Areas (W-2-10) (10-acre minimum)

- Controlled Development Areas (W-2-5)
- Light Agriculture (A-1-10)
- Heavy Agriculture (A-2-10)

Portions of the Project located within the City of Blythe are currently zoned:

- Agriculture (A)
- Service Industrial (I-S)

Surrounding Land Uses

Land uses surrounding the Project consist primarily of open space and agricultural land to the east and south. Other uses in the area include the unincorporated community of Mesa Verde/Nicholls Warm Springs, Blythe Airport, Blythe Energy Center, NRG Solar – Blythe Solar Project, Blythe Substation, electrical transmission lines, ancillary agricultural facilities, and dirt roads.

The residential development known as Mesa Verde (Nicholls Warm Springs) is located on the south side of I-10. This community is mainly composed of single-family dwellings and mobile homes. There are also a small number of dispersed farm and rural residences near the solar facility, mostly located to the south and east. The nearest residence is located approximately 260 feet east of the proposed solar facility.

The Blythe Airport is located one mile to the west, and highway-serving commercial uses are located at the interchange south of the Airport on the north side of I-10. The 3,094-acre airport is the largest in eastern Riverside County and serves primarily general aviation demand in the Blythe area. The Airport is classified in the National Plan of Integrated Airport Systems as a general aviation transport airport, designed to accommodate business jets, cargo type aircraft, light private planes, and flight school training activities. The Blythe Airport currently has two runways (8/26 and 17/35). The primary runway is Runway 8/26, which is oriented generally east-west. This public facility, owned by Riverside County and managed by the City of Blythe, is often used as a base for crop spraying operations, flight rental, and flight instruction. Aircraft operations average 69 per day (AirNav 2012). The Blythe Airport has been designated as a County redevelopment area with the intent to encourage expansion of airport facilities and commercial and industrial development at the airport.

Blythe Substation, situated east of the Blythe Airport, is owned by the Western Area Power Administration and connects five existing 161 kV transmission lines serving the region. The Blythe 230 kV gen-tie line also crosses the site in a northeasterly to southwesterly direction.

The area is also served by a spur line of the Arizona and California Railroad, I-10, and two State Highways. State Highway 95 runs north from Blythe to Needles and Las Vegas. State Highway 78 traverses the desert southwest from Blythe to the Imperial Valley.

Table 3.2.10-1 summarizes the existing land uses and general and area plan land use designations for the Project and surrounding area.

TABLE 3.2.10-1 SURROUNDING LAND USES, GENERAL PLAN, AND ZONING DESIGNATIONS

DIRECTION FROM PROJECT SOLAR FACILITY	EXISTING LAND USE	EXISTING LAND USE DESIGNATION
North	Vacant and Agriculture	**Riverside County**
		Agriculture
		Estate Density Residential
		Medium Density Residential
		Commercial Retail

DIRECTION FROM PROJECT SOLAR FACILITY	EXISTING LAND USE	EXISTING LAND USE DESIGNATION
		City of Blythe
		General Industrial (I-G)
East	Vacant and Agriculture	**Riverside County**
		Agriculture
		Estate Density Residential
		Commercial Tourist
		City of Blythe
		Agriculture (A)
		Service Industrial (I-S)
		General Commercial (C-G)
		Rural Residential (R-R)
		General Industrial (I-G)
South	Vacant and Agriculture	**Riverside County**
		Agriculture
		City of Blythe
		General Industrial (I-G)
West	Residential, Public Use, Vacant and Agriculture	**Riverside County**
		Agriculture
		Estate Density Residential
		Public Facilities
		City of Blythe
		General Industrial (I-G)

Source: General Plan and Zoning Map for City of Blythe (03/29/07).
Riverside County Land Information System (accessed 08/04/11).

The Project would be located on lands under the jurisdiction of the County of Riverside, the BLM, and the City of Blythe. A majority of the Project would be located within the County of Riverside and within the PVVAP. A portion of the solar array would be in the City of Blythe, and is subject to the City's General Plan. A portion of the Project's 230 kV gen-tie line would traverse BLM-managed lands. Refer to Figure 1-3 in Chapter 1, which illustrates the zoning for the County of Riverside and City of Blythe.

The adjacent and surrounding zonings within the PVVAP area consist of the following:

- Rural Residential (R-R)
- Light Agriculture (A-1-2 1/2 and A-1-10)
- Controlled Development Areas (W-2-10 and W-2-2 1/2)
- Residential Agricultural (R-A-5)
- Manufacturing-Service Commercial (M-SC)
- Controlled Development with Mobile Homes (W-2-M)
- Tourist Commercial (C-T)
- Scenic Highway Commercial (C-P-S)
- Industrial Park (I-P)
- Manufacturing-Heavy (M-H)
- Mobile Home Subdivision-Rural (R-T-R)
- Heavy Agriculture (A-2-10 and A-2-2 1/2)
- Natural Assets (N-A)

The adjacent and surrounding City of Blythe zoning consists of the following:

- Agriculture (A)
- Rural Residential (R-R)
- General Commercial (C-G)

Figure 1-4 in Chapter 1 illustrates the portion of the Project's gen-tie line that would traverse BLM-managed lands within the CDCA. These lands are designated Multiple-Use Class M (Moderate) which allows energy and utility development (BLM 1980). Within the CDCA, the Project's gen-tie line would be located within BLM's Utility Corridor K, which is also designated as Section 368 Federal Energy Corridor 30-52. Where it crosses public land, the gen-tie would be within the Riverside East SEZ. A majority of the private land portion of the Project would overlap BLM's Utility Corridor J.

Numerous authorized and proposed BLM ROWs are located within and adjacent to BLM Utility Corridor J and Utility Corridor K. Table 3.2.10-2 presents information on the existing and proposed ROWs, including the BLM ROW number, ROW width, total acreage, owner, and project type, which was obtained from BLM's LR2000. The table is organized based on location of the project within (1) Utility Corridor J or (2) Utility Corridor K and Corridor 30-52, which overlap, or (3) both Utility Corridors J and K and Corridor 30-52. Most projects listed in the table are existing ROW authorizations. A few of the proposed solar projects and transmission lines in Table 3.2.10-1, which are identified in bold font, are also listed in Table 4.1-1.

Regulatory Framework

Federal

Federal Land Policy and Management Act, 1976 as Amended

The United States Congress passed the FLPMA in 1976. Title V, "Rights-of-Way," of the FLPMA establishes public land policy and guidelines for administration, provides for management, protection, development, and enhancement of public lands, and provides the BLM authorization to grant ROW. Authorization of systems for generation, transmission, and distribution of electric energy is addressed in Section 501(4) of Title V. In addition, Section 503 specifically addresses "Right of Way Corridors" and requires common ROWs "to the extent practical." FLPMA, Title V, Section 501(a)(6) states, "[t]he Secretary, with respect to the public lands (including public lands, as defined in section 103(e) of this Act, which are reserved from entry pursuant to section 24 of the Federal Power Act (16 U.S.C. § 818)) [P.L. 102-486, 1992] and, the Secretary of Agriculture, with respect to lands within the National Forest System (except in each case land designated as wilderness), are authorized to grant, issue, or renew rights-of-way over, upon, under, or through such lands for roads, trails, highways, railroads, canals, tunnels, tramways, airways, livestock driveways, or other means of transportation except where such facilities are constructed and maintained in connection with commercial recreation facilities on lands in the National Forest System."

The Applicant is requesting a grant of ROW approval from the BLM (Palm Springs-South Coast Field Office) for the portion of the gen-tie line on land under the jurisdiction of the BLM.

See also Sections 3.2.1, *Aesthetics, Visual Resources, and Reflection*, and 3.2.5, *Cultural Resources*.

TABLE 3.2.10-2 EXISTING AND PROPOSED ROWS WITHIN UTILITY CORRIDORS J AND K

BLM ROW NUMBER	ENTIRE ROW (1) DIMENSIONS, ACRES	OWNER	PROJECT/LAND USE TYPE	PROJECT NAME
Utility Corridor J				
CACA 004163	Unknown	SCE	500-kV Transmission Line	**NA**
CACA 08974	50 ft wide x 214,398 ft (246.10 acres)	Imperial Irrigation District	161-kV Transmission Line	**Niland-Blythe**
CACA 021597	10 ft wide x 2,609 ft (0.6)	Verizon California Inc.	Telecomm Line	NA
CACA 042662	Unknown	North Baja Pipeline LLC	30" Gas Pipeline	NA
CACA 046331	95 ft wide x 44.6 miles (513 acres)	FPL Energy Cabazon Wind LLC	Transmission Line	NA
CARI 000214	25 ft wide x 18,342 ft long (10.53) acres)	SCE	12-kV Transmission Line	Midland Extension
CARI 000489	Two 100-foot x 100-foot sites	USGS	Observation Wells	NA
CARI 0003583	50 ft wide x 1,305 ft long (1.5 acres)	Eddie Basha	Water Pipelines	NA
Utility Corridor K and Corridor 30-52				
CACA 013506	2.2 acres	FAA	Road & Comm. Site – Federal Facility	McCoy Mtn.
CACA 016385	40 ft wide x 48.5 miles (235.15 acres)	AT&T	Telecomm Line	NA
CACA 016386	40 ft wide x 49.5 miles (237 acres)	AT&T	Telecomm Line	NA
CACA 018888	15 ft wide x 48 miles (87.27 acres)	Sprint Communications	Telecomm Line	NA
CACA 020252	10 ft wide x 41,580 ft (9.54 acres)	Verizon California	Underground Telecomm Line	NA
CACA 024660	50 ft wide x 68,805 ft (78.97 acres)	Southern CA Gas Co.	36" Natural Gas Pipeline	NA
CACA 047307	6 ft wide x 1,189 ft (.016 acre)	SCE	Energy Transmission	NA
CACA 051475	640 acres	Palo Verde Solar I LLC	*Solar Energy; pending addition of land to CACA 048811.*	**Blythe**
CACA 051476	NA	Palo Verde Solar I LLC	*Non-Energy (Pipeline-Other) related pending development associated with CACA 048811.*	**Blythe**
CALA 0053795 or 0053821	400 ft wide x 2,640 ft long (24.24 acres)	CA Dept. of Public Works	Federal Highway Facility	NA
CACA 051477	NA	Palo Verde Solar I LLC	*Non-Energy (Telecomm) related pending development associated with CACA 048811*	Blythe
CALA 0110795	50 ft wide x 319,199 ft (366.4 acres)	Southern CA Gas Co.	Gas Pipeline	NA
CALA 0149780	100 ft wide x 181,875 ft (417.52 acres)	SCE	161-kV Transmission Line	**Blythe – Eagle Mountain**
CARI 004694	25 ft wide x unknown length (16.31 acres)	SCE	Transmission Line	NA
CARI 0001515	30 ft wide x unknown length (1 acre)	FAA	Airport Station	NA
CACA 044491	280 ft wide x 580,000 ft (3,729.2 acres)	Imperial Irrigation District	Transmission Line	NA

AR062505

BLM ROW NUMBER	ENTIRE ROW (1) DIMENSIONS, ACRES	OWNER	PROJECT/LAND USE TYPE	PROJECT NAME
CACA 049980	Unknown	FERC	Pumped Storage Project	Eagle Mountain
CACA 051967	12,269 acres	BrightSource Energy	*Pending 540 MW Power Tower Solar Energy Project*	**Sonoran West SEGS**
CACA 052347	0.79 acre	SCE	Unknown Non-Energy Facility	NA
CARI 0001009	70 acres	FAA	Air Navigation Site	FAA Vortec Site, PLO 3205
CACA 027244	0.3 acres	Mountain West Communications	Telecomm Site and Access Road	Lower McCoy Peak
Utility Corridors J and K and Corridor 30-52				
CALA 0054204 CALA 000136 CARI 0004946	1,153.524 acres	CA Dept. of Public Works	Federal Highway	Interstate 10
CACA 020241	20 ft wide x 10 miles (23.2 acres)	SCE	33-kV Transmission Line	**Chanslor**
CACA 048811	7,025 acres	Palo Verde Solar I LLC	968 MW Photovoltaic Solar Energy Facility	**Blythe**
CACA 052175	0.1 acre	Genscape Inc.	Transmission line monitoring sites	Palo Verde Mesa
CALA 0054204 CALA 000136	1,153.524 acres	CA Dept. of Public Works	Federal Highway	Interstate 10
CALA 0107395	50 ft wide x 39 miles (24.25.56 acres)	Southern CA Gas Co.	30" Gas Pipeline	NA
CAAZLA 0077757 CACA 052663	50-100 ft. wide x unknown length (651.92 acres)	Bureau of Reclamation/Western Area Power Administration	161-kV Transmission lines	**Parker-Blythe No. 1, Blythe-Knob, Gila/ Pilotknob**
CACA 015563	20 ft wide x 5,200 ft. (2.38 acres)	Riverside County Transportation	Water pipeline	NA
CACA 029236FD	512.7 acres	Nature Conservancy	FLPMA Sec. 206 Exchange land	Dos Palmas/Salt Creek

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

BLM ROW NUMBER	ENTIRE ROW (1) DIMENSIONS, ACRES	OWNER	PROJECT/LAND USE TYPE	PROJECT NAME
CALA 0080941	Unknown	Bureau of Reclamation	Power Transmission/Irrigation Project	NA
CACA 017905 CACA 053059	130 ft wide x 57.2 miles (~ 901 acres)	SCE	500-kV Transmission line	**Devers-Palo Verde II**
CACA 049397	7,236.5 acres	First Solar Development Inc.	*Pending 600 MW photovoltaic solar energy project*	**Desert Quartzite**
CACA 053138	4,396 acres	Brightsource Energy	*Pending 750 MW concentrating solar energy project*	**Rio Mesa SEGP**

Source: BLM 2012c; BLM 2012d.
Notes: (1) Projects may be partially or entirely located within a Utility Corridor.
The data in the table is based on existing BLM GIS spatial data that identified J and K corridors as being two miles wide.
The data in the table are based on data from LR 2000 that was last updated in July 2010, accessed April 2012.
(2) Project names that are in a bold font are also listed in Table 4.1-1, *Cumulative Projects*.
Key: CACA - Assigned California BLM ROW serial numbers for projects
FERC – Federal Energy Regulatory Commission
ft – feet
NA – Not Available
SCE – Southern California Edison

California Desert Conservation Area Plan, 1980 as Amended

Section 601 of the FLPMA required preparation of a long-range plan for the CDCA. The CDCA Plan was adopted in 1980 to provide for the use of public lands and resources of the CDCA in a manner that enhances, wherever possible, and does not diminish, on balance, the environmental, cultural, and aesthetic values of the Desert and its productivity. The CDCA Plan is a comprehensive, long-range plan covering 25 million acres. Approximately 12 million acres (about half) of this total are public lands administered by the BLM. These public lands are dispersed throughout the California Desert, which includes the Mojave Desert, the Sonoran Desert, and a small portion of the Great Basin Desert.

The CDCA Plan includes 12 elements: Cultural Resources; Native American; Wildlife; Vegetation; Wilderness; Wild Horse and Burro; Livestock Grazing; Recreation; Motorized Vehicle Access; Geology, Energy and Mineral Resources; Energy Production and Utility Corridors; and Land-Tenure Adjustment. Each of the elements contains goals and specific actions for the management, use, development, and protection of the resources and public lands within the CDCA, and is based on the concepts of multiple use, sustained yield, and maintenance of environmental quality. In addition, each element provides both a desert-wide perspective of the planning decisions for one major resource or issue of public concern as well as more specific interpretation of multiple-use class guidelines for a given resource and its associated activities.

Chapter 2 of the CDCA Plan identifies four multiple-use classes, which are used to describe a different type and level or degree of use that is permitted within that particular geographic area. The four multiple-use classes are defined below. The Energy Production and Utility Corridors Element of the CDCA Plan indicates that the width of joint-use corridors vary in width from two to five miles. There is an acceptable two-mile standard for separation of existing facilities. A two-mile width generally provides sufficient flexibility in selecting alternative routes for a ROW. Also, a two-mile width generally provides sufficient space for evaluating a number of possible alternate routes. However, the CDCA Plan goes on to explain that the five-mile standard is selected where there is no existing facility and, therefore, little or no engineering and environmental data to define a narrower corridor alignment. The CDCA Plan states that the five-mile standard is also selected in those cases where there are so many facilities or merging corridors that a five-mile width is needed to ensure sufficient space for system integrity and flexibility.

Multiple-Use Class C

Multiple-Use Class C has two purposes. First, it shows those areas that are being “preliminarily recommended” as suitable for wilderness designation by Congress. This process is fully explained in the Wilderness Element in the CDCA Plan. Second, it will be used in the future to show those areas formally designated as wilderness by Congress. The Class C guidelines are different from the guidelines for other classes, as they summarize the kinds of management likely to be used in these areas in the CDCA when and if they are formally designated wilderness by Congress.

Multiple-Use Class L

Multiple-Use Class L (Limited Use) protects sensitive, natural, scenic, ecological, and cultural resource values. Public lands designated as Class L are managed to provide for generally lower intensity, carefully controlled multiple use of resources, while ensuring that sensitive values are not significantly diminished.

Multiple-Use Class M

Multiple-Use Class M (Moderate Use) is based upon a controlled balance between higher intensity use and protection of public lands. This class provides for a wide variety of present and future uses such as mining, livestock grazing, recreation, energy, and utility development. Class M management is also designed to conserve desert resources and to mitigate damage to those resources that permitted uses may cause.

Multiple-Use Class I

Multiple-Use Class I is an "intensive use" class. Its purpose is to provide for concentrated use of lands and resources to meet human needs. Reasonable protection will be provided for sensitive natural and cultural values. Mitigation of impacts on resources and rehabilitation of impacted areas will occur insofar as possible. The proposed gen-tie line would be situated within Multiple-Use Class M under the BLM's CDCA Plan. Multiple-Use Class M allows energy and utility development (BLM 1980).

Utility Corridor K

The CDCA Plan identifies "planning" and "contingency" utility corridors on BLM-administered land. One of the broad goals of the BLM system of utility corridors is to implement the network of joint-use planning corridors to meet projected utility needs. Planning corridors, commonly referred to as "designated" corridors, are the locations where the BLM requests that applicants focus their attention in developing proposals for linear facilities on BLM-administered land. "Contingency" corridors are identified as having potential for use in the future and can become a "designated" corridor after completion of a land use plan amendment. Both types of corridors are identified in the CDCA Plan using an alphabetic designation.

The Project's gen-tie line would be located within BLM Designated Utility Corridor K, as identified in the CDCA Plan. The CDCA Plan designated utility Corridor K for "multi-modal use," allowing the following types of facilities:

- New electrical gen-tie towers and cables of 161 kV or above;
- all pipelines with diameters greater than 12 inches;
- coaxial cables for interstate communications; and
- major aqueducts or canals for interbasin transfers of water.

Utility Corridor K is also designated as Section 368 Federal Energy Corridor 30-52 in the Record of Decision for the West-Wide Energy Corridor Programmatic EIS (BLM 2009). Energy Corridor 30-52 is identified for "multi-modal use," which allows for electricity transmission and distribution facilities, as well as oil, gas, and hydrogen pipelines. Section 368 corridors are identified with a numeric designation and are often overlain on locally designated corridors, as is the case with the east-west Section 368 Corridor 30-52 overlying BLM Designated Utility Corridor K.

Northern and Eastern Colorado Desert Coordinated Management Plan

Refer to Section 3.2.4, *Biological Resources*, and Section 3.2.14*, Recreation*.

Wild Horse and Burro Act of 1971, as Amended

Refer to Section 3.2.4, *Biological Resources*.

California Desert Renewables Energy Conservation Plan

Refer to Section 3.2.4, *Biological Resources*.

Programmatic Environmental Impact Statement to Develop and Implement Agency-Specific Programs for Solar Energy Development

In response to direction from Congress under Title II, Section 211 of the Energy Policy Act of 2005, as well as Executive Order 13212, Actions to Expedite Energy-Related Projects, the BLM and the U.S. Department of Energy have prepared a Solar Programmatic EIS (PEIS) pursuant to NEPA and CEQ regulations. The Solar PEIS evaluates utility-scale solar energy development in a six-state area, including that portion of the CDCA that is open to solar energy development in accordance with the provisions of the CDCA Plan. The Solar PEIS planning effort has focused on identifying locations on BLM lands that are most suitable for solar energy development. Portions of the proposed 230 kV gen-tie line would be

within BLM-managed lands and the Riverside East SEZ; the proposed solar facility is located on private lands and therefore would not be within the Riverside East SEZ. The Final Solar PEIS was released on July 24, 2012. The BLM issued a Record of Decision on October 12, 2012, that amended the CDCA Plan to identify all SEZ lands within the CDCA as sites associated with power generation or transmission.

Local

Land use and planning decisions within and adjacent to the Project area are guided and regulated by the Riverside County General Plan, PVVAP, City of Blythe General Plan, Riverside County Zoning Ordinance, and City of Blythe Zoning Ordinance. The relevant plans contain goals, policies, and implementation measures that provide an overall foundation for establishing land use patterns. This section lists relevant goals, objectives, policies, and implementation measures related to the proposed land use. The Riverside County and City of Blythe Zoning Ordinances contain regulations through which the applicable General Plan's provisions are implemented. The RCALUCP establishes procedures and criteria by which the County can address compatibility issues when making planning decisions concerning airports. The most relevant regulations pertaining to solar energy development are presented below.

Regional Comprehensive Plan and Regional Transportation Plan

Refer to Section 3.2.15, *Traffic and Transportation*.

Riverside County General Plan

Adoption of the 2003 Riverside County General Plan (RCGP) was on October 7, 2003. Through a series of resolutions, the Board of Supervisors adopted an update in 2008. This subsection draws primarily upon the most current, 2008 update. The RCGP consists of a vision statement and the following elements: Land Use, Circulation, Multi-purpose Open Space, Safety, Noise, Housing, Air Quality, and Administration. The RCGP sets forth County land use policies and guidance for implementation. The RCGP is augmented by more detailed Area Plans covering the County's territory. Area Plans provide a clear and more focused opportunity to enhance community identity within the County and stimulate quality of life at the community level.

RCGP land use designations within the Project area include Agriculture (AG) and Estate Density Residential-Rural Community (EDR-RC). The Agriculture land use designation is established to help conserve productive agricultural lands within the County. These include row crops, nurseries, citrus groves and vineyards, dairies, ranches, poultry and hog farms, and other agriculture-related uses. Areas designated AG generally lack an infrastructure that is supportive of urban development. This land use designation allows one single-family residence per 10 acres except as otherwise specified by a policy or an overlay. The RC designation is a foundation component in the RCGP that identifies communities that exhibit a rural character and allows limited development. The EDR land use designation allows single-family detached residences on large parcels of two to five acres. Limited agriculture and intensive equestrian and animal keeping uses are expected and encouraged.

Policies at the General Plan and Area Plan levels implement the vision and goals of Riverside County. The County of Riverside Vision details the physical, environmental, and economic qualities that the County aspires to achieve by the year 2020. Using that Vision as the primary foundation, the RCGP establishes policies for development and conservation within the entire unincorporated County territory (Riverside County 2008). The General Plan's policy goals that are potentially relevant to land use for the Project are provided below. Additional County of Riverside General Plan policy goals are detailed in other sections of this chapter, as applicable to the environmental resource topic analyzed.

Land Use Element (LU)

Policy LU 2.1.c. *The County shall provide a broad range of land uses, including a range of residential, commercial, business, industry, open space, recreation and public facility uses (General Plan pg. LU-20).*

Policy LU 5.1. *The County shall ensure that development does not exceed the ability to adequately provide supporting infrastructure and services (General Plan LU-24).*

Policy LU 6.1. *Require land uses to develop in accordance with the Riverside County General Plan (RCGP) and area plans to ensure compatibility and minimize impacts.*

Policy LU 6.2. *Notwithstanding the Public Facilities designation, public facilities shall also be allowed in any other land use designation except for the Open Space- Conservation and Open Space- Conservation Habitat land use designations. For purposes of this policy, a public facility shall include all facilities operated by the federal government, the State of California, the County of Riverside, any special district governed by the County of Riverside or any city, and all facilities operated by any combination of these agencies.*

Policy LU 7.1. *The County shall accommodate the development of a balance of land uses that maintain and enhance the County's fiscal viability, economic diversity and environmental integrity (General Plan LU-26).*

Policy LU 8.1. *The County shall provide for the permanent preservation of open space lands that contain important natural resources and scenic and recreational values (General Plan LU-28).*

Policy LU 8.2. *Require that development protect environmental resources by compliance with the Multipurpose Open Space Element of the RCGP and federal and state regulations such as CEQA, NEPA, the Clean Air Act, and the Clean Water Act.*

Policy LU 9.1. *Require that new development contribute their fair share to fund infrastructure and public facilities such as police and fire facilities.*

Policy LU 13.1. *The County shall preserve and protect outstanding scenic vistas and visual features for the enjoyment of the traveling public (General Plan LU-31).*

Policy LU 13.5. *Require new or relocated electric or communication distribution lines, which would be visible from Designated and Eligible State and County Scenic Highways, to be placed underground.*

Policy LU 15.15. *The County shall permit and encourage, in an environmentally and fiscally responsible manner, the development of renewable energy resources and related infrastructure, including but not limited to, the development of solar power plants in the County of Riverside (General Plan LU-37).*

Multi-Purpose Open Space Element (OS)

Policy OS 11.3. *Permit and encourage the use of passive solar devices and other state-of-the-art energy resources.*

Policy OS 15.2. *Development of renewable resources should be encouraged.*

Palo Verde Valley Area Plan

The Project is located on the Palo Verde Mesa in the Palo Verde Valley area within unincorporated Riverside County. The Project is within the planning area for the PVVAP. The PVVAP provides customized direction specifically for this easternmost reach of the County. The PVVAP guides the evolving character of the agricultural and desert area. The PVVAP focus is on the Colorado River and is anchored in the City of Blythe. The PVVAP planning area is bordered by Imperial County on the south, desert lands on the north and west, and the Colorado River on the east. The PVVAP is an extension of the RCGP and vision. The PVVAP's policy goals most relevant to the Project are provided in Sections 3.2.1, *Aesthetics, Visual Resources, and Reflection*; 3.2.2, *Agriculture*; 3.2.6, *Geology and Soils*; and 3.2.13, *Recreation*.

Riverside County Land Use Ordinance

Ordinance No. 348.4596 amends Ordinance No. 348 to authorize solar power plants on lots ten acres or larger, subject to a conditional use permit in the following zone classifications: General Commercial (C-1/C-P), Commercial Tourist (C-T), Scenic Highway Commercial (C-P-S), Rural Commercial (C-R),

Industrial Park (I-P), Manufacturing Servicing Commercial (M-SC), Medium Manufacturing (M-M), Heavy Manufacturing (M-H), Mineral Resources (M-R), Mineral Resource and Related Manufacturing (M-R-A), Light Agriculture (A-1), Light Agriculture with Poultry (A-P), Heavy Agriculture (A-2), Agriculture-Dairy (A-D), Controlled Development (W-2), Regulated Development Areas (R-D), Natural Assets (N-A), Waterways and Watercourses (W-1), and Wind Energy Resource Zone (W-E). Ordinance No. 348.4596 was last updated in 2010.

Portions of the proposed solar facility site would be located within unincorporated Riverside County and areas currently zoned[5] as Controlled Development Areas (W-2-10), Controlled Development Areas (W-2-5), Light Agriculture (A-1-10), and Heavy Agriculture (A-2-10).

City of Blythe General Plan and Zoning Ordinance

The City of Blythe General Plan 2025 (General Plan) was adopted in March 2007 and includes the seven elements required by State law (Land Use, Housing, Circulation, Open Space, Conservation, Noise, and Safety) and other elements that address local concerns and regional requirements. The General Plan includes guiding policies and implementing policies. Together, the guiding and implementing policies articulate a vision for Blythe that the General Plan seeks to achieve.

The General Plan land use designations/zones within the solar facility include Agriculture (A) and Service Industrial (I-S). The Agriculture land use designation/zone allows for the continued cultivation of land and for associated uses commonly tied to agriculture including the grazing of animals. Residential units are allowed at a density of one per 20 acres. Agriculture associated commercial uses, feed lots (more than forty head), labor camps, and recreational activities are allowed with a conditional use permit.

For the Agriculture zone, the City of Blythe Zoning Code lists utility operations facilities among the uses permitted through obtaining a conditional use permit.

The I-S land use designation/zone is intended to provide areas appropriate for moderate- to low-intensity industrial uses capable of being located next to commercial and residential areas with minimum buffering. Allowable uses include light manufacturing, wholesaling, distribution, storage, retailing as an accessory use only, and offices in a landscaped setting. Small restaurants and convenience stores will be permitted as ancillary uses, subject to appropriate standards. No raw materials processing would be allowed. The maximum Floor Area Ratio is 0.4, but increases may be permitted, up to 0.8, for uses such as wholesale, distribution, and storage with low employment intensity.

The City of Blythe Zoning Code lists utility operations facilities among the permitted uses in the I-S zone. Utility operations facilities are defined as facilities involved in the operation of the various public and quasi-public utilities, such as telephone switchboard centers, electrical generating plants and terminals, sewage treatment plants, and water pumping stations or reservoirs.

City of Blythe General Plan policies most relevant to land use for the proposed Project are provided below.

Land Use Element

Policy 23. *As required by Public Utilities Section 21676(b), prior to City approval, appropriate pre-zoning, specific plan, planned unit development, individual development projects, or other actions involving land within the City Sphere of Influence and AIA designated "planned development" will be submitted to the ALUC for review.*

[5] Refinements to the County Riverside's zoning is ongoing. The zoning in the Project area was recently updated in 2012; therefore, the zoning classifications listed in Ordinance No. 348.4596 do not match. However, the categories, such as Controlled Development, Light Agriculture, and Heavy Agriculture have not changed.

Open Space and Conservation Element

Refer to Sections 3.2.1, *Aesthetics, Visual Resources, and Reflection;* 3.2.2, *Agriculture*; and 3.2.6, *Geology and Soils*.

3.2.11 Noise

This section describes the environmental setting and regulatory framework in regards to noise for the proposed Project and Alternatives. Noise can be defined as unwanted sound. Human response to noise is most commonly expressed as an annoyance, and the level of annoyance may be affected by the amplitude (intensity or energy content) of the noise, its frequency (pitch), its duration of exposure, and/or its recurrence. Environmental noise is measured in decibels (dB). The A-weighted decibel scale (dBA) is used to approximate the range of sensitivity of the human ear to sounds of different frequencies. A noise level is a measure of noise at a given instance in time. A change in level of at least 5 dBA is noticeable to most people, and a 10-dBA increase is judged by most people as a doubling of the sound level. Typical noise sources and noise environments for common indoor and outdoor activities are listed in Table 3.2.11-1.

TABLE 3.2.11-1 TYPICAL NOISE SOURCES AND NOISE ENVIRONMENTS

COMMON OUTDOOR ACTIVITIES	NOISE LEVELS (DBA)	COMMON INDOOR ACTIVITIES
Jet Fly-over at 1,000 feet	110-120	Rock Band
Gas Lawn Mower at 3 feet	90-100	n/a
Diesel Truck at 50 feet, at 50 mph	80-90	Food Blender at 3 feet
Commercial Area, Gas Lawn Mover at 100 feet	70	Vacuum Cleaner at 10 feet
Heavy Traffic at 300 feet	60	Normal Speech at 3 feet
Quiet Urban Area (daytime)	40-50	Large Business Office
Quiet Urban Area/Suburban Nighttime	30-50	Theater, large Conference Room (background)
Quiet Rural Nighttime	20-30	Library, Bedroom at Night, Concert Hall (background)
NA	20-10	Broadcast/Recording Studio

Source: Caltrans 2009.
mph = miles per hour
NA = not available

The decibel scale is based on logarithms, and two noise sources do not combine in a simple additive fashion; rather, they combine logarithmically. For example, if two identical noise sources produced noise levels of 50 dBA, the combined sound level would be 53 dBA, not 100 dBA.

Noise Exposure and Community Noise

Community noise is primarily the product of many distant noise sources, which change gradually throughout a typical day. During the nighttime, exterior background noises are generally lower than the daytime levels. Most household noise also decreases at night and exterior noise becomes more noticeable. Further, most people sleep at night and are more sensitive to noise intrusion during evening and nighttime hours. To account for human sensitivity to noise levels at differing times of day, the Community Noise Equivalent Level (CNEL) was developed. CNEL is a noise index that accounts for the greater annoyance of noise during the evening and nighttime hours. CNEL values are calculated by averaging hourly L_{eq} (equivalent continuous noise level) sound levels for a 24-hour period, and apply a weighting factor to evening and nighttime L_{eq} values. To account for the fluctuation in noise levels over time, noise impacts are commonly evaluated using time-averaged noise levels. The weighting factor, which reflects increased sensitivity to noise during evening and nighttime hours, is added to each hourly L_{eq} sound level before the 24-hour CNEL is calculated. For the purposes of assessing noise, the 24-hour day is divided into three time periods with the following weighting:

- Daytime: 7 a.m. to 7 p.m., weighting factor of 0 dB
- Evening: 7 p.m. to 10 p.m., weighting factor of 5 dB
- Nighttime: 10 p.m. to 7 a.m., weighting factor of 10 dB

Surrounding land uses dictate what noise levels would be considered acceptable or unacceptable. Rural and suburban areas generally have lower noise levels (approximately 20 to 50 dBA) than commercial or industrial zones (approximately 70 dBA). Levels around 75 dBA are more common around busy urban areas, and levels up to 85 dBA occur near major freeways and airports. In areas with human occupants, noise levels above 45 dBA during nighttime hours may disrupt sleep and therefore may be considered adverse. At 70 dBA, sleep interference effects become considerable (EPA 1974).

Noise Attenuation

Sound level naturally decreases as one moves farther away from the source. The ground surface (reflective or absorptive) is also a factor in the sound levels. Point sources of noise, such as stationary mobile equipment or on-site construction equipment, attenuate (lessen) at a rate of 6.0 dBA per doubling of distance from the source when in an area with a reflective ground surface (e.g., parking lots). In areas where the ground is absorptive (e.g., soft dirt, grass, or scattered bushes and trees), noise attenuation from a point source is 7.5 dBA for each doubling of distance due to ground absorption (Caltrans 1998). Noise from large construction sites would have characteristics of both “point” and “line” sources, so attenuation would generally range between 4.5 and 7.5 dBA per doubling of distance.

Widely distributed noises, such as a street with moving vehicles (a “line” source), typically would attenuate at a lower rate of approximately 3.0 dBA for each doubling of distance between the source and the receiver. If the ground surface between source and receiver is absorptive, the excess ground attenuation rate would be 4.5 dBA for each doubling of distance (Caltrans 1998).

Noise attenuation rates for both line and point sources of noise may also be influenced by atmospheric effects, such as wind and temperature gradients. Trees and vegetation, buildings, and barriers reduce the noise level that would otherwise occur at a given receptor distance.

Vibration

Vibration is an oscillatory motion through a solid medium in which the motion’s amplitude can be described in terms of displacement, velocity, or acceleration. There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as a maximum instantaneous peak of the vibration signal and is typically expressed in units of inches per second (in/sec). The PPV is most frequently used to describe vibration impacts to buildings. The room mean square (RMS) amplitude is the average of the squared amplitude of the signal. Decibel notation (VdB) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration. Typically, ground-borne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration.

Environmental Setting

The primary noise sources in the proposed Project and Alternatives area are traffic from I-10 and nearby roadways; airplane noise from the Blythe Airport; steam blowing from the Blythe Energy Center, sounds from the agricultural operations; sounds emanating from neighborhoods (e.g., voices, radio and television broadcasts); and naturally occurring sounds (e.g., winds, wind-generated noises). Generally, intermittent, short-term noises do not significantly contribute to longer-term noise averages.

I-10 is a major transportation artery and the primary noise source in the area. Noise measurements within 300 feet of I-10 range from 65 dBA to levels exceeding 82 dBA caused by the passage of heavy trucks (Blythe 2007). During peak use periods, traffic noise levels can range from 80 to 90 dBA at 50 feet from the shoulder of the interstate. State Route 78 experiences lower traffic volumes and vehicle speeds and therefore likely have somewhat lower associated noise levels (BLM 2005). Agricultural activities are

conducted on land within the proposed Project boundary. Noise associated with farming activities includes that generated by heavy equipment used for cultivation and harvesting. Maximum noise levels associated with farm equipment typically range from 75 to 85 dBA at a distance of 50 feet. Noise impact contours for the Blythe Airport range from 65 CNEL, 60 CNEL, to 55 CNEL. The most stringent noise contour boundary (55 CNEL) is approximately 1,000 feet from the runways (RCALUCP 2004).

Ambient noise measurements were not conducted for the proposed Project because information could be extrapolated from noise measurements that were taken for the Blythe Energy Center Project. With the Blythe Energy Center in operation, the lowest average background noise level measured at 16531 West Hobson Way (APN 824-090-025) over any four-hour period was 47 dBA (L_{90}) (CEC 2005). L_{90} is generally taken as the background noise level. The noise level is primarily influenced by highway traffic. Other background noise contributions were attributed to airplane overflights associated with the Blythe Airport. The average ambient noise level on the northern boundary of the Blythe Energy Center was 44 dBA L_{eq} (CEC 1999). The lower noise level is a result of the property being farther away from I-10.

Noise-Sensitive Receptors

In general, residences, schools, hotels, hospitals, and nursing homes are considered to be the most sensitive to noise. Places such as churches, libraries, and cemeteries are also sensitive to noise. Commercial and industrial uses are considered the least noise-sensitive.

There are 369 residences within one mile of the solar facility and illustrated in Figure 3.2.1-1. Table 3.3.11-2 lists the parcel numbers of residences within a 0.25-mile (1,320 feet) of the proposed solar facility site; no residences are within 0.25-mile of the portion of the gen-tie line that extends outside the solar facility site. Within the solar facility site, three existing residences (two residences on APN 863-100-016 and one residence on APN 863-060-015) would be removed as part of the Project and therefore would not be considered sensitive receptors of the Project. The closest residence (APN 824-110-020) is approximately 260 feet away from the property boundary and adjacent to an area of the Project that is proposed to contain solar arrays. In addition, the Project is approximately 0.4 mile (2,200 feet) from the Mesa Verde Park and approximately 0.8 mile (4,400 feet) from the Roy Wilson Community and Child Center. The closest occupied residence to the Project's proposed 230 kV gen-tie line is approximately 0.7 mile (3,670 feet); the closest unoccupied mobile home (APN 863-020-002) is approximately 0.4 mile (1,960 feet). No schools, hospitals, libraries, or convalescent homes are located within one mile of the proposed Project.

TABLE 3.3.11-2 RESIDENCES WITHIN 0.25-MILE OF THE PROPOSED PROJECT

PARCEL NUMBER	DISTANCE FROM PROPOSED PROJECT (FEET)
863-060-015	within solar facility site
863-100-016	within solar facility site (two residences)
824-110-020	260 feet
824-090-025	576 feet
863-020-002	615 feet and 1,250 feet (two residences)
824-110-028	700 feet and 1,085 feet (two residences)
824-110-016	795 feet
824-110-004	855 feet
824-110-022	1,025 feet

Source: Riverside County 2011a.

Regulatory Framework

Federal

Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 (OSHA) set on-site occupational noise exposure levels, which are regulated in California via the Cal/OSHA. The maximum time-weighted average noise exposure level of workers is 90 dBA over an eight-hour work shift (29 CFR Part 1910.95).

State

California Occupational Safety and Health Administration

The California Department of Industrial Relations, Division of Occupational Safety and Health, enforces Cal/OSHA regulations, which are the same as the federal OSHA regulations described above. The regulations are contained in Title 8 of the CCR, General Industrial Safety Orders, Article 105, Control of Noise Exposure, Section 5095.

California Vehicle Code

The California Vehicle Code, Sections 23130 and 23130.5, limits highway vehicle noise and is enforced by the California Highway Patrol and the County Sheriff's Office.

California State Planning Law

The State of California requires local jurisdictions (via California Government Code Section 65302(f)) to develop general plans that include "Noise Elements." A key component of determining land use compatibility is defining appropriate noise thresholds and where such standards apply. "Noise-sensitive" land use classifications in the state of California include residential areas, schools, convalescent and acute care hospitals, parks and recreational areas, and churches. For exterior living areas, such as yards and patios, the noise threshold guideline for new residential land uses is 55 dBA CNEL and must not exceed 65 dBA CNEL.

Local

Riverside County General Plan

The Riverside County General Plan's Noise Element includes noise compatibility guidance. The Land Use Compatibility for Community Noise Exposure, included in the noise element, indicates that residential low density, single family, duplex, and mobile homes are normally acceptable up to 60 dBA day-night average sound level (L_{dn}) or CNEL.

Riverside County's Ordinance No. 847 addresses noise. Ordinance No. 847 states: "This ordinance is not intended to establish thresholds of significance for the purpose of any analysis required by the California Environmental Quality Act and no such thresholds are hereby established." Accordingly, noise in excess of the standards set in Ordinance 847 does not necessarily create a significant impact. Section 4 of ordinance 847, lists maximum nighttime and daytime sound levels for occupied property by General Plan land use designation (Riverside County 2011b). The most restrictive limit would apply to the nearest occupied receptors, which are classified as Rural Residential. The ordinance indicates the maximum decibel level allowed in Rural Residential is a daytime and nighttime limit of 45 dBA L_{max} (maximum sound level) when measured at the exterior of an occupied property:

- Private construction projects located one-quarter of a mile or more from an inhabited dwelling; or

- private construction projects located within one-quarter of a mile from an inhabited dwelling, provided that: 1) Construction does not occur between the hours of 6 p.m. and 6 a.m. during the months of June through September; and 2) Construction does not occur between the hours of 6 p.m. and 7 a.m. during the months of October through May.

The Riverside County General Plan includes policies that address noise within the County boundaries. The policies that would be applicable to the proposed Project are included below.

Noise Element (N)

Policy N 1.4. *Determine if existing land uses will present noise compatibility issues with proposed projects by undertaking site surveys.*

Policy N 1.5. *Prevent and mitigate the adverse impacts of excessive noise exposure on the residents, employees, visitors, and noise-sensitive uses of Riverside County.*

Policy N 3.3. *Ensure compatibility between industrial development and adjacent land uses. To achieve compatibility, industrial development projects may be required to include noise mitigation measures to avoid or minimize project impacts on adjacent uses.*

Policy N 7.1. *New land use development within Airport Influence Areas shall comply with airport land use noise compatibility criteria contained in the corresponding airport land use compatibility plan for the area. Each Area Plan affected by a public-use airport includes one or more Airport Influence Areas, one for each airport. The applicable noise compatibility criteria are fully set forth in Appendix L and summarized in the Policy Area section of the affected Area Plan.*

Policy N 7.4. *Check each development proposal to determine if it is located within an airport noise impact area as depicted in the applicable Area Plan's Policy Area section regarding Airport Influence Areas. Development proposals within a noise impact area shall comply with applicable airport land use noise compatibility criteria.*

Policy N 12.1. *Minimize the impacts of construction noise on adjacent uses within acceptable practices.*

Policy N 12.2. *Ensure that construction activities are regulated to establish hours of operation in order to prevent and/or mitigate the generation of excessive or adverse noise impacts on surrounding areas.*

Land Use Element (LU)

Policy LU 6.2(a). *The facility is compatible in scale and design with surrounding land uses, and does not generate excessive noise, traffic, light, fumes, or odors that might have a negative impact on adjacent neighborhoods.*

Policy LU 6.4. *Retain and enhance the integrity of existing residential, employment, agricultural, and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing, and traffic.*

Riverside County Airport Land Use Commission New Compatibility Plan

Noise policies related to the Riverside County Airport Land Use Commission's New Compatibility Plan are provided below.

Policy 3.1.4. *Nonresidential Development:* The compatibility of nonresidential development shall be assessed primarily with respect to its usage intensity (the number of people per acre) and the noise-sensitivity of the use. Additional criteria listed in Table 2A shall also apply.

1) The total number of people permitted on a project site at any time, except for rare special events, must not exceed the indicated usage intensity times the gross acreage of the site.

Usage intensity calculations shall include all people (e.g., employees, customers/ visitors, etc.) who may be on the property at any single point in time, whether indoors or outside.
Rare special events are ones (such as an air show at an airport) for which a facility is not designed and normally not used and for which extra safety precautions can be taken as appropriate.

No single acre of a project site shall exceed the number of people per acre indicated in Policy 4.2.5(b) and listed in Table 2A unless special risk reduction building design measures are taken as described in Policy 4.2.6.

The noise exposure limitations cited in Policy 4.1.4 and listed in Table 2B shall be the basis for assessing the acceptability of proposed nonresidential land uses relative to noise impacts. The ability of buildings to satisfy the interior noise level criteria noted in Policy 4.1.6 shall also be considered.

Policy 3.1.6. *Other Development Conditions:* All types of proposed development shall be required to meet the additional conditions listed in Table 2A for the respective compatibility zone where the development is to be located. Among these conditions are the following:

1) Avigation Easement Dedication: See Policy 4.3.5.
2) Deed Notice: See Policy 4.4.3.
3) Real Estate Disclosure: See Policy 4.4.2.
4) Noise Level Reduction: See Policy 4.1.6.
5) Airspace Review: See Policy 4.3.3.

Policy 4.1.1. *Policy Objective:* The purpose of noise compatibility policies is to avoid establishment of noise-sensitive land uses in the portions of airport environs that are exposed to significant levels of aircraft noise.

Policy 4.1.2. *Noise Contours:* The evaluation of airport/land use noise compatibility shall consider both the current and future CNEL contours of each airport as depicted in Chapter 3 of this *Plan*.

1) At most airports in the county, anticipated growth in aircraft operations results in projected future noise contours being larger than current ones. However, in some instances, factors such as introduction of a quieter aircraft fleet mix, planned changes to the configuration of airport runways, or expected modifications to flight procedures can result in current contours being larger than the future contours in some or all of the airport environs. In these cases, a composite of the contours for the two time frames shall be considered in compatibility analyses.
2) For airport at which aircraft activity has substantial seasonal or weekly characteristics, noise contours associated with the peak operating season or days of the week shall be taken into account in assessing land use compatibility.
3) Projected noise contours included in Chapter 3 are calculated based upon forecasted aircraft activity as indicated in an airport master plan or that is considered by the Riverside County Airport Land Use Commission to be plausible (refer to activity data in the Background Data volumes). The Airport Land Use Commission or the entities that operate airports in Riverside County should periodically review these projected noise level contours and update them if appropriate.

Policy 4.1.3. *Application of Noise Contours:* The locations of CNEL contours are among the factors used to define compatibility zone boundaries and criteria. Because of the inherent variability of flight paths and other factors that influence noise emissions, the depicted contour boundaries are not absolute determinants of the compatibility or incompatibility of a given land use on a specific site or a portion thereof. Noise contours can only quantify noise impacts in a general manner. Except on large parcels or blocks of land (sites large enough to have 3 dB or more of variation in CNELs), they should *not* be used as site design criteria. (Note, though, that the airport noise contours set forth in this *Plan* are to be used as the basis for determining compliance with interior noise level criteria as listed in Policy 4.1.6.)

Policy 4.1.4. *Noise Exposure in Residential Areas:* Unless otherwise indicated in the airport-specific policies listed in Chapter 3, the maximum CNEL considered normally acceptable for new residential land uses in the vicinity of the airports covered by this *Plan* is 60 dB for all airports except low-activity outlying airports (Chiriaco Summit and Desert Center) for which the criterion is 55 dB. These standards shall be based upon noise contours calculated as described above.

Policy 4.1.5. *Noise Exposure for Other Land Uses:* Noise level compatibility standards for other types of land uses shall be applied in the same manner as the above residential noise level criteria. The extent of outdoor activity associated with a particular land use is an important factor to be considered in evaluating its compatibility with airport noise. Examples of acceptable noise levels for other land uses in an airport's vicinity are presented in Table 2B.

Policy 4.1.6. *Interior Noise Levels:* Land uses for which interior activities may be easily disrupted by noise shall be required to comply with the following interior noise level criteria.

1) The maximum, aircraft-related, interior noise level that shall be considered acceptable for land uses near airports is 45 dB CNEL in:

    - Any habitable room of single- or multi-family residences;
    - Hotels and motels;
    - Hospitals and nursing homes;
    - Churches, meeting halls, theaters, and mortuaries;
    - Office buildings; and
    - Schools, libraries, and museums.

2) The noise contours depicted in Chapter 3 of this Plan shall be used in calculating compliance with these criteria. The calculations should assume that windows are closed.
3) When reviewed as part of a general plan or zoning ordinance amendment or as a major land use action, evidence that proposed structures will be designed to comply with the above criteria shall be submitted to the ALUC under the following circumstances:

    - Any mobile home situated within an airport's 55-dB CNEL contour. [A typical mobile home has an average exterior-to-interior noise level reduction (NLR) of approximately 15 dB with windows closed.]

City of Blythe General Plan

City policies in the City of Blythe General Plan 2025 (2007) related to noise are located in the Noise Element Guiding Policies of the City General Plan, and include:

Noise Element

Policy 1 (Noise): Protect the citizens of the City of Blythe from the harmful effects of exposure to excessive noise.

Policy S-1: *Areas shall be recognized as noise impacted if exposed to existing or projected future noise levels at the property line which exceed 65 L_{dn} (or CNEL).*

Policy S-2: *Noise sensitive land uses should be discouraged in noise impacted areas unless effective mitigation measures are incorporated into the specific design of such projects to reduce exterior noise levels to 65 dB L_{dn} (or CNEL) or less and 45 dB L_{dn} (or CNEL) or less within interior living spaces. Areas shall be designated as noise-impacted if exposed to existing or projected future noise levels at the exterior of buildings which exceed 60 dB L_{dn} (or CNEL).*

Policy S-3: *New industrial, commercial or other noise generating land uses (including roadways, railroads, and airports) should be discouraged if resulting noise levels will exceed 65 dB L_{dn} (or CNEL) at the boundary areas of planned or zoned noise sensitive land uses.*

Policy S-7: *The City shall review all relevant development plans, programs and proposals to ensure their conformance with the policy framework outlined in this Noise Element.*

Policy S-9: *Development on the Blythe Municipal Airport shall conform with the Blythe Airport Master Plan to minimize the impact of airport operation on noise sensitive land uses.*

Policy S-10: *Proposed land uses within the Airport Influence Area shall be reviewed for consistency with the Noise Compatibility Criteria set forth in Table 8.2-2, with Figure 8-5 Ultimate Noise Impacts used as a review guide.*

Policy 1 (Land Use Compatibility): *Areas within the City of Blythe shall be designated as noise impacted if exposed to existing or projected future noise levels at the exterior of buildings which exceed 60 dB L_{dn} (or CNEL).*

3.2.12 Paleontological Resources

A paleontological resource is any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that provide the only direct evidence of ancient life. They are considered to be non-renewable resources because they cannot be replaced once they are destroyed. For the purpose of this analysis, and accordance with the BLM Potential Fossil Yield Classification System (PFYC), scientifically significant paleontological resources are defined as vertebrate fossils that are identifiable to taxon and/or element, noteworthy occurrences of invertebrate and plant fossils, and vertebrate trackways.

Paleontological resources were inventoried and are described for the proposed Project and Alternatives. This section summarizes the results of a literature review and records searches regarding paleontological resources that could potentially be impacted by the Project and Alternatives. The information in this section is based on the *Blythe Mesa Solar Project Paleontological Resources Survey Report*, prepared by John Minch and Associates, Inc. 2012 (Appendix I of this Draft EIR/EA). This section also describes the affected environment and regulatory setting for paleontological resources.

Environmental Setting

Geologic Units within the Project Area

According to geologic mapping, Figure 3.2.6-1, the majority of the solar facility is underlain by alluvial deposits of the Palo Verde Mesa of Pleistocene age (Qpv); the gen-tie line corridor is underlain by Quaternary Alluvium of Holocene age (Qa_6) and Aeolian Sand (Qs) Holocene. The alluvial deposits of the Palo Verde Mesa are composed of unconsolidated sand and pebbly sand containing a mixture of local and river pebbles and are moderately to poorly exposed on the Palo Verde Mesa. These unconsolidated to weakly consolidated sediments are locally well-exposed along the scarp of Palo Verde Mesa, which bounds the flood plain of the Colorado River. Scarp exposures typically consist of an upper, slope-forming unit of tan to light-gray, sandy and pebbly alluvium and a lower, cliff-forming unit of light-reddish-brown, interbedded fine-grained sand, silt, and clay. Exposures of Palo Verde Mesa alluvial deposits to the northeast are overlain by, and may interfinger with, alluvial fan deposits. These deposits are interpreted to be fluvial river deposits of probable middle- to late-Pleistocene age.

Paleontological Resource Classifications

Society of Vertebrate Paleontology

The County of Riverside uses the Society of Vertebrate Paleontology (SVP) definitions for four categories of paleontological resource potential (potential for rock units: high, low, undetermined, and no potential) (SVP 1995):

High Potential. Rock units from which vertebrate or significant invertebrate fossils or suites of plant fossils have been recovered and are considered to have a high potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations, volcanic formations, and sedimentary rock units. Sensitivity comprises both (a) the potential for yielding significant vertebrate, invertebrate, or botanical fossils, and (b) the importance of recovery evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas that contain potentially datable organic remains older than Recent are also classified as significant.

Low Potential. Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potential for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections.

Undetermined Potential. Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials.

No Potential. Metamorphic and granitic rock units do not yield fossils and therefore have no potential to yield significant nonrenewable fossiliferous resources.

Fossil Yield Classification System

The BLM adopted a different paleontological resource assessment system known as the PFYC System. The PFYC system classifies geologic units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential. This classification is applied to the geologic formation, member, or other distinguishable unit, preferably at the most detailed mappable level. The BLM uses the PFYC system to assess the potential for discovery of significant paleontological resources or the impact of surface disturbing activities to such resources by using a five class ranking system.

Class 1 – Very Low. Geologic units that are not likely to contain recognizable fossil remains. This class usually includes units that are igneous or metamorphic, excluding reworked volcanic ash units; or units that are Precambrian in age or older. Management concern for paleontological resources in Class 1 units is usually negligible or not applicable. Assessment or mitigation is usually unnecessary except in very rare or isolated circumstances. The probability for impacting any fossils is negligible. Assessment or mitigation of paleontological resources is usually unnecessary. The occurrence of significant fossils is non-existent or extremely rare.

Class 2 – Low. Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils. This class typically includes vertebrate or significant invertebrate or plant fossils not present or very rare; units that are generally younger than 10,000 years before present; recent aeolian deposits; and sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration). Management concern for paleontological resources is generally low. Assessment or mitigation is usually unnecessary except in rare or isolated circumstances. The probability for impacting vertebrate fossils or scientifically significant invertebrate or plant fossils is low. Assessment or mitigation of paleontological resources is not likely to be necessary. Localities containing important resources may exist, but would be rare and would not influence the classification. These important localities would be managed on a case-by-case basis.

Class 3 – Moderate or Unknown. Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential. This class is often marine in origin with sporadic known

occurrences of vertebrate fossils, as well as vertebrate fossils and scientifically significant invertebrate or plant fossils known to occur intermittently. The predictability of the fossils within these units is known to be low or poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance. Class 3 is subdivided into two groups:

- Class 3a – Moderate Potential. Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.
- Class 3b – Unknown Potential. Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known. This may indicate the unit or area is poorly studied, and field surveys may uncover significant finds. The units in this Class may eventually be placed in another Class when sufficient survey and research is performed. The unknown potential of the units in this Class should be carefully considered when developing any mitigation or management actions.

For Class 3, the management concern for paleontological resources is moderate; or cannot be determined from existing data. Surface-disturbing activities may require field assessment to determine appropriate course of action. This classification includes a broad range of paleontological potential. It includes geologic units of unknown potential, as well as units of moderate or infrequent occurrence of significant fossils. Management considerations cover a broad range of options as well, and could include pre-disturbance surveys, monitoring, or avoidance. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action, and whether the action could affect the paleontological resources. These units may contain areas that would be appropriate to designate as hobby collection areas due to the higher occurrence of common fossils and a lower concern about affecting significant paleontological resources.

Class 4 – High. Geologic units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Surface disturbing activities may adversely affect paleontological resources in many cases. This class is subdivided into two groups, based primarily on the degree of soil cover.

- Class 4a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two acres. Paleontological resources may be susceptible to adverse impacts from surface disturbing actions. Illegal collecting activities may impact some areas.
- Class 4b – These are areas underlain by geologic units with high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

The management concern for paleontological resources in Class 4 is moderate to high, depending on the proposed action. A field survey by a qualified paleontologist is often needed to assess local conditions. Management prescriptions for resource preservation and conservation through controlled access or special management designation should be considered. Class 4 and Class 5 units may be combined as Class 5 for broad applications, such as planning efforts or preliminary assessments, when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations are similar at this level of analysis, and impacts and alternatives can be addressed at a level appropriate to the application.

Mitigation considerations must include assessment of the disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access

resulting in greater looting potential. If impacts to significant fossils can be anticipated, on-the-ground surveys prior to authorizing the surface disturbing action will usually be necessary. On-site monitoring or spot-checking may be necessary during construction activities.

Class 5 – Very High. Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation.

- Class 5a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two contiguous acres. Paleontological resources are highly susceptible to adverse impacts from surface disturbing actions. Unit is frequently the focus of illegal collecting activities.
- Class 5b – These are areas underlain by geologic units with very high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has very high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

Management concern for paleontological resources in Class 5 areas is high to very high. A field survey by a qualified paleontologist is usually necessary prior to surface disturbing activities or land tenure adjustments. Mitigation will often be necessary before and/or during these actions. Official designation of areas of avoidance, special interest, and concern may be appropriate. The probability for impacting significant fossils is high. Vertebrate fossils or scientifically significant invertebrate fossils are known or can reasonably be expected to occur in the impacted area. On-the-ground surveys prior to authorizing any surface disturbing activities will usually be necessary. On-site monitoring may be necessary during construction activities.

Combining Paleontological Resource Classifications

The two resource classification systems have distinctly different categories to evaluate paleontological resources. Generally, these two classification systems are compatible (see Table 3.2.12-1). However, PFYC classification 3 can potentially be rated three different SVP ratings (high, low, and undetermined).

TABLE 3.2.12-1 COMBINED PFYC AND SVP RATINGS

PFYC RATING	SVP RATING
1 Very Low	Low or No Potential
2 Low	Low Potential
3a Moderate	High or Low Potential
3b Unknown	Undetermined
4 High	High potential
5 Very High	High potential

Regional Paleontological Resources

Literature And Records Search

John Minch and Associates, Inc. prepared a paleontological resources assessment for the proposed Project. Part of the assessment include a literature search, including previously recorded lists of fossils and paleontological fossil localities recorded for the general site vicinity, was reviewed. The purpose of the literature search was to determine: (1) pertinent geologic and paleontologic site information, and (2) the paleontologic sensitivity of identified and/or anticipated geologic units underlying the Project area. The literature search included a review of all available data pertinent to the site, including environmental reports, professional geological publications, paleontological consultant reports, and other unpublished

documents related to regional and/or detailed geologic studies. The review also included the location of geologic maps delineating the geology of the rock formations underlying the Project area.

Records searches at the San Bernardino County Museum (SBCM) and review of databases from the University of California Berkeley Museum of Paleontology (UCBMP) provided additional data. Based on review of the SBCM and UCBMP records, fossil lists, and published and unpublished literature, no known paleontological resource localities are recorded in the Project area. Sedimentary geologic units within the Mojave Desert region are generally isolated and specific to local areas. Without datable ash beds or volcanic flows the age of the various units are generally determined by: 1) relationships to other units; 2) their general appearance; and 3) by their relative degree of dissection. Due to active faulting and differential rates of erosion, units of differing ages often exhibit similar characteristics in different basins. This makes the correlation of units from area to area difficult and speculative. Thus, any fossil localities in Pleistocene sediments are indicative of the high paleontological sensitivity of any Pleistocene sedimentary unit. However, the Pleistocene Colorado River alluvium in the Needles area has yielded the remains of an extinct mammoth. In addition, the Colorado River delta deposits in the northwestern Sonoran Desert have yielded many vertebrate fossils.

Paleontological Resources within the Project Area

Known sedimentary units of late Pleistocene to Recent age are exposed at the ground surface of the solar generation site. Older alluvium underlies the majority of the Project area. Thus, it would not be apparent from surface survey whether paleontological resources exist. The older alluvial sediments of the area are considered to be of high paleontological sensitivity and are known to contain significant fossils in other parts of Southern California. There is a high potential for significant paleontological resources on the portion of the site underlain by Quaternary Alluvium. The fossils recovered from the alluvial deposits of the Palo Verde Mesa are considered to be significant and of high scientific value. The sediments of the Older Alluvium are assigned a high paleontological sensitivity.

Recent alluvium, less than 11,000 years old, is not considered to contain paleontological resources. However, it is often difficult to distinguish recent alluvium from older alluvium because deposition has been continuous. This alluvium has low potential to contain significant, non-renewable paleontological resources subject to adverse impact by development-related excavation, and so is assigned low paleontological sensitivity. However, this unit is typically thin and can overlie units of moderate or high paleontological sensitivity.

Alluvial Deposits of Palo Verde Mesa (Qpv) Pleistocene

The Alluvial Deposits of the Palo Verde Mesa have been mapped as Qpv and dated as Pleistocene in age (1.2 Ma - 10,000 years B.P., Stone 2006). No fossil resources have been recorded from this geologic unit within the Project area. Numerous vertebrate localities have been reported from Older Pleistocene alluvial sediments elsewhere in southern California, Arizona, and Sonora, Mexico. These Older Pleistocene alluvial sediments have been reported to yield significant fossils of extinct animals from the Ice Age (Jefferson 1991; Reynolds and Reynolds 1991; Woodburne 1991; Springer and Scott 1994; Scott 1997; Springer et al. 1999, 2007), as well as fossil plants (Reynolds and Reynolds 1991; Anderson et al. 2002). Fossils vertebrates recovered from these Pleistocene sediments represent extinct taxa including mammoths, mastodons, ground sloths, dire wolves, short-faced bears, saber-toothed cats, large and small horses, large and small camels, and bison (Jefferson 1991; Reynolds and Reynolds 1991; Woodburne 1991; Springer and Scott 1994; Scott 1997; Springer et al. 1998, 2007). This geologic unit is a PFYC Classification 3a (BLM 2012). Based on the PFYC Classification of 3A, the Qpv formation could have a low or high rating under the SVP rating system. Due to the numerous vertebrate fossils found in similar formations this geologic unit is considered to have a high paleontological sensitivity under SVP (1995) criteria.

Alluvial Fan and Alluvial Valley Deposits (Qa_6) late Pleistocene? to Holocene

Holocene-age Unit 6, is mapped by Stone (2006) as Qa_6. Stone (2006) assigns this unit an age of 100 to 2,000 years B.P. No fossil resources are known to exist within this geologic unit within the Project area.

Fossil vertebrate localities have been recorded from similar deposits north of the Project area (McLeod 2011). Whereas Qa6 is considered too young to contain fossilized material and is considered to have a low paleontological sensitivity at least at the surface, it overlies and is poorly distinguished from older units that are considered as having high potential for containing significant fossil resources; therefore, the paleontological sensitivity increases to high paleontological sensitivity with depth. This geologic unit is a PFYC Classification 2 (BLM 2012). Due to the lack of substantial fossil localities the Qa_6 geologic unit is considered to have a low paleontological sensitivity under SVP (1995) criteria.

Eolian Sand (Qs) Holocene

The active sand dune deposits are too young to contain fossilized remains. However, older sand dune deposits, frequently stabilized with vegetation, may contain scientifically vertebrate specimens (McLeod 2011). Therefore, sand dune deposits within the Project area are assigned a low to high paleontological sensitivity, increasing with depth. The McCoy Solar Energy Project EIS determined this geologic unit as a PFYC Classification 2. Due to the lack of substantial fossil localities the Qs geologic unit is considered to have a low paleontological sensitivity under SVP (1995) criteria.

Regulatory Framework

Federal

Antiquities Act of 1906

The Antiquities Act of 1906 is used as the basis for federal protection of paleontological resources on federal lands. The act authorizes the government to regulate the disturbance of objects of antiquity on federal lands unauthorized damage or removal of such objects through the responsible managing agency and to prosecute individuals responsible for the

Federal Land Management and Policy Act

The FLMPA defines significant fossils as: unique, rare or particularly well-preserved; an unusual assemblage of common fossils; being of high scientific interest; or providing important new data concerning (1) evolutionary trends, (2) development of biological communities, (3) interaction between or among organisms, (4) unusual or spectacular circumstances in the history of life, (5) or anatomical structure.

Paleontological Resources Preservation Act of 2009

The Paleontological Resources Preservation Act, Title VI, Subtitle D of the Omnibus Public Lands Act directs the Secretaries of the Interior and Agriculture to manage and protect paleontological resources on federal land using "scientific principles and expertise." The Paleontological Resources Preservation Act incorporates most of the recommendations of the report of the Secretary of the Interior entitled *Assessment of Fossil Management on Federal and Indian Lands* (BLM 2000) in order to formulate a consistent paleontological resources management framework. In passing the Paleontological Resources Preservation Act, Congress officially recognized the scientific importance of paleontological resources on some federal lands by declaring that fossils from these lands are federal property that must be preserved and protected. The Paleontological Resources Preservation Act codifies existing policies of the BLM, NPS, United States Forest Service (USFS), Bureau of Reclamation, and USFWS, and provides the following:

1) criminal and civil penalties for illegal sale and transport, and theft and vandalism of fossils from federal lands;
2) minimum requirements for paleontological resource-use permit issuance (terms, conditions, and qualifications of Applicant);
3) definitions for "paleontological resources" and "casual collecting"; and
4) requirements for curation of federal fossils in approved repositories.

Federal legislative protections for scientifically significant fossils apply to projects that take place on federal lands (with certain exceptions such as Department of Defense), involve federal funding, require a federal permit, or involve crossing state lines. Because a portion of gen-tie line for the proposed Project and Alternatives occurs on BLM-managed lands, federal protections for paleontological resources apply under NEPA and FLPMA.

Paleontological resources are also afforded federal protection under 40 CFR Part 1508.27 as a subset of scientific resources. The most explicit federal protection for paleontological resources, enacted in 2009, is the Paleontological Resources Preservation Act. This act regulates who may collect fossils on public lands and where such fossils must be curated. It also provides for prosecution of violators.

Potential Fossil Yield Classification System

Occurrences of paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

The BLM uses the PFYC system, which classifies geologic units based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential. This classification is applied to the geologic formation, member, or other distinguishable unit, preferably at the most detailed mappable level. It is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

State

Public Resources Code §5097.5

Public Resources Code §5097.5 includes additional state-level requirements for the assessment and management of paleontological resources, including the reasonable mitigation of adverse impacts to paleontological resources resulting from development on public lands (lands under state, county, city, or public district or agency ownership or jurisdiction). This regulation defines the removal of paleontological "sites" or "features" from public lands as a misdemeanor, and prohibits the removal of any paleontological "site" or "feature" from public land without permission of the applicable jurisdictional agency. These protections apply only to non-federal public lands within California, and thus apply only to the small portion of the gen-tie line that would be located on County-owned land.

Public Resources Code §30244

If paleontological resources would be adversely impacted as identified by the State Historic Preservation Officer, reasonable mitigation measures shall be required.

Local

Riverside County General Plan

The Multipurpose Open Space Element of the Riverside County General Plan identifies a number of policies intended to minimize impacts to paleontological resources. It also includes a Paleontological Sensitivity Resources map indicating lands with low, undetermined, or high potential for finding paleontological resources. The following policies apply to the portions of the Project site within County- and privately owned lands (Riverside County 2008):

OS 19.6: Whenever existing information indicates that a site proposed for development has high paleontological sensitivity as shown on Figure OS-7, a paleontological resource impact mitigation program shall be filed with the County Geologist. The paleontological resource impact mitigation program shall specify the steps to be taken to mitigate impacts to paleontological resources.

OS 19.7: Whenever existing information indicates that a site proposed for development has low paleontological sensitivity as shown on Figure OS-7, no direct mitigation is required unless a fossil is encountered during site development. Should a fossil be encountered, the County Geologist shall be notified and a paleontologist retained by the Applicant. The paleontologist shall document the extent and potential significance of the paleontological resources on the site and establish appropriate mitigation measures for further site development.

OS 19.8: Whenever existing information indicates that a site proposed for development has undetermined paleontological sensitivity as shown on Figure OS-7, a report shall be filed with the County Geologist documenting the extent and potential significance of the paleontological resources on-site and identifying mitigation measures for the fossil and for impacts to significant paleontological resources.

OS 19.9: This policy requires that when existing information indicates that a site proposed for development may contain paleontological resources, a paleontologist shall monitor grading activities with the authority to halt grading to collect uncovered paleontological resources, curate any resources collected with an appropriate repository, and file a report with the Planning Department documenting any paleontological resources that are found during the course of site grading.

3.2.13 Population, Housing, Public Services, Utilities, and Socioeconomics

This section describes the population and housing, public services and utilities, and social and demographic background and existing conditions in the area surrounding the Project area and Alternatives, including the City of Blythe and the Broader Eastern Riverside County and neighboring Imperial County California and La Paz County, Arizona. This section also addresses the provision of public services and utilities to the Project and presents the regulatory framework in regards to population, housing, public services, utilities, and socioeconomics and environmental justice; and presents information on population and housing, public services and utilities, and socioeconomic conditions in the Project area

Information in this section is based on data obtained from national and regional sources, including the United States Census Bureau, California Department of Finance (DOF), and the California Employment Development Department (EDD).

Environmental Setting

Project Area and Vicinity

The Project's solar facility site is located on approximately 3,587 acres of privately owned, undeveloped, and agricultural lands in eastern Riverside County; the gen-tie line corridor would occupy 73 acres of private and public lands. The Imperial County line is approximately 14 miles south of the Project area, and the Colorado River and the Arizona border are approximately nine miles to the east of the Project area. As illustrated in Figure 3.2.1-1, there are three residences within the solar facility site (one on APN 863-060-015 and two residences on APN 863-100-016).

The expected source for the Project's construction workforce is the primary determinant of the affected social economic environment associated with the Project. The origin of Project workers likely would be a central factor determining the magnitude and extent of the Project's potential socioeconomic impacts to the local and regional economy and communities. Given the location of the Project area in eastern Riverside County, it is likely that most of the construction workforce would be derived from communities located in Riverside County, which has the largest concentration of construction workers in proximity to

the Project area. A smaller percentage of the workforce would be derived from Imperial County, California and La Paz County, Arizona.

For the purposes of this population and housing analysis, the "study area" is considered to be the counties within a hour commute from the Project area on mapped roads (federal, State, and local). There are four counties within an hour commute from the Project Area. Since the closest populated community in Yuma County is over an hour away, the study area only includes Riverside and Imperial Counties in California and La Paz County in Arizona (Figure 3.2.13-1). Local communities within an approximate one-hour commute from the proposed Project area are listed below; however, other communities within Riverside County were specifically evaluated as well, regardless of population, due to the County of Riverside's jurisdiction.

- Blythe, California - 5 miles east
- Palo Verde, California - 10 miles south
- Ripley , California - 10 miles south
- Cibola, California - 10 miles south
- Ehrenburg, Arizona -10.5 miles east
- Quartzite, Arizona - 27.5 miles east

For the purposes of this environmental justice screening, race, ethnic origin, and poverty status were obtained for the Project area and surrounding area, including the City of Blythe and the County of Riverside. The CEQ has oversight responsibility for the federal government's compliance. The CEQ, in consultation with the EPA and other agencies, has developed environmental justice guidance to assist federal agencies with NEPA administration. The guidelines suggest a demographic screening process analyze the census block group demographics within a six-mile radius around a proposed site, then determine if the population within this radius can be considered an "environmental justice population," i.e., if within that radius the population is greater than fifty percent minority or low income (CEQ 1997). The environmental justice study area is illustrates in Figure 3.2.13-2.

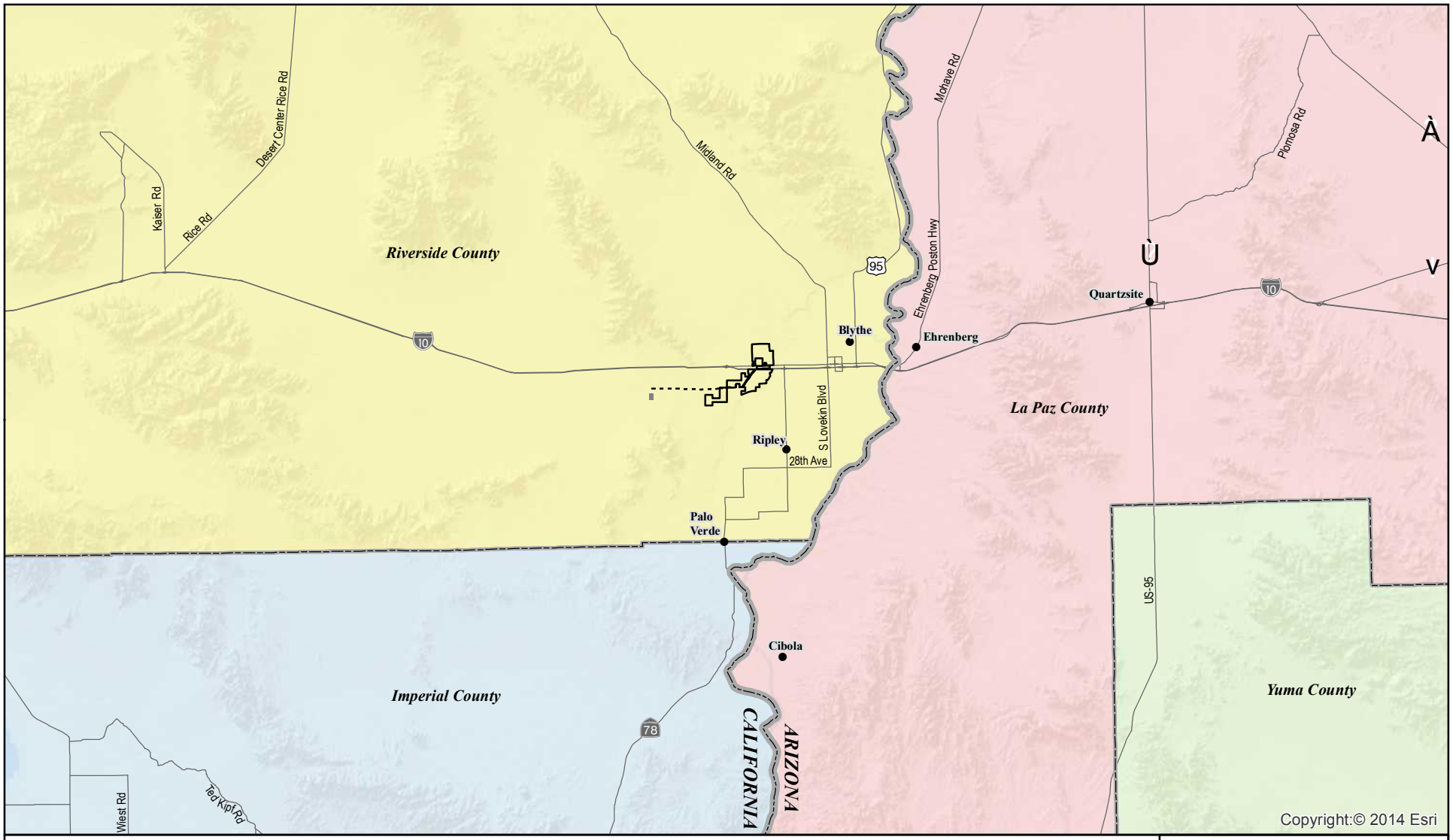
Population Characteristics

The Project is located in Riverside County, which is the fourth most populous county in California. According to the California DOF, the population in Riverside County grew from 1,545,387 in 2000 to 2,189,641 in 2010, which represents an annual growth rate of 4.17 percent. Riverside County grew at much faster rate than California as a whole. Between 2000 and 2010, Imperial, grew 2.3 percent.

Population growth in Riverside County is expected to slow during the next four decades. The growth rate is projected to be 3.3 percent annually from 2010 to 2020 and to fall to 2.1 percent from 2020 to 2030. The growth rate between 2030 and 2050 is projected to climb back up to 3.5 percent per year (California DOF 2010a, 2010b). The California DOF projections developed from 2010 to 2020 show that Riverside County will grow at a higher annual rate (3.3 percent) than the rate of California (1.3 percent), and at a rate second only to Imperial County (3.7 percent).

The cities in Riverside County that experienced the largest annual growth between 2000 and 2010 are Coachella, La Quinta, Indio, and Rancho Mirage, at 7.9, 5.8, 5.5, and 3.0 percent, respectively. The communities closest to the Project area grew at a much slower rate, such as the City of Blythe (0.17 percent growth) and Palo Verde (growth loss of 3.8 percent).

Population estimates, future projections, and average annual growth rates by county are summarized in Table 3.2.13-1. Table 3.2.13-2 illustrates the populations of the cities within the study area. Populations from 2000 and 2010 are listed with an average annual growth number and rate for the communities within the study area.



Legend

- Blythe Mesa Solar Project Boundary
- Proposed 230 Kv Transmission Line
- City
- State Line
- County Boundary
- Major Roads

N

0 5 10
Miles

1:633,600

FIGURE 3.2.13-1
POPULATION & HOUSING STUDY AREA

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS RENEWABLERESOURCESGROUP

AR062528

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 3.2.13-1 POPULATION ESTIMATES, PROJECTIONS, AND AVERAGE ANNUAL GROWTH RATES

JURISDICTION	2000	2010	AVERAGE ANNUAL GROWTH RATE 2000-2010	2020 PROJECTION	AVERAGE ANNUAL GROWTH RATE 2010-2020	2030 PROJECTION	AVERAGE ANNUAL GROWTH RATE 2020-2030	TOTAL 2050 PROJECTION	AVERAGE ANNUAL GROWTH RATE 2030-2050
California									
Riverside County	1,545,387	2,189,641	4.17%	2,904,848	3.3%	3,507,498	2.1%	4,730,922	3.5%
Imperial County	142,361	174,528	2.26%	239,149	3.7%	283,693	1.9%	387,763	3.7%
California	33,871,648	37,253,956	1.0%	42,206,743	1.3%	46,444,861	1.0%	59,507,876	2.8%
Arizona									
La Paz County	19,579	19,770	0.1%	25,487	2.9%	28,074	1.1%	30,909	1.0%
Arizona	5,130,632	6,999,810	3.6%	8,779,567	2.5%	10,347,543	1.8%	12,830,829	2.4%

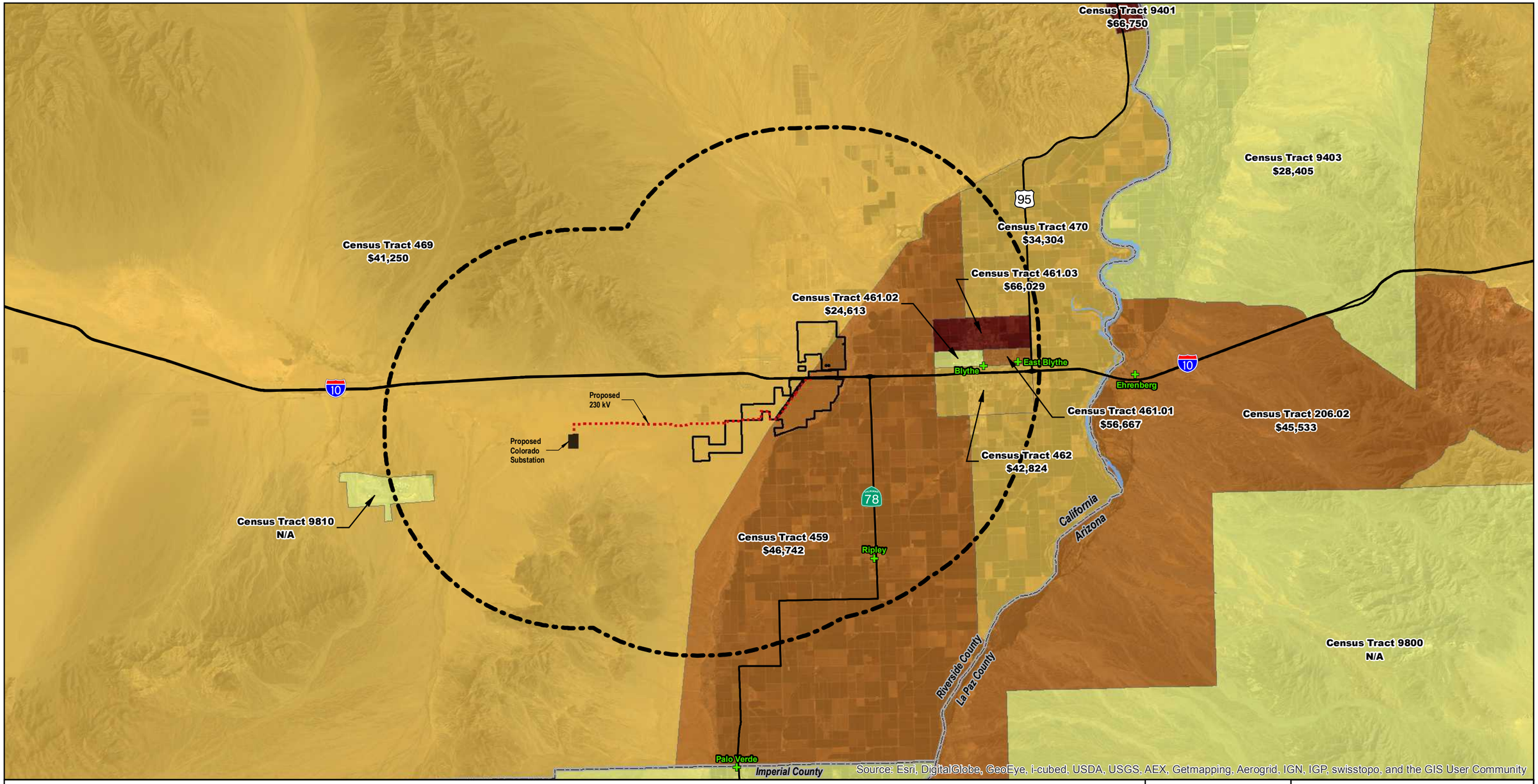
Source: California DOF 2010a; Arizona Department of Economic Security 2011.

TABLE 3.2.13-2 STUDY AREA COMMUNITIES POPULATION GROWTH

JURISDICTION	2000	2010	ANNUAL GROWTH RATE 2000-2010
Riverside County, California			
Riverside County	1,545,387	2,189,641	4.17%
Ripley[1],[2]	N/A	692	---
Blythe[2]	20,463	20,817	0.17%
Coachella	22,724	40,704	7.91%
Indio	49,116	76,036	5.48%
Indian Wells	3,816	4,958	2.99%
La Quinta	23,694	37,467	5.81%
Palm Desert	41,155	48,445	1.77%
Rancho Mirage	13,249	17,218	3.0%
Cathedral City	42,647	51,200	2.01%
Palm Springs	42,807	44,512	0.41%

JURISDICTION	2000	2010	ANNUAL GROWTH RATE 2000-2010
Imperial County, California			
Imperial County	142,361	174,528	2.26%
Palo Verde[2]	236	171	-3.8%
El Centro	37,835	42,598	1.26%
Calexico[3]	27,109	38,572	4.23%
La Paz County, Arizona			
La Paz County	19,715	20,489	0.39%
Cibola[2]	163	250	5.3%
Ehrenberg[2]	1,357	1,470	0.01%
Quartzite[2]	3,354	3,677	0.96%

Sources: California DOF 2010b; Arizona DES 2011; U.S. Census 2000a; U.S. Census 2010a (Census 2000 counts include changes from the Count Question Resolution program. Data may not match data published in Census 2000 reports.); U.S. Census 2010b.
Notes: Cities are shown (Riverside County and La Paz County) in order of their relative distance from the solar facility.
Census 2000 counts include changes from the Count Question Resolution program. Data may not match data published in Census 2000 reports.
[1] Data for 2000 not available.
[2] These are the communities nearest the solar facility that represent the local level of the study area.
[3] This community was incorporated as part of the study area because the population as of 2010 was approximately 40,000.



Legend

- Blythe Mesa Solar Project Boundary
- Proposed 230 kV Transmission Line
- City/Town
- County Boundary
- 6-Mile Project Buffer

Median Income

- 0 - $30,000
- $30,001 - $45,000
- $45,001 - $60,000
- Greater than $60,000

N

0 3 6
Miles
1:190,080



FIGURE 3.2.13-2
MEDIAN INCOME
BY CENSUS TRACT

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: Census Median Income, 2010. ArcGIS Online Imagery.

AR062532

THIS PAGE INTENTIONALLY LEFT BLANK

Housing Characteristics

Permanent Housing

The current occupied and vacant housing estimates and vacancy rates are presented for communities and counties within the study area in Table 3.2.13-3. Vacancy rates are high for the three counties, with a total of 128,339 vacant units. In 2010, Riverside County had 114,447 vacant units (14.3 percent), of which 63,909 (eight percent) are vacant and available and 50, 538 (six percent) are for seasonal, recreational, or occasional use. La Paz County in Arizona had 6. 951 vacant units (43 percent); however, 5,318 units (33 percent) are for seasonal, recreational, or occasional use. Due to the current economic downturn, the communities closest to the Project area (Blythe, Ripley, Cibola, Ehrenberg, and Quartzite) had very high vacancy rates in 2010, ranging from 17 to 56 percent, with a combined total of 3,835 vacant units.

Due to the current economic downturn, the communities closest to the Project area (Ripley, Blythe, Cibola, Ehrenberg, and Quartzite) had very high vacancy rates in 2010, ranging from 17.5 to 52.8.2 percent, with a combined total of 2,809 vacant units. The communities throughout the entire study area had vacancy rates ranging from 9.1 to 52.8 percent, with a total of 55,533 vacant units (see Table 3.2.13-3).

TABLE 3.2.13-3 2010 STUDY AREA HOUSING CHARACTERISTICS

TOTAL HOUSING UNITS		OCCUPIED HOUSING UNITS			VACANT HOUSING UNITS	
		Total	Owner Occupied		Total	For seasonal, recreational, or occasional use
			Number	Renter occupied		
Riverside County, CA	800,707	686,260 (86%)	462,212	224,048	114,447 (14%)	50,538 (6%)
Blythe CCD	6,140	5,123 (83%)	2,665	2,458	1,017 (17%)	342 (6%)
Blythe city (part)	5,100	4,348 (85%)	2,250	2,098	752 (15%)	263 (5%)
Ripley CDP	295	218 (74%)	78	140	77 (26%)	4 (1%)
Blythe city (part of Chuckwalla Valley CCD)	373	165 (44%)	108	57	208 (56%)	185 (50%)
Imperial County, CA	56,067	49,126 (88%)	27,456	21,661	6,941 (12%)	2,060 (4%)
Palo Verde CDP	211	84 (40%)	35	49	127 (60%)	91 (43%)
La Paz County, AZ	16,049	9,198 (57%)	7,072	2,126	6,951 (43%)	5,318 (33%)
Ehrenberg CDP	948	645 (68%)	405	240	303 (32%)	215 (23%)
Quartzsite town	3,378	2,027 (60%)	1,711	316	1,351 (40%)	1,097 (32%)

Sources: U.S. Census 2012
Notes: CCD is census county division.
CDP is census designated place.

In 2011, the City of Blythe had an estimated median household income of $41,892 and the State of California had median household income of $57,287 (City Data 2013). In 2011, the estimated median house or condo value for the City of Blythe was $130,281 and $355,600 for California (City Data 2013). For 2011, the median-gross rent in the City of Blythe was $696 (City Data 2013). For 2009, the median contract rent for the County of Riverside was $986 and $1058 for California (City Data 2013).

Temporary Housing Resources

Temporary housing in the Project area includes rental homes hotel and motel rooms, which are present throughout the study area and are typically concentrated in urban areas or near major transportation facilities. Other types of temporary housing units within the study area that may be used include campgrounds and recreational vehicle parks.

As shown in Table 3.2.13-3, the vacancy rates for seasonal, recreational, or occasional use rates for Riverside County and La Paz County are high, 50,338 vacant units (six percent) and 5,318 units (33 percent) respectively. With the additional of Imperial County's vacant seasonal, recreational, or occasional use units (2,060 units or 12 percent), there are a total of 57,916 vacant units. Within the local communities closes to the Project area, there are a total of 2,197 vacant seasonal, recreational, or occasional use units.

In the study area, 14 hotels and motels were identified with a total of 789 rooms. Twelve hotels and motels were identified in the Blythe, California with a total of at least 655 rooms (HotelGuides 2013); there are no other hotels or motels with 15 or more rooms within an hour drive from the Project area. One hotel was identified in Ehrenberg (approximately nine miles away) and one hotel in Parker, Arizona (approximately 42 miles away); they have 84 and 50 rooms respectively (HotelGuides 2013).

The BLM manages two long term visitor areas (LTVAs) that are located in the vicinity of the Project area: Midland LTVA and Mule Mountains LTVA. Both provide long-term camping opportunities. Two campgrounds are located within the boundaries of the Mule Mountains LTVA: Wiley's Well and Coon Hollow Campgrounds. Both are year-round facilities with campsites, picnic tables, grills, shade armadas, and handicapped-accessible vault toilets (BLM 2011b). For information regarding BLM managed recreational facilities, please refer to Section 3.2.14, *Recreation.*

Economy and Employment Characteristics

The 2010 employment statistics for Riverside and Imperial Counties and the State of California are listed in Table 3.2.13-4. The government is the largest employment sector for the State of California and Riverside and Imperial Counties, 17.0, 20.1, and 29 percent respectively. The construction sector contributed 36,000 employees (6.7 percent) for Riverside County and 1,300 employees (2.1 percent) for Imperial County, and 586,600 employees (4.1 percent) for California. Transportation, warehousing, and utilities sector contributed 19,500 employees (3.6 percent) in Riverside County and 10,300 employees (16.27 percent) in Imperial County, and 464,900 employees (3.3 percent) in California.

TABLE 3.2.13-4 2010 EMPLOYMENT BY INDUSTRY SECTOR FOR RIVERSIDE AND IMPERIAL COUNTY AND STATE OF CALIFORNIA

INDUSTRY GROUP	RIVERSIDE COUNTY EMPLOYMENT		IMPERIAL COUNTY EMPLOYMENT		CALIFORNIA EMPLOYMENT	
	Total	Percentage	Total	Percentage	Total	Percentage
Agriculture	12,800	2.38%	10,500	16.58%	381, 600	2.67%
Natural Resources, Mining, and Construction	36,000	6.7%	1,300	2.05%	586,600	4.1%
Manufacturing	38,000	7.08%	2,600	4.1%	1,242,400	8.7%
Transportation, Warehousing, and Utilities	19,500	3.63%	10,300	16.27%	464,900	3.25%
Wholesale Trade	19,100	3.55%	1,600	2.52%	643,200	4.5%
Retail Trade	78, 200	14.57%	6,800	10.74%	1,508,800	10.56%
Information	10,200	1.9%	400	0.63%	429,000	3%
Financial Activities	19,300	3.59%	1,300	2.05%	759,800	5.32%

INDUSTRY GROUP	RIVERSIDE COUNTY EMPLOYMENT		IMPERIAL COUNTY EMPLOYMENT		CALIFORNIA EMPLOYMENT	
	Total	Percentage	Total	Percentage	Total	Percentage
Professional and Business Services	50,600	9.42%	2,400	3.79%	2,069,400	14.49
Educational and Health Services	58,600	10.91%	3,700	5.84%	1,786,900	12.51%
Leisure and Hospitality	68,500	12.76%	3,300	5.21%	1,493,700	10.46%
All Other Services	18,100	3.37%	70	1.1%	484,700	10.46%
Government	107,800	20.08	18,400	29.06%	2,427,100	16.99%
Total*	**536,700**	**100% (1)**	**63,300**	**100% (1)**	**14,278,100**	**100% (1)**

Source: EDD 2011a.
Notes: Data presented in this table is reflective of the total of this table.
(1) There is a slight margin of error due to rounding.

For Arizona, Table 3.2.13-5 lists the 2010 employment by industry sectors for La Paz, Yuma, and Maricopa Counties. The largest employment sector was the government at 44.8, 30.2, and 17.0 percent respectively. The construction sector contributed 242 employees (4.4 percent) of the employment. Transportation, warehousing, and utilities contributed 2.4 percent of the employment.

TABLE 3.2.13-5 2010 EMPLOYMENT BY INDUSTRY SECTORS FOR LA PAZ COUNTY, ARIZONA

INDUSTRY GROUP	LA PAZ COUNTY EMPLOYMENT	
	Total	Percent of Total
Agriculture	309	5.65%
Natural Resources, Mining, and Construction	242 (1)	4.42%
Manufacturing	155	2.83%
Transportation, Warehousing, and Utilities	131 (2)	2.39%
Wholesale Trade	97	1.77%
Retail Trade	1,314	24.04%
Information	N/A (3)	N/A
Financial Activities	84	1.53%
Professional and Business Services	126	2.3%
Educational and Health Services	330	6.03%
Leisure and Hospitality	N/A (3)	N/A
All Other Services	340	6.22%
Government	2,337	42.76%
Total	**5,465**	**100% (1)**

Source: U.S. BEA 2009.
Notes: All numbers are current as of 2009.
(1) There is a very slight margin of error with percentages due to rounding.
(2) This number reflects construction only. Natural resources and mining numbers are not shown on the Bureau of Economic Analysis (BEA) table to avoid disclosure of confidential information; however, estimates for these items are included in the BEA totals (not included in this table).
(3) Utilities are not included in this number. This category of employment is estimated at less than 10 jobs, and therefore is not included. This category is included in totals on the BEA table, but not included on this table.

Tables 3.2.13-6, 3.2.13-7, 3.2.13-8 present a 10-year employment projection of new jobs by industry for the Riverside and Imperial Counties and State of California from 2008 to 2018. For the purposes of

employment projections, the California EDD groups Riverside and San Bernardino Counties as one statistical area; therefore, they are presented in Table 3.2.13-6 together. Employment by industry projections for California are included in Table 3.2.13-7, as well. Data for projected employment was not available for Arizona state or counties.

The highest number of new jobs projected for Riverside and San Bernardino Counties is in educational and health services, at a 22.8 percent increase. Construction and transportation, warehousing, and utilities sectors are projected to grow at 5 and 6.1 percent, respectively. The largest growth in California over this time period is anticipated to be in the educational and health services industry, at 24.5 percent, while transportation, warehousing, and utilities and construction are projected to grow by 8.1 and 9 percent, respectively.

TABLE 3.2.13-6 RIVERSIDE AND SAN BERNARDINO COUNTY INDUSTRY EMPLOYMENT PROJECTIONS

INDUSTRY	AVERAGE EMPLOYMENT		EMPLOYMENT CHANGE	
	2008	2018	Numerical	Percent
Agriculture	15,900	15,200	-700	-4.4
Natural Resources and Mining	1,200	1,100	-100	-8.3
Construction	90,700	95,200	4,500	5.0
Manufacturing	106,900	97,300	-9,600	-9.0
Transportation and Warehousing, and Utilities (1)	70,200	74,500	4,300	6.1
Wholesale Trade	54,100	59,900	5,800	10.7
Retail Trade	168,600	182,600	14,000	8.3
Information	14,900	15,000	100	0.7
Financial Activities	46,700	45,400	-1,300	-2.8
Professional and Business Services	137,400	152,500	15,100	11.0
Educational and Health Services	131,500	161,500	30,000	22.8
Leisure and Hospitality	131,000	144,200	13,200	10.1
All Other Services	40,800	44,400	3,600	8.8
Government	229,900	247,300	17,400	7.6

Sources: California EDD 2011b.
Notes: (1) Industry sectors are grouped together in California EDD data sets.

TABLE 3.2.13-7 IMPERIAL COUNTY (EL CENTRO MSA) INDUSTRY EMPLOYMENT PROJECTIONS

INDUSTRY	AVERAGE EMPLOYMENT		EMPLOYMENT CHANGE	
	2008	2018	Numerical	Percent
Agriculture	11,400	11,700	300	2.6
Natural Resources, Mining, and Construction (1)	1,700	2,100	400	23.5
Manufacturing	2,500	2,900	400	16.0
Transportation and Warehousing, and Utilities (1)	1,800	2,000	200	11.1
Wholesale Trade	1,800	2,000	200	11.1
Retail Trade	7,600	8,400	800	10.5
Information	400	400	0	0.0
Financial Activities	1,300	1,400	100	7.7
Professional and Business Services	3,000	3,200	200	6.7
Educational and Health Services	3,400	4,200	800	23.5
Leisure and Hospitality	3,600	3,700	100	2.8
All Other Services	1,000	1,100	100	10.0
Government	18,500	19,700	1,200	6.5

Source: California EDD 2011b.
Notes: (1) Industry sectors are grouped together in California EDD data sets.

TABLE 3.2.13-8 CALIFORNIA INDUSTRY EMPLOYMENT PROJECTIONS

INDUSTRY	AVERAGE EMPLOYMENT		EMPLOYMENT CHANGE	
	2008	2018	Numerical	Percent
Agriculture	389,300	386,500	-2,800	-0.7
Natural Resources and Mining	28,700	28,300	-400	-1.4
Construction	787,700	858,600	70,900	9.0
Manufacturing	1,425,300	1,292,400	-132,900	-9.3
Transportation and Warehousing, and Utilities (1)	504,600	545,600	41,000	8.1
Wholesale Trade	703,500	801,600	98,100	13.9
Retail Trade	1,640,900	1,798,800	157,900	9.6
Information	475,500	492,400	16,900	3.6
Financial Activities	850,300	847,900	-2,400	-0.3
Professional and Business Services	2,237,200	2,619,100	381,900	17.1
Educational and Health Services	1,724,700	2,146,400	421,700	24.5
Leisure and Hospitality	1,572,600	1,775,800	203,200	12.9
All Other Services	511,300	560,000	48,700	9.5
Government	2,518,900	2,725,600	206,700	8.2

Source: California EDD 2011b.
Notes: (1) Industry sectors are grouped together in California EDD data sets.

Public Services and Facilities

This subsection describes public services and facilities in the Project area, which includes education; law enforcement; fire protection; hazardous materials emergency response; parks and recreation; hospital facilities and emergency response; utilities; natural gas and electricity; water and wastewater; and solid waste.

Education

The solar array field is located within the Palo Verde Unified School District. Palo Verde Unified serves Blythe and other remote areas of Riverside County and consists of three elementary schools, two middle schools, one high school, and a continuation high school. Palo Verde Unified is the district with authority to assess school impact fees from the Project. Table 3.2.13-8 includes the schools and enrollment in Palo Verde Unified.

TABLE 3.2.13-8 SUMMARY OF SCHOOLS AND ENROLLMENT IN PALO VERDE UNIFIED SCHOOL DISTRICT, 2009 TO 2010

SCHOOL NAME	COMMUNITY	GRADES	LOCATION	STUDENTS
Felix J. Appleby Elementary School	Blythe	K – 6	401 S. Third Street	571
Margaret White Elementary School	Blythe	K – 6	610 N. Broadway	712
Ruth Brown Elementary School	Blythe	K – 6	241 N. Seventh Street	715
Blythe Middle School	Blythe	7 – 8	825 N. Lovekin Blvd.	562
Palo Verde Valley Community Day	Blythe	6 - 10	190 North Fifth Street	34
Palo Verde High School	Blythe	9 - 12	667 N. Lovekin Blvd.	927
Twin Palms Continuation	Blythe	9 - 12	811 West Chanslor Way	74

Source: National Center for Education Statistics 2011.

Law Enforcement

The City of Blythe and the Riverside County Sheriff's Department provide law enforcement and public safety to the solar facility. The City of Blythe Police Department (BPD) is located at 240 North Spring Street in Blythe and its service area covers all land in the City limits, which is approximately 27 square miles. The BPD service area is divided into a total of four beats. The Sheriff's Department services include traffic control and neighborhood policing, emergency calls, and crime prevention. The Riverside County Sherriff's Department's Colorado River Station at 260 North Spring Street in Blythe provides service from the community of Red Cloud to the west to the Arizona state line in the east, Imperial County line to the south, and San Bernardino County line to the north. Communities included in this service are Desert Center, Eagle Mountain, Blythe, Hayfield, Midland, Nicholls Warm Springs, Ripley, and the Colorado River area.

The BPD does not maintain a standard for emergency response times. However, BPD officers respond immediately to all emergency calls. Depending on the location of the officer at the time of the call, response times can range from one to ten minutes (City of Blythe 2007). According to the Riverside County Sheriff's Department, the average response time depends on the location of the deputies on call and the severity of the situation (Brightsource 2011).

The California Highway Patrol (CHP) is the primary law enforcement agency for state highways and roads. The nearest CHP station to the Project area (Blythe Station 660) is located at 430 S. Broadway in the City of Blythe. Services include law enforcement, traffic control, accident investigation, and the management of hazardous materials spill incidents.

Fire Protection

To the extent that off-site assistance is required, the City of Blythe Volunteer Fire Department and the Riverside County Fire Department (RCFD)/California Department of Forestry would provide fire protection to the solar array field. The Blythe Volunteer Fire Department station is located at 201 North Commercial Street and is staffed with a full-time fire marshal employed by the City Building Department and 35 trained, paid volunteers including a chief, assistant chief, and deputy chief. Equipment consists of one 50-foot telesquirt, four pumpers, one quick attack truck, one squad truck, and one command vehicle.

The Project area is located within the RCFD's East Desert Division, which encompasses the lower Coachella Valley, east to the Arizona state line. RCFD services include municipal and wildland fire protection and prevention services, pre-hospital emergency medical services including paramedics, hazardous materials response, and technical rescue services. There are two battalions, nine permanently staffed fire stations, and two all-volunteer fire stations. The nearest fire stations are within the jurisdiction of RCFD Battalion 8. These include the Blythe, Ripley, Blythe Air Base, River Bend, and Lake Tamarisk fire stations. The closest station to the proposed Project is Ripley Fire Station 44, on 13987 Main Street, approximately five miles away. This station has two firefighters and one certified paramedic. Ripley Fire Station 44 has one Type 1 fire engine and operates 24 hours per day, seven days a week.

The Project area falls within acceptable Total Response Time policy standards for an 'outlying' land use area based on its proximity to the nearest station (Station 45, Blythe Air Base, 17280 W. Hobson Way, Blythe, CA 92225) and that station's ability to meet the seventeen minute and 30 second response time standard. Additionally, the solar facility site is in close proximity to the City of Blythe Volunteer Fire Department.

Other nearby fire stations are Blythe Air Base Fire Station 45, Blythe Fire Station 43, River Bend Fire Station 46 (volunteer only), and Lake Tamarisk Fire Station 49 in Desert Center. Each of these fire stations has one Type 1 fire engine and provides paramedic services. Each of these fire stations has three personnel (two firefighters and one certified paramedic), with the exception of Lake Tamarisk, which has four personnel (two firefighters and two certified paramedics). The River Bend volunteer station is a reserve volunteer station and does not operate 24 hours per day, seven days a week. This station provides reserve personnel in case of an emergency but does not respond directly to an emergency. All stations are dispatched by California Department of Forestry and Fire Protection (CAL FIRE) Riverside Unit/RCFD Emergency Command Center under the integrated Fire Protection System (Brightsource 2011).

Hazardous Materials Emergency Response

The Riverside County Hazardous Materials Management Division under the Department of Environmental Health is the CUPA, with three participating agencies: Banning Fire Department, Corona Fire Department, and the RCFD. The CUPA Program conducts inspections of businesses that handle hazardous materials, generate hazardous waste, treat hazardous waste, and/or maintain underground storage tanks. RCFD would handle the response to emergency releases of hazardous material or waste for the Project. The closest RCFD Hazardous Materials Response Team (Station 81) is located at 37995 Washington Street in Palm Desert, California. Station 81 will respond with one Hazardous Materials Response Unit staffed with three personnel and one Hazardous Materials Support Unit staffed with two personnel. One member of the five-person team is a certified paramedic.

Parks and Recreation

As discussed in greater detail in Section 3.2.14, *Recreation*, the BLM CDCA Plan allows recreational use of BLM public lands in the vicinity of the Project area, which includes seven wilderness areas, seven LTVAs, and the Bradshaw Trail. Wilderness areas are popular for vehicle camping along roads that are adjacent to the wilderness areas. RV camping near wilderness areas, with associated hiking, OHV use, photography, sightseeing, etc. accounts for up to 2,000 visitors per year (BLM 2011). The LTVAs accommodate visitors who wish to camp for as long as seven consecutive months.

Most of the Project area is in agricultural uses and none of it is designated for active recreational use. The Mesa Verde Park, just south of the Nicholls Warm Springs/Mesa Verde residential area, is approximately 0.4 mile (2,200 feet) from the proposed solar array field. Other nearby park facilities to the proposed solar array field are located within the major developed portion of the City of Blythe, located approximately five miles east of the solar array field. The City of Blythe Parks Department is responsible for the maintenance and upkeep of the area's seven parks and one pocket park (City of Blythe 2011). Please refer to Section 3.2.13 for a detailed discussion on recreation.

Hospital Facilities and Emergency Response

There are several hospitals / medical facilities that provide medical services to the vicinity of the Project area. Table 3.2.13-12 below provides a summary of the following hospitals that provide medical services in eastern Riverside County, including the Project area. Desert Regional Medical Center is the closest trauma care center to the Project area and the only trauma center in the Coachella Valley. It is a Level II trauma center and provides a full range of specialists and services available 24 hours a day. Palo Verde Hospital provides intensive care services.

The CHP's Border Division Air Operations Unit, located at the Thermal California Station, may respond to a traumatic injury occurring in the Project area that requires medical evacuation via helicopter. However, the CHP usually covers Medevac situations in the area surrounding Palm Springs and rarely in the Blythe area. There are a number of additional Medevac companies that service the Project area. If a serious emergency medical incident were to occur at the solar array field, the paramedic or first responder would call in the emergency. Based on rotation and proximity, a Medevac service would be dispatched to the solar array field for evacuation to Desert Regional Medical Center in Palm Springs. The companies that provide Medevac services to the Project area are Merci Air Service, Reach Helicopter, Care Flight, and the CHP.

Blythe Ambulance, located at 129 South 1st Street in Blythe, also provides emergency medical response services in the Project area. This facility is located approximately seven miles east of the Project area.

TABLE 3.2.13-12 HOSPITALS AND CLINICS SERVING THE PROJECT AREA

FACILITY	APPROXIMATE DISTANCE FROM PROJECT AREA	SERVICES
Palo Verde Hospital 250 North First Street Blythe, California 92225	7 miles northeast	Hospital, blood bank, computerized tomography scan, intensive care unit, labor/delivery/recovery rooms, magnetic resonance imaging, nuclear medicine, outpatient services, ultrasound.
La Paz Medical Services 150 East Tyson Road Quartzsite, AZ 85359	30 miles east	General medical services and treatments.
John F. Kennedy Memorial Hospital 47111 Monroe Street Indio, CA 92201	85 miles west	Hospital, cardiac and vascular, orthopedics and JFK Bone and Joint Institute, obstetrics, outpatient rehabilitation, women and children, emergency department, emergency and express care.
Desert Regional Medical Center 1150 N. Indian Canyon Drive Palm Springs, CA 92262	105 miles west	Hospital, comprehensive cancer center, inpatient rehabilitation, institute of orthopedics and neurosciences, women and infants center, wound center, hospice, surgery, emergency/trauma services, cardiac/heart care, anesthesiologists, and physical therapists.

Utilities

A variety of purveyors in Riverside County and the City of Blythe provide and maintain utility and service system facilities associated with electricity, water, solid waste, and natural gas. Underground Service Alert (also known as USA or "Dig Alert"), a non-profit organization supported by utility firms, provides specific information on the location of underground utilities to contractors upon request, prior to ground-disturbing construction activities.

Natural Gas and Electricity

Southern California Gas Company (SCGC) provides gas service to the City of Blythe and surrounding Riverside County. SCGC's service territory encompasses approximately 20,000 square miles in diverse terrain throughout Central and Southern California, from Visalia to the Mexican border (SCGC 2012).

Southern California Edison (SCE) provides electric service to residences and businesses in the City of Blythe and surrounding area. Currently, SCE has transmission lines ranging from 500 kV to local distribution service lines of 12 kV. A major 500 kV transmission corridor passes through Palo Verde Valley and connects the Southern California market with generating plants located in Blythe and in the state of Arizona.

Water and Wastewater

The water supplies used for the Project area's agricultural irrigation and the water supplies underlying the Project area (Palo Verde Mesa Groundwater Basin), are under the jurisdiction of the PVID. Colorado River water, supplied through PVID canals, is lifted onto the mesa by private pumps to irrigate a portion of the acreage in the PVID. The remaining mesa irrigated acreage is irrigated from deep wells developed by the landowners. However, there are no wells supporting agricultural operations on the Project area.

A portion of the Project is within the City of Blythe. The City currently provides nearly 3,300 water service connections to customers, which are located within the City's municipal boundaries. The City consists of four individual water systems: City of Blythe proper water system, Mesa Bluffs water system, Hidden Beaches water system, and East Blythe County water district. Some rural residences with the City's corporate boundary obtain their water from private wells, as could be the case for rural residences in the Project area (Blythe General Plan 2007). The City's water supply is dependent upon a part of the Colorado River entitlement of the PVID. The City of Blythe lies entirely within the PVID, and the City's water use is almost entirely accounted for as a part of PVID's water use. PVID's water supply is unique in California. The District holds the Priority 1 rights to California's share of Colorado River water, and a shared portion of the Priority 3 rights, and their rights are not quantified by volume. Rather, their water rights are for irrigation and potable water needed to serve a total of 131,298 acres in the Palo Verde Valley, 26,798 of which are on the Palo Verde Mesa (PVID 2012). The great majority of water for the proposed Project (i.e., all of the non-potable water) would not be delivered by a public water system or using public water system connections. The proposed Project would use existing water infrastructure that currently delivers irrigation water from the PVID. Riverside County Community Service Area #122 (CSA #122) has substantiated its intention to provide this potable supply by issuing a will-serve letter (October 26, 2012 c/o Steve H. Jones – Manager) for the Project's limited potable water needs. CSA #122 has provided a will-serve letter for the small amount (up to 150 gallons per day) of potable water for the two O&M buildings.

The City of Blythe owns and operates the Regional Wastewater Reclamation Facility, a Class III Facility, located at 15901 South Broadway in the City of Blythe. The City also owns a sewage collection, treatment, and disposal system that provide sewage services to the City. The facility treats approximately 1.3 million gallons per day of Dry Weather Flow. The facility is permitted to discharge up to 2.4 million gallons per day of treated wastewater to percolation / evaporation ponds (City of Blythe 2012a).

On-site Wastewater Treatment Systems or Advanced Treatment Units would be installed to treat domestic sewage (non-hazardous liquid waste) from the operation and maintenance buildings on-site. Prior to the issuance of a building permit, the Project shall be required to obtain permit approval from Department of Environmental Health to install an On-site Wastewater Treatment System or Advanced Treatment Unit. Additional soils percolation testing shall be required at time of building plan check submittal.

Solid Waste

The Riverside County Waste Management Department operates seven landfills, seven transfer stations, and a grinding facility within the County. The nearest landfills that serve the Project area include the Blythe Landfill at 1000 Midland Road, which is approximately 10 miles away, and Desert Center Landfill at 17-991 Kaiser Road in Desert Center, which is approximately 60 miles away (Riverside County Waste Management Department 2012). The City of Blythe contracts with Palo Verde Valley Disposal for waste and recycling needs (City of Blythe 2012b).

Environmental Justice

The environmental justice analysis discusses the populations residing in census tracts 459, 461.01, 461.02, 461.03, 462, 469, 470, and 9810 (see Figure 3.2.13-2). The City of Blythe is located on the eastern portion of the study area. The Census tracts are small, relatively permanent statistical subdivisions of a county.

Table 3.2.13-13 presents the minority population composition of the study area, the City of Blythe, and Riverside County as a whole[6]. Riverside County as a whole exhibits a proportion of minority residents of 49 percent, which is higher than the City of Blythe and tracts 461.02 and 462, but higher than tracts 459, 461.01, 461.03, 469, 470, and 9810. Block Group 470, which is located to the northeast of the proposed Project, has a very low population and a small percentage of minority residents.

TABLE 3.2.13-13 ENVIRONMENTAL JUSTICE CHARACTERISTICS

GEOGRAPHIC AREA (CENSUS TRACTS)	TOTAL POPULATION	TOTAL MINORITY (PERCENTAGE MINORITY)	MEDIAN HOUSEHOLD INCOME (2010)	PROPORTION OF THE POPULATION LIVING BELOW THE POVERTY LEVEL (PERCENTAGE LOW INCOME)
459	1,838	683 (37%)	$46,742	23%
461.01	3,060	1,334 (44%)	$56,667	8%
461.02	2,027	1,169 (58%)	$24,613	26%
461.03	3,030	1,175 (39%)	$66,029	10%
462	3,341	1,845 (55%)	$42,824	16%
469	2,043	743 (36%)	$41,250	21%
470	1,749	562 (32%)	$34,304	6%
9810(1)	7,634	2,303 (30%)	NA	NA
City of Blythe	**20,817**	**8,421 (41%)**	**$41,856**	**16.8%**
Riverside County	**2,189,641**	**854,494 (49%)**	**$57,768**	**13.4%**

Source: U.S. Census Bureau 2000.
(1) Ironwood State Prison.

As indicated in Table 3.2.13-13, the total population of the eight tracts within a six-mile radius of the Project is 17,088 (excluding tract 9810, which encompasses Ironwood State Prison and has a total population of 7,634), of which 7,511 are classified as Black or African-American, Native American (or Alaskan Native), Asian, Native Hawaiian (or other Pacific Islander), some other race (including two or more races), and/or Hispanic or Latino.

The 2010 census data reported that the median household income for Riverside County was $57,768. The median household income for Riverside County is higher than all of the eight census tracts within the six-mile radius of the solar facility and the City of Blythe; except tract 461.03 that has the highest median household income ($66,029) which is located southeast of the solar facility on the northern side of Blythe.

[6] According to the U.S. Census Bureau, "minority" is defined as all persons except non-Hispanic whites. In other words, *minority* is defined as all racial groups other than white, and all persons of Hispanic origin, regardless of race.

Census tract 461.02 has the lowest median household income (at $24,613) and Census tract 461.02 has the highest proportion of residents below the poverty level (26 percent).

Regulatory Framework

Federal

National Environmental Policy Act of 1969

NEPA establishes a public, interdisciplinary framework for federal agencies reviewing projects under their jurisdiction to consider environmental impacts. NEPA's basic policy is to ensure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment.

The BLM is responsible for preparation of an EA in compliance with NEPA to evaluate the environmental impacts of the portions of the Project on federal lands. The Project gen-tie line is located on lands administered and managed by the BLM. NEPA compliance is required for this portion of the Project through preparation of a Draft and Final EA. BLM is also responsible for Native American consultation, including government-to-government consultation.

The President's CEQ developed guidelines and procedures to assist federal agencies with NEPA procedures so that environmental justice concerns are effectively identified and addressed. This includes guidelines for public participation, alternatives, and mitigation.

Executive Order 12898

Executive Order 12898 and the President's February 11, 1994 Memorandum on Environmental Justice (sent to the heads of all departments and agencies) are intended to ensure that federal departments and agencies identify and address disproportionately high and adverse human health or environmental effects of their policies, programs, and activities on minority populations and low-income populations. This consideration extends to permits issued by federal agencies. Because the Project would require federal agency approval (ROW grant from the BLM), the Executive Order applies to the Project.

Civil Rights Act of 1964, Public Law 88-352, 78 Stat. 241

Title VI of the Civil Rights Act of 1964 prohibits discrimination on the basis of race, color, or national origin by all federal agencies or activities receiving federal financial assistance. The Project would require federal agency approval (i.e., a ROW grant from the BLM) and, therefore, would require compliance with the Civil Rights Act.

State

California Revenue and Taxation Code § 73

California Revenue and Taxation Code § 73 allows property tax exclusion for certain types of solar energy systems installed before December 31, 2016. This section was amended in 2008 to include exemptions for active solar energy systems incorporated by an owner-builder in the initial construction of a new building that the owner-builder does not intend to occupy or use. Qualifying active solar energy systems are defined as those that are thermally isolated from living space or any other area where the energy is used, to provide for the collection, storage, or distribution of solar energy. These include solar space conditioning systems, solar water heating systems, active solar energy systems, solar process heating systems, photovoltaic systems, solar thermal electric systems, and solar mechanical energy.

Components included under the exclusion include storage devices, power conditioning equipment, transfer equipment, and parts. Pipes and ducts that are used to carry both solar energy and energy derived from other sources qualify for the exemption only to the extent of 75 percent of their full cash

value. Likewise, dual-use equipment for solar-electric systems qualifies for the exclusion only to the extent of 75 percent of its value.

Assembly Bill X1 15, signed by the California governor in June 2011, modified and extended existing state law excluding an "active solar energy system" from calculation of cash value subject to property taxation. An active solar energy system includes PV panels, inverters, and other improvements necessary to deliver electric power for transmission or final use. The exclusion applies to new systems constructed prior to January 1, 2017, and remains in effect until a change in ownership occurs (California State Board of Equalization 2012).

Education Code §17620

Education Code § 17620 allows a school district to levy a fee, charge, dedication, or other requirement against any construction within the boundaries of the district for the purpose of funding construction or reconstruction of school facilities, provided the district can show justification for the fees. California Government Code (GC) §65995 limits the fee to a statutory fee unless a school district conducts a Facility Needs Assessment (GC §65995.6) and meets certain conditions. The administering agent implementing school impact fees for the Project is the Palo Verde Unified School District.

California Government Code §§ 65995-65998 (amended by State Bill 50)

California GC §§ 65995-65998 limits fees, charges, dedications, or other requirements for the construction or reconstruction of school facilities. State Bill 50, adopted in 1998, imposed limitations on the power of cities and counties to require mitigation of school facilities impacts as a condition of approving new development. In the case of industrial construction, the amount of fees and/or charges levied under Education Code § 17620 with support of a Facilities Needs Assessment may not exceed $0.31 per square foot of covered, enclosed space. Development of the Project may require school impact fees.

Title 14 California Code of Regulations § 15131

The regulations implementing CEQA state that economic or social factors of a project may be included in a CEQA document but shall not be treated as significant effects on the environment. However, economic or social effects of a project may be used to determine the significance of physical changes caused by the Project. Additionally, economic, social, and housing factors should be considered by public agencies together with technological and environmental factors in deciding whether changes in a project are feasible to reduce or avoid the significant effects on the environment.

Local

Riverside County General Plan

The Riverside County General Plan does not have an element that specifically addresses public services and utilities. However, the Plan addresses safety issues through the Safety Element. Issues addressing open space and land use are discussed in the Plan's Multipurpose Open Space Element and the Land Use Element (LU) and include:

Land Use Element

Policy LU 5.1. *Ensure that development does not exceed the ability to adequately provide supporting infrastructure and services, such as libraries, recreational facilities, transportation systems, and fire/police/medical services.*

Riverside County Ordinance No. 659

This ordinance creates development impact fees "in order to effectively implement the Riverside County Comprehensive General Plan, manage new residential, commercial, and industrial development, and address impacts caused by such development" by providing funds for the construction of new or expanded public service facilities and open space.

City of Blythe General Plan

The General Plan addresses citywide concerns about growth and conservation, as well as safety. As the principal urban center in Palo Verde Valley, the plan emphasizes retaining the scale and character of existing neighborhoods. The City of Blythe Housing Element describes the housing needs and sets forth goals and implementation measures to address the identified housing needs; however, it does not contain any goals, policies or objectives related to population and housing that are relevant to the Project. Topics such as resource management, economic development, community design, affordable housing, safety, noise, and community services are included because they all have physical and environmental implications that are critical to the creation of a sustainable community.

Safety Element

Policy 8. *Cooperate with the City of Blythe Fire Department, Riverside County Department and the California Department of Forestry in periodically evaluating services and service criteria to ensure that the City continues to receive adequate fire protection and prevention services.*

Policy 9. *Coordinate with the City's Traffic Safety Committee in assessing the impact of incremental increase in development and traffic congestion on fire hazards and emergency response time.*

Policy 10. *Require new developments to install fire protection equipment/system.*

Policy 11. *Require new developments to pay for increased fire protection as necessitated by a particular development.*

Policy 12. *Continue to support the Fire Department's coordination with surrounding departments to provide fire protection services.*

Policy 13. *Enforce policies to protect the public-s safety from urban and wild-land fires.*

3.2.14 Recreation

This section describes the environmental setting and regulatory framework in regards to recreational resources for the proposed Project and Alternatives.

Environmental Setting

Regional Setting

BLM-Administered Recreation Resources

For BLM-managed lands, the CDCA Plan and the NECO Plan Amendment govern the types of recreational uses. The portion of the Project area that lies within BLM-managed lands is designated in the CDCA Plan as Multiple-Use Class M (Moderate Use), which provides for a wide variety of present and future uses such as mining, livestock grazing, recreation, energy, and utility development. Given the desert's vast expanse and great distances to recreation sites, it is difficult, if not impossible, in many circumstances, to engage in recreational activities in this region without employing a motorized vehicle in some fashion. In accordance with the CDCA Plan, motorized-vehicle access would be managed with Multiple-Use Class guidelines. Vehicle access in Multiple-Use Class M areas would be allowed on existing routes unless it is determined that use must be further limited. Designated Class L lands are located approximately 1.5 miles from the Project area. These lands are suitable for recreation activities

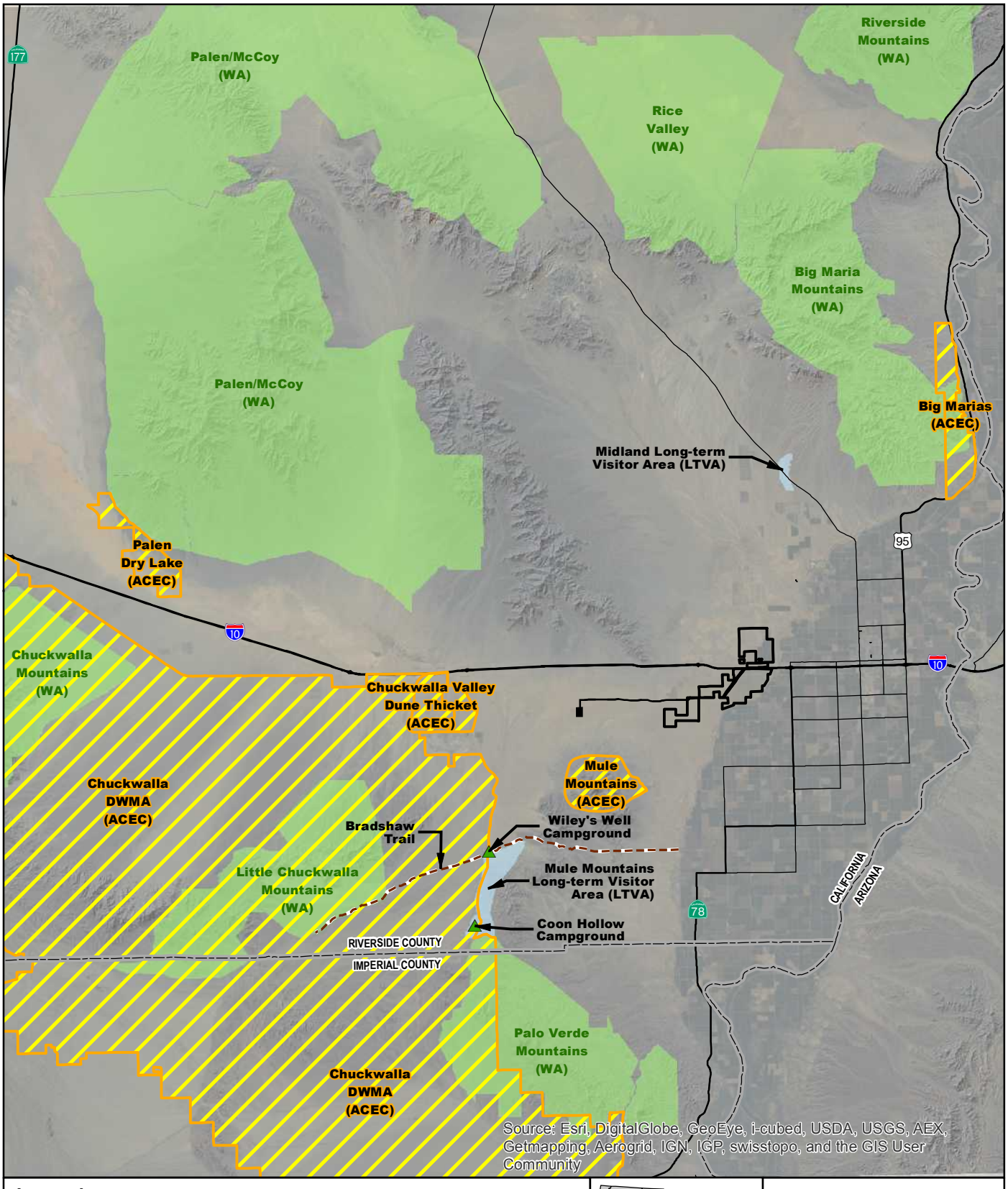
that generally involve low to moderate user densities, including backpacking, primitive unimproved site camping, hiking, horseback riding, rockhounding, nature study and observation, photography and painting, rock climbing, spelunking, hunting, landsailing on dry lakes, noncompetitive vehicle touring, mountain and trail biking, and events only on "approved" routes of travel (BLM 1980 and 2002). Stopping, parking, and vehicle camping are allowed to occur within 300 feet of a route, except within sensitive areas such as ACECs, where the limit is 100 feet (BLM 2002). Trails are open for non-vehicular use and new trails for non-motorized access may be allowed (BLM 1980).

The BLM administers wilderness areas, LTVAs, ACECs, and other recreational opportunities in the vicinity of the Project, which are listed in Table 3.2.14-1 and illustrated in Figure 3.2.14-1. ACECs and wilderness also provide dispersed recreation opportunities in the region. Overall, recreation use on BLM lands in the vicinity of the Project is limited to the cooler months of September through May, with little or no use in the summer. Popular recreation activities include car and recreational vehicle (RV) camping, OHV riding and touring, hiking, photography, hunting (dove, quail, deer), sightseeing, and visiting cultural sites. Outside of fee collection sites, the BLM has no accurate estimates of visitor use, but staff observations and ranger patrols indicate the area described in this section receives 2,000 to 3,000 visitors per year (BLM 2011a). Local residents and long-term winter visitors make up the majority of the use.

TABLE 3.2.14-1 BLM-ADMINISTERED RECREATIONAL AREAS AND OPPORTUNITIES IN THE PROJECT VICINITY

RECREATIONAL AREAS	DISTANCE FROM PROJECT (MILES)
ACEC	
Mule Mountains	1.7
Chuckwalla Desert Wildlife Management Area	4.3
Chuckwalla Valley Dune Thicket	4.5
Big Marias	9.7
Palen Dry Lake	17.9
Wilderness Areas	
Palen/McCoy	7.1
Big Maria Mountains	7.8
Little Chuckwalla Mountains	9.6
Palo Verde Mountains	10.2
Rice Valley	15.9
Chuckwalla Mountains	19.2
Riverside Mountains	23.0
Long-Term Visitor Area (LTVA)	
Midland LTVA	6.8
Mule Mountains LTVA	8.7
Campground	
Wiley's Well Campground	7.0
Coon Hollow Campground	10.1
Trail	
Bradshaw Trail	5.8

Source: POWER 2012.



Legend

- Blythe Mesa Solar Project Boundary
- Campground
- Bradshaw Trail
- Area of Critical Environmental Concern (ACEC)
- Long-term Visitor Areas
- Wilderness Area (WA)

N

0 6
Miles
1 in=6 miles



FIGURE 3.2.14-1
BLM-ADMINISTERED RECREATIONAL AREAS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

Source: Bureau of Land Management, Area of Critical Environmental Concern, 2012. ArcGIS Online Imagery.

AR062548

THIS PAGE INTENTIONALLY LEFT BLANK

Wilderness Areas

Seven wilderness areas are located in the vicinity of the Project: the Palen-McCoy Wilderness, Big Maria Mountains Wilderness, Little Chuckwalla Mountains Wilderness, Palo Verde Mountains Wilderness, Rice Valley Wilderness, Chuckwalla Mountains Wilderness, and Riverside Mountains Wilderness. The Wilderness Act limits allowable types of recreation on wilderness lands to those that are primitive and unconfined, depend on a wilderness setting, and do not degrade the wilderness character of the area. Motorized or mechanized vehicles or equipment are not permitted in wilderness. The BLM regulates such recreation on such lands within its jurisdiction in accordance with the policies, procedures and technologies set forth in 43 CFR Part 6300), BLM Manual 8560 (Management of Designated Wilderness Areas) (BLM 1983), BLM Handbook H-8560-1 (Management of Designated Wilderness Areas) (BLM 1988), and BLM's Principles for Wilderness Management in the California Desert (BLM 1995). More specifically, camping, hiking, rockhounding, hunting, fishing, non-commercial trapping, backpacking, climbing, and horseback riding are permissible (BLM 1988, 1983).

The seven wilderness areas in the vicinity of the Project have no developed trails, parking/trailheads, or other visitor use facilities. These areas are generally steep, rugged mountains, with no permanent natural water sources, thus limiting extensive hiking or backpacking opportunities. Visitor use within the wilderness areas is very light, though BLM has no visitor use counts. Observations by staff and Law Enforcement Rangers indicate only 100 to 200 hikers per year within each of the wilderness areas (BLM 2011a). More popular is vehicle camping along roads that are adjacent to the wilderness areas. RV camping near wilderness areas, with associated hiking, OHV use, photography, sightseeing, etc. accounts for up to 2,000 visitors per year (BLM 2011a).

Long Term Visitor Areas

The BLM manages LTVAs, which accommodate visitors who wish to camp for as long as seven consecutive months. Winter visitors who wish to stay in an LTVA must purchase either a long-term permit for $180 that is valid for the entire season or any part of the season (which runs from September 15 through April 15), or a short visit permit for $40 that is valid for 14 consecutive days. Permit holders may move from one LTVA to another within the permitted timeframe without incurring additional fees. Activities in and use of LTVAs are regulated by the rules of conduct set forth in 43 CFR subpart 8365 and the more than 30 supplemental rules that the BLM has determined are necessary to provide for public safety and health and to reduce the potential damage to natural and cultural resources of the public lands.

Two LTVAs are located in the vicinity of the Project area: Midland LTVA and Mule Mountains LTVA. Both provide long-term camping opportunities. In addition to long-term camping, recreational opportunities at LTVAs include hiking; OHV use; rockhounding; viewing cultural sites, wildlife, and unique desert scenery; and solitude (BLM 2011b and 2012; Wildernet 2011). By contrast, the landing or take-off of aircraft, including ultra-lights and hot air balloons, is prohibited in LTVAs (BLM 2012).

Two campgrounds are located within the boundaries of the Mule Mountains LTVA: Wiley's Well and Coon Hollow Campgrounds. Both are year-round facilities with campsites, picnic tables, grills, shade armadas, and handicapped-accessible vault toilets (BLM 2011b).

Areas of Critical Environmental Concern

Five ACECs are within 20 miles of the Project area: Mule Mountains, Chuckwalla Valley Dune Thicket, Chuckwalla Desert Wildlife Management Area, Big Marias, and Palen Dry Lake. Recreation activities allowed in ACECs are determined by the resources and values for which the ACECs were established, and by the associated ACEC Management Plan. Most ACECs allow low-intensity recreation use that is compatible with protection of the relevant values.

Mule Mountains ACEC primarily protects cultural resources. The Chuckwalla Desert Wildlife Management Area was designated to protect desert tortoise and significant natural resources. Chuckwalla Valley Dune Thicket and Palen Dry Lake ACECs protect both natural and cultural resources. These ACECs do not have recreation use facilities, but have signage to inform visitors of the special values of the areas and

associated protection measures. BLM has no visitor counts for these sites, but observations and patrols indicate very low use, in the hundreds per year (BLM 2011a).

The Bradshaw Trail

The BLM-administered portion of the Bradshaw Trail is a 65-mile Back Country Byway that begins about 35 miles southeast of Indio, California and ends about 15 miles southwest of Blythe (BLM 2011c). The Riverside County PVVAP Trails and Bikeway map shows a route for the Bradshaw Trail that continues east of this location through Blythe to the Colorado River (Riverside County 2010). The trail was the first road through Riverside County, created by William Bradshaw in 1862 as an overland stage route beginning in San Bernardino, California, and ending at Ehrenberg, Arizona. The trail was used extensively between 1862 and 1877 to transport miners and passengers. The trail is a graded dirt road that traverses mostly public land between the Chuckwalla Mountains and the Chocolate Mountain Aerial Gunnery Range. Recreational opportunities include four-wheel driving, wildlife viewing, plant viewing, birdwatching, scenic drives, rockhounding, and hiking (BLM 2011c).

Public Access

The CDCA Plan and the NECO Plan state that vehicle access is among the most important recreation issues in the desert. A primary consideration of the recreation program is to ensure that access routes necessary for recreation enjoyment are provided (BLM 2002).

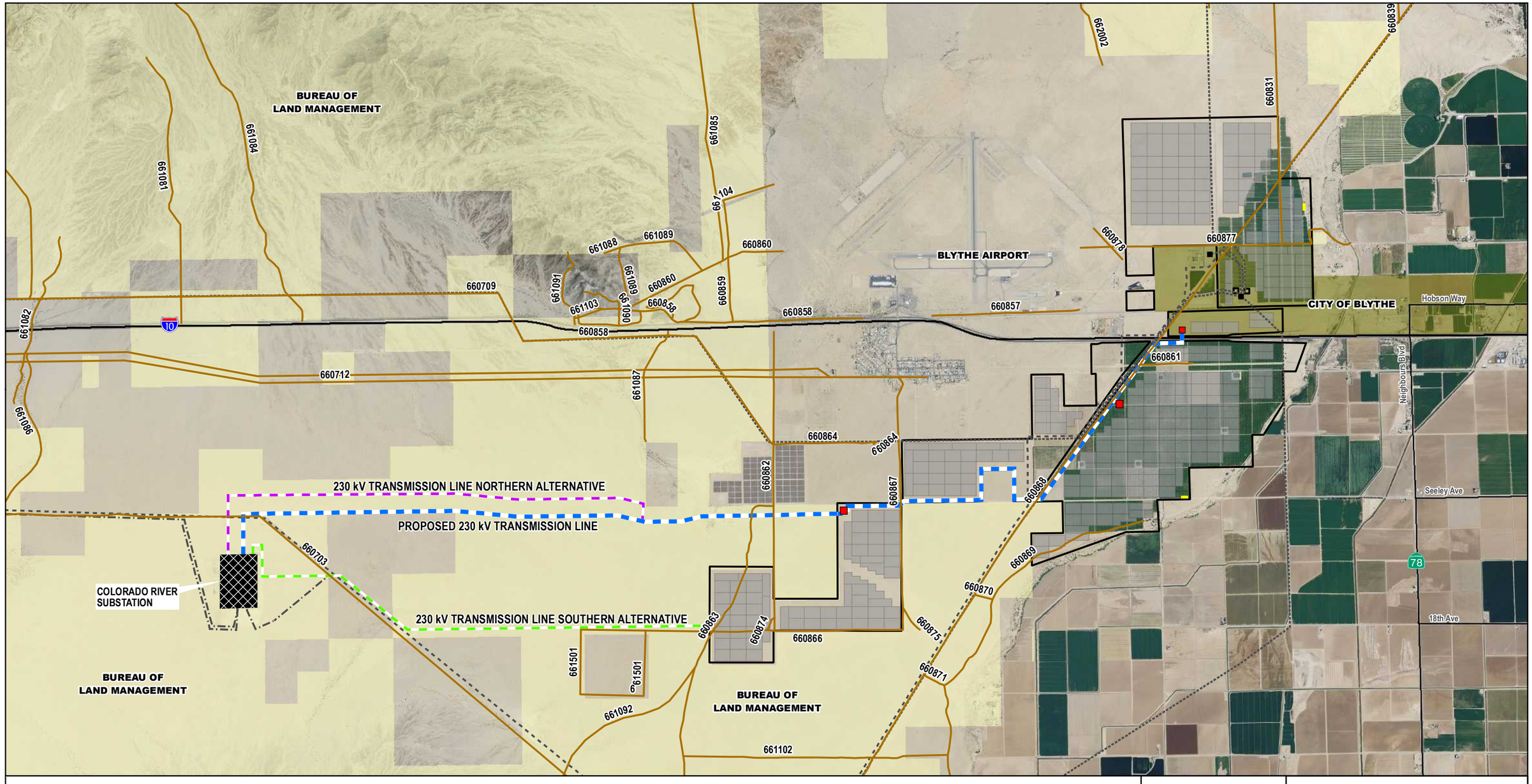
Recreation and motorized travel opportunities are determined, in part, by the CDCA Plan multiple-use class and by OHV area designations. The multiple-use class is based on the sensitivity of resources and kinds of uses for each geographic area. Each of the four multiple-use classes describes a different type and level or degree of use that is permitted within that particular geographic area (refer to Section 3.2.10, *Land Use and Planning*, for a detailed discussion regarding CDCA Plan multiple-use classes). The proposed Project and Alternatives would be located in BLM Designated Multiple-Use Class M, in which vehicle access in areas would be allowed on existing routes unless it is determined that use must be further limited.

During the CDCA and NECO planning process, a detailed inventory and designation of routes was developed. This route designation system, along with other land management actions such as setting aside ACECs and the congressional designation of wilderness areas, has resulted in a significant loss of OHV recreation opportunities in eastern Riverside County. Currently, there are no BLM-designated “open” OHV areas in Riverside County.

Under the CDCA Plan, travel routes are classified as Open, Limited, or Closed, with the following definitions:

1) Open Route: Access by motorized vehicles is allowed.
2) Limited Route: Access by motorized vehicles is limited to use by number of vehicles, type of vehicle, time or season, permitted or licensed, or speed limits.
3) Closed Route: Access by motorized vehicles is prohibited except for authorized use.

As required by the CDCA Plan, the NECO Plan Amendment created a detailed inventory of existing routes within the NECO planning area (see Figure 3.2.14-2). A route has high significance if it provides access to other routes, historical sites, or recreational areas.



Legend

Proposed Project
- Blythe Mesa Solar Project Boundary
- Solar Array Location
- Proposed 230 kV Transmission Line
- 230 kV Line Northern Alternative
- 230 kV Line Southern Alternative
- Project Substation
- Operations and Maintenance Building

Existing Transmission Lines
- Existing 138-161 kV Line
- Existing 230 kV Line
- Existing 500 kV Line

Electrical Facilities
- Colorado River Substation

NECO Plan Route Designation
- Open Route

Jurisdiction
- Bureau of Land Management
- City of Blythe

N

0 4,000 8,000
Feet
1:48,000



FIGURE 3.2.14-2
NECO PLAN
ROUTE DESIGNATIONS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: U.S. Bureau of Land Management, California Desert District, Routes of Travel, NECO Plan Area, 2000.

AR062552

THIS PAGE INTENTIONALLY LEFT BLANK

Regional Recreation Resources

The Riverside County Regional Park and Open-Space District also provides several recreational facilities in the Project vicinity. A regional trail is proposed by the County along an existing railroad line (Riverside County 2010). The Regional Park and Open-Space District also owns and operates Mayflower Park, the Blythe Marina, and McIntyre Park, each of which provides long- and short-stay RV and tent camping, showers, picnicking, fishing, and boat launching; and Miller Park and Goose Flats Wildlife Area, which provide boating and fishing opportunities (County of Riverside 2003; DesertUSA 2012). The aforementioned facilities are illustrated in Figure 3.2.14-3.

Other Recreational Areas and Opportunities

The City of Blythe provides year-round sporting activities. The Blythe Parks Department oversees eight parks (approximately 74 acres total), including five neighborhood parks, two community parks, and one regional park. The "Big Foot Skate-board Park" is located at Todd Park. The Blythe Municipal Golf Course is approximately three miles from the Project area. The Mesa Verde Park, located just south of the Nicholls Warm Springs/Mesa Verde residential area, is approximately 0.4 mile (2,200 feet) from the proposed solar facility. Other recreational opportunities in Blythe include soccer, football, track and volleyball leagues; indoor racquetball; basketball; aerobic activities; weight room; and summer swimming. Various nearby privately owned RV parks and campgrounds also provide recreational facilities, including a boat dock, launch ramp, fishing, swimming, horseshoe pits, wildlife observation, and other active and passive recreation opportunities (City of Blythe 2007). The aforementioned facilities are illustrated in Figure 3.2.14-3.

The Cibola National Wildlife Refuge, administered by the USFWS, can be reached from the California side of the Colorado River, just south of Blythe, or, from the Arizona side, south of Quartzsite. This refuge was established in 1964 as mitigation for dam construction on the Colorado River, and provides important habitat for migratory birds, wintering waterfowl, and resident species. Recreational opportunities include hunting, fishing, wildlife viewing, and a nature trail (USFWS 2012). The refuge is approximately 14 miles from the Project area.

Agricultural areas, including those on the Project area, may be used for recreational activities; however, these activities are not assumed to occur with high frequency.

Regulatory Framework

Federal

California Desert Conservation Area Plan

The CDCA Plan (BLM 1980) includes a Recreation Element to address use of, and access to, recreational destinations within the California Desert. The management goals of the CDCA Plan Recreation Element are as follows:

1) Provide for a wide range of quality recreation opportunities and experiences emphasizing dispersed undeveloped use.
2) Provide a minimum of recreation facilities. Those facilities should emphasize resource protection and visitor safety.
3) Manage recreation use to minimize user conflicts, provide a safe recreation environment, and protect desert resources.
4) Emphasize the use of public information and educational techniques to increase public awareness, enjoyment, and sensitivity to desert resources.
5) Adjust management approach to accommodate changing visitor use patterns and preferences.
6) Encourage the use and enjoyment of desert recreation opportunities by special populations, and provide facilities to meet the needs of those groups.

In order to accommodate the goals, access to the desert must be provided while protecting sensitive resources. The Recreation Element states the following with regard to access:

> "To engage in most desert recreational activities outside of open areas, visitors must use motorized vehicles and usually travel on some previously used or marked motorized-vehicle route. Understandably, vehicle access is among the most important recreation issues in the Desert. A primary consideration of the recreation program, therefore, is to ensure that access routes necessary for recreation enjoyment are provided" (BLM 1980, p. 84).

Northern and Eastern Colorado Desert Coordinated Management Plan

The NECO Plan (BLM and CDFG 2002), as amended to the CDCA Plan, provides for management of recreation within the California Desert area of El Centro, Blythe, Needles, and cities in the Coachella Valley, including the Project study area (BLM 2011). The NECO Plan specifies the type of recreational activities allowed in Multiple-Use Classes on BLM-administered land. Under this plan, new routes may be allowed if approved by the authorized officer.

Local

Riverside County General Plan

The solar facility is designated as Agriculture (AG) and Rural Community-Estate Density Residential (EDR-RC) according to the Riverside County General Plan Land Use Map. Both designations allow agriculture or limited agriculture. Agricultural areas may be used for recreational activities, such as hunting or walking. No specific policies relating to recreation apply to the proposed Project.

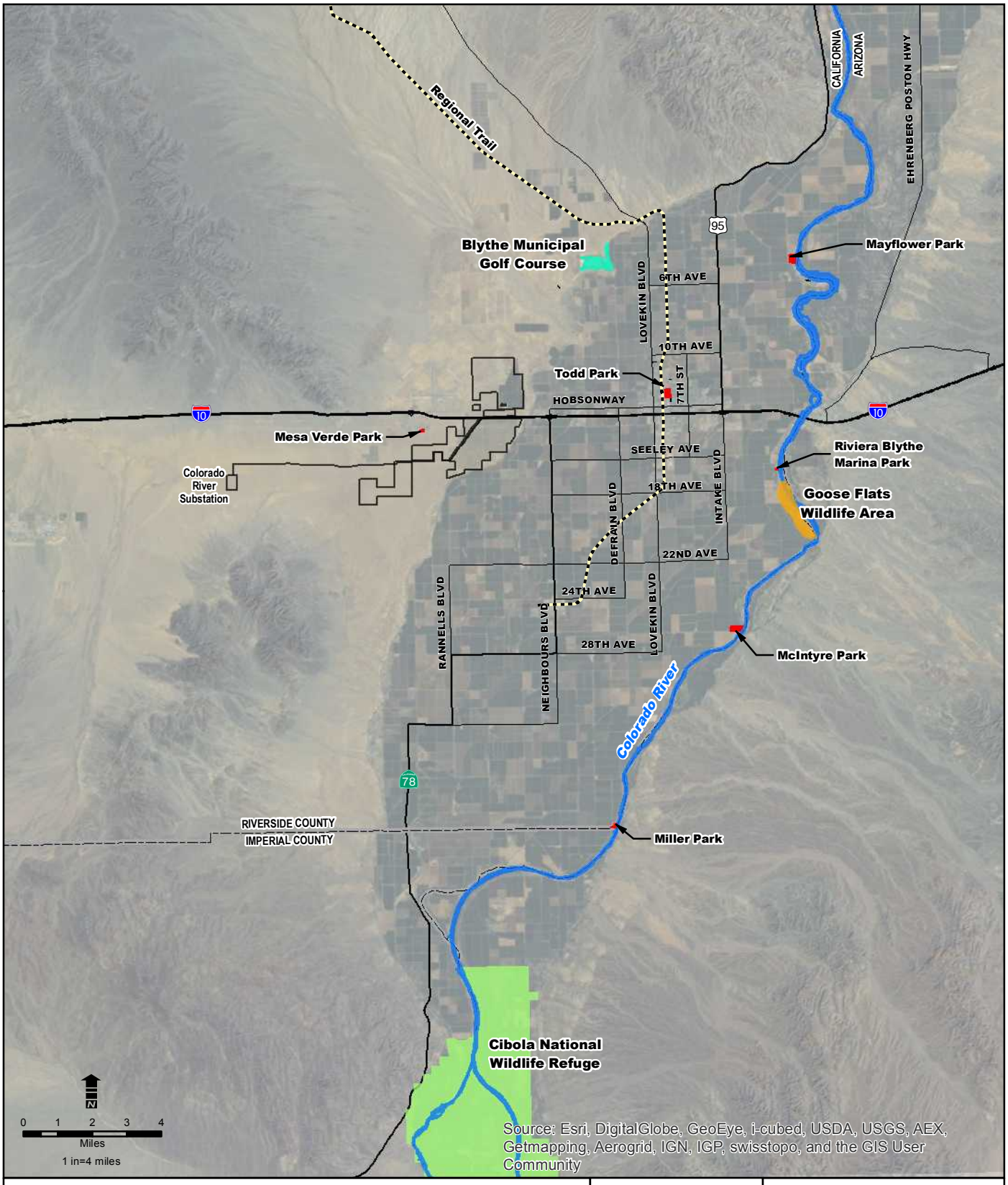
Palo Verde Valley Area Plan

Palo Verde Valley Area Plan (2008) policies that address recreational vehicle development include:

Policy PVVAP 5.4. *Allow remote recreational vehicle developments within the following land use designations: Very Low Density Residential, Estate Density Residential, Rural Residential, Rural Mountainous, Rural Desert, Open Space-Recreation, and Open Space-Rural*.

Trails and Bikeway System

Policy PVVAP 9.1. *Develop a system of multi-purpose trails that enhances the Colorado River's recreational values and connects with the adopted trails system of Riverside County*.



Legend

- Blythe Mesa Solar Project Boundary
- Regional Trail
- Golf Course
- Park
- Wildlife Area
- National Wildlife Refuge
- Colorado River



FIGURE 3.2.14-3
REGIONAL RECREATION AREAS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: ArcGIS Online Imagery.

AR062556

THIS PAGE INTENTIONALLY LEFT BLANK

3.2.15 Traffic and Transportation

This section describes the environmental setting and regulatory framework in regards to traffic and transportation for the proposed Project and Alternatives. The information in this section is based on the *Traffic Impact Study Report*, prepared by KOA Corporation 2013 (Appendix J of this Draft EIR/EA).

Environmental Setting

The Project area would be located in Riverside County approximately five miles west of the center of the City of Blythe and 40 miles east of Desert Center (refer to Figure 1-2 in Chapter 1). The Project would be located north and south of I-10, and west of State Route 89 and Highway 95. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region. Workers and delivery trucks would access the site using the Neighbors Boulevard off-ramp from I-10; therefore, it is anticipated that the following four intersections within the traffic study area are likely to experience a substantial increase in traffic volume during construction and were selected for capacity evaluation:

- Intersection 1- Neighbours Boulevard and Riverside Drive
- Intersection 2 - Neighbours Boulevard and I-10 Westbound Ramps
- Intersection 3 - Neighbours Boulevard and I-10 Eastbound Ramps
- Intersection 4 -Neighbours Boulevard and Seeley Avenue

Regional Roadway Facilities

Interstate 10 **(I-10)** is the nearest freeway to the solar facility site and gen-tie lines. It provides regional east/west travel throughout the state, beginning in Los Angeles and continuing west past the California state border to Arizona and beyond. In the vicinity of the Project area, it has two lanes per direction. Neighbours Boulevard provides a full interchange with this freeway.

Existing Circulation Network

The local roadway facilities in the vicinity of the Project area include Neighbours Boulevard, Riverside Drive, and Seeley Avenue.

Neighbours Boulevard (State Route 78) is a two-lane roadway running on a north/south alignment connecting to I-10 via an existing interchange. It provides one travel lane per direction and is divided by a double-yellow center line. Land uses along this roadway in the Project vicinity include rural residential, with vacant lots and some commercial, farming land, and industrial land uses. Neighbours Boulevard (State Route 78) has been identified as a key critical segment by the Riverside County's Congestion Management Program.

Riverside Drive is a two-lane roadway running on an east/west alignment connecting to Neighbours Boulevard. It provides one travel lane per direction, with no centerline delineation. Land uses along this roadway in the Project vicinity include rural residential, with vacant lots and some farming land and industrial land uses.

Seeley Avenue is a two-lane roadway running on an east/west alignment connecting to Neighbours Boulevard. It provides one travel lane per direction, with no centerline delineation. Land uses along this roadway in the Project vicinity include rural residential, with vacant lots and some farming land and industrial land uses.

Existing Traffic Conditions

Existing Roadway Levels of Service

The *Highway Capacity Manual* (National Research Council 2000) provides methodologies utilized by the Project to assess potential impacts to traffic flow. A Level of Service (LOS) scale is used to indicate the quality of traffic flow on roadway segments and at intersections. LOS is an indicator of operating conditions on a roadway or at an intersection and is defined in categories ranging from A to F. LOS A represents the best traffic flow conditions with very low delay, and LOS F represents poor conditions. LOS A indicates free-flowing traffic, and LOS F indicates substantial congestion with long delays at intersections.

LOS for signalized intersections is based upon the average time (seconds) that vehicles approaching an intersection are delayed. There is a specific delay and level of service associated with each approach and an overall average delay for all movements. The overall LOS for the intersection is based upon the overall average delay.

Unsignalized intersection LOS is also based upon the control delay, but delay is only assessed for those traffic movements that are stopped or must yield to through traffic. Some movements, including cross traffic on the minor street or left turns onto the major street, can be subject to long delays; however, through traffic and right turns from the major street would not experience any delays at stopped intersections. When delay for cross traffic is severe (LOS F), the intersection should be evaluated further for possible improvement with traffic signals. In some cases, this analysis determines that the delay is being experienced by a very low number of vehicles, and traffic signals are not warranted. In other cases, when the number of stopped vehicles is substantial, and the delay is caused or substantially exacerbated by the Project, traffic signals may be justified as a mitigation measure, additional analysis is required to determine the need and justification for the installation of a traffic signal.

Table 3.2.14-1 shows the relationship between LOS and the performance measures for signalized and unsignalized intersections and lists the *Highway Capacity Manual* delay criteria for signalized intersections.

TABLE 3.2.14-1 INTERSECTION LEVELS OF SERVICE DEFINITIONS

LEVEL OF SERVICE	SIGNALIZED INTERSECTION CONTROL DELAY (IN SEC/VEH)	UNSIGNALIZED INTERSECTION CONTROL DELAY (IN SEC/VEH)
A	0 – 10	0 – 10
B	10.1 – 20	10.1 – 15
C	20.1 – 35	15.1 – 25
D	35.1 – 55	25.1 – 35
E	55.1 – 80	35.1 – 50
F	80.1 or more	50.1 or more

Source: National Research Council 2000, Exhibits 16.2 and 17-2.

Intersection turning movement classification counts were performed during the weekday morning peak period from 7:00 a.m. to 9:00 a.m. and during the weekday evening peak period from 4:00 p.m. to 6:00 p.m. in September 2011. Intersection classification counts provide vehicle classification (cars, pickups, buses, trucks, etc.) data in addition to the individual vehicle movements. Due to the nature of this Project, passenger car equivalent (PCE) factors were used in order to accurately evaluate the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. The traffic impacts of heavy trucks at intersections are normally addressed by converting heavy vehicles into PCEs. Studies have indicated that each truck has a similar traffic impact that ranges between 1.5 and 3.0 passenger vehicles at intersections. A PCE factor of 3.0 for 4-axle trucks, 2.0 for 3-axle trucks, and 1.5 for 2-axle trucks was applied to classification counts.

Traffic volumes may fluctuate from minute to minute within the peak periods, so a peak hour factor was added to the hourly volume, which would simulate a higher 15-minute peak period for the entire peak period. The existing peak hour factor (ranging from 0.0 to 1.0) was obtained from existing traffic count information and applied to all intersections for the existing and year 2015 conditions.

Freeway

I-10 currently operates at an LOS C east and west of Neighbours Blvd, also referred to as State Route 78 (BrightSource 2011).

Intersections

As illustrated in Table 3.2.14-2, all intersections within the study area of the proposed Project are operating at an acceptable level of service (LOS A). For both a.m. and p.m. peak hours, most of the traffic originates from the south towards the ramps and Hobson Way, with a very limited amount of traffic heading towards Riverside Avenue. Most of this traffic can be attributed to the heavy agriculture activities located south of I-10 heading to and from the City of Blythe. The higher volumes heading northbound and southbound from Seeley Avenue cause a higher delay at the intersection; however, all of the intersections operate at LOS A, which represents a free-flow operation, and vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.

TABLE 3.2.14-2 EXISTING INTERSECTION CONDITIONS

INTERSECTION	WITHOUT PROJECT	
	Delay (sec/veh)	LOS
AM Peak Hour		
1. Riverside Dr & Neighbours Blvd*	9.0	A
2. I-10 WB Ramp & Neighbours Blvd*	9.0	A
3. I-10 EB Ramp & Neighbours Blvd*	9.2	A
4. Seeley Ave & Neighbours Blvd*	9.4	A
PM Peak Hour		
1. Riverside Dr & Neighbours Blvd*	8.6	A
2. I-10 WB Ramp & Neighbours Blvd*	9.5	A
3. I-10 EB Ramp & Neighbours Blvd*	9.5	A
4. Seeley Ave & Neighbours Blvd*	9.8	A

Note: *Unsignalized Intersection

Pedestrian

Pedestrian facilities currently do not exist in the proposed Project study area. There are no sidewalks, crosswalks, or related pedestrian facilities along Neighbours Boulevard, Riverside Drive, and Seeley Avenue.

Bus Service

Bus service is offered by the Palo Verde Valley Transit Agency along Neighbours Boulevard north and south of I-10. Bus routes 3, 4, and 5 travel along Hobson Way, which passes through the Project location and heads west towards Mesa Verde. There is a stop located adjacent to the Project at the intersection of Hobson Way and Buck Boulevard. Bus routes 3 and 5 run along Neighbours Boulevard towards Ripley, with stops on the corner of Hobson Way and 14th Avenue along Neighbours Boulevard.

Rail Service

Blythe is served by the Arizona and California Railroads, but there is no service directly to and from Blythe via rail.

Airport Service

Blythe Airport is a public airport located six miles west of Blythe and adjacent to the Project, serving Riverside County. The airport has two runways and is mostly used for general aviation. WR Byron Airport is a private airport located within city limits, approximately four miles northwest of central Blythe and 4.5 miles northeast of the Project. Cyr Airport is a private airport with two runways that is located two miles south from the center of Blythe and five miles east of the solar facility.

Bicycle

No bicycle facilities (e.g., bicycle paths, lanes, or routes) currently exist in the proposed Project study area.

School

The Palo Verde Unified School District comprises the Blythe area public elementary and secondary schools, including three elementary schools, one middle school, one high school, and one continuation/adult education school. Palo Verde Community College District is part of the California Community College system and includes Palo Verde Community College, a campus in Blythe, a center in Needles, and an extension for Adult Basic education and non-credit classes located on Spring Street in downtown Blythe. Table 3.2.14-3 indicates the schools and distance from the solar facility.

TABLE 3.2.14-3 SCHOOL BUS CHARACTERISTICS IN THE PROJECT VICINITY

SCHOOL NAME	DISTANCE FROM SOLAR FACILITY
Palo Verde College	2.50 miles north
Palo Verde Unified School District	
Palo Verde High School	3.75 miles east
Blythe Middle School	3.75 miles east
Twin Palms Continuation School	3.75 miles east
Margaret White Elementary School	4.25 miles east
Felix J. Appleby Elementary School	4.50 miles east
Ruth Brown Elementary School	4.75 miles east

Regulatory Framework

Federal

The CFR provides guidelines for regulations as they relate to the movement of hazardous materials via the Federal Motor Carrier Safety Administration. FAA guidelines, regulations are provided for aviation activities during the construction and post-construction periods. The following federal laws and regulations would be applicable to the proposed Project.

Objects Affecting the Navigable Air Space: Title 14 CFR Part 77

This regulation describes the criteria used to determine the need for an FAA "Notice of Proposed Construction or Alteration" in cases of potential obstruction hazards and requires applicants to submit the form for construction near an airport.

CFR Title 14 Aeronautics and Space, Part 77 Objects Affecting Navigable Airspace

This regulation establishes standards for determining physical obstructions to navigable airspace; sets noticing and hearing requirements; and provides for aeronautical studies to determine the effect of physical obstructions to the safe and efficient use of airspace.

Proposed Construction and/or Alteration of Objects that May Affect the Navigable Air Space: FAA Advisory Circular No. 70/7460-2K

This regulation describes FAA Standards for marking and lighting of obstructions identified by Title 14 CFR Part 77.

CFR Title 47 Section 15.2524

This regulation prohibits operation of devices that can interfere with radio-frequency communication.

CFR, Title 49, Subtitle B

This regulation includes procedures and regulations pertaining to interstate and intrastate transport (including hazardous materials program procedures) and provides safety measures for motor carriers and motor vehicles that operate on public highways.

State

The California Vehicle Code (CVC) and the California Streets and Highway Code outline regulations as pertains to the transportation of hazardous waste within the state; the following laws and regulations would be potentially applicable to the proposed Project.

CVC Section 353

This regulation defines hazardous materials.

CVC Sections 2500-2505

This regulation authorizes the issuance of licenses for the transport of hazardous materials.

CVC, Div 2, Chapter 2.5; Div 6; Chap. 7; Div 13; Chap. 5; Div. 14.1; Chap 1 & 2; Div. 14.8; Div. 15

These regulations pertain to licensing, size, weight, and load of vehicles operated on highways; safe operation of vehicles; and the transportation of hazardous materials.

California Streets and Highway Code, Div 1, Chap 3; Div 2 Chap 5.5

These regulations cover the care and protection of state and county highways and provisions for the issuance of written permits.

CVC Sections 13369, 15275 and 15278

These regulations address the licensing of drivers and the classification of licenses required for the operation of particular types of vehicles; they also require certificates permitting operation of vehicles transporting hazardous materials.

CVC Sections 31303-31309

These regulations regulate the highway transport of hazardous materials, the routes used, and restrictions on those facilities.

CVC Sections 35780

These regulations require permits for any load exceeding California Department of Transportation weight, length, or width standards for public roadways.

CVC Sections 31600-31620

These regulations regulate the transportation of explosive materials.

CVC Section 32100-32109

These regulations establish special requirements for the transportation of inhalation hazards and poisonous gases.

CVC Sections 32000-32053

These regulations regulate the licensing of carriers of hazardous materials, including noticing requirements.

CVC Sections 34000-34121

These regulations establish special requirements for the transportation of flammable and combustible liquids over public roads and highways.

CVC Section 34500 et seq.

These regulations regulate the safe operation of vehicles, including those that are used for the transportation of hazardous materials.

California Health and Safety Code Section 25160 et seq.

These regulations require that an authorized representative of the generator or facility operator that is responsible for loading hazardous waste into a transport vehicle shall, prior to loading, ensure that the driver of the transport vehicle is in possession of the appropriate class of driver's license and any endorsements required to operate the transport vehicle with the intended load.

California Streets and Highways Code Sections 117, 660-695, and 700-711

These regulations govern ROW encroachment and the granting of permits for encroachments on State Highways and freeways.

California Streets and Highways Code Sections 1450, 1460 et seq., and 1480 et seq.

These regulations govern ROW encroachment and the granting of permits for encroachments on county roads.

California Government Code Sections 65352, 65940, and 65944

These regulations require evaluation of compatibility with military activities for any land use proposal located near a military installation or airspace.

Local

2011 Riverside County Congestion Management Program

County of Riverside Congestion Management Plan

Riverside County's Congestion Management Plan specifies that all Congestion Management Plan roadways operate at a Level of Service (LOS) of "E" or better. All state highways and principal arterials are Congestion Management Plan roadways. I-10 and SR-177 are the only Congestion Management Plan roadways in the Project study area. The Congestion Management Plan was first established in 1990 under Proposition 111.

Proposition 111 established a process for each metropolitan county in California to designate a Congestion Management Agency that would be responsible for development and implementation of the Congestion Management Plan within county boundaries. The Riverside County Transportation Commission was designated as the Congestion Management Agency in 1990 and, therefore, prepares the Congestion Management Plan updates in consultation with the Technical Advisory Committee, which consists of local agencies, the County of Riverside, transit agencies, and subregional agencies.

The Riverside County Transportation Commission's adopted minimum LOS threshold is LOS "E." Therefore, when a Congestion Management Plan street or highway segment falls to "F," a deficiency plan must be required. Preparation of a deficiency plan will be the responsibility of the local agency where the deficiency is located. Other agencies identified as contributors to the deficiency will also be required to coordinate with the development of the plan. The plan must contain mitigation measures, including consideration of Transportation Demand Management strategies and transit alternatives, and a schedule for mitigating the deficiency.

Regional Comprehensive Plan and Regional Transportation Plan

The Southern California Association of Government's (SCAG's) Intergovernmental Review section, part of the Environmental Planning Division of Planning and Policy, is responsible for performing consistency review of regionally significant local plans, projects, and programs. Regionally significant projects are required to be consistent with SCAG's adopted regional plans and policies, such as the Regional Comprehensive Plan and the Regional Transportation Plan. The criteria for projects of regional significance are outlined in CEQA Guidelines Sections 15125 and 15206. According to the SCAG Intergovernmental Review Procedures Handbook, "new or expanded electrical generating facilities and transmission lines" qualify as regionally significant projects.

Policy 3.05: *Encourage patterns of urban development and land use which reduce costs on infrastructure construction and make better use of existing facilities.*

Policy 3.14: *Support local plans to increase density of future development located at strategic points along the regional commuter rail, transit systems, and activity centers.*

Policy 3.16: *Encourage developments in and around activity centers, transportation corridors, underutilized infrastructure systems, and areas needing recycling and redevelopment.*

Policy 3.17: *Support and encourage settlement patterns which contain a range of urban densities.*

Policy 3.18: *Encourage planned development in locations least likely to cause adverse environmental impact.*

Policy RTP G5: *Protect the environment, improve air quality and promote energy efficiency.*

Policy RTP G6: *Encourage land use and growth patterns that complement our transportation investments and improve the cost-effectiveness of expenditures.*

Policy GV P1.1: *Encourage transportation investments and land use decisions that are mutually supportive.*

Policy GV P4.2: *Focus development in urban centers and existing cities.*

Policy GV P4.3: *Develop strategies to accommodate growth that uses resources efficiently, eliminate pollution and significantly reduce waste.*

Policy GV P4.4: *Utilize "green" development techniques.*

Riverside County General Plan

The Riverside County General Plan (adopted October 2003) is applicable to all unincorporated lands within Riverside County. Countywide policies that address traffic and transportation within the County boundaries are located in the Circulation Element and Land Use Element of the County General Plan, and include:

Circulation Element (C)

Policy C 2.1. *Maintain the following countywide target Levels of Service: LOS "C" along all County maintained roads and conventional state highways. As an exception, LOS "D" may be allowed in Community Development areas, only at intersections of any combination of Secondary Highways, Major Highways, Arterials, Urban Arterials, Expressways, conventional state highways or freeway ramp intersections.*

LOS "E" may be allowed in designated community centers to the extent that it would support transit-oriented development and walkable communities.

Policy C2.2. *Apply level of service standards to new development via a program establishing traffic study guidelines to evaluate traffic impacts and identify appropriate mitigation measures for new development.*

Policy C 2.3. *Traffic studies prepared for development entitlements (tracts, plot plans, public use permits, conditional use permits, etc.). Shall identify project related traffic impacts and determine the "significance" of such impacts in compliance with CEQA.*

Policy C 2.4. *The direct project related traffic impacts of new development proposals shall be mitigated via conditions of approval requiring the construction of any improvements identified as necessary to meet level of service standards.*

Policy C 3.10. *Require private and public land developments to provide all on-site auxiliary facility improvements necessary to mitigate any development-generated circulation impacts. A review of each proposed land development project shall be undertaken to identify project impacts to the circulation system and its auxiliary facilities. The Transportation Department may require developers and/or subdividers to provide traffic impact studies prepared by qualified professionals to identify the impacts of a development.*

Policy C 6.2. *Require all-weather access to all new development.*

Policy C 7.1. *Work with incorporated cities to mitigate the cumulative impacts of incorporated and unincorporated development on the countywide transportation system.*

Policy C7.9. *Review development applications in cooperation with RCTC and as appropriate, to identify the precise location of CETAP corridors and act to preserve such areas from any permanent encroachments, pending dedication or acquisition.*

Policy C 20.4. *Control dust and mitigate other environmental impacts during all stages of roadway construction.*

Policy C 20.13. *Implement National Pollutant Discharge Elimination System Best Management Practices relating to construction of roadways to control runoff contamination from affecting the groundwater supply.*

Land Use Element (LU)

Policy LU 6.2(a). *The facility is compatible in scale and design with surrounding land uses, and does not generate excessive noise, traffic, light, fumes, or odors that might have a negative impact on adjacent neighborhoods.*

Policy LU 6.4. *Retain and enhance the integrity of existing residential, employment, agricultural, and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing, and traffic.*

Riverside County General Plan- Palo Verde Valley Area Plan

The applicable policy related to traffic and transportation included with the PVVAP is provided below.

Policy PVVAP 7.2. *Maintain the County's roadway Level of Service standards as described in the Level of Service section of the General Plan Circulation Element.*

Riverside County Municipal Code Title 10, Chapter 10.08, Sections 10.08.010 – 10.08.180

These regulations establish requirements and permits for oversize and overweight vehicles.

Riverside County Ordinance No. 460

This ordinance specifies that all work shall conform to the requirements of the Riverside County Transportation Department Subdivision Regulations.

Riverside County Ordinance No. 461

This ordinance specifies that all work shall conform to the requirements of the Riverside County Transportation Department Road Improvement Standards and Specifications.

City of Blythe General Plan

City policies in the City of Blythe General Plan 2025 (2007) related to traffic and transportation are located in the Circulation Element Guiding Policies of the City General Plan, and include:

Circulation Element

Policy 11*: Strive to maintain traffic LOS B on residential streets and LOS C or better on arterial and collector streets, at all intersections, and on principal arterials in the Congestion Management Plan during peak hours.*

Policy 12: *Accept LOS D for built-out areas served by transit after finding that:*

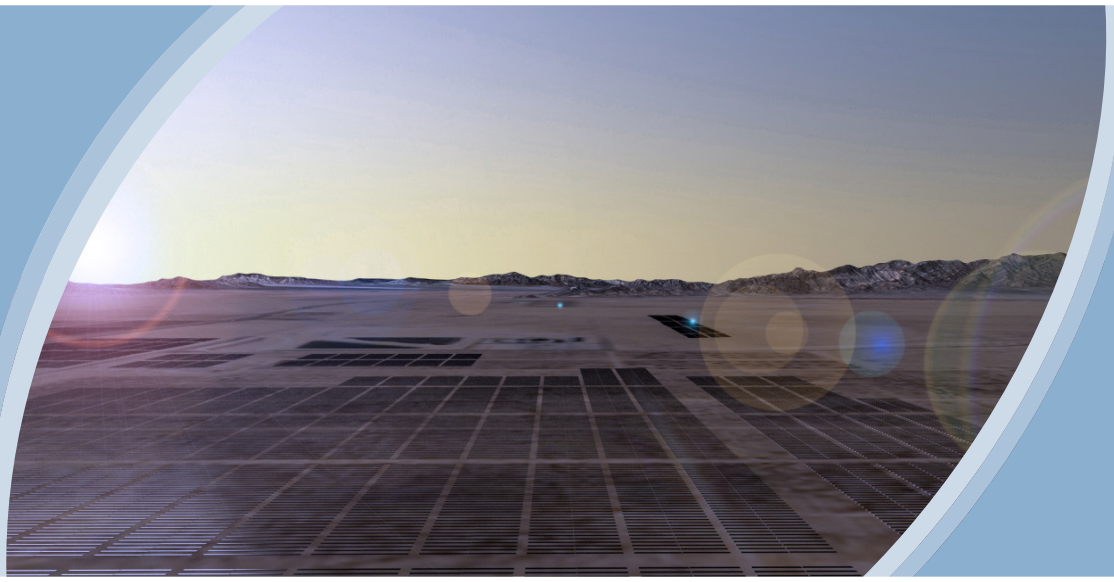
- There is no practical and feasible way to mitigate the lower level of service; and
- The uses resulting in the lower level of service are of clear, overall public benefit.

City of Blythe Municipal Code, Title 10, Article 19, Section 19.1

This code establishes permit requirements for moving heavy loads or equipment on city streets.

THIS PAGE INTENTIONALLY LEFT BLANK

BLYTHE MESA SOLAR PROJECT



Draft Environmental Impact Report/Environmental Assessment

Volume III: Technical Appendices

EIR No. 529
EA No. 0021
SCH No. 2011111056

June 2014

CEQA/NEPA Lead Agencies:

RIVERSIDE COUNTY
PLANNING DEPARTMENT

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

THIS PAGE INTENTIONALLY LEFT BLANK

Draft
Environmental Impact Report/ Environmental Assessment

Blythe Mesa Solar Project

EIR No. 529
EA No. 0021
SCH No. 2011111056

Volume III
Technical Appendices A – C

Project Proponent:

Renewable Resources Group
113 S. La Brea Ave., 3rd Floor
Los Angeles, CA 90036

Prepared by:

POWER Engineers, Inc.
731 East Ball Road, Suite 100
Anaheim, CA 92805

June 2014

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Volume III

Appendix A: Notice of Preparation
Appendix B: Air Quality and Global Climate Change Technical Report
Appendix C1: Biological Resources Technical Report
Appendix C2: 230 kV Transmission Line Alternatives Habitat Assessment Report
Appendix C3: Western Burrowing Owl Survey Report
Appendix C4: Avian and Bat Protection Plan
Appendix C5: Review of Federal Waters

AR060796

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A
NOTICE OF PREPARATION

THIS PAGE INTENTIONALLY LEFT BLANK

February 2012

RIVERSIDE COUNTY PLANNING DEPARTMENT

Blythe Mesa I Solar Project

Scoping Report

PROJECT NUMBER:
122512

PROJECT CONTACT:
Karen Cadavona
EMAIL:
karen.cadavonat@powereng.com
PHONE:
(714) 507-2700

POWER ENGINEERS

AR060800

Blythe Mesa I Solar Project
Scoping Report

PREPARED FOR:

RIVERSIDE COUNTY PLANNING DEPARTMENT
P.O. BOX 1409
RIVERSIDE, CA 92502-1409

RENEWABLE RESOURCES GROUP
5700 WILSHIRE BOULEVARD, SUITE 330
LOS ANGELES, CA 90036

PREPARED BY:

POWER ENGINEERS
731 E. BALL ROAD, SUITE 100
ANAHEIM, CA 92805

AR060801

CONTENTS

1.0 PROJECT BACKGROUND 1
2.0 NOTICE OF PREPARATION OF EIR 1
3.0 PUBLIC SCOPING MEETINGS 7
4.0 OUTREACH 7
4.1 NOTIFICATION TO SCOPING SESSION 7
4.2 NATIVE AMERICAN CONSULTATION 7
5.0 SCOPING COMMENTS SUMMARY 8
5.1 HUMAN ENVIRONMENT ISSUES 8
5.1.1 Air Quality 8
5.1.2 Public Services and Utilities 8
5.1.3 Socioeconomics 9
5.2 NATURAL ENVIRONMENT ISSUES 9
5.2.1 Hazardous Materials/Soils 9
5.2.2 Cultural Resources 9
5.2.3 Water Resources 10
6.0 NEXT STEPS IN THE EIR PROCESS 10

TABLES

Table 1. Agencies, Elected Officials, and Native American Tribes that Received the NOP 3
Table 2. Project Team Members Attending the Public Scoping Meeting 7

APPENDICES

Appendix A: Notice of Preparation and Mailing List
Appendix B: Newspaper Ad
Appendix C: Scoping Meeting Materials and Transcript
Appendix D: Scoping Meeting Notice
Appendix E: Representative Letter to Native American Tribes
Appendix F: Comment Letters

THIS PAGE INTENTIONALLY LEFT BLANK

AR060803

1.0 PROJECT BACKGROUND

Renewable Resources Group (RRG or Applicant) is proposing the Blythe Mesa I Solar Project (Proposed Project) that would involve the construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project would produce enough energy to power approximately 180,000 households and progress the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state.

In compliance with the California Environmental Quality Act (CEQA), the County of Riverside is the Lead Agency responsible for preparation of an Environmental Impact Report (EIR). POWER Engineers, Inc. has been hired by the Applicant to assist with the environmental studies and preparation of the EIR.

This Scoping Report for the Proposed Project documents the public outreach efforts by the County of Riverside and Applicant, and summarizes the issues and concerns expressed by agencies, organizations, members of the public, and Native American tribes during the public scoping period.

Scoping is an early and open process for determining the scope of issues to be addressed, and identifying the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in depth in the EIR.

2.0 NOTICE OF PREPARATION OF EIR

In compliance with Title 14 of the California Code of Regulations (CCR) Section 15082, Riverside County prepared a Notice of Preparation (NOP) of an EIR that described the proposed project and location, environmental review process, the potential environmental effects, and contact information; as well as announced the time and location of the public scoping meeting. On November 16, 2011, the NOP was filed with the State Clearinghouse (SCH) [SCH No. 2011111056]. The NOP was also filed with the County of Riverside's County Clerk on November 21, 2011 and commenced the public review period. Agencies, elected officials, and Native American Tribes listed in Table 1 were sent a copy of the NOP via certified mail. A copy of the NOP and mailing labels may be found in Appendix A.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 1. AGENCIES, ELECTED OFFICIALS, AND NATIVE AMERICAN TRIBES THAT RECEIVED THE NOP

AFFILIATION	DEPARTMENT	NAME	TITLE
Federal Agencies			
Bureau of Land Management			
U.S. Fish and Wildlife Service		Cleary-Rose, Karin	Monitoring Program Coordinator
U.S. Department of the Interior	National Park Service, Joshua Tree National Park		
U.S. Department of the Interior	Bureau of Indian Affairs		
Federal Aviation Administration	Western Pacific Region		
Marine Corps Air/Ground Combat Ctr.			Commanding General
Bureau of Indian Affairs	Southern California Agency		
State Agencies			
California Air Resources Board			
California Energy Commission			
California State Department of Parks & Recreation			
California Department of Water Resources			
Caltrans	District #8	Kopulsky, Dan	
Caltrans	Division of Aeronautics		
California State Department of Corrections	Cuckwalla Valley State Prison		
Colorado River Board of California			
California Geological Survey	Department of Conservation		State Geologist
California Department of Conservation			
California Department of Conservation	Mining & Geology Board		
California Department of Fish & Game	Inland Deserts		
California Department of Fish and Game	Eastern Sierra Inland Deserts Region	MacNair, Leslie	Staff Environmental Scientist
Mojave Desert Air Quality Management District			
Native American Heritage Commission			
Regional Water Quality Control Board #7	Colorado River Basin		
Southern California Association of Governments		Roth, Erik H.	Manager
Riverside County	Building & Safety Department	Laura, Mike	Director of Building & Safety
Riverside County Planning Commission		Zuppardo, Jan	c/o Desiree Bowie, Planning Commission Secretary
Riverside County	Environmental Health		Senior Public Health Engineer
Riverside County	Environmental Health		Hazardous Materials
Riverside County	Environmental Programs Department	Bond, Jared	
Riverside County	Executive Office		
Riverside County	Flood Control District	Degaga, Mekbif	
Riverside County	Regional Parks & Open Space District	Brewer, Marc	

AFFILIATION	DEPARTMENT	NAME	TITLE
Riverside County	Economic Development Agency		
Riverside County	Water Resources Management		
Desert Permit Assistance Center			
Riverside County Fire Department	Desert Office		
Riverside County Assessor			
Los Angeles County	Planning Department		
Western Riverside County Regional Conservation Authority		Landry, Charles	Executive Director
Orange County	Environmental & Project Planning Service Division		
Imperial County	Planning Department	Heuberger, Jurg	
La Paz County	Planning Department	Baker, Mike	Acting Planning & Zone Director
San Bernardino County	Planning Department		
San Diego County	Planning Department		
City/Local Agencies			
Airport Land Use Commission		Guerin, John	Principal Planner
Coachella Valley Association of Government			
City of Blythe	Community Services District		Development Services Director
City of Blythe	Development Services Department		
Blythe City Council	East Blythe Water District		
Palo Verde Irrigation District			
Palo Verde Resource Conservation District			
Elected Officials			
County of Riverside	4th Supervisor District, Board of Supervisors	Benoit, John	Supervisor
County of Riverside	5th Supervisor District, Board of Supervisors	Ashley, Marion	Supervisor
Native American Tribes			
Agua Caliente Band of Cahuilla Indians		Tuck, Patricia	THPO
AhaMaKav Cultural Society, Fort Mojave Indian Tribe		Otero, Linda	Director
Ah-Mut-Pipa Foundation (Quechan Kumeyaay)		Arrow-weed, Preston, J.	
Augustine Band of Cahuilla Mission Indians (Cahuilla)		Green, Mary Ann	Chairperson
Augustine Band of Cahuilla Mission Indians (Cahuilla)		Kupcha, Karen	
Cabazon Band of Mission Indians		Roosevelt, David	Chairperson
Cahuilla Band of Indians		Salgado, Luther	Sr. Chairperson
Chemehuevi		Joseph R. Benitez (Mike)	
Chemehuevi Reservation		Wood, Charles	Chairperson
Cocopah Museum/Cultural resources Dept. (Cocopah)		McCormick, Jill	Tribal Archaeologist
Colorado River Indian Tribe (Mojave, Chemehuevi)		Scott, Ginger	Museum Curator
Colorado River Indian Tribe (Mojave, Chemehuevi)		Ray, George	Coordinator

AFFILIATION	DEPARTMENT	NAME	TITLE
Fort Mojave Indian Tribe (Mojave)		McDowell, Nora	Cultural Resources Coordinator
Fort Yuma Quechan Indian Nation (Quechan)		Jackson, Michael	President
Morongo Band of Mission Indians (Cahuilla, Serrano)		Contreras, Michael	Cultural Heritage Prog.
Quechan Indian Nation		Nash-Chrabascz	THPO
Ramona Band of Cahuilla Mission Indians (Cahuilla)		Hamilton, Joseph	Chairman
San Manuel Band of Mission Indians (Serrano)		Brierty, Ann	Policy/Cultural Resources Dept.
Santa Rosa Band of Mission Indians (Cahuilla)		Estrada, Mayme	Chairwoman
Torres-Martinez Desert Cahuilla Indians (Cahuilla)		Chihuahua, Diana L.	Vice Chairperson, Cultural
Torres-Martinez Desert Cahuilla Indians (Cahuilla)		Resvaloso, Mary	
Twenty-nine Palms Band of Mission Indians (Chemehuevi)		Mike, Darrell	Chairperson

THPO = Tribal Historic Preservation Officer

THIS PAGE INTENTIONALLY LEFT BLANK

3.0 PUBLIC SCOPING MEETINGS

In compliance with CCR Section 15082(c), Riverside County conducted a public scoping meeting to inform the public about the project; describe the purpose and need of the project; provide information regarding the environmental review process; and gather public input regarding the scope and content of the EIR. The public scoping meeting was held on the following date and location:

December 12, 2011; 5:30 to 7 pm
Blythe City Council Chambers
235 N. Broadway
Blythe, CA 92225

The scoping meeting was announced in the NOP. The meeting was also advertised in the Desert Sun and Palo Verde Times on December 2, 2011. A copy of the newspaper advertisement may be found in Appendix B.

The copies of the PowerPoint presentation, display boards, comment form, and meeting transcript are located in Appendix C.

Project team members were available to answer questions about the displays and other project-related topics. The team members listed in Table 2 also listened to feedback, concerns and issues raised by the public.

TABLE 2. PROJECT TEAM MEMBERS ATTENDING THE PUBLIC SCOPING MEETING

Personnel	Role	Affiliation
Ken Baez	Principal Planner	Riverside County Planning Department
Jay Olivas	Planner	Riverside County Planning Department
Barbara Burrow	Planner	City of Blythe
Rupal Patel	Project Manager	Renewable Resources Group, Inc.
Jim James	Regulatory Affairs Manager	Renewable Resources Group, Inc.
Thomas Ryan	Project Manager	POWER Engineers, Inc.
Karen Cadavona	Project Coordinator	POWER Engineers, Inc.

A total of 6 people signed in at the scoping meeting (December 12, 2011). Attendees were encouraged to comment by filling out a comment form.

4.0 OUTREACH

4.1 NOTIFICATION TO SCOPING SESSION

A Notice of a Scoping Session was mailed to 120 property owners within 2,400 feet of the Project boundary (Appendix D). The notice briefly discussed the Proposed Project and date, time, and location of the scoping meeting.

4.2 NATIVE AMERICAN CONSULTATION

Tribal consultation under CEQA, Public Resources Code Section 21000 -21177, is “advisory” rather than mandated. However, the 2006 Senate Bill 1059 (Transmission Corridor Designation and Implementation) mandates tribal consultation for “electric transmission corridors.” This is codified in the California Public Resources Code, Chapter 4.3, and Section 25330 to Division 15, which require consultation with

California Native American tribes, and identifies both federally recognized and non-federally recognized tribes on a list maintained by the Native American Heritage Commission (NAHC).

In April 2011, a letter was submitted to the NAHC requesting information regarding Native American groups that may have historic ties to, and interest in, the proposed Blythe Mesa I Solar Project area. In May 2011, 20 CEQA scoping letters were sent to the tribes identified by the NAHC. A representative letter to the tribes may be found in Appendix E. Responses were received from the Aqua Caliente Band of Cahuilla Indians Tribal Historic Preservation Officer and Augustine Band of Cahuilla Indians

Tribal consultation required under Section 106 for the portion of the Project on public land will be performed by the U.S. Department of the Interior, Bureau of Land Management (BLM) on a government-to-government basis.

5.0 SCOPING COMMENTS SUMMARY

This section summarizes the comments received from the public and agencies during the scoping period for the Proposed Project from November 21, 2011 to December 21, 2011. A total of ten comments were received during the scoping period. All ten comments were received from agencies (one of the ten comments was a courtesy notice from the State Clearinghouse to comment in a timely manner).

Appendix F includes copies of the original comments as received during the NOP scoping period.

Below is a summary of the issues and comments that were raised by the commenters. The comments are organized by issue topic.

5.1 HUMAN ENVIRONMENT ISSUES

5.1.1 Air Quality

The Mojave Desert Air Quality Management District (MDAQMD) had no comment regarding the analysis of potential air quality impacts from the Proposed Project that would be included in the Draft EIR. The MDAQMD made mention of where to locate attainment plans.

5.1.2 Public Services and Utilities

The Riverside County Waste Management Department (RCWMD) was concerned that the quantity of waste generated during construction and demolition could have the potential to exceed a given landfill's daily permitted capacity. The RCWMD requested that the Draft EIR analyze the potential solid waste impact and specified that Project-generated waste would be disposed of at the Blythe Landfill (permitted to receive a maximum of 400 tons per day of refuse). In addition, the RCWMD requested the following measure for waste recycling: a Waste Recycling Plan (WRP), identifying the materials generated, their amounts, and recycling measures and reduction rates, to be submitted to the RCWMD for approval. The RCWMD also commented in acknowledgement of the Blythe Airport Dumpsite for use within the vicinity of the Proposed Project. Xeriscaping was also recommended, as well as the use of drought tolerant/low maintenance vegetation for landscaped Project areas.

Southern California Edison (SCE) commented that if the interconnection facilities to be constructed/relocated are over 200 kV, SCE is required to obtain a Certificate of Public Convenience and Necessity (CPCN) from the California Public Utilities Commission (CPUC). Early coordination with SCE is recommended to obtain certain permits for SCE facilities and scope of work necessary to

interconnect the Proposed Project. SCE also requested that the foreseeable SCE scope of work and associated impacts be submitted to the Lead Agency early in the environmental review process.

The Sheriff's Department, Colorado River Station commented on the location of the Project in relation to the Sheriff's Department Shooting Range in Parcel #824-080-004. 24-hour access is required and live fire activities could occur between 5:00 a.m. and 11:00 p.m. any day of the week.

5.1.3 Socioeconomics

The Southern California Association of Governments (SCAG) commented that the Draft EIR should reflect the most current SCAG forecasts, which is the 2008 Regional Transportation Plan (RTP), May 2008, Population, Household and Employment forecasts. SCAG also recommended referencing the 2008 RTP as well as SCAG's Regional Growth Principals. SCAG's List of Mitigation Measures should be reviewed and followed where applicable to the Project.

5.2 NATURAL ENVIRONMENT ISSUES

5.2.1 Hazardous Materials/Soils

The Department of Toxic Substances Control (DTSC) requests that the Draft EIR evaluate whether conditions within the Project area would pose a threat to human health or the environment using regulatory agency databases. DTSC also recommended that the Draft EIR identify the mechanism to initiate a required investigation and/or remediation for a site within the Proposed Project area that may be contaminated. Subsequently, any environmental investigation, sampling and/or remediation should be conducted under a regulatory agency approved work plan; any findings must be summarized in the document.

DTSC requested investigations for the presence of hazardous chemicals, mercury, and asbestos in buildings, structures, or paved surface areas to be demolished. If any soil excavation or filling is required, soil sampling may be necessary; if contaminated, it must be properly disposed of. Human health and sensitive receptors should be protected, and a health risk assessment may be necessary to determine if there are, have been, or will be, any hazardous materials releases. DTSC also recommended proper investigation and remedial actions, as on-site soils or groundwater could contain pesticides, agricultural chemical or organic waste. Any hazardous wastes generated must be managed under California Hazardous Waste Control Law. DTSC can provide cleanup oversight through an Environmental Oversight Agreement or Voluntary Cleanup Agreement if needed.

RCWMD commented regarding potential hazardous waste generated from Project activities. As hazardous materials are not accepted at Riverside County landfills, any hazardous waste generated must be disposed of at a permitted hazardous waste facility.

5.2.2 Cultural Resources

The Agua Caliente Band of Cahuilla Indians (ACBCI) commented that the Project is not located on lands managed by the ACBCI, but the Project is within the ACBCI's Traditional Trade Network Area. The ACBCI Tribal Historic Preservation Office (THPO) recommended a 100% cultural resources inventory of the Project area by a qualified archaeologist prior to any development activities (all documentation generated should be forwarded to the THPO for review). THPO also recommended the presence of an approved Native American Cultural Resource Monitor(s) during any ground disturbing activities.

Comments regarding cultural resources were also submitted by the NAHC. The NAHC's Sacred Lands File (SLF) search identified no Native American cultural resources within the Project area. However, the

absence of archaeological resources does not preclude their existence; the area is known to the NAHC to be culturally sensitive. Early consultation with Native American Tribes in the area is recommended and required. Tribes must be provided with all pertinent Project information. The NAHC recommended avoidance and resource documentation, as defined by CEQA Guidelines 15370(a) and 2183.2 respectively, for a project that would damage and/or destroy Native American cultural resources. In addition, the historic context of the Proposed Project and the cultural landscape must be considered. Any potential cultural resources discovered in the Project area may not be disclosed to keep historic properties of religious and cultural significance confidential.

5.2.3 Water Resources

The Riverside County Flood Control and Water Conservation District (District) commented regarding the watercourse and drainage patterns of the Project area. The District recommended that the Draft EIR describe the drainage of the general area, the Project site, and the site's tributary drainage. In addition, the Draft EIR should include a description of how on-site storm runoff would be collected and adequately conveyed, a description of how the Project collects and protects against off-site storm runoff, the identification and description of an existing drainage facility in the area, and detail regarding the impacts and mitigation for water quality caused by development. Hydrology/hydraulic study, exhibits, and other pertinent information should also be included. As a natural watercourse bisects the low southern portion of the Project, the Draft EIR should also address how the Project would mitigate impacts to floodplain(s) or watercourses. Lastly, the District recommends that a grading and drainage plan should be included in the Draft EIR; the maintenance access and site grading should be designed to maintain the existing natural drainage patterns with respect to tributary drainage areas, outlet points, and outlet conditions.

6.0 NEXT STEPS IN THE EIR PROCESS

Comments received during the public scoping period will be considered during the preparation of the Draft EIR. The Draft EIR is anticipated for public review in Summer 2012 and agencies, organizations, and Native American Tribes will have an opportunities to provide additional input on the Draft EIR. The Final EIR is expected in late summer 2012. The Project is expected to be considered by the County of Riverside Board of Supervisors in late summer 2012.

APPENDIX A: NOTICE OF PREPARATION AND MAILING LIST

AR060814

RIVERSIDE COUNTY
PLANNING DEPARTMENT

Carolyn Syms Luna
Director

Agency Notice of Preparation of an Draft Environmental Impact Report

DATE: November 16, 2011

TO: _____
_____
_____

PROJECT CASE NO./TITLE: Environmental Impact Report No. 529 / Conditional Use Permit No. 3670 / Public Use Permit No. 913 / Blythe Mesa I Solar Project

PROJECT LOCATION: East Riverside County - Palo Verde Area Plan, the Blythe Mesa I Solar Project is located approximately 5 miles west of central Blythe and 40 miles east of Desert Center; more specifically, the project is located north and south of Interstate 10, west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport. The site consists primarily of agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde. APNs 821-110-004, 821-120-025, 821-120-026, 821-120-027, etc. (see attached sheet entitled "Blythe Mesa Solar Project" "Assessor's Parcels for Solar Field (CUP03670)". Also, as shown on the exhibits entitled "Blythe Mesa Solar Project - Topographic Quadrangle Map", "Public Use Permit", "Blythe Mesa Solar Project Conditional Use Permit #3670 Pages 1 & 2", Exhibits "A1", "Notice of Preparation Attachment A", "Figure 1: Regional Area Map", "Figure 2: Site Plan & Solar Module", and "Figure 3: Typical Tiled Tracker Panels".

PROJECT DESCRIPTION: The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of approximately 3,660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of 8 feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. Since most of the site has nearly level to gently sloping topography, no mass grading would be required and the natural drainage patterns of the site would not be significantly altered. The Project site would be secured 24 hours per day by onsite private security personnel or remote services with motion-detection cameras. An equestrian-wire, wildlife-friendly and drainage-compaitble security fence that meets National Electric Safety Code would be placed around the perimeter of the site. The proposed lighting for the site would be consistent with County building code. A new 8.4 mile long, 230 kilovolt (kV) double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site subject to Public Use Permit (3.6 miles of the gen-tie line are located within the project site, and 4.8 miles are located off-site between the project site and the Colorado River Substation). A majority of the project is within the County of Riverside jurisdiction. An approximate 330-acre portion of the 3,660-acre project site is located within the City of Blythe jurisdiction. A Development Agreement between the County of Riverside and the applicant will be established setting forth the rights and responsibilities of each party with respect to project development and operation.

Riverside Office · 4080 Lemon Street, 12th Floor
P.O. Box 1409, Riverside, California 92502-1409
(951) 955-3200 · Fax (951) 955-1811

Desert Office · 38686 El Cerrito Road
Palm Desert, California 92211
(760) 863-8277 · Fax (760) 863-7555

LEAD AGENCY:
Riverside County Planning Department
4080 Lemon Street, 12th Floor
P.O. Box 1409
Riverside, CA 92502-1409
Attn: Jay Olivas, Project Planner

PROJECT SPONSOR:
Applicant: Renewable Resources Group
Address: 5700 Wilshire Blvd., Ste. 330
Los Angeles, CA 90036

Pursuant to Riverside County Rules to Implement the California Environmental Quality Act ("CEQA"), notice is given to responsible and interested agencies that the Riverside County Planning Department plans to oversee the preparation on an Environmental Impact Report for the above-described project. Given that the above-described project is subject to both CEQA and the National Environmental Policy Act ("NEPA"), a combined Environmental Impact Report – Environmental Impact Statement will be prepared. The purpose of this notice is to solicit guidance from your agency as to the scope and content of the environmental information to be included in the EIR. In accordance with the time limits mandated by State law, information in that regard should be submitted to this office as soon as possible, but **not later than thirty (30) days** after receiving this notice.

In addition to offering the opportunity to submit written comments, the County of Riverside will hold a scoping meeting to discuss the proposed project, environmental process, and provide agency representation, individuals, and other interested parties the opportunity to make oral comments regarding the scope of the EIR. The scoping meeting will be held at the time a place indicated below.

Blythe Mesa I Solar Project Scoping Meeting
Date: December 12, 2011
Time: 6:00 p.m.
Location: Blythe City Council Chambers
235 North Broadway
Blythe, CA 92225

Attached is a copy of the issues to be included in the draft EIR. If you have any questions please contact Jay Olivas, Project Planner at (951) 955-1195 or E-mail at jolivas@rctlma.org.

Sincerely,

RIVERSIDE COUNTY PLANNING DEPARTMENT
Carolyn Syms Luna, Director

Jay Olivas, Project Planner

Y:\Planning Master Forms\CEQA Forms\NOP Forms\Notice of Preparation-Agency.doc

Blythe Mesa Solar Project

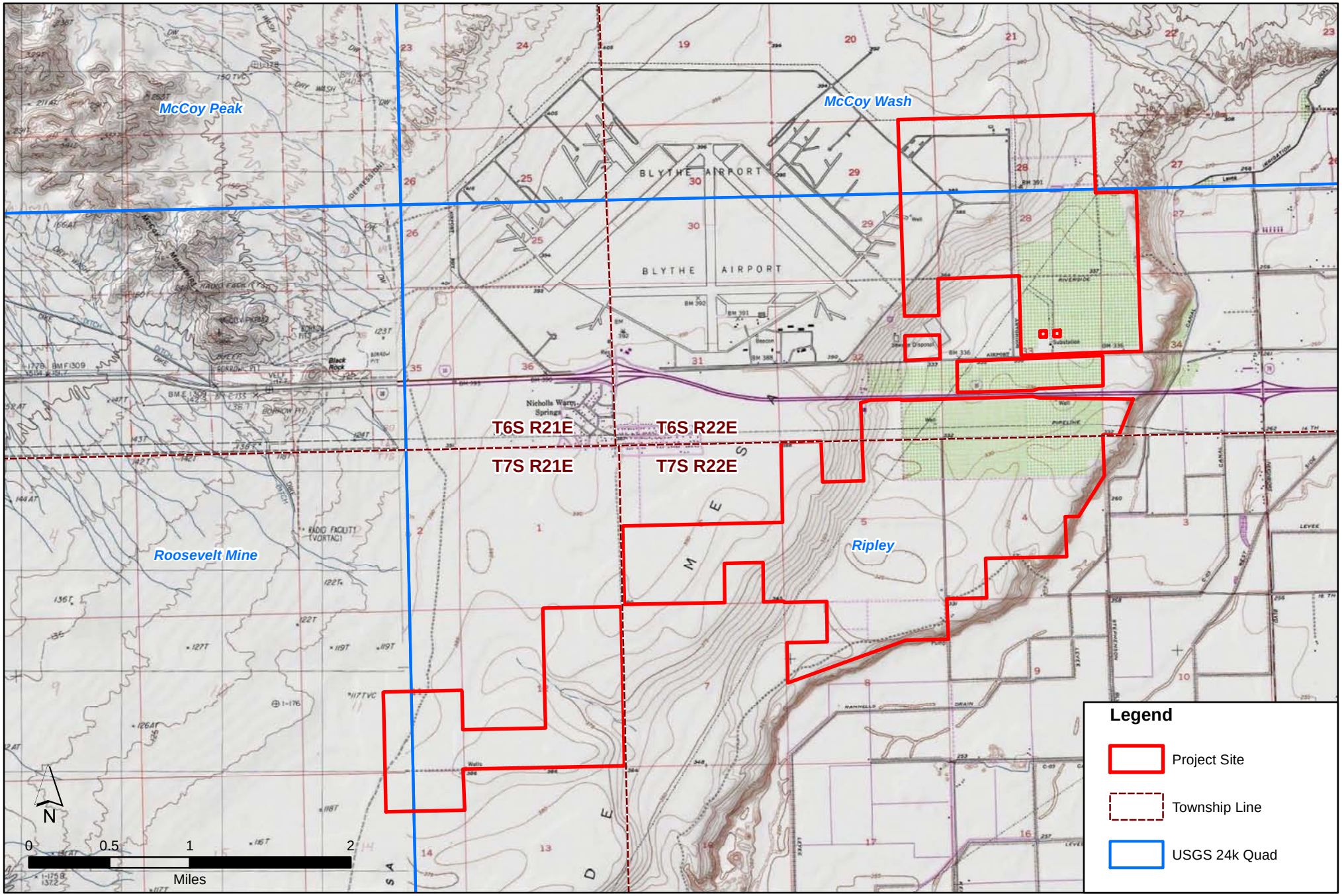
Assessor's Parcels for Solar Field (CUP03670)

Riverside County				City of Blythe
821110004	824102015	863040015	863100010	824101014
821120025	824102016	863040017	863100011	824101015
821120026	824130006	863040020	863100012	824101016
821120027	824130007	863040021	863100016	824101017
821120028	863030002	863050004	879090036	824102020
821120029	863030003	863050007	879090037	824102023
821120038	863030004	863050008	879090038	824102024
821120039	863030005	863050009	879090039	824102026
821120040	863030006	863060015	879090040	824102027
821120042	863030007	863060016	879090041	824110035
821120043	863030008	863060017	879090042	824110036
821120044	863030009	863060018	879090043	824110037
821120048	863030010	863070018	879090044	824110038
824080003	863030013	863070019	879090045	824122013
824080005	863030014	863070022	879090048	
824090009	863030015	863100005	879090049	
824090024	863030016	863100006	879090050	
824102013	863030017	863100008	879090051	
824102014	863040001	863100009	879110013	
			879110014	

Assessor's Parcels for Transmission Line

Riverside County	BLM
879080013	879080020
879080014	879080021
879080028	879080022
879080032	879080024
879090048	879080026
	879080027
	879090033
	879090034
	879090035

Blythe Mesa Solar Project



Topographic Quadrangle Map
Ripley, Roosevelt Mine, McCoy Wash, & McCoy Peak, CA
7.5 Min Series

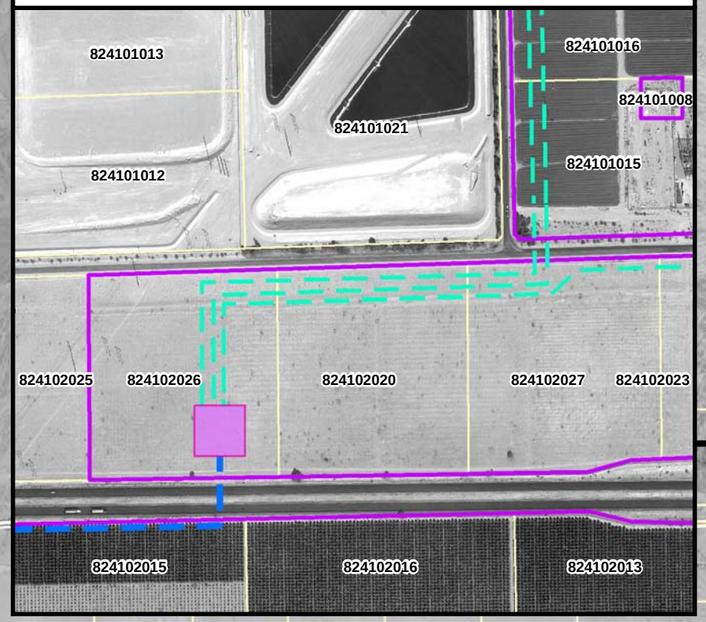
THIS PAGE INTENTIONALLY LEFT BLANK

Blythe Mesa Solar Project

Riverside County, CA

Public Use Permit

Parcel Detail Area



Blythe Airport

W Hobsonway

Mesa Dr

10

78

Colorado River Substation Site

Legend

- Parcel Boundaries
- Blythe Mesa Solar Project
- Proposed 230 kV Blythe Mesa Line
- Proposed 34.5 kV Blythe Mesa Lines
- Colorado River Substation Site
- Proposed Collector Substation



POWER ENGINEERS

RRG

N
W
E
S

0 1,600 3,200 6,400 9,600

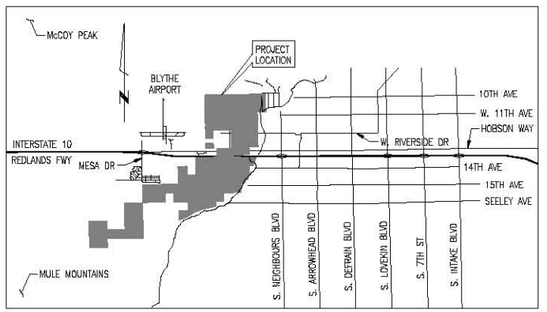
Feet

AR060820

P:\Projects\122512\DD\Apps\Public_Use_Permit.mxd

THIS PAGE INTENTIONALLY LEFT BLANK

BLYTHE MESA SOLAR PROJECT CONDITIONAL USE PERMIT #3670



Vicinity Map

Project Description:

Blythe Mesa Solar is a 485 megawatt (MW) photovoltaic solar power plant on approximately 84 parcels totaling 3,428.15 acres. A total of 330 power blocks will be constructed, each will be constructed containing an equipment pad and a 9'X18' parking area. The proposed panels will have a maximum height of 8'. The site will be secured with a 6 foot chain-linked fence topped with 2' of barbed wire and all construction staging and temporary facilities will be on site within the project area. These new project substations will consist of a 34.5 to 230kV transformer and will interconnect to the new Southern California Edison (SCE) Colorado River Substation 230 kV switchyard.

County Water Quality Management Plan:

Project is not located in the Santa Ana, Santa Margarita, San Jacinto and Whitewater River Watersheds. The project will not alter the existing natural drainage pattern of the site.

Utilities:

School District: Palo Verde Valley Unified School District
Water: Palo Verde Irrigation District and City of Blythe
Sewer: City of Blythe (Project will provide it's own private septic system)
Gas: Southern California Gas Company
Electricity: Southern California Edison
Telephone: Verizon
Cable Television: NPG Cable, Inc. (a.k.a. Blythe Cable)

Community Services District:

None

Dwelling Units/Lots and Recreational Vehicle Spaces:

None

Occupancy Classification:

U

Specific Plan:

None

Typical street improvement cross-sections:

None proposed.

Existing or Proposed Common, Open Space, Landscaped, Planting or Recreational Area:

None

Easement Notes:

Rivera #11. An easement shown or dedicated on the map of Parcel Map No. 14907 on file recorded January 29, 1981 in Book 87, Page 96, of Parcel Maps. For: Public roads and incidental purposes. The location of the easement cannot be determined from record information. (Not plottable).

Cocopah #27. An easement for pipeline for conveyance of water and incidental purposes, recorded December 5, 1955 as Instrument No 85-274269 of Official Records. (See sheet 2 for Location)

Cocopah #40/41/112. The effect of a Declaration of Dedication as show by the Owners Certificate on Parcel Map Book 100 pages 52 to 58 of Parcel Maps, purporting to irrevocably dedicate in perpetuity for public road purposes, public and public services, the property described therein. (See sheet 2 for Location)

The effect of a Resolution, on said Map, by the Riverside County Board of Supervisors accepting said offer of Dedication for the purpose of vesting title in the County of Riverside on behalf of the public, but not as part of the county-maintained road system.

Cocopah #45. An easement for road and incidental purposes, recorded October 10, 1922 in Book 544 of Deeds, Page 168. (See sheet 2 for Location)

Cocopah #64. An easement for road and incidental purposes, recorded October 3, 1922 in Book 544 of Deeds, Page 168.

Cocopah #111. The effect of a Declaration of Dedication as show by the Owners Certificate on said Parcel Map No. 14453, purporting to irrevocably dedicate in perpetuity for public road purposes, public utility and public services, the property described therein.

The effect of a Resolution, on said Map, by the Riverside County Board of Supervisors accepting said offer of dedication for the purpose of vesting title in the County of Riverside on behalf of the public, but not as part of the county-maintained road system. (Not plottable).

SunWorld #61. An easement for existing public utilities and/or public service facilities and incidental purposes, recorded May 29, 1975 as Instrument No. 62197 of Official Records. (See sheet 2 for Location)

SunWorld #70. An easement shown or dedicated on the map filed or recorded as Parcel Map 14093 in Book 105, Pages 78 through 87 of Parcel Maps. For: Road and public utilities and incidental purposes. (See sheet 2 for Location)

SunWorld #73. An easement shown or dedicated on the map filed or recorded as Parcel Map No. 16920 in Book 112, Pages 44 through 49 of Parcel Maps. For: Road and public utilities and incidental purposes. (See sheet 2 for Location)

Other Easements of Record have been provided by Applicant and can be obtained by contacting the Planner and requesting List of Exceptions and Plotted Easement Maps.

Drainage and Grading Notes:

See attached Preliminary Grading and Drainage Plan. The proposed improvements do not include significant alternation of the land or the existing drainage patterns. No significant hardscape is proposed that would warrant need for onsite retention or detention facilities.

No mass grading is required for site, which is nearly level to gently sloping topography. Light grubbing and minimal grading and trenching would be required where facilities and tracker arrays are proposed. The Project proposes balanced cut/fill grading of 800,000 cubic yards, to grade the 1,000-acre citrus orchard to a depth of 3 inches. In order to aim for balanced cut-and-fill quantities, grading activities may include placement and compaction of excess materials in low-elevation areas of site. Fine grading would be required for development of site access roads.

Installation of the electrical collection system within the arrays would require excavations to a depth of about three feet for underground electrical circuits. Inverter and switchgear enclosure foundations, and transformer foundations. The O&M building foundation would be excavated to a depth of about three feet. Foundations for substation structures and gen-tie towers or poles would be augured to depths of 10 feet for medium-voltage overhead lines to 45 feet for high-voltage overhead lines, depending on structural loads and soil conditions.

Flood Notes:

Land is not subject to overflow, inundation, flood hazard, liquefaction, geologic hazard, or a Special Studies Zone. FEMA maps are not available for subject area. Centerline curve radii and typical sections of open channels are not applicable to project site.

Assessor Parcel Numbers

821-110-004; 821-120-025; 821-120-026; 821-120-027; 821-120-028; 821-120-029; 821-120-030; 821-120-038; 821-120-039; 821-120-040; 821-120-042; 821-120-043; 821-120-044; 821-120-048; 824-080-003; 824-080-005; 879-090-036; 879-090-037; 879-090-038; 879-090-039; 879-090-040; 879-090-041; 879-090-042; 879-090-043; 879-090-044; 879-090-045; 879-090-048; 879-090-049; 879-090-050; 879-090-051; 879-110-013; 879-110-014; 824-090-009; 824-080-024; 824-102-013; 824-102-014; 824-102-015; 824-102-016; 824-130-006; 824-130-007; 863-040-001; 863-040-015; 863-040-017; 863-040-020; 863-040-021; 863-050-004; 863-050-007; 863-050-008; 863-050-009; 863-060-015; 863-060-016; 863-060-017; 863-060-018; 863-070-018; 863-070-019; 863-070-022; 863-100-005; 863-100-006; 863-100-008; 863-100-009; 863-100-010; 863-100-011; 863-100-012; 863-100-016; 863-100-017; 866-021-007; 866-022-002; 863-030-015; 863-030-007; 863-030-010; 863-030-009; 863-030-003; 863-030-004; 863-030-016; 863-030-017; 863-030-005; 863-030-006; 863-030-014; 863-030-002; 863-030-013; 863-030-008

Project Site Area Breakdown:

Facility/Structure	Total Square Feet
Piles	35,183
Drive Motors (0.5hp)	10,494
Equipment Pads	128,075
Switchyards	0
Project Substations	291,534
Paved Roads	0
O&M Buildings & Parking	183,892
TOTAL	649,478

Gross/Net Area:

3,428.15 acres

Zoning and Land Use:

Zoning: A-1-10, W-2-5, W-2-10, N-A
Land Use: Agriculture, RC-EDR (Project Site); OS-RUR (Gen-tie Line ROW)

Applicant:

Renewable Resources Group
5700 Wilshire Blvd., Suite 330
Los Angeles, CA 90036
Contact: Rupal Patel
Phone: 323-936-9303

Land Owner:

Gila Farm Land, LLC
5700 Wilshire Blvd., Suite 330
Los Angeles, CA 90036
Contact: Rupal Patel
Phone: 323-936-9303

Exhibit Preparer:

POWER Engineers
19820 N. 7th St.
Phoenix, Arizona 85024
Phone: 623-582-1006

Thomas Bros. Page:

Pages 5549 and 5550 – Generation Site
Page 86, Grid F4 – Gen-Tie Line ROW

LEGAL DESCRIPTION

PARCEL A: (APN: 824-130-007)
THAT PART OF THAT PORTION OF THE SOUTHWEST QUARTER OF SECTION 34, TOWNSHIP 6 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, ACCORDING TO UNITED STATES GOVERNMENT SURVEY APPROVED OCTOBER 6, 1858, AS SAID PORTION WAS CONVEYED TO THE STATE OF CALIFORNIA BY DEED RECORDED AUGUST 10, 1967, SOUTHERLY OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT THE SOUTHWESTERLY TERMINATION OF THAT COURSE DESCRIBED AS SOUTH 33°32'18" WEST, 241.29 FEET TO THE SOUTH LINE OF THE NORTHEAST QUARTER OF SAID SOUTHWEST QUARTER IN SAID DEED TO THE STATE OF CALIFORNIA, SAID POINT OF BEGINNING BEING A POINT ON THE EXISTING WESTERLY RIGHT OF WAY HIGHWAY INTERSTATE 10 AND 71.76 FEET RIGHT OF ENGINEERS STATION 2868 PLUS 16.58 OF THE ER LINE OF SAID HIGHWAY; THENCE SOUTH 89°12'33" WEST, 224.65 FEET; THENCE SOUTH 75°14'20" WEST, 610.16 FEET; THENCE NORTH 89°25'15" WEST, 1400.52 FEET TO A POINT 185 FEET RIGHT OF ENGINEERS STATION 276 PLUS 00 OF SAID ER LINE.

EXCEPT THAT PORTION LYING EAST OF THE FOLLOWING DESCRIBED LINE OF THE PALO VERDES IRRIGATION DISTRICT, BEGINNING AT A POINT ON THE SOUTH LINE OF SECTION 34, WHICH POINT IS EAST 509.08 FEET FROM THE SOUTHWEST CORNER THEREOF; THENCE NORTH 20°21'46" EAST 1408.97 FEET, MORE OR LESS TO THE NORTH LINE OF THE SOUTH HALF OF THE SOUTHWEST QUARTER OF SECTION 34, TOWNSHIP 6 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA.

PARCEL B: (APN: 863-040-001-3)
THE NORTHWEST 1/4 OF TRACT NO. 57, SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, SHOWN BY INDEPENDENT RESURVEY OF SAID TOWNSHIP, ACCEPTED BY THE UNITED STATES LAND OFFICE, IN MAY 1919.

PARCEL C: (APN: 863-040-017-7)

PARCEL 1:
THE SOUTH HALF OF TRACT NO. 57, IN SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY INDEPENDENT RESURVEY OF SAID TOWNSHIP, ACCEPTED BY THE UNITED STATES LAND OFFICE, IN MAY 1919.
EXCEPTING THEREFROM THAT PORTION LYING WITHIN THE FOLLOWING DESCRIBED PROPERTY:

LOTS 4 AND 5, IN SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES INDEPENDENT RESURVEY, APPROVED DECEMBER 18, 1919, TOGETHER WITH THAT PORTION OF THE SOUTH HALF OF TRACT NO. 57, IN SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY INDEPENDENT RESURVEY OF SAID TOWNSHIP, ACCEPTED BY THE UNITED STATES LAND OFFICE, IN MAY, 1919, SAID PORTION LYING SOUTHEASTERLY OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT THE INTERSECTION OF THE SOUTHERLY LINE OF SAID TRACT NO. 57, WITH THE CENTER LINE OF THAT CERTAIN STRIP OF LAND, 50 FEET IN WIDTH, AS IN THE RIGHT OF WAY EASEMENT TO THE IMPERIAL IRRIGATION DISTRICT, RECORDED FEBRUARY 11, 1954 AS INSTRUMENT NO. 6893, IN BOOK 1553 PAGES 574, 575 AND 576, ALL OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, SAID POINT OF INTERSECTION BEING WEST, 429.78 FEET FROM THE SOUTHEAST CORNER OF SAID TRACT NO. 57; THEN ALONG SAID CENTER LINE, AND IN NORTHEASTERLY PROLONGATIONS THEREOF, NORTH 37° 55' EAST, TO THE EASTERLY LINE OF SAID GOVERNMENT LOT 4.

PARCEL 2:
THAT PORTION OF GOVERNMENT LOTS 4 AND 5, IN SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES INDEPENDENT RESURVEY, APPROVED DECEMBER 16, 1919, LYING NORTHWESTERLY OF THE FOLLOWING DESCRIBED LINE:

BEGINNING AT THE INTERSECTION OF THE SOUTHERLY LINE OF SAID TRACT NO. 57, WITH THE CENTER LINE OF THAT CERTAIN STRIP OF LAND, 50 FEET IN WIDTH, AS IN THE RIGHT OF WAY EASEMENT TO THE IMPERIAL IRRIGATION DISTRICT, RECORDED FEBRUARY 11, 1954 AS INSTRUMENT NO. 6893, IN BOOK 1553 PAGES 574, 575 AND 576, ALL OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, SAID POINT OF INTERSECTION BEING WEST, 429.78 FEET FROM THE SOUTHEAST CORNER OF SAID TRACT NO. 57; THEN ALONG SAID CENTER LINE, AND IN NORTHEASTERLY PROLONGATIONS THEREOF, NORTH 37° 55' EAST, TO THE EASTERLY LINE OF SAID GOVERNMENT LOT 4.

PARCEL 3:
INTENTIONALLY DELETED

PARCEL 4:
INTENTIONALLY DELETED

PARCEL D: (APN: 824-090-009-0)
THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 32, TOWNSHIP 6 SOUTH, RANGE 23 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, ACCORDING TO UNITED STATES GOVERNMENT SURVEY.
EXCEPTING THEREFROM PORTION DESIGNATED FOR STATE HIGHWAY PURPOSES, AS SET FORTH IN THAT CERTAIN FINAL ORDER OF CONDEMNATION RECORDED MARCH 27, 1956 AS INSTRUMENT NO. 28928, OFFICIAL RECORDS OF SAID RIVERSIDE COUNTY.

PARCEL D1:
INTENTIONALLY DELETED

PARCEL D2:
INTENTIONALLY DELETED

PARCEL E: (APN: 863-050-009-1)
THAT PORTION OF PARCEL 11, INCLUSIVE, OF PARCEL MAP 14453, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY PARCEL MAP ON FILE IN BOOK 100, PAGES 53 THROUGH 58, INCLUSIVE, OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF PARCEL 11 OF PARCEL MAP NUMBER 14453 AS RECORDED IN BOOK 100 AT PAGES 52 THROUGH 58 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA; THENCE NORTH 89° 14' 22" EAST, 2242.89 FEET; THENCE SOUTH 38° 58' 48" WEST, 477.84 FEET; THENCE SOUTH 89° 14' 22" WEST, 1800.31 FEET TO THE WESTERLY LINE OF PARCEL 11; THENCE NORTH 0° 46' 13" WEST ALONG THE WEST LINE OF PARCEL 11, 377.57 FEET TO THE POINT OF BEGINNING.

EXCEPTING THEREFROM THAT PORTION FOR PUBLIC STREET AND UTILITY PURPOSES OVER THAT PORTION OF THE LAND WITHIN LAND EASEMENTS SHOWN AS 15TH AVENUE, AS SHOWN OR DEDICATED UPON THE MAP OF PARCEL MAP 14453 ON FILE IN BOOK 100, PAGES 52 THROUGH 58 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL F: (APN: 863-100-016-1)
PARCEL 18 OF PARCEL MAP NO. 14,453 FILED JANUARY 21, 1982 IN BOOK 100 PAGES 52 THROUGH 58, OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, EXCEPTING THEREFROM THAT PORTION DESCRIBED AS FOLLOWS:
BEGINNING AT THE CENTERLINE OF THE INTERSECTION OF 16TH AVENUE AND KEIM BOULEVARD AS SHOWN ON SAID PARCEL MAP 14,453;
THENCE NORTH 89° 06' 19" EAST ALONG THE CENTERLINE OF 16TH AVENUE A DISTANCE OF 218.58 FEET TO THE NORTHEAST CORNER OF SAID PARCEL 18;
THENCE SOUTH 01° 32' 20" EAST ALONG THE EASTERLY LINE OF SAID PARCEL 18 A DISTANCE OF 750.00 FEET;
THENCE SOUTH 89° 06' 19" WEST CONTINUING ON THE LOT LINE OF SAID PARCEL 18, A DISTANCE OF 75.00 FEET;
THENCE SOUTH 01° 32' 20" EAST ALONG THE EASTERLY LINE OF SAID PARCEL 18 A DISTANCE OF 1088.58 FEET TO THE SOUTHEASTERLY CORNER OF SAID PARCEL 18;
THENCE SOUTH 88° 56' 54" WEST ALONG THE SOUTHERLY LINE OF SAID PARCEL 18 A DISTANCE OF 1060.60 FEET TO A POINT ON THE CENTERLINE OF SAID KEIM BOULEVARD;
THENCE NORTH 01° 32' 20" WEST ALONG THE CENTERLINE OF SAID KEIM BOULEVARD A DISTANCE OF 498.51 FEET;
THENCE NORTH 03° 25' 40" WEST CONTINUING ALONG THE CENTERLINE OF SAID KEIM BOULEVARD A DISTANCE OF 1321.54 FEET TO THE POINT OF BEGINNING.
THIS DEED IS GIVEN PURSUANT TO LOT LINE ADJUSTMENT NO. 1747 APPROVED BY THE RIVERSIDE COUNTY PLANNING DEPARTMENT DATED AUGUST 24, 1983 WHEREIN THAT PORTION OF PARCEL 18 EXCEPTED FROM PARCEL "F" ABOVE BECOMES A PART OF PARCEL 14.

PARCEL F1:
AN EASEMENT FOR PUBLIC STREET AND UTILITY PURPOSES OVER THAT PORTION OF THE LAND WITHIN ROAD EASEMENTS SHOWN AS BUTCH AVENUE, 14TH AVENUE, 15TH AVENUE, 16TH AVENUE, AND KEIM BOULEVARD, AS SHOWN OR DEDICATED UPON THE MAP OF PARCEL MAP 14,453 RECORDED IN BOOK 100 PAGES 52 THROUGH 58 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA;
EXCEPTING THEREFROM THOSE ROAD EASEMENTS LYING WITHIN PARCEL "F" ABOVE.

PARCEL G: (APN'S: 863-100-005-1 AND 863-100-009-2)
THAT PORTION OF GOVERNMENT TRACT NO. 57, IN SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN ON THE SUPPLEMENTAL DIAGRAM OF THE SURVEY OF ENTRIES, INDEPENDENT RESURVEY ACCEPTED MAY 10, 1919, BY THE GOVERNMENT LAND OFFICE, LYING OUTSIDE OF THE PALO VERDE IRRIGATION DISTRICT BOUNDARY, AS THAT BOUNDARY EXISTED ON FEBRUARY 12, 1948;
EXCEPTING THAT PORTION, IF ANY, LOCATED IN THE EASTERLY 1182.6 FEET OF TRACT NO. 67.

PARCEL H: (APN'S: 824-090-024; 824-102-013 THROUGH 824-102-016; 863-080-015 THROUGH 863-080-018; 863-040-015; 863-050-004; 863-050-007; 863-050-008; 863-070-018; 863-070-019; 863-070-022; 863-100-008 THROUGH 863-100-012)
PARCELS 1 THROUGH 18, INCLUSIVE, AND PARCELS 19 THROUGH 33, INCLUSIVE, OF PARCEL MAP 14453, AS SHOWN BY MAP ON FILE IN BOOK 100 PAGE(S) 52 THROUGH 58, INCLUSIVE, OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA;
EXCEPTING THEREFROM THAT PORTION OF LOT 11 OF PARCEL MAP 14453, AS DEEDED TO KARIN HESSELBERG, GEE. SEIDL, A MARRIED WOMAN AS TO AN UNDIVIDED 1/6 INTEREST; WALTER LUCAS, A SINGLE MAN AS TO AN UNDIVIDED 1/6 INTEREST; HEINZ NORDMANN, A MARRIED MAN AS TO AN UNDIVIDED 1/6 INTEREST; HORNER DITTMANN, A MARRIED MAN AS TO AN UNDIVIDED 1/6 INTEREST; HERMANN CLASEN, A MARRIED MAN AS TO AN UNDIVIDED 1/6 INTEREST; AND STEFFEN DITTMANN, A MARRIED MAN AS TO AN UNDIVIDED 1/6 INTEREST, ALL AS TENANTS IN COMMON, BY DEED RECORDED OCTOBER 11, 1988 AS INSTRUMENT NO. 293738 OF OFFICIAL RECORDS; PURSUANT TO LOT LINE ADJUSTMENT CASE NO. 2184 APPROVED BY THE RIVERSIDE COUNTY PLANNING DEPARTMENT ON AUGUST 18, 1988.

PARCEL H1:
A NON-EXCLUSIVE EASEMENT FOR THE PURPOSE OF INGRESS AND EGRESS AND IRRIGATION INCLUDING THE RIGHT TO USE, MAINTAIN, REPAIR, RECONSTRUCT, ENLARGE AND OR INSTALL ROADS, IRRIGATION DITCHES, UTILITY SERVICES AND OR PIPELINES WITHIN SAID WESTERLY 100 FEET OF THE FOLLOWING DESCRIBED PROPERTY:
THE SOUTH HALF OF TRACT 68 IN SECTION 9, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES INDEPENDENT RESURVEY APPROVED DECEMBER 16, 1919 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA;
EXCEPTING THEREFROM THE NORTHERLY 30 ACRES.

PARCEL H2:
A NON-EXCLUSIVE EASEMENT FOR CONVEYANCE OF WATER THROUGH EXISTING CANAL, PIPES, AND PUMPING SYSTEM FOR IRRIGATION OVER AND ACROSS THE SOUTHERLY PORTION OF THE FOLLOWING SAID PROPERTY:
THAT PORTION OF THE NORTH HALF OF THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, BEING ALSO SHOWN AS THE WEST TWO-THIRDS OF TRACT 48 OF SECTION 3, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES GOVERNMENT SURVEY ACCEPTED MAY 10, 1919, LYING WEST OF THE MID-LINE OF THE PALO VERDE IRRIGATION DISTRICT'S DRAINAGE CANAL, DESIGNATED AS RUNNELL'S DRAIN ON RECORD OF SURVEY ON FILE IN BOOK 17 PAGE 48 OF RECORDS OF SURVEY, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, AS CONVEYED TO G.B. INVESTMENT CO., AN ARIZONA CORPORATION, BY DEED FROM J.E. HASON AND WIFE, RECORDED MAY 3, 1967, AS INSTRUMENT NO. 37728 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL H3:
AN EASEMENT FOR PUBLIC STREET AND UTILITY PURPOSES OVER THAT PORTION OF THE LAND WITHIN ROAD EASEMENTS SHOWN AS BUTCH AVENUE, 14TH AVENUE, 15TH AVENUE, 16TH AVENUE AND KEIM BOULEVARD, AS SHOWN OR DEDICATED UPON THE MAP OF PARCEL MAP 14,453 ON FILE IN BOOK 100 PAGES 52 THROUGH 58 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA;
EXCEPTING THEREFROM THOSE ROAD EASEMENTS LYING WITHIN PARCEL H AND PARCEL L.
SAID PARCEL MAP 14,453 BEING A DIVISION OF A PORTION OF SECTIONS 32 AND 33, TOWNSHIP 6 SOUTH, RANGE 23 EAST AND A PORTION OF SECTIONS 4, 5, 8 AND 9, TOWNSHIP 7 SOUTH, RANGE 22 EAST SAN BERNARDINO BASE AND MERIDIAN.

PARCEL I: (APN: 824-130-006-0)
THE WEST 30 FEET OF THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 34, TOWNSHIP 6 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN.
EXCEPTING THEREFROM THAT PORTION DESCRIBED BY FINAL ORDER OF CONDEMNATION RECORDED SEPTEMBER 4, 1998 AS INSTRUMENT NO. 85686 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL J: (APN'S: 863-040-022-9 AND 863-040-021-0)
THAT PORTION OF THE NORTH HALF OF SECTION 5, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN DESCRIBED AS FOLLOWS:

COMMENCING AT THE WESTERLY COMMON PARCEL CORNER OF PARCEL 1 AND PARCEL 10 OF PARCEL MAP NO. 14453 AS RECORDED IN BOOK 100 AT PAGE 52 THROUGH 58 RECORDS OF RIVERSIDE COUNTY CALIFORNIA; THENCE SOUTH 1° 50' 48" EAST ALONG THE WEST LINE OF PARCEL 10 A DISTANCE OF 384.20 FEET TO THE TRUE POINT OF BEGINNING; THENCE CONTINUING SOUTH 0° 50' 48" EAST ALONG THE WEST LINE OF PARCEL 10 A DISTANCE OF 2580.00 FEET TO THE NORTH CORNER OF PARCEL 17; THENCE SOUTH 0° 50' 48" EAST 1960.07 FEET TO THE SOUTHEAST CORNER OF PARCEL 17; THENCE SOUTH 88° 56' 18" WEST ALONG THE SOUTH LINE OF PARCEL 17 A DISTANCE OF 1321.68 FEET; THENCE SOUTH 89° 14' 22" WEST ALONG THE SOUTH LINE OF PARCEL 17, A DISTANCE OF 256.00 FEET TO THE WEST CORNER OF PARCEL 17; THENCE CONTINUING SOUTH 89° 14' 22" WEST ALONG THE NORTH LINE OF PARCEL 11, A DISTANCE OF 148.00 FEET; THENCE NORTH 39° 58' 48" EAST 2813.68 FEET TO THE TRUE POINT OF BEGINNING. SAID PROPERTY INCLUDES ALL OF PARCEL 17 OF PARCEL NO. 14453 AS SHOWN ON MAP ON FILE IN BOOK 100 PAGES 52 THROUGH 58 INCLUSIVE, OF PARCEL MAPS, RIVERSIDE COUNTY RECORDS.
A CERTIFICATE OF LOT LINE ADJUSTMENT NO. 2183 WAS APPROVED AUGUST 19, 1985.

PARCEL J1:
A NON EXCLUSIVE EASEMENT FOR THE PURPOSE OF INGRESS AND EGRESS AND IRRIGATION INCLUDING THE RIGHT TO USE, MAINTAIN, REPAIR, RECONSTRUCT, ENLARGE AND OR INSTALL ROADS, IRRIGATION DITCHES, UTILITY SERVICES AND OR PIPELINES WITHIN SAID WESTERLY 100 FEET OF THE FOLLOWING DESCRIBED PROPERTY:
THE SOUTH HALF OF TRACT 88 IN SECTION 9 TOWNSHIP 7 SOUTH RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN AS SHOWN BY UNITED STATES INDEPENDENT RESURVEY APPROVED DECEMBER 16, 1919 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.
EXCEPTING THEREFROM THE NORTHERLY 30 ACRES.

PARCEL J2:
A NON EXCLUSIVE EASEMENT FOR CONVENIENCE OF WATER THROUGH EXISTING CANAL, PIPES, AND PUMPING SYSTEM FOR IRRIGATION OVER AND ACROSS THE SOUTHERLY PORTION OF THE FOLLOWING SAID PROPERTY;
THAT PORTION OF THE NORTH HALF OF THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 7, SOUTH RANGE 22 EAST SAN BERNARDINO BASE AND MERIDIAN BEING ALSO SHOWN AS THE WEST TWO-THIRDS OF TRACT 48 OF SECTION 3 TOWNSHIP 7 SOUTH RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN AS SHOWN BY UNITED STATES GOVERNMENT SURVEY ACCEPTED MAY 10, 1919, LYING WEST OF THE MID-LINE OF THE PALO VERDE IRRIGATION DISTRICT'S DRAINAGE CANAL, DESIGNATED AS RUNNELL'S DRAIN ON RECORD OF SURVEY ON FILE IN BOOK 17 PAGE 48 OF RECORDS OF SURVEY, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, AS CONVEYED TO G.B. INVESTMENT CO., AN ARIZONA CORPORATION, BY DEED FROM J.E. HASON AND WIFE, RECORDED MAY 3, 1967, AS INSTRUMENT NO. 37728 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL J3:
AN EASEMENT FOR PUBLIC STREET AND UTILITY PURPOSE OVER THAT PORTION OF THE LAND WITHIN ROAD EASEMENTS SHOWN AS BUTCH AVENUE, 14TH AVENUE, 15TH AVENUE, 16TH AVENUE AND KEIM BOULEVARD, AS SHOWN OR DEDICATED UPON THE MAP OF PARCEL MAP 14453 ON FILE IN BOOK 100 PAGES 52 THROUGH 58 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.
EXCEPTING THEREFROM THOSE ROAD EASEMENTS LYING WITHIN PARCEL A ABOVE.

PARCEL K: (APN'S: 866-021-007-5 AND 866-022-002-8)
THE SOUTH 40 FEET OF THE NORTH 80 FEET OF THE WEST HALF OF THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES GOVERNMENT SURVEY APPROVED MAY 10, 1919 THE NORTH HALF OF SAID NORTHWEST QUARTER BEING SHOWN AS THE WEST TWO-THIRDS OF TRACT 48 IN SAID SECTION 3;

EXCEPTING THEREFROM THE PORTION WHICH LIES WEST OF THE MID-LINE OF THE PALO VERDE IRRIGATION DISTRICT'S DRAINAGE CANAL, DESIGNATED AS RANNELL'S DRAIN BY RECORD OF SURVEY ON FILE IN BOOK 17 PAGE 48 OF RECORDS OF SURVEY, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, THAT CROSSES SAID PROPERTY;
ALSO EXCEPTING THEREFROM THE EAST 30 FEET; ALSO EXCEPTING THEREFROM ANY PORTION LYING WITHIN STEPHENSON BOULEVARD.

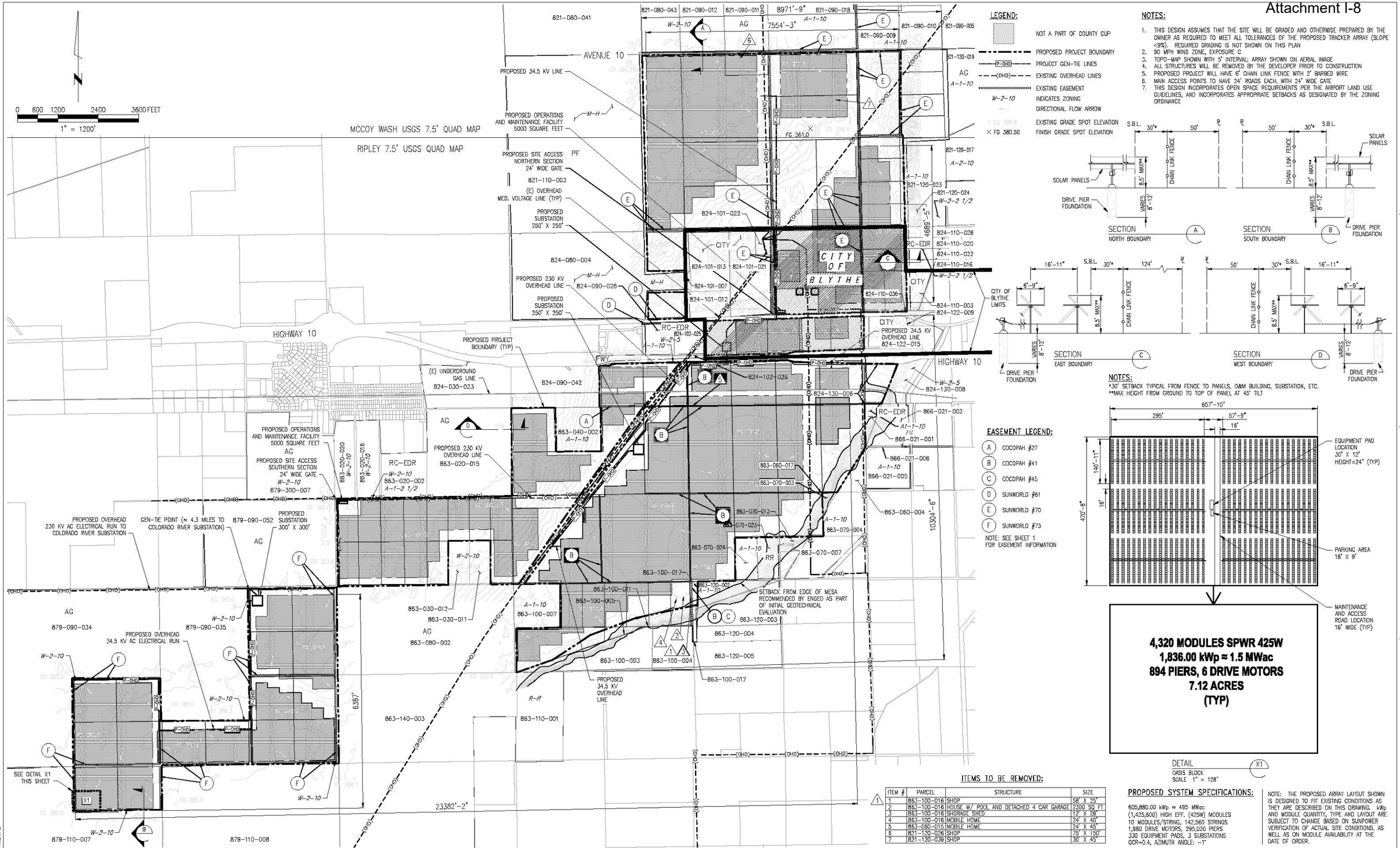
PARCEL L: (APN: 863-100-017-2)
THAT PORTION OF PARCEL 18 OF PARCEL MAP 14,453, AS SHOWN BY MAP ON FILE IN BOOK 100 PAGE(S) 52 THROUGH 58, INCLUSIVE, OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA;

BEGINNING AT THE CENTERLINE OF THE INTERSECTION OF 16TH AVENUE AND KEIM BOULEVARD AS SHOWN ON SAID PARCEL MAP 14,453; THENCE NORTH 89° 06' 19" EAST ALONG THE CENTERLINE OF 16TH AVENUE, A DISTANCE OF 218.58 FEET TO THE NORTHEAST CORNER OF SAID PARCEL 18; THENCE SOUTH 01° 32' 20" EAST ALONG THE EASTERLY LINE OF SAID PARCEL 18, A DISTANCE OF 750.00 FEET; THENCE SOUTH 89° 06' 19" WEST CONTINUING ON THE LOT LINE OF SAID PARCEL 18, A DISTANCE OF 75.00 FEET; THENCE SOUTH 01° 32' 20" EAST ALONG THE EASTERLY LINE OF SAID PARCEL 18, A DISTANCE OF 1088.58 FEET TO THE SOUTHEASTERLY CORNER OF SAID PARCEL 18; THENCE SOUTH 88° 56' 54" WEST ALONG THE SOUTHERLY LINE OF SAID PARCEL 18, A DISTANCE OF 100.00 FEET TO A POINT ON THE CENTERLINE OF SAID KEIM BOULEVARD; THENCE NORTH 01° 32' 20" WEST ALONG THE CENTERLINE OF SAID KEIM BOULEVARD, A DISTANCE OF 498.51 FEET; THENCE NORTH 03° 25' 40" WEST CONTINUING ALONG THE CENTERLINE OF SAID KEIM BOULEVARD, A DISTANCE OF 1321.54 FEET TO THE POINT OF BEGINNING, AS PER LOT LINE ADJUSTMENT NO. 1747 DATED AUGUST 24, 1983.

PARCEL L1:
A NON-EXCLUSIVE EASEMENT OF CONVEYANCE OF WATER THROUGH EXISTING CANAL, PIPES, AND PUMPING SYSTEM FOR IRRIGATION OVER AND ACROSS THE SOUTHERLY PORTION OF THE FOLLOWING SAID PROPERTY;

THAT PORTION OF THE NORTH HALF OF THE NORTHWEST QUARTER OF SECTION 3, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, BEING ALSO SHOWN AS THE WEST TWO-THIRDS OF TRACT 48 OF SECTION 3, TOWNSHIP 7 SOUTH, RANGE 22 EAST, SAN BERNARDINO BASE AND MERIDIAN, AS SHOWN BY UNITED STATES GOVERNMENT SURVEY ACCEPTED MAY 10, 1919, LYING WEST OF THE MID-LINE OF THE PALO VERDE IRRIGATION DISTRICT'S DRAINAGE CANAL, DESIGNATED AS RUNNELL'S DRAIN ON RECORD OF SURVEY ON FILE IN BOOK 17 PAGE 48 OF RECORDS OF SURVEY, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, AS CONVEYED TO G.B. INVESTMENT CO., AN ARIZONA CORPORATION, BY DEED FROM J.E. HASON AND WIFE, RECORDED MAY 3, 1967, AS INSTRUMENT NO. 37728 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.
EXCEPTING TH

THIS PAGE INTENTIONALLY LEFT BLANK



LEGEND:

- NOT A PART OF COUNTY CUP
- PROPOSED PROJECT BOUNDARY
- PROJECT GEN-TIE LINES
- EXISTING OVERHEAD LINES
- EXISTING EASEMENT
- W-2-10 INDICATES ZONING
- DIRECTIONAL FLOW ARROW
- EG 390.8 EXISTING GRADE SPOT ELEVATION
- FG 380.50 FINISH GRADE SPOT ELEVATION

NOTES:

1. THIS DESIGN ASSUMES THAT THE SITE WILL BE GRADED AND OTHERWISE PREPARED BY THE OWNER AS REQUIRED TO MEET ALL TOLERANCES OF THE PROPOSED TRACKER ARRAY (SLOPE <1%). REQUIRED GRADING IS NOT SHOWN ON THIS PLAN
2. 90 MPH WIND ZONE, EXPOSURE C
3. TOPO-MAP SHOWN WITH 5' INTERVAL; ARRAY SHOWN ON AERIAL IMAGE
4. ALL STRUCTURES WILL BE REMOVED BY THE DEVELOPER PRIOR TO CONSTRUCTION
5. PROPOSED PROJECT WILL HAVE 6' CHAIN LINK FENCE WITH 2' BARBED WIRE
6. MAIN ACCESS POINTS TO HAVE 24' ROADS EACH, WITH 24' WIDE GATE
7. THIS DESIGN INCORPORATES OPEN SPACE REQUIREMENTS PER THE AIRPORT LAND USE GUIDELINES, AND INCORPORATES APPROPRIATE SETBACKS AS DESIGNATED BY THE ZONING ORDINANCE

NOTES:
*30' SETBACK TYPICAL FROM FENCE TO PANELS, O&M BUILDING, SUBSTATION, ETC.
**MAX HEIGHT FROM GROUND TO TOP OF PANEL AT 45° TILT

EASEMENT LEGEND:

- (A) COCOPAH #27
- (B) COCOPAH #41
- (C) COCOPAH #45
- (D) SUNWORLD #61
- (E) SUNWORLD #70
- (F) SUNWORLD #73

NOTE: SEE SHEET 1 FOR EASEMENT INFORMATION

4,320 MODULES SPWR 425W
1,836.00 kWp ≈ 1.5 MWac
894 PIERS, 6 DRIVE MOTORS
7.12 ACRES
(TYP)

DETAIL X1
OASIS BLOCK
SCALE 1" = 128'

ITEMS TO BE REMOVED:

ITEM #	PARCEL	STRUCTURE	SIZE
1	863-100-016	SHOP	58' X 25'
2	863-100-016	HOUSE W/ POOL AND DETACHED 4 CAR GARAGE	2300 SQ FT
3	863-100-016	SHORAGE SHED	12' X 28'
4	863-100-016	MOBILE HOME	24' X 40'
5	863-060-015	MOBILE HOME	24' X 45'
6	821-120-026	SHOP	75' X 150'
7	821-120-039	SHOP	30' X 45'

PROPOSED SYSTEM SPECIFICATIONS:

605,880.00 kWp ≈ 495 MWac
(1,425,600) HIGH EFF. (425W) MODULES
10 MODULES/STRING, 142,560 STRINGS
1,980 DRIVE MOTORS, 295,020 PIERS
330 EQUIPMENT PADS, 3 SUBSTATIONS
GCR=0.4, AZIMUTH ANGLE: -1°

NOTE: THE PROPOSED ARRAY LAYOUT SHOWN IS DESIGNED TO FIT EXISTING CONDITIONS AS THEY ARE DESCRIBED ON THIS DRAWING. kWp AND MODULE QUANTITY, TYPE AND LAYOUT ARE SUBJECT TO CHANGE BASED ON SUNPOWER VERIFICATION OF ACTUAL SITE CONDITIONS, AS WELL AS ON MODULE AVAILABILITY AT THE DATE OF ORDER.

THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
						*	

DSGN
DRN MNR 6/14/11
CKD
SCALE: AS SHOWN
FOR 22x34 DWG ONLY

POWER ENGINEERS

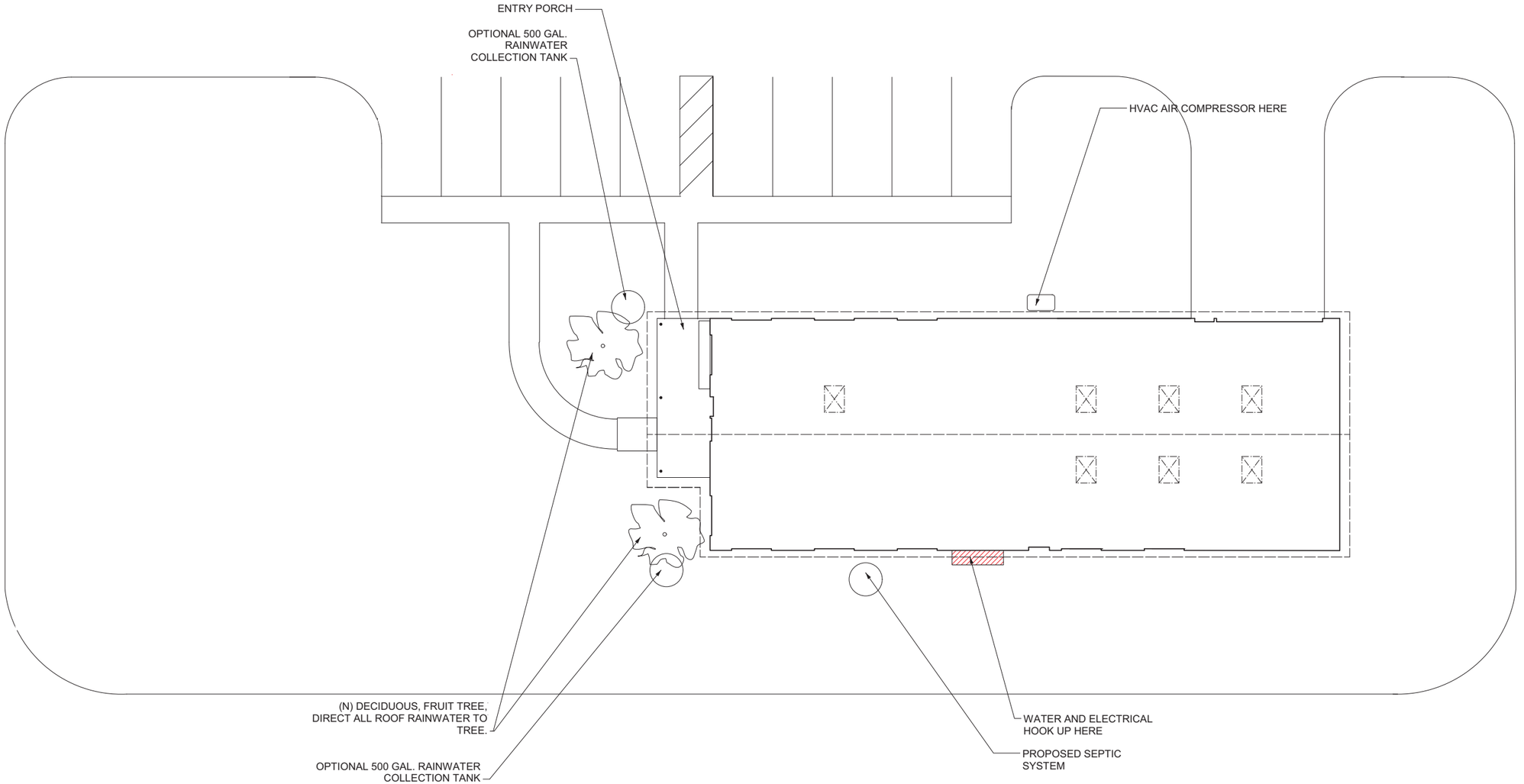
RENEWABLE RESOURCES GROUP, INC.
COLORADO RIVER
BLYTHE, CALIFORNIA
BLYTHE MESA SOLAR PROJECT SITE PLAN
FOR CONDITIONAL USE PERMIT NO. 3670

JOB NUMBER 123128 REV
DRAWING NUMBER 1 OF 2

123128_CUP_1.DWG

AR060824

THIS PAGE INTENTIONALLY LEFT BLANK



1 PLAN
1/4" = 1' 0"

N

ISSUE	DATE

LEGER WANASELJA ARCHITECTURE
2320 mcgee avenue berkeley,ca 94703
ph 510 . 848 . 8901 fax 510 . 848 . 8908
www.greendwellings.com

SunPower Corp.
O & M Building for
150 MWp Fields and Larger

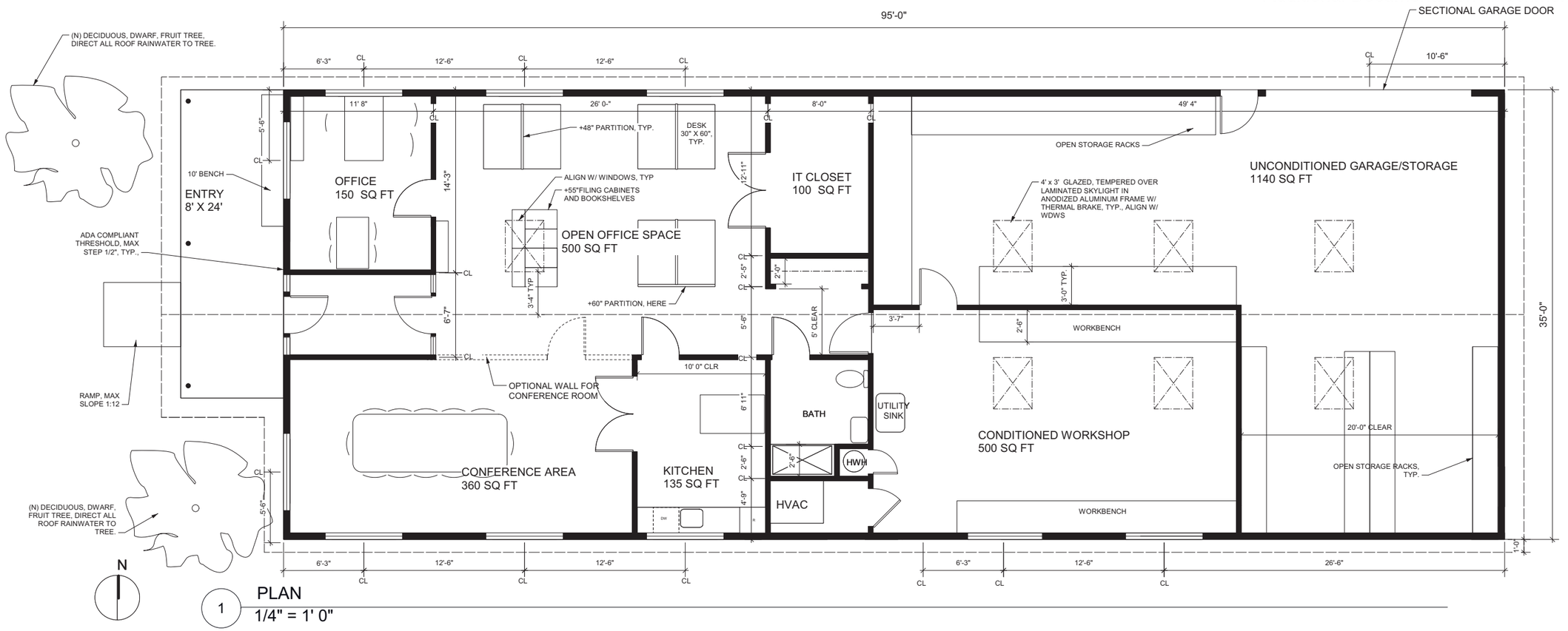
SITEPLAN

Date 3.30.11

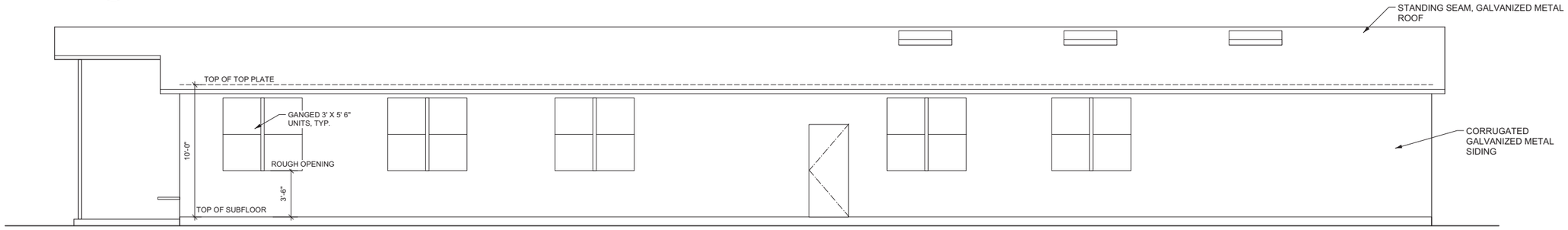
Sheet A1

AR060826

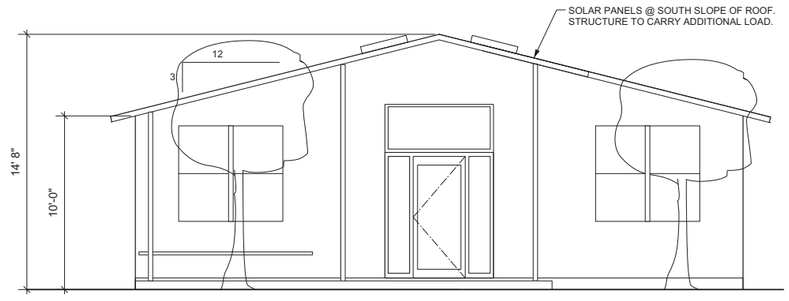
THIS PAGE INTENTIONALLY LEFT BLANK



1 PLAN
1/4" = 1' 0"



2 SOUTH ELEVATION
1/4" = 1' 0"



3 WEST ELEVATION
1/4" = 1' 0"

LEGER WANASELJA ARCHITECTURE
2320 mcgee avenue berkeley,ca 94703
ph 510 . 848 . 8901 fax 510 . 848 . 8908
www.greendwellings.com

ISSUE	DATE

SunPower Corp.
O & M Building for
150 - 250 MWp Plant Capacity

PLAN and ELEVS

Date 4.12.11

Sheet A1

AR060828

THIS PAGE INTENTIONALLY LEFT BLANK

NOTICE OF PREPARATION
ATTACHMENT A

BLYTHE MESA SOLAR PROJECT

1.0 DESCRIPTION OF THE PROPOSED PROJECT

Project Location
The proposed Blythe Mesa Solar Project (Project) is located in the Palo Verde Valley area of eastern Riverside County, approximately 5 miles west of the City of Blythe and 40 miles east of Desert Center **(Figure 1).** The Project would be located north and south of Interstate 10, and west of State Route 89 and Highway 95. The site consists primarily of agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde.

Project Description
The proposed 485 megawatt (MW) photovoltaic (PV) electrical generating facility and 8.4-mile transmission line would occupy a total of 3,660 acres. The proposed Project would produce enough energy to power approximately 180,000 households, and consist of the following components **(see Figure 2)**:

- Solar array field utilizing single-axis solar PV trackers
- System of interior collection power lines located between inverters and substations
- Three on-site substations (approximately 300 feet long by 300 feet wide each)
- Two operation and maintenance (O&M) buildings (approximately 3,500 square feet each)
- Two primary off-site access roads and several interior access roads
- 8.4 miles of 230 kilovolt (kV) double-circuit transmission line

The fenced-in solar field would occupy 3,587 acres of private land, 334 acres of which are within the City of Blythe. Within this area, a 230 kV transmission line would connect all three proposed substations, extending a distance of approximately 3.6 miles on site. The transmission line would extend another 4.8 miles within a 125-foot-wide right-of-way (or 73 acres) from the southernmost substation to the Colorado River Substation, traversing 3.8 miles of BLM managed lands (58 acres) and one mile of private land (15 acres).

Project Objectives
The objectives for the Blythe Mesa Solar Project are as follows:

- Construct a solar energy facility in order to help meet State and federal renewable energy standards and goals.
- Assist with Greenhouse Gas reduction objectives to the maximum extent possible.
- Locate the Project facilities as near as possible to electrical transmission facilities with anticipated capacity and a reserved California Independent System Operator (CAISO) interconnection position.
- Site the Project in an area with excellent solar energy resources in order to maximize energy productivity from the PV panels.
- To the extent feasible, site the Project on previously disturbed land with compatible topography and in a manner that minimizes environmental impacts.

- Use a proven and available solar PV technology.

Land Use Considerations
The proposed Project would be situated predominantly in the County of Riverside (as shown on **Figure 1**). The Riverside County General Plan (Palo Verde Area Plan) applies Agriculture and Rural Community land use designations to the proposed Project site. Parcels are currently zoned W-2-10 (Controlled Development Areas) (10 Acre Min.), W-2-5 (Controlled Development Areas), A-1-10 (Light Agriculture), and A-2-10 (Heavy Agriculture). The County of Riverside Planning Department has indicated that the proposed Project would be conditionally consistent with the agricultural land use designation, subject to issuance of a conditional use permit (CUP). A Development Agreement between the County of Riverside and the applicant will be established setting forth the rights and responsibilities of each party with respect to project development and operation.

A portion (334 acres) of the proposed Project site is located within the City of Blythe's incorporated boundary and Sphere of Influence. The City of Blythe designates the Project lands within the city as Service Industrial and Agricultural. The proposed Project would be a consistent use, subject to issuance of a CUP.

A portion (73 acres) of the proposed transmission line alignment between the Project site and the Colorado River Substation site is federal land under the jurisdiction of the U.S. Department of the Interior, Bureau of Land Management (BLM). A Right of Way Grant from BLM would be required for construction of the 230 kV transmission line on BLM-managed public land.

Project Components
Solar Array Field
The Project would utilize single-axis PV trackers with 1,425,600 high-efficiency, monocrystalline, silicon solar panels. The panels would be configured into trackers and the trackers configured into blocks (refer to the **Solar Module** inset in the right-hand corner of **Figure 2**). Each block would comprise six trackers with 18 north-south oriented rows of PV panels. The trackers would rotate up to 45 degrees from east to west to follow the daily motion of the sun, with the center of rotation being approximately four to eight feet above grade (refer to **Figure 3, Typical Tiled Tracker Panels**). Torque tubes would act as the horizontal support for the PV panels and would be in turn supported by micro-piles (15 to 20 feet long and having a 4.5-inch outer diameter), which would be driven directly into the ground and able to withstand high-wind conditions. The metal structural elements would be constructed of corrosion-resistant galvanized steel.

The support structure for panels would be constructed by first driving micro-piles into the ground to a depth of 8 to 12 feet using a vibration technology to reduce noise impacts. Torque tubes, electrical wire trays, and panels would then be installed on the piles. Concrete foundations for the drive motors (devices used to move drive struts back and forth) would be poured in place, and electrical equipment for the array would be set in place. A tracked backhoe would dive piles. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would place trackers on support piles.

Combiners, Inverters, and Transformers
Individual PV panels would be connected together in series to create a "string" to carry direct current (DC) electricity. Multiple DC strings would be brought together into an above-ground combiner box to merge the strings into a single high-current cable and provide overcurrent protection. From the combiner boxes, the cabling would run in raceways and underground to electrical inverters, which take the DC output from the combiner boxes and convert it to alternating current (AC) electricity.

The AC electricity would be increased to medium voltage with a "step-up" transformer. The medium-voltage (34.5 kV) collection lines would begin at the inverter/transformer pads and would be located in trenches until the output from 10 to 15 blocks is gathered and transferred at risers to a system of overhead medium-voltage collection lines for transmission to the substation. The medium voltage collection circuits would be mounted above ground on poles (35 to 60 feet tall) with an average tower-to-tower span of 200 feet, and would carry 20 to 30 MW of electricity.

Substation and Switchgear Pads

The three Project substations (each approximately 300 feet long by 300 feet wide) would collect all the medium-voltage circuits and would contain metering equipment, switchgear, protective relays, and larger transformers to step up the voltage to match the voltage of the transmission grid at the interconnection point (the Colorado River Substation). The Project substations and the interconnection point would be linked by a 230 kV transmission line. This line would cross over Interstate 10 at a point approximately 2.6 miles east of the Mesa Drive/Interstate 10 interchange.

The construction of the substations would involve site preparation, clearing of the switchyard site, and installation of substructures and electrical equipment. The substation site would be initially cleared and graded. A security fence would be installed around the substation. Grading would establish the desired site grade, and minor excavation would provide concrete footings for the substation equipment. Gravel would be spread inside the fence of the substation sites.

Operation and Maintenance Buildings

The two O&M buildings (approximately 3,500 square feet each, enclosed, and no more than 20 feet tall) would provide work space for maintenance staff and storage space for spare parts. The building would include bathroom facilities serviced by a private septic system and would be designed for occupancy Classification U. The buildings would be made of prefabricated steel on a concrete slab foundation.

Site Security Fencing

The entire Project site would be enclosed with fencing that meets National Electrical Safety Code (NESC) for protective arrangements in electric supply stations, such as a seven-foot equestrian-type wire fence. The fence would typically be set 30 feet from the arrays or the property boundary.

Access Roads

Two primary access points to the Project site are planned on Seeley Avenue and Riverside Drive, both from the Neighbors Boulevard off-ramp at Interstate 10.

Within the solar field, dirt access roads 12 feet wide would be constructed approximately every 200 to 400 feet to allow access and maintenance of the solar panels.

230 kV Transmission Line Interconnect

An approximately 8.4-mile-long 230 kV double-circuit overhead electric transmission line would be constructed from the easternmost substation on the Project site to the approved Colorado River Substation. The 230 kV transmission line would connect all three proposed substations, extending a distance of approximately 3.6 miles within the solar field site. From the westernmost substation to the Colorado River Substation, the transmission line would extend another 4.8 miles within a 125-foot-wide right-of-way (or 73 acres) traversing 3.8 miles of BLM-managed lands (58 acres) and one mile of private land (15 acres).

The transmission line would run parallel and immediately south of the approved Desert Southwest Transmission Line corridor. The Project has secured an interconnection queue position sufficient for the size of the Project at the Colorado River substation and has made the necessary reservation deposits to CAISO.

The transmission line facilities would include a single set of tubular steel poles that would be 85 to 125 feet tall, with an average distance between poles of 500 to 800 feet. Structure heights and corresponding span lengths would be selected to meet Federal Aviation Administration (FAA) requirements for the nearby Blythe Airport. The poles would be directly embedded in the soil or set in concrete foundations approximately 20 to 30 feet deep. Temporary access roads to each structure would be 16 to 20 feet wide by 8 inches deep of gravel over compacted sub-grade and located within the proposed right-of-way.

General Construction Process

Site Preparation

The PV system proposed for the site can operate on slopes up to nine percent. Since most of the site has nearly level to gently sloping topography, no mass grading would be required. Some of the proposed parcels for facilities and arrays would require light grubbing for leveling and trenching. Access roads would require minimal grading. In order to aim for balanced cut-and-fill quantities, grading activities may include placement and compaction of excess materials in low-elevation areas of the site.

Minor demolition of existing site structures (e.g., storage buildings in the citrus grove) would be required; however, where possible, existing on-site buildings would be used for O&M facilities or for equipment storage.

Installation of the electrical collection system would require excavations to a depth of about three feet for underground electrical circuits, inverter and switchgear enclosure foundations, and transformer foundations. The O&M building foundation would be excavated to a depth of about three feet.

Construction Activities

The Project would be constructed in the following phases, which would occur simultaneously on different portions of the site:

- Development of staging areas and assembly areas, and grading of site access roads.
- Construction of arrays including the pile installation, the assembly of trackers, the mounting of PV panels, and the pile-driving of support piles, placement of trackers on support piles, and trenching and installation of electrical equipment for arrays.
- Construction of electrical transmission facilities, including the construction of three substations, the double-circuit transmission line, and two O&M buildings.

Construction staging and material lay-down would be distributed across the Project site to allow for efficient distribution of components to different parts of the Project. Typically, one staging and material lay-down area would be set up for every 100 acres of the Project site. These lay-down areas would be fenced and would cover approximately five acres each. Lay-down areas would be temporary and would be converted to solar arrays as work is completed in the general area. Within the solar field, grubbing and light grading of 12-foot-wide access roads would also be performed approximately every 200 to 400 feet to allow access to and maintenance of the solar panels.

Separate activities would be associated with transmission line construction, including: (1) construction of staging areas for trailers, office personnel, equipment, material staging, lay-down and employee parking on private land; (2) construction of access roads to the structure locations; (3) pole erection and

installation of conductors and conductor hardware; (4) conductor installation; (5) construction of pulling sites to install conductors; and (6) installation of the overhead ground/fiber optic communications system.

Construction Sequence, Equipment, and Workforce

Construction is anticipated to occur over a three-year period with the construction phases (described above) occurring simultaneously. The solar field would be developed in six-month phases with six blocks constructed at a time (each block would be 100 acres, for a total of 600 acres at a time). As the arrays are being assembled, construction of the substations, transmission line, switchyard, and O&M buildings would also occur simultaneously. After the common facilities are completed in the earlier stages, the workforce would be devoted more to array construction in the later stages.

Approximately 300 to 500 daily workers would be present on site during construction over the construction period. Workers would gain primary access to the site using Seeley Avenue and Riverside Drive off of Neighbors Boulevard. Worker construction traffic would consist of approximately 150 to 250 daily vehicle roundtrips. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley and the Desert Center regions, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County regions. Anticipated average daily material deliveries would consist of about 40 truck deliveries per day for 24 months. Workers and delivery trucks would access site using the Neighbors Boulevard off ramp off Interstate 10. On-site work hours would be from 7:00 a.m. to 7:00 p.m. During the installation period, construction workers are projected to be on site five days per week, year round. Due to weather or other major types of delays, times may shift to start as early as 5:00 a.m. and end as late as 8:00 p.m., and work may continue on weekends. In extreme circumstances, work may be performed as many as 24 hours per day, although is not anticipated. Security would likely be onsite 24 hours per day.

Operation and Maintenance Activities

After the construction phase, the O&M building would serve as the Project's operations center for approximately 12 permanent full-time employees, which would include one plant manager, five engineers/technicians, and six security staff. The Project facilities would be monitored during operating (daylight) hours, even though the Project facilities would be capable of automatic start-up, shutdown, self-diagnosis, and fault detection.

The panels may be cleaned up to two times per year, if necessary to optimize output. Each cleaning would require a total of 5 acre-feet of water for a total usage of about 10 acre-feet of water per year (approximately 1.1 gallons per panel per year). No chemicals would be used during cleaning. The Project would work with Gila Farm Land, LLC (the landowner) and the Palo Verde Irrigation District for water services and supply during operation.

No heavy equipment would be used during normal operation. O&M vehicles would include trucks (pickup and flatbed), forklifts, and loaders for routine and scheduled maintenance and water trucks for solar panel washing. Large heavy-haul transport equipment may be brought to the Project site infrequently for equipment repair or replacement.

Long-term maintenance schedules would be developed to include periodic maintenance and equipment replacement in accordance with manufacturer recommendations. Solar panels are warranted for 25 years or longer and are expected to have a life of 30 or more years, with a degradation rate of 0.5% per year. Moving parts, such as motors and tracking module drive equipment, motorized circuit breakers and disconnects, and inverter ventilation equipment, would be serviced on a regular basis, and unscheduled maintenance would be performed as necessary.

The Project site would be secured 24 hours per day by onsite private security personnel or remote security services with motion-detection cameras.

2.0 ENVIRONMENTAL TOPICS TO BE ADDRESSED

Introduction
The County of Riverside has determined that an Environmental Impact Report (EIR) shall be prepared to address the potential significant impacts of the proposed BMSP. The EIR will involve research, analysis, and study of the following environmental topics:

- Aesthetics/Visual Resources
- Agricultural and Forestry Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Greenhouse Gas Emissions
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use
- Mineral Resources
- Noise
- Population and Housing
- Public Services
- Recreation
- Traffic and Circulation
- Utilities and Service Systems

The EIR will include all topical areas of content required by the California Environmental Quality Act (CEQA), including cumulative impacts, alternatives to the proposed Project, and growth-inducing impacts. For each resource topic, environmental impacts relating to construction, operations, and decommissioning phases of the Project will be identified; however, the level of analysis to be included may vary based on the complexity of the issues, public and agency input to this Notice of Preparation (NOP), and/or refinements to the Project description that may occur subsequent to the publication of this NOP. For impacts that are significant, mitigation measures will be proposed to alleviate or avoid the significant impact(s).

Aesthetics
Placement of PV solar panels, the transmission line, and other Project facilities may alter the views of the Project area. Potential visual impacts of this Project on sensitive receptors and scenic resources will be further evaluated in the EIR. Photo simulations of the proposed Project from key observation points will be provided to assist in the evaluation. The EIR will also analyze the possible impacts of reflection of the sun off the solar modules, and nighttime lighting of portions of the solar facility.

Agriculture and Forest Resources
The potential impact on prime and unique farmlands, forest lands, timberland, and lands zoned as such will be evaluated in the EIR, as will the potential impact of converting agricultural lands to non-agricultural uses.

Air Quality
The proposed Project site is located in the Mojave Desert Air Basin, and air emissions are regulated by the Mojave Desert Air Quality Management District (MDAQMD). The EIR will address consistency with regional and local air quality plans and evaluate and quantify the short-term and long-term sources of air pollutants generated by the Project, including mobile, stationary, and area source emissions.

Biological Resources
A biological resources assessment will be provided to evaluate the Project's effects on the area vegetation communities, wildlife habitats, wildlife movement, wetlands and waters, habitat conservation plans/protection ordinances, and sensitive and/or listed species.

Cultural Resources
Cultural resource effects will be analyzed in the EIR, including a query of the Northwest Information Center of the California Historical Resources Information System, analysis of sacred lands identified through consultation with the Native American Heritage Commission, and consultation with Native Americans and other interested parties (e.g., local historical societies). The evaluation will also address the potential impacts to historic resources and the occurrence of paleontological (fossil) resources.

Geology and Soils
The EIR will assess soil and geologic conditions of the Project area and address hazards related to seismic activity, including the potential for liquefaction, ground shaking, soil failure, soil stability and erosion potential.

Greenhouse Gas Emissions
The EIR will address the potential construction- and operation-related impacts relative to greenhouse gas emissions.

Hazards and Hazardous Materials
The EIR will evaluate the presence of hazards or hazardous conditions that could affect construction and operation of the Project, including the location of nearby or on-site hazardous waste sites included on State or federal databases, airport and airstrip hazard zones, emergency response routes, and wildfire hazards.

Hydrology and Water Quality
The EIR will include an analysis of existing drainage systems, and will evaluate potential impacts to water resources.

Land Use and Planning
The proposed Project may affect the use of the Project property. The EIR will evaluate potential environmental effects to land use that include compatibility with existing and proposed local zoning, and consistency with land use plans, policies or regulations of the applicable jurisdictions, which include the City of Blythe General Plan 2025, the Riverside County General Plan, and the BLM's Northern and Eastern Colorado Desert Coordinated Management Plan.

Mineral Resources
The Project's impact on mineral resource policies from local land use plans will be identified in the EIR. Project demand for mineral resources, including the need for sand and gravel, will be identified within the context of local supply.

Noise
The EIR will determine noise levels due to construction and operation of the proposed Project and will evaluate impacts for consistency with applicable laws, regulations, ordinances and guidelines.

Population and Housing
The EIR will address the short- and long-term population and housing impacts that would result from the construction workforce. These effects could include physical and service-related changes within area communities associated with demand for temporary housing.

Public Services
With the accommodation of the construction workforce, there may be a temporarily increased demand for public services, including community facilities and schools, and an increased need for police and fire protection services. The EIR will evaluate the potential for impacts on these public services.

Recreation
The temporary workforce may increase the demand for recreation facilities, including local and community parks in the Project area. The EIR will evaluate the changes to existing recreation services and parks that may result from Project implementation.

Traffic and Circulation
The EIR will include a traffic study that evaluates changes in circulation that could result from the proposed Project, focusing on effects during Project construction.

Utilities and Service Systems
Similar to the discussion under "Public Services," the proposed Project will be evaluated to determine the impact of any increases in the demand for public utilities, including demand for electricity and natural gas, increased demand for water, increased generation of wastewater requiring treatment, and increased generation of solid waste.

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 1: Regional Area Map

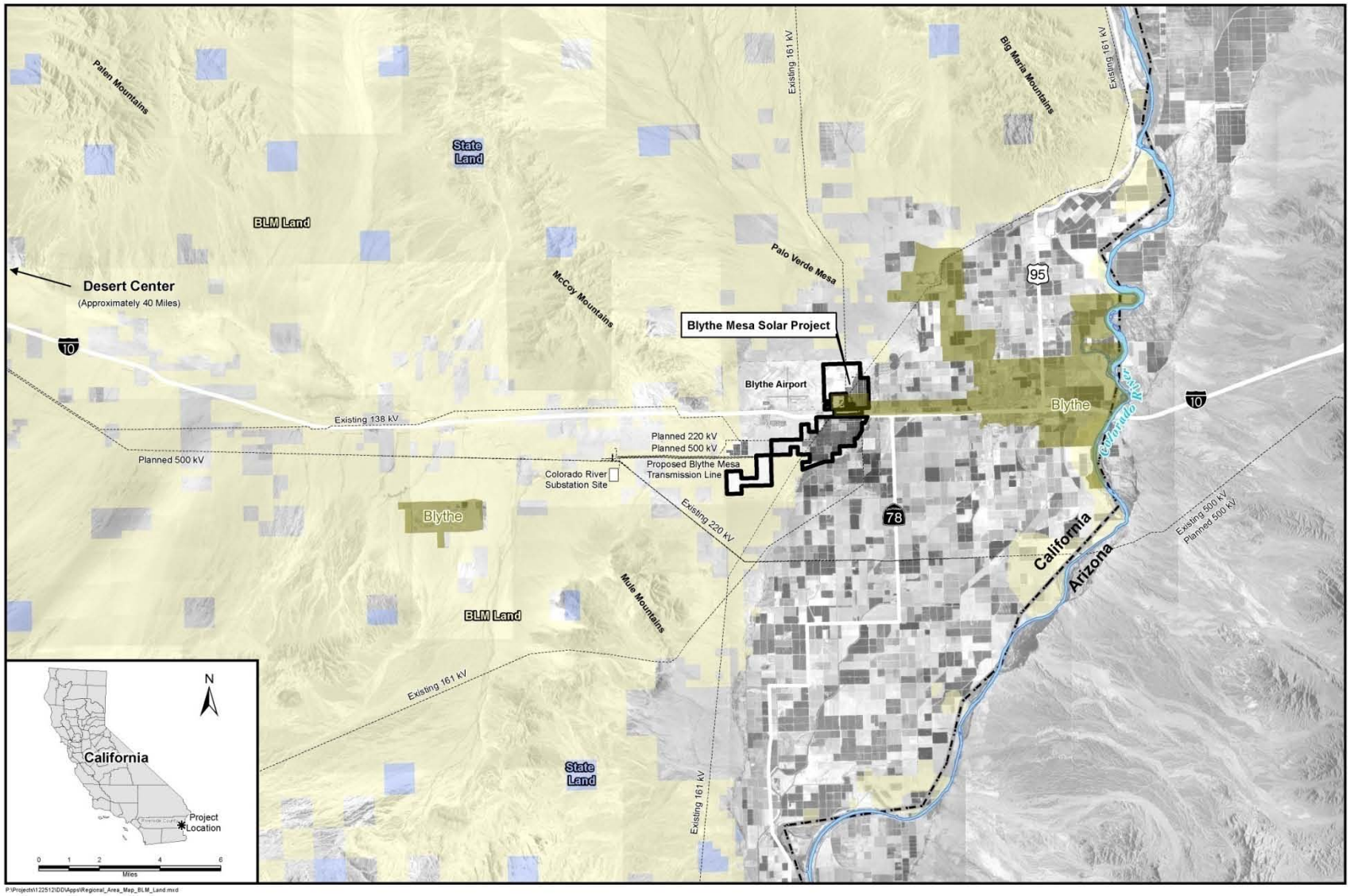
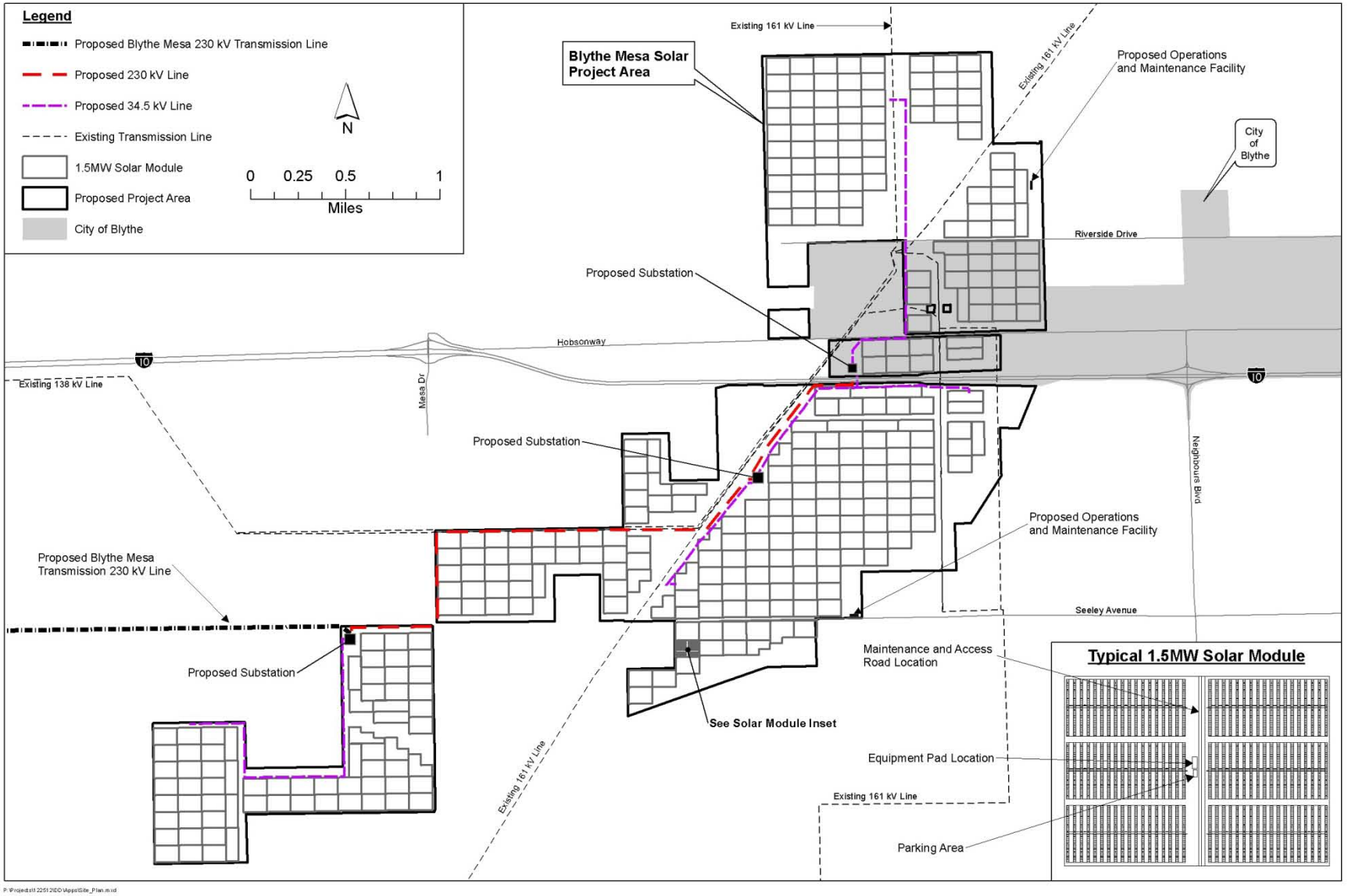


Figure 2: Site Plan & Solar Module

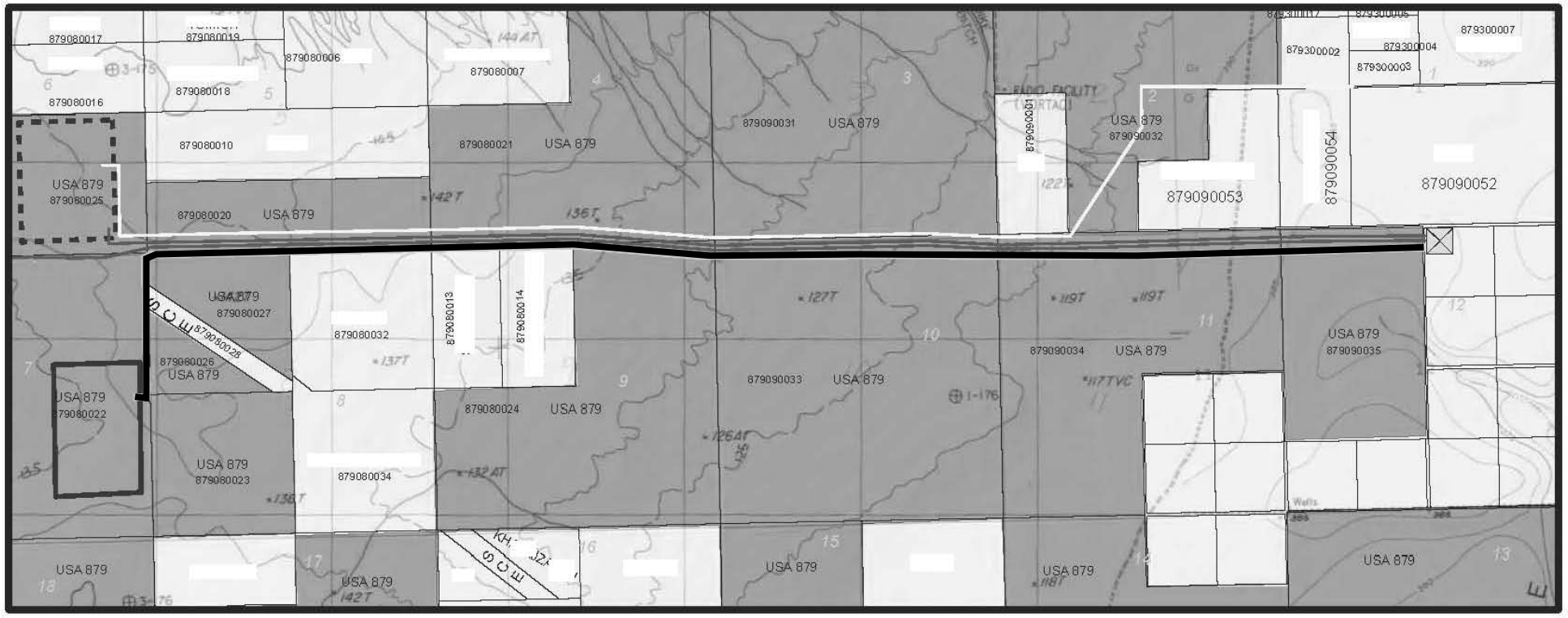


Blythe Mesa Solar Project NOP
Attachment A

Figure 3: Typical Tiled Tracker Panels



BLYTHE MESA SOLAR I GEN-TIE EXHIBIT



T7S R21E, Riverside County, CA



0 0.1250.25 0.5 0.75 1
Miles

Blythe Mesa Solar Project Substation
125' Proposed BLM ROW
Transmission Lines
Blythe Solar Millenium
Desert Southwest T-Line

New Colorado River Substation Site
Originally Proposed Colorado River Substation
Public Land
Private Land

ATTN: Division Manager
Ecological Service,
U.S. Fish & Wildlife Service
6010 Hidden Valley Rd.
Carlsbad, CA 92011

Environmental & Project Planning
Service Division, Orange County
300 N. Flower St.
P.O. Box 4048
Santa Ana, CA 92702-4048

ATTN: Senior Public Health Engineer
Environmental Health,
Riverside County
Mail Stop 3320

ATTN: Hazardous Materials
Environmental Health,
Riverside County
Mail Stop 3320

ATTN: Jared Bond
Environmental Programs Dept.,
Riverside County
Mail Stop 2715

Executive Office, Riverside County
Mail Stop 1020

ATTN: Mekbib Degaga
Flood Control District,
Riverside County
Mail Stop 2990

ATTN: David Jones
Geologist
Mail Stop 1070

Industrial Hygiene
Mail Stop 3320

Darrell Mike, Chairperson
Twenty-nine Palms Band of Mission Indians
46-200 Harrison Place
Coachella, CA 92236

Joseph R. Benitez
Chemehuevi Reservation
P.O. Box 1829
Indio, CA 92201

Lake Tamarisk Branch Library
43880 Lake Tamarisk Drive
Desert Center, CA 92239

Attn: Janet Laurain
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Ste. 1000
South San Francisco, CA 94080-7037

California Department of Conservation
801 K Street MS 24-01
Sacramento, CA 95814-3530

Charles Wood, Chairperson
Chemehuevi Reservation
P.O. Box 1976
Havasu Lake CA 92363

Mojave Desert Air Quality Management District
14306 Park Ave.
Victorville, CA 92392-2310

Native American Heritage Commission
915 Capitol Mall, Rm 364
Sacramento, CA 95814-4801

Palo Verde Irrigation District
180 W. 14th Ave.
Blythe, CA 92225-2714

Palo Verde
Resource Conservation District
P.O. Box 610
Blythe, CA 92225

Palo Verde Unified School District
295 N. First St.
Blythe, CA 92225-1824

Riverside County Assessor
Mail Stop 1110

ATTN: Jim Porras
c/o Desiree Bowie, Planning Commission Secretary
Planning Commission, Riverside County
Mail Stop 1070

ATTN: Jurg Heuberger
Planning Department, Imperial County
801 Main St.
El Centro, CA 92243-2843

Ginger Scott, Museum Curator
Colorado River Indian Tribe
26600 Mojave Road
Parker AZ 85344

Planning Department,
San Bernardino County
385 N. Arrowhead Ave.
San Bernardino, CA 92415-1002

Planning Department,
San Diego County
5201 Ruffin Rd., Suite B
San Diego, CA 92123

Reg. Water Quality Control Board #7
Colorado River Basin
73-720 Fred Waring Dr., Suite 100
Palm Desert, CA 92260-2564

ATTN: Marc Brewer
Regional Parks & Open Space District
Riverside County
4600 Crestmore Rd., MS2970
Riverside, CA 92509-6858

ATTN: Fast Track
Riverside County EDA
1325 Spruce St., Suite 400
Riverside, CA 92507

Riverside County Fire Department
Desert Office
Mail Stop 4009

ATTN: John Sarkasian
Riverside County Information Technology
Mail Stop 5567

San Gorgonio Chapter, Sierra Club
4079 Mission Inn Ave.
Riverside, CA 92501

ATTN: Stanley Sniff, Sheriff
Sheriff's Department, Riverside County
Mail Stop 1450

Southern California Agency,
Bureau of Indian Affairs
2038 Iowa Ave.
Riverside, CA 92507-2412

ATTN: Eric H. Roth, Manager
Southern California
Assoc. of Governments
818 W. 7th St., 12th Floor
Los Angeles, CA 90017-3407

Southern California Edison
2244 Walnut Grove Ave., Rm 312
P.O. Box 600
Rosemead, CA 91770

State Clearinghouse
(for certified or FedEx package delivery)
1400 Tenth St., Suite 222
Sacramento, CA 95814

ATTN: Transportation
Desert Permit Assistance Center
38686 El Cerrito Rd.
Palm Desert, CA 92211

Twenty Nine Palms
Band of Mission Indians
46-200 Harrison St.
Coachella, CA 92236

Union Pacific Railroad
1400 Douglas St.
Omaha, NE 68179

Verizon Engineering
9 South 4th St.,
Redlands, CA 92373

Waste Resources Management,
Riverside County
Mail Stop 5950

Western Pacific Region, F.A.A.
15000 Aviation Blvd.
Lawndale, CA 90261-1000

CA Department of Fish & Game
Inland Deserts
3602 Inland Empire Blvd.#C220
Ontario, CA 91764

George Ray, Coordinator
Colorado River Indian Tribe
26600 Mojave Road
Parker AZ 85344

Michael Jackson, President
Fort Yuma Quechan Indian Nation
P.O.Box 1899
Yuma AZ 85366

Linda Otero, Director
AhaMaKav Cultural Society,
Fort Mojave Indian Tribe
P.O. Box 5990
Mojave Valley, AZ 86440

Mayme Estrada, Chairwoman
Santa Rosa Band of Mission Indians
P.O. Box 609
Hemet, Ca 92546

Mary Ann Green, Chairperson
Augustine Band of Cahuilla Mission Indians
P.O. Box 846
Coachella, CA 92236

Michael Contreras, Cultural Heritage Programs
Morongo Band of Mission Indians
12700 Pumarra Road
Banning, CA 92220

Ann Brierty, Cultural Resources Dept.
San Manuel Band of Mission Indians
26569 Community Center Drive
Highland, CA 92346

Diana L. Chihuahua, Vice Chairperson,
Torres-Martinez Desert Cahuilla Indians
P.O. Box 1160
Thermal, CA 92274

Nora McDowell, Cultural Resources Coordinator
Fort Mojave Indian Tribe
500 Merriman Ave
Needles, CA 92363

Jill McCormick, Tribal Archaeologist
Cocopah Museum/Cultural Resources Department
County 15th and Ave G
Sommerton, AZ 85350

Patricia Tuck, THPO
Agua Caliente Band of Cahuilla Indians
5401 Dinah Shore Drive
Palm Springs, Ca 92264

Karen Kupcha
Augustine Band of Cahuilla Mission Indians
P.O.Box 846
Coachella, CA 92236

Bridget Nash-Chrabascz, THPO
Quechan Indian Nation
P.O.Box 1899
Yuma, AZ 85366

Preston J. Arrow-weed
Ah-Mut-Pipa Foundation
P.O. Box 160
Bard, CA 92222

Luther Salgado, Sr. Chairperson
Cahuilla Band of Indians
P.O. Box 391760
Anza, CA 92539

State Water Quality Control Board
P.O. Box 100
Sacramento, CA 95812-0100

CA Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

CA State Office of Historic Preservation
1725 23rd Street, Ste. 100
Sacramento, CA 95816

California ISO
POB 639014
Folsom, CA 95763-9014

Commander NAWCWD
1 Administration Circle Stop 1002
China Lake, CA 93555-6100

Torres Martinez Desert Cahuilla Indians
Attn: Mary Resvaloso
POB 1160
Thermal, CA 92274

Jody Fraser
U.S. Fish & Wildlife Service
6010 Hidden Valley Road, 101
Carlsbad, CA 92011

Community Development
Attn: Mike Baker, Acting Planning & Zoning Director
La Paz County
1112 Joshua, #202
Parker, AZ 85344

APPENDIX B: NEWSPAPER AD

AR060847

THIS PAGE INTENTIONALLY LEFT BLANK

A SCOPING SESSION has been scheduled before the **RIVERSIDE COUNTY PLANNING DIRECTOR** in order to bring together and hear the concerns of affected federal, state and local agencies, the proponent of the proposed project, and other interested persons; as well as inform the public of the nature and extent of the proposed project described below, and to provide an opportunity to identify the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in depth in the Environmental Impact Report and help eliminate from detailed study issues found not to be important.

The Scoping Session is **not** a public hearing on the merit of the proposed project and **NO DECISION** on the project will be made. **Public testimony is limited to identifying issues regarding the project and potential environmental impacts.** The project proponent will not be required to provide an immediate response to any concerns raised. The project proponent will be requested to address any concerns expressed at the Scoping Session, through revisions to the proposed project and/or completion of a Final Environmental Impact Report, prior to the formal public hearing on the proposed project. Mailed notice of the public hearing will be provided to anyone requesting such notification.

ENVIRONMENTAL IMPACT REPORT NO.: **529**

PROJECT CASE NO(S). / TITLE: **CONDITIONAL USE PERMIT NO. 3670 / PUBLIC USE PERMIT NO. 913 / BLYTHE MESA I SOLAR PROJECT**

PROJECT LOCATION: East Riverside County – Palo Verde Area Plan, the Blythe Mesa I Solar Project is located approximately 5 miles west of central Blythe and 40 miles east of Desert Center; more specifically, the project is located north and south of Interstate 10, west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport. The site consists primarily of agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde.

PROJECT DESCRIPTION: The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of approximately 3,660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of 8 feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. Since most of the site has nearly level to gently sloping topography, no mass grading would be required and the natural drainage patterns of the site would not be significantly altered. The Project site would be secured 24 hours per day by onsite private security personnel or remote services with motion-detection cameras. An equestrian-wire, wildlife-friendly and drainage-compatible security fence that meets National Electric Safety Code would be placed around the perimeter of the site. The proposed lighting for the site would be consistent with County building code. A new 8.4 mile long, 230 kilovolt (kV) double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site subject to Public Use Permit (3.6 miles of the gen-tie line are located within the project site, and 4.8 miles are located off-site between the project site and the Colorado River Substation). A majority of the project is within the County of Riverside jurisdiction. An approximate 330-acre portion of the 3,660-acre project site is located within the City of Blythe jurisdiction. A Development Agreement between the County of Riverside and the applicant will be established setting forth the rights and responsibilities of each party with respect to project development and operation.
APN's 821-110-004, 821-120-025, 821-120-026, 821-120-027, etc.

TIME OF SCOPING SESSION:	**6:00 p.m.** or as soon as possible thereafter.
DATE OF SCOPING SESSION:	**December 12, 2011**
PLACE OF SCOPING SESSION:	**Blythe City Council Chambers** **235 N. Broadway** **Blythe, CA 92225**

Please send all written correspondence to:
RIVERSIDE COUNTY PLANNING DEPARTMENT
Attn: Jay Olivas
P.O. Box 1409, Riverside, CA 92502-1409

For further information regarding this project, please contact Project Planner, Jay Olivas at 951-955-1195, or e-mail jolivas@rctlma.org.

APPENDIX C: SCOPING MEETING MATERIALS AND TRANSCRIPT

AR060850

THIS PAGE INTENTIONALLY LEFT BLANK

BLYTHE MESA SOLAR PROJECT
Scoping Meeting

December 12, 2011

Applicant: RENEWABLE RESOURCES GROUP

RIVERSIDE COUNTY
PLANNING DEPARTMENT

Introductions

- CEQA Lead Agency — RIVERSIDE COUNTY PLANNING DEPARTMENT
- Responsible Agency — City of Blythe
- Applicant — RENEWABLE RESOURCES GROUP
- Environmental Consultant — POWER ENGINEERS

Purpose of Meeting

- Provide information about the Blythe Mesa Solar Project
- Communicate the California Environmental Quality Act (CEQA) review process
- Seek comments and input on the scope of the Environmental Impact Report

Riverside County's Role

- Conditional Use Permit approval
- Public Use Permit approval
- Development Agreement
- Lead Agency for the California Environmental Quality Act (CEQA)

California Environmental Quality Act (CEQA)

- Requires the preparation, review, and certification of an environmental review document prior to an action on any non-exempt discretionary projects proposed by public agency in State of California.

Environmental Impact Report (EIR)

- An informational document that provides public agencies and the public with detailed information about the proposed project's significant affects on the environment. It also lists ways to avoid or minimize impacts, and identifies alternatives to the project.

EIR Process

- Distribute Notice of Preparation (NOP)
- Prepare Draft EIR
  - Identify and analyze significant impacts
  - Recommend measures to avoid/reduce impacts
  - Evaluate a reasonable range of alternatives
- Circulate Draft EIR for public review
- Respond to comments and prepare Final EIR
- Notice of Determination

EIR Resource Topics

- Aesthetics/Visual Resources
- Agricultural Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Greenhouse Gas Emissions
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use
- Noise
- Public Services and Utilities
- Socioeconomics
- Traffic and Circulation

Proposed Project

- Construction and operation of a 485 megawatt (MW) solar photovoltaic electrical generating facility that would occupy approximately 3,660 acres.

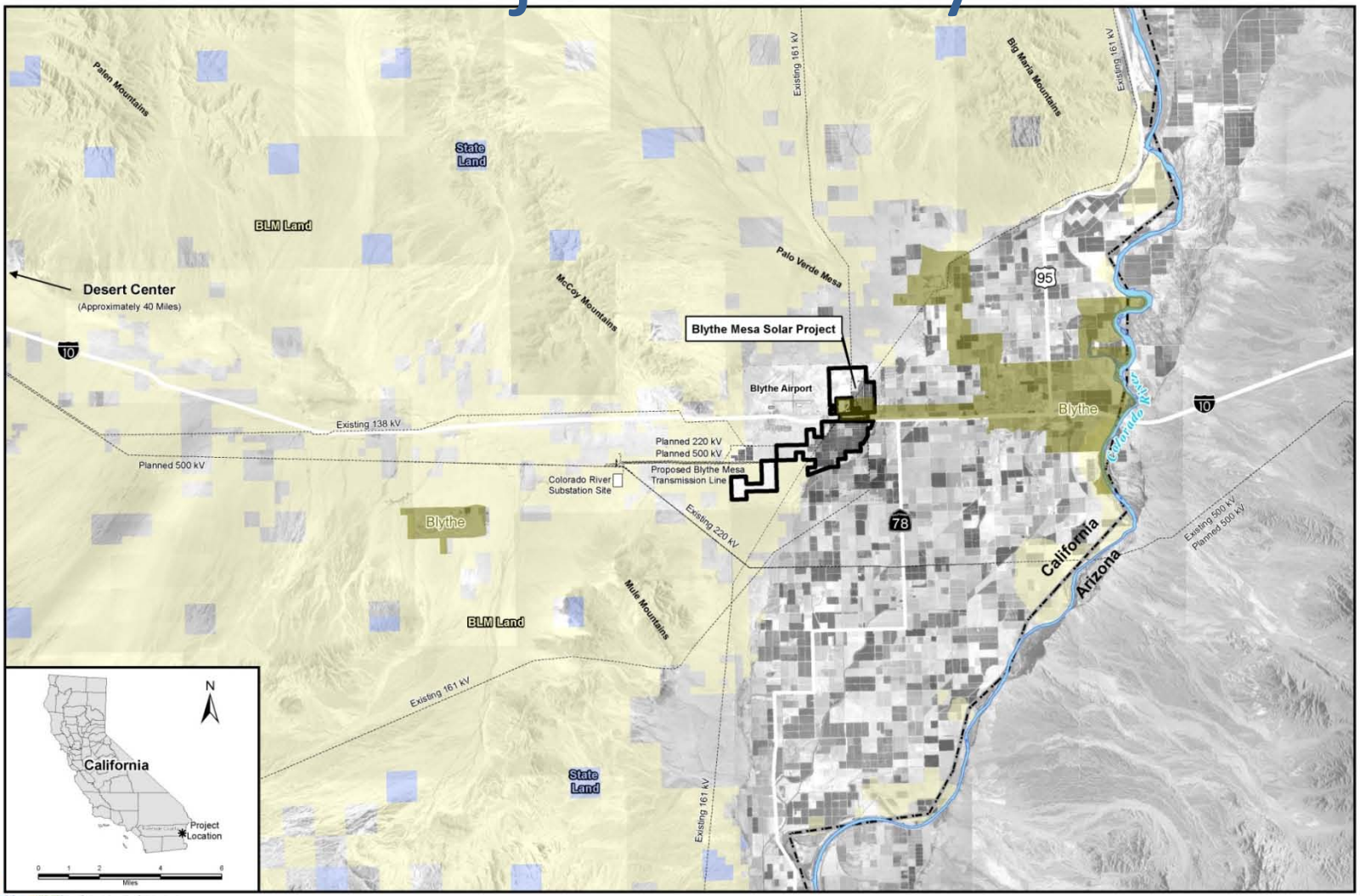
Project Objectives

- Assist with meeting California's Renewable Energy Standards and Goals
- Assist with greenhouse gas reduction
- Locate project facilities near electrical transmission facilities
- Site project in an area with excellent solar energy resources to maximize energy productivity from PV panels
- Site on disturbed land with compatible topography that minimizes environmental impacts
- Use a proven and available solar PV technology

Key Project Components

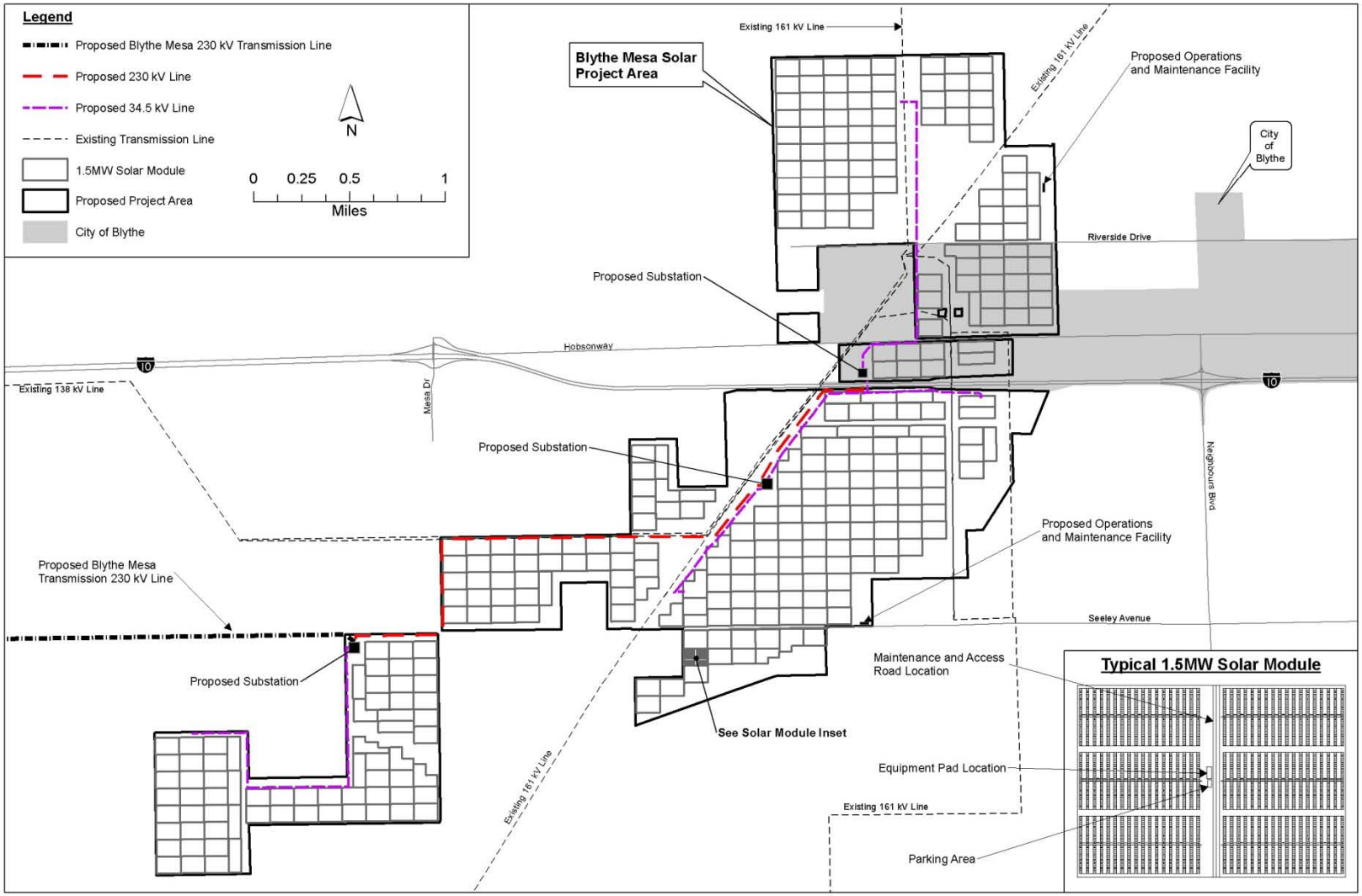
- Solar array field
  - Interior collection power lines (34.5 kV)
  - Three substations (300 feet by 300 feet)
  - Two operation & maintenance buildings (approximately 3,500 square feet each)
  - Two primary access roads (Seeley Avenue & Riverside Drive)
- 8.4 mile 230 kV double-circuit transmission line

Project Vicinity



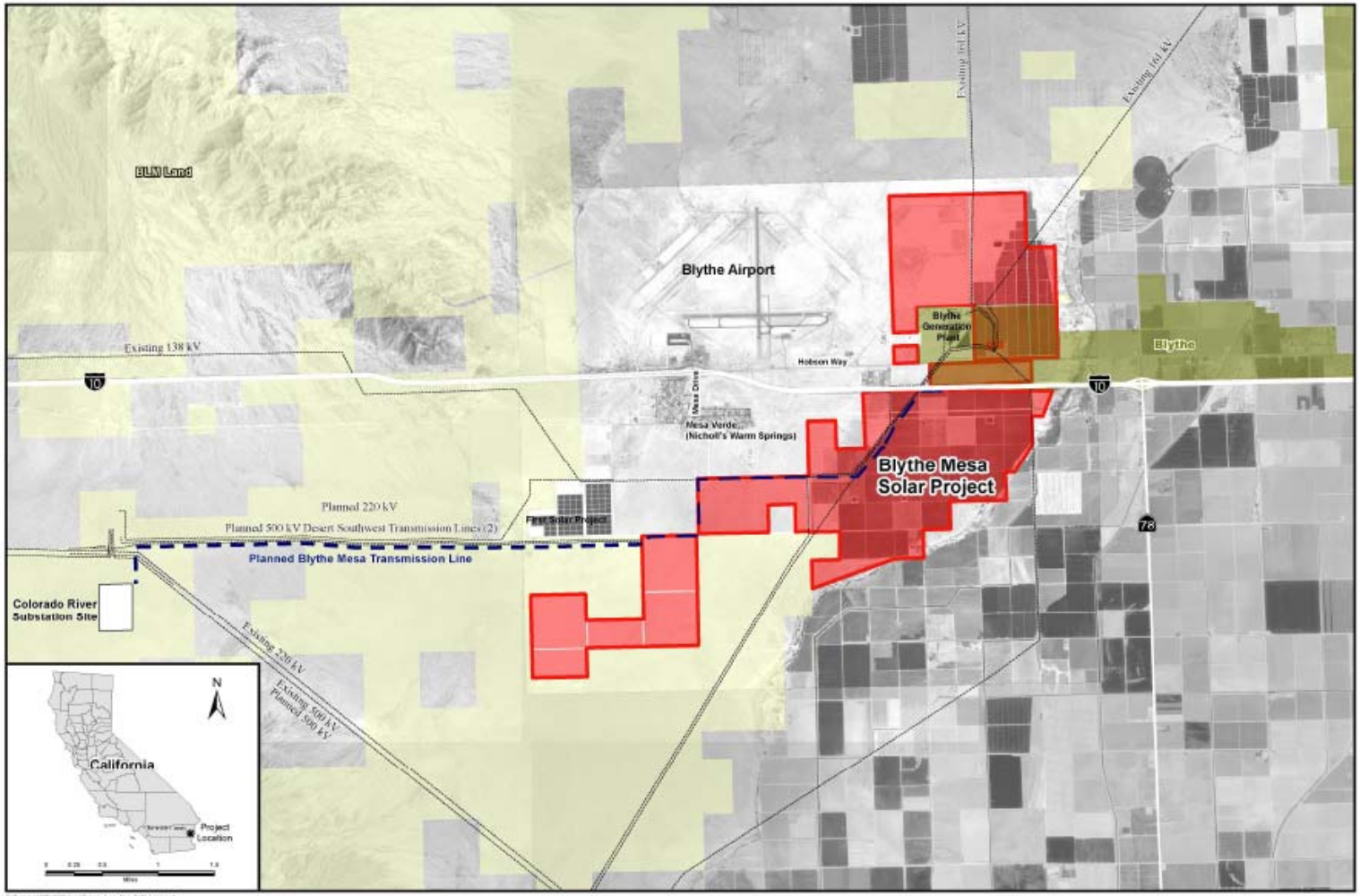
AR060862

Site Plan



AR060863

Transmission Component



AR060864

Opportunities for Public Involvement

Notice of Preparation (NOP) • Issue NOP for 30-day public review • Scoping Meeting	 November – December 2011 December 12, 2011
Draft EIR Preparation • Compile Draft EIR • Draft EIR Public Review and Comment	 Winter 2011 to Summer 2012 Summer 2012
Final EIR Preparation • Public Hearing – Board of Supervisors	 Late-Summer 2012

NOP Public Review

Comments concerning the scope of the environmental analysis are requested by **December 22, 2011** so that technical studies reflect that input.

- Submit a comment form during the public scoping meeting
- Email jolivas@rctlma.org
- Phone (951) 955-1195
- Write to:

  Jay Olivas, Project Planner
  Riverside County Planning Department
  4080 Lemon Street, 12th Floor
  P.O. Box 1409
  Riverside, CA 92502-1409

  For additional project information please visit the County of Riverside's web page at http://www.tlma.co.riverside.ca.us/planning/

Oral Scoping Comments

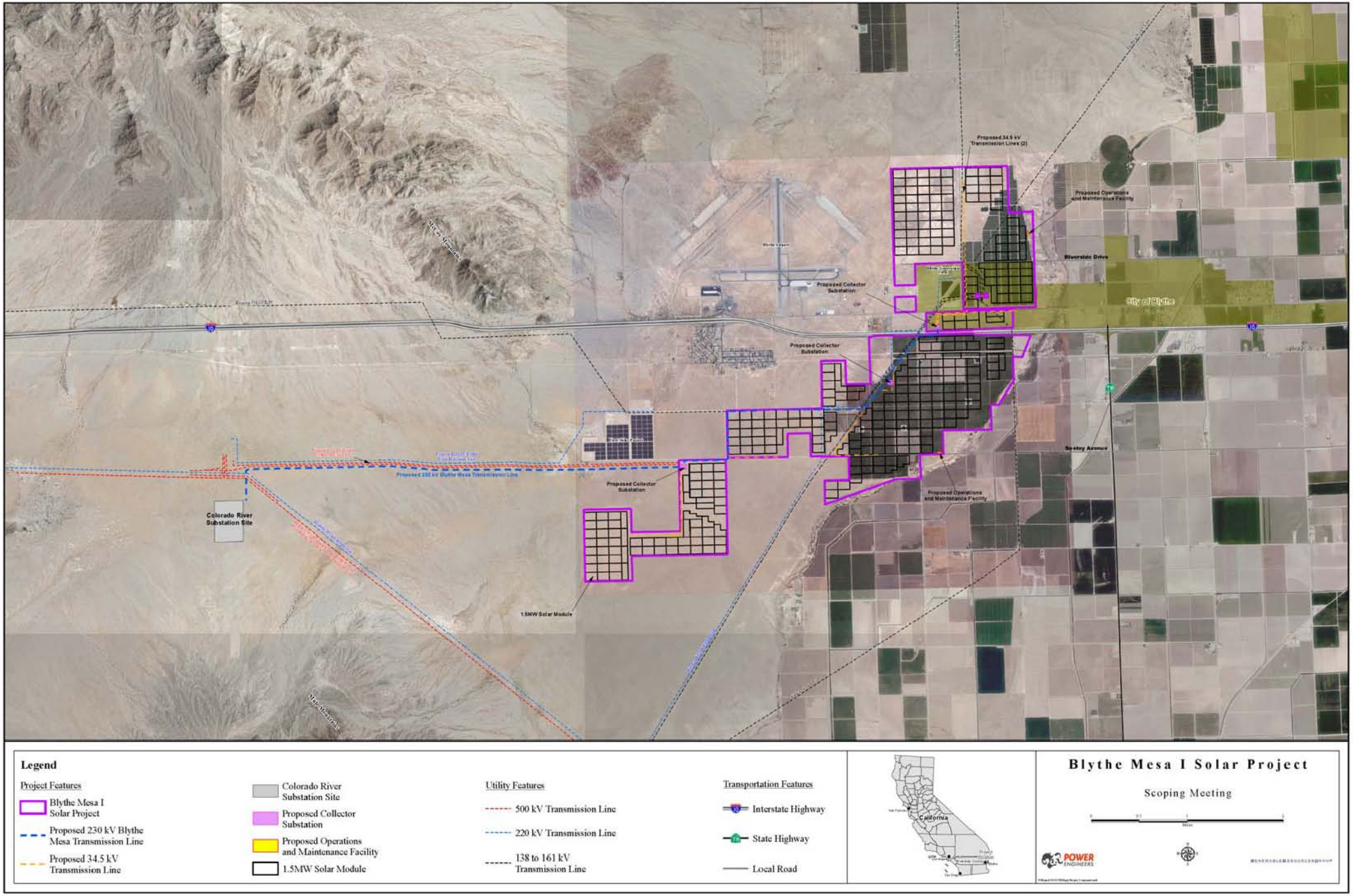
- Comment Cards

- Guidelines
  - State (and spell) your name clearly
  - Only one person shall speak at a time
  - Support everyone's participation
  - Respect others' opinions

Proposed Project

Construction and operation of a 485 megawatt (MW) solar photovoltaic electrical generating facility that would occupy approximately 3,660 acres.

- Solar array field
  - Interior collection power lines (34.5 kV)
  - Three substations (300 feet by 300 feet)
  - Two operation & maintenance buildings (approximately 3,500 square feet each)
  - Two primary access roads (Seeley Avenue & Riverside Drive)
- 8.4 mile 230 kV double-circuit transmission line


Proposed 34.5 kV Transmission Lines (2)
Proposed Operations and Maintenance Facility
Riverside Drive
City of Blythe
Proposed Collector Substation
Proposed Collector Substation
Proposed Collector Substation
Proposed Operations and Maintenance Facility
Seeley Avenue
Proposed 230 kV Blythe Mesa Transmission Line
Colorado River Substation Site
1.5MW Solar Module
Mule Mountains
Legend
Project Features
Blythe Mesa I Solar Project
Proposed 230 kV Blythe Mesa Transmission Line
Proposed 34.5 kV Transmission Line
Colorado River Substation Site
Proposed Collector Substation
Proposed Operations and Maintenance Facility
1.5MW Solar Module
Utility Features
500 kV Transmission Line
220 kV Transmission Line
138 to 161 kV Transmission Line
Transportation Features
Interstate Highway
State Highway
Local Road
California
Blythe Mesa I Solar Project
Scoping Meeting
POWER ENGINEERS

AR060869

RIVERSIDE COUNTY
PLANNING DEPARTMENT

Comment Form

The County of Riverside thanks you for your interest in the Blythe Mesa I Solar Project. Scoping meetings are being conducted to share information regarding the project and decision-making process, and listen to the public views on the range of issues to be considered during the preparation of a Draft Environmental Impact Report. Please take a moment to answer the questions below and return this sheet to the comment table or mail to the address on the back of this form by **December 22, 2011.**

NAME: _____ DATE: _____

ADDRESS: _____

CITY/STATE/ZIP: _____

EMAIL (optional): _____

Please describe any issues that should be considered during the resource studies and in environmental resource document preparation.

Fold Here

Fold Here

RIVERSIDE COUNTY
PLANNING DEPARTMENT

Riverside County Planning Department
4080 Lemon Street, 12th Floor
P.O. Box 1409
Riverside, CA 92502-1409
Attn: Jay Olivas, Project Planner

POSTAGE
REQUIRED

Riverside County Planning Department
4080 Lemon Street, 12th Floor
P.O. Box 1409
Riverside, CA 92502-1409
Attn: Jay Olivas, Project Planner

PUBLIC SCOPING MEETING FOR THE CONDITIONAL USE PERMIT NO. 3670/ PUBLIC USE PERMIT NO. 913/ BLYTHE MESA | SOLAR PROJECT

REPORTER'S TRANSCRIPT OF PROCEEDINGS

Taken on Monday, December 12, 2011

At 235 North Broadway
Blythe, California

At 6:00 p.m.

REPORTED BY: JULIETTE L. VIDAURRI CCR, RPR
AZ CR #50359/CA CSR #11081/NV CCR #748

APPEARANCES:

Ken Baez, Principal Planner for the Riverside County Planning Department

Thomas C. Ryan, Senior Project Manager, for Power Engineers

Rupal Patel for Renewable Resources Group, Inc.

MR. BAEZ: Well, good evening, everybody. How you doing? Glad you all can make it, and welcome to our Riverside County Director of Hearing Blythe Mesa Solar Project Scoping Meeting.

My name is Ken Baez, and I'm the Riverside County Planner assigned to the project, and with us here also we have the City of Blythe and some representatives from their planning department, as well as the applicant, and their engineer that will go over some of the details on the project.

The purpose of this meeting is pretty much to inform you and get feedback from you about the project, the solar project that's, um, by the name of Blythe Solar Management -- Blythe Solar Mesa. Sorry about that.

It is a project that entails 485 megawatts of power production and transmission line located on approximately 3,660 acres throughout unincorporated areas of Riverside County and also the City of Blythe. A small portion of that, um, located primarily on the southwesterly portion of the city.

And also we want to kind of go over the details of the California Environmental Quality Act, and the process in which allows the public to provide comments on the resources that we'll be analyzing.

We also will be requiring that the applicant get a

Conditional Use Permit approval as well as a Public Use Permit approval for the project.

Now, the two different permits are -- one is a Conditional Use Permit is for the generation facility where they will be generating and setting out the solar photovoltaic panels, and the transmission component is the transmission of power into the grid, which is the Public Use Component, and then we'll also be seeking to negotiate a development agreement as well as act on the Environmental Impact Report.

Now, the California Environmental -- Environmental Quality Act requires the preparation, review, and certification of an environmental review document prior to any action or any non-exempt discretionary projects proposed by the public agency of California, which essentially means that we're going to be analyzing this project for its environmental impact before we act on it, so... And the Environmental Impact Report essentially is a document that we will use to analyze those impacts.

MR. HOWARD: Excuse me. Can we ask questions or is it better just to save those?

MR. BAEZ: Yeah, save your questions until the end. And pretty much if you have any comments that you would like to provide to us, we'll have an opportunity at the end of the discussion to have you give us a comment

card, which we have available here. If you would like to write down your questions or comments and concerns, that way we can have those addressed in the document.

It's a question-and-answer session, please note that, and we will do the best we can with the experts that we have here today, so...

And as I said, the EIR process is where we have distributed a Notice of Preparation, which is available here in a handout, and it basically identifies the resources that we're analyzing for the impact from the project.

And we primarily look at identifying and analyzing significant impacts. Those are things that need to be mitigated. Recommend measures to avoid or reduce those impacts, i.e., the mitigation measures, and evaluate a reasonable range of alternatives, so we're looking at this project as well as other alternatives.

And we will circulate the Draft Environmental Impact Report for review, and we'll respond to the comments and prepare those in the final EIR, in which case after that we'll be issuing a Notice of Determination, which is the findings that we have for the Environmental Impact Report of the public agency.

And these are some of the topics that we will be covering in the Environmental Impact Report; and if you are seeking to have any comments that you may have from the

public, that we may address them further, any concerns that you might have about these resources.

With that said, I'll hand it over to Tom from the engineering firm to go over the details of the project.

MR. RYAN: Thank you, Ken.

My name is Tom Ryan with Power Engineers, and Power is assisting the County and the applicant with preparation of the Environmental Impact Report.

As Ken mentioned, this is a proposed of 485 megawatt solar photovoltaic project. It's total -- the total acreage is 3,660. That includes the project site itself plus another component, which is a transmission -- a short transmission line from the project site to a substation.

I'll show you a little bit more about the project in a moment, but I wanted to talk to you a little bit about project objectives, and project objectives are important from the CEQA standpoint because they basically answer why the project is being proposed.

So if we can get a good foundation for why a project is being proposed, it helps in quantification of the impacts and mitigation measures, it helps us justify alternatives, and it helps us with the findings that must be made later in the process when it comes to project consideration or approval.

So the project is being designed to obtain a number of objectives, and one is to assist with meeting the California Renewable Energy Standards and Goals.

The California Renewable Portfolio Standards that have been adopted require that 33 percent of the electricity used in the state be supplied from renewable resources by the year 2020, and there -- there was a previous deadline for that of 2010. There's an increasing percentage as we go forward into 2050, but the next step of that is the 33 percent by 2020.

And I know much progress has been made for renewable energy. It's projects like this that will help achieve that next level of the Renewable Portfolio Standard, so this projects contributes to that objective.

Next is assist with greenhouse gas reduction. We have in California the California Global Warming Solutions Act of 2006. There have been some amendments in the federal orders to that which establish the objective of reducing greenhouse gas emissions to 1990 levels by the year 2020. That means that we need to reduce greenhouse gas generation by about 25 percent to achieve that -- that 1990 level baseline.

So projects like this would provide electrical energy without using fossil fuels to help us meet the Global Warming Solutions Act objectives.

Locate the project near electrical transmission facilities. Um, I think a major impediment to meeting the Renewable Portfolio Standards is the fact that many of the solar projects and wind projects which are renewable are located in remote areas that aren't necessarily certified major transmission.

This project happens to be located close to the transmission. We are within four and a half miles of the major substation, and can -- this project will tie into to serve the regional grid.

Another objective is, of course, to take advantage of excellent solar resources, and the Blythe area, as you may know, is blessed with great solar resources. It's not just us saying that. It's Bureau of Land Management and Department of Energy have characterized the resources in the Riverside East study area as excellent potential for solar.

Um, another objective is the site the project is on disturbed lands with compatible topography. This project is by no means in an area of pristine desert environment. We've got the past -- current and previous agricultural use on the property. It's near the Blythe Airport, um, where a -- bisected by a major interstate highway. We've got regional transmission lines all surrounding the project site, so this is a disturbed property.

And then the final objective is use a proven and

available solar PV technology for the project. The solar panels and tracker systems which are proposed by Sun Power are proven photovoltaic systems. There's 250 megawatts of installed capacity and more projects in the works, so this is a good, reliable solar technology to use here.

And another thing about this particular technology is that it actually reduces the amount of land that is necessary for solar generation by the tracking mechanism taking full advantage of the solar radiation as well as minimizing shading over adjacent panels by the individual panels.

So those are some of the project objectives, and we will go on to key project components. There's two primary components. The Solar Array Field, which is -- has a number of self components to it. There's a few substations. There's a few O&M facilities. We have a system of both underground and aboveground collection -- electric collection lines. We have two major access roads on Seeley Avenue and Riverside Drive, which I will point out in a moment, and then the second primary component is the 230 kV transmission line from the project site to the Colorado River Substation.

This is just to give you an orientation of where the project is. We've got the project site outlined in black there, City of Blythe in the green shading, got the

Blythe Airport, and the California/Arizona border over here, Interstate 10 bisecting the project site, and the transmission line from the edge of the project to the Colorado River Substation, which is right there.

Some more detail site plan. These little squares on here are power blocks or actually what we call solar modules. There's a blow-up of solar module right here, which contains the rows of solar panels. There's some equipment that is necessary to convert the power -- collect the power, convert it to AC/DC, and then transmit it on to -- throughout the system on the project site.

Each one of these little squares is about 1.5 megawatts, and there's -- they're arranged on the project site and connected via a system of 34 and a half kV lines, and those lines show up as purple. There's one there, which connects down into the -- a project substation. There's also 34 and a half kV overhead lines here for this substation, and then on this parcel connecting to the third substation here.

The City of Blythe boundary here is about 330 acres on the project within the City of Blythe city limits. Major access is Riverside Drive here accessing this O&M facility right there, and then Seeley Avenue down here to access a second O&M building in this location.

The substations on the project site are connected

via 230 kV overhead transmission line, which follows an alignment from this first substation, across the freeway, down adjacent to some existing transmission lines, cutting across and reaching down here, and then exiting the project site in a westerly direction to the Colorado River Substation.

This is just another view of the project site. Um, I wanted to talk just for a minute about this transmission facility here. From the project site where the 230 kV line goes west to the Colorado River Substation, once you get about a mile in here just past the first solar project, which is right there, the project enters a combination of federal and private land.

So to permit and approve this -- this portion of the alignment, roughly this portion, will require the Bureau of Land Management to -- to give a right-of-way grant. And to issue that right-of-way grant they are likely to require some kind of environmental documentation, and we are not sure exactly what form of documentation, but that's a separate action, and, um, we will be working with the Bureau of Land Management to determine what their preference is for that, but wanted to -- to state that the CEQA requires us to look at the whole of an action, so the EIR will cover the entire project including the solar panel portion on private land and the transmission portion on federal land, and

hopefully then the federal government when they get around to doing their environmental documentation will draw from the EIR or maybe perhaps use the EIR for that purpose. So that's the proposed project.

Ken, would you like to close us.

MR. BAEZ: Throughout the CEQA process there are a number of opportunities for the public to comment and review the documentation; and as you see here today, we are at the scoping meeting here, and it will essentially be closing on December 22nd; so if you would like to give comment and you're not in a position to do it today, you can do it by the 22nd.

I have contact information that's at the end of the slide that you are more than welcome to have. I also have business cards that we will be giving out, as well as also during the Draft EIR preparation that is expected to come out in the summer of 2012 there will also be a public review and comment.

We will have a notice that will be circulated out in the newspaper and also identify that the opportunity to review and comment is open as well as the final EIR when we post it for the decision-making body, the Board of Supervisors of Riverside, to certify the document as well as approve the Conditional Use Permit and the Public Use Permit.

So with that, that concludes my presentation, and here's the contact information that we would like to hand out to you and give that to anyone who's interested.

So if you have any comments or questions, I urge you to fill out a card; and also if you stand up and speak, please clearly state your name, and I'll open the floor to any questions or comments.

Any questions or comments?

MR. HOWARD: My name is Ray Howard --

THE COURT REPORTER: I'm sorry. I didn't hear your last name.

MR. HOWARD: Howard, H-o-w-a-r-d. And my question is regarding the three substations. Just at the map I couldn't really tell where those are at. Are those already being used or is that something you are going to be building?

MR. RYAN: They will be built. They will be constructed.

MR. HOWARD: And can you again go back to that map and give me a little more information as to where they are?

MR. RYAN: Right. Okay. So here's Interstate 10 coming across here.

MR. HOWARD: Okay.

MR. RYAN: This is the Blythe Energy Center

right there.

MR. HOWARD: That's the current --

MR. RYAN: Yeah, the existing energy center. The airport is over here. So one of the substations is right there, and the other one is right here. This is pretty much an orchard right now.

MR. HOWARD: Okay. And both of those are on the south side of the freeway?

MR. RYAN: One's on the north side. This one's on the south side, and there's a third one down here.

MS. HOWARD: So is the top -- the first one at the top -- I'm sorry. I'm Shannon Howard. I'm his wife. Is the one at the top the one that's existing there now, that substation?

MR. RYAN: No. This will be new.

MS. HOWARD: So this is totally new?

MR. RYAN: Yeah. It's not there yet.

MS. HOWARD: So all of the stuff that's there is not part of this at all or won't be part of this?

MR. BAEZ: That's correct.

MR. RYAN: All of these facilities will be new -- newly constructed facilities.

MR. ELLIS: My name is Ron Ellis. I have a question of the group. Is Riverside and Blythe talking about doing this? I don't see a contractor or who's going

to try to put this together?

MR. BAEZ: The applicant is Renewable Recourses Group, and we have -- that's the applicant engineering.

MR. ELLIS: I didn't see this written down here. Maybe I missed it.

MR. BAEZ: It's in the beginning on the opening slide. It had an introduction that introduced them as the --

MR. ELLIS: Okay. I didn't recognize that as the name.

MR. RYAN: Yeah, this is not -- not -- it's in the permitting stage right now. We are going through the environmental process, and it will require a formal project approval, and then there will be some permits issued, and then construction would go.

MR. ELLIS: I've seen these processes go through, and sometimes it takes years to get this taken care of. Now, this PV, these processes, are they a little bit faster?

MR. BAEZ: Are they a little bit faster? It's kind of a new territory for Riverside County, and we're doing the best we can to permit these things when they come through, but the review process is the review process. We have to evaluate the environmental impact, and we're

dependent upon the applicant to provide the documentation that's needed, so there are studies that are required, and sometimes they are prepared on time, and sometimes they have to wait a year for specific focus surveys to be done, particularly in biology. Sometimes the season isn't right for those to be done, so sometimes there's a wait that we have to endure for these types of projects.

Any other questions?

MR. HOWARD: You mentioned that Riverside Avenue would be one of the access roads, and at this time Riverside Avenue doesn't go all the way up on the Mesa there. Will that be extended?

MR. BAEZ: It would be required to have improvements done when --

MR. HOWARD: Paved?

MR. BAEZ: It will be paved more than likely. It's up to our transportation department to establish the requirement for that, and that would be subject to a condition of approval on the approved projects such as the Conditional Use Permit as well as the Public Use Permit.

MR. HOWARD: I know it's part of the environmental impact in one of the reports in terms of the traffic. Um, what kind of traffic are you expecting to be involved in that area where the solar panels are at?

MR. BAEZ: That would primarily be -- the

higher point would be likely during the construction phase. That's where it would probably be the highest impact as well as some of the maintenance. That's where it would be evaluated. It's based on information that they provide to us on truck traffic trips, on daily truck traffic.

MR. HOWARD: Okay. At the present time there's some alfalfa fields, which I believe is part of the land that's going to be developed at some point in time.

Do you have any kind of a time frame? Because I've heard that those alfalfa fields would be staying for some time.

MR. BAEZ: That could potentially be there until they are ready to construct. That might be something part of what the land requisition between the applicant and the land owner, so it could be something that's worked out between them, but until that entitlement is actually -- a permit is being pulled for that, that can very well likely be until that time.

MR. HOWARD: Well, I am -- let me also state that I live up there. I have a house that's by those alfalfa fields, and there's a dirt road that kind of goes in front of our house, and I'm wondering if that is going to be considered one of the access roads, and if that's where part of this traffic is going to be going back and forth down.

MR. BAEZ: I can't say for any certainty

where that road is, what they're analyzing, what they are providing as far as what their access points are. That's our transportation department's. They have to look into our general plan and see what those roads require for any improvements when they go forward with their project.

MR. HOWARD: Okay.

MR. BAEZ: It wouldn't be done until after the approval process would be done.

MR. HOWARD: And I know there are lots of factors that will determine exactly when this is all under construction. Can you give me any kind of rough date of when to expect?

MR. BAEZ: I'd have to rely on the applicant quite honestly for that.

MS. PATEL: We are projecting probably January 2013.

MR. HOWARD: At least that's something to be aware of.

MS. PATEL: Uh-huh. Absolutely. And it will be completely spelled out and analyzed in the Environmental Impact Report.

MR. HOWARD: Okay. Now, can the general public get a copy of that Environmental Impact?

MR. BAEZ: It will be available.

MR. HOWARD: Do you have to sign up for

something to get that?

MS. PATEL: And you'll be able to comment. If you're part of this NOP scoping process -- I'm sorry. I'm probably speaking out of turn -- but if you're part of the NOP scoping process, you'll be included in the distribution of all notices and reports associated with this project.

MR. BAEZ: Okay. Because you signed in; right --

MR. HOWARD: Yes.

MR. BAEZ: -- with your address and contact information. You will be notified.

MR. HOWARD: Okay. Thank you.

MR. RYAN: Did you receive a letter by mail for this?

MR. HOWARD: Yes. And we appreciate that.

MR. RYAN: You will be notified.

MR. ELLIS: A project of this size, how long do you believe the construction project itself will take?

MR. RYAN: It's an estimate of about three years to construct. Um, the peak construction period, you know, there could be anywhere between two to 300 workers, 300 to 400 -- 200 to 400 workers at one time for the peak 24-month period, but a three-year total process.

So if it's January 2013, then it's three years

before it's completed.

MR. BAEZ: Anybody else?

(No response.)

MR. BAEZ: Okay. And if you happen to have any comments, like I said, or questions, we would be happy to answer those. Just be sure to get those in before the 22nd of December.

With that, I'll close this, and I'll have my contact information here so if you would like to jot that down.

(The meeting concluded at 6:25 p.m.)

CERTIFICATE OF REPORTER

State of Arizona)
)
County of Mohave)

I, Juliette L. Vidaurri, CCR, RPR, do hereby certify that I took down in shorthand (Stenotype) all of the proceedings had in the above-entitled matter at the time and place indicated, and that thereafter said shorthand notes were transcribed into typewriting at and under my direction and supervision, and the foregoing transcript constitutes a full, true, and accurate record of the proceedings had.

In witness whereof, I have hereunto affixed my hand the 28th day of December, 2011.

_____
Juliette L. Vidaurri, CCR, RPR
AZ CCR #50359/CA CCR #11081/NV CCR #748

APPENDIX D: SCOPING MEETING NOTICE

AR060893

NOTICE OF SCOPING SESSION

A SCOPING SESSION has been scheduled before the **RIVERSIDE COUNTY PLANNING DIRECTOR** in order to bring together and hear the concerns of affected federal, state and local agencies, the proponent of the proposed project, and other interested persons; as well as inform the public of the nature and extent of the proposed project described below, and to provide an opportunity to identify the range of actions, alternatives, mitigation measures, and significant effects to be analyzed in depth in the Environmental Impact Report and help eliminate from detailed study issues found not to be important.

The Scoping Session is **not** a public hearing on the merit of the proposed project and **NO DECISION** on the project will be made. **Public testimony is limited to identifying issues regarding the project and potential environmental impacts.** The project proponent will not be required to provide an immediate response to any concerns raised. The project proponent will be requested to address any concerns expressed at the Scoping Session, through revisions to the proposed project and/or completion of a Final Environmental Impact Report, prior to the formal public hearing on the proposed project. Mailed notice of the public hearing will be provided to anyone requesting such notification.

ENVIRONMENTAL IMPACT REPORT NO.: **529**

PROJECT CASE NO(S). / TITLE: **CONDITIONAL USE PERMIT NO. 3670 / PUBLIC USE PERMIT NO. 913 / BLYTHE MESA I SOLAR PROJECT**

PROJECT LOCATION: East Riverside County – Palo Verde Area Plan, the Blythe Mesa I Solar Project is located approximately 5 miles west of central Blythe and 40 miles east of Desert Center; more specifically, the project is located north and south of Interstate 10, west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport. The site consists primarily of agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde.

PROJECT DESCRIPTION: The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of approximately 3,660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of 8 feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. Since most of the site has nearly level to gently sloping topography, no mass grading would be required and the natural drainage patterns of the site would not be significantly altered. The Project site would be secured 24 hours per day by onsite private security personnel or remote services with motion-detection cameras. An equestrian-wire, wildlife-friendly and drainage-compatible security fence that meets National Electric Safety Code would be placed around the perimeter of the site. The proposed lighting for the site would be consistent with County building code. A new 8.4 mile long, 230 kilovolt (kV) double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site subject to Public Use Permit (3.6 miles of the gen-tie line are located within the project site, and 4.8 miles are located off-site between the project site and the Colorado River Substation). A majority of the project is within the County of Riverside jurisdiction. An approximate 330-acre portion of the 3,660-acre project site is located within the City of Blythe jurisdiction. A Development Agreement between the County of Riverside and the applicant will be established setting forth the rights and responsibilities of each party with respect to project development and operation. APN's 821-110-004, 821-120-025, 821-120-026, 821-120-027, etc.

TIME OF SCOPING SESSION:	**6:00 p.m.** or as soon as possible thereafter.
DATE OF SCOPING SESSION:	**December 12, 2011**
PLACE OF SCOPING SESSION:	**Blythe City Council Chambers** **235 N. Broadway** **Blythe, CA 92225**

Please send all written correspondence to:
RIVERSIDE COUNTY PLANNING DEPARTMENT
Attn: Jay Olivas
P.O. Box 1409, Riverside, CA 92502-1409

For further information regarding this project, please contact Project Planner, Jay Olivas at 951-955-1195, or e-mail jolivas@rctlma.org.

PROPERTY OWNERS CERTIFICATION FORM

I, VINNIE NGUYEN, certify that on 11/16/2011,

The attached property owners list was prepared by Riverside County GIS,

APN (s) or case numbers CUP03670 For

Company or Individual's Name Planning Department,

Distance buffered 2400'.

Pursuant to application requirements furnished by the Riverside County Planning Department, Said list is a complete and true compilation of the owners of the subject property and all other property owners within 600 feet of the property involved, or if that area yields less than 25 different owners, all property owners within a notification area expanded to yield a minimum of 25 different owners, to a maximum notification area of 2,400 feet from the project boundaries, based upon the latest equalized assessment rolls. If the project is a subdivision with identified off-site access/improvements, said list includes a complete and true compilation of the names and mailing addresses of the owners of all property that is adjacent to the proposed off-site improvement/alignment.

I further certify that the information filed is true and correct to the best of my knowledge. I understand that incorrect or incomplete information may be grounds for rejection or denial of the application.

NAME: Vinnie Nguyen

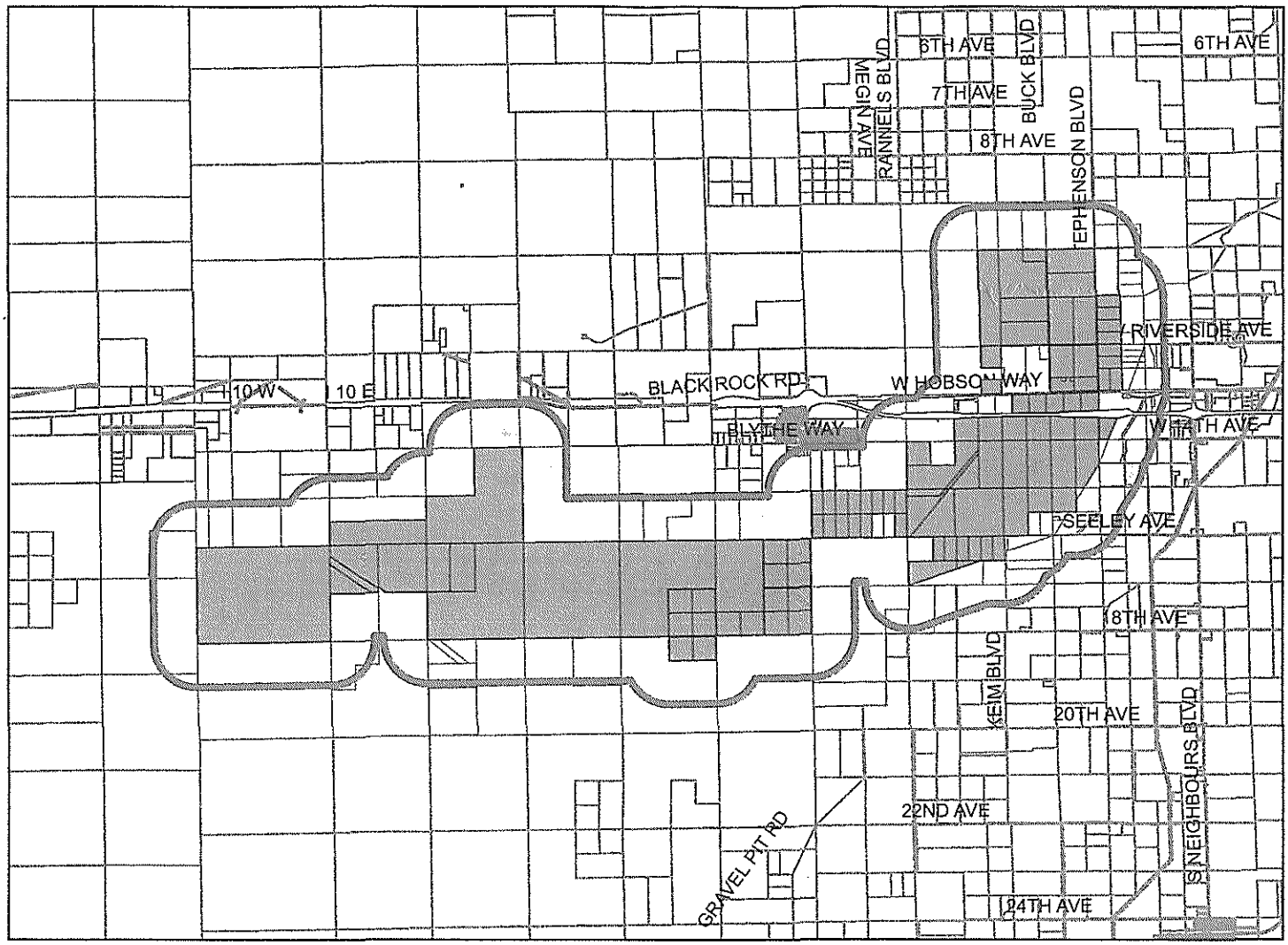
TITLE GIS Analyst

ADDRESS: 4080 Lemon Street 2nd Floor

Riverside, Ca. 92502

TELEPHONE NUMBER (8 a.m. – 5 p.m.): (951) 955-8158

2400 feet buffer



Selected Parcels

866-030-001	866-030-002	879-080-007	879-080-014	824-130-004	863-020-020	879-110-001	824-030-023	824-090-020	824-090-042
824-090-044	863-020-015	863-120-003	863-120-004	863-120-006	824-101-021	879-030-007	879-080-001	879-080-002	879-080-034
824-101-012	824-101-013	824-073-019	824-064-004	866-021-007	821-080-041	821-110-003	824-030-003	824-073-010	824-080-004
824-101-007	863-020-013	863-120-005	863-040-002	824-122-015	824-142-002	824-063-001	863-020-018	863-030-012	879-080-008
879-080-013	879-300-008	879-100-003	863-060-004	824-073-013	824-064-007	824-150-001	824-122-014	824-073-007	863-110-004
863-070-003	863-070-004	863-070-007	863-070-008	863-120-007	863-120-008	866-021-005	879-090-053	879-090-054	866-021-006
824-030-012	879-300-015	821-080-043	821-090-011	821-090-012	821-090-018	821-110-004	821-120-025	821-120-026	821-120-027
821-120-028	821-120-029	821-120-030	821-120-034	821-120-035	821-120-038	821-120-039	821-120-040	821-120-042	821-120-043
821-120-044	821-120-046	821-120-047	821-120-048	824-080-003	824-080-005	824-090-009	824-090-024	824-090-028	824-101-014

rst 90 parcels shown

7,2503,625 0 7,250 Feet

Maps and data are to be used for reference purposes only. Map features are approximate, and are not necessarily accurate to surveying or engineering standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.

ASMT: 821090010, APN: 821090010
KATHLEEN BARCINAS, ETAL
16120 KRAMERIA AVE
RIVERSIDE CA 92504

ASMT: 821120015, APN: 821120015
NANCY VANDERSLICE, ETAL
P O BOX 5354
MOHAVE VALLEY AZ 86440

ASMT: 821120017, APN: 821120017
ROBINSON FARMS
P O BOX 2399
BLYTHE CA 92226

ASMT: 821120019, APN: 821120019
LOS CERRITOS CAPITAL CORP
88100 AVENUE 58
THERMAL CA 92274

ASMT: 821120023, APN: 821120023
ANGELINA DILL, ETAL
P O DRAWER 1140
BLYTHE CA 92226

ASMT: 821120024, APN: 821120024
USA 821
US DEPT OF THE INTERIOR
WASHINGTON DC 21401

ASMT: 824030007, APN: 824030007
MI CASA PROP
1330 OAK VIEW AVE
SAN MARINO CA 91108

ASMT: 824030012, APN: 824030012
GARY KADING
10960 WILSHIRE BLVD 5TH FL
LOS ANGELES CA 90024

ASMT: 824063001, APN: 824063001
DARRELL FOSSETT
634 E MICHIGAN ST
BLYTHE CA 92225

ASMT: 824063002, APN: 824063002
TERESA LERMA, ETAL
17975 BLYTHE WAY
BLYTHE CA 92225

ASMT: 824063004, APN: 824063004
HELEN CRAWFORD, ETAL
42665 DEUR WAY
HEMET CA 92544

ASMT: 824064002, APN: 824064002
TINA MORGAN, ETAL
P O BOX 742
BLYTHE CA 92226

ASMT: 824064003, APN: 824064003
PATRICIA MORGA, ETAL
17845 BLYTHE WAY
BLYTHE, CA. 92225

ASMT: 824064004, APN: 824064004
CAROL WILYAT
17829 BLYTHEWAY
BLYTHE, CA. 92225

Easy Peel® Labels
Use Avery® Template 5162®
Feed Paper
Bend along line to expose Pop-up Edge™
AVERY® 5962®

ASMT: 824064007, APN: 824064007
EARL LAIRD
C/O RANDALL JAMES LAIRD
944 W MONTGOMERY
SPOKANE WA 99207

ASMT: 824064011, APN: 824064011
MARTINA RIVERA, ETAL
17825 BLYTHE WAY
BLYTHE CA 92225

ASMT: 824064013, APN: 824064013
EPIGENIA PEREZ, ETAL
17819 BLYTHE WAY
BLYTHE, CA. 92225

ASMT: 824072002, APN: 824072002
MICHAEL SMALLEY
1979 PIDE POOL CT
MARYSVILLE CA 95901

ASMT: 824072004, APN: 824072004
NORMAN BARNARD
35899 RED BLUFF PL
MURRIETA CA 92562

ASMT: 824072006, APN: 824072006
GMAC MORTGAGE
1100 VIRGINIA DR
FORT WASHINGTON PA 19034

ASMT: 824072008, APN: 824072008
PETE REYES, ETAL
17690 NICHOLLS RD
BLYTHE, CA. 92225

ASMT: 824072010, APN: 824072010
STRAUGHAN GRACE ESTATE OF
C/O JOHN PEREIRA
1112 CHERRY HEIGHTS RD
THE DALLES OR 97058

ASMT: 824072012, APN: 824072012
MARIA LOPEZ, ETAL
P O BOX 1754
BLYTHE CA 92226

ASMT: 824072014, APN: 824072014
STEVEN FOLEY, ETAL
14101 LIME DR
BLYTHE, CA. 92225

ASMT: 824073007, APN: 824073007
MARIA SILVA, ETAL
17530 NICHOLS RD
BLYTHE, CA. 92225

ASMT: 824073012, APN: 824073012
NADINE RENTERIA
C/O JOSE A FLORES
1214 NOGALES ST
SACRAMENTO CA 95838

ASMT: 824073013, APN: 824073013
JENNIFER HOPE, ETAL
P O BOX 855
BLYTHE CA 92226

ASMT: 824073019, APN: 824073019
CONSUELO LOZOYA, ETAL
14060 LIME DR
BLYTHE, CA. 92225

Étiquettes faciles à peler
Sens de
Repliez à la hachure afin de
AR060898
www.avery.com

ASMT: 824090025, APN: 824090025
DEDRA BENNETT, ETAL
16531 W HOBSON WAY
BLYTHE, CA. 92225

ASMT: 824090033, APN: 824090033
HEINZ NORDMANN, ETAL
WIEKSWEG 73 POSTFACH 1328
4840 RHEDA WIEDENBRUECK
WEST GERMANY

ASMT: 824090035, APN: 824090035
SANDRA NORDELL, ETAL
5321 COLORADO RIVER RD
BLYTHE CA 922259335

ASMT: 824090037, APN: 824090037
RITA DAWSON, ETAL
16275 W HOBSON WAY
BLYTHE CA 92225

ASMT: 824101013, APN: 824101013
CAITHNESS BLYTHE II
565 5TH AVE 29TH FL
NEW YORK NY 10017

ASMT: 824101022, APN: 824101022
USA
P O BOX 281213
LAKEWOOD CO 80228

ASMT: 824110012, APN: 824110012
DOROTHY HOOVER, ETAL
3721 W HOBSON WAY
BLYTHE, CA. 92225

ASMT: 824110018, APN: 824110018
PATRICIA CHOAT
P O BOX 946
BLYTHE CA 92226

ASMT: 824110021, APN: 824110021
SHARON HOWARD, ETAL
P O BOX 422
BLYTHE CA 92226

ASMT: 824110023, APN: 824110023
LETTY STILES, ETAL
P O BOX 1003
BLYTHE CA 92226

ASMT: 824110028, APN: 824110028
GLORIA DELGADO, ETAL
14515 HARRINGTON RD
RIVERSIDE CA 92508

ASMT: 824110029, APN: 824110029
PRISCILLA VANDYKE, ETAL
14271 RIVERSIDE DR
BLYTHE CA 92225

ASMT: 824110039, APN: 824110039
OLIVER WHITE, ETAL
361 N PALM DR
BLYTHE CA 92225

ASMT: 824110040, APN: 824110040
SCOTT DAVIS, ETAL
24372 ANTILLES WAY
DANA POINT CA 92629

Easy Peel® Labels
Use Avery® Template 5162®
Feed Paper
Bend along line to expose Pop-up Edge™
AVERY® 5962®

ASMT: 824122011, APN: 824122011
DIANNA BROWNING, ETAL
107 W HOBSONWAY
BLYTHE CA 92225

ASMT: 824122014, APN: 824122014
ROBERT ALVARADO, ETAL
3880 OLD STATE HWY RD
BLYTHE CA 92225

ASMT: 824122015, APN: 824122015
CROWN ENTERPRISES INC
C/O ARNIE MISTURA
12223 STEPHENS
WARREN MI 48089

ASMT: 824130004, APN: 824130004
MARY ELAM, ETAL
244 LOMA AVE
LONG BEACH CA 90803

ASMT: 824141001, APN: 824141001
SCHINDLER BROS INC
3595 W HOBSONWAY
BLYTHE CA 92225

ASMT: 824142002, APN: 824142002
MARTHA DELATORRE, ETAL
14386 BELL LN
BLYTHE CA 92225

ASMT: 824142011, APN: 824142011
ROBERT ALVARADO
C/O ROBERT ALVARADO
14499 W HOBSON WAY
BLYTHE CA 92225

ASMT: 824142019, APN: 824142019
JOAN WIGER, ETAL
C/O JOHN G PINIGTORE
43608 N BLACK CYN HWY
PHOENIX AZ 85087

ASMT: 824150001, APN: 824150001
ALFONSO CAMPOS, ETAL
13900 LEFINGWELL RD
WHITTIER CA 90604

ASMT: 863020002, APN: 863020002
PEDRO RANGEL
15033 S LOVEKIN
BLYTHE CA 92225

ASMT: 863020004, APN: 863020004
J MORGAN
14035 ORANGE ST
BLYTHE, CA. 92225

ASMT: 863020013, APN: 863020013
COUNTY OF RIVERSIDE
C/O REAL ESTATE DIVISION
P O BOX 1180
RIVERSIDE CA 92502

ASMT: 863020015, APN: 863020015
ANN GOSSER, ETAL
2137 W 183RD ST
TORRANCE CA 90504

ASMT: 863020018, APN: 863020018
DESERT ALLIANCE FOR COMMUNITY EMPOWI
53990 ENTERPRISE WAY STE 1
COACHELLA CA 92236

Étiquettes faciles à peler
Sens de
Repliez à la hachure afin de
AR060900
www.avery.com
1-800-GO-AVERY

Easy Peel® Labels
Use Avery® Template 5162®
Feed Paper
Bend along line to expose Pop-up Edge™
AVERY® 5962®

ASMT: 863020019, APN: 863020019
IRENE AUDET, ETAL
2110 POOPY DR
BURLINGAME CA 94010

ASMT: 863020020, APN: 863020020
SILVIA AVALOS, ETAL
57 VIA SANTO TOMAS
RANCHO MIRAGE CA 92270

ASMT: 863020021, APN: 863020021
LONEAR HEARD, ETAL
C/O LONEAR W HEARD
4900 LINCOLNSHIRE
BUENA PARK CA 90621

ASMT: 863030011, APN: 863030011
PRAKASH MEGHPARA
20 NEVADA
IRVINE CA 92606

ASMT: 863030012, APN: 863030012
DON DUNCAN
P O BOX 2082
PALM SPRINGS CA 92263

ASMT: 863030017, APN: 863030017
TERESA RIVERA, ETAL
1525 S FERN AVE
ONTARIO CA 91762

ASMT: 863040002, APN: 863040002
VICTORIA RAMIREZ, ETAL
10750 BENNETT DR
FONTANA CA 92337

ASMT: 863060004, APN: 863060004
DUC TRAN
13081 ROSALIND DR
SANTA ANA CA 92705

ASMT: 863070011, APN: 863070011
PATRICK CONNOLLY
680 W CALIFORNIA
BLYTHE CA 92225

ASMT: 863070012, APN: 863070012
MARY COX
1020 N LOVEKIN NO 40
BLYTHE CA 92225

ASMT: 863070013, APN: 863070013
VERNON STINSON
2610 PALOMA SENDA
BULLHEAD CITY AZ 86442

ASMT: 863070014, APN: 863070014
PVID
180 W 14TH AVE
BLYTHE CA 92225

ASMT: 863070016, APN: 863070016
MICHELLE WALKER
15937 STEPHENSON BLV
BLYTHE, CA. 92225

ASMT: 863070017, APN: 863070017
MICHELLE WALKER
15937 STEPHENSON BLVD
BLYTHE CA 92225

Étiquettes faciles à peler
Sens de
Repliez à la hachure afin de
www.avery.com

Easy Peel® Labels
Use Avery® Template 5162®
Feed Paper
Bend along line to expose Pop-up Edge™
AVERY® 5962®

ASMT: 863070023, APN: 863070023
ROBERT MCCALL
C/O STEVE MCCALL
405 E MURPHY ST
BLYTHE CA 92225

ASMT: 863100004, APN: 863100004
MARTHA HURTADO, ETAL
432 BLUEWATER DR
PARKER AZ 85344

ASMT: 863110004, APN: 863110004
ERIC STROSCHEIN
P O BOX 1030
BLYTHE CA 92226

ASMT: 863110007, APN: 863110007
SOUTH VALLEY HOLDINGS
C/O JOHN W SEILER
P O BOX 267
PALO VERDE CA 92266

ASMT: 863120002, APN: 863120002
LISA KONTILIS, ETAL
481 CORONADO ST
BLYTHE CA 92225

ASMT: 863120005, APN: 863120005
COX FAMILY FARMS
C/O RICHARD C COX
918 E MURPHY ST
BLYTHE CA 92225

ASMT: 863120006, APN: 863120006
BILL VASILIS RANCH
C/O KIRK KONTILIS
332 W CHANSLOR WAY
BLYTHE CA 92225

ASMT: 863130001, APN: 863130001
NORMA MARTIN, ETAL
31547 WHISPERING PALMS
CATHEDRAL CY CA 92234

ASMT: 866021002, APN: 866021002
KAY MASON
P O BOX 364
BLYTHE CA 92226

ASMT: 866021005, APN: 866021005
FISHER FAMILY PROP
C/O FISHER RANCH LLC
10610 ICEPLANT RD
BLYTHE CA 92225

ASMT: 866021006, APN: 866021006
G B INV CO
C/O COCOPAH NURSERIES INC
81880 ARUS AVE
INDIO CA 92201

ASMT: 866021007, APN: 866021007
WILLIAM ODEN, ETAL
81880 ARUS ST
INDIO CA 92201

ASMT: 866022002, APN: 866022002
SONS INC, ETAL
81910 ARUS AVE
INDIO CA 92201

ASMT: 866022003, APN: 866022003
TOHSHIN TRADING INC
P O BOX 1226
BLYTHE CA 92226

Étiquettes faciles à peler
Sens de
Repliez à la hachure afin de
AR060902
www.avery.com

Easy Peel® Labels
Use Avery® Template 5162®
Feed Paper
Bend along line to expose Pop-up Edge™
AVERY® 5962®

ASMT: 866022004, APN: 866022004
ROBERT ARTEAGA
P O BOX 700
BLYTHE CA 92226

ASMT: 866022005, APN: 866022005
MICHAEL MCGEE
14563 14TH AVE
BLYTHE, CA. 92225

ASMT: 866022006, APN: 866022006
DANA RETHWISCH, ETAL
541 32ND RD
RISING CITY NE 68658

ASMT: 866030002, APN: 866030002
ADRIAN DIAZ
P O BOX 128
PARKER AZ 85344

ASMT: 866080002, APN: 866080002
PURPLE VERBENA
C/O COLE FRATES
5700 WILSHIRE BLV STE 330
LOS ANGELES CA 90036

ASMT: 879080006, APN: 879080006
LIANG CHU
11640 BALD EAGLE LN
MORENO VALLEY CA 92557

ASMT: 879080007, APN: 879080007
AGUANGA PROP
C/O CYNTHIA C WALSH
35272 VISTA DE TODO
CAPISTRANO BEACH CA 92624

ASMT: 879080008, APN: 879080008
JOTTN HARRISON, ETAL
26346 RIDGEMOOR RD
SUN CITY CA 92586

ASMT: 879080010, APN: 879080010
LINNA CHEN, ETAL
C/O OLIVIA CHEN
5232 VIA RINCON
NEWBURY PARK CA 91320

ASMT: 879080013, APN: 879080013
DORIS SPEIERMAN
10630 HICKORY CREST LN
COLUMBIA MD 21044

ASMT: 879080014, APN: 879080014
ALEXANDER WALTENSPERGER
2316 11TH ST
NORTH BEND OR 97459

ASMT: 879080016, APN: 879080016
LILLIAN TOMICH, ETAL
C/O NATIVITY OF MOST HOLY THEOTOKOS
2148 MICHELSON DR
IRVINE CA 92612

ASMT: 879080018, APN: 879080018
MARIA VIRAMONTES
1534 N CALIFORNIA AVE
LA PUENTE CA 91744

ASMT: 879080027, APN: 879080027
USA 879
UNKNOWN 10-17-95

Étiquettes faciles à peler
Sens de
Repliez à la hachure afin de
AR060903
www.avery.com

ASMT: 879080032, APN: 879080032
RICHARD NELSON
46 THE COLONNADE
LONG BEACH CA 90803

ASMT: 879080034, APN: 879080034
BLYTHE ENERGY
700 UNIVERSE BLV
JUNO BEACH FL 33408

ASMT: 879090001, APN: 879090001
YAO LEE, ETAL
164 HONEYSUCKLE LN
BREA CA 92821

ASMT: 879090052, APN: 879090052
NANCY WOO, ETAL
82257 CROSBY DR
INDIO CA 92201

ASMT: 879090053, APN: 879090053
FSE BLYTHE 1
C/O TAX DEPT
211 CARNEGIE CENTER
PRINCETON NJ 8540

ASMT: 879090054, APN: 879090054
FSE BLYTHE 1
C/O NRG SOLAR PU
1817 ASTON AVE STE 104
CARLSBAD CA 92008

ASMT: 879100001, APN: 879100001
AUSTIN WHITNEY, ETAL
C/O PDS TAX SERVICES
P O BOX 13519
ARLINGTON TX 76094

ASMT: 879100003, APN: 879100003
CANDACE WALDRON, ETAL
949 OLD RANCH RD
SOLVANG CA 93463

ASMT: 879100005, APN: 879100005
AURORA ACOSTA, ETAL
1700 DEANNA WAY
REDLANDS CA 92374

ASMT: 879100007, APN: 879100007
USA 879
DEPT OF INTERIOR
WASHINGTON DC 21401

ASMT: 879100011, APN: 879100011
MAHMMAD KHALAJZADEH
C/O MAJID YOUSSEFIHA
6134 CASE ST
NORTH HOLLYWOOD CA 91606

ASMT: 879100012, APN: 879100012
MICKEY WU
3129 S HACIENDA BLV NO 345
HACIENDA HEIGHTS CA 91745

ASMT: 879100013, APN: 879100013
SOUTHERN CALIFORNIA EDISON CO
P O BOX 800
ROSEMEAD CA 91770

ASMT: 879110001, APN: 879110001
HSIEN CHAO, ETAL
21725 MARJORIE AVE
TORRANCE CA 90503

Easy Peel® Labels
Use Avery® Template 5162®
Feed Paper
Bend along line to expose Pop-up Edge™
AVERY® 5962®

ASMT: 879110008, APN: 879110008
USA 879
US DEPT OF INTERIOR
WASHINGTON DC 21401

ASMT: 879110014, APN: 879110014
GILA FARM LAND
5700 WILSHIRE BLV NO 330
LOS ANGELES CA 90036

ASMT: 879300007, APN: 879300007
MARGIE URRUTIA, ETAL
82822 VIA PALERMO
INDIO CA 92201

ASMT: 879300008, APN: 879300008
DOROTHY SZOLLOSI
14075 MESA DR
BLYTHE CA 92225

ASMT: 879300009, APN: 879300009
JOYCE PACIFICO
P O BOX 152
EHRENBERG AZ 85334

ASMT: 879300011, APN: 879300011
WILLIAM MILLER
1713 N PENNINGTON
CHANDLER AZ 85224

ASMT: 879300014, APN: 879300014
IRVIN TESKEY
P O BOX 1133
BLYTHE CA 92226

ASMT: 879300015, APN: 879300015
GEORGE BECERRA
27115 DARTMOUTH ST
HEMET CA 92544

Étiquettes faciles à peler
Sens de
Repliez à la hachure afin de
www.avery.com

APPENDIX E: REPRESENTATIVE LETTER TO NATIVE AMERICAN TRIBES

AR060906

POWER ENGINEERS, INC.
731 E. Ball Road
Suite 100
Anaheim, CA 92805 USA

PHONE 714-507-2700
FAX 714-507-2799

April 28, 2011

ENERGY
FACILITIES
COMMUNICATIONS
ENVIRONMENTAL

Ms. Ann Brierty, Policy/ Cultural Resources Department
San Manuel Band of Mission Indians
26569 Community Center Drive
Highland, CA 92346

Subject: Proposed Blythe Mesa Solar Farm in Riverside County, California

Dear Ms. Brierty:

POWER Engineers, Inc. (POWER) is sending you this letter on behalf of Renewable Resources Group (RRG) to inform you of the proposed Blythe Mesa Solar Farm in eastern Riverside County, California. We also request information you are willing to share regarding Native American cultural resources in the project area as well as any comments or concerns you may have about the project in general. The information you provide will be considered during project planning and design.

RRG is planning to construct and operate a 485 megawatt solar photovoltaic energy generating facility in the Palo Verde Mesa region of Riverside County. The proposed solar farm will help California meet its Renewable Portfolio Standard (RPS) mandate, which requires each of California's investor-owned utilities to supply 20 percent of its total electricity through renewable energy generation by the year 2020.

The proposed project would be located approximately 5 miles west of the city of Blythe. The project site is comprised of disturbed parcels that were previously farmed or fallow totaling approximately 3,828 acres, located to North and South interstate 10. The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles (see attached Project Area Map). The project is located on:

- Sections 1-14 of Township 7 South, Range 21East
- Sections 3, 4, 5, 6, 8, 9 of Township 7 South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East of the San Bernardino Base Meridian.

POWER is managing and conducting the overall permitting program for the proposed Blythe Mesa Solar Farm for RRG. An Environmental Impact Report (EIR) is currently being prepared for Riverside County.

We look forward to hearing from you, Ms. Brierty. If you have any questions or desire additional information, please do not hesitate to contact either of us at your convenience: Johanna Marty at (714) 507-2739 (johanna.marty@powereng.com) or Gini Austerman at (714) 507-2761 (gini.austerman@powereng.com).

Sincerely,



Johanna Marty,
Cultural Resource Specialist

Enclosure(s): Project Area Map (1)

APPENDIX F: COMMENT LETTERS

AR060909

AGUA CALIENTE BAND OF CAHUILLA INDIANS

TRIBAL HISTORIC PRESERVATION

December 19, 2011

Jay Olivas
Project Planner
38686 El Cerrito Road
Palm Desert, CA 92211

Re: Preparation of Draft Environmental Impact Report for Blythe Mesa Solar Project, Riverside County CA.

Dear Mr. Olivas:

The Agua Caliente Band of Cahuilla, ACBCI Indians appreciates your efforts to include the Tribal Historic Preservation Office (THPO) in the Blythe Mesa Solar Project. The proposed project is located in Riverside County in Blythe near the McCoy Mountains. The project is not located on lands managed by the Agua Caliente Band of Cahuilla Indians, but the project is within the ACBCI's Traditional Trade Network Area. The THPO comments and recommends:

1. A 100% cultural resources inventory of the project area by a qualified archaeologist prior to any development activities in this area. ***Please forward copies of any cultural resource documentation (report and site records) generated in connection with these efforts to the Tribal Historic Preservation Office for review and comment.***

2. The presence of an approved Native American Cultural Resource Monitor(s) during any ground disturbing activities (including archaeological testing). Should buried cultural deposits be encountered, the Monitor may request that destructive construction halt and the Monitor shall notify a Qualified Archaeologist (Secretary of the Interior's Standards and Guidelines) to investigate and, if necessary, prepare a mitigation plan for submission to the State Historic Preservation Officer and the Agua Caliente Tribal Historic Preservation Officer.

3. Please forward copies of any cultural resource documentation (report and site records) generated in connection with these efforts to the Tribal Historic Preservation Office for review and comment.

4. Should human remains be discovered during construction of the proposed project, the project contractor would be subject to the State law regarding the discovery and disturbance of human remains. In that circumstance destructive activity in the immediate vicinity shall halt and the County Coroner shall be contacted pursuant to State Health and Safety Code §7050.5. If the remains are determined to be of Native American origin, the Native American Heritage Commission (NAHC) shall be contacted. The NAHC will make a determination of the Most Likely Descendent (MLD). The City and Developer will work with the designated MLD to determine the final disposition of the remains.

The Agua Caliente appreciates your interest in our cultural heritage. If you have questions, need monitors or require additional information, please call me at (760) 699-6912. You may also email me at smilanovich@aguacaliente-nsn.gov.

Cordially,

Sean Milanovich
Cultural Specialist
Tribal Historic Preservation Office
AGUA CALIENTE BAND
OF CAHUILLA INDIANS

C: Agua Caliente Cultural Register

X:\CONSULTATIONSLetters\2012\External\TUA\RC_DraftEIR_BlytheMesaSolarProject_12_19_2011.doc

WARREN D. WILLIAMS
General Manager-Chief Engineer

1995 MARKET STREET
RIVERSIDE, CA 92501
951.955.1200
FAX 951.788.9965
www.rcflood.org

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

December 15, 2011

Mr. Jay Olivas
Riverside County
Planning Department
County Administrative Center
Riverside, California

Dear Mr. Olivas:

Re: Notice of Preparation of a
Draft Environmental Impact Report
CUP 3670

We have reviewed this case and have the following comments:

The Draft Environmental Impact Report (DEIR) analyzes the potential environmental impacts of Conditional Use Permit No. 3670. Conditional Use Permit No. 3670 proposes to construct and operate a 485-MW solar photovoltaic electric generating facility and associated infrastructure. The 3,660-acre site is located in the Blythe area, east of the Blythe Municipal Airport, west of Neighbors Boulevard, and north and south of Interstate 10.

The site is subject to offsite flows from the northwest and southwest with total tributary drainage areas of approximately 42 and 9 square miles, respectively. In general, these flows enter the site in a broad sheet flow manner. A natural watercourse bisects the lower southern portion of the project (APNs 879-090-043, 879-090-044, 879-090-050 and 879-090-051). The natural watercourse should be kept free of buildings and obstructions in order to maintain the natural drainage patterns of the area. It appears that the project avoids this area, however, additional information shall be provided.

Since the proposal is to construct solar panels, no increased runoff and/or flow diversion is anticipated.

The District recommends that the DEIR address the following:

1. The drainage for the overall area and site shall be described. The site's tributary drainage area shall be identified.

2. Description of how onsite storm runoff would be collected and conveyed to an adequate outlet.

3. Description of how the project is protected from offsite storm runoff and how it is collected.

4. As described above, a natural watercourse bisects the lower southern portion of the project (APNs 879-090-043, 879-090-044, 879-090-050 and 879-090-051). The DEIR shall address how the project would avoid or mitigate its impact to any floodplain/watercourse.

5. The report should identify any existing drainage facility within the area. A description of who owns and maintains the facility shall also be included.

6. The impacts and mitigation for water quality caused by the development and proposed mitigations shall be discussed.

7. The NOP indicates "light grubbing" and "minimal grading" will be performed as part of this development. A grading and drainage plan shall be included in the DEIR. The property's maintenance access and site grading shall be designed in a manner that perpetuates the existing natural drainage patterns with respect to tributary drainage areas, outlet points and outlet conditions.

8. Hydrology/hydraulic study, exhibits and other pertinent information shall also be included.

Any questions pertaining to this project may be directed to Tina Hanson of this office at 951.955.2511 or me at 951.955.1214.

Very truly yours,

MEKBIB DEGAGA
Engineering Project Manager

TTH:blj
P8/142767





Department of Toxic Substances Control



Matthew Rodriquez
Secretary for
Environmental Protection

Deborah O. Raphael, Director
5796 Corporate Avenue
Cypress, California 90630

Edmund G. Brown Jr.
Governor

December 19, 2011

Mr. Jay Olivas
Riverside County
4080 Lemon Street, 9th Floor
P.O. Box 1409
Riverside, California 92502-1409
jolivas@rctlma.org

NOTICE PREPARATION (NOP) OF A DRAFT ENVIRONMENTAL IMPACT REPORT NO. 529/CUP NO. 3670/PUP NO. 913 FOR THE BLYTHE MESA I SOLAR PROJECT, (SCH#201111056), RIVERSIDE COUNTY

Dear Mr. Olivas:

The Department of Toxic Substances Control (DTSC) has received your submitted Notice of Preparation for a draft Environmental Impact Report (EIR) for the above-mentioned project. The following project description is stated in your document: "The proposed project consists of the construction and operation of a 485 megawatt (MW) solar photovoltaic (PV) electric generating facility and associated infra structure on a total of approximately 3,660 acres. The Project site would be secured 24 hours per day by onsite private security personnel or remote services with motion-detection cameras. A new 8.4 mile long, 230 kilovolt (kV) double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site subject to Public Use Permit (PUP). A majority of the project is within the County of Riverside jurisdiction. An approximately 330-acre portion of the 3,660-acre project site is located within the City of Blythe jurisdiction. The Project is located approximately 5 miles west of central Blythe and 40 miles east of Desert Center, more specifically, the project is located north and south of Interstate 10 (I-10) west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport. The site consists of primarily of agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde. The proposed Project would be conditionally consistent with the agricultural land use designation, subject to issuance of a conditional use permit (CUP)".

Based on the review of the submitted document DTSC has the following comments:

1) The EIR should evaluate whether conditions within the Project area may pose a threat to human health or the environment. Following are the databases of some of the regulatory agencies:

- National Priorities List (NPL): A list maintained by the United States Environmental Protection Agency (U.S.EPA).
- EnviroStor (formerly CalSites): A Database primarily used by the California Department of Toxic Substances Control, accessible through DTSC's website (see below).
- Resource Conservation and Recovery Information System (RCRIS): A database of RCRA facilities that is maintained by U.S. EPA.
- Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS): A database of CERCLA sites that is maintained by U.S.EPA.
- Solid Waste Information System (SWIS): A database provided by the California Integrated Waste Management Board which consists of both open as well as closed and inactive solid waste disposal facilities and transfer stations.
- GeoTracker: A List that is maintained by Regional Water Quality Control Boards.
- Local Counties and Cities maintain lists for hazardous substances cleanup sites and leaking underground storage tanks.
- The United States Army Corps of Engineers, 911 Wilshire Boulevard, Los Angeles, California, 90017, (213) 452-3908, maintains a list of Formerly Used Defense Sites (FUDS).

2) The EIR should identify the mechanism to initiate any required investigation and/or remediation for any site within the proposed Project area that may be contaminated, and the government agency to provide appropriate regulatory oversight. If necessary, DTSC would require an oversight agreement in order to review such documents.

3) Any environmental investigations, sampling and/or remediation for a site should be conducted under a Workplan approved and overseen by a regulatory agency that has jurisdiction to oversee hazardous substance cleanup. The findings of any investigations, including any Phase I or II Environmental Site Assessment Investigations should be summarized in the document. All

sampling results in which hazardous substances were found above regulatory standards should be clearly summarized in a table. All closure, certification or remediation approval reports by regulatory agencies should be included in the EIR.

4) If buildings, other structures, asphalt or concrete-paved surface areas are being planned to be demolished, an investigation should also be conducted for the presence of other hazardous chemicals, mercury, and asbestos containing materials (ACMs). If other hazardous chemicals, lead-based paints (LPB) or products, mercury or ACMs are identified, proper precautions should be taken during demolition activities. Additionally, the contaminants should be remediated in compliance with California environmental regulations and policies.

5) Future project construction may require soil excavation or filling in certain areas. Sampling may be required. If soil is contaminated, it must be properly disposed and not simply placed in another location onsite. Land Disposal Restrictions (LDRs) may be applicable to such soils. Also, if the project proposes to import soil to backfill the areas excavated, sampling should be conducted to ensure that the imported soil is free of contamination.

6) Human health and the environment of sensitive receptors should be protected during any construction or demolition activities. If necessary, a health risk assessment overseen and approved by the appropriate government agency should be conducted by a qualified health risk assessor to determine if there are, have been, or will be, any releases of hazardous materials that may pose a risk to human health or the environment.

7) If the site was used for agricultural, livestock or related activities, onsite soils and groundwater might contain pesticides, agricultural chemical, organic waste or other related residue. Proper investigation, and remedial actions, if necessary, should be conducted under the oversight of and approved by a government agency at the site prior to construction of the project.

8) If it is determined that hazardous wastes are, or will be, generated by the proposed operations, the wastes must be managed in accordance with the California Hazardous Waste Control Law (California Health and Safety Code, Division 20, Chapter 6.5) and the Hazardous Waste Control Regulations (California Code of Regulations, Title 22, Division 4.5). If it is determined that hazardous wastes will be generated, the facility should also obtain a United States Environmental Protection Agency Identification Number by contacting (800) 618-6942. Certain hazardous waste treatment processes or hazardous materials, handling, storage or uses may require authorization from the local Certified Unified Program Agency (CUPA). Information about the requirement for authorization can be obtained by contacting your local CUPA.

9) DTSC can provide cleanup oversight through an Environmental Oversight Agreement (EOA) for government agencies that are not responsible parties, or a Voluntary Cleanup Agreement (VCA) for private parties. For additional information on the EOA or VCA, please see www.dtsc.ca.gov/SiteCleanup/Brownfields, or contact Ms. Maryam Tasnif-Abbasi, DTSC's Voluntary Cleanup Coordinator, at (714) 484-5489.

If you have any questions regarding this letter, please contact Rafiq Ahmed, Project Manager, at rahmed@dtsc.ca.gov, or by phone at (714) 484-5491.

Sincerely,

Greg Holmes
Unit Chief
Brownfields and Environmental Restoration Program

cc: Governor's Office of Planning and Research
State Clearinghouse
P.O. Box 3044
Sacramento, California 95812-3044
state.clearinghouse@opr.ca.gov.

CEQA Tracking Center
Department of Toxic Substances Control
Office of Environmental Planning and Analysis
P.O. Box 806
Sacramento, California 95812
Attn: Nancy Ritter
nritter@dtsc.ca.gov

CEQA # 3425

Mojave Desert Air Quality Management District
14306 Park Avenue, Victorville, CA 92392-2310
760.245.1661 • fax 760.245.2699
Visit our web site: http://www.mdaqmd.ca.gov
Eldon Heaston, Executive Director

December 2, 2011

Riverside County Planning Department
4080 Lemon Street, 12th Floor
P.O. Box 1409
Riverside, CA 92502-1409
Attn: Jay Olivas, Project Planner

Re: Notice of Preparation of a Draft Environmental Impact Report for the Blythe Mesa I Solar Project

Dear Mr. Olivas,

The Mojave Desert Air Quality Management District (District) has reviewed the Notice of Preparation of a Draft Environmental Impact Report for the Blythe Mesa I Solar Project. The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of approximately 3,660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of eight feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. A new 8.4 mile long, 230 kV double-circuit generation-tie transmission line would connect the proposed project with the Approved Colorado River Substation.

The District has no special comments or information that would be necessary to the environmental review process. District attainment plans are located at http://www.mdaqmd.ca.gov/index.aspx?page=13 for your information and review.

The District supports the development of renewable energy sources; such development is expected to produce cumulative and regional environmental benefits.

Thank you for the opportunity to review this notice of preparation. If you have any questions regarding this letter, please contact me at (760) 245-1661 or Tracy Walters at ext. 6122.

Sincerely,

Alan J. De Salvio
Supervising Air Quality Engineer

AJD/tw Blythe Mesa I Solar Project.doc

STATE OF CALIFORNIA Edmund G. Brown, Jr., *Governor*

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
ds_nahc@pacbell.net

November 21, 2011

Mr. Jay Olivas, Planner
Riverside County Planning Department
4080 Lemon Street, 12th Floor
Riverside, CA 92502-1409

Re: SCH#2011111056 CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the **"EIR No. 529/CUP No. 3670/PUP No. 913/Blythe Mesa I Solar Project"** located in the Blythe Area of eastern Riverside County, California

Dear Mr. Olivas:

The Native American Heritage Commission (NAHC), the State of California 'Trustee Agency' for the protection and preservation of Native American cultural resources pursuant to California Public Resources Code §21070 and affirmed by the Third Appellate Court in the case of EPIC v. Johnson (1985: 170 Cal App. 3rd 604). The court held that the NAHC has jurisdiction and special expertise, as a state agency, over affected Native American resources, impacted by proposed projects including archaeological, places of religious significance to Native Americans and burial sites. The NAHC wishes to comment on the proposed project.

This letter includes state and federal statutes relating to Native American historic properties of religious and cultural significance to American Indian tribes and interested Native American individuals as 'consulting parties' under both state and federal law. State law also addresses the freedom of Native American Religious Expression in Public Resources Code §5097.9.

The California Environmental Quality Act (CEQA – CA Public Resources Code 21000-21177, amendments effective 3/18/2010) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR) per the CEQA Guidelines defines a significant impact on the environment as 'a substantial, or potentially substantial, adverse change in any of physical conditions within an area affected by the proposed project, including ...objects of historic or aesthetic significance." In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE), and if so, to mitigate that effect.

The NAHC Sacred Lands File (SLF) search resulted as follows: **Native American cultural resources were not identified** within the project area identified (e.g. 'area of potential effect' or APE). Also, the absence of archaeological resources does not preclude their existence. . California Public Resources Code §§5097.94 (a) and 5097.96 authorize the NAHC to establish a Sacred Land Inventory to record Native American sacred sites and burial sites. These records are exempt from the provisions of the California Public Records Act pursuant to. California Government Code §6254 (r). The purpose of this code is to protect such sites from vandalism, theft and destruction. The NAHC "Sacred Sites,' as defined by the Native American Heritage Commission and the California Legislature in California Public Resources Code

§§5097.94(a) and 5097.96. Items in the NAHC Sacred Lands Inventory are confidential and exempt from the Public Records Act pursuant to California Government Code §6254 (r). This area is known to the NAHC to be culturally sensitive.

Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries of cultural resources or burial sites once a project is underway. Culturally affiliated tribes and individuals may have knowledge of the religious and cultural significance of the historic properties in the project area (e.g. APE). We strongly urge that you make contact with the list of Native American Contacts on the list of Native American contacts, to see if your proposed project might impact Native American cultural resources and to obtain their recommendations concerning the proposed project. Special reference is made to the *Tribal Consultation* requirements of the California 2006 Senate Bill 1059: enabling legislation to the federal Energy Policy Act of 2005 (P.L. 109-58), mandates consultation with Native American tribes (both federally recognized and non federally recognized) where electrically transmission lines are proposed. This is codified in the California Public Resources Code, Chapter 4.3 and §25330 to Division 15.

Furthermore, pursuant to CA Public Resources Code § 5097.95, the NAHC requests that the Native American consulting parties be provided pertinent project information. Consultation with Native American communities is also a matter of environmental justice as defined by California Government Code §65040.12(e). Pursuant to CA Public Resources Code §5097.95, the NAHC requests that pertinent project information be provided consulting tribal parties. The NAHC recommends *avoidance* as defined by CEQA Guidelines §15370(a) to pursuing a project that would damage or destroy Native American cultural resources and Section 2183.2 that requires documentation, data recovery of cultural resources.

Consultation with tribes and interested Native American consulting parties, on the NAHC list, should be conducted in compliance with the requirements of federal NEPA and Section 106 and 4(f) of federal NHPA (16 U.S.C. 470 *et seq*), 36 CFR Part 800.3 (f) (2) & .5, the President's Council on Environmental Quality (CSQ, 42 U.S.C 4371 *et seq.* and NAGPRA (25 U.S.C. 3001-3013) as appropriate. The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The aforementioned Secretary of the Interior's *Standards* include recommendations for all 'lead agencies' to consider the historic context of proposed projects and to "research" the cultural landscape that might include the 'area of potential effect.'

Confidentiality of "historic properties of religious and cultural significance" should also be considered as protected by California Government Code §6254(r) and may also be protected under Section 304 of he NHPA or at the Secretary of the Interior discretion if not eligible for listing on the National Register of Historic Places. The Secretary may also be advised by the federal Indian Religious Freedom Act (cf. 42 U.S.C., 1996) in issuing a decision on whether or not to disclose items of religious and/or cultural significance identified in or near the APEs and possibility threatened by proposed project activity.

Furthermore, Public Resources Code Section 5097.98, California Government Code §27491 and Health & Safety Code Section 7050.5 provide for provisions for accidentally discovered archeological resources during construction and mandate the processes to be followed in the event of an accidental discovery of any human remains in a project location other than a 'dedicated cemetery'.

To be effective, consultation on specific projects must be the result of an ongoing relationship between Native American tribes and lead agencies, project proponents and their contractors, in the opinion of the NAHC. Regarding tribal consultation, a relationship built around regular meetings and informal involvement with local tribes will lead to more qualitative consultation tribal input on specific projects.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton
Program Analyst

Cc: State Clearinghouse

Attachment: Native American Contact List

STATE OF CALIFORNIA Edmund G. Brown, Jr., *Governor*

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390
Web Site www.nahc.ca.gov
ds_nahc@pacbell.net

November 21, 2011

Mr. Jay Olivas, Planner
Riverside County Planning Department
4080 Lemon Street, 12th Floor
Riverside, CA 92502-1409

Re: SCH#2011111056 CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the **"EIR No. 529/CUP No. 3670/PUP No. 913/Blythe Mesa I Solar Project"** located in the Blythe Area of eastern Riverside County, California

Dear Mr. Olivas:

The Native American Heritage Commission (NAHC), the State of California 'Trustee Agency' for the protection and preservation of Native American cultural resources pursuant to California Public Resources Code §21070 and affirmed by the Third Appellate Court in the case of EPIC v. Johnson (1985: 170 Cal App. 3rd 604). The court held that the NAHC has jurisdiction and special expertise, as a state agency, over affected Native American resources, impacted by proposed projects including archaeological, places of religious significance to Native Americans and burial sites. The NAHC wishes to comment on the proposed project.

This letter includes state and federal statutes relating to Native American historic properties of religious and cultural significance to American Indian tribes and interested Native American individuals as 'consulting parties' under both state and federal law. State law also addresses the freedom of Native American Religious Expression in Public Resources Code §5097.9.

The California Environmental Quality Act (CEQA – CA Public Resources Code 21000-21177, amendments effective 3/18/2010) requires that any project that causes a substantial adverse change in the significance of an historical resource, that includes archaeological resources, is a 'significant effect' requiring the preparation of an Environmental Impact Report (EIR) per the CEQA Guidelines defines a significant impact on the environment as 'a substantial, or potentially substantial, adverse change in any of physical conditions within an area affected by the proposed project, including ...objects of historic or aesthetic significance." In order to comply with this provision, the lead agency is required to assess whether the project will have an adverse impact on these resources within the 'area of potential effect (APE), and if so, to mitigate that effect.

The NAHC Sacred Lands File (SLF) search resulted as follows: **Native American cultural resources were not identified** within the project area identified (e.g. 'area of potential effect' or APE). Also, the absence of archaeological resources does not preclude their existence. . California Public Resources Code §§5097.94 (a) and 5097.96 authorize the NAHC to establish a Sacred Land Inventory to record Native American sacred sites and burial sites. These records are exempt from the provisions of the California Public Records Act pursuant to. California Government Code §6254 (r). The purpose of this code is to protect such sites from vandalism, theft and destruction. The NAHC "Sacred Sites,' as defined by the Native American Heritage Commission and the California Legislature in California Public Resources Code

§§5097.94(a) and 5097.96. Items in the NAHC Sacred Lands Inventory are confidential and exempt from the Public Records Act pursuant to California Government Code §6254 (r). This area is known to the NAHC to be culturally sensitive.

Early consultation with Native American tribes in your area is the best way to avoid unanticipated discoveries of cultural resources or burial sites once a project is underway. Culturally affiliated tribes and individuals may have knowledge of the religious and cultural significance of the historic properties in the project area (e.g. APE). We strongly urge that you make contact with the list of Native American Contacts on the list of Native American contacts, to see if your proposed project might impact Native American cultural resources and to obtain their recommendations concerning the proposed project. Special reference is made to the *Tribal Consultation* requirements of the California 2006 Senate Bill 1059: enabling legislation to the federal Energy Policy Act of 2005 (P.L. 109-58), mandates consultation with Native American tribes (both federally recognized and non federally recognized) where electrically transmission lines are proposed. This is codified in the California Public Resources Code, Chapter 4.3 and §25330 to Division 15.

Furthermore, pursuant to CA Public Resources Code § 5097.95, the NAHC requests that the Native American consulting parties be provided pertinent project information. Consultation with Native American communities is also a matter of environmental justice as defined by California Government Code §65040.12(e). Pursuant to CA Public Resources Code §5097.95, the NAHC requests that pertinent project information be provided consulting tribal parties. The NAHC recommends *avoidance* as defined by CEQA Guidelines §15370(a) to pursuing a project that would damage or destroy Native American cultural resources and Section 2183.2 that requires documentation, data recovery of cultural resources.

Consultation with tribes and interested Native American consulting parties, on the NAHC list, should be conducted in compliance with the requirements of federal NEPA and Section 106 and 4(f) of federal NHPA (16 U.S.C. 470 *et seq*), 36 CFR Part 800.3 (f) (2) & .5, the President's Council on Environmental Quality (CSQ, 42 U.S.C 4371 *et seq.* and NAGPRA (25 U.S.C. 3001-3013) as appropriate. The 1992 *Secretary of the Interiors Standards for the Treatment of Historic Properties* were revised so that they could be applied to all historic resource types included in the National Register of Historic Places and including cultural landscapes. Also, federal Executive Orders Nos. 11593 (preservation of cultural environment), 13175 (coordination & consultation) and 13007 (Sacred Sites) are helpful, supportive guides for Section 106 consultation. The aforementioned Secretary of the Interior's *Standards* include recommendations for all 'lead agencies' to consider the historic context of proposed projects and to "research" the cultural landscape that might include the 'area of potential effect.'

Confidentiality of "historic properties of religious and cultural significance" should also be considered as protected by California Government Code §6254(r) and may also be protected under Section 304 of he NHPA or at the Secretary of the Interior discretion if not eligible for listing on the National Register of Historic Places. The Secretary may also be advised by the federal Indian Religious Freedom Act (cf. 42 U.S.C., 1996) in issuing a decision on whether or not to disclose items of religious and/or cultural significance identified in or near the APEs and possibility threatened by proposed project activity.

Furthermore, Public Resources Code Section 5097.98, California Government Code §27491 and Health & Safety Code Section 7050.5 provide for provisions for accidentally discovered archeological resources during construction and mandate the processes to be followed in the event of an accidental discovery of any human remains in a project location other than a 'dedicated cemetery'.

To be effective, consultation on specific projects must be the result of an ongoing relationship between Native American tribes and lead agencies, project proponents and their contractors, in the opinion of the NAHC. Regarding tribal consultation, a relationship built around regular meetings and informal involvement with local tribes will lead to more qualitative consultation tribal input on specific projects.

If you have any questions about this response to your request, please do not hesitate to contact me at (916) 653-6251.

Sincerely,

Dave Singleton
Program Analyst

Cc: State Clearinghouse

Attachment: Native American Contact List

California Native American Contacts
Riverside County
November 21, 2011

Twenty-Nine Palms Band of Mission Indians
Darrell Mike, Chairperson
46-200 Harrison Place — Chemehuevi
Coachella , CA 92236
tribal-epa@worldnet.att.net
(760) 775-5566
(760) 808-0409 - cell - EPA
(760) 775-4639 Fax

Colorado River Indian Tribe
Ginger Scott, Museum Curator; George Ray, Coor
26600 Mojave Road — Mojave
Parker , AZ 85344 — Chemehuevi
crit.museum@yahoo.com
(928) 669-9211-Tribal Office
(928) 669-8970 ext 21
(928) 669-1925 Fax

Joseph R. Benitez (Mike)
P.O. Box 1829 — Chemehuevi
Indio , CA 92201
(760) 347-0488
(760) 408-4089 - cell

Fort Yuma Quechan Indian Nation
Keeny Escalanti., President
PO Box 1899 — Quechan
Yuma , AZ 85366
qitpres@quechantribe.com
(760) 572-0213
(760) 572-2102 FAX

Chemehuevi Reservation
Charles Wood, Chairperson
P.O. Box 1976 — Chemehuevi
Chemehuevi Valley CA 92363
chair1cit@yahoo.com
(760) 858-4301
(760) 858-5400 Fax

AhaMaKav Cultural Society, Fort Mojave Indian
Linda Otero, Director
P.O. Box 5990 — Mojave
Mohave Valley AZ 86440
(928) 768-4475
LindaOtero@fortmojave.com
(928) 768-7996 Fax

Fort Mojave Indian Tribe
Tim Williams, Chairperson
500 Merriman Ave — Mojave
Needles , CA 92363
(760) 629-4591
(760) 629-5767 Fax

Morongo Band of Mission Indians
Michael Contreras, Cultural Heritage Prog.
12700 Pumarra Road — Cahuilla
Banning , CA 92220 — Serrano
(951) 201-1866 - cell
mcontreras@morongo-nsn.gov
(951) 922-0105 Fax

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed SCH#2011111056; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Blythe Mesa I Solar Project; located in the Blythe area of eastern Riverside County, California.

California Native American Contacts
Riverside County
November 21, 2011

San Manuel Band of Mission Indians
Ann Brierty, Policy/Cultural Resources Departmen
26569 Community Center. Drive Serrano
Highland , CA 92346
(909) 864-8933, Ext 3250
abrierty@sanmanuel-nsn.gov
(909) 862-5152 Fax

Quenchan Indian Nation
THPO
P.O. Box 1899 Quechan
Yuma , AZ 85366
b.nash@quechantribe.com
(928) 920-6068 - CELL
(760) 572-2423

Torres-Martinez Desert Cahuilla Indians
Diana L. Chihuahua, Vice Chairperson, Cultural
P.O. Boxt 1160 Cahuilla
Thermal , CA 92274
dianac@torresmartinez.
760) 397-0300, Ext. 1209
(760) 272-9039 - cell (Lisa)
(760) 397-8146 Fax

Ah-Mut-Pipa Foundation
Preston J. Arrow-weed
P.O. Box 160 Quechan
Bard , CA 92222 Kumeyaay
ahmut@earthlink.net
(928) 388-9456

Cocopah Museum/Cultural Resources Dept.
Jill McCormick, Tribal Archaeologist
County 15th & Ave. G Cocopah
Sommerton , AZ 85350
culturalres@cocopah.com
(928) 530-2291 - cell
(928) 627-2280 - fax

Agua Caliente Band of Cahuilla Indians THPO
Patricia Tuck, Tribal Historic Perservation Officer
5401 Dinah Shore Drive Cahuilla
Palm Springs, CA 92264
ptuck@augacaliente-nsn.gov
(760) 699-6907

(760) 699-6924- Fax

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is applicable for contacting local Native Americans with regard to cultural resources for the proposed SCH#2011111056; CEQA Notice of Preparation (NOP); draft Environmental Impact Report (DEIR) for the Blythe Mesa I Solar Project; located in the Blythe area of eastern Riverside County, California.

Riverside County
Waste Management Department
Hans W. Kernkamp, General Manager-Chief Engineer

December 16, 2011

Jay Olivas, Project Planner
Riverside County Planning Department
P. O. Box No. 1409
Riverside, CA 92502-1409

RE: Comments on the Notice of Preparation (NOP) for a Draft Environmental Impact Report (DEIR) for Blythe Mesa I Solar Project

Dear Mr. Olivas:

The Riverside County Waste Management Department (RCWMD) has reviewed the NOP for a DEIR for the Blythe Mesa I Solar Project. The RCWMD requests that the following potential project impact areas be analyzed and evaluated in the forthcoming DEIR:

1. The RCWMD is concerned about the quantity of construction and demolition (C&D) waste that could be generated by the project and how the waste will be disposed of. Should a large quantity of the projects' C&D waste be brought to a county landfill for disposal, it could exceed the landfill's daily permitted capacity, thus a violation of State regulations and an impact to County landfill operation. The DEIR should analyze this potential solid waste impact.

   CR&R is the franchise waste hauler for the project area. This hauler operates under a waste delivery agreement (WDA) which stipulates that any waste generated within the franchise area, including solid waste generated from the Project area, will be disposed of at the Blythe Landfill. The Blythe Landfill is described below:

   Blythe Landfill
   The Blythe Landfill is located at 1000 Midland Road, Blythe, CA, 92225. The landfill is owned and operated by the RCWMD. The landfill property encompasses approximately 335-acres, of which 78 acres are permitted for waste disposal. The landfill is currently permitted to receive a maximum of 400 tons per day of refuse, and as of January 1, 2011, had a remaining capacity of approximately 650,000 tons. It is estimated that the remaining disposal capacity will last until approximately 2047. During 2010, the Blythe Landfill accepted a daily average volume of 60 tons, for a period total of approximately 16,256 tons.

2. In order to preserve landfill capacity and support efforts to recycle, reuse, and/or reduce the amount of recyclable material going to the landfill, the Project will be conditioned to implement the following measures (see attached):

- **Prior to issuance of a grading and/or building permit**, A Waste Recycling Plan (WRP) shall be submitted to the Riverside County Waste Management Department for approval. At a minimum, the WRP must identify the materials (i.e., cardboard, concrete, asphalt, wood, etc.) that will be generated by construction and development, the projected amounts, the measures/methods that will be taken to recycle, reuse, and/or reduce the amount of materials, the facilities and/or haulers that will be utilized, and the targeted recycling or reduction rate. During project construction, the project site shall have, at a minimum, two (2) bins: one for waste disposal and the other for the recycling of Construction and Demolition (C&D) materials. Additional bins are encouraged to be used for further source separation of C&D recyclable materials. Accurate record keeping (receipts) for recycling of C&D recyclable materials and solid waste disposal must be kept. Arrangements can be made through the franchise hauler

- **Prior to final building inspection,** evidence (i.e., receipts or other type of verification) to demonstrate project compliance with the approved WRP shall be presented by the project proponent to the Planning Division of the Riverside County Waste Management Department. Receipts must clearly identify the amount of waste disposed and Construction and Demolition (C&D) materials recycled.

3. Hazardous materials are not accepted at Riverside County landfills. In compliance with federal, state, and local regulations and ordinances, any hazardous waste generated in association with the project shall be disposed of at a permitted Hazardous Waste disposal facility. Hazardous waste materials include, but are not limited to, paint, batteries, oil, asbestos, and solvents. For further information regarding the determination, transport, and disposal of hazardous waste, please contact the Riverside County Department of Environmental Health, Environmental Protection and Oversight Division, at 1.888.722.4234.

Thank you for the allowing us the opportunity to comment on the NOP. Please continue to include the RCWMD in future transmittals. Feel free to call me at (951) 486-3351 if you have any questions regarding the above comments.

Sincerely,

Ryan Ross
Planner IV

Attachments: RCWMD Conditions for CUP 3670, dated July 18, 2011
PD112748

Riverside County
Waste Management Department

Hans W. Kernkamp, General Manager-Chief Engineer

July 18, 2011

Jay Olivas, Project Planner
Riverside County Planning Department
P. O. Box No. 1409
Riverside, CA 92502-1409

RE: Conditional Use Plan (CUP) No. 3670
Proposal: The CUP proposes the development of a 485 MW photovoltaic facility on 3,428 acres (Blythe Mesa Solar)
APNs: 821-110-004, etc.

Dear Mr. Olivas:

The Riverside County Waste Management Department (Department) has reviewed the proposed project, located east of the Blythe Airport and west of Neighbors Boulevard, in the Palo Verde Area Plan. In order to mitigate the project's potential solid waste impacts and to help the County's efforts to comply with State law in diverting solid waste from landfill disposal, the Department is recommending that the following conditions be made a part of any Conditions of Approval for the project:

1. **Prior to issuance of a grading and/or building permit,** A Waste Recycling Plan (WRP) shall be submitted to the Riverside County Waste Management Department for approval. At a minimum, the WRP must identify the materials (i.e., cardboard, concrete, asphalt, wood, etc.) that will be generated by construction and development, the projected amounts, the measures/methods that will be taken to recycle, reuse, and/or reduce the amount of materials, the facilities and/or haulers that will be utilized, and the targeted recycling or reduction rate. During project construction, the project site shall have, at a minimum, two (2) bins: one for waste disposal and the other for the recycling of Construction and Demolition (C&D) materials. Additional bins are encouraged to be used for further source separation of C&D recyclable materials. Accurate record keeping (receipts) for recycling of C&D recyclable materials and solid waste disposal must be kept. Arrangements can be made through the franchise hauler

2. **Prior to final building inspection,** evidence (i.e., receipts or other type of verification) to demonstrate project compliance with the approved WRP shall be presented by the project proponent to the Planning Division of the Riverside County Waste Management Department. Receipts must clearly identify the amount of waste disposed and Construction and Demolition (C&D) materials recycled.

3. Please note that the Blythe Airport Dumpsite is located within the vicinity of the proposed solar project. For more information on the dumpsite and its location, please contact Chad Davies with the County of Riverside Economic Development Agency (EDA), Aviation Division at (951) 955-9722, or Laurie Holk with the Local Enforcement Agency (LEA) at 760-863-7008.

4. Hazardous materials are not accepted at Riverside County landfills. In compliance with federal, state, and local regulations and ordinances, any hazardous waste generated in association with the project shall be disposed of at a permitted Hazardous Waste disposal facility. Hazardous waste materials include, but are not limited to, paint, batteries, oil, asbestos, and solvents. For further information regarding the determination, transport, and disposal of hazardous waste, please contact the Riverside County Department of Environmental Health, Environmental Protection and Oversight Division, at 1.888.722.4234.

5. Use mulch and/or compost in the development and maintenance of landscaped areas within the project boundaries. Recycle green waste through either onsite composting of grass, i.e., leaving the grass clippings on the lawn, or sending separated green waste to a composting facility.

6. Consider xeriscaping and using drought tolerant/low maintenance vegetation in all landscaped areas of the project.

Thank you for the opportunity to review this proposal. If you have any questions, please call me at (951) 486-3351.

Sincerely,

Ryan Ross
Planner IV

Doc 88468v44

Cc: Chad Davies, EDA
Laurie Holk, LEA

SOUTHERN CALIFORNIA
ASSOCIATION of GOVERNMENTS

Main Office
818 West Seventh Street
12th Floor
Los Angeles, California
90017-3435

t (213) 236-1800
f (213) 236-1825

www.scag.ca.gov

Officers
President
Pam O'Connor, Santa Monica

First Vice President
Glen Becerra, Simi Valley

Second Vice President
Greg Pettis, Cathedral City

Immediate Past President
Larry McCallon, Highland

Executive/Administration Committee Chair
Pam O'Connor, Santa Monica

Policy Committee Chairs
Community, Economic and Human Development
Bill Jahn, Big Bear Lake

Energy & Environment
Margaret Clark, Rosemead

Transportation
Paul Glaab, Laguna Niguel

December 19, 2011

Mr. Jay Olivas
Project Planner
Riverside County Planning Department
4080 Lemon Street, 12th Floor
Riverside, CA 92502-1409
(951) 955-1195

RE: SCAG Comments on the Notice of Preparation of a Draft Environmental Impact Report for the Blythe Mesa I Solar Project [I20110201]

Dear Mr. Olivas:

Thank you for submitting the **Notice of Preparation of a Draft Environmental Impact Report for the Blythe Mesa I Solar Project [I20110201]** to the Southern California Association of Governments (SCAG) for review and comment. SCAG is the authorized regional agency for Inter-Governmental Review of Programs proposed for federal financial assistance and direct development activities, pursuant to Presidential Executive Order 12372 (replacing A-95 Review). Additionally, pursuant to Public Resources Code Section 21083(d) SCAG reviews Environmental Impact Reports of projects of regional significance for consistency with regional plans per the California Environmental Quality Act Guidelines, Sections 15125(d) and 15206(a)(1). SCAG is also the designated Regional Transportation Planning Agency and as such is responsible for both preparation of the Regional Transportation Plan (RTP) and Federal Transportation Improvement Program (FTIP) under California Government Code Section 65080 and 65082.

SCAG staff has reviewed this project and determined that the proposed project is regionally significant per California Environmental Quality Act (CEQA) Guidelines, Sections 15125 and/or 15206. The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic electric generating facility and associated infrastructure on a total of approximately 3,660 acres in the City of Blythe and unincorporated Riverside County.

Policies of SCAG's Regional Transportation Plan (RTP) and Compass Growth Visioning (CGV) that may be applicable to your project are outlined in the attachment. The RTP, CGV, and table of policies can be found on the SCAG web site at: http://scag.ca.gov/igr. For ease of review, we would encourage you to use a side-by-side comparison of all SCAG policies with a discussion of the consistency, non-consistency or non-applicability of the policy and supportive analysis in a table format (example attached).

The attached policies are meant to provide guidance for considering the proposed project within the context of our regional goals and policies. We also encourage the use of the SCAG List of Mitigation Measures extracted from the RTP to aid with demonstrating consistency with regional plans and policies. **When available, please send environmental documentation ONLY to SCAG's main office in Los Angeles and provide a minimum of 45 days for SCAG to review.** If you have any questions regarding the attached comments, please contact Pamela Lee at (213) 236-1895 or leep@scag.ca.gov. Thank you.

Sincerely,

Jacob Lieb, Manager
Environmental and Assessment Services

December 19, 2011 **SCAG No. I20110201**
Mr. Olivas

COMMENTS ON THE NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE BLYTHE MESA I SOLAR PROJECT [I20110201]

PROJECT LOCATION

The Blythe Mesa I Solar Project is located approximately 5 miles west of central Blythe and 40 miles east of Desert Center; more specifically, the project is located north and south of Interstate 10, west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport. The site consists of primarily agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde.

PROJECT DESCRIPTION

The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of approximately 3,660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of 8 feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. The project site would be secured 24 hours a day by onsite private security personnel or remote services with motion-detection cameras. An equestrian wire, wildlife-friendly and drainage-compatible security fence would be placed around the perimeter of the site. The proposed lighting for the site would be consistent with the County building code. A new 8.4 mile long, 230 kilovolt (kV) double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site (3.6 miles of the gen-tie line are located within the project site, and 4.8 miles are located off-site between the project site and the Colorado River Substation). A majority of the project is within the County of Riverside jurisdiction. An approximate 330-acre portion of the 3,660-acre project site is located within the City of Blythe jurisdiction. A Development Agreement between the County of Riverside and the applicant will be established setting forth the rights and responsibilities of each party with respect to project development and operation.

CONSISTENCY WITH REGIONAL TRANSPORTATION PLAN

Regional Growth Forecasts

The DEIR should reflect the most current SCAG forecasts, which are the 2008 RTP (May 2008) Population, Household and Employment forecasts. The forecasts for your region, subregion and city are as follows:

Adopted SCAG Regionwide Forecasts[1]

	2010	2015	2020	2025	2030	2035
Population	19,418,344	20,465,830	21,468,948	22,395,121	23,255,377	24,057,286
Households	6,086,986	6,474,074	6,840,328	7,156,645	7,449,484	7,710,722
Employment	8,349,453	8,811,406	9,183,029	9,546,773	9,913,376	10,287,125

Adopted Coachella Valley Association of Governments Subregion Forecasts[1]

	2010	2015	2020	2025	2030	2035
Population	507,318	590,368	712,462	827,009	929,522	1,045,814
Households	174,485	202,268	241,275	281,289	317,209	354552
Employment	196,475	220,121	244,519	267,606	289,564	315289

Adopted City of Blythe Forecasts[1]

	2010	2015	2020	2025	2030	2035
Population	23,124	24,170	25,897	26,496	27,011	27,626
Households	4,806	5,116	5,645	5,914	6,152	6,399
Employment	6,225	6,539	6,923	7,198	7,375	7,551

1. The 2008 RTP growth forecast at the regional, subregional, and city level was adopted by the Regional Council in May 2008. City totals are the sum of small area data and should be used for advisory purposes only.

The **2008 Regional Transportation Plan (RTP)** also has goals and policies that may be pertinent to this proposed project. This RTP links the goal of sustaining mobility with the goals of fostering economic development, enhancing the environment, reducing energy consumption, promoting transportation-friendly development patterns, and encouraging fair and equitable access to residents affected by socio-economic, geographic and commercial limitations. The RTP continues to support all applicable federal and state laws in implementing the proposed project. Among the relevant goals and policies of the RTP are the following:

Regional Transportation Plan Goals:

RTP G1 *Maximize mobility and accessibility for all people and goods in the region.*
RTP G2 *Ensure travel safety and reliability for all people and goods in the region.*
RTP G3 *Preserve and ensure a sustainable regional transportation system.*
RTP G4 *Maximize the productivity of our transportation system.*
RTP G5 *Protect the environment, improve air quality and promote energy efficiency.*
RTP G6 *Encourage land use and growth patterns that complement our transportation investments.*
RTP G7 *Maximize the security of our transportation system through improved system monitoring, rapid recovery planning, and coordination with other security agencies.*

GROWTH VISIONING

The fundamental goal of the **Compass Growth Visioning** effort is to make the SCAG region a better place to live, work and play for all residents regardless of race, ethnicity or income class. Thus, decisions regarding growth, transportation, land use, and economic development should be made to promote and sustain for future generations the region's mobility, livability and prosperity. The following "Regional Growth Principles" are proposed to provide a framework for local and regional decision making that improves the quality of life for all SCAG residents. Each principle is followed by a specific set of strategies intended to achieve this goal.

Principle 1: Improve mobility for all residents.

GV P1.1 *Encourage transportation investments and land use decisions that are mutually supportive.*
GV P1.2 *Locate new housing near existing jobs and new jobs near existing housing.*
GV P1.3 *Encourage transit-oriented development.*
GV P1.4 *Promote a variety of travel choices*

Principle 2: Foster livability in all communities.

GV P2.1 *Promote infill development and redevelopment to revitalize existing communities.*
GV P2.2 *Promote developments, which provide a mix of uses.*
GV P2.3 *Promote "people scaled," walkable communities.*
GV P2.4 *Support the preservation of stable, single-family neighborhoods.*

Principle 3: Enable prosperity for all people.

GV P3.1 *Provide, in each community, a variety of housing types to meet the housing needs of all income levels.*

GV P3.2 *Support educational opportunities that promote balanced growth.*
GV P3.3 *Ensure environmental justice regardless of race, ethnicity or income class.*
GV P3.4 *Support local and state fiscal policies that encourage balanced growth*
GV P3.5 *Encourage civic engagement.*

Principle 4: Promote sustainability for future generations.
GV P4.1 *Preserve rural, agricultural, recreational, and environmentally sensitive areas*
GV P4.2 *Focus development in urban centers and existing cities.*
GV P4.3 *Develop strategies to accommodate growth that uses resources efficiently, eliminate pollution and significantly reduce waste.*
GV P4.4 *Utilize "green" development techniques*

CONCLUSION

As the clearinghouse for regionally significant projects per Executive Order 12372, SCAG reviews the consistency of local plans, projects, and programs with regional plans. This activity is based on SCAG's responsibilities as a regional planning organization pursuant to state and federal laws and regulations. Guidance provided by these reviews is intended to assist local agencies and project sponsors to take actions that contribute to the attainment of regional goals and policies.

All feasible measures needed to mitigate any potentially negative regional impacts associated with the proposed project should be implemented and monitored, as required by CEQA. We recommend that you review the SCAG List of Mitigation Measures for additional guidance, and encourage you to follow them, where applicable to your project. The SCAG List of Mitigation Measures may be found here: http://www.scag.ca.gov/igr/documents/SCAG_IGRMMRP_2008.pdf

December 19, 2011 **SCAG No. I20110201**
Mr. Olivas

SUGGESTED SIDE BY SIDE FORMAT - COMPARISON TABLE OF SCAG POLICIES

For ease of review, we would encourage the use of a side-by-side comparison of all SCAG policies with a discussion of the consistency, non-consistency or not applicable of the policy and supportive analysis in a table format. All policies and goals must be evaluated as to impacts. Suggested format is as follows:

The complete table can be found at: http://www.scag.ca.gov/igr/

- Click on ***"Demonstrating Your Project's Consistency With SCAG Policies"***
- Scroll down to ***"Table of SCAG Policies for IGR"***

SCAG Regional Transportation Plan Goals and Compass Growth Visioning Principles		
Regional Transportation Plan Goals		
Goal/ Principle Number	**Policy Text**	**Statement of Consistency, Non-Consistency, or Not Applicable**
RTP G1	Maximize mobility and accessibility for all people and goods in the region.	***Consistent:*** *Statement as to why* ***Not-Consistent:*** *Statement as to why* *or* ***Not Applicable:*** *Statement as to why*
RTP G2	Ensure travel safety and reliability for all people and goods in the region.	***Consistent:*** *Statement as to why* ***Not-Consistent:*** *Statement as to why* *or* ***Not Applicable:*** *Statement as to why*
RTP G3	Preserve and ensure a sustainable regional transportation system.	***Consistent:*** *Statement as to why* ***Not-Consistent:*** *Statement as to why* *or* ***Not Applicable:*** *Statement as to why*
Etc.	Etc.	Etc.

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Louis B. Davis
Region Manager

December 19, 2011

Mr. Jay Olivas
Riverside County Planning Department
4080 Lemon Street, 12th Floor
P.O. Box 1409
Riverside, CA 92502-1409

RE: Notice of Preparation (NOP) for the Blythe Mesa I Solar Project

Dear Mr. Olivas:

Southern California Edison (SCE) appreciates the opportunity to provide comment on the NOP for the Blythe Solar PV I Project (Conditional Use Permit No. 3670) by Renewable Resources Group. The project is described as a proposal to develop a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on approximately 3,660 acres of land within the County of Riverside. Specifically, the project is stated to be located north and south of Interstate 10, west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport.

The proposed project includes a new 8.4 mile long, 230 kV double-circuit generator-tie line that will connect the proposed project with the approved Colorado River Substation located west of the project site. 3.6 miles of the gen-tie line are located within the project site, and 4.8 miles are located off-site between the project site and the Colorado River Substation.

Interconnection of renewable generators into SCE's California Independent System Operator (CAISO)-controlled grid is established through an application to CAISO under their rules and tariffs. SCE and CAISO work together to determine, through a series of Interconnection Studies, the new and/or upgraded electrical facilities required to be constructed to support interconnection of the project into SCE's transmission system. The generator enters into an Interconnection Agreement with SCE and CAISO to interconnect and operate its generation project, and for SCE to design, construct, install, operate and maintain any facilities or upgrades, and for the customer to pay for such upgrades. The Agreement also allows for refunds to be provided to the customer for any network upgrades financed up-front by the customer, pursuant to the Federal Energy Regulatory Commission (FERC) Tariff. Currently, the process includes projects studied serially and in clusters, which are queued for study purposes and for scheduling of construction activities.

CPUC Certificate of Public Convenience and Necessity (CPCN) Requirements

If the SCE interconnection facilities to be constructed or relocated are over 200 kV, GO 131-D, Section III.A requires SCE to obtain a CPCN from the CPUC unless certain exceptions apply. Accordingly, SCE would need to consult on a case-by-case basis with the CPUC for such projects to determine if the CPUC would allow the project to proceed "exempt" or instead allow SCE to proceed under an "expedited" CPCN application by attaching the final CEQA document completed by the Lead Agency in lieu of an SCE PEA.

24487 Prielipp Rd.
Wildomar, CA 92595

Office: (951) 249-8468
E-mail: louis.davis@sce.com

Such an expedited CPCN would typically take from 4-6 months for the CPUC to process.

For the benefits and reasons stated above, it is assumed that the project proponent for the generation project will include SCE's interconnection facilities and network upgrades work scope (including facilities to be constructed by others and deeded to SCE) in the reports/applications submitted to the Lead Agency permitting/entitling the generation project (e.g., California Energy Commission or applicable local, state or federal permitting agency, such as the Bureau of Land Management), and that such agencies will review the potential environmental impacts associated with SCE's work scope in any environmental document issued. However, depending on certain circumstances, the CPUC may still require SCE to undergo a standard PTC or CPCN for the generator tie-line and network upgrades associated with the generation project.

SCE Scope of Work NOT Subject to CPUC General Order 131-D

Certain SCE facilities and scope of work may not be subject to the CPUC's GO 131-D. In such instances, SCE will follow any and all other applicable environmental laws and regulations. In some cases, SCE will be required to obtain permits for SCE facilities and scope of work from state and federal agencies under other environmental laws and regulations, such as California Fish and Game Code, Clean Water Act, and Endangered Species Act. State and federal agencies may be required to comply with CEQA and NEPA prior to issuing their permits. The Lead Agency may also require evaluation of SCE's facilities and scope of work as part of the proposed generation project.

Coordination with SCE

For these reasons, SCE recommends that the project proponent and Lead Agency coordinate with SCE early in its environmental review process to identify the potential need to obtain certain permits for SCE facilities and scope of work necessary to interconnect the proposed project. SCE further suggests the project proponent submit to the Lead Agency information on the foreseeable SCE scope of work and its associated impacts, so that the Lead Agency can analyze such impacts during its environmental review process as appropriate. In this manner, the Lead Agency may coordinate with responsible agencies (under CEQA) or with cooperating agencies (under NEPA) to appropriately analyze impacts of the other agencies' actions and reduce the need for supplemental analyses and amendments to circulated environmental documents. In addition, SCE recommends that the project proponent coordinates with SCE when obtaining environmental permits in case both parties require permits issued under the same authorities.

For facilities that are not subject to GO 131-D, once all pre-construction requirements of applicable environmental laws and regulations are complied with, SCE would issue an in-house Environmental Clearance before commencement of its construction activities.

Impacts to SCE Facilities or Land Rights

In the event the project proposes to impact SCE facilities or its land related rights, please forward five (5) sets of project plans depicting SCE's facilities and its associated land rights to the following location for review:

Real Properties Department
Southern California Edison Company
2131 Walnut Grove Avenue, G.O.3 – Second Floor
Rosemead, CA 91770

Once again, SCE appreciates the opportunity to comment on the NOP for this project and looks forward to working closely with the applicant and the Lead Agency to support interconnection of this project into SCE's CAISO controlled transmission grid (or through SCE's WDAT). Please notify SCE when the DEIR for this project becomes available for public review. If you have any questions regarding this letter, please do not hesitate to contact me at (951) 249-8468.

Sincerely,

Louis Davis
Local Public Affairs Region Manager
Southern California Edison Company

STATE OF CALIFORNIA

Governor's Office of Planning and Research

State Clearinghouse and Planning Unit

Edmund G. Brown Jr.
Governor

Ken Alex
Director

Notice of Preparation

November 18, 2011

To: Reviewing Agencies

Re: EIR No. 529/CUP No. 3670/PUP No. 913/Blythe Mesa I Solar Projejct
SCH# 2011111056

Attached for your review and comment is the Notice of Preparation (NOP) for the EIR No. 529/CUP No. 3670/PUP No. 913/Blythe Mesa I Solar Projejct draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

Jay Olivas
Riverside County
4080 Lemon Street, 9th Floor
P.O. Box 1409
Riverside, CA 92502-1409

with a copy to the State Clearinghouse in the Office of Planning and Research. Please refer to the SCH number noted above in all correspondence concerning this project.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Attachments
cc: Lead Agency

Document Details Report
State Clearinghouse Data Base

SCH#	2011111056
Project Title	EIR No. 529/CUP No. 3670/PUP No. 913/Blythe Mesa I Solar Projejct
Lead Agency	Riverside County

Type	NOP Notice of Preparation
Description	The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of ~3,6660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of 8 feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. Since most of the site has nearly level to gently sloping topography, no mass grading would be required and the natural drainage patterns of the site would not be significantly altered. The project site would be secured 24 hours per day by onsite private security personnel or remote services with motion-detection cameras. An equestrian-wire, wildlife-friendly and drainage-compatible security fence that meets National Electric Safety Code would be placed around the perimeter of the site. The proposed lighting for the site would be consistent with County building code. A new 8.4 mile long, 230 kv double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site subject to Public Use Permit. A majority of the project is within the County of Riverside jurisdiction.

Lead Agency Contact

Name	Jay Olivas		
Agency	Riverside County		
Phone	(951) 955-1195	*Fax*	
email	jolivas@rctlma.org		
Address	4080 Lemon Street, 9th Floor P.O. Box 1409		
City	Riverside	*State* CA	*Zip* 92502-1409

Project Location

County	Riverside				
City	Blythe				
Region					
Cross Streets	No. & So. of I-10, W. of Neighbors Blvd, So. & E. of Blythe Airport				
Lat / Long	33° 36' N / 114° 41' 40" W				
Parcel No.	821-110-004, etc.,				
Township	7S	*Range* 2W	*Section* 27	*Base*	SBB&M

Proximity to:

Highways	I-10
Airports	Blythe Airport
Railways	Union Pacific
Waterways	Colorado River
Schools	Palo Verde Valley
Land Use	Active and inactive agriculture/Heavy Agricultural, Light Agriculture, Controlled Development Areas/Agriculture and Rural Community.

Project Issues Aesthetic/Visual; Agricultural Land; Air Quality; Archaeologic-Historic; Biological Resources; Drainage/Absorption; Economics/Jobs; Fiscal Impacts; Geologic/Seismic; Noise; Population/Housing Balance; Public Services; Septic System; Soil Erosion/Compaction/Grading; Toxic/Hazardous; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Landuse; Cumulative Effects; Other Issues

Note: Blanks in data fields result from insufficient information provided by lead agency.

Document Details Report
State Clearinghouse Data Base

Reviewing Agencies	Resources Agency; Colorado River Board; California Energy Commission; Office of Historic Preservation; Department of Parks and Recreation; Department of Water Resources; Department of Fish and Game, Region 6; Native American Heritage Commission; Public Utilities Commission; California Highway Patrol; Caltrans, District 8; Air Resources Board; Department of Toxic Substances Control; Regional Water Quality Control Board, Region 7

Date Received 11/18/2011 *Start of Review* 11/18/2011 *End of Review* 12/19/2011

Note: Blanks in data fields result from insufficient information provided by lead agency.

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

NOP Distribution List

a46

County: Riverside

SCH# 2011111056

Resources Agency

- [x] **Resources Agency**
  Nadell Gayou
- [ ] **Dept. of Boating & Waterways**
  Nicole Wong
- [ ] **California Coastal Commission**
  Elizabeth A. Fuchs
- [x] **Colorado River Board**
  Gerald R. Zimmerman
- [ ] **Dept. of Conservation**
  Elizabeth Carpenter
- [x] **California Energy Commission**
  Eric Knight
- [ ] **Cal Fire**
  Allen Robertson
- [ ] **Central Valley Flood Protection Board**
  James Herota
- [x] **Office of Historic Preservation**
  Ron Parsons
- [x] **Dept of Parks & Recreation**
  Environmental Stewardship Section
- [ ] **California Department of Resources, Recycling & Recovery**
  Sue O'Leary
- [ ] **S.F. Bay Conservation & Dev't. Comm.**
  Steve McAdam
- [x] **Dept. of Water Resources** Resources Agency
  Nadell Gayou

Fish and Game

- [ ] **Depart. of Fish & Game**
  Scott Flint
  Environmental Services Division
- [ ] **Fish & Game Region 1**
  Donald Koch
- [ ] **Fish & Game Region 1E**
  Laurie Harnsberger
- [ ] **Fish & Game Region 2**
  Jeff Drongesen
- [ ] **Fish & Game Region 3**
  Charles Armor
- [ ] **Fish & Game Region 4**
  Julie Vance
- [ ] **Fish & Game Region 5**
  Leslie Newton-Reed
  Habitat Conservation Program
- [x] **Fish & Game Region 6**
  Gabrina Gatchel
  Habitat Conservation Program
- [ ] **Fish & Game Region 6 I/M**
  Brad Henderson
  Inyo/Mono, Habitat Conservation Program
- [ ] **Dept. of Fish & Game M**
  George Isaac
  Marine Region

Other Departments

- [ ] **Food & Agriculture**
  Sandra Schubert
  Dept. of Food and Agriculture
- [ ] **Depart. of General Services**
  Public School Construction
- [ ] **Dept. of General Services**
  Anna Garbeff
  Environmental Services Section
- [ ] **Dept. of Public Health**
  Bridgette Binning
  Dept. of Health/Drinking Water
- [ ] **Delta Stewardship Council**
  Terry Macaulay

Independent Commissions,Boards

- [ ] **Delta Protection Commission**
  Linda Flack
- [ ] **Cal EMA (Emergency Management Agency)**
  Dennis Castrillo
- [x] **Native American Heritage Comm.**
  Debbie Treadway
- [x] **Public Utilities Commission**
  Leo Wong
- [ ] **Santa Monica Bay Restoration**
  Guangyu Wang
- [ ] **State Lands Commission**
  Jennifer Deleong
- [ ] **Tahoe Regional Planning Agency (TRPA)**
  Cherry Jacques

Business, Trans & Housing

- [ ] **Caltrans - Division of Aeronautics**
  Philip Crimmins
- [ ] **Caltrans - Planning**
  Terri Pencovic
- [x] **California Highway Patrol**
  Suzann Ikeuchi
  Office of Special Projects
- [ ] **Housing & Community Development**
  CEQA Coordinator
  Housing Policy Division

Dept. of Transportation

- [ ] **Caltrans, District 1**
  Rex Jackman
- [ ] **Caltrans, District 2**
  Marcelino Gonzalez
- [ ] **Caltrans, District 3**
  Bruce de Terra
- [ ] **Caltrans, District 4**
  Lisa Carboni
- [ ] **Caltrans, District 5**
  David Murray
- [ ] **Caltrans, District 6**
  Michael Navarro
- [ ] **Caltrans, District 7**
  Elmer Alvarez
- [x] **Caltrans, District 8**
  Dan Kopulsky
- [ ] **Caltrans, District 9**
  Gayle Rosander
- [ ] **Caltrans, District 10**
  Tom Dumas
- [ ] **Caltrans, District 11**
  Jacob Armstrong
- [ ] **Caltrans, District 12**
  Marlon Regisford

Cal EPA

Air Resources Board

- [x] Airport/Energy Projects
  Jim Lerner
- [ ] Transportation Projects
  Douglas Ito
- [ ] Industrial Projects
  Mike Tollstrup
- [ ] **State Water Resources Control Board**
  Regional Programs Unit
  Division of Financial Assistance
- [ ] **State Water Resources Control Board**
  Student Intern, 401 Water Quality Certification Unit
  Division of Water Quality
- [ ] **State Water Resouces Control Board**
  Phil Crader
  Division of Water Rights
- [x] **Dept. of Toxic Substances Control**
  CEQA Tracking Center
- [ ] **Department of Pesticide Regulation**
  CEQA Coordinator

Regional Water Quality Control Board (RWQCB)

- [ ] **RWQCB 1**
  Cathleen Hudson
  North Coast Region (1)
- [ ] **RWQCB 2**
  Environmental Document Coordinator
  San Francisco Bay Region (2)
- [ ] **RWQCB 3**
  Central Coast Region (3)
- [ ] **RWQCB 4**
  Teresa Rodgers
  Los Angeles Region (4)
- [ ] **RWQCB 5S**
  Central Valley Region (5)
- [ ] **RWQCB 5F**
  Central Valley Region (5)
  Fresno Branch Office
- [ ] **RWQCB 5R**
  Central Valley Region (5)
  Redding Branch Office
- [ ] **RWQCB 6**
  Lahontan Region (6)
- [ ] **RWQCB 6V**
  Lahontan Region (6)
  Victorville Branch Office
- [x] **RWQCB 7**
  Colorado River Basin Region (7)
- [ ] **RWQCB 8**
  Santa Ana Region (8)
- [ ] **RWQCB 9**
  San Diego Region (9)

- [ ] **Other** _____

- [ ] _____
  Conservancy

Last Updated [illegible]

AR060942

RIVERSIDE COUNTY
PLANNING DEPARTMENT

Carolyn Syms Luna
Director

Agency Notice of Preparation of an Draft Environmental Impact Report

Date: November 16, 2011

ATTN: Stanley Sniff, Sheriff
Sheriff's Department, Riverside County
Mail Stop 1450

PROJECT CASE NO./TITLE: Environmental Impact Report No. 529 / Conditional Use Permit No. 3670 / Public Use Permit No. 913 / Blythe Mesa I Solar Project

PROJECT LOCATION: East Riverside County - Palo Verde Area Plan, the Blythe Mesa I Solar Project is located approximately 5 miles west of central Blythe and 40 miles east of Desert Center; more specifically, the project is located north and south of Interstate 10, west of Neighbors Boulevard and Arrowhead Boulevard, south and east of the Blythe Airport. The site consists primarily of agricultural land located south and east of the community of Nicholls Warm Springs/Mesa Verde. APNs 821-110-004, 821-120-025, 821-120-026, 821-120-027, etc. (see attached sheet entitled "Blythe Mesa Solar Project" "Assessor's Parcels for Solar Field (CUP03670)". Also, as shown on the exhibits entitled "Blythe Mesa Solar Project - Topographic Quadrangle Map", "Public Use Permit", "Blythe Mesa Solar Project Conditional Use Permit #3670 Pages 1 & 2", Exhibits "A1", "Notice of Preparation Attachment A", "Figure 1: Regional Area Map", "Figure 2: Site Plan & Solar Module", and "Figure 3: Typical Tiled Tracker Panels".

PROJECT DESCRIPTION: The proposed project consists of the construction and operation of a 485 megawatt solar photovoltaic (PV) electric generating facility and associated infrastructure on a total of approximately 3,660 acres. The proposed project would consist of a solar array field utilizing single-axis solar PV trackers and panels with a combined maximum height of 8 feet. Supporting facilities on-site would include three electrical substations, two operation and maintenance buildings, inverters, transformers, and associated switchgear. Since most of the site has nearly level to gently sloping topography, no mass grading would be required and the natural drainage patterns of the site would not be significantly altered. The Project site would be secured 24 hours per day by onsite private security personnel or remote services with motion-detection cameras. An equestrian-wire, wildlife-friendly and drainage-compaitble security fence that meets National Electric Safety Code would be placed around the perimeter of the site. The proposed lighting for the site would be consistent with County building code. A new 8.4 mile long, 230 kilovolt (kV) double-circuit generation-tie transmission line would connect the proposed project with the approved Colorado River Substation located west of the project site subject to Public Use Permit (3.6 miles of the gen-tie line are located within the project site, and 4.8 miles are located off-site between the project site and the Colorado River Substation). A majority of the project is within the County of Riverside jurisdiction. An approximate 330-acre portion of the 3,660-acre project site is located within the City of Blythe jurisdiction. A Development Agreement between the County of Riverside and the applicant will be established setting forth the rights and responsibilities of each party with respect to project development and operation.

Riverside Office · 4080 Lemon Street, 12th Floor
P.O. Box 1409, Riverside, California 92502-1409
(951) 955-3200 · Fax (951) 955-1811

Desert Office · 38686 El Cerrito Road
Palm Desert, California 92211
(760) 863-8277 · Fax (760) 863-7555

Riverside County Sheriff- Colorado River Station
260 North Spring Street, Blythe CA. 92225
Stan Sniff - Sheriff

MEMORANDUM

To: Riverside Co. Planning Dept. **Date**: 12/15/2011

From: Capt. Jim Navarro
Station Commander
760-921-7900

Re: EIR No. 529, CUP No. 3670, PUP No. 913, Blythe Mesa Solar Project

The Sheriff's Department, Colorado River Station has no specific requests or changes at this time.

One comment concerning the location of the project in relation to the Sheriff's Department Shooting Range in Parcel # 824-080-004. Please be aware of our requirement to have 24-hour access to our site and that live fire activities can be occurring many times between 5:00 AM and 11:00 PM on any day of the week.

Thank you,

James D. Navarro
Sheriff's Captain

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B
AIR QUALITY AND GLOBAL CLIMATE CHANGE TECHNICAL REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

Air Quality and Global Climate Change Technical Report

for the

Blythe Mesa Solar Project

Submitted To:

Power Engineers, Inc.
731 East Ball Road, Suite 100
Anaheim, CA 92805

Prepared By:

Scientific Resources Associated
1328 Kaimalino Lane
San Diego, CA 92109

January 2013

Table of Contents

1.0 Introduction 1
1.1 Study Personnel 1
1.2 Project Description (Alternative 1) 1
1.3 Project Alternatives 2
2.0 Regulatory Framework 6
2.1 Federal Regulations 17
2.2 State Regulations 19
2.3 Local Regulations 26
3.0 Environmental Setting 27
3.1 Regional Climate 29
3.2 Existing Air Quality 32
4.0 Impact Assessment 34
4.1 Significance Thresholds 34
4.2 Impacts – Alternative 1 37
4.3 Impacts – Alternative 2 49
4.4 Impacts – Alternative 3 49
4.5 Impacts – Alternative 4 52
5.0 Global Climate Change 54
5.1 Potential Climate Change Impacts to Project 57
5.2 Impacts 60
6.0 Cumulative Impacts 64
7.0 Conclusions and Recommendations 65
8.0 References 67

1.0 Introduction

The purpose of this Air Quality Technical Report is to describe the existing regional air quality in the air basin of the Project area; to provide a discussion of applicable federal, state, and local air quality regulations; to assess the potential air quality impacts associated with construction and operation of the Project; and to identify measures that would be required to mitigate air quality impacts or minimize emissions.

The Project's potential for air quality impacts would be mainly associated with construction activities. Construction of the project would result in emissions of tailpipe emissions from vehicles and heavy construction equipment, and in emissions of fugitive dust from site preparation activities. Operational activities would also result in emissions from vehicles and inspection and maintenance activities.

This report also provides an evaluation of emissions of greenhouse gases (GHGs) from construction and operation activities, and an evaluation of the potential for cumulative impacts associated with GHG emissions.

1.1 Study Personnel

This Air Quality Technical Report was prepared by Valorie L. Thompson, Ph.D., Principal of Scientific Resources Associated. Scientific Resources Associated specializes in Air Quality and Global Climate Change technical studies.

1.2 Project Description (Alternative 1)

The proposed Blythe Mesa Solar Project (Project) consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect (Figure 1). The power produced by the Project

would be conveyed to the local power grid via interconnection to the Southern California Edison Colorado River Substation, an approved new substation located south of Highway 10 and approximately four miles west of the Project site. The Project has secured a California Independent System Operator (CAISO) interconnection queue position sufficient for the size of the Project. The Project would produce enough energy to power approximately 180,000 households and progress the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state.

The objectives for the Blythe Mesa Solar Project are as follows:

- Construct a solar energy facility in order to meet state and federal renewable energy standards and goals.
- Assist with greenhouse gas reduction objectives to the maximum extent possible.
- Locate the Project facilities as near as possible to electrical transmission facilities with anticipated capacity and reserved CASIO interconnection position.
- Site the Project in an area with excellent solar energy resource, in order to maximize productivity from the PV panels.
- To the extent feasible, site the Project on disturbed land and locate the facility on land with compatible topography in a manner that minimizes environmental impacts.
- Use a proven and available solar PV technology.

1.3 Project Alternatives

In addition to the Project (Alternative 1), this analysis addresses three project alternatives. The project alternatives include the following:

ALTERNATIVE 2: NO ACTION/PROJECT ALTERNATIVE

The No Action/Project Alternative is required by NEPA and CEQA. Under the No Action/Project Alternative, the construction of a solar generating facility and associated infrastructure would not occur. This alternative reflects existing conditions as well as what would be reasonably expected to occur in the foreseeable future if the Project was not approved and does not take place.

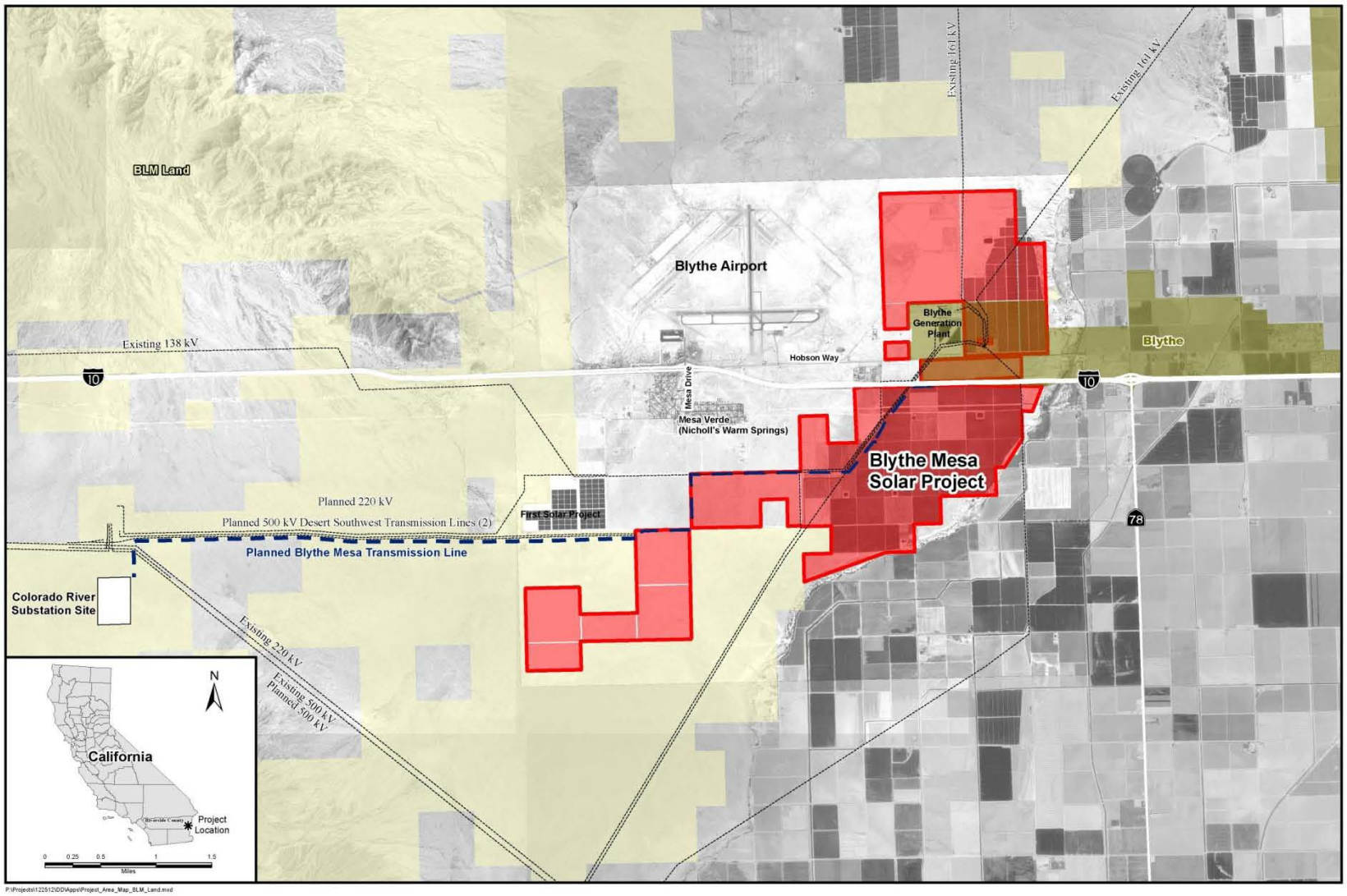
ALTERNATIVE 3: NORTHERN ALTERNATIVE 230 KV TRANSMISSION LINE LOCATION

Similar to Alternative 1 (Proposed Project), Alternative 3 would include the construction, operation, and potential decommissioning of a 485 MW solar PV electrical generating facility and associated infrastructure. It would occupy a total of 3,682 acres and would utilize the same solar array field as the proposed Project. The primary difference between Alternatives 1 and 3 is the location of the 230 kV transmission line that extends outside of the solar array field to the Colorado River Substation; the same 230 kV transmission alignment within the solar array field would be utilized for both Alternatives 1 and 3. The transmission alignment for Alternatives 1 and 3 would also be located within the same BLM utility corridor; however, Alternative 3 would be located on the north side of the corridor and within a 150-foot ROW entirely on BLM-managed lands. Under this alternative, the total length of the 230 kV transmission line both on-site and off-site would be 8.8 miles; 3.6 miles are located on private lands within the array site boundary and 5.2 miles located off-site on BLM managed lands. The BLM portion of the ROW would contain 95 acres.

ALTERNATIVE 4: SOUTHERN TRANSMISSION LINE ALTERNATIVE

Similar to Alternative 1, Alternative 4 would include the construction, operation, and decommissioning of a 485 MW solar PV electrical generating facility and associated infrastructure. Alternative 4 would occupy a total of 3,648 acres and would utilize the same solar array field location as the proposed Project. The primary difference between Alternatives 1 and 4 is the location of the 230 kV transmission line that extends between the solar array field (BMSP substation 3) to the Colorado River Substation. Alternative 4 would exit the southwestern portion of the solar array field and extend approximately 4.0 miles west to the Colorado River Substation within a 125-foot ROW. To facilitate this alignment, and additional 10,000 feet of 230 kV transmission line would need to be built on the solar array extending south from the BMSP substation 3 and angling west to the site boundary. The transmission line would continue westerly off-site across 3.4 miles of BLM managed lands and 0.6 miles of private lands before reaching the Colorado River Substation. Under this alternative, the total length of the 230 kV transmission line both on-site and off-site would be 9.5 miles; 5.5 miles are located on private

lands within the array site boundary and 4.0 miles located off-site (3.3 miles on BLM managed lands and 0.7 mile on private land). The total area of the ROW offsite is about 60 acres (50 acres of BLM managed land and 10 acres of private land).


BLM Land
Blythe Airport
Existing 161 kV
Existing 161 kV
Existing 138 kV
Blythe Generation Plant
Blythe
Hobson Way
Mesa Drive
Mesa Verde (Nicholl's Warm Springs)
Blythe Mesa Solar Project
Planned 220 kV
Planned 500 kV Desert Southwest Transmission Lines (2)
First Solar Project
Planned Blythe Mesa Transmission Line
Colorado River Substation Site
Existing 220 kV
Existing 500 kV
Planned 500 kV
10
78
N
California
Project Location
0 0.25 0.5 1 1.5
Miles

2.0 Regulatory Framework

Air quality is defined by ambient air concentrations of specific pollutants determined by the United States Environmental Protection Agency (USEPA) to be of concern with respect to the health and welfare of the general public. Seven major pollutants of concern, called "criteria pollutants," are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). The USEPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. Areas that violate a federal air quality standard are designated as non-attainment areas.

Ambient air quality refers to the atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) that occurs at a particular geographic location. The ambient air quality levels measured at a particular location are determined by the interactions of emissions, meteorology, and chemistry. Emission considerations include the types, amounts, and locations of pollutants emitted into the atmosphere. Meteorological considerations include wind and precipitation patterns affecting the distribution, dilution, and removal of pollutant emissions. Chemical reactions can transform pollutant emissions into other chemical substances. Ambient air quality data are generally reported as a mass per unit volume (e.g., micrograms per cubic meter of air) or as a volume fraction (e.g., parts per million [ppm] by volume).

Pollutant emissions typically refer to the amount of pollutants or pollutant precursors introduced into the atmosphere by a source or group of sources. Pollutant emissions contribute to the ambient air concentrations of criteria pollutants, either by directly affecting the pollutant concentrations measured in the ambient air or by interacting in the atmosphere to form criteria pollutants. Primary pollutants, such as CO, SO_2, Pb, and some particulates, are emitted directly into the atmosphere from emission sources.

Secondary pollutants, such as O_3, NO_2, and some particulates, are formed through atmospheric chemical reactions that are influenced by meteorology, ultraviolet light, and other atmospheric processes. PM_{10} and $PM_{2.5}$ are generated as primary pollutants by various mechanical processes

(for example, abrasion, erosion, mixing, or atomization) or combustion processes. However, PM_{10} and $PM_{2.5}$ can also be formed as secondary pollutants through chemical reactions or by gaseous pollutants condensing into fine aerosols. In general, emissions that are considered "precursors" to secondary pollutants in the atmosphere (such as reactive organic gases [ROG] and oxides of nitrogen [NOx], which are considered precursors for O_3), are the pollutants for which emissions are evaluated to control the level of O_3 in the ambient air.

The following specific descriptions of health effects for each of the criteria air pollutants associated with project construction and operations are based on information from the California Air Resources Board (ARB) (ARB 2012).

Ozone. O_3 is considered a photochemical oxidant, which is a chemical that is formed when reactive organic gases (ROG) and oxides of nitrogen (NOx), both by-products of combustion, react in the presence of ultraviolet light. O_3 is considered a respiratory irritant and prolonged exposure can reduce lung function, aggravate asthma and increase susceptibility to respiratory infections. Exposure to levels of ozone above the current ambient air quality standard can lead to human health effects such as lung inflammation and tissue damage and impaired lung functioning. Ozone exposure is also associated with symptoms such as coughing, chest tightness, shortness of breath, and the worsening of asthma symptoms. The greatest risk for harmful health effects belongs to outdoor workers, athletes, children and others who spend greater amounts of time outdoors during smoggy periods. Elevated ozone levels can reduce crop and timber yields, as well as damage native plants. Ozone can also damage materials such as rubber, fabrics and plastics. Children and those with existing respiratory diseases are at greatest risk from exposure to O_3.

Carbon Monoxide. CO is a product of combustion, and the main source of CO in the SDAB is from motor vehicle exhaust. CO is an odorless, colorless gas. Exposure to CO near the levels of the ambient air quality standards can lead to fatigue, headaches, confusion, and dizziness. CO interferes with the blood's ability to carry oxygen. Exposure to CO is especially harmful to those with heart disease, because the heart has to pump harder to get enough oxygen to the body. CO exposure has been associated with aggravation of angina pectoris and other aspects of coronary

heart disease, decreased exercise tolerance in people with peripheral vascular disease and lung disease, impairment of central nervous system functions, and possible increased risk to fetuses. At high altitudes (such as in the Lake Tahoe Air Basin), these effects are worsened. CO affects red blood cells in the body by binding to hemoglobin and reducing the amount of oxygen that can be carried to the body's organs and tissues.

Nitrogen Dioxide. NO_2 is also a by-product of fuel combustion, and is formed both directly as a product of combustion and in the atmosphere through the reaction of nitrogen oxide (NO) with oxygen. NO_2 is a respiratory irritant and may affect those with existing respiratory illness, including asthma. Exposure to NO_2 along with other traffic-related pollutants, is associated with respiratory symptoms, episodes of respiratory illness and impaired lung functioning. Studies in animals have reported biochemical, structural, and cellular changes in the lung when exposed to NO_2 above the level of the current state air quality standard. Clinical studies of human subjects suggest that NO_2 exposure to levels near the current standard may worsen the effect of allergens in allergic asthmatics, especially in children.

Respirable Particulate Matter and Fine Particulate Matter. Respirable particulate matter, or PM_{10}, refers to particulate matter with an aerodynamic diameter of 10 microns or less. Fine particulate matter, or $PM_{2.5}$, refers to particulate matter with an aerodynamic diameter of 2.5 microns or less. Particulate matter in this size range has been determined to have the potential to lodge in the lungs and contribute to respiratory problems. PM_{10} and $PM_{2.5}$ arise from a variety of sources, including road dust, diesel exhaust, combustion, tire and brake wear, construction operations and windblown dust. Extensive research indicates that exposure to outdoor PM_{10} and $PM_{2.5}$ levels exceeding current air quality standards is associated with increased risk of hospitalization for lung and heart-related respiratory illness, including emergency room visits for asthma. PM exposure is also associated with increased risk of premature deaths, especially in the elderly and people with pre-existing cardiopulmonary disease. In children, studies have shown associations between PM exposure and reduced lung function and increased respiratory symptoms and illnesses. Besides reducing visibility, the acidic portion of PM (nitrates, sulfates) can harm crops, forests, aquatic and other ecosystems.

Sulfur dioxide. SO_2 is a colorless, reactive gas that is produced from the burning of sulfur-containing fuels such as coal and oil, and by other industrial processes. Generally, the highest concentrations of SO_2 are found near large industrial sources. Effects from SO_2 exposures at levels near the one-hour standard include bronchoconstriction accompanied by symptoms, which may include wheezing, shortness of breath and chest tightness, especially during exercise or physical activity. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) are most susceptible to these symptoms. Continued exposure at elevated levels of SO_2 results in increased incidence of pulmonary symptoms and disease, decreased pulmonary function, and increased risk of mortality. SO_2 is a respiratory irritant that can cause narrowing of the airways leading to wheezing and shortness of breath. Long-term exposure to SO_2 can cause respiratory illness and aggravate existing cardiovascular disease.

Lead. Lead in the atmosphere occurs as particulate matter. Lead has historically been emitted from vehicles combusting leaded gasoline, as well as from industrial sources. With the phase-out of leaded gasoline, large manufacturing facilities are the sources of the largest amounts of lead emissions. Because lead is only slowly excreted, exposures to small amounts of lead from a variety of sources can accumulate to harmful levels. Effects from inhalation of lead near the level of the ambient air quality standard include impaired blood formation and nerve conduction. Lead can adversely affect the nervous, reproductive, digestive, immune, and blood-forming systems. Symptoms can include fatigue, anxiety, short-term memory loss, depression, weakness in the extremities, and learning disabilities in children. Lead is also classified as a probable human carcinogen.

Sulfates. Sulfates are the fully oxidized ionic form of sulfur. In California, emissions of sulfur compounds occur primarily from the combustion of petroleum-derived fuels (e.g., gasoline and diesel fuel) that contain sulfur. This sulfur is oxidized to sulfur dioxide (SO_2) during the combustion process and subsequently converted to sulfate compounds in the atmosphere. The conversion of SO_2 to sulfates takes place comparatively rapidly and completely in urban areas of California due to regional meteorological features. The ARB's sulfates standard is designed to prevent aggravation of respiratory symptoms. Effects of sulfate exposure at levels above the

standard include a decrease in ventilatory function, aggravation of asthmatic symptoms and an increased risk of cardio-pulmonary disease. Sulfates are particularly effective in degrading visibility, and due to fact that they are usually acidic, can harm ecosystems and damage materials and property.

Hydrogen Sulfide. H_2S is a colorless gas with the odor of rotten eggs. It is formed during bacterial decomposition of sulfur-containing organic substances. Also, it can be present in sewer gas and some natural gas, and can be emitted as the result of geothermal energy exploitation. Breathing H_2S at levels above the standard would result in exposure to a very disagreeable odor. In 1984, an ARB committee concluded that the ambient standard for H_2S is adequate to protect public health and to significantly reduce odor annoyance.

Vinyl Chloride. Vinyl chloride, a chlorinated hydrocarbon, is a colorless gas with a mild, sweet odor. Most vinyl chloride is used to make polyvinyl chloride (PVC) plastic and vinyl products. Vinyl chloride has been detected near landfills, sewage plants and hazardous waste sites, due to microbial breakdown of chlorinated solvents. Short-term exposure to high levels of vinyl chloride in air causes central nervous system effects, such as dizziness, drowsiness and headaches. Long-term exposure to vinyl chloride through inhalation and oral exposure causes liver damage. Cancer is a major concern from exposure to vinyl chloride via inhalation. Vinyl chloride exposure has been shown to increase the risk of angiosarcoma, a rare form of liver cancer, in humans.

Visibility Reducing Particles. Visibility-reducing particles consist of suspended particulate matter, which is a complex mixture of tiny particles that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. These particles vary greatly in shape, size and chemical composition, and can be made up of many different materials such as metals, soot, soil, dust, and salt. The CAAQS is intended to limit the frequency and severity of visibility impairment due to regional haze. A separate standard for visibility-reducing particles that is applicable only in the Lake Tahoe Air Basin is based on reduction in scenic quality.

Toxic air contaminants (TACs) are substances that have the potential to be emitted into the ambient air that have been determined to present some level of acute or chronic health risk (cancer or non-cancer) to the general public. These pollutants may be emitted in trace amounts from various types of sources, including combustion sources.

TACs do not have ambient air quality standards. Since no safe levels of TACs can be determined, there are no air quality standards for TACs. Instead, TAC impacts are evaluated by calculating the health risks associated with a given exposure. The requirements of the Air Toxic "Hot Spots" Information and Assessment Act apply to facilities that use, produce, or emit toxic chemicals. Facilities that are subject to the toxic emission inventory requirements of the act must prepare and submit toxic emission inventory plans and reports and periodically update those reports.

The main TACs that are emitted from mobile sources such as those that would be operating to construct and operate the Blythe Mesa Solar Project include those substances that the USEPA and the Federal Highway Administration (FHWA) have identified as Mobile Source Air Toxics. The USEPA reviewed the list of TACs and identified a group of 21 TAC's as Mobile Source Air Toxics (MSATs), which are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline. The USEPA also extracted a subset of this list of 21 MSAT's that it now labels as the seven priority MSATs. These are *benzene, formaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, 1,3-butadiene, naphthalene, and polycyclic organic matter (POM)* (FHWA 2009). While these MSATs are considered the priority transportation toxics, the USEPA stresses that the lists are subject to change and may be adjusted in future rules (FHWA 2009).

The following specific descriptions of health effects for each of the criteria air pollutants associated with project construction and operations are based on information on health effects of

TACs from the California Office of Environmental Health Hazard Assessment (OEHHA 2012) and the USEPA (USEPA 2012).

Benzene. Approximately 84 percent of the benzene emitted in California comes from motor vehicles, including evaporative leakage and unburned fuel exhaust. Currently, the benzene content of gasoline is less than one percent.

Benzene is found in the air from emissions from burning coal and oil, gasoline service stations, and motor vehicle exhaust. Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings. Reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing fetus have been observed in animal tests. Increased incidence of leukemia (cancer of the tissues that form white blood cells) have been observed in humans occupationally exposed to benzene. The USEPA has classified benzene as a Group A, human carcinogen.

Formaldehyde. Exposure to formaldehyde may occur by breathing contaminated indoor air, tobacco smoke, or ambient urban air. Acute (short-term) and chronic (long-term) inhalation exposure to formaldehyde in humans can result in respiratory symptoms, and eye, nose, and throat irritation. Limited human studies have reported an association between formaldehyde exposure and lung and nasopharyngeal cancer. Animal inhalation studies have reported an increased incidence of nasal squamous cell cancer. The USEPA considers formaldehyde a probable human carcinogen (Group B1).

The non-cancer adverse health effects of formaldehyde are largely a manifestation of its ability to irritate mucous membranes. As a result of its solubility in water and high reactivity, formaldehyde is efficiently absorbed into the mucus layers protecting the eyes and respiratory tract where it rapidly reacts, leading primarily to localized irritation. Acute high exposure may lead to eye, nose and throat irritation, and in the respiratory tract, nasal obstruction, pulmonary

edema and dyspnea. Prolonged or repeated exposures have been associated with allergic sensitization, respiratory symptoms (coughing, wheezing, shortness of breath), histopathological changes in respiratory epithelium, and decrements in lung function. Children, especially those with diagnosed asthma, may be more likely to show impaired pulmonary function and symptoms than are adults following chronic exposure to formaldehyde.

Diesel Particulate Matter. Diesel particulate matter is emitted from both mobile and stationary sources. In California, onroad diesel-fueled engines contribute approximately 24 percent of the statewide total, with an additional 71 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources contribute about five percent of total diesel particulate matter.

Diesel exhaust includes over 40 substances that are listed by the USEPA as hazardous air pollutants and by the ARB as toxic air contaminants. Fifteen of these substances are listed by the International Agency for Research on Cancer (IARC) as carcinogenic to humans, or as a probable or possible human carcinogen. Some of these substances are: acetaldehyde; antimony compounds; arsenic; benzene; beryllium compounds; bis(2-ethylhexyl)phthalate; dioxins and dibenzofurans; formaldehyde; inorganic lead; mercury compounds; nickel; POM (including PAHs); and styrene. Almost all of the diesel particle mass is in the fine particle range of 10 microns or less in diameter (PM_{10}). Approximately 94 percent of the mass of these particles are less than 2.5 microns in diameter. Because of their small size, these particles can be inhaled and a portion will eventually become trapped within the small airways and alveolar regions of the lung.

A number of adverse short-term health effects have been associated with exposures to diesel exhaust. Occupational exposures to diesel exhaust particles have been associated with significant cross-shift decreases in lung function. Increased cough, labored breathing, chest tightness, and wheezing have been associated with exposure to diesel exhaust in bus garage workers. A significant increase in airway resistance and increases in eye and nasal irritation were observed in human volunteers following one-hour chamber exposure to diesel exhaust. In

acute or subchronic animal studies, exposure to diesel exhaust particles induced inflammatory airway changes, lung function changes, and increased the animals' susceptibility to infection.

A number of adverse long-term noncancer effects have been associated with exposure to diesel exhaust. Occupational studies have shown that there may be a greater incidence of cough, phlegm and chronic bronchitis among those exposed to diesel exhaust than among those not exposed. Reductions in pulmonary function have also been reported following occupational exposures in chronic studies. Exposure to diesel exhaust has also shown cellular changes in laboratory animals.

Over 30 human epidemiological studies have investigated the potential carcinogenicity of diesel exhaust. These studies, on average, found that long-term occupational exposures to diesel exhaust were associated with a 40 percent increase in the relative risk of lung cancer. The lung cancer findings are consistent and the association is unlikely to be due to chance. These epidemiological studies strongly suggest a causal relationship between occupational diesel exhaust exposure and lung cancer.

Acrolein. Acrolein is a powerful irritant. Due to its highly reactive nature, the effects of acrolein are generally limited to the site of contact; skin, eyes and mucous membranes. Inhalation exposure to low levels (≤ 1 ppm) causes irritation of the eyes, nose and throat. Acute exposures to levels above 1 ppm result in mucous hypersecretion and exacerbation of allergic airway response in animal models. Moderately higher exposures may result in severe lacrimation, and irritation of the mucous membranes of the respiratory tract. Death due to respiratory failure has been associated with high level exposures. Long term exposure to acrolein may result in structural and functional changes in the respiratory tract, including lesions in the nasal mucosa, and pulmonary inflammation.

1,3–Butadiene. Motor vehicle exhaust is a constant source of 1,3-butadiene. Although 1,3-butadiene breaks down quickly in the atmosphere, it is usually found in ambient air at low levels in urban and suburban areas. Acute (short-term) exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Epidemiological studies

have reported a possible association between 1,3-butadiene exposure and cardiovascular diseases. Epidemiological studies of workers in rubber plants have shown an association between 1,3-butadiene exposure and increased incidence of leukemia. Animal studies have reported tumors at various sites from 1,3-butadiene exposure. The USEPA has classified 1,3-butadiene as carcinogenic to humans by inhalation.

Naphthalene. Naphthalene is used in the production of phthalic anhydride; it is also used in mothballs. Acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion. Chronic (long-term) exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy. Available data are inadequate to establish a causal relationship between exposure to naphthalene and cancer in humans. The USEPA has classified naphthalene as a Group C, possible human carcinogen. The state of California has classified naphthalene as a carcinogenic compound.

Polycyclic Organic Matter. The term polycyclic organic matter (POM) defines a broad class of compounds that includes the polycyclic aromatic hydrocarbon compounds (PAHs), of which benzo[a]pyrene is a member. POM compounds are formed primarily from combustion and are present in the atmosphere in particulate form. Sources of air emissions are diverse and include cigarette smoke, vehicle exhaust, home heating, laying tar, and grilling meat. Cancer is the major concern from exposure to POM. Epidemiologic studies have reported an increase in lung cancer in humans exposed to coke oven emissions, roofing tar emissions, and cigarette smoke; all of these mixtures contain POM compounds. Animal studies have reported respiratory tract tumors from inhalation exposure to benzo[a]pyrene and forestomach tumors, leukemia, and lung tumors from oral exposure to benzo[a]pyrene. The USEPA has classified seven PAHs (benzo[*a*]pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as Group B2, probable human carcinogens.

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. These emissions occur from natural processes as well as human activities. The accumulation of GHGs in the atmosphere regulates the earth's temperature. Scientific evidence indicates a trend of increasing global temperature over the past century, which a number of scientists attribute to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

Recent observed changes due to global warming include shrinking glaciers, thawing permafrost, a lengthened growing season, and shifts in plant and animal ranges (Intergovernmental Panel on Climate Change 2007). Generally accepted predictions of long-term environmental impacts due to global warming include sea level rise, changing weather patterns with increases in the severity of storms and droughts, changes to local and regional ecosystems including the potential loss of species, and a significant reduction in winter snow pack.

The most common GHGs emitted from natural processes and human activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Examples of GHGs created and emitted primarily through human activities include fluorinated gases (hydrofluorocarbons and perfluorocarbons) and sulfur hexafluoride. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. For example, CH_4 has a global warming potential of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis. Total GHG emissions from a source are often reported as a CO_2 equivalent (CO_2e). The CO_2e is calculated by multiplying the emission of each GHG by its global warming potential and adding the results together to produce a single, combined emission rate representing all GHGs. On a national scale, federal agencies are addressing emissions of GHGs by reductions mandated in federal laws and Executive Orders, most recently, Executive Order 13423 Strengthening Federal Environmental, Energy, and Transportation Management (January 24, 2007) was enacted. Several states have promulgated laws as a means to reduce statewide levels of GHG emissions. In particular, the California

Global Warming Solutions Act of 2006 directs the State of California to reduce statewide GHG emissions to 1990 levels by the year 2020.

The potential effects of proposed GHG emissions are by nature global, and have cumulative impacts. As individual sources, GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, the impact of proposed GHG emissions to climate change is discussed in the context of cumulative impacts.

Air quality in the air basin for the Project area is regulated by federal, state, and local regulatory agencies with the responsibility for maintaining ambient air quality within federal and state standards. The USEPA is the federal agency responsible for establishing air quality regulations on a federal level. The Federal Clean Air Act (CAA) and its subsequent amendments establish air quality regulations and the NAAQS and delegate the enforcement of these standards to the states. In California, the California Air Resources Board (ARB) is responsible for enforcing air pollution regulations. The ARB has in turn delegated the responsibility of regulating stationary emission sources to regional air agencies. In the air basin of the Project area, which is located in eastern Riverside County, the Mojave Desert Air Quality Management District (MDAQMD) has this responsibility.

The following sections summarize the air quality rules and regulations that apply to the Blythe Mesa Solar Project.

2.1 Federal Regulations

The Federal CAA applies to all air emission sources and to all areas within the United States. Regulations adopted under the CAA that would apply to the Blythe Mesa Solar Project would include the NAAQS, as well as other requirements that have been adopted as part of the MDAQMD's federally approved plans and programs.

As indicated in Federal Register Volume 75, No. 11, Page 2938, the USEPA is considering lowering the 8-hour O_3 standard from 0.075 ppm, which is its current level, to a lower level

within the range of 0.060 and 0.070 ppm. The lower level is proposed to provide increased protection for children and other "at risk" populations against O_3 health effects.

Recent actions by the USEPA have allowed for the regulation of greenhouse gases (GHGs). On April 17, 2009, USEPA issued its proposed endangerment finding for GHG emissions. On December 7, 2009, the USEPA Administrator signed and finalized two distinct findings regarding greenhouse gases under section 202(a) of the Clean Air Act:

> **Endangerment Finding:** The Administrator finds that the current and projected concentrations of the six key well-mixed greenhouse gases--carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)--in the atmosphere threaten the public health and welfare of current and future generations.
>
> **Cause or Contribute Finding:** The Administrator finds that the combined emissions of these well-mixed greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution which threatens public health and welfare.

These findings do not themselves impose any requirements on industry or other entities. However, this action was a prerequisite to finalizing the USEPA's proposed greenhouse gas emission standards for light-duty vehicles, which were jointly proposed by USEPA and the Department of Transportation's National Highway Safety Administration on September 15, 2009 and adopted on April 1, 2010. As finalized in April 2010, the emissions standards rule for vehicles will improve average fuel economy standards to 35.5 miles per gallon by 2016. In addition, the rule will require model year 2016 vehicles to meet an estimated combined average emission level of 250 grams of carbon dioxide per mile.

On March 10, 2009, in response to the FY2008 Consolidated Appropriations Act (H.R. 2764; Public Law 110–161), the USEPA proposed a rule that requires mandatory reporting of greenhouse gas (GHG) emissions from large sources in the United States. On September 22, 2009, the Final Mandatory Reporting of Greenhouse Gases Rule was signed, and was published in the Federal Register on October 30, 2009. The rule became effective on December 29, 2009.

The rule will collect accurate and comprehensive emissions data to inform future policy decisions.

The USEPA is requiring suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions to submit annual reports to USEPA. The gases covered by the proposed rule are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), and other fluorinated gases, including nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFE).

2.2 State Regulations

The ARB has oversight over air quality in the state of California, and has established the California Clean Air Act (CCAA). The CCAA was signed into law in 1988 and, for the first time, clearly spelled out in statute California's air quality goals, planning mechanisms, regulatory strategies, and standards of progress. The CCAA provides the State with a comprehensive framework for air quality planning regulation. Prior to passage of the Act, federal law contained the only comprehensive planning framework. As part of its authority within the state of California, and as allowed under the Federal CAA, the ARB has established the California Ambient Air Quality Standards (CAAQS). The CAAQS are at least as stringent as the NAAQS. Both the NAAQS and CAAQS are shown in Table 1.

The ARB is responsible for the development of the State Implementation Plan (SIP), which provides a framework for attaining and maintaining the NAAQS within the state of California. In turn, development of individual inputs to the SIP is the responsibility of local air pollution control agencies. Regulation of individual stationary sources has been delegated to local air pollution control agencies.

The ARB is responsible for developing programs designed to reduce emissions from non-stationary sources, including motor vehicles and off-road equipment. The ARB and the California Office of Environmental Health Hazard Assessment (OEHHA) are also responsible for developing regulations governing TACs. TACs include air pollutants that can cause serious

illnesses or increased mortality, even in low concentrations. The ARB and OEHHA identify specific air pollutants as TACs, develop health thresholds for exposure to TACs, and develop guidelines for conducting health risk assessments for sources of TAC emissions.

The state of California enacted some of the first legislation in the United States to regulate GHGs. The following subsections describe regulations and standards that have been adopted by the state of California to address GHG emissions.

Assembly Bill 32, the California Global Warming Solutions Act of 2006. In September 2006, Governor Schwarzenegger signed AB 32 into law. AB 32 directs the ARB to do the following:

- Make publicly available a list of discrete early action GHG emission reduction measures that can be implemented prior to the adoption of the statewide GHG limit and the measures required to achieve compliance with the statewide limit.
- Make publicly available a GHG inventory for the year 1990 and determine target levels for 2020.
- On or before January 1, 2010, adopt regulations to implement the early action GHG emission reduction measures.
- On or before January 1, 2011, adopt quantifiable, verifiable, and enforceable emission reduction measures by regulation that will achieve the statewide GHG emissions limit by 2020, to become operative on January 1, 2012, at the latest. The emission reduction measures may include direct emission reduction measures, alternative compliance mechanisms, and potential monetary and non-monetary incentives that reduce GHG emissions from any sources or categories of sources that ARB finds necessary to achieve the statewide GHG emissions limit.
- Monitor compliance with and enforce any emission reduction measure adopted pursuant to AB 32.

AB 32 required that, by January 1, 2008, the ARB determine what the statewide GHG emissions level was in 1990, and approve a statewide GHG emissions limit that is equivalent to that level, to be achieved by 2020. The ARB adopted its Scoping Plan in December 2008, which provided

estimates of the 1990 GHG emissions level and identified sectors for the reduction of GHG emissions. The ARB has estimated that the 1990 GHG emissions level was 427 MMT net CO_2e (ARB 2007b). The ARB estimates that a reduction of 173 MMT net CO_2e emissions below business-as-usual would be required by 2020 to meet the 1990 levels (ARB 2007b). This amounts to roughly a 30 percent reduction from projected business-as-usual levels in 2020 (ARB 2008a).

Senate Bill 97. Senate Bill (SB) 97, enacted in 2007, amends the CEQA statute to clearly establish that GHG emissions and the effects of GHG emissions are appropriate subjects for CEQA analysis. SB 97 directed the Governor's Office of Planning and Research (OPR) to develop draft CEQA guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions" by July 1, 2009, and directed the California Natural Resources Agency (CNRA) to certify and adopt the CEQA guidelines by January 1, 2010.

OPR published a technical advisory on CEQA and climate change on June 19, 2008. The guidance did not include a suggested threshold, but stated that the OPR had asked the ARB to "recommend a method for setting thresholds which will encourage consistency and uniformity in the CEQA analysis of greenhouse gas emissions throughout the state." The OPR technical advisory does recommend that CEQA analyses include the following components:

- Identification of greenhouse gas emissions;
- Determination of significance; and
- Mitigation of impacts, as needed and as feasible.

On December 31, 2009, the CNRA adopted the proposed amendments to the State CEQA Guidelines. These amendments became effective on March 18, 2010.

Executive Order S-3-05. Executive Order S-3-05, signed by Governor Schwarzenegger on June 1, 2005, calls for a reduction in GHG emissions to 1990 levels by 2020 and for an 80 percent reduction in GHG emissions below 1990 levels by 2050. Executive Order S-3-05 also calls for the California EPA (CalEPA) to prepare biennial science reports on the potential impact of continued GCC on certain sectors of the California economy. The first of these reports, "Our

Changing Climate: Assessing Risks to California", and its supporting document "Scenarios of Climate Change in California: An Overview" were published by the California Climate Change Center in 2006.

Executive Order S-21-09. Executive Order S-21-09 was enacted by the Governor on September 15, 2009. Executive Order S-21-09 requires that the ARB, under its AB 32 authority, adopt a regulation by July 31, 2010 that sets a 33 percent renewable energy target. Under Executive Order S-21-09, the ARB will work with the Public Utilities Commission and California Energy Commission to encourage the creation and use of renewable energy sources, and will regulate all California utilities. The ARB will also consult with the Independent System Operator and other load balancing authorities on the impacts on reliability, renewable integration requirements, and interactions with wholesale power markets in carrying out the provisions of the Executive Order. The order requires the ARB to establish highest priority for those resources that provide the greatest environmental benefits with the least environmental costs and impacts on public health.

California Code of Regulations Title 24. Although not originally intended to reduce greenhouse gas emissions, Title 24 of the California Code of Regulations, Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings, were first established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow for the consideration and possible incorporation of new energy efficiency technologies and methods. Energy efficient buildings require less electricity, natural gas, and other fuels. Electricity production from fossil fuels and on-site fuel combustion (typically for water heating) results in greenhouse gas emissions. Therefore, increased energy efficiency results in decreased greenhouse gas emissions.

The GHG emission inventory was based on Title 24 standards as of October 2005; however, Title 24 has been updated as of 2008 and standards are currently being phased in.

Senate Bill 1078, Senate Bill 107, and Executive Order S-14-08. SB 1078 initially set a target of 20% of energy to be sold from renewable sources by the year 2017. The schedule for

implementation of the RPS was accelerated in 2006 with the Governor's signing of SB 107, which accelerated the 20% RPS goal from 2017 to 2010. On November 17, 2008, the Governor signed Executive Order S-14-08, which requires all retail sellers of electricity to serve 33 percent of their load with renewable energy by 2020. The Governor signed Executive Order S-21-09 on September 15, 2009, which directs ARB to implement a regulation consistent with the 2020 33% renewable energy target by July 31, 2010.

State Standards Addressing Vehicular Emissions. California Assembly Bill 1493 (Pavley) enacted on July 22, 2002, required the ARB to develop and adopt regulations that reduce greenhouse gases emitted by passenger vehicles and light duty trucks. Regulations adopted by ARB would apply to 2009 and later model year vehicles. ARB estimated that the regulation would reduce climate change emissions from light duty passenger vehicle fleet by an estimated 18% in 2020 and by 27% in 2030 (AEP 2007). Overall within the state of California, implementation of the Pavley standards are anticipated to reduce GHG emissions by 17.23% (ARB 2011).

The ARB has adopted amendments to the Pavley regulations that reduce GHG emissions in new passenger vehicles from 2009 through 2016. The amendments, approved by the ARB Board on September 24, 2009, are part of California's commitment toward a nation-wide program to reduce new passenger vehicle GHGs from 2012 through 2016, and prepare California to harmonize its rules with the federal rules for passenger vehicles.

Executive Order S-01-07. Executive Order S-01-07 was enacted by the Governor on January 18, 2007, and mandates that: 1) a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020; and 2) a Low Carbon Fuel Standard ("LCFS") for transportation fuels be established for California. On April 23, 2009, the ARB adopted regulations to implement the LCFS.

Senate Bill 375. SB 375 finds that GHG from autos and light trucks can be substantially reduced by new vehicle technology, but even so "it will be necessary to achieve significant additional greenhouse gas reductions from changed land use patterns and improved

transportation. Without improved land use and transportation policy, California will not be able to achieve the goals of AB 32." Therefore, SB 375 requires that regions with metropolitan planning organizations adopt sustainable communities strategies, as part of their regional transportation plans, which are designed to achieve certain goals for the reduction of GHG emissions from mobile sources.

SB 375 also includes CEQA streamlining provisions for "transit priority projects" that are consistent with an adopted sustainable communities strategy. As defined in SB 375, a "transit priority project" shall: (1) contain at least 50 percent residential use, based on total building square footage and, if the project contains between 26 and 50 percent nonresidential uses, a floor area ratio of not less than 0.75; (2) provide a maximum net density of at least 20 dwelling units per acre; and (3) be within 0.5 mile of a major transit stop or high quality transit corridor.

Table 1
National Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards	NATIONAL STANDARDS [a]	
			Primary [b,c]	Secondary [b,d]
Ozone (O_3)	8-hour	0.070 ppm (137 µg/m^3)	0.075 ppm (147 µg/m^3)	Same as primary
	1-hour	0.09 ppm (180 µg/m^3)	—	—
Carbon monoxide (CO)	8-hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	—
	1-hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	—
Nitrogen dioxide (NO_2)	Annual	0.030 ppm (56 µg/m^3)	0.053 ppm (100 µg/m^3)	Same as primary
	1-hour	0.18 ppm (338 µg/m^3)	0.100 ppm (188 µg/m^3)	—
Sulfur dioxide (SO_2)	24-hour	0.04 ppm (105 µg/m^3)	—	—
	3-hour	—	—	0.5 ppm (1,300 µg/m^3)
	1-hour	0.25 ppm (655 µg/m^3)	0.075 ppm (196 µg/m^3)	—
PM_{10}	Annual	20 µg/m^3	—	—
	24-hour	50 µg/m^3	150 µg/m^3	Same as primary
$PM_{2.5}$	Annual	12 µg/m^3	12.0 µg/m^3	
	24-hour	—	35 µg/m^3	
Lead	Rolling 3-month period	—	0.15 µg/m^3	Same as primary
	Calendar Quarter	—	1.5 µg/m^3	Same as primary
	30-day average	1.5 µg/m^3	—	—
Hydrogen Sulfide	1-hour	0.03 ppm (42 µg/m^3)	—	—

Notes:

(a) Standards other than the 1-hour ozone, 24-hour PM_{10}, 24-hour $PM_{2.5}$, and those based on annual averages are not to be exceeded more than once a year. The 8-hour ozone national standard has replaced the 1-hour ozone national standard.

(b) Concentrations are expressed first in units in which they were promulgated. Equivalent units given in parenthesis.

(c) Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than 3 years after that state's implementation plan is approved by the USEPA.

(d) Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

2.3 Local Regulations

As discussed above, the Blythe Mesa Solar Project is located in the jurisdiction of the MDAQMD. The MDAQMD is responsible for regulating stationary sources of air emissions in the air basin of the Project area. Stationary sources that have the potential to emit air pollutants into the ambient air are subject to the Rules and Regulations adopted by the MDAQMD. The following MDAQMD rules are applicable to the project.

Rule 401 – Visible Emissions. Rule 401 states that a person shall not discharge into the atmosphere, from any single source of emissions whatsoever, any air contaminant for a period or periods aggregating more than three minutes in any one hour which is:

(a) As dark or darker in shade as that designated as No. 1 on the Ringelmann Chart, as published by the U.S. Bureau of Mines, or
(b) Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in Subsection A [of the Rules].

Rule 402 - Nuisance. Rule 402 prohibits a person from discharging from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

Rule 403 – Fugitive Dust. Rule 403 requires control of fugitive dust emissions during activities such as construction that have the potential to generate dust. The provisions of Rule 403 include the following:

(a) A person shall not cause or allow the emissions of fugitive dust from any transport, handling, construction or storage activity so that the presence of such dust remains visible in the atmosphere beyond the property line of the emission source. (Does not apply to emissions emanating from unpaved roadways open to public travel or farm roads. This exclusion shall not apply to industrial or commercial facilities).
(b) A person shall take every reasonable precaution to minimize fugitive dust emissions from wrecking, excavation, grading, clearing of land and solid waste disposal operations.
(c) A person shall not cause or allow particulate matter to exceed 100 micrograms per cubic meter when determined as the difference between upwind and downwind samples collected on high volume samplers at the property line for a minimum of five hours.
(d) A person shall take every reasonable precaution to prevent visible particulate matter from being deposited upon public roadways as a direct result of their operations. Reasonable precautions shall include, but are not limited to, the removal of particulate matter from equipment prior to movement on paved streets or the prompt removal of any material from paved streets onto which such material has been deposited.

(e) Subsections (a) and (c) shall not be applicable when the wind speed instantaneously exceeds 40 kilometers (25 miles) per hour, or when the average wind speed is greater than 24 kilometers (15 miles) per hour. The average wind speed determination shall be on a 15 minute average at the nearest official air-monitoring station or by wind instrument located at the site being checked.
(f) The provisions of this rule shall not apply to agricultural operations.

Rule 404 – Particulate Matter Concentration. Rule 404 restricts emissions of particulate matter from any source based on the concentrations specified in Table 404(a).

Rule 405 – Solid Particulate Matter Weight. Rule 405 restricts emissions of particulate matter from any source based on the concentrations specified in Table 405(a).

Rule 406 – Specific Contaminants. Rule 406 restricts emissions of sulfur compounds to 500 ppmv or less, and restricts emissions of halogens, which are not generally emitted from construction projects.

Rule 407 – Liquid and Gaseous Air Contaminants. Rule 407 restricts emissions of carbon monoxide to 2000 ppm or less.

Rule 408 – Circumvention. Rule 408 restricts the building, erection, installation or use of any equipment, the use of which, without resulting in a reduction in the total release of air contaminants to the atmosphere, reduces or conceals an emission which would otherwise constitute a violation of Chapter 3 (commencing with Section 41700) of Part 4, of Division 26 of the Health and Safety Code or of the MDAQMD Rules.

Rule 409 – Combustion Contaminants. Rule 409 restricts discharge into the atmosphere from the burning of fuel, combustion contaminants exceeding 0.23 gram per cubic meter (0.1 grain per cubic foot) of gas calculated to 12 percent of carbon dioxide (CO2) at standard conditions averaged over a minimum of 25 consecutive minutes.

Rule 431 – Sulfur Content of Fuels. Rule 431 restricts the use of any gaseous fuel containing sulfur compounds in excess of 800 ppm calculated as hydrogen sulfide at standard conditions, or any liquid or solid fuel having a sulfur content in excess of 0.5 percent by weight.

Rule 442 – Usage of Solvents. Rule 442 restricts the emission of VOCs from any solvent material to 1,190 pounds per month, and requires proper storage and handling of VOC-containing solvents.

To date, the MDAQMD has not enacted regulations governing GHGs.

3.0 Environmental Setting

As discussed in Section 1.2, the Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. The site is located in proximity to rural

agricultural lands, undeveloped lands, uses associated with the Blythe Airport, power generation, local roads, and interstate highway and other non-sensitive uses.

Sensitive receptors are people who are considered to be more sensitive than others to air pollutants. The reasons for greater than average sensitivity include pre-existing health problems, proximity to emissions sources, or duration of exposure to air pollutants. Schools, hospitals, and convalescent homes are considered to be sensitive to poor air quality because children, elderly people, and the infirmed are more susceptible to respiratory distress and other air quality-related health problems than the general public. Residential areas are considered sensitive to poor air quality because people usually stay home for extended periods of time, with associated greater exposure to ambient air quality. Recreational uses may also be considered sensitive due to the greater exposure to ambient air quality conditions because vigorous exercise associated with recreation places a high demand on the human respiratory system.

Sensitive air quality receptors (e.g., local residences, schools, hospitals, churches, and recreational facilities) are located within one mile of the project site, including several residences. There are 369 residences within one mile of the project site, of which eight individual residences are located within 1,000 feet of the site. The closest residence is located approximately 260 feet away. In addition, the project is approximately 0.4 miles (2,200 feet) from the Mesa Verde Park and approximately 0.8 miles (4,400 feet) from the Roy Wilson Community and Child Center. No schools, hospitals, or convalescent homes are located within one mile of the proposed project.

Areas that do not meet the NAAQS or CAAQS for a given criteria pollutant are designated as "nonattainment areas" by the USEPA and/or the ARB. Further classifications are given to nonattainment areas to identify the severity and number of violations experienced, and the year in which attainment is anticipated based on implementation of attainment plans. The Project area is located in a portion of the air basin considered an unclassified/attainment area for all of the NAAQS. The air basin of the Project area is considered a moderate nonattainment area for the CAAQS for O_3 and a nonattainment area for the CAAQS for PM_{10}. The air basin of the Project area is considered unclassified/attainment for all CAAQS for the other criteria pollutants.

3.1 Regional Climate

The project area is located in eastern California in the Colorado Desert. The Colorado Desert ranges in elevation from 2,000 feet above sea level to 5,000 feet above sea level. The climate in the Blythe area is categorized as a high desert climate, with dry, hot summers and cool winters. The region is characterized by extreme fluctuations of daily temperatures, strong seasonal winds, and clear skies. January is the coldest month, with a mean low temperature of 37.4°F. July is the hottest month, with a mean high temperature of 108.4°F.

In late winter and early spring the wind is a prominent feature, with dry winds blowing in the afternoon and evening. Winds in excess of 25 mph, with gusts of 75 mph or more are not uncommon. Although it is windy during all months, November, December and January are the calmest. The humidity is below 40% most of the year. During most winter nights, and during and after summer rains the humidity can get above 50%.

The Colorado Desert lies in the rainshadow of the Coast Ranges and receives an average annual precipitation of 5 inches. Most of the precipitation occurs between November and April. There is, however, a summer thunderstorm season from July to September with violent and heavy rainstorms possible.

Data from the Western Regional Climate Center (WRCC 2010) indicate that temperature and precipitation data were measured at Blythe from January 1913 through the present. The mean temperature for the Blythe station is 71.6°F, and the mean annual precipitation is 3.80 inches. Monthly average temperatures and precipitation for the area are summarized in Table 2.

Table 2 Monthly Average Temperatures and Precipitation Blythe Meteorological Station				
Month	**Monthly Average Temperatures, °F**			**Precipitation, inches**
	Maximum	**Minimum**	**Mean**	**Mean**
January	67.6	37.4	52.5	0.51
February	73.0	41.8	57.4	0.46
March	79.4	46.5	57.4	0.34
April	87.4	52.7	70.0	0.12
May	95.5	59.9	77.7	0.03
June	104.2	67.4	85.8	0.05
July	108.4	76.1	92.3	0.19
August	106.8	75.4	91.1	0.61
September	101.8	67.3	84.6	0.39
October	90.5	54.8	72.6	0.27
November	76.7	43.4	60.0	0.27
December	67.7	37.6	52.7	0.57
Annual	75.8	49.9	62.9	3.80

Source: www.wrcc.dri.edu

Figure 3 presents a wind rose from Blythe Airport showing the prevailing winds in the Project area.

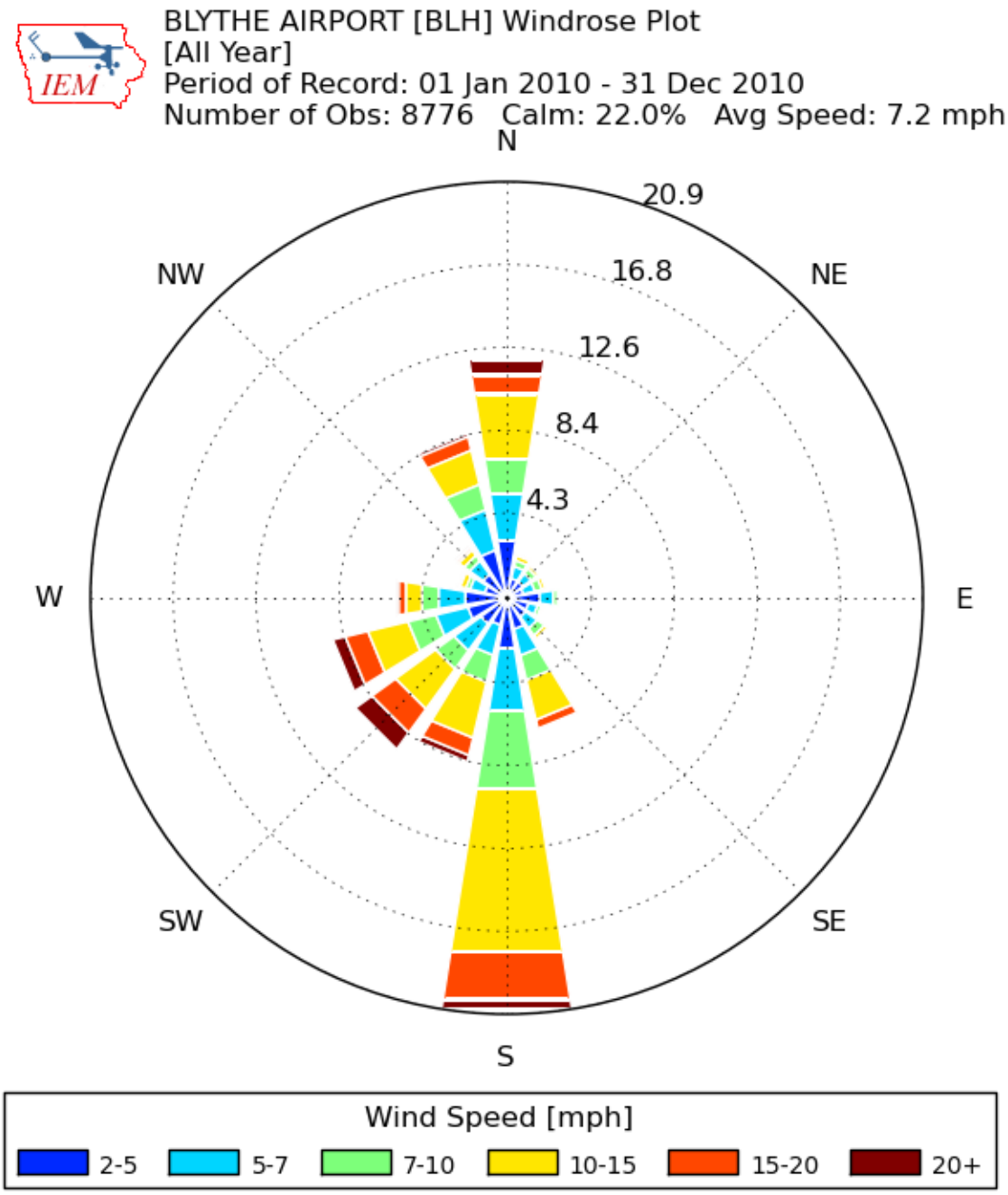


Figure 3. Blythe Wind Rose

3.2 Existing Air Quality

The ARB and the MDAQMD operate a series of ambient air quality monitoring stations throughout the southern California. The closest monitoring site to the Blythe Mesa Solar Project is located at 445 West Murphy Street in Blythe. The Blythe monitoring station measures O_3. The nearest monitoring station that measures $PM_{2.5}$ is located in Victorville; measurements in Victorville are not likely to be representative of conditions in the Project area. The nearest monitoring station that measures CO, NO_2, and PM_{10} is located at Barstow, which may also be substantially different from conditions in Blythe. Data from this station are shown below for informational purposes. Table 3 provides a summary of background air quality representative of the Project region.

Table 3
Representative Air Quality Data for the Blythe Mesa Solar Project Area (2006-2011)

Air Quality Indicator	2006	2007	2008	2009	2010	2011
Ozone (O_3) [1,3]						
Peak 1-hour value (ppm)	0.073	0.092	0.074	0.072	0.072	0.066
Days above state standard (0.09 ppm)	0	0	0	0	0	0
Peak 8-hour value (ppm)	0.059	0.075	0.071	0.066	0.067	0.061
Days above state standard (0.070 ppm)	0	1	1	0	0	0
Days above federal standard (0.075 ppm) [1,2]	0	0	0	0	0	0
Particulate matter less than or equal to 10 microns in diameter (PM_{10}) [4]						
Peak 24-hour value ($\mu g/m^3$)	80	202	93	76	38	108
Days above state standard (50 $\mu g/m^3$)	2	5	2	2	0	2
Days above federal standard (150 $\mu g/m^3$)	0	1	0	0	0	0
Annual Arithmetic Mean (ppm)	21.9	29.8	26.1	26.8	18.8	21.5
Carbon Monoxide [4]						
Peak 8-hour value ($\mu g/m^3$)	1.19	0.70	1.23	0.89	0.89	1.35
Days above federal standard (9 ppm)	0	0	0	0	0	0
Peak 8-hour value ($\mu g/m^3$)	3.5	1.4	1.4	1.2	1.1	4.3
Days above state standard (20 ppm)	0	0	0	0	0	0
Days above federal standard (35 ppm)	0	0	0	0	0	0
Nitrogen Dioxide (NO_2) [4]						
Peak 1-hour value (ppm)	0.082	0.073	0.081	0.060	0.062	0.077
Days above state standard (0.18 ppm)	0	0	0	0	0	0
Annual Arithmetic Mean (ppm)	0.022	0.020	0.019	0.016	0.017	0.017

Notes: [1] The federal O_3 standard was revised downward in 2008 to 0.075 ppm.
[2] The federal eight-hour ozone standard was previously defined as 0.08 ppm (1 significant digit). Measurements were rounded up or down to determine compliance with the standard; therefore a measurement of 0.084 ppm is rounded to 0.08 ppm. The 8-hour ozone ambient air quality standards are met at an ambient air quality monitoring site when the average of the annual fourth-highest daily maximum 8-hour average ozone concentration is less than or equal to the standard.
[3] Data from the Blythe monitoring station. Data for 1-hour CO concentrations unavailable.
[4] Data from the Barstow monitoring station.

ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter; * = not available
Source: http://www.arb.ca.gov/adam/php_files/aqdphp/topfourdisplay.php

4.0 Impact Assessment

4.1 Significance Thresholds

The CEQA thresholds of significance for air quality are derived from Appendix G of the state CEQA guidelines. These thresholds indicate that a project could have potentially significant impacts if it could:

a. Conflict with or obstruct implementation of the applicable air quality plan
b. Violate any air quality standard or contribute substantially to an existing or projected air quality violation
c. Result in cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including release emissions which exceed quantitative thresholds for ozone precursors);
d. Expose sensitive receptors to substantial pollutant concentrations; or
e. Create objectionable odors affecting a substantial number of people.

The MDAQMD has adopted CEQA Guidelines (MDAQMD 2009) based on the State CEQA Guidelines that indicate that a project would have a significant impact on air quality if it will:

1. Generates total emissions (direct and indirect) in excess of the thresholds given in Table 4 below; and/or,
2. Generates a violation of any ambient air quality standard when added to the local background; and/or,
3. Does not conform with the applicable attainment or maintenance plan(s); and/or,
4. Exposes sensitive receptors to substantial pollutant concentrations, including those resulting in a cancer risk greater than or equal to 10 in a million and/or a Hazard Index (HI) (non-cancerous) greater than or equal to 1.

As defined in the MDAQMD's CEQA Guidelines, sensitive receptors include residences, schools, daycare centers, playgrounds and medical facilities are considered sensitive receptor land uses. The following project types proposed for sites within the specified distance to an existing or planned (zoned) sensitive receptor land use must be evaluated using significance threshold criterion number 4:

- Any industrial project within 1000 feet;
- A distribution center (40 or more trucks per day) within 1000 feet;
- A major transportation project (50,000 or more vehicles per day) within 1000 feet;
- A dry cleaner using perchloroethylene within 500 feet;
- A gasoline dispensing facility within 300 feet.

Table 4 presents the quantitative thresholds by which a project's emissions are evaluated under significance threshold criterion number 1. The air quality impacts associated with the project were evaluated for significance based on these significance criteria.

Table 4
MDAQMD Significant Emission Thresholds

Criteria Pollutant	Annual Threshold (tons)	Daily Threshold (pounds)
Carbon Monoxide (CO)	100	548
Oxides of Nitrogen (NOx)	25	137
Volatile Organic Compounds (VOCs)	25	137
Oxides of Sulfur (SOx)	25	137
Particulate Matter (PM_{10})	15	82
Particulate Matter ($PM_{2.5}$)	15	82
Hydrogen Sulfide (H_2S)	10	54
Lead (Pb)	0.6	3

In addition to air quality impacts, this analysis addresses impacts associated with greenhouse gas emissions. The effects of project-specific greenhouse gas (GHG) emissions are cumulative, and therefore global climate change impacts are addressed as a cumulative, rather than a direct, impact. The guidance for determining significance of impacts has been developed from the requirements of AB 32. The guideline addresses the potential cumulative impacts that a project's GHG emissions could have on global climate change. Based on Appendix G of the CEQA Guidelines, the following criteria are used to evaluate whether a project would result in a significant impact for global climate change impacts:

Would the project:

- Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

As discussed in Section 15064.4 of the CEQA Regulations, the determination of the significance of greenhouse gas emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064. A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the amount of greenhouse gas emissions resulting from a project. A lead agency shall have discretion to determine, in the context of a particular project, whether to:

(1) Use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use. The lead agency has discretion to select the model or methodology it considers most appropriate provided it supports its decision with substantial evidence. The lead agency should explain the limitations of the particular model or methodology selected for use; and/or

(2) Rely on a qualitative analysis or performance based standards.

A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment:

(1) The extent to which the project may increase or reduce greenhouse gas emissions as compared to the existing environmental setting;

(2) Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.

(3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions. Such requirements must be adopted by the relevant public agency through a public review process and must reduce or mitigate the project's incremental contribution of greenhouse gas emissions. If there is substantial evidence that the possible effects of a particular project are

still cumulatively considerable notwithstanding compliance with the adopted regulations or requirements, an EIR must be prepared for the project.

Different agencies and studies estimate different goals for reduction of emissions to achieve 1990 levels by the year 2020, as set forth in AB 32. CAPCOA has suggested a screening-level significance threshold of 900 metric tons of CO_2-equivalent (CO_2e) emissions annually (CAPCOA 2008).

Impacts from GHG emissions were therefore evaluated based on a significance threshold of 900 metric tons of CO_2e as a screening threshold.

4.2 Impacts – Alternative 1

4.2.1 Construction Impacts – Alternative 1

Site Preparation

Since most of the site has nearly level to gently sloping topography, no mass grading would be required. Some of the parcels where facilities and arrays are located would require light grubbing for leveling and trenching. Access roads would require minimal grading. After grubbing and light grading, construction of staging areas would occur. On-site pre-assembly of trackers would take place in the assembly area.

The PV system proposed for the site can operate on slopes up to nine percent in all directions. Fine grading would only be required for the development of site access roads or to reduce extreme elevation areas. In order to aim for balanced cut-and-fill quantities, grading activities may include placement and compaction of excess materials in low-elevation areas of the site.

Minor demolition of existing site structures (e.g., storage buildings in citrus grove) is required.

Installation of the electrical collection system would require excavations to a depth of about three feet for underground electrical circuits, inverter and switchgear enclosure foundations, and

transformer foundation. The O&M building foundation would also be excavated to a depth of about three feet.

Construction Activities

The Project would be constructed in the following phases, which will occur simultaneously on different portions of the site:

- Development of staging areas and assembly areas, and grading of site access roads.
- Construction of arrays including the pile installation, the assembly of trackers, the mounting of PV panels, and trenching and installation of electrical equipment for arrays.
- Construction of electrical transmission facilities including the construction of three substation, double-circuit transmission line, and two O&M buildings.

Staging Areas, Assembly Areas, and Access Roads

Construction staging and material lay-down would be distributed across the project site evenly to allow for efficient distribution of components to different parts of the project. One staging and material lay-down area is typically set up for every 100 acres of a project site. These lay-down areas would be fenced and cover approximately five acres each. Lay-down areas would be temporary and would be converted to solar arrays as work is completed in the general area. Within the solar field, 12 foot wide access road would also be constructed approximately every 200 to 400 feet to allow access and maintenance of the solar panels.

Array Assembly

Tracker assembly may include up to 25 small gas-powered generators to power welding machines to assemble trackers and construct tracker arrays. Support piles up would be driven into the ground to a depth of eight to twelve feet using a vibration technology to reduce noise impacts. Torque tubes, electrical wire trays, and panels would then be installed on the piles. Concrete foundations for the drive motors would be poured in place, and electrical equipment for the array would be set in place. A tracked backhoe would drive piles. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would

place trackers on support tiles. Tracker installation would include small all-terrain vehicles to transport materials and workers on access roads and array aisles.

Substations

Construction of the substations would involve site preparation, clearing of the switchyard site, and installation of substructures and electrical equipment. The site would be initially cleared, graded, and security fenced for the duration of substation construction. Underground Service Alert would be contacted to mark the locations of existing buried utilities in the vicinity. Substation materials and equipment would be delivered to, and stored at, the substation site, as required, during construction. The site would be graded to maintain current drainage patters as much as possible.

The substation would be constructed with conventional grading and construction equipment. Grading would establish the desired site grade, and minor excavation would provide concrete footings for the substation equipment. The substation site would be graveled with crushed rock for grounding and employee safety purposes.

O&M Buildings

The O&M building area would be surveyed and staked. A concrete slab would be poured to the dimensions of the building. The prefabricated steel building structure would then be assembled. The exterior finished would be constructed as the mechanical and electrical systems are built inside. Interior finishing would follow, and final fixtures and equipment would be installed.

Transmission Line

The transmission line construction will involve the following activities: (1) construction of staging areas for trailers, office personnel, equipment, material staging, lay-down and employee parking; (2) construction of access roads to the structure locations; (3) pole erection; (4) conductor installation; (5) tension and pulling sites of conductors; and (6) installation of overhead ground/fiber optic communications system.

Construction Sequence, Equipment, and Workforce

Construction is anticipated to occur over a three-year period with the construction phases (described above) occurring simultaneously. The solar field would be developed in six-month phases, with six blocks constructed at a time (each block 100 acres or a total of 600 acres at a time). As the arrays are being assembled, construction of the substations, transmission line, switchyard, and O&M buildings would also occur simultaneously. The timing and workforce used for each construction activity/phase is illustrated in Table 3. After the common facilities (e.g., substations, switchyards, O&M buildings) are completed in the earlier stages, the workforce would be devoted more to array construction in the later stages.

Approximately 300-500 daily workers would be present on site during construction. Workers would gain primary access to the site using Seeley Avenue and Riverside Drive off of Neighbors Blvd. Worker construction traffic would consist of up to 400daily vehicle roundtrips. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region. Anticipated average daily material deliveries would consist of 20 truck deliveries per day for 24 months. Workers and delivery trucks will access site using the Neighbors Blvd. off ramp off Highway 10. On-site work hours would be from 7:00 a.m. to 7:00 p.m. During the installation period, construction workers are projected to be onsite five days per week, year round. Due to weather or other major type delays, times may shift to start as early as 5:00 a.m. and end as late as 8:00 p.m., as well as continue into the weekends. Security will be onsite 24 hours per day.

Table 5
Construction Phasing and Workforce Estimates

CONSTRUCTION ACTIVITY/PHASE*	DURATION	WORKERS
Site Preparation/Clearing/Grading	6 months	20
Staging & Assembly Areas (including access roads)	6 months	20
Construction of Solar Array, Substations, O&M Buildings	24 months	200-400
Installation of 230 kV Transmission Line & Fiber Optic Cable	12 months	30
Testing	3 months	20
Clean up/restoration	1 month	20

*Construction would occur over a three-year period with construction activities staggered.

During construction, a variety of equipment and vehicles would be operating on the site. Table 6 provides a list of the type and number of equipment and vehicles expected to construct each construction phase.

Table 6
Construction Equipment by Construction Phase

	CONSTRUCTION PHASES					
EQUIPMENT	**Site Preparation**	**Construction of Solar Array**	**Installation of Transmission Line Poles**	**Fiber Optic Cable**	**Substation & O&M Building**	**Clean up & Restoration**
Backhoe		X	X		X	
Cranes		X	X	X	X	
Vibratory Post Divers		X				
Fork Lifts	X	X	X	X	X	
Dozers	X				X	
Excavator	X				X	
Grader	X				X	X
Loaders, Rubber Tired	X	X	X	X		
Rollers	X				X	
Scrapers	X					
Trenchers		X				
Dump Truck	X	X				
Water Truck	X	X			X	
Concrete Truck	X	X	X			
Flatbed Truck		X	X	X	X	
Light-weight Truck	X	X	X	X	X	
ATV Gator Carts	X	X			X	

The assumptions used to calculate construction emissions are as follows:

- Heavy construction equipment would be similar to other similar projects for site preparation, installation of the solar array, construction of the transmission line, and construction of the substation and O&M buildings.
- It was assumed that watering three times daily would control emissions of PM_{10} and $PM_{2.5}$ by 75 percent (based on the Midwest Research Institute's evaluation of fugitive

dust control measures, considering the application of water and dust suppressants on unpaved surfaces, control of stockpiles using water, use of enclosures and minimum freeboard on trucks, and limiting vehicles speeds on unpaved roadways).

- For the purpose of estimating maximum daily traffic, it was assumed that the maximum number of employees (500) could arrive in a single day. For conservative purposes,it was assumed that carpooling would reduce the total number of daily round trips to 400. It was also assumed that 20 truck trips could occur in a single day.
- Workers and trucks would travel, on average, 40 miles round trip per day.

Emissions of ROG, SOx, and GHGs from heavy equipment used in construction of the Blythe Mesa Solar Project were estimated based on emission factors for the SCAB from the ARB's OFFROAD2007 Model (ARB 2007a), as published on the SCAQMD's website. Emissions of NOx, CO, and PM were calculated based on the assumption that the equipment used for construction would, at a minimum, meet USEPA Tier 2 emission standards. Emission factors for 2012 represent the average fleet emissions throughout the SCAB and were considered representative of construction equipment that would be used during construction of the project. Emissions from worker travel and truck traffic were calculated using the ARB's EMFAC2007 Model (ARB 2007b) for on-road vehicles. Emissions of fugitive dust were estimated based on SCAQMD and USEPA emission factors. Unmitigated construction emissions may have the potential to result in a temporary significant impact on the air quality. Under the MDAQMD Rules and Regulations, all projects must comply with Rule 403, which prohibits fugitive dust from construction activities that results in emissions that are visible in the atmosphere beyond the property line where construction is occurring. Through the implementation of Rule 403, fugitive dust control measures must be utilized to reduce emissions of particulate matter during construction, and emissions from construction would therefore not conflict with or obstruct implementation of the applicable air quality management plan, and will be mitigated to below a level of significance.

Solar Array, O&M Buildings, Substation, and Transmission Line. Construction of these portions of the project would occur on site. The project also includes construction of an 8.4-mile transmission line to connect with the grid. Emissions were estimated based on the construction

schedule and equipment requirements for the project provided by the project team. Table 7 presents a summary of the daily construction emissions for the construction of the solar array, O&M buildings, substation, and transmission line based on the above assumptions and assuming standard mitigation measures would be implemented, in comparison with the MDAQMD significance thresholds.

Table 7
Estimated Construction Emissions – Solar Arrays, O&M Buildings, Substation and Transmission Line
Blythe Mesa Solar Project

Emission Source	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
Maximum Daily Construction Emissions, lbs/day						
Offroad Equipment	35.35	99.36	63.31	12.81	4.61	4.10
On-Road Vehicles	19.10	33.84	207.51	0.02	4.04	4.00
Fugitive Dust	---	---	---	---	41.82	8.78
TOTAL	**54.45**	**133.20**	**270.82**	**12.83**	**50.47**	**16.88**
Significance Thresholds	137	137	548	137	82	82
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*
Annual Construction Emissions, tons/year						
Offroad Equipment	1.71	13.90	8.61	0.39	0.62	0.55
On-Road Vehicles	2.41	4.54	25.97	0.00	0.52	0.51
Fugitive Dust	---	---	---	---	5.02	0.96
TOTAL	**4.12**	**18.44**	**34.58**	**0.39**	**6.16**	**2.02**
Significance Thresholds	25	25	100	25	15	15
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*

As shown in Table 7, maximum daily emissions from construction of the solar array, O&M buildings, and substation would be below the significance thresholds for the maximum daily construction for all pollutants. Annual emissions would also be below the significance thresholds for all pollutants. Construction would therefore result in a less than significant impact on air quality.

Mitigation measures include fugitive dust control measures as required under MDAQMD Rule 403. Additional measures to reduce emissions during construction include the following:

Mitigation Measure AQ-1: Employ the following measures to reduce emissions from construction equipment and fugitive dust generating activities, as feasible.

- Require off-road construction equipment to meet or exceed Tier 3 standards with available CARB verified technologies, or
- Alternatively, require the use of alternative fueled off-road construction equipment, and
- Reroute construction trucks away from congested streets or sensitive receptor areas.
- Operating equipment in an idling mode shall be minimized not idle for more than five minutes. All equipment should be turned off when not in use, to the extent feasible.
- Minimize obstruction of through-traffic lanes. When feasible, construction should be planned so that lane closures on existing streets are kept to a minimum. If necessary, a flag person shall be retained to maintain the safety adjacent to existing roadways. Provide temporary traffic controls such as a flag person, during all phases of construction to maintain smooth traffic flow.
- Dedicated turn lanes and/or other roadway improvements shall be provided as appropriate at heavily congested roadways.
- Require the application of non-toxic soil stabilizers according to manufacturers' specifications to all inactive construction areas (previously graded areas inactive for ten days or more),
- Install wheel washers where vehicles enter and exit the construction site onto paved roads or wash off trucks and any equipment leaving the site,
- Require all trucks hauling dirt, sand, soil, or other loose materials to be covered,
- Suspend all excavating and grading operations when wind gusts (as instantaneous gusts) exceed 25 mph,
- Appoint a construction relations officer to act as a community liaison concerning on-site construction activity including resolution of issues related to PM_{10} generation,
- When sweeping streets to remove visible soil materials use certified street sweepers or roadway washing trucks, and
- Replace ground cover in disturbed areas as quickly as possible.
- Construct or build with materials that do not require painting, and
- Require the use of pre-painted construction materials.

These construction mitigation measures will reduce emissions from construction. Impacts will be less than significant.

4.2.2 Operational Emissions – Alternative 1

Operations and maintenance include general operational activities in support of the site, as well as periodic washing of the solar panels. After the construction phase, the O&M building would serve the Project's approximately 12 permanent full-time employees, which would include one plant manager, five engineers/technicians, and six security staff. Project facilities would be monitored during operating (daylight) hours, even though the Project facilities would be capable of automatic start up, shutdown, self-diagnosis, and fault detection. The panels may be cleaned up to two times per year, if necessary to optimize output. No heavy equipment would be used during normal operation. O&M vehicles would include trucks (pickup and flatbed), forklifts, and loaders for routine and unscheduled maintenance and water trucks for solar panel washing. Large heavy-haul transport equipment may be brought to the project site infrequently for equipment repair or replacement. Fugitive dust would be generated from vehicles and equipment on unpaved surfaces.

Operational emissions would be confined to inspection and maintenance activities, including washing of the solar panels. Emissions associated with operations are summarized in Table 8.

Table 8
Estimated Operational Emissions
Blythe Mesa Solar Project

Emission Source	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
Total Operational Emissions, lbs/day						
Offroad Equipment	10.99	37.59	19.95	1.32	1.15	1.02
On-Road Vehicles	3.25	9.48	36.90	0.00	0.38	0.38
Fugitive Dust	---	---	---	---	6.87	0.69
TOTAL	**14.24**	**47.07**	**56.84**	**1.32**	**8.40**	**2.09**
Significance Thresholds	137	137	548	137	82	82
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*
Total Operational Emissions, tons/year						
Offroad Equipment	0.97	2.83	1.50	0.12	0.09	0.08
On-Road Vehicles	0.06	0.09	0.72	0.00	0.01	0.01
Fugitive Dust	---	---	---	---	0.20	0.03
TOTAL	**1.03**	**2.92**	**2.22**	**0.12**	**0.30**	**0.12**
Significance Thresholds	25	25	100	25	15	15
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*

As shown in Table 8, operational emissions would be below the maximum daily and annual

significance thresholds within the MDAQMD. Impacts from operations would therefore be less than significant.

4.2.3 Toxic Air Contaminant Emissions – Alternative 1

Construction activities would result in emissions of diesel particulate matter from heavy construction equipment used on site and truck traffic to and from the site, as well as minor amounts of TAC emissions from motor vehicles (such as benzene, 1,3-butadiene, toluene, and xylenes). Health effects attributable to exposure to diesel particulate matter are long-term effects based on chronic (i.e., long-term) exposure to emissions. Health effects are generally evaluated based on a lifetime (70 years) of exposure. As discussed in Section 4.1, a project would result in a significant impact if it exposes sensitive receptors to substantial pollutant concentrations, including those resulting in a cancer risk greater than or equal to 10 in a million and/or a Hazard Index (HI) (non-cancerous) greater than or equal to 1.

The risk-driving TAC associated with construction activities at the Blythe Mesa project site is diesel particulate emitted from equipment and vehicles operating on site. Sources of diesel particulate matter at the site would include haul truck activities, heavy construction equipment, and contractor vehicles. Construction emissions were modeled using the SCREEN3 model to evaluate whether diesel particulate matter would result in a significant health risk to sensitive receptors in and adjacent to the Project area.

Based on the construction emissions analysis as shown in Table 7, the annual particulate emissions from offroad equipment operating on site would be 0.62 tons per year. The on-road diesel emissions would be 0.52 tons per year, which includes the 40-mile round trip distance traveling on roads to the site. For the purpose of providing a worst case analysis of the potential for TAC impacts to sensitive receptors, it was assumed that all of the on-road emissions could occur at the site.

The emissions were modeled using the SCREEN3 model as a volume source on the site, assuming the nearest off-site receptor would be located 100 meters from the site boundary.

Because SCREEN3 only provides maximum one-hour concentrations and excess cancer and chronic risks from diesel particulate matter are calculated on an annualized basis, the concentration predicted by the model was multiplied by the USEPA's recommended scaling factor of 0.08 to convert a 1-hour maximum concentration to an annual concentration.

The expected diesel construction emission concentrations from the SCREEN3 model are shown below in Table 9. Based upon the model results, the particulate matter concentrations are below the inhalation Chronic Risk Factor of 1.0 and the Cancer Risk Threshold of 10 in one million. There is no other substantial evidence in the record demonstrating that the Proposed Project would have a significant impact. Therefore, impacts for cancer risks from toxic air emissions during construction activities would be less than significant.

Table 9
Screening Health Risk Assessment Results

Diesel Particulate Matter Emissions (tons per year)	**1-hour Ground-Level Concentration, micrograms/cubic meter**	Annual **Ground-Level Concentration, micrograms/cubic meter**	**Calculated Cancer Risk (in a million)**	**Inhalation Chronic Risk Factor**	**Significant?**
1.14	0.4807	0.03846	0.549	0.00769	***No***

Notes:
1. SCREEN3 inputs were calculated by converting the diesel engine particulate matter emissions in tons per year for construction activities to grams per second per meters squared. The following conversion factors were utilized: 1 day = 86,400 seconds; 1 pound = 453.592 grams; 1 acre = 4,046.873 square meters
2. Pollutant concentrations based upon SCREEN3 modeling results.
3. The inhalation cancer risk was calculated based on the following equation:

Inhalation cancer risk = $((Cair*DBR*A*EF*ED*1x10^{-6})/AT)*$Inhalation Cancer Potency Factor)

Where

Cair = concentration in the air of DPM;
DBR = daily breathing rate (based on OEHHA guidance, assume 80th percentile breathing rate of 303 L/kg-day);
A = inhalation absorption factor (1);
EF = exposure frequency (365 days/year);
ED = duration of construction (3 years)
AT = average time period over which exposure is averaged (25,550 days);
Inhalation Cancer Potency Factor = 1.1 $(mg/kg\text{-}d)^{-1}$

4. The inhalation chronic risk was based upon the following equation:

Inhalation chronic risk = (Cair/Chronic Reference Exposure Level)

Where

Cair = concentration in the air of DPM;
Chronic Reference Exposure Level = Concentration level at which OEHHA has determined a significant chronic risk may result from inhalation exposure (5.0 $\mu g/m^3$)

4.2.4 Consistency with Ambient Air Quality Plans – Alternative 1

The MDAQMD's most recently adopted air quality management plan is its 2004 Ozone Attainment Plan (MDAQMD 2004). The MDAQMD has adopted the control measures recommended in the plan in its Rules and Regulations. The MDAQMD has also adopted fugitive dust control requirements in its Rule 403. Because the project will comply with the MDAQMD's Rules and Regulations, including those adopted from the SIP, the project will not conflict with the applicable Air Quality Plan.

4.2.5 Decommissioning Emissions – Alternative 1

At the end of the energy contract term, the facilities would be decommissioned and dismantled and the site restored. Decommissioning activities would require a workforce similar to that of construction. Activities for decommissioning of the Blythe Mesa Solar Project would include:

- Dismantling and removal of all above-ground equipment (solar panels, tracker units, transformers, substation, O&M building, etc.)
- Excavation and removal of all below-ground cabling
- Removal of posts
- Removal of primary roads (aggregate-based)
- Break-up and removal of concrete pads and foundations
- Scarification of compacted areas

Decommissioning of the 230-kV transmission line would be completed using traditional heavy construction equipment, such as front-end loaders, cranes, track-mounted and rubber-tired excavators, and motor graders. Dismantling would proceed in the following general stages: (1) dismantling and demolishing above-ground structures; (2) removing concrete foundations; (3) excavating and removing soiled and broken concrete from the site; and (4) surface contouring to return the disturbed area to its pre-Project state to the greatest extent feasible.

Table 10 presents an estimate of decommissioning emissions based on the assumption that the workforce and truck trips would be the same as construction emissions.

Table 10
Estimated Decommissioning Emissions
Blythe Mesa Solar Project

Emission Source	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
Maximum Daily Construction Emissions, lbs/day						
Heavy Construction Equipment	15.75	62.40	35.17	4.52	2.26	2.01
On-Road Vehicles	19.10	33.84	207.51	0.02	4.04	4.00
Fugitive Dust	---	---	---	---	41.82	8.78
TOTAL	**34.85**	**96.24**	**242.68**	**4.54**	**48.12**	**14.79**
Significance Thresholds	137	137	548	137	82	82
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*
Annual Construction Emissions, tons/year						
Heavy Construction Equipment	1.42	5.62	3.16	0.41	0.20	0.20
On-Road Vehicles	2.41	4.54	25.97	0.00	0.52	0.51
Construction Truck Trips					5.02	0.96
TOTAL	**3.83**	**10.16**	**29.13**	**0.41**	**5.74**	**1.67**
Significance Thresholds	25	25	100	25	15	15
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*

As shown in Table 10, emissions would be below the significance thresholds, and no significant impact would result from decommissioning activities.

4.3 Impacts – Alternative 2

As discussed in Section 1.0, Alternative 2 is the No Action/No Project Alternative. Under Alternative 2, the construction of a solar generating facility and associated infrastructure would not occur. Alternative 2 would therefore not generate air emissions associated with construction or operation and maintenance activities. Alternative 2 would therefore not result in any air quality impacts.

4.4 Impacts – Alternative 3

4.4.1 Construction Impacts – Alternative 3

Construction of Alternative 3 would be essentially identical to construction of Alternative 1, except for the total acreage that would be disturbed and the location of the 230 kV transmission line that extends outside of the solar array field to the Colorado River Substation. Alternative 3 would therefore require the same construction activities for construction of the solar array. Under Alternative 3, the total length of the transmission line both on-site and off-site would be 8.8 miles, and a total of 3,682 acres would be required for the solar array and associated infrastructure. As for Alternative 1, construction for Alternative 3 is anticipated to occur over a three-year period with the construction phases occurring simultaneously. Alternative 3 would require the same workforce and construction equipment as Alternative 1.

Emissions of ROG, SOx, and GHGs from heavy equipment used in construction of Alternative 3 were estimated based on the same assumptions as described under Alternative 1. Table 11 presents a summary of the daily construction emissions for the construction of the solar array, O&M buildings, substation, and transmission line based on the above assumptions and assuming standard mitigation measures would be implemented, in comparison with the MDAQMD significance thresholds.

Table 11
Estimated Construction Emissions – Solar Arrays, O&M Buildings, Substation and Transmission Line, Alternative 3
Blythe Mesa Solar Project

Emission Source	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
Maximum Daily Construction Emissions, lbs/day						
Heavy Construction Equipment	35.35	99.36	63.31	12.81	4.61	4.10
On-Road Vehicles	19.10	33.84	207.51	0.02	4.04	4.00
Fugitive Dust	---	---	---	---	42.07	8.83
TOTAL	**54.45**	**133.20**	**270.82**	**12.83**	**50.72**	**16.94**
Significance Thresholds	137	137	548	137	82	82
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*
Annual Construction Emissions, tons/year						
Heavy Construction Equipment	1.71	13.97	8.65	0.39	0.62	0.55
On-Road Vehicles	2.41	4.55	25.97	0.00	0.52	0.52
Construction Truck Trips					5.02	0.96
TOTAL	**4.12**	**18.52**	**34.62**	**0.39**	**6.17**	**2.03**
Significance Thresholds	25	25	100	25	15	15
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*

As shown in Table 11, maximum daily emissions from construction of the solar array, O&M buildings, and substation for Alternative 3 would be below the significance thresholds for the maximum daily construction for all pollutants. Annual emissions would also be below the significance thresholds for all pollutants. Construction would therefore result in a less than significant impact on air quality.

Mitigation measures adopted under Alternative 1 would also be adopted under Alternative 3.

4.4.2 Operational Emissions – Alternative 3

Operations and maintenance activities under Alternative 3 would be identical to activities under Alternative 1, and emissions would therefore be the same as for Alternative 1. Impacts would be less than significant.

4.4.3 Toxic Air Contaminant Emissions – Alternative 3

Construction activities under Alternative 3 would be similar to those under Alternative 1. Emissions are slightly higher under Alternative 3 due to the slightly longer length of the transmission line; however, as with Alternative 1, due to the short-term nature of construction at the site, no adverse health effects would be anticipated from short-term diesel particulate emissions. Motor vehicle emissions would not be concentrated in any one area but would be dispersed along travel routes and would not be anticipated to pose a significant health risk to receptors.

4.4.4 Consistency with Ambient Air Quality Plans – Alternative 3

As for Alternative 1, because Alternative 3 will comply with the MDAQMD's Rules and Regulations, including those adopted from the SIP, the project will not conflict with the applicable Air Quality Plan.

4.4.5 Decommissioning Emissions – Alternative 3

Decommissioning activities under Alternative 3 would be similar to those under Alternative 1. As discussed under Alternative 1, emissions would be below the significance thresholds, and no air quality impact would occur.

4.5 Impacts – Alternative 4

4.5.1 Construction Impacts – Alternative 4

Construction of Alternative 4 would be essentially identical to construction of Alternative 1, except for the total acreage that would be disturbed and the location of the 230 kV transmission line that extends outside of the solar array field to the Colorado River Substation. Alternative 3 would therefore require the same construction activities for construction of the solar array. Under Alternative 4, the total length of the transmission line both on-site and off-site would be 9.5 miles, and a total of 3,648 acres would be required for the solar array and associated infrastructure. As for Alternative 1, construction for Alternative 4 is anticipated to occur over a three-year period with the construction phases occurring simultaneously. Alternative 4 would require the same workforce and construction equipment as Alternative 1.

Emissions of ROG, SOx, and GHGs from heavy equipment used in construction of Alternative 4 were estimated based on the same assumptions as described under Alternative 1. Table 12 presents a summary of the daily construction emissions for the construction of the solar array, O&M buildings, substation, and transmission line based on the above assumptions and assuming standard mitigation measures would be implemented, in comparison with the MDAQMD significance thresholds.

Table 12
Estimated Construction Emissions – Solar Arrays, O&M Buildings, Substation and Transmission Line, Alternative 4
Blythe Mesa Solar Project

Emission Source	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
Maximum Daily Construction Emissions, lbs/day						
Heavy Construction	35.35	99.36	63.31	12.81	4.61	4.10

Table 12
Estimated Construction Emissions – Solar Arrays, O&M Buildings, Substation and Transmission Line, Alternative 4
Blythe Mesa Solar Project

Emission Source	ROG	NOx	CO	SOx	PM_{10}	$PM_{2.5}$
Maximum Daily Construction Emissions, lbs/day						
Equipment						
On-Road Vehicles	19.10	33.84	207.51	0.02	4.04	4.00
Fugitive Dust	---	---	---	---	41.68	8.75
TOTAL	**54.45**	**133.20**	**270.82**	**12.83**	**50.33**	**16.85**
Significance Thresholds	137	137	548	137	82	82
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*
Annual Construction Emissions, tons/year						
Heavy Construction Equipment	1.71	14.08	8.72	0.39	0.63	0.56
On-Road Vehicles	2.41	4.57	25.97	0.00	0.52	0.52
Construction Truck Trips					5.01	0.96
TOTAL	**4.12**	**18.65**	**34.70**	**0.39**	**6.16**	**2.03**
Significance Thresholds	25	25	100	25	15	15
Above Significance Thresholds?	*No*	*No*	*No*	*No*	*No*	*No*

As shown in Table 12, maximum daily emissions from construction of the solar array, O&M buildings, and substation for Alternative 4 would be below the significance thresholds for the maximum daily construction for all pollutants. Annual emissions would also be below the significance thresholds for all pollutants. Construction would therefore result in a less than significant impact on air quality.

Mitigation measures adopted under Alternative 1 would also be adopted under Alternative 4.

4.5.2 Operational Emissions – Alternative 4

Operations and maintenance activities under Alternative 4 would be identical to activities under Alternative 1, and emissions would therefore be the same as for Alternative 1. Impacts would be less than significant.

4.5.3 Toxic Air Contaminant Emissions – Alternative 4

Construction activities under Alternative 4 would be similar to those under Alternative 1. Emissions are slightly higher under Alternative 4 due to the slightly longer length of the transmission line; however, as with Alternative 1, due to the short-term nature of construction at the site, no adverse health effects would be anticipated from short-term diesel particulate emissions. Motor vehicle emissions would not be concentrated in any one area but would be dispersed along travel routes and would not be anticipated to pose a significant health risk to receptors.

4.5.4 Consistency with Ambient Air Quality Plans – Alternative 4

As for Alternative 1, because Alternative 4 will comply with the MDAQMD's Rules and Regulations, including those adopted from the SIP, the project will not conflict with the applicable Air Quality Plan.

4.5.5 Decommissioning Emissions – Alternative 4

Decommissioning activities under Alternative 4 would be similar to those under Alternative 1. As discussed under Alternative 1, emissions would be below the significance thresholds, and no air quality impact would occur.

5.0 Global Climate Change

Global Climate Change (GCC) refers to changes in average climatic conditions on Earth as a whole, including temperature, wind patterns, precipitation and storms. Global temperatures are moderated by naturally occurring atmospheric gases, including water vapor, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which are known as greenhouse gases (GHGs). These gases allow solar radiation (sunlight) into the Earth's atmosphere, but prevent radiative heat from escaping, thus warming the Earth's atmosphere. Gases that trap heat in the atmosphere are often called greenhouse gases, analogous to a greenhouse. GHGs are emitted by both natural processes and human activities. The accumulation of GHGs in the atmosphere regulates the Earth's temperature. Emissions from human activities, such as burning fossil fuels for electricity production and vehicle use, have elevated the concentration of these gases in the atmosphere.

The State of California has been at the forefront of developing solutions to address GCC. GCC refers to any significant change in measures of climate, such as average temperature, precipitation, or wind patterns over a period of time. GCC may result from natural factors, natural processes, and/or human activities that change the composition of the atmosphere and alter the surface and features of land.

The United Nations Intergovernmental Panel on Climate Change (IPCC) constructed several emission trajectories of GHGs needed to stabilize global temperatures and climate change impacts. The IPCC concluded that a stabilization of GHGs at 400 to 450 ppm CO_2 equivalent concentration is required to keep global mean warming below 3.6º Fahrenheit (2º Celsius), which is assumed to be necessary to avoid dangerous climate change (Association of Environmental Professionals 2007).

State law defines greenhouse gases as any of the following compounds: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) (California Health and Safety Code Section 38505(g).) CO_2, followed by CH_4 and N_2O, are the most common GHGs that result from human activity.

The State of California GHG Inventory performed by the California Air Resources Board (ARB), compiled statewide anthropogenic GHG emissions and sinks. It includes estimates for CO_2, CH_4, N_2O, SF_6, HFCs, and PFCs. The current inventory covers the years 1990 to 2009, and is summarized in Table 13. Data sources used to calculate this GHG inventory include California and federal agencies, international organizations, and industry associations. The calculation methodologies are consistent with guidance from the IPCC. The 1990 emissions level is the sum total of sources and sinks from all sectors and categories in the inventory. The inventory is divided into seven broad sectors and categories in the inventory. These sectors include: Agriculture; Commercial; Electricity Generation; Forestry; Industrial; Residential; and Transportation.

Table 13 State of California GHG Emissions by Sector				
Sector	**Total 1990 Emissions ($MMTCO_2e$)**	**Percent of Total 1990 Emissions**	**Total 2009 Emissions ($MMTCO_2e$)**	**Percent of Total 2009 Emissions**
Agriculture	23.4	5%	32.13	7%
Commercial	14.4	3%	13.41	3%
Electricity Generation	110.6	26%	103.68	23%
Forestry (excluding sinks)	0.2	<1%	0.19	<1%
Industrial	103.0	24%	81.38	18%
Residential	29.7	7%	28.61	6%
Transportation	150.7	35%	172.92	38%
Recycling and Waste			7.32	2%
High GWP Gases			16.32	4%
Forestry Sinks	(6.7)		(3.80)	

When accounting for GHGs, all types of GHG emissions are expressed in terms of CO_2 equivalents (CO_2e) and are typically quantified in metric tons (MT) or millions of metric tons (MMT).

GHGs have varying global warming potential (GWP). The GWP is the potential of a gas or aerosol to trap heat in the atmosphere; it is the "cumulative radiative forcing effect of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas" (USEPA 2006). The reference gas for GWP is CO_2; therefore, CO_2 has a GWP of 1. The other main greenhouse gases that have been attributed to human activity include CH_4, which has a GWP of 21, and N_2O, which has a GWP of 310. Table 14 presents the GWP and atmospheric lifetimes of common GHGs.

Table 14 Global Warming Potentials and Atmospheric Lifetimes of GHGs			
GHG	**Formula**	**100-Year Global Warming Potential**	**Atmospheric Lifetime (Years)**
Carbon Dioxide	CO_2	1	Variable
Methane	CH_4	21	12 ± 3
Nitrous Oxide	N_2O	310	120
Sulfur Hexafluoride	SF_6	23,900	3,200

Human-caused sources of CO_2 include combustion of fossil fuels (coal, oil, natural gas, gasoline and wood). Data from ice cores indicate that CO_2 concentrations remained steady prior to the current period for approximately 10,000 years. Concentrations of CO_2 have increased in the atmosphere since the industrial revolution.

CH_4 is the main component of natural gas and also arises naturally from anaerobic decay of organic matter. Human-caused sources of natural gas include landfills, fermentation of manure and cattle farming. Human-caused sources of N_2O include combustion of fossil fuels and industrial processes such as nylon production and production of nitric acid.

Other GHGs are present in trace amounts in the atmosphere and are generated from various industrial or other uses.

5.1 Potential Climate Change Impacts to Project

The Climate Scenarios Report (CCCC 2006), uses a range of emissions scenarios developed by the IPCC to project a series of potential warming ranges (i.e., temperature increases) that may occur in California during the 21st century. Three warming ranges were identified: Lower warming range (3.0 to 5.5 degrees Fahrenheit (ºF)); medium warming range (5.5 to 8.0 ºF); and higher warming range (8.0 to 10.5 ºF). The Climate Scenarios report then presents an analysis of the future projected climate changes in California under each warming range scenario.

According to the report, substantial temperature increases would result in a variety of impacts to the people, economy, and environment of California. These impacts would result from a

projected increase in extreme conditions, with the severity of the impacts depending upon actual future emissions of GHGs and associated warming. These impacts are described below.

Public Health. Higher temperatures are expected to increase the frequency, duration, and intensity of conditions conducive to air pollution formation. For example, days with weather conducive to O_3 formation are projected to increase by 25 to 35 percent under the lower warming range and 75 to 85 percent under the medium warming range. In addition, if global background O_3 levels increase as is predicted in some scenarios, it may become impossible to meet local air quality standards. An increase in wildfires could also occur, and the corresponding increase in the release of pollutants including $PM_{2.5}$ could further compromise air quality. The Climate Scenarios report indicates that large wildfires could become up to 55 percent more frequent of GHG emissions are not significantly reduced.

Potential health effects from global climate change may arise from temperature increases, climate-sensitive diseases, extreme events, and air quality. There may be direct temperature effects through increases in average temperature leading to more extreme heat waves and less extreme cold spells. Those living in warmer climates are likely to experience more stress and heat-related problems (e.g., heat rash and heat stroke). In addition, climate sensitive diseases (such as malaria, dengue fever, yellow fever, and encephalitis) may increase, such as those spread by mosquitoes and other disease-carrying insects.

Climate change could affect the project area in that it is located in the desert area of California, where warmer climates may lead to more of the problems identified above related to heat, should increases in average temperature in the project area occur.

Water Resources. A vast network of reservoirs and aqueducts capture and transport water throughout the State from northern California rivers and the Colorado River. The current distribution system relies on Sierra Nevada mountain snowpack to supply water during the dry spring and summer months. Rising temperatures, potentially compounded by decreases in precipitation, could severely reduce spring snowpack, increasing the risk of summer water shortages. In addition, if temperatures continue to rise more precipitation would fall as rain

instead of snow, further reducing the Sierra Nevada spring snowpack by as much as 70 to 90 percent. The State's water resources are also at risk from rising sea levels. An influx of seawater would degrade California's estuaries, wetlands, and groundwater aquifers.

This global climate change impact is not likely to have a direct effect on the operation of the project.

Agriculture. Increased GHG and associated increases in temperature are expected to cause widespread changes to the agricultural industry, reducing the quantity and quality of agricultural products statewide. Significant reductions in available water supply to support agriculture would also impact production. Crop growth and development will change as will the intensity and frequency of pests and diseases. This effect of global climate change would not be anticipated to affect the project site directly because there are no agricultural uses present.

Ecosystems/Habitats. Continued global warming will likely shift the ranges of existing invasive plants and weeds, thus alternating competition patterns with native plants. Range expansion is expected in many species while range contractions are less likely in rapidly evolving species with significant populations already established. Continued global warming is also likely to increase the populations of and types of pests. Continued global warming would also affect natural ecosystems and biological habitats throughout the State. This effect of global climate change could affect current ecosystems/habitats at the project site.

Wildland Fires. Global warming is expected to increase the risk of wildfire and alter the distribution and character of natural vegetation. If temperatures rise into the medium warming range, the risk of large wildfires in California could increase by as much as 55 percent, which is almost twice the increase expected if temperatures stay in the lower warming range. However, since wildfire risk is determined by a combination of factors including precipitation, winds, temperature, and landscape and vegetation conditions, future risks will not be uniform throughout the State. Should global climate change in the southern California region lead to increased risk of wildfires, this impact could directly affect the project site in that the potential for wildfire at the project location would increase.

Rising Sea Levels. Rising sea levels, more intense coastal storms, and warmer water temperatures will increasing threaten the State's coastal regions. Under the high warming scenario, sea level is anticipated to rise 22 to 35 inches by 2100. A sea level risk of this magnitude would inundate coastal areas with salt water, accelerate coastal erosion, threaten levees and inland water systems, and disrupt wetlands and natural habitats. Because the project site is located in the high desert area, it is not anticipated that rising sea levels would have a direct affect on the project.

5.2 Impacts

The effects of project-specific GHG emissions are cumulative, and therefore GCC impacts are addressed as a cumulative, rather than a direct, impact. The guidance for determining significance of impacts has been developed from the requirements of AB 32. The guideline addresses the potential cumulative impacts that a project's GHG emissions could have on GCC. Based on Appendix G of the CEQA Guidelines, the following criteria are used to evaluate whether a project would result in a significant impact for GCC impacts:

Would the project:

- Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

As discussed in Section 15064.4 of the CEQA Regulations, the determination of the significance of greenhouse gas emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064. A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the amount of greenhouse gas emissions resulting from a project. A lead agency shall have discretion to determine, in the context of a particular project, whether to:

(1) Use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use. The lead agency has discretion to select the model or methodology it considers most appropriate provided it supports its decision with substantial evidence. The lead agency should explain the limitations of the particular model or methodology selected for use; and/or

(2) Rely on a qualitative analysis or performance based standards.

A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment:

(1) The extent to which the project may increase or reduce greenhouse gas emissions as compared to the existing environmental setting;

(2) Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.

(3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions. Such requirements must be adopted by the relevant public agency through a public review process and must reduce or mitigate the project's incremental contribution of greenhouse gas emissions. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with the adopted regulations or requirements, an EIR must be prepared for the project.

Different agencies and studies estimate different goals for reduction of emissions to achieve 1990 levels by the year 2020, as set forth in AB 32. Some agencies have estimated a reduction of 28 percent to 29 percent, based on the ARB's analysis that statewide 2020 business as usual GHG emissions would be 596 $MMTCO_2e$, with 1990 emissions of 427 $MMTCO_2e$, for a reduction of 28.35% (ARB 2008).

Projects that meet the criteria for conducting a climate change analysis are required to conduct a GHG inventory and disclose GHG emissions associated with project implementation and

operation under "business as usual" conditions. "Business as usual" is defined as the emissions that would have occurred in the absence of reductions mandated under AB 32.

The main source of greenhouse gas emissions associated with the projects would be combustion of fossil fuels during construction of the project. Emissions of GHG were calculated using the same approach as emissions for overall construction emissions discussed in Section 4.1. Estimated emissions of construction greenhouse gases for Alternative 1 are summarized in Table 15. Emission calculations are provided in Appendix A.

Table 15
Construction Greenhouse Gas Emissions – Alternative 1

Emissions, metric tons/year	**CO_2**
Solar Array, O&M Building, Substation and Transmission Line	5,479
Total	**5,479**

Some lead agencies recommend amortization of GHG emissions associated with construction activities over a 30-year period to account for the project's contribution over the lifetime of the project (SCAQMD 2008, County of San Diego 2010). Amortization of the construction emissions for the Blythe Mesa Solar Project would result in a contribution of 183 metric tons of CO_2e emissions over the lifetime of the project.

GHG emissions associated with the construction of Alternative 3 would be similar to construction of Alternative 1, with a total of 5,480 metric tons of CO_2e annually. GHG emissions associated with the construction of Alternative 4 would be similar to construction of Alternative 1, with a total of 5,483 metric tons of CO_2e annually. Amortized over a 30-year period, the emissions from both of these alternatives would be the same as Alternative 1, at 183 metric tons of CO_2e emissions.

Emissions associated with construction would be temporary, likely to occur in only one three-year period. Emissions associated with operations are estimated to be 271 metric tons per year of CO_2e, which is below the CAPCOA recommended threshold of 900 metric tons per year of CO_2e. Operational impacts to global climate change would therefore be less than significant.

Adding the amortized construction emissions to the operational emissions would result in an estimate of 453 metric tons of CO_2e annually, which remains below the CAPCOA recommended threshold of 900 metric tons per year of CO_2e.

It should also be noted that the purpose of the project is to provide electricity generation from a renewable resource. The Blythe Mesa Solar Project would serve to meet the state's goals for the Renewable Portfolio Standard, which has been identified by the state as a means of meeting the goals of AB 32 to reduce emissions to 1990 levels by the year 2020.

The project is proposed to produce approximately 485 MW of electrical energy, which would be approximately 1,062,635,000 kilowatt hour (kWh) of electrical energy per year. In comparison, GHG emissions were estimated for a conventional fossil-fuel combustion power plant producing the same electrical energy (kWh) per year as the Project facility. Data from the U.S. Department of Energy, USEPA, and the Electric Power Research Institute provided GHG production rates per megawatt (MWh). GHG emissions from the most efficient combined cycle gas turbine power plant and a coal-fired power plant were calculated based on 0.35 and 1.0 metric tons of CO_2 equivalent (CO_2e) per MWh of electricity produced by gas turbine and coal-fired plants, respectively. Therefore, gas turbine and coal-fired plants are estimated to produce approximately 371,922 and 1,062,635 metric tons of CO_2e, respectively.

The net GHG displacement or off-set would therefore be the difference between the annual operational GHG emissions associated with the Blythe Mesa Solar Project and the emissions associated with operation of a conventional power plant. The project would result in a net GHG displacement through the replacement of fossil-fuel generated electricity with solar electricity of from 371,116 to 1,061,829 metric tons of CO_2e. Operation of the Blythe Mesa Solar Project would therefore result in a substantial net reduction (displacement) in GHG emissions in the region with the implementation of the Project's solar facility, when compared to a conventional fossil-fuel combustion power plant.

The Project's construction and operational emissions would therefore be offset by the Project's provision of renewable energy that would replace conventionally-generated electricity in the service area.

Because the project's construction GHG emissions are temporary, and the project's long-term operational GHG emissions are less than significant, and the project would result in a reduction in GHG emissions, the project is therefore consistent with the goals of AB 32 and impacts to global climate are less than significant.

6.0 Cumulative Impacts

In analyzing cumulative impacts from a proposed project, the analysis must specifically evaluate a project's contribution to the cumulative increase in pollutants for which the air basin for the Project area is listed as "non-attainment" for the federal or state AAQS. In the event direct impacts from a project are less than significant, a project may still have a cumulatively considerable impact on air quality if the emissions from the project, in combination with the emissions from other proposed, or reasonably foreseeable future projects are in excess of screening levels identified above, and the project's contribution accounts for more than an insignificant proportion of the cumulative total emissions.

As discussed in Section 2.0, the air basin for the Project area is considered an unclassified/attainment area for all of the NAAQS. The air basin for the Project area is considered a moderate nonattainment area for the CAAQS for O_3 and a nonattainment area for the CAAQS for PM_{10}. The air basin for the Project area is considered unclassified/attainment for all CAAQS for the other criteria pollutants.

While the region is nonattainment for the CAAQS for O_3 and PM_{10}, not all projects would result in a significant impact to air quality. Permitting agencies and lead agencies with jurisdiction over nonattainment areas, such as the USEPA and the MDAQMD, typically establish thresholds below which a project would have neither direct, nor cumulative impacts. The Blythe Mesa Solar Project's potential for air quality impacts are mainly attributable to construction activities.

Each air district in a nonattainment area is responsible for developing emissions inventory data as part of the planning process to develop its attainment plan. The emissions budget for the MDAQMD includes emissions associated with construction activity, including construction equipment, fugitive dust, and vehicles. The MDAQMD construction emissions budget for off-road construction equipment and vehicles includes 1.63 tons per day of ROG, 4.67 tons per day of NOx and 0.28 tons per day of PM_{10}. The MDAQMD fugitive dust emissions budget attributable to construction activities also includes 8.77 tons per day of PM_{10}. During construction, the Blythe Mesa Solar Project's estimated ROG emissions are less than 1 percent of the total emissions budget, NOx emissions are less than 1 percent of the total emissions budget, and PM_{10} emissions are less than 1 percent of the total emissions budget. Operational emissions of nonattainment pollutants are also a small percentage of the overall emissions budget for the air basin. The Blythe Mesa Solar Project's emissions are therefore not cumulatively considerable. Because the project would also provide renewable energy, the project would reduce emissions of both criteria pollutants and greenhouse gases, thus lessening the amount of pollution emitted overall.

7.0 Conclusions and Recommendations

In summary, the proposed project and Alternatives 3 and 4 would result in emissions of air pollutants for both the construction phase and operational phase of the project. The air quality impact analysis evaluated the potential for adverse impacts to the ambient air quality due to construction and operational emissions. Construction emissions would include emissions associated with fugitive dust, heavy construction equipment and construction workers commuting to and from the site. The emissions associated with construction would be below the MDAQMD's significance thresholds for all pollutants. Emissions from construction would be temporary. The project would implement mitigation measures in accordance with MDAQMD Rule 403 to reduce emissions to the extent possible. Construction impacts would be less than significant.

Project operational emissions would be minor and would only be associated with operation and maintenance activities. These activities would involve on-road vehicle travel, minor heavy equipment use, and emissions associated with periodic solar panel washing activities. Operational emissions are less than significant.

The project would provide renewable energy and would therefore serve the purpose of meeting the state's goals for renewable energy as set forth in AB 32. The project would therefore not conflict with the goals of AB 32 in reducing emissions of GHG, and would result in a less than significant impact on global climate.

8.0 References

Association of Environmental Professionals. 2007. *Recommendations by the Association of Environmental Professionals (AEP) on How to Analyze Greenhouse Gas Emissions and Global Climate Change in CEQA Documents*. June.

California Air Pollution Control Officers Association. 2008. *CEQA and Climate Change – Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act.* January.

California Air Resources Board. 2007. EMFAC2007 Emissions Model.

California Air Resources Board. 2008. *Climate Change Scoping Plan*. December.

California Air Resources Board. 2011. *Final Supplement to the AB 32 Scoping Plan – Functional Equivalent Document*. August 19.

California Air Resources Board. 2012. California Ambient Air Quality Standards. http://www.arb.ca.gov/research/aaqs/caaqs/caaqs.htm.

California Climate Action Registry General Reporting Protocol, Version 3.1. 2009. January.

California Climate Change Center (CCCC). 2006. *Our Changing Climate, Assessing the Risks to California: A Summary Report from the California Climate Change Center*. July.

California Coastal Commission (CCC). 2006. *Discussion Draft – Global Warming and the California Coastal Commission*. December 12.

California Department of Water Resources. 2006. *Progress on Incorporating Climate Change into Management of California's Water Resources*. July.

California Energy Commission. 2006. *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004.* December.

Federal Highway Administration. 2009. *Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents.* September 30.

MDAQMD. 2004. *2004 Ozone Attainment Plan.* Adopted April 26.

MDAQMD. 2011. *Rules and Regulations.*

Office of Environmental Health Hazard Assessment. 2012. http://www.oehha.ca.gov/air/allrels.html.

South Coast Air Quality Management District. 2011. OFFROAD Mobile Source Emission Factors. http://www.aqmd.gov/ceqa/handbook/offroad/offroad.html.

United Nations Framework Convention on Climate Change. 2006. *Greenhouse Gas Emissions Data, Predefined Queries, Annex I Parties – GHG total without LULUCF (land-use, land-use change and forestry).* http://unfccc.int/ghg_emissions_data/predefined_queries/items/3841.php.

USEPA. 2006. *The U.S. Inventory of Greenhouse Gas Emissions and Sinks: Fast Facts.* www.epa.gov/climatechange/emissions/downloads06/06FastFacts.pdf.

USEPA. 2012. Technology Transfer Air Toxics Website. http://www.epa.gov/ttn/atw/hlthef/hapindex.html.

Western Regional Climatic Center. 2010. Climate Data for Blythe, www.wrcc.dri.edu.

Appendix A

Emission Calculations

Table A-1a. Air Emissions Calculations Summary - Solar Field, Alternative 1

Offroad Tiers 2 emission factors (EFs) are applied to NOx, PM, and CO. Load factors (LFs) are used in conjunction with Tiers 2 EFs.
2012 SCAB EFs (OFFROAD2007 model) are applied to CO2, ROG, SOX. LFs already incorporated in OFFROAD model.
Onroad model (EMFAC) assumes 1990-2012 composite fleet across light, medium, and heavy duty vehicle classes.

Maximum Daily Emissions of Proposed Project		NOX lbs/day	ROG lbs/day	PM10 lbs/day	PM2.5 lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day
Riverside County	Offroad Vehicles and Equipment	99.36	35.35	4.61	4.10	63.31	12.81	33598.70
	Onroad Vehicles	33.84	19.10	4.04	4.00	207.51	0.02	34903.50
	Fugitive Dust	---	---	41.82	8.78	---	---	---
	Total for Riverside County	**133.20**	**54.45**	**50.47**	**16.88**	**270.82**	**12.83**	**68502.20**

Overall Emissions of MSSF1	NOX (ton)	ROG (ton)	PM10 (ton)	PM2.5 (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Offroad Vehicles and Equipment	25.13	1.71	1.03	0.91	14.94	0.39	1,082.1
Onroad Vehicles	4.54	2.41	0.52	0.52	25.97	0.00	4,396.4
Fugitive Dust			5.02	0.96			
Total Emissions for Project Duration	**29.68**	**4.12**	**6.56**	**2.39**	**40.91**	**0.39**	**5,478.5**

Table A-1b. Air Emissions Calculations Summary - Solar Field, Alternative 3

Offroad Tiers 2 emission factors (EFs) are applied to NOx, PM, and CO. Load factors (LFs) are used in conjunction with Tiers 2 EFs.
2012 SCAB EFs (OFFROAD2007 model) are applied to CO2, ROG, SOX. LFs already incorporated in OFFROAD model.
Onroad model (EMFAC) assumes 1990-2012 composite fleet across light, medium, and heavy duty vehicle classes.

Maximum Daily Emissions of Proposed Project		NOX lbs/day	ROG lbs/day	PM10 lbs/day	PM2.5 lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day
Riverside County	Offroad Vehicles and Equipment	99.36	35.35	4.61	4.10	63.31	12.81	33598.70
	Onroad Vehicles	33.84	19.10	4.04	4.00	207.51	0.02	34903.50
	Fugitive Dust	---	---	42.07	8.83	---	---	---
	Total for Riverside County	**133.20**	**54.45**	**50.72**	**16.94**	**270.82**	**12.83**	**68502.20**

Overall Emissions of MSSF1	NOX (ton)	ROG (ton)	PM10 (ton)	PM2.5 (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Offroad Vehicles and Equipment	13.97	1.71	0.62	0.55	8.65	0.39	1,082.1
Onroad Vehicles	4.55	2.41	0.52	0.52	25.97	0.00	4,397.9
Fugitive Dust			5.02	0.96			
Total Emissions for Project Duration	**18.52**	**4.12**	**6.17**	**2.03**	**34.62**	**0.39**	**5,480.0**

Table A-1c. Air Emissions Calculations Summary - Solar Field, Alternative 4

Offroad Tiers 2 emission factors (EFs) are applied to NOx, PM, and CO. Load factors (LFs) are used in conjunction with Tiers 2 EFs.
2012 SCAB EFs (OFFROAD2007 model) are applied to CO2, ROG, SOX. LFs already incorporated in OFFROAD model.
Onroad model (EMFAC) assumes 1990-2012 composite fleet across light, medium, and heavy duty vehicle classes.

Maximum Daily Emissions of Proposed Project		NOX lbs/day	ROG lbs/day	PM10 lbs/day	PM2.5 lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day
Riverside County	Offroad Vehicles and Equipment	99.36	35.35	4.61	4.10	63.31	12.81	33598.70
	Onroad Vehicles	33.84	19.10	4.04	4.00	207.51	0.02	34903.50
	Fugitive Dust	---	---	41.68	8.75	---	---	---
	Total for Riverside County	**133.20**	**54.45**	**50.33**	**16.85**	**270.82**	**12.83**	**68502.20**

Overall Emissions of MSSF1	NOX (ton)	ROG (ton)	PM10 (ton)	PM2.5 (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Offroad Vehicles and Equipment	14.08	1.71	0.63	0.56	8.72	0.39	1,082.1
Onroad Vehicles	4.57	2.41	0.52	0.52	25.97	0.00	4,400.9
Fugitive Dust			5.01	0.96			
Total Emissions for Project Duration	**18.65**	**4.12**	**6.16**	**2.03**	**34.70**	**0.39**	**5,483.0**

Table A-2. 2012 SCAB Fleet Average Emission Factors (OFFROAD2007)

These emission factors are applied to CO2, ROG, SOX only. Load factors are already incorporated.

Equipment	MaxHP	NOX (lbs/hr)	ROG (lbs/hr)	PM (lbs/hr)	CO (lbs/hr)	SOX (lbs/hr)	CO2 (lbs/hr)
Aerial Lifts	15	0.0102	0.0528	0.0642	0.0001	0.0030	8.7
	25	0.0175	0.0517	0.0957	0.0001	0.0055	11.0
	50	0.0650	0.1822	0.1916	0.0003	0.0169	19.6
	120	0.0607	0.2451	0.4012	0.0004	0.0324	38.1
	500	0.1276	0.4941	1.6553	0.0021	0.0491	213
	750	0.2379	0.8930	3.0795	0.0039	0.0903	385
Aerial Lifts Total		0.0576	0.1976	0.3249	0.0004	0.0219	34.7
Air Compressors	15	0.0129	0.0494	0.0768	0.0001	0.0052	7.2
	25	0.0286	0.0779	0.1337	0.0002	0.0087	14.4
	50	0.1010	0.2646	0.2310	0.0003	0.0239	22.3
	120	0.0891	0.3287	0.5333	0.0006	0.0492	47.0
	175	0.1135	0.5074	0.8954	0.0010	0.0512	88.5
	250	0.1066	0.3052	1.2194	0.0015	0.0379	131
	500	0.1709	0.5726	1.9077	0.0023	0.0623	232
	750	0.2681	0.8849	3.0371	0.0036	0.0980	358
	1000	0.4533	1.5617	5.4098	0.0049	0.1589	486
Air Compressors Total		0.0984	0.3445	0.6494	0.0007	0.0469	63.6
Bore/Drill Rigs	15	0.0120	0.0632	0.0754	0.0002	0.0029	10.3
	25	0.0194	0.0658	0.1233	0.0002	0.0054	16.0
	50	0.0351	0.2335	0.2768	0.0004	0.0149	31.0
	120	0.0514	0.4724	0.5026	0.0009	0.0328	77.1
	175	0.0750	0.7538	0.7479	0.0016	0.0366	141
	250	0.0838	0.3435	0.8722	0.0021	0.0268	188
	500	0.1354	0.5526	1.3152	0.0031	0.0437	311
	750	0.2685	1.0916	2.6320	0.0062	0.0865	615
	1000	0.4491	1.6773	6.6123	0.0093	0.1699	928
Bore/Drill Rigs Total		0.0854	0.5068	0.9013	0.0017	0.0367	165
Cement and Mortar Mixers	15	0.0075	0.0386	0.0475	0.0001	0.0023	6.3
	25	0.0293	0.0852	0.1548	0.0002	0.0091	17.6
Cement and Mortar Mixers Total		0.0093	0.0425	0.0564	0.0001	0.0029	7.2
Concrete/Industrial Saws	25	0.0199	0.0678	0.1261	0.0002	0.0050	16.5
	50	0.1047	0.3015	0.2972	0.0004	0.0268	30.2
	120	0.1155	0.4880	0.7625	0.0009	0.0639	74.1
	175	0.1685	0.8723	1.4507	0.0018	0.0767	160
Concrete/Industrial Saws Total		0.1090	0.4148	0.5910	0.0007	0.0491	58.5
Cranes	50	0.1101	0.2979	0.2478	0.0003	0.0258	23.2
	120	0.0982	0.3650	0.5844	0.0006	0.0533	50.1
	175	0.1089	0.4838	0.8259	0.0009	0.0479	80.3
	250	0.1103	0.3103	1.0712	0.0013	0.0388	112
	500	0.1635	0.5691	1.5327	0.0018	0.0571	180
	750	0.2767	0.9554	2.6486	0.0030	0.0974	303
	9999	0.9905	3.5715	10.9484	0.0098	0.3384	971
Cranes Total		0.1425	0.4946	1.2753	0.0014	0.0553	129
Crawler Tractors	50	0.1262	0.3333	0.2713	0.0003	0.0289	24.9
	120	0.1374	0.4906	0.8120	0.0008	0.0729	65.8
	175	0.1758	0.7491	1.3245	0.0014	0.0765	121
	250	0.1854	0.5225	1.7044	0.0019	0.0667	166
	500	0.2659	1.0217	2.3914	0.0025	0.0942	259
	750	0.4784	1.8248	4.3817	0.0047	0.1705	465
	1000	0.7229	2.8959	7.7626	0.0066	0.2503	658
Crawler Tractors Total		0.1671	0.6051	1.2309	0.0013	0.0752	114
Crushing/Proc. Equipment	50	0.1927	0.5215	0.4545	0.0006	0.0462	44.0
	120	0.1525	0.5829	0.9172	0.0010	0.0851	83.1
	175	0.2088	0.9654	1.6343	0.0019	0.0946	167
	250	0.1953	0.5592	2.1896	0.0028	0.0682	245
	500	0.2733	0.8961	2.9457	0.0037	0.0972	374
	750	0.4361	1.3892	4.8387	0.0059	0.1560	589
	9999	1.2112	4.0327	14.2648	0.0131	0.4203	1,308
Crushing/Proc. Equipment Total		0.1872	0.6911	1.2633	0.0015	0.0819	132
Dumpers/Tenders	25	0.0100	0.0324	0.0614	0.0001	0.0031	7.6
Dumpers/Tenders Total		0.0100	0.0324	0.0614	0.0001	0.0031	7.6
Excavators	25	0.0198	0.0677	0.1253	0.0002	0.0048	16.4
	50	0.0912	0.2933	0.2568	0.0003	0.0237	25.0
	120	0.1183	0.5220	0.7300	0.0009	0.0657	73.6
	175	0.1288	0.6678	0.9613	0.0013	0.0569	112
	250	0.1301	0.3630	1.2438	0.0018	0.0415	159
	500	0.1805	0.5493	1.6112	0.0023	0.0574	234
	750	0.3013	0.9096	2.7605	0.0039	0.0969	387
Excavators Total		0.1300	0.5401	0.9817	0.0013	0.0536	120

Table A-2. 2012 SCAB Fleet Average Emission Factors (OFFROAD2007)

These emission factors are applied to CO2, ROG, SOX only. Load factors are already incorporated.

Equipment	MaxHP	NOX (lbs/hr)	ROG (lbs/hr)	PM (lbs/hr)	CO (lbs/hr)	SOX (lbs/hr)	CO2 (lbs/hr)
Forklifts	50	0.0514	0.1682	0.1488	0.0002	0.0136	14.7
	120	0.0489	0.2195	0.3017	0.0004	0.0277	31.2
	175	0.0624	0.3304	0.4664	0.0006	0.0278	56.1
	250	0.0595	0.1638	0.5872	0.0009	0.0187	77.1
	500	0.0806	0.2241	0.7257	0.0011	0.0252	111
Forklifts Total		0.0585	0.2257	0.4330	0.0006	0.0231	54.4
Generator Sets	15	0.0157	0.0698	0.1063	0.0002	0.0061	10.2
	25	0.0276	0.0951	0.1632	0.0002	0.0096	17.6
	50	0.0959	0.2734	0.2966	0.0004	0.0255	30.6
	120	0.1206	0.4956	0.8099	0.0009	0.0640	77.9
	175	0.1460	0.7413	1.3131	0.0016	0.0644	142
	250	0.1372	0.4502	1.8047	0.0024	0.0508	213
	500	0.1952	0.7617	2.5896	0.0033	0.0756	337
	750	0.3257	1.2296	4.3019	0.0055	0.1241	544
	9999	0.8673	3.0642	10.8871	0.0105	0.3104	1,049
Generator Sets Total		0.0832	0.3121	0.5779	0.0007	0.0351	61.0
Graders	50	0.1182	0.3365	0.2882	0.0004	0.0286	27.5
	120	0.1348	0.5355	0.8223	0.0009	0.0740	75.0
	175	0.1554	0.7363	1.1931	0.0014	0.0688	124
	250	0.1575	0.4508	1.5344	0.0019	0.0547	172
	500	0.1947	0.6639	1.8193	0.0023	0.0671	229
	750	0.4147	1.4022	3.9602	0.0049	0.1439	486
Graders Total		0.1533	0.6129	1.2503	0.0015	0.0649	133
Off-Highway Tractors	120	0.2224	0.7269	1.2964	0.0011	0.1143	93.7
	175	0.2135	0.8404	1.6085	0.0015	0.0923	130
	250	0.1718	0.4896	1.5282	0.0015	0.0644	130
	750	0.6814	3.0883	6.1417	0.0057	0.2515	568
	1000	1.0246	4.8137	10.5080	0.0082	0.3620	814
Off-Highway Tractors Total		0.2170	0.7878	1.7969	0.0017	0.0871	151
Off-Highway Trucks	175	0.1533	0.7593	1.1072	0.0014	0.0666	125
	250	0.1469	0.3944	1.3513	0.0019	0.0461	167
	500	0.2263	0.6661	1.9463	0.0027	0.0705	272
	750	0.3695	1.0792	3.2612	0.0044	0.1164	442
	1000	0.5790	1.7854	6.4025	0.0063	0.1933	625
Off-Highway Trucks Total		0.2241	0.6635	2.0158	0.0027	0.0715	260
Other Construction Equipment	15	0.0118	0.0617	0.0737	0.0002	0.0028	10.1
	25	0.0160	0.0544	0.1019	0.0002	0.0044	13.2
	50	0.0842	0.2740	0.2707	0.0004	0.0228	28.0
	120	0.1104	0.5320	0.7540	0.0009	0.0633	80.9
	175	0.1008	0.5880	0.8599	0.0012	0.0467	107
	500	0.1517	0.5426	1.6573	0.0025	0.0545	254
Other Construction Equipment Total		0.0925	0.3847	0.8599	0.0013	0.0366	123
Other General Industrial Equipr	15	0.0066	0.0391	0.0466	0.0001	0.0018	6.4
	25	0.0185	0.0632	0.1170	0.0002	0.0045	15.3
	50	0.1085	0.2856	0.2332	0.0003	0.0253	21.7
	120	0.1274	0.4542	0.7277	0.0007	0.0703	62.0
	175	0.1349	0.5757	1.0001	0.0011	0.0599	95.9
	250	0.1235	0.3281	1.2983	0.0015	0.0417	136
	500	0.2232	0.6772	2.2367	0.0026	0.0758	265
	750	0.3707	1.1162	3.8016	0.0044	0.1273	437
	1000	0.5621	1.8453	6.4018	0.0056	0.1947	560
Other General Industrial Equipmen Total		0.1635	0.5362	1.4520	0.0016	0.0632	152
Other Material Handling Equipr	50	0.1506	0.3950	0.3243	0.0004	0.0352	30.3
	120	0.1239	0.4423	0.7103	0.0007	0.0684	60.7
	175	0.1703	0.7292	1.2706	0.0014	0.0759	122
	250	0.1305	0.3496	1.3863	0.0016	0.0443	145
	500	0.1590	0.4876	1.6124	0.0019	0.0545	192
	9999	0.7467	2.4395	8.4619	0.0073	0.2565	741
Other Material Handling Equipment Total		0.1566	0.5108	1.4125	0.0015	0.0613	141
Pavers	25	0.0255	0.0811	0.1531	0.0002	0.0080	18.7
	50	0.1451	0.3680	0.3038	0.0004	0.0327	28.0
	120	0.1467	0.5107	0.8788	0.0008	0.0776	69.2
	175	0.1864	0.7833	1.4495	0.0014	0.0819	128
	250	0.2182	0.6365	2.0698	0.0022	0.0818	194
	500	0.2383	0.9957	2.2418	0.0023	0.0883	233
Pavers Total		0.1596	0.5445	0.8980	0.0009	0.0642	77.9
Paving Equipment	25	0.0153	0.0520	0.0974	0.0002	0.0042	12.6
	50	0.1239	0.3124	0.2591	0.0003	0.0279	23.9
	120	0.1150	0.3997	0.6897	0.0006	0.0610	54.5
	175	0.1455	0.6114	1.1384	0.0011	0.0640	101
	250	0.1349	0.3946	1.2976	0.0014	0.0507	122
Paving Equipment Total		0.1204	0.4365	0.8114	0.0008	0.0570	68.9

Table A-2. 2012 SCAB Fleet Average Emission Factors (OFFROAD2007)

These emission factors are applied to CO2, ROG, SOX only. Load factors are already incorporated.

Equipment	MaxHP	NOX (lbs/hr)	ROG (lbs/hr)	PM (lbs/hr)	CO (lbs/hr)	SOX (lbs/hr)	CO2 (lbs/hr)
Plate Compactors	15	0.0050	0.0263	0.0314	0.0001	0.0013	4.3
Plate Compactors Total		0.0050	0.0263	0.0314	0.0001	0.0013	4.3
Pressure Washers	15	0.0075	0.0334	0.0509	0.0001	0.0029	4.9
	25	0.0112	0.0385	0.0662	0.0001	0.0039	7.1
	50	0.0349	0.1074	0.1339	0.0002	0.0102	14.3
	120	0.0332	0.1458	0.2385	0.0003	0.0172	24.1
Pressure Washers Total		0.0173	0.0635	0.0921	0.0001	0.0063	9.4
Pumps	15	0.0133	0.0508	0.0790	0.0001	0.0054	7.4
	25	0.0386	0.1051	0.1803	0.0002	0.0117	19.5
	50	0.1155	0.3229	0.3362	0.0004	0.0299	34.3
	120	0.1250	0.5036	0.8226	0.0009	0.0669	77.9
	175	0.1498	0.7431	1.3164	0.0016	0.0664	140
	250	0.1357	0.4345	1.7375	0.0023	0.0501	201
	500	0.2089	0.8032	2.6861	0.0034	0.0803	345
	750	0.3557	1.3279	4.5700	0.0057	0.1350	571
	9999	1.1456	4.0641	14.2305	0.0136	0.4081	1,355
Pumps Total		0.0813	0.2983	0.4999	0.0006	0.0351	49.6
Rollers	15	0.0074	0.0386	0.0461	0.0001	0.0018	6.3
	25	0.0162	0.0549	0.1029	0.0002	0.0045	13.3
	50	0.1105	0.2994	0.2677	0.0003	0.0263	26.0
	120	0.1054	0.4098	0.6619	0.0007	0.0574	59.0
	175	0.1320	0.6220	1.0725	0.0012	0.0591	108
	250	0.1347	0.4083	1.4103	0.0017	0.0498	153
	500	0.1755	0.6752	1.8093	0.0022	0.0652	219
Rollers Total		0.1038	0.4107	0.6936	0.0008	0.0488	67.1
Rough Terrain Forklifts	50	0.1315	0.3910	0.3455	0.0004	0.0330	33.9
	120	0.1038	0.4364	0.6425	0.0007	0.0585	62.4
	175	0.1444	0.7268	1.1204	0.0014	0.0652	125
	250	0.1353	0.3896	1.4082	0.0019	0.0458	171
	500	0.1894	0.5985	1.8577	0.0025	0.0642	257
Rough Terrain Forklifts Total		0.1093	0.4680	0.6995	0.0008	0.0587	70.3
Rubber Tired Dozers	175	0.2209	0.8528	1.6304	0.0015	0.0945	129
	250	0.2545	0.7124	2.1985	0.0021	0.0942	183
	500	0.3345	1.5220	2.8822	0.0026	0.1210	265
	750	0.5042	2.2809	4.4100	0.0040	0.1832	399
	1000	0.7807	3.6654	7.7816	0.0060	0.2729	592
Rubber Tired Dozers Total		0.3114	1.2491	2.6866	0.0025	0.1137	239
Rubber Tired Loaders	25	0.0205	0.0697	0.1295	0.0002	0.0052	16.9
	50	0.1315	0.3756	0.3242	0.0004	0.0319	31.1
	120	0.1045	0.4187	0.6404	0.0007	0.0576	58.9
	175	0.1312	0.6288	1.0135	0.0012	0.0583	106
	250	0.1330	0.3838	1.3129	0.0017	0.0462	149
	500	0.1961	0.6755	1.8555	0.0023	0.0677	237
	750	0.4044	1.3812	3.9115	0.0049	0.1408	486
	1000	0.5480	1.9543	6.3337	0.0060	0.1909	594
Rubber Tired Loaders Total		0.1272	0.4855	1.0034	0.0012	0.0558	109
Scrapers	120	0.1990	0.7011	1.1749	0.0011	0.1054	93.9
	175	0.2172	0.9158	1.6429	0.0017	0.0945	148
	250	0.2367	0.6699	2.1849	0.0024	0.0859	209
	500	0.3333	1.3000	3.0162	0.0032	0.1190	321
	750	0.5779	2.2380	5.3231	0.0056	0.2075	555
Scrapers Total		0.2916	1.0984	2.5680	0.0027	0.1087	262
Signal Boards	15	0.0072	0.0377	0.0450	0.0001	0.0017	6.2
	50	0.1270	0.3587	0.3564	0.0005	0.0324	36.2
	120	0.1284	0.5269	0.8360	0.0009	0.0703	80.2
	175	0.1661	0.8370	1.4268	0.0017	0.0750	155
	250	0.1746	0.5516	2.1599	0.0029	0.0639	255
Signal Boards Total		0.0203	0.0940	0.1470	0.0002	0.0083	16.7
Skid Steer Loaders	25	0.0211	0.0635	0.1189	0.0002	0.0067	13.8
	50	0.0596	0.2332	0.2402	0.0003	0.0180	25.5
	120	0.0482	0.2769	0.3536	0.0005	0.0286	42.8
Skid Steer Loaders Total		0.0534	0.2360	0.2686	0.0004	0.0207	30.3
Surfacing Equipment	50	0.0513	0.1441	0.1411	0.0002	0.0128	14.1
	120	0.1040	0.4251	0.6895	0.0007	0.0557	63.8
	175	0.0950	0.4745	0.8195	0.0010	0.0422	85.8
	250	0.1095	0.3526	1.1993	0.0015	0.0413	135
	500	0.1631	0.6813	1.7819	0.0022	0.0622	221
	750	0.2601	1.0660	2.8642	0.0035	0.0986	347
Surfacing Equipment Total		0.1362	0.5467	1.3678	0.0017	0.0512	166

Table A-2. 2012 SCAB Fleet Average Emission Factors (OFFROAD2007)

These emission factors are applied to CO2, ROG, SOX only. Load factors are already incorporated.

Equipment	MaxHP	NOX (lbs/hr)	ROG (lbs/hr)	PM (lbs/hr)	CO (lbs/hr)	SOX (lbs/hr)	CO2 (lbs/hr)
Sweepers/Scrubbers	15	0.0124	0.0729	0.0870	0.0002	0.0034	11.9
	25	0.0237	0.0808	0.1501	0.0002	0.0060	19.6
	50	0.1195	0.3565	0.3179	0.0004	0.0302	31.6
	120	0.1233	0.5204	0.7534	0.0009	0.0706	75.0
	175	0.1575	0.8008	1.2212	0.0016	0.0717	139
	250	0.1205	0.3447	1.3019	0.0018	0.0402	162
Sweepers/Scrubbers Total		0.1278	0.5215	0.7403	0.0009	0.0576	78.5
Tractors/Loaders/Backhoes	25	0.0199	0.0662	0.1250	0.0002	0.0061	15.9
	50	0.1006	0.3305	0.3030	0.0004	0.0267	30.3
	120	0.0760	0.3557	0.4910	0.0006	0.0432	51.7
	175	0.1058	0.5866	0.8294	0.0011	0.0478	101
	250	0.1264	0.3755	1.2813	0.0019	0.0415	172
	500	0.2386	0.7714	2.2621	0.0039	0.0784	345
	750	0.3611	1.1563	3.5105	0.0058	0.1199	517
Tractors/Loaders/Backhoes Total		0.0862	0.3824	0.5816	0.0008	0.0435	66.8
Trenchers	15	0.0099	0.0517	0.0617	0.0001	0.0024	8.5
	25	0.0398	0.1355	0.2519	0.0004	0.0101	32.9
	50	0.1656	0.4176	0.3536	0.0004	0.0374	32.9
	120	0.1354	0.4732	0.8257	0.0008	0.0709	64.9
	175	0.2050	0.8694	1.6306	0.0016	0.0901	144
	250	0.2483	0.7418	2.3854	0.0025	0.0951	223
	500	0.3135	1.4011	3.0220	0.0031	0.1190	311
	750	0.5949	2.6307	5.8034	0.0059	0.2259	587
Trenchers Total		0.1507	0.4749	0.6995	0.0007	0.0582	58.7
Welders	15	0.0111	0.0425	0.0660	0.0001	0.0045	6.2
	25	0.0224	0.0609	0.1044	0.0001	0.0068	11.3
	50	0.1071	0.2854	0.2637	0.0003	0.0260	26.0
	120	0.0708	0.2687	0.4376	0.0005	0.0387	39.5
	175	0.1183	0.5475	0.9688	0.0011	0.0531	98.2
	250	0.0909	0.2704	1.0791	0.0013	0.0329	119
	500	0.1154	0.4072	1.3538	0.0016	0.0431	168
Welders Total		0.0703	0.2150	0.2702	0.0003	0.0243	25.6

Table A-3a. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 1

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Conformity Emissions

ROG (tons)	SOX (tons)	CO2 (tons)
1.42	0.41	1491.14

Blythe Mesa Solar Project

Site Preparation/Grading/Earthwork

3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 6,120	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOx lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Grader	Grader	185	1	90	6	540	250	0.1575	0.0547	172.1133	0.9449	0.3279	1032.6795	0.0425	0.0148	46.4706
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	90	4	720	120	0.0955	0.0007	62.4498	0.7640	0.0059	499.5985	0.0344	0.0003	22.4819
Track Type Dozer	Crawler Tractor	185	1	90	6	540	250	0.1764	0.0019	166.1315	1.0584	0.0112	996.7893	0.0476	0.0005	44.8555
Excavator	Excavator	85	1	90	8	720	120	0.1183	0.0657	73.6231	0.9462	0.5260	588.9848	0.0426	0.0237	26.5043
Rubber-Tired Loaders	Rubber Tired Loader	78	1	90	8	720	120	0.0971	0.0007	58.9135	0.7765	0.0055	471.3081	0.0349	0.0002	21.2089
Rollers	Roller	100	1	90	6	540	120	0.1054	0.0574	58.9888	0.6327	0.3446	353.9325	0.0285	0.0155	15.9270
Scrapers	Scraper	365	1	90	6	540	500	0.3186	0.0032	321.4286	1.9118	0.0189	1928.5717	0.0860	0.0009	86.7857
DumpTruck	Grader	473	1	90	4	360	500	0.2263	0.0705	272.3339	0.9052	0.2822	1089.3355	0.0407	0.0127	49.0201
4000 Gallon Water Truck	Off-highway Truck	250	1	90	8	720	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0529	0.0166	59.9563
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	120	0.1104	0.0633	80.8587	0.8832	0.5066	646.8698	0.0397	0.0228	29.1091

Concrete Foundations

3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,100	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Pavers	Paving Equipment	173	1	90	6	540	250	0.1349	0.0507	122.2913	0.8093	0.3041	733.7475	0.0364	0.0137	33.0186
Concrete Pump	Concrete Pumps	10	4	90	4	1440	50	0.1155	0.0299	34.3348	1.8475	0.4782	549.3575	0.0831	0.0215	24.7211
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	90	6	1080	120	0.0955	0.0007	62.4498	1.1460	0.0088	749.3978	0.0516	0.0004	33.7229
Concrete Truck	Off-highway Truck	250	2	90	4	720	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0529	0.0166	59.9563
Drum Type Compactor	Paving Equipment	250	1	90	6	540	250	0.1349	0.0507	122.2913	0.8093	0.3041	733.7475	0.0364	0.0137	33.0186
ATV Gator Carts	Other Construction Equipment	100	1	90	6	540	120	0.1104	0.0633	80.8587	0.6624	0.3799	485.1523	0.0298	0.0171	21.8319
Welders	Welders	50	6	90	6	3240	50	0.1071	0.0260	25.9581	3.8551	0.9346	934.4901	0.1735	0.0421	42.0521

Table A-3a. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 1

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Conformity Emissions

Structural Steel Work
4 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,760	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	120	5	1200	120	0.0955	0.0007	62.4498	0.9550	0.0073	624.4981	0.0573	0.0004	37.4699
30 Ton Crane Truck	Off-highway Truck	99	1	120	5	600	175	0.1441	0.0014	125.0878	0.7206	0.0070	625.4389	0.0432	0.0004	37.5263
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	120	6	720	250	0.1400	0.0019	166.5454	0.8398	0.0112	999.2724	0.0504	0.0007	59.9563
Compressor Truck	Air Compressor	25	2	120	8	1920	50	0.0266	0.0002	14.4462	0.4253	0.0029	231.1396	0.0255	0.0002	13.8684
Welders	Welders	50	6	120	6	4320	50	0.1071	0.0260	25.9581	3.8551	0.9346	934.4901	0.2313	0.0561	56.0694

Electrical/Instrumentation Work
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 3,240	HP Used for OFFROAD	SCAB ROG (lb/hr)	SCAB SOX (lb/hr)	SCAB CO2 (lb/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
30 Ton Crane Truck	Off-highway Truck	99	1	60	4	240	175	0.1441	0.0014	125.0878	0.5764	0.0056	500.3511	0.0173	0.0002	15.0105
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	60	6	720	120	0.0955	0.0007	62.4498	1.1460	0.0088	749.3978	0.0344	0.0003	22.4819
Carryall Vehicles	Off-highway Truck	180	2	60	4	480	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0353	0.0111	39.9709
Generator	Generator Sets	30	3	60	10	1800	50	0.0959	0.0255	30.6230	2.8770	0.7641	918.6896	0.0863	0.0229	27.5607

Architectural and Landscape
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,680	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	120	0.0694	0.0006	51.7280	0.5555	0.0049	413.8241	0.0167	0.0001	12.4147
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	175	0.1441	0.0014	125.0878	1.1529	0.0113	1000.7022	0.0346	0.0003	30.0211
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	120	0.0955	0.0007	62.4498	0.3820	0.0029	249.7993	0.0115	0.0001	7.4940
Vibratory Compactor	Paving Equipment	80	1	60	2	120	120	0.1150	0.0610	54.4994	0.2299	0.1219	108.9987	0.0069	0.0037	3.2700
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	120	0.0760	0.0432	51.7280	0.6083	0.3456	413.8241	0.0182	0.0104	12.4147
Trencher	Trencher	75	1	60	8	480	120	0.1354	0.0709	64.8951	1.0830	0.5671	519.1611	0.0325	0.0170	15.5748
Manlifts	Aerial Lift	75	2	60	8	960	120	0.0607	0.0324	38.0718	0.9718	0.5183	609.1490	0.0292	0.0155	18.2745
Generator	Generator Sets	30	3	60	8	1440	50	0.0959	0.0255	30.6230	2.3016	0.6112	734.9517	0.0690	0.0183	22.0486

Substation and O&M Bldgs
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 9,000	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	120	0.0694	0.0006	51.7280	0.5555	0.0049	413.8241	0.0167	0.0001	12.4147
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	120	0.0185	0.0045	15.3491	0.1481	0.0358	122.7929	0.0044	0.0011	3.6838
Track Type Dozer	Crawler Tractor	185	1	90	8	720	250	0.1764	0.0019	166.1315	1.4112	0.0150	1329.0524	0.0635	0.0007	59.8074
Excavator	Excavator	85	1	90	8	720	120	0.1183	0.0657	73.6231	0.9462	0.5260	588.9848	0.0426	0.0237	26.5043
Rollers	Roller	100	1	90	8	720	120	0.1054	0.0574	58.9888	0.8436	0.4595	471.9100	0.0380	0.0207	21.2360
4000 Gallon Water Truck	Off-highway Truck	250	2	90	8	1440	250	0.1469	0.0461	166.5454	2.3502	0.7368	2664.7258	0.1058	0.0332	119.9127
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	120	0.0955	0.0007	62.4498	0.3820	0.0029	249.7993	0.0115	0.0001	7.4940
Vibratory Compactor	Paving Equipment	80	1	60	2	120	120	0.1155	0.0299	34.3348	0.2309	0.0598	68.6697	0.0069	0.0018	2.0601
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	120	0.5949	0.2259	586.8778	4.7593	1.8072	4695.0227	0.1428	0.0542	140.8507
Trencher	Trencher	75	1	60	8	480	120	0.0703	0.0243	25.6027	0.5625	0.1944	204.8214	0.0169	0.0058	6.1446
Manlifts	Aerial Lift	75	2	60	8	960	120	0.0984	0.0469	63.6073	1.5737	0.7511	1017.7170	0.0472	0.0225	30.5315
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	120	0.1104	0.0633	80.8587	0.8832	0.5066	646.8698	0.0397	0.0228	29.1091
Generator	Generator Sets	30	3	60	8	1440	50	0.4147	0.1439	485.7416	9.9529	3.4547	11657.7984	0.2986	0.1036	349.7340

Table A-3a. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 1

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Conformity Emissions

Transmission Line Installation

12 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 5,116	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOX lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Sleeving Rigs	Other Gen Indust Equipment	85	1	152	4	608	120	0.5779	0.2075	555.2765	2.3116	0.8301	2221.1061	0.1757	0.0631	168.8041
Hydralic Pump Motor	Pumps	10	2	10	5	100	15	0.2050	0.0901	143.8979	2.0499	0.9009	1438.9789	0.0102	0.0045	7.1949
580 Case Backhoe	Tractor/loader/backhoe	120	1	152	2	304	120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Spacing Carts	Other Gen Indust Equipment	10	4	152	4	2432	15	0.2916	0.1087	262.4958	4.6649	1.7389	4199.9328	0.3545	0.1322	319.1949
3 Drum Strawline Pullers	Other Gen Indust Equipment	85	1	152	4	608	120	0.1284	0.0703	80.2066	0.5135	0.2812	320.8265	0.0390	0.0214	24.3828
60lk Puller	Other Gen Indust Equipment	250	1	152	3	456	250	0.1661	0.0750	154.5445	0.4984	0.2249	463.6335	0.0379	0.0171	35.2361
Triple Conductor Tensioner	Other Gen Indust Equipment	250	1	152	2	304	250	0.1661	0.0750	154.5445	0.3323	0.1499	309.0890	0.0253	0.0114	23.4908
Sag Cat w2 winches	Grader	350	1	152	2	304	500	0.1894	0.0642	256.5709	0.3787	0.1285	513.1418	0.0288	0.0098	38.9988

Decommissioning

6 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 9,720	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOx lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Grader	Grader	185	1	180	6	1080	250	0.1312	0.0583	106.3152	0.7874	0.3499	637.8911	0.0709	0.0315	57.4102
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	180	4	1440	120	0.0955	0.0007	62.4498	0.7640	0.0059	499.5985	0.0688	0.0005	44.9639
Track Type Dozer	Crawler Tractor	185	1	180	6	1080	250	0.1764	0.0019	166.1315	1.0584	0.0112	996.7893	0.0953	0.0010	89.7110
Excavator	Excavator	85	1	180	8	1440	120	1.1456	0.4081	1354.8351	9.1651	3.2647	10838.6809	0.8249	0.2938	975.4813
Rubber-Tired Loaders	Rubber Tired Loader	78	1	180	8	1440	120	0.0971	0.0007	58.9135	0.7765	0.0055	471.3081	0.0699	0.0005	42.4177
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	180	6	1080	250	0.1400	0.0019	166.5454	0.8398	0.0112	999.2724	0.0756	0.0010	89.9345
DumpTruck	Grader	473	1	180	4	720	500	0.0072	0.0017	6.1697	0.0287	0.0070	24.6790	0.0026	0.0006	2.2211
4000 Gallon Water Truck	Off-highway Truck	250	1	180	8	1440	250	0.2916	0.1087	262.4958	2.3325	0.8694	2099.9664	0.2099	0.0783	188.9970
											15.75	**4.52**	**16568.19**	**1.42**	**0.41**	**1491.14**

AR061028

Table A-4a. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 1

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	25.13	1.03	14.94

Conformity Emissions

NOX (tons)	PM (tons)	CO (tons)
5.62	0.20	3.16

Blythe Mesa Solar Project

Site Preparation/Grading/Earthwork

3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,320	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Road Grader	Grader	185	1	90	6	540	0.61	250	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	90	4	720	0.6	250	0.7333	0.0393	0.4845	5.87	0.31	3.88	0.2640	0.0141	0.1744
Track Type Dozer	Grader	185	1	90	6	540	0.61	500	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Excavator	Excavator	85	1	90	8	720	0.57	120	0.5981	0.0320	0.3952	4.79	0.26	3.16	0.2153	0.0115	0.1423
Rubber-Tired Loaders	Rubber Tired Loader	78	1	90	8	720	0.54	250	0.5200	0.0279	0.3436	4.16	0.22	2.75	0.1872	0.0100	0.1237
Rollers	Roller	100	1	90	6	540	0.56	120	0.6049	0.0272	0.4568	3.63	0.16	2.74	0.1633	0.0073	0.1233
Scrapers	Scraper	365	1	90	6	540	0.72	250	2.7810	0.0869	1.5063	16.69	0.52	9.04	0.7509	0.0235	0.4067
DumpTruck	Grader	473	1	90	4	360	0.57	500	2.8530	0.0892	1.5454	11.41	0.36	6.18	0.5135	0.0160	0.2782
4000 Gallon Water Truck	Off-highway Truck	250	1	90	8	720	0.57	250	1.5394	0.0471	0.8168	12.31	0.38	6.53	0.5542	0.0170	0.2940
ATV Gator Carts	Other Construction Equipment	100	1	90	4	360	0.62	120	0.6698	0.0301	0.5057	2.68	0.12	2.02	0.1206	0.0054	0.0910

Concrete Foundations

3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,100	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Pavers	Paving Equipment	173	1	90	6	540	0.53	250	0.9905	0.0445	0.7479	5.94	0.27	4.49	0.2674	0.0120	0.2019
Concrete Pump	Concrete Pumps	10	4	90	4	1440	0.74	50	0.0914	0.0098	0.0979	1.46	0.16	1.57	0.0658	0.0070	0.0705
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	90	6	1080	0.6	250	0.7333	0.0393	0.4845	8.80	0.47	5.81	0.3960	0.0212	0.2616
Concrete Truck	Off-highway Truck	250	2	90	4	720	0.57	250	1.5394	0.0471	0.8168	12.31	0.38	6.53	0.5542	0.0170	0.2940
Drum Type Compactor	Paving Equipment	250	1	90	6	540	0.53	250	1.4313	0.0438	0.7595	8.59	0.26	4.56	0.3865	0.0118	0.2051
ATV Gator Carts	Other Construction Equipment	100	1	90	6	540	0.53	250	0.5725	0.0257	0.4323	3.44	0.15	2.59	0.1546	0.0069	0.1167
Welders	Welders	50	6	90	6	3240	0.45	50	0.2778	0.0149	0.1835	10.00	0.54	6.61	0.4500	0.0241	0.2973

Table A-4a. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 1

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	25.13	1.03	14.94

Blythe Mesa Solar Project

Conformity Emissions

Structural Steel Work

4 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,520	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	120	5	1200	0.6	250	0.7333	0.0393	0.4845	7.33	0.39	4.85	0.4400	0.0236	0.2907
30 Ton Crane Truck	Off-highway Truck	99	1	120	5	600	0.57	500	0.6967	0.0373	0.4603	3.48	0.19	2.30	0.2090	0.0112	0.1381
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	120	4	480	0.57	500	1.5394	0.0471	0.8168	6.16	0.19	3.27	0.3694	0.0113	0.1960
Compressor Truck	Off-highway Truck	25	2	120	8	1920	0.57	500	0.1759	0.0141	0.1288	2.81	0.23	2.06	0.1689	0.0136	0.1237
Welders	Welders	50	6	120	6	4320	0.45	50	0.2778	0.0149	0.1835	10.00	0.54	6.61	0.6000	0.0321	0.3964

Electrical/Instrumentation Work

2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 3,240	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lb/hr)	TIER 2 PM (lb/hr)	TIER 2 CO (lb/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
30 Ton Crane Truck	Off-highway Truck	99	1	60	4	240	0.57	500	0.6967	0.0373	0.4603	2.79	0.15	1.84	0.0836	0.0045	0.0552
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	60	6	720	0.6	500	0.7333	0.0393	0.4845	8.80	0.47	5.81	0.2640	0.0141	0.1744
Carryall Vehicles	Off-highway Truck	180	2	60	4	480	0.57	250	1.1083	0.0339	0.5881	8.87	0.27	4.70	0.2660	0.0081	0.1411
Generator	Generator Sets	30	3	60	10	1800	0.74	50	0.2741	0.0220	0.2007	8.22	0.66	6.02	0.2467	0.0198	0.1806

Architectural and Landscape **Upgrade**

2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,680	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	0.55	250	0.5296	0.0284	0.3499	4.24	0.23	2.80	0.1271	0.0068	0.0840
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	0.57	250	0.6967	0.0373	0.4603	5.57	0.30	3.68	0.1672	0.0090	0.1105
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	0.6	250	0.7333	0.0393	0.4845	2.93	0.16	1.94	0.0880	0.0047	0.0581
Vibratory Compactor	Paving Equipment	80	1	60	2	120	0.53	120	0.5235	0.0280	0.3459	1.05	0.06	0.69	0.0314	0.0017	0.0208
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	0.55	120	0.5772	0.0309	0.3813	4.62	0.25	3.05	0.1385	0.0074	0.0915
Trencher	Trencher	75	1	60	8	480	0.75	120	0.6944	0.0372	0.4588	5.56	0.30	3.67	0.1667	0.0089	0.1101
Manlifts	Aerial Lift	75	2	60	8	960	0.46	120	0.4259	0.0228	0.2814	6.81	0.37	4.50	0.2044	0.0110	0.1351
Generator	Generator Sets	30	3	60	8	1440	0.74	50	0.2741	0.0220	0.2007	6.58	0.53	4.82	0.1973	0.0159	0.1445

Substation and O&M Bldgs

2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,220	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	6	360	0.55	250	0.5296	0.0284	0.3499	3.18	0.17	2.10	0.0953	0.0051	0.0630
30 Ton Crane Truck	Off-highway Truck	99	1	60	6	360	0.57	250	0.6967	0.0373	0.4603	4.18	0.22	2.76	0.1254	0.0067	0.0829
Track Type Dozer	Grader	185	1	90	6	540	0.61	500	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Excavator	Excavator	85	1	90	6	540	0.57	120	0.5981	0.0320	0.3952	3.59	0.19	2.37	0.1615	0.0087	0.1067
Rollers	Roller	100	1	90	6	540	0.56	120	0.6049	0.0272	0.4568	3.63	0.16	2.74	0.1633	0.0073	0.1233
4000 Gallon Water Truck	Off-highway Truck	250	2	90	8	1440	0.57	250	1.5394	0.0471	0.8168	24.63	0.75	13.07	1.1083	0.0339	0.5881
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	0.6	250	0.7333	0.0393	0.4845	2.93	0.16	1.94	0.0880	0.0047	0.0581
Vibratory Compactor	Paving Equipment	80	1	60	2	120	0.53	120	0.5235	0.0280	0.3459	1.05	0.06	0.69	0.0314	0.0017	0.0208
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	0.55	120	0.5772	0.0309	0.3813	4.62	0.25	3.05	0.1385	0.0074	0.0915
Trencher	Trencher	75	1	60	8	480	0.75	120	0.6944	0.0372	0.4588	5.56	0.30	3.67	0.1667	0.0089	0.1101
Manlifts	Aerial Lift	75	2	60	8	960	0.46	120	0.4259	0.0228	0.2814	6.81	0.37	4.50	0.2044	0.0110	0.1351
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	0.62	120	0.6698	0.0301	0.5057	5.36	0.24	4.05	0.2411	0.0108	0.1821
Generator	Generator Sets	30	3	60	8	1440	0.74	50	0.2741	0.0220	0.2007	6.58	0.53	4.82	0.1973	0.0159	0.1445

Table A-4a. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 1

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	25.13	1.03	14.94

Blythe Mesa Solar Project

Conformity Emissions

Transmission Line Installation
12 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 5,116	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Sleeving Rigs	Other Gen Indust Equipment	85	1	152	4	608	0.51	120	0.5352	0.0287	0.3536	2.14	0.11	1.41	0.1627	0.0087	0.1075
Hydralic Pump Motor	Pumps	10	2	10	5	100	0.74	15	0.0914	0.0098	0.0979	0.91	0.10	0.98	0.0046	0.0005	0.0049
580 Case Backhoe	Tractor/loader/backhoe	120	1	152	2	304	0.55	120	0.7130	0.0320	0.5384	1.43	0.06	1.08	0.1084	0.0049	0.0818
Spacing Carts	Other Gen Indust Equipment	10	4	152	4	2432	0.51	15	0.0630	0.0067	0.0675	1.01	0.11	1.08	0.0766	0.0082	0.0820
3 Drum Strawline Pullers	Other Gen Indust Equipment	85	1	152	4	608	0.51	120	0.5352	0.0287	0.3536	2.14	0.11	1.41	0.1627	0.0087	0.1075
60lk Puller	Other Gen Indust Equipment	250	1	152	3	456	0.51	250	1.3773	0.0422	0.7308	4.13	0.13	2.19	0.3140	0.0096	0.1666
Triple Conductor Tensioner	Other Gen Indust Equipment	250	1	152	2	304	0.51	250	1.3773	0.0422	0.7308	2.75	0.08	1.46	0.2094	0.0064	0.1111
Sag Cat w2 winches	Grader	350	1	152	2	304	0.61	500	2.2593	0.0706	1.2238	4.52	0.14	2.45	0.3434	0.0107	0.1860

Decommissioning
6 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 9,720	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Grader	Grader	185	1	180	6	1080	0.61	250	1.2191	0.0373	0.6468	7.3144	0.2239	3.8811	0.6583	0.0202	0.3493
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	180	4	1440	0.6	250	0.7333	0.0393	0.4845	5.8667	0.3143	3.8762	0.5280	0.0283	0.3489
Track Type Dozer	Crawler Tractor	185	1	180	6	1080	0.61	500	1.2191	0.0373	0.6468	7.3144	0.2239	3.8811	0.6583	0.0202	0.3493
Excavator	Excavator	85	1	180	8	1440	0.57	120	0.5981	0.0320	0.3952	4.7852	0.2563	3.1616	0.4307	0.0231	0.2845
Rubber-Tired Loaders	Rubber Tired Loader	78	1	180	8	1440	0.54	480	0.5200	0.0279	0.3436	4.1600	0.2229	2.7486	0.3744	0.0201	0.2474
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	180	6	1080	0.57	250	1.5394	0.0471	0.8168	9.2361	0.2827	4.9008	0.8313	0.0254	0.4411
DumpTruck	Grader	473	1	180	4	720	0.57	500	2.8530	0.0892	1.5454	11.4121	0.3566	6.1815	1.0271	0.0321	0.5563
4000 Gallon Water Truck	Off-highway Truck	250	1	180	8	1440	0.57	250	1.5394	0.0471	0.8168	12.3148	0.3770	6.5344	1.1083	0.0339	0.5881
												62.40	**2.26**	**35.17**	**5.62**	**0.20**	**3.16**

Table A-3b. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 3

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Blythe Mesa Solar Project
Site Preparation/Grading/Earthwork
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 6,120	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOx lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Grader	Grader	185	1	90	6	540	250	0.1575	0.0547	172.1133	0.9449	0.3279	1032.6795	0.0425	0.0148	46.4706
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	90	4	720	120	0.0955	0.0007	62.4498	0.7640	0.0059	499.5985	0.0344	0.0003	22.4819
Track Type Dozer	Crawler Tractor	185	1	90	6	540	250	0.1764	0.0019	166.1315	1.0584	0.0112	996.7893	0.0476	0.0005	44.8555
Excavator	Excavator	85	1	90	8	720	120	0.1183	0.0657	73.6231	0.9462	0.5260	588.9848	0.0426	0.0237	26.5043
Rubber-Tired Loaders	Rubber Tired Loader	78	1	90	8	720	120	0.0971	0.0007	58.9135	0.7765	0.0055	471.3081	0.0349	0.0002	21.2089
Rollers	Roller	100	1	90	6	540	120	0.1054	0.0574	58.9888	0.6327	0.3446	353.9325	0.0285	0.0155	15.9270
Scrapers	Scraper	365	1	90	6	540	500	0.3186	0.0032	321.4286	1.9118	0.0189	1928.5717	0.0860	0.0009	86.7857
DumpTruck	Grader	473	1	90	4	360	500	0.2263	0.0705	272.3339	0.9052	0.2822	1089.3355	0.0407	0.0127	49.0201
4000 Gallon Water Truck	Off-highway Truck	250	1	90	8	720	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0529	0.0166	59.9563
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	120	0.1104	0.0633	80.8587	0.8832	0.5066	646.8698	0.0397	0.0228	29.1091

Concrete Foundations
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,100	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Pavers	Paving Equipment	173	1	90	6	540	250	0.1349	0.0507	122.2913	0.8093	0.3041	733.7475	0.0364	0.0137	33.0186
Concrete Pump	Concrete Pumps	10	4	90	4	1440	50	0.1155	0.0299	34.3348	1.8475	0.4782	549.3575	0.0831	0.0215	24.7211
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	90	6	1080	120	0.0955	0.0007	62.4498	1.1460	0.0088	749.3978	0.0516	0.0004	33.7229
Concrete Truck	Off-highway Truck	250	2	90	4	720	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0529	0.0166	59.9563
Drum Type Compactor	Paving Equipment	250	1	90	6	540	250	0.1349	0.0507	122.2913	0.8093	0.3041	733.7475	0.0364	0.0137	33.0186
ATV Gator Carts	Other Construction Equipment	100	1	90	6	540	120	0.1104	0.0633	80.8587	0.6624	0.3799	485.1523	0.0298	0.0171	21.8319
Welders	Welders	50	6	90	6	3240	50	0.1071	0.0260	25.9581	3.8551	0.9346	934.4901	0.1735	0.0421	42.0521

Table A-3b. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 3

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Structural Steel Work
4 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,760	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	120	5	1200	120	0.0955	0.0007	62.4498	0.9550	0.0073	624.4981	0.0573	0.0004	37.4699
30 Ton Crane Truck	Off-highway Truck	99	1	120	5	600	175	0.1441	0.0014	125.0878	0.7206	0.0070	625.4389	0.0432	0.0004	37.5263
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	120	6	720	250	0.1400	0.0019	166.5454	0.8398	0.0112	999.2724	0.0504	0.0007	59.9563
Compressor Truck	Air Compressor	25	2	120	8	1920	50	0.0266	0.0002	14.4462	0.4253	0.0029	231.1396	0.0255	0.0002	13.8684
Welders	Welders	50	6	120	6	4320	50	0.1071	0.0260	25.9581	3.8551	0.9346	934.4901	0.2313	0.0561	56.0694

Electrical/Instrumentation Work
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 3,240	HP Used for OFFROAD	SCAB ROG (lb/hr)	SCAB SOX (lb/hr)	SCAB CO2 (lb/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
30 Ton Crane Truck	Off-highway Truck	99	1	60	4	240	175	0.1441	0.0014	125.0878	0.5764	0.0056	500.3511	0.0173	0.0002	15.0105
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	60	6	720	120	0.0955	0.0007	62.4498	1.1460	0.0088	749.3978	0.0344	0.0003	22.4819
Carryall Vehicles	Off-highway Truck	180	2	60	4	480	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0353	0.0111	39.9709
Generator	Generator Sets	30	3	60	10	1800	50	0.0959	0.0255	30.6230	2.8770	0.7641	918.6896	0.0863	0.0229	27.5607

Architectural and Landscape
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,680	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	120	0.0694	0.0006	51.7280	0.5555	0.0049	413.8241	0.0167	0.0001	12.4147
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	175	0.1441	0.0014	125.0878	1.1529	0.0113	1000.7022	0.0346	0.0003	30.0211
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	120	0.0955	0.0007	62.4498	0.3820	0.0029	249.7993	0.0115	0.0001	7.4940
Vibratory Compactor	Paving Equipment	80	1	60	2	120	120	0.1150	0.0610	54.4994	0.2299	0.1219	108.9987	0.0069	0.0037	3.2700
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	120	0.0760	0.0432	51.7280	0.6083	0.3456	413.8241	0.0182	0.0104	12.4147
Trencher	Trencher	75	1	60	8	480	120	0.1354	0.0709	64.8951	1.0830	0.5671	519.1611	0.0325	0.0170	15.5748
Manlifts	Aerial Lift	75	2	60	8	960	120	0.0607	0.0324	38.0718	0.9718	0.5183	609.1490	0.0292	0.0155	18.2745
Generator	Generator Sets	30	3	60	8	1440	50	0.0959	0.0255	30.6230	2.3016	0.6112	734.9517	0.0690	0.0183	22.0486

Substation and O&M Bldgs
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 9,000	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	120	0.0694	0.0006	51.7280	0.5555	0.0049	413.8241	0.0167	0.0001	12.4147
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	120	0.0185	0.0045	15.3491	0.1481	0.0358	122.7929	0.0044	0.0011	3.6838
Track Type Dozer	Crawler Tractor	185	1	90	8	720	250	0.1764	0.0019	166.1315	1.4112	0.0150	1329.0524	0.0635	0.0007	59.8074
Excavator	Excavator	85	1	90	8	720	120	0.1183	0.0657	73.6231	0.9462	0.5260	588.9848	0.0426	0.0237	26.5043
Rollers	Roller	100	1	90	8	720	120	0.1054	0.0574	58.9888	0.8436	0.4595	471.9100	0.0380	0.0207	21.2360
4000 Gallon Water Truck	Off-highway Truck	250	2	90	8	1440	250	0.1469	0.0461	166.5454	2.3502	0.7368	2664.7258	0.1058	0.0332	119.9127
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	120	0.0955	0.0007	62.4498	0.3820	0.0029	249.7993	0.0115	0.0001	7.4940
Vibratory Compactor	Paving Equipment	80	1	60	2	120	120	0.1155	0.0299	34.3348	0.2309	0.0598	68.6697	0.0069	0.0018	2.0601
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	120	0.5949	0.2259	586.8778	4.7593	1.8072	4695.0227	0.1428	0.0542	140.8507
Trencher	Trencher	75	1	60	8	480	120	0.0703	0.0243	25.6027	0.5625	0.1944	204.8214	0.0169	0.0058	6.1446
Manlifts	Aerial Lift	75	2	60	8	960	120	0.0984	0.0469	63.6073	1.5737	0.7511	1017.7170	0.0472	0.0225	30.5315
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	120	0.1104	0.0633	80.8587	0.8832	0.5066	646.8698	0.0397	0.0228	29.1091
Generator	Generator Sets	30	3	60	8	1440	50	0.4147	0.1439	485.7416	9.9529	3.4547	11657.7984	0.2986	0.1036	349.7340

Table A-3b. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 3

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Transmission Line Installation

12 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 5,357	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOX lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Sleeving Rigs	Other Gen Indust Equipment	85	1	159	4	636	120	0.5779	0.2075	555.2765	2.3116	0.8301	2221.1061	0.1838	0.0660	176.5779
Hydralic Pump Motor	Pumps	10	2	11	5	110	15	0.2050	0.0901	143.8979	2.0499	0.9009	1438.9789	0.0113	0.0050	7.9144
580 Case Backhoe	Tractor/loader/backhoe	120	1	159	2	318	120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Spacing Carts	Other Gen Indust Equipment	10	4	159	4	2544	15	0.2916	0.1087	262.4958	4.6649	1.7389	4199.9328	0.3709	0.1382	333.8947
3 Drum Strawline Pullers	Other Gen Indust Equipment	85	1	159	4	636	120	0.1284	0.0703	80.2066	0.5135	0.2812	320.8265	0.0408	0.0224	25.5057
60lk Puller	Other Gen Indust Equipment	250	1	159	3	477	250	0.1661	0.0750	154.5445	0.4984	0.2249	463.6335	0.0396	0.0179	36.8589
Triple Conductor Tensioner	Other Gen Indust Equipment	250	1	159	2	318	250	0.1661	0.0750	154.5445	0.3323	0.1499	309.0890	0.0264	0.0119	24.5726
Sag Cat w2 winches	Grader	350	1	159	2	318	500	0.1894	0.0642	256.5709	0.3787	0.1285	513.1418	0.0301	0.0102	40.7948

Table A-4b. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 3

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	13.97	0.62	8.65

Blythe Mesa Solar Project
Site Preparation/Grading/Earthwork
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,320	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 CO (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Road Grader	Grader	185	1	90	6	540	0.61	250	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	90	4	720	0.6	250	0.7333	0.0393	0.4845	5.87	0.31	3.88	0.2640	0.0141	0.1744
Track Type Dozer	Grader	185	1	90	6	540	0.61	500	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Excavator	Excavator	85	1	90	8	720	0.57	120	0.5981	0.0320	0.3952	4.79	0.26	3.16	0.2153	0.0115	0.1423
Rubber-Tired Loaders	Rubber Tired Loader	78	1	90	8	720	0.54	250	0.5200	0.0279	0.3436	4.16	0.22	2.75	0.1872	0.0100	0.1237
Rollers	Roller	100	1	90	6	540	0.56	120	0.6049	0.0272	0.4568	3.63	0.16	2.74	0.1633	0.0073	0.1233
Scrapers	Scraper	365	1	90	6	540	0.72	250	2.7810	0.0869	1.5063	16.69	0.52	9.04	0.7509	0.0235	0.4067
DumpTruck	Grader	473	1	90	4	360	0.57	500	2.8530	0.0892	1.5454	11.41	0.36	6.18	0.5135	0.0160	0.2782
4000 Gallon Water Truck	Off-highway Truck	250	1	90	8	720	0.57	250	1.5394	0.0471	0.8168	12.31	0.38	6.53	0.5542	0.0170	0.2940
ATV Gator Carts	Other Construction Equipment	100	1	90	4	360	0.62	120	0.6698	0.0301	0.5057	2.68	0.12	2.02	0.1206	0.0054	0.0910

Concrete Foundations
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,100	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 CO (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Pavers	Paving Equipment	173	1	90	6	540	0.53	250	0.9905	0.0445	0.7479	5.94	0.27	4.49	0.2674	0.0120	0.2019
Concrete Pump	Concrete Pumps	10	4	90	4	1440	0.74	50	0.0914	0.0098	0.0979	1.46	0.16	1.57	0.0658	0.0070	0.0705
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	90	6	1080	0.6	250	0.7333	0.0393	0.4845	8.80	0.47	5.81	0.3960	0.0212	0.2616
Concrete Truck	Off-highway Truck	250	2	90	4	720	0.57	250	1.5394	0.0471	0.8168	12.31	0.38	6.53	0.5542	0.0170	0.2940
Drum Type Compactor	Paving Equipment	250	1	90	6	540	0.53	250	1.4313	0.0438	0.7595	8.59	0.26	4.56	0.3865	0.0118	0.2051
ATV Gator Carts	Other Construction Equipment	100	1	90	6	540	0.53	250	0.5725	0.0257	0.4323	3.44	0.15	2.59	0.1546	0.0069	0.1167
Welders	Welders	50	6	90	6	3240	0.45	50	0.2778	0.0149	0.1835	10.00	0.54	6.61	0.4500	0.0241	0.2973

Table A-4b. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 3

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	13.97	0.62	8.65

Blythe Mesa Solar Project
Structural Steel Work
4 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,520	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	120	5	1200	0.6	250	0.7333	0.0393	0.4845	7.33	0.39	4.85	0.4400	0.0236	0.2907
30 Ton Crane Truck	Off-highway Truck	99	1	120	5	600	0.57	500	0.6967	0.0373	0.4603	3.48	0.19	2.30	0.2090	0.0112	0.1381
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	120	4	480	0.57	500	1.5394	0.0471	0.8168	6.16	0.19	3.27	0.3694	0.0113	0.1960
Compressor Truck	Off-highway Truck	25	2	120	8	1920	0.57	500	0.1759	0.0141	0.1288	2.81	0.23	2.06	0.1689	0.0136	0.1237
Welders	Welders	50	6	120	6	4320	0.45	50	0.2778	0.0149	0.1835	10.00	0.54	6.61	0.6000	0.0321	0.3964

Electrical/Instrumentation Work
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 3,240	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lb/hr)	TIER 2 PM (lb/hr)	TIER 2 CO (lb/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
30 Ton Crane Truck	Off-highway Truck	99	1	60	4	240	0.57	500	0.6967	0.0373	0.4603	2.79	0.15	1.84	0.0836	0.0045	0.0552
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	60	6	720	0.6	500	0.7333	0.0393	0.4845	8.80	0.47	5.81	0.2640	0.0141	0.1744
Carryall Vehicles	Off-highway Truck	180	2	60	4	480	0.57	250	1.1083	0.0339	0.5881	8.87	0.27	4.70	0.2660	0.0081	0.1411
Generator	Generator Sets	30	3	60	10	1800	0.74	50	0.2741	0.0220	0.2007	8.22	0.66	6.02	0.2467	0.0198	0.1806

Architectural and Landscape **Upgrade**
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,680	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	0.55	250	0.5296	0.0284	0.3499	4.24	0.23	2.80	0.1271	0.0068	0.0840
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	0.57	250	0.6967	0.0373	0.4603	5.57	0.30	3.68	0.1672	0.0090	0.1105
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	0.6	250	0.7333	0.0393	0.4845	2.93	0.16	1.94	0.0880	0.0047	0.0581
Vibratory Compactor	Paving Equipment	80	1	60	2	120	0.53	120	0.5235	0.0280	0.3459	1.05	0.06	0.69	0.0314	0.0017	0.0208
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	0.55	120	0.5772	0.0309	0.3813	4.62	0.25	3.05	0.1385	0.0074	0.0915
Trencher	Trencher	75	1	60	8	480	0.75	120	0.6944	0.0372	0.4588	5.56	0.30	3.67	0.1667	0.0089	0.1101
Manlifts	Aerial Lift	75	2	60	8	960	0.46	120	0.4259	0.0228	0.2814	6.81	0.37	4.50	0.2044	0.0110	0.1351
Generator	Generator Sets	30	3	60	8	1440	0.74	50	0.2741	0.0220	0.2007	6.58	0.53	4.82	0.1973	0.0159	0.1445

Substation and O&M Bldgs
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,220	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	6	360	0.55	250	0.5296	0.0284	0.3499	3.18	0.17	2.10	0.0953	0.0051	0.0630
30 Ton Crane Truck	Off-highway Truck	99	1	60	6	360	0.57	250	0.6967	0.0373	0.4603	4.18	0.22	2.76	0.1254	0.0067	0.0829
Track Type Dozer	Grader	185	1	90	6	540	0.61	500	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Excavator	Excavator	85	1	90	6	540	0.57	120	0.5981	0.0320	0.3952	3.59	0.19	2.37	0.1615	0.0087	0.1067
Rollers	Roller	100	1	90	6	540	0.56	120	0.6049	0.0272	0.4568	3.63	0.16	2.74	0.1633	0.0073	0.1233
4000 Gallon Water Truck	Off-highway Truck	250	2	90	8	1440	0.57	250	1.5394	0.0471	0.8168	24.63	0.75	13.07	1.1083	0.0339	0.5881
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	0.6	250	0.7333	0.0393	0.4845	2.93	0.16	1.94	0.0880	0.0047	0.0581
Vibratory Compactor	Paving Equipment	80	1	60	2	120	0.53	120	0.5235	0.0280	0.3459	1.05	0.06	0.69	0.0314	0.0017	0.0208
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	0.55	120	0.5772	0.0309	0.3813	4.62	0.25	3.05	0.1385	0.0074	0.0915
Trencher	Trencher	75	1	60	8	480	0.75	120	0.6944	0.0372	0.4588	5.56	0.30	3.67	0.1667	0.0089	0.1101
Manlifts	Aerial Lift	75	2	60	8	960	0.46	120	0.4259	0.0228	0.2814	6.81	0.37	4.50	0.2044	0.0110	0.1351
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	0.62	120	0.6698	0.0301	0.5057	5.36	0.24	4.05	0.2411	0.0108	0.1821
Generator	Generator Sets	30	3	60	8	1440	0.74	50	0.2741	0.0220	0.2007	6.58	0.53	4.82	0.1973	0.0159	0.1445

Table A-4b. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 3

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	13.97	0.62	8.65

Blythe Mesa Solar Project

Transmission Line Installation
12 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 5,357	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Sleeving Rigs	Other Gen Indust Equipment	85	1	159	4	636	0.51	120	0.5352	0.0287	0.3536	2.14	0.11	1.41	0.1702	0.0091	0.1124
Hydralic Pump Motor	Pumps	10	2	11	5	110	0.74	15	0.0914	0.0098	0.0979	0.91	0.10	0.98	0.0050	0.0005	0.0054
580 Case Backhoe	Tractor/loader/backhoe	120	1	159	2	318	0.55	120	0.7130	0.0320	0.5384	1.43	0.06	1.08	0.1134	0.0051	0.0856
Spacing Carts	Other Gen Indust Equipment	10	4	159	4	2544	0.51	15	0.0630	0.0067	0.0675	1.01	0.11	1.08	0.0801	0.0086	0.0858
3 Drum Strawline Pullers	Other Gen Indust Equipment	85	1	159	4	636	0.51	120	0.5352	0.0287	0.3536	2.14	0.11	1.41	0.1702	0.0091	0.1124
60lk Puller	Other Gen Indust Equipment	250	1	159	3	477	0.51	250	1.3773	0.0422	0.7308	4.13	0.13	2.19	0.3285	0.0101	0.1743
Triple Conductor Tensioner	Other Gen Indust Equipment	250	1	159	2	318	0.51	250	1.3773	0.0422	0.7308	2.75	0.08	1.46	0.2190	0.0067	0.1162
Sag Cat w2 winches	Grader	350	1	159	2	318	0.61	500	2.2593	0.0706	1.2238	4.52	0.14	2.45	0.3592	0.0112	0.1946

Table A-3c. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 4

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Blythe Mesa Solar Project
Site Preparation/Grading/Earthwork
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 6,120	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOx lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Grader	Grader	185	1	90	6	540	250	0.1575	0.0547	172.1133	0.9449	0.3279	1032.6795	0.0425	0.0148	46.4706
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	90	4	720	120	0.0955	0.0007	62.4498	0.7640	0.0059	499.5985	0.0344	0.0003	22.4819
Track Type Dozer	Crawler Tractor	185	1	90	6	540	250	0.1764	0.0019	166.1315	1.0584	0.0112	996.7893	0.0476	0.0005	44.8555
Excavator	Excavator	85	1	90	8	720	120	0.1183	0.0657	73.6231	0.9462	0.5260	588.9848	0.0426	0.0237	26.5043
Rubber-Tired Loaders	Rubber Tired Loader	78	1	90	8	720	120	0.0971	0.0007	58.9135	0.7765	0.0055	471.3081	0.0349	0.0002	21.2089
Rollers	Roller	100	1	90	6	540	120	0.1054	0.0574	58.9888	0.6327	0.3446	353.9325	0.0285	0.0155	15.9270
Scrapers	Scraper	365	1	90	6	540	500	0.3186	0.0032	321.4286	1.9118	0.0189	1928.5717	0.0860	0.0009	86.7857
DumpTruck	Grader	473	1	90	4	360	500	0.2263	0.0705	272.3339	0.9052	0.2822	1089.3355	0.0407	0.0127	49.0201
4000 Gallon Water Truck	Off-highway Truck	250	1	90	8	720	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0529	0.0166	59.9563
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	120	0.1104	0.0633	80.8587	0.8832	0.5066	646.8698	0.0397	0.0228	29.1091

Concrete Foundations
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,100	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Pavers	Paving Equipment	173	1	90	6	540	250	0.1349	0.0507	122.2913	0.8093	0.3041	733.7475	0.0364	0.0137	33.0186
Concrete Pump	Concrete Pumps	10	4	90	4	1440	50	0.1155	0.0299	34.3348	1.8475	0.4782	549.3575	0.0831	0.0215	24.7211
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	90	6	1080	120	0.0955	0.0007	62.4498	1.1460	0.0088	749.3978	0.0516	0.0004	33.7229
Concrete Truck	Off-highway Truck	250	2	90	4	720	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0529	0.0166	59.9563
Drum Type Compactor	Paving Equipment	250	1	90	6	540	250	0.1349	0.0507	122.2913	0.8093	0.3041	733.7475	0.0364	0.0137	33.0186
ATV Gator Carts	Other Construction Equipment	100	1	90	6	540	120	0.1104	0.0633	80.8587	0.6624	0.3799	485.1523	0.0298	0.0171	21.8319
Welders	Welders	50	6	90	6	3240	50	0.1071	0.0260	25.9581	3.8551	0.9346	934.4901	0.1735	0.0421	42.0521

Table A-3c. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 4

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Structural Steel Work
4 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,760	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	120	5	1200	120	0.0955	0.0007	62.4498	0.9550	0.0073	624.4981	0.0573	0.0004	37.4699
30 Ton Crane Truck	Off-highway Truck	99	1	120	5	600	175	0.1441	0.0014	125.0878	0.7206	0.0070	625.4389	0.0432	0.0004	37.5263
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	120	6	720	250	0.1400	0.0019	166.5454	0.8398	0.0112	999.2724	0.0504	0.0007	59.9563
Compressor Truck	Air Compressor	25	2	120	8	1920	50	0.0266	0.0002	14.4462	0.4253	0.0029	231.1396	0.0255	0.0002	13.8684
Welders	Welders	50	6	120	6	4320	50	0.1071	0.0260	25.9581	3.8551	0.9346	934.4901	0.2313	0.0561	56.0694

Electrical/Instrumentation Work
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 3,240	HP Used for OFFROAD	SCAB ROG (lb/hr)	SCAB SOX (lb/hr)	SCAB CO2 (lb/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
30 Ton Crane Truck	Off-highway Truck	99	1	60	4	240	175	0.1441	0.0014	125.0878	0.5764	0.0056	500.3511	0.0173	0.0002	15.0105
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	60	6	720	120	0.0955	0.0007	62.4498	1.1460	0.0088	749.3978	0.0344	0.0003	22.4819
Carryall Vehicles	Off-highway Truck	180	2	60	4	480	250	0.1469	0.0461	166.5454	1.1751	0.3684	1332.3629	0.0353	0.0111	39.9709
Generator	Generator Sets	30	3	60	10	1800	50	0.0959	0.0255	30.6230	2.8770	0.7641	918.6896	0.0863	0.0229	27.5607

Architectural and Landscape
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,680	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	120	0.0694	0.0006	51.7280	0.5555	0.0049	413.8241	0.0167	0.0001	12.4147
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	175	0.1441	0.0014	125.0878	1.1529	0.0113	1000.7022	0.0346	0.0003	30.0211
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	120	0.0955	0.0007	62.4498	0.3820	0.0029	249.7993	0.0115	0.0001	7.4940
Vibratory Compactor	Paving Equipment	80	1	60	2	120	120	0.1150	0.0610	54.4994	0.2299	0.1219	108.9987	0.0069	0.0037	3.2700
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	120	0.0760	0.0432	51.7280	0.6083	0.3456	413.8241	0.0182	0.0104	12.4147
Trencher	Trencher	75	1	60	8	480	120	0.1354	0.0709	64.8951	1.0830	0.5671	519.1611	0.0325	0.0170	15.5748
Manlifts	Aerial Lift	75	2	60	8	960	120	0.0607	0.0324	38.0718	0.9718	0.5183	609.1490	0.0292	0.0155	18.2745
Generator	Generator Sets	30	3	60	8	1440	50	0.0959	0.0255	30.6230	2.3016	0.6112	734.9517	0.0690	0.0183	22.0486

Substation and O&M Bldgs
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 9,000	HP Used for OFFROAD	SCAB ROG (lbs/hr)	SCAB SOX (lbs/hr)	SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB PM lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	120	0.0694	0.0006	51.7280	0.5555	0.0049	413.8241	0.0167	0.0001	12.4147
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	120	0.0185	0.0045	15.3491	0.1481	0.0358	122.7929	0.0044	0.0011	3.6838
Track Type Dozer	Crawler Tractor	185	1	90	8	720	250	0.1764	0.0019	166.1315	1.4112	0.0150	1329.0524	0.0635	0.0007	59.8074
Excavator	Excavator	85	1	90	8	720	120	0.1183	0.0657	73.6231	0.9462	0.5260	588.9848	0.0426	0.0237	26.5043
Rollers	Roller	100	1	90	8	720	120	0.1054	0.0574	58.9888	0.8436	0.4595	471.9100	0.0380	0.0207	21.2360
4000 Gallon Water Truck	Off-highway Truck	250	2	90	8	1440	250	0.1469	0.0461	166.5454	2.3502	0.7368	2664.7258	0.1058	0.0332	119.9127
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	120	0.0955	0.0007	62.4498	0.3820	0.0029	249.7993	0.0115	0.0001	7.4940
Vibratory Compactor	Paving Equipment	80	1	60	2	120	120	0.1155	0.0299	34.3348	0.2309	0.0598	68.6697	0.0069	0.0018	2.0601
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	120	0.5949	0.2259	586.8778	4.7593	1.8072	4695.0227	0.1428	0.0542	140.8507
Trencher	Trencher	75	1	60	8	480	120	0.0703	0.0243	25.6027	0.5625	0.1944	204.8214	0.0169	0.0058	6.1446
Manlifts	Aerial Lift	75	2	60	8	960	120	0.0984	0.0469	63.6073	1.5737	0.7511	1017.7170	0.0472	0.0225	30.5315
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	120	0.1104	0.0633	80.8587	0.8832	0.5066	646.8698	0.0397	0.0228	29.1091
Generator	Generator Sets	30	3	60	8	1440	50	0.4147	0.1439	485.7416	9.9529	3.4547	11657.7984	0.2986	0.1036	349.7340

Table A-3c. Offroad Emissions Calculation - Using SCAB Emission Factors - Alternative 4

2012 SCAB emission factors (EFs) corresponding to OFFROAD2007 model are applied to CO2, ROG, and SOX.
Tier 2 and 3 EFs are applied to NOx, PM, and CO. Calculation details are provided in *Offroad Tier 2* and *Offroad Tier 3* worksheets.
Load factors are used in conjunction with Tier 2and 3 EFs.

Offroad Equipment Project Total

ROG lbs/day	SOx lbs/day	CO2 lbs/day	ROG (tons)	SOX (tons)	CO2 (tons)
35.35	12.81	33598.70	1.71	0.39	1,082.07

Transmission Line Installation

12 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 5,796	HP Used for OFFROAD	2012 SCAB ROG (lbs/hr)	2012 SCAB SOX (lbs/hr)	2012 SCAB CO2 (lbs/hr)	2012 SCAB ROG lbs/day	2012 SCAB SOX lbs/day	2012 SCAB CO2 lbs/day	2012 SCAB ROG (tons)	2012 SCAB SOX (tons)	2012 SCAB CO2 (tons)
Sleeving Rigs	Other Gen Indust Equipment	85	1	172	4	688	120	0.5779	0.2075	555.2765	2.3116	0.8301	2221.1061	0.1988	0.0714	191.0151
Hydralic Pump Motor	Pumps	10	2	12	5	120	15	0.2050	0.0901	143.8979	2.0499	0.9009	1438.9789	0.0123	0.0054	8.6339
580 Case Backhoe	Tractor/loader/backhoe	120	1	172	2	344	120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Spacing Carts	Other Gen Indust Equipment	10	4	172	4	2752	15	0.2916	0.1087	262.4958	4.6649	1.7389	4199.9328	0.4012	0.1495	361.1942
3 Drum Strawline Pullers	Other Gen Indust Equipment	85	1	172	4	688	120	0.1284	0.0703	80.2066	0.5135	0.2812	320.8265	0.0442	0.0242	27.5911
60lk Puller	Other Gen Indust Equipment	250	1	172	3	516	250	0.1661	0.0750	154.5445	0.4984	0.2249	463.6335	0.0429	0.0193	39.8725
Triple Conductor Tensioner	Other Gen Indust Equipment	250	1	172	2	344	250	0.1661	0.0750	154.5445	0.3323	0.1499	309.0890	0.0286	0.0129	26.5817
Sag Cat w2 winches	Grader	350	1	172	2	344	500	0.1894	0.0642	256.5709	0.3787	0.1285	513.1418	0.0326	0.0111	44.1302

Table A-4c. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 4

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	14.08	0.63	8.72

Blythe Mesa Solar Project
Site Preparation/Grading/Earthwork
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,320	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 CO (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Road Grader	Grader	185	1	90	6	540	0.61	250	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Rough-Terrain Forklifts	Rough Terrain Forklift	99	2	90	4	720	0.6	250	0.7333	0.0393	0.4845	5.87	0.31	3.88	0.2640	0.0141	0.1744
Track Type Dozer	Grader	185	1	90	6	540	0.61	500	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Excavator	Excavator	85	1	90	8	720	0.57	120	0.5981	0.0320	0.3952	4.79	0.26	3.16	0.2153	0.0115	0.1423
Rubber-Tired Loaders	Rubber Tired Loader	78	1	90	8	720	0.54	250	0.5200	0.0279	0.3436	4.16	0.22	2.75	0.1872	0.0100	0.1237
Rollers	Roller	100	1	90	6	540	0.56	120	0.6049	0.0272	0.4568	3.63	0.16	2.74	0.1633	0.0073	0.1233
Scrapers	Scraper	365	1	90	6	540	0.72	250	2.7810	0.0869	1.5063	16.69	0.52	9.04	0.7509	0.0235	0.4067
DumpTruck	Grader	473	1	90	4	360	0.57	500	2.8530	0.0892	1.5454	11.41	0.36	6.18	0.5135	0.0160	0.2782
4000 Gallon Water Truck	Off-highway Truck	250	1	90	8	720	0.57	250	1.5394	0.0471	0.8168	12.31	0.38	6.53	0.5542	0.0170	0.2940
ATV Gator Carts	Other Construction Equipment	100	1	90	4	360	0.62	120	0.6698	0.0301	0.5057	2.68	0.12	2.02	0.1206	0.0054	0.0910

Concrete Foundations
3 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,100	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 CO (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Pavers	Paving Equipment	173	1	90	6	540	0.53	250	0.9905	0.0445	0.7479	5.94	0.27	4.49	0.2674	0.0120	0.2019
Concrete Pump	Concrete Pumps	10	4	90	4	1440	0.74	50	0.0914	0.0098	0.0979	1.46	0.16	1.57	0.0658	0.0070	0.0705
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	90	6	1080	0.6	250	0.7333	0.0393	0.4845	8.80	0.47	5.81	0.3960	0.0212	0.2616
Concrete Truck	Off-highway Truck	250	2	90	4	720	0.57	250	1.5394	0.0471	0.8168	12.31	0.38	6.53	0.5542	0.0170	0.2940
Drum Type Compactor	Paving Equipment	250	1	90	6	540	0.53	250	1.4313	0.0438	0.7595	8.59	0.26	4.56	0.3865	0.0118	0.2051
ATV Gator Carts	Other Construction Equipment	100	1	90	6	540	0.53	250	0.5725	0.0257	0.4323	3.44	0.15	2.59	0.1546	0.0069	0.1167
Welders	Welders	50	6	90	6	3240	0.45	50	0.2778	0.0149	0.1835	10.00	0.54	6.61	0.4500	0.0241	0.2973

Table A-4c. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 4

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	14.08	0.63	8.72

Blythe Mesa Solar Project
Structural Steel Work
4 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,520	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
10,000 lb Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	120	5	1200	0.6	250	0.7333	0.0393	0.4845	7.33	0.39	4.85	0.4400	0.0236	0.2907
30 Ton Crane Truck	Off-highway Truck	99	1	120	5	600	0.57	500	0.6967	0.0373	0.4603	3.48	0.19	2.30	0.2090	0.0112	0.1381
80 Ton Rough Terrain Cranes	Off-highway Truck	250	1	120	4	480	0.57	500	1.5394	0.0471	0.8168	6.16	0.19	3.27	0.3694	0.0113	0.1960
Compressor Truck	Off-highway Truck	25	2	120	8	1920	0.57	500	0.1759	0.0141	0.1288	2.81	0.23	2.06	0.1689	0.0136	0.1237
Welders	Welders	50	6	120	6	4320	0.45	50	0.2778	0.0149	0.1835	10.00	0.54	6.61	0.6000	0.0321	0.3964

Electrical/Instrumentation Work
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 3,240	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lb/hr)	TIER 2 PM (lb/hr)	TIER 2 CO (lb/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
30 Ton Crane Truck	Off-highway Truck	99	1	60	4	240	0.57	500	0.6967	0.0373	0.4603	2.79	0.15	1.84	0.0836	0.0045	0.0552
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	2	60	6	720	0.6	500	0.7333	0.0393	0.4845	8.80	0.47	5.81	0.2640	0.0141	0.1744
Carryall Vehicles	Off-highway Truck	180	2	60	4	480	0.57	250	1.1083	0.0339	0.5881	8.87	0.27	4.70	0.2660	0.0081	0.1411
Generator	Generator Sets	30	3	60	10	1800	0.74	50	0.2741	0.0220	0.2007	8.22	0.66	6.02	0.2467	0.0198	0.1806

Architectural and Landscape **Upgrade**
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 4,680	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	8	480	0.55	250	0.5296	0.0284	0.3499	4.24	0.23	2.80	0.1271	0.0068	0.0840
30 Ton Crane Truck	Off-highway Truck	99	1	60	8	480	0.57	250	0.6967	0.0373	0.4603	5.57	0.30	3.68	0.1672	0.0090	0.1105
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	0.6	250	0.7333	0.0393	0.4845	2.93	0.16	1.94	0.0880	0.0047	0.0581
Vibratory Compactor	Paving Equipment	80	1	60	2	120	0.53	120	0.5235	0.0280	0.3459	1.05	0.06	0.69	0.0314	0.0017	0.0208
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	0.55	120	0.5772	0.0309	0.3813	4.62	0.25	3.05	0.1385	0.0074	0.0915
Trencher	Trencher	75	1	60	8	480	0.75	120	0.6944	0.0372	0.4588	5.56	0.30	3.67	0.1667	0.0089	0.1101
Manlifts	Aerial Lift	75	2	60	8	960	0.46	120	0.4259	0.0228	0.2814	6.81	0.37	4.50	0.2044	0.0110	0.1351
Generator	Generator Sets	30	3	60	8	1440	0.74	50	0.2741	0.0220	0.2007	6.58	0.53	4.82	0.1973	0.0159	0.1445

Substation and O&M Bldgs
2 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 8,220	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Front Loader	Tractor/loader/backhoe	78	1	60	6	360	0.55	250	0.5296	0.0284	0.3499	3.18	0.17	2.10	0.0953	0.0051	0.0630
30 Ton Crane Truck	Off-highway Truck	99	1	60	6	360	0.57	250	0.6967	0.0373	0.4603	4.18	0.22	2.76	0.1254	0.0067	0.0829
Track Type Dozer	Grader	185	1	90	6	540	0.61	500	1.2191	0.0373	0.6468	7.31	0.22	3.88	0.3291	0.0101	0.1746
Excavator	Excavator	85	1	90	6	540	0.57	120	0.5981	0.0320	0.3952	3.59	0.19	2.37	0.1615	0.0087	0.1067
Rollers	Roller	100	1	90	6	540	0.56	120	0.6049	0.0272	0.4568	3.63	0.16	2.74	0.1633	0.0073	0.1233
4000 Gallon Water Truck	Off-highway Truck	250	2	90	8	1440	0.57	250	1.5394	0.0471	0.8168	24.63	0.75	13.07	1.1083	0.0339	0.5881
20,000 lb. Rough Terrain Fork Lift	Rough Terrain Forklift	99	1	60	4	240	0.6	250	0.7333	0.0393	0.4845	2.93	0.16	1.94	0.0880	0.0047	0.0581
Vibratory Compactor	Paving Equipment	80	1	60	2	120	0.53	120	0.5235	0.0280	0.3459	1.05	0.06	0.69	0.0314	0.0017	0.0208
Backhoe	Tractor/loader/backhoe	85	1	60	8	480	0.55	120	0.5772	0.0309	0.3813	4.62	0.25	3.05	0.1385	0.0074	0.0915
Trencher	Trencher	75	1	60	8	480	0.75	120	0.6944	0.0372	0.4588	5.56	0.30	3.67	0.1667	0.0089	0.1101
Manlifts	Aerial Lift	75	2	60	8	960	0.46	120	0.4259	0.0228	0.2814	6.81	0.37	4.50	0.2044	0.0110	0.1351
ATV Gator Carts	Other Construction Equipment	100	1	90	8	720	0.62	120	0.6698	0.0301	0.5057	5.36	0.24	4.05	0.2411	0.0108	0.1821
Generator	Generator Sets	30	3	60	8	1440	0.74	50	0.2741	0.0220	0.2007	6.58	0.53	4.82	0.1973	0.0159	0.1445

Table A-4c. Offroad Emissions Calculations - Using Tier 2 Emission Factors - Alternative 4

Tier 2 emission factors (EFs) are applied to NOx, PM, and CO. Load Factors (LFs) are used in conjunction with Tier 2 EFs.
2012 SCAB EFs (OFFROAD2007) are applied to CO2, ROG, and SOX. Calculation detail is provided in Offroad SCAB worksheet.

Offroad Equipment Project Total

NOX lbs/day	PM lbs/day	CO lbs/day	NOX (tons)	PM (tons)	CO (tons)
99.36	4.61	63.31	14.08	0.63	8.72

Blythe Mesa Solar Project

Transmission Line Installation
12 months

Primary Equipment Description	Offroad Equip Category	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization 5,796	Load Factor for Tier 2	HP Used for OFFROAD	TIER 2 NOX (lbs/hr)	TIER 2 PM (lbs/hr)	TIER 2 CO (lbs/hr)	TIER 2 NOX lbs/day	TIER 2 PM lbs/day	TIER 2 CO lbs/day	TIER 2 NOX (tons)	TIER 2 PM (tons)	TIER 2 CO (tons)
Sleeving Rigs	Other Gen Indust Equipment	85	1	172	4	688	0.51	120	0.5352	0.0287	0.3536	2.14	0.11	1.41	0.1841	0.0099	0.1216
Hydralic Pump Motor	Pumps	10	2	12	5	120	0.74	15	0.0914	0.0098	0.0979	0.91	0.10	0.98	0.0055	0.0006	0.0059
580 Case Backhoe	Tractor/loader/backhoe	120	1	172	2	344	0.55	120	0.7130	0.0320	0.5384	1.43	0.06	1.08	0.1226	0.0055	0.0926
Spacing Carts	Other Gen Indust Equipment	10	4	172	4	2752	0.51	15	0.0630	0.0067	0.0675	1.01	0.11	1.08	0.0866	0.0093	0.0928
3 Drum Strawline Pullers	Other Gen Indust Equipment	85	1	172	4	688	0.51	120	0.5352	0.0287	0.3536	2.14	0.11	1.41	0.1841	0.0099	0.1216
60lk Puller	Other Gen Indust Equipment	250	1	172	3	516	0.51	250	1.3773	0.0422	0.7308	4.13	0.13	2.19	0.3553	0.0109	0.1886
Triple Conductor Tensioner	Other Gen Indust Equipment	250	1	172	2	344	0.51	250	1.3773	0.0422	0.7308	2.75	0.08	1.46	0.2369	0.0073	0.1257
Sag Cat w2 winches	Grader	350	1	172	2	344	0.61	500	2.2593	0.0706	1.2238	4.52	0.14	2.45	0.3886	0.0121	0.2105

Table A-5. ARB and USEPA Off-Road Compression-Ignition (Diesel) Engine Standards (NMHC+NOx/CO/PM in g/bhp-hr). When ARB and USEPA standards differ, the standards shown here represent the more stringent of the two.

Maximum horsepower	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2012	2012	2015+
<11	See Table 2 footnote (a)					7.8 / 6.0 / 0.75					5.6 / 6.0 / 0.6			5.6 / 6.0 / 0.30[a]							
11≤hp<25						7.1 / 4.9 / 0.60					5.6 / 4.9 / 0.60			5.6 / 4.9 / 0.30							
25≤hp<50	-					7.1 /4.1 / 0.60				5.6 / 4.1 / 0.45				5.6 / 4.1 / 0.22				3.5 / 4.1 / 0.02			
50≤hp< 75						- / 6.9 / - / -[b]				5.6 / 3.7 / 0.30				3.5 / 3.7 / 0.22[c]				3.5 / 3.7 / 0.02[c]			
75≤hp<100														3.5 / 3.7 / 0.30			0.14 / 2.5 / 3.7 / 0.015[b,d]				0.14 / 0.30 / 3.7 / 0.015[b]
100≤hp<175									4.9 / 3.7 / 0.22				3.0 / 3.7 / 0.22								
175≤hp<300									4.9 / 2.6 / 0.15			3.0 / 2.6 / 0.15[e]					0.14 / 1.5 / 2.6 / 0.015[b,d]				0.14 / 0.30 / 2.2 / 0.015[b]
300≤hp<600	-		1.0 / 6.9 / 8.5 / 0.40[b]				4.8 / 2.6 / 0.15														
600≤hp≤750																					
Mobile Machines > 750hp	-					1.0 / 6.9 / 8.5 / 0.40[b]					4.8 / 2.6 / 0.15						0.30 / 2.6 / 2.6 / 0.07[b]				0.14 / 2.6 / 2.6 / 0.03[b]
750hp<GEN ≤1200hp																					0.14 / 0.50 / 2.6 / 0.02[b]
GEN>1200 hp																	0.30 / 0.50 / 2.6 / 0.07[b]				

a) The PM standard for hand-start, air cooled, direct injection engines below 11 hp may be delayed until 2010 and be set at 0.45 g/bhp-hr.
b) Standards given are NMHC/NOx/CO/PM in g/bhp-hr.
c) Engine families in this power category may alternately meet Tier 3 PM standards (0.30 g/bhp-hr) from 2008-2011 in exchange for introducing final PM standards in 2012.
d) The implementation schedule shown is the three-year alternate NOx approach. Other schedules are available.
e) Certain manufacturers have agreed to comply with these standards by 2005.

: Tier 1 : Tier 2 : Tier 3 : Tier 4 Interim / Final

	TIER 2 Emission Factors						TIER 3 Emission Factors						% reduction from TIER 2 to TIER 3		
	NOx		CO		PM		NOx		CO		PM		NOx	CO	PM
Maximum horsepower	g/bhp-hr	lb/bhp-hr	g/bhp-hr	lb/bhp-hr	g/bhp-hr	lb/bhp-hr	g/bhp-hr	lb/bhp-hr	g/bhp-hr	lb/bhp-hr	g/bhp-hr	lb/bhp-hr			
<11	5.6	0.0123457	6	0.0132275	0.6	0.0013228	5.6	0.0123457	6	0.0132275	0.6	0.0013228	0.00%	0.00%	0.00%
11≤hp<25	5.6	0.0123457	4.9	0.0108025	0.6	0.0013228	5.6	0.0123457	4.9	0.0108025	0.6	0.0013228	0.00%	0.00%	0.00%
25≤hp<50	5.6	0.0123457	4.1	0.0090388	0.45	0.0009921	5.6	0.0123457	4.1	0.0090388	0.45	0.0009921	0.00%	0.00%	0.00%
50≤hp< 75	5.6	0.0123457	3.7	0.008157	0.3	0.0006614	5.6	0.0123457	3.7	0.008157	0.3	0.0006614	0.00%	0.00%	0.00%
75≤hp<100	5.6	0.0123457	3.7	0.008157	0.3	0.0006614	3.5	0.007716	3.7	0.008157	0.3	0.0006614	37.50%	0.00%	0.00%
100≤hp<175	4.9	0.0108025	3.7	0.008157	0.22	0.000485	3	0.0066138	3.7	0.008157	0.22	0.000485	38.78%	0.00%	0.00%
175≤hp<300	4.9	0.0108025	2.6	0.0057319	0.15	0.0003307	3	0.0066138	2.6	0.0057319	0.15	0.0003307	38.78%	0.00%	0.00%
300≤hp<600	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	3	0.0066138	2.6	0.0057319	0.15	0.0003307	37.50%	0.00%	0.00%
600≤hp≤750	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	3	0.0066138	2.6	0.0057319	0.15	0.0003307	37.50%	0.00%	0.00%
Mobile Machines > 750hp	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	0.00%	0.00%	0.00%
	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	0.00%	0.00%	0.00%
750hp<GEN ≤1200hp	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	0.00%	0.00%	0.00%
GEN>1200 hp	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	4.8	0.010582	2.6	0.0057319	0.15	0.0003307	0.00%	0.00%	0.00%

: Tier 2

: Tier 3

Table A-6. PSR Offroad Load Factors

Used in conjunction with Tier 2-3 emission factors.

Source: mailout MSC99-32, http://www.arb.ca.gov/msei/onroad/downloads/pubs/mo9932.zip (4/2/2009)

Category	Equipment	HP	P/N	Activity (hrs/yr)	Load
Agricultural	Agricultural Mowers	120	P	363	0.43
	Agricultural Tractors	50	P	475	0.70
		120	P	475	0.70
		175	P	475	0.70
		250	N	475	0.70
		500	N	475	0.70
	Balers	50	P	95	0.58
		120	P	95	0.58
	Combines	120	P	150	0.70
		175	P	150	0.70
		250	N	150	0.70
		500	N	150	0.70
	Hydro Power Units	50	P	790	0.48
		120	P	790	0.48
	Irrigation Pumps	50	P	749	0.65
		120	P	749	0.65
		175	P	749	0.65
		250	N	749	0.65
		500	N	749	0.65
	Other Agricultural Equipment	50	P	381	0.51
		120	P	381	0.51
		175	P	381	0.51
		250	N	381	0.51
		500	N	381	0.51
	Sprayers	50	P	90	0.50
		120	P	90	0.50
		175	P	90	0.50
		250	N	90	0.50
		500	N	90	0.50
	Swathers	120	P	110	0.55
		175	P	110	0.55
	Tillers >5 HP	250	N	172	0.78
		500	N	172	0.78
Commercial	Air Compressors	50	P	815	0.48
		120	P	815	0.48
		175	P	815	0.48
		250	N	815	0.48
		500	N	815	0.48
		750	N	815	0.48
		9999	N	815	0.48
	Generator Sets	50	N	338	0.74
		120	N	338	0.74
		175	N	338	0.74
		250	N	338	0.74
		500	N	338	0.74
		750	N	338	0.74
		9999	N	338	0.74
	Pressure Washers	50	P	145	0.30
		120	P	145	0.30
	Pumps	50	P	403	0.74
		120	P	403	0.74
		175	P	403	0.74
		250	N	403	0.74
		500	N	403	0.74
		9999	N	403	0.74
	Welders	50	P	643	0.45
		120	P	643	0.45
		175	P	643	0.45

Table A-6. PSR Offroad Load Factors
Used in conjunction with Tier 2-3 emission factors.
Source: mailout MSC99-32, http://www.arb.ca.gov/msei/onroad/downloads/pubs/mo9932.zip (4/2/2009)

Category	Equipment	HP	P/N	Activity (hrs/yr)	Load
Construction	Bore/Drill Rigs	50	P	726	0.75
		120	P	726	0.75
		175	P	726	0.75
		250	N	726	0.75
		500	N	726	0.75
		750	N	726	0.75
		9999	N	726	0.75
	Concrete/Industrial Saws	50	P	580	0.73
		120	P	580	0.73
		175	P	580	0.73
	Cranes	50	P	1464	0.43
		120	P	1464	0.43
		175	P	1464	0.43
		250	N	1464	0.43
		500	N	1464	0.43
		750	N	1464	0.43
	Crawler Tractors	50	P	936	0.64
		120	P	936	0.64
		175	P	936	0.64
		250	N	936	0.64
		500	N	936	0.64
		750	N	936	0.64
		9999	N	936	0.64
	Crushing/Proc. Equipment	50	P	955	0.78
		120	P	955	0.78
		175	P	955	0.78
		250	N	955	0.78
		500	N	955	0.78
		750	N	955	0.78
		9999	N	955	0.78
	Excavators	50	P	1162	0.57
		120	P	1162	0.57
		175	P	1162	0.57
		250	N	1162	0.57
		500	N	1162	0.57
		750	N	1162	0.57
	Graders	50	P	965	0.61
		120	P	965	0.61
		175	P	965	0.61
		250	N	965	0.61
		500	N	965	0.61
		750	N	965	0.61
	Off-Highway Tractors	120	P	855	0.65
		175	P	855	0.65
		250	N	855	0.65
		750	N	855	0.65
		9999	N	855	0.65
	Off-Highway Trucks	175	P	1641	0.57
		250	N	1641	0.57
		500	N	1641	0.57
		750	N	1641	0.57
		9999	N	1641	0.57
	Other Construction Equipment	50	P	606	0.62
		120	P	606	0.62
		175	P	606	0.62
		500	N	606	0.62
	Pavers	50	P	828	0.62
		120	P	828	0.62
		175	P	828	0.62
		250	N	828	0.62
		500	N	828	0.62
	Paving Equipment	50	P	622	0.53
		120	P	622	0.53
		175	P	622	0.53
		250	N	622	0.53
	Rollers	50	P	748	0.56
		120	P	748	0.56
		175	P	748	0.56
		250	N	748	0.56
		500	N	748	0.56
	Rough Terrain Forklifts	50	P	1198	0.60
		120	P	1198	0.60
		175	P	1198	0.60
		250	N	1198	0.60
		500	N	1198	0.60
	Rubber Tired Dozers	175	P	899	0.59
		250	N	899	0.59
		500	N	899	0.59
		750	N	899	0.59
		9999	N	899	0.59
	Rubber Tired Loaders	50	P	1346	0.54
		120	P	1346	0.54
		175	P	1346	0.54
		250	N	1346	0.54
		500	N	1346	0.54
		750	N	1346	0.54
		9999	N	1346	0.54
	Scrapers	120	P	1090	0.72
		175	P	1090	0.72
		250	N	1090	0.72
		500	N	1090	0.72
		750	N	1090	0.72
	Signal Boards	50	P	535	0.78
		120	P	535	0.78
		175	P	535	0.78
		250	N	535	0.78
	Skid Steer Loaders	50	P	811	0.55
		120	P	811	0.55
	Surfacing Equipment	50	P	561	0.45
		120	P	561	0.45
		175	P	561	0.45
		250	N	561	0.45
		500	N	561	0.45
		750	N	561	0.45
	Tractors/Loaders/Backhoes	50	P	1135	0.55
		120	P	1135	0.55
		175	P	1135	0.55
		250	N	1135	0.55
	Trenchers	50	P	620	0.75
		120	P	620	0.75
		175	P	620	0.75
		250	N	620	0.75
		500	N	620	0.75
		750	N	620	0.75

Table A-6. PSR Offroad Load Factors

Used in conjunction with Tier 2-3 emission factors.

Source: mailout MSC99-32, http://www.arb.ca.gov/msei/onroad/downloads/pubs/mo9932.zip (4/2/2009)

Category	Equipment	HP	P/N	Activity (hrs/yr)	Load
Dredging	Compressor (Dredging)	50	P	815	0.48
		120	P	815	0.48
	Crane	750	N	1464	0.43
	Deck/door engine	250	N	142	0.80
	Dredger	175	P	878	0.51
		250	N	878	0.51
		750	N	878	0.51
	Generator (Dredging)	50	P	1011	0.74
		120	P	1011	0.74
		175	P	1011	0.74
		250	N	1011	0.74
		500	N	1011	0.74
		750	N	1011	0.74
		9999	N	1011	0.74
	Hoist/swing/winch	50	P	878	0.51
		120	P	878	0.51
		175	P	878	0.51
		250	N	878	0.51
		500	N	878	0.51
		750	N	878	0.51
		9999	N	878	0.51
	Other (Dredging)	120	P	878	0.51
		175	P	878	0.51
		250	N	878	0.51
		500	N	878	0.51
	Pump (Dredging)	175	P	403	0.74
		250	N	403	0.74
		500	N	403	0.74
		9999	N	403	0.74
Drilling	Compressors (Workover)	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
	Generator (Drilling)	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
	Generator (Workover)	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
		9999	N	1231	0.60
	Lift (Drilling)	250	N	1231	0.60
		750	N	1231	0.60
	Other Drilling Equipment	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
		9999	N	1231	0.60
	Other Workover Equipment	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
		9999	N	1231	0.60
	Pump (Drilling)	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
		9999	N	1231	0.60
	Pump (Workover)	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
		9999	N	1231	0.60
	Snubbing	120	P	1231	0.60
	Swivel	120	P	1231	0.60
		175	P	1231	0.60
		250	N	1231	0.60
		750	N	1231	0.60
Ground Support Equipment	A/C Tug Narrow Body	250	N	606.1839847	0.80
	A/C Tug Wide Body	500	N	759.2692308	0.80
	Air Conditioner	175	N	808.1666667	0.75
	Air Start Unit	500	N	332.9655172	0.90
	Baggage Tug	120	N	1623.8	0.55
	Belt Loader	120	N	1037.643678	0.50
	Bobtail	120	N	1867.428571	0.55
	Cargo Loader	120	N	901.7941176	0.50
	Cargo Tractors	120	N	101	0.54
	Catering Truck	250	N	1600	0.52
	Forklift	175	P	731.5	0.30
	Fuel Truck	250	N	3489.166667	0.25
	Generator	175	N	1629.714286	0.78
	Ground Power Unit	175	N	968.4296875	0.75
	Hydrant Truck	175	N	224.25	0.70
	Lav Truck	175	N	1306.5	0.25
	Lift	120	N	917.3636364	0.50
	Other	175	N	1645.590909	0.50
	Passenger Stand	120	N	70	0.59
	Service Truck	175	N	1930.75	0.20
	Sweeper	120	N	12	0.51
Industrial	Aerial Lifts	50	P	384	0.46
		120	P	384	0.46
		500	N	384	0.46
		750	N	384	0.46
	Forklifts	50	P	1800	0.30
		120	P	1800	0.30
		175	P	1800	0.30
		250	N	1800	0.30
		500	N	1800	0.30
	Other General Industrial Equipment	50	N	878	0.51
		120	N	878	0.51
		175	N	878	0.51
		250	N	878	0.51
		500	N	878	0.51
		750	N	878	0.51
		9999	N	878	0.51
	Other Material Handling Equipment	50	N	421	0.59
		120	N	421	0.59
		175	N	421	0.59
		250	N	421	0.59
		500	N	421	0.59
	Sweepers/Scrubbers	50	N	1220	0.68
		120	N	1220	0.68
		175	N	1220	0.68
		250	N	1220	0.68

Table A-6. PSR Offroad Load Factors

Used in conjunction with Tier 2-3 emission factors.

Source: mailout MSC99-32, http://www.arb.ca.gov/msei/onroad/downloads/pubs/mo9932.zip (4/2/2009)

Category	Equipment	HP	P/N	Activity (hrs/yr)	Load
Lawn and Garden	Chippers/Stump Grinders	120	P	465	0.73
		175	P	465	0.73
		250	N	465	0.73
		500	N	465	0.73
		750	N	465	0.73
	Leaf Blowers/Vacuums	120	N	120	0.40
		250	N	120	0.40
	Snowblowers	175	P	400	0.65
		250	N	400	0.65
		500	N	400	0.65
Logging	Fellers/Bunchers	120	P	1276	0.71
		175	P	1276	0.71
		250	N	1276	0.71
		500	N	1276	0.71
		750	N	1276	0.71
	Shredders	175	P	120	0.40
	Skidders	120	P	1442	0.74
		175	P	1442	0.74
		250	N	1442	0.74
		500	N	1442	0.74
Military Tactical Support	A/C unit	120	P	300	0.60
		250	N	300	0.60
		500	N	300	0.60
	Aircraft Support	120	P	300	0.60
		175	P	300	0.60
	Cart	120	P	300	0.60
		175	P	300	0.60
		250	N	300	0.60
	Communications	50	P	300	0.60
		120	P	300	0.60
	Compressor (Military)	50	P	300	0.60
		120	P	300	0.60
		175	P	300	0.60
		250	N	300	0.60
		500	N	300	0.60
	Crane	120	P	300	0.60
		175	P	300	0.60
		250	N	300	0.60
	Deicer	120	P	300	0.60
	Generator (Military)	50	P	300	0.60
		120	P	300	0.60
		175	P	300	0.60
		250	N	300	0.60
		500	N	300	0.60
	Hydraulic unit	120	P	300	0.60
	Lift (Military)	120	P	300	0.60
	Light	50	P	300	0.60
	Other tactical support equipment	50	P	300	0.60
		120	P	300	0.60
		175	P	300	0.60
		250	N	300	0.60
		500	N	300	0.60
		750	N	300	0.60
	Pressure Washer	175	P	300	0.60
	Pump (Military)	50	P	300	0.60
		120	P	300	0.60
	Start Cart	120	P	300	0.60
		500	N	300	0.60
	Test Stand	120	P	300	0.60
		175	P	300	0.60
		250	N	300	0.60
		500	N	300	0.60
	Welder	50	P	300	0.60
		120	P	300	0.60
Misc. Portable Equipment	Misc Portable Equipment	120	P	484	0.56
		175	P	484	0.56
		250	N	484	0.56
		500	N	484	0.56
		750	N	484	0.56
		9999	N	484	0.56
Transport Refrigeration	Transport Refrigeration Unit	50	N	1341	0.28
		120	P	1341	0.28

Table A-7a. Onroad Emissions Calculation - Solar Field - Alternative 1

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Light Duty Autos and Trucks

Overall Personnel to Work Sites Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles
Maximum Labor Force	400	12	400	40	16,000	4,224,000
Typical Labor Force	200	10	200	40	8,000	1,760,000
* Estimated rideshare factor	1			SubTot Personnel (mi)		5,984,000

Composite Emissions for Fleet of Vehicles

NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839
0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400

NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839

TOTAL Light Duty Autos and Trucks (vmt) 6,048,400

Medium to Heavy Duty Trucks Max Daily 2

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles
Splicing/testing vans, dump trucks under 200hp	40	100	4,000
Water transportation	40	100	4,000
Fuel transportation	40	100	4,000

Composite Emissions for Fleet of Vehicles

NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000
4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000
4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000

TOTAL Medium Duty Trucks (vmt) 12,000

Heavy-Heavy Duty Trucks Max Daily 7

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles
Local material deliveries and waste removal	40	1,995	79,800
Equipment deliveries	20	1,995	39,900
Transmission Line deliveries (occurs during line construction)	40	42	15120

Composite Emissions for Fleet of Vehicles

NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791
26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791
26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791

TOTAL Heavy-Heavy Duty Trucks (vmt) 134,820

Table A-7a. Onroad Emissions Calculation - Solar Field - Alternative 1

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Overall Onroad Emissions

NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
33.84	19.10	4.04	207.51	0.02	34,903.50	4.54	2.41	0.52	25.97	0.00	4,396.41

Light Duty Autos and Trucks

Overall Personnel to Work Sites / Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Maximum Labor Force	400	12	400	40	16,000	4,224,000	14.47	12.06	2.41	134.27	0.00	21708.54	1.9104	1.5920	0.3184	17.7238	0.0000	2865.5276
Typical Labor Force	200	10	200	40	8,000	1,760,000	7.24	6.03	1.21	67.14	0.00	10854.27	0.7960	0.6633	0.1327	7.3849	0.0000	1193.9698
* Estimated rideshare factor	1			SubTot Personnel (mi)		5,984,000												

Total Emissions for Vehicles

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400	0.07	0.06	0.01	0.67	0.00	108.54	0.0291	0.0243	0.0049	0.2702	0.0000	43.6884

TOTAL Light Duty Autos and Trucks (vmt) 6,048,400

Medium to Heavy Duty Trucks Max Daily 2

Total Emissions for Vehicles

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Splicing/testing vans, dump trucks under 200hp	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000
Water transportation	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000
Fuel transportation	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000

TOTAL Medium Duty Trucks (vmt) 12,000

Heavy-Heavy Duty Trucks Max Daily 7

Total Emissions for Vehicles

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Local material deliveries and waste removal	40	1,995	79,800	7.40	0.52	0.27	2.22	0.01	1168.10	1.0542	0.0734	0.0392	0.3166	0.0016	166.4540
Equipment deliveries	20	1,995	39,900	3.70	0.26	0.14	1.11	0.01	584.05	0.5271	0.0367	0.0196	0.1583	0.0008	83.2270
Transmission Line deliveries (occurs during line construction)	40	42	15120	7.40	0.52	0.27	2.22	0.01	1168.10	0.1997	0.0139	0.0074	0.0600	0.0003	31.5387

TOTAL Heavy-Heavy Duty Trucks (vmt) 134,820

Table A-7a. Onroad Emissions Calculation - Solar Field - Alternative 1

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Light Duty Autos and Trucks

Overall Personnel to Work Sites Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles
Maximum Labor Force	400	12	400	40	16,000	4,224,000
Typical Labor Force	200	10	200	40	8,000	1,760,000
* Estimated rideshare factor	1				**SubTot Personnel (mi)**	**5,984,000**

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400

TOTAL Light Duty Autos and Trucks (vmt) **6,048,400**

Medium to Heavy Duty Trucks Max Daily 2

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles
Splicing/testing vans, dump trucks under 200hp	40	100	4,000
Water transportation	40	100	4,000
Fuel transportation	40	100	4,000

TOTAL Medium Duty Trucks (vmt) **12,000**

Heavy-Heavy Duty Trucks Max Daily 7

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles
Local material deliveries and waste removal	40	1,995	79,800
Equipment deliveries	20	1,995	39,900
Transmission Line deliveries (occurs during line construction)	40	42	15120

TOTAL Heavy-Heavy Duty Trucks (vmt) **134,820**

Table A-8a. Onroad Vehicle Mix and Schedules - Solar Field - Alternative 1

Source: Equipment mix and schedules from similar projects

Total Vehicle Workdays		
Light	Medium	Heavy
1,610.00	100.00	2,325.00

Site Preparation

1 month

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					2,460				
1/2 Ton Pick-up Truck, 4X4	200	6	30	4	720	light	60.0		
Mechanic Truck	300	2	30	8	480	heavy			40.0
Fuel Truck	300	2	30	8	480	heavy			40.0
40' Flat Bed Truck & Trailer	350	2	30	10	600	heavy			50.0
Dump Truck (Trash)	350	1	30	6	180	heavy			15.0

Grading and Earthwork

3 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					9,000				
1/2 Ton Pick-up Truck, 4X4	200	6	90	4	2160	light	180.0		
Mechanic Truck	300	2	90	8	1440	heavy			120.0
Fuel Truck	300	2	90	8	1440	heavy			120.0
40' Flat Bed Truck & Trailer	350	2	90	10	1800	heavy			150.0
Dump Truck	350	4	90	6	2160	heavy			180.0

Concrete Foundations

3 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					10,800				
1/2 Ton Pick-up Truck, 4X4	200	6	90	4	2160	light	180.0		
Mechanic Truck	300	2	90	8	1440	heavy			120.0
Fuel Truck	300	2	90	8	1440	heavy			120.0
10 cu.yd. Concrete Mixer Trucks	425	8	90	8	5760	heavy			480.0

Structural Steel Work

4 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					18,960				
1/2 Ton Pick-up Truck, 4X4	200	8	120	4	3840	light	320.0		
1 Ton Crew Cab 4X4	300	1	120	2	240	light	20.0		
30 Ton Boom Truck	300	1	120	2	240	heavy			20.0
1 Ton Crew Cab Flat Bed, 4X4	300	9	120	4	4320	light	360.0		
40' Flat Bed Truck & Trailer	350	2	120	10	2400	heavy			200.0
3/4 Ton Pick-up Truck, 4X4	300	4	120	4	1920	light	160.0		
1 Ton Crew Cab Flat Bed, 4X4	300	2	120	4	960	light	80.0		
Wire Trucks & Trailers	350	6	120	6	4320	heavy			360.0
Dump Truck (Trash)	350	1	120	6	720	heavy			60.0

Table A-8a. Onroad Vehicle Mix and Schedules - Solar Field - Alternative 1

Source: Equipment mix and schedules from similar projects

Total Vehicle Workdays		
Light	Medium	Heavy
1,610.00	100.00	2,325.00

Electrical/Instrumentation Work

2 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					3,180				
Foreman Truck	180	1	60	4	240	light	20.0		
Mechanic Truck	250	1	60	10	600	heavy			50.0
5-Ton Flatbed Truck	180	5	60	5	1500	heavy			125.0
Pickup Trucks	180	4	60	2	480	light	40.0		
Crew Trucks	180	2	60	2	240	light	20.0		
Support Trucks	180	1	60	2	120	light	10.0		

Architectural and Landscape

2 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					3,180				
1/2 Ton Pick-up Truck, 4X4	200	6	60	2	720	light	60.0		
Fuel Truck	300	2	60	3	360	heavy			30.0
Crew Trucks	180	2	60	5	600	light	50.0		
5 CY Dump Trucks	180	2	60	10	1200	medium		100.0	
Mulch Truck	350	1	60	5	300	heavy			25.0

Testing

1 month

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					840				
1/2 Ton Pick-up Truck, 4X4	200	1	30	8	240	light	20.0		
1/2 Ton Pick-up Truck, 4X4	200	1	30	8	240	light	20.0		
1 Ton Crew Cab 4X4	300	1	30	4	120	light	10.0		
Water Trucks	350	1	30	8	240	heavy			20.0

Estimated Deliveries from Port to Marshalling Yard and Miscellaneous Hardware

Material	No. Deliveries	Origin	RIV Co R/T Miles	
Transmission Lines				
Steel	42	Long Beach	150	6300
Conductors	42	Long Beach	150	6300
Misc Hardware	42	Local	60	2520
				15120
				0
				0
				0
				0

Table A-7b. Onroad Emissions Calculation - Solar Field - Alternative 3

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Light Duty Autos and Trucks

Overall Personnel to Work Sites Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
							Composite Emissions for Fleet of Vehicles					
Maximum Labor Force	400	12	400	40	16,000	4,224,000	0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839
Typical Labor Force	200	10	200	40	8,000	1,760,000	0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839
* Estimated rideshare factor	1			SubTot Personnel (mi)		5,984,000						

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400	0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839

TOTAL Light Duty Autos and Trucks (vmt) **6,048,400**

Medium to Heavy Duty Trucks Max Daily 2

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
				Composite Emissions for Fleet of Vehicles					
Splicing/testing vans, dump trucks under 200hp	40	100	4,000	4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000
Water transportation	40	100	4,000	4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000
Fuel transportation	40	100	4,000	4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000

TOTAL Medium Duty Trucks (vmt) **12,000**

Heavy-Heavy Duty Trucks Max Daily 7

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
				Composite Emissions for Fleet of Vehicles					
Local material deliveries and waste removal	40	1,995	79,800	26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791
Equipment deliveries	20	1,995	39,900	26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791
Transmission Line deliveries (occurs during line construction)	40	44	15840	26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791

TOTAL Heavy-Heavy Duty Trucks (vmt) **135,540**

Table A-7b. Onroad Emissions Calculation - Solar Field - Alternative 3

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Overall Onroad Emissions

NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
33.84	19.10	4.04	207.51	0.02	34,903.50	4.55	2.41	0.52	25.97	0.00	4,397.91

Light Duty Autos and Trucks

Overall Personnel to Work Sites / Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Maximum Labor Force	400	12	400	40	16,000	4,224,000	14.47	12.06	2.41	134.27	0.00	21708.54	1.9104	1.5920	0.3184	17.7238	0.0000	2865.5276
Typical Labor Force	200	10	200	40	8,000	1,760,000	7.24	6.03	1.21	67.14	0.00	10854.27	0.7960	0.6633	0.1327	7.3849	0.0000	1193.9698
* Estimated rideshare factor	1			SubTot Personnel (mi)		5,984,000												

Total Emissions for Vehicles

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400	0.07	0.06	0.01	0.67	0.00	108.54	0.0291	0.0243	0.0049	0.2702	0.0000	43.6884

TOTAL Light Duty Autos and Trucks (vmt) 6,048,400

Medium to Heavy Duty Trucks Max Daily 2

Total Emissions for Vehicles

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Splicing/testing vans, dump trucks under 200hp	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000
Water transportation	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000
Fuel transportation	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000

TOTAL Medium Duty Trucks (vmt) 12,000

Heavy-Heavy Duty Trucks Max Daily 7

Total Emissions for Vehicles

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Local material deliveries and waste removal	40	1,995	79,800	7.40	0.52	0.27	2.22	0.01	1168.10	1.0542	0.0734	0.0392	0.3166	0.0016	166.4540
Equipment deliveries	20	1,995	39,900	3.70	0.26	0.14	1.11	0.01	584.05	0.5271	0.0367	0.0196	0.1583	0.0008	83.2270
Transmission Line deliveries (occurs during line construction)	40	44	15840	7.40	0.52	0.27	2.22	0.01	1168.10	0.2093	0.0146	0.0078	0.0628	0.0003	33.0405

TOTAL Heavy-Heavy Duty Trucks (vmt) 135,540

Table A-7b. Onroad Emissions Calculation - Solar Field - Alternative 3

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Light Duty Autos and Trucks

Overall Personnel to Work Sites Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles
Maximum Labor Force	400	12	400	40	16,000	4,224,000
Typical Labor Force	200	10	200	40	8,000	1,760,000
* Estimated rideshare factor	1				**SubTot Personnel (mi)**	**5,984,000**

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400

TOTAL Light Duty Autos and Trucks (vmt) **6,048,400**

Medium to Heavy Duty Trucks Max Daily 2

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles
Splicing/testing vans, dump trucks under 200hp	40	100	4,000
Water transportation	40	100	4,000
Fuel transportation	40	100	4,000

TOTAL Medium Duty Trucks (vmt) **12,000**

Heavy-Heavy Duty Trucks Max Daily 7

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles
Local material deliveries and waste removal	40	1,995	79,800
Equipment deliveries	20	1,995	39,900
Transmission Line deliveries (occurs during line construction)	40	44	15840

TOTAL Heavy-Heavy Duty Trucks (vmt) **135,540**

Table A-8b. Onroad Vehicle Mix and Schedules - Solar Field - Alternative 3

Source: Equipment mix and schedules from similar projects

Total Vehicle Workdays		
Light	Medium	Heavy
1,610.00	100.00	2,325.00

Site Preparation

1 month

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					2,460				
1/2 Ton Pick-up Truck, 4X4	200	6	30	4	720	light	60.0		
Mechanic Truck	300	2	30	8	480	heavy			40.0
Fuel Truck	300	2	30	8	480	heavy			40.0
40' Flat Bed Truck & Trailer	350	2	30	10	600	heavy			50.0
Dump Truck (Trash)	350	1	30	6	180	heavy			15.0

Grading and Earthwork

3 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					9,000				
1/2 Ton Pick-up Truck, 4X4	200	6	90	4	2160	light	180.0		
Mechanic Truck	300	2	90	8	1440	heavy			120.0
Fuel Truck	300	2	90	8	1440	heavy			120.0
40' Flat Bed Truck & Trailer	350	2	90	10	1800	heavy			150.0
Dump Truck	350	4	90	6	2160	heavy			180.0

Concrete Foundations

3 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					10,800				
1/2 Ton Pick-up Truck, 4X4	200	6	90	4	2160	light	180.0		
Mechanic Truck	300	2	90	8	1440	heavy			120.0
Fuel Truck	300	2	90	8	1440	heavy			120.0
10 cu.yd. Concrete Mixer Trucks	425	8	90	8	5760	heavy			480.0

Structural Steel Work

4 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					18,960				
1/2 Ton Pick-up Truck, 4X4	200	8	120	4	3840	light	320.0		
1 Ton Crew Cab 4X4	300	1	120	2	240	light	20.0		
30 Ton Boom Truck	300	1	120	2	240	heavy			20.0
1 Ton Crew Cab Flat Bed, 4X4	300	9	120	4	4320	light	360.0		
40' Flat Bed Truck & Trailer	350	2	120	10	2400	heavy			200.0
3/4 Ton Pick-up Truck, 4X4	300	4	120	4	1920	light	160.0		
1 Ton Crew Cab Flat Bed, 4X4	300	2	120	4	960	light	80.0		
Wire Trucks & Trailers	350	6	120	6	4320	heavy			360.0
Dump Truck (Trash)	350	1	120	6	720	heavy			60.0

Table A-8b. Onroad Vehicle Mix and Schedules - Solar Field - Alternative 3

Source: Equipment mix and schedules from similar projects

Total Vehicle Workdays

Light	Medium	Heavy
1,610.00	100.00	2,325.00

Electrical/Instrumentation Work

2 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					3,180				
Foreman Truck	180	1	60	4	240	light	20.0		
Mechanic Truck	250	1	60	10	600	heavy			50.0
5-Ton Flatbed Truck	180	5	60	5	1500	heavy			125.0
Pickup Trucks	180	4	60	2	480	light	40.0		
Crew Trucks	180	2	60	2	240	light	20.0		
Support Trucks	180	1	60	2	120	light	10.0		

Architectural and Landscape

2 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					3,180				
1/2 Ton Pick-up Truck, 4X4	200	6	60	2	720	light	60.0		
Fuel Truck	300	2	60	3	360	heavy			30.0
Crew Trucks	180	2	60	5	600	light	50.0		
5 CY Dump Trucks	180	2	60	10	1200	medium		100.0	
Mulch Truck	350	1	60	5	300	heavy			25.0

Testing

1 month

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					840				
1/2 Ton Pick-up Truck, 4X4	200	1	30	8	240	light	20.0		
1/2 Ton Pick-up Truck, 4X4	200	1	30	8	240	light	20.0		
1 Ton Crew Cab 4X4	300	1	30	4	120	light	10.0		
Water Trucks	350	1	30	8	240	heavy			20.0

Estimated Deliveries from Port to Marshalling Yard and Miscellaneous Hardware

Material	No. Deliveries	Origin	RIV Co R/T Miles	
Transmission Lines				
Steel	44	Long Beach	150	6600
Conductors	44	Long Beach	150	6600
Misc Hardware	44	Local	60	2640
				15840
				0
				0
				0
				0

Table A-7c. Onroad Emissions Calculation - Solar Field - Alternative 4

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Light Duty Autos and Trucks

Overall Personnel to Work Sites Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
							Composite Emissions for Fleet of Vehicles					
Maximum Labor Force	400	12	400	40	16,000	4,224,000	0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839
Typical Labor Force	200	10	200	40	8,000	1,760,000	0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839
* Estimated rideshare factor	1			SubTot Personnel (mi)		5,984,000						

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400	0.9045	0.7538	0.1508	8.3920	0.0000	1356.7839

TOTAL Light Duty Autos and Trucks (vmt) 6,048,400

Medium to Heavy Duty Trucks Max Daily 2

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
				Composite Emissions for Fleet of Vehicles					
Splicing/testing vans, dump trucks under 200hp	40	100	4,000	4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000
Water transportation	40	100	4,000	4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000
Fuel transportation	40	100	4,000	4.0000	0.7500	0.0000	8.7500	0.0000	2000.0000

TOTAL Medium Duty Trucks (vmt) 12,000

Heavy-Heavy Duty Trucks Max Daily 7

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
				Composite Emissions for Fleet of Vehicles					
Local material deliveries and waste removal	40	1,995	79,800	26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791
Equipment deliveries	20	1,995	39,900	26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791
Transmission Line deliveries (occurs during line construction)	40	48	17280	26.4213	1.8405	0.9816	7.9346	0.0409	4171.7791

TOTAL Heavy-Heavy Duty Trucks (vmt) 136,980

Table A-7c. Onroad Emissions Calculation - Solar Field - Alternative 4

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Overall Onroad Emissions

NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
33.84	19.10	4.04	207.51	0.02	34,903.50	4.57	2.41	0.52	25.97	0.00	4,400.91

Light Duty Autos and Trucks

Total Emissions for Vehicles

Overall Personnel to Work Sites / Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Maximum Labor Force	400	12	400	40	16,000	4,224,000	14.47	12.06	2.41	134.27	0.00	21708.54	1.9104	1.5920	0.3184	17.7238	0.0000	2865.5276
Typical Labor Force	200	10	200	40	8,000	1,760,000	7.24	6.03	1.21	67.14	0.00	10854.27	0.7960	0.6633	0.1327	7.3849	0.0000	1193.9698
* Estimated rideshare factor	1			SubTot Personnel (mi)		5,984,000												

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400	0.07	0.06	0.01	0.67	0.00	108.54	0.0291	0.0243	0.0049	0.2702	0.0000	43.6884

TOTAL Light Duty Autos and Trucks (vmt) 6,048,400

Medium to Heavy Duty Trucks Max Daily 2

Total Emissions for Vehicles

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Splicing/testing vans, dump trucks under 200hp	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000
Water transportation	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000
Fuel transportation	40	100	4,000	0.32	0.06	0.00	0.70	0.00	160.00	0.0080	0.0015	0.0000	0.0175	0.0000	4.0000

TOTAL Medium Duty Trucks (vmt) 12,000

Heavy-Heavy Duty Trucks Max Daily 7

Total Emissions for Vehicles

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles	NOX lbs/day	ROG lbs/day	PM lbs/day	CO lbs/day	SOX lbs/day	CO2 lbs/day	NOX (ton)	ROG (ton)	PM (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Local material deliveries and waste removal	40	1,995	79,800	7.40	0.52	0.27	2.22	0.01	1168.10	1.0542	0.0734	0.0392	0.3166	0.0016	166.4540
Equipment deliveries	20	1,995	39,900	3.70	0.26	0.14	1.11	0.01	584.05	0.5271	0.0367	0.0196	0.1583	0.0008	83.2270
Transmission Line deliveries (occurs during line construction)	40	48	17280	7.40	0.52	0.27	2.22	0.01	1168.10	0.2283	0.0159	0.0085	0.0686	0.0004	36.0442

TOTAL Heavy-Heavy Duty Trucks (vmt) 136,980

Table A-7c. Onroad Emissions Calculation - Solar Field - Alternative 4

Emission factors generated by EMFAC assuming 1990-2012 composite fleet of light, medium, and heavy duty vehicles.

Light Duty Autos and Trucks

Overall Personnel to Work Sites Worker Commute Trips *	Workers	Months	Veh/Day	RT/day (mi)	Miles/Day	Total Miles
Maximum Labor Force	400	12	400	40	16,000	4,224,000
Typical Labor Force	200	10	200	40	8,000	1,760,000
* Estimated rideshare factor	1				**SubTot Personnel (mi)**	**5,984,000**

Max Daily 2

Operational Emissions - Light Duty	RT/day (mi)	Vehicle Days	Total Miles
SubTot Crew and QA/QC Mobilize (mi)	40	1,610	64,400

TOTAL Light Duty Autos and Trucks (vmt) **6,048,400**

Medium to Heavy Duty Trucks Max Daily 2

Operational Emissions - Medium Duty	RT/day (mi)	Vehicle Days	Total Miles
Splicing/testing vans, dump trucks under 200hp	40	100	4,000
Water transportation	40	100	4,000
Fuel transportation	40	100	4,000

TOTAL Medium Duty Trucks (vmt) **12,000**

Heavy-Heavy Duty Trucks Max Daily 7

Operational Emissions - Heavy Duty	RT/day (mi)	Vehicle Days	Total Miles
Local material deliveries and waste removal	40	1,995	79,800
Equipment deliveries	20	1,995	39,900
Transmission Line deliveries (occurs during line construction)	40	48	17280

TOTAL Heavy-Heavy Duty Trucks (vmt) **136,980**

Table A-8c. Onroad Vehicle Mix and Schedules - Solar Field - Alternative 4

Source: Equipment mix and schedules from similar projects

Total Vehicle Workdays		
Light	Medium	Heavy
1,610.00	100.00	2,325.00

Site Preparation

1 month

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					2,460				
1/2 Ton Pick-up Truck, 4X4	200	6	30	4	720	light	60.0		
Mechanic Truck	300	2	30	8	480	heavy			40.0
Fuel Truck	300	2	30	8	480	heavy			40.0
40' Flat Bed Truck & Trailer	350	2	30	10	600	heavy			50.0
Dump Truck (Trash)	350	1	30	6	180	heavy			15.0

Grading and Earthwork

3 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					9,000				
1/2 Ton Pick-up Truck, 4X4	200	6	90	4	2160	light	180.0		
Mechanic Truck	300	2	90	8	1440	heavy			120.0
Fuel Truck	300	2	90	8	1440	heavy			120.0
40' Flat Bed Truck & Trailer	350	2	90	10	1800	heavy			150.0
Dump Truck	350	4	90	6	2160	heavy			180.0

Concrete Foundations

3 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					10,800				
1/2 Ton Pick-up Truck, 4X4	200	6	90	4	2160	light	180.0		
Mechanic Truck	300	2	90	8	1440	heavy			120.0
Fuel Truck	300	2	90	8	1440	heavy			120.0
10 cu.yd. Concrete Mixer Trucks	425	8	90	8	5760	heavy			480.0

Structural Steel Work

4 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					18,960				
1/2 Ton Pick-up Truck, 4X4	200	8	120	4	3840	light	320.0		
1 Ton Crew Cab 4X4	300	1	120	2	240	light	20.0		
30 Ton Boom Truck	300	1	120	2	240	heavy			20.0
1 Ton Crew Cab Flat Bed, 4X4	300	9	120	4	4320	light	360.0		
40' Flat Bed Truck & Trailer	350	2	120	10	2400	heavy			200.0
3/4 Ton Pick-up Truck, 4X4	300	4	120	4	1920	light	160.0		
1 Ton Crew Cab Flat Bed, 4X4	300	2	120	4	960	light	80.0		
Wire Trucks & Trailers	350	6	120	6	4320	heavy			360.0
Dump Truck (Trash)	350	1	120	6	720	heavy			60.0

Table A-8c. Onroad Vehicle Mix and Schedules - Solar Field - Alternative 4

Source: Equipment mix and schedules from similar projects

Total Vehicle Workdays		
Light	Medium	Heavy
1,610.00	100.00	2,325.00

Electrical/Instrumentation Work

2 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					3,180				
Foreman Truck	180	1	60	4	240	light	20.0		
Mechanic Truck	250	1	60	10	600	heavy			50.0
5-Ton Flatbed Truck	180	5	60	5	1500	heavy			125.0
Pickup Trucks	180	4	60	2	480	light	40.0		
Crew Trucks	180	2	60	2	240	light	20.0		
Support Trucks	180	1	60	2	120	light	10.0		

Architectural and Landscape

2 months

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					3,180				
1/2 Ton Pick-up Truck, 4X4	200	6	60	2	720	light	60.0		
Fuel Truck	300	2	60	3	360	heavy			30.0
Crew Trucks	180	2	60	5	600	light	50.0		
5 CY Dump Trucks	180	2	60	10	1200	medium		100.0	
Mulch Truck	350	1	60	5	300	heavy			25.0

Testing

1 month

Primary Equipment Description	HP Estimate	Primary Equip Quantity	Activity Schedule Estimate (Days)	Duration of Use (Hours/ Day)	Total Hours of Utilization	Onroad Vehicle Category	Light Duty Fractional Total Vehicle Workdays	Medium Duty Fractional Total Vehicle Workdays	Heavy Duty Fractional Total Vehicle Workdays
					840				
1/2 Ton Pick-up Truck, 4X4	200	1	30	8	240	light	20.0		
1/2 Ton Pick-up Truck, 4X4	200	1	30	8	240	light	20.0		
1 Ton Crew Cab 4X4	300	1	30	4	120	light	10.0		
Water Trucks	350	1	30	8	240	heavy			20.0

Estimated Deliveries from Port to Marshalling Yard and Miscellaneous Hardware

Material	No. Deliveries	Origin	RIV Co R/T Miles	
Transmission Lines				
Steel	48	Long Beach	150	7200
Conductors	48	Long Beach	150	7200
Misc Hardware	48	Local	60	2880
				17280
				0
				0
				0
				0

Table A-9. Onroad Emission Factors - Solar Field

Source: EMFAC2007 v.2.3, burden reports for Riverside County.

Composite fleet: 1990 - 2012 for light, medium, and heavy duty vehicle classes

1990-2012 Composite Fleet County-Wide

Riverside County Vehicle Class	2012 Fleet (VMT/1000)	NOX (ton/day)	ROG (ton/day)	PM (ton/day)	CO (ton/day)	SOX (ton/day)	CO2 (ton/day)	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
LDA-TOT	191	0.05	0.05	0.01	0.63	0.00	120.00	0.524	0.524	0.105	6.597	0.000	1256.545
LDT1-TOT	111	0.06	0.06	0.01	0.55	0.00	80.00	1.081	1.081	0.180	9.910	0.000	1441.441
LDT2-TOT	96	0.07	0.04	0.01	0.49	0.00	70.00	1.458	0.833	0.208	10.208	0.000	1458.333
MDV-TOT	51	0.04	0.02	0.00	0.24	0.00	50.00	1.569	0.784	0.000	9.412	0.000	1960.784
LHDT1-TOT	18	0.04	0.01	0.00	0.04	0.00	20.00	4.444	1.111	0.000	4.444	0.000	2222.222
LHDT2-TOT	4	0.02	0.00	0.00	0.03	0.00	0.00	10.000	0.000	0.000	15.000	0.000	0.000
MHDT-TOT	7	0.06	0.00	0.00	0.04	0.00	10.00	17.143	0.000	0.000	11.429	0.000	2857.143
HHDT-TOT	489	6.46	0.45	0.24	1.94	0.01	1020.00	26.421	1.840	0.982	7.935	0.041	4171.779

1990-2011 Composite Fleet County-Wide

Riverside Composite Vehicle Class	2012 Fleet (VMT/1000)	NOX (ton/day)	ROG (ton/day)	PM (ton/day)	CO (ton/day)	SOX (ton/day)	CO2 (ton/day)	NOX (lb/1000mi)	ROG (lb/1000mi)	PM (lb/1000mi)	CO (lb/1000mi)	SOX (lb/1000mi)	CO2 (lb/1000mi)
Light Duty Autos and Trucks Composite	398	0.18	0.15	0.03	1.67	0.00	270.00	0.905	0.754	0.151	8.392	0.000	1356.784
Medium to Heavy Trucks Composite	80	0.16	0.03	0.00	0.35	0.00	80.00	4.000	0.750	0.000	8.750	0.000	2000.000
Heavy-Heavy Duty Trucks Composite	489	6.46	0.45	0.24	1.94	0.01	1020.00	26.421	1.840	0.982	7.935	0.041	4171.779

	LDA-TOT	LDT1-TOT	LDT2-TOT	MDV-TOT	LHDT1-TOT	LHDT2-TOT	MHDT-TOT	HHDT-TOT
Vehicles	5219	2983	2465	1365	401	116	135	2766
VMT/1000	191	111	96	51	18	4	7	489
Trips	33148	18724	15604	8702	11044	2765	4200	14854
Reactive Organic Gas Emissions								
Run Exh	0.02	0.02	0.02	0.01	0	0	0	0.4
Idle Exh	0	0	0	0	0	0	0	0.05
Start Ex	0.01	0.01	0.01	0	0	0	0	0
Total Ex	0.03	0.03	0.02	0.01	0	0	0	0.45
Diurnal	0	0	0	0	0	0	0	0
Hot Soak	0.01	0	0	0	0	0	0	0
Running	0.01	0.02	0.01	0	0	0	0	0
Resting	0	0	0	0	0	0	0	0
Total	0.05	0.06	0.04	0.02	0.01	0	0	0.45
Carbon Monoxide Emissions								
Run Exh	0.48	0.42	0.38	0.19	0.01	0.01	0.02	1.67
Idle Exh	0	0	0	0	0	0	0	0.23
Start Ex	0.16	0.12	0.11	0.06	0.03	0.01	0.02	0.04
Total Ex	0.63	0.55	0.49	0.24	0.04	0.03	0.04	1.94
Oxides of Nitrogen Emissions								
Run Exh	0.04	0.05	0.05	0.03	0.02	0.01	0.05	5.85
Idle Exh	0	0	0	0	0	0	0	0.6
Start Ex	0.01	0.01	0.01	0.01	0.02	0	0	0
Total Ex	0.05	0.06	0.07	0.04	0.04	0.02	0.06	6.46
Carbon Dioxide Emissions (000)								
Run Exh	0.11	0.08	0.07	0.05	0.02	0	0.01	0.98
Idle Exh	0	0	0	0	0	0	0	0.03
Start Ex	0	0	0	0	0	0	0	0
Total Ex	0.12	0.08	0.07	0.05	0.02	0	0.01	1.02
Total Particulate Emissions								
Run Exh	0	0	0.01	0	0	0	0	0.2
Idle Exh	0	0	0	0	0	0	0	0.01
Start Ex	0	0	0	0	0	0	0	0
Total Ex	0	0	0.01	0	0	0	0	0.2
TireWear	0	0	0	0	0	0	0	0.02
BrakeWr	0	0	0	0	0	0	0	0.02
Total	0.01	0.01	0.01	0	0	0	0	0.24
Lead	0	0	0	0	0	0	0	0
SOx	0	0	0	0	0	0	0	0.01
Fuel Consumption (000 gallons)								
Gasoline	11.97	8.24	7.55	5.44	1.69	0.32	0.09	0.25
Diesel	0.01	0.22	0.01	0.01	0.24	0.11	0.86	91.3

< --- > Title : Blythe Mesa Solar Project
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2011/09/16 17:00:07
Scen Year: 2012 -- All model years in the range 1990 to 2012 selected
Season : Annual
Area : Riverside (MD/MDAQMD)
I/M Stat : COO Basic (2005)
Emissions: Tons Per Day

Table A-10a. Fugitive Dust Generating Activity Estimates - Solar Field - Alternative 1

Proposed Activity Sites and Areas	
(Activity Areas)	**Site**
Source: Project Description Table B-3, B-7, B-9.	
Site Area	**(acres)**
Total site area	3660.0
Construction Staging Areas and Fly Yards	
Staging Area	20.0
Total Activity Sites and Areas (acres)	3680.0
Duration of Activity (months)	**3**
Total Acres	**3,680**

Proposed Access Roads	**Riverside**
(Grading)	**County**
Assume 1% of site would be used for access roads	**(acres)**
Proposed Solar Field Access Roads	36.6

Proposed Structures - Solar Array	**Average**	**Riverside**	
(Excavation, Material Unloading)	**Excavation**	**County**	**All Links**
	(cu.yd per #)	**#**	**(cu.yd)**
Each Structure			
Total	1	1425600	1,425,600
			All Links
Avg Rate of Excavation	**(cu.yd/day)**	**(cu.yd)**	**(cu.yd)**
Each Structure	250	1,425,600	1,425,600

AR061068

Table A-11a. Fugitive Dust Emissions by Activity - Solar Field - Alternative 1
Source: Emission factors from USEPA AP-42 and South Coast Air Quality Management District, where noted.

									SubTotals of Fugitive Dust Emissions			
									Overall Fugitive Dust Emissions			
						PM10	**PM2.5**				**PM10**	**PM2.5**
						lbs/day	**lbs/day**				**(ton)**	**(ton)**
						41.8	**8.8**		**Overall Proposed Proj.**		**5.0**	**1.0**
Activity Sites and Areas												
Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for												
South Coast AQMD by Midwest Research Institute, March 1996												
E = Level 2 Factor = tonPM10/ac-month	0.011	tonPM10/acre-month		22	= activity days/mo						Overall	Overall
f = 0.21 for PM2.5	0.21	PM2.5 fraction (SCAQMD Methodology for PM 2.5, October 2006)		Activity Areas	Activity Areas	PM10	PM2.5			Activity Areas	PM10	PM2.5
Control Effectiveness (watering) =	75.0%	Emission Factors		(acres)	(ac-day)	(lb/day)	(lb/day)			(acres)	(ton)	(ton)
		5.5000	lbPM10 (per acre activity-per mo)	3,680	167	41.82	---			3,680	0.8	---
		1.1550	lbPM2.5 (per acre activity-per mo)	3,680	167	---	8.78			3,680	---	0.2
Access Roads												
Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for												Overall
South Coast AQMD by Midwest Research Institute, March 1996												PM2.5
E = Level 2 Factor = tonPM10/ac-month	0.011	tonPM10/acre-month		22	= activity days/mo						Overall	(ton)
f = 0.21 for PM2.5	0.21	PM2.5 fraction (SCAQMD Methodology for PM 2.5, October 2006)		Activity Areas	Activity Areas	PM10	PM2.5			Activity Areas	PM10	---
Control Effectiveness (watering) =	75.0%	Emission Factors		(acre-mo)	(ac-day)	(lb/day)	(lb/day)			(acre-mo)	(ton)	
		5.5000	lbPM10 (per acre activity-per mo)	37	2	0.42	---			37	0.0	---
		1.1550	lbPM2.5 (per acre activity-per mo)	37	2	---	0.09			37	---	0.0
											Overall	Overall
Grading (Bulldozing of Overburden)				Doz/Grad/Scrap		PM10	PM2.5		Doz/Grad/Scrap		PM10	PM2.5
Source: USEPA AP-42, Table 11.9-1, 10/98		Emission Factors		(hr/day)		(lb/day)	(lb/day)		(hr)		(ton)	(ton)
E = 0.75 * (s^1.5) / (M^1.4) = lbPM10/hr		0.143	lbPM10 (per hr bulldozer or grader)	24		3.44	---		1,080		0.1	---
E = 0.105 * 5.7 * (s^1.2) / (M^1.3) = lbPM2.5/hr		0.077	lbPM2.5 (per hr bulldozer or grader)	24		---	1.85		1,080		---	0.0
s = silt content =	8.50	percent (average for construction sites, USEPA AP-42 Table 13.2.2-1)										
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)										
											Overall	Overall
Excavation / Trenching (Removal of Overburden)				Excavation		PM10	PM2.5		Excavation		PM10	PM2.5
Source: USEPA AP-42, Table 11.9-2 (dragline operations), 10/98		Emission Factors		(yd3/day)		(lb/day)	(lb/day)		(cu.yd)		(ton)	(ton)
E = 0.75 * 0.0021 (d^0.7)/(M^0.3) = lbPM10/yd3		0.0006	lbPM10 (per yd3 excavated)	250		0.14	---		1,425,600		0.411	---
E = 0.017 * 0.0021 (d^1.1)/(M^0.3) = lbPM2.5/yd3		0.0000	lbPM2.5 (per yd3 excavated)	250		---	0.01		1,425,600		---	0.018
d = drop height =	5	ft (estimate)										
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)										
Material Unloading/Loading												
Source: USEPA AP-42, p. 13.2.4-3, 11/06												
E = (k)(0.0032)[(U/5)^1.3]/[(M/2)^1.4] = lb/ton												
U = average wind speed =	15.00	mph (upper bound wind, p.13.2.4-4)										
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)		2	= transfers						Overall	Overall
lb of material / yd3 =	2600.00	for moist soil		Excavation	Unloading	PM10	PM2.5		Excavation	Unloading	PM10	PM2.5
		Emission Factors		(yd3/day)	(yd3/day)	(lb/day)	(lb/day)		(cu.yd)	(cu.yd)	(ton)	(ton)
k = 0.35 for PM10	0.35	for PM10	0.00012 lbPM10 (per yd3 unloaded)	250	500	0.06	---		1,425,600	2,851,200	0.176	---
k = 0.053 for PM2.5	0.05	for PM2.5	0.00002 lbPM2.5 (per yd3 unloaded)	250	500	---	0.01		1,425,600	2,851,200	---	0.027

AR061069

Table A-11a. Fugitive Dust Emissions by Activity - Solar Field - Alternative 1
Source: Emission factors from USEPA AP-42 and South Coast Air Quality Management District, where noted.

	PM10 lbs/day	PM2.5 lbs/day	SubTotals of Fugitive Dust Emissions Overall Fugitive Dust Emissions	PM10 (ton)	PM2.5 (ton)
	41.8	8.8	Overall Proposed Proj.	5.0	1.0

Equipment on Unpaved/Industrial Roads

Source: USEPA AP-42, Section 13.2.2, 11/06
E = k (s/12)^0.9 (W/3)^0.45 = lb/vmt
s = silt content = 8.50 percent (average for construction sites, USEPA AP-42 Table 13.2.2-1) **2.5%** = Unpaved VMT of Total
Control Effectiveness (watering) = 75.0%

	k (lb/vmt)	W (ton)	Emission Factors (lb/vmt)		VMT Class (VMT/day)	VMT Unpave (VMT/day)	PM10 (lb/day)	PM2.5 (lb/day)	VMT Class (vmt)	VMT Unpave (vmt)	Overall PM10 (ton)	Overall PM2.5 (ton)
Light Duty Vehicles (PM10)	1.5	2	0.2291	lbPM10 (per LDA vmt unpaved)	80	2	0.46	---	64,400	1,610	0.2	---
Medium to Heavy Duty Trucks (PM10)	1.5	13	0.5319	lbPM10 (per MDT vmt unpaved)	80	2	1.06	---	12,000	300	0.1	---
Heavy-Heavy Duty Trucks (PM10)	1.5	20	0.6457	lbPM10 (per HHDT vmt unpaved)	280	7	4.52	---	134,820	3,371	1.1	---
Light Duty Vehicles (PM2.5)	0.15	2	0.0229	lbPM2.5 (per LDA vmt unpaved)	80	2	---	0.05	64,400	1,610	---	0.0
Medium to Heavy Duty Trucks (PM2.5)	0.15	13	0.0532	lbPM2.5 (per MDT vmt unpaved)	80	2	---	0.11	12,000	300	---	0.0
Heavy-Heavy Duty Trucks (PM2.5)	0.15	30	0.0775	lbPM2.5 (per HHDT vmt unpaved)	280	7	---	0.54	134,820	3,371	---	0.1

Equipment on Paved Roads

Source: USEPA AP-42, Section 13.2.1, 11/06.
E = k (sL/2)^0.65 (W/3)^1.5 - C = lb/vmt
sL = road surface silt loading (grams per square meter) (g/m2) = 0.06 g/m2, medium ADT roads (USEPA AP-42 Table 13.2.1-3)
C = correction factor to remove exhaust
W = fleet average weight of the heavy vehicles = 2.413 ton (fleet average weight)

	W (ton)	VMT All (vmt)
Light Duty Vehicles (PM10)	2	6,048,400
Medium to Heavy Duty Trucks (PM10)	13	12,000
Heavy-Heavy Duty Trucks (PM10)	20	134,820

	k (lb/vmt)	C (lb/vmt)	Emission Factors (lb/vmt)		VMT All (VMT/day)	VMT Paved (VMT/day)	PM10 (lb/day)	PM2.5 (lb/day)	VMT All (vmt)	VMT Paved (vmt)	Overall PM10 (ton)	Overall PM2.5 (ton)
Fleet Average (PM10)	0.016	0.00047	0.000711	lbPM10 (per vmt on paved road)	16,440	16,029	11.40	---	6,195,220	6,040,340	2.1	---
Fleet Average (PM2.5)	0.0024	0.00036	0.000177	lbPM2.5 (per vmt on paved road)	16,440	16,029	---	2.84	6,195,220	6,040,340	---	0.5

AR061070

Table A-10b. Fugitive Dust Generating Activity Estimates - Solar Field - Alternative 3

Proposed Activity Sites and Areas	
(Activity Areas)	**Site**
Source: Project Description Table B-3, B-7, B-9.	
Site Area	**(acres)**
Total site area	3682.0
Construction Staging Areas and Fly Yards	
Staging Area	20.0
Total Activity Sites and Areas (acres)	3702.0
Duration of Activity (months)	**3**
Total Acres	**3,702**

Proposed Access Roads	**Riverside**
(Grading)	**County**
Assume 1% of site would be used for access roads	**(acres)**
Proposed Solar Field Access Roads	36.82

Proposed Structures - Solar Array	**Average**	**Riverside**	
(Excavation, Material Unloading)	**Excavation**	**County**	**All Links**
	(cu.yd per #)	**#**	**(cu.yd)**
Each Structure			
Total	1	1425600	1,425,600
			All Links
Avg Rate of Excavation	**(cu.yd/day)**	**(cu.yd)**	**(cu.yd)**
Each Structure	250	1,425,600	1,425,600

Table A-11b. Fugitive Dust Emissions by Activity - Solar Field - Alternative 3
Source: Emission factors from USEPA AP-42 and South Coast Air Quality Management District, where noted.

SubTotals of Fugitive Dust Emissions
Overall Fugitive Dust Emissions

	PM10 lbs/day	PM2.5 lbs/day		PM10 (ton)	PM2.5 (ton)
	42.1	8.8	**Overall Proposed Proj.**	5.0	1.0

Activity Sites and Areas

Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for South Coast AQMD by Midwest Research Institute, March 1996

										Overall	Overall
E = Level 2 Factor = tonPM10/ac-month	0.011	tonPM10/acre-month	22	= activity days/mo							
f = 0.21 for PM2.5	0.21	PM2.5 fraction (SCAQMD Methodology for PM 2.5, October 2006)	Activity Areas	Activity Areas	PM10	PM2.5		Activity Areas		PM10	PM2.5
Control Effectiveness (watering) =	75.0%	Emission Factors	(acres)	(ac-day)	(lb/day)	(lb/day)		(acres)		(ton)	(ton)
		5.5000 lbPM10 (per acre activity-per mo)	3,702	168	42.07	---		3,702		0.8	---
		1.1550 lbPM2.5 (per acre activity-per mo)	3,702	168	---	8.83		3,702		---	0.2

Access Roads

Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for South Coast AQMD by Midwest Research Institute, March 1996

										Overall	Overall
											PM2.5
E = Level 2 Factor = tonPM10/ac-month	0.011	tonPM10/acre-month	22	= activity days/mo						Overall	(ton)
f = 0.21 for PM2.5	0.21	PM2.5 fraction (SCAQMD Methodology for PM 2.5, October 2006)	Activity Areas	Activity Areas	PM10	PM2.5		Activity Areas		PM10	---
Control Effectiveness (watering) =	75.0%	Emission Factors	(acre-mo)	(ac-day)	(lb/day)	(lb/day)		(acre-mo)		(ton)	
		5.5000 lbPM10 (per acre activity-per mo)	37	2	0.42	---		37		0.0	---
		1.1550 lbPM2.5 (per acre activity-per mo)	37	2	---	0.09		37		---	0.0

								Overall	Overall
Grading (Bulldozing of Overburden)			Doz/Grad/Scrap		PM10	PM2.5	Doz/Grad/Scrap	PM10	PM2.5
Source: USEPA AP-42, Table 11.9-1, 10/98		Emission Factors	(hr/day)		(lb/day)	(lb/day)	(hr)	(ton)	(ton)
E = 0.75 * (s^1.5) / (M^1.4) = lbPM10/hr		0.143 lbPM10 (per hr bulldozer or grader)	24		3.44	---	1,080	0.1	---
E = 0.105 * 5.7 * (s^1.2) / (M^1.3) = lbPM2.5/hr		0.077 lbPM2.5 (per hr bulldozer or grader)	24		---	1.85	1,080	---	0.0
s = silt content =	8.50	percent (average for construction sites, USEPA AP-42 Table 13.2.2-1)							
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)							

								Overall	Overall
Excavation / Trenching (Removal of Overburden)			Excavation		PM10	PM2.5	Excavation	PM10	PM2.5
Source: USEPA AP-42, Table 11.9-2 (dragline operations), 10/98		Emission Factors	(yd3/day)		(lb/day)	(lb/day)	(cu.yd)	(ton)	(ton)
E = 0.75 * 0.0021 (d^0.7)/(M^0.3) = lbPM10/yd3		0.0006 lbPM10 (per yd3 excavated)	250		0.14	---	1,425,600	0.411	---
E = 0.017 * 0.0021 (d^1.1)/(M^0.3) = lbPM2.5/yd3		0.0000 lbPM2.5 (per yd3 excavated)	250		---	0.01	1,425,600	---	0.018
d = drop height =	5	ft (estimate)							
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)							

Material Unloading/Loading

Source: USEPA AP-42, p. 13.2.4-3, 11/06

E = (k)(0.0032)[(U/5)^1.3]/[(M/2)^1.4] = lb/ton

										Overall	Overall
U = average wind speed =	15.00	mph (upper bound wind, p.13.2.4-4)									
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)	2	= transfers							
lb of material / yd3 =	2600.00	for moist soil	Excavation	Unloading	PM10	PM2.5	Excavation	Unloading		PM10	PM2.5
		Emission Factors	(yd3/day)	(yd3/day)	(lb/day)	(lb/day)	(cu.yd)	(cu.yd)		(ton)	(ton)
k = 0.35 for PM10	0.35	for PM10 0.00012 lbPM10 (per yd3 unloaded)	250	500	0.06	---	1,425,600	2,851,200		0.176	---
k = 0.053 for PM2.5	0.05	for PM2.5 0.00002 lbPM2.5 (per yd3 unloaded)	250	500	---	0.01	1,425,600	2,851,200		---	0.027

AR061072

Table A-11b. Fugitive Dust Emissions by Activity - Solar Field - Alternative 3
Source: Emission factors from USEPA AP-42 and South Coast Air Quality Management District, where noted.

	PM10 lbs/day	PM2.5 lbs/day	SubTotals of Fugitive Dust Emissions Overall Fugitive Dust Emissions	PM10 (ton)	PM2.5 (ton)
	42.1	8.8	Overall Proposed Proj.	5.0	1.0

Equipment on Unpaved/Industrial Roads

Source: USEPA AP-42, Section 13.2.2, 11/06
E = k (s/12)^0.9 (W/3)^0.45 = lb/vmt
s = silt content = 8.50 percent (average for construction sites, USEPA AP-42 Table 13.2.2-1) **2.5%** = Unpaved VMT of Total
Control Effectiveness (watering) = 75.0%

	k (lb/vmt)	W (ton)	Emission Factors (lb/vmt)		VMT Class (VMT/day)	VMT Unpave (VMT/day)	PM10 (lb/day)	PM2.5 (lb/day)	VMT Class (vmt)	VMT Unpave (vmt)	Overall PM10 (ton)	Overall PM2.5 (ton)
Light Duty Vehicles (PM10)	1.5	2	0.2291	lbPM10 (per LDA vmt unpaved)	80	2	0.46	---	64,400	1,610	0.2	---
Medium to Heavy Duty Trucks (PM10)	1.5	13	0.5319	lbPM10 (per MDT vmt unpaved)	80	2	1.06	---	12,000	300	0.1	---
Heavy-Heavy Duty Trucks (PM10)	1.5	20	0.6457	lbPM10 (per HHDT vmt unpaved)	280	7	4.52	---	134,820	3,371	1.1	---
Light Duty Vehicles (PM2.5)	0.15	2	0.0229	lbPM2.5 (per LDA vmt unpaved)	80	2	---	0.05	64,400	1,610	---	0.0
Medium to Heavy Duty Trucks (PM2.5)	0.15	13	0.0532	lbPM2.5 (per MDT vmt unpaved)	80	2	---	0.11	12,000	300	---	0.0
Heavy-Heavy Duty Trucks (PM2.5)	0.15	30	0.0775	lbPM2.5 (per HHDT vmt unpaved)	280	7	---	0.54	134,820	3,371	---	0.1

Equipment on Paved Roads

Source: USEPA AP-42, Section 13.2.1, 11/06.
E = k (sL/2)^0.65 (W/3)^1.5 - C = lb/vmt
sL = road surface silt loading (grams per square meter) (g/m2) = 0.06 g/m2, medium ADT roads (USEPA AP-42 Table 13.2.1-3)
C = correction factor to remove exhaust
W = fleet average weight of the heavy vehicles = 2.413 ton (fleet average weight)

	W (ton)	VMT All (vmt)
Light Duty Vehicles (PM10)	2	6,048,400
Medium to Heavy Duty Trucks (PM10)	13	12,000
Heavy-Heavy Duty Trucks (PM10)	20	134,820

	k (lb/vmt)	C (lb/vmt)	Emission Factors (lb/vmt)		VMT All (VMT/day)	VMT Paved (VMT/day)	PM10 (lb/day)	PM2.5 (lb/day)	VMT All (vmt)	VMT Paved (vmt)	Overall PM10 (ton)	Overall PM2.5 (ton)
Fleet Average (PM10)	0.016	0.00047	0.000711	lbPM10 (per vmt on paved road)	16,440	16,029	11.40	---	6,195,220	6,040,340	2.1	---
Fleet Average (PM2.5)	0.0024	0.00036	0.000177	lbPM2.5 (per vmt on paved road)	16,440	16,029	---	2.84	6,195,220	6,040,340	---	0.5

AR061073

Table A-10c. Fugitive Dust Generating Activity Estimates - Solar Field - Alternative 4

Proposed Activity Sites and Areas	
(Activity Areas)	**Site**
Source: Project Description Table B-3, B-7, B-9.	
Site Area	**(acres)**
Total site area	3648.0
Construction Staging Areas and Fly Yards	
Staging Area	20.0
Total Activity Sites and Areas (acres)	3668.0
Duration of Activity (months)	**3**
Total Acres	**3,668**

Proposed Access Roads	**Riverside**
(Grading)	**County**
Assume 1% of site would be used for access roads	**(acres)**
Proposed Solar Field Access Roads	36.48

Proposed Structures - Solar Array	**Average**	**Riverside**	
(Excavation, Material Unloading)	**Excavation**	**County**	**All Links**
	(cu.yd per #)	**#**	**(cu.yd)**
Each Structure			
Total	1	1425600	1,425,600
			All Links
Avg Rate of Excavation	**(cu.yd/day)**	**(cu.yd)**	**(cu.yd)**
Each Structure	250	1,425,600	1,425,600

AR061074

Table A-11c. Fugitive Dust Emissions by Activity - Solar Field - Alternative 4
Source: Emission factors from USEPA AP-42 and South Coast Air Quality Management District, where noted.

									SubTotals of Fugitive Dust Emissions			
									Overall Fugitive Dust Emissions			
						PM10	**PM2.5**				**PM10**	**PM2.5**
						lbs/day	**lbs/day**				**(ton)**	**(ton)**
						41.7	**8.8**		**Overall Proposed Proj.**		**5.0**	**1.0**
Activity Sites and Areas												
Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for												
South Coast AQMD by Midwest Research Institute, March 1996												
E = Level 2 Factor = tonPM10/ac-month	0.011	tonPM10/acre-month		22	= activity days/mo						Overall	Overall
f = 0.21 for PM2.5	0.21	PM2.5 fraction (SCAQMD Methodology for PM 2.5, October 2006)		Activity Areas	Activity Areas	PM10	PM2.5			Activity Areas	PM10	PM2.5
Control Effectiveness (watering) =	75.0%	Emission Factors		(acres)	(ac-day)	(lb/day)	(lb/day)			(acres)	(ton)	(ton)
		5.5000	lbPM10 (per acre activity-per mo)	3,668	167	41.68	---			3,668	0.8	---
		1.1550	lbPM2.5 (per acre activity-per mo)	3,668	167	---	8.75			3,668	---	0.2
Access Roads												
Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for												Overall
South Coast AQMD by Midwest Research Institute, March 1996												PM2.5
E = Level 2 Factor = tonPM10/ac-month	0.011	tonPM10/acre-month		22	= activity days/mo						Overall	(ton)
f = 0.21 for PM2.5	0.21	PM2.5 fraction (SCAQMD Methodology for PM 2.5, October 2006)		Activity Areas	Activity Areas	PM10	PM2.5			Activity Areas	PM10	---
Control Effectiveness (watering) =	75.0%	Emission Factors		(acre-mo)	(ac-day)	(lb/day)	(lb/day)			(acre-mo)	(ton)	
		5.5000	lbPM10 (per acre activity-per mo)	36	2	0.41	---			36	0.0	---
		1.1550	lbPM2.5 (per acre activity-per mo)	36	2	---	0.09			36	---	0.0
											Overall	Overall
Grading (Bulldozing of Overburden)				Doz/Grad/Scrap		PM10	PM2.5		Doz/Grad/Scrap		PM10	PM2.5
Source: USEPA AP-42, Table 11.9-1, 10/98		Emission Factors		(hr/day)		(lb/day)	(lb/day)		(hr)		(ton)	(ton)
E = 0.75 * (s^1.5) / (M^1.4) = lbPM10/hr		0.143	lbPM10 (per hr bulldozer or grader)	24		3.44	---		1,080		0.1	---
E = 0.105 * 5.7 * (s^1.2) / (M^1.3) = lbPM2.5/hr		0.077	lbPM2.5 (per hr bulldozer or grader)	24		---	1.85		1,080		---	0.0
s = silt content =	8.50	percent (average for construction sites, USEPA AP-42 Table 13.2.2-1)										
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)										
											Overall	Overall
Excavation / Trenching (Removal of Overburden)				Excavation		PM10	PM2.5		Excavation		PM10	PM2.5
Source: USEPA AP-42, Table 11.9-2 (dragline operations), 10/98		Emission Factors		(yd3/day)		(lb/day)	(lb/day)		(cu.yd)		(ton)	(ton)
E = 0.75 * 0.0021 (d^0.7)/(M^0.3) = lbPM10/yd3		0.0006	lbPM10 (per yd3 excavated)	250		0.14	---		1,425,600		0.411	---
E = 0.017 * 0.0021 (d^1.1)/(M^0.3) = lbPM2.5/yd3		0.0000	lbPM2.5 (per yd3 excavated)	250		---	0.01		1,425,600		---	0.018
d = drop height =	5	ft (estimate)										
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)										
Material Unloading/Loading												
Source: USEPA AP-42, p. 13.2.4-3, 11/06												
E = (k)(0.0032)[(U/5)^1.3]/[(M/2)^1.4] = lb/ton												
U = average wind speed =	15.00	mph (upper bound wind, p.13.2.4-4)										
M = moisture content =	12.00	percent (SCAQMD CEQA Handbook Table A9-9-G-1, with watering)		2	= transfers						Overall	Overall
lb of material / yd3 =	2600.00	for moist soil		Excavation	Unloading	PM10	PM2.5		Excavation	Unloading	PM10	PM2.5
		Emission Factors		(yd3/day)	(yd3/day)	(lb/day)	(lb/day)		(cu.yd)	(cu.yd)	(ton)	(ton)
k = 0.35 for PM10	0.35	for PM10	0.00012 lbPM10 (per yd3 unloaded)	250	500	0.06	---		1,425,600	2,851,200	0.176	---
k = 0.053 for PM2.5	0.05	for PM2.5	0.00002 lbPM2.5 (per yd3 unloaded)	250	500	---	0.01		1,425,600	2,851,200	---	0.027

AR061075

Table A-11c. Fugitive Dust Emissions by Activity - Solar Field - Alternative 4

Source: Emission factors from USEPA AP-42 and South Coast Air Quality Management District, where noted.

	PM10 lbs/day	PM2.5 lbs/day		PM10 (ton)	PM2.5 (ton)
SubTotals of Fugitive Dust Emissions					
Overall Fugitive Dust Emissions					
	41.7	**8.8**	**Overall Proposed Proj.**	**5.0**	**1.0**

Equipment on Unpaved/Industrial Roads

Source: USEPA AP-42, Section 13.2.2, 11/06

E = k (s/12)^0.9 (W/3)^0.45 = lb/vmt

s = silt content = 8.50 percent (average for construction sites, USEPA AP-42 Table 13.2.2-1) **2.5%** = Unpaved VMT of Total

Control Effectiveness (watering) = 75.0%

	k (lb/vmt)	W (ton)	Emission Factors (lb/vmt)		VMT Class (VMT/day)	VMT Unpave (VMT/day)	PM10 (lb/day)	PM2.5 (lb/day)	VMT Class (vmt)	VMT Unpave (vmt)	Overall PM10 (ton)	Overall PM2.5 (ton)
Light Duty Vehicles (PM10)	1.5	2	0.2291	lbPM10 (per LDA vmt unpaved)	80	2	0.46	---	64,400	1,610	0.2	---
Medium to Heavy Duty Trucks (PM10)	1.5	13	0.5319	lbPM10 (per MDT vmt unpaved)	80	2	1.06	---	12,000	300	0.1	---
Heavy-Heavy Duty Trucks (PM10)	1.5	20	0.6457	lbPM10 (per HHDT vmt unpaved)	280	7	4.52	---	134,820	3,371	1.1	---
Light Duty Vehicles (PM2.5)	0.15	2	0.0229	lbPM2.5 (per LDA vmt unpaved)	80	2	---	0.05	64,400	1,610	---	0.0
Medium to Heavy Duty Trucks (PM2.5)	0.15	13	0.0532	lbPM2.5 (per MDT vmt unpaved)	80	2	---	0.11	12,000	300	---	0.0
Heavy-Heavy Duty Trucks (PM2.5)	0.15	30	0.0775	lbPM2.5 (per HHDT vmt unpaved)	280	7	---	0.54	134,820	3,371	---	0.1

Equipment on Paved Roads

Source: USEPA AP-42, Section 13.2.1, 11/06.

E = k (sL/2)^0.65 (W/3)^1.5 - C = lb/vmt

sL = road surface silt loading (grams per square meter) (g/m2) = 0.06 g/m2, medium ADT roads (USEPA AP-42 Table 13.2.1-3)

C = correction factor to remove exhaust

W = fleet average weight of the heavy vehicles = 2.413 ton (fleet average weight)

	W (ton)	VMT All (vmt)
Light Duty Vehicles (PM10)	2	6,048,400
Medium to Heavy Duty Trucks (PM10)	13	12,000
Heavy-Heavy Duty Trucks (PM10)	20	134,820

	k (lb/vmt)	C (lb/vmt)	Emission Factors (lb/vmt)		VMT All (VMT/day)	VMT Paved (VMT/day)	PM10 (lb/day)	PM2.5 (lb/day)	VMT All (vmt)	VMT Paved (vmt)	Overall PM10 (ton)	Overall PM2.5 (ton)
Fleet Average (PM10)	0.016	0.00047	0.000711	lbPM10 (per vmt on paved road)	16,440	16,029	11.40	---	6,195,220	6,040,340	2.1	---
Fleet Average (PM2.5)	0.0024	0.00036	0.000177	lbPM2.5 (per vmt on paved road)	16,440	16,029	---	2.84	6,195,220	6,040,340	---	0.5

Table A-12. Air Emissions Calculations Summary - General Conformity Emissions (BLM Land)

Offroad Tiers 2 emission factors (EFs) are applied to NOx, PM, and CO. Load factors (LFs) are used in conjunction with Tiers 2 EFs.
2012 SCAB EFs (OFFROAD2007 model) are applied to CO2, ROG, SOX. LFs already incorporated in OFFROAD model.
Onroad model (EMFAC) assumes 1990-2012 composite fleet across light, medium, and heavy duty vehicle classes.

Overall Emissions of MSSF1	NOX (ton)	ROG (ton)	PM10 (ton)	PM2.5 (ton)	CO (ton)	SOX (ton)	CO2 (ton)
Offroad Vehicles and Equipment	5.62	1.42	0.20	0.18	3.16	0.41	1,491.1
Onroad Vehicles	0.20	0.01	0.01	0.01	0.06	0.00	31.54
Fugitive Dust			0.01	0.00			
Total Emissions for Project Duration	**5.82**	**1.43**	**0.22**	**0.19**	**3.22**	**0.41**	**1,522.7**

Appendix B

SCREEN3 Model Results

Diesel Particulate Emissions

SCREEN3 Model Output

Screening Health Risk Assessment

```
01/11/13

09:13:42
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***

 Blythe Mesa Screening HRA - Diesel Particulate Matter

 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE               =       VOLUME
    EMISSION RATE (G/S)       =      .327900E-01
    SOURCE HEIGHT (M)         =       1.0000
    INIT. LATERAL DIMEN (M)   =    1000.0000
    INIT. VERTICAL DIMEN (M)  =       2.0000
    RECEPTOR HEIGHT (M)       =        .0000
    URBAN/RURAL OPTION        =        RURAL

 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


 BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =     .000 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING
DISTANCES ***

   DIST     CONC              U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB   (M/S)   (M/S)    (M)    HT (M)   Y (M)   Z (M)
DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------
-----
    100.   .0000        0      .0     .0      .0     .00     .00     .00
    200.   .0000        0      .0     .0      .0     .00     .00     .00
    300.   .0000        0      .0     .0      .0     .00     .00     .00
    400.   .0000        0      .0     .0      .0     .00     .00     .00
    500.   .0000        0      .0     .0      .0     .00     .00     .00
    600.   .0000        0      .0     .0      .0     .00     .00     .00
    700.   .0000        0      .0     .0      .0     .00     .00     .00
    800.   .0000        0      .0     .0      .0     .00     .00     .00
```

```
    900.   .0000        0      .0     .0      .0     .00     .00     .00
   1000.   .0000        0      .0     .0      .0     .00     .00     .00
   1100.   .0000        0      .0     .0      .0     .00     .00     .00
   1200.   .0000        0      .0     .0      .0     .00     .00     .00
   1300.   .0000        0      .0     .0      .0     .00     .00     .00
   1400.   .0000        0      .0     .0      .0     .00     .00     .00
   1500.   .0000        0      .0     .0      .0     .00     .00     .00
   1600.   .0000        0      .0     .0      .0     .00     .00     .00
   1700.   .0000        0      .0     .0      .0     .00     .00     .00
   1800.   .0000        0      .0     .0      .0     .00     .00     .00
   1900.   .0000        0      .0     .0      .0     .00     .00     .00
   2000.   .0000        0      .0     .0      .0     .00     .00     .00
   2100.   .0000        0      .0     .0      .0     .00     .00     .00
   2200.   .4745        6     1.0    1.0 10000.0    1.00  958.71   22.92
NO
   2300.   .4623        6     1.0    1.0 10000.0    1.00  960.71   23.48
NO
   2400.   .4509        6     1.0    1.0 10000.0    1.00  962.70   24.02
NO
   2500.   .4402        6     1.0    1.0 10000.0    1.00  964.69   24.56
NO
   2600.   .4301        6     1.0    1.0 10000.0    1.00  966.68   25.08
NO
   2700.   .4206        6     1.0    1.0 10000.0    1.00  968.67   25.60
NO
   2800.   .4116        6     1.0    1.0 10000.0    1.00  970.66   26.11
NO
   2900.   .4030        6     1.0    1.0 10000.0    1.00  972.64   26.61
NO
   3000.   .3960        6     1.0    1.0 10000.0    1.00  974.63   27.02
NO

 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
   2151.   .4807        6      .0     .0      .0     .00     .00     .00

  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

  ******************************************
  *  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
  *    SIMPLE ELEVATED TERRAIN PROCEDURE     *
  ******************************************

       TERRAIN        DISTANCE RANGE (M)
        HT (M)       MINIMUM     MAXIMUM
       -------      --------    --------
            0.          100.       3000.

      ************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
```

```
     ************************************

 CALCULATION         MAX CONC     DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)     MAX (M)    HT (M)
--------------     -----------   -------   -------
SIMPLE TERRAIN       .4807         2151.        0.


************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
************************************************
```

APPENDIX C1
BIOLOGICAL RESOURCES TECHNICAL REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

June 2012

RENEWABLE RESOURCES GROUP

Blythe Mesa Solar Project

Biological Resources Technical Report

PROJECT NUMBER:
122512

PROJECT CONTACT:
Thom Ryan
EMAIL:
thom.ryan@powereng.com
PHONE:
(714) 507-2748

POWER ENGINEERS

PREPARED FOR: *RENEWABLE RESOURCES GROUP*
PREPARED BY: *POWER ENGINEERS, INC.*

TABLE OF CONTENTS

INTRODUCTION **1**

1.0 PROJECT DESCRIPTION **1**

1.1 PROJECT LOCATION AND COMPONENTS 1

2.0 REGULATORY FRAMEWORK **5**

2.1 FEDERAL 5
2.2 STATE 6
2.3 LOCAL ORDINANCES 7

3.0 INVENTORY METHODS **8**

3.1 APPROACH TO DATA COLLECTION 8
3.2 LITERATURE REVIEW 9
3.3 FIELD SURVEY METHODOLOGY 21
3.3.1 Reconnaissance Survey 21
3.3.2 Vegetation Communities 23
3.3.3 Focused Rare Plant Survey 23
3.3.4 Protocol Western Burrowing Owl Survey 23

4.0 AFFECTED ENVIRONMENT **24**

4.1 ENVIRONMENTAL SETTING 24
4.1.1 Vegetation Communities 25
4.1.2 Jurisdictional Waters 30
4.1.3 Flora 30
4.1.4 Fauna 45
4.1.5 Critical Habitat 55

5.0 REFERENCES **61**

APPENDICES

Appendix A – Plant Species Observed During Surveys
Appendix B – Wildlife Species Observed During Reconnaissance and Focused Surveys
Appendix C – USFWS Species Information for the Project area

TABLES

Table 1. Adjacent Project Survey Information 13
Table 2. Vegetation Communities and Cover Types (Acres) 25
Table 3. Special-Status Plant Species Relevant to the Proposed Project Potentially Occurring in the study area 41
Table 4. Special-Status Wildlife Species Relevant to the Proposed Project Potentially Occurring in the study area 57

FIGURES

Figure 1. Regional Area Project Location Map 3
Figure 2. CNDDB Map 11
Figure 3. Existing Project Data Overlap with BMSP Study Area 19
Figure 4. Vegetation Communities within the Study Area 27
Figure 5. Special-Status Plant and Wildlife Species Observed in the Project Area 33
Figure 6. Burrowing Owl Location Data 49

INTRODUCTION

The proposed Blythe Mesa Solar Project (BMSP, Project) consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. This technical report analyzes the biological resources with the potential to occur within the proposed Project. The analysis consists of a review of published peer-reviewed documents, databases and biological reports in conjunction with biological field surveys to determine areas that have suitable habitat to potentially support listed, proposed for listing, and candidate threatened and endangered species, and other identified sensitive species. This technical report first addresses the applicable laws, ordinances, regulations, and a standard related to biological resources, and then describes conditions in the study area, which encompasses the proposed disturbance area.

1.0 PROJECT DESCRIPTION

The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 acres for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison Colorado River Substation, an approved new substation located south of Highway 10 and approximately four miles west of the Project site.

1.1 PROJECT LOCATION AND COMPONENTS

The 3,660-acre site is five miles west of Blythe and consists mostly of agricultural land, including citrus orchards. The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles (see Figure 1). The Project is located on:

- Sections 11 and 12 of Township 7 South, Range 21 East
- Sections 3, 4, 5, 6, 8, 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

State Highway 10 bisects the Project area, which is bounded on the north and south by undeveloped open desert, on the east by agricultural lands, and on the west by the Blythe City Airport and open desert lands.

The Project would utilize single-axis PV trackers with silicon solar panels. All panels would be oriented in the same direction as they track the sun's movement. By design, the PV panels absorb sunlight to maximize electrical output and use anti-reflective glass, resulting in about half the reflectance of standard residential and commercial glass. Due to the limited rotation angles, the solar panels have no potential for reflecting the sun's rays upon any ground-plane position.

The panels would be configured into trackers, and the trackers configured into blocks. Each block comprises six trackers with 18 north-south oriented rows of PV panels (295 feet long and 140 feet wide) that rotate up to 45 degrees from east to west to follow the daily motion of the sun, with the center of rotation being approximately four to eight feet above grade. The panels would be supported by micro-piles that would be driven directly into the ground to a depth of 8 to 12 feet using a vibration technology to reduce noise impacts. Torque tubes, electrical wire trays, and panels would then be installed on the piles. Concrete foundations for the drive motors (devices used to move the drive strut back and forth) would be poured in place, and electrical equipment for the array would be set in place. A tracked backhoe would drive piles. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would place trackers on support piles.

Individual PV panels would be connected together in series to create a "string" to carry direct current (DC) electricity. Multiple DC strings would be brought together into an above-ground combiner box to merge the strings into a single high-current cable. From the combiner boxes, the cabling would run in raceways and underground to inverters (5.0 feet wide and 10.5 feet tall) mounted on small concrete pads (minimum 0.5 feet above grade) distributed across the site. The inverters would take the DC output from the combiner boxes and convert it to alternating current (AC) electricity. Within the solar field, dirt access roads 12 feet wide would be constructed approximately every 200 to 400 feet to allow access and maintenance of the solar panels.

Next, the alternating current (AC) electricity would be increased to medium voltage with a standard "step-up" transformer. The medium voltage collection lines would begin at the inverter/transformer pads and would be placed in trenches until the output from 10 to 15 blocks is gathered and transferred at risers to a system of overhead medium voltage collection lines for transmission to the substation. The medium voltage collection circuits would be mounted above-ground on poles (35 to 60 feet tall) and carry 20 to 30 MW of electricity.

The three Project substations (each 300 feet long by 300 feet wide) would collect all the medium-voltage circuits (34.5 kV) and would step up the voltage to 230 kV.

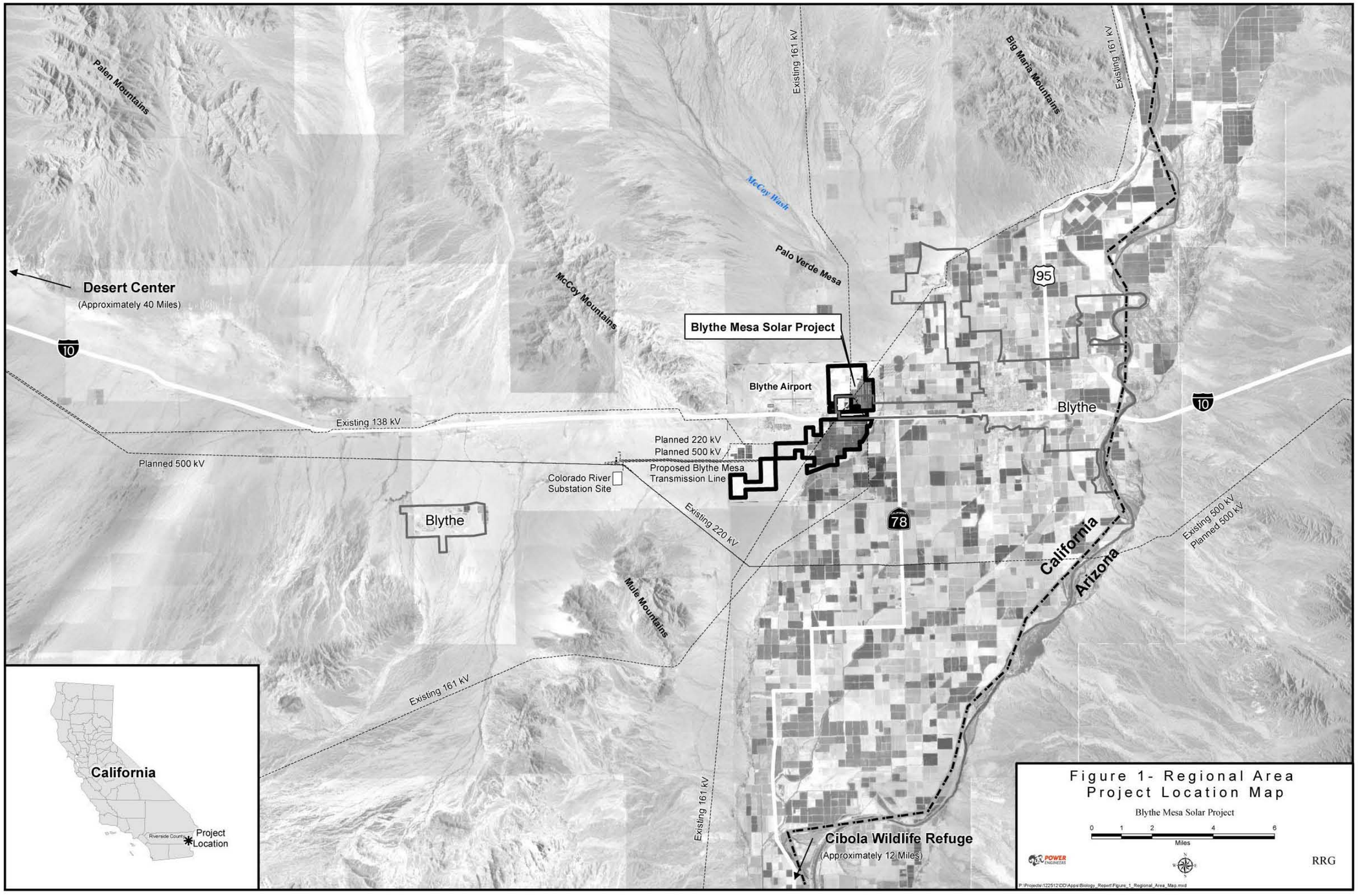
The Project substations and the interconnection point would be linked by a 230 kV double-circuit transmission line. The transmission line facilities include a single set of tubular steel poles that are 85 to 125 feet tall with an average distance between poles of 500 to 800 feet. The poles would be directly embedded in the soil or set in concrete foundations approximately 20 to 30 feet deep. Access roads to each structure will be 16 to 20 feet wide by eight inches deep of gravel over compacted subgrade and located within the proposed right-of-way (ROW).

Two operation and maintenance (O&M) buildings—approximately 3,500 square feet each, enclosed, and no more than 30 feet tall—would provide work and storage space. A covered outdoor temporary assembly and storage area (80,000 square feet, 25 feet tall) would be directly adjacent to the O&M buildings.

The site would be enclosed with equestrian-type fencing that would typically be set 30 feet from the array. The fence would be approximately seven feet high and consist of posts set into the ground on approximately 8- to 12-foot spacing, with approximately six strands of smooth wire at about one-foot vertical spacing.

All of the solar panels, substations, inverters, and O&M facilities would be located on lands in private ownership. The transmission line easement, from the Colorado River Substation to near the Project site substation, would be located mostly on federal land under management of the U.S. Department of the Interior, Bureau of Land Management (BLM) and some private land.

FIGURE 1. REGIONAL AREA PROJECT LOCATION MAP



THIS PAGE INTENTIONALLY LEFT BLANK

2.0 REGULATORY FRAMEWORK

The Project must comply with various federal, State, and local laws. While some laws and policies provide constraints, others provide intent and direction for certain actions to occur. The following is a general overview of such guidance, which gives intent or direction for the proposed Project relevant to biological resources.

2.1 FEDERAL

Endangered Species Act of 1973; 16 USC § 1531 et seq.; 50 CFR Parts 17 and 222

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

The Endangered Species Act (ESA) includes provisions for protection and management of species that are federally listed as threatened or endangered or proposed for such listing, and of designated critical habitat for these species. The administering agency for the above authority for non-marine species is the U.S. Fish and Wildlife Service (USFWS).

Migratory Bird Treaty Act: 16 USC § 703-711; 50 CFR Subchapter B

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

The Migratory Bird Treaty Act (MBTA) includes provisions for protection of migratory birds, including basic prohibitions against any taking not authorized by federal regulation. The administering agency for the above authority is the USFWS. The law contains no requirement to prove intent to violate any of its provisions. Wording in the MBTA makes it clear that most actions that result in "taking" or possession (permanent or temporary) of a protected species can be a violation of the act. The word "take" is defined as "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect (including nests, eggs, and feathers)."

Bald and Golden Eagle Protection Act

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

Bald eagle protection began in 1940 with the passage of the Eagle Protection Act, which was later amended to include golden eagle and was renamed. The Bald and Golden Eagle Protection Act makes it unlawful to import, export, take, sell, purchase, or barter any bald eagle or golden eagle, their parts, products, nests, or eggs. Take includes pursuing, shooting, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing. Exceptions may be granted by USFWS for scientific or exhibition use, or for traditional and cultural use by Native Americans. However, no permits may be issued for import, export, or commercial activities involving eagles.

Clean Water Act (33 USC Section 1251 et seq.)

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

The Clean Water Act (CWA) is the principal federal statute protecting navigable waters and adjoining shorelines from pollution. The Clean Water Act is administered by the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE). USACE is responsible for regulating the discharge of fill material into waters of the United States. Waters of the United States include lakes, rivers, streams and their tributaries, as well as wetlands. Since its enactment, the CWA prohibits the discharge of pollutants into waters of the United States without a permit. Section 404 of the CWA provides that whenever any person dredges or places any fill material from or into waters of the U.S. including, without limitation, wetlands, streams, and bays (e.g., while undertaking road construction, bridge construction, or streambed alteration), a permit is required from USACE. Through field reconnaissance surveys and analyses of National Wetlands Inventory (NWI) and watershed data, it is

unlikely that there are any jurisdictional waters of the U.S. within the Project area. It is anticipated that USACE will not assert jurisdiction over any waters and/or aquatic features occurring within the disturbance area.

Northern and Eastern Colorado Desert Coordinated Management Plan (BLM 2002)

Applicable to the transmission line (BLM jurisdiction)

The Northern and Eastern Colorado Desert Coordinated Management (NECO) Plan is a landscape-scale, multi-agency planning effort that protects and conserves the natural resources of the California portion of the Sonoran Desert while also managing its use for humans. This plan was prepared under the same regulations that implement the Federal Land Policy and Management Act of 1976. The NECO Plan provides management areas for the desert tortoise (*Gopherus agassizii*), a system of integrated ecosystem management for special-status species and natural communities on federal lands, and regional standards and guidelines for public land health on BLM lands.

California Desert Conservation Area Plan

Applicable to the transmission line (BLM jurisdiction)

The California Desert Conservation Area (CDCA) Plan guides the management of all BLM-administered lands in the Mojave, Sonoran, and a small portion of the Great Basin Deserts. In total, the CDCA Plan includes an area of approximately 25 million acres, 12 million of which are public lands. The primary goal of the CDCA Plan is to provide guidance for the overall maintenance of the land while simultaneously planning for multiple uses and balancing the human needs with the need to protect the natural environment.

Executive Order 11312

Applicable to the transmission line (BLM jurisdiction)

This Executive Order from 1999 requires all federal agencies to prevent and control the introduction of invasive non-native species in cost-effective and environmentally sound manners. It established a nation-wide Invasive Species Council and Invasive Species Advisory Committee to oversee and facilitate the implementation of the Executive Order.

2.2 STATE

California Endangered Species Act of 1984, California Fish and Game Code § 2050-2098

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

The California Endangered Species Act (CESA) includes provisions for the protection and management of species listed by the State as endangered or threatened, or designated as candidates for such listings. CESA includes a requirement for consultation "to ensure that any action authorized by a state lead agency is not likely to jeopardize the continued existence of any endangered or threatened species… or result in the destruction or adverse modification of habitat essential to the continued existence of the species" (§ 2090). Plants of California declared to be endangered, threatened, or rare are listed at 14 California Code of Regulations (CCR) §670.2. Animals of California declared to be endangered, threatened, or rare are listed at 14 CCR §670.5. The administering agency for the above authority is the California Department of Fish and Game (CDFG).

California Fish and Game Code Section 3503, 3511, 4700, 5050, and 5515

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

These California Fish and Game Codes (CFGC) list bird (primarily raptor), mammal, amphibian, and reptile species that are classified as fully protected in California. Fully protected species are prohibited from being taken or possessed except under specific permit requirements. These Codes also prohibit the take, possession, or needless destruction of the nests or eggs of any bird, including birds of prey or their nests or eggs, except as otherwise provided by the code or any regulation made pursuant thereto.

Native Plant Protection Act (CFGC Section 1900 et seq.)

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

The California Native Plant Protection Act prohibits importation of rare and endangered plants into California, "take" of rare and endangered plants, and sale of rare and endangered plants. CESA defers to the California Native Plant Protection Act, which ensures that State-listed plant species are protected when State agencies are involved in projects subject to the California Environmental Quality Act (CEQA). In this case, plants listed as rare under the California Native Plant Protection Act are not protected under CESA but rather under CEQA.

California Fish and Game Code §1600-1616 – Streambed Alteration Agreement

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

This Code requires that any person, state or local government agency, or public utility notify CDFG and obtain a streambed alteration agreement before they begin any construction project that will divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake, use materials from a streambed, or result in the disposal or disposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake. In general, CDFG jurisdiction extends to the top of the stream or bank, or to the outer edge of riparian vegetation, whichever is wider.

Porter-Cologne Water Quality Control Act of 1969 (California Water Code Section 13000 et seq.)

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

The Porter-Cologne Water Quality Control Act provides state coordination with the Clean Water Act, which is described above. It provides a mechanism by which the Regional Water Quality Control Boards (RWQCBs) certify federally issued CWA permits to ensure the compatibility of federal and state water quality guidelines. The act provides for the development and periodic review of water quality control plans (basin plans) that designate beneficial uses of California's major rivers and groundwater basins and establish narrative and numerical water quality objectives for those waters. Basin plans are primarily implemented by using the National Pollution Discharge Elimination System permitting system to regulate waste discharges to ensure that water quality objectives are met. Waste discharges may include fill, any material resulting from human activity, or any other "discharge" that may directly or indirectly impact waters of the State relative to the implementation of Section 401 of the CWA.

2.3 LOCAL ORDINANCES

Riverside General Plan, Land Use and Multi-Purpose Open Space Elements (2003)

Applicable to the solar array (private land) and transmission line (BLM jurisdiction)

Riverside County requires actions to ensure that proposed development projects demonstrate a high degree of compatibility with any threatened or endangered species habitat they may affect. The administering agency is the Riverside County Planning Department.

3.0 INVENTORY METHODS

The evaluation of biological resources included a review of applicable documents and the identification of resources during the reconnaissance-level survey and focused surveys conducted by qualified biologists. The details and methods used in this evaluation are presented below.

3.1 APPROACH TO DATA COLLECTION

The first step in the approach to data collection for this analysis was the identification and characterization of biological resources, including vegetation community types, riparian habitats, and special-status plant and animal species that are known to occur or have potential to occur in the Project area. The biological study area included the Project site and adjacent lands containing suitable habitat for biological species. For the purpose of this report, "study area" refers to the Project site and adjacent lands.

"Special-status" as used in this section refers to species that are:

- Listed, proposed for listing, or candidates for listing as threatened or endangered under the Federal Endangered Species Act (FESA) (50 CFR 17.12 [listed plants], 50 CFR 17.11 [listed animals], 67 FR 40657 [candidate species], and various notices in the Federal Register [FR] [proposed species]);

- Listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (CESA) (CDFG 2011a);

- Identified by the California Department of Fish and Game (CDFG) as species of concern or fully protected species, including fish and wildlife that do not have state or federal threatened or endangered status but may still be threatened with extinction (CDFG 2011b);

- California Species of Special Concern (CSC), vertebrate species that have been designated as "species of special concern" by the CDFG because declining population levels, limited range, and/or continuing threats have made them vulnerable to extinction (CDFG 2011b);

- Listed by the Bureau of Land Management (BLM) as sensitive (BLM 2007);

- Listed by the CNPS as List 1A (presumed extinct in California), 1B (rare, threatened, and endangered in California and elsewhere), or 2 (rare, threatened, or endangered in California, but more common elsewhere). CNPS List 1A, 1B, and 2 species are considered special-status plant species if they fall within any of these categories as defined in the NPPA, CFGC Section 1901, or the CESA, CFGC Sections 2050 through 2098 (CNPS 2001, 2011);

- Covered as a State-protected furbearing mammal (PFM); or

- Otherwise defined as rare, threatened, or endangered under the California Environmental Quality Act;

The NECO Plan (BLM and CDFG 2002) was consulted for lands designated as Wildlife Management Areas, documentation of sensitive vegetation communities, and documentation of special-status plant and wildlife species. Several plant and wildlife special-status species with potential for occurrence within the study area are described in the NECO Plan.

Only CNPS Lists 1 and 2 are considered to be "special status" species because of their higher sensitivity to impacts. CNPS List 3 and List 4 species are of lower sensitivity; the mitigation for impacts to sensitive vegetation communities would provide compensation for impacts to these species, so no additional mitigation for impacts to them would be required.

3.2 LITERATURE REVIEW

Preliminary investigation included review of information obtained from the USFWS, CDFG, BLM, literature searches, reports from surrounding projects, examinations of aerial photographs, and database searches including CNPS, California Natural Diversity Data Base (CNDDB) records, and other sensitive species accounts for Riverside County. Regional resource planning documents prepared by federal, state and local agencies were also reviewed, including the NECO Plan, the CDCA Plan, and the Riverside General Plan. Additionally, USFWS was consulted regarding the federal listed species that could occur within the Project quads. USFWS identified only desert tortoise as having the potential to occur in the affected Project quadrangles (Appendix C).

To identify the existing and potential biological resources present in the vicinity of the proposed Project, a Geographic Information System (GIS) search was performed. This consisted of mapping baseline biological resource data (vegetation mapping, CNDDB records, habitat conservation areas, water resources, and potential jurisdictional areas). The following US Geological Survey quadrangles were reviewed: McCoy Wash, Ripley, and Roosevelt Mine. Figure 2 shows the CNDDB records that were located within or adjacent to the project area.

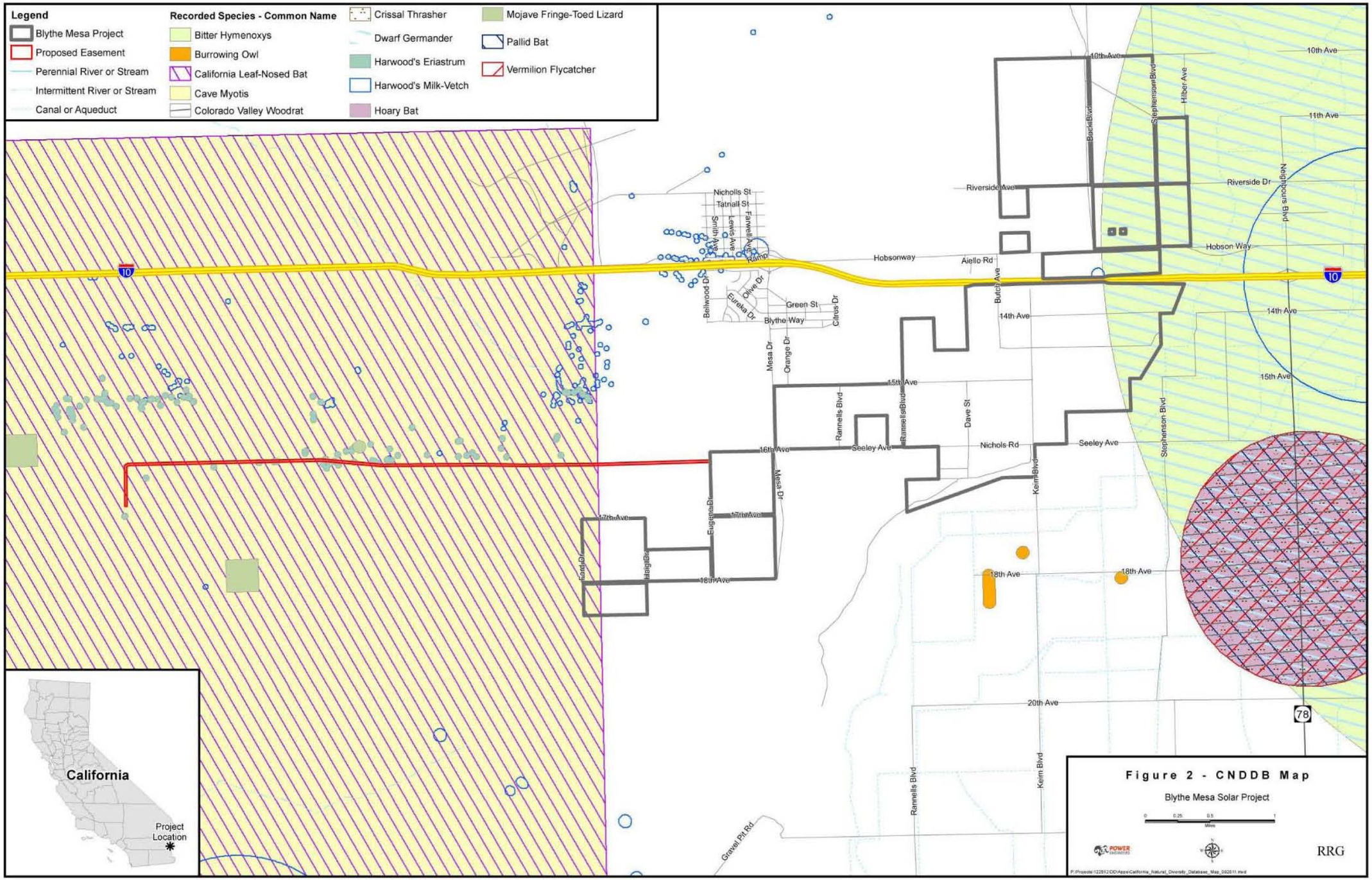
Other references used included the soil data from the US Department of Agriculture, the Jepson Manual, the CNPS Inventory of Rare and Endangered Plants of California, and several other published and technical references for the region. By reviewing the surveys conducted by other projects in the area, POWER was able to determine where focused surveys may be required and where recently acquired existing data may be able to be used for a species inventory instead. The surrounding projects that were reviewed for existing survey information include:

- Blythe Solar Power Project (AECOM 2010)
- Genesis Solar Energy Project (BLM and CEC 2010, TetraTech 2010a, TetraTech 2010b)
- Devers-Palo Verde No. 2 Transmission Line Project (Aspen 2006)
- Devers-Palo Verde No. 2 Transmission Line Project Telecommunication System Route (CH2MHill 2010)
- Devers-Palo Verde No. 2 Transmission Line Project Colorado River Substation Expansion (Aspen 2011)
- First Solar Electric Blythe Solar 1 Project (First Solar Electric, LLC (First Solar). No Date)
- Blythe Airport Solar Project (US Solar Holdings, LLC (US Solar). No Date.)

These projects were reviewed for survey information, including target species, survey areas, survey dates, and survey results. This was conducted through a combination of textual reviews and reviews of project survey maps, when available. Based on these reports, the following information was acquired for focused surveys that have been conducted in the areas surrounding the BMSP. Refer to Table 1 for a complete analysis of the existing data that was collected. Figure 3 shows the existing data that overlaps with the Project's transmission line.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 2. CNDDB MAP



THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 1. ADJACENT PROJECT SURVEY INFORMATION

Species	Project*	Species Detected	BMSP Survey Area Overlap
Burrowing Owl	Blythe Solar Power Project	Yes, two within solar site, four in transmission line and multiple sign. Not determined how sign was confirmed.	Overlaps with BMSP transmission line and Colorado River Substation (CRS) survey areas.
	Genesis Solar Energy Project	Yes, three individuals detected around the generation tie line and one burrow around the main site.	No overlap
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Burrow sites detected along project segment that encompasses Colorado River Substation, but specific locations not mapped.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, burrowing owls detected along southern telecom route. Three owls detected just east of Colorado River Substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.
Desert Tortoise	Blythe Solar Power Project	Yes, three to west side of project site with multiple sign (carcass fragment) on the remainder of the site. Sign detected in northern portion of transmission line. No sign detected within southern portion of transmission line (overlapping with BMSP).	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	Yes, sign detected within main site and generation tie line.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Detected in several project segments but not in the vicinity of BMSP.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, many sign (mostly scat) detected. Mainly scat detected around substation. Historical data of an adult and an occupied burrow.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.

Species	Project*	Species Detected	BMSP Survey Area Overlap
Golden Eagle	Blythe Solar Power Project	No, golden eagle active nests are not known within 10 miles of Blythe Solar site. One inactive nest in study area.	Overlaps with entire BMSP project area.
	Genesis Solar Energy Project	No.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	No.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	No.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.
Rare Plants	Blythe Solar Power Project	Yes. However, no federal or State protected species. Multiple species observed in project area. Multiple species observed in transmission line study area. Species observed in transmission line study area overlapping with BMSP include Harwood's milkvetch, Harwood's woollystar, winged cryptantha, and ribbed cryptantha.	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	Yes, numerous rare plants detected throughout entire project area. Species detected include ribbed cryptantha, Harwood's milkvetch, desert unicorn plant, winged cryptantha, and Harwood's woollystar.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	No State or federal listed species detected in the vicinity of BMSP.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, multiple species (no State or federal listed) detected. Ribbed cryptantha detected at overlap area near substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.

Species	Project*	Species Detected	BMSP Survey Area Overlap
Avian Use	Blythe Solar Power Project	Yes, various migratory and resident species observed.	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	Yes, various migratory and resident species observed.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Various special-status birds detected in project segment that encompasses CRS, but specific locations not mapped.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, various species detected in vicinity of substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	Yes, one special-status bird species detected.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.
Bat Risk	Blythe Solar Power Project	One instance of bat guano in main site. .	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	No.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	No.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	No.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	No.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.
Mojave Fringe-toed Lizard	Blythe Solar Power Project	Yes, multiple locations along transmission line	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	Yes, species detected abundantly throughout entire Project area.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Detected in project segment that encompasses Colorado River Substation, but specific locations not mapped.	The project areas overlap at the CRS.

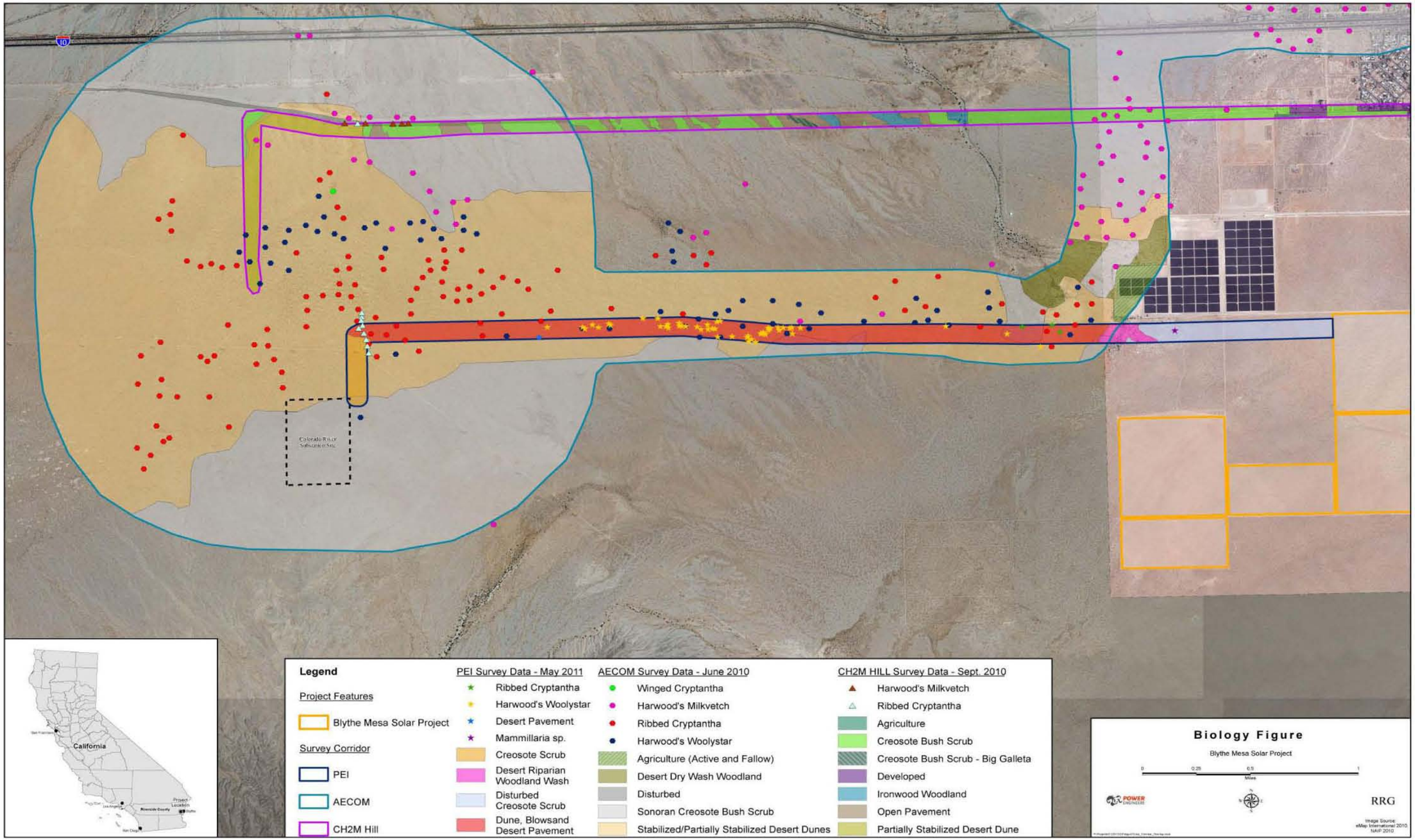
Species	Project*	Species Detected	BMSP Survey Area Overlap
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, numerous individuals detected at and around the substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.
Sensitive Mammals (Badger, Kit Fox, Coyote)	Blythe Solar Power Project	Yes, numerous badger and kit fox sign. Several kit fox burrow complexes in northern transmission line.	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	Yes, kit fox and burro deer sign detected throughout project area.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	No.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, one badger skull and likely badger den detected.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.
Jurisdictional Waters	Blythe Solar Power Project	State waters delineated in main site, no waters delineated in transmission line or substation areas.	Overlaps with BMSP transmission line and CRS survey areas.
	Genesis Solar Energy Project	Yes, 91 acres of state jurisdictional waters within project area.	No overlap.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Potential jurisdictional waterways along project route noted but not mapped. No formal delineations conducted.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	No.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.

Species	Project*	Species Detected	BMSP Survey Area Overlap
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.

*See the project list above this table for reference information for each project.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 3. EXISTING PROJECT DATA OVERLAP WITH BMSP STUDY AREA



THIS PAGE INTENTIONALLY LEFT BLANK

3.3 FIELD SURVEY METHODOLOGY

The following section describes the methodology used to collect biological data in the field. Field surveys were conducted to supplement the data collected from the review of existing data. During spring 2011, Project biologists completed the following surveys within the study area: vegetation mapping, reconnaissance surveys, focused rare plant surveys, and protocol burrowing owl surveys. Comprehensive biological resource survey methodologies were designed to meet applicable BLM, USFWS, and CDFG requirements.

3.3.1 Reconnaissance Survey

Biologists first developed a potential list of special-status species by consulting the CDFG California Natural Diversity Database (CNDDB) (RareFind Version 3.1.1; CDFG 2011) and California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants (2011) for documented occurrences of special-status or rare plants and animals within the McCoy Wash, Ripley, and Roosevelt Mine USGS 7.5-minute quadrangles (Figure 2). These resources, along with the species range maps, were utilized to determine historic occurrence of special-status plant and wildlife species and other natural resources within the study area. Additionally, USFWS was consulted regarding the federal listed species that could occur within the Project quads (Appendix C).

Once a complete list was developed of potential species that could occur within the Project area, POWER conducted a reconnaissance survey (refer to Tables 3 and 4 for species lists). The reconnaissance survey was conducted in the proposed solar array footprint by POWER biologists Tom Herzog and Ken McDonald on April 19 and 20, 2011. The survey was a comprehensive habitat assessment conducted across the whole site, identifying key habitat features for both flora and fauna.

Species-habitat correlations assume the occurrence of an organism with a series of environmental variables. Environmental variables can describe the habitat components organisms are dependent upon and, therefore, predict their pattern of habitat occupancy. Therefore, a habitat-based survey approach was used to assess the proposed Project footprint.

The field survey evaluated the quality of the habitat for each species and/or proximity of the habitat to a known occurrence of a species. Information used to determine known occurrence locations included CNDDB data, CNPS records, consultation with Wildlife Agencies, and reference to published species accounts. Field survey activities included documenting plant and animal species or sign observed within the study corridor, mapping vegetation communities, and photo-documenting existing biological conditions for all identified potential Project routes.

The potential for occurrence of special-status species not observed during field investigations was assessed based upon evaluation of species distribution and habitat use and information from previous research studies and biological reports. Therefore, based on the existing data and observations made during the field reconnaissance surveys, the following methodology was used to assess the following species.

Avian use: Numerous bird surveys have been completed by solar projects surrounding the Project area, including the Solar Millennium project (EDAW AECOM and Bloom Biological 2009). For the non-agricultural land within the Project area, information on late spring migrant songbirds and resident birds in native habitats (i.e., Sonoran creosote shrub scrub and desert dry wash woodland) is available (EDAW AECOM and Bloom Biological 2009).

Based on migratory bird data collected from adjacent projects, it was assumed that the agricultural land within the Project site may be used as foraging habitat (AECOM 2009). To the east of the Project area is the Lower Colorado River Valley. The Lower Colorado River Valley is in the Pacific Flyway, one of the

four major migration flyways in North America (Bird Nature 2001), and is a globally important bird area (IBA) (Audubon 2011). The IBA consists of the Colorado River, associated riparian areas and marshes, and agricultural fields in the area. Waterfowl are known to move daily between water bodies and irrigated agricultural fields to forage (Randall et al. 2011). The Project site comprises primarily irrigated orchard and non-irrigated field crops and fallow fields. However, approximately 90,000 acres of irrigated agricultural land is within the Palo Verde Valley just east of the Project area. Due to the existing suitable forage land east of the Project site and the distance from the Colorado River, it is assumed that migratory birds would only incidentally use the Project area for forage land and that these lands are of lesser value and importance for migratory bird foraging compared to lands closer to the River.

The Migratory Bird Treaty Act of 1918 (MBTA) is the main driver for protection of migratory birds in the United States. In the biological sense, a migratory bird is a bird that has a seasonal and somewhat predictable pattern of movement and includes some special-status species and more common species, as well. Based on the data reviewed and observations in the field, avian point count surveys were not conducted. Conducting a point count survey at this time would only provide a snapshot of the migratory species potentially using the site; the use by these species and numbers of species would vary widely each year. However, since it is expected that migratory species potentially use the Project site, preconstruction surveys are recommended. The purpose of the preconstruction survey is to avoid or minimize construction-related impacts on bird species that may be present or passing through the Project site. In addition, it is recommended that Best Management Practices be implemented prior to and during construction to further reduce and avoid construction-related impacts on bird species including nesting.

Bat risk: A reconnaissance survey was conducted to help determine the potential for bat species to occur within the Project area. Based on the results of the reconnaissance survey and lack of suitable habitat, no focused surveys were conducted or recommended.

Desert tortoise: Although desert tortoise was indicated as potentially occurring in the vicinity of the Project area, the only habitat initially deemed suitable occurred within the proposed transmission line corridor. During focused plant surveys, incidental observations of wildlife and wildlife sign were noted and no desert tortoise sign was detected. The habitat substrate was deemed too sandy for tortoise burrows, and vegetation was only marginally suitable to support tortoise foraging. Meetings with regulatory agencies confirmed that this area, and any of the other land within the proposed Project area, is unlikely to support desert tortoise; therefore, no protocol surveys are considered necessary. A preconstruction survey should be conducted. If desert tortoises are not observed during the preconstruction surveys, additional conservation measures will not be needed.

Golden eagle: Research conducted, including mapping of CNDDB records, shows that Golden eagle active nests are not located within 10 miles of the Project site. Existing data and reports from the Blythe Solar Power Project (AECOM 2010) also indicated no Golden eagles within 10 miles of their project site. Based on the existing records and the reconnaissance survey, no further survey is proposed for the Project.

Mojave fringe-toed lizard: During the spring rare plant survey, POWER recorded approximately 100 observations of Mojave fringe-toed lizard along the transmission line survey area. Based on the known presence of the species, focused surveys are not proposed for this species. Mitigation measures should be developed to avoid, minimize and mitigate impacts to the Mojave fringe-toed lizard.

American Badger and Desert Kit Fox: Based on the surrounding project survey results and no small mammal records within CNDDB, no additional surveys are proposed. A preconstruction clearance survey should be conducted to help identify and avoid any potential species that may be present within the Project footprint.

Bighorn Sheep: A bighorn sheep skull was found within the proposed solar array project footprint. It is unknown how long this skull had been here and if the animal died near this location, or if the skull was washed downstream from somewhere else. Focused surveys for this species were not conducted and this sign was noted incidentally during the reconnaissance surveys.

Jurisdictional waters: Based on delineations conducted for the Blythe Solar Power Project (AECOM 2010) and the Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route (CH2MHill 2010), review of watershed maps and inventories, and observations during field surveys, no jurisdictional waters are believed to be present within the Project area. No delineations are proposed.

3.3.2 Vegetation Communities

Vegetation mapping was conducted within the study area during April and May, 2011. Aerial photography and Project maps were utilized and vegetation community boundaries were recorded. Because most of the solar array footprint is agricultural, intensive ground surveys were not necessary for vegetation mapping. The transmission line footprint, which mostly comprises creosote bush scrub, was surveyed on foot, allowing more precise recording of habitat changes within the proposed corridor

3.3.3 Focused Rare Plant Survey

Based on observations made during the reconnaissance survey, a focused rare plant survey was conducted within a 500-foot corridor around the proposed transmission line on May 5 and May 6, 2011 by POWER biologists Ken McDonald, Melissa Lippincott, Tom Herzog, and Ryan Winkleman. The surveys were floristic, meaning that all plants observed were identified to the taxonomic level needed to determine whether they were special-status plant species. Exceptions to this included instances where characteristics essential for identification were not present during the field survey period. Botanists identified all plant species detected during field surveys using personal knowledge of the plants and keys in *The Jepson Manual* (Hickman 1993). Scientific nomenclature in this report mainly follows Hickman (1993). Common names are derived from Hickman (1993) and CalFlora (2008). The survey methodology generally followed the U.S. Fish and Wildlife Service's (USFWS) *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 1996a), and the recommended botanical survey guidelines of the California Department of Fish and Game (CDFG 2000) and the California Native Plant Society (CNPS 2001).

Prior to going into the field, a list of potentially occurring sensitive plant species was compiled based on species information with known populations within/near the study area and results of the reconnaissance survey (refer to Table 3). POWER botanists prepared photographs and habitat descriptions for each potential special-status plant species prior to the surveys and trained the other biologists in their detection. Biologists walked approximately 30 feet apart in parallel transects on both sides of the proposed transmission centerline. The biologists all studied the first instances of special-status plants that were observed to obtain a survey image of the plants' current appearances. The survey was floristic in nature, in that each species of plant detected was either identified and recorded in the field to species level, or collected for later identification using standard taxonomic floral keys.

Wildlife sign and sightings were also recorded and special-status wildlife species incidentally observed during the plant surveys were mapped using global positioning system (GPS) units.

3.3.4 Protocol Western Burrowing Owl Survey

Protocol surveys were started on May 6 and extended through July 23, 2011. Survey methods were derived from generally accepted professional standards, the 1993 California Burrowing Owl Consortium (CBOC) Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993), and the 1995

California Department of Fish and Game (CDFG) Staff Report on Burrowing Owl Mitigation (CDFG 1995). In summary, a methodical pedestrian survey for owl burrows was conducted by walking through areas of suitable habitat within the study area, including man-made structures.

POWER biologists Tom Herzog, Steve Hicks, Ken McDonald, Melissa Lippincott, and Garcia and Associates, Inc. biologists Andrew McCadden, Angelique Herman, and Laura Megill conducted pedestrian survey transects, spaced at approximately 100 feet to allow for 100% visual coverage of the study area. Where necessary, transect spacing was reduced or expanded to account for differences in terrain, vegetation density, and visibility. The locations of all potential owl burrows and sign were recorded and mapped using handheld global positioning devices and aerial imagery. Incidental observations of other avian species, plants and other wildlife were also noted. The presence of each observed wildlife species was based on direct observation of individual(s), sign, and/or vocalization. CBOC survey protocols and POWER's full methodology and results are described in the burrowing owl survey report (POWER 2011).

4.0 AFFECTED ENVIRONMENT

The results of the literature review, records search, GIS analysis, and field data are provided below.

4.1 ENVIRONMENTAL SETTING

The Project area is in the Palo Verde Valley, along the western edge of the Colorado River in the Sonoran Desert. This area is on Palo Verde Mesa, a series of ancient raised river terraces. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The Project area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert. Development in the Project vicinity includes agricultural fields and groves as well as the Blythe City Airport. The Project area also includes undeveloped open desert.

The subtropical climate of the Colorado Desert is characterized by dry, mild winters averaging 54 degrees Fahrenheit (°F) and dry, hot summers that average 90°F. Summer highs are known to reach 122°F. Yearly average precipitation is 3.83 inches (Western Regional Climate Center, 2011). Although rainfall is primarily in the winter months, the region is influenced by summer monsoons from July through September.

Surface water is minimal on Palo Verde Mesa, limited to seasonal and perennial sources. Perennial water comes from McCoy Springs in the McCoy Mountains west of the Project area and the Colorado River, which lies eight miles east of the Project area. The Colorado River is the source of irrigation water for agriculture in the area.

Vegetation communities within the Project area consisted of Creosote Bush Scrub, Desert Dunes, Desert Dry Wash Woodland, and Agricultural Land. Creosote bush (*Larrea tridentata)* was the dominant plant species in creosote bush scrub communities and was co-dominant with big galleta grass (*Pleuraphis rigida*) and indigo bush (*Psorothamnus emoryi*) in desert dune communities. Palo verde (*Cercidium floridum*), mesquite (*Prosopis* spp.), ironwood (*Olneya tesota*) and smoketree (*Psorothamnus spinosus*) occurred within Desert Dry Wash Woodland. Agricultural land use within the Project area included drip-irrigated citrus orchards, flood-irrigated alfalfa, non-irrigated winter wheat, abandoned jojoba orchards, and fallow fields. Approximately 70% of the Project area was actively cultivated agricultural land, 24% was previously disturbed by agricultural or military activities, and approximately 6% remained undisturbed.

The Project area borders or is in the vicinity of Nicholls Warm Springs/Mesa Verde, solar array facilities, Blythe Airport, the 520 MW natural gas-fired Blythe Generating Plant, electrical substations, electrical transmission lines, Interstate 10 (I-10), and other paved and dirt roads. The Project area is bound on the east by agricultural land use that extends to the Colorado River. Beyond the urban disturbances immediately adjacent, the Project area is bound on the other three compass bearings by undeveloped native desert habitat.

Wildlife species commonly observed within the Project area included round-tailed ground squirrel (*Spermophilus tereticaudus*), kangaroo rat (*Dipodomys* sp.), kit fox (*Vulpes macrotis*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canis latrans*), mourning dove (*Zenaida macroura*), white-wing dove (*Zenaida asiatica*), horned lark (*Eremophila alpestris*), greater roadrunner (*Geococcyx californianus*), Le Conte's thrasher (*Toxostoma lecontei*), western kingbird (*Tyrannus verticalis*), loggerhead shrike (*Lanius ludovicianus*), common zebra-tailed lizard (*Callisaurus draconoides draconoides*), desert iguana (*Dipsosaurus dorsalis*), common side-blotched lizard (*Uta stansburiana*), Mohave fringe-toed lizard (*Uma scoparia*), western diamondback (*Crotalus atrox*), and western whiptail (*Cnemidophorus tigris*).

4.1.1 Vegetation Communities

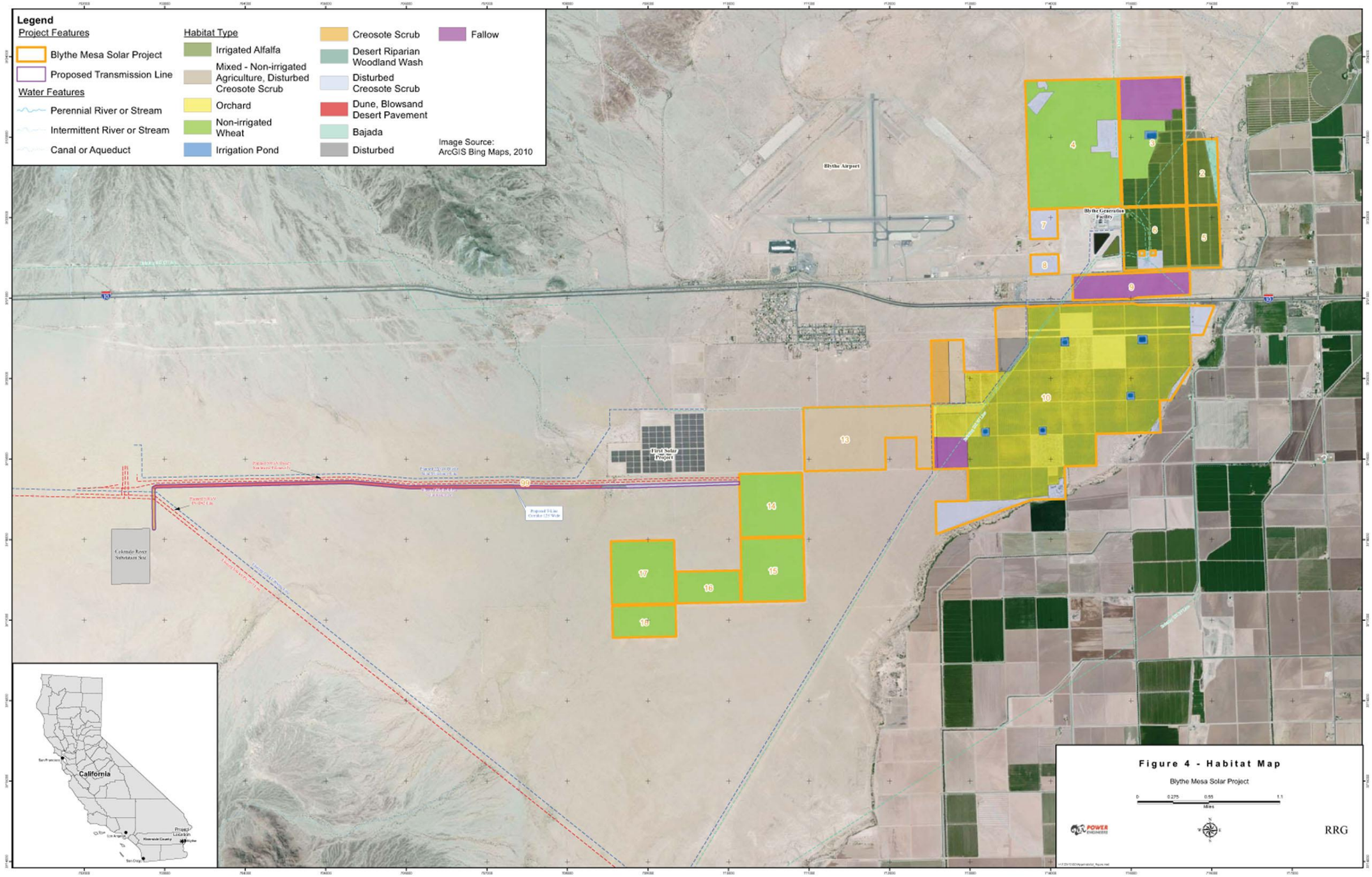
Eleven vegetation communities and other cover types were identified within the study area during the reconnaissance and focused surveys, including upland, riparian, and other cover types (Table 2; Figure 4). Vegetation communities are described in detail below and based on a classification system by R. Holland (1986). When appropriate, vegetation classification by J.O. Sawyer and T. Keeler-Wolf (1995) are also considered. Community types according to CDFG are listed where applicable. Of the vegetation communities listed in Table 2, desert riparian woodland wash is considered sensitive. Desert riparian woodland wash is sensitive because it is included with State waters under the jurisdiction of CDFG. In addition, desert riparian woodland wash is a special community type (e.g., high priority for inventory in the California Natural Diversity Database) per CDFG's Vegetation and Mapping Program.

TABLE 2. VEGETATION COMMUNITIES AND COVER TYPES (ACRES)

Vegetation Communities and Other Cover Types	Acreage
Desert Riparian Woodland Wash	2.83 acres
Creosote Scrub	4.80 acres
Dune, Blowsand Desert Pavement	52.52 acres
Bajada	18.07 acres
Disturbed Creosote Scrub	122.27 acres
Disturbed Creosote Scrub and Fallow Agriculture	720.61 acres
Irrigated Cropland	404.02 acres
Irrigation Pond	13.34 acres
Orchard	1299.49 acres
Row Crop	863.18 acres
Ruderal	171.82 acres
	(wildlife forage)

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 4. VEGETATION COMMUNITIES WITHIN THE STUDY AREA


Legend
Project Features
Blythe Mesa Solar Project
Proposed Transmission Line
Water Features
Perennial River or Stream
Intermittent River or Stream
Canal or Aqueduct
Habitat Type
Irrigated Alfalfa
Mixed - Non-irrigated Agriculture, Disturbed Creosote Scrub
Orchard
Non-irrigated Wheat
Irrigation Pond
Creosote Scrub
Desert Riparian Woodland Wash
Disturbed Creosote Scrub
Dune, Blowsand Desert Pavement
Bajada
Disturbed
Fallow
Image Source: ArcGIS Bing Maps, 2010
Blythe Airport
Blythe Generation Facility
First Solar Project
Colorado River Substation Site
Proposed ROW Corridor 150' Wide
Proposed 161kV Project Line
Existing 161kV Project Line
Existing 500kV Project Line
Existing 230kV Project Line
Proposed 500kV Project Line
Proposed 230kV Project Line
Proposed 161kV Project Line
Proposed Project Access Road
Proposed Project Perimeter Road
Proposed Project Internal Road
Proposed Project Boundary
Proposed Project Fence
Proposed Project Gate
Proposed Project Substation
Proposed Project Laydown Area
Proposed Project Solar Field
Proposed Project Solar Field Boundary
Proposed Project Solar Field Fence
Proposed Project Solar Field Gate
Proposed Project Solar Field Substation
Proposed Project Solar Field Laydown Area
Proposed Project Solar Field Solar Field
Proposed Project Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Boundary
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Fence
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Gate
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Substation
Proposed Project Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Solar Field Laydown Area
Proposed Project Solar Field
Proposed Project Solar Field Boundary
Proposed Project Solar Field Fence
Proposed Project Solar Field Gate
Proposed Project Solar Field Substation
Proposed Project Solar Field

THIS PAGE INTENTIONALLY LEFT BLANK

Desert Riparian Woodland Wash. This vegetation community consists of open, drought deciduous, riparian scrub woodland and is made up of three primary components: wash-dependent vegetation, vegetated ephemeral dry wash, and islands of Sonoran creosote bush scrub (e.g., riparian interfluves). Dominant and indicator plants of this community within the study area include honey mesquite (*Prosopis glandulosa*), palo verde (*Cercidium floridum*), desert ironwood (*Olneya tesota*), cat-claw acacia (*Acacia greggii*), and rush milkweed (*Asclepias subulata*). Creosote bush (*Larrea tridentata*) and burro brush (*Ambrosia dumosa*) were scattered throughout the canopy. The herbaceous layer was dominated by desert plantain (*Plantago ovata*), *Cryptantha* spp., and Mediterranean grass (*Schismus barbatus*). Desert riparian woodland wash is equivalent to Holland's desert dry wash woodland (Code 62200). It also approximates Sawyer and Keeler-Wolf's Catclaw Acacia Series.

Approximately 2.83 acres of desert riparian woodland wash occurs in the Project area, all located within the proposed transmission line disturbance area.

Creosote Bush. Within the study area, this community is characterized by sandy soils with a shallow clay pan on a broad gentle southeast trending slope. Dominant plants within the study area for this community include creosote bush, burro brush, brittlebush (*Encelia farinosa*), and cheesebush. This is the most common plant community within the study area, dominating the alluvial soil deposits. This plant community intergrades into the desert dry wash woodland. Within the study area, there are areas of desert pavement that are covered with rounded cobbles that range in size from one to three inches. Typically, these areas are higher than the surrounding landscape by three to 15 feet. These areas are within Sonoran creosote bush scrub, though the plant density is lower. Sonoran creosote bush scrub is designated by Holland as Code 33100 and Sawyer and Keeler-Wolf as the Ocotillo Series.

Within the utility corridor on the south side of I-10, fine sand drifts are interspersed within this community type. In these areas, Emory's indigo bush occurs in stands and was more prevalent than in other portions of the Sonoran creosote bush scrub.

Approximately 4.80 acres of relatively undisturbed Sonoran creosote bush scrub occurs within the Project area. This is present within the proposed transmission line disturbance area and is relatively undisturbed, except for occasional vehicle tracks. There are larger blocks of disturbed creosote bush scrub in the solar array disturbance area. Past disturbances in these areas consist of military training and agricultural use, including cultivation of jojoba (*Simmondsia chinensis*). These disturbances occurred in the past and the Sonoran creosote bush scrub within the study area has been recovering through natural recruitment. As a result, two invasive plant species, Russian thistle (*Salsola tragus*) and Sahara mustard (*Brassica tournefortii*), can be found in disturbed areas throughout the study area, especially near roads, and fallow and active agricultural areas. Another exotic plant, Mediterranean grass (*Schismus* sp.), is prevalent throughout the Sonoran creosote bush scrub. There are approximately 122.27 acres of disturbed creosote bush scrub within the Project area and an additional 720.61 acres of disturbed creosote bush scrub that is growing in fallow agricultural fields.

Dunes, Blowsand Desert Pavement. This community is characterized by sand that is locally stabilized by evergreen and/or deciduous shrubs, scattered low annuals, and perennial grasses, and that therefore is an actively changing part of the desert environment. Desert pavement is generally more stabilized and is covered with rock fragments to resemble a "pavement" surface. This group of communities was present throughout most of the proposed transmission line disturbance area. This community most closely resembles Holland's "Desert Dunes" community, designated by Holland as Code 22000.

Approximately 52.52 acres of dunes and blowsand desert pavement are present within the Project area.

Irrigated Cropland, Irrigation Pond, Orchard, and Row Crop. These community types fall into the broader category of agriculture. The majority of agricultural land is fallow and active agriculture within

the proposed solar array disturbance area. It includes lands that are currently under cultivation and those that are abandoned (e.g., fallow). In the soils within abandoned agriculture areas, native vegetation is growing back; Russian thistle, Saharan mustard, and other exotic plants were observed interspersed with the native vegetation and are indicative of past agricultural disturbance. Irrigated cropland encompasses approximately 404.02 acres within the Project area, while irrigation ponds are 13.34 acres, orchards are 1,299.49 acres, and row crops are 863.18 acres. There is no associated Holland or Sawyer and Keeler-Wolf classification for this land cover type.

Bajada. Bajadas are essentially alluvial fans or desert washes. This community is present in the northeastern corner of the Project area and is typically characterized as the shallow, sandy, braided bottoms of wide canyons. Although much of this community is sparsely vegetated, it most closely resembles Holland's "Mojave Desert Wash Scrub," Code 63700.

Approximately 60.03 acres of bajada are present within the Project area.

Ruderal. Ruderal communities have been previously disturbed and have been converted to mostly non-native, weedy areas. Ruderal vegetation is that which grows quickly in disturbed areas and may consist of native species, such as fire-following plants, or non-native species, such as invasive grasses or forbs. Examples of invasive species that would occur in these areas include redstem filaree (*Erodium cicutarium*), Sahara mustard, and Mediterranean grass. Ruderal areas in the Project area are primarily concentrated within the proposed solar array area.

Approximately 219.83 acres of ruderal vegetation is present within the Project area.

4.1.2 Jurisdictional Waters

Delineation surveys conducted for the Blythe Solar Power Project, which overlaps the BMSP transmission line corridor, did not identify any jurisdictional waters within the overlapping area (AECOM 2010). Additionally, delineation surveys conducted for the Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route, which runs parallel to the BMSP transmission line corridor and is approximately one mile north and in the same hydrological flow route, did not identify the presence of jurisdictional waters within the area of the BMSP transmission line corridor (CH2MHill 2010). There is an agricultural irrigation ditch running close to the eastern edge of the proposed solar array, but it does not cross the Project area and is approximately 75 to 90 feet below the edge of the Project area. There are several palustrine open-water wetlands (POWs), likely stock ponds, located in a block in an area that is surrounded by the Project east of the Blythe Airport and north of I-10, but there are no POWs within the Project boundaries.

Through field reconnaissance surveys and analyses of National Wetlands Inventory (NWI) and watershed data, it is unlikely that there are any jurisdictional waters of the U.S. within the Project area. It is anticipated that USACE will not assert jurisdiction over any waters and/or aquatic features occurring within the disturbance area.

4.1.3 Flora

This section discusses plant species detected or with potential to occur within the study area. In total, 79 plant species were detected in the study area during vegetation mapping and rare plant surveys, including 15 non-native plant species (Appendix A). A total of 18 special-status plant species have potential to occur within the study area (Table 3). Harwood's woollystar (*Eriastrum sparsiflorum* ssp. *harwoodii*) and desert unicorn (*Proboscidea althaeifolia*) were observed within the study area. Harwood's woollystar, a CNPS List 1B.2 (rare, threatened, or endangered in California and elsewhere) species, was detected in the transmission line footprint and in the buffer, while desert unicorn plant, a CNPS List 4.3 (limited distribution, not very endangered in California) species, was detected in the solar array area. No other

federal-listed, State-listed, or other special-status plant species was observed within the study area. More detail on special-status species that occur or have the potential to occur within the study area is provided in Table 5.

Plant species observed during the individual reconnaissance and focused surveys are listed in Appendix A. Species most commonly observed during biological surveys included burro bush, Sahara mustard, creosote bush, and galleta grass (*Pleuraphis rigida*). Other common species that occurred less frequently included desert pincushion (*Chaenactis stevioides*), Spanish needles (*Palafoxia arida*), several *Cryptantha* species, four-wing saltbush (*Atriplex canescens*), Russian thistle, palo verde, and bottlebrush primrose (*Camissonia boothii*).

Species accounts are provided below for the special-status plant species that could occur within the Project area. This includes both species that were and were not detected during surveys. These species are based on records searches with the CNDDB (CDFG 2011) and CNPS (2011), and reviews of documentation from other nearby projects, such as the Blythe Solar Power Project (AECOM 2010).

Federal Listed Plant Species. No federal-listed plant species were detected within the study area during spring 2011. Based on a CNDDB search, no federal endangered plant species have potential to occur within the study area.

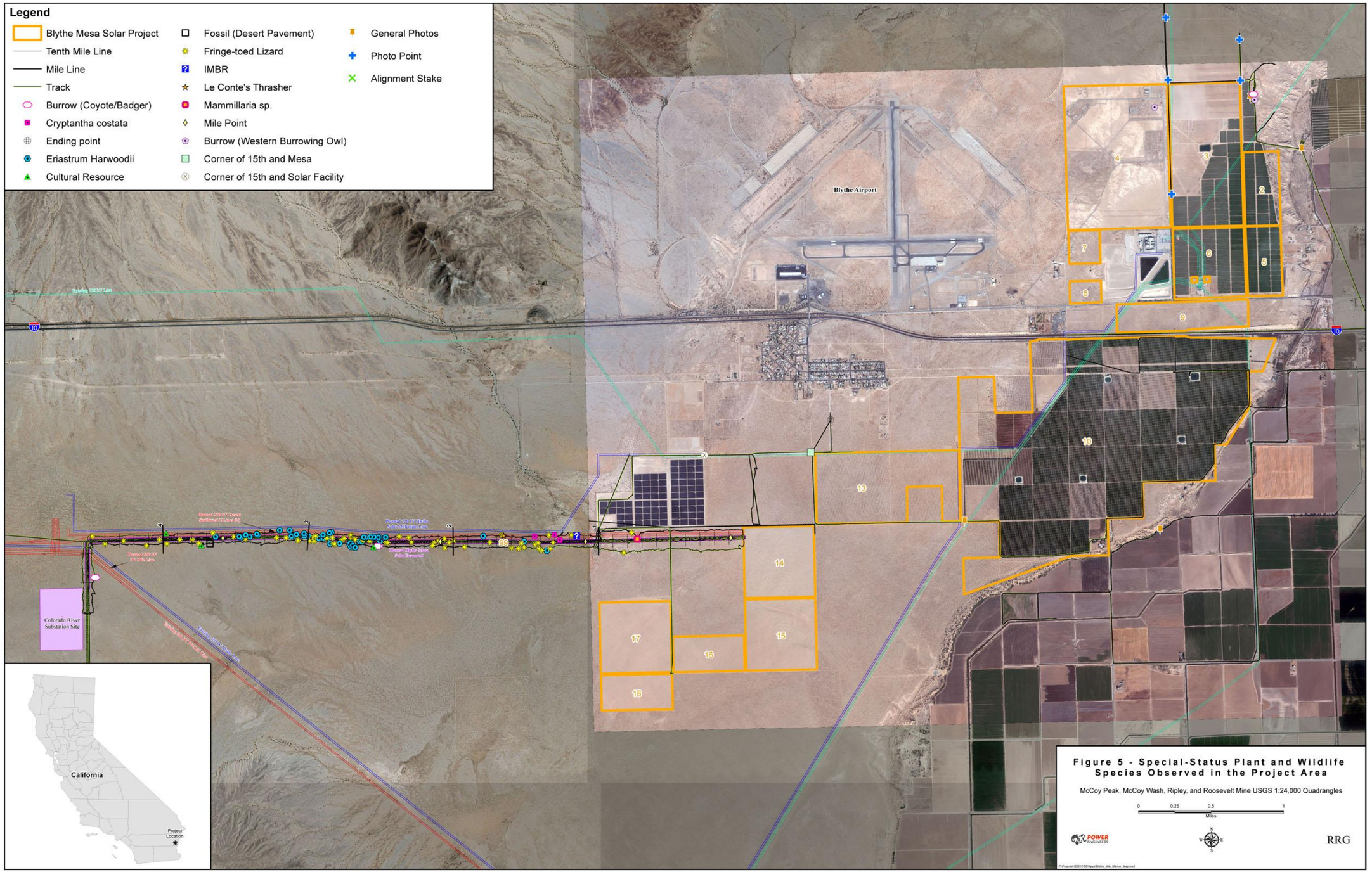
State-listed Plant Species. Based on regional databases, no State-listed plant species were determined to have potential to occur within the study area. Based on site-specific habitat evaluations conducted by Project biologists and a literature review, including a CNDDB record search and a compiled list, it was determined that no State-listed plant species have been recorded near the study area or have potential to occur in the study area. No State-listed plant species were detected within the study area.

Other Special-Status Plant Species. Harwood's woollystar was observed within the study area. Harwood's woollystar, a CNPS List 1B.2 (rare, threatened, or endangered in California and elsewhere) species, was detected in the transmission line Project area and in the buffer. Forty-nine individuals were observed in flower within the survey area. These individuals are displayed as point locations on Figure 5. Based on a CNDDB search, Harwood's milk-vetch (*Astragalus insularis* var. *harwoodii*), a CNDDB List 2.2 species, has a high potential to occur within the proposed transmission line disturbance area. There are numerous records in the vicinity and several that are just outside the survey buffer area.

Species accounts are provided below for special-status plant species that occur or have potential to occur in the Project area. Table 3 provides a summary of the special-status plant species with the potential to occur within the Project area.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 5. SPECIAL-STATUS PLANT AND WILDLIFE SPECIES OBSERVED IN THE PROJECT AREA



THIS PAGE INTENTIONALLY LEFT BLANK

Special-Status Plant Species Accounts

Angel Trumpet

Angel trumpet (*Acleisanthes longiflora*) is a thick-taprooted perennial herb in the *Nyctaginaceae* family. Angel trumpet is a CNPS list 2.3 species, meaning that it is rare, threatened or endangered in California. It occurs in carbonate soils within Sonoran Desert creosote bush scrub from 30 to 8,000 feet and flowers during May (Jepson Interchange 2011, CNPS 2011). This species is known from only one occurrence in California in eastern Riverside County near the southern edge of Big Maria Mountain, North of Blythe and north east of the Project area (CalFlora 2011).

Soils in the majority of the Project area are composed of sandy decomposed granite. Potentially suitable habitat for angel trumpet could occur in the northeast corner of the site in the Bajada vegetation area. However, based on soils in the Project area and known records for this species, there is low potential for it to occur within the Project area. Furthermore, angel trumpet was not observed during focused surveys conducted within the appropriate blooming period for this species.

Coachella Valley Milkvetch

Coachella valley milkvetch (*Astragalus lentiginosus* var. *coachellae*) is federally listed as an endangered species, is a BLM sensitive species, and is included in the CNPS Inventory of Rare and Endangered Plants on list 1B.2. It is also covered under the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP). Coachella Valley milkvetch is an annual or perennial herb historically known to occur in Sonoran Desert scrub in sandy soils at elevations ranging from 131 to 2,149 feet (CNPS 2011). Coachella Valley milkvetch blooms from February to May. There are 81 recorded occurrences for this species in Riverside County. Coachella Valley milkvetch is known to occur in the Coachella Valley; the record nearest the Project area is east of Victory Pass, approximately five miles north of Desert Center along State Highway 177, approximately 49 miles west of the Project area (CalFlora 2011).

Suitable Sonoran Desert scrub with sandy soils occurs throughout the Project area. Coachella Valley milkvetch was not observed during focused surveys conducted within the blooming period (surveys were conducted May 4 and 5, 2011).

Harwood's Milk-vetch

Harwood's milk-vetch (*Astragalus insularis* var. *harwoodii*) is a CNPS 2.2 species, meaning that is it fairly threatened in California. It is also a covered species under the NECO Plan. It mainly occurs in Sonoran desert scrub habitat throughout the Colorado Desert (BLM 2002). This species is found in desert dunes and sandy or gravelly areas throughout the Mojavean and Sonoran Deserts covering portions of Imperial, Riverside, and San Diego counties (CNPS 2011). There are known occurrences of this species from Elephant Tree Nature Trail in San Diego County and Carrizo Station. Herbarium collections occur for this species from Ogilby Road in Imperial County and three locales west of Blythe, the Pinto Basin, and Chuckwalla Basin in Riverside County. Harwood's milk-vetch has also been reported from Baja California, Sonora Mexico, and portions of Yuma County, Arizona (Reiser 1994). There are several CNDDB records for this species outside of the Project area (CNDDB 2010) within a 10-mile radius. There is a record in the Consortium of California Herbaria database from Wiley's Well Road between McCoy and Mule Mountains from 400 feet elevation (CCH 2010). The Harwood's milk-vetch populations on the southern deserts are presumed stable given limited disturbance to their desert habitats (Reiser 1994).

Harwood's milk-vetch was not found within the Project area, although it is known to occur just north of the proposed transmission line (CNDDB 2011). Suitable habitat for this species occurred along the proposed transmission line corridor in the southern portion of the study area.

Pink Fairyduster

Fairyduster (*Calliandra eriophylla*) is a deciduous, perennial subshrub in the *Fabaceae* family. Pink fairyduster is a CNPS List 2.3 species (rare, threatened or endangered in California) inhabiting sandy washes, slopes and mesas in the Sonoran Desert from 390 to 5,000 feet elevation and blooms from March to April (CNPS 2011) but may flower from January to March depending on site and seasonal rainfall (Jepson Interchange 2011). There are 12 records of pink fairyduster in San Diego County west of Blythe, southwest of McCoy Mountain, north, west and south of Mule Mountain, and north of Black Hill. The closest record of this species occurs approximately 10 miles from the Project area (CalFlora 2011).

Although suitable habitat occurs within the desert riparian woodland wash along the proposed transmission line and in the northeast Bajada portion of the site, pink fairyduster was not observed during surveys conducted in May. Surveys were conducted outside of the blooming period for this species.

Crucifixion Thorn

Crucifixion thorn (*Castela emoryi*) is a CNPS List 2.3 deciduous shrub in the *Simaroubaceae* family. This species blooms from April through May and is known to occur in gravelly soils in Mojave and Sonoran Desert scrub, and playas at elevations ranging from 295 to 2,198 feet (CNPS 2011). The nearest recorded occurrence of this species is along the Bradshaw Trail, 2.5 miles west of Wiley's Well Camp, approximately 12 miles south west of the Project area (CalFlora 2011).

Crucifixion thorn was not observed during surveys conducted during the appropriate blooming period. Furthermore, this large, obvious shrub would be difficult to miss while conducting walking transects during focused surveys. This species does not occur at the Project site.

Abram's Spurge

Abram's spurge (*Chamaesyce platysperma*) is a CNPS List 2.2 species, meaning it is fairly rare in California but more common elsewhere (CNPS 2011). Habitat consists of sandy flats in creosote bush scrub habitat from approximately 600 to 2,700 feet above mean sea level. Based on fourteen Consortium of California Herbaria database records for this species, habitats in Riverside, San Diego, and Imperial counties consist of sandy soil habitats often along dry lake margins, whereas record locations in San Bernardino County occur on coarser, possibly sandy loams.

Abram's spurge occurs from San Bernardino County to Imperial and eastern San Diego counties to Arizona, Nevada, Mexico, and Baja California (GSEP 2009f). A recent 2000 CNDDB record is from a location approximately 0.50 mile east of Ford Dry Lake on Gasline Road just south of I-10, and the occurrence was reported as a "substantial population" (CNDDB 2010).

The blooming period is identified by CNPS as September through November (CNPS 2011).

Abram's spurge is a late-summer, early-fall blooming plant species and was therefore not targeted or detectable during field surveys, which were performed during May 2011. Suitable habitat for this species is present along the proposed transmission line, in the Bajada area in the northeast corner of the Project site, and within intact creosote scrub throughout the Project area. Focused surveys for this species should be conducted during the appropriate blooming period.

Flat-seeded Spurge

Flat-seeded Spurge (*Chamaesyce platysperma*) is an annual, prostrate herb that blooms from February to September but typically in May (CNPS 2011). This is a CNPS list 1B.2 species. Flat-seeded Spurge occurs in the Sonoran Desert in dunes and desert scrub with sandy soils below 330 feet elevation. Flat-seeded Spurge is known to occur in Imperial, Riverside, San Bernardino Counties and in Arizona and Mexico. It is known in California from only four herbarium collections near Cathedral City.

Suitable sandy soils and Sonoran Desert scrub exists throughout the site. Flat-seeded Spurge was not observed during focused surveys conducted within the appropriate blooming period.

Las Animas Colubrina

Las Animas colubrina (*Colubrina californica*) is a CNPS List 2.3 species, indicating it is not very endangered in California and more common elsewhere (CNPS 2011). This is a covered species under the NECO Plan. This species is an evergreen shrub and occurs in Mojavean and Sonoran Desert creosote bush scrub and at elevations from approximately 30 to 3,000 feet above mean sea level. Dry canyon lands in Mojavean Desert scrub is the preferred habitat of this species. This species has also been reported from Joshua tree woodland habitats, but primarily occurs in dry canyons with gravelly, sandy soils (TetraTech 2010).

The distribution of this species includes San Diego, Imperial, and Riverside counties; portions of Arizona; Baja California; and Sonora, Mexico. This species has been reported from isolated desert locales in Joshua Tree National Monument, the Eagle Mountains, and the Chuckwalla Mountains (TetraTech 2010). There are approximately 27 occurrences primarily from the Chocolate Mountains area (BLM 2002). The nearest CNDDB record is from McCoy Springs in the McCoy Mountains in 1976 from approximately 2,800 feet elevation (CNDDB 2010). This species typically blooms from April through June.

This species was not observed during May 2011 surveys; however, habitat for this species occurs within the Project area. Although deciduous, this small shrub would have been easy to locate and identify during surveys conducted in early May.

Glandular Ditaxis

Glandular ditaxis (*Ditaxis claryana*) is a CNPS List 2 perennial herb covered under the NECO Plan. Glandular ditaxis is in the *Euphorbiaceae* family and occurs in Mojavean and Sonoran Desert creosote bush scrub with sandy soils at elevations below 1,526 feet; the flowering period ranges from October to March depending on seasonal rainfall (CNPS 2011). The nearest known location occurs near Desert Center, approximately 25 miles west of the Project area (CalFlora 2011).

This species has moderate potential to occur based on habitat suitability. Appropriate vegetation and soil conditions exist throughout the Project site in relatively undisturbed areas. Glandular ditaxis was not observed during surveys conducted in May 2011, outside of the appropriate blooming period for this species.

Harwood's Woollystar

Harwood's woollystar (*Eriastrum harwoodii*) is an annual herb in the *Polemoniaceae* family that flowers from March to June. Harwood's woollystar is a CNPS List 1B.2 species occurring on desert dunes and loose sand in Sonoran Desert scrub below 3,000 feet in elevation.

Harwood's woollystar was observed in stabilized desert dunes and creosote bush scrub with loose sandy soils throughout the proposed transmission line corridor south of I-10. This species was found in the same loose, sandy habitat as ribbed cryptantha and was limited to the transmission line portion of the proposed Project (Figure 3).

Bitter Rubberweed

Bitter rubberweed (*Hymenoxys odorata*) is an annual herb in the *Asteraceae* family that blooms from March to June. It is a CNPS List 2 species. Bitter rubberweed occurs in seeps and riparian zones within Mojavean and Sonoran Desert scrub in mesic sandy or alkaline soils, from 145 to 500 feet elevation, and blooms from February to November (CNPS 2011). Hickman (1993) gives the blooming period from

February to May for this species, so the actual blooming period may vary based on location and seasonal rainfall. There are only 10 occurrences of Bitter rubberweed in California. One known occurrence south of I-10 lies just south of the Project area in the Ripley USGS quadrangle (CalFlora 2011). Bitter rubberweed is threatened by agriculture; most of the sandy flats along the Colorado river where this species historically occurred have been converted to agriculture.

Suitable habitat for this species is limited to the desert riparian woodland wash located in the easternmost portion of the proposed transmission line. Surveys were conducted in the Project area within the blooming period for bitter rubberweed. The species was not observed.

California Satintail

California satintail (*Imperata brevifolia*) is a CNPS List 2.1 species. This perennial, rhizomatous grass is found in wet alkaline meadows, stream sides and floodplains below 4,000 feet elevation. Known occurrences exist several miles north of Blythe Airport, between the McCoy Mountains and Midland Road.

Habitat for California satintail does not occur within the Project area.

Lobed Ground-cherry

Lobed ground-cherry (*Physalis lobata*) is a CNPS List 2.3 perennial herb in the *Solanaceae* family. It occurs in Mojavean Desert scrub on decomposed granitic soils and playas from 1,640 to 2,625 feet elevation and blooms from September to January. There are no records of lobed ground-cherry in Riverside County. The nearest records are located north in San Bernardino County near the Calumet Mountains and Old Woman Mountains, well outside of the Project vicinity.

Based on elevation criteria and known occurrences, there is no potential for lobed ground-cherry to occur at the Project site. Focused surveys should not be required for this species.

Orocopia Sage

Orocopia sage (*Salvia greatae*) is a CVMSHCP-listed, CNPS List 1B.3 evergreen shrub that blooms from March to April. This species occurs in Mojavean and Sonoran Desert scrub habitats on alluvial slopes at elevations ranging from 131 feet to 2,706 feet and is known to occur in the Orocopia and Chocolate Mountains in the southeast Sonoran Desert. The nearest known occurrence lies approximately 35 miles west of the Project area, near Desert Center. Orocopia sage is known from Imperial, Riverside and San Bernardino Counties.

Orocopia sage was not observed during recent surveys, which fell outside of the blooming period for this species. However, an evergreen shrub in the *Lamiaceae* family would have been observed and identified during surveys conducted in May 2011. There is low potential for this species to occur based on habitat requirements and occurrence records.

Desert Spike-moss

Desert spike-moss (*Selaginella eremophila*) is a CNPS List 2.2 rhizomatous mat-forming herb that occurs in shaded sites among rocks and in crevices in gravelly soils. It is found in the eastern peninsular ranges of the Sonoran Desert below 3,000 feet elevation.

Suitable habitat for desert spike-moss was not present at the Project site.

Cove's Cassia

Cove's cassia (*Senna covesii*) is a CNPS List 2.2 perennial herb in the *Fabaceae* family that blooms from March to June, but typically blooms in April (CNPS 2011). It occurs in dry, sandy desert washes and along sandy slopes in the Sonoran desert in the Chuckwalla Mountains at elevations ranging from 1,000 to 3,510 feet. The nearest known occurrence is one mile northwest of the Cottonwood Springs Road and I-10 interchange, approximately 45 miles west of the proposed Project.

Habitat for Cove's cassia is not present based on elevation criteria. Furthermore, it was not observed during focused surveys conducted within the appropriate blooming period for this species.

Jackass Clover

Jackass clover (*Wislizenia refracta* ssp. *refracta*) is a CNPS List 2.2 species covered by the NECO Plan. Jackass clover is an annual herb in the *Capparaceae* family that blooms between April and October and occurs in sandy washes, roadsides, alkaline flats, desert dunes and scrub in the Mojave and Sonoran Deserts from 1,600 to 2,000 feet elevation. There are five records for this species in Riverside County; however, there are no records in the vicinity of the Project area. The nearest occurrence lies northwest of the site in the Palen Mountains, approximately 30 miles from the site (CalFlora 2011).

Based on elevation criteria and known records, jackass clover is not likely to occur within the Project area.

Orcutt's Woody Aster

Orcutt's woody aster (*Xylorhiza orcuttii*), a perennial herb in the *Asteraceae* family, blooms from March to April in arid canyons with creosote bush scrub from 60 to 1,000 feet elevation. It is a CNPS List 1B.2 species and a BLM sensitive species. According to California Energy Commission (CEC) data, one plant was recorded in Riverside County north of the San Diego/Imperial County border in Indio.

Surveys were conducted outside of the blooming window for Orcutt's woody aster; however, only marginal habitat for this species occurs in the Bajada area in the northeast portion of the Project site, north of I-10.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 3. SPECIAL-STATUS PLANT SPECIES RELEVANT TO THE PROPOSED PROJECT POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name Scientific Name	Sensitivity Status[1]	General Habitat Description (CNPS 2007)	Plant Habit, Flowering Period	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
Angel trumpets *(Acleisanthes longiflora)*	CNPS: List 2.3 NECO Plan	Dry places, generally on carbonate or limestone derived soils in mountainous areas 30 to 8,000 feet	Prostrate to ascending perennial stems less than three feet. Flowers produced during May.	The closest record of this species is in the Big Maria Mountains.	Low	Low
Coachella Valley Milkvetch *(Astragalus lentiginosus var. coachellae)*	ESA: Endangered CNPS: List 1B.2 BLM: Sensitive	Sonoran Desert, in sandy areas growing at elevations of 0 to 1,150 feet.	Annual or perennial herb that flowers February to May	Habitat for this species occurs within the sandy washes. Most populations are restricted to the Coachella Valley, approximately 50 miles west of the airport.	Low	Low
Harwood's milkvetch *(Astragalus insularis var. harwoodii)*	CNPS: List 2.2 NECO Plan	Sonoran Desert, sandy to gravely areas 0 to 1,000 feet.	Annual that blooms January – May	This species was detected in the Project vicinity toward the northwestern limits in 2009 (CEC).	Moderate	High
Fairyduster *(Calliandra eriophylla)*	CNPS: List 2.3 NECO Plan	Sonoran Desert, sandy washes, slopes and mesas typically between 390 and 5,000 feet.	Shrubs less that 1 foot in height; blooms March to April	Minimal potential habitat present. Site elevation is approximately 500 feet.	Low	Low
Crucifixion horn *(Castela emoryi)*	CNPS: List 2.3 NECO Plan	Desert areas on dry, gravelly washes, slopes, plains ±2,150 feet.	Shrub less than 10 feet in height; blooms April to May	Site elevation is approximately 500 feet. This large shrub was not observed in the surveys, which were conducted within the appropriate blooming period.	None	None
Abrams' spurge *(Chamaesyce abramsiana)*	CNPS List 2.2	Mojavean Desert scrub and Sonoran Desert scrub on sandy soils up to 3,000 feet.	Annual herb that blooms from September to November		Moderate	High

Common Name Scientific Name	Sensitivity Status[1]	General Habitat Description (CNPS 2007)	Plant Habit, Flowering Period	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
Flat-seeded spurge *(Chamaesyce platysperma)*	CNPS List 1B.2	Desert dunes and Sonoran desert scrub on sandy soils from 210 to 330 feet.	Annual herb that blooms from February to September but typically in May		Moderate	High
Las Animas colubrine *(Colubrina californica)*	CNPS: List 2.3 NECO Plan	Sonoran creosote bush scrub less than 3,500 feet.	Plants are generally less than 3 feet; blooms April to June	According to CEC 2009 data, specimens were observed in flower during April; an early blooming period for this species. Similar habitat is expected to occur in the Project area.	Low	High
Glandular ditaxis (*Ditaxis claryana)*	CNPS List 2.2 NECO Plan	Sonoran Desert at elevations less than 350 feet; sandy soils in creosote bush scrub	Annual or perennial herb that blooms from December to May.	Sandy soils at low elevations are present. Site elevation is approximately 500 feet.	Low	Moderate
Harwood's woollystar *(Eriastrum harwoodii)*	CNPS List 1B.2	Desert dunes and Sonoran Desert scrub on sandy soils from 655 to 3,000 feet.	Annual herb that blooms from March to June	Observed throughout the transmission line portion of the Project area.	Low	Present
Bitter hymenoxys *(Hymenoxys odorata)*	CNPS List 2	Chaparral, coastal scrub, Mojavean Desert scrub, and meadows and seeps, often in alkali soils, and riparian scrub with mesic soils. Most often found on sandy sites from 145 to 490 feet.	Annual herb that blooms from February to November (CNPS, 2011); February to May (Hickman, 1993)	Habitat for this species is limited to the desert riparian woodland wash located in the easternmost portion of the proposed transmission line.	Low	Low
California satintail *(Imperata brevifolia)*	CNPS List 2.1	San Bernardino Mountains, Mojave Desert, in cultivation. Found up to 1,700 feet	Perennial grass found near wet springs, meadows, streamsides and flood plains. Flowering September to May.	The habitat for this species (wet springs, meadows, stream sides and flood plains) does not occur	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	General Habitat Description (CNPS 2007)	Plant Habit, Flowering Period	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
Lobed ground-cherry *(Physalis lobata)*	CNPS List 2.3	Mojavean Desert scrub on decomposed granitic soils, and on playas. From 1,640 to 2,625 feet.	Perennial herb that blooms from September to January	Suitable habitat is not present based on elevation criteria.	None	None
Orocopia sage *(Salvia greatae)*	CNPS List 1B.3 NECO Plan	Southeast Sonoran Desert (Orocopia, Chocolate Mtns.) on alluvial slopes between 100 to 800 feet.	Evergreen shrubs less than 3 feet in height with white blooms from March to April.	Nearest known occurrence near Desert Center; 35 miles west of the Project.	Low	Low
Desert spikemoss *(Selaginella eremophila)*	CNPS List 2.2	Eastern Peninsular Ranges to the Sonoran Desert at elevations less than 3,000 feet. Shaded sites among rocks, in crevices and gravelly soils.	Rhizomatous mat-forming non-flowering herb.	The habitat for this species (shaded gravel soil in crevices and rocks) is limited in the Project area.	Low	Low
Coves' cassia *(Senna covesii)*	CNPS List 2.2 NECO Plan	Dry, sandy desert washes, slopes of the Sonoran Desert between 1,600 to 2,000 feet.	Small perennial herb up to 2 feet tall blooming in April.	This species occurs in desert washes and slopes. Occurs in the Chuckwalla mountains. Habitat is not present based on elevation criteria.	None	None
Dwarf germander *(Teucrium cubense ssp. depressum)*	CNPS List 2.2	Sandy soils, washes and fields in the Sonoran Desert below 1,200 feet.	Annual plants up to 6 inches tall; blooms March to May.	Habitat for this species is present within the Project area and vicinity.	Low	High
Jackass clover *(Wislizenia refracta ssp. refracta)*	CNPS List 2.2 NECO Plan	Sandy washes, roadsides, alkaline flats in the Mojave Desert, and northern Sonoran Desert between 1,600 to 2,000 feet	Annual; flowers between April and November.	Habitat is not present based on elevation criteria.	None	None
Orcutt's woodyaster *(Xylorhiza orcuttii)*	CNPS List 1B.2 BLM Sensitive	Arid canyons between 60 to 1000 feet.	Shrubs less than 5 feet in height; blooms March to April.	According to California Energy Commission data, one plant recorded north of the San Diego / Imperial County border in Indio (Riverside County).	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	General Habitat Description (CNPS 2007)	Plant Habit, Flowering Period	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]

[1]Sensitivity Status Key

ESA Endangered
CNPS California Native Plant Society Lists:
1B: Considered rare, threatened, or endangered in California and elsewhere.
2: Plants rare, threatened, or endangered in California, but more common elsewhere
Decimal notations: .1 - Seriously endangered in California, .2 – Fairly endangered in California, .3 – Not very endangered in California
BLM Special-Status Plants
NECO Plan: Northern and Eastern Colorado Desert Coordinated Management Plan special-status species

[2]Species Potential for Occurrence
Low Potential –low potential to occur because suitable habitat expected, but of marginal quality
Moderate Potential –has moderate potential to occur because suitable habitat expected to be present but was not found during focused plant surveys
High Potential –has high potential to occur because suitable habitat expected to be present, and species known to occur within the vicinity but was not found during focused plant surveys
Present – if detected during surveys

4.1.4 Fauna

This section discusses special-status wildlife species detected within the study area or with potential to occur on site. In total, 57 wildlife species were detected during general reconnaissance and protocol wildlife surveys (Appendix B). Of these, seven special-status wildlife species or their sign were observed within the study area (Table 6), including Mojave fringe-toed lizard, western burrowing owl, Le Conte's thrasher, loggerhead shrike, American badger, desert kit fox, and Nelson's bighorn sheep. In total, 11 insect, 9 reptile, 28 bird, and 9 mammal species were detected during biological surveys.

Wildlife species observed during the individual reconnaissance and focused surveys are listed in Appendix B. The species most commonly observed during biological surveys included lizards, such as the common side-blotched lizard (*Uta stansburiana*), desert iguana (*Dipsosaurus dorsalis)* and western whiptail (*Aspidoscelis tigris*), along with desert ironclad beetle (*Asbolus verrucosus*), common raven (*Corvus corax*), great-tailed grackle (*Quiscalus mexicanus*), and white-tailed antelope squirrel (*Ammospermophilus leucurus*).

Species accounts are provided below for the special-status species that could occur within the Project area. This includes species that both were and were not detected during surveys. Razorback sucker, while listed with a record in CNDDB (CDFG 2011), is expected to be absent due to a lack of habitat within the Project area and is not discussed below. Table 4 provides a summary of the species accounts and potential to occur.

Federal Listed Wildlife Species

No federal listed wildlife species or their sign were detected during surveys.

Desert Tortoise

Desert tortoise (DT) is a federal- and State-listed as Threatened species. Its range includes the Mojave and Sonoran Deserts. It is most common in desert scrub, creosote bush scrub, desert wash, and Joshua tree habitats. It occurs from near sea level to up to 5,241 feet in elevation (Stebbins 2003). Tortoises typically inhabit soft sandy loams and loamy sands, although they are also found on rocky slopes and in rimrock that provide natural-cover sites in crevices. These may include desert oases, riverbanks, washes, dunes, rocky slopes, creosote bush flats, juniper woodland, or other desert habitats (Stebbins 2003). It requires friable soil for burrowing and nest construction. Tortoises will construct burrows in firm sand, typically at the base of bushes, or else use rocks for shelter or caves in well-developed calcic layers. In some instances, burrows and caves will be used communally or constructed in a group. A typical year consists of hibernation during the winter; feeding, courting, and mating in the spring; feeding and courting in the summer; and mating and hibernation in the fall (Berry 2008, USFWS 2008). Juveniles are typically active during more of the year than adults, as their smaller mass allows them to respond faster to temperature changes. DTs emerge from hibernation and begin the reproductive process in March and April. Nests are often constructed at the opening or just inside of burrows. If conditions are unfavorable for egg-laying, females may carry sperm in the albumen gland in their oviducts for two to three years, and sometimes for as long as 15 years. Eggs are usually laid between May and July in clutches of 1 to 12 eggs. DTs reach sexual maturity between 12 to 25 years of age, or at around 180 mm (Berry 2008). DTs will typically forage on winter and summer annuals, herbaceous perennials, succulents, and grasses, usually found in intershrub spaces, washes, and washlets. Preferred vegetation includes lupines, lotuses, vetches, evening primroses, and other native plants.

No individuals or sign were detected during surveys. Suitable habitat to support this species is present within the Project area, primarily in the proposed transmission line corridor. This species is expected to have a low to moderate potential to occur within the Project area, with higher potential to occur within the proposed transmission line corridor, which presents more suitable habitat than the proposed solar array area. The agricultural fields or recovering fields that make up much of the proposed solar array do not

present suitable habitat for this species. Although DT is present in the general Project vicinity and designated critical habitat (Chuckwalla Unit; 59 FR 5820 5866) is located approximately 15 miles west of the Project area, based on surveys conducted for the Blythe Solar Power Project in areas that overlap the BMSP, occurrences and detections of sign seem to primarily be located in the foothills (AECOM 2010), not in the areas immediately surrounding the Project area. Thus, while it's possible that DT may occur in or near the Project area, it is much more likely to be found, based on recent surveys, in areas northwest of the BMSP.

State-listed Wildlife Species

No State-listed wildlife species or their sign were detected during surveys.

Swainson's Hawk

Swainson's hawk is a State-listed Threatened and Forest Service Sensitive species, as well as a USFWS Bird of Conservation Concern. Its breeding habitat includes grasslands with scattered trees, juniper-sage flats, riparian areas, savannahs, and agricultural fields and ranches. It also requires adjacent suitable foraging areas, such as grasslands or alfalfa or grain fields that support rodent populations. It is not known to breed or winter in the southeastern California area, but may pass through the area as a migrant (Stokes and Stokes 2010).

Swainson's hawk is expected to have a low potential to occur within the Project area. It is not expected to be nesting or breeding in the area and may pass through on its migration route.

Gilded Flicker

The gilded flicker is a State-listed Endangered species and USFWS Bird of Conservation Concern. It is a year-round resident of the Colorado Desert area (CDFG 2008, Stokes and Stokes 2010), typically inhabiting cottonwood and riparian areas near the Colorado River, as well as washes and Joshua tree habitats (CDFG 2008). It requires snags and hollow trees for nesting and uses trees, shrubs, nests, and roost cavities for cover (CDFG 2008). Its breeding period is during April and May (CDFG 2008). Its diet is composed primarily of insects, but it also consumes a large amount of plant matter.

Gilded flicker was not detected within the Project area during surveys and is expected to have a low potential for occurrence based on the availability of habitat within the Project area.

Gila Woodpecker

The Gila woodpecker is a State-listed Endangered species and USFWS Bird of Conservation Concern. It is found in cottonwood trees and other desert riparian areas and nests in cavities in riparian trees or in saguaro (*Carnegiea gigantea*), breeding from April to July and peaking in April and May (CDFG 2008). It may occasionally raise two broods in a single season (CDFG 2008). This species feeds on insects pecked or probed out of bark, crevices in trees, or inside cacti. It also eats certain cactus fruits.

Gila woodpecker was not detected within the Project area. It is expected to have a low potential to occur based on a general lack of suitable habitat within the Project area.

Non-listed Special-Status Wildlife Species

Seven non-listed special-status wildlife species or their sign were detected on site, including the Mojave fringe-toed lizard, western burrowing owl, Le Conte's thrasher, loggerhead shrike, desert kit fox, Nelson's bighorn sheep, and American badger. These detections are discussed in detail below.

Special Status Wildlife Species Accounts

Mojave Fringe-toed Lizard
Mojave fringe-toed lizard (MFTL) is a Species of Special Concern and a BLM Sensitive species that occurs on wind-blown sandy areas with creosote bush scrub cover in the Mojave and northern Colorado Deserts. It can usually be found in dunes, in margins of dry lakebeds and washes, or in isolated dune pockets against hillsides at elevations below sea level to up to 900 meters (Espinoza 2009). They are most active from March to October and typically brumate from November to February, usually depositing one to five eggs in the sand from May to July (Stebbins 2003, Espinoza 2009). While they will often produce multiple clutches of eggs in wet years, in dry years they may skip breeding entirely (Espinoza 2009). Their home ranges are typically 0.25 acre for males, and one-third that size for females (Espinoza 2009).

Mojave fringe-toed lizards were detected throughout the Project area, mainly in the transmission line portion both under the centerline and in the adjacent survey buffer zones. A total of 64 detections were made during the transmission line surveys. MFTL was the most common reptile species observed during surveys. No MFTL were observed within the solar array footprint.

Couch's Spadefoot Toad
Couch's spadefoot toad is a Species of Special Concern and a BLM Sensitive species. In California, it is found in the extreme southeast, including southeastern San Bernardino County and eastern Riverside and Imperial Counties (Jennings and Hayes 1994). They are found in desert washes, creosote bush scrub, alkali sink scrub, palm oases, and other vegetated areas that can support their habitat needs (CDFG 2008). They require areas that have substrate capable of sustaining temporary pools for breeding but that are still loose enough for burrowing (Jennings and Hayes 1994, BLM and CDFG 2002). Their breeding habitat includes temporary impoundments at the base of dunes as well as road or railroad embankments, temporary pools in washes or channels, pools that form at the downstream end of culverts, and playas (BLM and CEC 2010). Possibly due to the difficulty of locating naturally occurring ponds within the short retaining periods, most of the known Couch's spadefoot toad breeding ponds are artificial. This species is dormant from 8 to 10 months of the year, emerging from burrows after summer rains typically anywhere between May and September (Stebbins 2003, CDFG 2008). Couch's spadefoot toads typically eat termites, but will also eat beetles, ants, spiders, moths, or other insects (CDFG 2008).

Couch's spadefoot toad was not observed in the Project area during surveys. It is expected to have a low potential to occur in the Project area, although it is difficult to be certain where they may be present due to their long dormancies each year.

Golden Eagle
The golden eagle is a CDFG Fully Protected Species and Watch List Species and a USFWS Bird of Conservation Concern. It breeds throughout the United States and in Canada, Europe, and Asia, and is a year-round resident of much of the western United States (Kochert et al. 2002). It is more rare in California's Central Valley and southeastern deserts from the Salton Sea and east. In California, the golden eagle typically nests in open grasslands and oak savannas and less frequently in oak woodlands and open shrublands (Kochert et al. 2002). Preferred nesting sites are on cliffs or in large trees surrounded by open habitat (CDFG 2008). Foraging also typically occurs in open grassland habitats, and winter habitat in Southern California is primarily in mountainous areas (Kochert et al. 2002). Territories in Southern California are around 36 square miles on average, and home ranges are believed to be the same (CDFG 2008). Breeding occurs from late January through August, peaking from March to July (CDFG 2008).

Golden eagles or their nests were not observed during surveys for this Project. While the Project area is generally inadequate to support nesting, there is adequate foraging habitat for this species in the area and

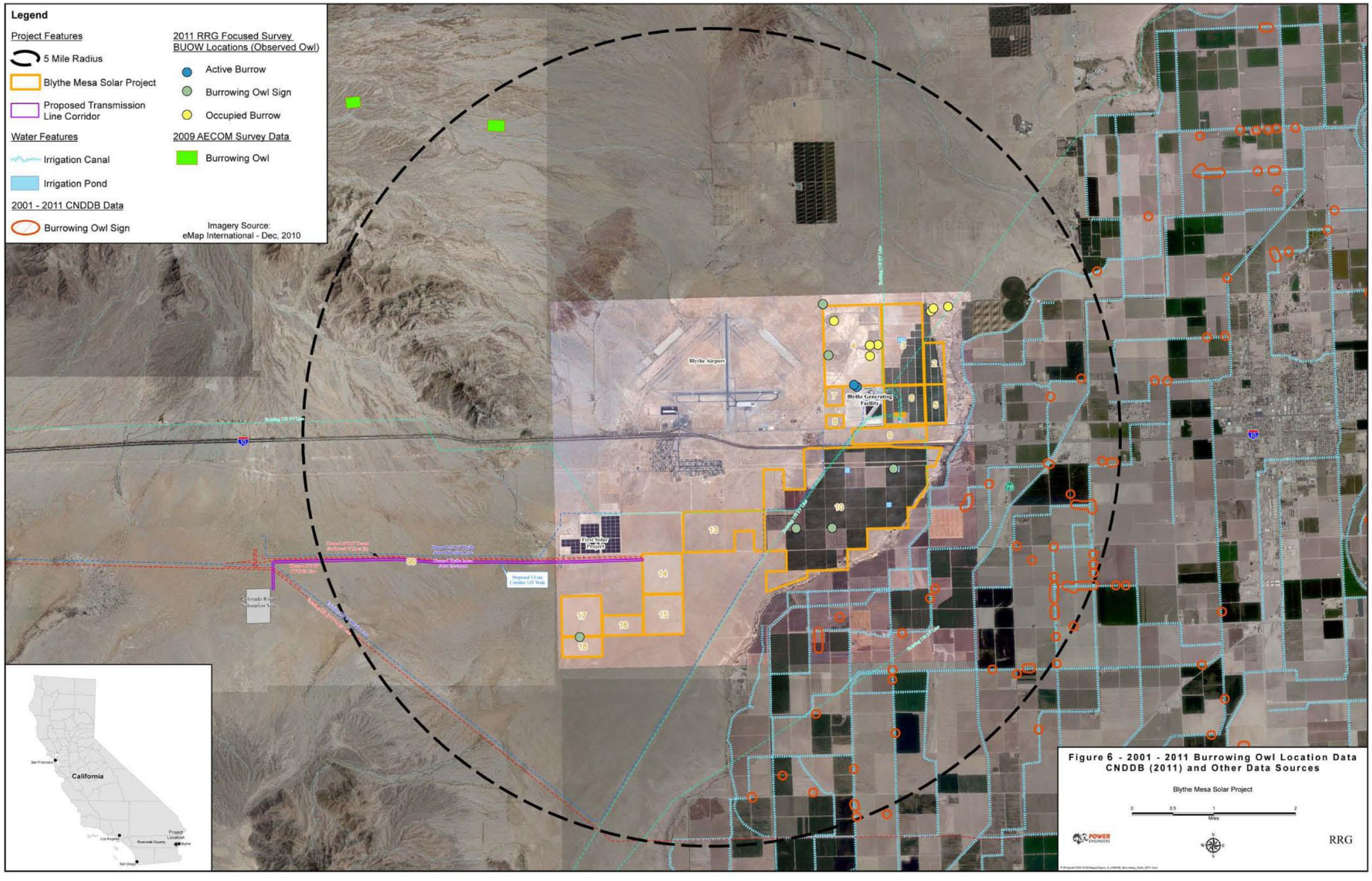
it is expected to have a moderate potential to occur as a forager. There are no known golden eagle nests in the general vicinity of the Project area (AECOM 2010).

Western Burrowing Owl

Western burrowing owl (WBO) is designated as a Priority 2 Bird Species of Special Concern by CDFG due to rapid habitat loss and degradation from urbanization. It is also designated as a BLM Sensitive species and a USFWS Bird of Conservation Concern. Its range extends through all states west of the Mississippi Valley and into Mexico, Central America, and South America. In California, it typically inhabits lowlands, including those in the Central Valley, northeastern plateau, southeastern deserts, and coastal areas. For shelters, the burrowing owl uses rodent burrows in sparse grassland, desert, and agricultural habitats, as well as open areas of pinyon-juniper or ponderosa pine habitats (CDFG 2008). Breeding populations generally display greater site fidelity than winter populations, which tend to move about more, even taking refuge into vegetation instead of nearby burrows (Poulin et al. 2011). Individuals in California, particularly Southern California, are mostly residents (CDFG 2008). Nesting begins from late March to August, peaking in April and May (CDFG 2008). While some pairs have been observed to have double broods within a single breeding season, it is considered to be uncommon and is not always successful (Poulin et al. 2011). Burrowing owls are typically active at dusk and dawn, but can sometimes be active at night, as well.

Two WBO burrows were detected in the northeastern section of the Project, with a single individual observed outside one of the burrows, during the Project reconnaissance surveys. The individual and its burrow were observed in a disturbed creosote field previously used for military purposes. During the protocol burrowing owl surveys, six owls were observed within the Project area, and an additional two owls were observed outside the Project area in an area that could be indirectly affected.

FIGURE 6. BURROWING OWL LOCATION DATA



THIS PAGE INTENTIONALLY LEFT BLANK

Ferruginous Hawk

Ferruginous hawk is a CDFG Watch List species. It does not breed in California, but is a winter resident of most of the state, including the Project area (Stokes and Stokes 2010). In California, it is most common in open areas, such grasslands, agricultural areas, and deserts, and is typically associated with small mammal populations.

Ferruginous hawks were not observed during Project surveys, which did not occur within the winter. It has a low potential to occur within the Project area, which it may use for wintering habitat, but not for breeding.

Yellow Warbler

The Sonoran subspecies of yellow warbler is a Species of Special Concern and USFWS Bird of Conservation Concern. It is a winter resident of the Colorado River valley (CDFG 2008). It inhabits riparian woodlands, montane chaparral, ponderosa pine and mixed conifer habitats, and desert lowlands. It typically eats insects and spiders from the upper canopy of deciduous trees and shrubs, but will occasionally take insects from the air or eat berries (CDFG 2008).

Yellow warbler was not detected during surveys within the Project area. It is expected to have a low potential for occurrence based on a lack of suitable habitat. No breeding is expected within the Project area, but migrants may be passing through or overwintering in the area.

Loggerhead Shrike

The loggerhead shrike is listed as a CDFG Species of Special Concern and USFWS Bird of Conservation Concern. Their range in California extends throughout most of the state, except for the northwest. Habitats typically occupied by loggerhead shrike include those possessing open space with patchily distributed trees, shrubs, or other areas to perch (Yosef 1996, CDFG 2008). Deserts possessing spiny shrubs and scrubby vegetation as well as pastoral, agricultural, valley-foothill hardwood or hardwood-conifer, pinyon-juniper, juniper, Joshua tree woodland, or suburban settings are frequently occupied (Yosef 1996, CDFG 2008). They are often found near water (CDFG 2008). Nests will usually be constructed in isolated trees or large shrubs within the occupied habitat. Pairs in California remain together year-round and defend their territories from other individuals of their kind. They typically nest earlier than most other passerines, perhaps as a result of their year-round association with mates (Yosef 1996). This bird species preys mainly on arthropods, but will also feed on reptiles, amphibians, fish, small mammals, and other small birds (CDFG 2008).

Loggerhead shrikes were detected on both the proposed solar array and transmission line areas.

Vermilion Flycatcher

The vermillion flycatcher is a Species of Special Concern. It is found in desert, cropland, savanna, chaparral, and other desert riparian and woodland habitats adjacent to irrigated fields, ditches, pastures, or other open mesic areas (CDFG 2008). Its peak nesting time is in April and May, when it nests in willows, cottonwoods, mesquite, or other large trees or shrubs. It often raises two broods. Its diet mainly comprises insects caught by flycatching, particularly bees, and from the ground surface (CDFG 2008).

Vermilion flycatcher was not observed during surveys in the Project area. It is expected to have a low to moderate potential to occur within the Project area, as some suitable habitat can be found in the solar array area, but available ground water and mesic areas are somewhat restricted.

Crissal Thrasher

Crissal thrasher is a Species of Special Concern. It is a non-migratory resident of southern Nevada and southeastern California to western Texas and central Mexico. It typically prefers riparian brush at lower elevations within its northwestern range in the Colorado River valley (Martin 1999). In the summer around the Colorado River, it has a greater utilization of mesquite and other native habitat, but also frequents habitat dominated by non-native species such as tamarisk (*Tamarix* sp.) (Martin 1999). Breeding typically occurs from mid-January to late July or early August (Martin 1999).

Crissal thrasher has a low to moderate potential to occur in the Project area. While no individuals were observed during surveys, some habitat is present in the area that could support foraging, although the available habitat is less likely to support nesting.

Le Conte's Thrasher

Le Conte's thrasher is a Species of Special Concern and a USFWS Bird of Conservation Concern. In California, Le Conte's thrasher is a resident species in the San Joaquin Valley and the Mojave and Colorado Deserts in southeastern California. It occurs in desert washes, desert scrub, alkali desert scrub, and desert succulent shrub habitat (CDFG 2008). Because creosote bush is unable to sufficiently support nests, Le Conte's thrashers typically do not occur in monotypic creosote bush scrub habitat or in massive Sonoran Desert woodlands (Prescott 2005). Preferred nest substrate includes thorny shrubs or cholla cactus (Shepard 1996). Breeding activity occurs from January to early June, peaking from mid-March to mid-April (CDFG 2008). Pairs typically attempt up to three broods each year. Le Conte's thrashers forage for food by digging and probing in the soil with their bills, searching for arthropods (the majority of their diet), small lizards and snakes, other vertebrates, and seeds and fruit (Sheppard 1996, CDFG 2008).

Two Le Conte's thrashers were detected during the transmission line ROW surveys.

Pallid Bat

The pallid bat is a Species of Special Concern, Forest Service Sensitive species, and BLM Sensitive species. Pallid bats inhabit low elevation (less than 6,000 feet) rocky arid deserts and canyonlands, and shrub-steppe grasslands, but also occur in higher elevation coniferous forests (greater than 7,000 feet). They are most abundant in xeric ecosystems, including the Great Basin, Mojave, and Sonoran Deserts (Hermanson and O'Shea 1983). Pallid bats roost alone, in small groups, or in large groups composed of hundreds of individuals (Rambaldini 2005). Day and feeding roosts include escarpments and cliffs, caves, mines, trees (especially oak cavities, exfoliating bark, and deciduous trees in riparian areas) and man-made structures such as bridges, barns, porches, bat boxes, and buildings. Roosts are generally warmer than ambient temperature, have unobstructed entrances/exits, and are at such a height that access by terrestrial predators is dissuaded (Rambaldini 2005). Although roost fidelity is common, they may switch day roosts on a daily or seasonal basis. Females typically have one or two pups each year, although incidences of three pups have been reported. Mating generally occurs between October and February, followed by parturition from late April to July, and finally weaning in August. Timing of these events varies across latitudes and between years, and is probably influenced by prey availability and temperature. Populations at higher latitudes and in cooler climates give birth later in the season. Maternity colonies dissolve between weaning in August and the next mating season in October (Rambaldini 2005). Pallid bats forage over many habitat types, including shrub-steppe or oak savannah grasslands, Ponderosa pine forests, talus slopes, gravel roads, lava, orchards, and vineyards (Rambaldini 2005). Known prey include a large variety of beetles, centipedes, lepidopterans, moths, praying mantids, scorpions, and termites, as well as vertebrates such as geckos, lizards, skink, and small rodents (Whitaker et al. 1981).

Pallid bats are expected to have a moderate potential to occur within the Project area. Although suitable roosting habitat is present, particularly in the area around the desert riparian woodland wash, the closest documented occurrence of this species is from 1992 and is approximately 30 miles away (CDFG 2011).

Hoary Bat

The hoary bat is tracked by the CNDDB and does not have any particular agency protection status (CDFG 2011). It is present throughout most of California, but is patchily distributed in southeastern California (CDFG 2008). In migration events, males are typically found in foothills, deserts, and mountains, while females are found in lowlands and coastal valleys. Water is required. Its roost sites are usually in large trees with dense foliage that are obscured from above and relatively open below. Although breeding occurs in the fall, fertilization is delayed and young are born from mid-May through July (CDFG 2008). Food is primarily composed of moths and other flying insects.

The hoary bat was not detected within the Project area during surveys. It is expected to have a low potential to occur in the Project area, as water is generally limited in availability. The closest documented occurrence is from 1919, less than two miles from the Project area (CDFG 2011).

California Leaf-nosed Bat

The California leaf-nosed bat is a Species of Special Concern, BLM Sensitive, and Forest Service Sensitive species. It is found in desert riparian, desert wash, desert scrub, desert succulent scrub, alkali desert scrub, and palm oasis habitats (CDFG 2008). It roosts in caves, old buildings, and abandoned mines. While mating occurs in September and November, implantation is delayed until the following May and June (CDFG 2008). Diet for this species consists of large insects, insect larvae, and fruit.

California leaf-nosed bat was not detected within the Project area. It is expected to have a moderate potential to occur within the Project area due to the availability of suitable habitat within the Project area and a 2002 CNDDB record (CDFG 2011) that is located in an adjacent quadrangle (specific location information is suppressed).

Arizona Myotis

The Arizona myotis is a Species of Special Concern. Its California range is restricted to the Colorado River valley and the surrounding desert areas, where it inhabits the lowlands and mountain ranges around the Colorado River and forages in desert riparian areas. Its daily roosts may be in buildings, trees, caves, or under rocks or wood, though its hibernation roosts are typically in caves or mines (CDFG 2008). Although mating occurs in the fall, fertilization is delayed until the following spring, with birth occurring between May and August, typically only one young each year (CDFG 2008). This species tends to feed on small, flying insects, but may take larger prey in some circumstances.

Arizona myotis was not detected within the Project area during surveys. It is expected to have a moderate potential to occur based on the availability of roosting and foraging habitat in the Project area. The closest documented record from the CNDDB (CDFG 2011) is from 1942, approximately five miles south of the Project area.

Cave Myotis

The cave myotis is a Species of Special Concern and BLM Sensitive species. It is restricted in California to the Colorado River and its adjacent mountain ranges, inhabiting desert scrub, desert succulent scrub, desert wash, and desert riparian habitats (CDFG 2008). It utilizes caves primarily, but will also use mines and buildings. Mating typically occurs in the fall and winter, with one young born in June and July (CDFG 2008). The diet of the cave myotis consists of mostly flying insects, which are generally caught near water.

Cave myotis was not detected within the Project area during surveys. It is expected to have a moderate potential to occur based on the availability of foraging habitat. However, roosting habitat within the

Project area is limited. The closest documented potential occurrence is a colony in an adjacent quadrangle from 2002, although the specific species present is unknown and the location is suppressed (CDFG 2011).

Nelson's Bighorn Sheep

The Nelson's bighorn sheep is a BLM sensitive species. It occurs from the Transverse Ranges into the desert mountain ranges of California, Nevada, and northern Arizona to Utah. Bighorn sheep require steep, rocky slopes for escape routes from predators. They may be found in mountains, high meadows, deserts, or other areas that provide quick access to these steep escape routes (Reid 2006). Surface water is also essential. In the spring and summer, bighorn tend to disperse downhill to bajadas and alluvial fans and forage on grasses and sedges; alternately, in the winter when annual plants are not blooming, bighorn sheep will tend to forage on woody plants instead (Reid 2006). While rutting begins in November and December, young are not typically born until the following May or June (Reid 2006). Two metapopulations of bighorn sheep, the Southern Mojave and Sonoran metapopulations, occur within the NECO Planning Area. Within these metapopulations are demes, or smaller subpopulations of bighorn sheep, nine of which occur in the Sonoran metapopulation (BLM and CDFG 2002). These metapopulations have been fragmented by transportation corridors (roads and highways), aqueducts, and other types of linear development, such as fences or transmission lines. While these present potentially major barriers to bighorn sheep movements, bighorn sheep are also known to be able to cross many linear features.

A bighorn sheep skull was found within the proposed solar array disturbance area. It is unknown how long this skull had been there and if the animal died near this location or if the skull was washed downstream from somewhere else. Focused surveys for this species were not conducted and this sign was noted incidentally during the reconnaissance surveys.

American Badger

The American badger is listed as a CDFG Species of Special Concern. This species is distributed throughout California in open habitats containing friable soil for burrowing, except for the northern coast regions. It occurs in highest densities in relatively dry, open stages of shrub, forest, and herbaceous habitats, including plains, prairies, deserts, open valleys, woodland edges, and alpine meadows (Reid 2006, CDFG 2008). American badger ranges average from 400 acres for females to 600 acres for males in Idaho, whereas in Utah they have been measured ranging from 338 to 751 acres for females and 1,327 to 1,549 acres for males (CDFG ND). Although they mate in the summer and fall, actual implantation is delayed until the following March or April (Reid 2006). This species functions to control rodent populations in their respective ecosystems (CDFG 2008). American badgers are vertically compressed mustelids that prey chiefly on fossorial rodents, though reptiles, insects, birds and their eggs, carrion, and other items are also taken (Reid 2006).

Potential American badger burrows were observed in both the proposed transmission line and solar array portions of the Project area. One burrow was located in the northeast corner of the Project in the bajada habitat, another near the center of the four-mile proposed transmission line, and the third in the southwest corner of the Project just north of the alternative Colorado River Substation site. American badger prey species were observed during surveys (white-tailed antelope ground squirrels, kangaroo rats, etc.). Most of the study area is suitable for this species.

Desert Kit Fox

This particular subspecies of kit fox is a Protected Furbearing Mammal. Desert kit fox range in the U.S. extends from Southern California to western Colorado and west into Texas. Its northern range includes southern Oregon and Idaho. The kit fox is associated with multiple habitats, including desert scrub, saltbush, chaparral and grassland. They are mainly nocturnal, and use multiple burrows in their home range. Natal dens possess multiple entrances (Egoscue 1962). While the species is territorial, the primary

resource of concern is the natal den, which requires a significant level of energy to excavate compared to a single burrow. Litters are born in February or March (Reid 2006). Kit foxes are small canids that feed primarily on black-tailed jackrabbits, desert cottontails, kangaroo rats, ground squirrels, insects, reptiles, birds and bird eggs.

Potential desert kit fox scat and tracks were found scattered throughout the proposed solar array disturbance area.

4.1.5 Critical Habitat

The study area does not include any designated critical habitat for special-status plant or wildlife species. The Chuckwalla Unit, an area of designated critical habitat for the desert tortoise (59 FR 5820 5866), is approximately 15 miles west of the Project area.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 4. SPECIAL-STATUS WILDLIFE SPECIES RELEVANT TO THE PROPOSED PROJECT POTENTIALLY OCCURRING IN THE STUDY AREA

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
Reptiles					
Desert tortoise (*Gopherus agassizii*)	ESA: Threatened CESA: Threatened	Various desert scrubs and desert washes up to about 5,000 feet, but not including playas.	Desert tortoise is present to north and west of project areas but in foothill habitat. POWER walked 8 transects along 4 miles of the proposed transmission line corridor in suitable habitat but did not observe desert tortoise or its sign.	Low	Low
Mojave fringe-toed lizard (*Uma scoparia*)	CDFG: Species of Special Concern, BLM: Sensitive	Fine, wind-blown sand in creosote bush scrub of the Mojave and northern Colorado Deserts. From below sea level to 2,952 feet.	Species detected throughout the transmission line ROW during rare plant surveys. Suitable habitat is present within the solar array, though no individuals were detected.	High	Present
Amphibians					
Couch's spadefoot toad (*Scaphiopus couchii*)	CDFG: Species of Special Concern, BLM: Sensitive	Various arid and semiarid environments. Breeds in desert ponds quickly following rainfall.	Suitable habitat is not known to be present, but some areas may still support ponded water.	Low	Low
Birds					
Golden eagle (*Aquila chrysaetos*)	Eagle Protection Act, CDFG: Species of Special Concern, BLM Sensitive	Nest in rock cliff aerie.	Known to region. According to BLM and California Energy Commission reports (,AECOM 2010) no known nest within 10 miles of proposed Project (2009 data) but expected to use area for foraging.	Moderate (forage habitat)	Moderate
Western burrowing owl (*Athene cunicularia hypugaea*)	CDFG: Species of Special Concern Priority 2, BLM: Sensitive, USFWS: Bird of Conservation Concern	Found mainly in grassland and open scrub from the seashore to foothills. Also found in deserts and scrublands.	The northern portion of the Project area and vicinity is considered suitable western burrowing owl foraging and nesting habitat. Two burrows and a single owl were found in the proposed solar array disturbance area during reconnaissance surveys, and eight owls were detected during protocol burrowing owl surveys.	Present	Low
Ferruginous hawk (*Buteo regalis*)	CDFG: Watch List (wintering)	Open country, primarily plains, prairies, badlands, sagebrush, shrubland, desert.	The species is known to winter in the Colorado River Valley. They are most often seen in agricultural fields around Blythe, but occasionally in the open desert as well. There is no breeding habitat on site.	Low (non-breeding only)	Low (non-breeding only)

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
Swainson's hawk (*Buteo swainsoni*)	CESA: Threatened, USFWS: Bird of Conservation Concern, USFS: Sensitive	Nesting habitat consists of open habitats with trees, either isolated, scattered or in windrows.	Migrants more frequently occur near western edge of desert such as Borrego and Morongo valleys, as reflected in annual data from the various regional hawk-watch reports. No suitable breeding habitat exists on site.	Low (non-breeding only)	Low (non-breeding only)
Gilded flicker (*Colaptes chrysoides*)	CESA: Endangered, USFWS: Bird of Conservation Concern	Found in habitats with giant cactus, Joshua trees (Yucca brevifolia), and riparian groves in desert lowlands and foothills (AOU 1995).	Within California, now confined to a small area of Joshua tree woodland in the eastern Mojave Desert (Cima Dome).	None	None
Yellow warbler (*Dendroica petechia sonorana*)	CDFG: Species of Special Concern, USFWS: Bird of Conservation Concern	Found along mature riparian woodlands that consist of cottonwood, willow, alder, and ash trees.	There is no breeding habitat for this species based on breeding range, but migrants are recorded in the vicinity and migratory habitat is expected to be present on site.	Low (non-breeding only)	Low (non-breeding only)
Loggerhead shrike (*Lanius ludovicianus*)	CDFG: Species of Special Concern Priority 2, USFWS: Bird of Conservation Concern	Occurs in semi-open country with utility posts, wires, and trees to perch on.	Suitable habitat occurs throughout the Project vicinity. Although declining over most of the range in California and elsewhere and now absent over large areas, this species is still common in the California deserts.	Present	Present
Gila Woodpecker (*Melanerpes uropygialis*)	CESA: Endangered, USFWS: Bird of Conservation Concern	Requires live tree-size cactus or dead trees (Winkler et al. 1995).	Nearest occupied habitat is near Blythe on the Colorado River.	Low	Low
Vermilion flycatcher (*Pyrocephalus rubinus*)	CDFG: Species of Special Concern	Open farmlands, shrubby grasslands, and streamsides and small wooded ponds in desert habitat. Found in diverse areas near open water.	Some suitable habitat is present within the agricultural areas of the Project, but available surface water is mainly restricted to irrigation channels.	Moderate	Low
Crissal thrasher (*Toxostoma crissale*)	CDFG: Species of Special Concern Priority 3	Occurs in dense riparian and mesquite scrub, microphyll woodland, and riparian washes with a dense understory of shrubs	Some habitat present that could support species foraging but not typical for nesting.	Low	Moderate

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
Le Conte's thrasher (*Toxostoma lecontei*)	CDFG: Species of Special Concern, USFWS: Bird of Conservation Concern	Arid and open plains that are sparsely vegetated and dominated by saltbush and creosote bush	Suitable habitat for this species is present mainly in the creosote bush areas of the Project. Two individuals were detected in the proposed transmission line disturbance area.	High	Present
Mammals					
Pallid bat (*Antrozous pallidus*)	CDFG: Species of Special Concern	This gregarious species usually roosts in small colonies in rock crevices and buildings, but may nest in caves, mines, rock piles and tree cavities.	Roosting habitat for pallid bats is present in tree cavities in desert riparian woodland wash in the southeastern portion of the site. The closest documented occurrence in the CNDDB is from 1992, approximately 30 miles to the southwest of the airport near Corn Springs.	Low	Low
California leaf-nosed bat (*Macrotus californicus*)	CDFG: Species of Special Concern, BLM: Sensitive, USFS: Sensitive	Lowland desert scrub, desert riparian and wash areas, alkali scrub, or palm oases. Requires rugged or rocky terrain with mines or caves for roosting.	Suitable foraging habitat is present throughout the Project area, although roosting habitat is limited in the immediate region. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low
Arizona myotis (*Myotis occultus*)	CDFG: Species of Special Concern	Lowlands of the Colorado River and adjacent desert mountain ranges. Roosts in tree hollows, rock crevices, and similar areas.	The closest documented occurrence in the CNDDB is from 1942, approximately 5 miles south of the Project.	Low	Low
Cave myotis (*Myotis velifer*)	CDFG: Species of Special Concern, BLM: Sensitive	Low elevation arid regions near the Colorado River and in adjacent mountains. Requires caves or mines for roosting.	Suitable foraging habitat is present throughout the Project area, although roosting habitat is limited in the immediate region. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low
Nelson's bighorn sheep (*Ovis canadensis nelson*)	BLM: Sensitive	Mountain slopes with sparse growth of trees above the desert floor in California.	Nelson's bighorn sheep is known within the region. While the species is generally associated with mountainous areas, desert floor areas are important for dispersal and seasonal movement. A bighorn sheep skull was found in the proposed solar array area.	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array[2]	Potential for Occurrence within the Transmission Line (BLM Jurisdiction)[2]
American badger (*Taxidea taxus*)	CDFG: Species of Special Concern	Coastal sage scrub, mixed chaparral, grassland, oak woodland, chamise chaparral, mixed conifer, pinyon-juniper, desert scrub, desert wash, montane meadow, open areas, and sandy soils.	Suitable badger habitat occurs throughout the vicinity in undeveloped areas. Badger is present in adjacent areas surveyed for other projects (CEC 2009). Suitable burrows were observed within the Project area.	High	High
Desert kit fox (*Vulpes macrotis arsipus*)	Calif. Code of Regulations: PFM	Suitable habitat for this fossorial mammal consists of arid open areas, shrub grassland, and desert ecosystems.	Suitable kit fox habitat occurs throughout the vicinity in undeveloped areas. Kit fox is present in adjacent areas surveyed for other projects (CEC 2009).	High	High
Fish					
Razorback sucker (Xyrauchen texanus)	ESA: Endangered, CESA: Endangered, CDFG: Fully Protected	Colorado River. Uses both quiet and swift waters and spawns in shallow water where there is abundant sand, gravel, and rocks.	There is no suitable habitat to support this species within the Project area.	None	None

[1]Sensitivity Status Key

Federal Endangered Species Act (ESA)
State California Department of Fish and Game (CDFG)
California Endangered Species Act (CESA)
BLM Sensitive

[2] Species Potential for Occurrence

Low Potential –low potential to occur because suitable habitat present, but of marginal quality
Moderate Potential –moderate potential to occur because suitable habitat present; not found during surveys
High Potential –high potential to occur because suitable habitat present, and species known to occur within the vicinity; not found during surveys
Present – Species detected during Project surveys on adjacent areas.

5.0 REFERENCES

AECOM. 2010. Blythe Solar Power Project Biological Resources Technical Report. Prepared for Palo Verde Solar I, LLC. June 2010.

Aspen Environmental Group (Aspen). 2006. Devers-Palo Verde No. 2 500 kV Transmission Line Project Final Environmental Impact Report/Environmental Impact Statement. Prepared for California Public Utilities Commission. October 2006.

_____. 2011. Draft Supplemental Environmental Impact Report, Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion. Prepared for Southern California Edison. February 2011.

Avian Power Line Interaction Committee (APLIC). 2006. *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006*. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, D.C. and Sacramento, CA.

Bates, C. 2006. Burrowing Owl (*Athene cunicularia*). *In* The Draft Desert Bird Conservation Plan: a strategy for reversing the decline of desert-associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/desert.html

Berry, K.H. 2008. Threats to Desert Tortoises and Their Habitats. Introduction to Desert Tortoise Surveying, Monitoring, and Handling Techniques Workshop. The Desert Tortoise Council. Ridgecrest, CA. October 25-26, 2008.

Bevanger, K. 1998. Biological and conservation aspects of birds mortality caused by electricity power lines: a review. Biological Conservation 86: 67-76.

Bureau of Land Management and California Energy Commission (BLM and CEC). 2010. Genesis Solar Energy Project Staff Assessment and Environmental Impact Statement. March 2010.

Bureau of Land Management and California Department of Fish and Game (BLM and CDFG). 2002. Proposed Northern & Eastern Colorado Desert Coordinated Management Plan. An amendment to the California Desert Conservation Area Plan 1980 and Sikes Act Plan with the California Department of Fish and Game and Final Environmental Impact Statement. U.S. Department of Interior Bureau of Land Management California Desert District and California Department of Fish and Game Inland, Deserts, and Eastern Sierra Region.

Calflora: Information on California plants for education, research and conservation. [web application]. 2011. Berkeley, California: The Calflora Database [a non-profit organization]. Available: http://www.calflora.org/ (Accessed: Sep 09, 2011).

California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. Tech. Rep. Burrowing Owl Consortium, Alviso, California.

California Department of Fish and Game (CDFG). 2008. California Interagency Wildlife Task Group. CWHR version 8.2 personal computer program. Sacramento, CA.

_____. 2011. California Natural Diversity Database, Rare Find3, commercial version 3.1.1.

_____. ND. American Badger species account. California Wildlife Habitat Relationships System. California Interagency Wildlife Task Group.

_____. 2011a. State and federally listed endangered, threatened and rare plants of California. Accessed at: http://www.dfg.ca.gov/hcpb/species/lists.shtml

_____. 2011b. Special Animals List. Accessed online at http://www.dfg.ca.gov/biogeodata/cnddb/plants_and_animals.asp.

California Native Plant Society (CNPS). 2001. Inventory of rare and endangered plants of California. California Native Plant Society. Special Publication #1, Sixth Edition.

_____. 2011. Inventory of Rare and Endangered Plants (online edition, v7-11aug). California Native Plant Society. Sacramento, CA. Accessed on Sep. 8, 2011 from http://www.cnps.org/inventory

CH2MHill. 2010. Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunication System Route Biological Review. Prepared for Southern California Edison. November 2010.

Dorin, M. and L. Spiegel. 2005. Assessment of Avian Mortality from Collisions and Electrocutions. California Energy Commission. CEC-700-2005-015.

Dunn, J.L. and J. Alderfer, editors. 2006. Field Guide to the Birds of North America, Fifth Edition. National Geographic Society; Washington, D.C.

Egoscue, H. J. 1962. Ecology and life history of the kit fox in Tooele County, Utah. Ecology 3:481-497.

Elliott, L., Gerhardt, C. and C. Davidson. 2009. The Frogs and Toads of North America. Houghton Mifflin Harcourt: Boston.

Espinoza, R.E. 2009. Mohave Fringe-toed Lizard. In: Jones, L.C. and R.E. Lovich, editors. Lizards of the American Southwest: A Photographic Field Guide. Tucson: Rio Nuevo Publishers, p. 278 – 281.

Ferrer, M., M. de la Riva, and J. Castroviejo. 1991. Electrocution of Raptors on Power Lines in Southwestern Spain. Journal of Field Ornithology 62(2): 181-190.

First Solar Electric, LLC (First Solar). No Date. First Solar Electric Blythe Solar 1 Project Environmental Assessment Form: Initial Study. Environmental Assessment Number 42019.

Hickman, J.C. (ed). 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley

Jaeger, Edmund, C. 1965. The California Deserts, fourth edition. Stanford University Press, Stanford, California.

Janss, G.F.E. and M. Ferrer. 2001. Avian electrocution mortality in relation to pole design and adjacent habitat in Spain. Bird Conservation International 11: 3-12.

Kochert, M. N., K. Steenhof, C. L. Mcintyre and E. H. Craig. 2002. Golden Eagle (*Aquila chrysaetos*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/684

Cody, Martin L. 1999. Crissal Thrasher (*Toxostoma crissale*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/419

Norris, R. M., and R. W. Webb. 1990. Geology of California, second edition. John Wiley & Sons, New York, p. 277– 300.

Poulin, Ray, L. Danielle Todd, E. A. Haug, B. A. Millsap and M. S. Martell. 2011. Burrowing Owl (*Athene cunicularia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/061

POWER Engineers, Inc. (POWER). 2011. Western Burrowing Owl 2011 Survey. Prepared for Renewable Resources Group. September 2011.

Prescott B.G. 2005. Le Conte's Thrasher Species Account, West Mojave Plan, Bureau of Land Management. Final environmental impact report and statement for the West Mojave plan: a habitat conservation plan and California desert conservation area plan amendment. Moreno Valley (CA): U.S. Dept. of the Interior, Bureau of Land Management, California Desert District.

Reid, F.A. 2006. *A Field Guide to Mammals of North America, Fourth Edition*. Houghton Mifflin Company: Boston.

Ryan, R. Mark. 1968. Mammals of Deep Canyon, Colorado Desert, California, The Desert Museum, Palm Springs, California.

Sheppard, Jay M. 1996. Le Conte's Thrasher (*Toxostoma lecontei*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/230

Sibley, D.A. 2000. National Audubon Society The Sibley Guide to Birds. Alfred A. Knopf, Inc.; New York, NY.

Stebbins, R.C. 2003. Western reptiles and amphibians. Third Edition. Houghton Mifflin Co.: Boston.

Stokes, D. and L. Stokes. 2010. The Stokes Field Guide to the Birds of North America. Little, Brown and Company: New York.

TetraTech EC, Inc. (TetraTech). 2010a. Fall 2009 and Spring 2010 Biological Resources Technical Report, Genesis Solar Energy Project. Prepared for Genesis Solar, LLC. June 2010.

_____. 2010b. Supplemental Information, Genesis Solar Energy Project. Prepared for Genesis Solar, LLC. June 2010.

U.S. Department of the Interior, Bureau of Land Management (BLM). 2007. California BLM Special Status Plants. Available at: http://www.blm.gov/ca/pa/ssp/lists/by_species/ssplist_all.html

United States Fish and Wildlife Service (USFWS). 2008. Draft revised recovery plan for the Mojave population of the desert tortoise (*Gopherus agassizii*). U.S. Fish and Wildlife Service, California and Nevada Region, Sacramento, California. 209 pp.

US Solar Holdings, LLC (US Solar). No Date. Blythe Airport Solar Project Environmental Assessment Form: Initial Study. Environmental Assessment Number 42340.

Van Devender, Thomas R., and W. Geoffrey Spaulding. 1979. Development of Vegetation and Climate in the Southwestern United States. Science 294:701-710.

Western Regional Climate Center. 2011. Available: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?cablyt+sca (Accessed: Sep., 20, 2011).

Yosef, Reuven. 1996. Loggerhead Shrike (*Lanius ludovicianus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/231

APPENDIX A – PLANT SPECIES OBSERVED DURING SURVEYS

Scientific Name	Common Name	Observed in Solar Array	Observed in Transmission Line
ANGIOSPERMS (DICOTYLEDONS)			
AMARANTHACEAE	**AMARANTH FAMILY**		
Tidestromia oblongifolia	honeysweet	X	X
APIACEAE	**CARROT FAMILY**		
Lomatium sp.	lomatium	X	X
ASCLEPIADACEAE	**MILKWEED FAMILY**		
Asclepias sp.	milkweed	X	
Asclepias subulata	rush milkweed		X
Sarcostemma cynanchoides ssp. hartwegii	climbing milkweed		X
ASTERACEAE	**SUNFLOWER FAMILY**		
Ambrosia dumosa	burro bush	X	X
Baileya pauciradiata	Colorado Desert marigold		X
Bebbia juncea	sweetbush		X
Chaenactis sp.	pincushion	X	
Chaenactis stevioides	desert pinchushion		X
Dicoria canescens	bugseed	X	X
Geraea canescens	desert sunflower	X	X
Hymenoclea salsola	cheesebush		X
Palafoxia arida	Spanish needles	X	X
Pluchea sericea	arrow weed	X	
Stephanomeria pauciflora	wire lettuce	X	X
BORAGINACEAE	**BORAGE FAMILY**		
Cryptantha sp.	cryptantha	X	X
Cryptantha angustifolium	narrowleaf cryptantha		X
Cryptantha costata	ribbed cryptantha		X
Cryptantha maritime	Guadalupe cryptantha		X
Cryptantha nevadensis	cryptantha		X
Cryptantha pterocarya	wing nut cryptantha		X
Nama demissum	purple desert mat		X
Pectocarya sp.	pectocarya	X	X
Tiquilia palmeri	Palmer's tiquilia	X	
Tiquilia plicata	plicate tiquilia	X	X
BRASSICACEAE	**MUSTARD FAMILY**		
*Brassica tournefortii**	Sahara mustard	X	X
*Buxus microphylla**	Japanese box	X	
Lepidium sp.	peppergrass	X	X
Lepidium lasiocarpum	peppergrass		X
Simmondsia chinensis	jojoba	X	
CASUARINACEAE	**SHE OAK FAMILY**		
Casuarina sp.*	she oak	X	
CACTACEAE	**CACTUS FAMILY**		
Cylindropuntia echinocarpa	golden cholla		X
Mammillaria sp.	fish-hook cactus		X
CHENOPODIACEAE	**GOOSEFOOT FAMILY**		

Scientific Name	Common Name	Observed in Solar Array	Observed in Transmission Line
Atriplex canescens	four-wing saltbush	X	
Atriplex lentiformis	quail brush	X	
*Bassia hyssopifolia**	five-hooked bassia	X	
Salsola tragus	Russian thistle		X
CUCURBITACEAE	**GOURD FAMILY**		
Cucurbita sp.*	squash	X	
EUPHORBIACEAE	**SPURGE FAMILY**		
Stillingia spinulosa	annual stillingia		X
FABACEAE	**LEGUME FAMILY**		
Acacia greggii	cat claw acacia	X	X
Astragalus sp.	astragalus	X	
Cercidium floridum	palo verde	X	X
Dallea mollissima	downy dalea		X
*Medicago sativa**	alfalfa	X	
Olneya tesota	desert ironwood		X
Prosopis sp.	mesquite	X	
Prosopis glandulosa	Honey mesquite		X
Psorothamnus emoryi	indigobush		X
Psorothamnus schottii	indigobush	X	X
GERANIACEAE	**GERANIUM FAMILY**		
*Erodium cicutarium**	red-stemmed filaree	X	X
LOASACEAE	**LOASA FAMILY**		
Eucnide urens	rock nettle	X	
Mentzelia sp.	blazing star	X	X
Mentzelia multiflora	blazing star		
Petalonyx thurberi ssp. thurberi	sandpaper plant		X
MARTYNIACEAE	**UNICORN PLANT FAMILY**		
Proboscidea althaeifolia	desert unicorn plant	X	
MYRTACEAE	**MYRTLE FAMILY**		
Eucalyptus sp.*	gum tree	X	X
NYCTAGINACEAE	**FOUR O'CLOCK FAMILY**		
Abronia villosa	sand verbena	X	
ONAGRACEAE	**EVENING PRIMROSE FAMILY**		
Camissonia boothii	bottlebrush primrose	X	X
Oenothera deltoids ssp. deltoides	bird-cage primrose		X
PLANTAGINACEAE	**PLANTAIN FAMILY**		
Plantago erecta	western plantain	X	
Plantago ovata	wooly plantain		X
POLEMONIACEAE	**PHLOX FAMILY**		
Eriastrum harwoodii	Harwood's woollystar		X
Gilia sp.			X
Langloisia setosissima	lilac sunbonnet		X
POLYGONACEAE	**BUCKWHEAT FAMILY**		
Chorizanthe brevicornu	brittle spineflower		X
Chorizanthe rigida	rigid spineflower	X	X
Eriogonum sp.			X
RESDACEAE	**MIGNONETTE FAMILY**		

Scientific Name	Common Name	Observed in Solar Array	Observed in Transmission Line
Oligomeris linifolia	Narrow-leaf oligomeris		X
ROSACEAE	**ROSE FAMILY**		
*Prunus persica**	peach	X	
RUTACEAE	**RUE FAMILY**		
*Citrus limon**	lemon	X	
*Citrus sinensis**	orange	X	
TAMARICACEAE	**TAMARISK FAMILY**		
*Tamarix ramosissima**	Mediterranean tamarisk	X	
VISCACEAE	**MISTLETOE FAMILY**		
Phoradendron californicum	desert mistletoe	X	
ZYGOPHYLLACEAE	**CALTROP FAMILY**		
Larrea tridentata	creosote bush	X	X
ANGIOSPERMS (MONOCOTYLEDONS)			
ARECACEAE	**PALM FAMILY**		
Phoenix sp.*	date palm	X	
LILIACEAE	**LILY FAMILY**		
Hesperocaulis undulata	desert lily		X
POACEAE	**GRASS FAMILY**		
Pleuraphis rigida	galleta grass	X	X
*Schismus barbatus**	Mediterranean schismus	X	X
*Triticum aestivum**	wheat		

* = nonnative species

APPENDIX B – WILDLIFE SPECIES OBSERVED DURING RECONNAISSANCE AND FOCUSED SURVEYS

Scientific Name	Common Name	Observed in Reconnaissance Survey	Observed in Focused Survey
CLASS INSECTA	**INSECTS**		
MELOIDAE	**BLISTER BEETLES**		
Lytta auriculata	red-eared blister beetle	X	X
TENEBRIONIDAE	**DARKLING BEETLES**		
Asbolus verrucosus	desert ironclad beetle	X	X
Eleodes spinipes	darkling beetle	X	
MANTIDAE	**MANTIDS**		
Litaneutria minor	ground mantis	X	
PIERIDAE	**WHITE & SULPHUR BUTTERFLIES**		
Pieris rapae	cabbage white	X	
Pontia protodice	checker-white		X
NYMPHALIDAE	**BRUSH-FOOTED BUTTERFLIES**		
Vanessa virginiensis	Virginia lady	X	
LYCAENIDAE	**GOSSAMER WING BUTTERFLIES**		
Brephidium exilis	pygmy blue	X	
FORMICIDAE	**ANTS**		
Messor pergandei	desert harvester ant	X	
MUTILLIDAE	**VELVET ANTS**		
Dasymutilla sp.	velvet ant	X	X
POMPILIDAE	**SPIDER WASPS**		
Pepsis formosa	tarantula wasp	X	X
CLASS REPTILIA	**REPTILES**		
TRIONYCHIDAE	**SOFTSHELL TURTLES**		
Apalone spinifera	spiny softshell turtle	X	
IGUANIDAE	**IGUANID LIZARDS**		
Callisaurus draconoides draconoides	common zebra-tailed lizard	X	X
Dipsosaurus dorsalis	desert iguana	X	X
Phrynosoma sp.	horned lizard	X	
Uma scoparia	Mojave fringe-toed lizard	X	X
Uta stansburiana	common side-blotched lizard	X	X
TEIIDAE	**WHIPTAIL LIZARDS**		
Cnemidophorus sp.	whiptail	X	X
COLUBRIDAE	**COLUBRID SNAKES**		
Arizona elegans occidentalis	Glossy snake		X
Chinoactis occipitalis	shovel-nosed snake	X	
VIPERIDAE	**VIPERS**		
Crotalus cerastes	sidewinder	X	X

Scientific Name	Common Name	Observed in Reconnaissance Survey	Observed in Focused Survey
CLASS AVES	**BIRDS**		
CATHARTIDAE	**NEW WORLD VULTURES**		
Cathartes aura	turkey vulture	X	X
ACCIPITRIDAE	**HAWKS, KITES, EAGLES**		
Buteo jamaicensis	red-tailed hawk	X	
FALCONIDAE	**FALCONS**		
Falco sparverius	American kestrel	X	
ODONTOPHORIDAE	**NEW WORLD QUAIL**		
Callipepla gambelii	Gambel's quail	X	X
CHARADRIIDAE	**PLOVERS**		
Charadrius vociferus	killdeer	X	
COLUMBIDAE	**PIGEONS & DOVES**		
Columba livia	rock pigeon	X	
Streptopelia risoria	ringed turtle-dove	X	
Zenaida aurita	white-winged dove	X	X
Zenaida macroura	mourning dove	X	
CUCULIDAE	**CUCKOOS & ROADRUNNERS**		
Geococcyx californianus	greater roadrunner	X	X
STRIGIDAE	**TRUE OWLS**		
Athene cunicularia	burrowing owl	X	
APODIDAE	**SWIFTS**		
Aeronautes saxatalis	white-throated swift	X	
TYRANNIDAE	**TYRANT FLYCATCHERS**		
Tyrannus verticalis	western kingbird	X	X
ALAUDIDAE	**LARKS**		
Eremophila alpestris	horned lark	X	X
HIRUNDINIDAE	**SWALLOWS**		
Petrochelidon pyrrhonota	cliff swallow	X	
CORVIDAE	**JAYS & CROWS**		
Corvus corax	common raven	X	X
LANIIDAE	**SHRIKES**		
Lanius ludovicianus	loggerhead shrike	X	X
STURNIDAE	**STARLINGS**		
Sturnus vulgaris	European starling	X	
ICTERIDAE	**BLACKBIRDS**		
Agelaius phoeniceus	red-winged blackbird	X	
Euphagus cyanocephalus	Brewer's blackbird	X	
Icterus cucullatus	hooded oriole		X
Xanthocephalus xanthocephalus	yellow-headed blackbird	X	
Quiscalus mexicanus	great-tailed grackle	X	X

Scientific Name	Common Name	Observed in Reconnaissance Survey	Observed in Focused Survey
MIMIDAE	**MOCKINGBIRDS & THRASHERS**		
Toxostoma lecontei	Le Conte's thrasher		X
THRAUPIDAE	**TANAGERS**		
Piranga ludoviciana	Western tanager		X
SYLVIIDAE	**GNATCATHERS**		
Polioptila caerulea	black-tailed gnatcatcher		X
EMBERIZIDAE	**EMBERIZIDS**		
Zonotrichia leucophrys	white-crowned sparrow	X	
FRINGILLIDAE	**FINCHES**		
Carduelis tristis	American goldfinch	X	
CLASS MAMMALIA	**MAMMALS**		
LEPORIDAE	**HARES & RABBITS**		
Lepus californicus	black-tailed jackrabbit	X	
Sylvilagus audubonii	desert cottontail	X	
SCIURIDAE	**SQUIRRELS**		
Ammospermophilus leucurus	white-tailed antelope squirrel	X	X
Spermophilus tereticaudus	Round-tailed ground squirrel		X
HETEROMYIDAE	**POCKET MICE & KANGAROO RATS**		
Dipodomys sp.	kangaroo rat	X	
CANIDAE	**WOLVES & FOXES**		
Canis familiaris	domestic dog	X	
Canis latrans	coyote	X	
Vulpes macrotis	kit fox	X	X
MUSTELIDAE	**WEASELS, SKUNKS & OTTERS**		
Taxidea taxus	American badger	X	
BOVIDAE	**BISON, GOATS & SHEEP**		
Ovis canadensis	bighorn sheep	X (bones and skull)	
CHIROPTERA	**BATS**		
Myotis sp.	Myotis	X	X

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C – USFWS SPECIES INFORMATION FOR THE PROJECT AREA

From: Tony_McKinney@fws.gov
To: Ryan Winkleman 2731;
Subject: spp. list
Date: Friday, July 01, 2011 7:02:34 PM
Attachments: McCoy_Wash.htm
Ripley.htm
Roosevelt_Mine.htm

Tony McKinney, GIS Coordinator
USFWS Carlsbad Fish and Wildlife Office
6010 Hidden Valley Rd.
Carlsbad, CA 92011
760.431.9440.x259

(See attached file: McCoy_Wash.htm)(See attached file: Ripley.htm)(See attached file: Roosevelt_Mine.htm)

U.S. Fish & Wildlife Service

Carlsbad Fish & Wildlife Office

Pacific Southwest Region

==========

Listed/Proposed Threatened and Endangered Species for the MCCOY WASH Quad

November 9, 2010

==========

KEY:

Category:

E = Endangered - Listed in the Federal Register as being in danger of extinction

PE = Proposed Endangered - Proposed in the Federal Register as being in danger of extinction

T = Threatened Listed as likely to become endangered within the foreseeable future

Critical Habitat:

N = None Designated

P = Proposed

Y = Designated

Type	Scientific Name	Common Name	Category	Critical Habitat
Reptiles	*Gopherus agassizii*	desert tortoise	T	Y

Last updated: May 3, 2011

U.S. Fish & Wildlife Service

Carlsbad Fish & Wildlife Office

Pacific Southwest Region

==========

Listed/Proposed Threatened and Endangered Species for the RIPLEY Quad

November 23, 2010

==========

KEY:

Category:

E = Endangered - Listed in the Federal Register as being in danger of extinction

PE = Proposed Endangered - Proposed in the Federal Register as being in danger of extinction

T = Threatened Listed as likely to become endangered within the foreseeable future

Critical Habitat:

N = None Designated

P = Proposed

Y = Designated

Type	Scientific Name	Common Name	Category	Critical Habitat
Reptiles	*Gopherus agassizii*	desert tortoise	T	Y

Last updated: May 3, 2011

U.S. Fish & Wildlife Service

Carlsbad Fish & Wildlife Office

Pacific Southwest Region

==========

Listed/Proposed Threatened and Endangered Species for the ROOSEVELT MINE Quad

November 23, 2010

==========

KEY:

Category:

E = Endangered - Listed in the Federal Register as being in danger of extinction

PE = Proposed Endangered - Proposed in the Federal Register as being in danger of extinction

T = Threatened Listed as likely to become endangered within the foreseeable future

Critical Habitat:

N = None Designated

P = Proposed

Y = Designated

Type	Scientific Name	Common Name	Category	Critical Habitat
Reptiles	*Gopherus agassizii*	desert tortoise	T	Y

Last updated: May 3, 2011

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C2
230 KV TRANSMISSION LINE ALTERNATIVES HABITAT ASSESSMENT REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

August 2012

BLYTHE MESA SOLAR PROJECT

230 kV Transmission Line Alternatives
Habitat Assessment Report

PROJECT NUMBER:
122512

PROJECT CONTACT:
VANESSA SANTISTEVAN

vanessa.santistevan@powereng.com

(303) 716-8908

POWER ENGINEERS

AR061166

BLYTHE MESA SOLAR PROJECT

230 KV TRANSMISSION LINE ALTERNATIVES HABITAT ASSESSMENT REPORT

PREPARED FOR:

Renewable Resources Group, Inc.

PREPARED BY:

POWER Engineers, Inc.

CONTENTS

1.0 Introduction 1
1.1 Project Overview 1
1.1.1 Northern Alternative 230 kV Transmission Line 1
1.1.2 Southern Alternative 230 kV Transmission Line 1
2.0 Methods 5
3.0 Results 5
3.1 Vegetation Communities 5
3.2 Flora 7
3.3 Wildlife 11
4.0 References 19

FIGURES

Figure 1. Site Plan 3

TABLES

Table 1. Vegetation Communities and Cover Types (Acres) 6
Table 2. Special-status Plant Species with Potential to Occur within the Project Area 9
Table 3. Special-status Wildlife Species with Potential to Occur within the Project Area 13

APPENDICES

Appendix A: Vegetation Communities and Botanical Survey Results
Appendix B: Vegetation Communities and Wildlife Survey Results
Appendix C: Vegetation Communities and Mojave Fringe-toed Lizard Survey Results
Appendix D: Observed Plants
Appendix E: Observed Wildlife

ACRONYMS AND ABBREVIATIONS

ABBREVIATION	DEFINITION
BLM	U.S. Department of the Interior, Bureau of Land Management
CDFG	California Department of Fish and Game
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
ESA	Endangered Species Act
F	Fahrenheit
kV	Kilovolt
MW	Megawatt
NECO Plan	Northern and Eastern Colorado Desert Coordinated Management Plan
PV	Photovoltaic
ROW	Right-of-way
USGS	U.S. Geological Survey

1.0 INTRODUCTION

The proposed Blythe Mesa Solar Project (Project) consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure and connection to the statewide electricity transmission grid. In 2011, a Habitat Assessment, Protocol Rare Plant Surveys, and burrowing owl surveys were conducted on the solar array field and proposed 8.4-mile 230 kilovolt (kV) transmission line (73 acres). Two new transmission line corridor alternatives, a Northern Alternative and a Southern Alternative to the proposed alignment, were introduced in 2012. This report documents the results of the habitat assessment that was conducted on the new 230 kV alternatives. The habitat assessment consisted of a review of published peer-reviewed documents, databases, and biological reports in conjunction with biological field surveys. This data was used to determine areas that have suitable habitat to potentially support listed, proposed for listing, and candidate threatened and endangered species, and other identified sensitive species.

1.1 Project Overview

The Proposed Project is a 485 MW PV electrical generating facility and 230 kV transmission line that would occupy a total of 3,660 acres. The Proposed Project would produce enough energy to power approximately 180,000 households, and would consist of the following two major components: 1) a solar array field utilizing single-axis solar PV trackers (3,587 acres); and 2) 8.4 miles of 230 kV transmission (4.2 miles of this line would be located outside of the solar array site within a 125-foot-wide Right-of-Way (ROW) totaling approximately 73 acres).

This habitat assessment analyzes only the 230 kV northern and southern alternative transmission line alignments, as the proposed solar array field remains the same for all transmission alternatives. The 230 kV alternatives are described below and illustrated in Figure 1.

1.1.1 Northern Alternative 230 kV Transmission Line

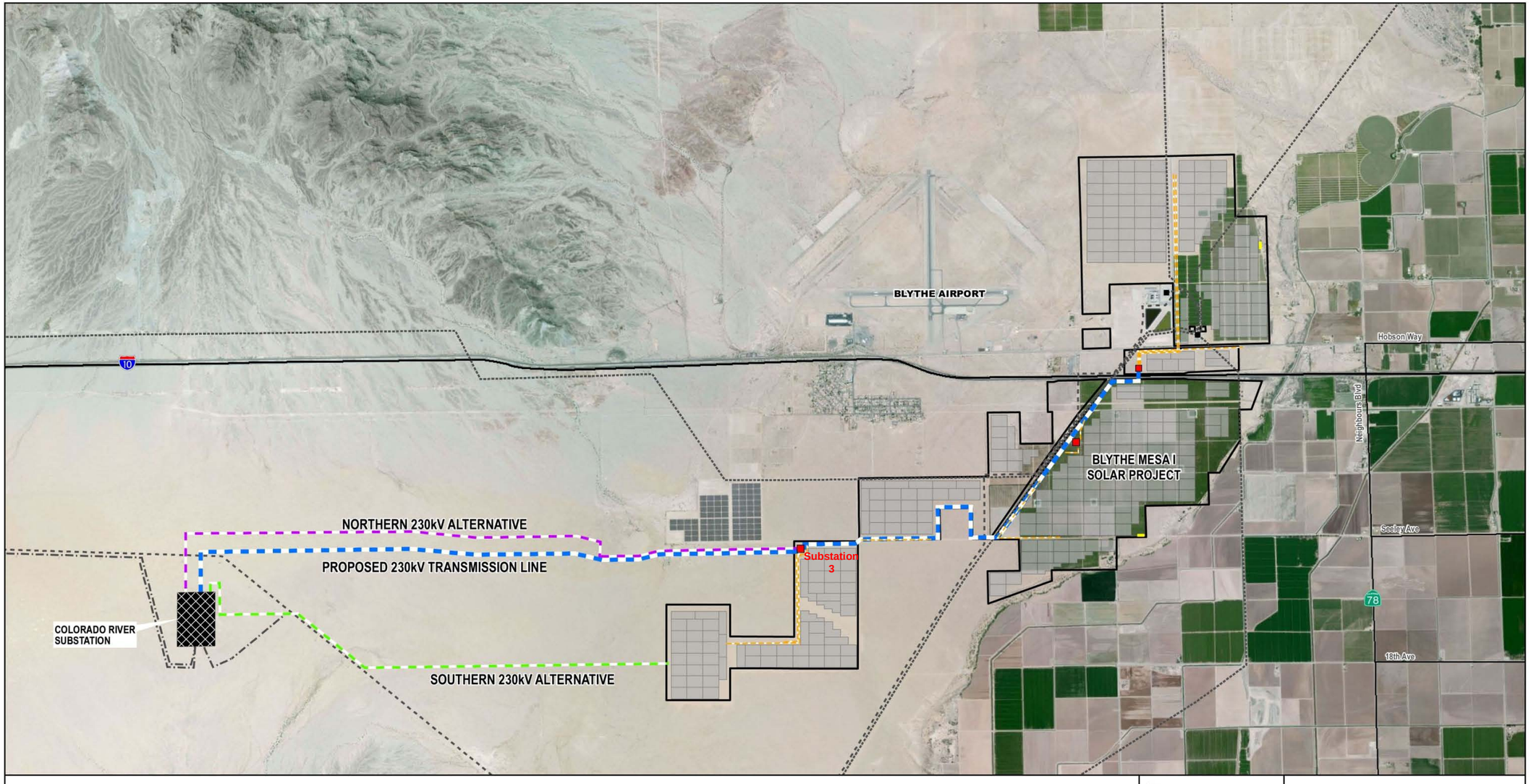
Similar to the proposed alignment, the Northern Alternative would include the construction, operation, and decommissioning of a 485 MW solar PV electrical generating facility and associated infrastructure. It would occupy a total of 3,588 acres and would utilize the same solar array field as the Proposed Project. The primary difference between the Northern Alternative and the proposed Project is the location of the 230 kV transmission line that extends outside of the solar array field to the Colorado River Substation; the same 230 kV transmission alignment within the solar array field would be utilized for both the proposed Project and Northern Alternative. Both the Proposed alignment and the Northern Alternative would be located within the same BLM utility corridor; however, the Northern Alternative would be located on the north side of the corridor and within a 125-foot ROW entirely on BLM-managed lands. Under this alternative, the total length of the 230 kV transmission line both on-site and off-site would be 8.8 miles; 3.6 miles would be located on private lands within the array site boundary and 5.2 miles would be located entirely off-site on BLM-managed lands. The BLM portion of the ROW would contain 79 acres.

1.1.2 Southern Alternative 230 kV Transmission Line

Also similar to the proposed alignment, the Southern Alternative would include the construction, operation, and decommissioning of a 485 MW solar PV electrical generating facility and associated infrastructure. The Southern Alternative would occupy a total of 3,647 acres and would utilize the same solar array field location as the Proposed Project. The primary difference between the proposed Project and the Southern Alternative is the location of the 230 kV transmission line that extends between the solar array field to the Colorado River Substation. The Southern Alternative would exit the southwestern portion of the solar array field and extend approximately four miles west to the Colorado River Substation within a 125-foot ROW. To facilitate this alignment, an additional 10,000 feet of 230 kV transmission line would need to be built on the solar array field extending south from the proposed substation 3 and

angling west to the site boundary. The transmission line would continue westerly off-site across 3.4 miles of BLM-managed lands and 0.6 mile of private lands before reaching the Colorado River Substation. Under this alternative, the total length of the 230 kV transmission line both on-site and off-site would be 9.5 miles; 5.5 miles would be located on private lands within the array site boundary and 4.0 miles would be located off-site on private land. The total area of the ROW offsite would be about 60 acres (50 acres of BLM-managed land and 10 acres of private land).

FIGURE 1. SITE PLAN



THIS PAGE INTENTIONALLY LEFT BLANK

2.0 METHODS

Prior to initiating the reconnaissance survey, available data was reviewed from resource management plans and other relevant documents to determine the locations and types of biological resources that have the potential to exist within and adjacent to the biological resources survey area. The California Natural Diversity Database (CNDDB), maintained by the California Department of Fish and Game (CDFG 2012), and California Native Plant Society (CNPS) Electronic Inventory of Rare and Endangered Plants of California (CNPS 2012) were also accessed for records of occurrence of special-status species and habitats within the Roosevelt Mine, Ripley, McCoy Spring, McCoy Peak, McCoy Wash, Blythe NE, Blythe, Mule Wash, Palo Verde, Thumb Peak, Wiley Well, and Hopkins Well U.S. Geological Survey (USGS) 7.5-minute quadrangles. These search parameters encompass an approximately 10-mile buffer around the Project area.

Habitat mapping was conducted within the two alternative transmission line routes by POWER Engineers, Inc. (POWER) biologists Ken McDonald and Ryan Winkleman from May 1 through May 3, 2012. Surveys were commenced between 6:30 and 7:00 a.m., when temperatures were approximately 60-70° F. The biologists walked transects approximately 30 feet apart and noted vegetation communities, plant species observed, and wildlife observed or detected. Surveys were conducted within the 500-foot biological survey corridor. No pedestrian surveying was conducted outside of the ROW.

The habitat mapping survey was conducted to assess general and dominant vegetation types, community sizes, habitat types, and species present within communities. Community types were based on observed dominant vegetation composition and density. Vegetation communities were classified based on Holland (1986). Sawyer and Keeler-Wolf (1995), and CDFG classifications were used to provide additional detail when needed, such as denoting special vegetation communities that are either known or believed to be of high priority for inventory in CNDDB due to significance or rarity. Plants of uncertain identity were collected and subsequently identified from taxonomic keys (Hickman 1993) and field guides (Stuart & Sawyer 2001). Scientific and common species names were recorded according to The Jepson Manual: Higher Plants of California. A list of observed plant species is provided in Appendix D.

The presence of a wildlife species was based on direct observation, wildlife sign (e.g., tracks, burrows, nests, scat), or vocalization. Field data compiled for wildlife included the species scientific name, common name, and evidence of sign when no direct observations were made. Wildlife were identified and named based on field guides and other related literature (Burt & Grossenheider 1980, Elbroch 2003, Sibley 2000, and Stebbins 2003). A list of observed animal species is presented in Appendix E.

The potential for occurrence of special-status species was also determined for the biological survey area. The survey area was assessed in the field for its potential to support both common and special-status plant and animal species based on habitat suitability comparisons with reported occupied habitats.

3.0 RESULTS

3.1 Vegetation Communities

Three vegetation communities and other cover types were identified within the survey area during the reconnaissance and focused surveys (see Table 1 below and Appendix A). Vegetation communities are described in detail below and based on a classification system by R. Holland (1986). When appropriate, vegetation classification by J.O. Sawyer and T. Keeler-Wolf (1995) are also considered. Community types according to CDFG are listed where applicable. Of the vegetation communities listed in Table 1, desert dry wash woodland is considered sensitive. Desert dry wash woodland is sensitive because it is included with State waters under the jurisdiction of CDFG. In addition, desert dry wash woodland is a special community type (e.g., high priority for inventory in the CNDDB) per CDFG's Vegetation and

Mapping Program. The elevation of both alternative transmission line corridors ranges between 380 and 480 feet.

Table 1. Vegetation Communities and Cover Types (Acres)

Vegetation Communities and Other Cover Types	Acreage on Northern Alternative	Acreage on Southern Alternative
Sonoran Creosote Bush Scrub	303.07 acres	231.01 acres
Desert Dry Wash Woodland	22.87 acres	11.39 acres
Developed/Disturbed	0.51 acre	0.33 acre

Note: solar array field acreage is not included in this analysis.

Sonoran Creosote Bush Scrub. Sonoran creosote bush scrub is an open, sparsely vegetated community, usually with bare ground between plants, and is the most common vegetation community of the Sonoran desert. This community experiences growth during the winter and spring seasons, if rainfall is sufficient. Many annual species occur in early to late spring during years of adequate rainfall. Sonoran creosote bush scrub occurs on well-drained secondary soils of slopes, fans, and valleys, with thin residual soils or on sites with high soil salinity, and intergrades with Mojave creosote bush scrub. This plant community intergrades into the desert dry wash woodland community within the survey area.

Creosote bush (*Larrea tridentata*) is the dominant species within the Sonoran creosote bush scrub community observed with the survey area. Other species observed that varied from abundant to common within this community included burro bush (*Ambrosia dumosa*), big galleta grass (*Pleuraphis rigida*), and Sahara mustard (*Brassica tournefortii*). Within the survey area, this community is characterized by either sandy soils with pockets of stabilized desert sand fields, or by weakly developed desert pavement. In areas within the creosote bush scrub vegetation where the weakly developed desert pavement occurs, the topography is generally very flat, and plant species abundance and diversity is very low.

Approximately 303.07 acres of Sonoran creosote bush scrub occur within the survey area of the Northern Alignment, and 231.01 acres in the Southern Alignment.

Desert Dry Wash Woodland. Desert dry wash woodland is an open to dense, drought-deciduous microphyllous thorn scrub woodland, dominated by leguminous trees. This community occurs in sandy or gravelly washes and arroyos of the lower Mojave, Sonoran, and Colorado deserts, generally in areas that do not experience frost. These washes typically have braided channels that may be changed substantially with each surface flow event. This plant community intergrades into the Sonoran creosote bush scrub community within the survey area.

Where the observed washes were more obvious, Palo Verde (*Cercidium floridum*), honey mesquite (*Prosopis glandulosa*), and ironwood (*Olneya tesota*) were the dominant species, with abundant to common big galleta grass, burrobush, and Sahara mustard. As washes become more shallow and less obvious, the dominant species was big galleta grass and Sahara mustard. Other perennial and annual species were observed occasionally throughout this community.

Approximately 22.87 acres of desert dry wash woodland occur within the survey area of the Northern Alignment, and 11.39 acres in the Southern Alignment.

Developed/Disturbed. Developed and disturbed areas consist of dirt access roads, active or fallow agriculture, and areas mechanically cleared of native vegetation. Approximately 0.51 acre of developed/disturbed occurs within the survey area of the Northern Alignment, and 0.33 acre in the Southern Alignment.

3.2 Flora

This section discusses plant species detected or with potential to occur within the survey area. No federal-listed, State-listed, or other special-status plant species were observed within the biological survey area. In total, 15 plant species were determined to have a potential to occur within the vicinity of the Project, based on records searches with the CNDDB (CDFG 2012) and CNPS (2012) and reviews of documentation from other nearby projects, such as the Blythe Solar Power Project (AECOM 2010) and previous surveys in the vicinity conducted by POWER biologists. These include one BLM sensitive species and eight species listed as present within the area covered by the Northern & Eastern Colorado Desert (NECO) Plan (BLM and CDFG 2002). No federal- or State-listed plant species have the potential to occur within the Project area.

Plant species observed during the initial habitat mapping surveys are listed in Appendix D. Species most commonly observed during biological surveys included burro bush, Sahara mustard, creosote bush, and galleta grass. Other common species that occurred less frequently included four-wing saltbush (*Atriplex canescens*), Palo Verde, ironwood, Russian thistle (*Salsola tragus*), Mediterranean grass (*Schismus barbatus*), and devil's spineflower (*Chorizanthe rigida*).

Federal-listed Plant Species. No federal-listed plant species were detected within the survey area during spring 2012 habitat mapping surveys. Based on regional databases, no federal-listed as endangered plant species have potential to occur within the survey area (CNDDB 2012, CNPS 2012).

State-listed Plant Species. No State-listed plant species were detected within the survey area during 2012 habitat mapping surveys. Based on regional databases, no State-listed plant species were determined to have potential to occur within the survey area (CNDDB 2012, CNPS 2012).

BLM-listed Plant Species: Based on the BLM's Palm Springs Field Office list of sensitive plant species, only one BLM sensitive plant species is documented as being present in and adjacent to the Project area. Harwood's woolystar (*Eriastrum harwoodii*) was detected by POWER in 2011 in a potential transmission line corridor located between the northern and southern alternatives. It was not detected during POWER's 2012 habitat mapping surveys on the northern and southern alternatives.

Other Special-status Plant Species. No other special-status plant species were detected during habitat mapping surveys in spring 2012. Based on a CNDDB search, Harwood's milk-vetch (*Astragalus insularis* var. *harwoodii*), a CNDDB List 2.2 species, has a high potential to occur within the proposed transmission line disturbance area and has numerous records in the vicinity, with several that are within the immediate vicinity of the survey area.

Table 2 provides a summary of the special-status plant species with the potential to occur within the Project area.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 2. Special-status Plant Species with Potential to Occur within the Project Area

Common Name Scientific Name	Sensitivity Status[1]	Plant Habit and General Habitat Description (CNPS 2012)	Flowering Period (CNPS 2012)	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Angel trumpets *(Acleisanthes longiflora)*	CNPS: List 2.3 NECO Plan	Prostrate to ascending perennial stems less than three feet. Occurs in dry places, generally on carbonate or limestone derived soils in mountainous areas 30 to 8,000 feet.	May	The closest record of this species is in the Big Maria Mountains.	Low	Low
Harwood's milkvetch *(Astragalus insularis* var. *harwoodii)*	CNPS: List 2.2 NECO Plan	Annual plant. Occurs in the Sonoran Desert in sandy to gravely areas 0 to 1,000 feet.	January to May	This species was detected in the Project vicinity toward the northwestern limits in 2009 (CEC).	High	High
Gravel milkvetch (*Astragalus sabulonum*)	CNPS List 2.2	Annual and perennial herb. Occurs in desert dunes and Mojavean and Sonoran desert scrub in sandy or gravelly areas. Also in washes or along roadsides. Occurs between 195 and 3,050 feet.	February to June	The closest CNDDB record is approximately 1.5 miles north of the Project area in a "best guess" location.	Moderate	Moderate
Pink fairyduster *(Calliandra eriophylla)*	CNPS: List 2.3 NECO Plan	Shrubs less than one foot in height. Occurs in Sonoran Desert, sandy washes, slopes, and mesas typically between 390 and 5,000 feet.	January to March	Some suitable habitat is present. Species most often occurs at sites above 500 feet.	Low	Low
Saguaro (*Carnegiea gigantea*)	CNPS: List 2.2 NECO Plan	Perennial stem succulent. Occurs in Sonoran desert scrub in rocky areas, typically between 165 and 4,920 feet.	May to June	The only CNDDB record is approximately 15 miles south of the Project area.	None	None
Crucifixion horn *(Castela emoryi)*	CNPS: List 2.3 NECO Plan	Shrub less than 10 feet in height. Occurs in Mojavean and Sonoran desert scrub on dry, gravelly washes from 295 to 3,000 feet.	April to May	This large shrub was not observed in the surveys, which were conducted within the appropriate blooming period.	None	None
Abrams' spurge *(Chamaesyce abramsiana)*	CNPS: List 2.2	Annual herb. Occurs in Mojavean and Sonoran desert scrub on sandy soils up to 3,000 feet.	September to November	The only CNDDB record is approximately 9.5 miles west of the Project area.	Moderate	Moderate
Las Animas colubrine *(Colubrina californica)*	CNPS: List 2.3 NECO Plan	Perennial, deciduous shrub generally less than three feet. Occurs in Sonoran creosote bush scrub less than 3,500 feet.	April to June	According to CEC 2009 data, specimens were observed in flower during April; an early blooming period for this species. Similar habitat is expected to occur in the Project area.	Moderate	Moderate
Alverson's foxtail cactus (*Coryphantha alversonii*)	CNPS: List 4.3 NECO Plan	Perennial stem succulent. Occurs in sandy, rocky, or granitic areas of Mojavean and Sonoran desert scrub, usually from 245 to 5,005 feet.	April to June	All CNDDB records are mapped north of Blythe in the Big Maria Mountains.	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	Plant Habit and General Habitat Description (CNPS 2012)	Flowering Period (CNPS 2012)	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Harwood's woollystar *(Eriastrum harwoodii)*	CNPS: List 1B.2 BLM: Sensitive	Annual herb. Occurs in desert dunes and Sonoran Desert scrub on sandy soils from 400 to 3,000 feet.	March to June	Observed in abundance in an area between the northern and southern alternatives in 2011. Not observed in 2012.	High	High
Bitter hymenoxys *(Hymenoxys odorata)*	CNPS: List 2	Annual herb. Occurs in chaparral, coastal scrub, Mojavean Desert scrub, and meadows and seeps, often in alkali soils, and riparian scrub with mesic soils. Most often found on sandy sites from 145 to 490 feet.	February to November	Habitat for this species is limited to the desert riparian woodland wash located in the easternmost portion of the proposed transmission line.	Low	Low
California satintail *(Imperata brevifolia)*	CNPS: List 2.1	Perennial grass. Occurs in San Bernardino Mountains and Mojave Desert in cultivation. Found near wet springs, meadows, streamsides and flood plains up to 1,700 feet.	September to May	The habitat for this species (wet springs, meadows, stream sides and flood plains) does not occur within the Project area.	Low	Low
Darlington's blazing star (*Mentzelia puberula*)	CNPS: List 2.2	Perennial herb. Occurs in sandy or rocky areas of Mojavean and Sonoran desert scrub, between 295 and 4,200 feet.	March to May	The only CNDDB record is approximately 14.5 miles south of the Project area.	Low	Low
Wiggins' cholla (*Opuntia wigginsii*)	CNPS: List 3.3 NECO Plan	Perennial stem succulent. Occurs in sandy Sonoran desert scrub from 100 to 2,905 feet.	March	The only CNDDB record is approximately 13.75 miles south of the Project area.	Low	Low
Dwarf germander *(Teucrium cubense* ssp. *depressum)*	CNPS: List 2.2	Annual plant up to six inches tall. Occurs in sandy soils, washes and fields in the Sonoran Desert below 1,200 feet.	March to November	Habitat for this species is present within the Project area and vicinity.	Moderate	Moderate

[1]Sensitivity Status Key

ESA Endangered
CNPS California Native Plant Society Lists:
1B: Considered rare, threatened, or endangered in California and elsewhere.
2: Plants rare, threatened, or endangered in California, but more common elsewhere
Decimal notations: .1 - Seriously endangered in California, .2 – Fairly endangered in California, .3 – Not very endangered in California
BLM Special-Status Plants
NECO Plan Northern and Eastern Colorado Desert Coordinated Management Plan special-status species

[2]Species Potential for Occurrence

Low – low potential to occur, because suitable habitat was observed, but was of marginal quality, or the area may be at the limits of the known ranges, and the species was not observed during the survey.
Moderate – has moderate potential to occur because suitable habitat was observed to be present, but the species was not found during focused plant surveys
High – has high potential to occur because suitable habitat was present, and species is known to occur within the vicinity, but it was not found during focused plant surveys
Present – if detected during surveys

3.3 Wildlife

This section discusses special-status wildlife species detected within the survey area or with potential to occur on site. Thirty-two special-status wildlife species were determined to have the potential to occur within the Project area or its vicinity. In total, 35 wildlife species or their sign were detected during the habitat mapping surveys (see Appendix E). Of these, three special-status wildlife species or their sign were observed within the survey area (see Table 3), including Mojave fringe-toed lizard, loggerhead shrike, and desert kit fox. In addition, a thrasher species was detected by call but was not identified. In total, five insect, seven reptile, 17 bird, and six mammal species or their sign were detected during biological surveys.

Wildlife species observed during the survey are listed in Appendix E. The species most commonly observed during biological surveys included Mojave fringe-toed lizard (*Uma scoparius*), western whiptail (*Aspidoscelis tigris*), Wilson's warbler (*Wilsonia pusilla*), round-tailed ground squirrel (*Spermophilus tereticaudus*), desert ironclad beetle (*Asbolus verrucosus*), and tarantula hawk (*Pepsis formosa*).

Table 3 provides a summary of the species accounts and potential to occur. Habitat requirements are taken primarily from the CNDDB (CDFG 2012) and sensitivity status is current to the 2011 CDFG Special Animals List (CDFG 2011).

Federal-listed Wildlife Species: No federal-listed wildlife species or their sign were detected during surveys. Based on a CNDDB (CDFG 2012) search, four federal-listed species and one federal candidate species have records in the Project vicinity. These include desert tortoise (*Gopherus agassizii*), southwestern willow flycatcher (*Empidonax traillii extimus*), Yuma clapper rail (*Rallus longirostris yumanensis*), razorback sucker (*Xyrauchen texanus*), and the candidate species western yellow-billed cuckoo (*Coccyzus americanus occidentalis*).

State-listed Wildlife Species: No State-listed wildlife species or their sign were detected during surveys. Based on a CNDDB (CDFG 2012) search, seven State-listed species have records in the Project vicinity. These include desert tortoise, western yellow-billed cuckoo, southwestern willow flycatcher, Gila woodpecker (*Melanerpes uropygialis*), elf owl (*Micrathene whitneyi*), Yuma clapper rail, and razorback sucker.

BLM-listed Wildlife Species: One BLM sensitive species was detected during POWER's 2012 habitat mapping surveys. Mojave fringe-toed lizard was detected on the northern alternative, but was not detected on the southern alternative. However, based on habitat present in the southern alternative and the large number of Mojave fringe-toed lizards that POWER detected in 2011 in a proposed transmission line corridor located between the northern and southern alternatives, this species has a high potential to occur on the southern alternative.

Other Special-Status Wildlife Species: Two other special-status wildlife species or their sign were positively identified on site, including the loggerhead shrike (*Lanius ludovicianus*) and desert kit fox (*Vulpes macrotis arsipus*). In addition, an unidentified thrasher species (*Toxostoma* sp.) was detected aurally during surveys.

THIS PAGE INTENTIONALLY LEFT BLANK

Table 3. Special-status Wildlife Species with Potential to Occur within the Project Area

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Amphibians					
Couch's spadefoot toad (*Scaphiopus couchii*)	CDFG: Species of Special Concern BLM: Sensitive NECO Plan	Various arid and semiarid environments. Breeds in desert ponds quickly following rainfall.	Suitable habitat is not known to be present, but some areas may still support ponded water after rain events.	Low	Low
Reptiles					
Desert tortoise (*Gopherus agassizii*)	ESA: Threatened CESA: Threatened NECO Plan	Various desert scrubs and desert washes up to about 5,000 feet, but not including playas.	Desert tortoise was documented approximately 0.5 mile south of the southern alignment (CH2M Hill 2010) and sign was scattered around the Colorado River Substation (AECOM 2010). POWER walked transects along both alternatives in suitable habitat but did not observe desert tortoise or its sign.	Low	Moderate
Mojave fringe-toed lizard (*Uma scoparia*)	CDFG: Species of Special Concern BLM: Sensitive NECO Plan	Fine, wind-blown sand in creosote bush scrub of the Mojave and northern Colorado Deserts. From below sea level to 2,952 feet.	Species detected in the northern alternative during habitat mapping. Suitable habitat is present within the southern alternative, though no individuals were detected during the survey.	Present	High
Birds					
Western burrowing owl (*Athene cunicularia hypugaea*)	CDFG: Species of Special Concern BLM: Sensitive USFWS: Bird of Conservation Concern NECO Plan	Found mainly in grassland and open scrub from the seashore to foothills. Also found in deserts and scrublands.	Habitat marginally suitable for this species. May be occasionally present as foragers but unlikely to be present as residents.	High	High

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	ESA: Candidate CESA: Endangered USFWS: Bird of Conservation Concern	Nests along large river systems, typically in areas dominated by willows and cottonwoods.	No suitable habitat observed in Project area.	None	None
Sonoran yellow warbler (*Dendroica petechia sonorana*)	CDFG: Species of Special Concern USFWS: Bird of Conservation Concern NECO Plan	Occurs in riparian deciduous habitat, such as cottonwood and willow areas, nesting in understories. Summer resident of the Colorado River Valley.	No suitable habitat observed in Project area.	None	None
Southwestern willow flycatcher (*Empidonax traillii extimus*)	ESA: Endangered CESA: Endangered NECO Plan	Riparian woodlands.	No suitable habitat observed in Project area.	None	None
Yellow-breasted chat (*Icteria virens*)	CDFG: Species of Special Concern	Inhabits riparian willow thickets near watercourses. Nests in low, dense riparian areas. Summer resident.	No suitable habitat observed in Project area.	None	None
Loggerhead shrike (*Lanius ludovicianus*)	CDFG: Species of Special Concern USFWS: Bird of Conservation Concern	Occurs in semi-open country with utility posts, wires, and trees to perch on.	Pair detected just north of the northern alternative. Suitable habitat occurs along the southern alternative but no individuals were detected.	Present	High
Gila Woodpecker (*Melanerpes uropygialis*)	CESA: Endangered USFWS: Bird of Conservation Concern NECO Plan	Nests in cottonwoods or other desert riparian trees, shade trees, or date palms.	Limited suitable habitat available in the Project area. Nearest occupied habitat is near Blythe on the Colorado River.	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Elf owl (*Micrathene whitneyi*)	CESA: Endangered USFWS: Bird of Conservation Concern NECO Plan	In California, nests only in cottonwood-willow and mesquite riparian areas along the Colorado River.	No suitable nesting habitat in Project area. May forage in or near the Project area.	Low	Low
Summer tanager (*Piranga rubra*)	CDFG: Species of Special Concern	Requires cottonwood-willow riparian forests for nesting and foraging. Summer resident on the Colorado River.	No suitable habitat present in the Project area.	None	None
Vermilion flycatcher (*Pyrocephalus rubinus*)	CDFG: Species of Special Concern NECO Plan	Open farmlands, shrubby grasslands, streamsides, and small wooded ponds in desert habitat. Found in diverse areas near open water.	Limited suitable habitat within the proposed alternatives.	Low	Low
Yuma clapper rail (*Rallus longirostris yumanensis*)	ESA: Endangered CESA: Threatened CDFG: Fully Protected	Nests in freshwater marshes surrounded by tules and cattails. Found along the Colorado River.	No suitable habitat within the Project area.	None	None
Crissal thrasher (*Toxostoma crissale*)	CDFG: Species of Special Concern NECO Plan	Occurs in dense riparian and mesquite scrub, microphyll woodland, and riparian washes with a dense understory of shrubs	Some habitat present that could support species foraging but not typical for nesting. Riparian wash present south of the southern alternative. An unidentified thrasher was heard calling during the survey on the northern alternative.	Moderate	Moderate
Le Conte's thrasher (*Toxostoma lecontei*)	CDFG: Species of Special Concern USFWS: Bird of Conservation Concern NECO Plan	Arid and open plains that are sparsely vegetated and dominated by saltbush and creosote bush	This species was previously detected in 2011 in an area between the northern and southern alternatives. Suitable habitat for this species is present mainly in the creosote bush areas of the Project. An unidentified thrasher was heard calling during the survey on the northern alternative.	High	High

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Mammals					
Pallid bat (*Antrozous pallidus*)	CDFG: Species of Special Concern BLM: Sensitive NECO Plan	This gregarious species usually roosts in small colonies in rock crevices and buildings, but may nest in caves, mines, rock piles, and tree cavities.	Roosting habitat for pallid bats is present in tree cavities in desert riparian woodland wash in the southeastern portion of the survey area. The closest documented occurrence in the CNDDB is from 1992, approximately 30 miles to the southwest of the airport near Corn Springs.	Low	Low
Pallid San Diego pocket mouse (*Chaetodipus fallax pallidus*)	CDFG: Species of Special Concern	Along desert borders in eastern San Diego County in desert washes, desert scrub, desert succulent scrub, and pinyon-juniper areas. Usually in rocky or gravelly areas.	Very little habitat observed within the Project area. Closest CNDDB occurrence is from 1957 approximately 11 miles southwest.	Low	Low
Townsend's big-eared bat (*Corynorhinus townsendii*)	CDFG: Species of Special Concern BLM: Sensitive NECO Plan	Occurs in a wide variety of habitats but most commonly in mesic areas. Roosts in open areas.	Suitable foraging habitat within the Project area but limited roosting habitat. The closest CNDDB record is from 1919 and is approximately seven miles southeast of the surveyed areas.	Low	Low
Western yellow bat (*Lasiurus xanthinus*)	CDFG: Species of Special Concern	Occurs in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats. Roosts in trees and forages over water and in trees.	Limited roosting habitat available in the Project area; no water observed during surveys. The only CNDDB record is from 1980 and is mapped in Blythe.	Low	Low
California leaf-nosed bat (*Macrotus californicus*)	CDFG: Species of Special Concern BLM: Sensitive NECO Plan	Lowland desert scrub, desert riparian and wash areas, alkali scrub, or palm oases. Requires rugged or rocky terrain with mines or caves for roosting.	Suitable foraging habitat is present throughout the Project area, although roosting habitat is limited in the immediate region. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low
Arizona myotis (*Myotis occultus*)	CDFG: Species of Special Concern	Lowlands of the Colorado River and adjacent desert mountain ranges. Roosts in tree hollows, rock crevices, and similar areas.	The closest documented occurrence in the CNDDB is from 1942, approximately five miles south of the Project.	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Cave myotis (*Myotis velifer*)	CDFG: Species of Special Concern BLM: Sensitive NECO Plan	Low elevation arid regions near the Colorado River and in adjacent mountains. Requires caves or mines for roosting.	Suitable foraging habitat is present throughout the Project area, although roosting habitat is limited in the immediate region. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low
Yuma myotis (*Myotis yumanensis*)	BLM: Sensitive	Prefers open forests and woodlands. Requires water for foraging. Roosts in mines, caves, buildings, and crevices.	No roosting or foraging habitat available within the Project area.	None	None
Colorado Valley woodrat (*Neotoma albigula venusta*)	NECO Plan	Low-lying deserts in southeastern California, particularly those with beavertail cactus (*Opuntia basilaris*) and mesquite (*Prosopis* sp.).	While there is ample foraging habitat for this species, there is very little rocky habitat for constructing middens into. There were no obvious signs of woodrat at the burrows that were observed.	Low	Low
Pocketed free-tailed bat (*Nyctinomops femorosaccus*)	CDFG: Species of Special Concern NECO Plan	Occurs in rocky areas with high cliffs in pine-juniper woodland, desert scrub, palm oasis, desert wash, and desert riparian habitat.	No suitable habitat in Project area.	None	None
Nelson's bighorn sheep (*Ovis canadensis nelson*)	BLM: Sensitive NECO Plan	Mountain slopes with sparse growth of trees above the desert floor in California.	Nelson's bighorn sheep is known within the region. While the species is generally associated with mountainous areas, desert floor areas are important for dispersal and seasonal movement.	Low	Low
Colorado River cotton rat (*Sigmodon arizonae plenus*)	CDFG: Species of Special Concern	Occurs in alluvial areas along the Colorado River in areas supporting marshy vegetation.	No suitable habitat in Project area.	None	None
American badger (*Taxidea taxus*)	CDFG: Species of Special Concern	Coastal sage scrub, mixed chaparral, grassland, oak woodland, chamise chaparral, mixed conifer, pinyon-juniper, desert scrub, desert wash, montane meadow, open areas, and sandy soils.	Suitable badger habitat occurs throughout the vicinity in undeveloped areas. Some large burrows were observed within the Project area but were likely kit fox and/or coyote.	High	High
Desert kit fox (*Vulpes macrotis arsipus*)	Calif. Code of Regulations: PFM	Suitable habitat for this fossorial mammal consists of arid open areas, shrub grassland, and desert ecosystems.	Suitable kit fox habitat occurs throughout the vicinity in undeveloped areas. A kit fox den was detected on the southern alternative.	High	Present

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Northern Transmission Line (BLM Jurisdiction)[2]	Potential for Occurrence within the Southern Transmission Line (BLM Jurisdiction)[2]
Fish					
Razorback sucker (*Xyrauchen texanus*)	ESA: Endangered CESA: Endangered CDFG: Fully Protected	Colorado River. Uses both quiet and swift waters and spawns in shallow water where there is abundant sand, gravel, and rocks.	There is no suitable habitat to support this species within the Project area.	None	None

[1]Sensitivity Status Key

Federal Endangered Species Act (ESA)
State California Department of Fish and Game (CDFG)
California Endangered Species Act (CESA)
BLM Sensitive
NECO Plan Northern and Eastern Colorado Desert Coordinated Management Plan special-status species

[2] Species Potential for Occurrence
Low – low potential to occur because suitable habitat is present, but is of marginal quality
Moderate – moderate potential to occur because suitable habitat is present, but the species was not found during surveys
High – high potential to occur because suitable habitat is present, and the species is known to occur within the vicinity, but it was not found during surveys
Present – Species detected during Project surveys on adjacent areas.

4.0 REFERENCES

AECOM. 2010. Blythe Solar Power Project Biological Resources Technical Report. Prepared for Palo Verde Solar I, LLC. June 2010.

Bureau of Land Management and California Department of Fish and Game (BLM and CDFG). 2002. Proposed Northern & Eastern Colorado Desert Coordinated Management Plan. An amendment to the California Desert Conservation Area Plan 1980 and Sikes Act Plan with the California Department of Fish and Game and Final Environmental Impact Statement. U.S. Department of Interior Bureau of Land Management California Desert District and California Department of Fish and Game Inland, Deserts, and Eastern Sierra Region.

Burt, W. and R. Grossenheider. 1980. *Peterson Field Guide: Mammals*. New York: Houghton Mifflin Co.

California Department of Fish and Game (CDFG). 2011. Special Animals List. Accessed online at http://www.dfg.ca.gov/biogeodata/cnddb/plants_and_animals.asp.

_____. 2012. California Natural Diversity Database, Rare Find3, commercial version 3.1.1.

California Native Plant Society (CNPS). 2011. Inventory of Rare and Endangered Plants (online edition, v7-11aug). California Native Plant Society. Sacramento, CA. http://www.cnps.org/inventory

CH2MHill. 2010. Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunication System Route Biological Review. Prepared for Southern California Edison. November 2010.

Elbroch, Mark. 2003. *Mammal Tracks and Sign: A Guide to North American Species*. Stackpole Books: Mechanicsburg, PA.

Hickman, J.C. (ed). 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley.

POWER Engineers, Inc. (POWER). 2011. Blythe Mesa Solar Project Biological Resource Technical Report. Prepared for Renewable Resources Group, Inc. September 2011.

Sawyer, J. O., and T. Keeler-Wolf. 1995. *A Manual of California Vegetation*. California Native Plant Society. Sacramento, California.

Sibley, D.A. 2000. National Audubon Society: *The Sibley Guide to Birds*. Alfred A. Knopf, Inc.; New York, NY.

Stebbins, R.C. 2003. *Western Reptiles and Amphibians.* Third Edition. Houghton Mifflin Co.: Boston, MA.

Stuart, J.D., and J.O. Sawyer. 2001. *Trees and Shrubs of California*. University of California Press, Berkeley, CA. 467 p.

United States Department of the Interior, Fish and Wildlife Service (USFWS). 2010. Mojave Population of the Desert Tortoise (*Gopherus agassizii*): 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Desert Tortoise Recovery Office, Reno, NV.

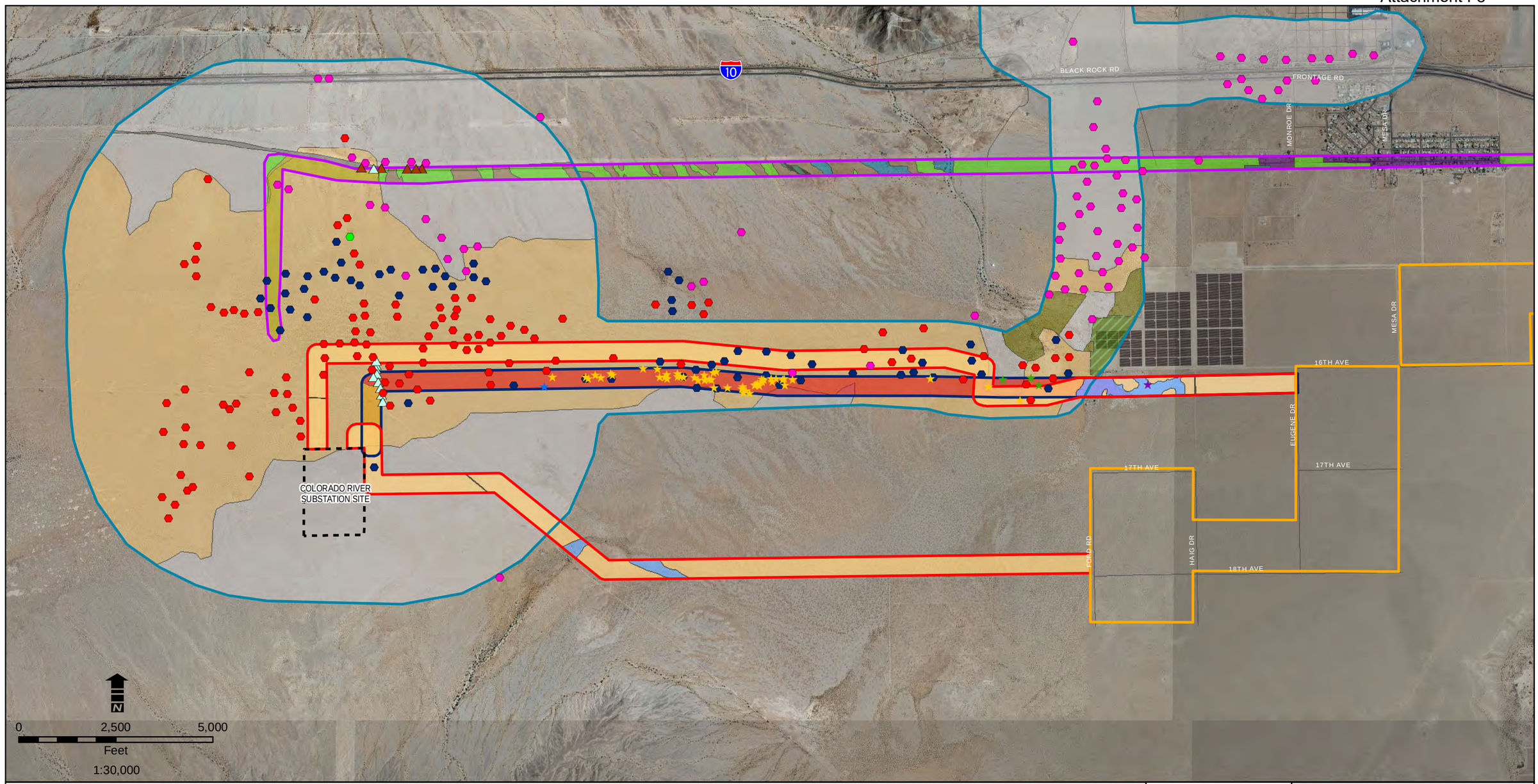
_____. 2011. Section 7 Biological and Conference Opinion on the Devers to Palo Verde No. 2 Transmission Line Project, Riverside County, CA. FWS-ERIV-07B0060-10F0884.

THIS PAGE INTENTIONALLY LEFT BLANK

AR061189

APPENDIX A: VEGETATION COMMUNITIES AND BOTANICAL SURVEY RESULTS

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Project
- Blythe Mesa I Site Boundary

Survey Corridor
- Power Engineers 2012
- Power Engineers 2011
- AECOM 2010
- CH2M Hill 2010

Blythe Mesa Solar Project 2012
- Mammalaria (sp.) cactus
- Desert Dry Wash Woodland
- Sonoran Creosote Bush Scrub
- Developed/Disturbed

Blythe Mesa Solar Project 2011
- Ribbed Cryptantha
- Harwood's Woolystar
- Desert Pavement
- Mammallaria (sp.) cactus
- Creosote Scrub
- Desert Riparian Woodland Wash
- Disturbed Creosote Scrub
- Dune, Blowsand Desert Pavement

Blythe Solar Power Project
- Winged Cryptantha
- Harwood's Milkvetch
- Ribbed Cryptantha
- Harwood's Woolystar
- Agriculture (Active and Fallow)
- Desert Dry Wash Woodland
- Disturbed
- Sonoran Creosote Bush Scrub
- Stabilized/Partially Stabilized Desert Dunes

Devers-Palo Verde No. 2 Transmission Line Project
- Harwood's Milkvetch
- Ribbed Cryptantha
- Agriculture
- Creosote Bush Scrub
- Creosote Bush Scrub - Big Galleta
- Developed
- Ironwood Woodland
- Open Pavement
- Partially Stabilized Desert Dune



VEGETATION COMMUNITIES AND BOTANICAL SURVEY RESULTS

BLYTHE MESA SOLAR PROJECT

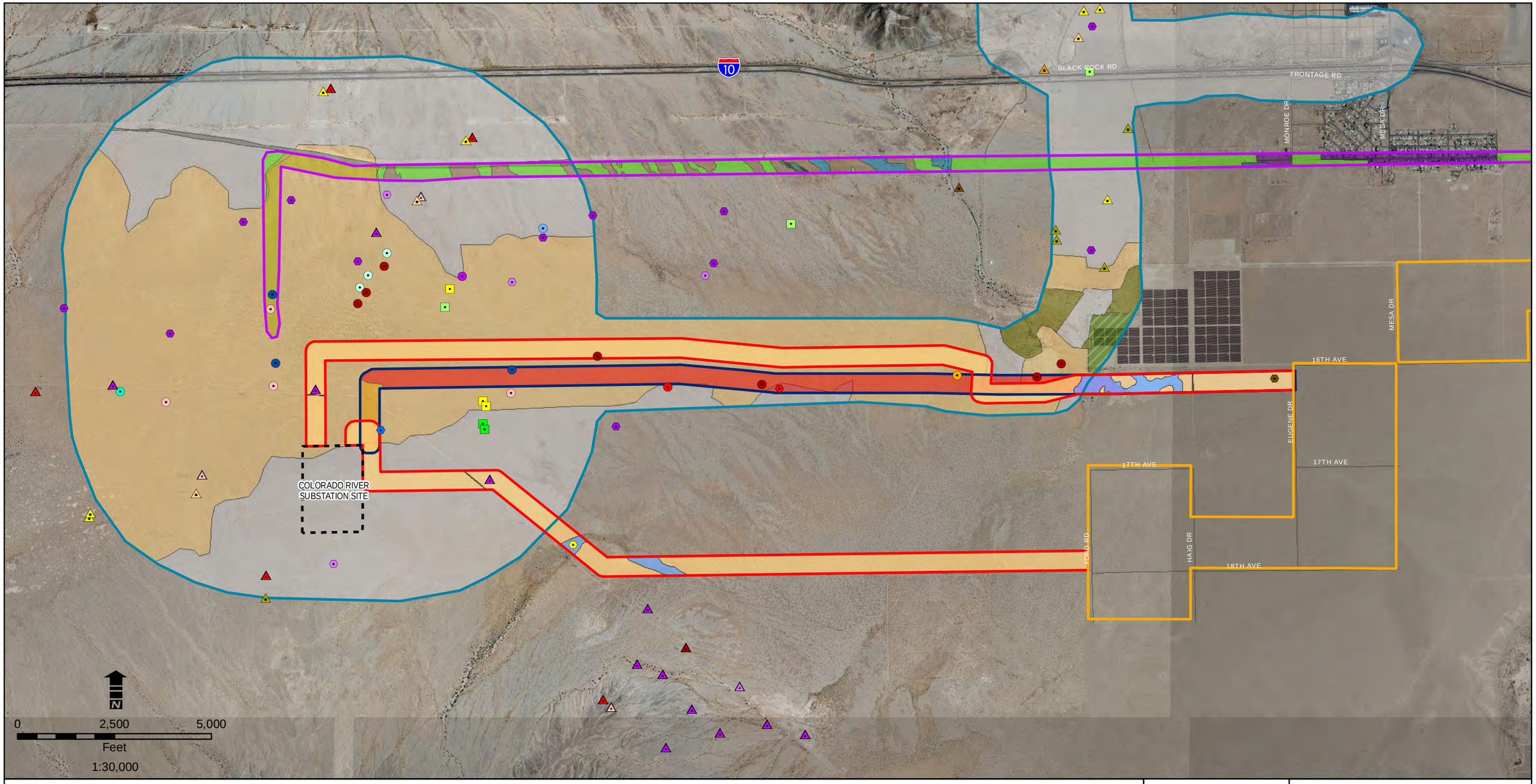
POWER ENGINEERS | RENEWABLERESOURCESGROUP

AR061192

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B: VEGETATION COMMUNITIES AND WILDLIFE SURVEY RESULTS

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Project
- Blythe Mesa I Site Boundary

Survey Corridor
- Power Engineers 2012
- Power Engineers 2011
- AECOM 2010
- CH2M Hill 2010

Blythe Mesa Solar Project 2012
- Kit Fox Burrow
- Potential Coyote or Kit Fox Den
- Desert Dry Wash Woodland
- Sonoran Creosote Bush Scrub
- Developed/Disturbed

Blythe Mesa Solar Project 2011
- Burrowing Owl Burrow
- Burrow
- Coyote Burrow
- Coyote/Badger Burrow
- Le Conte's Thrasher
- Creosote Scrub
- Desert Riparian Woodland Wash
- Disturbed Creosote Scrub
- Dune, Blowsand Desert Pavement

Blythe Solar Power Project
- Desert Tortoise Bone Fragment (Class 5) - Mineral*
- Desert Tortoise Bone Fragment (Class 5) - Non-min*
- Desert Tortoise Burrow (Class 3)
- Desert Tortoise Burrow (Class 4)
- Desert Tortoise Pallet (Class 5)
- Desert Tortoise Tracks
- Burrowing Owl Active Burrow
- Burrowing Owl Burrow with Sign
- Ferruginous Hawk
- Loggerhead Shrike
- Northern Harrier
- Swainson's Hawk
- Kit Fox Burrow
- Kit Fox Burrow Complex
- Agriculture (Active and Fallow)
- Desert Dry Wash Woodland
- Disturbed
- Sonoran Creosote Bush Scrub
- Stabilized/Partially Stabilized Desert Dunes

Devers-Palo Verde No. 2 Transmission Line Project
- Adult Desert Tortoise
- Desert Tortoise Bone Fragment
- Desert Tortoise Burrow
- Desert Tortoise Occupied Burrow
- Desert Tortoise Scat
- Burrowing Owl
- Loggerhead Shrike
- Northern Harrier
- Swainson's Hawk
- Unknown Raptor Nest
- Agriculture
- Creosote Bush Scrub
- Creosote Bush Scrub - Big Galleta
- Developed
- Ironwood Woodland
- Open Pavement
- Partially Stabilized Desert Dune



VEGETATION COMMUNITIES AND WILDLIFE SURVEY RESULTS

BLYTHE MESA SOLAR PROJECT

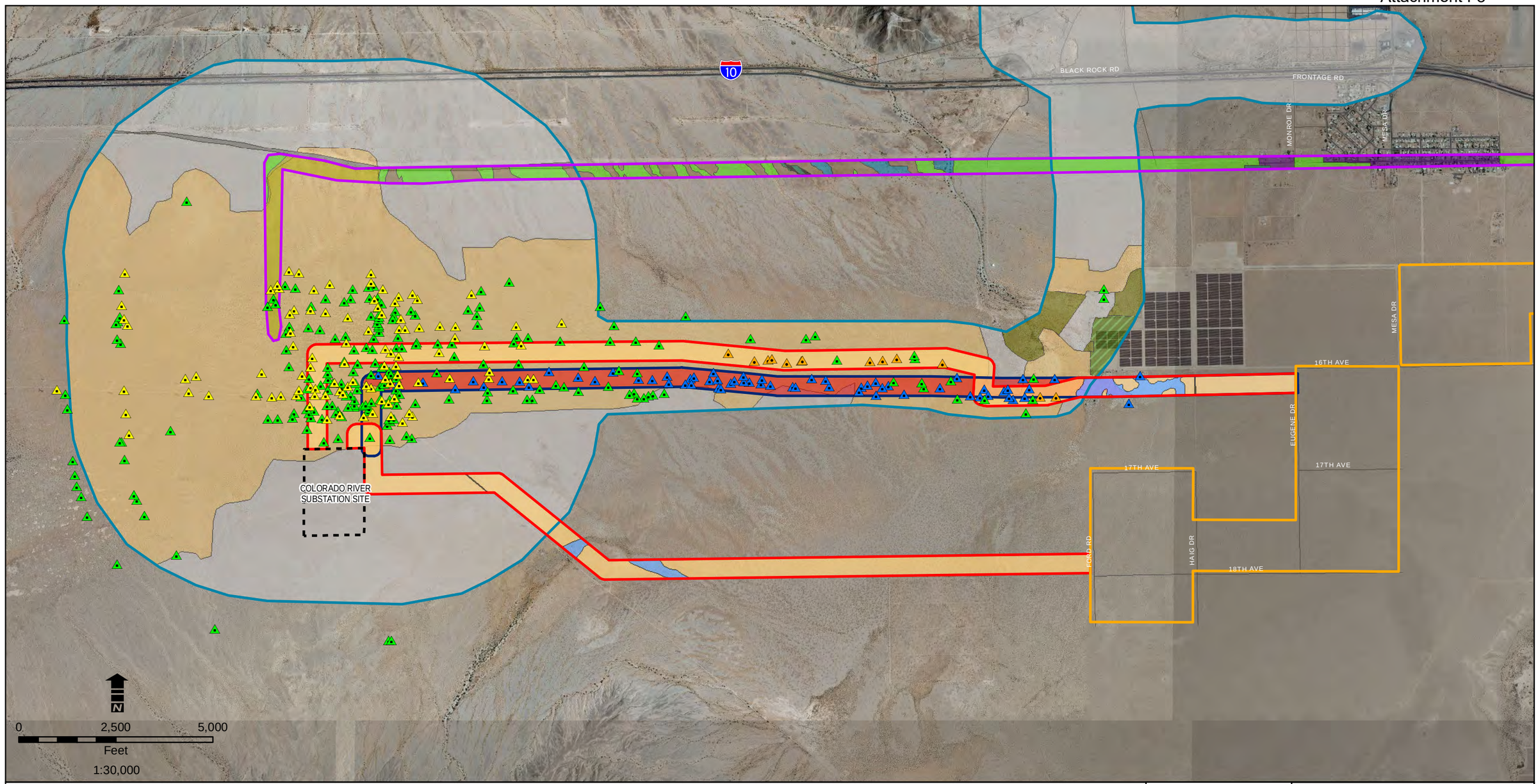
POWER ENGINEERS | RENEWABLERESOURCESGROUP

AR061196

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C: VEGETATION COMMUNITIES AND MOJAVE FRINGE-TOED LIZARD SURVEY RESULTS

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

Project
- Blythe Mesa I Site Boundary

Survey Corridor
- Power Engineers 2012
- Power Engineers 2011
- AECOM 2010
- CH2M Hill 2010

Blythe Mesa Solar Project 2012
- Mojave Fringe-toed Lizard
- Desert Dry Wash Woodland
- Sonoran Creosote Bush Scrub
- Developed/Disturbed

Blythe Mesa Solar Project 2011
- Mojave Fringe-toed Lizard
- Creosote Scrub
- Desert Riparian Woodland Wash
- Disturbed Creosote Scrub
- Dune, Blowsand Desert Pavement

Blythe Solar Power Project
- Mojave Fringe-toed Lizard
- Agriculture (Active and Fallow)
- Desert Dry Wash Woodland
- Disturbed
- Sonoran Creosote Bush Scrub
- Stabilized/Partially Stabilized Desert Dunes

Devers-Palo Verde No. 2 Transmission Line Project
- Mojave Fringe-toed Lizard
- Agriculture
- Creosote Bush Scrub
- Creosote Bush Scrub - Big Galleta
- Developed
- Ironwood Woodland
- Open Pavement
- Partially Stabilized Desert Dune



VEGETATION COMMUNITIES AND MOJAVE FRINGE-TOED LIZARD SURVEY RESULTS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

AR061200

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D: OBSERVED PLANTS

Scientific Name	Common Name	Northern Alternative	Southern Alternative
ANGIOSPERMS (DICOTYLEDONS)			
AMARANTHACEAE	AMARANTH FAMILY		
Tidestromia oblongifolia	honeysweet	X	
ASCLEPIADACEAE	MILKWEED FAMILY		
Asclepias sp.	milkweed	X	
ASTERACEAE	SUNFLOWER FAMILY		
Ambrosia dumosa	burro bush	X	X
Bebbia juncea	sweetbush	X	
Dicoria canescens	desert dicoria	X	
Encelia farinosa	brittlebush	X	
Hymenoclea salsola	cheesebush	X	
Palafoxia arida	Spanish needles	X	
Stephanomeria pauciflora	wire lettuce	X	X
BORAGINACEAE	BORAGE FAMILY		
Cryptantha circumscissa	cushion cryptantha	X	
Tiquilia plicata	plicate tiquilia	X	
BRASSICACEAE	MUSTARD FAMILY		
Brassica tournefortii	wild turnip	X	X
Lepidium sp.	peppergrass	X	X
CACTACEAE	CACTUS FAMILY		
Cylindropuntia echinocarpa	golden cholla	X	
Cylindropuntia sp.	cholla	X	
Mammillaria tetrancistra	fish hook cactus	X	
CHENOPODIACEAE	GOOSEFOOT FAMILY		
Atriplex polycarpa	allscale	X	
*Salsola tragus**	Russian thistle	X	
EUPHORBIACEAE	SPURGE FAMILY		
Stillingia spinulosa	Mohave stillingia	X	
FABACEAE	LEGUME FAMILY		
Cercidium floridum	palo verde	X	X
Olneya tesota	ironwood	X	X
Psorothamnus sp.	indigo bush	X	X
GERANIACEAE	GERANIUM FAMILY		
*Erodium cicutarium**	red-stemmed filaree	X	
MARTYNIACEAE	UNICORN-PLANT FAMILY		
Proboscidea althaeifolia	desert unicorn plant	X	
NYCTAGINACEAE	FOUR O'CLOCK FAMILY		
Abronia villosa	sand verbena	X	X
ONAGRACEAE	EVENING PRIMROSE FAMILY		
Camissonia bistorta	California sun cup		X
Camissonia boothii	bottlebrush primrose	X	
Camissonia sp.	camissonia	X	X
POLEMONIACEAE	PHLOX FAMILY		
Langloisia setosissima	langlosia	X	
POLYGONACEAE	BUCKWHEAT FAMILY		

Scientific Name	Common Name	Northern Alternative	Southern Alternative
Chorizanthe rigida	rigid spineflower		X
ZYGOPHYLLACEAE	CALTROP FAMILY		
Larrea tridentata	creosote bush	X	X
ANGIOSPERMS (MONOCOTYLEDONS)			
POACEAE	GRASS FAMILY		
Pleuraphis rigida	galleta grass	X	X
*Schismus barbatus**	Mediterranean schismus	X	X

* - non-native species

APPENDIX E: OBSERVED WILDLIFE

Scientific Name	Common Name	Northern Alternative	Southern Alternative
CLASS INSECTA	INSECTS		
TENEBRIONIDAE	DARKLING BEETLES		
Asbolus verrucosus	desert ironclad beetle	X	X
Eleodes sp.	stink beetle	X	X
MUTILLIDAE	VELVET ANTS		
Dasymutilla sp.	velvet ant	X	X
POMPILIDAE	SPIDER WASPS		
Pepsis formosa	tarantula hawk	X	X
THERAPHOSIDAE	TARANTULAS		
Aphonopelma sp.	tarantula		X (tracks)
CLASS REPTILIA	REPTILES		
IGUANIDAE	IGUANAS AND CHUCKWALLAS		
Dipsosaurus dorsalis	desert iguana	X	
PHRYNOSOMATIDAE	PHRYNOSOMATID LIZARDS		
Callisaurus draconoides	zebra-tailed lizard	X	
Phrynosoma platyrhinos	desert horned lizard	X (scat)	
Uma scoparia	Mojave fringe-toed lizard	X	
Uta stansburiana	side-blotched lizard	X	
TEEIDAE	WHIPTAILS, ALLIES		
Aspidoscelis tigris	western whiptail	X	X
VIPERIDAE	PIT VIPERS		
Crotalus cerastes	sidewinder		X (tracks)
CLASS AVES	BIRDS		
ODONTOPHORIDAE	NEW WORLD QUAIL		
Callipepla gambelii	Gambel's quail	X (call)	
CATHARTIDAE	NEW WORLD VULTURES		
Cathartes aura	turkey vulture	X	X
ACCIPITRIDAE	HAWKS, KITES, EAGLES		
Buteo jamaicensis	red-tailed hawk	X	X
FALCONIDAE	CARACARAS, FALCONS		
Falco sparverius	American kestrel		X
COLUMBIDAE	PIGEONS, DOVES		
Zenaida asiatica	white-winged dove	X	
Zenaida macroura	mourning dove	X	
TYRANNIDAE	TYRANT FLYCATCHERS		
Tyrannus verticalis	western kingbird	X	
LANIIDAE	SHRIKES		
Lanius ludovicianus	loggerhead shrike	X	
CORVIDAE	CROWS, JAYS		
Corvus corax	common raven	X	X
ALAUDIDAE	LARKS		
Eremophila alpestris	horned lark	X	X
HIRUNDINIDAE	SWALLOWS		
Hirundo rustica	barn swallow		X
TROGLODYTIDAE	WRENS		
Campylorhynchus brunneicapillus	cactus wren	X (song)	
SYLVIIDAE	OLD WORLD WARBLERS, GNATCATCHERS		
Polioptila melanura	black-tailed gnatcatcher	X	
MIMIDAE	MOCKINGBIRDS, THRASHERS		

Scientific Name	Common Name	Northern Alternative	Southern Alternative
Toxostoma sp.	thrasher	X (song)	
PARULIDAE	WOOD-WARBLERS		
Wilsonia pusilla	Wilson's warbler	X	
ICTERIDAE	BLACKBIRDS		
Icterus bullockii	Bullock's oriole	X	
FRINGILLIDAE	FRINGILLINE AND CARDUELINE FINCHES, ALLIES		
Carpodacus mexicanus	house finch	X (song)	
CLASS MAMMALIA	MAMMALS		
SCIURIDAE	SQUIRRELS AND ALLIES		
Ammospermophilus leucurus	white-tailed Antelope ground squirrel (probable call)	X (probable call)	
Spermophilus tereticaudus	round-tailed ground squirrel	X	X
HETEROMYIDAE	POCKET MICE AND KANGAROO RATS		
Dipodomys sp.	kangaroo rat	X (tracks and burrow)	
LEPORIDAE	RABBITS AND HARES		
Lepus californicus	black-tailed jackrabbit	X	
CANIDAE	WOLVES AND FOXES		
Canis latrans	coyote (potential den)	X (potential den)	
Vulpes macrotis arsipus	desert kit fox (tracks)	X (tracks and scat)	X (burrow, scat, and tracks)

APPENDIX C3
WESTERN BURROWING OWL SURVEY REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

January, 2012

BLYTHE MESA I SOLAR PROJECT

Western Burrowing Owl Survey Report

PROJECT NUMBER:
122512

PROJECT CONTACT:
Vanessa Santistevan
EMAIL:
vanessa.santistevan@powereng.com
PHONE:
(303) 716-8908

POWER ENGINEERS

AR061208

PREPARED FOR: RENEWABLE RESOURCES GROUP
LOS ANGELES, CALIFORNIA

PREPARED BY: *MELISSA LIPPINCOTT*
TOM HERZOG
VANESSA SANTISTEVAN

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 PROJECT OVERVIEW 1
1.2 REGIONAL SETTING 1
1.3 EXISTING CONDITIONS 5
2.0 SPECIES DESCRIPTION 5
3.0 SURVEY METHODOLOGY 6
4.0 SURVEY RESULTS 9
4.1 FIELD RESULTS 9
4.2 WILDLIFE AND PLANTS OBSERVED DURING BURROWING OWL SURVEY 11
5.0 CONCLUSION 11
6.0 LITERATURE CITED / REFERENCES 12

FIGURES

Figure 1 - Regional Area Project Location Map 3
Figure 2 – Focused Burrowing Owl Survey Area, Observed Owls, Burrows and Sign 7

TABLES

Table 1. Observed Habitat Acreage within the Study Area 5
Table 2. Adjacent Project Survey Information 9

APPENDICES

Appendix A – Observed Plant List
Appendix B – Observed Wildlife List

ACRONYMS AND ABBREVIATIONS

˚F	Fahrenheit
AMSL	above mean sea level
BLM	United States Department of the Interior, Bureau of Land Management
CBOC	California Burrowing Owl Consortium
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
CNWR	Cibola National Wildlife Refuge
GPS	Global Positioning System
km	kilometers
kV	kilovolt
MBTA	Migratory Bird Treaty Act
mph	miles per hour
MW	megawatt
POWER	POWER Engineers, Inc.
PV	photovoltaic
RRG	Renewable Resources Group, LLC
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

Power Engineers, Inc. (POWER) conducted a western burrowing owl (*Athene cunicularia hypugaea*) protocol-level survey for the Renewable Resources Group, LLC (RRG) as part of the proposed Blythe Mesa I Solar Project (BMSP, Project). The primary purpose of the surveys was to determine the presence or absence of burrowing owls within the defined study area. The study area is located within Riverside County, California near the community of Blythe; on approximately 3,679 acres in the Palo Verde Mesa (Figure 1). The study area for the purposes of this document is delineated on Figure 2 and includes a 125-foot proposed right-of-way along the transmission line.

1.1 PROJECT OVERVIEW

The proposed Project consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project footprint is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. POWER conducted the surveys within proposed Project transmission line footprint which included a 500 feet wide corridor centered on the 125-foot wide project right-of-way. The survey area of array parcels included a 500-foot (150-meter) wide buffer around the project limits. The proposed project would occupy a total of 3,660 acres and consist of the following components:

- Solar array field utilizing single axis solar PV trackers
- System of interior collection power lines located between inverters and substations
- Three on-site substations (approximately 300 feet long by 300 feet wide)
- Two operation and maintenance (O&M) buildings (approximately 3,500 square feet each)
- Two primary off-site access roads and several interior access roads
- 4.8 miles of 230 kV double-circuit transmission line between the solar field and Colorado River Substation

1.2 REGIONAL SETTING

The 3,660-acre site is five miles west of Blythe and consists mostly of agricultural land, including lemon orchards. The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles (see Figure 1). The Project is located on:

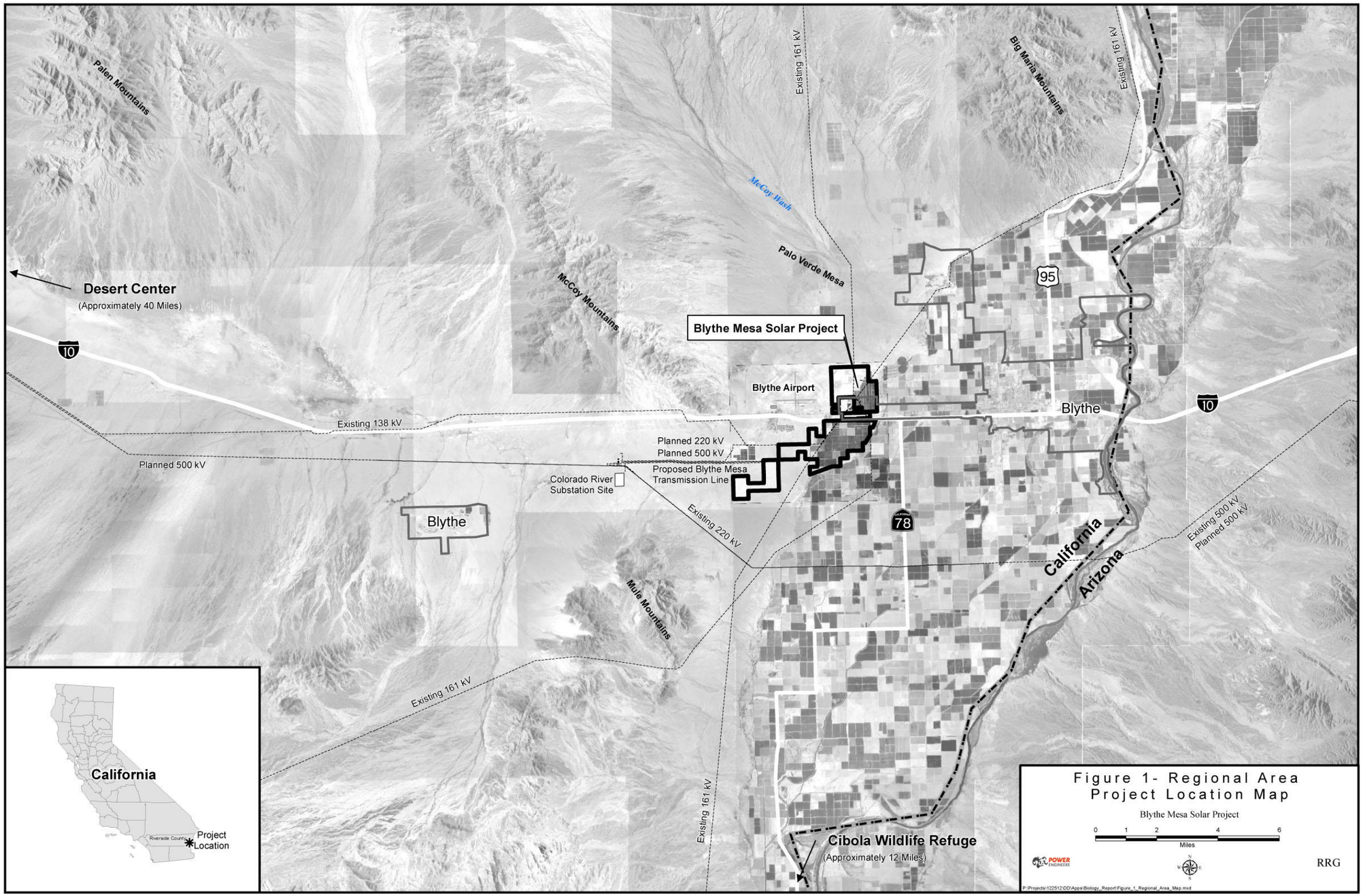
- Sections 11 and 12 of Township 7 South, Range 21East
- Sections 3, 4, 5, 6, 8, 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

State Highway 10 bisects the Project area, which is bounded on the north and south by undeveloped open desert, on the east by agricultural lands and on the west by the Blythe City Airport and open desert lands.

The Project area is located on the western mesa of the Palo Verde Valley. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The subtropical climate of the Colorado Desert is currently characterized by dry, mild winters averaging 45 degrees Fahrenheit (˚F) and dry, hot summers that average 104˚F. Summer highs are known to reach up to 120˚F. Precipitation ranges between two and ten inches per year, with most of the precipitation occurring between November and March. Although rainfall occurs primarily in the winter months, the region is periodically influenced by tropical weather conditions, including sudden monsoonal summer storms which typically occur from July to later September.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 1 - REGIONAL AREA PROJECT LOCATION MAP



THIS PAGE INTENTIONALLY LEFT BLANK

1.3 EXISTING CONDITIONS

The proposed project consists primarily of desert scrub and agricultural lands. Along the four mile transmission line route and eastern and southern ends of the project limits there are discrete areas of disturbed native creosote scrub and disturbed stabilized dune and blow sand habitats. Table 1 presents the estimated acreage observed for each habitat type within the study area. This data does not represent the actual proposed project disturbance footprint for the solar areas, transmission lines, substations, and facility buildings and roads.

TABLE 1. OBSERVED HABITAT ACREAGE WITHIN THE STUDY AREA

Habitat	Acres	Percentage Within the Project Site
Bajada	18.07	0.5%
Creosote Scrub	46.74	1.3%
Desert Riparian Woodland Wash	2.83	0.1%
Disturbed	31.15	0.8%
Disturbed Creosote Scrub	233.44	6.3%
Disturbed Creosote Scrub and Fallow Agricultural	271.10	7.4%
Dune, Blowsand Desert Pavement	52.52	1.4%
Fallow	249.72	6.8%
Irrigated Cropland	404.02	11.0%
Irrigation Pond	17.21	0.5%
Mixed	75.92	2.1%
Non-Irrigated Cropland	1088.15	29.6%
Orchard	1188.36	32.3%
Total Project Area Acreage (Includes 125 ft right-of-way)	**3679.24**	**100.0%**

As listed above, the Project area comprises mainly agricultural land and desert scrub. Existing land consists of farmland, fallow farmland, creosote bush scrub, or stabilized desert dune and blowsand habitat. Active agricultural uses include citrus orchard and ornamental date palms, and wheat and alfalfa fields. Jojoba was previously grown for commercial purposes in some portions of the project area. The jojoba fields have been abandoned at some point in the recent past and are currently a mix of jojoba and reestablishing creosote bush scrub.

The study area is also situated among energy generating facilities (i.e., solar and natural gas-fired), active transmission lines, and electrical substations. Given the extent of the existing human-influenced environment (e.g., active agricultural operations [harvesting, discing, and planting]; high levels of automobile traffic [Interstate 10 bisects the Project]; energy generation, distribution and maintenance facilities; and ongoing aviation related activities) within the study area, any animals currently using these lands are assumed to be acclimated to the disturbance regime present.

2.0 SPECIES DESCRIPTION

Western burrowing owl is designated as a Priority 2 Bird Species of Special Concern by the California Department of Fish and Game (CDFG) due to rapid habitat loss and degradation from urbanization. It is also designated as a U.S. Department of the Interior, Bureau of Land Management (BLM) Sensitive species and a U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern. Its range extends through all states west of the Mississippi Valley and into Mexico, Central America, and South America.

In California, it typically inhabits lowlands, including those in the Central Valley, northeastern plateau, southeastern deserts, and coastal areas. For shelters, the burrowing owl uses rodent burrows in sparse grassland, desert, and agricultural habitats, as well as open areas of pinyon-juniper or ponderosa pine habitats (CDFG 2008). Breeding populations generally display greater site fidelity than winter populations, which tend to move about more, even taking refuge into vegetation instead of nearby burrows (Poulin et al. 2011). Individuals in California, particularly Southern California, are mostly residents (CDFG 2008). Nesting begins from late March to August, peaking in April and May (CDFG 2008). While some pairs have been observed to have double broods within a single breeding season, it is considered to be uncommon and is not always successful (Poulin et al. 2011). Burrowing owls are typically active at dusk and dawn, but can sometimes be active at night, as well.

3.0 SURVEY METHODOLOGY

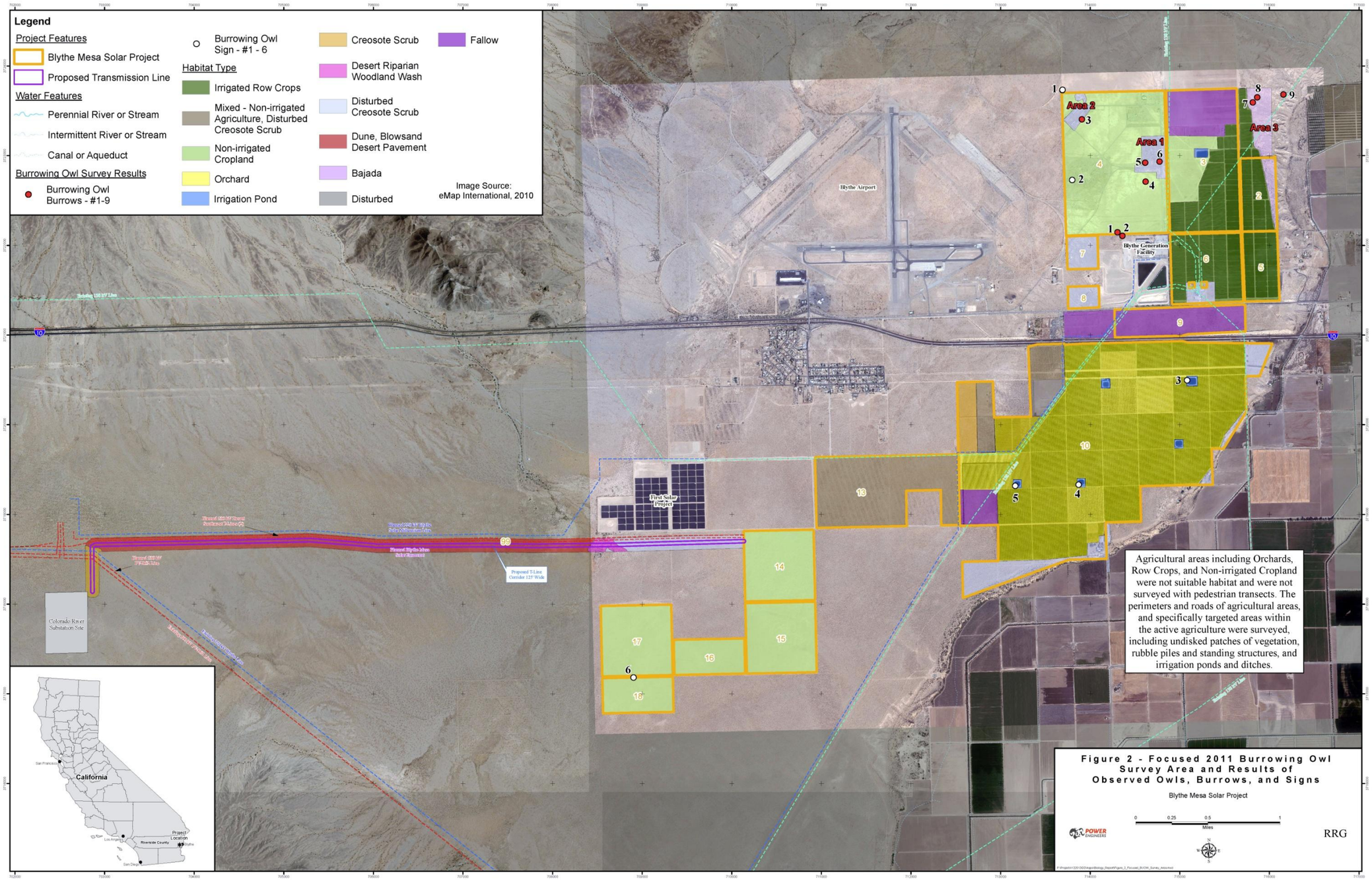
Collection of burrowing owl baseline data in the Project area included a review of the California Natural Diversity Database (CNDDB) records and of applicable biological documents, including several solar projects that have completed burrowing owl surveys. Additionally, a systematic pedestrian assessment of the study area to determine the habitat suitability for burrowing owls was conducted on the 5th and 6th of May 2011.

Protocol surveys were started on May 6 and extended through July 23, 2011. Survey methods were derived from generally accepted professional standards, the 1993 California Burrowing Owl Consortium (CBOC) Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993), and the 1995 CDFG Staff Report on Burrowing Owl Mitigation (CDFG 1995). In summary, a methodical pedestrian survey for owl burrows was conducted by walking through areas of suitable habitat within the study area, including man-made structures. In addition, biologists visited the Cibola National Wildlife Refuge (CNWR) 12 miles to the south of the Project limits to view the known burrowing owls there as a reference population; biologists saw six burrowing owls foraging near an agricultural field at the CNWR, which confirmed activity in middle to late July in this region of the owls' range.

POWER biologists Tom Herzog, Steve Hicks, Ken McDonald, and Melissa Lippincott, and Garcia and Associates, Inc. biologists Andrew McCadden, Angelique Herman, and Laura Megill conducted pedestrian survey transects, spaced at approximately 100 feet to allow for 100% visual coverage of the study area. Where necessary, transect spacing was reduced or expanded to account for differences in terrain, vegetation density, and visibility. The locations of all potential owl burrows and sign were recorded and mapped using handheld global positioning devices and aerial imagery. Figure 2 presents the protocol burrowing owl survey areas for the Project area.. Incidental observations of other avian species, plants and other wildlife were also noted. The presence of each observed wildlife species was based on direct observation of individual(s), sign, and/or vocalization.

Field surveys were conducted when weather conditions were conducive to observing owls and other avian species. The surveys were not performed during rain, high winds (greater than 20 mph), dense fog, or temperatures over 90 ºF. Observations were made from the nearest appropriate vantage points with the use of binoculars when access to discrete portions of the study area were not possible due to private property, topographic relief, physical barriers, health and safety considerations, etc.

FIGURE 2 – FOCUSED BURROWING OWL SURVEY AREA, OBSERVED OWLS, BURROWS AND SIGN



THIS PAGE INTENTIONALLY LEFT BLANK

4.0 SURVEY RESULTS

A nine-quad search of the CNDDB (CNDDB, 2011a) including USGS quadrangles McCoy Peak, McCoy Wash, Blythe NE, Roosevelt Mine, Ripley, Blythe, Thumb Peak, Palo Verde, and Mule Wash identified 46 occurrences of burrowing owls in the Blythe area, with two occurrences on the Project site. In addition to the CNDDB records search, recent surveys and reports for similar projects near the Project area were also reviewed (Table 2).

TABLE 2. ADJACENT PROJECT SURVEY INFORMATION

Species	Project	Species Detected	BMSP Survey Area Overlap
Burrowing Owl	Blythe Solar Power Project	Yes, two within solar site, four in transmission line and multiple sign. Not determined how sign was confirmed.	Overlaps with BMSP transmission line and Colorado River Substation (CRS) survey areas.
	Genesis Solar Energy Project	Yes, three individuals detected around the generation tie line and one burrow around the main site.	No overlap
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Burrow sites detected along project segment that encompasses Colorado River Substation, but specific locations not mapped.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, burrowing owls detected along southern telecom route. Three owls detected just east of Colorado River Substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.

4.1 FIELD RESULTS

During the habitat assessment survey, biologists determined that the Project area contained suitable habitat conditions to support burrowing owls. Of the 3,679 acres in the study area, approximately 1,970 acres (54%) of suitable burrowing owl habitat were identified (Figure 2). Suitable habitat consisted of both fallow and active agricultural fields, irrigation ponds and canals, and creosote bush scrub. Suitable habitat also occurred along the edges of orchards. The remaining 1,703 acres consisted of orchards and alfalfa fields. Orchards within the project area did not contain suitable habitat; burrowing owls prefer open areas and do not inhabit areas with dense vegetation (U.S. Fish and Wildlife Service, 2003). Alfalfa fields provide suitable forage areas for burrowing owls, but heavy and frequent disturbance of the fields by disking and harvesting decreases burrow availability. Burrows can occur along the edges of agricultural fields, orchards and road banks; all road banks, field edges and irrigation ditches along the agricultural areas throughout the Project site were surveyed. Six irrigation ponds located in the orchard area and irrigation channels throughout the agricultural area and to the east of the project limits provide accessible fresh water for wildlife.

The field data from the protocol surveys identified the presence of six burrowing owls during the May survey and eight owls during the July surveys, and an additional two owls were observed outside the project site but within the survey buffer. Nine suitable burrows or burrow complexes were observed in the northern portion of the site (Figure 2). No suitable burrows were observed in the southern portion of the site. Soil conditions in the southern half of the site within Project Parcels 4, 13-18 and the transmission corridor were very sandy and unstable. However, burrowing owl sign (white wash, pellets, feathers) was observed in five locations in the southern region of the Project area. Burrows observed in the southern half of the site belonged to either kit fox (*Vulpes macrotis*) or kangaroo rat (*Dipodomys* sp.). No burrowing owl sign was observed near the kit fox burrows. Several of the kit fox burrows were recent and active kit fox sign was documented; however, most of the burrows were old and collapsed and would not support burrowing owl because the instability of the soil.

During the July surveys (14-19 and 21-23) burrowing owl activity and use was determined to the extent possible. Burrows were monitored at sunrise or sunset on different days to ensure a complete activity period was evaluated for each observed bird. The northern end of the Project site was divided into three burrowing owl monitoring sites. Please refer to Figure 2 for the location of Areas 1, 2, and 3.

Area 1 supported four burrowing owls. The four burrowing owls were observed flying in and out of three separate concrete / brick lined cylindrical, man-made structures, which have concrete collars above ground level and are open to below ground level to a depth of approximately four feet. Appendix C includes site photographs and images of the well location burrows and these described elements. In Area 1, Burrow #4 contained the greatest number of observed sign, including pellets, prey detritus, feathers, and white wash. Burrows # 5 and 6 also featured significant amounts of pellets, detritus, white wash, and feathers. Biologists were unable to determine if the owls were two separate pairs or one pair with two juveniles. Burrowing owls at Area 1 consistently exhibited social and foraging behavior. Several perch sites were favored in this area, including a metal rod with a rounded top, a fence post, a large pile of cleared vegetation and, most frequently, the edges of the concrete wells. Area 1 consisted of approximately five acres of disturbed creosote bush scrub dominated by creosote bush and bur sage; concrete rubble piles from old demolished barracks were scattered throughout the creosote bush scrub. Area 1 was bound on the south, west and north by recently tilled, non-irrigated wheat fields that have been farmed for approximately one year. This field is bound to the north by open space comprising creosote scrub habitat, and to the west by disturbed creosote scrub habitat within the area of the former military base and current Blythe Airport.

In Area 2, two burrowing owls occupied a single burrow located in a concrete rubble pile. The two owls were observed consistently during morning and evening hours perched on top of the rubble pile. Burrowing owl tracks were identified around and into the rubble pile, with feathers and pellets near a small burrow entrance beneath the rubble. Sex and age of the two burrowing owls observed during the surveys was not established. The burrowing owls occupying Area 2 were easily distressed and would flush and call to one another whenever biologists entered the vicinity. Area 2 consisted of approximately two acres of disturbed creosote bush scrub dominated by creosote bush and bur sage. Concrete rubble piles and two concrete foundations were scattered throughout the creosote bush scrub. Area 2 was surrounded to the south, east and north by recently tilled, non-irrigated wheat fields and disturbed creosote bush scrub to the west.

In Area 3, two burrowing owls occupied a burrow complex within a native Bajada area in the buffer study area. One burrow appeared to be a former canid burrow due to its size, shape, and location in an area of naturally formed earth mounds. Biologists identified three separate burrowing complexes on the earth mounds within an approximately ten-acre zone. Each burrow complex contained several burrows with recent sign, including white wash, feathers, tracks, and pellets. The two burrowing owls were typically

perched on top of earthen mounds when the biologists accessed the area. Biologists could not determine if the pair was nesting without additional harassment.

4.2 WILDLIFE AND PLANTS OBSERVED DURING BURROWING OWL SURVEY

Round-tailed ground squirrel (*Spermophilus tereticaudus*) and white-tailed antelope squirrel (*Ammospermophilus leucurus*) burrows where observed throughout the northern and eastern portions of the site along road sides, agricultural fields and disturbed areas with mounded soils or dump sites. Creosote bush (*Larrea tridentata*) was the dominant species in undisturbed portions of the site. Additional plants and wildlife species frequently observed within suitable habitat included bur sage (*Ambrosia dumosa*), wheat (*Triticum* sp.), mourning dove (*Zenaida macroura*), white-wing dove (*Zenaida asiatica*), horned lark (*Eremophila alpestris*), greater roadrunner (*Geococcyx californianus*), black-tailed jackrabbit (*Lepus californicus*), desert iguana (*Dipsosaurus dorsalis*), and western whiptail (*Cnemidophorus tigris*). Three CDFG Species of Special Concern, Le Conte's thrasher (*Toxostoma lecontei*), loggerhead shrike (*Lanius ludovicianus*) and Mohave fringe-toed lizard (*Uma scoparia*) were observed in multiple locations on both the northern and southern portions of the Project area. Complete plant and wildlife species observed are included in Appendices A and B.

5.0 CONCLUSION

The study area supports a relatively small population of burrowing owl, and based on the burrowing owl survey results from surrounding solar projects burrowing owl may occupy habitat outside of the study area limits (AECOM 2010, Aspen 2011). It was not determined if this population is increasing or decreasing in size or the length of occupancy. The surveys determined that in July 2011, eight individual burrowing owls were present within the study area and may be directly or indirectly affected by the Project. This determination is valid for 12 months from the completion of this report (October 2011 through October 2012). The number of owls or burrows affected at the time of ground disturbance may be greater than or less than this number because of the natural variation in the owl population in this region, and natural and man-made conditions that may occur prior to construction.

6.0 LITERATURE CITED / REFERENCES

AECOM. 2010. Blythe Solar Power Project Biological Resources Technical Report. Prepared for Palo Verde Solar I, LLC. June 2010.

Aspen Environmental Group (Aspen). 2006. Devers-Palo Verde No. 2 500 kV Transmission Line Project Final Environmental Impact Report/Environmental Impact Statement. Prepared for California Public Utilities Commission. October 2006.

_____. 2011. Draft Supplemental Environmental Impact Report, Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion. Prepared for Southern California Edison. February 2011.

Bloom, Pete. 2003. Letter to California Department of Fish and Game, December 2003. Personal letter from Mr. Pete Bloom.

California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. Tech. Rep. Burrowing Owl Consortium, Alviso, California. http://www.dfg.ca.gov/wildlife/nongame/docs/boconsortium.pdf

California Department of Fish and Game (CDFG). 1995. Staff Reporting on Burrowing Owl. October 17, 1995. California Department of Fish and Game. Memorandum from Mr. Ron Rempel.

_____. 2008. California Interagency Wildlife Task Group. CWHR version 8.2 personal computing program. Sacramento, CA.

California Natural Diversity Data Base (CNDDB). 2011a. California Natural Diversity Data Base. Element occurrence search for Project area quadrangles.

_____. 2011b. Special Animals List. Biogeographic Data Branch, CNDDB.

Cibola National Wildlife Refuge. 2011. Wild At Heart Owl Relocation to Cibola NWR. http://www.mirror-pole.com/wild_at_heart/bur_owl/rel_sites/cibola/cibola_release_site.html

Haug, E. A., B. A. Millsap and M. S. Martell. 1993. Burrowing Owl (Athene cunicularia), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/061.

Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. Vegetation Ecologist Nongame-Heritage Program. Sacramento, CA.

Klute, David S., Ayers, Loren W., Green, Michael T., Howe, William H., Jones, Stephanie L., Shaffer, Jill A., Sheffield, Steven R., and Zimmerman, Tara S. 2003. Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States Biological Technical Publication BTP-R6001-2003. U.S. Fish and Wildlife Service.

Sawyer, Keeler-Wolf, Evens. 2009. A manual of California Vegetation, Second Edition, California Native Plant Society Press. Sacramento, CA.

Representative Relevant Planned Projects in vicinity of Blythe, California

AECOM. 2009. Blythe Solar Power Project Application for Certification. Submitted by Solar Millennium, LLC to the California Energy Commission.

California Energy Commission. 2010. Genesis Solar Energy Project Application for Certification Supplemental Information. March 2010. California Energy Commission Docket Number 09-AFC-8.

Devers–Palo Verde No. 2 Transmission Line Project Colorado River Substation Expansion Final Supplemental Environmental Impact Report. April 2010.

Southern California Edison. 2009. First Solar Electric, Blythe, California Environmental Assessment Initial Study. February, 2009. County of Riverside EA40219.

TetraTech Environmental, Inc. 2010. Genesis Solar Energy Project Supplemental Information. June 2010. California Energy Commission Docket Number 09-AFC-8. TetraTech Environmental, Inc.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A – OBSERVED PLANT LIST

Plant Species Observed During Surveys

Scientific Name	Common Name
ANGIOSPERMS (DICOTYLEDONS)	
AMARANTHACEAE	**AMARANTH FAMILY**
Tidestromia oblongifolia	honeysweet
APIACEAE	**CARROT FAMILY**
Lomatium sp.	lomatium
ASCLEPIADACEAE	**MILKWEED FAMILY**
Asclepias sp.	milkweed
Asclepias subulata	rush milkweed
Sarcostemma cynanchoides ssp. hartwegii	climbing milkweed
ASTERACEAE	**SUNFLOWER FAMILY**
Ambrosia dumosa	burro bush
Baileya pauciradiata	Colorado Desert marigold
Bebbia juncea	sweetbush
Chaenactis sp.	pincushion
Chaenactis stevioides	desert pinchushion
Dicoria canescens	bugseed
Geraea canescens	desert sunflower
Hymenoclea salsola	cheesebush
Palafoxia arida	Spanish needles
Pluchea sericea	arrow weed
Stephanomeria pauciflora	wire lettuce
BORAGINACEAE	**BORAGE FAMILY**
Cryptantha sp.	cryptantha
Cryptantha angustifolium	narrowleaf cryptantha
Cryptantha costata	ribbed cryptantha
Cryptantha maritime	Guadalupe cryptantha
Cryptantha nevadensis	cryptantha
Cryptantha pterocarya	wing nut cryptantha
Nama demissum	purple desert mat
Pectocarya sp.	pectocarya
Tiquilia palmeri	Palmer's tiquilia
Tiquilia plicata	plicate tiquilia
BRASSICACEAE	**MUSTARD FAMILY**
*Brassica tournefortii**	Sahara mustard
*Buxus microphylla**	Japanese box
Lepidium sp.	peppergrass
Lepidium lasiocarpum	peppergrass
Simmondsia chinensis	jojoba
CASUARINACEAE	**SHE OAK FAMILY**
Casuarina sp.*	she oak
CACTACEAE	**CACTUS FAMILY**
Cylindropuntia echinocarpa	golden cholla
Mammillaria sp.	fish-hook cactus
CHENOPODIACEAE	**GOOSEFOOT FAMILY**
Atriplex canescens	four-wing saltbush
Atriplex lentiformis	quail brush

Scientific Name	Common Name
*Bassia hyssopifolia**	five-hooked bassia
Salsola tragus	Russian thistle
CUCURBITACEAE	**GOURD FAMILY**
Cucurbita sp.*	squash
EUPHORBIACEAE	**SPURGE FAMILY**
Stillingia spinulosa	annual stillingia
FABACEAE	**LEGUME FAMILY**
Acacia greggii	cat claw acacia
Astragalus sp.	astragalus
Cercidium floridum	palo verde
Dallea mollissima	downy dalea
*Medicago sativa**	alfalfa
Olneya tesota	desert ironwood
Prosopis sp.	mesquite
Prosopis glandulosa	Honey mesquite
Psorothamnus emoryi	indigobush
Psorothamnus schottii	indigobush
GERANIACEAE	**GERANIUM FAMILY**
*Erodium cicutarium**	red-stemmed filaree
LOASACEAE	**LOASA FAMILY**
Eucnide urens	rock nettle
Mentzelia sp.	blazing star
Mentzelia multiflora	blazing star
Petalonyx thurberi ssp. thurberi	sandpaper plant
MARTYNIACEAE	**UNICORN PLANT FAMILY**
Proboscidea althaeifolia	desert unicorn plant
MYRTACEAE	**MYRTLE FAMILY**
Eucalyptus sp.*	gum tree
NYCTAGINACEAE	**FOUR O'CLOCK FAMILY**
Abronia villosa	sand verbena
ONAGRACEAE	**EVENING PRIMROSE FAMILY**
Camissonia boothii	bottlebrush primrose
Oenothera deltoids ssp. deltoides	bird-cage primrose
PLANTAGINACEAE	**PLANTAIN FAMILY**
Plantago erecta	western plantain
Plantago ovata	wooly plantain
POLEMONIACEAE	**PHLOX FAMILY**
Eriastrum harwoodii	Harwood's eriastrum
Gilia sp.	
Langloisia setosissima	lilac sunbonnet
POLYGONACEAE	**BUCKWHEAT FAMILY**
Chorizanthe brevicornu	brittle spineflower
Chorizanthe rigida	rigid spineflower
Eriogonum sp.	
RESDACEAE	**MIGNONETTE FAMILY**
Oligomeris linifolia	Narrow-leaf oligomeris
ROSACEAE	**ROSE FAMILY**

Scientific Name	Common Name
*Prunus persica**	peach
RUTACEAE	**RUE FAMILY**
*Citrus limon**	lemon
*Citrus sinensis**	orange
TAMARICACEAE	**TAMARISK FAMILY**
*Tamarix ramosissima**	Mediterranean tamarisk
VISCACEAE	**MISTLETOE FAMILY**
Phoradendron californicum	desert mistletoe
ZYGOPHYLLACEAE	**CALTROP FAMILY**
Larrea tridentata	creosote bush
ANGIOSPERMS (MONOCOTYLEDONS)	
ARECACEAE	**PALM FAMILY**
Phoenix sp.*	date palm
LILIACEAE	**LILY FAMILY**
Hesperocaulis undulata	desert lily
POACEAE	**GRASS FAMILY**
Pleuraphis rigida	galleta grass
*Schismus barbatus**	Mediterranean schismus
*Triticum aestivum**	wheat

* = non-native species

APPENDIX B – OBSERVED WILDLIFE LIST

Scientific Name	Common Name
CLASS INSECTA	**INSECTS**
MELOIDAE	**BLISTER BEETLES**
Lytta auriculata	red-eared blister beetle
TENEBRIONIDAE	**DARKLING BEETLES**
Asbolus verrucosus	desert ironclad beetle
Eleodes spinipes	darkling beetle
MANTIDAE	**MANTIDS**
Litaneutria minor	ground mantis
PIERIDAE	**WHITE & SULPHUR BUTTERFLIES**
Pieris rapae	cabbage white
Pontia protodice	checker-white
NYMPHALIDAE	**BRUSH-FOOTED BUTTERFLIES**
Vanessa virginiensis	Virginia lady
LYCAENIDAE	**GOSSAMER WING BUTTERFLIES**
Brephidium exilis	pygmy blue
FORMICIDAE	**ANTS**
Messor pergandei	desert harvester ant
MUTILLIDAE	**VELVET ANTS**
Dasymutilla sp.	velvet ant
POMPILIDAE	**SPIDER WASPS**
Pepsis formosa	tarantula wasp
CLASS AMPHIBIA	**AMPHIBIANS**
Bufo woodhousii	Woodhouse's toad
CLASS REPTILIA	**REPTILES**
TRIONYCHIDAE	**SOFTSHELL TURTLES**
Apalone spinifera	spiny softshell turtle
IGUANIDAE	**IGUANID LIZARDS**
Callisaurus draconoides draconoides	common zebra-tailed lizard
Dipsosaurus dorsalis	desert iguana
Phrynosoma sp.	horned lizard
Uma scoparia	Mojave fringe-toed lizard
Uta stansburiana	common side-blotched lizard
TEIIDAE	**WHIPTAIL LIZARDS**
Cnemidophorus sp.	whiptail
COLUBRIDAE	**COLUBRID SNAKES**
Arizona elegans occidentalis	Glossy snake
Chinoactis occipitalis	shovel-nosed snake
VIPERIDAE	**VIPERS**
Crotalus cerastes	sidewinder

Scientific Name	Common Name
CLASS AVES	**BIRDS**
CATHARTIDAE	**NEW WORLD VULTURES**
Cathartes aura	turkey vulture
ACCIPITRIDAE	**HAWKS, KITES, EAGLES**
Buteo jamaicensis	red-tailed hawk
FALCONIDAE	**FALCONS**
Falco sparverius	American kestrel
ODONTOPHORIDAE	**NEW WORLD QUAIL**
Callipepla gambelii	Gambel's quail
CHARADRIIDAE	**PLOVERS**
Charadrius vociferus	killdeer
COLUMBIDAE	**PIGEONS & DOVES**
Columba livia	rock pigeon
Streptopelia risoria	ringed turtle-dove
Zenaida aurita	white-winged dove
Zenaida macroura	mourning dove
CUCULIDAE	**CUCKOOS & ROADRUNNERS**
Geococcyx californianus	greater roadrunner
STRIGIDAE	**TRUE OWLS**
Athene cunicularia	burrowing owl
APODIDAE	**SWIFTS**
Aeronautes saxatalis	white-throated swift
TYRANNIDAE	**TYRANT FLYCATCHERS**
Tyrannus verticalis	western kingbird
ALAUDIDAE	**LARKS**
Eremophila alpestris	horned lark
HIRUNDINIDAE	**SWALLOWS**
Petrochelidon pyrrhonota	cliff swallow
CORVIDAE	**JAYS & CROWS**
Corvus corax	common raven
LANIIDAE	**SHRIKES**
Lanius ludovicianus	loggerhead shrike
STURNIDAE	**STARLINGS**
Sturnus vulgaris	European starling
ICTERIDAE	**BLACKBIRDS**
Agelaius phoeniceus	red-winged blackbird
Euphagus cyanocephalus	Brewer's blackbird
Icterus cucullatus	hooded oriole
Xanthocephalus xanthocephalus	yellow-headed blackbird
Quiscalus mexicanus	great-tailed grackle

Scientific Name	Common Name
MIMIDAE	**MOCKINGBIRDS & THRASHERS**
Toxostoma lecontei	Le Conte's thrasher
THRAUPIDAE	**TANAGERS**
Piranga ludoviciana	Western tanager
SYLVIIDAE	**GNATCATHERS**
Polioptila caerulea	black-tailed gnatcatcher
EMBERIZIDAE	**EMBERIZIDS**
Zonotrichia leucophrys	white-crowned sparrow
FRINGILLIDAE	**FINCHES**
Carduelis tristis	American goldfinch
CLASS MAMMALIA	**MAMMALS**
LEPORIDAE	**HARES & RABBITS**
Lepus californicus	black-tailed jackrabbit
Sylvilagus audubonii	desert cottontail
SCIURIDAE	**SQUIRRELS**
Ammospermophilus leucurus	white-tailed antelope squirrel
Spermophilus tereticaudus	Round-tailed ground squirrel
HETEROMYIDAE	**POCKET MICE & KANGAROO RATS**
Dipodomys sp.	kangaroo rat
CANIDAE	**WOLVES & FOXES**
Canis familiaris	domestic dog
Canis latrans	coyote
Vulpes macrotis	kit fox
MUSTELIDAE	**WEASELS, SKUNKS & OTTERS**
Taxidea taxus	American badger
BOVIDAE	**BISON, GOATS & SHEEP**
Ovis canadensis	bighorn sheep (skull)
CHIROPTERA	**BATS**
Myotis sp.	Myotis

APPENDIX C4
AVIAN AND BAT PROTECTION PLAN

THIS PAGE INTENTIONALLY LEFT BLANK

March 2014

BLYTHE MESA SOLAR PROJECT

Avian and Bat Protection Plan

PROJECT NUMBER:
122512

BIOLOGISTS:
Bill Doering
Vanessa Santistevan

EMAIL:
bill.doering@powereng.com
vanessa.santistevan@powereng.com

PHONE:
(208) 288-6461
(303) 716-8908

POWER ENGINEERS

PREPARED FOR: RENEWABLE RESOURCES GROUP, LLC
AND
SOLAR STAR BLYTHE MESA 1, LLC

PREPARED BY: POWER ENGINEERS, INC.
731 EAST BALL ROAD, SUITE 100
ANAHEIM, CA 92805

BILL DOERING AND VANESSA SANTISTEVAN

CONTENTS

1.0 INTRODUCTION 1

1.1 PROJECT DESCRIPTION 1
1.1.1 Regional Setting 2
1.2 PURPOSE AND GOAL OF THIS AVIAN AND BAT PROTECTION PLAN 5
1.2.1 Coordination with Others 6
1.3 REGULATORY FRAMEWORK 7
1.3.1 Federal 7
1.3.2 State 8
1.3.3 Local 8
1.4 CORPORATE POLICY AND COMMITMENT TO ENVIRONMENTAL PROTECTION 8

2.0 ENVIRONMENTAL SETTING 9

2.1 DATA COLLECTION 9
2.1.1 Desktop Exercise 9
2.1.2 Baseline Biological Surveys 10
2.2 EXISTING CONDITIONS 10
2.2.1 Vegetation and Habitat 11
2.2.2 Avian and Bat Species in the Project Area 12

3.0 RISK ASSESSMENT 19

3.1 BIRDS 19
3.1.1 Collision 19
3.1.2 Electrocution 22
3.1.3 Displacement 22
3.2 EAGLES 23
3.2.1 Collision 23
3.2.2 Displacement 23
3.3 BATS 24
3.3.1 Collision 24
3.3.2 Electrocution 24
3.3.3 Displacement 24

4.0 PROJECT DESIGN STANDARDS AND IMPACT-REDUCING CONSERVATION MEASURES 24

4.1 PROJECT DESIGN FEATURES 24
4.2 PROPONENT-COMMITTED CONSERVATION MEASURES 26
4.3 ADDITIONAL PRE-CONSTRUCTION SURVEYS AND MONITORING 27

5.0 OPERATIONAL BIRD AND BAT MONITORING AND REPORTING 28

6.0 POST-CONSTRUCTION MITIGATION AND ADAPTIVE MANAGEMENT 29

6.1 ADAPTIVE MANAGEMENT PROCESS 29
6.2 AVIAN AND BAT FATALITY THRESHOLDS 29
6.3 ADDITIONAL RISK REDUCTION MEASURES AND ADAPTIVE MANAGEMENT 30
6.3.1 Additional Risk Reduction Measures 30

7.0 LITERATURE CITED 31

AR061238

FIGURES

Figure 1. Project Area 3
Figure 2. Regional Area Map 4

TABLES

Table 1. Coordination with Agencies 6
Table 2. Special-Status Bird and Bat Species Occurrence Potential within the Project Development Area 13

APPENDICES

Appendix A: Western Burrowing Owl Mitigation and Monitoring Plan
Appendix B: Pre-construction Nesting Survey Protocol
Appendix C: Construction Nest Monitoring Forms
Appendix D: Operational Nest Monitoring Forms
Appendix E: Mortality Reporting Form

1.0 INTRODUCTION

This Avian and Bat Protection Plan (ABPP) has been designed to protect resident and migrating avian and bat species that may be at risk from construction, operation and maintenance (O&M) of the proposed Blythe Mesa Solar Project (BMSP, Project). At the request of the Proponents, Renewable Resources Group, Inc. and Solar Star Blythe Mesa 1, LLC, this ABPP was prepared by POWER Engineers, Inc. as part of the proposed BMSP.

This ABPP has been written with consideration to and guidance from the data and suggestions presented in the U.S. Fish and Wildlife Service's (USFWS) *Region 8 Interim Guidelines for the Development of a Project-specific Avian and Bat Protection Plan for Solar Energy Plants and Related Transmission Facilities* (USFWS 2010), and the Avian Power Line Action Committee's (APLIC) *Mitigating Bird Collisions with Power Lines: The State of the Art in 1994* (APLIC 1994), *Avian Protection Plan Guidelines* (APLIC 2005), and *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006* (APLIC 2006). In addition, existing information on bird and bat use in the Project area has been utilized to effectively address avian and bat safety specific to the construction and operation and maintenance (O&M) work of BMSP to reduce impacts to migratory birds, bald and golden eagles, listed bat and avian species.

The Project is commitment to avian and bat safety and compliance with the Migratory Bird Treaty Act of 1918 (MBTA, 16 U.S.C. 703 – 712), the Bald and Golden Eagle Protection Act of 1940 (BGEPA, 16 U.S.C. 668 – 668d), and the Endangered Species Act of 1973, as amended (ESA, 16 U.S.C. 1531 – 1544). The following plan will outline the methods, and requirements to ensure that birds and bat are protected during the construction and O&M work of the proposed BMSP.

1.1 Project Description

The proposed Project consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid via interconnection to the Southern California Edison (SCE) Colorado River Substation, an approved new substation located south of Interstate 10 (I-10) and approximately four miles west of the Project site. The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar facility and 73 acres for the 230 kilovolt (kV) transmission line interconnect. The proposed Project would consist of the following components (Figure 1):

- Solar Facility site (3,587 total acres)
    - Solar array field would utilize single-axis solar PV trackers (295 feet long and 140 feet wide). Six trackers with 18 north-south oriented rows of PV panels would be configured into 1.5 MW blocks (600 feet long by 470 feet wide).
    - System of interior collection power lines located between inverters and substations
    - Three on-site substations (each approximately 300 feet long by 300 feet wide)
    - Two operation and maintenance (O&M) buildings (approximately 3,500 square feet each)
    - Two primary off-site access roads and several interior access roads
- Approximately 8.4 miles of 230 kV double-circuit transmission line
    - Approximately 3.6 miles would be located within the solar facility
    - Approximately 4.8 miles would extend outside of the solar facility and would be placed within a 125-foot-wide right-of-way (ROW) and occupy 73 acres.

1.1.1 Regional Setting

The 3,660-acre site is five miles west of Blythe and consists mostly of agricultural land, including lemon orchards. The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles (see Figure 2). The Project is located on:

- Sections 11 and 12 of Township 7 South, Range 21 East
- Sections 3, 4, 5, 6, 8, 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

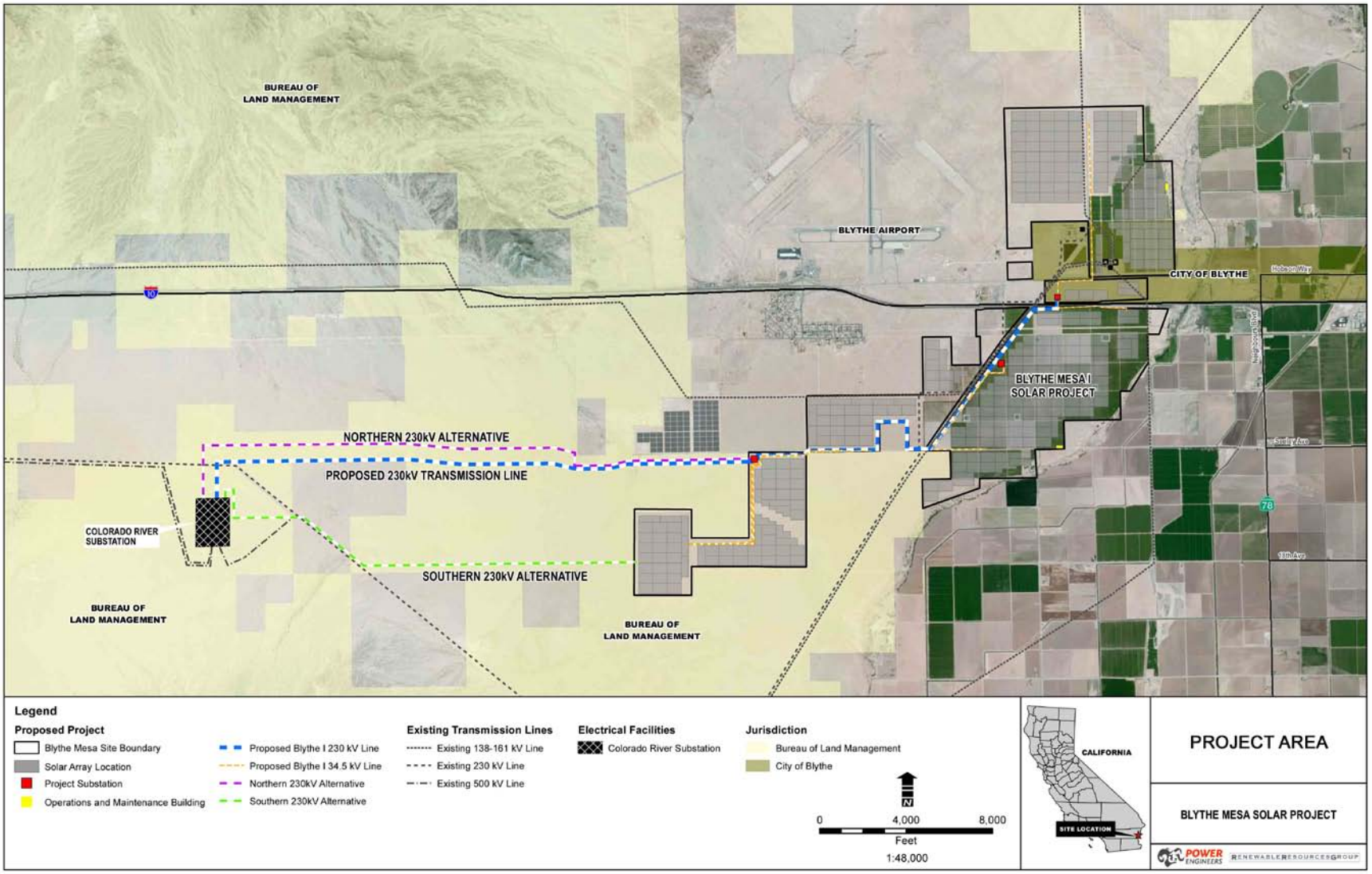
State Highway 10 bisects the Project area, which is bounded on the north and south by undeveloped open desert, on the east by agricultural lands, and on the west by the Blythe City Airport and open desert lands.

The Project area is located on the western mesa of the Palo Verde Valley. The valley is a portion of the Colorado River floodplain. The Project area is on Palo Verde Mesa and is situated in the greater Sonoran Desert. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The Project area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert.

The subtropical climate of the Colorado Desert is currently characterized by dry, mild winters averaging 45 degrees Fahrenheit (ºF) and dry, hot summers that average 104ºF. Summer highs are known to reach up to 120ºF. Precipitation ranges between two and ten inches per year, with most of the precipitation occurring between November and March. Although rainfall occurs primarily in the winter months, the region is periodically influenced by tropical weather conditions, including sudden monsoonal summer storms, which typically occur from July to later September.

The general area has a long history of human use and disturbance with dominant land uses consisting of agricultural fields and groves (citrus orchards), residences, Blythe Municipal Airport, Blythe Energy Center, electrical transmission lines, an interstate highway, and commercial businesses. Within this matrix of human development and disturbance some patches of open desert habitat remain in the form of creosote bush scrub and desert riparian wash. To the west, the Project area also includes undeveloped open desert that is managed by the U.S. Department of the Interior, Bureau of Land Management (BLM). The solar facility associated with this Project would be situated within agricultural land or otherwise disturbed land (primarily former agriculture and military training), and the generation interconnection ("gen-tie") line within private, disturbed lands and BLM lands. Areas north and west of the Project are preserved as open space for recreational use and wildlife.

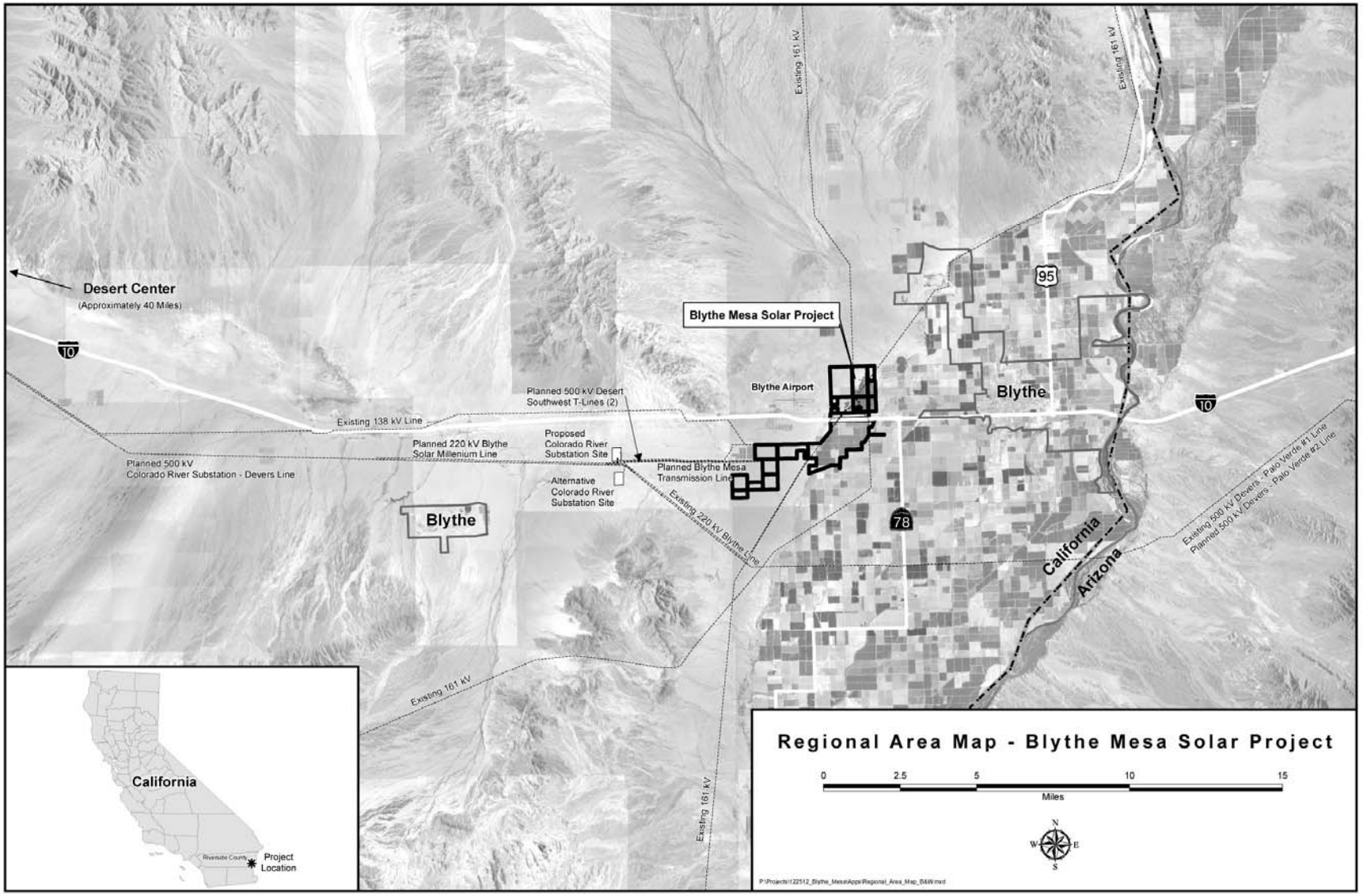
FIGURE 1. PROJECT AREA



AR061242

FIGURE 2. REGIONAL AREA MAP

FIGURE 2. REGIONAL AREA MAP



AR061244

THIS PAGE INTENTIONALLY LEFT BLANK

1.2 Purpose and Goal of this Avian and Bat Protection Plan

Recent advances in technology along with environmental concerns associated with fossil fuel extraction, transportation, refining and combustion have stimulated the expansion of the renewable energy industry and its promotion through federal, state and local legislative efforts. With its abundant sunshine, desirable climate and proximity to large population centers, the Colorado Desert of Southern California is an ideal location to develop solar energy resources. Consequently, a number of solar energy projects (utilizing a variety of technologies) are in various stages of development in the region.

Concern over bird and bat fatalities (primarily associated with commercial wind farms) has led to increased attention from resource management agencies and efforts to minimize impacts to birds and bats from any renewable energy development. These efforts often include systematic monitoring to quantify effects on birds and bats, increasing agency coordination or consultation, risk assessments, and application of design and operational strategies to reduce impacts. Efforts are typically set forth and documented in planning documents such as ABPPs, sometimes known as Bat and Bird Conservation Strategies (USFWS 2010). ABPPs establish a commitment to identify and address known causes of bird and bat mortality that could occur from normal operation activities, and are intended to provide a framework for compliance with federal and state laws. The USFWS has prepared an interim guideline for developing project-specific ABPPs for solar energy facilities and associated transmission lines (USFWS 2010).

Based on specific recommendations from USFWS, this ABPP presents a good-faith, voluntary effort by the Proponents to initiate a program to minimize bird and bat mortality during both construction and operations at the Blythe Mesa Solar Project site. Specifically, this ABPP provides:

- A statement of the Proponents' understanding of the importance of bird and bat safety and management's commitment to remain in compliance with relevant laws
- Documentation of conservation measures BMSP is implementing through design and operations to avoid and reduce bird and bat fatalities at both solar generation facilities as well as the associated gen-tie line
- Consistent, practical and up-to-date direction to BMSP staff how to avoid, reduce and monitor bird and bat fatalities
- Establishment of accepted processes to monitor and mitigate bird and bat fatalities,
- Establishment of accepted fatality thresholds that, if surpassed, will trigger adaptive changes to management and mitigation management
- An adaptive management framework to be applied, if thresholds are surpassed.

ABPPs are considered "living documents" that articulate a power producer's commitment to develop and implement a program to increase avian and bat safety and reduce risk. As progress is made through the program or challenges are encountered, the ABPP may be reviewed, modified and updated. The initial goals of this ABPP are to:

- Provide a framework to facilitate compliance with federal law protecting avian species and means to document compliance for regulators and the interested public
- Allow the Proponents to manage risk to protected bird and bat species in an organized and cost-effective manner
- Establish a mechanism for communication between BMSP managers and natural resource regulators (primarily USFWS)
- Foster a sense of stewardship with BMSP owners, managers and field engineers
- Articulate and cultivate a culture of wildlife awareness (specifically birds and bats) and the importance of their protection.

As stated above, it is presumed that this avian and bat protection plan is a "living document" and will be modified or updated based upon changing conditions, site modifications, unforeseen events, and evidence of lower risk. New versions will be dated and given a revision number.

This ABPP is not to be considered a delineation of legal requirements. Instead, it provides guidance for achieving and maintaining regulatory compliance, minimizing risk, and documenting good-faith efforts to maintain bird and bat safety associated with the Blythe Mesa Solar Project.

1.2.1 Coordination with Others

Early coordination and pre-consultation with the USFWS, the California Department of Fish and Wildlife (CDFW), the County of Riverside, and the BLM was conducted during a series of meetings, email correspondences, and phone conversations. The early coordination helped guide the approach and need for the development of this ABPP. A summary of coordination and consultation to date is provided below (Table 1).

Table 1. Coordination with Agencies

Agency	Study Component	Date	Type of Contact	Summary
USFWS, CDFW, County of Riverside	Biological surveys	August 23, 2011	Meeting	Project Overview and discussion of biological resources and surveys needed.
Kim Marsden, BLM	Review of Survey effort	March 29, 2012	Meeting	Review of Biological Resources, existing data, site conditions, and surveys completed. Also discussed data needs moving forward.
USFWS, BLM, County of Riverside	Review of Project information, including the biological data collected	May 10, 2012	Meeting	This meeting was a pre-application meeting. Several resources were discussed in addition the biological resources.
Shankar Sharma and Magdalena Rodriguez, CDFW	Review of survey effort.	June 13, 2012	Meeting	Review of Previous Studies in Project Area & Vicinity, Analysis of Existing Conditions, Survey Work and Present Findings and Steps moving forward
Nisa Marks, USFWS	Avian Data	August 09, 2012	Email Correspondence	Reviewed the relevant and available migratory bird species data that was collected for BMSP. Requested that the next steps would be to prepare a ABPP
Kim Marsden, BLM; Jared Bond, County of Riverside	Habitat Assessment data along the transmission line alternatives	August 30, 2012	Email Correspondence	Submitted the BMSP Bio Transmission Line Alternative Habitat Assessment Report for review.
Jared Bond, County of Riverside	ABPP and Burrowing Owl Protection Plan	September 20, 2012	Phone conversation	Review of Habitat Assessment Report and suggested the preparation of a burrowing owl plan and ABPP.
Nisa Marks, USFWS	Avian and Bat Protection Plan	October 22, 2012	Email Correspondence	Provided written guidance for preparing a ABPP for solar projects
USFWS	ESA species	November 14, 2012	Letter	Concurrence that the BMSP is not likely to incidentally take or affect ESA species, specifically the desert tortoise

1.3 Regulatory Framework

Native birds and bats in the U.S. are afforded protection under federal and state laws, including the Endangered Species Act (ESA), the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act (BGEPA), and provisions of the California Code.

1.3.1 Federal

Endangered Species Act (ESA): The ESA is administered under the U.S. Fish and Wildlife Service (USFWS). The purpose of the ESA is to "provide a means whereby ecosystems upon which endangered and threatened species depend may be conserved, and to provide a program for the conservation of these species." Section 9 of the ESA prohibits purposeful or incidental "take" of listed species, including killing or harming a listed species or its habitat. Any activity that is expected to result in incidental take of a threatened or endangered species requires a USFWS permit issued under section 7 or 10 of the ESA. It should be noted that no federally-listed bird or bat species is known to occur of find habitat with the area of the Project's solar array fields or gen-tie line. Future revisions of this ABPP will note changes in listing status of any covered species.

Migratory Bird Treaty Act (MBTA): All native birds in the U.S. are protected under the Migratory Bird Treaty Act. The MBTA states that "Unless and except as permitted by regulations…it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, [or] kill…any migratory bird". Unauthorized take of any of the protected bird species constitutes a violation of the MBTA. The USFWS has established permits for certain intentional activities that result in take, such as scientific research and hunting, but currently does not provide provisions for the incidental take of migratory birds at energy facilities. Consequently, there is no permitting framework that allows a renewable energy developer to protect itself from the liability of take. However, demonstrable good faith efforts to affectively avoid and minimize impacts are considered by USFWS prior to MBTA enforcement actions.

Bald and Golden Eagle Protection Act (BGEPA): The BGEPA prohibits the take of any bald or golden eagle. "Take" is defined as "Pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." "Disturb" means "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." Recent USFWS regulations (Federal Register 74:46836-46879, September 11 2009) allow for the issuance of permits for eagle take that is associated with, but not the purpose of, an activity. Permits may be issued when "the take is unavoidable even though advanced conservation practices are being implemented." Stipulations of the permitting framework include periodic monitoring of eagle use near the project during and for three years following the proposed activity (50 CFR 22:26). Such permitting has not been identified for this Project nor anticipated.

It should be noted that each avian protection regulation described above includes the concept of "take." Section 9 of the ESA most clearly defines take as "to harass, harm, pursue, hunt, shoot, wound, kill trap, capture, or collect or attempt to engage in any such conduct." "Harm" has been further defined as "an act which actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering."

The active nests of all migratory birds are afforded protection. Both active and inactive nests of eagles and colonial nesting birds are afforded protection. Disturbance or destruction of a nest in any protected category is considered "take" under the law.

Northern and Eastern Colorado Desert Coordinated Management Plan (BLM 2002): The Northern and Eastern Colorado Desert Coordinated Management (NECO) Plan is a landscape-scale, multi-agency planning effort that protects and conserves the natural resources of the California portion of the Sonoran Desert while also managing its use for humans. This plan was prepared under the same regulations that implement the FLPMA of 1976. The NECO Plan provides management areas for the desert tortoise (*Gopherus agassizii*), a system of integrated ecosystem management for special-status species and natural communities on federal lands, and regional standards and guidelines for public land health on BLM lands. This management plan is only applicable to BLM administered lands within the gen-tie line ROW.

California Desert Conservation Area Plan: The California Desert Conservation Area (CDCA) Plan guides the management of all BLM-administered lands in the Mojave, Sonoran, and a small portion of the Great Basin Deserts. In total, the CDCA Plan includes an area of approximately 25 million acres, 12 million of which are public lands. The primary goal of the CDCA Plan is to provide guidance for the overall maintenance of the land while simultaneously planning for multiple uses and balancing the human needs with the need to protect the natural environment. This management plan is only applicable to BLM administered lands within the gen-tie line ROW.

1.3.2 State

California Endangered Species Act of 1984, California Fish and Game Code § 2050-2098: The California Endangered Species Act (CESA) includes provisions for the protection and management of species listed by the State as endangered or threatened, or designated as candidates for such listings. CESA includes a requirement for consultation "to ensure that any action authorized by a state lead agency is not likely to jeopardize the continued existence of any endangered or threatened species… or result in the destruction or adverse modification of habitat essential to the continued existence of the species" (§ 2090). Plants of California declared to be endangered, threatened, or rare are listed at 14 California Code of Regulations (CCR) § 670.2. Animals of California declared to be endangered, threatened, or rare are listed at 14 CCR § 670.5. The administering agency for the above authority is the CDFW.

California Fish and Game Code Section 3503, 3511, 4700, 5050, and 5515: These California Fish and Game Codes (CFGC) list bird (primarily raptor), mammal, amphibian, and reptile species that are classified as fully protected in California. Fully protected species are prohibited from being taken or possessed except under specific permit requirements. These Codes also prohibit the take, possession, or needless destruction of the nests or eggs of any bird, including birds of prey or their nests or eggs, except as otherwise provided by the code or any regulation made pursuant thereto.

1.3.3 Local

No relevant local ordinances related to birds or bats applicable to this ABPP are identified at this time.

1.4 Corporate Policy and Commitment to Environmental Protection

It is the policy of the Proponents, their owners, and management to balance the goal of providing clean, renewable energy with the protection of bird and bat resources that may be affected by its generation and transmission facilities. The Proponents are committed to a good-faith effort to comply with applicable laws regarding bird and bat safety and with developing and operating its BMSP in a way that minimizes direct impacts on wildlife. This Avian and Bat Protection Plan presents the Proponents' commitment to minimize impacts on local bird and bat populations.

2.0 ENVIRONMENTAL SETTING

2.1 Data Collection

The evaluation of habitats and species with the potential to be affected by the Project included a review of available information supplemented with reconnaissance-level survey and focused surveys. Methods are detailed in the Biological Resources Technical Report (POWER 2011) prepared to support the Blythe Mesa Solar Project Draft Environmental Impact Report/Environmental Assessment (EIR/EA) for the California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) process. Collected data are synthesized into the baseline conditions summary presented in section 2.2 below.

2.1.1 Desktop Exercise

Preliminary environmental review of the Project area included review of information obtained from the USFWS, CDFW, BLM, Cibola National Wildlife Refuge, literature searches, reports from surrounding projects, examinations of aerial photographs, and database searches including the California Native Plant Society (CNPS), California Natural Diversity Data Base (CNDDB) records, and other sensitive species accounts for Riverside County. Regional resource planning documents prepared by federal, state and local agencies were also reviewed, including the NECO Plan, the CDCA Plan, and the Riverside General Plan. Additionally, USFWS was consulted regarding the federally listed species that could occur within the Project quads.

To identify the existing and potential biological resources present in the vicinity of the proposed Project, a Geographic Information System (GIS) search was performed. This consisted of mapping baseline biological resource data (vegetation mapping, CNDDB records, habitat conservation areas, water resources, and potential jurisdictional areas). The following US Geological Survey quadrangles were reviewed for the Project development area and environs: McCoy Wash, Ripley, and Roosevelt Mine.

Additional references used included soil data from the US Department of Agriculture, the Jepson Manual, the CNPS Inventory of Rare and Endangered Plants of California, and several other published and technical survey reports for the region. By reviewing vegetation, soils and surveys conducted by other projects in the area, biologists were able to determine where focused surveys were required and where recently acquired existing data may be able to be used for a species inventory instead. The surrounding projects that were reviewed for existing survey information include:

- Blythe Solar Power Project (AECOM 2010)
- Genesis Solar Energy Project (BLM and CEC 2010, TetraTech 2010a, TetraTech 2010b)
- Devers-Palo Verde No. 2 Transmission Line Project (Aspen 2006)
- Devers-Palo Verde No. 2 Transmission Line Project Telecommunication System Route (CH2MHill 2010)
- Devers-Palo Verde No. 2 Transmission Line Project Colorado River Substation Expansion (Aspen 2011)
- First Solar Electric Blythe Solar 1 Project (First Solar Electric, LLC (First Solar). No Date)
- Blythe Airport Solar Project (US Solar Holdings, LLC (US Solar). No Date.)
- McCoy Solar Energy Project (BLM 2012)
- Rio Mesa (Bright Source Energy, Inc.)

These projects were reviewed for survey information, including target species, survey areas, survey dates, and survey results. This was conducted through a combination of document reviews and reviews of project spatial data, when available. Because birds and bats are wide-ranging creatures,

such information on surrounding projects can help identify transient species, rare species, or target species that may have elevated concern or require specific mitigation.

2.1.2 Baseline Biological Surveys

Prior to field reconnaissance surveys, biologists first developed a potential list of special-status species by consulting the CNDDB (RareFind Version 3.1.1; CDFW 2011) and CNPS Inventory of Rare and Endangered Plants (2011) for documented occurrences of special-status or rare plants and animals within the McCoy Wash, Ripley, and Roosevelt Mine USGS 7.5-minute quadrangles. These resources, along with the species range maps, were utilized to determine historic occurrence of special-status plant and wildlife species and other natural resources within the study area. Additionally, USFWS was consulted regarding the federal listed species that could occur within the Project quads (see Appendix C in Biological Resources Technical Report, POWER 2011).

Once a complete list was developed of potential species that could occur within the Project area, POWER conducted a general reconnaissance survey. The reconnaissance survey was conducted in the proposed solar array footprint by POWER biologists Tom Herzog and Ken McDonald on April 19 and 20, 2011. The survey was a comprehensive habitat assessment conducted across the solar facility site and 500-foot wide transmission line corridor (which is centered on the assumed centerline) , identifying key habitat features and observations of both plants and wildlife (including any birds and bats).

Species-habitat correlations assume the occurrence of an organism with a series of environmental variables. Environmental variables can describe the habitat components organisms are dependent upon and, therefore, predict their pattern of habitat occupancy. Therefore, a habitat-based survey approach was used to assess the Project footprints.

The field survey evaluated the quality of the habitat for each species and/or proximity of the habitat to a known occurrence of a species. Information used to determine known occurrence locations included CNDDB data, CNPS records, consultation with Wildlife Agencies, and reference to published species accounts. Field survey activities included documenting plant and animal species or sign observed within the study corridor, mapping vegetation communities, and photo-documenting existing biological conditions for all identified potential Project routes.

2.2 Existing Conditions

Prior to Project development, agricultural land use within the solar array site included drip-irrigated citrus orchards, flood-irrigated alfalfa, non-irrigated winter wheat, abandoned jojoba orchards, and fallow fields. Some additional land was heavily disturbed and had been used for World War II-era military training. Less than five percent of the area supported disturbed remnant creosote bush scrub and bajada habitat. In contrast, the gen-tie line corridors pass through BLM lands and other private lands mainly comprising desert scrub habitat and disturbed lands associated with existing infrastructure. Several utility lines and maintenance roads run through or parallel the gen-tie line corridors. Additionally, the Project area has been previously disturbed by off-road vehicle use, trash dumping, and historic use for military training during World War II. The Project site is located in the Colorado Desert in gently rolling open terrain dominated by desert scrub vegetation. The Colorado Desert is a part of the larger Sonoran Desert, which extends across the southwest United States and into Mexico. The climate is very hot and dry in the summer months, and cool and moist in the winter.

Surface water is minimal on Palo Verde Mesa and consists of limited seasonal and perennial sources. Perennial water comes from McCoy Springs in the McCoy Mountains west of the Project area and the Colorado River, which lies approximately eight miles east of the Project area. The Colorado River is the source of irrigation water for agriculture in the area.

No designated critical habitat, special management areas, wilderness study areas, or Areas of Critical Environmental Concern (ACEC) are located within the solar array site or gen-tie line corridors.

2.2.1 Vegetation and Habitat

Based on initial surveys, eleven vegetation communities and other cover types were identified within the Project development area (solar array sites and gen-tie line ROWs). Vegetation communities were classified according to the second edition of *A Manual of California Vegetation, Second Edition* (Sawyer et al. 2009). Community classifications were based on dominant species comprising approximately 50 percent or more of the total cover within the mapped unit relative to the list of dominant species for a given vegetation community. Habitat mapping is presented in the biological resources technical report (POWER 2011). Vegetation communities included the following:

***Bajada*.** Bajadas are associated with broad merged alluvial fans or desert washes. This community is present in the northeastern corner of the Project area and is typically characterized as the shallow, sandy, braided bottoms of wide canyons. This community most closely resembles Holland's "Mojave Desert Wash Scrub," Code 63700 (Holland 1986).

Creosote Bush Scrub/Disturbed Creosote Scrub. Within the study area, this community is characterized by sandy soils with a shallow clay pan on a broad gentle southeast-trending slope. Dominant plants within the study area for this community include creosote bush, burro brush, brittlebush (*Encelia farinosa*), and cheesebush. This is the most common plant community consisting of non-agricultural plants within the study area. This plant community intergrades into the desert riparian woodland wash. Within the study area, there are areas of desert pavement that are covered with rounded cobbles that range in size from one to three inches. Typically, these areas are higher than the surrounding landscape by three to 15 feet. These areas are within creosote bush scrub, though the plant density is lower. Sonoran creosote bush scrub is designated by Holland as Code 33100 and Sawyer Keeler-Wolf and Evens as the Ocotillo Series (Holland 1986 and Sawyer et al. 2009). Within the gen-tie corridors, the creosote bush scrub is relatively undisturbed, except for occasional vehicle tracks. In these areas, fine sand drifts are interspersed within this community type; the Emory's indigo bush occurs in stands and is more prevalent than in other portions of the creosote bush scrub.

There are more areas of disturbed creosote bush scrub on the solar facility site compared to the gen-tie line. Past disturbances in these areas consist of military training and agricultural use, including cultivation of jojoba (*Simmondsia chinensis*). These disturbances occurred in the past, and the Sonoran creosote bush scrub within the solar array area has been recovering through natural recruitment. Two invasive plant species, Russian thistle (*Salsola tragus*) and Sahara mustard (*Brassica tournefortii*), can be found in disturbed areas throughout the study area, especially near roads and fallow and active agricultural areas. Another exotic plant, Mediterranean grass (*Schismus* sp.), is prevalent throughout the creosote bush scrub.

Desert Riparian Woodland Wash. This vegetation community consists of open, drought-deciduous, riparian scrub woodland and is made up of three primary components: wash-dependent vegetation, vegetated ephemeral dry wash, and islands of Sonoran creosote bush scrub (e.g., riparian interfluves). Dominant and indicator plants of this community within the study area include honey mesquite (*Prosopis glandulosa*), palo verde (*Cercidium floridum*), desert ironwood (*Olneya tesota*), cat-claw acacia (*Acacia greggii*), and rush milkweed (*Asclepias subulata*). Creosote bush (*Larrea tridentata*) and burro brush (*Ambrosia dumosa*) were scattered throughout the canopy. The herbaceous layer is dominated by desert plantain (*Plantago ovata*), *Cryptantha* spp., and Mediterranean grass (*Schismus barbatus*). Of the vegetation communities listed in Table 3.2.4-1, the CDFW considers desert riparian woodland wash to be a sensitive habitat/biological resource. In addition, desert riparian woodland wash is a special community type (i.e., high priority for inventory in the CNDDB) per the CDFW's

Vegetation and Mapping Program. Desert riparian woodland wash is equivalent to Holland's desert dry wash woodland (Code 62200) and Sawyer, Keeler-Wolf and Evens' Catclaw Acacia Series (Holland 1986 and Sawyer et al. 2009).

Irrigated Cropland/Irrigation Pond/Orchard/Jojoba/Wheat. These community types fall into the broader category of agriculture. The majority of agricultural land within the proposed solar array disturbance area is fallow and active agriculture. It includes lands that are currently under cultivation and those that are abandoned (e.g., fallow). Within abandoned agriculture areas, native vegetation is growing back; Russian thistle, Sahara mustard, and other exotic plants were observed interspersed with the native vegetation and are indicative of past agricultural disturbance.

Disturbed/Ruderal. Disturbed/Ruderal communities have been previously disturbed and have been converted to mostly non-native, weedy areas. Ruderal vegetation is that which grows quickly in disturbed areas and may consist of native species, such as fire-following plants, or non-native species, such as invasive grasses or forbs. Examples of invasive species that would occur in these areas include redstem filaree (*Erodium cicutarium*), Sahara mustard, and Mediterranean grass. Ruderal areas in the Project area are primarily concentrated within the proposed solar array area.

2.2.2 Avian and Bat Species in the Project Area

Because of agricultural development and general state of disturbance, the solar facility site provided little habitat for bird or bat species prior to construction. In contrast, the gen-tie line extends westward through undeveloped BLM lands supporting wildlife habitats. Certainly the gen-tie ROW supports a community of desert scrub bird species and seasonal transient migrants. Terrain across the entire area is relatively level with deep alluvium and no exposed rock features. No bat roost habitat is presented within the Project development areas or adjacent areas. Bat species may occur as daily or seasonal transients, but would not otherwise be expected to occur. Based on a review of available information, studies conducted for nearby projects, reconnaissance surveys and protocol surveys conducted as part of impacts assessment for the Project, Table2 presents a list of special status bird and bat species as well as their occurrence potential within the Project development area (solar generation site and gen-tie line ROWs). No federally-listed or state listed bird or bat species were detected at the Project site or are expected to find habitat at the Project site. Three non-listed special-status avian species or their sign were detected on site, including the western burrowing owl, Le Conte's thrasher, and loggerhead shrike. Detections of all wildlife species are discussed in detail in the Biological Technical Report (POWER 2011).

Table 2. Special-Status Bird and Bat Species Occurrence Potential within the Project Development Area

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array Project Boundary[2]	Potential for Occurrence within the Gen-tie Line (BLM Jurisdiction)[2]
Birds					
Golden Eagle (*Aquila chrysaetos)*	BGEPA species, CDFW: Species of Special Concern, BLM Sensitive	Nest in high relief areas with exposed rock (e.g., cliffs or canyons). Forage widely over level terrain.	Known to region. According to McCoy Solar Energy Project survey data (Tetra Tech EC, Inc. 2012) there were numerous golden eagle nests detected in the McCoy and Big/Little Maria Mountains, but only one of 19 was found to be active (in 2010). Expected to use area for foraging.	Moderate (may traverse level terrain)	Moderate (forage habitat present)
Short-eared owl *Asio flammeus*	CDFW: Species of Special Concern	Open fields, marshes, dunes, and grasslands.	Some suitable habitat for this species is present in and around the solar array boundary, but habitat is more marginal around the gen-tie line. No CNDDB records in the Project vicinity.	Moderate	Low
Western burrowing owl (*Athene cunicularia hypugaea*)	CDFW: Species of Special Concern, BLM: Sensitive, NECO Plan	Found mainly in grassland and open scrub from the seashore to foothills. Also found in deserts and scrublands.	Habitat marginally suitable for this species within the gen-tie corridors. May be occasionally present as foragers but unlikely to be present as residents. Suitable habitat and the species were detected within the solar array site during the survey work.	Present	Moderate
Swainson's hawk (*Buteo swainsoni*)	CESA: Threatened, USFS: Sensitive	Nesting habitat consists of open habitats with trees, either isolated, scattered or in windrows.	Migrants more frequently occur near western edge of desert such as Borrego and Morongo valleys, as reflected in annual data from the various regional hawk-watch reports. No suitable breeding habitat exists on site.	Low (non-breeding only) High (foraging)	Low (non-breeding only) High(foraging)
Vaux's swift (*Chaetura vauxi*)	CDFW: Species of Special Concern	Occurs in coniferous forests, particular redwoods and Douglas-firs. Usually nests in flocks in large hollow trees or snags. Forages over rivers and lakes.	No nesting habitat occurs in or near the Project area. Nesting habitat located primarily in mountains in coniferous habitat. May forage in water bodies in the Project vicinity but foraging habitat expected to be minimal or not present within the Project area. No CNDDB results in the Project vicinity.	Low	Low
Mountain plover *Charadrius montanus*	CDFW: Species of Special Concern, BLM: Sensitive	Occurs in short grasslands or other flat areas with short or no vegetation. Most often found in grazed areas.	Habitat for this species is primarily found in agricultural fields in and surrounding the solar array boundary. The gen-tie line contains marginal habitat for this species. Only CNDDB record for this area is a non-specific location in the general Blythe vicinity from 1981.	Moderate	Low

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array Project Boundary[2]	Potential for Occurrence within the Gen-tie Line (BLM Jurisdiction)[2]
Northern harrier (*Circus cyaneus*)	CDFW: Species of Special Concern	Occurs in coastal salt and freshwater marshes, usually nesting on the ground in shrubby vegetation in the surrounding grasslands, especially at the marsh's edge. Also forages in grasslands.	No suitable habitat observed in Project area.	None	None
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	ESA: Candidate, CESA: Endangered	Nests along large river systems, typically in areas dominated by willows and cottonwoods.	No suitable habitat observed in Project area.	None	None
Gilded flicker *Colaptes chrysoides*	CESA: Endangered	Found in desert habitat and riparian woodlands along the Colorado River, utilizing willows, cottonwoods, and saguaro.	Limited habitat for this species in the washes in and around the Project area. Closest CNDDB record for this species is approximately nine miles away at the edge of the Colorado River.	Low	Low
Sonoran yellow warbler (*Dendroica petechia sonorana*)	CDFW: Species of Special Concern, NECO Plan	Occurs in riparian deciduous habitat, such as cottonwood and willow areas, nesting in understories. Summer resident of the Colorado River Valley.	Some potentially suitable habitat located on the eastern edge of the gen-tie line and just north of the gen-tie line. One yellow warbler detected just north of the gen-tie line during surveys conducted for the McCoy Solar Energy Project (Tetra Tech EC, Inc. 2012).	High	Present
Southwestern willow flycatcher (*Empidonax traillii extimus*)	ESA: Endangered, CESA: Endangered, NECO Plan	Riparian woodlands.	No suitable habitat observed in Project area.	None	None
Peregrine falcon (*Falco peregrinus*)	CDFW: Fully Protected	Nests on cliffs, banks, dunes, mounds, human structures, or other types of depressions or ledges near wetlands, lakes, rivers, or other bodies of water.	No suitable habitat observed in Project area.	None	None

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array Project Boundary[2]	Potential for Occurrence within the Gen-tie Line (BLM Jurisdiction)[2]
Yellow-breasted chat (*Icteria virens*)	CDFW: Species of Special Concern	Inhabits riparian willow thickets near watercourses. Nests in low, dense riparian areas. Summer resident.	No suitable habitat observed in Project area.	None	None
Loggerhead shrike (*Lanius ludovicianus*)	CDFW: Species of Special Concern	Occurs in semi-open country with utility posts, wires, and trees to perch on.	Pair detected just north of the northern alternative. Suitable habitat occurs along the southern alternative but no individuals were detected.	High	Present
Gila Woodpecker (*Melanerpes uropygialis*)	CESA: Endangered, NECO Plan	Nests in cottonwoods or other desert riparian trees, shade trees, or date palms.	Limited suitable habitat available in the Project area. Nearest occupied habitat is near Blythe on the Colorado River.	Low	Low
Elf owl (*Micrathene whitneyi*)	CESA: Endangered, NECO Plan	In California, nests only in cottonwood-willow and mesquite riparian areas along the Colorado River.	No suitable nesting habitat in Project area. May forage in or near the Project area.	Low	Low
Lucy's warbler (*Oreothlypis luciae*)	CDFW: Species of Special Concern	Occurs primarily in thickets of mesquite, riparian scrub, and tamarisk in the lower Colorado River Valley and its tributaries.	Limited suitable habitat located in areas of desert riparian woodland wash.	Low	Low
American white pelican (*Pelacanus erythrorhynchos*)	CDFW: Species of Special Concern	Nests on large lakes and protected and isolated islets within them.	No suitable habitat observed in Project area.	None	None
Summer tanager (*Piranga rubra*)	CDFW: Species of Special Concern	Requires cottonwood-willow riparian forests for nesting and foraging. Summer resident on the Colorado River.	No suitable habitat present in the Project area.	None	None

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array Project Boundary[2]	Potential for Occurrence within the Gen-tie Line (BLM Jurisdiction)[2]
Vermilion flycatcher (*Pyrocephalus rubinus*)	CDFW: Species of Special Concern, NECO Plan	Open farmlands, shrubby grasslands, streamsides, and small wooded ponds in desert habitat. Found in diverse areas near open water.	Limited suitable habitat within the proposed alternatives.	Moderate	Low
Yuma clapper rail (*Rallus longirostris yumanensis*)	ESA: Endangered, CESA: Threatened, CDFW: Fully Protected	Nests in freshwater marshes surrounded by tules and cattails. Found along the Colorado River.	No suitable habitat within the Project area.	None	None
Bendire's thrasher *Toxostoma bendirei*	CDFW: Species of Special Concern, BLM: Sensitive	Occurs in open, arid areas, especially in grasslands.	Marginal habitat in the Project area. No CNDDB records in the Project vicinity.	Low	Low
Crissal thrasher (*Toxostoma crissale*)	CDFW: Species of Special Concern, NECO Plan	Occurs in dense riparian and mesquite scrub, microphyll woodland, and riparian washes with a dense understory of shrubs	Some habitat present that could support species foraging but not typical for nesting. Riparian wash present south of the southern alternative. An unidentified thrasher was heard calling during the survey on the northern alternative.	Low	Moderate
Le Conte's thrasher (*Toxostoma lecontei*)	CDFW: Species of Special Concern, NECO Plan	Arid and open plains that are sparsely vegetated and dominated by saltbush and creosote bush	This species was previously detected in 2011 in an area between the northern and southern alternatives. Suitable habitat for this species is present mainly in the creosote bush areas of the Project. An unidentified thrasher was heard calling during the survey on the northern alternative.	High	Present
Arizona Bell's vireo *Vireo bellii arizonae*	CESA: Endangered	Occurs in the summer along the Colorado River, primarily in thickets of willow, mesquite, or other small riparian trees and shrubs.	No suitable habitat observed in Project area. The habitat in the desert riparian woodland wash is marginal. Nearest CNDDB occurrence is approximately nine miles away near the Colorado River.	None	Low

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array Project Boundary[2]	Potential for Occurrence within the Gen-tie Line (BLM Jurisdiction)[2]
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)	CDFW: Species of Special Concern	Nests in freshwater wetlands with dense vegetation and deep water, as well as along the borders of other lacustrine water bodies.	No suitable habitat observed in Project area.	None	None
Bats					
Pallid bat (*Antrozous pallidus*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	This gregarious species usually roosts in small colonies in rock crevices and buildings, but may nest in caves, mines, rock piles, and tree cavities.	Roosting habitat for pallid bats is present in tree cavities in desert riparian woodland wash in the southeastern portion of the survey area. The closest documented occurrence in the CNDDB is from 1992, approximately 30 miles to the southwest of the airport near Corn Springs.	Low	Low
Townsend's big-eared bat (*Corynorhinus townsendii*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Occurs in a wide variety of habitats but most commonly in mesic areas. Roosts in open areas.	Suitable foraging habitat within the Project area but limited roosting habitat. The closest CNDDB record is from 1919 and is approximately seven miles southeast of the surveyed areas.	Low	Low
Spotted bat *Euderma maculatum*	CDFW: Species of Special Concern, BLM: Sensitive	Occurs in a large number of different habitats, feeding over water and in washes. Roosts in rock crevices, cliffs, or caves.	There is very little wash habitat for foraging available on-site, with some in the vicinity outside of the Project area. There is no roosting habitat on-site.	Low	Low
Western mastiff bat *Eumops perotis*	CDFW: Species of Special Concern, BLM: Sensitive	Occurs in a large number of different habitats, roosting in crevices in cliffs, high buildings, trees, and tunnels.	Limited roosting habitat is available on-site.	Low	Low
Western yellow bat (*Lasiurus xanthinus*)	CDFW: Species of Special Concern	Occurs in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats. Roosts in trees and forages over water and in trees.	No roosting habitat available in the Project area; no water observed during surveys. The only CNDDB record is from 1980 and is mapped in Blythe.	Low	Low

Common Name Scientific Name	Sensitivity Status[1]	Habitat Requirements	Discussion	Potential for Occurrence within the Solar Array Project Boundary[2]	Potential for Occurrence within the Gen-tie Line (BLM Jurisdiction)[2]
California leaf-nosed bat (*Macrotus californicus*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Lowland desert scrub, desert riparian and wash areas, alkali scrub, or palm oases. Requires rugged or rocky terrain with mines or caves for roosting.	Suitable foraging habitat is present throughout the Project area, although roosting habitat is limited in the immediate region, due to lack of a rugged or rocky terrain. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low
Arizona myotis (*Myotis occultus*)	CDFW: Species of Special Concern	Lowlands of the Colorado River and adjacent desert mountain ranges. Roosts in tree hollows, rock crevices, and similar areas.	The closest documented occurrence in the CNDDB is from 1942, approximately five miles south of the Project.	Low	Low
Cave myotis (*Myotis velifer*)	CDFW: Species of Special Concern BLM: Sensitive NECO Plan	Low elevation arid regions near the Colorado River and in adjacent mountains. Requires caves or mines for roosting.	Suitable foraging habitat is present throughout the Project area, although roosting habitat is limited in the immediate region. A 2002 CNDDB record lists a colony of bats in the general vicinity (in the Roosevelt Mine quad), but specific location information is suppressed and it is unclear which species of bat may be present.	Low	Low
Yuma myotis (*Myotis yumanensis*)	BLM: Sensitive	Prefers open forests and woodlands. Requires water for foraging. Roosts in mines, caves, buildings, and crevices.	No roosting or foraging habitat available within the Project area.	Low	Low
Pocketed free-tailed bat (*Nyctinomops femorosaccus*)	CDFW: Species of Special Concern NECO Plan	Occurs in rocky areas with high cliffs in pine-juniper woodland, desert scrub, palm oasis, desert wash, and desert riparian habitat.	No suitable habitat in Project area.	None	None
Big free-tailed bat *Nyctinomops macrotis*	CDFW: Species of Special Concern	Occurs in arid, hilly regions. Roosts primarily in rock crevices in canyons but can also occasionally be found in buildings and caves.	No suitable habitat in Project area.	None	None

3.0 RISK ASSESSMENT

The primary risk categories to birds and bats posed by photovoltaic solar array development are primarily fatalities due to collision or electrocution through contact with array-associated power lines and tie lines and displacement associated with habitat loss. In addition, bird nests could be at risk during construction activities and during normal maintenance of generation and transmission facilities. Currently bat collision with power transmission and distribution facilities is not recognized as a potentially significant risk. Bats do not build nests. Anticipated risks to birds in general, eagles in particular, and bats will be discussed below within the context of risk factors within these categories.

3.1 Birds

3.1.1 Collision

Under certain conditions, transmission line collisions can be a major factor in avian mortality along utility corridors. Site-specific collision risk is affected by a number of independent factors. Factors that influence collision risk can be divided into three categories: those related to bird biology, those related to the environment, and those related to the configuration and location of transmission lines (APLIC 2006, Savereno et al. 1996).

Biological Factors Related to Bird Collisions

Biological factors include habitat use, body size, flight behavior, age, sex, and flocking behavior. Wetlands tend to have a high concentration of birds nesting, feeding, roosting, and migrating back and forth, and add to the collision risk if transmission lines are nearby (Bevanger 1994).

Many birds, especially raptors, will use transmission poles and towers as perches. This can conserve energy by lowering the amount of time dedicated to flying as the birds search for prey below (APLIC 2006). Bird species that spend an abundance of time in the air may face a greater risk than those that are predominantly ground-based (Bevanger 1994). For example, predators that fly at high speeds when tracking prey such as peregrine falcons or goshawks (*Accipiter gentilis*) may be more likely to collide with a power line. A bird's flight performance has been shown to be one of the most important factors determining the chances of collision with a transmission line, perhaps more important than the sheer frequency of birds flying near the lines (Janss 2000). Juvenile birds, which are not as familiar with the surrounding area and are less experienced in both flight and, in the case of raptors, hunting methods, can be expected to have greater likelihoods of colliding with transmission lines (Bevanger 1994, Bevanger 1998, Dorin and Spiegel 2005). However, larger birds also tend to be more likely to collide with power lines.

Environmental Factors Related to Bird Collisions

Environmental factors influencing collision risk include the effects of weather and time of day for transmission line visibility, surrounding land use practices that may attract birds, and human activities that may flush birds into transmission lines. Overcast weather or thick fog tend to cause birds to lower their flying altitudes. Likewise, headwinds generally cause birds to fly lower, whereas tailwinds may cause birds to fly higher (Bevanger 1994, Perdeck and Speek 1984). High winds may cause some species, especially waterfowl, to fly at lower elevations, increasing collision risk (Hunting 2002). If winds are blowing perpendicular to the wires, this can increase collision possibility even further (Hunting 2002). To the east of the Project area is the Lower Colorado River Valley. The Lower Colorado River Valley is in the Pacific Flyway, one of the four major migration flyways in North America, and is a globally important bird area (IBA) (Audubon 2011). The IBA consists of the Colorado River, associated riparian areas and marshes, and agricultural fields in the area. Waterfowl are known to move daily between water bodies and irrigated agricultural fields to forage (Randall et al. 2011). However, the Project would be to the west of agricultural fields in the Lower Colorado River Valley and would not place any Project

facilities between the river and irrigated agricultural fields. A previous study of avian migrants found that the lowest daily number of migrants was recorded on a day where the average wind speed was 15.5 miles per hour (mph) (Pope et al. 2006). If wind speeds become too strong, thermal formation may be disrupted, reducing the amount of migration through an area. Additionally, excessive cloud cover may also limit ground heating, reducing thermal wind formation and potentially causing a decline in migration of species that predominantly rely on thermals for movement, such as raptors (Pope et al. 2006). Depending on the visibility due to the aforementioned weather conditions or other factors such as rain, fog, or snow, transmission lines may be more difficult to see, increasing the likelihood of a collision (Mathiasson 1992). Visibility can also be affected by the time of day. Lines become increasingly difficult to see at times with poor lighting, such as night, dawn, or dusk, which may pose a greater risk to migratory species because they are not necessarily as familiar with a particular region as resident species. One study found that, during observations of waterfowl flights across a transmission line, out of 433 strikes, 432 occurred at night or during poor weather (Hunting 2002). A similar study at the Lake Sangchris-Kincaid Power Plant in Illinois found that only one in 250,000 waterfowl collided with the power lines during the day (Anderson 1978). Further studies by Stout and Cornwell (1976) also emphasize the risk that poor visibility poses to waterfowl in the midst of power lines. The Project area was selected as a solar generation site because of the prevalence of clear weather.

Wetlands, lakes, and streams are all potential "hot spots" for avian risk due to power lines because water is often used by birds to forage or congregate. However, the proposed power lines are not adjacent to surface water sources and therefore do not pose collision risks to birds as a result of these potential "hot spots." Based on migratory bird data collected from adjacent projects and data collected during the habitat assessment (POWER 2011), it was determined that the agricultural land within the Project site may be used as foraging habitat by raptors or waterfowl that are using the Colorado River. Stout and Cornwell (1976) found that in a review of reported non-hunting mortality of wild waterfowl from 1930 to 1964, 65% of collision mortalities were due to telephone and power lines. A study of migrating mute swans on the coast of Sweden found that, out of 54 swan flocks recorded during the observation period, six flocks had difficulty—but no collisions—crossing power lines, and four mortalities were observed by locals during the same period (Mathiasson 1992). Anderson (1978) postulated that the five factors that most influence waterfowl collision frequency with power lines are: 1) the number of birds present; 2) visibility; 3) species composition and behavior; 4) disturbance; and 5) familiarity with the area. Mathiasson (1992) determined that in his study, the rate of collisions was "mainly a factor of swan frequency and behaviour, and positioning of the wires in the landscape [sic]." Larger water bodies, such as the Colorado River, would theoretically attract more birds, and the more birds that are present, the higher the potential to have a collision with power lines. However, approximately 90,000 acres of irrigated agricultural land is within the Palo Verde Valley which is adjacent to the Colorado River and east of the Project site. Due to the existing suitable forage land east of the Project site and the distance from the Colorado River, it is assumed that migratory birds would only incidentally use the Project site for forage land and that these lands are of lesser value and importance for migratory bird foraging compared to lands closer to the River. If birds are attempting to fly through the area at night when visibility is very poor, especially if they are unfamiliar with the area's vertical spatial layout, the likelihood of a bird flying into one of the lines increases. Therefore, aquatic areas are a determining factor in the risk to avian species. As discussed above, the Project area is in desert scrub without any nearby aquatic features. In addition, the Project's solar generation facility and gen-tie line would not be located between waterfowl use areas. Collision risk to waterfowl species would be low.

Anthropogenic land use is a consideration in evaluating avian collision risk as these features may attract or push birds into areas that contain transmission lines. A simple stretch of highway, for instance, may be an attractive area to vultures or similar species because of the sheer amount of roadkill that is created. Agriculture may attract birds foraging in the vegetation or raptors foraging for crop pests. Relatively dense building clusters may push birds into areas with transmission lines because of the flight obstacles. The gen-tie line would be routed through an area dominated by sparse desert scrub with little

anthropogenic development. It would cross I-10 at its west end and parallel the highway for approximately one quarter mile. However, it would quickly diverge from the highway and be well over one mile from the highway for most of its remaining length. Because of the surrounding conditions and the limited extent of the gen-tie line near the freeway, roadkill is unlikely to cause birds to concentrate near the gen-tie line or drive them towards it. Collision risks associated with anthropogenic land uses is considered low.

Line-related Factors Related to Bird Collisions

Line-related factors include the configuration and location of the transmission line and transmission line placement with respect to other structures or topographic features. While it is believed that horizontal line configurations are less of an avian risk than vertical configurations (Bevanger 1994), power line structure design has not been sufficiently demonstrated to suggest a specific correlation with bird collisions (Janss 2000). However, there seems to be a positive relationship between the presence of a static wire and the number of bird collisions (Bevanger 1994, Savereno et al. 1996). It is thought that, in many cases, the bird sees the conductor wires, changes its altitude to avoid them, and subsequently collides with the thinner, less-visible static wire instead. Consequently, studies have demonstrated an average mortality decline of 50 to 60% when markers are placed on static wires in relation to when wires are left unmarked (Savereno et al. 1996).

Transmission line location can also play an important role in the risks imparted to birds. Generally, there is more of a risk in placing a transmission line corridor in an open area than against an existing backdrop (Bevanger 1994). The risks to birds flying across a single corridor in an open space become dependent not only on the line's visibility, but on the altitude of the bird and its ability to first see the intruding wires, and then change its flight pattern to avoid them. On the other hand, lines that are placed against existing lines or against a landscape reference are theoretically easier to avoid. Multiple lines going through one corridor prevent birds from having to continually change their flight patterns, allowing them to instead avoid several sets of lines all at once. Similarly, lines placed along the base of a cliff, a row of trees, a building, a bridge, or a similar barrier will theoretically help avoid collisions because birds are forced to change their altitude to avoid the impediment (Bevanger 1994). The simple parallel or perpendicular placement of transmission line corridors relative to avian flyways is also an influence on the risk that the lines pose. There tends to be a greater risk in putting lines in between areas necessary for life history, such as foraging and roosting, especially if the two areas are separated by a short distance (Bevanger 1994). If a line is placed near a ridgeline, the risk to avian species can increase. When horizontal winds get deflected upward by ridgelines, the resulting updrafts get used by raptors to gain elevation for gliding purposes. Raptors will also use thermals, which can rise to hundreds or thousands of meters, for gliding purposes (Pope et al. 2006). Lines that are placed near ridgelines can pose collision risks to birds that may be using updrafts or thermals in their migratory paths and may not see the transmission lines in time to maneuver out of the way. Alternatively, canyons or valleys may act as funnels for migrating birds, and can pose collision risks if lines cross perpendicular to the natural direction of flight. Research suggests that wind turbines placed near gullies may pose higher risks to birds passing through (Thelander and Rugge 2000). It may be reasonably assumed that transmission towers, poles, or lines pose a similar risk. If water is present, the issue may become further complicated because more birds have the potential to be attracted to the area as they are migrating through.

Bird collisions also tend to occur with transmission lines when migrant species travel at reduced altitudes near tall structures, such as transmission lines and towers. It is difficult to predict the magnitude of collision-caused bird mortality without extensive information on bird species and movements in the Project vicinity. These data are not available for the gen-tie line; however, the line is constructed on level desert terrain in proximity to existing similar lines and not near any feature that would concentrate avian movements. Based on a review of the known factors influencing avian transmission line collision risk, the proposed gen-tie transmission line does present risk but is not expected to substantially increase avian collision risk above current conditions.

3.1.2 Electrocution

The electrical design factor most crucial to avian electrocutions is the physical separation between energized and/or grounded structures, conductors, hardware, or equipment that can be bridged by birds to complete a circuit (APLIC 2006). Energized components would typically consist of phase conductors, while grounded components could include overhead static wires, neutral conductors, grounding conductors, grounded metal braces, or other pole or tower components. It appears that electrocutions are less common on transmission line towers, because line spacing is at a sufficient distance to lessen the chance of birds completing the electrical circuit (Dorin and Spiegel 2005). High mortality rates are associated with structures that have conductors situated over the crossarms (Janss and Ferrer 2001, Ferrer et al. 1991); Ferrer et al. (1991) found that the least dangerous structures possess insulators below the crossarms. Electrical transmission lines tend to electrocute avian species when the animal touches two conductors, or a positive conductor and a ground, at once, especially if the feather area is wet (Bevanger 1998). Hence, body size and behavior, such as perching and roosting on poles or wires, are the keys to understanding why and how birds become electrocuted. Species frequently affected by electrocution seem to include birds of prey, ravens, and thermal soarers (Bevanger 1998). The majority of raptor electrocutions are caused by power lines that are energized at voltage levels of 69 kV and below, whereas "the likelihood of electrocutions occurring at voltages greater than 69 kV is extremely low" (APLIC 2006).

Electrocutions are largely due to the bird perching on conductors and/or insulators and coming in contact with the energized conductor and grounded insulator base or bonding conductor. While wet feathers may raise the risk of electrocution for a bird by increasing conductivity, dry feathers provide insulation, meaning that in most cases birds are electrocuted when they bridge two energized or an energized and grounded piece of equipment with conductive fleshy parts such as the feet, mouth, bill, or wrists (APLIC 2006). Research has demonstrated that skin-to-skin contact is approximately ten times more dangerous to birds than the amperages conducted by contact between conductors and wet feathers, and approximately 100 times more dangerous than the conductivity between conductors and dry feathers (APLIC 2006). Wet feathers can conduct dangerous amperages beginning at around 5 kV, whereas dry feathers require currents greater than 70 kV before they will begin conducting current. High winds increase the problem by reducing the amount of control that birds have over their flight and landing patterns and increasing the risk that they will collide with transmission lines or accidentally bridge two components on a transmission structure and become electrocuted.

Because of the high voltages involved with the Project's internal and external transmission lines, electrocution is not a risk to even the largest bird species likely to occur in the Project area.

3.1.3 Displacement

Displacement of wildlife may occur due to habitat loss, habitat fragmentation, or avoidance of the area (through habitat changes or human disturbance). PV solar facilities can cover large areas of the landscape. Habitat fragmentation would clearly be an important consideration for solar developments proposed to occur within large, intact, contiguous natural vegetation communities. The Project array areas are sited on agricultural land (irrigated crops and orchards) and disturbed land with very little breeding and foraging habitat suitable for avian or bat species (except as noted above). The gen-tie line traverses more natural habitats of desert scrub and some displacement of breeding or foraging bird could occur during construction. Permanent habitat loss would be minimal within the gen-tie ROW; once completed transmission lines are passive structures not restricting avian or bat use in the area. Some potential for habitat fragmentation exists at the Project site but the potential risk does not appear to be high, because the history of land use in the area (i.e., agricultural land, urban development, interstate highway, transmission line corridor, and energy development), and the due to the nature of the development the lack of potential habitat

3.2 Eagles

3.2.1 Collision

Golden eagles are the largest avian species likely to occur in proximity to Project facilities. Golden eagles may forage widely over broad areas of low-relief desert habitat near steep, rocky roosting or nesting habitat. Bald eagles are larger, but typically forage near large water bodies. Although bald eagles may be found along the Lower Colorado River, some 8.5 miles east of the Project area, their probability of occurrence within the Project area is diminishingly small. For these reasons the following discussion will focus on golden eagles.

Among avian species of the region, golden eagles would be expected to be more susceptible to collisions with transmission elements, presumably due to their flight and foraging behavior. Healthy golden eagle populations contain breeders, juveniles, and "floaters"—subadults or adults that have not settled on a territory (Brown 1969, Hunt 1998, USFWS 2011). Floaters have been shown to be more vulnerable to collision than locally breeding adults and juveniles (Hunt et al. 1999, Hunt 2002). Population stability depends on the non-breeding population of floaters to replace breeding individuals that die (Hunt 1998, USFWS 2011).

Risk to eagles is influenced by four primary factors:

1) the amount of eagle use of the area,
2) residency status (dispersers, migrants, and floaters are at higher risk than resident adults and juveniles)
3) the interaction of topography, wind, and seasons (e.g., wind waves along upwind side of ridges and escarpments used for soaring, gliding, and kiting), and
4) behavior that distracts eagles (e.g., hunting or territorial interaction; USFWS 2011).

The Project area has no golden eagle nest territories recorded with 10 miles. In addition, the Project would be in an area of level terrain and desert scrub with no high relief rocky areas or large tress providing nesting habitat. Wide-ranging golden eagles could traverse the Project area during foraging forays, but this activity would be expected to be low. The Project area would fall within the lowest risk category for golden eagles based on the USFWS draft Eagle Conservation Plan Guidance (2011).

No specific risk to golden eagles is identified at this point. No biological, environmental, design, or operational factors have been identified by the USFWS or the Project developer that would increase specific risk to golden eagles. Nevertheless, if conditions change and increased golden eagle activity in proximity to Project gen-tie facilities is detected during monitoring, management of facilities for eagle safety would be adapted and this ABPP updated to further lower the risk to golden eagles. See Section 6.3 regarding adaptive management, specifically Section 6.3.1, Additional Risk Reduction Measures. In the unlikely event that eagle fatalities are observed at the BMSP area, the Proponents will perform appropriate mitigation (see Section 6.2 regarding fatality thresholds and Section 6.3 regarding adaptive management) and additionally consult with USFWS to determine if it is appropriate to apply for an eagle take permit under BGEPA. No necessity for pursuit of an eagle take permit exists at this time or is anticipated.

3.2.2 Displacement

Displacement of golden eagles may occur due to habitat loss, habitat fragmentation, or avoidance of Project elements. Golden eagle use of the Project area would be expected to be rare and incidental. The Project development areas present no nesting or foraging habitat features that would concentrate eagle activity. For most of its length, the gen-tie line would be over a mile to a mile-and-a-half from I-10. However, at its west end, the gen-tie line would cross the highway in an area of orchards, ruderal land, and an existing transmission line. There are no records indicating that increased road kill associated with

the highway in this area creates an opportunistic carcass food source for eagles. The gen-tie line would not be expected to displace golden eagles from an established food source. Because of the lack of golden eagle occurrence records and the fact that much of the solar site was orchards, the solar array sites would not likely have provided foraging habitat for golden eagles prior to development; this condition would be the same with the Project in operation.

For these reasons, the Project would present very low risk of golden eagle displacement.

3.3 Bats

3.3.1 Collision

Because they are volant, bats could be at some risk of colliding with either gen-tie line, transmission conductors, or PV solar facilities. The Project would be composed of static elements (or with elements that slowly track the sun during the day). Bats are highly maneuverable nocturnal echolocators that can effectively fly through highly cluttered environments.

No collision risk is expected.

3.3.2 Electrocution

All bats that could occur in the Project area or interact with Project energized facilities are small with wingspans less than 16 to 20 inches. It would be highly unlikely for bats to experience electrocution risk from phase to phase or phase to ground contact. The Project presents no electrocution risk for bats.

3.3.3 Displacement

Displacement has not been identified as a risk to bats in recent reviews of renewable energy facility impacts on bats (Kuvlesky et al. 2007, Arnett et al. 2008, Strickland et al. 2011). As most Project development areas consisted of orchards and crop fields, no bat roost habitat was removed or blocked by solar array development. It is possible that some tree roosting bats (either residents or migrants) could have used orchard trees as day roosts in a somewhat opportunistic fashion; however, tree bat species have generally low fidelity for roost sites (Lewis 1995) and groves are prevalent throughout the lower Colorado River Valley that could provide roost sites for displaced bats. No significant displacement risk is expected from the Project.

4.0 PROJECT DESIGN STANDARDS AND IMPACT-REDUCING CONSERVATION MEASURES

4.1 Project Design Features

In general PV solar projects are passive facilities that are low to the ground (within ten feet) and do not present any intrinsic dangers to avian or bat species. With proper siting, design and management through coordination with USFWS and other resource agencies (e.g., CDFW), risk to these species can be further reduced. The BMSP has integrated a number of design standards and best management practices to avoid and reduce impacts to all wildlife (including avian and bat species) during construction and operation. These include, at the coarsest scale, proper siting of facilities on previously-disturbed lands and lands unlikely to concentrate avian or bat activity to the maximum extent possible, design energized facilities using industry accepted standards for avian safety, and the following integrated BMPs:

- **Fire Management and Protection Plan.** As required by existing law (Title 8 California Code of Regulations [CCR] Section 3221), a Fire Management and Protection Plan would be developed in consultation with the Riverside County Fire Department to identify potential hazards and accident scenarios that would exist at the facility during construction, operation, and decommissioning of

the Project. The Plan would include the identification of the following: potential fire hazards and ignition sources; proper handling and storage of potential fire hazards; control of potential ignition sources; persons responsible for equipment and systems maintenance; location of portable fire extinguishers; automatic sprinkler fire suppression system; water-spray fire system; coordination with local fire department; and recordkeeping requirements.

- **Gen-tie lines.** Gen-tie line support structures and other facility structures shall be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This design would minimize avian risk and would provide the added benefit of not increasing the potential for increased predation of special-status species, such as the desert tortoise be not creating structures that enhance perching or nesting opportunities for ravens or other tortoise predators. Mechanisms to visually warn birds (permanent markers or bird flight diverters) shall be placed on gen-tie lines at regular intervals to prevent birds from colliding with the lines. To the extent practicable, the use of guy wires shall be avoided because they pose a collision hazard for birds and bats. Necessary guy wires shall be clearly marked with bird flight diverters to reduce the probability of collision. Shield wires shall be marked with devices that have been scientifically tested and found to significantly reduce the potential for bird collisions. Gen-tie lines shall utilize non-specular conductors and non-reflective coatings on insulators.

- **Integrated Weed Management Plan.** In compliance with the Federal Noxious Weed Act, the Plant Protection Act, the California Food and Agricultural Code, and the BLM's requirement for a Project-specific integrated weed management plan for the control of noxious weeds and invasive plant species would be prepared. The plan would identify presence, location, and abundance of weed species in the Project area and surrounding area adjacent to the Project, as well as identify suppression and containment measures to prevent the spread of weed species and introduction of weed species. Prevention techniques would include: limiting disturbance areas during construction to the minimum required to perform work; limiting ingress and egress to defined routes; maintaining vehicle wash and inspection stations; and closely monitoring the types of materials brought on site to minimize the potential for weed introduction. During operations, noxious and invasive weed management will be incorporated as a part of mandatory site training for groundskeepers and maintenance personnel. Training will include weed identification and the impacts on agriculture, wildlife, and fire frequencies. Training will also cover the importance of preventing the spread of noxious weeds and of controlling the proliferation of existing weeds.

- **Plants and wildlife.** In compliance with the California Department of Fish and Wildlife Codes, while on the Project property, workers or visitors would be prohibited from: feeding wildlife; moving live, injured, or dead wildlife off roads, ROWs, or the Project site; bringing domestic pets to the Project site; collecting native plants; and harassing wildlife. Areas where wildlife could hide or be trapped (e.g., open trenches, sheds, pits, uncovered basins, and laydown areas) would be minimized. For example, an uncovered pipe that has been placed in a trench should be capped at the end of each workday to prevent animals from entering the pipe. If a special-status species is discovered inside a component, that component must not be moved, or, if necessary, moved only to remove the animal from the path of activity, until the animal has escaped. As open trenches could impede the seasonal movements of large game animals and alter their distribution, they would be backfilled as quickly as possible. Open trenches could also entrap smaller animals; therefore, escape ramps would be installed along open trench segments at distances identified in the applicable land use plan or by the best available information and science. If traffic is being unreasonably delayed by wildlife in roads, personnel would contact the Project biologist, who will take any necessary action.

- Any vehicle-wildlife collisions would be immediately reported to the Project biologist. Observations of potential wildlife problems, including wildlife mortality, would be immediately reported to the BLM or other appropriate agency authorized officer.

4.2 Proponent-Committed Conservation Measures

This section identifies voluntary conservation and impact minimization measures that the Proponents have committed to carry out for the BMSP. These measures were derived through coordination with USFWS and a review of the USFWS *Region 8 Interim Guidelines for the Development of a Project-Specific Avian and Bat Protection Plan for Solar Energy Plants and Related Transmission Facilities* (USFWS 2010). These integrate effective design, construction and operation measures to reduce impacts to bird and bat species and their habitats during construction and operation of the facility. The following measures will be implemented to minimize risk to bird and bat species:

1) Solar arrays for the Project are located on disturbed land used primarily for agriculture. This limits direct loss of bird and bat habitat.
2) All Project generation and transmission elements are located on a level alluvial mesa, far from topographical relief. This characteristic limits transmission line conflicts with raptor flight paths, which often follow the upwind side of ridges and escarpments.
3) The erection of guyed structures is prohibited to reduce avian and bat collision risk.
4) No FAA lighting will be used at the Project site.
5) Where possible, existing roads were used for access roads. New access road construction will be minimized. This limits habitat loss, fragmentation, and displacement.
6) Vegetation clearance and ground surface disturbance will be minimized and within defined and approved work limits.
7) During construction, vegetation clearance will be conducted outside the breeding season to the maximum extent feasible. Pre-construction avian surveys will be conducted in appropriate habitats prior to any human disturbance or ground disturbing activities.
8) In the event that ground disturbing activities are to occur in suitable avian nesting habitat during the breeding season (February 1 to September 15), pre-construction clearance surveys for nesting birds will be conducted by qualified biologists. Identified nests of migratory birds (other than raptors) will be flagged for avoidance with a 300-foot buffer. Work activities will be prohibited within this buffer until the Project biologist determines that the nest has failed or the young have fledged. Activity associated with this nest identification and monitoring will be recorded on appropriate reporting forms (Appendix C).
9) Identified active nests will be avoided up to a distance of 5 miles for golden eagles and up to 600 feet for all other raptors. All construction disturbing activities will be prohibited within this distance to the maximum extent possible during the breeding season (January 1 to July 15, as determined by the Project biologist). Any reduction in this buffer distance will require specific coordination with USFWS.
10) Any nighttime construction will be generally avoided and specifically prohibited within the migratory bird breeding season.
11) Specific measures detailed in the western burrowing owl mitigation and monitoring plan are included here by reference, see Appendix A. Burrowing owls have been identified to occur with Project development areas. Ground disturbing activities will be scheduled to avoid the burrowing owl breeding season (i.e., scheduled to occur between September 1 and January 31). Burrowing owl clearance surveys will be conducted 30-days prior to initial site disturbance within suitable habitats.
12) No Project element will create bat day or night roost sites or provide open water sources that may be attractive to bats or birds.
13) Lighting at the operation and maintenance (O&M) facility and the substation are kept to a minimum to avoid confusing birds or attracting bats. Specifically, the lights at the O&M facility

are downward directed floodlights. Lights at the substation are switched on manually and only used during rare occasions when someone is at the substation at night.

14) Vehicle collision risk to wildlife will be minimized by driving at appropriate speeds within the Project. BMSP will implement a 25 mph speed limit at the Project for site personnel.
15) Garbage at the site will be properly managed to avoid creating an attractive nuisance for bird species.
16) Personnel will remove or bury carcasses found on site that might attract eagles and other avian scavengers.
17) Removal of inactive non-raptor nests from solar generating facilities will occur outside the breeding season
18) The Project will operate under and approved fire management plan to reduce further habitat loss caused by Project-started wildfire.
19) Following the useful life of the Project (likely about 25 years), BMSP will either repower with some future technology or return to the site to agricultural use.

It should be noted that because of the existing conditions of the Project area as developed lands and the low potential for risk to avian and bat species, USFWS advised that a Habitat Equivalency Analysis not be performed for the BMSP (USFWS October 22, 2012 personal communication; see Table 1). Thus, no habitat acquisition, conservation easements or compensatory acreages are developed as part of this ABPP.

4.3 Additional Pre-Construction Surveys and Monitoring

General Avian Species Use: Numerous bird surveys have been completed by solar projects and proposed solar projects surrounding the Project area, including the withdrawn Solar Millennium proposed project (EDAW AECOM and Bloom Biological 2009). For the non-agricultural land within the Project area, information on late spring migrant songbirds and resident birds in native habitats (i.e., Sonoran creosote shrub scrub and desert dry wash woodland) is readily available (EDAW AECOM and Bloom Biological 2009).

Based on migratory bird data collected from adjacent projects, it was assumed that the agricultural land within the Project site may be used as foraging habitat (AECOM 2009). However, due to the existing suitable forage land east of the Project site and the distance from Colorado River habitats (approximately 8.5 miles), it is assumed that migratory birds would only incidentally use the Project area for forage land and that these lands are of lesser value and importance for migratory bird foraging compared to lands closer to the river.

Based on the review of data from surrounding projects and observations in the field of low quality avian habitat on the Project site, avian point count surveys were not conducted during environmental evaluation. Conducting point count survey during environmental review would only provide a snapshot of the migratory species potentially using the site and not aide in species protection during construction and operation; abundance and species diversity would be expected to vary widely each year. However, since it is presumed (based on existing information) that migratory bird species may use the Project site in at least a transient fashion, preconstruction nesting surveys would be conducted. The purpose of these preconstruction surveys is to avoid or minimize specific construction-related impacts on bird species that may be present. (See general pre-construction nesting survey protocol, Appendix B, and nest monitoring forms, Appendix C.)

Western Burrowing Owl: During environmental evaluation, baseline surveys for western burrowing owls were conducted. POWER biologists and Garcia and Associates, Inc. biologists conducted pedestrian survey transects for burrowing owls spaced at approximately 100 feet to allow for 100% visual coverage of suitable habitat within the study area. Where necessary, transect spacing was reduced or expanded to account for differences in terrain, vegetation density, and visibility. Survey methods were derived from generally accepted professional standards, the 1993 California Burrowing Owl Consortium (CBOC)

Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993), and the 1995 California Department of Fish and Game (CDFW) Staff Report on Burrowing Owl Mitigation (CDFW 1995). A methodical pedestrian survey for owl burrows was conducted by walking through areas of suitable habitat within the study area, including man-made structures.

The locations of all potential owl burrows and sign were recorded and mapped using handheld global positioning devices and aerial imagery. Incidental observations of other avian species, plants and other wildlife were also noted. The presence of each observed wildlife species was based on direct observation of individual(s), sign, and/or vocalization. CBOC survey protocols and POWER's full methodology and results are described in the burrowing owl survey report (POWER 2011). As part of ABPP development, these data were used to inform agency coordination, identify initial voluntary mitigation and in the preparation of the Western Burrowing Owl Mitigation and Monitoring Plan (Appendix A).

Golden eagle: A review of existing information, including CNDDB records and previous studies, shows that Golden eagle active nests are not located within 10 miles of the Project site. Existing data and reports from the Blythe Solar Power Project (AECOM 2010) also indicated no Golden eagles within 10 miles of their project site. Based on the existing records and the reconnaissance survey, no further survey is proposed for the Project. If changes are observed, revisions to this ABPP will be incorporated.

Bats: A reconnaissance survey was conducted to help determine the potential for bat species to occur within the Project area. The Project site is in an area dominated by either agriculture or sparse desert scrub over lying deep Pleistocene-aged alluvium with little topographic relief. Foraging habitat is limited and roosting habitat is absent. Based on the results of the reconnaissance survey and lack of suitable habitat, no focused surveys are recommended. Bats may use the Project site in an incidental fashion as seasonal transients or migrants.

5.0 OPERATIONAL BIRD AND BAT MONITORING AND REPORTING

The primary objective of the operational (i.e., post-construction) avian and bat monitoring is to monitor undesirable nest construction on Project equipment and estimate the annual number of avian and bat fatalities attributable to the Project. These data will provide a measure of plan efficacy and inform adaptive management. Because of the presumed low risk potential for the site, this ABPP does not direct the assignment of a full-time operational Project biologist. BMSP will implement a wildlife reporting system to document incidentally found bird and bat fatalities and to monitor for significant fatality events. The site manager will lead the program. Site personnel will be trained to follow the wildlife reporting system procedures and complete the wildlife reporting form. Post-construction monitoring will be conducted by facility operators and field engineers during normally scheduled activities.

Personnel will complete searches of solar arrays within the Project development area as part of normal maintenance and line patrols of the gen-tie line. Searches will consist of walking around solar generation structures to identify carcasses of birds or bats or nesting materials on equipment. Bird nest monitoring and reporting forms for gen-tie line and the solar array are provided in Appendix D. When a dead or injured bird or bat is found, a wildlife incident reporting form will be filled out (Appendix E) and turned in to the site manager. Personnel without the appropriate federal and state permits will not move or transport dead or injured birds. Bird carcasses (except for raptors) can be buried on site but not transported without a permit.

Injured birds and bats will not be handled by personnel. If an injured raptor or sensitive species is found, the CDFW will be contacted to determine whether a rehabilitator should come pick up the injured animal.

Bird nests constructed on site equipment can lower efficiency, create operational problems, and lead to down time (outages) and safety issues. Because the solar facilities and gen-tie line provide vertical

structure over a fairly large area, the probability exists for birds to occasionally attempt nest construction on equipment. Workers should be diligent in observing attempts by bird to construct nests on equipment during the breeding season. BMSP personnel are not authorized to remove active nests or destroy young birds at this time. In the event that an active nest is observed on equipment, BMSP personnel will contact CDFW and USFWS for direction. Note that inactive nests of all non-raptors can be removed outside the breeding season without a depredation permit.

Each year, a concise annual report will be provided to USFWS, briefly summarizing each year's wildlife reporting system findings. If a significant fatality event is discovered (e.g., any eagle fatality, more than three raptors in a single event, more than ten birds or bats in a single event) or nesting attempts reach a nuisance level, the site manager will contact environmental contractors (if any), and the USFWS as soon as possible for coordination.

6.0 POST-CONSTRUCTION MITIGATION AND ADAPTIVE MANAGEMENT

6.1 Adaptive Management Process

Adaptive management is an iterative process in which impact minimization and mitigation measures are continuously reevaluated in order to improve them. As action is taken the results are monitored and future actions are modified accordingly. This is an especially useful strategy for managing resources where uncertainty surrounds appropriate management actions and there consequences. Because utility-scale solar energy development is a relatively new and rapidly expanding industry, its effect on bird and bat populations is uncertain. There is also uncertainty surrounding current fatality predictions as well as which measures are most effective at reducing fatalities and mitigating impacts to bird and bat populations. As more data is gathered at facilities and new strategies are tested, these uncertainties will be reduced and agency guidance will be refined.

The Proponents are committed to incorporating adaptive management principles into its ABPP. To facilitate the adaptive management process, BMSP will submit timely reports to USFWS and CDFW summarizing results of operational monitoring and the wildlife reporting system. Fatality thresholds will be used to determine when adaptation is required. When a threshold is surpassed, BMSP will evaluate the species, timing, and locations of fatalities and consult with USFWS to determine if additional avoidance or minimization measures are appropriate. If thresholds are surpassed again, compensatory plan measures will be triggered, along with additional avoidance and minimization measures. As part of the adaptive management process, the thresholds may be adjusted if new information is gained regarding the number of solar facility fatalities necessary to significantly impact bird or bat population trends and the extent to which solar facility fatalities are compensated by density-dependent demographic factors (e.g., lower natural mortality or higher productivity). An initial set of avoidance and minimization, are proposed to be implemented if thresholds are surpassed; measures may be replaced with measures of similar scope and cost if more effective measures become available and are deemed appropriate to the specific circumstances surrounding the fatality patterns identified at the Project site.

6.2 Avian and Bat Fatality Thresholds

The identification of fatality thresholds to trigger mitigation is an unavoidably arbitrary process developed through agency coordination and mutual agreement. Most solar energy facilities are unlikely to significantly impact populations of most species. But population effects may be difficult to identify, particularly for some species, such as bats, for which populations are not well understood. With continued rapid growth of renewable generation facilities, cumulative impacts may become an important concern. It is prudent to mitigate bird and bat fatalities in situations where unusually high numbers of fatalities occur.

Based on a review of western renewable generation facilities (including wind farms) the following initial thresholds have been developed. During formal post-construction monitoring at BMSP, fatality estimates, expressed as fatalities/MW/year, will be reported in annual reports. The thresholds that will trigger adaptation and mitigation measures are as follows:

1) more than four total native bird fatalities/MW/year,
2) more than 0.3 raptor fatalities/MW/year,
3) more than one golden eagles across entire project,
4) more than one active raptor nest constructed on generating equipment,
5) more than three bat fatalities/MW/year, or
6) more than ten active non-raptor nests requiring removal

6.3 Additional Risk Reduction Measures and Adaptive Management

If events are demonstrated to exceed any of the identified thresholds, and upon consultation with USFWS, adaptation may be triggered. Adaptation will include investigation, evaluation of the factors associated with the fatalities, exploration of engineering solutions, consideration of available avoidance and minimization measures, and likely implementation of one or more appropriate avoidance and minimization measure. If the same threshold is surpassed again, additional plan measures may be triggered.

It is important to note that the implementation of clean solar energy generation is in and of itself a difficult to quantify but nonetheless compensatory mitigation measure. ABPPs are designed to address proximate impacts to wildlife but ultimate project benefits to the ecosystem are part of the Project's purpose. When solar energy substitutes for fossil fuel energy sources, the result is a net decrease in toxic air emissions. In turn, the decrease of pollutant emissions reduces many broad scale harmful effects to wildlife. The Proponents are also committed to reducing direct impacts to local wildlife populations by implementing appropriate avoidance, minimization, and mitigation measures.

In the event fatality thresholds are surpassed, additional compensatory measures will be implemented by BMSP as discussed below.

6.3.1 Additional Risk Reduction Measures

In the event that the above thresholds are met, the following adaptive measures will be implemented to reduce impacts. This ABPP will be updated to reflect the additional measures and monitoring for efficacy will be conducted for three years following implementation.

- Installation of remedial avian protection equipment (bird flight diverters or perch preventers or dissuaders) in problem areas. Provide annual budget for such equipment
- Manage, monitor and remove potential bird nesting materials near solar arrays
- Modification of existing equipment to prevent nesting, perching or other undesired bird access
- Obtain necessary Federal and State permits for problem nest removal
- Formal, systematic fatality monitoring along the gen-tie line or within problem areas at the array facilities
- Employ a dedicated and qualified site biological monitor either full-time or seasonally, depending on the specific issue identified

7.0 LITERATURE CITED

AECOM. 2009. Blythe Solar Power Project Application for Certification. Submitted by Solar Millennium, LLC to the California Energy Commission.

Anderson, W.L. 1978. Waterfowl Collisions with Power Lines at a Coal-Fired Power Plant. Wildlife Society Bulletin 6(2): 77-83.

Avian Power Line Interaction Committee (APLIC). 1994. *Mitigating Bird Collisions with Power Lines: The State of the Art in 1994.* Edison Electric Institute. Washington, D.C.

2005. Avian Protection Plan (APP) Guidelines. APLIC and the U.S. Fish and Wildlife Service.

_____. 2006. *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006*. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, D.C. and Sacramento, CA.

Bevanger, K. 1994. Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. Ibis 136: 412-425.

California Natural Diversity Data Base (CNDDB). 2011. California Natural Diversity Data Base. Element occurrence search for Project area quadrangles.

California Energy Commission. 2010. Genesis Solar Energy Project Application for Certification Supplemental Information. March 2010. California Energy Commission Docket Number 09-AFC-8.

Dorin, M. and L. Spiegel. 2005. Assessment of Avian Mortality from Collisions and Electrocutions. California Energy Commission. CEC-700-2005-015.

Ferrer, M., M. de la Riva, and J. Castroviejo. 1991. Electrocution of Raptors on Power Lines in Southwestern Spain. Journal of Field Ornithology 62(2): 181-190.

Hunting, K. 2002. A Roadmap for PIER Research on Avian Collisions with Power Lines in California. California Energy Commission. P500-02-071F.

Janss, G.F.E. 2000. Avian mortality from power lines: a morphologic approach of a species-specific mortality. Biological Conservation 95: 353-359.

Mathiasson, S. 1992. Mute Swans, Cygnus olor, Killed from Collision with Electrical Wires, a Study of Two Situations in Sweden. Environmental Pollution 80: 239-246.

Perdeck, A.C. and G. Speek. 1984. A Radar Study on the Influence of Expected Ground Speed, Cloudiness and Temperature on Diurnal Migration Intensity. Ardea 72: 189-198.

Savereno, A.J., L.A. Savereno, R. Boettcher, and S.M. Haig. 1996. Avian Behavior and Mortality at Power Lines in Coastal South Carolina. Wildlife Society Bulletin 24(4): 636-648.

Southern California Edison. 2009. First Solar Electric, Blythe, California Environmental Assessment Initial Study. February, 2009. County of Riverside EA40219.

_____. 2010. Devers-Palo Verde No. 2 Transmission Line Project Colorado River Substation Expansion Final Supplemental Environmental Impact Report. April 2010.

Stout, I.J. and G.W. Cornwell. 1976. Nonhunting Mortality of Fledged North American Waterfowl. The Journal of Wildlife Management 40(4): 681-693.

TetraTech Environmental, Inc. 2010. Genesis Solar Energy Project Supplemental Information. June 2010. California Energy Commission Docket Number 09-AFC-8.

_____. 2012. *McCoy Solar Energy Project Biological Resources Technical Report.* Prepared for McCoy Solar, LLC, December 2012.

Thelander, C.G. and L. Rugge. 2000. Avian Risk Behavior and Fatalities at the Altamont Wind Resource Area, March 1998 to February 1999. Prepared for National Renewable Energy Laboratory. NREL/SR-500-27545.

United States Department of the Interior, Fish and Wildlife Service (USFWS). 2003. MBPM-2. Migratory Bird Permit Memorandum. Online. Available at: http://www.fws.gov/policy/m0208.pdf

_____. 2007. National Bald Eagle Management Guidelines. U.S. Fish and Wildlife Service. May 2007. Online. Available at: http://www.fws.gov/pacific/eagle/NationalBaldEagleManagementGuidelines.pdf

_____. 2010. Region 8 Interim Guidelines for the Development of a Project-specific Avian and Bat Protection Plan for Solar Energy Plants and Related Transmission Facilities. Pacific Southwest Region. September 2.

APPENDIX A: WESTERN BURROWING OWL MITIGATION AND MONITORING PLAN

THIS PAGE INTENTIONALLY LEFT BLANK

December 2012

BLYTHE MESA SOLAR PROJECT

Western Burrowing Owl Monitoring and Mitigation Plan

PROJECT NUMBER:
122512

PROJECT CONTACT:
Vanessa Santistevan
EMAIL:
vanessa.santistevan@powereng.com
PHONE:
(303) 716-8908

POWER ENGINEERS

AR061276

PREPARED FOR: RENEWABLE RESOURCES GROUP
LOS ANGELES, CALIFORNIA

PREPARED BY:
POWER ENGINEERS, INC.
VANESSA SANTISTEVAN

CONTENTS

1.0 INTRODUCTION 1

1.1 PROJECT DESCRIPTION 1
1.2 REGIONAL SETTING 2
1.3 LOCAL SETTING AND SURROUNDING LAND USES 7

2.0 WESTERN BURROWING OWL OVERVIEW 7

2.1.1 Burrowing Owl Survey Results 8
2.1.2 Burrowing Owl Impacts 10

3.0 WESTERN BURROWING OWL AVOIDANCE MEASURES 13

3.1 MONITORING AND REPORTING PROGRAM 13
3.1.1 Pre-construction Burrowing Owl Surveys 13
3.1.2 Biological Monitors 13
3.2 WORKER'S EDUCATION AWARENESS PROGRAM 13
3.3 AVOIDANCE 14
3.4 EXCAVATION OF INACTIVE BURROWS 14
3.5 PASSIVE RELOCATION FROM THE PROJECT AREA 14
3.5.1 Artificial Burrow Installation in Relocation Area 14
3.5.2 Passive Relocation and Exclusion Methodology 15
3.5.3 Relocation Mitigation Management Plan and Vegetation Management Goals 15
3.5.4 Reporting 16
3.5.5 Western Burrowing Owl Compensation Lands 16

4.0 CONTINGENCY PLANNING AND PROGRAM CONTACTS 19

5.0 LITERATURE CITED / REFERENCES 20

FIGURES

Figure 1. Site Plan 3
Figure 2. Regional Area Project Location Map 5
Figure 3. Focused Burrowing Owl Survey Area, Observed Owls, Burrows and Sign 11
Figure 4. Potential Burrowing Owl Mitigation Land 17

TABLES

Table 1. Vegetation Communities and Cover Types (Acres) 7
Table 2. Adjacent Project Survey Information 8
Table 3. CDFG Burrowing Owl Buffer Recommendations 14

APPENDICES

Appendix A: Artificial Burrow Design
Appendix B: Best Management Practices
Appendix C: Survey Results

ACRONYMS AND ABBREVIATIONS

˚F	Fahrenheit
AMSL	above mean sea level
BLM	United States Department of the Interior, Bureau of Land Management
BMSP	Blythe Mesa Solar Project
CBOC	California Burrowing Owl Consortium
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
CNWR	Cibola National Wildlife Refuge
EIR/EA	Environmental Impact Report/Environmental Assessment
GPS	Global Positioning System
km	kilometers
kV	kilovolt
MBTA	Migratory Bird Treaty Act
mph	miles per hour
MW	megawatt
POWER	POWER Engineers, Inc.
PV	photovoltaic
RRG	Renewable Resources Group, LLC
USGS	U.S. Geological Survey

1.0 INTRODUCTION

POWER Engineers, Inc. (POWER) prepared this western burrowing owl (*Athene cunicularia hypugaea*) mitigation monitoring plan for Renewable Resources Group, LLC (RRG) as part of the proposed Blythe Mesa Solar Project (BMSP, Project). The western burrowing owl (burrowing owl) is a Bureau of Land Management (BLM) Sensitive species, California Department of Fish and Game (CDFG) Species of Special Concern, and is protected under the federal Migratory Bird Treaty Act (MBTA). Reconnaissance and protocol surveys were conducted to determine if the proposed Project could affect the protected western burrowing owl. The Study Area for the purposes of this document is delineated on Figure 2 and includes a 125-foot proposed right-of-way along the transmission line and a 500-foot (150-meter) wide buffer around the solar facility site. The Study Area supports a relatively small population of burrowing owl, and supports burrowing owl that may occupy habitat outside of the Study Area limits. The July 2011 protocol surveys found eight individual burrowing owls present within the study area that may be directly or indirectly affected by the Project (POWER 2011).

The study area is located in eastern Riverside County, California near the City of Blythe. The proposed Project consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar facility and 73 acres for the 230 kilovolt (kV) transmission line interconnect. POWER conducted the surveys throughout the Study Area.

This Burrowing Owl Monitoring and Mitigation Plan (Plan) has been developed to describe monitoring, reporting, and management of the burrowing owl during the construction, operation and maintenance (O&M), and decommissioning of the proposed Project, as required by the BLM, CDFG, and County of Riverside. It has been prepared following the 2012 CDFG Staff Report on Burrowing Owl Mitigation (CDFG 2012), and describes a multi-tiered approach to prevent or reduce impacts during construction and operation of the Project. While avoidance measures often focus on protecting animals by making adjustments to construction activities near occupied burrows, moving individuals out of harm's way to off-site locations is sometimes the best alternative. Based on the survey results, there is a small population of approximately eight individuals that was identified within the study area (POWER 2011). It may be necessary to move individuals out of harm's way when they are within the portion of the Project area scheduled for construction. This Plan is designed to provide an effective but feasible strategy that would avoid, minimize, and mitigate potential Project impacts to the burrowing owl.

1.1 Project Description

The Blythe Mesa Solar Project is proposing to construct a 485 MW solar PV electrical generating facility and 8.4-mile gen-tie line that would occupy a total of 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587acres for the solar facility component and 73 acres for the 230 kV gen-tie line. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison (SCE) Colorado River Substation, an approved new substation located south of Interstate 10 (I-10) and approximately 5 miles west of the Project site.

The proposed project site plan consists of the following components (Figure 1):

- Solar array field utilizing single axis solar PV trackers
- System of interior collection power lines located between inverters and substations
- Three on-site substations (each approximately 300 feet long by 300 feet wide)
- Two O&M buildings (approximately 3,500 square feet each)
- Two primary off-site access roads and several interior access roads

- 4.8 miles of 230 kV double-circuit transmission line between the solar facility and Colorado River Substation, which would be within a 125-foot-wide right-of-way

1.2 Regional Setting

The 3,660-acre site is five miles west of Blythe and consists mostly of agricultural land, including both irrigated and non-irrigated crops. The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles (see Figure 2). The Project is located on:

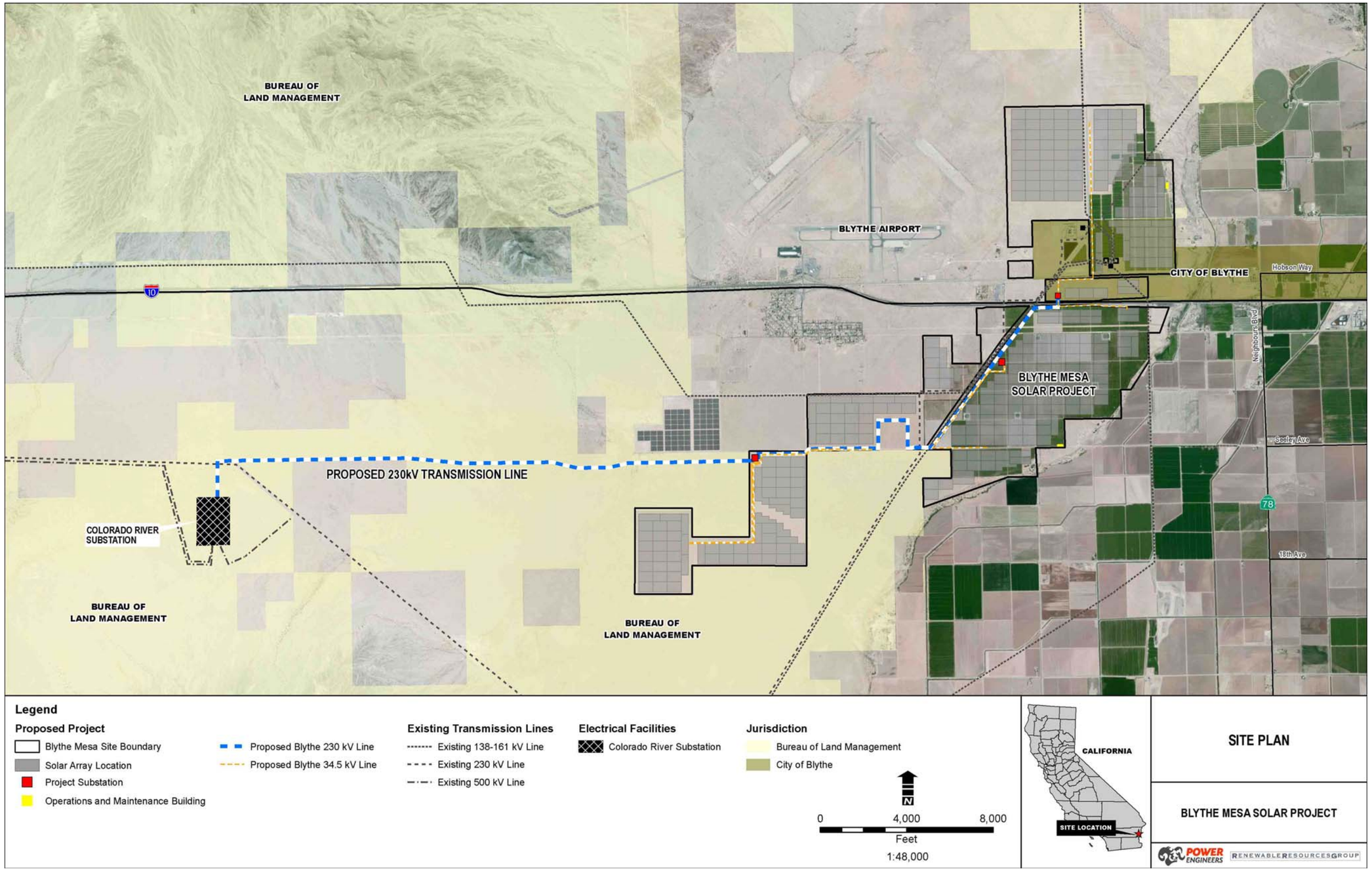
- Sections 11 and 12 of Township 7 South, Range 21 East
- Sections 3, 4, 5, 6, 8, 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

State Highway 10 bisects the Project area, which is bounded on the north and south by undeveloped desert, on the east by agricultural lands, and on the west by the Blythe City Airport and undeveloped desert.

The Project area is located on the western mesa of the Palo Verde Valley. The valley is a portion of the Colorado River floodplain. The Project area is on Palo Verde Mesa and is situated in the greater Sonoran Desert. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The Project area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert.

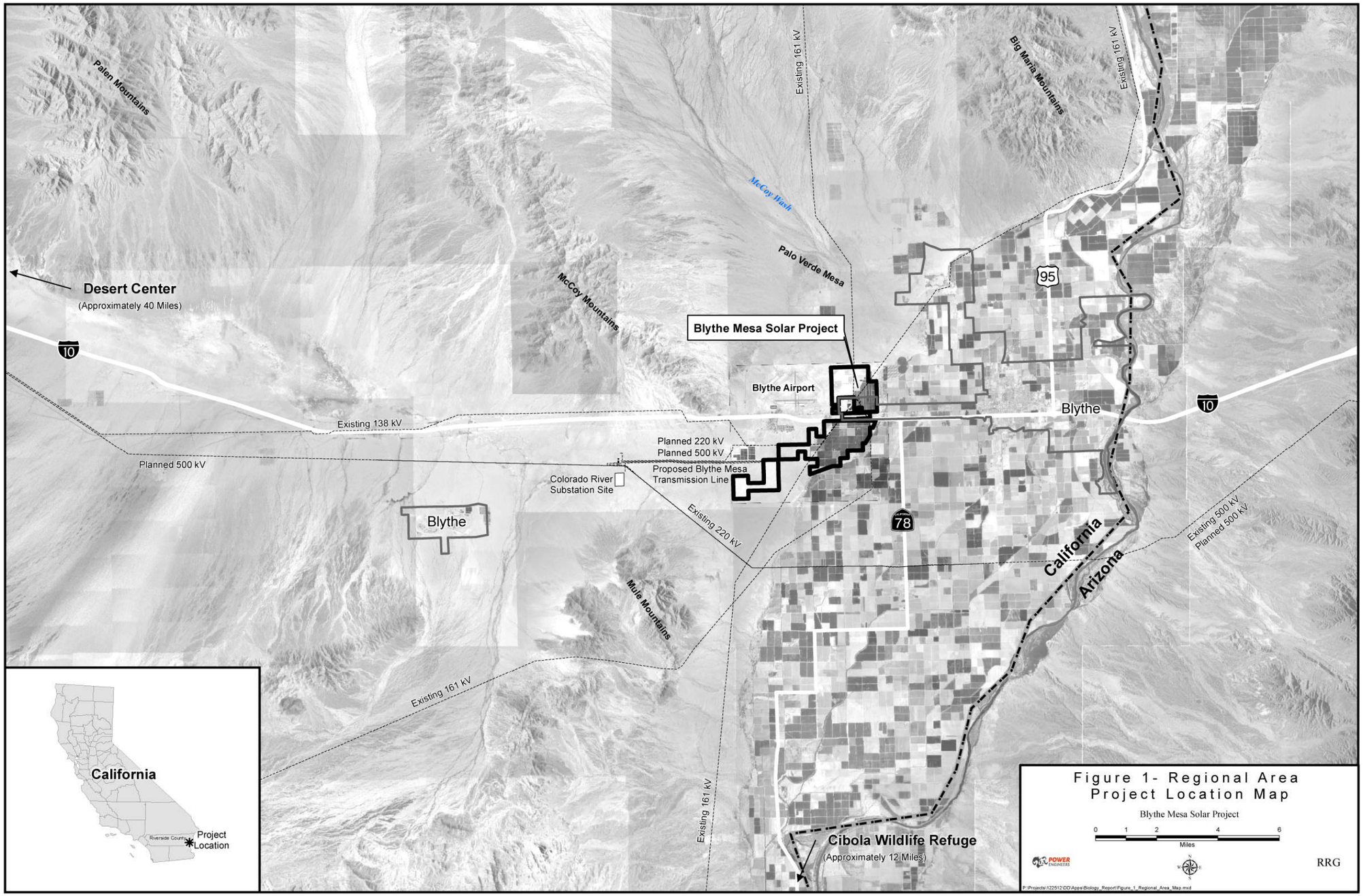
The subtropical climate of the Colorado Desert is currently characterized by dry, mild winters averaging 45 degrees Fahrenheit (˚F) and dry, hot summers that average 104˚F. Summer highs are known to reach up to 120˚F. Precipitation ranges between two and ten inches per year, with most of the precipitation occurring between November and March. Although rainfall occurs primarily in the winter months, the region is periodically influenced by tropical weather conditions, including sudden monsoonal summer storms, which typically occur from July to later September.

FIGURE 1. SITE PLAN



THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 2. REGIONAL AREA PROJECT LOCATION MAP



THIS PAGE INTENTIONALLY LEFT BLANK

1.3 Local Setting and Surrounding Land Uses

The Study Area encompasses land ranging from 260 to 400 feet AMSL. The topography on site is generally flat with gentle relief formed by desert alluvial flow patterns.

The Study Area consists primarily of agricultural lands and desert scrub. Along the four-mile transmission line route and eastern and southern ends of the Project limits there are discrete areas of disturbed native creosote scrub and disturbed stabilized dune and blow sand habitats. Table 1 presents the estimated acreage observed for each habitat type within the study area. This data does not represent the actual proposed Project disturbance footprint for the solar array areas, transmission lines, substations, and facility buildings and roads.

Table 1. Vegetation Communities and Cover Types (Acres)

Vegetation Communities and Other Cover Types	Acreage on the Solar Facility Site Project Boundary*	Acreage on the Proposed Gen-tie Line**
Bajada	18.1	0.0
Creosote Bush Scrub	41.9	278.8
Desert Riparian Woodland Wash	0.0	22.9
Disturbed Creosote Scrub	220.1	0.0
Disturbed/Ruderal	31.2	0.5
Fallow Agriculture	249.7	0.0
Irrigated Alfalfa	404	0.0
Irrigation Pond	17.2	0.0
Mixed – Drip-irrigated Jojoba and Disturbed Creosote Scrub	347	0.0
Non-irrigated Wheat	1088.2	0.0
Orchard	1188.4	0.0
Total Acreage	3605.8 acres	302.1 acres

*The acreage was calculated using GIS data and totals 3,605 acres; however, the County calculates the same area as 3,587 acres.
**A 250-foot buffer was placed on either side of the gen-tie centerline to account for potential indirect and direct impacts to biological resources.

As listed above, approximately 70% of the solar facility area is actively cultivated agricultural land, 24% is previously disturbed by agricultural or military activities, and 6% remains undisturbed. Agricultural land use within the solar facility site includes drip-irrigated citrus orchards, flood-irrigated alfalfa, non-irrigated winter wheat, abandoned jojoba orchards, and fallow fields. The gen-tie line corridors would pass through BLM lands and other private lands mainly comprising desert scrub habitat and disturbed lands associated with existing infrastructure. Several utility lines and maintenance roads run through or parallel the gen-tie line corridors. Additionally, the Project area has been previously disturbed by off-road vehicle use, trash dumping, and historic use for military training during World War II. The Project area borders or is in the vicinity of Nicholls Warm Springs/Mesa Verde, an existing solar facility, Blythe Airport, the 520 MW natural gas-fired Blythe Energy Center, electrical substations, electrical transmission lines, I-10, and other paved and dirt roads. The Project area is bound on the east by agricultural land use that extends to the Colorado River.

2.0 WESTERN BURROWING OWL OVERVIEW

This section provides an overview of the listing status, ecology, local distribution, and survey results of the western burrowing owl.

2.1.1 Burrowing Owl Survey Results

Protocol surveys were conducted in 2011 to document the presence or absence of burrowing owl within the Project area and, if present, their abundance and the amount of suitable habitat. The following is a summary of the survey analysis and results (POWER 2011)

Records Search

A nine-quad search of the California Natural Diversity Database (CNDDB) (CNDDB 2011a), including USGS quadrangles McCoy Peak, McCoy Wash, Blythe NE, Roosevelt Mine, Ripley, Blythe, Thumb Peak, Palo Verde, and Mule Wash, identified 46 occurrences of burrowing owls in the Blythe area, with two occurrences on the Project site. In addition to the CNDDB records search, recent surveys and reports for similar projects near the Project area were also reviewed. There are several solar projects being planned or in the permitting process in the vicinity, and some have completed burrowing owl surveys and results are available (Appendix C)

Table 2. Adjacent Project Survey Information

Species	Project	Species Detected	BMSP Survey Area Overlap
Burrowing Owl	Blythe Solar Power Project	Yes, two within solar site, four in transmission line and multiple sign. Not determined how sign was confirmed.	Overlaps with BMSP transmission line and Colorado River Substation (CRS) survey areas.
	Genesis Solar Energy Project	Yes, three individuals detected around the generation tie line and one burrow around the main site.	No overlap
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Burrow sites detected along project segment that encompasses Colorado River Substation, but specific locations not mapped.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, burrowing owls detected along southern telecom route. Three owls detected just east of Colorado River Substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.

Survey Results

A systematic pedestrian assessment of the study area to determine the habitat suitability for burrowing owls was conducted on the 5th and 6th of May 2011. During the habitat assessment survey, biologists determined that the Project area contained suitable habitat conditions to support burrowing owls. Of the 3,679 acres in the Study Area, approximately 1,970 acres (54%) of suitable burrowing owl nesting and foraging habitat were identified (Figure 2). Suitable habitat consisted of both fallow and active agricultural fields, irrigation ponds and canals, and creosote bush scrub. Suitable habitat also occurred

along the edges of orchards. The remaining 1,703 acres consisted of orchards and alfalfa fields. Orchards within the Project area did not contain suitable habitat; burrowing owls prefer open areas and do not inhabit areas with dense vegetation (Klute et al. 2003). Alfalfa fields provide suitable forage areas for burrowing owls, but heavy and frequent disturbance of the fields by disking and harvesting decreases burrow availability. Burrows can occur along the edges of agricultural fields, orchards, and road banks; all road banks, field edges, and irrigation ditches along the agricultural areas throughout the Project site were surveyed. Six irrigation ponds located in the orchard area and irrigation channels throughout the agricultural area and to the east of the Project limits provide accessible fresh water for wildlife.

Protocol surveys were started on May 6 and extended through July 23, 2011. Survey methods were derived from generally accepted professional standards, the 1993 California Burrowing Owl Consortium (CBOC) Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993), and the 1995 CDFG Staff Report on Burrowing Owl Mitigation (CDFG 1995). In summary, a methodical pedestrian survey for owl burrows was conducted by walking through areas of suitable habitat within the study area, including man-made structures. The field data from the protocol surveys identified the presence of six burrowing owls during the May survey and eight owls during the July surveys, and an additional two owls were observed outside the Project site but within the Survey Area. Nine suitable burrows or burrow complexes were observed in the northern portion of the site (Figure 2). No suitable burrows were observed in the southern portion of the site. Soil conditions for Project parcels 4 and 13 through 18 and the transmission corridor were very sandy and unstable. Sandy soil would not support burrowing owls; however, burrowing owls are opportunistic and could use other potential burrows in the area that may be found in the berms of roads or concrete piles. Burrowing owl sign (white wash, pellets, feathers) was observed in five locations in the southern region of the Project area. Burrows observed in the southern half of the site belonged to either kit fox (*Vulpes macrotis*) or kangaroo rat (*Dipodomys* sp.). No burrowing owl sign was observed near the kit fox burrows. Several of the kit fox burrows were recent and active kit fox sign was documented; however, most of the burrows were old and collapsed and would not support burrowing owl because the instability of the soil.

Burrowing owl activity and use was determined during the subsequent surveys (July 14 through 19 and 21 through 23). Burrows were monitored at sunrise or sunset on different days to ensure a complete activity period was evaluated for each observed bird. Burrows #1 and #2 were determined not active during the initial monitoring phase and were therefore not included in further monitoring. The other active burrows within the northern end of the Project site were divided into three burrowing owl monitoring sites. Please refer to Figure 2 for the location of Areas 1, 2, and 3.

Area 1 supported four burrowing owls. The four burrowing owls were observed flying in and out of three separate concrete/brick-lined cylindrical, man-made structures (Burrows #4, 5, and 6), which have concrete collars above ground level and are open below ground level to a depth of approximately 4 feet. In Area 1, Burrow #4 contained the greatest number of observed sign, including pellets, prey detritus, feathers, and white wash. Burrows #5 and #6 also featured significant amounts of pellets, detritus, white wash, and feathers. Biologists were unable to determine if the owls were two separate pairs or one pair with two juveniles. Burrowing owls at Area 1 consistently exhibited social and foraging behavior. Several perch sites were favored in this area, including a metal rod with a rounded top, a fence post, a large pile of cleared vegetation and, most frequently, the edges of the concrete wells. Area 1 consisted of approximately 5 acres of disturbed creosote bush scrub dominated by creosote bush and bur sage; concrete rubble piles from old demolished barracks were scattered throughout the creosote bush scrub. Area 1 was bound on the south, west and north by recently tilled, non-irrigated wheat fields that have been farmed for approximately one year. This field is bound to the north by open space comprising creosote scrub habitat, and to the west by disturbed creosote scrub habitat within the area of the former military base and current Blythe Airport.

In Area 2, two burrowing owls occupied a single burrow (Burrow #3) located in a concrete rubble pile. The two owls were observed consistently during morning and evening hours perched on top of the rubble pile. Burrowing owl tracks were identified around and into the rubble pile, with feathers and pellets near a small burrow entrance beneath the rubble. Sex and age of the two burrowing owls observed during the surveys were not established. The burrowing owls occupying Area 2 were easily distressed and would flush and call to one another whenever biologists entered the vicinity. Area 2 consisted of approximately 2 acres of disturbed creosote bush scrub dominated by creosote bush and bur sage. Concrete rubble piles and two concrete foundations were scattered throughout the creosote bush scrub. Area 2 was surrounded to the south, east, and north by recently tilled, non-irrigated wheat fields and disturbed creosote bush scrub to the west.

Area 3 is outside the Project footprint but within the buffer Study Area. In Area 3, two burrowing owls occupied a burrow complex within a native Bajada area. One burrow appeared to be a former canid burrow due to its size, shape, and location in an area of naturally formed earth mounds. Biologists identified three separate burrowing complexes on the earthen mounds within an approximately 10-acre zone. Each burrow complex contained several burrows with recent sign, including white wash, feathers, tracks, and pellets. The two burrowing owls were typically perched on top of earthen mounds when the biologists accessed the area. Without additional harassment, biologists could not determine if the two burrowing owls were nesting.

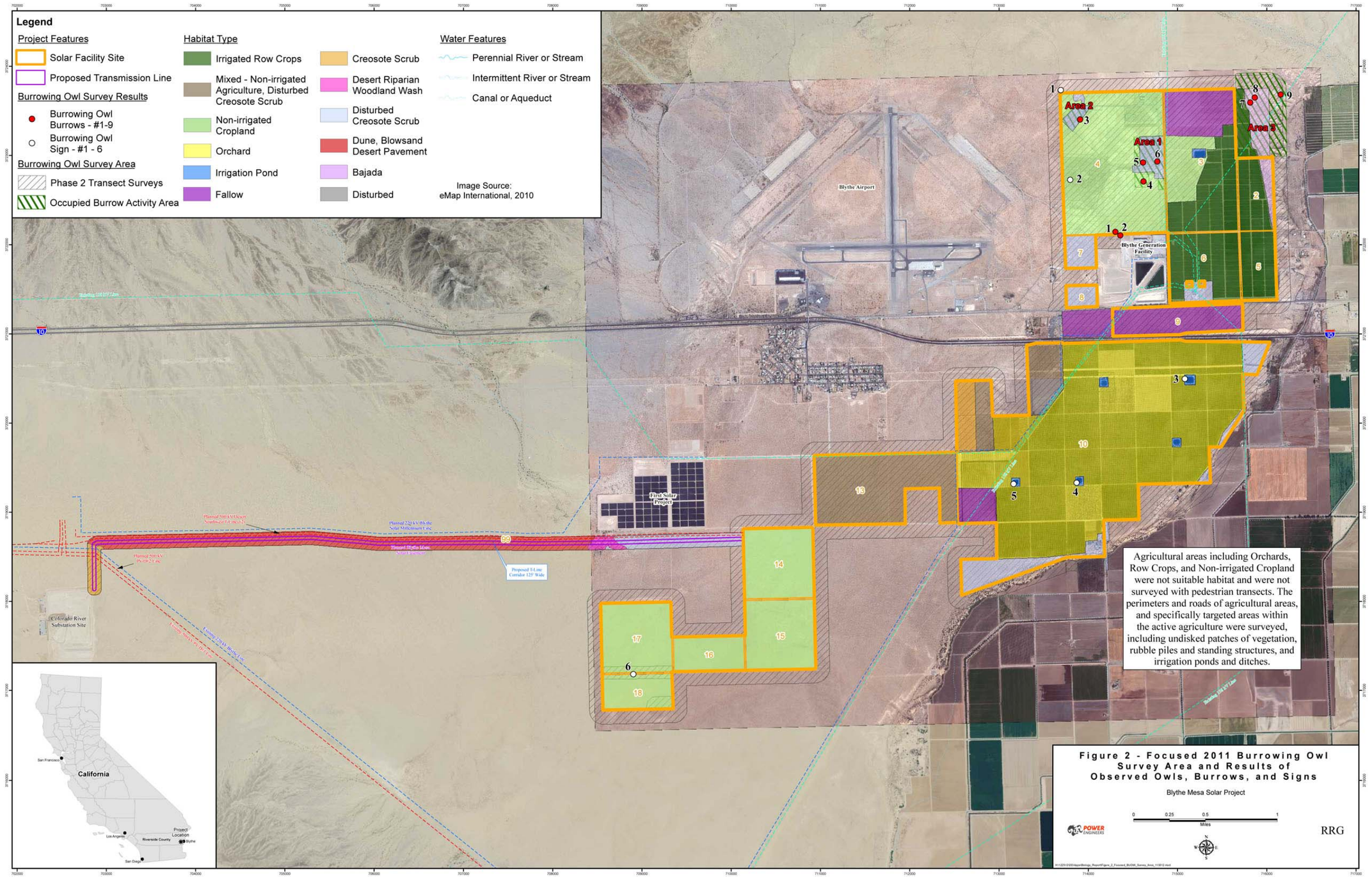
2.1.2 Burrowing Owl Impacts

Western Burrowing Owl

Direct Impacts: Based on spring 2011 protocol survey data, construction activities, including the installation of the solar facility, would permanently impact western burrowing owl by removing accessible foraging and nesting habitat for at least six to eight burrowing owls that were detected within the solar array area. No burrowing owl breeding was documented during 2011 surveys; however, most of the proposed solar facility site contains suitable burrowing owl habitat. It is possible that the solar facility site may be used more during migration or other seasonal movements or during winter. If the solar facility site is used for breeding, it is possible that nests or eggs may be lost as a result of construction activities near burrows. Temporary direct impacts to burrowing owl would also result from an increase in vehicle traffic while the Project is under construction and, consequently, an increase in vehicular strikes of burrowing owl. Project noise, vibration, or visual disturbance may also affect burrowing owls.

Indirect Impacts: The Project may result in increased common raven and raptor predation on burrowing owls as associated with the addition of new elevated perching sites, including the gen-tie structures, perimeter fencing, and gen-tie lines. Other native or introduced animals that may be drawn to human activity and subsequently prey upon burrowing owls include coyotes, cats, or dogs (Bates 2006). Additionally, temporarily ponded water from construction (e.g., dust suppression during construction) and garbage from increased human presence might attract common ravens. These indirect impacts would potentially impact burrowing owls, burrowing owl breeding habitat, or adjacent foraging habitat.

FIGURE 3. FOCUSED BURROWING OWL SURVEY AREA, OBSERVED OWLS, BURROWS AND SIGN



THIS PAGE INTENTIONALLY LEFT BLANK

3.0 WESTERN BURROWING OWL AVOIDANCE MEASURES

The primary purpose of this plan is to avoid, minimize, and mitigate for significant Project impacts to burrowing owls. The following program will be implemented to specifically address impacts to the burrowing owls. Refer to Appendix B for additional best management practices that will also minimize potential impacts to the burrowing owl.

3.1 Monitoring and Reporting Program

3.1.1 Pre-construction Burrowing Owl Surveys

Pre-construction surveys will be conducted throughout the Study Area for burrowing owls, possible burrows, and sign of owls (e.g., pellets, feathers, white wash). The purpose of the pre-construction surveys will be to locate and identify active burrowing owl burrows, estimate the current number of burrowing owl individuals or pairs on site, and determine if the burrowing owls observed on site are considered breeding pairs or migrating transient birds within the Project area. Surveyors will walk line transects spaced 7 meters to 20 meters apart, adjusting for vegetation height and density. All potential burrows, sign, or calls will be documented. Appendix D of the CDFG 2012 survey guidelines will be implemented and are summarized below.

3.1.2 Biological Monitors

The résumé of the proposed biologists will be provided to the County of Riverside, CDFG, and BLM for concurrence before conducting pre-construction surveys or monitoring. The approved Biologist will be on-site to conduct pre-construction surveys and monitor ground disturbance, grading, and construction activities that take place in burrowing owl habitat near burrowing owls and/or burrowing owl burrows. This will help prevent or minimize harm or injury to the burrowing owl.

The approved biologist shall be responsible for documenting the results of the surveys and the ongoing monitoring and will provide a copy of the monitoring reports for impact areas to the respective agencies (e.g., on BLM lands, documentation will be provided to the BLM Biologist). The approved Biologist will be responsible for flagging, staking, and/or other marking appropriate setback distances from active burrows. If destruction of an occupied burrow is unavoidable, the owl(s) will be passively relocated. The approved Biologist will report injuries and mortalities within 24 hours to the Construction Contractor and together they will inform the respective agencies.

The approved Biologist will oversee the installation of the artificial burrows and passive relocation activity. They will also monitor the burrowing owl post-relocation activity and submit annual monitoring reports to the BLM and CDFG.

3.2 Worker's Education Awareness Program

An approved biologist(s) shall conduct a detailed biological Worker Environmental Awareness Program (WEAP) for all Project personnel before any construction or activities within the Project footprint. The WEAP shall include discussions of Project permits and brief summaries of their conditions; discussions of agency involvement, their applicable sensitivity measures, and relevant environmental protection legislation (e.g., the Endangered Species Act, the Migratory Bird Treaty Act); descriptions of the burrowing owl that could exist in the Project area, along with their locations, legal status, and protections; and a review of all measures to be implemented for avoidance of the burrowing owl. Construction workers will be encouraged to alert the biologist on site if they detect a burrowing owl.

3.3 Avoidance

Should any of the pre-construction surveys yield positive results for the presence of burrowing owl or active burrows within the Project area, the approved Biologist will coordinate with the Construction Contractor to implement avoidance and set-back distances.

Occupied burrows will not be disturbed during the breeding season (February 1 through August 31) unless an approved biologist verifies, through non-invasive methods, that: 1) the birds have not begun egg-laying and incubation; and 2) that juveniles from the occupied burrow are foraging independently and are capable of independent survival. The following table describes the CDFG 2012 guidelines for activities around occupied burrowing owl nests and recommended buffers based on low, medium, and high disturbance activities, respectively.

Table 3. CDFG Burrowing Owl Buffer Recommendations

Location	Time of Year	Level of Disturbance		
		Low	*Med*	*High*
Nesting sites	April 1 to Aug 15	200 m*	500 m	500 m
Nesting sites	Aug 16 to Oct 15	200 m	200 m	500 m
Nesting sites	Oct 16 to Mar 31	50 m	100 m	500 m

*meters (m)

The approved Biologist will coordinate with the Construction Contractor to determine the level of disturbance and buffer distance needed. As topography and site conditions allow, setback distances can be reduced. Where appropriate, the setback distances can be reduced by screening burrows (i.e., installing hay bales or another type of material to create a visual and auditory barrier between construction and the burrow) as a means of minimizing disturbance to owls. If hay bales are used, they shall be certified as weed-free in accordance with the Project's weed control management plan. In addition, the approved Biologist will monitor the set-back distances to ensure that the applied distance is an effective buffer. Effective buffers are those that minimize indirect impacts on the burrowing owl by providing a distance between the burrow and construction activities.

3.4 Excavation of Inactive Burrows

If suitable burrows are observed and documented during the pre-construction surveys within the Project footprint and determined to be inactive, these burrows will be excavated and filled in under the supervision of the approved Biologist(s) prior to clearing and grading. Excavation (by hand) of inactive but potentially suitable burrows will help deter burrowing owls from occupying burrows within the active construction areas. Refer to Section 3.6 below for details on the excavation protocols for the burrowing owl.

3.5 Passive Relocation From the Project Area

3.5.1 Artificial Burrow Installation in Relocation Area

To compensate for impacts to the burrowing owls in activity areas on the northern part of the Project, 146 acres of habitat have been identified adjacent to the Project area to the northeast (Figure 3). Surveys have not been conducted on all adjacent lands; however, they are within the same habitat that supports the burrowing owls currently within the Project area. The 2012 CDFG guidelines will be followed to identify the location within the 146 acres to install the artificial burrows. Installation of the artificial burrows shall occur after identification of the specific relocation sites and prior to ground disturbance of heavy equipment staging. The results of the proposed relocation, including photographs and details of the vegetation and topography where the artificial burrows are proposed, will be provided to the CDFG and County of Riverside for review and approval.

Design of the artificial burrows shall be consistent with the CDFG guidelines (CDFG 2012) and developed in consultation with CDFG. A representative design schematic for an artificial burrow is provided as Attachment A.

Five locations in the southern portion of the Project (south of Interstate 10) contained burrowing owl sign (white wash, pellets, feathers). However, no burrowing owl, its sign, or suitable burrows were observed in this area of suitable habitat. In the event that active burrowing owl burrows are located in the southern portion of the solar facility site during pre-construction surveys, additional potential mitigation land for burrowing owls was identified within and outside the Project boundary and is illustrated in Figure 3.

3.5.2 Passive Relocation and Exclusion Methodology

Passive relocation is considered the preferred option to trapping (CBOC 1993), and the CDFG will not authorize the capture and relocation of burrowing owls except in the context of scientific research (CDFG 2012). During the non-breeding season, owls shall be given a minimum of three weeks to become familiar with the new artificial burrows, after which eviction of owls within the Project area shall begin. A time period of at least one week is recommended to allow the owls to be passively moved and acclimate to alternate burrows (CBOC 1993). As recommended by CDFG 2012 guidelines and described by Truilo (1995) and Johnson et al. (2010), a one-way door shall be used to facilitate passive relocation of owls. The one-way door shall be left in place for 48 hours to ensure burrowing owls have left the burrow before excavation (CDFG 2012)

The following exclusion methodology shall be implemented to prevent burrowing owls from reestablishing themselves once relocated. Following installation of the one-way doors, intensive monitoring of the burrow will be conducted by the approved Biologists to count the number of departing birds. All evicted burrowing owls will be monitored daily from dawn until dusk to determine their post-eviction fate until one of the following events occurs: 1) the burrowing owl is observed to reside in the artificial burrow for at least 10 consecutive days; 2) the owl is consumed by a predator or otherwise dies, and its death is documented and reported to CDFG, USFWS, and the County of Riverside; or 3) the monitoring team is unable to locate the owl in the vicinity of the Project area for 10 consecutive days, in which case the monitoring team will report the owl as “disappeared” in the final post-eviction report sent to the three agencies. The monitoring schedule may be adjusted upon review and approval by CDFG and the County of Riverside.

Burrows shall be excavated after being determined vacant by use of a down-hole camera, monitoring, and the use of one-way doors. Excluded burrows shall be monitored daily for one week to confirm no additional burrowing owls use them before excavation. After burrows are confirmed to no longer be in use, the burrow shall be excavated using hand tools and refilled to prevent reoccupations. Sections of flexible plastic pipe or burlap bag shall be inserted into the tunnels during excavation to maintain an escape route for any burrowing owls inside the burrow. The implementation of the exclusion plan shall occur after successful relocation and prior to ground disturbance of heavy equipment staging. The exclusion plan shall be consistent with the CDFG guidelines (CDFG 2012) and developed in consultation with CDFG.

3.5.3 Relocation Mitigation Management Plan and Vegetation Management Goals

Monitoring of the mitigation site and vegetation will be implemented to ensure the appropriate maintenance for the mitigation site and that persistence of the burrowing owls on site is successful and long-term (CDFG 2012). Monitoring of the site will occur four times per year for a two-year program. Two visits will be conducted during the breeding season, and the other two visits will be conducted during the non-breeding season to evaluate the burrowing owl use of the artificial burrows or other natural burrows. The approved Biologists will also document site conditions within the mitigation area(s) with photographs and a monitoring memo report that will be provided to the maintenance contractor following

each visit. The monitoring memo will include specific guidance in the form of a list of necessary maintenance within the mitigation area(s).

Maintenance of artificial burrows shall occur three to four times during the year immediately following relocation, as necessary. Maintenance will include weed management, trash removal, semi-annual and annual artificial burrow cleaning and maintenance, and management of vegetation height and density (especially in immediate proximity to burrows) (Appendix F of CDFG 2012). The relocation mitigation management and vegetation plan shall be consistent with the CDFG guidelines (CDFG 2012) and developed in consultation with CDFG.

3.5.4 Reporting

An annual report will be submitted to CDFG, USFWS and County of Riverside following each breeding season for two years post-relocation. The annual reports will include the date when passive relocation efforts begin, the date of the burrow excavations, findings, initiation of construction activities, monitoring efforts, and vegetation management. Any injuries, mortality, or other unforeseen circumstances would be reported to all resource agencies within 24 hours.

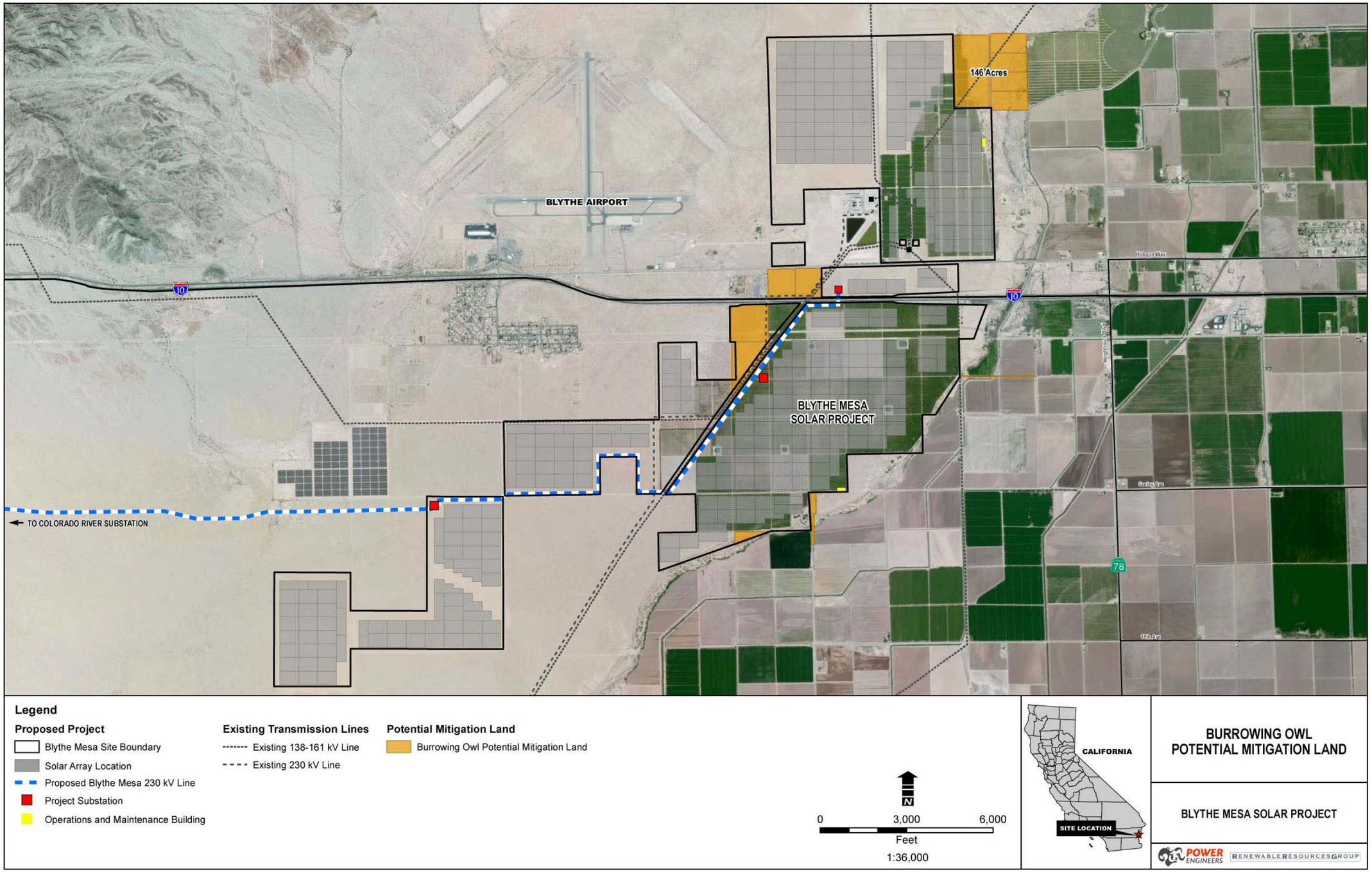
The report would include the following data:

- Project name, location, and all pertinent information pertaining to the Project or Mitigation site
- Known predators or humans visiting or disturbing the Project or Mitigation site
- Dates of removal of one-way trap doors and the collapse of unoccupied burrows
- Monitoring results
- Weed removal efforts
- Any other pertinent data gathered through the exclusion, passive relocation efforts, and post-relocation monitoring

3.5.5 Western Burrowing Owl Compensation Lands

A total of 277 acres of habitat are located adjacent to the Project area and owned by RRG. It is anticipated that the available 146 acres would fully mitigate potential impacts to the burrowing owl. However, an additional 131 acres are available if needed. The California Burrowing Owl Consortium guidelines recommend 6.5 acres of compensation land be preserved and managed in perpetuity for each individual burrowing owl or burrowing owl pair identified as potentially impacted at the Project site. Based on the protocol burrowing owl surveys conducted in 2011, if it is assumed that nine active burrowing owl burrows are detected, the Project would require a minimum of 58 acres for compensation lands. However, per the 2012 CDFG mitigation guidelines, a pre-construction survey will be conducted to determine the number of burrowing owls and the amount of compensation land that shall be required to be protected.

FIGURE 4. POTENTIAL BURROWING OWL MITIGATION LAND



THIS PAGE INTENTIONALLY LEFT BLANK

4.0 CONTINGENCY PLANNING AND PROGRAM CONTACTS

An adaptive management program that functions within the constraints of the Project permit and approvals will be implemented to help handle any unanticipated circumstances that may arise. Adaptive management decisions will be made with input from pertinent regulatory agency staff in a timely manner to ensure the protection of the burrowing owl. The following is a list of agency staff members who shall be contacted, as applicable, on various aspects of relocation site selection and long-term management of the relocation site:

California Department of Fish and Game:
TBD

County of Riverside
Jared Bond
Senior Ecological Resource Specialist
Environmental Programs Division
County of Riverside
951-955-0314
JBOND@rctlma.org

Bureau of Land Management
Kim Marsden
Natural Resources Specialist
Renewable Energy Coordinating Office
California Desert District
22835 Calle San Juan De Los Lagos
Moreno Valley, CA 92553-9046
Phone: 951-697-5223
kmarsden@blm.gov

United Stated Fish and Wildlife Service
Nisa Marks
Palm Springs Fish and Wildlife Office
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
760.322.2070 extension 208
Nisa_Marks@fws.gov

5.0 LITERATURE CITED / REFERENCES

California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. Tech. Rep. Burrowing Owl Consortium, Alviso, California. http://www.dfg.ca.gov/wildlife/nongame/docs/boconsortium.pdf

California Department of Fish and Game (CDFG). 1995. Staff Reporting on Burrowing Owl. October 17, 1995. California Department of Fish and Game. Memorandum from Mr. Ron Rempel.

_____. 2008. California Interagency Wildlife Task Group. CWHR version 8.2 personal computing program. Sacramento, CA.

_____. 2012. Staff Report on Burrowing Owl Mitigation. March 7, 2012. State of California Natural Resource Agency, Department of Fish and Game.

California Natural Diversity Data Base (CNDDB). 2011a. California Natural Diversity Data Base. Element occurrence search for Project area quadrangles.

Cibola National Wildlife Refuge. 2011. Wild At Heart Owl Relocation to Cibola NWR http://www.mirror-pole.com/wild_at_heart/bur_owl/rel_sites/cibola/cibola_release_site.html.

Haug, E. A., B. A. Millsap and M. S. Martell. 1993. Burrowing Owl (Athene cunicularia), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/061.

Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. Vegetation Ecologist Nongame-Heritage Program. Sacramento, CA.

Klute, David S., Loren W. Ayers, Michael T. Green, William H. Howe, Stephanie L. Jones, Jill A. Shaffer, Steven R. Sheffield, and Tara S. Zimmerman. 2003. Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States Biological Technical Publication BTP-R6001-2003. U.S. Fish and Wildlife Service. http://www.fws.gov/mountain-prairie/species/birds/wbo/Western%20Burrowing%20Owlrev73003a.pdf

Johnson, D.H., D.C. Gillis, M.A. Gregg, J.L. Rebholz, J.L. Lincer, and J.R. Belthoff. 2010. Users' Guide to Installation of Artificial Burrows for Burrowing Owls. Tree Top, Inc. Selah, Washington. 34 pp. PDF available from URLs: http://www.globalowlproject.com/ or http://www.wildlife-research.org/

POWER Engineers, Inc. (POWER). 2011. Blythe Mesa Solar Project Western Burrowing Owl Survey Report. Prepared for Renewable Resources Group. California.

Sawyer, J.O., T. Keeler-Wolf, J.M. Evens. 2009. A manual of California Vegetation, Second Edition, California Native Plant Society Press. Sacramento, CA.

Trulio, Lynne, A. 1995. Passive Relocation. A Method to Preserve Burrowing Owls on Disturbed Sites. Journal of Field Ornithology 66(11): 99-106.

Representative Relevant Planned Projects in vicinity of Blythe, California

AECOM. 2009. Blythe Solar Power Project Application for Certification. Submitted by Solar Millennium, LLC to the California Energy Commission.

California Energy Commission. 2010. Genesis Solar Energy Project Application for Certification Supplemental Information. March 2010. California Energy Commission Docket Number 09-AFC-8.

Southern California Edison. 2009. First Solar Electric, Blythe, California Environmental Assessment Initial Study. February, 2009. County of Riverside EA40219.

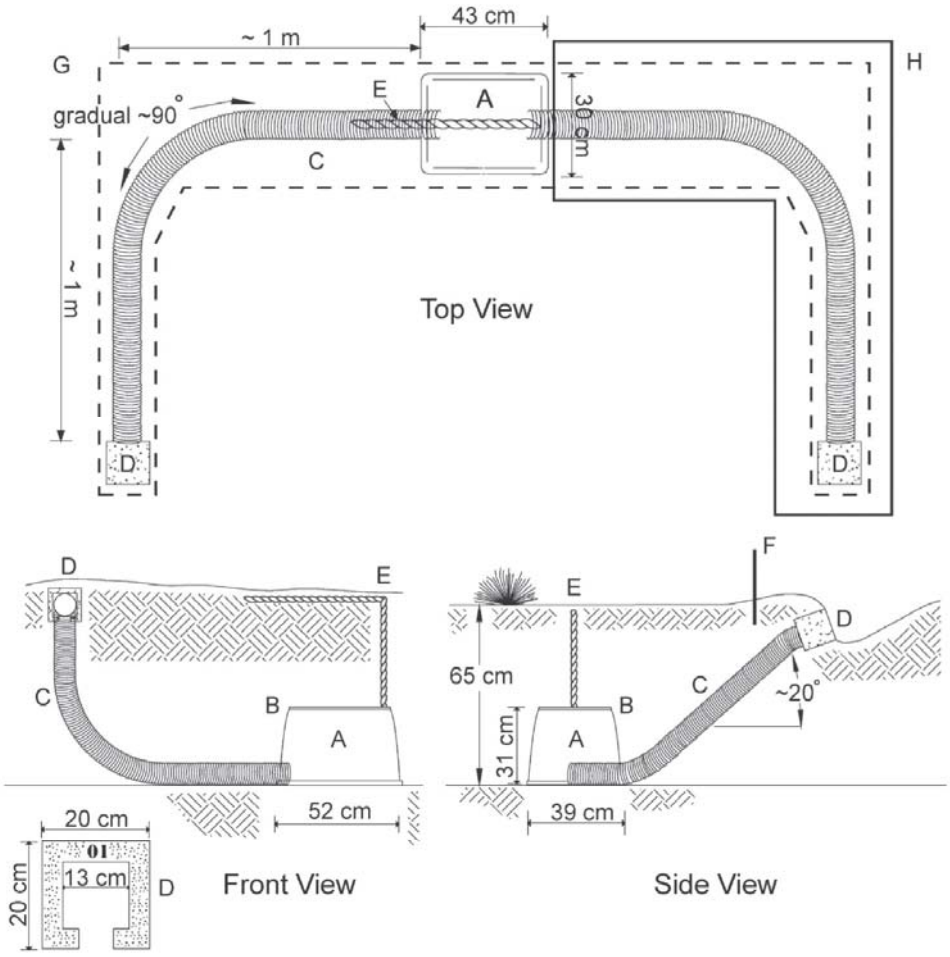
_____. 2010. Devers-Palo Verde No. 2 Transmission Line Project Colorado River Substation Expansion Final Supplemental Environmental Impact Report. April 2010.

TetraTech Environmental, Inc. 2010. Genesis Solar Energy Project Supplemental Information. June 2010. California Energy Commission Docket Number 09-AFC-8.

THIS PAGE INTENTIONALLY LEFT BLANK

AR061301

APPENDIX A: ARTIFICIAL BURROW DESIGN



A - Plastic irrigation valve box, 48 cm long x 35 cm wide x 27 cm high (inside dimensions)
B - Removable lid
C - Ca. 2 m of 10-cm diameter perforated flexible plastic pipe
D - 20 x 20 x 15 cm hollow concrete block
E - Plastic rope or chain marking location of nest chamber on ground surface
F - 0.5 m perch post (optional)
G - Excavation footprint for installation – – –
H - Optional second entrance

Source: Albion Environmental (John H. Barclay, 2008, http://www.albionenvironmental.com/burrow_design.pdf)

THIS PAGE INTENTIONALLY LEFT BLANK

AR061303

APPENDIX B: BEST MANAGEMENT PRACTICES

THIS PAGE INTENTIONALLY LEFT BLANK

The analysis assumes that the Applicants would implement the following BMPs to provide additional protection to western burrowing owl.

Drainage, Erosion, and Sedimentation Control Plan. As part of the County of Riverside's Conditional Use Permit (CUP) requirements, a Drainage, Erosion, and Sedimentation Control Plan would be developed for the Project. The plan would address the drainage, erosion, and sediment control requirements to support all activities associated with construction, operation, and decommissioning of the Project.
Stormwater Pollution Prevention Plan. In compliance with requirements of the National Pollutant Discharge Elimination System (NPDES) permit, a Stormwater Pollution Prevention Plan (SWPPP) would be developed and prepared for the Project to ensure that protection of water quality and soil resources is consistent with County and State regulations.
Fugitive Dust Abatement Plan. As required by the Mojave Desert Air Quality Management District Rule 403, a Fugitive Dust Abatement Plan would be prepared to address fugitive dust emissions during Project construction, operation, and decommissioning.
Fire Management and Protection Plan. As required by existing law (Title 8 California Code of Regulations [CCR] Section 3221), a Fire Management and Protection Plan would be developed in consultation with the Riverside County Fire Department to identify potential hazards and accident scenarios that would exist at the facility during construction, operation, and decommissioning of the Project.
Trash Abatement Plan. A Trash Abatement Plan shall be developed that focuses on containing trash and food in closed and secure, sealable containers, with lids that latch, and removing them periodically to reduce their attractiveness to opportunistic species, such as common ravens, coyotes, and feral dogs, that could serve as predators of native wildlife and special-status animals. Also establish a regular litter pick-up procedure within and around the perimeter of the Project site, and remove from the Project site those containers associated with construction when construction is complete.
Integrated Weed Management Plan. In compliance with the Federal Noxious Weed Act, the Plant Protection Act, and the California Food and Agricultural Code, a Project-specific integrated weed management plan for the control of noxious weeds and invasive plant species would be prepared. The plan would identify presence, location, and abundance of weed species in the Project area and surrounding area adjacent to the Project, as well as identify suppression and containment measures to prevent the spread of weed species and introduction of weed species.
Project structures and building surfaces. Project facilities would be sited to ensure that there is adequate space (i.e., setbacks of no less than 100 feet) between solar facilities and natural washes. These setbacks would preserve and maintain the natural washes' hydrological functions.
Gen-tie lines. Gen-tie line support structures and other facility structures shall be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices).
Ground and surface disturbance. Construction boundaries would be clearly delineated to minimize areas of ground and surface disturbance. Ground-disturbing activities shall be minimized, especially during the rainy season. To the maximum extent possible, construction-related activities (such as vehicle and foot traffic) would avoid areas with intact biological soil crusts.
Travel and traffic. Vehicular traffic on site shall be confined to existing or designated travel routes and designated work areas. Access to the construction site and staging areas shall be limited to authorized vehicles and only through the designated roads.
Plants and wildlife. In compliance with the California Department of Fish and Game Codes, while on the Project property, workers or visitors would be prohibited from: feeding wildlife; moving live, injured, or dead wildlife off roads, ROWs, or the Project site; bringing domestic pets to the Project site; collecting native plants; and harassing wildlife. Areas where wildlife could hide or be trapped (e.g., open trenches, sheds, pits, uncovered basins, and laydown areas) would be minimized. For example, an uncovered pipe that has been placed in a trench should be capped at the end of each workday to prevent animals from entering the pipe. If a special-status species is discovered inside a component, that component must not be moved, or, if necessary, moved only to remove the animal from the path of activity, until the animal has escaped. As open trenches could impede the seasonal movements of large game animals and alter their distribution, they would be backfilled as quickly as possible. Open trenches could also entrap smaller animals; therefore, escape ramps would be installed along open trench segments at distances identified in the applicable land use plan or by the best available information and science. If traffic is being unreasonably delayed by wildlife in roads, personnel would contact the Project biologist, who will take any necessary action. Any vehicle-wildlife collisions would be immediately reported to the Project biologist. Observations of potential wildlife problems, including wildlife mortality, would be immediately reported to the BLM or other appropriate agency authorized officer.

THIS PAGE INTENTIONALLY LEFT BLANK

AR061307

APPENDIX C: SURVEY RESULTS

THIS PAGE INTENTIONALLY LEFT BLANK

AR061309

January, 2012

BLYTHE MESA I SOLAR PROJECT

Western Burrowing Owl Survey Report

PROJECT NUMBER:
122512

PROJECT CONTACT:
Vanessa Santistevan
EMAIL:
vanessa.santistevan@powereng.com
PHONE:
(303) 716-8908

POWER ENGINEERS

AR061310

PREPARED FOR: RENEWABLE RESOURCES GROUP
LOS ANGELES, CALIFORNIA

PREPARED BY: *MELISSA LIPPINCOTT*
TOM HERZOG
VANESSA SANTISTEVAN

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 PROJECT OVERVIEW 1
1.2 REGIONAL SETTING 1
1.3 EXISTING CONDITIONS 5

2.0 SPECIES DESCRIPTION 5

3.0 SURVEY METHODOLOGY 6

4.0 SURVEY RESULTS 9

4.1 FIELD RESULTS 9
4.2 WILDLIFE AND PLANTS OBSERVED DURING BURROWING OWL SURVEY 11

5.0 CONCLUSION 11

6.0 LITERATURE CITED / REFERENCES 12

FIGURES

Figure 1 - Regional Area Project Location Map 3
Figure 2 – Focused Burrowing Owl Survey Area, Observed Owls, Burrows and Sign 7

TABLES

Table 1. Observed Habitat Acreage within the Study Area 5
Table 2. Adjacent Project Survey Information 9

APPENDICES

Appendix A – Observed Plant List
Appendix B – Observed Wildlife List

ACRONYMS AND ABBREVIATIONS

˚F	Fahrenheit
AMSL	above mean sea level
BLM	United States Department of the Interior, Bureau of Land Management
CBOC	California Burrowing Owl Consortium
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
CNWR	Cibola National Wildlife Refuge
GPS	Global Positioning System
km	kilometers
kV	kilovolt
MBTA	Migratory Bird Treaty Act
mph	miles per hour
MW	megawatt
POWER	POWER Engineers, Inc.
PV	photovoltaic
RRG	Renewable Resources Group, LLC
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

Power Engineers, Inc. (POWER) conducted a western burrowing owl (*Athene cunicularia hypugaea*) protocol-level survey for the Renewable Resources Group, LLC (RRG) as part of the proposed Blythe Mesa I Solar Project (BMSP, Project). The primary purpose of the surveys was to determine the presence or absence of burrowing owls within the defined study area. The study area is located within Riverside County, California near the community of Blythe; on approximately 3,679 acres in the Palo Verde Mesa (Figure 1). The study area for the purposes of this document is delineated on Figure 2 and includes a 125-foot proposed right-of-way along the transmission line.

1.1 PROJECT OVERVIEW

The proposed Project consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project footprint is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. POWER conducted the surveys within proposed Project transmission line footprint which included a 500 feet wide corridor centered on the 125-foot wide project right-of-way. The survey area of array parcels included a 500-foot (150-meter) wide buffer around the project limits. The proposed project would occupy a total of 3,660 acres and consist of the following components:

- Solar array field utilizing single axis solar PV trackers
- System of interior collection power lines located between inverters and substations
- Three on-site substations (approximately 300 feet long by 300 feet wide)
- Two operation and maintenance (O&M) buildings (approximately 3,500 square feet each)
- Two primary off-site access roads and several interior access roads
- 4.8 miles of 230 kV double-circuit transmission line between the solar field and Colorado River Substation

1.2 REGIONAL SETTING

The 3,660-acre site is five miles west of Blythe and consists mostly of agricultural land, including lemon orchards. The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles (see Figure 1). The Project is located on:

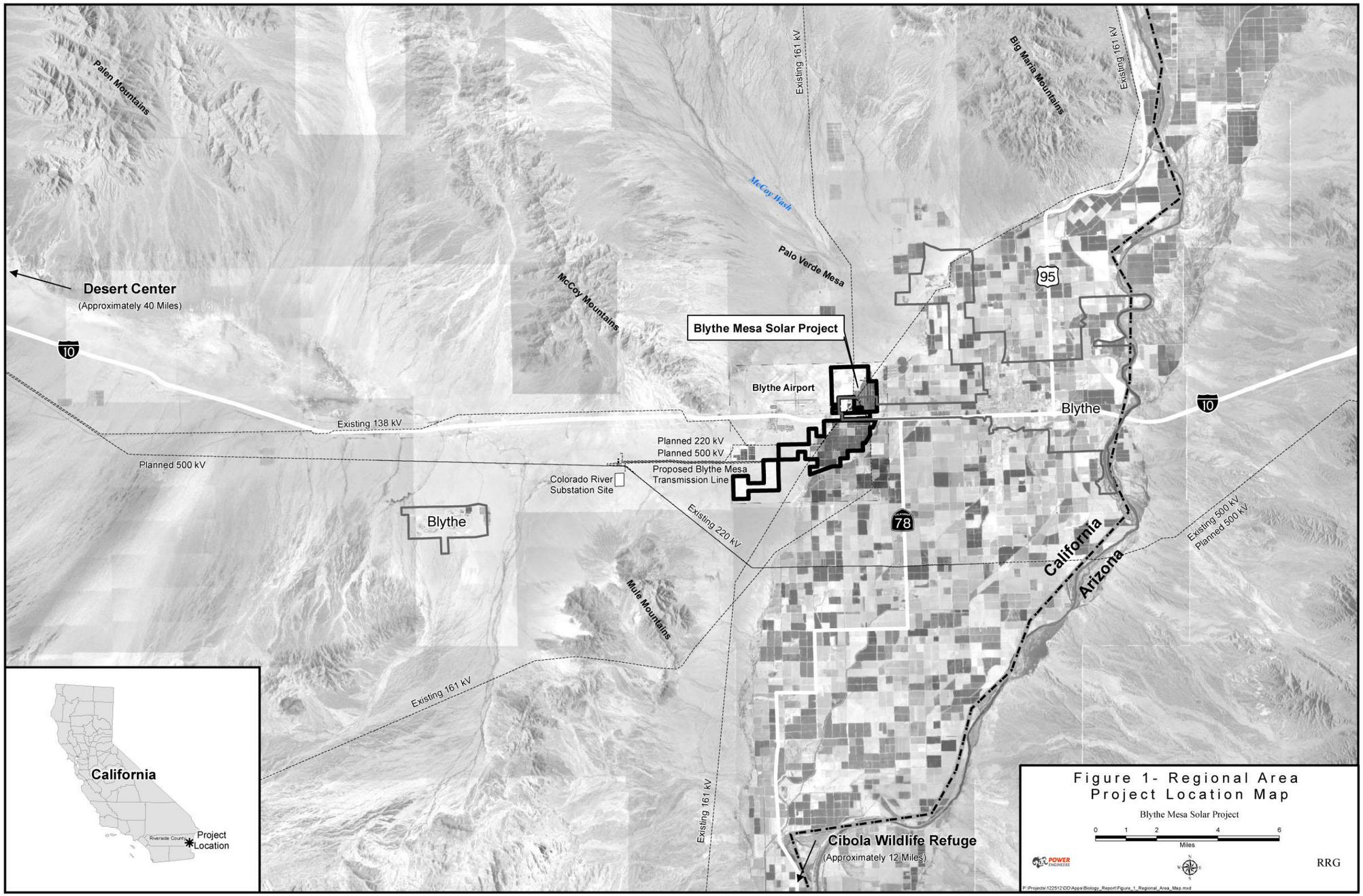
- Sections 11 and 12 of Township 7 South, Range 21East
- Sections 3, 4, 5, 6, 8, 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

State Highway 10 bisects the Project area, which is bounded on the north and south by undeveloped open desert, on the east by agricultural lands and on the west by the Blythe City Airport and open desert lands.

The Project area is located on the western mesa of the Palo Verde Valley. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The subtropical climate of the Colorado Desert is currently characterized by dry, mild winters averaging 45 degrees Fahrenheit (˚F) and dry, hot summers that average 104˚F. Summer highs are known to reach up to 120˚F. Precipitation ranges between two and ten inches per year, with most of the precipitation occurring between November and March. Although rainfall occurs primarily in the winter months, the region is periodically influenced by tropical weather conditions, including sudden monsoonal summer storms which typically occur from July to later September.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 1 - REGIONAL AREA PROJECT LOCATION MAP



THIS PAGE INTENTIONALLY LEFT BLANK

1.3 EXISTING CONDITIONS

The proposed project consists primarily of desert scrub and agricultural lands. Along the four mile transmission line route and eastern and southern ends of the project limits there are discrete areas of disturbed native creosote scrub and disturbed stabilized dune and blow sand habitats. Table 1 presents the estimated acreage observed for each habitat type within the study area. This data does not represent the actual proposed project disturbance footprint for the solar areas, transmission lines, substations, and facility buildings and roads.

TABLE 1. OBSERVED HABITAT ACREAGE WITHIN THE STUDY AREA

Habitat	Acres	Percentage Within the Project Site
Bajada	18.07	0.5%
Creosote Scrub	46.74	1.3%
Desert Riparian Woodland Wash	2.83	0.1%
Disturbed	31.15	0.8%
Disturbed Creosote Scrub	233.44	6.3%
Disturbed Creosote Scrub and Fallow Agricultural	271.10	7.4%
Dune, Blowsand Desert Pavement	52.52	1.4%
Fallow	249.72	6.8%
Irrigated Cropland	404.02	11.0%
Irrigation Pond	17.21	0.5%
Mixed	75.92	2.1%
Non-Irrigated Cropland	1088.15	29.6%
Orchard	1188.36	32.3%
Total Project Area Acreage (Includes 125 ft right-of-way)	**3679.24**	**100.0%**

As listed above, the Project area comprises mainly agricultural land and desert scrub. Existing land consists of farmland, fallow farmland, creosote bush scrub, or stabilized desert dune and blowsand habitat. Active agricultural uses include citrus orchard and ornamental date palms, and wheat and alfalfa fields. Jojoba was previously grown for commercial purposes in some portions of the project area. The jojoba fields have been abandoned at some point in the recent past and are currently a mix of jojoba and reestablishing creosote bush scrub.

The study area is also situated among energy generating facilities (i.e., solar and natural gas-fired), active transmission lines, and electrical substations. Given the extent of the existing human-influenced environment (e.g., active agricultural operations [harvesting, discing, and planting]; high levels of automobile traffic [Interstate 10 bisects the Project]; energy generation, distribution and maintenance facilities; and ongoing aviation related activities) within the study area, any animals currently using these lands are assumed to be acclimated to the disturbance regime present.

2.0 SPECIES DESCRIPTION

Western burrowing owl is designated as a Priority 2 Bird Species of Special Concern by the California Department of Fish and Game (CDFG) due to rapid habitat loss and degradation from urbanization. It is also designated as a U.S. Department of the Interior, Bureau of Land Management (BLM) Sensitive species and a U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern. Its range extends through all states west of the Mississippi Valley and into Mexico, Central America, and South America.

In California, it typically inhabits lowlands, including those in the Central Valley, northeastern plateau, southeastern deserts, and coastal areas. For shelters, the burrowing owl uses rodent burrows in sparse grassland, desert, and agricultural habitats, as well as open areas of pinyon-juniper or ponderosa pine habitats (CDFG 2008). Breeding populations generally display greater site fidelity than winter populations, which tend to move about more, even taking refuge into vegetation instead of nearby burrows (Poulin et al. 2011). Individuals in California, particularly Southern California, are mostly residents (CDFG 2008). Nesting begins from late March to August, peaking in April and May (CDFG 2008). While some pairs have been observed to have double broods within a single breeding season, it is considered to be uncommon and is not always successful (Poulin et al. 2011). Burrowing owls are typically active at dusk and dawn, but can sometimes be active at night, as well.

3.0 SURVEY METHODOLOGY

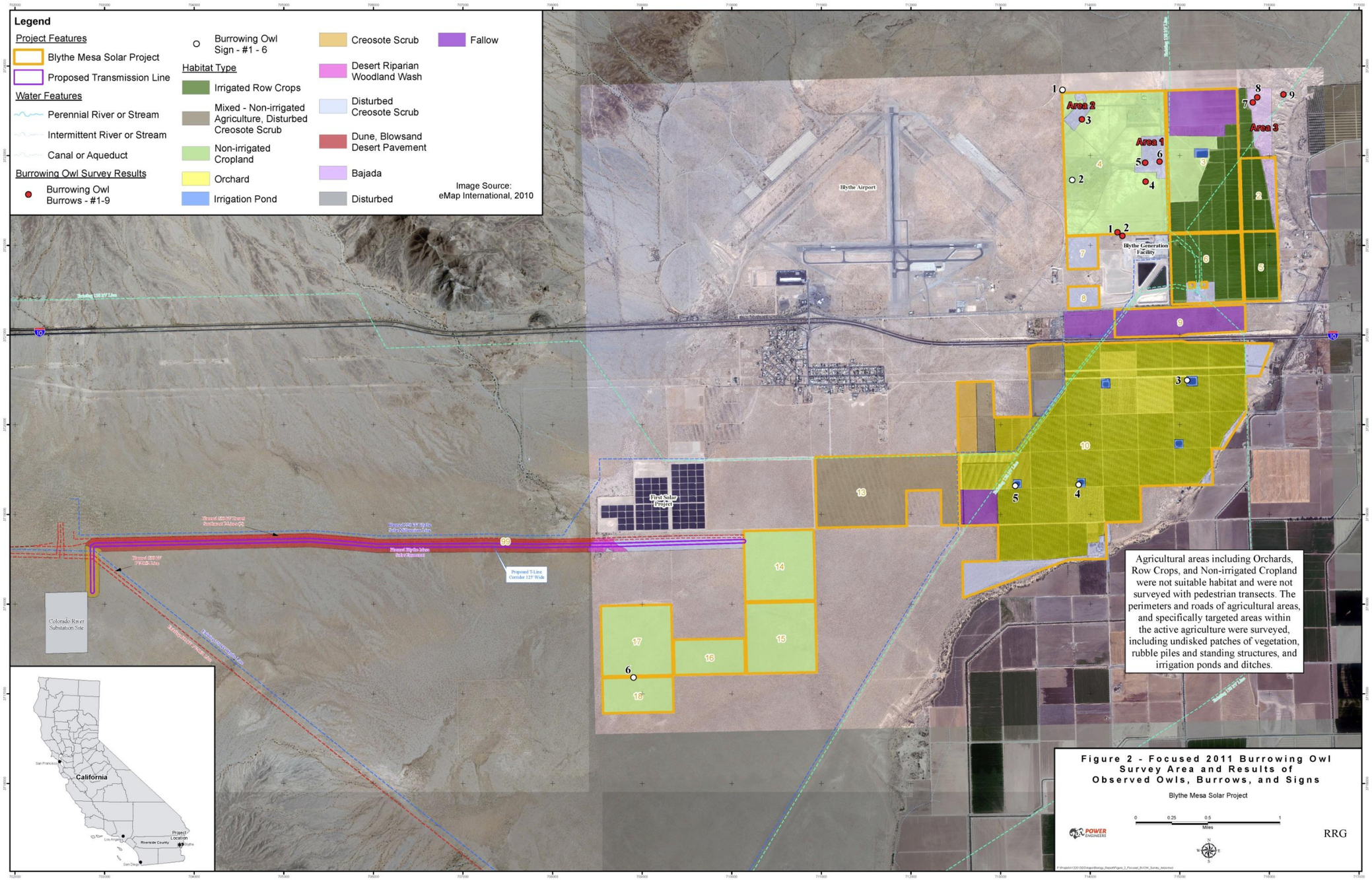
Collection of burrowing owl baseline data in the Project area included a review of the California Natural Diversity Database (CNDDB) records and of applicable biological documents, including several solar projects that have completed burrowing owl surveys. Additionally, a systematic pedestrian assessment of the study area to determine the habitat suitability for burrowing owls was conducted on the 5th and 6th of May 2011.

Protocol surveys were started on May 6 and extended through July 23, 2011. Survey methods were derived from generally accepted professional standards, the 1993 California Burrowing Owl Consortium (CBOC) Burrowing Owl Survey Protocol and Mitigation Guidelines (CBOC 1993), and the 1995 CDFG Staff Report on Burrowing Owl Mitigation (CDFG 1995). In summary, a methodical pedestrian survey for owl burrows was conducted by walking through areas of suitable habitat within the study area, including man-made structures. In addition, biologists visited the Cibola National Wildlife Refuge (CNWR) 12 miles to the south of the Project limits to view the known burrowing owls there as a reference population; biologists saw six burrowing owls foraging near an agricultural field at the CNWR, which confirmed activity in middle to late July in this region of the owls' range.

POWER biologists Tom Herzog, Steve Hicks, Ken McDonald, and Melissa Lippincott, and Garcia and Associates, Inc. biologists Andrew McCadden, Angelique Herman, and Laura Megill conducted pedestrian survey transects, spaced at approximately 100 feet to allow for 100% visual coverage of the study area. Where necessary, transect spacing was reduced or expanded to account for differences in terrain, vegetation density, and visibility. The locations of all potential owl burrows and sign were recorded and mapped using handheld global positioning devices and aerial imagery. Figure 2 presents the protocol burrowing owl survey areas for the Project area.. Incidental observations of other avian species, plants and other wildlife were also noted. The presence of each observed wildlife species was based on direct observation of individual(s), sign, and/or vocalization.

Field surveys were conducted when weather conditions were conducive to observing owls and other avian species. The surveys were not performed during rain, high winds (greater than 20 mph), dense fog, or temperatures over 90 ºF. Observations were made from the nearest appropriate vantage points with the use of binoculars when access to discrete portions of the study area were not possible due to private property, topographic relief, physical barriers, health and safety considerations, etc.

FIGURE 2 – FOCUSED BURROWING OWL SURVEY AREA, OBSERVED OWLS, BURROWS AND SIGN



THIS PAGE INTENTIONALLY LEFT BLANK

4.0 SURVEY RESULTS

A nine-quad search of the CNDDB (CNDDB, 2011a) including USGS quadrangles McCoy Peak, McCoy Wash, Blythe NE, Roosevelt Mine, Ripley, Blythe, Thumb Peak, Palo Verde, and Mule Wash identified 46 occurrences of burrowing owls in the Blythe area, with two occurrences on the Project site. In addition to the CNDDB records search, recent surveys and reports for similar projects near the Project area were also reviewed (Table 2).

TABLE 2. ADJACENT PROJECT SURVEY INFORMATION

Species	Project	Species Detected	BMSP Survey Area Overlap
Burrowing Owl	Blythe Solar Power Project	Yes, two within solar site, four in transmission line and multiple sign. Not determined how sign was confirmed.	Overlaps with BMSP transmission line and Colorado River Substation (CRS) survey areas.
	Genesis Solar Energy Project	Yes, three individuals detected around the generation tie line and one burrow around the main site.	No overlap
	Devers-Palo Verde No. 2 500 kV Transmission Line Project	Burrow sites detected along project segment that encompasses Colorado River Substation, but specific locations not mapped.	The project areas overlap at the CRS.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route	Yes, burrowing owls detected along southern telecom route. Three owls detected just east of Colorado River Substation.	Project areas overlap at and near the CRS but otherwise do not share the same corridors. Northern telecom route is approximately one mile from the BMSP transmission line corridor.
	Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion	See Blythe Solar and Devers-Palo Verde Telecom survey results above.	BMSP would tie into this substation. Surveys conducted on and around the substation site would overlap with the BMSP.
	First Solar Electric Blythe Solar 1 Project	No surveys conducted. Biological analysis based on a desktop study of existing information.	Project area is located directly adjacent (north) to the BMSP transmission line.
	Blythe Airport Solar Project	No.	Project area is located directly adjacent (west) to the northeastern BMSP solar array area.

4.1 FIELD RESULTS

During the habitat assessment survey, biologists determined that the Project area contained suitable habitat conditions to support burrowing owls. Of the 3,679 acres in the study area, approximately 1,970 acres (54%) of suitable burrowing owl habitat were identified (Figure 2). Suitable habitat consisted of both fallow and active agricultural fields, irrigation ponds and canals, and creosote bush scrub. Suitable habitat also occurred along the edges of orchards. The remaining 1,703 acres consisted of orchards and alfalfa fields. Orchards within the project area did not contain suitable habitat; burrowing owls prefer open areas and do not inhabit areas with dense vegetation (U.S. Fish and Wildlife Service, 2003). Alfalfa fields provide suitable forage areas for burrowing owls, but heavy and frequent disturbance of the fields by disking and harvesting decreases burrow availability. Burrows can occur along the edges of agricultural fields, orchards and road banks; all road banks, field edges and irrigation ditches along the agricultural areas throughout the Project site were surveyed. Six irrigation ponds located in the orchard area and irrigation channels throughout the agricultural area and to the east of the project limits provide accessible fresh water for wildlife.

The field data from the protocol surveys identified the presence of six burrowing owls during the May survey and eight owls during the July surveys, and an additional two owls were observed outside the project site but within the survey buffer. Nine suitable burrows or burrow complexes were observed in the northern portion of the site (Figure 2). No suitable burrows were observed in the southern portion of the site. Soil conditions in the southern half of the site within Project Parcels 4, 13-18 and the transmission corridor were very sandy and unstable. However, burrowing owl sign (white wash, pellets, feathers) was observed in five locations in the southern region of the Project area. Burrows observed in the southern half of the site belonged to either kit fox (*Vulpes macrotis*) or kangaroo rat (*Dipodomys* sp.). No burrowing owl sign was observed near the kit fox burrows. Several of the kit fox burrows were recent and active kit fox sign was documented; however, most of the burrows were old and collapsed and would not support burrowing owl because the instability of the soil.

During the July surveys (14-19 and 21-23) burrowing owl activity and use was determined to the extent possible. Burrows were monitored at sunrise or sunset on different days to ensure a complete activity period was evaluated for each observed bird. The northern end of the Project site was divided into three burrowing owl monitoring sites. Please refer to Figure 2 for the location of Areas 1, 2, and 3.

Area 1 supported four burrowing owls. The four burrowing owls were observed flying in and out of three separate concrete / brick lined cylindrical, man-made structures, which have concrete collars above ground level and are open to below ground level to a depth of approximately four feet. Appendix C includes site photographs and images of the well location burrows and these described elements. In Area 1, Burrow #4 contained the greatest number of observed sign, including pellets, prey detritus, feathers, and white wash. Burrows # 5 and 6 also featured significant amounts of pellets, detritus, white wash, and feathers. Biologists were unable to determine if the owls were two separate pairs or one pair with two juveniles. Burrowing owls at Area 1 consistently exhibited social and foraging behavior. Several perch sites were favored in this area, including a metal rod with a rounded top, a fence post, a large pile of cleared vegetation and, most frequently, the edges of the concrete wells. Area 1 consisted of approximately five acres of disturbed creosote bush scrub dominated by creosote bush and bur sage; concrete rubble piles from old demolished barracks were scattered throughout the creosote bush scrub. Area 1 was bound on the south, west and north by recently tilled, non-irrigated wheat fields that have been farmed for approximately one year. This field is bound to the north by open space comprising creosote scrub habitat, and to the west by disturbed creosote scrub habitat within the area of the former military base and current Blythe Airport.

In Area 2, two burrowing owls occupied a single burrow located in a concrete rubble pile. The two owls were observed consistently during morning and evening hours perched on top of the rubble pile. Burrowing owl tracks were identified around and into the rubble pile, with feathers and pellets near a small burrow entrance beneath the rubble. Sex and age of the two burrowing owls observed during the surveys was not established. The burrowing owls occupying Area 2 were easily distressed and would flush and call to one another whenever biologists entered the vicinity. Area 2 consisted of approximately two acres of disturbed creosote bush scrub dominated by creosote bush and bur sage. Concrete rubble piles and two concrete foundations were scattered throughout the creosote bush scrub. Area 2 was surrounded to the south, east and north by recently tilled, non-irrigated wheat fields and disturbed creosote bush scrub to the west.

In Area 3, two burrowing owls occupied a burrow complex within a native Bajada area in the buffer study area. One burrow appeared to be a former canid burrow due to its size, shape, and location in an area of naturally formed earth mounds. Biologists identified three separate burrowing complexes on the earth mounds within an approximately ten-acre zone. Each burrow complex contained several burrows with recent sign, including white wash, feathers, tracks, and pellets. The two burrowing owls were typically

perched on top of earthen mounds when the biologists accessed the area. Biologists could not determine if the pair was nesting without additional harassment.

4.2 WILDLIFE AND PLANTS OBSERVED DURING BURROWING OWL SURVEY

Round-tailed ground squirrel (*Spermophilus tereticaudus*) and white-tailed antelope squirrel (*Ammospermophilus leucurus*) burrows where observed throughout the northern and eastern portions of the site along road sides, agricultural fields and disturbed areas with mounded soils or dump sites. Creosote bush (*Larrea tridentata*) was the dominant species in undisturbed portions of the site. Additional plants and wildlife species frequently observed within suitable habitat included bur sage (*Ambrosia dumosa*), wheat (*Triticum* sp.), mourning dove (*Zenaida macroura*), white-wing dove (*Zenaida asiatica*), horned lark (*Eremophila alpestris*), greater roadrunner (*Geococcyx californianus*), black-tailed jackrabbit (*Lepus californicus*), desert iguana (*Dipsosaurus dorsalis*), and western whiptail (*Cnemidophorus tigris*). Three CDFG Species of Special Concern, Le Conte's thrasher (*Toxostoma lecontei*), loggerhead shrike (*Lanius ludovicianus*) and Mohave fringe-toed lizard (*Uma scoparia*) were observed in multiple locations on both the northern and southern portions of the Project area. Complete plant and wildlife species observed are included in Appendices A and B.

5.0 CONCLUSION

The study area supports a relatively small population of burrowing owl, and based on the burrowing owl survey results from surrounding solar projects burrowing owl may occupy habitat outside of the study area limits (AECOM 2010, Aspen 2011). It was not determined if this population is increasing or decreasing in size or the length of occupancy. The surveys determined that in July 2011, eight individual burrowing owls were present within the study area and may be directly or indirectly affected by the Project. This determination is valid for 12 months from the completion of this report (October 2011 through October 2012). The number of owls or burrows affected at the time of ground disturbance may be greater than or less than this number because of the natural variation in the owl population in this region, and natural and man-made conditions that may occur prior to construction.

6.0 LITERATURE CITED / REFERENCES

AECOM. 2010. Blythe Solar Power Project Biological Resources Technical Report. Prepared for Palo Verde Solar I, LLC. June 2010.

Aspen Environmental Group (Aspen). 2006. Devers-Palo Verde No. 2 500 kV Transmission Line Project Final Environmental Impact Report/Environmental Impact Statement. Prepared for California Public Utilities Commission. October 2006.

_____. 2011. Draft Supplemental Environmental Impact Report, Devers-Palo Verde No. 2 500 kV Transmission Line Project Colorado River Substation Expansion. Prepared for Southern California Edison. February 2011.

Bloom, Pete. 2003. Letter to California Department of Fish and Game, December 2003. Personal letter from Mr. Pete Bloom.

California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. Tech. Rep. Burrowing Owl Consortium, Alviso, California. http://www.dfg.ca.gov/wildlife/nongame/docs/boconsortium.pdf

California Department of Fish and Game (CDFG). 1995. Staff Reporting on Burrowing Owl. October 17, 1995. California Department of Fish and Game. Memorandum from Mr. Ron Rempel.

_____. 2008. California Interagency Wildlife Task Group. CWHR version 8.2 personal computing program. Sacramento, CA.

California Natural Diversity Data Base (CNDDB). 2011a. California Natural Diversity Data Base. Element occurrence search for Project area quadrangles.

_____. 2011b. Special Animals List. Biogeographic Data Branch, CNDDB.

Cibola National Wildlife Refuge. 2011. Wild At Heart Owl Relocation to Cibola NWR. http://www.mirror-pole.com/wild_at_heart/bur_owl/rel_sites/cibola/cibola_release_site.html

Haug, E. A., B. A. Millsap and M. S. Martell. 1993. Burrowing Owl (Athene cunicularia), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/061.

Holland, R.F. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. Vegetation Ecologist Nongame-Heritage Program. Sacramento, CA.

Klute, David S., Ayers, Loren W., Green, Michael T., Howe, William H., Jones, Stephanie L., Shaffer, Jill A., Sheffield, Steven R., and Zimmerman, Tara S. 2003. Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States Biological Technical Publication BTP-R6001-2003. U.S. Fish and Wildlife Service.

Sawyer, Keeler-Wolf, Evens. 2009. A manual of California Vegetation, Second Edition, California Native Plant Society Press. Sacramento, CA.

Representative Relevant Planned Projects in vicinity of Blythe, California

AECOM. 2009. Blythe Solar Power Project Application for Certification. Submitted by Solar Millennium, LLC to the California Energy Commission.

California Energy Commission. 2010. Genesis Solar Energy Project Application for Certification Supplemental Information. March 2010. California Energy Commission Docket Number 09-AFC-8.

Devers–Palo Verde No. 2 Transmission Line Project Colorado River Substation Expansion Final Supplemental Environmental Impact Report. April 2010.

Southern California Edison. 2009. First Solar Electric, Blythe, California Environmental Assessment Initial Study. February, 2009. County of Riverside EA40219.

TetraTech Environmental, Inc. 2010. Genesis Solar Energy Project Supplemental Information. June 2010. California Energy Commission Docket Number 09-AFC-8. TetraTech Environmental, Inc.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A – OBSERVED PLANT LIST

AR061328

Plant Species Observed During Surveys

Scientific Name	Common Name
ANGIOSPERMS (DICOTYLEDONS)	
AMARANTHACEAE	**AMARANTH FAMILY**
Tidestromia oblongifolia	honeysweet
APIACEAE	**CARROT FAMILY**
Lomatium sp.	lomatium
ASCLEPIADACEAE	**MILKWEED FAMILY**
Asclepias sp.	milkweed
Asclepias subulata	rush milkweed
Sarcostemma cynanchoides ssp. hartwegii	climbing milkweed
ASTERACEAE	**SUNFLOWER FAMILY**
Ambrosia dumosa	burro bush
Baileya pauciradiata	Colorado Desert marigold
Bebbia juncea	sweetbush
Chaenactis sp.	pincushion
Chaenactis stevioides	desert pinchushion
Dicoria canescens	bugseed
Geraea canescens	desert sunflower
Hymenoclea salsola	cheesebush
Palafoxia arida	Spanish needles
Pluchea sericea	arrow weed
Stephanomeria pauciflora	wire lettuce
BORAGINACEAE	**BORAGE FAMILY**
Cryptantha sp.	cryptantha
Cryptantha angustifolium	narrowleaf cryptantha
Cryptantha costata	ribbed cryptantha
Cryptantha maritime	Guadalupe cryptantha
Cryptantha nevadensis	cryptantha
Cryptantha pterocarya	wing nut cryptantha
Nama demissum	purple desert mat
Pectocarya sp.	pectocarya
Tiquilia palmeri	Palmer's tiquilia
Tiquilia plicata	plicate tiquilia
BRASSICACEAE	**MUSTARD FAMILY**
*Brassica tournefortii**	Sahara mustard
*Buxus microphylla**	Japanese box
Lepidium sp.	peppergrass
Lepidium lasiocarpum	peppergrass
Simmondsia chinensis	jojoba
CASUARINACEAE	**SHE OAK FAMILY**
Casuarina sp.*	she oak
CACTACEAE	**CACTUS FAMILY**
Cylindropuntia echinocarpa	golden cholla
Mammillaria sp.	fish-hook cactus
CHENOPODIACEAE	**GOOSEFOOT FAMILY**
Atriplex canescens	four-wing saltbush
Atriplex lentiformis	quail brush

Scientific Name	Common Name
*Bassia hyssopifolia**	five-hooked bassia
Salsola tragus	Russian thistle
CUCURBITACEAE	**GOURD FAMILY**
Cucurbita sp.*	squash
EUPHORBIACEAE	**SPURGE FAMILY**
Stillingia spinulosa	annual stillingia
FABACEAE	**LEGUME FAMILY**
Acacia greggii	cat claw acacia
Astragalus sp.	astragalus
Cercidium floridum	palo verde
Dallea mollissima	downy dalea
*Medicago sativa**	alfalfa
Olneya tesota	desert ironwood
Prosopis sp.	mesquite
Prosopis glandulosa	Honey mesquite
Psorothamnus emoryi	indigobush
Psorothamnus schottii	indigobush
GERANIACEAE	**GERANIUM FAMILY**
*Erodium cicutarium**	red-stemmed filaree
LOASACEAE	**LOASA FAMILY**
Eucnide urens	rock nettle
Mentzelia sp.	blazing star
Mentzelia multiflora	blazing star
Petalonyx thurberi ssp. thurberi	sandpaper plant
MARTYNIACEAE	**UNICORN PLANT FAMILY**
Proboscidea althaeifolia	desert unicorn plant
MYRTACEAE	**MYRTLE FAMILY**
Eucalyptus sp.*	gum tree
NYCTAGINACEAE	**FOUR O'CLOCK FAMILY**
Abronia villosa	sand verbena
ONAGRACEAE	**EVENING PRIMROSE FAMILY**
Camissonia boothii	bottlebrush primrose
Oenothera deltoids ssp. deltoides	bird-cage primrose
PLANTAGINACEAE	**PLANTAIN FAMILY**
Plantago erecta	western plantain
Plantago ovata	wooly plantain
POLEMONIACEAE	**PHLOX FAMILY**
Eriastrum harwoodii	Harwood's eriastrum
Gilia sp.	
Langloisia setosissima	lilac sunbonnet
POLYGONACEAE	**BUCKWHEAT FAMILY**
Chorizanthe brevicornu	brittle spineflower
Chorizanthe rigida	rigid spineflower
Eriogonum sp.	
RESDACEAE	**MIGNONETTE FAMILY**
Oligomeris linifolia	Narrow-leaf oligomeris
ROSACEAE	**ROSE FAMILY**

Scientific Name	Common Name
*Prunus persica**	peach
RUTACEAE	**RUE FAMILY**
*Citrus limon**	lemon
*Citrus sinensis**	orange
TAMARICACEAE	**TAMARISK FAMILY**
*Tamarix ramosissima**	Mediterranean tamarisk
VISCACEAE	**MISTLETOE FAMILY**
Phoradendron californicum	desert mistletoe
ZYGOPHYLLACEAE	**CALTROP FAMILY**
Larrea tridentata	creosote bush
ANGIOSPERMS (MONOCOTYLEDONS)	
ARECACEAE	**PALM FAMILY**
Phoenix sp.*	date palm
LILIACEAE	**LILY FAMILY**
Hesperocaulis undulata	desert lily
POACEAE	**GRASS FAMILY**
Pleuraphis rigida	galleta grass
*Schismus barbatus**	Mediterranean schismus
*Triticum aestivum**	wheat

* = non-native species

APPENDIX B – OBSERVED WILDLIFE LIST

Scientific Name	Common Name
CLASS INSECTA	**INSECTS**
MELOIDAE	**BLISTER BEETLES**
Lytta auriculata	red-eared blister beetle
TENEBRIONIDAE	**DARKLING BEETLES**
Asbolus verrucosus	desert ironclad beetle
Eleodes spinipes	darkling beetle
MANTIDAE	**MANTIDS**
Litaneutria minor	ground mantis
PIERIDAE	**WHITE & SULPHUR BUTTERFLIES**
Pieris rapae	cabbage white
Pontia protodice	checker-white
NYMPHALIDAE	**BRUSH-FOOTED BUTTERFLIES**
Vanessa virginiensis	Virginia lady
LYCAENIDAE	**GOSSAMER WING BUTTERFLIES**
Brephidium exilis	pygmy blue
FORMICIDAE	**ANTS**
Messor pergandei	desert harvester ant
MUTILLIDAE	**VELVET ANTS**
Dasymutilla sp.	velvet ant
POMPILIDAE	**SPIDER WASPS**
Pepsis formosa	tarantula wasp
CLASS AMPHIBIA	**AMPHIBIANS**
Bufo woodhousii	Woodhouse's toad
CLASS REPTILIA	**REPTILES**
TRIONYCHIDAE	**SOFTSHELL TURTLES**
Apalone spinifera	spiny softshell turtle
IGUANIDAE	**IGUANID LIZARDS**
Callisaurus draconoides draconoides	common zebra-tailed lizard
Dipsosaurus dorsalis	desert iguana
Phrynosoma sp.	horned lizard
Uma scoparia	Mojave fringe-toed lizard
Uta stansburiana	common side-blotched lizard
TEIIDAE	**WHIPTAIL LIZARDS**
Cnemidophorus sp.	whiptail
COLUBRIDAE	**COLUBRID SNAKES**
Arizona elegans occidentalis	Glossy snake
Chinoactis occipitalis	shovel-nosed snake
VIPERIDAE	**VIPERS**
Crotalus cerastes	sidewinder

Scientific Name	Common Name
CLASS AVES	**BIRDS**
CATHARTIDAE	**NEW WORLD VULTURES**
Cathartes aura	turkey vulture
ACCIPITRIDAE	**HAWKS, KITES, EAGLES**
Buteo jamaicensis	red-tailed hawk
FALCONIDAE	**FALCONS**
Falco sparverius	American kestrel
ODONTOPHORIDAE	**NEW WORLD QUAIL**
Callipepla gambelii	Gambel's quail
CHARADRIIDAE	**PLOVERS**
Charadrius vociferus	killdeer
COLUMBIDAE	**PIGEONS & DOVES**
Columba livia	rock pigeon
Streptopelia risoria	ringed turtle-dove
Zenaida aurita	white-winged dove
Zenaida macroura	mourning dove
CUCULIDAE	**CUCKOOS & ROADRUNNERS**
Geococcyx californianus	greater roadrunner
STRIGIDAE	**TRUE OWLS**
Athene cunicularia	burrowing owl
APODIDAE	**SWIFTS**
Aeronautes saxatalis	white-throated swift
TYRANNIDAE	**TYRANT FLYCATCHERS**
Tyrannus verticalis	western kingbird
ALAUDIDAE	**LARKS**
Eremophila alpestris	horned lark
HIRUNDINIDAE	**SWALLOWS**
Petrochelidon pyrrhonota	cliff swallow
CORVIDAE	**JAYS & CROWS**
Corvus corax	common raven
LANIIDAE	**SHRIKES**
Lanius ludovicianus	loggerhead shrike
STURNIDAE	**STARLINGS**
Sturnus vulgaris	European starling
ICTERIDAE	**BLACKBIRDS**
Agelaius phoeniceus	red-winged blackbird
Euphagus cyanocephalus	Brewer's blackbird
Icterus cucullatus	hooded oriole
Xanthocephalus xanthocephalus	yellow-headed blackbird
Quiscalus mexicanus	great-tailed grackle

Scientific Name	Common Name
MIMIDAE	**MOCKINGBIRDS & THRASHERS**
Toxostoma lecontei	Le Conte's thrasher
THRAUPIDAE	**TANAGERS**
Piranga ludoviciana	Western tanager
SYLVIIDAE	**GNATCATHERS**
Polioptila caerulea	black-tailed gnatcatcher
EMBERIZIDAE	**EMBERIZIDS**
Zonotrichia leucophrys	white-crowned sparrow
FRINGILLIDAE	**FINCHES**
Carduelis tristis	American goldfinch
CLASS MAMMALIA	**MAMMALS**
LEPORIDAE	**HARES & RABBITS**
Lepus californicus	black-tailed jackrabbit
Sylvilagus audubonii	desert cottontail
SCIURIDAE	**SQUIRRELS**
Ammospermophilus leucurus	white-tailed antelope squirrel
Spermophilus tereticaudus	Round-tailed ground squirrel
HETEROMYIDAE	**POCKET MICE & KANGAROO RATS**
Dipodomys sp.	kangaroo rat
CANIDAE	**WOLVES & FOXES**
Canis familiaris	domestic dog
Canis latrans	coyote
Vulpes macrotis	kit fox
MUSTELIDAE	**WEASELS, SKUNKS & OTTERS**
Taxidea taxus	American badger
BOVIDAE	**BISON, GOATS & SHEEP**
Ovis canadensis	bighorn sheep (skull)
CHIROPTERA	**BATS**
Myotis sp.	Myotis

APPENDIX B: PRE-CONSTRUCTION NESTING SURVEY PROTOCOL

THIS PAGE INTENTIONALLY LEFT BLANK

The following protocol is intended to help assist with the discovery of bird nests in or around the solar array and gen-tie line prior to construction. This protocol is not suitable to survey for golden eagle nests, which are typically found in mountainous areas, but is instead intended to meet the need to locate passerine, corvid, and raptor nests.

Equipment

All surveyors should possess and use a professional set of binoculars while conducting the nesting survey. A spotting scope may also be necessary for distant nests, nests that are in tall trees, or to determine if or how many birds are in an active nest. At least one GPS should be carried, as well as a rangefinder and compass in the event that approaching a nest could be dangerous to the birds inside it. Flagging is also suggested to mark vegetation where nests are found as an additional safeguard.

Survey Period and Time

Surveys should be conducted in and around the project area (a 500-foot survey buffer from project limits is suggested) no more than two weeks prior to construction if construction is to take place between February and August. Surveys should be repeated for each new section of the project that is undertaken For example, if construction crews are working in one area for several weeks and then move to another area a mile away, a pre-construction nesting survey should be conducted in the new area.

While nests can be located during any time of day with sufficient daylight, surveys should ideally be conducted within the first three hours after sunrise or before sunset, depending on temperature. These periods are when birds are most likely to be located while foraging or singing, and may increase the likelihood of finding a nest.

Survey Conditions

Surveys should be conducted under clear conditions. Rain, high winds, or other inclement weather that can affect visibility or the ability of surveyors to move through vegetation may make it less likely to find nests or increase the risk of destroying a nest if located in a shrub or on the ground. Weather conditions including temperature, cloud cover, and precipitation should be recorded.

Survey Protocol

It is suggested that all surveyors be able to identify the commonly-occurring bird species of the area and be familiar with the habitat types within the project area. If surveyors are present who are not familiar with this information, they should survey alongside an experienced surveyor to reduce the chance of uncertain observations or unidentified birds. Surveyors should be spaced10-20 feet apart depending on the density of vegetation cover and should walk transects to cover 100% of upcoming work areas. If birds are found to be using alarm calls during the survey, particular attention and care should be given to that area, as it may indicate a nest nearby. If possible, surveyors should wait until the adult bird(s) leaves before approaching this area to reduce the risk of nest abandonment. All nest, species, and behavioral data should be recorded on the appropriate datasheet (Appendix C).

APPENDIX C: CONSTRUCTION NEST MONITORING FORMS

THIS PAGE INTENTIONALLY LEFT BLANK

RRG Blythe Mesa Solar Project Construction Phase – Solar Facility
Avian Nest Reporting Form

Discoverer's Name _____

Phone Number _____ **Date of Nest Discovery** _____

Nest Location (circle one) Tree Shrub Ground

Nest Coordinates _____

Other Location Information _____

Surrounding Habitat (circle all that apply)

Agricultural Desert Scrub Riparian
Grassland Disturbed/Developed Bare

Nest Condition (circle one) Active Inactive, Intact
Inactive, Partial Deterioration Inactive, Heavy Deterioration

Describe any Bird Signs around the Nest (feathers, scat, prey remains) _____

_____

Are Birds Present? (circle one) Yes No

Number of Birds Visible _____

Age of Bird(s) (circle all that apply) Adult Juvenile Nestling Eggs Unknown

Bird Species (if known) _____

Type of Bird (circle one if species is unknown)

Diurnal Raptor (hawk, falcon, eagle) Owl Crow/Raven
Passerine (songbird) Unknown

Risk to Birds/Construction (circle one)

No Risk Potential Risk – Not Imminent Potential Risk – Imminent

Additional Comments _____

_____

_____

RRG Blythe Mesa Solar Project Construction Phase – Gen-tie Line
Avian Nest Reporting Form

Discoverer's Name _____

Phone Number _____ **Date of Nest Discovery** _____

Nest Location (circle one) Tree Shrub Ground

Nest Coordinates or Closest Pole Location _____

Other Location Information _____

Surrounding Habitat (circle all that apply)

Agricultural Desert Scrub Riparian
Grassland Disturbed/Developed Bare

Nest Condition (circle one) Active Inactive, Intact
Inactive, Partial Deterioration Inactive, Heavy Deterioration

Describe any Bird Signs Around the Nest (feathers, scat, prey remains)

_____

_____

Are Birds Present? (circle one) Yes No

Number of Birds Visible _____

Age of Bird(s) (circle all that apply) Adult Juvenile Nestling Eggs Unknown

Bird Species (if known) _____

Type of Bird (circle one if species is unknown)

Diurnal Raptor (hawk, falcon, eagle) Owl Crow/Raven
Passerine (songbird) Unknown

Risk to Birds/Construction (circle one)

No Risk Potential Risk – Not Imminent Potential Risk – Imminent

Additional Comments_____

_____

_____

APPENDIX D: OPERATIONAL NEST MONITORING FORMS

THIS PAGE INTENTIONALLY LEFT BLANK

RRG Blythe Mesa Solar Project Operational Phase – Solar Facility Avian Nest Reporting Form

Discoverer's Name _____

Phone Number _____ **Date of Nest Discovery** _____

Nest Location (circle one) Facility Equipment Tree Shrub Ground

Nest Coordinates _____

Other Location Information _____

Surrounding Habitat outside of Solar Array Fence (circle all that apply)

Agricultural Desert Scrub Riparian
Grassland Disturbed/Developed Bare

Nest Condition (circle one) Inactive Under Construction Active

Describe any Bird Signs around the Nest (feathers, whitewash, scat, prey remains)

_____

_____

Are Birds Present? (circle one) Yes No

Number of Birds Visible _____

Age of Bird(s) (circle all that apply) Adult Juvenile Nestling Eggs Unknown

Bird Species (if known) _____

Type of Bird (circle one if species is unknown)

Diurnal Raptor (hawk, falcon, eagle) Owl Crow/Raven
Passerine (songbird) Unknown

Risk to Solar Array and Equipment (circle one)

No Risk Potential Risk – Not Imminent Potential Risk – Imminent

Additional Comments _____

_____

_____

RRG Blythe Mesa Solar Project Operations Phase – Gen-tie Line
Avian Nest Reporting Form

Discoverer's Name _____

Phone Number _____ **Date of Nest Discovery** _____

Pole Number of Nest Location _____

Other Location Information _____

Surrounding Habitat (circle all that apply)

Agricultural	Desert Scrub	Riparian
Grassland	Disturbed/Developed	Bare

Nest Condition (circle one) Inactive Under Construction Active

Describe any Bird Signs Around the Nest (feathers, scat, prey remains) _____

_____

Are Birds Present? (circle one) Yes No

Number of Birds Visible _____

Age of Bird(s) (circle all that apply) Adult Juvenile Nestling Eggs Unknown

Bird Species (if known) _____

Type of Bird (circle one if species is unknown)

Diurnal Raptor (hawk, falcon, eagle)	Owl	Crow/Raven
Passerine (songbird)	Unknown	

Risk to Electrical Equipment (circle one)

Potential Risk – Not Imminent Potential Risk – Imminent

Additional Comments _____

_____

_____

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX E: MORTALITY REPORTING FORM

RRG Blythe Mesa Solar Project Avian/Bat Incident Reporting Form

Discoverer's Name _____

Phone Number _____ **Date of Discovery** _____

Date and Time of Incident/Discovery
_____

Location, include Pole and GPS Coordinates (if available) _____

_____

Species (if known) _____

Type of Bird or Bat (circle one if species is unknown)

Diurnal Raptor (hawk, falcon, eagle)	Owl	Crow / Raven
Passerine (songbird)	Bat	Unknown / Other

Number of Individuals _____

Age of Bird(s) (circle all that apply) Adult Juvenile Nestling Eggs Unknown

Surrounding Habitat (circle all that apply)

Agricultural	Chaparral/Shrubs	Desert Scrub
Disturbed/Developed	Grassland	Riparian

Type of Incident (circle one) Injury Mortality

Description of Incident. Include condition of bird, circumstances of incident and cause of injury or mortality (if known), and any damage to facilities._____

_____

_____

_____

_____

_____

_____

Please attach a picture of the bird or bat, if possible.

BLYTHE MESA SOLAR PROJECT

OPERATIONS MORTALITY REPORTING FORM FOR AVIAN AND BAT SPECIES

DATE: _____ TIME: _____ OBSERVER: _____

PROXIMAL TO PROJECT COMPONENT: _____

CARCASS POSITION

GPS COORDINATES (UTM NAD83) 11S East: _____ North: _____

BEARING (degrees) to PROJECT COMPONENT: _____

DISTANCE (meters) to PROJECT COMPONENT: _____

CARCASS DESCRIPTION

SPECIES: _____

SEX (*circle*): M F U AGE (*circle*): A J U Tag/Band Number: _____

CONDITION (*circle*): intact scavenged dismembered feather spot injured

ESTIMATED TIME SINCE DEATH/INJURY (no. of days): >1 1 2 3 4 5 6 7 7+

CAUSE OF DEATH:

_____

_____

OBSERVABLE INJURIES:

_____

_____

SUBSTRATE/GROUND COVER (*at carcass location)*:_____

DISPOSITION OF CARCASS[1] (*circle*): left in place removed collected for trials collected for other: _____

SHIPPED TO:

[name of institution] _____

[physical address] _____

[phone/email] _____

WEATHER CONDITIONS

AIR TEMPERATURE (degrees Fahrenheit): _____

PRECIPITATON (last 24 hours, *circle*): none light rain rain heavy rain hail snow

CLOUD COVER (*circle*): clear mostly clear partly cloudy mostly cloudy cloudy

WIND DIRECTION: _____ SPEED (mph, *circle*): 0-10 10-20 20-30 30+ gusty

NOTES (describe noteworthy weather conditions since last search, including high wind, fog, precipitation, and storm events):

_____

_____

_____

_____

PHOTOGRAPHS[2]:

Close Up: Photo 1 _____ Photo 2 _____

Landscape: Photo 3 _____ Photo 4 _____

PHOTO NOTES:

_____

_____

NOTIFICATION[3]:

DATE: _____ TIME: _____

NAME: _____ AGENCY/ASSOCIATION: _____

NOTES:

_____

_____

_____

_____

_____

[1] Permit required to handle bird carcasses.

[2] At least four photographs should be taken. Two should be close-in shots of the carcass and should be taken from at least two different angles. Two should be shots taken farther away showing the landscape (project components, surrounding habitat, etc.) and should be taken from at least two different angles).

[3] Indicate who was notified of the event, date, time, etc.

APPENDIX C5
REVIEW OF FEDERAL WATERS

THIS PAGE INTENTIONALLY LEFT BLANK

February 2013

BLYTHE MESA SOLAR PROJECT

Review of Federal Waters

PROJECT NUMBER:
122512

PROJECT CONTACT:
Vanessa Santistevan

EMAIL:
Vanessa.Santistevan@powereng.com

PHONE:
303-716-8908

POWER ENGINEERS

PREPARED FOR: SOLAR STAR BLYTHE MESA 1
SAN JOSE, CALIFORNIA
AND
RENEWABLE RESOURCES GROUP
LOS ANGELES, CALIFORNIA

PREPARED BY:
POWER ENGINEERS, INC.

CONTENTS

1.0 INTRODUCTION 1

1.1 PROJECT LOCATION 1
1.2 ENVIRONMENTAL SETTING 1
1.2.1 Vegetation 5
1.2.2 Climate and Hydrology 6
1.2.3 Soils 7

2.0 METHODS 11

3.0 RESULTS 11

3.1 EPHEMERAL WASHES 11
3.2 SUMMARY OF JURISDICTIONAL ASSESSMENT 15

4.0 LITERATURE CITED / REFERENCES 25

FIGURES

Figure 1. Regional Area Project Location Map 3
Figure 2. Vegetation Communities within the Project area 9
Figure 3. Soils within the Project area 10
Figure 4. Hydrologic Features 13
Figure 5. 2012 Aerial Photo with Contour Overlay 17
Figure 6. Ephemeral Channel 19
Figure 7: Site Photo, Facing Northwest 21
Figure 8: Site Photo, Facing Northeast 22
Figure 9: Site Photo, Facing Southeast 23

TABLES

Table 1. Vegetation Communities and Cover Types (Acres) 5

APPENDICES

Appendix A: Best Management Practices

ACRONYMS AND ABBREVIATIONS

˚F	Fahrenheit
AMSL	above mean sea level
BLM	United States Department of the Interior, Bureau of Land Management
BMSP	Blythe Mesa Solar Project
CEQA	California Environmental Quality Act
EIR/EA	Environmental Impact Report/Environmental Assessment
GPS	Global Positioning System
km	kilometers
kV	kilovolt
MBTA	Migratory Bird Treaty Act
mph	miles per hour
MW	megawatt
POWER	POWER Engineers, Inc.
PV	photovoltaic
RRG	Renewable Resources Group, LLC
USGS	U.S. Geological Survey

AR061357

1.0 INTRODUCTION

The Blythe Mesa Solar Project (Project) includes a 485-megawatt (MW alternating current solar photovoltaic (PV) electrical generating facility and 8.4-mile gen-tie line that would occupy a total of 3,660 acres in the Palo Verde Mesa region of Riverside County (Figure 1). Once constructed, the Project would occupy 3,587 acres for the solar facility component and 73 acres for the 230 kV gen-tie line. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison (SCE) Colorado River Substation, an approved new substation located south of Interstate 10 (I-10) and approximately five miles west of the Project site.

The following report describes the results of an investigation and assessment to determine the potential presence of waters of the United States (i.e., Federal waters) within the boundaries of the Project. The information contained in this report is intended to provide the U.S. Army Corps of Engineers (USACE) with sufficient information to determine whether there are water features on the project site that are subject to jurisdiction under Section 404 of the federal Clean Water Act.

1.1 Project Location

The proposed Project is located in east Riverside County, approximately five miles west of central Blythe and 40 miles east of Desert Center; more specifically, the proposed Project is located north and south of I-10, west of Neighbors Boulevard and Arrowhead Boulevard, and south and east of the Blythe Airport (Figure 1). The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5' U.S. Geological Survey (USGS) Topographic Quadrangles. The Project is located on:

- Sections 11 and 12 of Township 7 South, Range 21 East
- Sections 3, 4, 5, 6, 8, 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

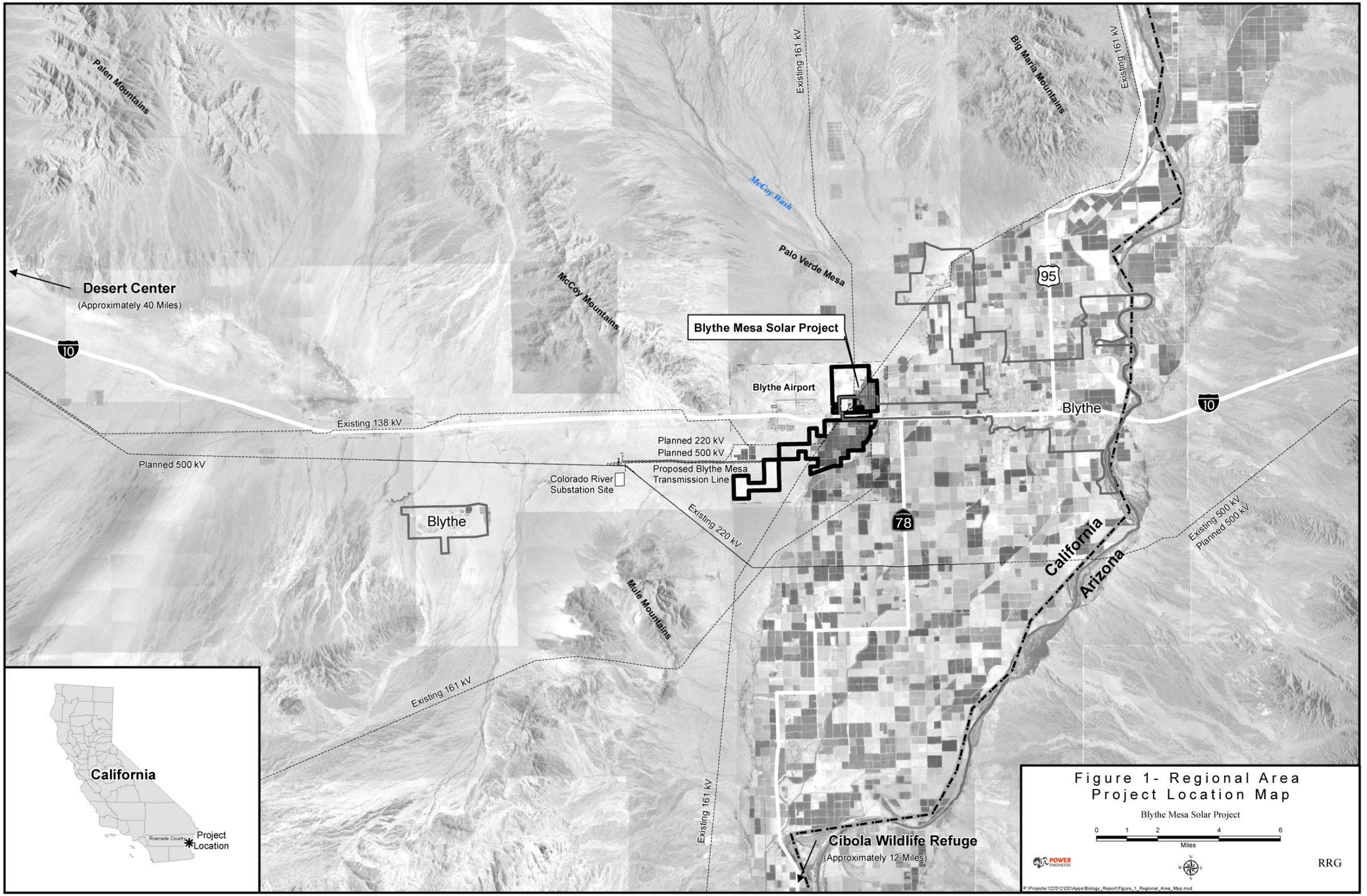
1.2 Environmental Setting

The Project area is located on the western mesa of the Palo Verde Valley. The valley is a portion of the Colorado River floodplain. The Project area is on Palo Verde Mesa and is situated in the greater Sonoran Desert. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The Project area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert. Approximately 70% of the solar facility area is actively cultivated agricultural land, 24% is previously disturbed by agricultural or military activities, and 6% is undisturbed. Agricultural land use within the solar facility site includes drip-irrigated citrus orchards, flood-irrigated alfalfa, non-irrigated winter wheat, abandoned jojoba orchards, and fallow fields. The gen-tie line corridors would pass through BLM lands and other private lands mainly comprising desert scrub habitat and disturbed lands associated with existing infrastructure. Several utility lines and maintenance roads run through or parallel the gen-tie line corridors. Additionally, the Project area has been previously disturbed by off-road vehicle use, trash dumping, and historic use for military training during World War II. The Project area borders or is in the vicinity of Nicholls Warm Springs/Mesa Verde, an existing solar facility, Blythe Airport, the 520 MW natural gas-fired Blythe Energy Center, electrical substations, electrical transmission lines, I-10, and other paved and dirt roads. The Project area is bound on the east by agricultural land use that extends through the Palo Verde Valley to the Colorado River.

THIS PAGE INTENTIONALLY LEFT BLANK

AR061359

FIGURE 1. REGIONAL AREA PROJECT LOCATION MAP



THIS PAGE INTENTIONALLY LEFT BLANK

1.2.1 Vegetation

The Project area consists primarily of desert scrub and agricultural lands. Along the four-mile transmission line route and eastern and southern ends of the Project limits there are discrete areas of disturbed native creosote scrub and disturbed stabilized dune and blow sand habitats. Table 1 presents the estimated acreage observed for each habitat type within the study area. This data does not represent the actual proposed Project disturbance footprint for the solar array areas, transmission lines, substations, and facility buildings and roads.

Table 1. Vegetation Communities and Cover Types (Acres)

Vegetation Communities and Other Cover Types	Acreage on the Solar Array Site Project Boundary	Acreage on the Proposed Gen-tie Line**	Acreage on the Northern Alternative Gen-tie Line**	Acreage on the Southern Alternative Gen-tie Line**
Bajada	18.1	0.0	0.0	0.0
Creosote Bush Scrub	41.9	278.8	303.6	232.3
Desert Riparian Woodland Wash	0.0	22.9	22.9	11.4
Disturbed Creosote Scrub	220.1	0.0	0.5	0.3
Disturbed/Ruderal	31.2	0.5	0.0	0.0
Fallow Agriculture	249.7	0.0	0.0	0.0
Irrigated Alfalfa	404	0.0	0.0	0.0
Irrigation Pond	17.2	0.0	0.0	0.0
Mixed – Drip-irrigated Jojoba and Disturbed Creosote Scrub	347	0.0	0.0	0.0
Non-irrigated Wheat	1088.2	0.0	0.0	0.0
Orchard	1188.4	0.0	0.0	0.0
Total Acreage	**3605.8 acres***	**302.1 acres**	**327 acres**	**244.1 acres**

*The acreage was calculated using GIS data and totals 3,605 acres; however, the County calculates the same area as 3,587 acres.
**A 250-foot buffer was placed on either side of the gen-tie centerline to account for potential indirect and direct impacts to biological resources.

Eleven vegetation communities and other cover types were identified within the Project area during the field surveys (Table 1; Figure 2). Vegetation communities were mapped according to the second edition of *A Manual of California Vegetation, Second Edition* (Sawyer *et al.*, 2009). Community classifications were based on dominant species comprising approximately 50 percent or more of the total cover within the mapped unit relative to the list of dominant species for a given vegetation community.

Bajada. Bajadas are essentially alluvial fans or desert washes. This community is present in the northeastern corner of the Project area and is typically characterized as the shallow, sandy, braided bottoms of wide canyons. This community most closely resembles Holland's "Mojave Desert Wash Scrub," Code 63700 (Holland 1986).

Creosote Bush Scrub/Disturbed Creosote Scrub. Within the study area, this community is characterized by sandy soils with a shallow clay pan on a broad gentle southeast-trending slope. Dominant plants within the study area for this community include creosote bush, burro brush, brittlebush (*Encelia farinosa*), and cheesebush. This is the most common plant community consisting of non-agricultural plants within the study area. This plant community intergrades into the desert riparian woodland wash. Within the study area, there are areas of desert pavement that are covered with rounded cobbles that range in size from one

to three inches. Typically, these areas are higher than the surrounding landscape by three to 15 feet. These areas are within creosote bush scrub, though the plant density is lower. Sonoran creosote bush scrub is designated by Holland as Code 33100 and Sawyer Keeler-Wolf and Evens as the Ocotillo Series (Holland 1986 and Sawyer *et al*. 2009). Within the gen-tie corridors, the creosote bush scrub is relatively undisturbed, except for occasional vehicle tracks. In these areas, fine sand drifts are interspersed within this community type; the Emory's indigo bush occurs in stands and is more prevalent than in other portions of the creosote bush scrub.

There are more areas of disturbed creosote bush scrub in the solar array area compared to the gen-tie line. Past disturbances in these areas consist of military training and agricultural use, including cultivation of jojoba (*Simmondsia chinensis*). These disturbances occurred in the past, and the Sonoran creosote bush scrub within the solar array area has been recovering through natural recruitment. Two invasive plant species, Russian thistle (*Salsola tragus*) and Sahara mustard (*Brassica tournefortii*), can be found in disturbed areas throughout the study area, especially near roads and fallow and active agricultural areas. Another exotic plant, Mediterranean grass (*Schismus* sp.), is prevalent throughout the creosote bush scrub.

Desert Riparian Woodland Wash. This vegetation community consists of open, drought-deciduous, riparian scrub woodland and is made up of three primary components: wash-dependent vegetation, vegetated ephemeral dry wash, and islands of Sonoran creosote bush scrub (e.g., riparian interfluves). Dominant and indicator plants of this community within the study area include honey mesquite (*Prosopis glandulosa*), palo verde (*Cercidium floridum*), desert ironwood (*Olneya tesota*), cat-claw acacia (*Acacia greggii*), and rush milkweed (*Asclepias subulata*). Creosote bush (*Larrea tridentata*) and burro brush (*Ambrosia dumosa*) were scattered throughout the canopy. The herbaceous layer is dominated by desert plantain (*Plantago ovata*), *Cryptantha* spp., and Mediterranean grass (*Schismus barbatus*). Of the vegetation communities listed in Table 3.2.4-1, the CDFG considers desert riparian woodland wash to be a sensitive habitat/biological resource. In addition, desert riparian woodland wash is a special community type (i.e., high priority for inventory in the CNDDB) per the CDFG's Vegetation and Mapping Program. Desert riparian woodland wash is equivalent to Holland's desert dry wash woodland (Code 62200) and Sawyer, Keeler-Wolf and Evens' Catclaw Acacia Series (Holland 1986 and Sawyer *et al*. 2009).

Irrigated Cropland/Irrigation Pond/Orchard/Jojoba/Wheat. These community types fall into the broader category of agriculture. The majority of agricultural land within the proposed solar array disturbance area is fallow and active agriculture. It includes lands that are currently under cultivation and those that are abandoned (e.g., fallow). Within abandoned agriculture areas, native vegetation is growing back; Russian thistle, Sahara mustard, and other exotic plants were observed interspersed with the native vegetation and are indicative of past agricultural disturbance.

Disturbed/Ruderal. Disturbed/Ruderal communities have been previously disturbed and have been converted to mostly non-native, weedy areas. Ruderal vegetation is that which grows quickly in disturbed areas and may consist of native species, such as fire-following plants, or non-native species, such as invasive grasses or forbs. Examples of invasive species that would occur in these areas include redstem filaree (*Erodium cicutarium*), Sahara mustard, and Mediterranean grass. Ruderal areas in the Project area are primarily concentrated within the proposed solar array area.

1.2.2 Climate and Hydrology

The subtropical climate of the Colorado Desert is currently characterized by dry, mild winters averaging 45 degrees Fahrenheit (˚F) and dry, hot summers that average 104˚F. Summer highs are known to reach up to 120˚F. Precipitation ranges between two and ten inches per year, with most of the precipitation occurring between November and March. Although rainfall occurs primarily in the winter months, the region is periodically influenced by tropical weather conditions, including sudden monsoonal summer storms, which typically occur from July to later September.

The Project is located in an undefined Hydrologic Sub-Area (HSA 715.40) of the Palo Verde Hydrologic Area within the Colorado (River) Hydrologic Unit in eastern Riverside County, California. Surface water is minimal on the Palo Verde Mesa, limited to seasonal and perennial sources. The Project would be located near the eastern edge of the Palo Verde Mesa, above the Palo Verde Valley and west of the 100-year floodplain of the Colorado River. Lands not utilized for agriculture are crossed by a number of small ephemeral drainages, generally flowing from northwest to southeast toward the Colorado River, either dissipating prior to reaching the edge of the Mesa or flowing into the valley. Precipitation in the form of sheet flow typically flows overland toward the edge of the Mesa. In areas used for agriculture, flow may be diverted by earthen berms or irrigation ditches. Sheet flow eventually reaches the edge of the Mesa and flows into the canal and drain system of the Palo Verde Valley south of 10th Street. This system eventually returns water to the Colorado River via the Outfall Drain, approximately 18 miles south of the Project. Perennial water comes from the Colorado River, which lies eight miles east of the Project area and is the primary source of irrigation water for agriculture in the area.

1.2.3 Soils

The USDA survey identified 15 soil types on the solar facility site (see Figure 3, *Soils*). These include: Aco gravelly loamy sand; Aco sandy loam; badland; Carrizo gravelly sand; Cibola silty clay loam; duneland; Imperial silty clay; Meloland fine sandy loam; Orita fine sand; Orita gravelly fine sandy loam; Ripley very fine sandy loam; Rositas fine sand 0 to 2 percent slopes and 2 to 9 percent slopes; Rositas fine sand, wet, 0 to 2 percent slopes; and Rositas gravelly loamy sand, 0 to 2 percent slopes. None of the soils identified are characteristic of wetlands for California.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 2. VEGETATION COMMUNITIES WITHIN THE PROJECT AREA

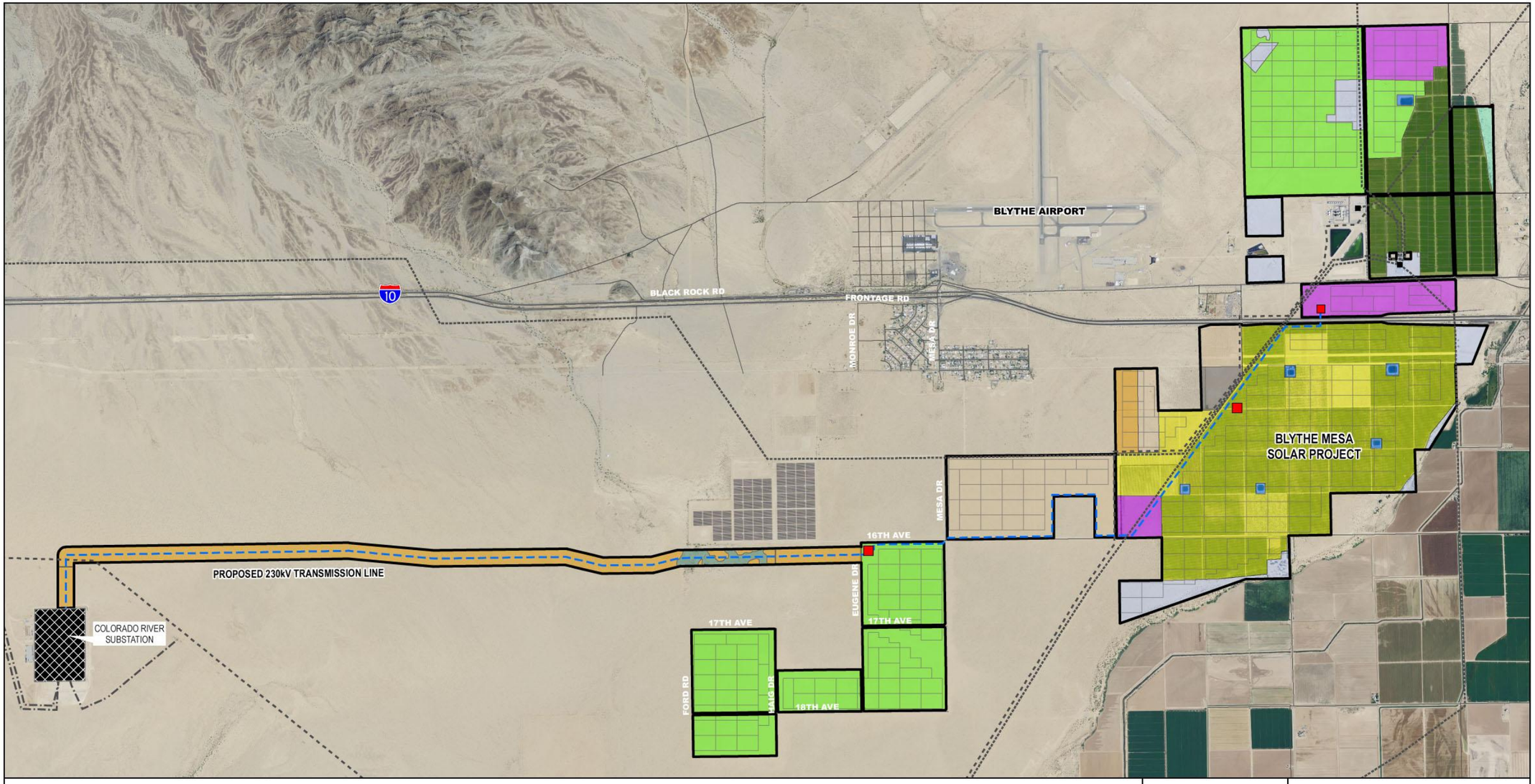
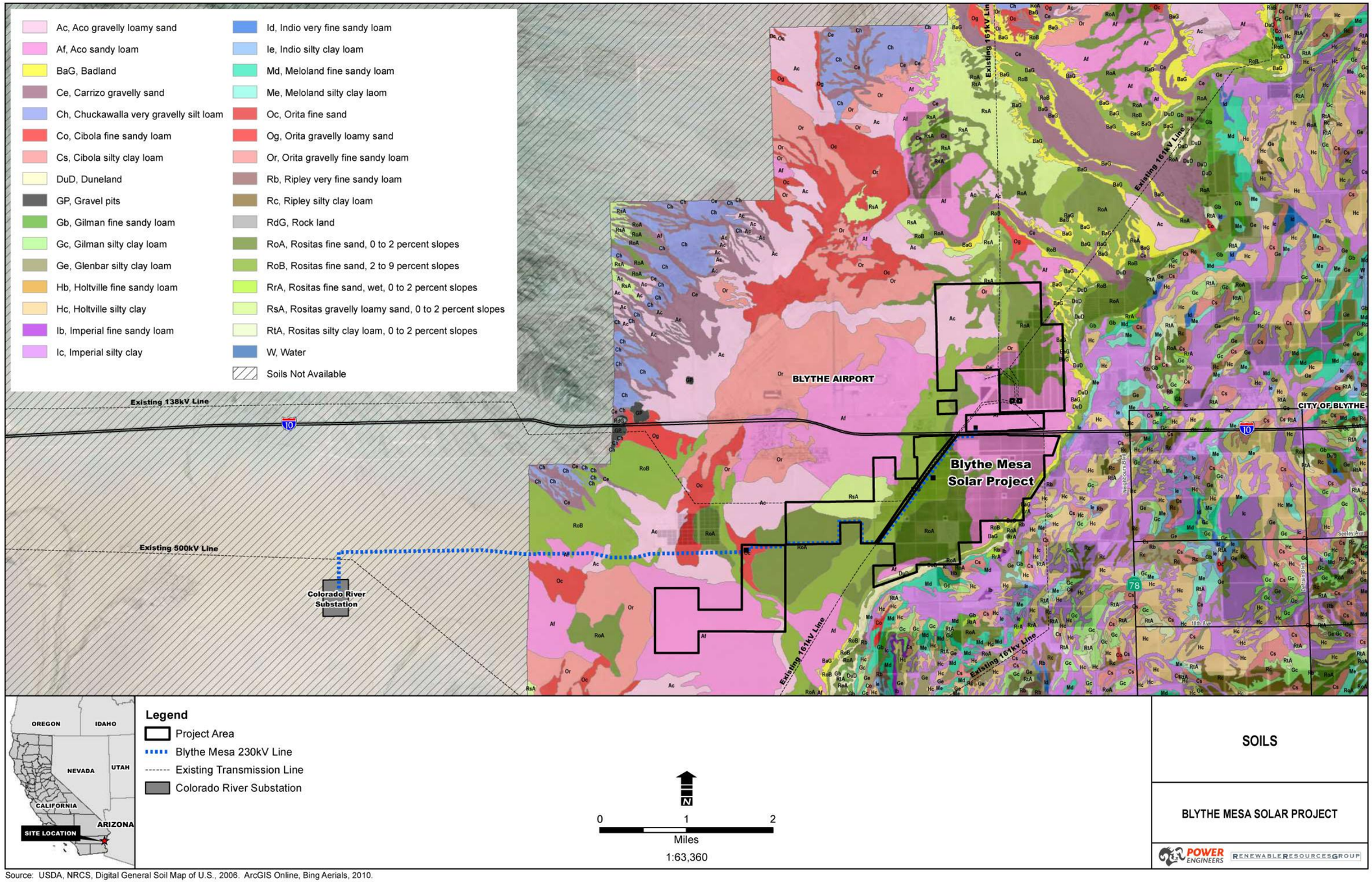


FIGURE 3. SOILS WITHIN THE PROJECT AREA



Source: USDA, NRCS, Digital General Soil Map of U.S., 2006. ArcGIS Online, Bing Aerials, 2010.

2.0 METHODS

POWER conducted a field visit within the proposed Project footprint, which focused on a 500-foot-wide corridor centered on the 125-foot-wide Project right-of-way. During POWER's field visit, the portion of the Blythe Mesa project along Mesa Drive, which has been identified as a possible wash feature, was surveyed. This location was the topographic low along Mesa Drive in the vicinity of the wash feature. The photo locations of the pictures taken at this wash feature are shown on Figure 5. The photos taken are shown in Figures 7 through 9. The potential for federal wetlands was evaluated based on the presence of wetland hydrology, wetland vegetation, and hydric soils pursuant to guidance from the Federal Manual for Delineating Wetlands (USACE 1987) as augmented by the USACE (2008b). The Project area does not exhibit features demonstrative of wetland hydrology, wetland vegetation, and/or hydric soils. Therefore, no wetland data points were selected and no wetland datasheets were recorded.

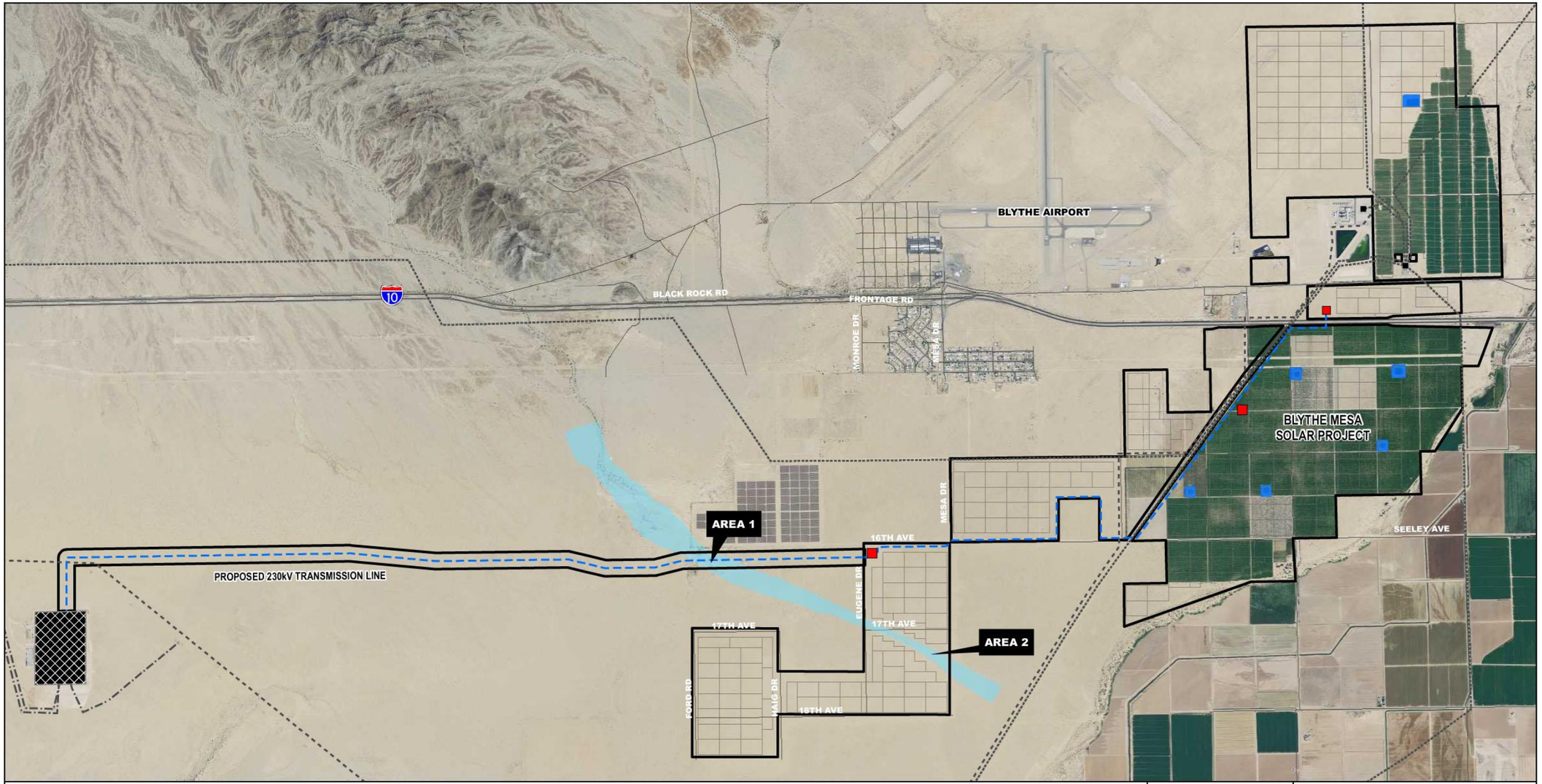
3.0 RESULTS

3.1 Ephemeral Washes

There are two discontinuous ephemeral channels on the project site. The discontinuous ephemeral channel first crosses the transmission line corridor and again southeast across the solar array site (Figure 4 and Figure 6). The discontinuous ephemeral channels on the project site consist of swales and erosional features including gullies and potential small washes characterized by low volume, infrequent or short duration flow. There is an agricultural irrigation ditch running close to the eastern edge of the proposed solar array, but it does not cross the Project area and is approximately 75 to 90 feet below the edge of the Project area. There are several palustrine open-water wetlands (POWs), likely stock ponds, located in a block in an area that is surrounded by the Project east of the Blythe Airport and north of I-10, but there are no POWs within the Project's boundary.

THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 4. HYDROLOGIC FEATURES



THIS PAGE INTENTIONALLY LEFT BLANK

3.2 Summary of Jurisdictional Assessment

Waters of the U.S. are defined as all navigable waters, including all:

- tidal waters
- interstate waters and wetlands
- other waters such as lakes, rivers, streams (perennial or intermittent), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds; the use, degradation, or destruction of which could affect interstate commerce
- impoundments of water mentioned above
- tributaries to waters mentioned above
- territorial seas
- wetlands adjacent to waters mentioned above

Waste treatment systems, including treatment ponds, are not Waters of the U.S. (33 Code of Federal Regulations Section 328.3). Based on the recent guidance issued from USACE Headquarters, jurisdictional Waters of the U.S. include traditional navigable waters (TNWs), all wetlands adjacent to TNWs, non-navigable tributaries of TNWs that are relatively permanent (i.e., tributaries that typically flow year-round or have continuous flow at least seasonally), and wetlands that directly abut such tributaries (USACE 2008b). Additionally, jurisdiction is asserted over water bodies that are not relatively permanent if that body is determined to have a significant nexus with a TNW (USACE 2008b). Under the recent guidance, desert swales defined as "shallow features in the landscape that may convey water across upland areas during and following storm events," and erosional gullies are generally considered non-jurisdictional features because they are not tributaries nor do they have a significant nexus to a TNW (USACE 2008b).

Based on current interpretations of the USACE's jurisdictional authority and the definition of Waters of the U.S., POWER concludes that the two discontinuous ephemeral channels on the Project site do not meet the criteria for regulable waters of the U.S. provided in the USACE Jurisdictional Determination Form Instruction Guidebook. These channels are not traditional navigable waters (TNWs), relatively permanent waters (RPWs), or tributaries to RPWs with seasonal flow or tributaries to non-RPWs. The two discontinuous ephemeral channels do not meet the definition of Waters of the U.S. found at 33 CFR 328.3, including consideration of additional guidance from the USACE:

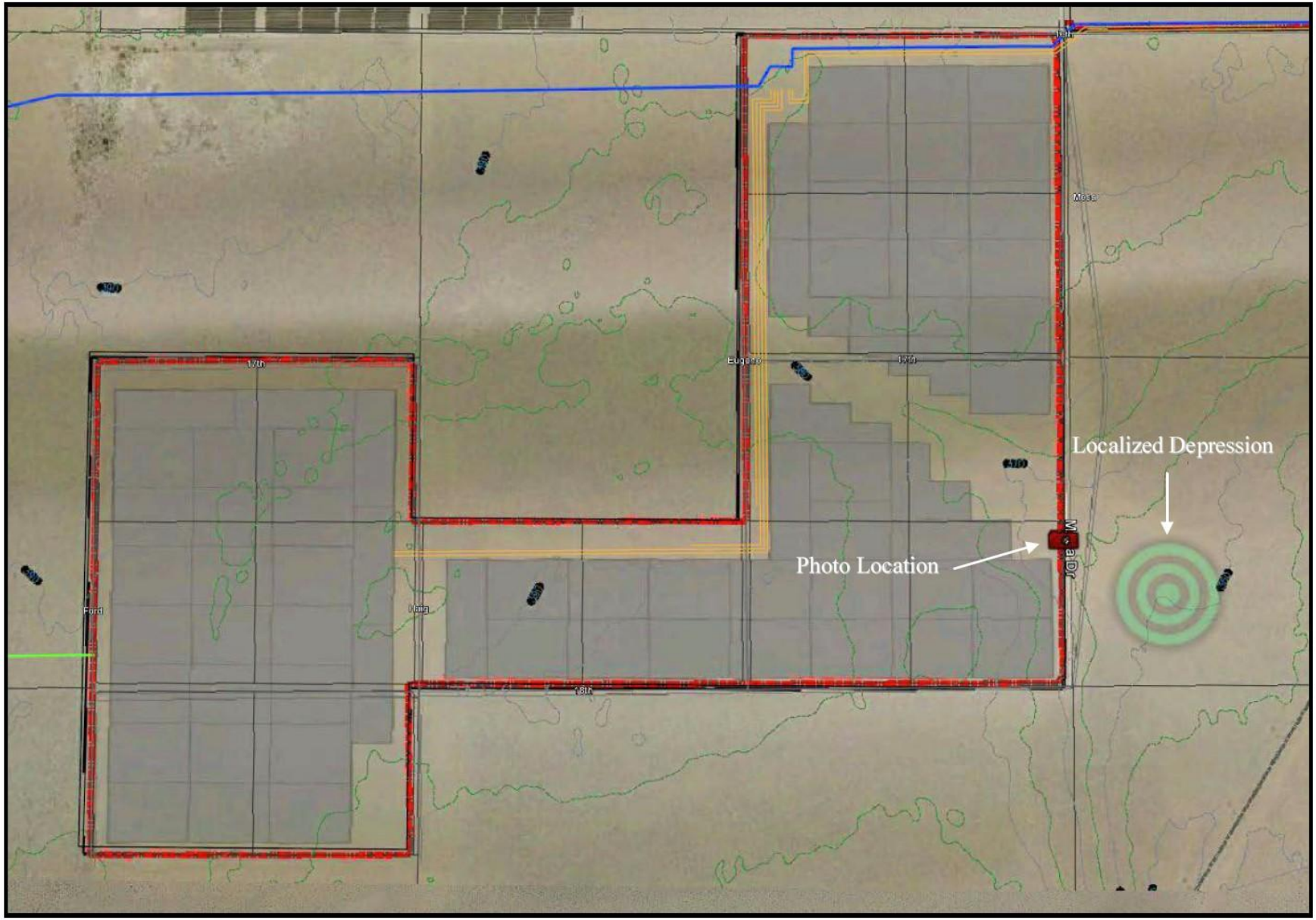
- There is no evidence that potential waters on site are currently used, were used in the past, or may be used in the future in interstate or foreign commerce.
- These discontinuous ephemeral channels are not interstate waters.
- These discontinuous ephemeral channels are not and cannot be used by interstate or foreign travelers for recreational or other purposes, there are no fish or shellfish, and there is no use or potential use for industrial purpose of such waters for interstate commerce.
- There are no impoundments of waters of the U.S.
- The discontinuous ephemeral channels on site are not tributaries to Waters of the U.S.
- There are no territorial seas or wetlands on the site, or prior converted croplands on the site.

It should be noted that delineation surveys conducted for the Blythe Solar Power Project, which overlaps the Project gen-tie line corridor, did not identify any jurisdictional waters within the overlapping area (AECOM 2010). Also, delineation surveys conducted for the Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunications System Route, which runs parallel to the Project gen-tie line corridor and is approximately one mile north and in the same hydrological flow route, did not identify the presence of jurisdictional waters within the area of the Project's gen-tie line corridor (CH2MHill

2010). Therefore, these previous surveys provide further evidence that this specific portion of the Project site is not jurisdictional.

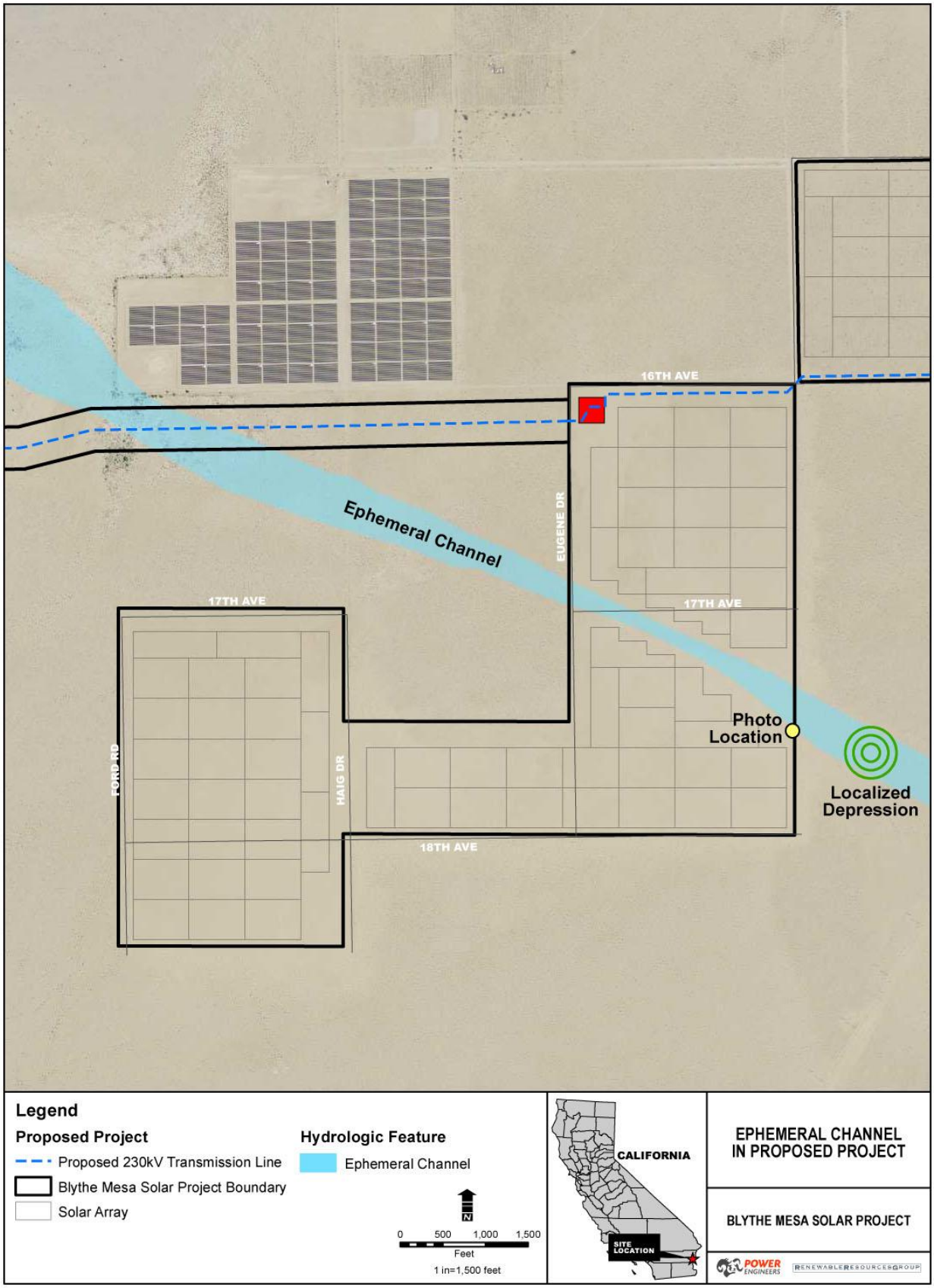
Under the CWA Section 401, every applicant for a federal permit or license for any activity which may result in a discharge to a water body must obtain State Water Quality Certification (Certification) that the proposed activity will comply with state water quality standards. Most Certifications are issued in connection with USACE CWA Section 404 permits; however the RWQB regulates isolated waters under Section 401(c) of the federal CWA as Waters of the State despite the USACE lack of authority, and a 401 Certification could be required.

FIGURE 5. 2012 AERIAL PHOTO WITH CONTOUR OVERLAY



THIS PAGE INTENTIONALLY LEFT BLANK

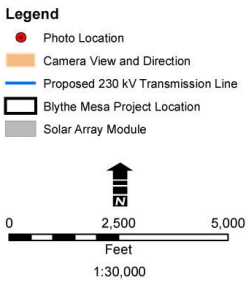
FIGURE 6. EPHEMERAL CHANNEL



THIS PAGE INTENTIONALLY LEFT BLANK

FIGURE 7: SITE PHOTO, FACING NORTHWEST





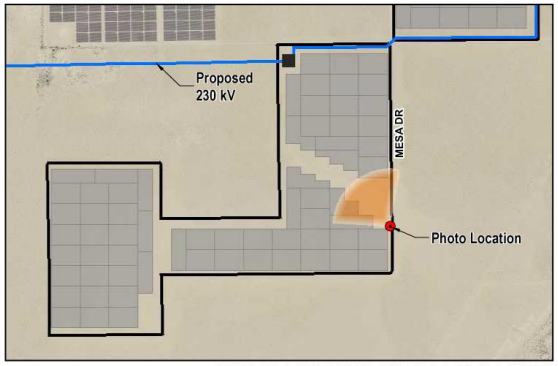


PHOTO LOCATION WITH CAMERA VIEW

SITE PHOTO
FACING NORTHWEST

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

AR061378

FIGURE 8: SITE PHOTO, FACING NORTHEAST



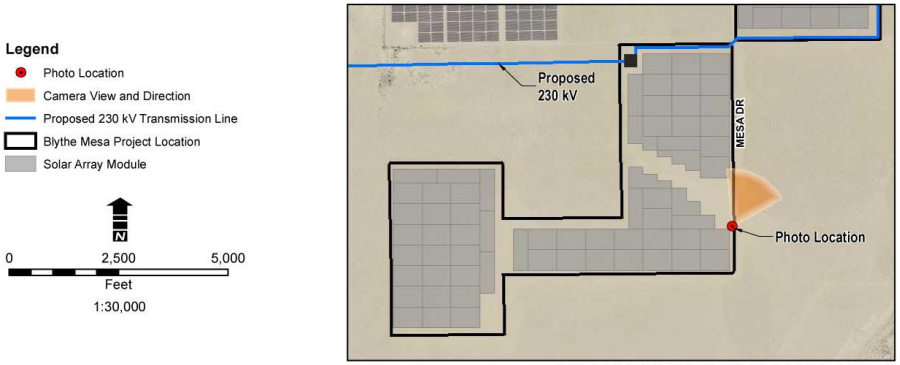


PHOTO LOCATION WITH CAMERA VIEW

SITE PHOTO
FACING NORTHEAST

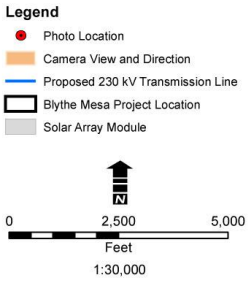
BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

FIGURE 9: SITE PHOTO, FACING SOUTHEAST



SITE PHOTO, FACING SOUTHEAST



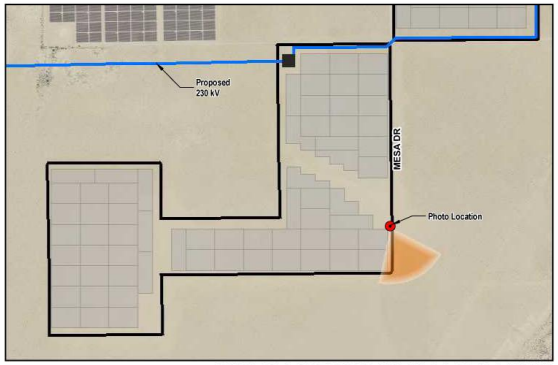


PHOTO LOCATION WITH CAMERA VIEW

SITE PHOTO
FACING SOUTHEAST

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

THIS PAGE INTENTIONALLY LEFT BLANK

4.0 LITERATURE CITED / REFERENCES

AECOM. 2010. Blythe Solar Power Project Biological Resources Technical Report. Prepared for Palo Verde Solar I, LLC. June 2010.

CH2MHill. 2010. Devers-Palo Verde No. 2 500 kV Transmission Line Project Telecommunication System Route Biological Review. Prepared for Southern California Edison. November 2010.

U.S. Army Corps of Engineers (USACE). 2001. Final Summary Report: Guidelines for Jurisdictional Determinations for Waters of the United States in the Arid Southwest. U.S. Army Corps of Engineers, South Pacific Division.

_____. 2004. Review of Ordinary High Water Mark Indicators for Delineating Arid Streams in the Southwestern United States. Edited by Robert W. Lichvar and James S. Wakeley. ERDC TR-04-1. January 2004.

_____. 2008a. A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. Robert W. Lichvar and Shawn M. McColley. ERDC/CRREL TR-08-12. August 2008.

_____. 2008b. Regional Supplement to the U.S. Army Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0). ERDC/EL TR-08-28. September 2008.

APPENDIX A: BEST MANAGEMENT PRACTICES

The Best Management Practices (BMPs) listed below would minimize or avoid the environmental impacts associated with the proposed Project. These BMPs differ from mitigation measures, because BMPs are: 1) requirements of existing policies, practices, and measures required by law, regulation, or local policy; 2) ongoing, regularly occurring practices; and 3) not specific to this proposed Project.

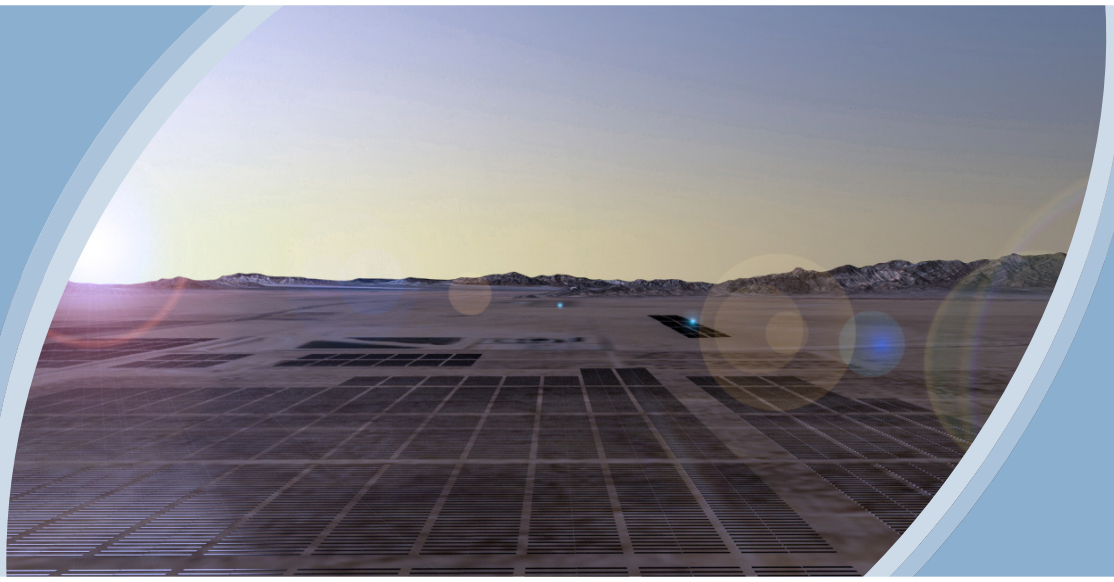
BMP	Description
BMP-1	**Drainage, Erosion, and Sedimentation Control Plan**. As part of the County of Riverside's Conditional Use Permit (CUP) requirements, a Drainage, Erosion, and Sedimentation Control Plan would be developed for the Project. The plan would address the drainage, erosion, and sediment control requirements to support all activities associated with construction, operation, and decommissioning of the Project. For example, any stockpiles created would be kept on site, with an upslope barrier in place to divert runoff. Stockpiles would be sprayed with water, covered with tarpaulins, and/or treated with appropriate dust suppressants, especially in preparation for high wind or storm conditions. Certified weed-free straw bale barriers would be installed to control sediment in runoff water; straw bale barriers would be installed only where sediment-laden water can pond, thus allowing the sediment to settle out. Topsoil from the site would be stripped, stockpiled, and stabilized before excavating earth for facility construction. Topsoil would be segregated and spread on freshly disturbed areas to reduce color contrast and aid rapid revegetation.
BMP-2	**Stormwater Pollution Prevention Plan.** In compliance with requirements of the National Pollutant Discharge Elimination System (NPDES) permit, a Stormwater Pollution Prevention Plan (SWPPP) would be developed and prepared for the Project to ensure that protection of water quality and soil resources is consistent with County and State regulations. The plan would identify site surface water runoff patterns and include measures that prevent excessive and unnatural soil deposition and erosion throughout and downslope of the Project site and Project-related construction areas, and would also include measures for non-stormwater discharge and waste management. The SWPPP would cover all activities associated with the construction of the Project, including clearing, grading, and other ground disturbance such as stockpiling or excavation erosion control. The plan would prevent off-site migration of contaminated stormwater, changes in pre-Project storm hydrographs, or increased soil erosion.
BMP-3	**Fugitive Dust Abatement Plan.** As required by the Mojave Desert Air Quality Management District Rule 403, a Fugitive Dust Abatement Plan would be prepared to address fugitive dust emissions during Project construction, operation, and decommissioning. The plan would include measures to minimize fugitive dust emissions from wrecking, excavation, grading, clearing of land, and solid waste disposal operations, and would take every reasonable precaution to prevent visible particulate matter from being deposited upon public roadways as a direct result of operations. During construction, all unpaved roads, disturbed areas (e.g., areas of scraping, excavation, backfilling, grading, and compacting), and loose materials generated during Project construction activities would be watered as frequently as necessary to minimize fugitive dust generation. In water-deprived locations, water spraying would be limited to active disturbance areas only, and non-water-based dust control measures would be implemented in areas with intermittent use or use that is not heavy, such as stockpiles or access roads. Alternatively, chemical dust suppressants or durable polymeric soil stabilizers could be used. The dust suppression measures would consider the sensitivity of wildlife to the windborne dispersal of fugitive dust containing dust suppressants and the potential impact on future reclamation.
BMP-4	**Fire Management and Protection Plan.** As required by existing law (Title 8 California Code of Regulations [CCR] Section 3221), a Fire Management and Protection Plan would be developed in consultation with the Riverside County Fire Department to identify potential hazards and accident scenarios that would exist at the facility during construction, operation, and decommissioning of the Project. The Plan would include the identification of the following: potential fire hazards and ignition sources; proper handling and storage of potential fire hazards; control of potential ignition sources; persons responsible for equipment and systems maintenance; location of portable fire extinguishers; automatic sprinkler fire suppression system; water-spray fire system; coordination with local fire department; and recordkeeping requirements.

BMP	Description
BMP-5	**Emergency Action Plan.** As required by Title 8 CCR Section 3220, the Project would develop a site-specific operations phase Emergency Action Plan. The operations Emergency Action Plan would address potential emergency situations requiring emergency response and/or planned evacuation. The plan would describe accident scenarios, evacuation routes, alarm systems, points of contact, assembly areas, responsibilities, and other actions to be taken in the event of an emergency. In particular, the plan would describe arrangements with local emergency response agencies.
BMP-6	**Lighting Plan.** A lighting plan would be prepared that documents how lighting will be designed and installed to minimize night-sky impacts during facility construction and operations. Lighting for facilities will not exceed the minimum number of lights and brightness required for safety and security and will not cause excessive reflected glare. Light fixtures will not spill light beyond the Project boundary. Where feasible, vehicle-mounted lights will be used for night maintenance activities. Wherever feasible, consistent with safety and security, lighting will be kept off when not in use. The lighting plan will include a process for promptly addressing complaints about lighting.
BMP-7	**Trash Abatement Plan**. A Trash Abatement Plan shall be developed that focuses on containing trash and food in closed and secure sealable containers, with lids that latch, and removing them periodically to reduce their attractiveness to opportunistic species, such as common ravens, coyotes, and feral dogs, that could serve as predators of native wildlife and special-status animals. The Plan would also establish a regular litter pick-up procedure within and around the perimeter of the Project site, and removal of construction-related trash containers from the Project site when construction is complete.
BMP-8	**Cleanup and Restoration.** Upon completion of construction activities, all unused materials and equipment shall be removed from the Project site. All construction equipment and refuse including, but not limited to, wrapping material, cables, cords, wire, boxes, rope, broken equipment parts, twine, strapping, buckets, and metal or plastic containers shall be removed from the site and disposed of properly after completion of construction. Any unused or leftover hazardous products shall be properly disposed of off-site.
BMP-9	**Hazardous materials.** As required by the Clean Air Act, Section 401 of the Clean Water Act, the Toxic Substance Control Act, and the Hazardous Materials Transportation Act, all vehicles and equipment must be in proper working condition to ensure that there is no potential for fugitive emissions or accidental release of motor oil, fuel, antifreeze, hydraulic fluid, grease, or other hazardous materials. Equipment must be checked for leaks prior to operation and repaired as necessary. Refueling of equipment must take place on existing paved roads, where possible, and not within or adjacent to drainages. Hazardous spills must be cleaned up immediately. Contaminated soil would be disposed of at an approved offsite landfill, and spills reported to the permitting agencies. Service/maintenance vehicles should carry appropriate equipment and materials to isolate and remediate leaks or spills, and an on-site spill containment kit for fueling, maintenance, and construction will be available. Cleaning of construction vehicles at commercial car washes should be considered rather than washing vehicles on the Project site so that dirt, grease, and detergents are treated effectively at existing facilities designed to handle those types of wastes.
BMP-10	**Integrated Weed Management Plan.** In compliance with the Federal Noxious Weed Act, the Plant Protection Act, and the California Food and Agricultural Code, a Project-specific integrated weed management plan for the control of noxious weeds and invasive plant species would be prepared. The plan would identify presence, location, and abundance of weed species in the Project area and surrounding area adjacent to the Project, as well as identify suppression and containment measures to prevent the spread of weed species and introduction of weed species. Prevention techniques would include: limiting disturbance areas during construction to the minimum required to perform work; limiting ingress and egress to defined routes; maintaining vehicle wash and inspection stations; and closely monitoring the types of materials brought on site to minimize the potential for weed introduction. During operations, noxious and invasive weed management will be incorporated as a part of mandatory site training for groundskeepers and maintenance personnel. Training will include weed identification and the impacts on agriculture, wildlife, and fire frequencies. Training will also cover the importance of preventing the spread of noxious weeds and of controlling the proliferation of existing weeds.

BMP	Description
BMP-11	**Project structures and building surfaces.** Project facilities would be sited to ensure that there is adequate space (i.e., setbacks of no less than 100 feet) between solar facilities and natural washes. These setbacks would preserve and maintain the natural washes' hydrological functions. The color and finish of Project structure and building surfaces that are visible to the public will be designed to ensure minimal visual intrusion, contrast, and glare. Grouped structures will be painted the same color to reduce visual complexity and color contrast. Solar panel backs will be color-treated to reduce visual contrast with the landscape setting. Materials, coatings, or paints having little or no reflectivity will be used wherever possible. The visual color contrast of graveled surfaces will be reduced with approved color treatment practices.
BMP-12	**Gen-tie lines.** Gen-tie line support structures and other facility structures shall be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This design would also reduce the potential for increased predation of special-status species, such as the desert tortoise. Mechanisms to visually warn birds (permanent markers or bird flight diverters) shall be placed on gen-tie lines at regular intervals to prevent birds from colliding with the lines. To the extent practicable, the use of guy wires shall be avoided because they pose a collision hazard for birds and bats. Necessary guy wires shall be clearly marked with bird flight diverters to reduce the probability of collision. Shield wires shall be marked with devices that have been scientifically tested and found to significantly reduce the potential for bird collisions. Gen-tie lines shall utilize non-specular conductors and non-reflective coatings on insulators.
BMP-13	**Ground and surface disturbance.** Construction boundaries would be clearly delineated to minimize areas of ground and surface disturbance. Ground-disturbing activities shall be minimized, especially during the rainy season. To the maximum extent possible, construction-related activities (such as vehicle and foot traffic) would avoid areas with intact biological soil crusts. For cases in which impacts cannot be avoided, soil crusts would be salvaged and restored on the basis of recommendations by the County of Riverside and BLM once construction has been completed. Existing rocks, vegetation, and drainage patterns shall be preserved to the maximum extent possible. No paint or permanent discoloring agents shall be applied to rocks or vegetation (to indicate surveyor construction activity limits or for any other purpose). All stakes and flagging shall be removed from the construction area and disposed of in an approved facility. Where feasible, brush-beating, mowing, or use of protective surface matting rather than removing vegetation shall be employed. Clearing and disturbing of sensitive areas (e.g., steep slopes and natural drainages) and other areas shall be avoided outside the construction zone. Surface disturbance would be minimized by utilizing undulating surface disturbance edges; stripping, salvaging, and replacing topsoil; using contoured grading; controlling erosion; using dust suppression techniques; and restoring exposed soils to their original contour and vegetation.
BMP-14	**Travel and traffic.** Vehicular traffic on site shall be confined to existing or designated travel routes and designated work areas. Access to the construction site and staging areas shall be limited to authorized vehicles and only through the designated roads. The extent of habitat disturbance during construction shall be reduced by keeping vehicles on access roads and minimizing foot and vehicle traffic through undisturbed areas. To the extent practical, travel shall be limited to stabilized roads. Road maintenance activities shall avoid blading existing forbs and grasses in ditches and adjacent to roads. Abandoned roads and roads no longer needed shall be subsoiled to increase infiltration and reduce soil compaction, then recontoured and revegetated. Construction traffic shall avoid unpaved surfaces to the extent practical (to reduce the risk of compaction) and reduce speed to lessen fugitive dust emissions. On unpaved or unstabilized surfaces within the construction site, speed limits (e.g., 20 mph) shall be posted with visible signs and enforced to minimize airborne fugitive dust. Project vehicle speeds shall be limited in areas occupied by special-status animal species. Traffic shall stop to allow wildlife to cross roads. Shuttle vans or carpooling shall be used where feasible to reduce the amount of traffic on access roads. Workers shall be trained to comply with the speed limit, use good engineering practices, minimize the drop height of materials, and minimize the number and extent of disturbed areas. The Project developer shall enforce these requirements.

BMP	Description
BMP-15	**New access roads and parking lots.** New access roads shall be designed and constructed to the appropriate road design standards, such as those described in BLM Manual 9113 or County standards, whichever is applicable. New access roads shall be designed to follow natural land contours in the Project area and avoid existing desert washes. The specifications and codes developed by the U.S. Department of Transportation (DOT) are also to be taken into account. Primary access roads and parking lots shall be surfaced with aggregate that is hard enough that vehicles cannot crush it and thus cause dust or compacted soil conditions. Paving may also be used on access roads and parking lots. Alternatively, chemical dust suppressants or durable polymeric soil stabilizers would be used on these locations.
BMP-16	**Diesel engines.** All diesel engines used in the facility would be fueled only with ultra-low sulfur diesel with a sulfur content of 15 parts per million (ppm) or less. The Project would require use of construction diesel engines with a rating of 50 horsepower (hp) or higher that meet, at a minimum, the Tier 3 California Emission Standards for Off-Road Compression Ignition Engines, as specified in the California Code of Regulations, Title 13, Section 2423(b)(1), unless such engines are not available. If a Tier 3 engine is not available for off-road equipment larger than 100 hp, a Tier 2 engine, or an engine equipped with retrofit controls to reduce exhaust emissions of nitrogen oxides (NO_x) and diesel particulate matter (DPM) to no more than Tier 2 levels, may be used. Regulatory agencies may determine that use of such devices is not practical when: • There is no available retrofit control device verified by either the California Air Resources Board (CARB) or the U.S. Environmental Protection Agency (EPA) to control engines in question to Tier 2 equivalent emission levels and the retrofitted or Tier 1 engines use the highest level of available control technology. • The construction equipment is intended to be on site for five days or less. • It can be demonstrated there is a good faith effort to comply with the recommendation and that compliance is not practical. The idling time of diesel equipment would be limited to no more than 10 minutes, unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).
BMP-17	**High wind conditions.** In compliance with MDAQMD Rule 403 criteria, all soil-disturbing activities and travel on unpaved roads must be suspended during periods of high winds. A 25 mph wind speed has been determined on the basis of soil properties identified during site characterization. Monitoring of the wind speed would be required at the site during construction, operation, and decommissioning.
BMP-18	**Noise.** The Project would minimize construction- and operation-related noise levels to minimize impacts to wildlife and nearby residents.
BMP-19	**Plants and wildlife.** In compliance with the California Department of Fish and Game Codes, while on the Project property, workers or visitors would be prohibited from: feeding wildlife; moving live, injured, or dead wildlife off roads, ROWs, or the Project site; bringing domestic pets to the Project site; collecting native plants; and harassing wildlife. Areas where wildlife could hide or be trapped (e.g., open trenches, sheds, pits, uncovered basins, and laydown areas) would be minimized. For example, an uncovered pipe that has been placed in a trench should be capped at the end of each workday to prevent animals from entering the pipe. If a special-status species is discovered inside a component, that component must not be moved, or, if necessary, moved only to remove the animal from the path of activity, until the animal has escaped. As open trenches could impede the seasonal movements of large game animals and alter their distribution, they would be backfilled as quickly as possible. Open trenches could also entrap smaller animals; therefore, escape ramps would be installed along open trench segments at distances identified in the applicable land use plan or by the best available information and science. If traffic is being unreasonably delayed by wildlife in roads, personnel would contact the Project biologist, who will take any necessary action. Any vehicle-wildlife collisions would be immediately reported to the Project biologist. Observations of potential wildlife problems, including wildlife mortality, would be immediately reported to the BLM or other appropriate agency authorized officer.

BLYTHE MESA SOLAR PROJECT



Draft Environmental Impact Report/Environmental Assessment

Volume IV: Technical Appendices

EIR No. 529
EA No. 0021
SCH No. 2011111056

June 2014

CEQA/NEPA Lead Agencies:

RIVERSIDE COUNTY
PLANNING DEPARTMENT

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

THIS PAGE INTENTIONALLY LEFT BLANK

Draft
Environmental Impact Report/ Environmental Assessment

Blythe Mesa Solar Project

EIR No. 529
EA No. 0021
SCH No. 2011111056

Volume IV
Technical Appendices D – N

Project Proponent:

Renewable Resources Group
113 S. La Brea Ave., 3rd Floor
Los Angeles, CA 90036

Prepared by:

POWER Engineers, Inc.
731 East Ball Road, Suite 100
Anaheim, CA 92805

June 2014

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Volume IV

Appendix D1:	Archaeological Resource and Built Environment Survey Final Report
Appendix D2:	Archaeological Resource and Built Environment Survey Transmission Line Alternatives Supplemental Report
Appendix E:	Limited Geotechnical Evaluation
Appendix F:	EDR Data Map
Appendix G:	Water Supply Assessment
Appendix H:	Wash Feature Summary of Findings
Appendix I:	Paleontological Resources Survey Report
Appendix J:	Traffic Impact Study Report
Appendix K:	Glare and Reflection Study
Appendix L:	Land Evaluation and Site Assessment
Appendix M:	Fish and Wildlife Service Informal Consultation Memo
Appendix N:	Airport Land Use Commission Development Review

AR061391

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D1
ARCHAEOLOGICAL RESOURCES AND BUILT ENVIRONMENT SURVEY
FINAL REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

April 2013

BLYTHE MESA SOLAR PROJECT

Archaeological Resource and Built Environment Survey

FINAL REPORT

Riverside County, California

Riverside County Planning Department Case Number CUP 03685

BLM Cultural Resource Use Permit No. CA-09-36

Fieldwork Authorization No. 66.66 11-18

PROJECT NUMBER: 122512

PROJECT CONTACT: Jim Rudolph, Ph.D.

EMAIL:

jim.rudolph@powereng.com

PHONE: (208) 288-6323

LEGAL DESCRIPTION: T6S, R22E, Sections 27, 28, 29, 32, 33, AND 34; T7S,R22E, Sections 3, 4, 5, 6, 8, and 9; T7S, R21E, Sections 1, 7, 8, 9, 10, 11 12, and 14

ACREAGE: 3,660 acres

USGS QUADRANGLES: McCoy Wash, Ripley, and Roosevelt Mine

KEY WORDS: Inventory, Historic Sites, Archaeological Sites, Blythe Army Air Base, Riverside County, P-33-009186,P-33-012532, P-33-14083, P-33-018837, P-33-19996, P-33-019997, P-33-019999, P-33-020000, P-33-020001, P-33-020004, P-33-020005, P-33-020006, P-33-020007, P-33-020008, P-33-020009, P-33-020010, P-33-020011, P-33-020012, P-33-020013, P-33-020014, P-33-020015, P-33-020016, P-33-020017, P-33-020020, P-33-020021, P-33-020022, P-33-020023, P-33-020024, P-33-020025, P-33-020026

FIELDWORK PREFORMED: April-June 2011

POWER ENGINEERS

AR061395

BLYTHE MESA SOLAR PROJECT
ARCHAEOLOGICAL RESOURCE AND BUILT ENVIRONMENT SURVEY
FINAL REPORT
RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR:

Applicants
SOLAR STAR BLYTHE MESA 1, LLC
and
RENEWABLE RESOURCES GROUP
5700 WILSHIRE BLVD., SUITE 330
LOS ANGELES, CALIFORNIA 90036
(323) 936-9303

Lead Agencies
BUREAU OF LAND MANAGEMENT
RENEWABLE ENERGY COORDINATION OFFICE
CALIFORNIA DESERT DISTRICT
MORENO VALLEY, CALIFORNIA
and
COUNTY OF RIVERSIDE
PLANNING DEPARTMENT
4080 Lemon Street
Riverside, CA 92502-1409
(951) 955-6863

PREPARED BY:

POWER ENGINEERS, INC.
731 EAST BALL ROAD, SUITE 100
ANAHEIM, CALIFORNIA 92805
(714) 507-2700

GINI AUSTERMAN, JOHANNA MARTY
and JIM RUDOLPH (PRINCIPAL INVESTIGATOR)

Blythe Mesa Solar Project
Archaeological Resource and Built Environment Survey
Final Report, April 2013
Errata Sheet (responses to County comments), September 2013

County Comment 6/27/13	Errata
Cover Page	Replace cover page with attachment
Title Page:	Replace on Title Page: *PREPARED FOR:* *Applicants* *SOLAR STAR BLYTHE MESA 1, LLC* *and* *RENEWABLE RESOURCES GROUP* *5700 WILSHIRE BLVD., SUITE 330* *LOS ANGELES, CALIFORNIA 90036* *(323) 936-9303* *Lead Agencies* *BUREAU OF LAND MANAGEMENT* *RENEWABLE ENERGY COORDINATION OFFICE* *CALIFORNIA DESERT DISTRICT* *MORENO VALLEY, CALIFORNIA* *and* *COUNTY OF RIVERSIDE* *PLANNING DEPARTMENT* *4080 Lemon Street* *Riverside, CA 92502-1409* *(951) 955-6863* *PREPARED BY:* *POWER ENGINEERS, INC.* *731 EAST BALL ROAD, SUITE 100* *ANAHEIM, CALIFORNIA 92805* *(714) 507-2700* *GINI AUSTERMAN, JOHANNA MARTY* *and JIM RUDOLPH (PRINCIPAL INVESTIGATOR)*
Page i, fifth paragraph, last sentence	Change the sentence to: "In addition, two archaeological sites (P-33-019998 and P-33-020002) and two isolated finds (P-33-020018 and P-33-020019) were identified in an area that was later excluded from the APE."
Appendix E-	Add to the table: APN 863100005

Riverside County Requirements. Table "Parcels within the Solar Field"	
Page 11, Section 2.3.1, first paragraph	Replace discussion of Riverside County General Plan policies with the following: "Cultural Resources: The Multipurpose Open Space Element of the Riverside County General Plan (amended March 22, 2011) outlines policies intended to promote the preservation of cultural resources in the County of Riverside, as follows: **OS 19.2** -The County of Riverside shall establish a cultural resources program in consultation with Tribes and the professional cultural resources consulting community. Such a program shall, at a minimum, address each of the following: application processing requirements; information database (s); confidentiality of site locations; content and review of technical studies; professional consultant qualifications and requirements; site monitoring; examples of preservation and mitigation techniques and methods; and the descendant community consultation requirements of local, state, and federal law. (AI-A) **OS 19.3-** Review proposed development for the possibility of cultural resources and for compliance with the cultural resources program. **OS 19.4**- To the extent feasible designate as open space and allocate resources and/or tax credits to prioritize the protection of cultural resources preserved in place or left in an undisturbed state, (AI-B) **OS 19.5**- Exercise sensitivity and respect for human remains form both prehistoric and historic time periods and comply with all applicable laws concerning such remains."
Page 45, fifth paragraph	Add the following text: The four identified areas correspond to clusters of buildings shown on the BAAB map from the 1940s. Smaller features observed in the field (e.g., fire hydrants) were not shown on the map, nor where artifact clusters identified in the field. A radio tower is shown on the BAAB map, but no evidence of this structure was seen during the surface survey in 2011. The tower could have been removed in the past, or the map may show the tower in an incorrect location. A sewage pond is shown on the USGS map about 200 meters southeast of Cluster 3. A likely sewage pond is also shown at this location on an aerial photograph from 1943 (Wilson 2008). The general shape of the sewage pond can be seen on modern aerial photographs, but there is also visible evidence in these photographs of extensive earth moving in the vicinity. In 2011, POWER archaeologists did not identify any artifacts or features at this location. Because only a small portion of the sewage pond would have extended into the survey area, it is possible that evidence of the pond still exists outside the Project boundary.
Page 27, first paragraph, first sentence	Replace with the following: "POWER archaeologist, Gini Austerman, conducted a records search at the Eastern Information Center (EIC), housed at the University of California, Riverside (UCR), on April 7, 2011."

Page 27, second paragraph	Add the following text: "POWER conducted a BLM Class III archaeological and historic built environment survey of 3,660 acres of lands within the Project boundary that include the 125-foot ROW of the proposed 230 kV transmission line. These lands included private and BLM-managed public lands. The survey crew consisted of Dan Woodward, Trish Webb, Johanna Marty, April Shand, Reilly Murphy, Joshua Garr, Stacey Stanley, and Sam Smith. During the surveys, archaeologists walked parallel transects, using 15-meter (50-foot) intervals, to identify archaeological and architectural resources within or adjacent to the APE."
Page 27, last paragraph, Native American Communication	Add the following text: "In April 2011, POWER sent a letter to the NAHC requesting information regarding Native American groups with historic ties to, and interest in, the proposed Project area. The NAHC conducted a Sacred Lands search to determine if there are any sacred sites within the project area. On April 15, 2011 the NAHC recommended that additional information be requested from a list of Native American contacts the NAHC provided. In May 2011, 20 letters were sent to the tribes identified by the NAHC, which are listed in Table 4. The letter provided a brief description of the proposed Project and requested information concerning Native American cultural resources in the Project area, as well as any comments or concerns about the Project."
Page 37, Table 7	Add to the bottom of table: "*All resources are on private land."
Page 40, last paragraph	Replace with the following text: "P-33-012532 is a transmission line constructed between the 1940s and 1950s. It is still in use and has been subject to various upgrades. There is no indication that this resource is associated with events that have made a significant contribution to the broad patterns of history (Criterion A of the NRHP/Criterion 1 of the CRHR), or associated with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This architectural resource does not embody distinctive characteristics of a type, period, or method of construction; the work of a master; or possess high artistic value (NHRP Criterion C/CRHR Criterion 3). Nor does this resource meet NRHP Criterion 4/CRHR Criterion D for containing important scientific or historical data. Therefore, POWER agrees with previous researchers and recommends that P-33-012532, the Niland-Blythe 161 kV Transmission Line, is not eligible for listing in either the NRHP or the CRHR."
Pages 39, 40	Move the caption "FIGURE 6. P-33-009186. SITE OVERVIEW, NORTH OF RIVERSIDE AVENUE, FACING EAST" from page 40 to page 39.
Pages40, 41	Move the caption "FIGURE 7. P-33-012532. NILAND-BLYTHE 161 KV TRANSMISSION LINE" from page 41 to page 40.
Page 41, third paragraph	Replace with: "P-33-014083 is a transmission line constructed in the 1940s. This resource is still in use and has been modified by various upgrades. There is no indication that this resource is associated with events that have made a significant contribution to the broad patterns of history (Criterion A of the NRHP/Criterion 1 of the CRHR), or is associated with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This architectural resource does not embody distinctive characteristics of a type, period, or method of construction; the work of a master; or possess high artistic value (NHRP Criterion C/CRHR Criterion 3). Nor does this resource meet the criteria for NRHP Criterion 4/CRHR Criterion D for containing scientific or historical data. POWER recommends that the transmission line does not meet the criteria for the CRHR or the NRHP and therefore is not eligible for listing."

Page 47, third paragraph	Add the following paragraph: In addition to assessing integrity, POWER evaluated the eligibility of each of the areas by considering the buildings' association with General Patton and with the DTC/C-AMA. At the County archaeologist's recommendation, each of the clusters is considered a contributing element within the Blythe Army Air Base Historic District.
Page 46, second paragraph	Change the following text: "BAAB's association with the DTC lasted less than a year, and its association with General Patton was even briefer, only five months. The barracks, warehouses, fire station, utility building, and hospital within the Project APE were ~~for the most part~~ built and used after BAAB's ties to the DTC and General Patton ended. Nonetheless, BAAB's support for desert training missions continued until 1944. POWER agrees the Blythe Army Air Base Historic District (P-33-018837), including the portion with the APE, is associated with events that have made a significant impact on broad patterns of history (NRHP Criterion A/CRHR Criterion 1). While BAAB as a whole has ties to General Patton and therefore with the life of a significant person (NRHP Criterion B/CRHR Criterion 2), Patton's association with the portion of BAAB in the Project APE is very limited to non-existent.
Page 46, third paragraph	Insert the following text: "After several discussions and a site visit with the Riverside County Archaeologist on November 11, 2011, POWER recommends that despite the limited physical integrity of the features within the Project APE, the portion of BAAB falling within the current Project boundaries contain contributing elements and are, like the historic district, recommended eligible to the NRHP and CRHR."
Page 64, second paragraph	Insert the following text: "The utility shop is still standing, but its entire exterior has been modified. The exact dates of construction are unknown; however it was most likely built in late 1942. The Utility Shop and Yard are shown just north of the Hospital building on a historic aerial photo dating to 1943 (Wilson 2008). POWER's evaluation of this building finds that while integrity of location is maintained, integrity of design, materials, and workmanship has been lost. Integrity of setting has been diminished by the removal of most other physical features of the military base."
Page 65, first paragraph, last sentence	Insert the following text: "In addition, two archaeological sites (P-33-019998 and P-33-020002) and two isolated finds (P-33-020018 and P-33-020019) were identified in an area that was later excluded from the APE."
Page 39, first paragraph, second sentence.	Insert the following text: "A large quantity of historic debris included predominantly food cans and miscellaneous metal pieces (n = 200 to 1000). The surface material in the current Project area extends 3 meters north of the road and spans 30 meters east/west. A larger portion of the site extends into the power plant property on the south side of Riverside Avenue outside the Project APE, where thousands of cans are visible. Construction of the road and power plant has disturbed the site."
Page 48, last paragraph, second and third sentences.	Insert the following text: "Concentration 1 contains 15 cans and one bottle in a 5-by-5-meter area. Concentration 2 covers a 10-by-5-meter area 15 to 20 meters north of Concentration 1, and contains approximately 50 artifacts."
Page 56, first paragraph, first sentence.	Insert the following text: "P-33-020000 (Figure 23) is a sparse historic refuse scatter mixed with modern debris, containing approximately 30 artifacts.

MANAGEMENT SUMMARY

Solar Star Blythe Mesa 1, LLC (SSBM) and its development representative Renewable Resources Group (RRG) propose to develop the Blythe Mesa Solar Project (Project), a 485 megawatt (MW) solar photovoltaic electrical generation facility in Riverside County, California. The Project involves the construction and operation of the generation facility and associated infrastructure, which includes substations, maintenance facilities, access routes, and a 230 kilovolt (kV) transmission line that will interconnect the generation facility to the statewide electrical transmission grid through the Colorado River Substation. SSBM and RRG requested that POWER Engineers, Inc. (POWER) conduct an archaeological resource and historic built environment inventory of 3,660 acres for the proposed solar facility and transmission line right-of-way (ROW). This survey report describes the results of surveys on both public and private land. Two alternatives transmission line corridors are addressed in a separate report (POWER 2012).

The proposed solar facility would be entirely on private land; the proposed transmission line would cross public land managed by the Bureau of Land Management (BLM), Palm Springs-South Coast Field Office. Because of the proposed Project's location on both private and federal land, it must comply with both Section 106 of the National Historic Preservation Act (NHPA), with the BLM as lead federal agency, and the California Environmental Quality Act (CEQA), with the Riverside County Planning Department as the lead state agency.

The Project area, as currently planned, is in Township 6S, Range 22E, Sections 27, 28, 29, 31, 32, 33, and 34; Township 7S, Range 22E, Sections 3, 4, 5, 6, 8, and 9; and Township 7S, Range 21E, Sections 1, 7, 8, 9, 10, 11, 12 and 14.

Prior to the field investigations, a records search was conducted at the Eastern Information Center at the University of California-Riverside on April 4, 2011. The records search indicated 25 cultural resource studies had been performed previously within one mile of the Project boundaries and 82 cultural resources have been documented within the same radius. Three of the previously recorded cultural resources are within the Project area. Two are transmission lines (P-33-12532 and P-33-14083) and one is a World War II-era refuse deposit (P-33-9186). These resources had been previously evaluated and recommended to be not eligible for inclusion in the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR) (Eckhardt and Jordan 2008; Pignolio 2003; Pignolio, Baksh, and Dietler 1999).

POWER performed a BLM Class III survey of 100 percent of the lands in the area of potential effects (APE) as defined at that time, including the proposed solar facility and transmission line ROW; only 20 acres within the Project boundaries had been previously surveyed. A total of 31 cultural resources were identified in the APE, including a portion of the World War II Blythe Army Air Base (archaeological resources and one standing building), six other archaeological sites, two transmission lines, and 22 isolated finds. In addition, two archaeological sites and two isolated finds were identified in an area that was later excluded from the APE.

Only one of the resources, the Blythe Army Air Base Historic District (P-33-018837), meets the criteria for either the NRHP or the CRHR and is recommended eligible.

Resource P-33-018837 was recorded in 2010 immediately adjacent to the western boundary of the Project, and was recommended eligible for listing in the NRHP (Mitchell 2010 a, b). Although the boundaries of the district as recorded in 2010 did not extend into the Project area, features associated with BAAB were found by POWER within the Project boundaries. These features were added to the existing district record. POWER recommends that the boundary of the Blythe Army Air Base Historic District be extended to include the components within Project boundaries because they contain contributing elements. This resource also qualifies as a historical resource under CEQA.

CONTENTS

ERRATA SHEET

MANAGEMENT SUMMARY I

1.0 INTRODUCTION 1

1.1 Purpose of the report 1
1.2 Project Overview 1

2.0 REGULATORY FRAMEWORK 7

2.1 Federal 7
2.1.1 National Environmental Policy Act 7
2.1.2 National Historic Preservation Act 7
2.1.3 Antiquities Act 8
2.1.4 Federal Land Policy and Management Act 8
2.1.5 Archaeological Resources Protection Act 8
2.1.6 American Indian Religious Freedom Act 8
2.1.7 Native American Graves Protection and Repatriation Act 9
2.1.8 Executive Order 11593, Protection and Enhancement of the Cultural Environment 9
2.1.9 Executive Order 13007, Indian Sacred Sites 9
2.1.10 Executive Order 13175, Consultation and Coordination with Indian Tribal Governments 9
2.1.11 Executive Order 13287, Preserve America 9
2.1.12 Memorandum for the Heads of Executive Departments and Agencies Regarding Government-to-Government Relations with Native American Tribal Governments 9
2.2 State 10
2.2.1 California Environmental Quality Act (CEQA) 10
2.3 Local 11
2.3.1 Riverside County General Plan 11

3.0 ENVIRONMENTAL SETTING 12

4.0 CULTURAL SETTING 14

4.1 Prehistoric Context 14
4.1.1 Paleoindian Period (San Dieguito) (12,000-7,000 BP) 14
4.1.2 Archaic Period (Pinto and Amargosa) (7,000–1,500 BP) 14
4.1.3 Late Prehistoric (Patayan Complex) (1,500–150 BP) 15
4.2 Ethnography 17
4.2.1 Colorado River Peoples: the Quechan, Halchidhoma, and Mojave 17
4.2.2 Chemehuevi 19
4.2.3 Cahuilla 19
4.3 Euro-American Context 20
4.3.1 Transportation 20
4.3.2 Mining 21
4.3.3 Homesteading and Agriculture 21
4.3.4 City of Blythe 21
4.3.5 World War II Desert Training Center/California-Arizona Maneuver Area 21
4.3.6 Blythe Army Air Base 22
4.4 Research Goals 23
4.4.1 Prehistoric Chronology 23
4.4.2 Prehistoric Settlement and Subsistence 24
4.4.3 Interaction of Native Americans with Europeans and Euroamericans 25
4.4.4 20th Century Use 25

5.0 INVENTORY METHODS 27
5.1 Historic Background and Records Search 27
5.2 Field Methods 27
5.3 Native American Communication 27
6.0 INVENTORY RESULTS 29
6.1 Results of Background Research and Record Search 29
6.2 Results of Survey 36
6.2.1 Archaeological Sites and Built Environment 38
6.2.1 Isolated Finds 58
6.3 Native American Coordination 61
7.0 IMPACTS/EFFECTS 63
7.1 Effects Under the National Historic Preservation Act 63
7.1.1 Assessment of Effects 63
7.2 Impacts Under the California Environmental Quality Act 64
7.2.1 Assessment of Impacts 65
7.2.2 Application of CEQA Significance Thresholds 65
8.0 RECOMMENDATIONS 67
9.0 REFERENCES 68
10.0 REPORT PREPARERS 75
11.0 FIELD PERSONNEL 75

FIGURES

Figure 1. Project Location 5
Figure 2. Ethnographic Boundaries 18
Figure 3. Previous Cultural Resource Surveys 33
Figure 6. P-33-009186. Site Overview, North of Riverside Avenue, Facing East 40
Figure 7. P-33-012532. Niland-Blythe 161 kV Transmission Line 41
Figure 8. P-33-014083. Parker-Headgate Rock-Blythe 161kV Transmission Line, Facing Northeast 41
Figure 9. P-33-018837. Blythe Army Air Base. Concrete Footings for Hospital Wing 43
Figure 10. P-33-018837. Blythe Army Air Base. Remains of Latrines and Showers at Hospital Wing 43
Figure 11. P-33-018837. Blythe Army Air Base. Rubble Pile from Barracks 44
Figure 12. P-33-018837. Blythe Army Air Base. Utility Shop 44
Figure 13. P-33-019996. Site Overview, Facing South 47
Figure 14. P-33-019996. K's Fruit Beverage Bottle 48
Figure 15. P-33-019996. Coca-Cola Bottle Base, "Los Angeles, Calif" 48
Figure 16. P-33-019997. Site Overview, Facing South 49
Figure 17. P-33-019997. Velvet Tobacco Tin 50
Figure 18. P-33-019997. Mobil Oil Company Key Chain, 1958 50
Figure 19. P-33-019998. Site Overview, Facing South-Southwest 52
Figure 20. P-33-019998. Bowl Fragments 52
Figure 21. P-33-019999. Site Overview with Push Pile, Facing Southeast 53
Figure 22. P-33-019999. Whiteware Dish with Homer Laughlin Maker's Mark, January 1943 53
Figure 23. P-33-020000. Site Overview, Facing South 54
Figure 24. P-33-020001. Site Overview, Facing South 55
Figure 25. P-33-020001. Gray Sherd 56
Figure 26. P-33-020001. Lower Colorado Buffware Sherds 56
Figure 27. P-33-020002. Sherd, Exterior Surface 57

Figure 28. P-33-020002. Sherd, Interior Surface 58
Figure 4. Previously Recorded Cultural Resources (CONFIDENTIAL) D-3
Figure 5. Results of Survey (CONFIDENTIAL) D-4

TABLES

Table 1. Project Acreage and Jurisdiction 1
Table 2. Assessor Parcels within the Solar Facility 2
Table 3. Assessor Parcels within the Proposed Transmission Line 125-Foot ROW 3
Table 4. Native American Tribes Contacted 28
Table 5. Previous Cultural Resource Studies within One Mile of Project Area 30
Table 6. Previously Recorded Cultural Resources within One Mile of the Project APE 35
Table 7. All Cultural Resources within the Project APE* 37
Table 8. Impacts on Cultural Resources 65
Table A-1. Communication with Native American Representatives A-3
Table C-1. General Land Office Land Patents within One Mile of the Project C-3

APPENDICES

Appendix A: Native American Coordination
Appendix B (CONFIDENTIAL): California Office of Historic Preservation DPR-523 Forms
Appendix C: General Land Office Records within One Mile of the Project
Appendix D (CONFIDENTIAL): Cultural Resource Location Maps
Appendix E: Riverside County Requirements

ACRONYMS AND ABBREVIATIONS

AC	alternating current
ACHP	Advisory Council on Historic Preservation
ADOE	Archaeological Determinations of Eligibility
AIRFA	American Indian Religious Freedom Act of 1978
AMSL	above mean sea level
APE	area of potential effects
APN	Assessor Parcel Numbers
ARPA	Archaeological Resources Protection Act of 1979
BAAB	Blythe Army Air Base
BLM	United States Department of the Interior, Bureau of Land Management
BP	before present
CAA	Civil Aeronautics Administration
C-AMA	California-Arizona Maneuver Area
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CHL	California Historic Landmarks
CHPO	County Historic Preservation Officer
CHRIS	California Historical Resources Information System
CPHI	California Points of Historic Interest
CRHR	California Register of Historical Resources
CRMMP	Cultural Resources Monitoring and Mitigation Plan
CRUP	Cultural Resource Use Permit
DC	direct current
DPR	Department of Parks and Recreation
DTC/C-AMA	Desert Training Center/California-Arizona Maneuver Area
E.O.	Executive Order
EIC	Eastern Information Center
˚F	degrees Fahrenheit
FLPMA	Federal Land Policy and Management Act of 1976
GLO	General Land Office
GPS	Global Positioning System
kV	kilovolt
MLD	Most Likely Descendant
MW	megawatt
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
O&M	operation and maintenance
OHP	California State Office of Historic Preservation
POWER	POWER Engineers, Inc.
PRC	Public Resources Code
Project	Blythe Mesa Solar Project
PTNCL	Prehistoric Trails Network Cultural Landscape
PV	photovoltaic
ROW	right-of-way
RRG	Renewable Resources Group, LLC
SHPO	California State Historic Preservation Officer

SPRR	Southern Pacific Railroad
SSBM	Solar Star Blythe Mesa 1, LLC
THPO	Tribal Historic Preservation Officer
UCR	University of California, Riverside
USGS	U.S. Geological Survey
WAAC	Women's Army Auxiliary Corps
WPA	Works Progress Administration

1.0 INTRODUCTION

1.1 Purpose of the report

This cultural resource survey report has been prepared by POWER Engineers, Inc. (POWER) to summarize the results of a records search, literature review, archaeological resource and built environment surveys, and communications with Native American representatives regarding cultural resources that could potentially be adversely affected by construction, operation, and maintenance of the proposed Blythe Mesa Solar Project (Project). This Project, which has been proposed by Solar Star Blythe Mesa 1, LLC (SSBM) and Renewable Resources Group (RRG), would be in Riverside County, California. The analysis is based primarily on an intensive archaeological and built environment survey of the area of potential effects (APE) for the Project. The study was also performed to support a joint environmental impact report/environmental assessment (EIR/EA) prepared to comply with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

1.2 Project Overview

The proposed Project consists of construction and operation of a 485 megawatt (MW) solar photovoltaic (PV) electrical generating facility and associated infrastructure on approximately 3,660 acres, primarily on private land (Table 1). For this report, the APE is defined to include the solar facility and the 125-foot wide right-of-way (ROW) of the proposed transmission line. Subsequent to completion of the survey, the APE was modified by the BLM to include a wider 300-foot ROW for the proposed transmission line and 300-foot corridors for two alternative routes. The results of archaeological survey of the additional APE are addressed in a separate report (POWER 2012). The proposed Project would produce enough energy to power approximately 180,000 households, and would consist of the following components:

- Solar array field utilizing single axis solar PV trackers.
- System of interior collection power lines located between inverters and substations.
- Three on-site substations (approximately 300 feet long by 300 feet wide).
- Two operation and maintenance (O&M) buildings (approximately 3,500 square feet each).
- Two primary off-site access roads and several interior access roads.
- Approximately 8.4 miles of 230 kilovolt (kV) transmission line, depending on the selected route alternative (archaeological survey of two alternative routes is discussed in a separate report [POWER 2012]).

Table 1. Project Acreage and Jurisdiction

	Private Land	BLM-Managed Lands	TOTAL
Solar Facility Site	3,587 acres	n/a	3587 acres
230 kV Transmission Line*	1.0 mile (15 acres)	3.8 miles (58 acres)	4.8 miles (73 acres)
TOTAL ACREAGE	3602 acres	58 acres	3660 acres

*Proposed transmission line only

The Project is in the Palo Verde Mesa region of Riverside County (Figure 1). The fenced-in solar facility would occupy 3,587 acres of private land. Within this area, a 230 kV transmission line would connect all three proposed substations, extending a distance of approximately 3.6 miles on site. From the southernmost substation to the Colorado River Substation, the transmission line would extend another 4.8 miles within a 125-foot wide right-of-way (ROW) (or 73 acres) traversing 3.8 miles of United States Department of the Interior, Bureau of Land Management (BLM)-managed lands (58 acres) and 1.0 mile of private land (15 acres). The proposed route was surveyed as part of the study, but two alternative routes had not been defined at the time of the survey, and therefore, were not included in this field survey. These two routes plus a wider 300-foot survey corridor for the proposed route are addressed in a separate survey report (POWER 2012).

The Project area to be occupied by the solar array field is primarily characterized by vacant and agricultural land uses. Existing vacant land consists of either fallow farmland or creosote bush scrub. The Project site includes both active and previously farmed lands. Active agricultural uses include a citrus grove and wheat and alfalfa fields. Jojoba was previously grown for commercial purposes. The area for the proposed transmission line, west of the solar array field, is primarily actively cultivated agricultural land, abandoned agricultural land, or disturbed creosote scrub.

Development in the surrounding area includes the community of Nicholls Warm Springs/Mesa Verde, Blythe Airport, the 520-MW natural gas-fired Blythe Generating Plant, electrical substations, electrical transmission lines, other solar projects, ancillary agricultural facilities, and dirt roads.

The location is depicted on the Roosevelt Mine, Ripley, and McCoy Wash 7.5-minute United States Geological Survey (USGS) Topographic Quadrangles. The Project is in:

- Sections 1, 7, 8, 9, 10, 11, 12, and 14 of Township 7 South, Range 21 East
- Sections 3, 4, 5, 6, 8, and 9 of Township 7S, South, Range 22 East
- Sections 27, 28, 29, 32, 33, and 34 of Township 6 South, Range 22 East, of the San Bernardino Base Meridian

Interstate Highway 10 bisects the Project area, which is bounded on the north and south by undeveloped open desert, on the east by agricultural lands and on the west by the Blythe Airport and open desert lands. The Assessor Parcel Numbers (APN) for the solar facility, included for Riverside County Planning Department purposes, are listed in Table 2, and Table 3 lists the APNs for the proposed transmission line 125-foot ROW.

Table 2. Assessor Parcels within the Solar Facility

RIVERSIDE COUNTY				CITY OF BLYTHE
821110004	824102015	863040015	863100010	824101014
821120025	824102016	863040017	863100011	824101015
821120026	824130006	863040020	863100012	824101016
821120027	824130007	863040021	863100016	824101017
821120028	863030002	863050004	879090036	824102020
821120029	863030003	863050007	879090037	824102023
821120038	863030004	863050008	879090038	824102024
821120039	863030005	863050009	879090039	824102026
821120040	863030006	863060015	879090040	824102027
821120042	863030007	863060016	879090041	824110035
821120043	863030008	863060017	879090042	824110036
821120044	863030009	863060018	879090043	824110037
821120048	863030010	863070018	879090044	824110038
824080003	863030013	863070019	879090045	824122013
824080005	863030014	863070022	879090048	
824090009	863030015	863100005	879090049	
824090024	863030016	863100006	879090050	
824102013	863030017	863100008	879090051	
824102014	863040001	863100009	879110013	
			879110014	

Table 3. Assessor Parcels within the Proposed Transmission Line 125-Foot ROW

RIVERSIDE COUNTY	BLM
879080013	879080020
879080014	879080021
879080028	879080022
879080032	879080024
879090048	879080026
	879080027
	879090033
	879090034
	879090035

The Project would utilize single-axis PV trackers with 1,425,600 silicon solar panels. All panels would be oriented in the same direction as they track the sun's movement. By design, the PV panels absorb sunlight to maximize electrical output and use anti-reflective glass, resulting in about half the reflectance of standard residential and commercial glass.

The panels would be configured into trackers, and the trackers configured into blocks. Each block is comprised of six trackers with 18 north-south oriented rows of PV panels (295 feet long and 140 feet wide) that rotate up to 45 degrees from east to west to follow the daily motion of the sun (total number of rows is 35,640), with the center of rotation being 4 to 8 feet above grade. Torque tubes act as the horizontal support for the PV panels. The panels would be supported by micro-piles that would be driven directly into the ground to a depth of 8 to 12 feet using a vibration technology to reduce noise impacts. Torque tubes, electrical wire trays, and panels would then be installed on the piles. Concrete foundations for the drive motors (device used to move drive strut back and forth) would be poured in place, and electrical equipment for the array would be set in place. A tracked backhoe would drive piles. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would place trackers on support piles.

Individual PV panels would be connected together in series to create a 'string' to carry direct current (DC) electricity. Multiple DC strings would be brought together into an above-ground combiner box to merge the strings into a single high-current cable. From the combiner boxes, the cabling would run in raceways and underground to inverters (5 feet wide and 10.5 feet tall) mounted on small concrete pads (minimum 0.5 feet above grade) distributed across the site. The inverters would take the DC output from the combiner boxes and convert it to alternating current (AC) electricity. Within the solar facility, 12-foot-wide dirt access roads would be constructed every 200 to 400 feet to allow access and maintenance of the solar panels.

Next, the AC electricity would be increased to medium voltage with a standard 'step-up' transformer. The medium voltage collection lines would begin at the inverter/transformer pads and would be placed in 3-foot deep trenches until the output from 10 to 15 blocks is gathered and transferred at risers to a system of overhead medium voltage collection lines for transmission to the substation. The medium voltage collection circuits would be mounted above ground on poles (35 to 60 feet tall), and carry 20 to 30 MW of electricity. To the extent possible, the poles would be located along the northern edge of the blocks.

The three Project substations (each 300 feet long by 300 feet wide) would collect all the medium voltage circuits (34.5 kV) and would step-up the voltage to 230 kV.

The Project substations and the interconnection point would be linked by a 230 kV double-circuit transmission line. The transmission line facilities include a single set of tubular steel poles 85 to 125 feet tall with an average distance between poles of 500 to 800 feet. The poles would be directly embedded in

the soil or set in concrete foundations 20 to 30 feet deep. Access roads to each structure will be 16 to 20 feet wide by 8 inches deep of gravel over compacted subgrade and located in the proposed ROW.

Two O&M buildings (approximately 3,500 square feet each, enclosed, and no more than 30 feet tall) would provide work and storage space. A covered outdoor temporary assembly and storage area (80,000 square feet, 25 feet tall) would be directly adjacent to the O&M buildings.

The site would be enclosed with fencing typically set 30 feet from the array. The purpose of the fencing is to restrict public access to the site.

Figure 1 - Blythe Mesa Solar Project

Legend

- Proposed Solar Facility
- Colorado River Substation
- Proposed 230 kV Transmission Line

N
W E
S

POWER ENGINEERS

1: 48,000

0 0.25 0.5 1 1.5 2

Miles

H:\122512\DD\Apps\Cultural_Report\Figure_1_Project_Area_Map_Fed.mxd

Blythe Mesa Solar Project

Blythe Airport

Hobson Way

Mesa Drive

Nicholls Warm Springs

Mesa Verde
(Nicholl's Warm Springs)

Blythe Mesa 230 kV
Transmission Line

Colorado River
Substation Site

California

Riverside County

Project
Location

AR061411

THIS PAGE INTENTIONALLY LEFT BLANK

2.0 REGULATORY FRAMEWORK

The principal laws relevant to the protection of cultural resources in the proposed Project area are the California Environmental Quality Act (CEQA), with particular reference to California Public Resources Code (PRC) 21083.2 to 21084.1, and the National Historic Preservation Act of 1966, as amended (NHPA). This document also supports an environmental analysis prepared to comply with the National Environmental Policy Act of 1969 (NEPA).

2.1 Federal

2.1.1 National Environmental Policy Act

NEPA (42 U.S.C. 4321-4346) establishes national policy for the protection and enhancement of the environment. Part of the function of the federal government in protecting the environment is to "preserve important historic, cultural, and natural aspects of our national heritage." The act is implemented by the Council on Environmental Quality (CEQ) regulations at 40 CFR 1500-1508.

For this Project, the BLM is the lead federal agency for NEPA compliance.

Although the only component of the Project on Federal land would be the proposed transmission line, the BLM considers the entire Project to be a connected action as defined by NEPA (40 CFR 1508.25 (a)(1)). Actions are connected if they automatically trigger other actions that may require an EIS; cannot or will not proceed unless other actions are taken previously or simultaneously; or if the actions are interdependent parts of a larger action and depend upon the larger action for their justification (40 CFR 1508.25 (a)(i, ii, iii)).

2.1.2 National Historic Preservation Act

The NHPA (16 U.S.C. 470f) is the principal federal law in the United States protecting cultural resources. Section 106 of the NHPA directs all federal agencies to take into account the effects of their undertakings (i.e., actions, financial support, and authorizations) on properties included in or eligible for the National Register of Historic Places (NRHP).

The Advisory Council on Historic Preservation (ACHP) regulations at 36 Code of Federal Regulations (CFR) Part 800 implement Section 106 of the NHPA. These regulations establish the NRHP as a planning tool to help federal agencies evaluate cultural resources in consultation with the State Historic Preservation Officer (SHPO) and the ACHP. The criteria for determining whether cultural resources are eligible for listing in the NRHP are provided in 36 CFR 60.4. These criteria are:

A. associated with events that have made a significant contribution to the broad patterns of history;
B. associated with the lives of persons significant in the past;
C. embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; or
D. have yielded, or may be likely to yield, information important in prehistory or history.

A cultural resource eligible for the NRHP is called a historic property regardless of the time period to which it dates. To be listed in, or determined eligible for listing in, the NRHP a cultural resource must meet one or more of the above criteria and possess integrity. Integrity is defined as the authenticity of a resource's historic identity as evidenced by the survival of physical characteristics that existed during the prehistoric or historic period of use. The NRHP recognizes seven aspects, which in various combinations define integrity: location, design, setting, materials, workmanship, feeling, and association. Integrity of location means the resource has not been moved from its historic location. Integrity of design, materials,

and workmanship mean the resource's original building materials, plan, shape, and design elements remain intact. Integrity of setting means the surrounding landscape has changed very little since the period of importance for the resource. Integrity of feeling and association means the resource retains a link to an earlier time and place and is able to evoke that era.

Historic properties must generally be at least 50 years old; however, certain cultural resources associated with more recent, exceptionally important events (e.g., the development of nuclear energy; space exploration) may also be considered eligible to the NRHP.

Compliance with Section 106 is required whenever a project has a federal nexus, meaning the project is on federal land, uses federal funds, or is permitted by a federal agency. The BLM proposes to issue a new ROW grant for the proposed transmission line. This activity constitutes an undertaking as defined in 36 CFR 800.16 (y).

As discussed in Section 2.1.1, the BLM considers the development of the proposed solar facility to be a connected action, even though the solar facility would not itself be on federal land. The BLM's 8100 manual series on cultural resources explains BLM's Section 106 responsibility on non-federal lands. Factors taken into consideration include the degree of federal involvement; the nature and extent of potential effects on historic properties; the likely nature and the location of historic properties in the APE; and the views of the SHPO, Tribes, and interested public. However, the primary factor is the extent to which BLM's authorization (in this case of the proposed transmission line) could result in effects to historic properties, including properties within the proposed solar facility.

2.1.3 Antiquities Act

The Antiquities Act of 1906 (16 U.S.C. 431-433) was the first law to protect and preserve cultural resources on federal lands. It makes it illegal to remove cultural resources from federal lands without a permit and establishes penalties for illegal excavation and looting. The Archaeological Resources Protection Act of 1979 (ARPA) (16 U.S.C. 470) reinforces and replaces portions of the Antiquities Act as the authority for special use permits regarding archaeological investigations.

2.1.4 Federal Land Policy and Management Act

The Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. 1701) requires the BLM to manage their lands on the basis of multiple use in a manner that will "protect the quality of…historical …resources and archaeological values." FLPMA is a comprehensive law that provides for the periodic inventory of public lands and resources, for long-range, comprehensive land use planning, for permits to regulate the use of public lands, and for the enforcement of public land laws and regulations. FLPMA compels agencies to manage all cultural resources on public lands through the land management planning process.

2.1.5 Archaeological Resources Protection Act

The ARPA (16 U.S.C. 470 aa-mm)establishes civil and criminal penalties for the unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources; prohibits trafficking in resources from public lands; and directs federal agencies to establish educational programs on the importance of archaeology. The act also establishes permit requirements for removal or excavation of archaeological resources from federal lands. The law applies to archaeological resources more than 100 years old found on public lands. No distinction is made regarding NRHP eligibility.

2.1.6 American Indian Religious Freedom Act

The American Indian Religious Freedom Act of 1978 (AIRFA) requires federal agencies to consult Native American groups when a proposed land use might conflict with traditional Indian religious beliefs

or practices; to avoid interference with these beliefs to the extent possible; and to maintain access to religious or sacred areas whenever feasible.

2.1.7 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 U.S.C. 3001) provides a process for federal agencies to return certain Native American cultural items – human remains, funerary objects, sacred objects, or objects of cultural patrimony – to lineal descendants and culturally affiliated Indian tribes. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional excavation and unanticipated discovery of Native American cultural items on federal lands, and penalties for noncompliance and illegal trafficking. Permits for the excavation or removal of cultural items protected by the act require Tribal consultation, as do discoveries of cultural items made during activities on federal lands. The Secretary of the Interior's implementing regulations are at 43 CFR Part 10.

2.1.8 Executive Order 11593, Protection and Enhancement of the Cultural Environment

Issued in 1971, Executive Order (E.O.) 11593 directs land-holding federal agencies to identify and nominate historic properties to the NRHP and requires that these agencies avoid damaging historic properties that might be eligible to the NRHP. It also directs agencies to treat resources eligible to the NRHP as if they were already listed.

2.1.9 Executive Order 13007, Indian Sacred Sites

E.O. 13007, issued in 1996, directs federal agencies responsible for managing federal lands to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners; avoid adversely affecting the physical integrity of such sacred sites; and maintain the confidentiality of sacred sites.

2.1.10 Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

E.O. 13175 issued in 2000, directs federal agencies to establish regular and meaningful consultation and collaboration with Tribal officials in the development of federal policies that have Tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.

2.1.11 Executive Order 13287, Preserve America

This executive order, issued in 2003, encourages the federal government to take a leadership role in the protection, enhancement, and contemporary use of historic properties and establishes new accountability for agencies with regard to inventories and stewardship.

2.1.12 Memorandum for the Heads of Executive Departments and Agencies Regarding Government-to-Government Relations with Native American Tribal Governments

The Presidential memorandum, issued in 2009, directs each federal agency to operate within a government-to-government relationship with federally recognized tribal governments; consult with tribal governments; assess the impact of plans, projects, programs, and activities on tribal trust resources; and assure tribal rights are taken into account during consideration of such plans, projects and activities.

2.2 State

2.2.1 California Environmental Quality Act (CEQA)

Under CEQA, a project is considered to have a significant effect on the environment if it causes a substantial adverse change in the significance of a historical resource or unique archaeological resource. Substantial adverse change means physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of the resource would be materially impaired or diminished. Furthermore, it is recommended by CEQA that cultural resources be preserved *in situ* whenever possible through avoidance of the resource. Whenever a historical resource or unique archaeological resource (Public Resources Code [PRC] 21083.2) cannot be avoided by project activities, effects shall be addressed and mitigated as outlined in PRC 15126.4 and 15331 of CEQA.

For this Project, Riverside County is the lead state agency for CEQA compliance.

Historical Resources

According to CEQA, lead agencies are required to identify historical resources that may be affected by any undertaking involving state or county lands, funds, or permitting. Also, the significance of such resources that may be affected by the undertaking must be evaluated using the criteria for listing in the California Register of Historical Resources (CRHR) (PRC 5024.1, Title 14 CCR, Section 4852). Generally, a resource is considered by the lead agency to be historically significant if the resource has integrity and meets the criteria for listing in the CRHR. Resources already listed in or determined eligible for the NRHP and California Historic Landmarks (CHL) No. 770 and above are by definition eligible for the CRHR. Historical resources included in resource inventories prepared according to California State Office of Historic Preservation (OHP) guidelines or designated under county or city historic landmark ordinances may be eligible.

For a resource to be eligible for the CRHR, it must satisfy each of the following three standards:

I. A property must be significant at the local, state or national level, under one or more of the following criteria:

    1) It is associated with events or patterns of events that have made a significant contribution to the broad patterns of the history and cultural heritage of California and the United States.
    2) It is associated with the lives of persons important to the nation or California's past.
    3) It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
    4) It has yielded, or may be likely to yield, information important to the prehistory or history of the state or the nation.

II. A resource must retain enough of its historic character or appearance to be recognizable as a historic property, and to convey the reasons for its significance.
III. It must be fifty years old or older (except for rare cases)

Integrity is defined as the authenticity of a historical resource's physical identity, evidenced by the survival of characteristics that existed during the resource's period of significance. CRHR regulations specify that integrity is a quality that applies to historical resources in seven ways: location, design, setting, materials, workmanship, feeling, and association.

Unique Archaeological Resources

Under CEQA, the lead agency must also determine whether a proposed project will have a significant effect on unique archaeological resources. PRC 21082.2(g) states:

"…a 'unique archaeological resource' means an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1. Contains information needed to answer important scientific research questions and that there is demonstrable public interest in that information.
2. Has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. Is directly associated with a scientifically recognized important prehistoric or historic event or person."

A non-unique archaeological resource does not meet these criteria and does not need to be given further consideration other than simple recording, unless it happens to qualify as a historical resource.

Native American Human Remains

CEQA (PRC 15064.5) provides that when an initial study identifies the existence of, or probable likelihood, of Native American human remains within the project, a lead agency will work with the appropriate Native Americans as identified by the Native American Heritage Commission (NAHC).

2.3 Local

2.3.1 Riverside County General Plan

Chapter 5 of the Riverside County General Plan outlines policies intended to promote the preservation of cultural resources in the County of Riverside. Open Space Policies 19.2-19.4 within this chapter identify the need for a review of project's archaeological sensitivity, resource confidentiality, Native American consultation, and a report of findings. Open Space Policies 19.5-19.7 identify the need for review of large development project proposals by the History Division of the Riverside County Regional Park and Open-Space District with respect to the potential destruction or preservation of historical sites. The chapter also calls for promotion of built environment preservation through application of the Historic Building Code and authorization of tax credits for historic building and structure retrofitting.

County requirements for the management of cultural resources impacted by the Project are listed in Appendix E.

3.0 ENVIRONMENTAL SETTING

The Project area is in the Palo Verde Valley, which is along the western edge of the Colorado River. This area is on Palo Verde Mesa, a series of ancient raised river terraces, and is part of the Sonoran Desert. The topography is relatively flat and slopes toward the southeast; elevations range from 260 to 400 feet above mean sea level (AMSL). The Project area is near the Big Maria Mountains on the northwest, the McCoy Mountains on the west, the Mule Mountains on the southwest, and the Colorado River on the east. These mountain ranges, trending northwest to southeast, create a natural barrier between the Colorado River and the greater Colorado Desert. Development in the Project vicinity includes agricultural fields and groves as well as the Blythe Airport. The Project area also includes undeveloped open desert.

The subtropical climate of the Colorado Desert, a sub-region of the Sonoran Desert, is currently characterized by dry, mild winters averaging 45 degrees Fahrenheit (˚F) and dry, hot summers that average 104˚F. Summer highs are known to reach 120˚F. Precipitation ranges between two and ten inches per year, with most of the precipitation occurring between November and March. Although rainfall is primarily in the winter months, the region is periodically influenced by tropical weather conditions including sudden monsoonal summer storms.

In the Riverside County region, conditions during the Late Pleistocene (22,000 to 11,000 years before present [BP]) were cooler and wetter than today, and supported pinyon-juniper woodlands, lakes, savannah grasslands and creosote scrub at the lower elevations. The course of the Colorado River changed over time, creating terraces and depositing sediments between its headwaters in the Colorado Rocky Mountains and its terminus in the Gulf of California. During the Early Holocene (11,000 to 8,000 BP) the river flowed into previously dry areas inland and with periodic flooding episodes, the extent of inland lakes, such as the Salton Trough and the ancient Lake Cahuilla, increased dramatically. During the Middle to Late Holocene (8,000 BP to present) the warm and dry conditions continued and were dominated by summer monsoons in the desert and winter storms along the coast. Lakes became ephemeral (Van Devender and Spaulding 1983).

Research of the Mojave Desert paleohydrology is provided by packrat midden studies. The reduction in the presence of blackbrush (*Coleogyne ramosissima*) desert scrub in middens clearly indicated a warmer and drier environment. However, to the south in the Salton Sink the timing of the filling and emptying of ancient Lake Cahuilla contradicts the chronology of droughts experienced in the Mojave Desert. Geomorphic evidence demonstrates that the high lake stands were the result of the shifting of the Lower Colorado River channel. Lake Cahuilla was frequently filled between 500 and 1,500 BP, although not necessarily due to climatic factors (Waters 1983).

Surface water sources are minimal on Palo Verde Mesa, limited to seasonal and perennial sources. Perennial water comes from McCoy Springs in the McCoy Mountains west of the Project area. Springs, including McCoy Springs, are at the bases of the nearby mountains. Monsoon activity turns dry washes into raging torrents that cut through Palo Verde Mesa. The Colorado River is eight miles to the east of the Project area.

Sediments in the Project area originated from quaternary deposits from the Colorado, which ran through the Project area, and from alluvial fan deposits from the mountains to the northwest. Alluvium, colluvium, and slope-wash deposits of the Late Pleistocene and Holocene are found in drainage features, including valleys and streams. The alluvial deposits grade indiscernibly with colluvium and slope-wash deposits flanking the lower slopes next to the valleys. Large remnant river terraces remain in the Project area. Heavily patinated desert pavement (a layer of course pebbles and gravel created after wind removal of the finer materials) is common in this climate and is often present in broad, well-developed patches in the Project area (Norris and Webb 1990). Nearby terrace-top cobble deposits were a source of stone

material collected by Native Americans. This lithic material includes quartzite, chert and chalcedony, all of which were used by the prehistoric inhabitants for stone tools.

Today, the vegetation communities in the Project area are similar to those of the Mojave Desert to the northwest. These vegetation and habitat communities are sparse but are able to support Creosote Bush Scrub and also include Desert Dunes, Desert Dry Wash Woodland, and Agricultural Land. The natural vegetation community is primarily creosote bush scrub, which includes creosote bush (*Larrea tridentate)* and white bursage or burrobush (*Ambrosia dumosa).* Closer to the Colorado River, palo verde (*Parkinsonia florida)* is found in drainages as well as mesquite (*Prosopis* spp.) and ironwood (*Olneya tesota)* bushes. These are among the important food plants used by the local tribes (Bean and Saubel 1972). Currently, the land within the Project boundaries is used for agriculture or is open, undeveloped desert.

Fauna in the Project area include desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), mule deer (*Odocoileus hemionus*) and Desert bighorn sheep (*Ovis canadensis nelsoni*). The desert cottontail is most abundant in the dunes area whereas the black-tailed jackrabbit is more prevalent on the desert floor, floodplains, and rocky slopes (Ryan 1968; Jaeger 1965). Reptiles include lizards and snakes, particularly the western diamondback (*Crotalus atrox*), and the desert tortoise (*Gopherus agassizi*). Avian species common to the Project area include the common raven (*Corvus corax*) and the greater roadrunner (*Geococcyx californianus*).

4.0 CULTURAL SETTING

4.1 Prehistoric Context

Archaeological research in the Colorado Desert began in the 1930s with Malcolm Rogers. He established artifact typologies and a chronology based on tools and settlement patterns. His research is used as the foundation of current research in the area. The majority of archaeologists working in the region use the following cultural sequence, which is a brief synthesis of the prehistory of the region as we understand it, Paleoindian Period (about 12,000-7,000 BP), Archaic Period (7,000 – 1,500 BP) Late Prehistoric Period (1,500 to 150 BP).

4.1.1 Paleoindian Period (San Dieguito) (12,000-7,000 BP)

The Paleoindian period experienced profound environmental changes, as the cool, moist conditions of the Pleistocene gave way to the warmer, drier climate of the Holocene (Spaulding 1990). Settlement patterns of this period suggest habitation occurred along prehistoric lakeshores and on mesas near springs and washes (Schaefer and Laylander 2007). The Palo Verde Mesa area was not conducive to settlement due to the limited water resources available and was likely used as a travel corridor between the mountains and rivers (von Werlhof 2004). In the larger Riverside County region, Paleoindian sites may be found on stable landforms and in protected caves above floodplains and valley/riparian environments and along ridge systems and in mountain passes that may have served as travel routes (Moratto 1998).

The Paleoindian inhabitants were nomadic large-game hunters whose tool assemblage included choppers; percussion-flaked scrapers and knives; large, well-made fluted, leaf-shaped, or stemmed projectile points (e.g., Lake Mojave, Silver Lake); crescents; heavy core/cobble tools; hammerstones; bifacial cores; and scraper planes (Rogers 1939, 1966; Warren 1968). The subsistence strategy used during the San Dieguito period focused primarily on hunting large and small game as well as gathering available plants available throughout the seasons. Near the end of this period, the climate began to warm, which caused the lakes and marshes to dry, resulting in the need for different subsistence and settlement strategies (Moratto 1984).

4.1.2 Archaic Period (Pinto and Amargosa) (7,000–1,500 BP)

The climatic patterns of the Late Paleoindian period continued into the Early Archaic period. In the Colorado Desert region, Rogers (1939) assigned the Amargosa complex to this period, which dates to approximately 8,000 – 1,500 BP (Vaughn and Warren 1980). Tool types identified with this period include Pinto and Amargosa projectile points and knives, scrapers and choppers. The use of ground stone tools increased during this period (McGuire and Schiffer 1982; Warren 1984).

In the inland regions of Southern California, this period of cultural development is marked by tools used for grinding seed for flour. Artifacts dating to this period include large leaf-shaped projectile points and knives; manos and milling stones used for hard-seed grinding; and many other artifacts, such as beads, pendants, charmstones, discoidals, spherical stones, and cogged stones (Kowta 1969; Warren, et al. 1961).

The beginning of the Late Archaic coincides with a period of increased moisture in the region. Research suggests the California desert environment was unstable during these time periods, forcing the hunter-gatherers towards more hospitable regions (Crabtree 1981; Schaefer 1994; Weide 1974). However, Late Archaic sites have been recorded in more southern portions of Riverside County's low desert near the Peninsular Ranges where water was more available.

Late Archaic site types include residential bases with large, diverse artifact assemblages, abundant faunal remains, and cultural features, as well as temporary bases, temporary camps, and task-specific activity areas. Diagnostic projectile points of this period include more refined notched (Elko), concave base

(Humboldt), and small stemmed (Gypsum) forms (Warren 1984). The mortar and pestle were used to process acorns, an important storable resource. *Haliotis* and *Olivella* shell beads, and ornaments and split-twig animal figurines indicate the interior California occupants were in contact with populations on the California coast and in the southern Great Basin.

4.1.3 Late Prehistoric (Patayan Complex) (1,500–150 BP)

A period of even more persistent drought began by 1,500 years ago, and conditions became significantly warmer and drier (Jones et al. 1999; Kennett and Kennett 2000). The dry period continued until 750 years ago (Spaulding 2001).

The Patayan complex is marked by strong regional cultural developments to the economic system and settlement patterns, especially in the Southern California desert regions, which were heavily influenced by the Hakataya (Patayan) culture of the lower Colorado River area (Warren 1984). This period includes a pre-ceramic transitional phase ranging between 1,500 and 1,200 years BP. The Patayan complex is distinguished from the transitional phase by the introduction of pottery using the paddle-and-anvil technique as well as the use of bow-and-arrow technology. Also noted is the use of floodplain agriculture (Rogers 1945). The annual flooding of the Colorado River provided water to sustain the crops and also revitalize the soil. Nearby Lake Cahuilla appears to have flooded between 950 and 300 years BP (Laylander 1997; Schaefer 1994). These technological advancements are believed to be from Mexico or the ancestral Pueblo cultures of the Southwest deserts (McGuire and Schiffer 1982; Rogers 1945; Schroeder 1979).

Diagnostic artifacts include Saratoga Springs projectile points, small triangular projectile points, mortars and pestles, steatite ornaments and containers, perforated stones, circular shell fishhooks, numerous and varied bone tools, and bone and shell ornaments. Elaborate mortuary customs and extensive trade networks are also characteristic of this period. Additionally, abundant amounts of obsidian were being imported into the region from the Obsidian Butte source exposed by the desiccation of Lake Cahuilla.

Two ceramic types have been identified as the most prevalent for the Palo Verde Valley area, Lower Colorado Buffware and Tizon Brownware. Harner (1957) observed in the Chuckwalla Valley the frequency of Lower Colorado Buff was double that of the Tizon Brown. When this pottery was compared and cross-dated with a collection from the Bouse Site in Arizona, Harner found the pottery from the Chuckwalla Valley could date between A.D. 1300 and 1900.

Lower Colorado Buffware is made from riverine and lacustrine clay, usually with fine grains of sub-angular to sub-round quartz, feldspars, and other opaque spars. Most vessels are highly oxidized due to the firing process. The surface finish is typically smoothed with faint wipe marks left by mops. The larger vessels may display anvil marks on the interior surfaces. A thick cream-colored scum coat is common in the desert regions, and stucco treatment is also common along the Colorado River and in the desert. The surface color is usually tan with pink tones. Recurved rims are common, polish is rare, and decorations often include fingernail impressions, in casing and punched holes. Colorado Buff dates to Patayan III (A.D. 1500 to post-1900).

Tizon Brownware is made from clays from decomposing granite outcrops in the California-Colorado desert regions, and usually contains higher iron content. The vessels are typically reddish brown and contain little to no temper. Both Tizon Brown and Lower Colorado Buff were usually made using coils, smoothed and shaped by a paddle and anvil.

In an ongoing study, Laylander and Schaefer (2010) have applied a regional perspective to evaluate and treat cultural resources within a broad landscape approach (2010). The current Project falls within their

Prehistoric Trails Network Cultural Landscape (PTNCL) area, which includes Palo Verde Valley, McCoy Wash and Palen Valley.

By the Late Prehistoric period there appears to have been a transition to more mobile patterns of travel and trade between the Colorado River and Lake Cahuilla (Pendleton 1984). Long range travel for resource procurement and trade resulted in a system of trails through the Colorado Desert. The increased mobility along the trail system also allowed the opportunity for interaction between neighboring tribes. As the Spanish began to explore the area, native trails and trade routes were used and expanded.

Three prehistoric trails, described below, were in the Project vicinity; these were likely used to travel to and from springs and other water sources. McCarthy (1993) explained trails in the McCoy Springs region were unbordered and did not indicate evidence of deliberate construction.

Early research in the area noted recognizable trail types, including major long-distance, minor long-distance, and subsidiary trails between settlements and resources areas (Rogers 1941). McCarthy (1993) defines two types of trails, primary and secondary. Primary trails are based around a destination fixed on the landscape, such as a spring. McCoy Springs was the destination spot for all of the trail segments in the current Project vicinity. Secondary trails branch off from the primary trails. McCarthy identified CA-RIV-53, east and northwest of the Project, as the predominant trail leading to McCoy Springs. The trails along the southern flank of the McCoy Mountains probably emanate from the Colorado River (Palo Verde Valley) and lead toward Chuckwalla Valley. Between the McCoy and the Chuckwalla Mountains, several springs (McCoy, Chuckwalla, and Corn Springs), tanks (Palen and Mule Tanks), and dry lake beds (Ford Dry Lake and Palen Lake) were linked with a network of trails. The trails found on the desert pavement were in excellent condition. These trails include CA-RIV-53 (known as the Halchidhoma Trail), CA-RIV-885, less than a mile southwest of the Project, and CA-RIV-3673 less than a mile northeast of the Project.

Other trails lead toward canyons containing temporary water sources. Petroglyph sites have been documented in these canyons; two short trail segments that lead to a large canyon southeast of McCoy Peak have been documented in the Project vicinity. In addition to water sources, other resource areas would include lithic quarries and assay areas. A line of pebble terraces line the southern flank of the McCoy Mountains. Several extremely large prehistoric lithic sources and assay sites have been recorded in these terraces. Trail segments between these sites have been documented. One segment, CA-RIV-3671, is within one mile of the Project (von Werlhof 1987). McCarthy speculates shorter trail segments in the area of McCoy Wash were used to connect specialized activity areas within larger habitation areas (McCarthy 1993).

Trails were also used for trade routes. Trade between southern California and the Southwest may have begun more than 9,000 years ago (Ruby 1970), but the predominant trading activity ranged between A.D. 900 and A.D. 1300. Exchange items included California marine shell and Southwestern pottery. Johnston and Johnston (1957) found segments of trails from the Colorado River through the San Gorgonio Pass and into Riverside County. The system connected the Palo Verde Valley to the McCoy Mountains through the Chuckwalla Valley into the Chuckwalla Mountains.

Trails are also a significant element in the sacred landscape; they link the spiritual world to the natural landscape. Trails have been marked with rock shrines and artifacts such as pottery drops and flaked stone scatters, particularly white quartz. Songs and stories contain named places such as mountains, water sources, valleys and other geographical locations along known trails (Fowler 2009).

4.2 Ethnography

The Colorado Desert area of Riverside County is within the ethnographic boundaries of several different 18th and 19th century Native American groups. Ethnographers documented these tribes and prepared syntheses for the Quechan (Bee 1981, 1982, 1983, 1989; Forbes 1965; Forde 1931), Halchidhoma (Harwell and Kelly 1983; Spier 1933), the Mojave (Kroeber 1925; Stewart 1983), and the Chemehuevi (Kelly and Fowler 1986; Laird 1976, 1984), as well as the Cahuilla (Bean 1972; Bean and King 1974; Bean and Vane 1978) (see Figure 2).

4.2.1 Colorado River Peoples: the Quechan, Halchidhoma, and Mojave

The first Europeans to encounter and document the traditional inhabitants of the Lower Colorado River tribes were the Spanish, followed by American explorers. Kroeber (1920, 1925) conducted extensive fieldwork at the turn of the 20th century; in particular, he studied the Mojave tribe in the Needles area. Spanish missionary influence did not reach the desert cultures, which enabled them to retain much of their language, religion, and cultural practices. Early ethnographers were able to conduct fieldwork and documented many details about oral histories, ritual and burial practices, as well as life-ways practiced prior to contact and those during the first half of the 20th century. Malcolm Rogers studied the Colorado River Tribes in the 1930s and documented lithic and ceramic technologies.

After A.D. 1000, the Colorado River tribes appear to have become more mobile and extended their travel between the river and Lake Cahuilla; and consequently expanded their resource procurement patterns (Pendleton 1984). This resulted in the development of an extensive trail network throughout the Colorado Desert. Evidence of travel and trade is indicated by the presence of pottery drops and shrines lining the trails (McCarthy 1993). The trails network was also a major component of the tribe's belief system, interconnecting important geographical locations and ceremonial sites with song cycles and rituals.

Lithic quarries along various mountain ranges were used for tool material, springs within these mountains provided water. Several springs are located within a day's travel of the Project area, in addition to McCoy Springs, Corn and Chuckwalla Springs are less than 30 miles to the west.

The lower Colorado River region was inhabited by numerous tribes at the time of the first Spanish contact. Alarcon and Diaz were the first to travel up the Colorado River in 1540; their description of the interaction between tribes indicates shifting boundaries and inter-tribal hostilities (Forbes 1965). A later expedition by Onate in 1605 documents several tribes, including the Halchidhoma, the Quechan and the Mojave at various points along the river. By 1774, the Anza Expedition encountered the Halchidhoma living between the Mojave and Quechan territories near Parker, Arizona. Historical accounts describe constant conflict among the tribes with the Quechan and Mojave against the Halchidhoma. Ultimately, the Halchidhoma left the area and resettled in the mid-1800s in the Gila River area (Dobyns et al. 1963; Kroeber 1925).

Settlement was determined primarily by proximity to permanent water sources. Villages and camp sites were most often in the foothills and less frequently on the desert floor, depending on the availability of water. Tribal boundaries and territories were dynamic as a result of interactions and warfare between tribes (Forbes 1965).

Like some of the other river Yuman tribes, the Mojave focused on floodplain agriculture, producing close to half of their dietary needs from crops, including maize, squash, melons, beans and a variety of grasses (Bee 1983; Castetter and Bell 1951). Similarly, the Quechan also relied on agriculture as well as fish from the Colorado River. In addition, both small and large game were hunted, adding important dietary protein.

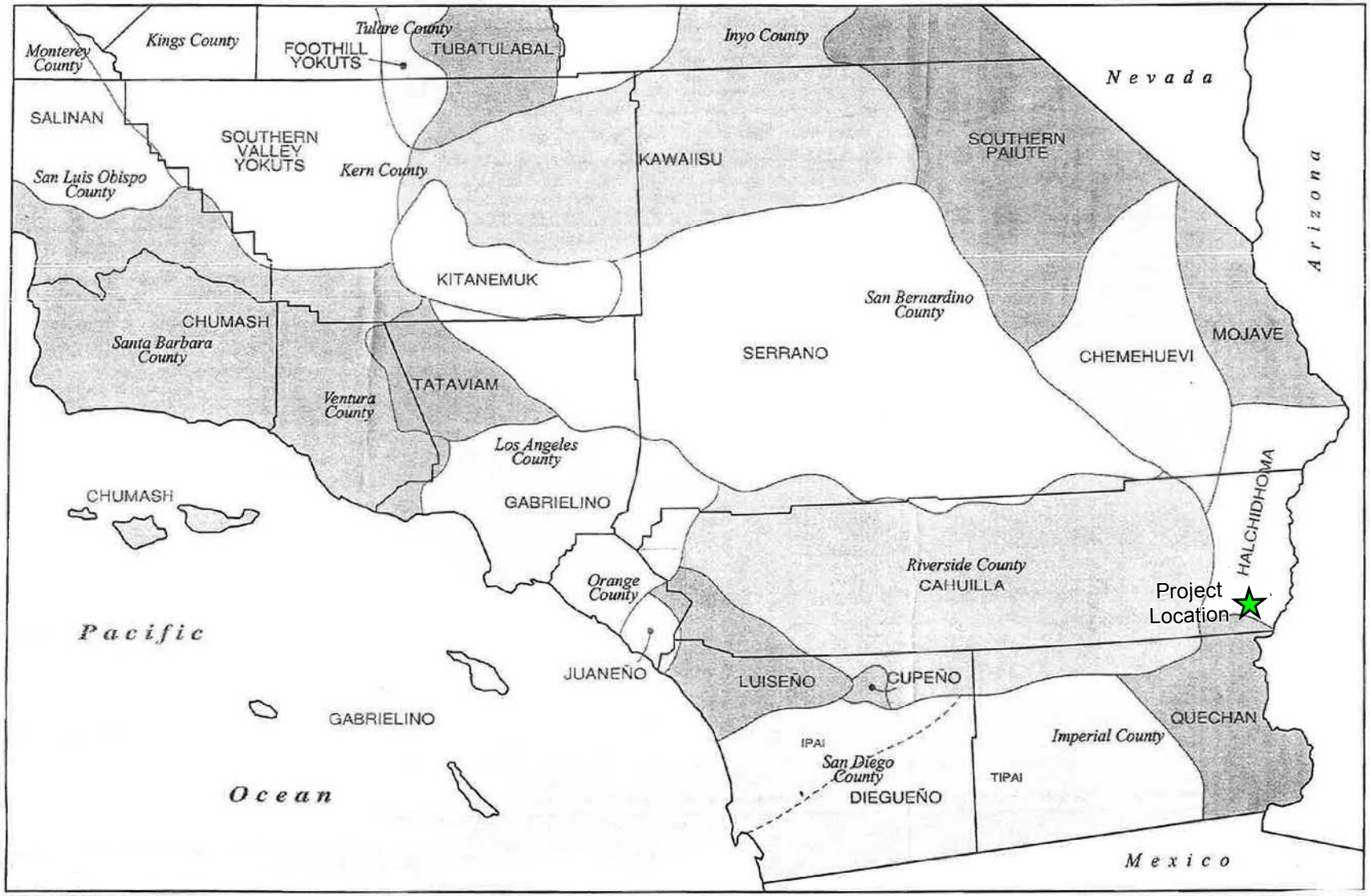


Figure 2 - Ethnographic Boundaries

The Colorado River Tribes share similar beliefs strongly linked to dreaming and ritual songs that apply to daily life and personal knowledge. These beliefs are based on real places that are visited physically or in dreams (Kroeber 1925). Forbes noted religion, cultural identity, various aspects of daily life, and the landscape on which they lived were intricately intertwined. Important ceremonial locations include intaglios, petroglyphs, lithic scatters and cleared circles along the Colorado River and in the surrounding hills. As previously mentioned, one key component of the cultural landscape is a regional trail system (Forbes 1965).

4.2.2 Chemehuevi

The Chemehuevi tribe is the southern-most group of the Southern Paiutes (Kelly and Fowler 1986). Their territory included the western side of the Colorado River into the Palo Verde Mountains and north toward Cadiz Dry Lake.

The Chemehuevi share many cultural elements with the Mojave, including habitation structures, ground stone tool types as well as spiritual beliefs. The Chemehuevi were organized in small mobile groups who traveled widely, interacting with neighboring tribes. They subsisted on small game, hunting as far west as San Bernardino, and on harvesting seasonal plant resources throughout the region. They hunted with the Quechan in Arizona and the Serrano in Tehachapi, and were reported to have hunted abalone shell in the Santa Barbara Channel and to have journeyed to the Hopi Villages (Kelly and Fowler 1986). They were not known to have used pottery but rather chose basketry and other woven implements, often decorated. The Chemehuevi who settled along the Colorado River lived in relatively permanent structures and utilized agriculture to a greater extent than related groups to the west (Laird 1976). Historically, they grew a variety of crops including vegetables, beans, winter wheat and grasses.

Chemehuevi spiritual beliefs include a sacred landscape that incorporates both the spirit world and the natural world. These rituals include songs and dreams that are the basis of their daily lives, linking their beliefs, material existence and the cultural landscape. Kroeber states that knowledge is acquired by each man according to his dreams (Kroeber 1925). The "Salt Song" describes a ceremonial trail across three states and the significance of the mountains and the medicines found in them.

4.2.3 Cahuilla

The Cahuilla are one of several groups who migrated into California from the Great Basin, although the specific time, duration, and process is unclear, it is estimated to have taken place around 1,500 BP (Kroeber 1925; Laylander 1985). The Cahuilla's traditional territory encompassed diverse topography ranging from 273 feet below sea level at the Salton Sink to 11,000 feet AMSL in the San Bernardino Mountains. Their territory extended from the summit of the San Bernardino Mountains in the north to the Chocolate Mountains and Borrego Springs in the south. Its eastern border included the Colorado Desert west of Orocopia Mountain, and its western border included the San Jacinto Plain near Riverside and the eastern slopes of Palomar Mountain (Bean 1978).

Although the traditional territory is vast, the Santa Rosa and San Jacinto Mountains and the Coachella Valley in Riverside County are the center of the Cahuilla, including Palo Verde Mesa. Numerous land holding clans claim territory in this area, each of which ranged from the desert to the mountain areas. Clans could include more than one lineage that had independent community areas owned within the larger clan area (Wilke and Lawton 1975).

Cahuilla villages usually were in canyons or along alluvial fans near adequate sources of water and food plants. The immediate village territory was owned in common by a lineage group or band. The other lands were divided into tracts owned by clans, families, or individuals. Trails used for hunting, trading, and social interaction connected the villages. Each village was near numerous sacred sites such as rock art panels (Bean and Shipek 1978).

The Cahuilla belief system and oral tradition indicate that when Lake Cahuilla dried up, the desert floor was settled; 17 or more rancherias have been identified in Coachella Valley. These rancheria locations are associated with hand-dug wells, springs, or palm oases. Water collection and conveyance features and associated agricultural fields have been documented from the early 1800s (Wilke and Lawton 1975).

4.3 Euro-American Context

European presence in the Colorado River region began with explorations in the 16th century; however permanent settlement occurred in the mid-19th century as a result of the development of transportation and water conveyance. Exploration was primarily for travel routes in search of interior waterways and from Mexico north toward Monterey for the establishment of the California missions by the Spanish. The end of the Mexican War of 1846-1848, the discovery of gold in California in 1849, and the establishment of California as a state on September 9, 1850 all contributed to a steady influx of non-Hispanic settlers into the area. Later, mining, agriculture and military training brought settlement to the Riverside County area.

4.3.1 Transportation

Prior to the European presence in the Colorado Desert area, transportation was limited to foot trails used by the Native Americans. As the Spanish began to explore the area, these native trails and trade routes were further used and expanded. One of the more important routes, known as the Bradshaw Trail, was developed as the result of the search for gold in Southern California, specifically in the area of La Paz, along the eastern side of the Colorado River (Gunther 1984; Johnston 1972, 1987), north of the Project area. William D. Bradshaw, a forty-niner working in the San Bernardino County area, was determined to find an overland route from the Pacific Ocean to the Colorado River, where gold had been recently discovered in what is now Ehrenberg. Bradshaw had previously mined for gold in Sutter's Mill in 1849, and anticipated La Paz to become a gold strike boom-town. To accommodate the expected influx of miners headed toward La Paz, Bradshaw recruited a group of eight men to scout out a direct route (Gunther 1984; Johnston 1972, 1987).

Bradshaw worked with Chief Cabazon, the leader of the Desert Cahuilla, and a Coco Maricopa Indian mail runner to map a route using an ancient native trail that linked water sources across the Colorado Desert. The trail passed through the San Gorgonio Pass through Palm Springs, then turned south and ran through Martinez to the north side of the Salton Sink and between the Orocopia and Chocolate Mountains ranges. The route then skirted the southern edge of the Chuckwalla range crossed through the Mule Mountains and reached the Palo Verde Valley. Bradshaw also established a ferry service to cross the Colorado River and proceeded to promote his new trail and ferry enterprise (Gunther 1984; Johnston 1972, 1987). The Bradshaw Trail is 5.5 miles south of the Project area.

Also paramount to the development of the Colorado Desert was the arrival of the Southern Pacific Railroad (SPRR), a transcontinental railroad system. The SPRR was founded as a land holding company in 1865 and acquired various smaller railroad companies that would eventually link New Orleans, Texas, New Mexico, Arizona and California through Los Angeles and then north into San Francisco through to Portland, Oregon. Numerous communities sprang up along the route and greatly accommodated the mining boom in the local area (Vredenburgh et al. 1981). The railroad was instrumental in settlement of the Colorado Desert areas by providing access to immigrants as well as shipping consumer goods and produce between the east and west coasts (Fickewirth 1992). The SPRR reached Yuma, Arizona in 1877 and links north on the river were provided by commercial river boat traffic (Vredenburgh et al. 1981). Later, to facilitate the mining activities in the Blythe area, a spur was constructed to the Atchison, Topeka, and Santa Fe Blythe-Ripley Line in 1916.

4.3.2 Mining

With the signing of the Treaty of Guadalupe-Hidalgo in 1848, the U.S. Southwest came under the control of the United States. The Colorado Desert was the scene of prolonged mining from 1850, with the beginning of the gold rush in California. The small town of La Paz, 45 miles northeast of Blythe on the eastern bank of the Colorado River, was a boomtown in the 1860s (Wilson 1961). The mid-1860s saw the town of La Paz swell in population to over 5,000, but by 1870 the miners had gleaned most of the gold-bearing ore from this site.

Mining and prospecting was primarily focused in the mountains and high desert north of Blythe but small-scale mining did occur from the 1860s until after the Great Depression in the 1930s (Morton 1977). Although gold was found only in small amounts, mining of gypsum and manganese were more successful ventures. To the north in the McCoy Mountains, several significant manganese mines provided ore for armaments during both World Wars I and II (Butler 1998). Other minerals mined from the areas surrounding the Project area include fluorite, copper and uranium (E. Warren et al. 1981).

4.3.3 Homesteading and Agriculture

The passage of the Homestead Act in 1862 and the Desert Land Act in 1877 were instrumental in the settlement of the Lower Colorado River area. The Homestead Act offered the opportunity for United States citizens to file a claim on 160 acres or less of land for $1.25 per acre. The Act stipulated that the claim be for purposes of actual settlement and cultivation, and the claimant was required to 'improve' the plot by building a dwelling and cultivating the land. After five years on the land, the original filer was entitled to the property, free and clear.

The Desert Land Act was similar to the Homestead Act in that it was enacted to encourage and promote economic development of the desert lands of the Western states. This act also required the filer to irrigate and cultivate the land within three years. A married couple could pay $1.25 per acre for a maximum of 640 acres whereas a single man would receive half the land but pay the same price. Proof of irrigation was required for the filer to obtain title. This act was later revised to offer a maximum of 320 acres with proof of irrigation required within four years.

The agriculture in the Palo Verde Valley was made possible by the construction of canals and pipelines as well as the securing of water appropriations. The first irrigation project was completed in 1883, after the death of Thomas Blythe who made the first appropriation (E. Warren et al. 1981). The valley was subject to flooding until after the completion of Boulder Dam in the 1930s.

4.3.4 City of Blythe

Thomas Blythe, an Englishman, arrived in the area in 1882 in search of gold and real estate development possibilities. Having been successful in real estate investments in San Francisco, Blythe came to the Lower Colorado River area and established water rights along the Colorado River. His efforts in irrigation and cultivation of the land were successful; 40,000 acres were irrigated as a result of his diverting water from the Colorado River (Blythe Chamber of Commerce 2011). Further development of the desert lands into fertile agricultural fields continued. The city was incorporated in 1916.

4.3.5 World War II Desert Training Center/California-Arizona Maneuver Area

A comprehensive historic context for the Desert Training Center/California-Arizona Maneuver Area (DTC/C-AMA) was published by Bischoff in 2000. The following is a very brief summary of Bischoff's (2000) report.

Soon after the United States entered World War II, General George S. Patton, Jr. was assigned the task of developing a training center to prepare Army troops for combat against German forces in North Africa. Patton identified an area in the California desert that offered realistic terrain and combat conditions to train the troops. The lack of water, extreme heat and difficult terrain as well as the remote location would assist preparing troops for mobilization and combat tactics. Ultimately, training missions were both ground and air; all manner of equipment and battle strategies were tested and perfected there (Bischoff 2000).

Patton established base operations headquarters at Camp Young, near Indio, and began training troops in April 1942. The Desert Training Center (DTC) facility extended from Desert Center in California to the Colorado River, as far north as Searchlight, Nevada and as far south as Yuma, Arizona. To accommodate the massive number of troops brought to the region, several desert airfields were taken over by the Army in 1942, including the airfield that was to become Blythe Army Air Base (BAAB).The name of the DTC was changed to the California-Arizona Maneuver Area (C-AMA) in October 1943, and the mission of the C-AMA was expanded to include simulation of large-scale operations and logistics beyond exclusively desert warfare tactics.

The DTC/C-AMA consisted of 11 major camps, of which seven were in California and four were in Arizona. The largest camps, Camp Iron Mountain, Camp Granite, and Camp Coxcomb, were north of Desert Center. All of the facilities were connected by railroads and major roads (Vredenburgh 1981).

The DTC/C-AMA was where actual battle simulation was first used. The training offered in surviving the elements, tactical mobility and mastering ordinance and engagement provided unparalleled experience for troops and commanding officers. In April 1944 the facilities began evacuations and closing, eventually being turned back to the U.S. Department of the Interior and private landowners (Bischoff 2000).

4.3.6 Blythe Army Air Base

The Project area is on the eastern side of BAAB that, beginning in 1942, supported the military training missions associated with the DTC/C-AMA and later provided aerial bombardment training between 1942 and 1944. As a cultural resource, BAAB was documented in 2010 as P-33-18837 and evaluated for the NRHP (Mitchell 2010). This report provides a brief summary based on Mitchell (2010) and Wilson (2008; personal communication 2011).

Under the Civil Aeronautics Act of 1938, the Civil Aeronautics Administration (CAA) was charged with developing civilian airfields throughout California that could be used for defense. BAAB had humble beginnings in 1940 as a private, unpaved airstrip, originally known as Intermediate Flying Field Site 21. In addition, Site 21 was intended for emergency landings for flights between Los Angeles and Phoenix. The following year (1941) the Works Progress Administration (WPA) provided funds to upgrade the airfield to two paved runways as part of the National Defense Program, with Riverside County sponsoring the project and maintaining the airfield.

In February 1942, General Patton was tasked to identify a location suitable for training troops in desert warfare as preparation for deployment to North Africa. The selected location became the DTC/C-AMA (see Section 4.3.4) . Construction was planned for DTC airfields at Thermal, Desert Center, Rice and Shaver's Summit (now Chiriaco Summit). Because construction for the Site 21 airfield outside Blythe was already underway, it was incorporated into General Patton's DTC/C-AMA operation and used immediately for air support until the four new airfields became operational.

On April 7, 1942, approval was given for Site 21 to become BAAB, and improvements were begun in preparation for the arrival of the 46th Bombardment Group, whose initial mission was to provide medium bomber crews in support of Patton's rigorous desert warfare training. This group was joined by the 3rd

Observation Squadron to perform observation missions in support of the army ground forces on maneuvers at the DTC. For five months, General Patton oversaw the operations of the DTC/C-AMA, including BAAB. In September 1942, General Henry "Hap" Arnold and Lt. Col. Richard Lee took over command of the base from General Patton; by the end of that year the base population was 800 officers and 5,400 enlisted men. (Wilson 2008).

Construction continued on the base throughout 1942; by December a deep water well, a small hanger, an engineering building, the base theater, four warehouses and 60 barracks had been completed, and four runways with aprons had been paved and were in use. However, by the end of 1942, DTC airfields were operational at Thermal, Rice and Desert Center and support from BAAB was no longer needed. At that point, BAAB was relieved of its DTC air support role and changed to heavy bomber training under the 2nd Air Force. The 34th Bombardment Group was assigned to BAAB; its mission was training in B-17 Flying Fortress and B-24 Liberator aircraft (Wilson 2008). In total, BAAB's direct association with the DTC/C-AMA lasted eight months, from April 1942 to the end of the same year, and its association with General Patton lasted only five months.

In 1943, the base hospital, an officer's club and the pool were opened for use. Also, a mess hall, a base chapel, a barber shop and additional hangers were completed. Numerous bombardment groups trained at the base for the next two years. Included in the troops assigned to the base for short periods were the Women's Army Auxiliary Corps (WAAC) and the 99th Fighter Squadron, also known as the Tuskegee Airmen (Wilson 2008).

By March 1944, the training mission at BAAB began to gear down. Most of the troops had completed training and were deployed to new assignments; no new crews were being assigned to BAAB for training. The DTC was closed in April 1944; BAAB became an alternative landing site for March Field in Riverside. BAAB remained staffed for providing emergency landing for airplanes unable to land at their designated home fields due to weather. By October 1945, BAAB was downgraded to an airfield, being closed and surplus government property the following year. It continued to be used for various training purposes until 1948 when the government transferred the property to the County of Riverside, which currently operates a portion of the property as the Blythe Airport. Farming on the airfield property during the 1970s and 1980s destroyed most of the original buildings and features (Wilson 2008).

4.4 Research Goals

The goal of the inventory and analysis is to provide the BLM and the County of Riverside with information with which to assess potential effects to NRHP and CRHR-eligible archaeological sites and architectural resources within the Project APE to support compliance with the NHPA, NEPA, and CEQA.

This research design guides the interpretation of cultural resources within the Project APE and helps in evaluating their eligibility to the NRHP and CRHR (see Section 6.0). The key research questions presented below address: 1) prehistoric chronology; 2) prehistoric settlement and subsistence; 3) interaction of Native Americans with Europeans and Euroamericans; and 4) 20th century use.

4.4.1 Prehistoric Chronology

Chronology is a key component in understanding prehistoric cultural change in the Palo Verde Valley/Colorado Desert area. In the past, archaeologists in this region have had sparse data to draw from, relying primarily on artifact cross-dating and other relative dating techniques rather than absolute dating techniques.

Research Questions

1. Do diagnostic artifacts from sites in the Project area occur in sufficient numbers and in suitable contexts to allow reliable cross-dating with archaeological sites elsewhere in the Palo Verde Valley/Colorado Desert area?
2. Do artifacts and other evidence from archaeological sites indicate Paleoindian, Archaic or Late Prehistoric period occupation or use of the Project area?
3. Can the characteristics and contexts of ceramics in the Project area allow further refinement of chronological change within the Late Prehistoric Patayan Complex?

Data Requirements

The ages of prehistoric sites can best be determined by using absolute-dating technologies, such as radio-carbon dating of botanical and faunal remains or archaeomagnetic dating of fired clay found in thermal features. Obsidian hydration analysis of tools can sometimes be used for dating sites. Sites containing these types of data (i.e., botanical and faunal remains, thermal features, abundant obsidian) from interpretable contexts are rare in the archaeological record of the Colorado River area.

Relative dating techniques, such as the comparison of ceramic and projectile points found in the Project area with datable types from other regions, can be used to determine the approximate age of artifact collections. In general, the larger the artifact collection one has from a single discrete context or site, the more confidence one will have in the estimated age of the collection. However, while some projectile point and pottery types are excellent chronological markers, the age ranges for other tool types may be very broad, spanning thousands of years.

4.4.2 Prehistoric Settlement and Subsistence

Because of the desert environment, prehistoric settlement and cultural use of the area would have typically been close to reliable water sources or along travel routes between water sources. In addition, for Paleoindian, Archaic and Late Prehistoric period cultures, as well ethnographic cultures, resource gathering strategies would also have been affected by the size and distribution of the human population and the types of plant, animal, lithic and other resources available for exploitation.

Research Questions

1. Did chronological variation in the types of resources exploited reflect environmental change, technological change, or fluctuations in the size and distribution of the human population?
2. Do archaeological sites in the Project area represent base camps, temporary camps, or specific task-related loci?
3. What environmental variables (e.g., water, natural habitats) influenced the use of the site or the distribution of the human population?
4. Are the distribution of prehistoric sites and the contents of the sites associated with known prehistoric trails?

Data Requirements

Faunal and botanical remains from a site indicate the resources available at the particular time and location and their relative importance to the occupants. Temporary camps would typically contain the remains of resources found in the vicinity, while remains from base camps would reflect a wider catchment area. Sourcing of raw materials used for stone tools and the different raw materials identified during debitage analysis can indicate either trade with other prehistoric groups or travel to and use of quarry sites. The presence of thermal features, such as roasting pits; of processing features, such as grinding surfaces; of certain types of tools; and of possible hunting blinds would indicate specific subsistence activities. A regional analysis of the artifacts found at sites may reveal patterns how often

certain artifact or raw material classes are associated with trails, which may in turn indicate trade among groups.

4.4.3 Interaction of Native Americans with Europeans and Euroamericans

The first documented accounts of contact between Native Americans and Spanish explorers are from the mid-18th century, followed by accounts of interaction with Euroamericans in the 19th century. Non-native settlement in the Palo Verde Valley began in the mid-19th century with the influx of mining and homestead activities. Euroamerican settlement and land use practices had profound effects on the native populations.

Research Questions

1. Is there evidence of early European (i.e. Spanish) activity at archaeological sites in the Project area?
2. Do any archaeological sites in the Project area contain artifacts or other evidence suggesting 18th or 19th-century occupation by Native Americans?
3. How did Native American and Euroamerican populations interact, and how did this interaction change as Euroamerican population increase?
4. How did the subsistence practices of Native Americans in the Project area change after Euroamericans land use practices had altered the distribution and abundance of natural resources?
5. How did the introduction of Euroamerican agriculture and domesticated animals affect the artifact assemblages found at Native American sites?
6. How did the Euroamerican mining and transportation activities affect traditional tribal practices?

Data Requirements

Information to address these research questions would most likely be found in Native American habitation sites, should they exist within the Project area. Evidence would be based on how stone tools, pottery, and plant and animal remains at sites from the 19th century compare to similar artifacts and food remains at Late Prehistoric sites. Refuse-filled features with depositional integrity and recognizable association to the specific activities would be of particular value for such an analysis. Particularly valuable would be undisturbed features or other contexts with both Native American and Euroamerican artifacts.

4.4.4 20th Century Use

Major events of the twentieth century in the Project vicinity include small-scale mining, development of roads and railroads, implementation of the Homestead Act of 1862 and Desert Land Act of 1877 and subsequent agricultural activities, and World War II training activities related to the DTC/C-AMA and BAAB.

Research Questions

1. How were land improvements first made under the Homestead Act and Desert Land Act affected by later development of extensive irrigation systems in the Blythe area?
2. Did historic settlement and use of the project area change as transportation into the Blythe area improve?
3. Did the reduced incidence of flooding brought on by the construction of Boulder Dam in the 1930s affect land use in the Project area?
4. Are there differences in the location and contents of archaeological resources associated with the DTC/C-AMA and those associated strictly with BAAB after it was no longer tied to the DTC/C-AMA?

Data Requirements

Research questions related to the twentieth century can often best be answered through archival research supplemented by archaeological data. Existing archaeological information pertaining to the twentieth century use of Palo Verde Valley is minimal, as few historic cultural resources of this period in the surrounding area have been investigated. However, historic artifacts and sites can be used to verify the accuracy of some historic records and maps, to pinpoint locations of documented features, and to understand how land use practices have changed. The locations of individual homesteads and mining claims may be associated with historic roads. Survey and site recording can verify whether facilities shown on World War II-era maps of BAAB are still standing, still exist only as rubble and artifact scatters, or perhaps were never actually built.

5.0 INVENTORY METHODS

5.1 Historic Background and Records Search

POWER conducted a records search at the Eastern Information Center (EIC), housed at the University of California, Riverside (UCR) on April 7, 2011. California Historical Resources Information System (CHRIS) records were reviewed to determine the location of previously recorded archaeological and architectural resources and the locations of prior cultural resource surveys within one mile of the Project APE. Also consulted were the NRHP, Archaeological Determinations of Eligibility (ADOE) provided by the EIC, CRHR, CHL lists, and the California Points of Historic Interest (CPHI). In addition, the online BLM General Land Office (GLO) patent information was consulted. Also consulted were Art Wilson, a local historian, the General George S. Patton Memorial Museum and the Palo Verde Historical Museum and Society.

5.2 Field Methods

POWER conducted a BLM Class III archaeological and historic built environment survey of 3,660 acres of lands within the Project boundary that include the 125-foot ROW of the proposed 230 kV transmission line. These lands included private and BLM-managed public lands. During the surveys, archaeologists walked parallel transects, using 15-meter (50-foot) intervals, to identify archaeological and architectural resources within or adjacent to the APE. The ground surface was visually examined for evidence of prehistoric or historic archaeological materials and historic structures. Visible ground surfaces were examined, including fence lines, drainage channels, and other exposures. No subsurface survey (e.g., shovel test pits) was conducted by POWER. A sub-meter Global Positioning System (GPS) was used to identify the location of each cultural resource. A 235-acre parcel surveyed in 2011 was later removed from the Project APE due to design changes. Sites identified within this parcel are described in this report but will not be affected by the Project. The parcel eliminated from the Project is APN 879090052.

Isolated finds, typically three or fewer prehistoric artifacts of the same type (e.g., flakes or sherds), for five or fewer historic artifacts (e.g., cans, bottle glass) were recorded at the time of discovery by collecting GPS data, photographs and measurements of the artifacts. Archaeological sites, typically four or more prehistoric artifacts or six or more historic artifacts within a 10 meter square area, were point-located when discovered and later recorded in more detail during the second field session. Overview photographs of survey areas and comprehensive field notes were also taken.

All field methods were discussed with and reviewed by County Archaeologist, Leslie Mouriquand. The survey on BLM land was performed under Cultural Resource Use Permit (CRUP) #CA-09-36 and Fieldwork Authorization #66.66 11-18.

The archaeological field survey was conducted in three sessions between April and June, 2011. A site visit was attended by POWER archaeologists Jim Rudolph, Gini Austerman, and Dan Woodward on September 7, 2011; a site visit was conducted by Ms. Mouriquand and Riverside County Historic Preservation Officer, Keith Herron on November 22, 2011.

5.3 Native American Communication

Tribal consultation required under Section 106 of the NHPA is ongoing and is being performed by the BLM on a government-to-government basis. Section 106 Tribal consultation is not discussed in this report.

In April 2011, POWER sent a letter to the NAHC requesting information regarding Native American groups with historic ties to, and interest in, the proposed Project area. In May 2011, 20 letters were sent to the tribes identified by the NAHC, which are listed in Table 4. The letter provided a brief description of

the proposed Project and requested information concerning Native American cultural resources in the Project area, as well as any comments or concerns about the Project.

Table 4. Native American Tribes Contacted

AFFILIATION	REPRESENTATIVE
Agua Caliente Band of Cahuilla Indians	Patricia Tuck, THPO
AhaMaKav Cultural Society, Fort Mojave Indian Tribe	Linda Otero, Director
Ah-Mut-Pipa Foundation (Quechan Kumeyaay)	Preston J. Arrow-weed
Augustine Band of Cahuilla Mission Indians (Cahuilla)	Mary Ann Green, Chairperson
Augustine Band of Cahuilla Mission Indians (Cahuilla)	Karen Kupcha
Cahuilla Band of Indians	Luther Salgado, Sr. Chairperson
Chemehuevi	Joseph R. Benitez (Mike)
Chemehuevi Reservation	Charles Wood, Chairperson
Cocopah Museum/Cultural Resources Dept. (Cocopah)	Jill McCormick, Tribal Archaeologist
Colorado River Indian Tribe (Mojave, Chemehuevi)	Ginger Scott, Museum Curator; George Ray, Coordinator
Fort Mojave Indian Tribe (Mojave)	Mr. Tim Williams, Chairperson
Fort Mojave Indian Tribe (Mojave)	Nora McDowell, Cultural Resources Coordinator
Fort Yuma Quechan Indian Nation (Quechan)	Michael Jackson, President
Morongo Band of Mission Indians (Cahuilla, Serrano)	Michael Contreras, Cultural Heritage Program
Quechan Indian Nation	Bridget Nash-Chrabascz, THPO
Ramona Band of Cahuilla Mission Indians (Cahuilla)	Joseph Hamilton, Chairman
San Manuel Band of Mission Indians (Serrano)	Ann Brierty, Policy/Cultural Resources Dept.
Santa Rosa Band of Mission Indians (Cahuilla)	Mayme Estrada, Chairwoman
Torres-Martinez Desert Cahuilla Indians (Cahuilla)	Diana L. Chihuahua, Vice Chairperson, Cultural
Twentynine Palms Band of Mission Indians (Chemehuevi)	Darrell Mike, Chairperson

In November 2011, a Notice of Preparation of an EIR (NOP) was sent via certified mail to 22 Native American Tribes (20 Tribes listed above and additional contacts from the Colorado River Indian Tribe and Torres Martinez Desert Cahuilla Indians). The NOP described the proposed Project and location, environmental review process, potential environmental effects, and contact information, and announced the time and location of the public scoping meeting.

On May 10, 2012, the Applicants hosted an information meeting in Palm Desert and invited Native American groups to attend. Representatives of the Colorado River Indian Tribes, Augustine Band of Cahuilla Indians, Agua Caliente Band of Cahuilla Indians, and Mohave Elders Management attended. Information was presented to them about the Project and about the results of the cultural resource investigations, and the representatives asked questions and expressed concerns. This meeting was an informal coordination meeting with the Applicants only and was not part of BLM government-to-government consultation.

6.0 INVENTORY RESULTS

6.1 Results of Background Research and Record Search

The official federal land record site available through the BLM GLO web site (www.glorecords.blm.gov) patent list was reviewed on June 15, 2011 for homestead information within a one-mile radius of the Project. This land record data can provide background information related to the type of land grant filed, acreage amount and date of issuance. The information is organized by the Township, Range and Section numbers rather than by the APN. One hundred and four (104) land patents were filed within portions of the Project areas between 1911 and 1957; most of the land patents were granted under the Homestead Entry Act of 1862 and the Desert Land Act of 1877. The results are listed in Table C-1 in Appendix C. GLO maps for this part of California were not found online, so it was not possible to use the locations of improvements as a guide for identifying and interpreting historic archaeological sites. Historic military maps and aerial photographs of BAAB were also reviewed (Wilson 2008).

The record search conducted by POWER in March 2011 at the EIC indicated 25 cultural resource studies were previously conducted within one mile of the Project area, eight of which are within or adjacent to the Project. Approximately 20 acres within the current Project had been previously surveyed (RI-03029 and RI-04061); one archaeological site (P-33-009186) and two standing structures (P-33-012532 and P-33-014083) had been previously documented as a result of these studies. The reports are listed in Table 5, and Figure 3 illustrates the areas previously surveyed.

As a result of the record searches performed in April 2011, 82 previously recorded archaeological resources and historic built resources were identified within one mile of the Project (i.e., solar field and proposed transmission line. Information on these resources is presented in Table 5. Of the 82 resources, 28 are prehistoric (16 archaeological sites and 12 isolated finds), 48 are historic (30 archaeological sites, 10 isolated finds, seven built resources, and one district) and 6 are both prehistoric and historic (five archaeological sites and one isolated find). For the purposes of this report, only archaeological and built resources within the Project APE were analyzed.

Three of the 82 cultural resources are within the Project APE. All three are historic (P-33-009186, a refuse deposit recorded in 1999; P-33-012532, a transmission line recorded in 2005; and P-33-014083, a transmission line recorded in 2000). One historic district, the Blythe Army Air Base Historic District (P-33-018837), was recorded in 2010 adjacent to but not within the current Project boundary. These four resources are further described in Section 6.2. One prehistoric site (P-33-018821) appeared to fall within the APE but was incorrectly mapped by the EIC. The previously recorded archaeological and built resources are listed in Table 6; and Figure 4 (in Appendix D) illustrates recorded archaeological resources and standing structures within one mile of the Project APE.

The records search indicates that many prehistoric sites consisting of lithic and ceramic artifact scatters have been documented within a one-mile radius of the Project. The historic sites appear primarily to be refuse deposits and the remains of the World War II training use of the area. POWER anticipated encountering these types of archaeological sites during the survey of the Project area.

Table 5. Previous Cultural Resource Studies within One Mile of Project Area

REPORT NUMBER	AUTHOR	YEAR	TITLE	NUMBER OF IDENTIFIED CULTURAL RESOURCES	WITHIN APE
RI-00220	Cowen, R.A., and K. Wallof	1977	Interim Report Field Work and Data Analysis: Cultural Resource Survey of the Proposed Southern California Edison Palo Verde-Devers 500 kV Transmission Line	7	
RI-00243	von Werlhof, J., and Howard Pritchett	1977	Archaeological Examinations of Mesa Drive into Sundesert Sites, An Addendum Report	0	
RI-02210	Underwood, J., J. Cleland, C.M. Wood, and R. Apple	1986	Preliminary Cultural Resources Survey Report for the US Telecom Fiber Optic Cable Project, From San Timoteo Canyon to Socorro, Texas: The California Segment	13	
RI-03029	Padon, B., S. Crownover, J. Rosenthal, and R. Conrad	1990	Cultural Resources Assessment Southern California Gas Company Proposed Line 5000, Riverside County, California	14	X
RI-03410	Keller, J.A.	1991	A Phase II Investigation of Ca-RIV-4173, Tentative Parcel Map 26395	1	
RI-03418	Broeker, G.	1991	Cultural Resource Inventory Report: Gosser Exchange	0	
RI-03735	Keller, J.A.	1993	A Phase I Archaeological Assessment of General Plan Amendment 380/Change of Zone 6198, 46.21 acres of Land Near Blythe, Riverside County, California	0	
RI-04061	McDonald, M., and J. Schaeffer	1998	Cultural Resources Inventory of 1542 Acres of Palo Verde Mesa Palo Verde Valley Catellus/Bureau of Land Management Land Exchange Area	11	X
RI-04415	Pigniolo, A., M. Baksh, and J. Dietler	1999	Cultural Resource Survey for the Blythe Energy Project, Riverside County, California	9	
RI-04768	Pigniolo, A., and S. Murphy	2001	Cultural Resource Survey Report for the Blythe Water Project, Riverside and Imperial Counties, California	22	X
RI-04784	von Werlhof, J.	2004	Archaeological Examinations of Mesa Verde Pipeline Improvement	1	
RI-06181	Wahof, T., and J. Cleland	2002	Addendum 13 to Cultural Resources Overview and Survey for the North Baja Gas Pipeline Project, Negative Cultural Resources Survey of One Temporary Extra Work Space	0	
RI-06184	Apple, R.M.	2001	Addendum 4 to Cultural Resources Overview and Survey for North Baja Gas Pipeline Project, Archaeological Survey of an Interconnection, A Temp. Workspace for the Colorado River Crossing, Extra Work Spaces Along 18th Ave. & an Access Road	1	
RI-06185	Underwood, J.	2000	Cultural Resources Overview and Survey for the Proposed Alignment of the North Baja Gas Pipeline: Addendum 1, Archaeological Survey of Ancillary Facilities	2	

REPORT NUMBER	AUTHOR	YEAR	TITLE	NUMBER OF IDENTIFIED CULTURAL RESOURCES	WITHIN APE
RI-06186	Kirkish, A., R.M. Apple, J. Underwood, and J. Cleland	2000	Cultural Resources Overview and Survey for the Proposed Alignment of the North Baja Gas Pipeline	0	
RI-06707	McDougall, D., J. George, and S. Goldberg	2006	Cultural Resource Surveys of Alternative Routes within California for the Proposed Devers-Palo Verde 2 Transmission Project	43	
RI-07405	Keller, J.A.	2007	A Phase I Cultural Resources Assessment of Tentative Parcel Map 35085 in Blythe, Riverside County, California, USGS Ripley, California Quadrangle, 7.5' Series	0	
RI-07790	Schaefer, J.	2003	A Class II Cultural Resources Assessment for the Desert-Southwest Transmission Line, Colorado Desert, Riverside and Imperial Counties, California	0	X
RI-08232	Pigniolo, A.	2003	Assessment of Effects to CA-RIV-6370H from Proposed Riverside Avenue Drain Improvements, Blythe, California	1	
RI-08410	Carrico, R., K. Walker, and W. Eckhardt	2004	Draft Cultural Resources Inventory of the Proposed Devers to Palo Verde II 500 kV Transmission Line, Riverside County, California	42	
RI-08411	Farrell, J., F. Budinger, and R. Carrico	2009	Final Amendment to Cultural Resources Inventory of the Proposed Blythe Energy Project Transmission Line, Riverside County, California	14	X
RI-08417	Giacomini, B., M. Murray, and N. Stewart	2002	A Cultural Resources Inventory of Selected Properties along Public Routes from Twentynine Palms, California to Yuma Proving Ground, Arizona, in Support of Operation Desert Scimitar 2002: First Marine Division, Camp Pendleton, California	1	
RI-08439	Leftwich, B.	2008	Phase I Archaeological Assessment: Blythe Solar 1 Project, Riverside County, California	2	X
RI-08440	Leftwich, B.	2008	Phase II Archaeological Assessment: CA-RIV-8953 Blythe Solar 1 Project, Riverside County, California	1	X
RI-07753	Schaefer, J., D. Pallette, and J. Eighmey	1998	A Cultural Resources Inventory and Evaluation of the Parker-Blythe 161 kV Transmission Line No. 2 Riverside & San Bernardino Counties, California	13	X

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 3 – Previous Cultural Resource Surveys

Legend

- Proposed Solar Facility
- Colorado River Substation
- Proposed Transmission Line
- One-Mile Record Search Buffer
- Township Line
- Section Line
- Cultural Resource Survey
- 4061 — Cultural Resource Survey Report Number (refer to Table 5, Section 6.1 for key to report numbers)"

N W E S

1: 48,000

0 0.25 0.5 1 1.5 2

Miles

H:\122512\DD\Apps\Cultural_Report\\Figure_3_Cultural_Resources_Surveys.mxd

POWER ENGINEERS

THIS PAGE INTENTIONALLY LEFT BLANK

Table 6. Previously Recorded Cultural Resources within One Mile of the Project APE

PRIMARY NUMBER	TRINOMIAL	SITE DESCRIPTION	AGE	Within APE
P-33-001481	CA-RIV-1481	Sherds, pot drop	Prehistoric	
P-33-001819	CA-RIV-1819	Chert quarry	Prehistoric	
P-33-002795	CA-RIV-2795	Lithic scatter	Prehistoric	
P-33-002796	CA-RIV-2796	Lithic scatter	Prehistoric	
P-33-008136	CA-RIV-6046	Lithic and ceramic scatter:	Prehistoric	
P-33-008137	CA-RIV-6047	Lithic scatter	Prehistoric	
P-33-009182	CA-RIV-6366H	Refuse scatter	Historic	
P-33-009183	CA-RIV-6367H	Refuse scatter	Historic	
P-33-009184	CA-RIV-6368H	Refuse scatter	Historic	
P-33-009185	CA-RIV-6369H	Refuse scatter	Historic	
P-33-009186	CA-RIV-6370H	Refuse scatter	Historic	X
P-33-009187	--	Isolated find - flake	Prehistoric	
P-33-009189	CA-RIV-9189	Isolated find – core	Prehistoric	
P-33-010862	CA-RIV-6575	Pot drop; World War II refuse scatter.	Prehistoric/Historic	
P-33-011057	--	Rannels Drain, canal	Historic	
P-33-011110	--	Blythe to Knob Transmission Line	Historic	
--	CA-RIV-6725H	Refuse scatter	Historic	
P-33-012532	CA-RIV-7127H	Niland-Blythe 161 kV Transmission Line	Historic	X
P-33-013672	--	Lithic scatter	Prehistoric	
P-33-014082	--	Parker-Blythe #2 161 kV Transmission Line	Historic	
P-33-014083	--	Parker-Headgate Rock-Blythe 161 kV Transmission Line	Historic	X
P-33-014150	CA-RIV-9100H	Two-track road	Historic	
P-33-014175	--	Isolated find - sherds	Prehistoric	
P-33-017205	CA-RIV-8952	Refuse scatter	Historic	
P-33-017206	CA-RIV-8953	Thermal feature - hearth	Prehistoric	
P-33-017312	CA-RIV-9005H	Refuse scatter	Historic	
P-33-017315	--	World War II refuse scatter	Historic	
P-33-017318	CA-RIV-9008	Lithic scatter	Prehistoric	
P-33-017319	CA-RIV-9009H	Refuse scatter	Historic	
P-33-017320	CA-RIV-9010	Lithic scatter	Prehistoric	
P-33-017323	CA-RIV-9011H	Refuse scatter	Historic	
P-33-017864	--	Isolated find - flake	Prehistoric	
P-33-017865	--	Isolated find - flake	Prehistoric	
P-33-017866	--	Isolated find - flake	Prehistoric	
P-33-017915	CA-RIV-9457	Isolated find - bottle	Historic	
P-33-017916	CA-RIV-9457	Refuse scatter - bottles	Historic	
P-33-017954	--	Isolated find - flake, ceramic mug	Prehistoric/Historic	
P-33-018052	CA-RIV-9276H	Refuse scatter - cans	Historic	
P-33-018053	CA-RIV-9277H	World War II refuse scatter	Historic	
P-33-018057	CA-RIV-9281H	World War II refuse scatter	Historic	
P-33-018058	CA-RIV-9282H	Refuse scatter	Historic	
P-33-018059	CA-RIV-9283H	Refuse scatter, lithic scatter, ceramic scatter	Prehistoric/Historic	
P-33-018060	CA-RIV-9284H	Refuse scatter, ceramic scatter	Prehistoric/Historic	
P-33-018063	--	Isolated find - can	Historic	
P-33-018064	--	Isolated find – pot sherd	Prehistoric	
P-33-018066	--	Isolated find – pocket knife	Historic	
P-33-018067	--	Isolated find – bottle base, 1942	Historic	
P-33-018068	--	Isolated find – bottle base	Historic	
P-33-018069	--	Isolated find – 1917 survey marker	Historic	
P-33-018071	--	Isolated find – 1917 survey marker	Historic	

PRIMARY NUMBER	TRINOMIAL	SITE DESCRIPTION	AGE	Within APE
P-33-018661	--	Fence	Historic	
P-33-018815	--	Isolated find - flake	Prehistoric	
P-33-018816	--	Isolated find - core	Prehistoric	
P-33-018817	--	Isolated find - flake	Prehistoric	
P-33-018819	--	Lithic scatter	Prehistoric	
P-33-018820	--	Refuse scatter	Historic	
P-33-018821	--	Lithic scatter	Prehistoric	
P-33-018837	--	Blythe Army Air Base Historic District	Historic	
P-33-018850	CA-RIV-9646	World War II refuse scatter,	Historic	
P-33-018851	CA-RIV-9647	Pre- and post-World War II refuse scatter	Historic	
P-33-018852	CA-RIV-9648	Pre- and post-World War II refuse scatter	Historic	
P-33-018853	CA-RIV-9649	World War II refuse scatter	Historic	
P-33-018854	CA-RIV-9650	World War II refuse scatter	Historic	
P-33-018855	CA-RIV-9651	Refuse scatter	Historic	
P-33-018914	CA-RIV-9983	17 mile pipeline and Pipeline Road	Historic	
P-33-018915	CA-RIV-9981	Two track road	Historic	
P-33-018935	CA-RIV-9982	Two track road	Historic	
P-33-018972	CA-RIV-9761	World War II refuse scatter	Historic	
P-33-018973	CA-RIV-9762	World War II refuse scatter	Historic	
P-33-018974	CA-RIV-9763	World War II refuse scatter	Historic	
P-33-019010	CA-RIV-9799	World War II refuse scatter, ceramic scatter	Prehistoric/Historic	
P-33-019011	CA-RIV-9800	World War II refuse scatter, mano	Prehistoric/Historic	
P-33-019012	CA-RIV-9801	Refuse scatter, World War II, pot drop	Prehistoric/Historic	
P-33-019020	CA-RIV-9809	Lithic scatter	Prehistoric	
P-33-019021	CA-RIV-9810	Lithic scatter	Prehistoric	
P-33-019045		Isolated find – pot sherd	Prehistoric	
P-33-019189		Isolated find – tested cobble	Prehistoric	
P-33-019325		Isolated find - bottle	Historic	
P-33-019326		Isolated find - bottle	Historic	
P-33-019390		Ceramic scatter	Prehistoric	
P-33-019612		Refuse scatter	Historic	
P-33-019618	CA-RIV-9935	Lithic scatter, cleared area	Prehistoric	

6.2 Results of Survey

A total of 35 resources were recorded or updated as part of the BLM Class III survey, as described in Table 7, including four previously recorded resources, seven newly recorded archaeological sites and 24 isolated finds. The resources are both prehistoric and historic. Of the seven archaeological sites, two are prehistoric and five are historic. Of the isolated finds, 17 are historic, six are prehistoric (four contain ceramic sherds, one contains a hammerstone, and the other a tested cobble), and one contained both prehistoric and historic artifacts. Four of the newly recorded resources (P-33-019998, P-33-020002, P-33-020018, and P-33-020019) were within a parcel later removed from the Project, so the resources are now outside the APE. One previously recorded site, P-33-018821, was incorrectly mapped by the EIC and was initially thought to be within the APE. The correct location is actually near the western boundary of the Blythe Army Air Base Historic District outside the Project APE.

During the field survey, four previously documented cultural resources were revisited and their site records updated. These sites are:

- **P-33-009186:** A large World War II-era refuse deposit
- **P-33-012532:** Niland-Blythe 161 kV Transmission Line

- **P-33-014083:** Parker-Headgate Rock-Blythe 161 kV Transmission line
- **P-33-018837:** Blythe Army Air Base Historic District, previously recorded up to but not within the Project boundary.

All resources were updated on Department of Parks and Recreation (DPR) forms, photographed and given updated location maps. The DPR forms can be found in Appendix B. Locations of the identified cultural resources are shown on Figure 5 (see Appendix D).

Table 7. All Cultural Resources within the Project APE*

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	AGE	NRHP/CRHR ELIGIBILITY RECOMMENDATIONS
Within Current Project Boundaries				
P-33-009186		Refuse scatter	Historic	Not Eligible
P-33-012532		Transmission line	Historic	Not Eligible
P-33-014083		Transmission line	Historic	Not Eligible
P-33-018837		Blythe Army Air Base Historic District	Historic	Contributing Elements, Eligible
P-33-019996	CA-RIV-10165	Refuse scatter	Historic	Not Eligible
P-33-019997	CA-RIV-10166	Refuse scatter	Historic	Not Eligible
P-33-019999	CA-RIV-10168	Refuse scatter	Historic	Not Eligible
P-33-020000	CA-RIV-10169	Refuse scatter	Historic	Not Eligible
P-33-020001	CA-RIV-10170	Ceramic scatter	Prehistoric	Not Eligible
P-33-020003		Isolated find - 1 bottle	Historic	Not Eligible
P-33-020004		Isolated find - 1 hole-in-top can	Historic	Not Eligible
P-33-020005		Isolated find - 1 hole-in-top can	Historic	Not Eligible
P-33-020006		Isolated find - 1 hole-in-top can	Historic	Not Eligible
P-33-020007		Isolated find - 1 hole-in-top can	Historic	Not Eligible
P-33-020008		Isolated find - 3 hole-in-top cans, 2 sanitary cans	Historic	Not Eligible
P-33-020009		Isolated find - 1 bottle fragment	Historic	Not Eligible
P-33-020010		Isolated find - 2 hole-in-cap cans, 1 tin, 2 glass fragments	Historic	Not Eligible
P-33-020011		Isolated find - 1 hole-in-top can, 1 tin, 2 glass fragments	Historic	Not Eligible
P-33-020012		Isolated find - 2 hole-in-top cans, 1 tobacco tin	Historic	Not Eligible
P-33-020013		Isolated find - 1 sherd, 1 hole-in-top can	Prehistoric/Historic	Not Eligible
P-33-020014		Isolated find - 2 sherds	Prehistoric	Not Eligible
P-33-020015		Isolated find – 1 hammerstone	Prehistoric	Not Eligible
P-33-020016		Isolated find - 1 sherd	Prehistoric	Not Eligible
P-33-020017		Isolated find - 1 sherd	Prehistoric	Not Eligible
P-33-020020		Isolated find - 1 tobacco tin	Historic	Not Eligible
P-33-020021		Isolated find - 1 bottle	Historic	Not Eligible
P-33-020022		Isolated find - 1 oil can	Historic	Not Eligible
P-33-020023		Isolated find - 1 hole-in-top can	Historic	Not Eligible
P-33-020024		Isolated find - 1 tested cobble	Prehistoric	Not Eligible
P-33-020025		Isolated find - 1 hole-in-top can	Historic	Not Eligible
P-33-020026		Isolated find - 1 bottle	Historic	Not Eligible

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	AGE	NRHP/CRHR ELIGIBILITY RECOMMENDATIONS
Outside Current Project APE				
P-33-019998	CA-RIV-10167	Refuse scatter	Historic	Not Eligible
P-33-020002	CA-RIV-10171	Ceramic scatter	Prehistoric	Not Eligible
P-33-020018		Isolated find - 1 glass jar	Historic	Not Eligible
P-33-020019		Isolated find - 5 sherds (from 2 vessels)	Prehistoric	Not Eligible

*All resources are on private land.

6.2.1 Archaeological Sites and Built Environment

P-33-009186
Type: Refuse Scatter
Time Period: Historic (1942-1943)
Setting: The site area was recently planted in winter wheat.
Elevation: 350 feet (106 meters) AMSL
Nearest Water Source: The Colorado River is nine miles east
Dimensions: 10 by 30 meters (portion within current Project area)
NRHP and CRHR Eligibility Recommendation: Not Eligible

P-33-009186 is a large World War II-era (but probably not DTC-related) refuse dump, deposited in a pit dug by bulldozers, partially burned, and then incompletely buried. The site was originally recorded by Pigniolo, McGinnis, and Dietler (1999), who recommended that the site be evaluated for the NRHP. During their 1999 survey, they observed .50-caliber shell casings, machine gun clips, bottles, food cans, ceramics, and miscellaneous pieces of metal.

In 2002 and 2003, portions of the site were test excavated, including the part of the site north of Riverside Avenue and within the current Project APE. In January 2002, backhoe trenches were excavated by Tierra Environmental to locate subsurface cultural deposits, evaluate integrity, and identify concentrations of material for further investigation. Additionally, four 0.5-by-1.0- meter units were excavated (Reinoehl 2003). Based on the results of the testing, Tierra determined that the site did not retain integrity or have other characteristics that would make it eligible for the NRHP or the CRHR (Reinoehl 2003).

In 2003, Pigniolo excavated five shovel test pits (STPs) next to Riverside Avenue; three just south of the road and two just north of the road (Pignolio 2003). The STPs were 30 cm in diameter and excavated in 10 cm levels. A close (1 to 2 meter) transect survey was conducted and three areas of concern were identified within Pigniolo's survey area. Test pits were excavated in these areas to evaluate subsurface content and integrity of the deposits. The test pits were excavated to depths ranging between 50 to 70 centimeters. However no cultural material was observed more than 40 cm below surface (Pignolio 2003). Evidence obtained from the testing program indicated the cultural material consisted primarily of construction debris scraped from nearby terraces and was the result of numerous deposition episodes. Although the initial survey identified historic military debris, the results of the testing indicate that the site is primarily a deposit of construction-related debris. Pigniolo found the site did not contain diagnostic artifacts and recommended that it was not eligible for listing in the NRHP, presumably under Criterion D (Pigniolo 2003).

The material Pigniolo found in 1999 and 2003 gave no indication of being associated with BAAB's role in 1942 of providing air support to DTC activities (see Section 4.3.5 and 4.3.6 and description of resource P-33-018837). The large amount of building material throughout the site suggested that the refuse was

deposited at this location at the end of military activity at the Blythe Airport and may be the result of demolition and cleanup of the base prior to the transfer of the land to the county (Reinoehl 2003).

In June 2011, archaeologists from POWER revisited the portion of the site falling within the current Project APE and found it to be in fair condition. A large quantity of historic debris included predominantly food cans and miscellaneous metal pieces. The surface material in the current Project area extends 10 feet north of the road and spans 30 meters east/west. A larger portion of the site extends into the power plant property on the south side of Riverside Avenue outside the Project APE; the construction of the road and plant have damaged the site. The depth of the deposit is unknown for most of the site, but the STPs excavated in 2003 indicated that the depth of the deposit on either side of Riverside Avenue is approximately 40 centimeters. There is a wash cutting into the center of the concentration with debris eroding out of the bank showing the deposit to be over one meter deep in that area. Modern debris is also present at the site and the majority of the material appears to have been burned.

The setting is a generally flat, with low rolling dunes, alluvial soils, and desert creosote scrub vegetation. The ground surface visibility was 90 to 100 percent.

The site has been damaged by grading and construction of Riverside Drive and the power plant. Therefore, it does not retain adequate integrity to satisfy Criterion A of the NRHP/Criterion 1 of the CRHR, because it no longer conveys its association with events that have made a significant contribution to the broad patterns of history, or NRHP Criterion B/CRHR Criterion 2, associated with the lives of significant persons. The site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). Because the site is a secondary deposit, the site does not meet the criteria for NRHP Criterion 4/CRHR Criterion D for containing scientific or historical data. Based on the 2011 survey, the site structure and contents appear to be consistent with Pigniolo's (2003) analysis and recommendations. POWER agrees that research potential has been exhausted with Pigniolo's test excavations. The site, already a disturbed secondary deposit, has been further disturbed by continued modern refuse dumping. POWER recommends that P-33-009186 is not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 6. P-33-009186. SITE OVERVIEW, NORTH OF RIVERSIDE AVENUE, FACING EAST

P-33-012532
Type: Transmission Line
Time Period: Historic (1940s-present)
Setting: Cultivated land, developed landscapes, and open desert.
Elevation: 340-360 feet AMSL
Nearest Water Source: Colorado River is 10 miles east
Dimensions: 2.5 miles long and 100 feet wide within the current Project area
NRHP and CRHR Eligibility Recommendation: Not Eligible

Initially recorded in 2000 as the Niland-Blythe 161 kV Transmission Line, this resource consists of a wooden pole, H-frame transmission line running between the Niland substation in Imperial County and the Blythe substation in Riverside County (Dolan 2000). The line was constructed between the 1940s and 1950s and is part of a system of lines carrying power from the Davis and Parker Dams on the Colorado River to 31 substations (Dolan 2000). The resource was re-recorded in 2005 by Wilson, Kwiatkowski, and Eckhardt, who found the line to be in good condition with various upgrades evident on the wooden poles (Carrico and Eckhardt 2005).

A 100-foot portion of the line was revisited in 2008 by Eckhardt who reported the condition of the resource to be the same as in 2005. The transmission line was recommended not eligible to either the NRHP or the CRHR (CEC and WAPA 2000; Eckhardt and Jordan 2008).

In 2011, archaeologists from POWER revisited the 2.5 miles of the line crossing the current Project area. The resource is in good condition and currently in use. The transmission line, oriented northeast to southwest, consists of wooden H-frame poles. The line crosses dune sand and alluvial soils at an elevation of 340 to 360 feet AMSL, passing through citrus groves, cultivated lands, and developed landscapes.

POWER agrees with previous researchers and recommends that P-33-012532, the Niland-Blythe 161 kV Transmission Line, is not eligible for listing in either the NRHP or the CRHR.



FIGURE 7. P-33-012532. NILAND-BLYTHE 161 KV TRANSMISSION LINE

P-33-014083
Type: Transmission Line
Time Period: Historic (1940-present)
Setting: Cultivated land, citrus groves, developed landscapes, and open desert.
Elevation: 340-360 feet AMSL
Nearest Water Source: Colorado River
Dimensions: 1.9 miles long, 125 feet wide within the current Project boundaries
NRHP and CRHR Eligibility Determination: Not Eligible

Placed into service initially in 1943 and modified and completed in 1951, this linear resource, the Parker-Headgate Rock-Blythe 161kV Transmission Line, consists of 777 H-frame structures placed along 64.4 miles (Pigniolo, Baksh, and Dietler 1999). A 0.8-mile segment of the line was recorded in 1999 and recommended not eligible for listing on the NRHP and CRHR (OHP Status Code 6Z) (CEC and WAPA 2000), although the inventory form and report do not mention the reasons for this recommendation.

In 2011, POWER archaeologists updated the existing site record of the 1.9-mile northeast/southwest segment of the transmission that falls within the current Project area. The transmission line is in good condition and is still in use. The segment in the Project area crosses flat, cultivated alfalfa fields and open desert with dune sand, alluvial soils, and creosote bush scrub vegetation

The original evaluation of this resource recommended that the transmission line does not meet the criteria for the CRHR or the NRHP and therefore is ineligible for listing. POWER agrees and recommends that P-33-014083 is not eligible to either the NRHP or the CRHR.



FIGURE 8. P-33-014083. PARKER-HEADGATE ROCK-BLYTHE 161KV TRANSMISSION LINE, FACING NORTHEAST

P-33-018837
Type: Blythe Army Air Base Historic District
Time Period: Historic (1942-1944)
Setting:. Remains of military base surrounded by the current Blythe Airport, modern industrial/commercial properties, and agricultural fields.
Elevation: 390 feet AMSL
Nearest Water Source: The Colorado River is nine miles east; McCoy Wash is two miles northeast
Dimensions: Approximately 1,500 by 1,600 meters, irregularly shaped
NRHP and CRHR Eligibility Recommendation: Contributing elements to the historic district previously recommended eligible to the NRHP

The Blythe Army Air Base Historic District (P-33-018837) was first recorded by KP Environmental in 2010 (Mitchell 2010a, b). The 1942-1944 airfield known as BAAB originally covered 6,372 acres, but Mitchell recorded only an 829-acre portion of the airfield, roughly the eastern portion of the original base (Mitchell 2010a, b). The remaining 5,543 acres within BAAB were not recorded by Mitchell because they fell outside KP Environmental's project area. However, Mitchell (2010a) noted that although she did not survey land at the Blythe Airport, west of her project area, there appeared to be numerous foundations and other remains associated with 1940s military use on the airport (Mitchell 2010a, b). To the east, Mitchell (2010a, b) documented the property only up to what is now the western boundary of the current Project; none of the structures, runways, taxiways, aprons, or features recorded by Mitchell extended into the current APE.

An audit of the airfield was conducted by the Chief of Engineers in 1946. A total of 473 buildings and structures were listed: 164 housing structures; 47 lavatories/latrines; 38 administrative buildings, warehouses, shops and sheds; 16 mess halls; and 11 hospital buildings (Wilson 2008).

POWER updated the P-33-018837 DPR form with an extended boundary and descriptions of additional features identified during the current survey. The updated DPR form documents only the features and artifacts within the current Project APE immediately east of and adjacent to the portion of BAAB documented Mitchell (2010a, b).

BAAB began in 1940 as an emergency landing strip, Flying Field Site 21. In response to the attack on Pearl Harbor, the War Department began to upgrade existing facilities as part of the National Defense Program. In early 1942, improvements began on the Site 21 airstrip to accommodate the largest military aircraft, but the majority of the buildings were not available for use until the end of that year and into 1943. By December 1942, the base had a deep water well, one hanger, an engineering building, 60 barracks, four warehouses, a theater and four paved runways with aprons. The hospital building was completed in 1943 as was a mess hall, barber shop, base chapel and an additional hanger building.

While BAAB was used for World War II training from 1942 through 1944, the base was used for less than a year by the 46th Bombardment Group to provide air support to the army troops under command of General Patton during desert warfare training operations (see Sections 4.3.4 and 4.3.5). In 1942, airfields were under construction for the DTC at Thermal, Rice and Shaver's Summit, When these fields became operational in late 1942, the 46th Bombardment Group relocated and BAAB ceased its support role for the DTC. BAAB came under command of the Second Air Force for training missions by the 34th Bombardment Group and many other groups until it was returned to civil control in 1947.

During the brief period in 1942 when the 46th Bombardment Group and the 3rd Observation Squadron used the field to support the DTC, troops were housed in tents across the highway from the base, planes were parked and serviced in the open, and medical services were performed in a tent. For this reason, the barracks, hospital, and hangers at BAAB are not directly associated with the DTC.

Although the majority of the original structures at BAAB had been reported by others to have been destroyed, Mitchell documented surface artifacts and 133 features within what she defined as the district boundary (Mitchell 2010a, b). The features documented by Mitchell included tank tracks, concrete



FIGURE 9. P-33-018837. BLYTHE ARMY AIR BASE. CONCRETE FOOTINGS FOR HOSPITAL WING



FIGURE 10. P-33-018837. BLYTHE ARMY AIR BASE. REMAINS OF LATRINES AND SHOWERS AT HOSPITAL WING



FIGURE 11. P-33-018837. BLYTHE ARMY AIR BASE. RUBBLE PILE FROM BARRACKS



FIGURE 12. P-33-018837. BLYTHE ARMY AIR BASE. UTILITY SHOP

foundations, rock lined paths and walkways, oiled gravel roads, taxiways and aircraft use areas, one standing shack, one collapsed structure, a livestock corral and associated shelter, a fence line and several piles of bulldozed rubble . The surface artifacts are primarily cans and soda bottles.

As a result of the 2011 survey, POWER identified four distinct areas within the Project APE that contain remnant features of BAAB. These areas include: 1) the hospital area (Figures 9 and 10); 2) the barracks (Figure 11) and adjacent fire station area; 3) the warehouse area; and 4) the utility shop and yard (Figure 12). All of the buildings that once stood in this portion of BAAB have been demolished with the exception of a utility building (Figure 12). Numerous concrete footings and foundation remains, fire hydrants, manholes, walking paths, and oiled roads remain, and subsurface infrastructure (e.g., water and sewer pipes) may also exist. POWER also recorded three clusters of refuse (Clusters 1, 2, and 3) with artifacts associated with life on the base.

- The hospital area consists of foundations, block walls and dirt paths; no standing buildings remain (Figures 9 and 10). The hospital, once a large concrete building with eight wards and hallways connecting several wings, now consists of eight rows of footings and foundations. A concentration of refuse in the hospital area, designated Cluster 2, contains bottles, ceramics, food cans, beer cans, canning jars, ceramic ashtrays, cold cream jars, toothpaste tubes, and mouthwash bottles. The hospital was built in 1943.

- The barracks area (Figure 11) consists of four building foundation pads and a wall footing with a hardstand apron. The barracks were probably built in the latter part of 1942. A fire station once stood next to the barracks area.

- The buildings in the warehouse area were also demolished; the remains include four foundations for several storage facilities and a cold storage. A large refuse deposit, recorded as Cluster 1, in the warehouse area contained glass and ceramic household debris, machinery parts, and oil and gas cans. Warehouses at BAAB were completed by the end of 1942.

- The utility shop (Figure 12) is still standing, but its entire exterior has been modified by the facing of the original wood siding with metal sheeting. The building has a series of 4-over-4 clearstory windows, many of them damaged. The full monitor roof is relatively intact but has also incurred damage. The building has large bay doors. POWER's evaluation of this building finds that while integrity of location is maintained, integrity of design, materials, and workmanship has been lost. Integrity of setting has been diminished by the removal of most other physical features of the military base. The building is currently used as a maintenance and storage facility.

As mentioned in Section 4.3.5, after the United States entered World War II, General Patton was tasked with developing a training center to prepare Army troops for desert combat. To accommodate the troops brought to the region, several existing airfields were taken over by the Army between 1942 and 1944, including Site 21, which was to become BAAB. BAAB was used for a brief period as support for the DTC.

Numerous other resources have been documented within the larger DTC area far outside the Project APE (Bischoff 2000), including airfields and airports. The other airfields associated with the DTC include:

- Shaver's Summit Airport, recommended not eligible to the NRHP .
- Desert Center Army Airfield, recommended not eligible to the NRHP.
- Essex Airfield, recommended eligible to the NRHP.
- Needles Airport, not yet evaluated.
- Rice Field, recommended eligible to the NRHP.
- Thermal Army Airfield, recommended not eligible to the NRHP.

Mitchell (2010a) recommended the Blythe Army Air Base Historic District as eligible for the NRHP under Criterion A and for the CRHR under Criterion 1 for its association with an event that has made a significant contribution to the broad patterns of history, that is, World War II desert training missions. She also recommended the district as eligible under Criterion B for the NRHP and Criterion 2 for the CRHR for its association with the life of a person important to our past, General George S. Patton. However, a formal determination of eligibility was never made (Lloyd, personal communication 2012).

BAAB's association with the DTC lasted less than a year, and its association with General Patton was even briefer. The barracks, warehouses, fire station, utility building, and hospital within the Project APE were for the most part built and used after BAAB's ties to the DTC and General Patton ended. Nonetheless, BAAB's support for desert training missions continued until 1944. POWER agrees the Blythe Army Air Base Historic District (P-33-018837), including the portion with the APE, is associated with events that have made a significant impact on broad patterns of history (NRHP Criterion A/CRHR Criterion 1). While BAAB as a whole has ties to General Patton and therefore with the life of a significant person (NRHP Criterion B/CRHR Criterion 2), Patton's association with the portion of BAAB in the Project APE is less direct. The only standing structure within the APE is the utility shop, which has retained very little integrity. It is not recommended eligible under NRHP Criterion C/CRHR Criterion 3. Finally, given the temporary nature of much of the original construction, the demolition of the buildings, the extensive archival documentation of BAAB, and the types of likely subsurface features (i.e., sewer and water lines), the portion of BAAB within the Project APE has little potential for significant archaeological information. Therefore, this portion of the resource is recommended not eligible under NRHP Criterion D/CRHR Criterion 4.

After several discussions and site visits with the Riverside County Archaeologist, POWER recommends that despite the limited physical integrity of the features within the Project APE, the portion of BAAB falling within the current Project boundaries contain contributing elements and are, like the historic district, recommended eligible to the NRHP and CRHR. POWER also recommends that the proposed district boundaries be expanded to include the components identified within the Project APE.

P-33-019996 (CA-RIV-10165)
Type: Refuse Scatter
Time Period: Historic
Setting: Agricultural field
Elevation: 391 feet (119 meters) AMSL
Nearest Water Source: There is a seasonal wash 1.5 miles to the south and the Colorado River is 10 miles to the east.
Dimensions: 66 by 42 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

This site consists of a sparse scatter of historic debris covering approximately 0.25 acre (Figure 14). There are no artifact concentrations; rather, all are spread evenly across the surface. Approximately 100 artifacts were counted, including six intact glass bottles and jars, seven glass bottle and jar bases, fragments of glass in a variety of colors, three hole-in-top cans, a crushed oil can and other metal debris, a flag holder, and a porcelain doll leg (Figures 15 and 16). The maker's marks on several of the bottles indicate they were produced between the 1930s and the early 1960s. A K's Fruit Beverage soda bottle dates to 1950 (Toulouse 1971).

The topography is generally flat with low rolling dunes. The site is on land recently cultivated and the dunes are vegetated with creosote bushes and low-growing xeric grasses. The ground visibility was 90 to 100 percent. The site condition is poor due to agricultural activity.

P-33-019996 contains general household refuse dating to the mid-20th century. The refuse appears to be secondary deposition from multiple sources and episodes over a 30-year period. The artifacts do not appear to be related to a specific location or activity.

There is no evidence this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). This site and the artifacts are typical of refuse disposal sites common to the area. There is no archaeological evidence (e.g., buried deposits) to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, P-33-019996 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 13. P-33-019996. SITE OVERVIEW, FACING SOUTH



FIGURE 14. P-33-019996. K'S FRUIT BEVERAGE BOTTLE



FIGURE 15. P-33-019996. COCA-COLA BOTTLE BASE, "LOS ANGELES, CALIF"

P-33-019997 (CA-RIV-10166)
Type: Refuse Scatter
Time Period: Historic (post-1945)
Setting: Agricultural field
Elevation: 373 feet (113 meters) AMSL
Nearest Water Source: There is a seasonal wash 0.2 mile to the south and the Colorado River is 10 miles to the east.
Dimensions: 50 by 10 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

The site consists of two concentrations of historic debris, primarily cans and glass (Figure 17). Concentration 1 contains 15 cans and one bottle in a 5-by-5-meter area. Concentration 2 covers a 10-by-5-meter area 15 to 20 meters north of Concentration 1. Concentration 2 contains numerous sanitary cans, bottle bases, a "Velvet" tobacco tin (Figure 18), a plastic key chain with a Mobil Oil logo and "1958" printed on it (Figure 19), and metal debris. Based on the presence of jars or bottles with diagnostic

maker's marks (Toulouse 1971) and the keychain, the age of the site likely falls between the late 1950s and late 1960s.

The site is in an agricultural field covered in aeolian sands and sparsely vegetated with low-growing grasses, creosote, chamise, and Palo Verde trees. The topography is generally flat with low rolling dunes. The ground surface visibility was 90 to 100 percent. The condition of the site is poor as the artifacts have been disturbed by disking and other agricultural activities.

P-33-019997 contains general household refuse from the mid-to-late 20th century. There is no evidence to suggest that this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). P-33-019997 is typical of refuse disposal sites common to the area. There is no archaeological evidence (e.g., buried deposits) to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, P-33-019997 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 16. P-33-019997. SITE OVERVIEW, FACING SOUTH



FIGURE 17. P-33-019997. VELVET TOBACCO TIN



FIGURE 18. P-33-019997. MOBIL OIL COMPANY KEY CHAIN, 1958

P-33-019998 (CA-RIV-10167)
Type: Refuse Scatter
Time Period: Historic
Setting: Agricultural field
Elevation: 391 feet (119 meters) AMSL
Nearest Water Source: There is a seasonal wash 0.2 mile to the northeast and the Colorado River is 10 miles to the east.
Dimensions: 77 by 70 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

Because of modifications to the Project boundaries after completion of the cultural resource survey, P-33-019998 no longer falls within the Project APE.

P-33-019998 consists of a dense scatter of historic refuse mixed with modern trash (Figure 20). Approximately 100 domestic and other artifacts were seen, including hole-in-top cans, sanitary cans, juice cans, porcelain fragments (Figure 21), clear glass bottles, and canning jars manufactured from 1937 to 1977 (Whitten n.d.).

The site condition is poor; it has been affected by past agricultural activity and recent dumping. The topography is generally flat with low, rolling dunes vegetated with creosote bushes and low-growing xeric grasses. The ground surface visibility was 90 to 100 percent.

P-33-019998 contains household refuse dating from the 1930s to the1970s, likely the result of numerous depositional episodes. The site consists of secondary deposits that lack evidence this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). This site and the materials found are typical of refuse disposal sites common to the area. There is no archaeological evidence to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, P-33-019998 is recommended not eligible for inclusion in either the NRHP or the CRHR.

P-33-019999 (CA-RIV-10168)
Type: Refuse Scatter
Time Period: Historic
Setting: Agricultural field
Elevation: 392 feet (119 meters) AMSL
Nearest Water Source: There is a seasonal wash 1.2 miles to the south and the Colorado River is 10 miles to the east.
Dimensions: 67 by 58 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

P-33-019999 is a scatter of historic refuse with modern trash mixed in (Figure 22). More than 100 artifacts were seen, including whiteware (Figure 23) dating to the early 1940s (Kovel and Kovel 1986), hobbleskirt Coca-Cola bottles produced between 1916 and 1957 (Bates 2011), sanitary cans, and porcelain.



FIGURE 19. P-33-019998. SITE OVERVIEW, FACING SOUTH-SOUTHWEST

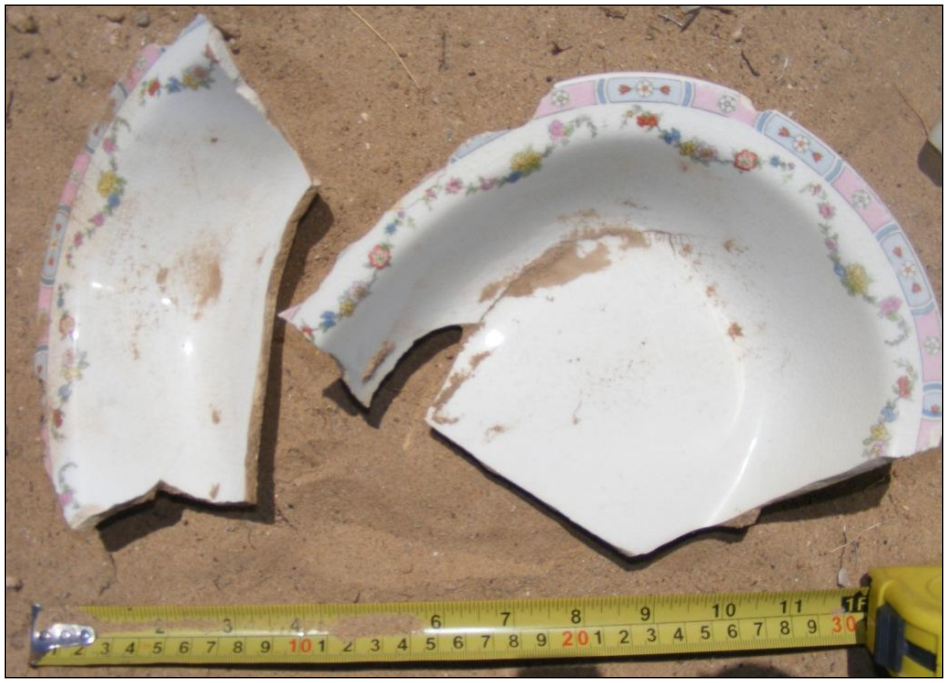


FIGURE 20. P-33-019998. BOWL FRAGMENTS

The topography is generally flat with low, rolling dunes vegetated with creosote bushes and low-growing xeric grasses. The ground visibility was 90 to 100 percent. The site condition is poor; it has been affected by past agricultural activities, recent dumping and construction of concrete pads and poles.

Although the artifacts at the site date to the mid-20th century, there is no evidence to suggest this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP

Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). This type of site and the material within it are typical of refuse disposals common to the area. There is no archaeological evidence to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, P-33-019999 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 21. P-33-019999. SITE OVERVIEW WITH PUSH PILE, FACING SOUTHEAST



FIGURE 22. P-33-019999. WHITEWARE DISH WITH HOMER LAUGHLIN MAKER'S MARK, JANUARY 1943

P-33-020000 (CA-RIV-10169)
Type: Historic Refuse Scatter
Time Period: Historic (1950s-1960s)
Setting: Agricultural field
Elevation: 392 feet (119 meters) AMSL
Nearest Water Source: McCoy Wash is three miles northeast and the Colorado River is ten miles east
Dimensions: 36 by 70 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

P-33-020000 (Figure 23) is a sparse historic refuse scatter mixed with modern debris. The artifacts include church-key opened sanitary and combination cans manufactured between 1952 and 1960 (Goodman 2002), aluminum pull-top cans dating to the early 1960s (Goodman 2002), clear and brown glass fragments, and clear glass soda bottles.

The site is in an area recently planted in winter wheat; the surrounding area is generally flat with low, rolling dunes. The vegetation consists primarily of creosote bushes and low-growing xeric grasses. The ground surface visibility was 90 to 100 percent.

The artifacts at P-33-020000 cannot be linked to events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). This material found at the site is typical of refuse disposal sites common to the area. There is no archaeological evidence to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, P-33-020000 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 23. P-33-020000. SITE OVERVIEW, FACING SOUTH

P-33-020001 (CA-RIV-10170
Type: Ceramic Scatter
Time Period: Prehistoric
Setting: Agricultural field
Elevation: 390 feet (118 meters) AMSL
Nearest Water Source: There is a seasonal wash 0.6 mile to the northeast and the Colorado River is 10 miles to the east.
Dimensions: 17 by 17 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

P-33-020001 (Figure 24) consists of 16 ceramic vessel fragments, most resembling Lower Colorado Buffware (Society for California Archaeology 2011). Several of the sherds have a gray exterior with dark gray/black interior (Figure 25), but most are tan. Two of the tan sherds also have a possible white decoration (Figure 26). White designs have been found on Lower Colorado Buffware pottery from other sites (Simon n.d.). The sherds range in size from 3-by-1 centimeters to 6-by-5 centimeters. Thickness is 5 to 6 millimeters. The temper is large-grained with flecks of mica. There are no rim or base sherds in the assemblage. The age range for Lower Colorado Buffware is A.D. 1500 to post-1800 (Waters 1982; Seymour and Lawrence 1997).

The site is in an agricultural field. The topography is generally flat with low, rolling dunes vegetated with creosote bushes and low-growing xeric grasses. Disturbances to the site are from agricultural activity.

Because P-33-020001 contained only 16 prehistoric sherds on the surface of a plowed field, no evidence suggests this site is associated with events that have made a significant impact on the broad patterns of history (NRHP Criterion A/CRHR Criterion 1) or that this site is associated with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The limited number and range of artifacts and the level of agricultural disturbance suggests that the site has little potential to provide additional scientific information (NRHP Criterion D/CRHR Criterion 4).

Therefore, P-33-020001 is recommended not eligible to either the NRHP or the CRHR.



FIGURE 24. P-33-020001. SITE OVERVIEW, FACING SOUTH

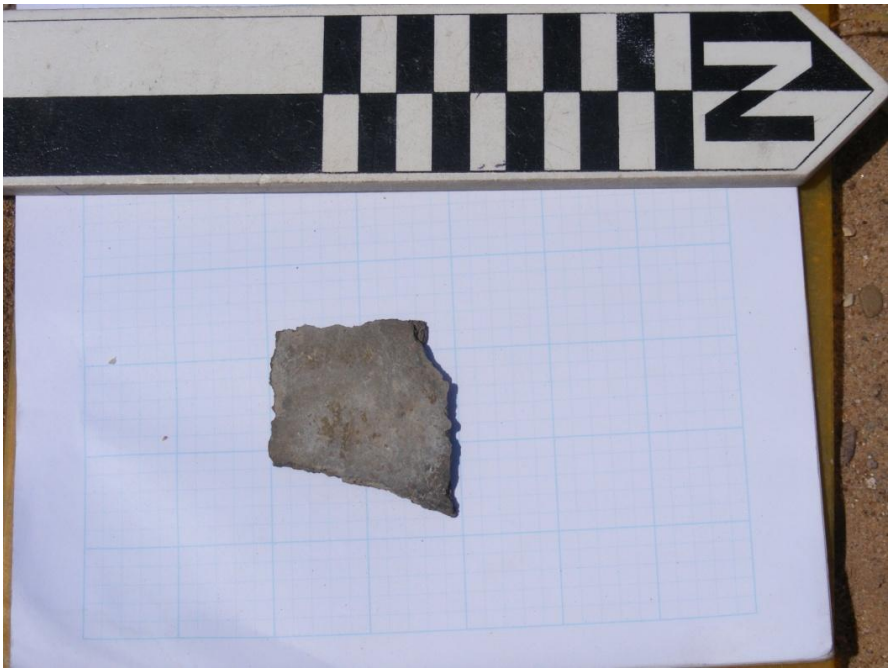


FIGURE 25. P-33-020001. GRAY SHERD



FIGURE 26. P-33-020001. LOWER COLORADO BUFFWARE SHERDS

P-33-020002 (CA-RIV-10171)
Type: Ceramic Scatter
Time Period: Prehistoric
Setting: Agricultural field
Elevation: 390 feet (118 meters) AMSL
Nearest Water Source: There is a seasonal wash 0.2 mile to the south and the Colorado River is 10 miles to the east.
Dimensions: 17 by 17 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

Because of modifications to the Project boundaries after completion of the archaeological survey, P-33-020002 no longer falls within the Project APE.

P-33-020002 consists of eight ceramic sherds of Lower Colorado Buffware (Society for California Archaeology 2011) and three small weathered fragments of indeterminate shell. The exterior of each sherd is rough with accretions; the interior has a smooth finish (Figures 27 and 28). The sherds have a fine paste with a silica temper. The age range for Lower Colorado Buffware is A.D. 1500 to post-1800 (Waters 1982; Seymour and Lawrence 1997).

The site is in a desert landscape of rolling sand dunes of moderate to fine sand. Vegetation includes creosote and desert grasses; the ground surface visibility was 90 to 100 percent.

No evidence suggests that P-33-020002 is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1) or that this site is associated with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The site consists of very little cultural material that has been disturbed by long-term agriculture, limiting its information potential (NRHP Criterion D/CRHR Criterion 4).

P-33-020002 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 27. P-33-020002. SHERD, EXTERIOR SURFACE



FIGURE 28. P-33-020002. SHERD, INTERIOR SURFACE

6.2.1 Isolated Finds

For this report, isolated finds are defined as three or fewer prehistoric artifacts of the same type or five or fewer historic artifacts.

During the current survey, POWER identified 24 isolated finds within the Project APE, including 17 historic and 6 prehistoric isolated finds, and one isolated find with both prehistoric and historic artifacts. The 17 historic isolated finds are primarily hole-in-top cans; several bottle fragments were also documented. Four of the prehistoric isolated finds are ceramic sherds and one is a hammerstone and one is a tested cobble. One isolated find included a prehistoric sherd and a hole-in-top can. Most of the isolated ceramic fragments were brown with no decoration. Although prehistoric isolated finds have been found in association to Native American trails, no trails were identified within the current Project area. Isolated finds are not considered either historic properties under NHPA or historical resources under CEQA.

P-33-020003
This isolated find is a complete aqua glass, six ounce hobbleskirt Coca-Cola bottle embossed with "LOS ANGELES, CALIF." on the base. This particular bottle type was produced between 1916 and 1957 (Bates 2011). P-33-020003 is in open desert with low rolling sand dunes and creosote bush; the ground surface visibility was 90 percent.

P-33-020004
This isolated find is a single hole-in-top can measuring 4¼ inches tall by 3 inches in diameter. Production of hole-in-top cans began in 1900 and they are still used for condensed milk today (Rock 1984). P-33-020004 is in open desert with low rolling sand dunes and creosote bushes; the ground surface visibility was 90 percent.

P-33-020005
The isolated find consists of one hole-in-top evaporated milk can measuring 3⅞ inches by 2⅞ inches with a knife opening. Production of hole-in-top cans began in 1900 and they are still used for condensed milk (Rock 1984:100). The can is in an agricultural field covered in aeolian sands and vegetated with creosote, chamise, and Palo Verde trees. The ground surface visibility was 90 percent.

P-33-020006
Isolated find P-33-020006 is one hole-in-top can measuring $2^{9}/_{16}$ inches by 3 inches. Production of hole-in-top cans began in 1900 and they are used for condensed milk today (Rock 1984). This isolated find is

in an agricultural field covered in aeolian sand and vegetated with creosote bushes and Palo Verde trees; the ground surface visibility was 90 percent.

P-33-020007
Isolated find P-33-020007 is a knife-opened hole-in-top can measuring 3 inches in diameter by 4 inches high. Production of hole-in-top cans began in 1900 and they are still used for condensed milk (Rock 1984). This isolated find was found close to a road in a parcel of open land. The area is vegetated with low-growing grasses and native desert shrubs, including creosote. Winter wheat was planted in this area in 2011, and there are cultivated fields on the other side of the road to the east. Modern litter and evidence of plowing or grading is visible throughout the area. The ground surface visibility was 90 to 100 percent.

P-33-020008
This isolated find consists of five cans: three hole-in-top cans, each measuring 2⅞ inches in diameter by 4 inches high, and two very deteriorated sanitary cans. Production of hole-in-top cans began in 1900 and they are still used for condensed milk (Rock 1984). Found near the road in a parcel of open land, the cans are crushed and deteriorating. Winter wheat was planted in this area in 2011. Uncultivated fields and alfalfa fields are on the other side of the road to the east. The area is vegetated with low-growing grasses and native desert shrubs, including creosote; the ground surface visibility was 90 to100 percent.

P-33-020009
Isolated find P-33-020009 is a partial amber glass bottle base with stippling and "Durag…" embossed on the fragment. "Duraglas" was the proprietary name for a process used by the Owens-Illinois Glass Company that began in 1940 and continued until the mid 1950s (Toulouse 1971). The bottle fragment is in an agricultural field; the ground visibility was poor due to dense vegetation.

P-33-020010
Isolated find P-33-020010 consists of a hole-in-cap can measuring 3 by 4⅜ inches, a hole-in-cap can measuring 4⅛ by 4⅞ inches, a rectangular, single- seam meat or tobacco tin measuring 2⅜ inches by 1⅜ by 3¼ inches, and two small aqua glass fragments. All five artifacts were found in a 3.3 by 2.5 meter area. The isolated find is in an agricultural field with 100 percent ground surface visibility. Production of hole-in-cap cans began as early as 1820 and lasted up until 1930 (Rock 1984).

P-33-020011
Isolated find P-33-020011 consists of one hole-in-top can measuring 3 by3⅞ inches, one circular tin measuring $3\frac{5}{16}$ by 1½ inch with a maker's mark of a diamond with a "C" in the center, and one canning jar lid. Production of hole-in-top cans began in 1900 and they are still used for condensed milk (Rock 1984). The isolated find is in an agricultural field with 100 percent ground surface visibility.

P-33-020012
Isolated find P-33-020012 consists of two hole-in-top cans, both crushed, and one tobacco tin. Production of hole-in-top cans began in 1900 (Rock 1984). The isolated find is in an agricultural field with 100 percent ground surface visibility.

P-33-020013
Isolated find P-33-020013 consists of two artifacts: one Late Prehistoric buffware sherd measuring 4 by 3 centimeters with a thickness of 4 millimeters, and one hole-in-top can. Production of hole-in-top cans began in 1900 (Rock 1984) The isolated find is in an agricultural field with 100 percent ground surface visibility.

P-33-020014
Isolated find P-33-020014 consists of two prehistoric ceramic sherds; one measuring 3 by 6 centimeters and 4 millimeters thick, the other measuring 2 by 2 centimeters and 4 millimeters thick. Both are an

untyped brown ware, with chunky large-grained temper, a tan exterior, a reddish interior and fire clouding on both surfaces. The isolated find is near a seasonal drainage in an agricultural field with 100 percent ground surface visibility.

P-33-020015
P-33-020015 is a quartz hammerstone with crushing or pecking on both ends. The isolated find is near a seasonal drainage in an agricultural field with 100 percent ground surface visibility.

P-33-020016
Isolated find P-33-020016 is an untyped brownware sherd with fire clouding on the exterior surface. The sherd measures 8 by 4 centimeters and four millimeters thick. The isolated find is near a seasonal drainage in an agricultural field with 100 percent ground surface visibility.

P-33-020017
Isolated find P-33-020017 consists of an untyped brown ware prehistoric sherd measuring 5 by 3 centimeters and four millimeters thick. This isolated find is near a seasonal drainage in an agricultural field with 100 percent ground surface visibility.

P-33-020018
Isolated find P-33-020018 is a complete Mason jar with a Hazel-Atlas maker's mark, manufactured at the Ada, Oklahoma plant between 1931 and 1964 (Toulouse 1971). The isolated find is in a desert landscape consisting of rolling sand dunes, creosote and chamise. The ground surface visibility was 90 to 100 percent. Because of modifications to the Project after completion of the cultural resource survey, isolated find P-33-020018 no longer falls within the Project boundaries.

P-33-020019
Isolated find P-33-020019 consists of five separate prehistoric ceramic sherds that fit together to make two individual vessel fragments. They are both rim sherds, one 8.0 by 6.9 centimeters and the other 7.0 by 5.3 centimeters. The sherds have a reddish interior and a gray exterior. The paste ranged from a fine to course paste, and some silica was seen in cross-section. This isolated find is in a desert landscape of rolling sand dunes, creosote and chamise. The ground surface visibility was 90 to 100 percent. Because of modifications to the Project after completion of the cultural resource survey, isolated find P-33-020019 no longer falls within the Project boundaries.

P-33-020020
Isolated find P-33-020020 is a single tobacco tin, very weathered with a minimal amount of the red label remaining. The label possibly reads "Velvet." It is in an agricultural field with 100 percent ground surface visibility.

P-33-020021
Isolated find P-33-020021 is a complete Coca-Cola bottle measuring 7¾ by $2\frac{5}{16}$ inches with a one inch mouth. Embossed on the base is "BLYTHE CALIF," and on one side the bottle reads "Coca-Cola" written in script and "Trade Mark Register bottle Pat 0 105529." On the opposite side shows "Coca-Cola" written in script and "Trade Mark Registered Min. Contents 6 Fl ozs." The hobbleskirt bottle of this size and with embossing dates from 1916 to 1957 (Bates 2011). The isolated find is in an agricultural field planted in winter wheat in 2011. The ground surface visibility was 100 percent.

P-33-020022
Isolated find P-33-020022 is a spool-opened oil can measuring $5\frac{9}{16}$ by 4⅞ inches, with a "Piton" maker's mark stamped on the base. The isolated find is in an agricultural field that was planted in winter wheat in 2011. The site area had 100 percent ground surface visibility.

P-33-020023
Isolated find P-33-020023 is a single hole-in-top can measuring $4\frac{7}{16}$ by $3\frac{1}{16}$ inches, knife-opened and in very poor condition. Production of hole-in-top cans began in 1900 and they are still used for condensed milk today (Rock 1984). This isolated find is in an agricultural field planted in winter wheat in 2011. The field had 100 percent ground surface visibility.

P-33-020024
Isolated find P-33-020024 is a tested cobble with one flake scar on both the dorsal and ventral sides. This prehistoric isolated find is in an agricultural field that had been planted in winter wheat in 2011. Ground surface visibility was 100 percent.

P-33-020025
Isolated find P-33-020025 consists of one hole-in-top can measuring $2\frac{3}{16}$ by 2½ inches. Production of hole-in-top cans began in 1900 and they are still used for condensed milk today (Rock 1984). This isolated find is in an agricultural field planted in winter wheat in 2011. The field had 100 percent ground surface visibility.

P-33-020026
Isolated find P-33-020026 is a liquor bottle measuring $11\frac{15}{16}$ by 3⅝ inches, with a paper label and an Owens-Illinois Duraglas maker's mark on the base. The bottle was produced by Plant 9 in Streator, Illinois in 1930 (Toulouse 1971). The isolated find is in an agricultural field planted in winter wheat in 2011. The field had 100 percent ground surface visibility.

6.3 Native American Coordination

As discussed in Section 5.3, *Native American Communication*, POWER contacted the NAHC requesting information regarding Native American groups with historic ties to, and interest in, the proposed Project area. In May 2011, POWER sent letters to 20 tribes identified by the NAHC (see Table 4 and Appendix A) requesting information concerning Native America cultural resources in the Project area. Responses were received from the Aqua Caliente Band of Cahuilla Indians Tribal Historic Preservation Officer (THPO) and the Augustine Band of Cahuilla Indians. The Aqua Caliente Band THPO requested the name of the consultant conducting cultural resource investigations and additional information (phone message dated May 12, 2011). Later, the Aqua Caliente Band requested Native American monitoring during field survey and construction (letter dated June 12, 2011). However, by the time the letter was received by POWER, the field survey had been completed.

The Augustine Band of Cahuilla Indians submitted a letter on May 17, 2011 indicating they were unaware of specific cultural resources that may be affected by the Project and encouraging contact with Native American Tribes and individuals in the immediate vicinity of the Project site, contracting with a qualified construction monitor, and notifying the Augustine Band should cultural resources be discovered during the development of the Project.

In November 2011, a CEQA Notice of Preparation (NOP) of an EIR was sent via certified mail to 22 Native American Tribes (see Section 5.3). The NOP described the proposed Project and location, environmental review process, potential environmental effects, and contact information, and announced the time and location of the public scoping meeting.

In April 2012, 22 Native American Tribes were sent invitations to an informational meeting. This was an informal meeting hosted by the Applicants, which the BLM and County attended; however, the informational meeting was not part of the BLM government-to-government consultation. Representatives of the Colorado River Indian Tribes, the Augustine Band of Cahuilla Indians, the Agua Caliente Band of Cahuilla Indians, and the Mohave Elders Management attended. Information was presented to them about

the Project and about the results of the cultural resource investigations, and the representatives asked questions and expressed concerns.

Tribal consultation required under Section 106 is being performed by the BLM on a government-to-government basis; this consultation has begun and is ongoing.

7.0 IMPACTS/EFFECTS

This section addresses impacts to cultural resources under CEQA and NEPA; however, the process for assessing effects to historic properties under Section 106 of the NHPA is described briefly in Section 7.1. The site-specific effects will be identified in the joint Environmental Impact Report/Environmental Assessment (EIR/EA) prepared in compliance with CEQA and NEPA.

7.1 Effects Under the National Historic Preservation Act

Under Section 106 of the NHPA, adverse effects to a historic property (i.e., a cultural resource eligible for or listed in the NRHP) can include physical demolition, destruction, relocation, or alteration of the property or its immediate surroundings such that the integrity of the property's location, design, setting, materials, workmanship, feeling, or association would be materially impaired or diminished.

Whenever a historic property cannot be avoided by project activities, adverse effects must be resolved through development of either a Memorandum of Agreement or Programmatic Agreement in consultation with the various consulting parties.

Section 106 regulation states that the regulatory definition of "effect," pursuant to 36 CFR 800.16 (i) is that the term means "alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the NRHP." In practice, a direct effect under Section 106 is that which is a "direct physical disturbance of a historic property." Effects that are immediate but not physical in character, such as visual intrusion, and reasonably foreseeable effects that may occur at some point subsequent to the implementation of the proposed undertaking are referred to as "indirect effects."

Direct effects on historic properties in the Project area could result from ground disturbing activities associated with the construction of the solar generation and transmission facilities, such as clearing vegetation, grading roads, installing underground infrastructure, installing tower foundations, and driving supports for solar arrays.

Historic properties can also be subject to indirect effects, such as changes in public access that increase the potential for vandalism.

7.1.1 Assessment of Effects

A total of 31 archaeological and built resources have been identified in the APE, including a portion of Blythe Army Air Base (BAAB) (archaeological resources and one standing building), six other archaeological sites, two transmission lines, and 22 isolated finds. Only one resource—P-33-018837, BAAB—has been previously recommended eligible to the NHRP as the Blythe Army Air Base Historic District. The original boundaries of this resource have been expanded to include the portion within the BMSP APE. As such, this would be the only resource potentially adversely affected by the proposed undertaking.

P-33-018837 would extend into the proposed solar facility site. The principal components of the portion of BAAB within the BMSP APE include:

- **Hospital Area.** The hospital area consists of foundations, block walls, and dirt paths; no standing buildings remain, and there is a concentration of refuse in the hospital area. The hospital was built in 1943.
- **Barracks and Fire Station Area.** The barracks area consists of four building foundation pads and a wall footing with a hardstand apron. The barracks were probably built in the latter part of 1942. A fire station once stood next to the barracks.

- **Warehouse Area.** The warehouse area consists of foundations for several storage facilities and a cold storage and a large refuse deposit. Warehouses at BAAB were completed by the end of 1942.
- **Utility Shop and Yard.** The utility shop is still standing, but its entire exterior has been modified. POWER's evaluation of this building finds that while integrity of location is maintained, integrity of design, materials, and workmanship has been lost. Integrity of setting has been diminished by the removal of most other physical features of the military base.

Each of these components would be in areas of proposed PV panel blocks and access roads, although a small portion of the hospital area near Buck Boulevard would fall outside.

The Project would utilize silicon PV panels configured into trackers, and the trackers configured into blocks. Each block would be made up of six trackers and would be 295 feet long and 140 feet wide. The panels would be supported by micro-piles that would be driven directly into the ground to a depth of 8 to 12 feet using vibration technology. A tracked backhoe would drive piles. Concrete foundations for the drive motors (device used to move drive strut back and forth) would be poured in place, and electrical equipment for the array would be set in place. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would place trackers on support piles.

Within the solar facility, 12-foot-wide dirt access roads would be constructed every 200 to 400 feet to allow access and maintenance of the solar panels.

7.2 Impacts Under the California Environmental Quality Act

Under CEQA, a project is considered to have an impact on the environment if it alters any characteristics of a historical resource that qualify the it for inclusion in the CRHR. Furthermore, it is stated in CEQA that the lead agency may require that reasonable efforts be made to permit any or all of these resources to be preserved in place or left in an undisturbed state. CEQA also requires that impacts as defined by PRC 21083.2 must be addressed and mitigated as outlined in PRC 15126.4 and 15331.

Under CEQA, a checklist provides a common set of guidelines that set forth the significance criteria generally applied to cultural resources within the state. The checklist provides questions to be addressed using the following criteria:

- Potentially significant impact
- Less than significant impact with mitigation
- Less than significant impact
- No impact

Three questions pertaining to cultural resources are presented below.

A) Would the project cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?

B) Would the project cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?

C) Would the project disturb any human remains, including those interred outside of formal cemeteries?

7.2.1 Assessment of Impacts

A total of 31 cultural resources have been identified in the APE, including a portion of BAAB (archaeological resources and one standing building), six other archaeological sites, two transmission lines, and 22 isolated finds. In addition, two archaeological sites and two isolated finds were identified in an area that was later excluded from the APE.

Table 8 summarizes the anticipated impacts on nine cultural resources within the Project area. Isolated finds are not included in Table 8 because none of them are eligible to the CRHR. Under CEQA, impacts would occur only to historical resources (those eligible to the CRHR), unique archaeological resources (none of which have been identified in the Project area), or human remains (none of which have been identified in the Project area). Only one resource—P-33-018837, a portion of BAAB—is recommended eligible to the CRHR. As such, this would be the only resource potentially impacted by the proposed Project.

All nine cultural resources were recorded within the proposed solar field; none were found along the proposed transmission line.

Table 8. Impacts on Cultural Resources

PRIMARY NUMBER	TRINOMIAL	NRHP/CRHR ELIGIBILITY RECOMMENDATION	JURISDICTION	PROJECT COMPONENT	IMPACTS
P-33-009186	CA_RIV-6370	Not Eligible	Private	Solar Field	No Impact
P-33-012532	CA_RIV-7127	Not Eligible	Private	Solar Field	No Impact
P-33-014083	--	Not Eligible	Private	Solar Field	No Impact
P-33-018837	--	Eligible	Private	Solar Field	Impact
P-33-019996	CA-RIV-10165	Not Eligible	Private	Solar Field	No Impact
P-33-019997	CA-RIV-10166	Not Eligible	Private	Solar Field	No Impact
P-33-019999	CA-RIV-10168	Not Eligible	Private	Solar Field	No Impact
P-33-020000	CA-RIV-10169	Not Eligible	Private	Solar Field	No Impact
P-33-020001	CA-RIV-10170	Not Eligible	Private	Solar Field	No Impact

7.2.2 Application of CEQA Significance Thresholds

A) Would the project cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?

One historical resource, the Blythe Army Air Base (P-33-018837), has been identified as within the Project APE.

Based on the proposed Project site plan, several of the elements of P-33-018837 would be physically removed or altered during Project construction, whereas other elements could be avoided. Cultural resource management recommendations, described in the next section, have been developed in consultation with the Applicants and the Riverside County Archaeologist and Historic Preservation Officer to mitigate the impact from significant to less than significant.

B) Would the project cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?

None of the archaeological sites recorded in the Project area qualify as unique archaeological resources.

C) Would the project disturb any human remains, including those interred outside of formal cemeteries?

No human remains have been previously recorded or discovered during surveys for this Project and, as such, no impacts to this type of resource are anticipated; however, should human remains be discovered on private land at any time during implementation of the Project, construction in the vicinity will halt and the coroner will be contacted immediately (PRC 7050.5). If the coroner determines that the remains do not require an assessment of cause of death and are probably Native American, then the NAHC will be contacted to identify the most likely descendents. Other steps should be implemented according to the requirements of PRC 5097.98.

8.0 RECOMMENDATIONS

Specific cultural resource management recommendations for the expanded P-33-018837 have been developed in consultation with the Applicants and the County Archaeologist. These were developed as part of the CEQA process; mitigation measures to comply with Section 106 of the NHPA and with NEPA will be developed by the BLM and included in the environmental document.

These management recommendations are defined in the Conditions of Approval and pertain to the portion of the Project area that includes privately owned land. The Conditions of Approval specify the following:

- Archaeological monitoring shall be conducted by a qualified county-approved Archaeologist who shall manage and oversee archaeological monitoring of all initial ground disturbing activities and excavations of each portion of the Project site.
- A Special Interest Monitor designated by the General Patton Memorial Museum in Chiriaco Summit, California shall be allowed on-site during all initial ground disturbing activities and excavation of the parcels within the Project site that contain BAAB-related features and artifacts.
- A Tribal Observer designated by the Agua Caliente Band of Cahuilla Indians or other designated Tribal representative shall be allowed on-site when the Project Archaeologist is present during all initial ground disturbing activities and excavations for each portion of the Project site.
- A Cultural Resources Monitoring and Mitigation Plan (CRMMP) shall be submitted to the County Archaeologist and the County Historic Preservation Officer (CHPO). The CRMMP shall address the details of all activities that must be completed in order to reduce the impacts to cultural and historical resources to a level that is less than significant. The CRMMP shall define the roles and responsibilities of cultural resource personnel and provides the timelines for the completion of the required mitigation.

During Project construction, if human remains are encountered on private land, the provisions of State Health and Safety Code Section 7050.5 will apply. This code section states that no further disturbance shall occur until the Riverside County Coroner has made a determination of origin and disposition pursuant to PRC Section 5097.98. If the remains are determined to be Native American in origin, the County Coroner will notify the NAHC, which will determine and notify a Most Likely Descendant (MLD). With the permission of the landowner and his/her authorized representative, the MLD may inspect the site of the discovery. The MLD shall complete the inspection within 48 hours of notification by the NAHC and granting of landowner permission. The MLD may recommend scientific removal and nondestructive analysis of human remains and items associated with Native American burials.

If human remains are discovered on BLM land, NAGPRA (25 U.S.C. 3001) provides a process for federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, or objects of cultural patrimony—to lineal descendants and culturally affiliated Indian tribes. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional excavation and unanticipated discovery of Native American cultural items on federal lands, and penalties for noncompliance and illegal trafficking. The Secretary of the Interior's implementing regulations are at 43 CFR part 10.

9.0 REFERENCES

Bates, T. 2011. Coca Cola Hobbleskirt Bottles. http://www.gono.com/museum2003/hobbleskirts/hobbleskirts.htm. Accessed 2011.

Bean, L.J. 1972. *Mukat's People: The Cahuilla of Indians of Southern California.* University of California Press, Berkeley, California.

Bean, L.J. 1978. Cahuilla. In *California*, edited by R. F. Heizer, pp. 575-587. *Handbook of North American Indians,* vol. 8, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Bean, L.J., and T.F. King. 1974. *Antap – California Indian Political and Economic Organization.* Ballena Press, Ramona, California.

Bean, L. J, and F. Shipek. 1978. Luiseño. In *California*, edited by R. F. Heizer, pp. 550-563. *Handbook of North American Indians,* vol. 8, W. C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Bean, L.J., and K. Saubel. 1972. *Temalpakh: Cahuilla Indian Knowledge and Usage of Plants.* Malki Museum Press, Banning, California.

Bean, L.J., and S.B. Vane. 1978. *Persistence and Power: A Study of American Peoples in the Sonoran Desert and Devers-Palo Verde High Voltage Transmission Line.* Report submitted to Southern California Edison Company. Cultural Systems Research, Inc., Menlo Park, California.

Bee, R.L. 1981. *Crosscurrents Along the Colorado.* University of Arizona, Tucson.

_____. 1982. The Quechan. In *The APS/SDG&E Interconnection Project, Miguel to the Colorado River and Miguel to Mission Tap: Identification and Evaluation of Native American Cultural Resources,* edited by C. Woods, pp. 34-55. Document on file with San Diego Gas and Electric Company. San Diego, California

_____. 1983. The Quechan. In S*outhwest*, edited by Alfonso Ortiz, pp. 86-98. *Handbook of North American Indians,* Vol. 10, W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

_____. 1989. *The Yuma*. Chelsea House, New York.

Bischoff, M.C. 2000. *The Desert Training Center/California-Arizona Maneuver Area, 1942-1944: Historical and Archaeological Contexts.* Technical Series 75. Statistical Research, Inc., Tucson, Arizona.

Blythe Chamber of Commerce. 2011. www.blytheareachamberofcommerce.com, accessed May 2011.

Butler, G.A. 1998. *Rockhounding in California.* Falcon Publishing, Inc., Helena, Montana.

California Energy Commission and Western Area Power Administration (CEC and WAPA). 2000. Final Staff Assessment/Environmental Assessment, Blythe Energy Power Plant Project. Http://www.energy.ca.goc/sitingcases/blythe/documents/2000-11-13_Blythe_FSA.PDF.

Carrico, R.L., and W.T. Eckhardt. 2005. *Cultural Resource Inventory of the Proposed Blythe Energy Transmission Project, Riverside County, CA.* Prepared for Southern California Edison, Rosemead, California.

Castetter, E.F., and W.H. Bell. 1951. *Yuman Indian Agriculture.* University of New Mexico Press, Albuquerque, New Mexico.

Crabtree, R.H. 1981. Archaeology. In *A Cultural Resources Overview of the Colorado Desert Planning Units*, by E.V. Warren, R. H. Crabtree, C. N. Warren, M. Knack, and R. McCarty. Bureau of Land Management, Cultural Resources Publications, Anthropology-History (unnumbered), Riverside, California.

Dobyns, H.F., P.H. Ezell, and G.S. Ezell. 1963. The Death of a Society: The Halchidhoma. *Ethnohistory* 10(2): 105-161.

Dolan, C. 2000. Site Record CA-RIV-7127H. On file at the California Historical Resource Information System, Eastern Information Center, University of California, Riverside.

Eckhardt, W.T. and S.C. Jordan. 2008. *Cultural Resources Inventory of the Proposed Midpoint DPV II Substation Project Riverside County, CA.* Submitted to Bureau of Land Management, Palm Springs, California.

Fickewirth, A.A. 1992. *California Railroads.* Golden West Books, San Marino, California.

Forbes, J.D. 1965. *Warriors of the Colorado: The Yumans of the Quechan Nation and their Neighbors.* University of Oklahoma Press, Norman, Oklahoma,

Forde, D. C. 1931. Ethnography of the Yuma Indians. *University of California Publications in American Archaeology and Ethnology* 28(4):83-278. University of California Press, Berkeley.

Fowler, C.S. 2009. Reconstructing Southern Paiute-Chemehuevi Trails in the Mojave Desert of Southern Nevada and California: Ethnographic Perspectives from the 1930s. In *Landscapes of Movement: Trails, Paths, and Roads in Anthropological Perspective*, edited by J.E. Snead, C.L. Erickson, and J.A. Darling, pp. 84-105. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Goodman, J. 2002. *Historical Artifacts Dating Guide*. San Bernardino National Forest, San Bernardino, California.

Gunther, J. 1984. *Riverside County Place Names and Their Origins and Their Stories.* Rubidoux Printing Co., Riverside, California.

Harner, M.J. 1957. Potsherds and the Tentative Dating of the San Gorgonio-Big Maria Trail. *University of California Archaeological Survey Reports* 37:35-39. Berkeley.

Harwell, H.O., and M.C.S. Kelly. 1983. Maricopa. In *Southwest*, edited by A. Ortiz, pp. 71-85. *Handbook of North American Indians,* Vol. 10, W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Heizer, R.F. (editor). 1978. *Handbook of North American Indians,* Vol. 8, *California*. W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Jaeger, E.C. 1965. *The California Deserts,* Fourth edition. Stanford University Press, Stanford, California.

Johnston, F.J. 1972. Stagecoach Travel through San Gorgonio Pass. *Journal of the West* 11(4):616-635.

_____. 1987. *The Bradshaw Trail.* Historical Commission Press, Riverside, California.

Johnston, F.J., and P.H. Johnston. 1957. An Indian Trail Complex of the Central Colorado Desert: A Preliminary Survey. *University of California Archaeological Survey Reports* 37:22-34. Berkeley.

Jones, T. L., G. M. Brown, L. M. Raab, J. L. McVickar, W. G. Spaulding, D. J. Kennett, A. York, and P. L. Walker. 1999. Environmental Imperatives Reconsidered: Demographic Crises in Western North America during the Medieval Climatic Anomaly. *Current Anthropology*, 40(2):137–170.

Kelly, I., and C. Fowler. 1986. Southern Paiute. In *Great Basin*, edited by W.L. D'Azevedo, pp. 368-397. *Handbook of North American Indians* Vol. 11, W.G. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Kennett, D. J., and J. P. Kennett. 2000. Competitive and Cooperation Responses to Climatic Instability in Coastal Southern California. *American Antiquity* 65:379–395.

Kovel, R. and T. Kovel. 1986. *Kovel's New Dictionary of Marks: Pottery and Porcelain 1850 to the Present.* Crown Publishers, New York.

Kroeber, A.L. 1920. Yuman Tribes of the Lower Colorado River. *University of California Publications in American Archaeology and Ethnology* 16(8):475-4.85.

_____. 1925. *Handbook of the Indians of California.* Smithsonian Institution, Washington, D.C.

Kowta, M. 1969. The Sayles Complex: A Late Milling Stone Assemblage from the Cajon Pass and the Ecological Implications of Its Scraper Planes. *University of California Publications in Anthropology* 6. Berkeley.

Laird, C.. 1976. *The Chemehuevis.* Malki Museum Press, Banning, California.

_____. 1984. *Mirror and Pattern, George Laird's World of Chemehuevi Mythology.* Malki Museum Press, Banning, California.

Laylander, D. 1985. Some Linguistic Approaches to Southern California's Prehistory. *San Diego State University Cultural Resources Management Center Casual Papers* 2(1):14-58.

_____. 1997. The Last Days of Lake Cahuilla: The Elmore Site. *Pacific Coast Archaeological Society Quarterly* 33(1-2): 1-138.

Laylander, D., and J. Schaefer. 2010. *Chuckwalla Valley Prehistoric Trails Network Cultural Landscape: Historic Context, Research Questions, and Resource Evaluation Criteria.* Prepared for the California Energy Commission. Sacramento, California.

Lloyd, M. 2012. Personal Communication. Staff, California Historical Resource Information System, Eastern Information Center, University of California, Riverside, California.

McGuire, R.H., and M.B. Schiffer (editors). 1982. *Hohokam and Patayan: Prehistory of Southwestern Arizona.* Academic Press, New York.

McCarthy, D.F. 1993. *Prehistoric Land-Use at McCoy Spring: An Arid-Land Oasis in Eastern Riverside County, California*. Unpublished Master's thesis, Department of Anthropology, University of California, Riverside.

Mitchell, P.C. 2010a. *Final Phase I Cultural Resource Assessment of the Proposed Blythe Airport Solar Project, Blythe, Riverside County, California.* KP Environmental, LLC, Cardiff By The Sea, California.

_____. 2010b. Site Record, Blythe Army Air Base Historic District P-33-18837. On file at the California Historical Resource Information System, Eastern Information Center, University of California, Riverside.

Moratto, M.J. 1984. *California Archaeology*. Academic Press, New York.

_____. 1998. *Prospects for Pleistocene Archaeology in California*. Paper presented at the Annual Meeting of the Society of California Archaeology, San Diego.

Morton, P.K. 1977. Geology and Mineral Resources of Imperial County, California. *County Report 7. Sacramento: California Division of Mines and Geology*. Sacramento, California.

Norris, R. M., and R. W. Webb. 1990. *Geology of California*, second edition. John Wiley & Sons, New York.

Pendleton, L. 1984. *Archaeological Investigations in the Picacho Basin.* Wirth Environmental Services, Inc. Prepared for San Diego Gas and Electric. San Diego.

Pigniolo, A. 2003. *Assessment of Effects to CA-RIV-6370H, from Proposed Riverside Avenue Drain Improvements, Blythe, California.* Prepared for FPL Energy, LLC, Juno Beach, Florida.

Pigniolo, A., M. Baksh, and J. Dietler. 1999. *Cultural Resources Survey Report for the Blythe Energy Project, Riverside County, California and Yuma County, Arizona*. Prepared for Greystone, Sacramento, California. Tierra Environmental Services, San Diego, California.

Pigniolo, A., McGinnis, and J. Dietler. 1999. Site record, P-33-9186 (CA-RIV-6370H). On file at the California Historical Resource Information System, Eastern Information Center, University of California, Riverside.

Reinoehl, G. 2003. Blythe Energy Project Phase II (02-AFC-01) Responses to Data Request #3 Questions 189 – 235. Submitted to the CEC June 13, 2003.

Rock, J.T. 1984. Cans in the Countryside. *Historical Archaeology* 18 (2).

Rogers, M.J. 1939. Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Areas. *San Diego Museum of Man Papers* No. 3. San Diego.

_____. 1941. Aboriginal Culture Relations between Southern California and the Southwest. *San Diego Museum Bulletin* 5(3):1-6. San Diego.

_____. 1945. An Outline of Yuman Prehistory. *Southwest Journal of Anthropology* 1(2):167-168.

_____. 1966. San Dieguito Implements from the Terraces of the Rincon-Patano and Rillito Drainage System. *The Kiva* 24 (1):1-23.

Ruby, J.W. 1970. Excavations at One Horse Canyon Rockshelter. *University of California Archaeological Survey Annual Report*, Los Angeles.

Ryan, R. M. 1968. *Mammals of Deep Canyon, Colorado Desert, California.* The Desert Museum, Palm Springs, California.

Schaefer, J. 1994. The Challenge of Archaeological Research in the Colorado River: Recent Approaches and Discoveries. *Journal of California and Great Basin Anthropology* 16 (1):60–80.

Schaefer, J., and D. Laylander. 2007. The Colorado Desert: Ancient Adaptations to Wetlands and Wastelands. In *California Prehistory: Colonization, Culture, and Complexity.* Edited by T.L. Jones and K.A. Klar, pp. 247–257. Alta Mira Press, Lanham, Maryland

Schroeder, A.H. 1979. Prehistory: Hakataya. In *Southwest*, edited by A. Ortiz, pp. 100-107. *Handbook of North American Indians,* Vol. 9, W.G. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Seymour, G.R., and P. Lawrence. 1997. Assigning Geographic Origins to Ceramics at CA-RIV-1950. *Proceedings of the Society for California Archaeology* 10:51-59.

Simon, A.W. n.d. *Pottery and Pigments in Arizona: Salado Polychrome.* Archaeological Research Institute, Arizona State University, Tempe.

Snead, J.E., C.L. Erickson, and J.A. Darling (editors). 2009. *Landscapes of Movement: Trails, Paths, and Roads in Anthropological Perspective*. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Society for California Archaeology. 2011. A Glossary of Proper Names in California Prehistory. http://www.scahome.org/about_ca_archaeology/ceramics.html. Accessed May 2011.

Spaulding, W.G. 1990. Vegetational And Climatic Development Of The Mojave Desert: The Last Glacial Maximum To The Present. In *Packrat Middens: The Last 40,000 Years Of Biotic Change,* edited by J. L. Betancourt, T. R. Van Devender, and P. S. Martin, pp. 166– 199. University of Arizona Press, Tucson.

_____. 2001. Paleoenvironmental Context of the Study Area. In *Metropolitan Water District of Southern California Eastside Reservoir Project Archaeological Investigations,* Vol. IV: Chapter 5, S. K. Goldberg, general editor. Report prepared by Applied EarthWorks, Inc., Hemet, California. Report submitted to the Metropolitan Water District of Southern California, Los Angeles.

Spier, L. 1933. *Yuman Tribes of the Gila River.* University of Chicago Press, Chicago. Reprinted Edition, Dover Publications, New York, 1978.

Stewart, K.M. 1983. Mohave. In *Southwest,* edited by A. Ortiz, pp. 55-70. *Handbook of North American Indians*, Vol. 10, W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Toulouse, J.H. 1971. *Bottle Maker's and Their Marks*. Thomas Nelson, New York.

U.S. Geological Survey. 1970. McCoy Wash, California [map]. 1:24,000 7.5 Minute Series. Reston, Virginia.

_____. 1975. Ripley, California [map]. 1:24,000 7.5 Minute Series. Reston, Virginia.
_____. 1980. McCoy Peak, California [map]. 1:24,000 7.5 Minute Series. Reston, Virginia.

_____. 1983. Roosevelt Mines, California [map]. 1:24,000 7.5 Minute Series. Reston, Virginia.

Vaughn, S., and C.N. Warren. 1980. Toward a Definition of Pinto Points, In *Test Excavations and Data Recovery at the Awl Site, A Pinto Site at Fort Irwin, San Bernardino County, California,* by D.L. Jenkins and C.N. Warren. Wirth Environmental Associates, San Diego.

Van Devender, T.R., and W.G. Spaulding. 1983. Development of Vegetation and Climate in the Southwestern United States. In *Origin and Evolution of Deserts*, edited by S.G. Wells and Donald R. Haragan, pp. 131-156. University of New Mexico Press, Albuquerque.

von Werlhof, J. 1987. *Spirits of the Earth, A Study of Earthen Art in the North American Deserts, Volume I: The North Desert*. Imperial Valley College Museum, Ocotillo, California.

_____. 2004. *That They May Know and Remember* Vol. 2: *Spirits of the Earth.* Imperial Valley College Desert Museum Society. Self-published, Ocotillo, California.

Vredenburgh, L., G.L. Shumway, and R. Hartill. 1981. *Desert Fever: An Overview of Mining in the Desert Conservation Area.* Prepared for the Bureau of Land Management, Riverside, California.

Waters, M. R. 1982. The Lowland Ceramic Tradition. In *Hohokam and Patayan, Prehistory of Southwestern Arizona.* Edited by R.H. McGuire and M.B. Schiffer. Pp. 275-297. Academic Press, New York.

_____. 1983. Late Holocene Lacustrine Chronology and Archaeology of Ancient Lake Cahuilla, California. *Quaternary Research* 19:373–387.

Warren, E.V., R.H. Crabtree, C.N. Warren, M. Knack, and R. McCarthy. 1981. *A Cultural Resources Overview of the Colorado Desert Planning Units.* U.S.D.I, Bureau of Land Management, California Desert District, Riverside.

Warren, C. N. 1968. Cultural Tradition and Ecological Adaptation on the Southern California Coast. *Eastern New Mexico University Contributions in Archaeology* 1(3):1–15.

_____. 1984. The Desert Region. In *California Archaeology,* by M.J. Moratto, pp. 339–430. Academic Press, New York.

Warren, C. N., D. L. True, and A. A. Eudey. 1961. Early Gathering Complexes of Western San Diego County: Results of Interpretation of an Archaeological Survey. *Archaeological Survey Annual Report* 1960–1961, pp. 1–106. Institute of Archaeology, University of California, Los Angeles.

Weide, D.L. 1974. Regional Environmental History of the Yuha Desert Region. In *Background to Prehistory of the Yuha Desert Region,* edited by Philip J. Wilke, pp. 9-20. Ballena Press Anthropological Papers No. 5. Ramona, California.

Whitten, D. n.d. Glass Factory Marks on Bottles. http://myinsulators.com/glass-factories/bottlemarks2.html. Accessed May 2011.

Wilson, A. 2008. *Runways in the Sand: the History of Blythe Army Air Base in World War II.* Self Published, Blythe, California.

Wilson, E.D. 1961. Arizona Gold Placers and Placering: Prospecting and Treasure Hunting. *Arizona Geological Survey, Bulletin* 168.

Wilke, P.J., and H.W. Lawton. 1975. Early Observations on the Cultural Geography of the Coachella Valley. In *The Cahuilla Indians of the Colorado Desert: Ethnohistory and Prehistory,* pp. 9-43. Ballena Press, Ramona, California.

10.0 REPORT PREPARERS

POWER Engineers, Inc.

Gini Austerman, M.A., Archaeologist
Johanna Marty, B.A., Archaeologist
Katherine Knapp, M.A., Archaeologist
Jim Rudolph, Ph.D., Archaeologist

11.0 FIELD PERSONNEL

POWER Engineers, Inc.

Gini Austerman
Dan Woodward
Trish Webb
Johanna Marty
Josh Garr
Reilly Murphy
April Shand
Sam Smith
Stacey Stanley

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A: NATIVE AMERICAN COORDINATION

THIS PAGE INTENTIONALLY LEFT BLANK

Table A-1. Communication with Native American Representatives

AFFILIATION	CONTACT	COMMUNICATIONS
Fort Mojave Indian Tribe (Mojave)	Mr. Tim Williams, Chairperson	5/2/11 POWER sent certified letter and email with map of Project area
Ramona Band of Cahuilla Mission Indians (Cahuilla)	Joseph Hamilton, Chairman	5/2/11 POWER sent certified letter and email with map of Project area
Twentynine Palms Band of Mission Indians (Chemehuevi)	Darrell Mike, Chairperson	5/2/11 POWER sent certified letter and email with map of Project area
Chemehuevi	Joseph R. Benitez (Mike)	5/2/11 POWER sent certified letter and email with map of Project area
Chemehuevi Reservation	Charles Wood, Chairperson	5/2/11 POWER sent certified letter and email with map of Project area
Colorado River Indian Tribe (Mojave, Chemehuevi)	Ginger Scott, Museum Curator; George Ray, Coordinator	5/2/11 POWER sent certified letter and email with map of Project area
Fort Yuma Quechan Indian Nation (Quechan)	Michael Jackson, President	5/2/11 POWER sent certified letter and email with map of Project area
AhaMaKav Cultural Society, Fort Mojave Indian Tribe	Linda Otero, Director	5/2/11 POWER sent certified letter and email with map of Project area
Santa Rosa Band of Mission Indians (Cahuilla)	Mayme Estrada, Chairwoman	5/2/11 POWER sent certified letter and email with map of Project area
Augustine Band of Cahuilla Mission Indians (Cahuilla)	Mary Ann Green, Chairperson	5/2/11 POWER sent certified letter and email with map of Project area **Response:** 5/25/11-received response letter from Mary Ann Green. No action requested.
Morongo Band of Mission Indians (Cahuilla, Serrano)	Michael Contreras, Cultural Heritage Program	5/2/11 POWER sent certified letter and email with map of Project area
San Manuel Band of Mission Indians(Serrano)	Ann Brierty, Policy/Cultural Resources Department	5/2/11 POWER sent certified letter and email with map of Project area
Torres-Martinez Desert Cahuilla Indians (Cahuilla)	Diana L. Chihuahua, Vice Chairperson, Cultural	5/2/11 POWER sent certified letter and email with map of Project area
Fort Mojave Indian Tribe (Mojave)	Nora McDowell, Cultural Resources Coordinator	5/2/11 POWER sent certified letter and email with map of Project area
Cocopah Museum/Cultural Resources Department (Cocopah)	Jill McCormick, Tribal Archaeologist	5/2/11 POWER sent certified letter and email with map of Project area
Agua Caliente Band of Cahuilla Indians	Patricia Tuck, THPO	5/2/11 POWER sent certified letter and email with map of Project area **Response:** 5/12/11- Telephone message from P. Tuck requesting name of arch. firm contracted to survey and a copy of the records search results.

AFFILIATION	CONTACT	COMMUNICATIONS
		6/22/11- Letter received from P. Tuck requesting copies of cultural resource reports generated for review and comment; an approved monitor to be present during survey and/or ground disturbance; the coroner must be contacted if human remains are found.
Augustine Band of Cahuilla Mission Indians (Cahuilla)	Karen Kupcha	5/2/11 POWER sent certified letter and email with map of Project area
Quechan Indian Nation	Bridget Nash-Chrabascz, THPO	5/2/11 POWER sent certified letter and email with map of Project area
Ah-Mut-Pipa Foundation (Quechan Kumeyaay)	Preston J. Arrow-weed	5/2/11 POWER sent certified letter and email with map of Project area
Cahuilla Band of Indians	Luther Salgado, Sr., Chairperson	5/2/11 POWER sent certified letter and email with map of Project area

APPENDIX B (CONFIDENTIAL): CALIFORNIA OFFICE OF HISTORIC PRESERVATION DPR-523 FORMS

CONFIDENTIAL APPENDIX UNDER SEPARATE COVER

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C: GENERAL LAND OFFICE RECORDS WITHIN ONE MILE OF THE PROJECT

THIS PAGE INTENTIONALLY LEFT BLANK

Table C-1. General Land Office Land Patents within One Mile of the Project

BLM SERIAL #	NAME	ISSUE DATE	ACRES	ALIQUOT PARTS	SECT/ BLOCK	AUTHORITY
CALA 0079580	Russell A. Duquette	1/20/1954	70	Lot 1 NE¼ SW¼, Lot 2 E½SE¼SW¼, Lot 3 NW¼ SE¼ SW¼	27	Desert Land Act 1877
CALA 0006914	R. Elliott, R. Merwin	7/15/1915	160	W½ SW¼	27	Homestead Entry 1862
CALA 0169319	W. E. Epperson	5/14/1965	40	SE¼ NW¼	27	Sale-Title 32 Ch. 7
CALA 0169319 01	W. E. Epperson	5/14/1965	40	NE¼ NW¼	27	Sale-Title 32 Ch. 7
CALA 0003815	A. F. Gardner	10/22/1912	160	SE¼	27	Homestead Entry 1862
CALA 0004263	William A. Taber	10/31/1916	160	NE¼	27	Homestead Entry 1862
CALA 0049018	Frank D. Thomas	1/9/1935	160	W½ NW¼	27	Homestead Entry 1862
CALA 0079580	Elizabeth E. Estle and Joe G. Joseph	7/16/1968	160	Lot 1 S½ NE¼, Lot 2 W½ SE¼	28	Desert Land Act 1877
CALA 0006914	County of Riverside	9/10/1948	4287.5	W½	28	Quit Claim Deed by GSA 1935
CALA 0169319	William A. Taber	10/31/1916	160	NE¼	27	Homestead Entry 1862
CALA 0078967	Gus O. Dodson	11/7/1912	160	NW¼	28	Sale-Cash Entry 1820
CALA 0142405	County of Riverside	9/10/1948	4287.5		29	Quit Claim Deed by GSA 1935
CALA 0011582	State of California	12/17/1973	0.17	Lot/Trct 57	32	Acquired Gifts
CALA 0142405	State of California	5/13/1922	2069.11	NE¼	32	Indemnity Selections 1927
CACA 000344	Connie Basha	9/20/1955	160	SE¼	33	Desert Land Act 1877
CACA 017527 02	Lawrence Borba, Elizabeth E. Estle	7/16/1968	160	NE¼	33	Desert Land Act 1877
CALA 0095125	Ernest W. Hubner	7/14/1920	160	NW¼	33	Homestead Entry 1862
CARI 000045	Lawrence Marshall	6/27/1912	160	SW¼	33	Homestead Entry 1862
CAEC 0000760	County of Riverside	9/10/1948	4287.5	NW¼ SW¼	33	Quit Claim Deed by GSA 1935
CALA 0011068	George England	1/12/1913	160	W½ E½	34	Homestead Entry 1862
CALA 0142405	Lawrence Borba, Elizabeth E. Estle	7/16/1968	160	NE¼	33	Desert Land Act 1877
CALA 0003966	Ernest W. Hubner	7/14/1920	160	NW¼	33	Homestead Entry 1862
CALA 0002844	Francis J. Folsom	2/15/1912	160	Lot N½ NW¼, Lot 2 SW¼ NW¼, Lot 3 NW¼ SW¼	34	Homestead Entry 1862
CALA 0006873	John N. Mynes	9/14/1911	160	E½ E½	34	Sale-Cash Entry 1820

BLM SERIAL #	NAME	ISSUE DATE	ACRES	ALIQUOT PARTS	SECT/ BLOCK	AUTHORITY
CALA 0006098	James Talbert	9/14/1911	160	Lot 1 S½ SW¼, Lot 2 SE¼ NW¼, Lot 3 NE¼ SW¼	34	Sale-Cash Entry 1820
T 7S, R 22E						
CAEC 0002216	Henry G. Douglas	2/4/1920	80.14	Lot/Trct 47	3	Homestead Entry 1862
CALA 0010614	Samuel Z. Hanlin	7/6/1916	160	Lot/Trct 53	3	Homestead Entry 1862
CALA 0002448	Ellbey L. Kelsey	5/3/1911	160	Lot/Trct 49	3	Homestead Entry 1862
CALA 0002447	George W. Kelsey	3/21/1910	157.39	Lot/Trct 51	3	Homestead Entry 1862
CAEC 0000661	Michael McCabe	11/17/1922	80.44	Lot/Trct 46	3	Homestead Entry 1862
CALA 0010619	Maurice J. Sheahan	1/23/1914	120	Lot/Trct 48	3	Homestead Entry 1862
CALA 0010570	Henry G. Douglas	2/4/1920	80.14	Lot/Trct 47	3	Homestead Entry 1862
CALA 0010629	Carrie Tobias, John T. Tobias	4/9/1915	40	Lot/Trct 50	3	Sale-Cash Entry 1820
CALA 0038747	Harry Tobias	7/6/1914	120	Lot/Trct 55	3	Sale-Cash Entry 1820
CALA 0086427	Samuel Z. Hanlin	10/5/1931	162.53	Lot/Trct 54	4	Desert Land Act 1877
CAEC 0005264	Mildred S. Mason, Estelle S. Weeks	6/2/1960	39.77	Lot/Trct 56	4	Desert Land Act 1877
CAEC 0004067	Walter S. Wilkinson	4/9/1923	164.14	Lot/Trct 52	4	Sale-Cash Entry 1820
CALA 0024359	Robert M. Gilliam	6/8/1922	139.73	Lot/Trct 3,4,5, and 6	5	Homestead Entry 1862
CAEC 0004066	Jonathan F. Green	7/13/1916	160	Lot/Trct 57	5	Sale-Cash Entry 1820
CALA 0084836	Zelma C. B. Salmeri, Elbert W. Weeks	10/24/1955	161.55	Lot/Trct 58	5	Desert Land Act 1877
CACAAA 009079	State of California	6/19/1951	10003.58	Lot/Trct 61	6	Indemnity Selections 1927
CACAAA 009079 03	State of California	3/28/1957	691.7	Lot/Trct 61	6	Conveyance Doc Correction 1954
CALA 0005424	William Marsden	12/21/1911	158	Lot/Trct 60	6	Sale-Cash Entry 1820
CACAAA 000575 02	State of California	7/14/1927	10158.84	NW¼ NE¼	8	Indemnity Selections 1927
CAEC 0002599	Gertrude J. Clark	8/27/1923	163.4	S½ SW¼, NE¼ SW1/4, Lot/Trct 1,2, and 3	8	Desert Land Act 1877
CAEC 0001212	Edwin R. Knox	5/3/1920	160.8	Lot/Trct 68	8	Desert Land Act 1877
CALA 0010670	Edwin Peet	4/3/1916	160	Lot/Trct 67	8	Homestead Entry 1862
CALA 0010605	Peter Burnett	11/10/1915	80	Lot/Trct 72	9	Homestead Entry 1862
CACAAA 000575 02	State of California	7/14/1927	10158.84	Lot/Trct 66	9	Indemnity Selections 1927
CALA 0013932	Emma Hartmann	10/16/1914	160	Lot/Trct 70	9	Sale-Cash Entry 1820
CAEC 0001212	Edwin Knox	5/3/1920	160.8	Lot/Trct 68	9	Desert Land Act 1877

BLM SERIAL #	NAME	ISSUE DATE	ACRES	ALIQUOT PARTS	SECT/ BLOCK	AUTHORITY
CALA 0010577	Charles E. Oliver	4/3/1916	80	Lot/Trct 71	9	Homestead Entry 1862
CALA 0005424	Robert C. Stevenson	10/24/1914	160	Lot/Trct 73	9	Homestead Entry 1862
CALA 0010601	Edwin Williams	2/25/1922	161.28	Lot/Trct 69	9	Homestead Entry 1862
CAEC 0002774	Florence V. Bodkin	10/23/1919	158.8	Lot/Trct 78	11	Homestead Entry 1862
CAEC 0001877	Patrick H. Bodkin, Gilford M. Dunn	7/28/1915	80	Lot/Trct 80	11	Homestead Entry 1862
CALA 0022871	Patrick H. Bodkin, Peter Dieckmann	8/6/1915	40	Lot/Trct 81	11	Homestead Entry 1862
CALA 0022869	Edwin R. Knox	5/3/1920	160.8	Lot/Trct 68	8	Desert Land Act 1877
CALA 0022870	Patrick H. Bodkin, Benjamin F. Howland	8/6/1915	40	Lot/Trct 82	11	Homestead Entry 1862
CALA 0000231	James Jackson	11/8/1909	160	Lot/Trct 76	11	Homestead Entry 1862
CACAAA 089883	James E. Neighbours	1/30/1908	320	Lot/Trct 79	11	Desert Land Act 1877
CALA 0000693	Frederick F. Nelson	3/22/1909	160	Lot/Trct 77	11	Sale-Cash Entry 1820
CALA 0010606	Frederick A. White	5/19/1913	160	Lot/Trct 83	11	Sale-Cash Entry 1820
CALA 0010601	Lawrence Fleischer	1/15/1915	166.66	Lot/Trct 88	12	Homestead Entry 1862
CALA 0010655	Charles D. Gilson	5/19/1913	80	Lot/Trct 84	12	Sale-Cash Entry 1820
CALA 0010646	Edward A. Green	7/26/1916	80	Lot/Trct 85	12	Sale-Cash Entry 1820
CALA 0018533	Dennis D. Ocheltree	9/22/1919	160.34	Lot/Trct 87	12	Homestead Entry 1862
CALA 0010654	James M. Ocheltree	2/4/1915	160	Lot/Trct 86	12	Sale-Cash Entry 1820
CALA 0010653	Frederick A. White	5/19/1913	160	Lot/Trct 83	12	Sale-Cash Entry 1820
CALA 0010606	Harry S. Dye	11/25/1910	160	Lot/Trct 93	12	Homestead Entry 1862
CALA 0003454	Wayne H. Fisher, George H. Timmings	3/30/1921	80.14	B, Lot/Trct 90	13	Desert Land Act 1877
CAEC 0003220	Patrick H. Bodkin, Benjamin F. Howland	8/6/1915	40	Lot/Trct 82	11	Homestead Entry 1862
CALA 0010597	Samuel H. Guthery	5/29/1913	160	Lot/Trct 91	13	Sale-Cash Entry 1820
CAEC 0001970	Olaf A. Olson	12/15/1919	171.5	Lot/Trct 92	13	Homestead Entry 1862
CALA 0010655	James Rennie	2/24/1916	92.5	Lot/Trct 95	13	Sale-Cash Entry 1820
CALA 0015516	George Timmings	1/26/1921	160.37	Lot/Trct 89	13	Homestead Entry 1862
CAEC 0001971	George Timmings	12/10/1921	80.29	A, Lot/Trct 90	13	Desert Land Act 1877
CAEC 0000691	James Haslam	5/29/1913	160	Lot/Trct 104	14	Sale-Cash Entry 1820

BLM SERIAL #	NAME	ISSUE DATE	ACRES	ALIQUOT PARTS	SECT/ BLOCK	AUTHORITY
CALA 0010607	Charles Longworth	1/30/1908	160	Lot/Trct 96	14	Desert Land Act 1877
CACAAA 089884	Guy Prior	12/10/1920	40.62	Lot/Trct 99	14	Homestead Entry 1862
CALA 0002429	Benjamin White, Abner Peterson	1/24/1920	40.52	Lot/Trct 98	14	Desert Land Act 1877
CAEC 0001190	Samuel H. Guthery	5/29/1913	160	Lot/Trct 91	13	Sale-Cash Entry 1820
T 7S, R 21E						
CACAAA 018296 03	State of California	6/13/1957	840.14	W½ SW¼	1	Conveyance Doc Correction 1954
CACAAA 018296 04	State of California	12/21/1953	1456.86	W½ SW¼, Lot/Trct 7	1	Indemnity Selections 1927
CACAAA 020122 01	State of California	7/6/1917	1901.86	SE¼, E½ SW¼	1	Indemnity Selections 1927
CALA 0043048	Russell D. Freeman	1/17/1928	158.38	S½ NW¼, Lot/Trct 5, Lot/Trct 6	1	Homestead Entry 1862
CALA 0040951	Edmond B. Kasold	9/20/1927	158.66	S½ NE¼, Lot/Trct 3, Lot/Trct 4	1	Homestead Entry 1862
CALA 0043961	William Egan, Kate Thomas, Roscoe Buckner	1/20/1928	120	W½ SW¼	2	Sale-Cash Entry 1820
NONE IN SECTION 3						
CALA 0043923	Albert Edmiston	1/3/1930	316.19	S½ NW¼, Lot/Trct 5, Lot/Trct 6	4	Homestead Entry 1862
CALA 0043639	Starr Titus	6/22/1928	315.84	S½ NW¼, Lot/Trct 5, Lot/Trct 6	5	Homestead Entry 1862
CALA 0043962	Alice Wedeking, Margaret Kelo, Diedrich Wedeking	8/27/1929	149.55	N½ SW¼, N½ SE¼	5	Desert Land Act 1877
CALA 0043984	Myron T. Johnston	12/21/1931	317.88	Lot/Trct 5,6,11,12,13,14,19,20	6	Homestead Entry 1862
CALA 0044010	Steve Kostick	1/21/1931	253.59	Lot/Trct 7,8,9,10,15,16,17,18	6	Homestead Entry 1862
CACAAA 020122 01	Carl A. Benson	11/26/1913	160	NE¼	8	Sale-Cash Entry 1820
CALA 0011526	John L. Price	4/11/1928	154.5	N½ NW¼, SW¼ NW¼, SE¼ NW¼	8	Homestead Entry 1862
CALA 0043935	Josef Siebold	9/18/1913	160	SE¼	8	Sale-Cash Entry 1820
CALA 0011527	Perry A. Ball	10/30/1912	160	NW¼	9	Sale-Cash Entry 1820
CALA 0011525	Carl A. Benson	11/26/1913	160	NE¼	8	Sale-Cash Entry 1820
CACAAA 012277 02	State of California	11/23/1953	1991.63	SE¼	11	Indemnity Selections 1927
CACAAA 012277 03	State of California	6/10/1957	1297.17	SE¼	11	Conveyance Doc Correction 1954
CALA 0038266	Virginia L. Cunningham, William D. Hammell	5/29/1951	80	S½ SW¼	12	Desert Land Act 1877

BLM SERIAL #	NAME	ISSUE DATE	ACRES	ALIQUOT PARTS	SECT/ BLOCK	AUTHORITY
CALA 0046019	Claude P. Kitchen	3/29/1930	160	SE¼	12	Homestead Entry 1862
CALA 0045611	John W. Kline	11/7/1931	160	NE¼	12	Homestead Entry 1862

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D (CONFIDENTIAL): CULTURAL RESOURCE LOCATION MAPS

CONFIDENTIAL APPENDIX UNDER SEPARATE COVER

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX E: RIVERSIDE COUNTY REQUIREMENTS

THIS PAGE INTENTIONALLY LEFT BLANK

LEVEL OF SIGNIFICANCE CHECKLIST
For Archaeological Resources
(Must be attached to report)

(Check the level of significance that applies) APN: See table below	Project No: 122512	EA Number:

□ Potentially Significant Impact	**X** Less than Significant With Mitigation Incorporated	□ Less than Significant Impact	□ No Impact

Historic Resources

Would the project:

Alter or destroy a historic site? Yes. A World War II historic district, the Blythe Army Air Base (BAAB) (33-018837), located immediately adjacent to a western boundary of the Project, had been recorded in 2010 and recommended eligible for listing on the NRHP. Although the boundaries of the historic district as recorded in 2010 did not extend into the Project area, remnant features of the BAAB were found by POWER within the proposed solar Project boundaries. These features were documented and added to the existing district record. POWER recommends that the features within the Project area retain sufficient integrity to be considered contributing elements to the district. Site 33-018837 qualifies as a historical resource and would potentially be altered by the proposed Project.

Cause a substantial adverse change in the significance of a historical resource as defined in California Code of Regulations §15064.5? Yes. Based on the proposed Project site plan, several of the elements of 33-018837 would be physically removed or altered during Project construction, while other elements would be avoided. The proposed Project would potentially cause a substantial adverse change in the significance of this historical resource.

Is the resource listed in, or determined to be eligible by the State Resources Commission, for listing in the California Register of Historical Resources (Pub. Res. Code §5024.1)? No. However, site 33-018837 has been recommended eligible to the NRHP by Mitchell (2010). This recommendation has not yet been reviewed by the State.

Findings of Fact: After considerable discussion with the Riverside County Archaeologist, it was agreed that the features of 33-018837 within the Project boundaries retain sufficient integrity to be considered contributing elements to the existing BAAB Historic District. Therefore, POWER recommends that the portion of the BAAB Historic District that extends into the Blythe Mesa Solar Project boundaries qualifies as a historical resource for the purposes of the California Environmental Quality Act (CEQA).

Proposed Mitigation: Cultural resource management recommendations will be developed in consultation with the applicant, the Bureau of Land Management, and the Riverside County Archaeologist and Historic Preservation Officer to mitigate the impact from significant to less than significant. Such measures include:

1. Expansion of the existing BAAB Historic District boundary to incorporate the resource elements of 33-018837.
2. Preparation of a Cultural Resources Management Plant (CRMP) that details resources to be protected, specifies the necessary agency and Native American notifications and coordination, and implements review and approval of the plan by BLM and County of Riverside prior to the start of construction

Monitoring: Monitors will be provided at appropriate times and places on the Project site during construction as specified in the CRMP, including during construction in areas of the former BAAB.

Archaeological Resources

Would the project:

Alter or destroy an archaeological site? No. Four previously recorded resources, seven new archaeological sites, and 23 isolated finds were identified during the survey of the Project area. Only one of the resources (33-018837, discussed above) meets the criteria for either the NRHP or the CRHR and is recommended eligible. For the purposes of CEQA, none of the other resources qualify as unique archaeological resources.

Cause a substantial adverse change in the significance of an archaeological resource pursuant to California Code of Regulations §15064.5? No.

Disturb and human remains, including those interred outside of formal cemeteries? No.

Restrict existing religious or sacred uses within the potential impact area? No.

Findings of Fact: No archaeological resources are recommended eligible for listing in the CRHR not do any qualify as unique archaeological resources under CEQA.

Proposed Mitigation: No specific resource mitigation is necessary.

Monitoring Proposed: A CRMP will be prepared that may, based on agency consultation, stipulate that archaeological and/or Native American monitoring will be conducted in specific areas to protect resources in the event of inadvertent or unanticipated discovery.



Prepared By: _____ Date: **6/6/12**

PARCELS WITHIN THE SOLAR FIELD

Riverside County				City of Blythe
821110004	824102015	863040015	863100011	824101014
821120025	824102016	863040017	863100012	824101015

Riverside County				City of Blythe
821120026	824130006	863040020	863100016	824101016
821120027	824130007	863040021	879090036	824101017
821120028	863030002	863050004	879090037	824102020
821120029	863030003	863050007	879090038	824102023
821120038	863030004	863050008	879090039	824102024
821120039	863030005	863050009	879090040	824102026
821120040	863030006	863060015	879090041	824102027
821120042	863030007	863060016	879090042	824110035
821120043	863030008	863060017	879090043	824110036
821120044	863030009	863060018	879090044	824110037
821120048	863030010	863070018	879090045	824110038
824080003	863030013	863070019	879090048	824122013
824080005	863030014	863070022	879090049	
824090009	863030015	863100006	879090050	
824090024	863030016	863100008	879090051	
824102013	863030017	863100009	879110013	
824102014	863040001	863100010	879110014	

PARCELS WITHIN THE TRANSMISSION LINE ROW

Riverside County	BLM
879080013	879080020
879080014	879080021
879080028	879080022
879080032	879080024
879090048	879080026
	879080027
	879090033
	879090034
	879090035

Certificate of Completion

This certifies that **Gini Austerman** completed the required Riverside County Cultural Sensitivity Training Course on **February 17, 2011.**

Register No. **121**

Expires: **February 17, 2013**

Carolyn Syms Luna

Carolyn Syms Luna,
Planning Director

Leslie J. Mouriquand M.A., RPA
County Archaeologist

VIRGINIA AUSTERMAN, RPA

ENVIRONMENTAL SPECIALIST

YEARS OF EXPERIENCE
9

EDUCATION
> M.A., Anthropology, Emphasis Archaeology, California State University-Fullerton, 2004
> B.A., Anthropology, Emphasis Archaeology; Minor Art/Illustration, California State University-Fullerton, 2002

AREAS OF EXPERTISE
> NEPA compliance
> CEQA compliance
> Field investigations and surveys
> Section 106 consultation

SPECIAL TRAINING
> Section 106 Essentials Workshop
> CEQA Workshop, Society for California Archaeology
> Archaeological Illustration
> Union Pacific Railroad Safety Training
> BNSF Railroad Safety Training
> Mine Hazard Safety Awareness (MSHA)
> County of Riverside, Cultural Sensitivity Training

CERTIFICATION
> Registered Professional Archaeologist
> Certified Archaeological Consultant, County of Riverside (Certification #121)

AFFILIATIONS
> Society of American Archaeology
> Society for California Archaeology
> National Trust for Historic Preservation
> California Preservation Foundation

HONORS
> Society of California Archaeology Certificate of Appreciation, 2004

EXPERIENCE SUMMARY

Ms. Austerman is an archaeologist with experience in environmental consulting in all phases of cultural resources management. Her experience includes archival research, Phase I, II, and III field investigations, Native American consultation, report preparation, mitigation monitoring, and artifact curation. She has managed approximately 100 cultural resources projects and has prepared documentation under the jurisdiction of Section 106 of National Historic Preservation Act, National Environmental Policy Act, and the California Environmental Quality Act. Ms. Austerman also has experience in laboratory analyses and reporting for prehistoric lithic artifacts, historic artifacts, and marine shell analysis. She has served as a project manager, assistant project manager, field director, and researcher for private environmental planning firms, and city, state, and federal agencies. As a project manager and crew chief, she has prepared proposals, managed budgets and invoices, and managed client relations, field crews, and subconsultants.

PREVIOUS WORK HISTORY

SWCA Environmental Consultants, California

Cultural Resources Project Manager and Archaeologist responsible for conducting and managing cultural resources projects in compliance with CEQA, NEPA, and Section 106 NHPA.

LSA Associates, Inc., California

Cultural Resources Manager and Archaeologist responsible for Phase I resource identification and impact assessments for private development and public infrastructure projects; constraints analyses and feasibility studies; Native American and historical consultation; Initial Study, Mitigated Negative Declaration, Environmental Impact Report and Environmental Impact Statement support services; and projects involving coordination with multiple team members and specialists. Prepared proposals, managed budgets and invoices, and managed clients, field crews and subconsultants. Position required a working knowledge of regulations under CEQA, NEPA, Section 106, and local and county jurisdictions.

Statistical Research, Inc., California

Archaeologist, Crew Chief, and Lab Technician responsible for leading teams of archaeologists in conducting archaeological surveying and mapping projects, as well as a long-term prehistoric data recovery project in the Ballona Wetlands area of Los Angeles. Conducted and participated in over 50 projects within southern California, Arizona, and Nevada. Assisted in lab inventory, cataloguing, and analysis of the archaeological artifacts and human remains and produced over 20 osteological illustrations collected from the wetlands

project.

San Bernardino National Forest, Idyllwild Ranger Station, California

Archaeologist and Crew Chief responsible for the survey, assessment, and recording of archaeological sites located within the Thomas Mountain Range for a fuels reduction program.

LSA Associates, Inc., California

Field Crew Member and Lab Technician responsible for assisting in the excavation of a prehistoric rock shelter shell midden site on the Newport Coast. Assisted in the laboratory inventory and cataloguing of the artifacts from the site.

Statistical Research, Inc., / California State University, San Bernardino, Field School, California

Participated in a four-week field school within the Big Bear region of the San Bernardino National Forest. Tasks completed during the field school included survey and documentation of sites located near the Pan Hot Springs area.

Department of the Navy, MV22 Osprey Project, Robert Stump Training Complex, California & Arizona

Field Director for the survey, documentation, and evaluation of numerous project areas within California and Arizona Naval and Marine bases, including Barry M. Goldwater West, Chocolate Mountains Aerial Gunnery Range, and Camp Pendleton.

Alameda Corridor East, San Gabriel Trench, California

Crew Chief for a cultural resources testing and excavation project for a grade separation within the Alameda Corridor. Excavation of resources built during the Mission period and related to the San Gabriel Mission.

NextEra, Kramer Junction Solar Project, California

Crew Chief for survey, literature review, site documentation, and NRHP evaluation of three historical-period resources at the site of a new solar generation project.

Barrick Goldstrike Mines, Environmental Assessment Services, Nevada

Archaeologist responsible for a field survey for proposed mine expansion project in northern Nevada.

NV Energy, Sunrise Tap LV#1 69 kV Corridor, Nevada

Cultural Resources Specialist responsible for a field survey and site record updates for the repair of existing lines and assessment for proposed additional lines to the transmission system in Las Vegas.

NCP, Microwave and Mobile Radio EA, Nevada

Archaeologist responsible for a field survey and site record updates for and environmental assessment for a proposed new microwave transmission system.

Sheep Creek Channel Invert Restoration Project, California

Cultural Resources Specialist responsible for a literature review, field survey, site record updates, and preparation of cultural resources technical report for the Initial Study for this channel restoration project in San Bernardino County. Research indicated the presence of several historic resources for which current evaluations and updates were conducted.

Monument Fuel Break Project, California

Cultural Resources Specialist responsible for assisting in the preparation of cultural resources technical report and DPR site records for a brush removal project on BLM lands within Riverside County.

San Diego Gas & Electric Company, Sunrise Powerlink EIS/EIR, California

Archaeologist responsible for cultural and paleontological resources services for an approximately 125-mile-long transmission line in San Diego and Imperial counties. Assisted with preparation of cultural resources technical report and EIS / EIR section for alternatives routes.

BLM, Bragg Shooflies Project, California

Cultural Resources Specialist responsible for preparing the BLM Class III cultural resources inventory report for a road-grading trespass on BLM-managed lands Imperial County.

Los Angeles Unified School District, South Region Elementary School No. 3, California

Archaeologist responsible for a literature review for a proposed construction site for the LAUSD.

CAJA, Avenue of the Stars, California

Archaeologist responsible for a literature review for a constraints analysis for a proposed construction site in an undisclosed location on Avenue of the Stars in Los Angeles.

U.S. Army Corps of Engineers, San Gabriel Trench, California

Archaeologist responsible for a literature review for a proposed grade separation project in the cities of Alhambra and San Gabriel in Los Angeles County.

Norco Regional Conservancy, Lake Norconian Club Historic District, California

Archaeologist participating in the ongoing preservation efforts for the National Register listed resource. Responsibilities include consultation with the U.S. Navy Cultural Resources Southwest Division, the California Office of Historic Preservation, the California State Historical Resources Commission, the National Trust for Historic Preservation, the Advisory Council for Historic Preservation, and various state and local preservation organizations and specialists.

Moreno House Preservation, California

Archaeologist participating in the preservation efforts, significance evaluation, and nomination process for the Moreno House in Norco. Responsibilities included consultation with the landowner and the City of Norco Planning Commission and City Council.

NearCal, Lake Elsinore Auto Complex Project, California

Archaeologist responsible for a cultural resources assessment in compliance with CEQA of the proposed Lake Elsinore Auto Complex project located in Lake Elsinore in Riverside County. No resources were identified within the project boundaries.

Leighton Consulting, Fairmount Park Lake Dredging Project, California

Archaeologist responsible for research that indicated a dredging project fell within the boundaries of Fairmount Park, listed as a Landmark of the City of Riverside, as well as numerous significant prehistoric sites. Recommended mitigation measures to reduce the impact to historic resources located within the lake and surrounding landscape features.

City of Highland, Wal-Mart Superstore, California

Archaeologist responsible for a cultural resources assessment of a proposed 20-acre development for the Highland Wal-Mart Superstore in the city of Highland, San Bernardino County. The literature review indicated four cultural resources had been documented within the project boundaries, all of which were determined to be ineligible for inclusion to the National Register of Historic Places and the California Register of Historical Resources in compliance with CEQA.

Riverside County Transportation Commission, Mid-County Parkway, California

Archaeologist responsible for the survey, site testing, data recovery, and artifact illustration in compliance with Section 106 of the NHPA. This project consisted of an approximately 25-mile corridor in which were located a large volume of sensitive prehistoric resources in Riverside County.

Specialty Mines, Cushenbury 21 Mine Reclamation Project, California

Archaeologist responsible for a field survey, historic site evaluation, and recording for a mine reclamation project San Bernardino County in

compliance with CEQA. One previously undocumented historic site was identified and documented during the field survey.

United Engineering, Apple Valley / Bear Valley Environmental Impact Assessment, California

Archaeologist responsible for a cultural resources assessment for the proposed development of the Bear Valley and Apple Valley Residential Project within the town of Apple Valley in San Bernardino County. The project assessment included a field survey and site recording in compliance with CEQA.

City of Adelanto, Target Gateway Initial Study, California

Archaeologist responsible for a cultural resources assessment for a proposed commercial development in Adelanto. The project included a field survey and site recording in compliance with CEQA.

Bergantz Development Corporation, P.I. Market Demolition Project, California

Archaeologist responsible for architectural demolition monitoring for the historic P. I. Market (P-40-041174), in the city of Pismo Beach of San Luis Obispo County. The site had been previously evaluated for inclusion to the California Register of Historical Resources. In compliance with CEQA, the client was required to retain a professional historical archaeologist to document and report any artifacts of relevance located during monitoring of the demolition process that may add materially to the understanding of the building and its place in the history of Pismo Beach.

SunCal, McSweeny Farms Residential Development, California

Archaeologist responsible for participating in a survey that identified 19 prehistoric and/or historic sites within the McSweeny Farms Specific Plan area of potential effects (APE) for the proposed residential development in Riverside County. A testing and evaluation plan was developed which included data recovery, data analysis, and artifact analysis to evaluate the sites regarding their eligibility for inclusion to the National Register of Historic Places in compliance with Section 106 of the NHPA.

South Coast Winery Resort and Spa, CEQA Compliance, California

Archaeologist responsible for a records search and field survey in compliance with CEQA for a new winery in the city of Temecula in Riverside County. No cultural resources were identified as a result of the 109-acre survey.

BMLA Inc., El Cerrito Park Project, California

Archaeologist responsible for conducting an assessment of the proposed 26-acre El Cerrito Park project pursuant to CEQA. The literature review and field survey did not locate any cultural resources within the project.

Thomas Olsen Associates, French Valley Business Center, California

Archaeologist responsible for a literature review and field survey of a commercial development in Riverside County. Identified two prehistoric cultural resources within the project boundary that were potentially significant under CEQA and determined that, based on the proximity to a previously documented village site, there was a high potential for subsurface deposits, features, and artifacts associated with the site. Phase II archaeological evaluation and monitoring were recommended.

City of San Jacinto, Sanderson Avenue Widening, California

Archaeologist responsible for the literature review and field survey to determine that one cultural resource, a portion of the Colorado River Aqueduct (33-11265), crosses below ground under Sanderson Avenue in the city of San Jacinto, Riverside County. No additional resources were identified and no further investigation or monitoring was recommended in compliance with CEQA.

Kroh Architects, Calvary the Brook Project, California

Archaeologist responsible for the literature review and field survey that determined no cultural resources were present within the project boundaries pursuant to CEQA. The project fell within the community of Highgrove, Riverside County.

Lim and Nascimento Engineering Corporation, East Palm Canyon Bridge Widening Project, California

Archaeologist responsible for the literature review and field survey that determined no cultural resources were present within the project boundaries pursuant to CEQA. This project consisted of the cultural resources assessment for the 1.76-acre East Palm Canyon Bridge Widening project in Cathedral City, Riverside County.

California Business Condos, Minthorn Street Project, California

Archaeologist responsible for the historical background research and archaeological field survey of a street project within the city of Lake Elsinore, Riverside County. The survey identified one historical-period residence and related features (33-15437) which were recorded and evaluated for listing with the National Register of Historic Places and the California Register of Historical Resources. The site did not appear to be eligible for listing and, therefore, was not considered a historical resource under CEQA.

Mr. Chuck Hain, Beacon Way Project, California

Archaeologist responsible the cultural resources assessment of the Beacon Way project, located on a 0.4-acre parcel within the City of Riverside. The records search and historic background research indicate that the property is situated within a previously documented historic archaeological site (CA-RIV-4172H) which contains an extensive network of terracing, rockwork, and landscaping as well as a historic water pumping station and associated pipelines known as Mary Evans Booster Station.

Department of Public Works, City of Temecula, Temecula Education Center, California

Archaeologist responsible for the cultural resource excavation monitoring program and report in compliance with CEQA. The project was in Riverside County.

Southern California Edison, Substation Project, California

Archaeologist responsible for a records search and literature review for an approximate 45-mile project including San Timotoe Canyon and Live Oak Canyon roads for a proposed substation project within unincorporated Riverside and San Bernardino counties.

Southern California Edison, San Timoteo Canyon Road Survey, California

Archaeologist responsible for conducting a pedestrian survey of an approximately 10-mile length of San Timoteo Canyon Road in unincorporated Riverside County.

Southern California Edison, Replacement Pole Survey, California

Archaeologist responsible for surveys of deteriorating transmission line structures within Tulare, San Bernardino, and Riverside counties.

Whelton-Mohawk Cultural Survey, Arizona

Archaeologist responsible for a field survey of large tracts of land in Yuma for a federal land transfer project. The survey was in compliance with Section 106 of the NHPA.

U.S. Forest Service, Thomas Mountain Fuels Reduction Survey, California

Archaeologist responsible for a survey that relocated nine previously documented archaeological sites and identified nine previously undocumented archaeological sites Riverside County. The survey area covered approximately 10,000 acres and was conducted in compliance with NHPA.

Nellis Air Force Base, Joint Red Flag Project, Nevada

Archaeologist responsible for a survey in compliance with NHPA of multiple sections of land for potential use in military training maneuvers.

Lewis Homes, Inc., Lakeview, California

Archaeologist responsible for a survey and testing of a large section of land for residential development in Riverside County in compliance with CEQA.

U.S. Air Force, Barry M. Goldwater Range, Arizona

Archaeologist responsible for a survey and the flagging for protection of sensitive sites in Gila Bend during an ordnance removal project. The survey was conducted in compliance with NHPA.

Playa Vista, California

Archaeologist responsible for an excavation in Los Angeles County of a prehistoric and historical-period cemetery site in the Ballona Wetlands. Provided archaeological illustrations of the site.

U.S. Army Corps of Engineers, Prado Dam, California

Archaeologist responsible for construction monitoring of a historical-period site for expansion of the flood-control overflow area north of the Prado Dam in San Bernardino County.

San Bernardino National Forest, Pan Hot Springs, California

Archaeologist responsible for a survey and emergency excavation of a prehistoric site exposed as the result of a fire break.

Irvine Company, CA-ORA-269 Site, California

Archaeologist responsible for the excavation of a rock shelter shell midden site and the laboratory cataloging of artifacts on the Newport Coast in Orange County.

Publications/Reports

- Austerman, Virginia. 2009. Archaeological Survey of Nineteen Proposed MV-22 Osprey Landing Areas, Chocolate Mountains Aerial Gunnery Range, Imperial County, California. Report prepared for client, on file at the South Coast Information Center, San Diego State University, San Diego, California.
- Austerman, Virginia. 2009, Draft Cultural Resources Survey for the Proposed Oxnard Airport Land/Easement Acquisition Project, City of Oxnard, Ventura County, California. Report prepared for client, on file at the South Central Coastal Information Center, California State University, Fullerton, California.
- Austerman, Virginia. 2009. Cultural Resources Survey for the Kramer Junction Solar Energy Center Project, San Bernardino County, California. Report prepared for client, on file at the San Bernardino Archaeological Information Center, San Bernardino County Museum, Redlands, California.
- Austerman, Virginia. 2008. Cultural Resources Survey for the Sheep Creek Channel Invert Restoration Project, Wrightwood, San Bernardino County, California. Report prepared for client, on file at the San Bernardino Archaeological Information Center, San Bernardino County Museum, Redlands, California.
- Austerman, Virginia. 2008. Cultural Resources Assessment for the Thomas Mountain Fuels Reduction Project, San Bernardino National Forest, San Jacinto Ranger District, Idyllwild, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2008. Cultural Resources Assessment for the Highland Wal-Mart Superstore Project, City of Highland, San Bernardino County, California. Report prepared for client, on file at the San Bernardino Archaeological Information Center, San

Bernardino, California.

- Austerman, Virginia. 2008. Cultural Resources Assessment for the San Sevaine Multiple Family Residential Affordable Housing Project, City of Rancho Cucamonga, California. Report prepared for client, on file at the San Bernardino Archaeological Information Center, San Bernardino, California.
- Austerman, Virginia. 2008. Cultural Resources Assessment for the Riverside Community College District for the Nursing and Physical Sciences Building in the Downtown Riverside Campus, City of Riverside, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2008. Cultural Resources Assessment for the Magnolia Avenue Widening-Cahuenga Boulevard to Vineland Avenue Project, City of Los Angeles, California. Report prepared for client, on file at the South Central Coastal Information Center, CSUF, Fullerton, California.
- Austerman, Virginia. 2007. Cultural Resources Assessment for the Fairmount Park Lake Dredging Project, City of Riverside, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2007. Cultural Resources Revisions to the Mine Reclamation Plan 96M-02, Arctic Canyon, Cushenbury 21 and Marble Canyon Quarries Project, Lucerne Valley, San Bernardino County, California. Report prepared for client, on file at the San Bernardino Archaeological Information Center, San Bernardino Museum, Redlands, California.
- Austerman, Virginia. 2007. Cultural Resources Assessment for the Sanderson Avenue Widening Project, City of San Jacinto, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2007. Cultural Resources Assessment for the Adelanto Target Gateway Project, City of Adelanto, San Bernardino County, California. Report prepared for client, on file at the San Bernardino Archaeological Information Center, San Bernardino County Museum, Redlands, California.
- Austerman, Virginia. 2007. Cultural Resources Assessment for the French Valley Business Center, Unincorporated Area of Riverside County, Riverside, California. Report prepared for client, on file at the Eastern Information Center, UCR. Riverside, California.
- Austerman, Virginia, with Casey Tibbett. 2007. Cultural Resources Assessment for the Minthorn Street Project, City of Lake Elsinore, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2007. Cultural Resources Assessment for the Bear Valley/Apple Valley Project, Town of Apple Valley, San Bernardino County, California. Report prepared for client, on file at San Bernardino County Archaeological Center, San Bernardino County Museum, Redlands California.
- Austerman, Virginia. 2006. Archaeological Monitoring Program for Temecula Education Center, City of Temecula, Riverside County, California. Report prepared for client, on file at Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2006. Cultural Resources Assessment for the Mission Creek Project, City of Desert Hot Springs, Riverside County, California. Report prepared for client, on file at Eastern Information

Center, UCR, Riverside, California.

- Austerman, Virginia. 2006. Cultural Resources Assessment for the Citrus Estates Project, City of Perris, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2006. Cultural Resources Assessment of the Murrieta Date Street Project, City of Murrieta, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2006. Archaeological Monitoring Report for the Stoneridge Ranch Project, City of Moreno Valley, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2006. Cultural Resources Assessment for the Village Walk Project, City of Murrieta, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR, Riverside, California.
- Austerman, Virginia. 2006. Cultural Resources Assessment for the Valle Reseda Project, City of San Jacinto, Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR Riverside, California.
- Austerman, Virginia. 2006. Cultural Resources Assessment for the Baxter Street Project, in an Unincorporated Area of Riverside County, California. Report prepared for client, on file at the Eastern Information Center, UCR Riverside, California.
- Austerman, Virginia, with Kenneth Becker. 2005. Cultural Resources Survey of the Feole Property, APN 0405-052-02, Hesperia, San Bernardino, California. Draft report prepared for Lewis Operating Corp., Upland, California. Statistical Research, Inc., Technical Report 05-44; Redlands, California.
- Austerman, Virginia, with Katherine H. Pollack and Michael K. Lerch. 2005. Deteriorated Pole Replacement Project: Archaeological Survey of Five Pole Locations on the Valley-MWD-Stetson 115 kV Transmission Line, Riverside County, California. Draft report prepared for Southern California Edison Company, Rosamond, California. Statistical Research, Inc. Technical Report 05-71; Redlands, California.
- Austerman, Virginia, with Katherine H. Pollack and Michael K. Lerch. 2005. Deteriorated Pole Replacement Project: Archaeological Survey of One Pole Location on the Eucalypts 12kV Transmission Line, City of Chino Hills, San Bernardino County, California. Draft report prepared for Southern California Edison Company, Rosamond, California. Statistical Research Inc., Technical Report 05-72; Redlands, California.
- Austerman, Virginia, with Katherine H. Pollack and Michael K. Lerch. 2005. Deteriorated Pole Replacement Project: Archaeological Survey of One Pole Location on the Cram 12kV Transmission Line, San Bernardino National Forest, San Bernardino County, California. Draft report prepared for Southern California Edison Company, Rosamond, California. Statistical Research, Inc., Technical Report 05-73; Redlands, California.
- Austerman, Virginia, with Katherine H. Pollack and Michael K. Lerch. 2005. Archaeological Survey of a 2.75 Mile Section of the Etiwanda-Arch line-Cucamonga-Genomic 66kV Transmission Line to be Rebuilt, Riverside County, California. Draft report prepared for

Southern California Edison Company, Rosemead, California. Statistical Research Inc., Technical Report 05-74; Redlands, California.

- Austerman, Virginia, with Katherine H. Pollack and Michael K. Lerch. 2005. Archaeological Survey of a 3000 Foot Section of the Bloomington-Colton-Colton-Cement 66kV Transmission Line to be Rebuilt, Riverside County, California. Draft report prepared for Southern California Edison Company, Rosemead, California. Statistical Research, Inc., Technical Report 05-75; Redlands, California.
- Austerman, Virginia, with Kenneth Baker. 2004. Archaeological Monitoring at Prado Dam, CA-SBR-8091/H, San Bernardino County, California. Prepared for the Army Corps of Engineers Los Angeles District Ecosystem Planning Section, Los Angeles, California. Statistical Research, Inc.; Technical Report 04-50, Redlands, California.
- Austerman, Virginia. 2004. Ground, Grooved, Pecked and Painted: Indigenous Imagery of Orange County. Unpublished Master's Thesis on file at California State University, Fullerton, California.

Papers Read / Posters Presented

- "When a National Register Historic District Falls through the Cracks: Rescuing the Lake Norconian Club." Poster presented at the Society for California Archaeology annual meeting, Burbank, California, April 2008.
- "When a National Register Historic District Falls through the Cracks: Rescuing the Lake Norconian Club." Poster presented at the Society for American Archaeology annual meeting, Vancouver, British Columbia, March 2008.
- "Indigenous Imagery of Orange County, California." Poster presented at the Society for American Archaeology annual meeting, Austin, Texas, April 2007.
- "Structures of Unknown Origin"; Society for California Archaeology Southern Data Sharing Meeting, San Diego, California, November 2003.
- "The Date Debate: The Effects of Technological Dating on the Stylistic Chronologies of the Decorated Caves of the Upper Paleolithic Franco-Cantabrian Region", CSU Fullerton, Fall Colloquia, November 2002.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D2
ARCHAEOLOGICAL RESOURCES AND BUILT ENVIRONMENT SURVEY
TRANSMISSION LINE ALTERNATIVES
SUPPLEMENTAL REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

February 2013

BLYTHE MESA SOLAR PROJECT

Archaeological Resource and Built Environment Survey

Transmission Line Alternatives Supplemental Report

Riverside County, California

Riverside County Planning Department Case Number CUP 03685

BLM Cultural Resource Use Permit No. CA-09-36
Fieldwork Authorization No. 66.66 11-18 (Issued 6/5/11)
Fieldwork Authorization No. 66.66 12-16 (Issued 5/24/12)

PROJECT NUMBER:
122512

PROJECT CONTACT:
Jim Rudolph, PH.D.
EMAIL:
jim.rudolph@powereng.com
PHONE:
(208) 288-6323

LEGAL DESCRIPTION: T7S, R21E, Sections 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12

ACREAGE: 454 acres

USGS QUADRANGLES: Roosevelt Mine

KEY WORDS: Inventory, Historic Sites, Archaeological Sites, Riverside County, P-33-014150, P-33-017319, P-33-019612, P-33-019682, P-33-019703, P-33-019704, P-33-019712, P-33-019714, P-33-019733, P-33-019736, P-33-019737, P-33-019739, P-33-019760, P-33-019770, P-33-020317, P-33-021130, P-33-021131, P-33-021132, P-33-021133, P-33-021134, P-33-021135, P-33-021137

FIELDWORK CONDUCTED: June-July 2012

POWER ENGINEERS

AR061519

BLYTHE MESA SOLAR PROJECT
ARCHAEOLOGICAL RESOURCE AND BUILT ENVIRONMENT SURVEY
TRANSMISSION LINE ALTERNATIVES SUPPLEMENTAL REPORT
RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR:

Applicants
SOLAR STAR BLYTHE MESA 1, LLC
and
RENEWABLE RESOURCES GROUP
5700 WILSHIRE BLVD., SUITE 330
LOS ANGELES, CALIFORNIA 90036
(323) 936-9303

Lead Agencies
BUREAU OF LAND MANAGEMENT
RENEWABLE ENERGY COORDINATION OFFICE
CALIFORNIA DESERT DISTRICT
MORENO VALLEY, CALIFORNIA
and
COUNTY OF RIVERSIDE
PLANNING DEPARTMENT
4080 Lemon Street
Riverside, CA 92502-1409
(951) 955-6863

PREPARED BY:

POWER ENGINEERS, INC.
731 EAST BALL ROAD, SUITE 100
ANAHEIM, CALIFORNIA 92805
(714) 507-2700

GINI AUSTERMAN, JOHANNA MARTY
and JIM RUDOLPH (PRINCIPAL INVESTIGATOR)

Blythe Mesa Solar Project
Archaeological Resource and Built Environment Survey
Transmission Line Alternatives Supplemental Report, April 2013
Errata Sheet (responses to County comments), September 2013

County Comment 7/22/13	Errata
Cover Page	Replace cover page with attachment
Title page	Replace on Title Page *PREPARED FOR:* *Applicants* *SOLAR STAR BLYTHE MESA 1, LLC* *and* *RENEWABLE RESOURCES GROUP* *5700 WILSHIRE BLVD., SUITE 330* *LOS ANGELES, CALIFORNIA 90036* *(323) 936-9303* *Lead Agencies* *BUREAU OF LAND MANAGEMENT* *RENEWABLE ENERGY COORDINATION OFFICE* *CALIFORNIA DESERT DISTRICT* *MORENO VALLEY, CALIFORNIA* *and* *COUNTY OF RIVERSIDE* *PLANNING DEPARTMENT* *4080 Lemon Street, 12th Floor* *P.O. Box 1409* *RIVERSIDE, CALIFORNIA 92502-1409* *(951) 955-1811* *PREPARED BY:* *POWER ENGINEERS, INC.* *731 EAST BALL ROAD, SUITE 100* *ANAHEIM, CALIFORNIA 92805* *(714) 507-2700* *GINI AUSTERMAN, JOHANNA MARTY* *and JIM RUDOLPH (PRINCIPAL INVESTIGATOR)*

Page 6, fourth paragraph	Insert the following text: "Archaeological resources were divided into two categories: archaeological sites and isolated finds. Isolated finds are here defined as three or fewer prehistoric artifacts of the same type (e.g., flakes or sherds) or five or fewer historic artifacts (e.g., cans, bottle glass), that are spatially discrete from any other artifacts by a minimum distance of 30 meters. Archaeological sites are defined as four or more prehistoric artifacts or six or more historic artifacts within a 10-meter-square area.
Page 10, Table 3, last row	Replace: "RI-8730*" with "RI-8730"
Page 14, second paragraph, beginning with second sentence	Change the following text: "A total of 23 cultural resources were recorded or revisited as part of the BLM Class III survey, as described in Table 5, including 15 previously recorded archaeological sites and isolated finds ~~resources~~ (see Table 4) and eight newly recorded archaeological sites and isolated finds. Of the 23 resources, 14 are archaeological sites, of which seven are prehistoric and eight are historic (one site has both prehistoric and historic components). Nine of the resources within the APE are isolated finds, of which four have prehistoric artifacts and six are historic (one isolated find contained both prehistoric and historic artifacts). There were no architectural resources within the APE."
Page 14, third paragraph, first sentence	Replace with the following: "Of the 15 previously recorded cultural resources within the APE, all had been recorded within the past five years, some as recently as 2011, and did not require updated DPR forms because their conditions had not changed."
Page 18. Third paragraph	Insert the following text: "The site contained nearly 30 complete cans and more than 100 can fragments related to the military use of the area between 1942 and 1944. Most of the cans were in a very small (2.1-by-1.5-meter) area. This concentration included three No. 10 sanitary cans, 20 No. 2 sanitary cans, and one evaporated milk can. The manufacturing age of the cans ranges from the mid-1930s to the 1950s, but it is most likely they were discarded in a single episode. It is possible that the can scatter was deposited during military training activities associated with BAAB."
Page 18, fifth paragraph, last sentence	Insert the following text: "None of the cans and can fragments demonstrate ties with the DTC/C-AMA. The cans date to the 1930s to 1950s and are not described as military-issue (i.e. K- or C-ration tins).
Page 19, eighth paragraph	Change the following text: "ASM Affiliates revisited this site in June 2011 to perform detailed recording. Using a metal detector, ~~Applied EarthWorks~~ ASM determined that metal objects may exist beneath the surface. They also reported disturbance to part of the site by off-road vehicles."
Page 28, first paragraph	Insert the following text: "Isolated finds are here defined as three or fewer prehistoric artifacts of the same type (e.g., flakes or sherds) or five or fewer historic artifacts (e.g., cans, bottle glass), that are spatially discrete from any other artifacts by a minimum distance of 30 meters."
A-3 Table:	Insert the following title above table: "Previously Recorded Cultural Resources within One Mile of APE"
References	Reference page attached

6.0 REFERENCES

Bischoff, M.C. 2000. *The Desert Training Center/California-Arizona Maneuver Area, 1942-1944: Historical and Archaeological Contexts.* Technical Series 75. Statistical Research, Inc., Tucson, Arizona.

Carper, M., and J. Farrell. 2009. Site Record, 33-14150 (CA-RIV9100). On file at the Eastern Information Center, University of California-Riverside, Riverside, California.

Carrico, R. and W. Eckhardt. 2005. Cultural Resource Inventory of the Proposed Blythe Energy Transmission Line Project, Riverside County, California. Prepared for the BLM, Palm Springs South Coast Field Office and Southern California Edison, Rosemead, California.

Carrico, R., K. Walker, and W. Eckhardt. 2004. Draft Cultural Resources Inventory of the Proposed Devers to Palo Verde II 500 kV Transmission Line, Riverside County, California

Eckhardt, W., and S.C. Jordan. 2008. Cultural Resource Inventory of the Proposed Midpoint DPVII Substation Project, Riverside County, California. Submitted to the BLM Desert District, Moreno Valley. On file at the Eastern Information Center, University of California-Riverside, Riverside, California.

Enright, E., and M. Mirro. 2011. Class III Cultural Resources Survey for the Colorado River Substation Alternatives Analysis, Unincorporated Riverside County, California. On file at the Eastern Information Center, University of California-Riverside, Riverside, CA.

Farrell, J., F. Buddinger and R. L. Carrico. 2009. Final Amendment to Cultural Resources Inventory of the Proposed Blythe Energy Project Transmission Line, Riverside County, California. Report prepared for the BLM, Palm Springs South Coast Field Office, On file at the Eastern Information Center, University of California-Riverside, Riverside, California. Jones and Stokes, San Diego, CA.

Horn, Jonathon C. 2005. *Historic Artifact Handbook.* Prepared for Alpine Archaeological Consultants, Inc. Montrose, CA.

Mitchell, P.C. 2010a. *Final Phase I Cultural Resource Assessment of the Proposed Blythe Airport Solar Project, Blythe, Riverside County, California.* KP Environmental, LLC, Cardiff By The Sea, California.

_____. 2010b. Site Record, Blythe Army Air Base Historic District P-33-18837. On file at the California Historical Resource Information System, Eastern Information Center, University of California, Riverside.

POWER Engineers, Inc. (POWER). 2013. Blythe Mesa Solar Project Cultural Resources Survey Report. Prepared for the BLM and Renewable Resources Group, LLC. POWER Engineers, Inc. Anaheim, California.

Rock, J.T. 1984. Cans in the Countryside. *Historical Archaeology* 18 (2).

Sharley, Ann. 2002. *Bleach Bottles as an Aid to Dating Historic Sites*. Paper presented at the 55Th Annual Northwest Anthropological Conference, Boise, Idaho.

Society for Historical Archaeology (SHA) and Bureau of Land Management (BLM). 2012. *Historic Glass Bottle Identification & Information Website*.: http://www.sha.org/bottle/index.htm. Accessed August 1, 2012.

Torres, C. 2012. California Department of Parks and Recreation (DPR) 523 Site Form for P-33-20318. On file at the Eastern Information Center, University of California-Riverside, Riverside, California.

Toulouse, J.H. 1971. *Bottle Makers and Their Marks*. Thomas Nelson, New York.

U.S. Geological Survey. 1983. Roosevelt Mine, California [map]. 1:24,000 7.5 Minute Series. Reston, Virginia.

Whitten, D. n.d. Glass Bottle Marks. http://www.glassbottlemarks.com

Wilson, A. 2008. *Runways in the Sand: the History of Blythe Army Air Base in World War II*. Self Published, Blythe, California.

MANAGEMENT SUMMARY

This supplemental archaeological resource and built environment survey report has been prepared by POWER Engineers, Inc. (POWER) to summarize the results of a records search, literature review, and survey for archaeological and architectural resources potentially affected by construction, operation, and maintenance of proposed and alternative transmission lines associated with the proposed Blythe Mesa Solar Project (Project). No architectural resources were identified within the portion of the Project area of potential effects (APE) addressed in this supplemental report. This Project, which has been proposed by Renewable Resources Group and Solar Star Blythe Mesa 1, LLC, would be on both private and public land in Riverside County, California. The Blythe Mesa Solar Project Archaeological Resource and Built Environment Survey Final Report (POWER 2013) was submitted to the U.S. Department of the Interior, Bureau of Land Management (BLM) in January 2013; this document is a supplemental report addressing only the APE for the proposed 230 kilovolt (kV) transmission line and two alternatives.

The initial report (POWER 2013) addressed the results of a 2011 survey of the entire 3,587-acre electrical generating facility and associated infrastructure and of a 125-foot-wide corridor along a proposed 4.8-mile transmission line (Alternative 1, the proposed Project). It was later decided by the BLM that, to satisfy the requirements for Section 106 of the National Historic Preservation Act, the proposed transmission line APE should be 300 feet wide rather than 125 feet. Also, the BLM required the survey of two transmission line alternatives, a Northern Alternative and a Southern Alternative. This supplemental report addresses survey of the entire 300-foot off-site corridor of Alternative 1 (including resurvey of the original 125-foot corridor) and survey of the 300-foot off-site corridors of the two alternative transmission lines.

All identified cultural resources were found on BLM-managed land. None are on private land under the jurisdiction of Riverside County.

Table MS-1 presents the cultural resources identified during the inventory of the transmission line APE, ownership, recommended National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR) eligibility, and project alternative. All were either archaeological sites or isolated finds. No architectural features were found.

Table MS-1. Cultural Resources within the APEs of Transmission Line Alternatives

FIELD NUMBER OR PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	AGE	JURIS-DICTION	NRHP OR CRHR ELIGIBILITY RECOMMENDATION	ALTERNATIVE 1	NORTHERN ALTERNATIVE	SOUTHERN ALTERNATIVE
Archaeological Sites								
P-33-014150	CA-RIV-9100	Two-track road	Historic	BLM	Determined not eligible by SHPO 2/11/09			X
P-33-017319	CA-RIV-9009	World War II refuse scatter	Historic	BLM	Not eligible		X	
P-33-019682	CA-RIV-9997	World War II refuse scatter	Historic	BLM	Not eligible			X
P-33-019703	CA-RIV-10018	World War II fighting hole, refuse scatter	Historic	BLM	Not eligible			X
P-33-019714	CA-RIV-10028	World War II refuse scatter; one chert core	Prehistoric/Historic	BLM	Eligible pending further investigation			X
P-33-019733	CA-RIV-10047	Lithic scatter	Prehistoric	BLM	Not eligible			X
P-33-019736	CA-RIV-10050	Wood debris	Historic	BLM	Not eligible			X
P-33-019737	CA-RIV-10051	Lithic scatter	Prehistoric	BLM	Not eligible			X
P-33-019739	CA-RIV-10053	Lithic scatter	Prehistoric	BLM	Not eligible			X
P-33-019760	CA-RIV-10073	Lithic scatter	Prehistoric	BLM	Eligible pending further investigation			X
P-33-021130	CA-RIV-10962	Ceramic scatter	Prehistoric	BLM	Not eligible			X
P-33-021131	CA-RIV-10963	Ceramic scatter	Prehistoric	BLM	Not eligible			X
P-33-021132	CA-RIV-10964	Refuse scatter	Historic	BLM	Not eligible			X
P-33-021133	CA-RIV-10965	World War II refuse scatter	Historic	BLM	Not eligible		X	
Isolated Finds								
P-33-019612		Can	Historic	BLM	Not eligible		X	
P-33-019704	CA-RIV-10019	Metal debris	Historic	BLM	Not eligible			X
P-33-019712		Survey marker	Historic	BLM	Not eligible			X
P-33-019770		Flake and can	Prehistoric/Historic	BLM	Not eligible	X		
P-33-020317		Hammerstone	Prehistoric	BLM	Not eligible			X
P-33-021134		Sherds	Prehistoric	BLM	Not eligible		X	
P-33-021135		Cans	Historic	BLM	Not eligible		X	
P-33-021136		Sherds	Prehistoric	BLM	Not eligible	X		
P-33-021137		Cans	Historic	BLM	Not eligible	X		

CONTENTS

ERRATA SHEET
MANAGEMENT SUMMARY ..... **I**
ACRONYMS AND ABBREVIATIONS ..... **V**
1.0 INTRODUCTION **1**
1.1 PURPOSE OF REPORT 1
1.2 PROJECT OVERVIEW 1
2.0 INVENTORY METHODS **6**
2.1 HISTORIC BACKGROUND AND RECORDS SEARCH 6
2.2 FIELD METHODS 6
2.3 NATIVE AMERICAN COORDINATION 6
3.0 INVENTORY RESULTS **8**
3.1 RESULTS OF BACKGROUND RESEARCH AND RECORD SEARCH 8
3.2 RESULTS OF SURVEY 14
3.2.1 Archaeological Sites 16
3.2.2 Isolated Finds 28
4.0 IMPACTS/EFFECTS **30**
4.1 EFFECTS UNDER THE NATIONAL HISTORIC PRESERVATION ACT 30
4.2 IMPACTS UNDER THE CALIFORNIA ENVIRONMENTAL QUALITY ACT 30
4.2.1 Application of CEQA Significance Thresholds 32
5.0 RECOMMENDATIONS **33**
6.0 REFERENCES **34**
7.0 REPORT PREPARERS **36**
8.0 FIELD PERSONNEL **36**

FIGURES

FIGURE 1. PROJECT LOCATION 2
FIGURE 2. PREVIOUS CULTURAL RESOURCE SURVEYS 12
FIGURE 5. SITE P-33-021130 OVERVIEW, FACING SOUTH-SOUTHWEST 24
FIGURE 6. SITE P-33-021131 OVERVIEW, FACING NORTHEAST 25
FIGURE 7. SITE P-33-021132 OVERVIEW, FACING EAST 26
FIGURE 8. SITE P-33-021133 OVERVIEW, FACING WEST 28
FIGURE 3. PREVIOUSLY RECORDED CULTURAL SITES (CONFIDENTIAL) A-8
FIGURE 4. CULTURAL SITES IN THE AREA OF POTENTIAL EFFECTS (CONFIDENTIAL) D-3

TABLES

TABLE MS-1. CULTURAL RESOURCES WITHIN THE APES OF TRANSMISSION LINE ALTERNATIVES ii
TABLE 1. APE ACREAGE AND JURISDICTION 1
TABLE 2. ASSESSOR PARCELS WITHIN THE PROPOSED AND ALTERNATIVE TRANSMISSION LINE ROWS 5
TABLE 3. PREVIOUS CULTURAL RESOURCE STUDIES WITHIN ONE MILE OF TRANSMISSION LINE ALTERNATIVES 9
TABLE 4. PREVIOUSLY RECORDED CULTURAL RESOURCES WITHIN APES OF TRANSMISSION LINE ALTERNATIVES 11
TABLE 5. CULTURAL RESOURCES WITHIN APES OF TRANSMISSION LINE ALTERNATIVES 15
TABLE 6 ELIGIBILITY RECOMMENDATIONS FOR CULTURAL RESOURCES WITHIN APE 16
TABLE 7. ARCHAEOLOGICAL SITES WITHIN PROJECT BOUNDARIES 31

APPENDICES

APPENDIX A (CONFIDENTIAL): PREVIOUSLY RECORDED CULTURAL RESOURCES WITHIN ONE MILE OF ALTERNATIVES
APPENDIX B: GENERAL LAND OFFICE RECORDS WITHIN ONE MILE OF THE PROJECT
APPENDIX C (CONFIDENTIAL): ARCHAEOLOGICAL RESOURCES IN THE PROPOSED AND ALTERNATIVE APES
APPENDIX D (CONFIDENTIAL): CALIFORNIA OFFICE OF HISTORIC PRESERVATION DPR-523 FORMS

ACRONYMS AND ABBREVIATIONS

AMSL	above mean sea level
APE	area of potential effects
BLM	United States Department of the Interior, Bureau of Land Management
CEQA	California Environmental Quality Act
CHRIS	California Historical Resources Information System
CRHR	California Register of Historical Resources
CRUP	Cultural Resource Use Permit
DPR	Department of Parks and Recreation
DTC/CAMA	Desert Training Center/California Arizona Maneuver Area
EIC	Eastern Information Center
GLO	General Land Office
GPS	Global Positioning System
kV	kilovolt
MLD	Most Likely Descendant
MW	megawatt
NAHC	Native American Heritage Commission
NAGPRA	Native American Graves Protection and Repatriation Act
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
OHP	California State Office of Historic Preservation
POWER	POWER Engineers, Inc.
PRC	Public Resources Code
Project	Blythe Mesa Solar Project
PV	photovoltaic
ROW	right-of-way
RRG	Renewable Resources Group, LLC
SHPO	California State Historic Preservation Officer
SSBM	Solar Star Blythe Mesa 1, LLC.
USGS	U.S. Geological Survey

1.0 INTRODUCTION

1.1 Purpose of Report

This supplemental archaeological resource and built environment survey report has been prepared by POWER Engineers, Inc. (POWER) to summarize the results of a records search, literature review, and survey for archaeological and architectural resources potentially affected by construction, operation and maintenance of proposed and alternative transmission lines associated with the proposed Blythe Mesa Solar Project (Project). The purpose of this investigation was to identify archaeological and architectural resources within the area of potential effects (APE) and evaluate these resources for eligibility for listing on the National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR). Archaeological resources, but no architectural resources, were identified within the portion of the Project APE addressed in this supplemental report. This Project, which has been proposed by Renewable Resources Group (RRG) and Solar Star Blythe Mesa 1 (SSBM), would be on both private and public land in Riverside County, California. For purposes of compliance with the California Environmental Quality Act (CEQA), the County of Riverside is the lead agency, and for the segments of the transmission line crossing federal land, the U.S. Department of the Interior, Bureau of Land Management (BLM) is the lead agency. The Blythe Mesa Solar Project Archaeological Resource and Built Environment Survey Final Report (POWER 2013) was submitted to the BLM in February 2013; this document is a supplemental report addressing only the APE for the proposed 230 kilovolt (kV) transmission line and two alternatives.

The initial survey report (POWER 2013) addressed the results of a 2011 inventory of the entire 3,587-acre electrical generating facility and of a 125-foot-wide right-of-way (ROW) along a proposed 4.8-mile transmission line (Alternative 1, the proposed Project). It was later decided by the BLM that, to satisfy the requirements for Section 106 of the National Historic Preservation Act (NHPA), the proposed transmission line APE should be 300 feet wide rather than 125 feet. Also, the BLM required the survey of two transmission line alternatives, a Northern Alternative and a Southern Alternative. This supplemental report addresses survey of the entire 300-foot APE of Alternative 1 (including resurvey of the original 125-foot corridor) and survey of the 300-foot APEs of the two alternative transmission lines (Table 1; Figure 1).

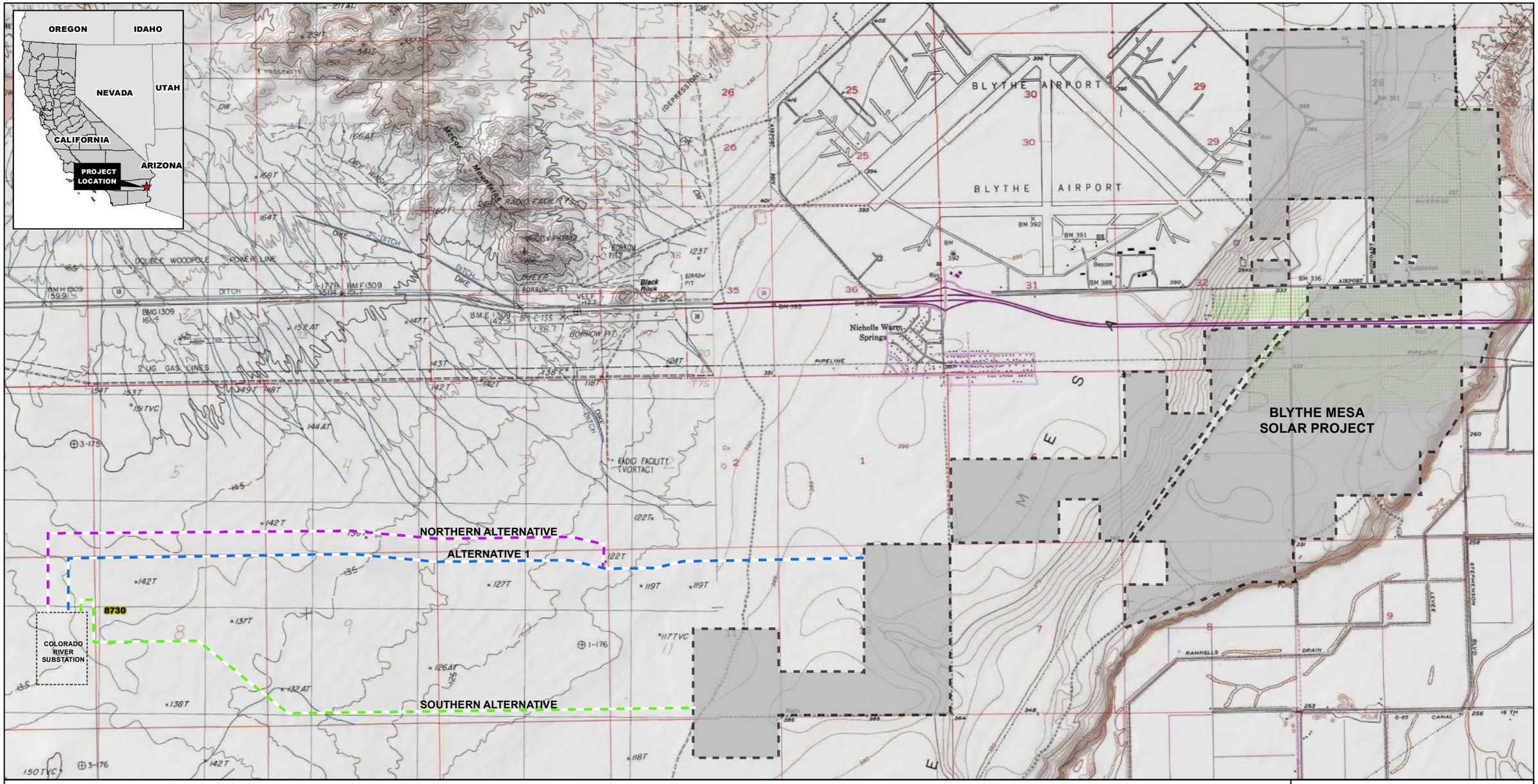
Table 1. APE Acreage and Jurisdiction

	Private Land	BLM-Managed Lands	TOTAL
Solar Facility Site	3,587 acres	0 acres	3,587 acres
230 kV Transmission Line[1]			
Alternative 1[1]	1.0 mile (36 acres)	3.8 miles (138 acres)	4.8 miles (174 acres)[2]
Northern Alternative[1]	0 mile (0 acre)	5.2 miles (189 acres)	5.2 miles (189 acres)[2]
Southern Alternative[1]	0.6 mile (25 acres)	3.4 miles (120 acres)	4.0 miles (145 acres)[2]
Total Project Acreage	3,587 to 3,623 acres	120 to 189 acres	3,732 to 3,776 acres

[1]300-foot-wide corridors outside solar facility site
[2]About 1.5 miles of APE (54 acres) are shared by Alternative 1 and the Northern Alternative.

1.2 Project Overview

A detailed description of the proposed Project is included in the initial survey report (POWER 2013).



Legend

- Alternative 1 230 kV Line
- Northern Alternative 230kV Line
- Southern Alternative 230kV Line
- Colorado River Substation
- Proposed Solar Facility

0 3,000 6,000

Scale in Feet

1:36,000

FIGURE 1

BLYTHE MESA SOLAR PROJECT

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: ArcGIS Online, National Geographic TOPO! 2011, USGS 7.5' Topographic Quadrangle, 1:24,000.

AR061531

THIS PAGE INTENTIONALLY LEFT BLANK

The proposed Project consists of construction and operation of a 485 megawatt (MW) solar photovoltaic (PV) electrical generating facility and associated infrastructure, primarily on private land. The proposed Project would consist of two major components: 1) a solar array field utilizing single-axis solar PV trackers (3,587 acres); and 2) a 230 kV transmission line. The 3,587-acre solar array field would be entirely on private land. The proposed and alternative transmission lines would be built partly within the solar facility and partly off site between the facility and the Colorado River Substation. The ROW for each route would be 125 feet wide, but the APE established by the BLM is 300 feet wide. Depending on which alternative is selected, the transmission line APE would affect an additional 4.8 miles (174 acres), 5.2 miles (189 acres), or 4.0 miles (145 acres) outside the solar facility, primarily on BLM land. The Colorado River Substation site is not included in the APE because the facility has already been permitted and was under construction at the time of the archaeological survey.

The locations of the proposed and alternative transmission lines are on the Roosevelt Mine 7.5-minute U.S. Geological Survey (USGS) Topographic Quadrangles. The transmission line portion of the Project is in Sections 3 through 12 of Township 7 South, Range 21 East, of the San Bernardino Base Meridian.

1.2.1 Proposed 230 kV Transmission Line Location (Alternative 1)

The applicants propose to construct an 8.4-mile-long, 230 kV overhead transmission line from the proposed solar facility to the approved Colorado River Substation (Alternative 1). Approximately 3.6 miles of the transmission line would be within the solar facility. From the edge of the solar facility to the Colorado River Substation, the transmission line would extend another 4.8 miles within a 125-foot-wide ROW (3.8 miles would cross BLM-managed lands and 1.0 mile would cross private land). The transmission line would run parallel and immediately south of the Desert Southwest Transmission Line corridor. The total area of the 125-foot ROW off site would be about 73 acres. The total area of the 300-foot APE off site would be 174 acres (138 acres of BLM-managed land and 36 acres of private land) (Table 1). The parcel numbers of the property included within the Alternative 1 ROW are listed in Table 2.

1.2.2 Northern Alternative 230 kV Transmission Line Location

Similar to Alternative 1, the Northern Alternative would utilize the same alignment within the solar array field and would occupy the same BLM utility corridor. The primary difference between the proposed transmission line and the Northern Alternative is the location of the 230 kV transmission line extending outside the solar array field to the Colorado River Substation. They share a common corridor from the solar array site west for approximately 1.5 miles. At that point, the Northern Alternative would continue west on the north side of the corridor and within a 125-foot ROW entirely on BLM-managed lands, whereas Alternative 1 would continue in a more direct corridor as shown on Figure 1. Under this alternative, the total length of the 230 kV transmission line both on site and off site would be 8.8 miles; 5.2 miles would be off site entirely on BLM-managed lands. The 125-foot easement outside the solar facility boundary (also the BLM portion of the ROW) would contain 79 acres. The total area of the 300-foot APE off site would be 189 acres, all public land (Table 1). The parcel numbers of the property included within the Northern Alternative ROW are listed in Table 2.

1.2.3 Southern Alternative 230 kV Transmission Line Location

The Southern Alternative would exit the southwestern portion of the solar facility and extend approximately 4.0 miles west to the Colorado River Substation within a 125-foot ROW, across 3.4 miles of BLM-managed land and 0.6 mile of private land. The total area of the 125-foot ROW outside the solar array site would be approximately 60 acres. The total area of the 300-foot APE off site would be 145 acres, 120 acres of BLM land and 25 acres of private land (Table 1). The parcel numbers of the property included within the Southern Alternative ROW are listed in Table 2.

Table 2. Assessor Parcels within the Proposed and Alternative Transmission Line ROWs

RIVERSIDE COUNTY	BLM
Alternative 1	
879080013	879080022
879080014	879090033
879080032	879080024
	879090034
	879090035
Northern Alternative	
	879080020
	879080022
	879080033
	879080025
	879090034
	879090031
	879080021
	879090035
Southern Alternative	
879080034	879080023
	879080022
	879090033
	879080024
	879090034

2.0 INVENTORY METHODS

2.1 Historic Background and Records Search

Prior to the survey of the transmission line alternatives, POWER archaeologist Johanna Marty conducted a records search at the Eastern Information Center (EIC), housed at the University of California, Riverside on May 31, 2012. California Historical Resources Information System (CHRIS) records were reviewed to determine the location of previously recorded archaeological and architectural resources and the locations of past cultural resource surveys within one mile of the three alternatives. Also consulted were the NRHP, Archaeological Determinations of Eligibility provided by the EIC, CRHR, California Historical Landmarks, and California Points of Historic Interest. In addition, online BLM General Land Office (GLO) patent information was consulted. As part of the initial survey (POWER 2013), POWER had also consulted Art Wilson, a local historian; the General George S. Patton Memorial Museum; and the Palo Verde Historical Museum and Society.

2.2 Field Methods

POWER conducted a BLM Class III archaeological survey of approximately 454 acres of lands within the portions of the proposed and alternative 230 kV transmission line corridors outside the solar facility site. These lands included private and BLM-managed public lands. During the surveys, archaeologists walked parallel transects, using 15-meter (50-foot) intervals, to identify archaeological and architectural resources within the APE. The survey area included 150 feet on each side of the centerline of each alignment (300 feet total for each alignment) including the proposed Project (Alternative 1). The ground surface was examined for evidence of prehistoric and historic archaeological materials and historic structures. There was little vegetation and ground surface visibility was very high. No subsurface survey (e.g., shovel test pits) was conducted. A sub-meter Global Positioning System (GPS) was used to record the location of each cultural resource.

The archaeological field survey was conducted in two sessions in June and July, 2012. Archaeological sites and isolated finds were recorded at the time of discovery by collecting GPS data and photographs and measurements of artifacts. Overview photographs of survey areas were taken and comprehensive field notes were written. Previously recorded sites within the APE were revisited. However, their site records were not updated because they had been recorded or re-recorded within the last five years, sometimes as recently as 2011, and their conditions had not changed.

Archaeological resources were divided into two categories: archaeological sites and isolated finds. Isolated finds are here defined as three or fewer prehistoric artifacts of the same type (e.g., flakes or sherds), or five or fewer historic artifacts (e.g., cans, bottle glass). Archaeological sites are defined as four or more prehistoric artifacts or six or more historic artifacts within a 10-meter-square area.

All field methods were discussed with and reviewed by County Archaeologist, Leslie Mouriquand. The surveys conducted on BLM-managed lands were performed under Cultural Resource Use Permit (CRUP) #CA-09-36, in 2011 under Fieldwork Authorization #66.66 11-18 and in 2012 under Fieldwork Authorization #66.66 12-16.

2.3 Native American Coordination

Tribal consultation required under Section 106 is ongoing and is being performed by the BLM on a government-to-government basis. Section 106 Tribal consultation is not discussed in this report.

Coordination with Native American groups performed as part of the CEQA process in 2011 and 2012 is discussed in the initial survey report (POWER 2013). On May 10, 2012, the Applicants hosted an

information meeting in Palm Desert and invited Native American groups to attend. POWER provided the initial survey report, maps, and inventory forms to several Tribes. Also, two Tribal monitors observed the archaeological survey of the transmission line alternatives in June and July 2012.

3.0 INVENTORY RESULTS

3.1 Results of Background Research and Record Search

Federal land records available through the BLM GLO website (www.glorecords.blm.gov) patent list were reviewed on July 26, 2012 for homestead information within a one-mile radius of the Project. This land record data can provide background information related to the type of land grant filed, acreage amount, and date of issuance. The information is organized by the Township, Range and Section numbers rather than by the Assessor Parcel Numbers (see Table 2). Between 1911 and 1957, 24 land patents were filed within portions of the two-mile-wide study area; most of the land patents were granted under the Homestead Entry Act of 1862 and the Desert Lands Act of 1877. The results are listed in Appendix B. GLO maps for this part of California are not available online, so it was not possible to use the locations of improvements as a guide for identifying and interpreting historic archaeological sites.

The record search conducted by POWER on May 31, 2012 at the EIC showed 19 cultural resource studies were previously conducted within one mile of the alternatives. The reports are listed in Table 3, and Figure 2 illustrates the areas previously surveyed. It is estimated that, before 2012, 39 percent of the Alternative 1 APE had been surveyed (excluding the portion surveyed in 2011 by POWER), 31 percent of the Northern Alternative APE had been surveyed, and 70 percent of the Southern Alternative APE had been surveyed. Much of the land was surveyed as recently as 2010 (Enright and Mirro 2011). All of the 300-foot transmission line APEs were re-surveyed in 2012. Survey did not include any land within the Colorado River Substation, which was already permitted and under construction at the time of survey.

As a result of the record search performed in May 2012, 220 previously recorded cultural resources were identified within one mile of the transmission line alternatives, and 15 cultural resources (archaeological sites and isolated finds) were previously recorded within the 300-foot-wide off-site APE of one or more alternatives. These sites are listed in Table 4. Information on the previously documented resources is in Appendix A; Figure 3, also in Appendix A, depicts the locations of previously recorded cultural resources.

One previously recorded site, P-33-001819 (CA-RIV-1819), appeared on EIC maps to be within the APE of the Southern Alternative. However, other information on the DPR-523 form demonstrates that P-33-001819 was mapped incorrectly and that it falls outside, but within 0.5 mile, of the Southern Alternative APE.

Of the 220 resources recorded before 2011 within one mile of the transmission line alternatives (see Appendix A), 146 are archaeological sites, 66 are isolated finds, and 8 have missing information. None of the resources are standing buildings or structures. Of the archaeological sites, 78 had prehistoric components and 89 had historic components (21 of these sites had both prehistoric and historic components). Of the isolated finds, 44 had prehistoric artifacts, 24 had historic artifacts (four had both prehistoric and historic artifacts), and two inventory forms lacked descriptions on the artifacts found. The prehistoric sites are predominantly lithic and ceramic scatters. The historic sites are primarily refuse deposits, many related to World War II training in the area.

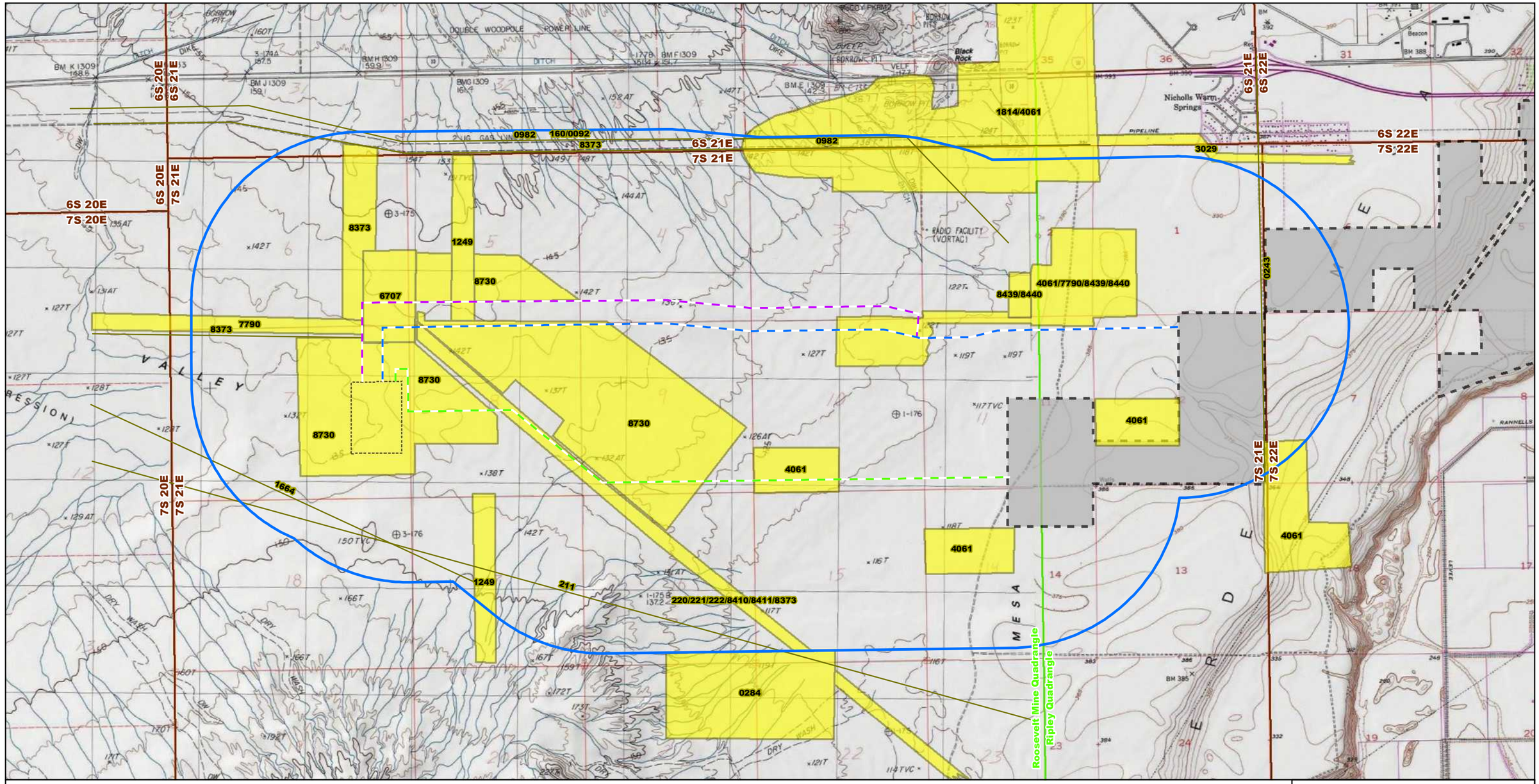
Table 3. Previous Cultural Resource Studies within One Mile of Transmission Line Alternatives

REPORT NUMBER	AUTHOR	YEAR	TITLE	NUMBER OF IDENTIFIED CULTURAL RESOURCES	WITHIN 300-FOOT APE		
					Alternative 1	Northern Alternative	Southern Alternative
RI-00092	King, T.F., G.T. Jefferson, and M. Gardner	1973	Archaeological and Paleontological Impact Evaluation: American Telephone & Telegraph Company's Oklahoma City-Los Angeles "A" Cable Route, Between the Colorado River and Coma, California	0			
RI-00160	Greenwood, R.	1977	Archaeological Resources Survey - West Coast-Mid-Continent Pipeline Project, Long Beach to Colorado River	2			
RI-00211	Craib, J.L.	1980	Archaeological Test Sampling of Site Within the La Quinta Flood Control Channel Easement	6			
RI-00220	Cowen, R.A., and K. Wallof	1977	Interim Report: Field Work and Data Analysis: Cultural Resource Survey of the Proposed Southern California Edison Palo Verde-Devers 500 kV Transmission Line	7			X
RI-00222	Cowen, R.A., and K. Wallof	1977	Final Report: Cultural Resource Survey of the Proposed Southern California Edison Palo Verde-Devers 500 kV Transmission Line	7			X
RI-00243	von Werlhof, J., and H. Pritchett	1977	Archaeological Examinations of Mesa Drive into Sundesert Sites, An Addendum Report	0			
RI-00284	Weaver, R.	1977	Cultural Resources Identification- Sundesert Nuclear Project	0			
RI-01249	Bureau of Land Management	1978	California Desert Program: Archaeological Sample Units Records for the Big Maria Planning Unit	31		X	
RI-01664	Westec Services, Inc.	1982	Cultural Resource Inventory of Seisdata Services Chuckwalla Geophysical Test Corridor, Riverside County, California	1			
RI-03029	Padon, B., S. Crownover, J. Rosenthal, and R. Conrad	1990	Cultural Resources Assessment Southern California Gas Company Proposed Line 5000, Riverside County, California	14			
RI-04061	McDonald, M., and J. Schaeffer	1998	Cultural Resources Inventory of 1542 Acres of Palo Verde Mesa Palo Verde Valley Catellus/ Bureau of Land Management Land Exchange Area	11	X	X	X

REPORT NUMBER	AUTHOR	YEAR	TITLE	NUMBER OF IDENTIFIED CULTURAL RESOURCES	WITHIN 300-FOOT APE		
					Alternative 1	Northern Alternative	Southern Alternative
RI-06707	McDougall, D., J. George, and S. Goldberg	2006	Cultural resource surveys of Alternative Routes Within California for the Proposed Devers-Palo Verde 2 Transmission Project	43	X	X	
RI-07790	Schaefer, J.	2003	A Class II Cultural Resources Assessment for the Desert-Southwest Transmission Line, Colorado Desert, Riverside and Imperial Counties, California	0		X	
RI-08373	Wilson, S., and W.T. Eckhardt	2009	Final Cultural Resources Inventory of the Proposed DPV2 Colorado River Switchyard Project, Riverside County, California			X	X
RI-08410	Carrico, R., K. Walker, and W. Eckhardt	2004	Draft Cultural Resources Inventory of the Proposed Devers to Palo Verde II 500 kV Transmission Line, Riverside County, California	42			X
RI-08411	Farrell, J., F. Budinger, and R. Carrico	2009	Final Amendment to Cultural Resources Inventory of the Proposed Blythe Energy Project Transmission Line, Riverside County, California	14			X
RI-08439	Leftwich, B.	2008	Phase I Archaeological Assessment: Blythe Solar 1 Project, Riverside County, California	2	X	X	
RI-08440	Leftwich, B.	2008	Phase II Archaeological Assessment: CA-RIV-8953 Blythe Solar 1 Project, Riverside County, California	1	X	X	
RI-8730*	Enright, E., and M. Mirro	2011	Class III Cultural Resources Survey for the Colorado River Substation Alternatives Analysis, Unincorporated Riverside County, California	87	X	X	X

Table 4. Previously Recorded Cultural Resources Within APEs of Transmission Line Alternatives

PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	AGE	WITHIN 300-FOOT APE		
				ALTERNATIVE 1	NORTHERN ALTERNATIVE	SOUTHERN ALTERNATIVE
P-33-014150	CA-RIV-9100	Two-track road	Historic			X
P-33-017319	CA-RIV-9009	World War II refuse scatter	Historic		X	
P-33-019612	CA-RIV-19612	Can	Historic		X	
P-33-019682	CA-RIV-9997	World War II refuse scatter	Historic			X
P-33-019703	CA-RIV-10018	World War II fighting hole and refuse scatter	Historic			X
P-33-019704	CA-RIV-10019	Metal debris	Historic			X
P-33-019712		Survey marker	Historic			X
P-33-019714	CA-RIV-10028	World War II refuse scatter; one core	Prehistoric/Historic			X
P-33-019733	CA-RIV-10047	Lithic scatter	Prehistoric			X
P-33-019736	CA-RIV-10050	Wood debris	Historic			X
P-33-019737	CA-RIV-10051	Lithic scatter	Prehistoric			X
P-33-019739	CA-RIV-10053	Lithic scatter	Prehistoric			X
P-33-019760	CA-RIV-10073	Lithic scatter	Prehistoric			X
P-33-019770		Flake; can	Prehistoric/Historic	X		
P-33-020317		Hammerstone	Prehistoric			X



Legend

- Previous Cultural Resource Survey
- 1-Mile Records Search Buffer
- 4061 Cultural Resource Survey Report Number (refer to Table 3, Section 3.1 for key to report numbers)
- Alternative 1 230 kV Line
- Northern Alternative 230kV Line
- Southern Alternative 230kV Line
- Colorado River Substation
- Proposed Solar Facility
- USGS Quadrangle Boundary
- PLSS Township & Range

N

0 3,000 6,000

Scale in Feet

1:36,000

FIGURE 2

PREVIOUS CULTURAL RESOURCE SURVEYS

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Source: ArcGIS Online, National Geographic TOPO! 2011, USGS 7.5' Topographic Quadrangle, 1:24,000.

THIS PAGE INTENTIONALLY LEFT BLANK

3.2 Results of Survey

The intensive pedestrian survey of the three alternatives was conducted in June and July, 2012 by POWER archaeologists. A total of 23 resources were recorded or revisited as part of the BLM Class III survey, as described in Table 5, including 15 previously recorded resources (see Table 4) and eight newly recorded archaeological sites and isolated finds. Of the 14 archaeological sites, seven are prehistoric and eight are historic (one site has both prehistoric and historic components). Of the nine isolated finds, four have prehistoric artifacts and six are historic (one isolated find contained both prehistoric and historic artifacts). There were no architectural resources within the APE.

During the field survey, 15 previously recorded cultural resources within the APE were revisited. These sites had been recorded within the past five years, some as recently as 2011, and did not require updated DPR forms because their conditions had not changed. Also, as mentioned above, site P-33-001819 (CA-RIV-01819) was placed incorrectly on EIC maps. It falls outside the APE, and was neither revisited nor re-recorded.

Table 6 summarizes the NRHP and CRHR eligibility recommendations for the cultural resources.

The DPR forms for all cultural resources within the APE can be found in Appendix D. Locations of the identified cultural resources are shown on Figure 4 (see Appendix C).

Table 5. Cultural Resources within APEs of Transmission Line Alternatives

FIELD NUMBER OR PRIMARY NUMBER	TRINOMIAL	DESCRIPTION	AGE	JURIS-DICTION	WITHIN APE		
					ALTERNATIVE 1	NORTHERN ALTERNATIVE	SOUTHERN ALTERNATIVE
Archaeological Sites							
P-33-014150	CA-RIV-9100	Two-track road	Historic	BLM			X
P-33-017319	CA-RIV-9009	World War II refuse scatter	Historic	BLM		X	
P-33-019682	CA-RIV-9997	World War II refuse scatter	Historic	BLM			X
P-33-019703	CA-RIV-10018	World War II fight hole, refuse scatter	Historic	BLM			X
P-33-019714	CA-RIV-10028	World War II refuse scatter; one chert core	Prehistoric/ Historic	BLM			X
P-33-019733	CA-RIV-10047	Lithic scatter	Prehistoric	BLM			X
P-33-019736	CA-RIV-10050	Wood debris	Historic	BLM			X
P-33-019737	CA-RIV-10051	Lithic scatter	Prehistoric	BLM			X
P-33-019739	CA-RIV-10053	Lithic scatter	Prehistoric	BLM			X
P-33-019760	CA-RIV-10073	Lithic scatter	Prehistoric	BLM			X
P-33-021130	CA-RIV-10962	Ceramic scatter	Prehistoric	BLM			X
P-33-021131	CA-RIV-10963	Ceramic scatter	Prehistoric	BLM			X
P-33-021132	CA-RIV-10964	Refuse scatter	Historic	BLM			X
P-33-021133	CA-RIV-10965	World War II refuse scatter	Historic	BLM		X	
Isolated Finds							
P-33-019612		Can	Historic	BLM		X	
P-33-019704	CA-RIV-10019	Metal debris	Historic	BLM			X
P-33-019712		Survey marker	Historic	BLM			X
P-33-019770		Flake and can	Prehistoric/ Historic	BLM	X		
P-33-020317		Hammerstone	Prehistoric	BLM			X
P-33-021134		Sherds	Prehistoric	BLM		X	
P-33-021135		Cans	Historic	BLM		X	
P-33-021136		Sherds	Prehistoric	BLM	X		
P-33-021137		Cans	Historic	BLM	X		

Table 6 Eligibility Recommendations for Cultural Resources Within APE

FIELD NUMBER OR PRIMARY NUMBER	TRINOMIAL	ELIGIBILITY RECOMMENDATION
Archaeological Sites		
P-33-014150	CA-RIV-9100	Determined not eligible by SHPO 2/11/09
P-33-017319	CA-RIV-9009	Not eligible
P-33-019682	CA-RIV-9997	Not eligible
P-33-019703	CA-RIV-10018	Not eligible
P-33-019714	CA-RIV-10028	Eligible pending further investigation
P-33-019733	CA-RIV-10047	Not eligible
P-33-019736	CA-RIV-10050	Not eligible
P-33-019737	CA-RIV-10051	Not eligible
P-33-019739	CA-RIV-10053	Not eligible
P-33-019760	CA-RIV-10073	Eligible pending further investigation
P-33-021130	CA-RIV-10962	Not eligible
P-33-021131	CA-RIV-10963	Not eligible
P-33-021132	CA-RIV-10964	Not eligible
P-33-021133	CA-RIV-10965	Not eligible
Isolated Finds		
P-33-019612		Not eligible
P-33-019704	CA-RIV-10019	Not eligible
P-33-019712		Not eligible
P-33-019770		Not eligible
P-33-020317		Not eligible
P-33-021134		Not eligible
P-33-021135		Not eligible
P-33-021136		Not eligible
P-33-021137		Not eligible

3.2.1 Archaeological Sites

P-33-014150 (CA-RIV-009100)
Type: Two-track road
Time Period: Historic
Setting: Sand dunes; creosote bush scrub
Elevation: 480 feet (146 meters)
Dimensions: 2 by 3,220 meters
NRHP and CRHR Eligibility Determination: Not eligible to NRHP or CRHR

Site P-33-014150 is a two-track road originally recorded by ICF Jones & Stokes in 2005, re-recorded by the same firm in 2008, and re-recorded by TetraTech in 2009 (Carrico and Eckhardt 2005; Eckhardt and Jordan 2008; Carper and Farrell 2009). The northwest/southeast trending road is five to six feet wide. Intermittent segments roughly parallel Power Line Road, which runs along the existing Southern California Edison (SCE) Devers – Palo Verde #1 transmission line. At least nine segments of the road have been identified within two miles. The maps provided by the EIC show a continuous roadway for the entire distance, but the DPR forms prepared in 2005, 2008, 2009 show the roadway as intermittent, with intact segments identified either by field survey or from aerial photographs.

Isolated artifacts found along the road included soda bottles, a sanitary can, ration cans and lids, and a boot sole, suggesting that the road may have been in use during the 1940s, 1950s, and 1960s. GLO maps from 1856 and 1919 and USGS maps were examined in 2008 and 2009, but no road was shown in this

location. Previous researchers suggested the roadway may be the survey road used for the original transmission line survey.

Site P-33-014150 was not seen or re-recorded by POWER. While the road as depicted on EIC maps crosses the APE for the Southern Alternative, POWER did not see any evidence of the road in 2012. It is possible the current APE does not include any of the previously identified segments. It is also possible construction activity in the vicinity in 2012 may have obliterated previously recorded road segments.

The site was recommended by TetraTech as not eligible to the NRHP or CRHR because it does not represent a major road system and was not used in a historically significant context. In addition, the road does not reflect a distinctive type, period, or method of construction. Site P-33-014150 was determined to be not eligible to the NRHP or the CRHR by the California State Historic Preservation Officer (SHPO) in 2009 (Farrell et al. 2009).

P-33-017319 (CA-RIV-009009)
Type: Refuse scatter
Time Period: Historic (World War II)
Setting: Sand dunes; creosote bush scrub
Elevation: 460 feet (140 meters) AMSL
Dimensions: 3 by 5 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

This site was recorded in 2008 (Eckhardt and Jordan 2008) as a small scatter of historic refuse dating to the 1942 to 1944 use of the area by the military. This site was not previously evaluated for NRHP or CRHR eligibility.

Artifacts found in 2008 included 15 cans and one glass jar. Cans included knife-punched evaporated milk cans, which were manufactured after 1931; sanitary cans, some of which may have been opened with a military P-38 opener; one key-wind can; and a key-wind can lid. The maker's mark indicates the glass jar was manufactured after 1937.

POWER revisited site P-33-017319 in 2012 and did not observe any changes, so it was not re-recorded.

The artifacts suggest the can scatter is associated with World War II use of the area. The initial survey report (POWER 2013) summarizes information about Blythe Army Air Base (BAAB) (Mitchell 2010a, b; Wilson 2008) and the Desert Training Center/California-Arizona Maneuver Area (DTC/C-AMA) (Bischoff 2000). BAAB, part of which has been recommended eligible to the NRHP (Mitchell 2010a, b; POWER 2013), was used for military training activities from 1942 through 1944, and this can scatter could have been associated with those training activities. Components of the DTC/C-AMA are also eligible to the NRHP. However, BAAB's direct association with the DTC/C-AMA lasted only eight months, from April 1942 to the end of the same year. None of the artifacts can be dated precisely to that eighth-month period, nor can they can be shown to have a direct association with the DTC/C-AMA.

Because of the nature of this small can scatter, there is no evidence that site P-33-017319 has an important association with specific events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). While General George S. Patton was associated with BAAB and DTC/C-AMA, the cans and jar do not link this site to General Patton or to the lives of any other significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). Site P-33-017319 is typical of small military refuse sites. The site is a small surface scatter of cans and other items; the potential for significant scientific data is low (NRHP Criterion D/CRHR Criterion 4).

Therefore, POWER recommends that site P-33-017319 is not eligible for listing in the NRHP or the CRHR.

P-33-019682 (CA-RIV-009997)
Type: Refuse scatter
Time Period: Historic (World War II)
Setting: Sand dunes; creosote bush scrub
Elevation: 404 feet (123 meters) AMSL
Dimensions: 22 by 6 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

Site P-33-019682 is a historic refuse scatter recorded in 2010 by Applied EarthWorks (Enright and Mirro 2011).

The site contained nearly 30 complete cans and more than 100 can fragments related to the military use of the area between 1942 and 1944. Most of the cans were in a very small (2.1-by-1.5-meter) area. This concentration included three No. 10 sanitary cans, 20 No. 2 sanitary cans, and one evaporated milk can. The manufacturing age of the cans ranges from the mid-1930s to the 1950s, but it is most likely they were discarded in a single episode during military training activities associated with BAAB.

POWER revisited site P-33-019682 in 2012 and did not observe any changes, so it was not re-recorded.

POWER's initial survey report (2013) summarizes information about BAAB (Mitchell 2010a, b; Wilson 2008) and the DTC/C-AMA (Bischoff 2000). BAAB, part of which has been recommended eligible to the NRHP (Mitchell 2010a, b; POWER 2013), was used for military training activities from 1942 through 1944, and this can scatter was probably associated with those activities. BAAB's direct association with the DTC/C-AMA lasted only eight months, from April to December 1942. None of the cans and can fragments demonstrate ties with the DTC/C-AMA.

Because of the nature of this can scatter, there is no evidence to suggest that site P-33-019682 has an important association with specific events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). The artifacts contain no elements that directly link this site to the lives of significant persons, such as General George S. Patton (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). Site P-33-019682 is typical of small military refuse sites. The potential for the site to contain significant scientific data is low (NRHP Criterion D/CRHR Criterion 4).

Therefore, POWER recommends that this site is not eligible for listing in the NRHP or the CRHR.

P-33- 019703 (CA-RIV-010018)
Type: Refuse scatter and fighting hole
Time Period: Historic (World War II)
Setting: Sand dunes; creosote bush scrub
Elevation: 357 feet (108 meters) AMSL
Dimensions: 11 by 8 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

Originally recorded by Applied EarthWorks in 2011 (Enright and Mirro 2011), site P-33-019703 is a single-use temporary military camp consisting of a fighting hole and a small refuse scatter related to the World War II use of the area between 1942 and 1944.

The fighting hole measures about 4 meters by 4 meters and is only 30 centimeters deep. The fighting hole has been eroded and is partially filled. The refuse scatter includes 12 C-ration cans and can fragments and a Barrington Hall Pure Soluble Coffee internal pry-out friction lid cylinder tin. Baker and Company produced Barrington Hall soluble (i.e., instant) coffee before World War I. During World War II, the U.S. Government took over the company.

The site integrity was described by Applied EarthWorks to be fair. The cans have been scattered and partially buried by dune sand; the fighting hole had been partially filled with sand.

POWER revisited site P-33-019703 in 2012 and did not observe any changes, so it was not re-recorded.

POWER's initial survey report (POWER 2013) briefly describes BAAB (Mitchell 2010a, b; Wilson 2008) and the DTC/C-AMA (Bischoff 2000). Part of BAAB has been recommended eligible to the NRHP as a historic district (Mitchell 2010a, b; POWER 2013). BAAB was used for military training activities from 1942 through 1944, and the can scatter and fighting hole were associated with those activities. BAAB's direct association with the DTC/C-AMA lasted only eight months, from April to December 1942. Neither the cans nor the fighting hole can be dated specifically to that eight-month period, nor can they be used to demonstrate a direct link to the DTC/C-AMA.

While there is an association between the fighting hole and can scatter with World War II activities, the limited nature of the material and features suggests site P-33-019703 did not have an important role (NRHP Criterion A/CRHR Criterion 1). The artifacts contain no elements that directly link this site to the lives of significant persons, such as General Patton (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The small quantity and limited variety of cans and the simple nature of the fighting hole indicate that the site's potential to contain significant scientific data is low (NRHP Criterion D/CRHR Criterion 4).

Therefore, POWER recommends that site P-33-019703 is not eligible for listing in the NRHP or the CRHR.

P-33-019714 (CA-RIV-010028)
Type: Isolated tool; refuse scatter
Time Period: Prehistoric and Historic (World War II)
Setting: Creosote bush scrub
Elevation: 361 feet (110 meters) AMSL
Dimensions: 9.5 by 59 meters
NRHP and CRHR Eligibility Recommendation: Eligible pending further investigation

Site P-33-019714 was recorded by Applied EarthWorks in 2011 as a refuse scatter related to the military use of the area. The site also contains a single prehistoric artifact, a quartzite core.

The historic artifacts were found mostly in a 1-meter-by-5-meter concentration of six C-ration cans and lids, and eight Barrington Hall Pure Soluble Coffee cans and lids. Elsewhere on the site there were one crushed sanitary can, one evaporated milk can, six C-ration cans or lids, one piece of milled lumber, and two D-cell batteries. Baker and Company produced Barrington Hall soluble coffee before World War I. During World War II, the U.S. Government took over the company to produce coffee for the military. The artifacts suggest the site was a single-use, temporary campsite.

Using a metal detector, Applied EarthWorks determined that metal objects may exist beneath the surface. They also saw disturbance to part of the site by off-road vehicles.

POWER revisited site P-33-019714 in 2012 and did not observe any changes, so it was not re-recorded.

POWER's initial survey report (POWER 2013) briefly describes BAAB (Mitchell 2010a, b; Wilson 2008) and the DTC/C-AMA (Bischoff 2000). Part of BAAB has been recommended eligible to the NRHP as a historic district (Mitchell 2010a, b; POWER 2013). BAAB was used for military training activities from 1942 through 1944, and the cans found at P-33-019714 were probably associated with those activities. BAAB's direct association with the DTC/C-AMA lasted only eight months, from April to December 1942. None of the artifacts demonstrate direct links with the DTC/C-AMA.

While there is an association between the can scatter with World War II activities, the limited nature of the material suggests that site P-33-019714 did not have an important role (NRHP Criterion A/CRHR Criterion 1). The artifacts contain no elements that directly link this site to the lives of significant persons, such as General George S. Patton (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The small quantity and limited variety of cans suggest the site's potential to contain significant scientific data is low. However, there is evidence that metal objects exist below the ground surface. Further investigation may be warranted to investigate the subsurface remains (NRHP Criterion D/CRHR Criterion 4).

Therefore, POWER recommends that site P-33-019714 is eligible for listing in the NRHP or the CRHR pending further investigation of subsurface deposits.

P-33-019733 (CA-RIV-010047)
Type: Lithic scatter
Time Period: Prehistoric
Setting: Creosote bush scrub
Elevation: 397 feet (121 meters) AMSL
Dimensions: 162 by 70 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

This site was recorded by Applied EarthWorks in 2011 (Enright and Mirro 2011) as a sparse prehistoric lithic assay site containing chert and quartzite tools, flakes and cobbles. The density of artifacts is about one per 230 square meters.

The artifacts reflect opportunistic early-stage reduction of rounded chert and quartzite cobbles. Items include 19 chert artifacts (one biface, one core, one edge-modified flake, five primary flakes, nine secondary flakes, and two tertiary flakes); 15 quartzite artifacts (four tested cobbles, eight primary flakes, two secondary flakes, and one piece of shatter); and four jasper artifacts (three secondary flakes and one tertiary flake).

The site integrity has been affected by vehicular traffic and alluvial activity. A two-track road passes through the site and a seasonal wash runs adjacent to the western border of the site. Applied EarthWorks thought the site was deflated and concluded the artifacts were limited to the surface. Applied EarthWorks considered the site's information potential to be low.

POWER revisited site P-33-019733 in 2012 and did not observe any changes, so it was not re-recorded.

There is no evidence that this prehistoric lithic scatter is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The very low density of artifacts and the observation by Applied EarthWorks that the site is deflated and limited to the ground surface suggest there is little potential for additional information on prehistoric chronology, settlement, or subsistence (NRHP Criterion D/CRHR Criterion 4).

Based upon the previously recorded information about the site (Enright and Mirro 2011), POWER recommends that site P-33-019733 is not eligible for listing in the NRHP or the CRHR.

P-33-019736 (CA-RIV-010050)
Type: Refuse
Time Period: Historic
Setting: Creosote bush scrub
Elevation: 403 feet (123 meters) AMSL
Dimensions: 30 by 15 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

P-33-019736 was originally recorded in 2011 by Applied EarthWorks (Enright and Mirro 2011). The site contains over 50 milled boards next to an abandoned two-track road. There was no evidence of a structure, so Applied EarthWorks concluded the site was the result of dumping. The site also contained wire nails (in boards), steel wire, and a metal gasket for a straight-six cylinder engine.

The boards are in poor condition and are deteriorating due to weathering. The boards vary in length up to 96 inches. Widths and thicknesses varied from 3 by 1 ½ inches to 6 ½ by ½ inches. These are probably nominal two-by-four and one-by-six boards, although the actual dimensions (standardized in 1961) may have been altered by weathering, drying, and warping. Based on weathering, Applied EarthWorks estimated the age of the boards as 40 to 70 years.

POWER revisited site P-33-019733 in 2012 and did not observe any changes, so it was not re-recorded.

Applied EarthWorks did not report any evidence that subsurface deposits were present, although abundant animal burrows at the site might have revealed subsurface material if any was present. There is no evidence this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features present to link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The limited variety of artifacts and the lack of subsurface deposits suggest that the potential for the site to yield important scientific or historical data is very low (NRHP Criterion D/CRHR Criterion 4).

Based on the information recorded by Applied EarthWorks (Enright and Mirro 2011), POWER recommends the site is not eligible for either the NRHP or the CRHR.

P-33-019737 (CA-RIV-010051)
Type: Lithic scatter
Time Period: Prehistoric
Setting: Nearly flat; creosote bush scrub
Elevation: 403 feet (123 meters) AMSL
Dimensions: 54 by 44 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

P-33-019737 was recorded by Applied EarthWorks in 2011 as a sparse (one artifact per 80 square meters) scatter of primary and secondary flakes.

The artifacts consist of about 11 primary flakes (five chert, five quartzite, and one vesicular volcanic), 10 secondary flakes (eight chert and two quartzite), one piece of chert shatter, and one quartzite core. Applied EarthWorks concluded that the site represents opportunistic assay and early-state reduction of naturally occurring chert and quartzite cobbles.

The site condition is fair; it appears to be deflated, and an abandoned two-track road bisects the site. Applied EarthWorks concluded that the flakes are likely limited to the surface, although shallow drift sand may obscure a few.

POWER revisited site P-33-019733 in 2012 and did not observe any changes, so it was not re-recorded.

There is no evidence that this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The very low quantity and density of artifacts and the observation by Applied EarthWorks that the site is deflated and limited to the ground surface indicate that there is little potential for additional information on prehistoric chronology, settlement, or subsistence (NRHP Criterion D/CRHR Criterion 4).

Based on the information presented by Applied EarthWorks (Enright and Mirro 2011), POWER recommends the site does not meet the criteria for listing on either the NRHP or the CRHR.

P-33-019739 (CA-RIV-010053)
Type: Lithic scatter
Time Period: Prehistoric
Setting: Sand dunes; creosote bush scrub
Elevation: 403 feet (123 meters) AMSL
Dimensions: 40 by 27 meters
NRHP and CRHR Eligibility Recommendation: Not eligible

Site P-33-019739 was originally recorded in 2011 by Applied EarthWorks. The site is a sparse (one artifact per 47 square meters) lithic scatter with primary flakes, secondary flakes, and cores.

The assemblage included sixteen artifacts: six primary flakes (three chert and three quartzite), seven secondary flakes (five chert, one quartzite and one metavolcanic), and three cores (two chert and one quartzite). Drifted sand may have obscured other artifacts. Based on the artifact assemblage, this site may have been used as a prehistoric lithic procurement and processing site (Enright and Mirro 2011). Impacts to the site include wind erosion (deflation), animal burrowing, and sheet wash.

POWER revisited site P-33-019733 in 2012 and did not observe any changes, so it was not re-recorded.

There is no evidence that this lithic scatter is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The very low quantity and density of artifacts, as well as the lack of diagnostic material, show that there is little potential for additional information on prehistoric chronology, settlement, or subsistence (NRHP Criterion D/CRHR Criterion 4).

Based on the information presented by Applied EarthWorks (Enright and Mirro 2011), POWER recommends the site does not meet the criteria for listing on either the NRHP or the CRHR.

P-33-019760 (CA-RIV-010073)
Type: Lithic scatter
Time Period: Prehistoric
Setting: sand dunes; creosote bush scrub
Elevation: 433 feet (132 meters) AMSL
Dimensions: 7 by 57 meters
NRHP and CRHR Eligibility Recommendation: Eligible pending further investigation

This site, recorded in 2011 by Applied EarthWorks (Enright and Mirro 2011), is a small scatter of chert debitage.

The artifacts include three primary flakes, one secondary flake, and one piece of shatter. Given the size of the site, the overall density is one artifact per 63 square meters. Applied EarthWorks interpreted the site as a temporary use area of early-stage lithic reduction activities.

POWER revisited site P-33-019733 in 2012 and did not observe any changes, so it was not re-recorded.

The site has been disturbed by modern off-road vehicle traffic along a two-track crossing the site. Modern dune sands have drifted across much of the site area. Applied EarthWorks suggested the site may be larger than recorded because much of the original ground surface may be covered with dune sand.

There is no evidence that this lithic scatter is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). Applied EarthWorks suggested that modern sand may obscure evidence that the site is more extensive than reflected on the surface. Given this uncertainty, and the lack of subsurface investigation, it is not possible to conclude whether the site may contain information that would help address research questions pertaining to prehistoric chronology, subsistence, or settlement. (NRHP Criterion D/CRHR Criterion 4).

Based on the information presented by Applied EarthWorks (Enright and Mirro 2011), POWER recommends that site P-33-019760 (CA-RIV-010073) may be eligible for listing on the NRHP or CRHR, pending further investigation regarding the presence or absence of subsurface deposits.

P-33-021130 (CA-RIV-10962)
Type: Ceramic scatter
Time Period: Prehistoric
Setting: Open desert
Elevation: 459 feet (140 meters) AMSL
Dimensions: 2.0 by 1.5 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

Site P-33-021130 is a small concentration of 22 prehistoric sherds, all of which are body fragments of Lower Colorado Buffware (Figure 5). The sherds appeared to be from one vessel, although they were not re-fitted. Colorado Buff is Patayan III and dates between A.D. 1500 and post-1900.

The site condition is fair; it has been affected by sheet wash and wind erosion. The topography is generally flat with low, rolling dunes vegetated with creosote bushes and low-growing xeric grasses. The ground surface visibility was 90 to 100 percent.

The site may represent a single prehistoric activity, probably a pot drop, although this was not confirmed through refitting. There is no evidence that this site is associated with events that have made a significant

contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). There are no artifacts other than sherds of the same type, which suggest that important scientific or historical data is not likely to be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, site P-33-021130 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 5. SITE P-33-021130 OVERVIEW, FACING SOUTH-SOUTHWEST

P-33-021131 (CA-RIV-10963)
Type: Ceramic scatter
Time Period: Prehistoric/Protohistoric
Setting: Open desert
Elevation: 462 feet (140 meters) AMSL
Dimensions: 6 by 2 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

This site consists of 10 fragments of prehistoric Lower Colorado Buffware sherds, all of which are body fragments that are probably from the same vessel, although they were not refitted (Figure 6). The sherds have a light brown exterior with a rough interior and coarse gritty temper. Colorado Buff is Patayan III and dates between A.D. 1500 and post-1900.

The topography is generally flat with low, rolling dunes vegetated with creosote bushes and low-growing xeric grasses; the ground visibility was 90 to 100 percent. The site condition is fair; it has been affected by sheet wash and wind erosion.

This site represents a single event, probably a pot drop. There is no evidence this site is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no diagnostic artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The ceramics may represent one vessel, although this was not confirmed

by refitting. There is no archaeological evidence to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, site P-33-021131 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 6. SITE P-33-021131 OVERVIEW, FACING NORTHEAST

P-33-021132 (CA-RIV-10964)
Type: Refuse Scatter
Time Period: Historic (1930s to 1940s)
Setting: Open desert
Elevation: 381 feet (110 meters) AMSL
Dimensions: 3.0 by 2.5 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

Site P-33-021132 is a small, compact refuse scatter of more than 25 artifacts recorded by POWER in 2012. Maker's marks on the bottles show the site dates to the 1930s and 1940s.

The topography is generally flat with low rolling dunes (Figure 7). The site is in open desert; the dunes are vegetated with creosote bushes and low-growing xeric grasses. The ground visibility was 90 to 100 percent.

Site P-33-021132 contains general household refuse dating to the early to mid-20th century. The items were evidently discarded at this location in a single episode; there are no roads or two-tracks in the immediate vicinity.

Artifacts from the site include:

- Six hole-in-top cans with ice pick openings; 2 $^{7}/_{8}$ inches in diameter and 3 $^{7}/_{8}$ inches tall. These were evaporated milk cans manufactured between 1900 and 1990 (Horn 2005).
- Six juice cans; 2 $^{5}/_{8}$ inches in diameter and 4 $^{7}/_{8}$ inches tall.

- Two indeterminate cans; 4 ¼ inches in diameter and 7 inches tall.
- Three possible paint cans; 4 ¼ inches in diameter and 4 ¼ inches tall
- One meat can, knife-opened; 3 $^{3}/_{8}$ inches in diameter and 1 ¾ inches tall.
- One clear glass bottle with a bunch of grapes embossed on the front. There is a Northwestern Glass Company maker's mark on the base. This company manufactured bottles from 1931 to the present.
- One amber glass bottle with a metal screw top lid. "Duraglass" is embossed on the heel and an Owens-Illinois maker's mark is on the base. The bottle was manufactured in 1943. (Toulouse 1971; SHA n.d.).
- One clear glass bottle with a black screw top lid. "Listerine" is embossed on the shoulder; "Lambert Pharmaceutical Co." and "Duraglass" are embossed on the heel. It also has an Owens-Illinois maker's mark on the base. The bottle was manufactured in 1942 (Toulouse 1971; SHA n.d.).
- One amber glass Purex bottle with an "LM" maker's mark on the base. The size, design and threaded screw top indicate a manufacture date from 1937, when hard rubber stoppers were replaced with metal screw tops (Sharley 2002). "LM" is the maker's mark for the Latchford-Marble Glass Company from 1938 to 1956 (Whitten n.d.).
- One clear glass ketchup bottle with an Owens-Illinois maker's mark is on the base. The maker's mark indicates that the bottle was manufactured in 1933 (Toulouse 1971).

There is no evidence that this refuse scatter is associated with events that have made a significant contribution to the broad patterns of history (NRHP Criterion A/CRHR Criterion 1). There are no artifacts or features that link this site with the lives of significant persons (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). This site and the artifacts there are typical of refuse disposal sites common to the area. There is no archaeological evidence (e.g., buried deposits) to suggest that important scientific or historical data may be obtained from the site (NRHP Criterion D/CRHR Criterion 4).

Therefore, site P-33-021132 is recommended not eligible for inclusion in either the NRHP or the CRHR.



FIGURE 7. SITE P-33-021132 OVERVIEW, FACING EAST

P-33-021133 (CA-RIV-10965)
Type: Refuse Scatter
Time Period: Historic (World War II)
Setting: Open desert
Elevation: 462 feet (141 meters) AMSL
Dimensions: 15 by 10 meters
NRHP and CRHR Eligibility Recommendation: Not Eligible

Site P-33-021133 is a small refuse scatter consisting of 10 deteriorating K-ration cans, first recorded by POWER in 2012. The site is in an area of open desert among small rolling sand dunes (Figure 8). Disturbance to the site is minimal and the result of sheet wash and wind erosion. The ground surface visibility was excellent at over 90 percent.

Six of the cans measure 2 $^{13}/_{16}$ inches tall by 2 $^{14}/_{16}$ inches wide and are key opened; several strips of metal with an attached twist key opener were also found. Four of the cans measure 4 $^{13}/_{16}$ inches tall by 2 $^{3}/_{16}$ inches wide and are embossed with "Barrington [Hall] Soluble Coffee" on the lid.

K-rations contained an individual daily combat food ration. They were developed by the U.S. Army in 1941 and first used in 1942 by U.S. airborne troops. They were used to the end of the War and were discontinued in 1948.

Baker and Company produced Barrington Hall soluble (i.e., instant) coffee before World War I. During World War II, the U.S. Government took over the company to produce coffee for K-rations.

Information on World War II-era use of the area is presented under site P-33-017319 (CA-RIV-009009). POWER's initial survey report (POWER 2013) briefly describes BAAB (Mitchell 2010a, b; Wilson 2008) and the DTC/C-AMA (Bischoff 2000). Part of BAAB has been recommended eligible to the NRHP as a historic district (Mitchell 2010a, b; POWER 2013). BAAB was used for military training activities from 1942 through 1944, and the can scatter was probably associated with those activities. BAAB's direct association with the DTC/C-AMA lasted only eight months, from April to December 1942. None of the cans demonstrate direct ties with the DTC/C-AMA.

While there is an association between the can scatter with World War II activities, the limited nature of the material suggests site P-33-021133 did not have an important role (NRHP Criterion A/CRHR Criterion 1). The artifacts contain no elements that directly link this site to the lives of significant persons, such as General George S. Patton (NRHP Criterion B/CRHR Criterion 2). This site does not contain architecture (NRHP Criterion C/CRHR Criterion 3). The small quantity and limited variety of cans suggest that the site's potential to contain significant scientific data is low (NRHP Criterion D/CRHR Criterion 4).

Therefore, POWER recommends that site P-33-021133 is not eligible for listing in the NRHP or the CRHR.



FIGURE 8. SITE P-33-021133 OVERVIEW, FACING WEST

3.2.2 Isolated Finds

For this report, isolated finds are defined as three or fewer prehistoric artifacts of the same type or five or fewer historic artifacts.

During the transmission line survey, POWER identified nine isolated finds within the Project APE, including five historic and three prehistoric isolated finds, and one isolated find with both prehistoric and historic artifacts. The historic isolated finds are primarily food cans. The prehistoric isolated finds are lithics or sherds. Isolated finds are not considered either historic properties under the NHPA or historical resources under CEQA.

P-33-019612

This isolated find is actually a number of widely dispersed isolated cans recorded in 2010 by AECOM. AECOM assumed that the cans were once associated with historic archaeological sites, but were re-deposited throughout the area by alluvial action (Vargas 2010). Each can location was recorded separately, but was assigned the same primary number. One can location is within the current APE (Figure 4, Appendix C). The can is related to the World War II military use of the area.

P-33-019704 (CA-RIV-010019)

This isolated find was documented in 2011 by Applied EarthWorks as a small refuse scatter containing only a section of heavy-gauge wire, one tapered meat can, and one cut metal disk (Enright and Mirro 2011).

P-33-019712

Originally recorded by Applied EarthWorks in 2011, this isolated find is a GLO brass-capped survey marker for a quarter section boundary between Sections 7 and 8 of Township 7 South, Range 21 East of the San Bernardino Base Meridian (Enright and Mirro 2011).

P-33-019770

This isolated find, recorded in 2010 by Applied EarthWorks, consists of two artifacts. One is a prehistoric chert flake and the other is an evaporated milk can (Enright and Mirro 2011).

P-33-020317

Originally recorded in 2012 by ASM Affiliates (Torres 2012), this resource is an isolated quartzite hammerstone.

P-33-021134

This isolated find consists of three sherds of Lower Colorado Buffware that may be from the same vessel. The temper is very coarse with inclusions of sand. At the time of the survey, the ground surface visibility was excellent at nearly 100 percent.

P-33-021135

Isolated find P-33-021135 contains four cans, three of which are evaporated milk cans and the fourth a "Coors" beer can with two church key openings.

P-33-021136

This isolated find consists of three prehistoric sherds, all of which are body fragments and probably from the same vessel. The sherds have a grayish tan exterior, a red interior, and a very coarse temper. The largest fragment measures 5.0 by 3.5 centimeters and is 0.4 centimeter thick. The ground surface visibility was 90 percent.

P-33-021137

Isolated find P-33-021137 consists of three historic cans, all of which are key-opened. Two of the cans are crushed, the third has "EST A, 12 42" embossed on the lid. The cans are within a small ephemeral drainage.

4.0 IMPACTS/EFFECTS

This section addresses impacts to cultural resources under CEQA and NEPA; however, the process for assessing effects to historic properties under Section 106 of the NHPA is described briefly in Section 4.1. The site-specific effects will be identified in the joint Environmental Impact Report/Environmental Assessment (EIR/EA) prepared in compliance with CEQA and NEPA.

4.1 Effects Under the National Historic Preservation Act

Under Section 106 of the NHPA, adverse effects to a historic property (i.e., a cultural resource eligible for or listed in the NRHP) can include physical demolition, destruction, relocation, or alteration of the property or its immediate surroundings such that the integrity of the property's location, design, setting, materials, workmanship, feeling, or association would be materially impaired or diminished.

Whenever a historic property cannot be avoided by project activities, adverse effects must be resolved through development of either a Memorandum of Agreement or Programmatic Agreement in consultation with the various consulting parties.

Section 106 regulation states that the regulatory definition of "effect," pursuant to 36 CFR 800.16 (i) is that the term means "alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the NRHP." In practice, a direct effect under Section 106 is that which is a "direct physical disturbance of a historic property." Effects that are immediate but not physical in character, such as visual intrusion, and reasonably foreseeable effects that may occur at some point subsequent to the implementation of the proposed undertaking are referred to as "indirect effects."

Direct effects on historic properties in the Project area could result from ground disturbing activities associated with the construction of the solar generation and transmission facilities, such as clearing vegetation, grading roads, installing underground infrastructure, installing tower foundations, and driving supports for solar arrays.

Historic properties can also be subject to indirect effects, such as changes in public access that increase the potential for vandalism.

4.2 Impacts Under the California Environmental Quality Act

Under CEQA, a project is considered to have an impact on the environment if it alters any characteristics of a historical resource that qualify it for inclusion in the CRHR. Furthermore, it is stated in CEQA that the lead agency may require that reasonable efforts be made to permit any or all of these resources to be preserved in place or left in an undisturbed state. CEQA also requires that impacts as defined by PRC 21083.2 must be addressed and mitigated as outlined in PRC 15126.4 and 15331.

Under CEQA, a checklist provides a common set of guidelines that set forth the significance criteria generally applied to cultural resources within the state. The checklist provides questions to be addressed using the following criteria:

- Potentially significant impact
- Less than significant impact with mitigation
- Less than significant impact
- No impact

Three questions pertaining to cultural resources are presented below.

A) Would the project cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?

B) Would the project cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?

C) Would the project disturb any human remains, including those interred outside of formal cemeteries?

A total of 23 cultural resources have been identified in the APE for one or more of the transmission line alternatives, including 14 other archaeological sites and nine isolated finds.

Table 7 summarizes the anticipated impacts on the 14 archaeological resources within the Project area. Isolated finds are not included in Table 7 because none of them are eligible to the NRHP or CRHR. Only two sites, both of which are within the APE for the Southern Alternative, may be eligible to the NRHP or CRHR, pending further investigation to confirm the presence or absence of subsurface cultural deposits. Adverse effects to either site would occur only if the site is determined eligible.

Under CEQA, impacts would occur only to historical resources (those eligible to the CRHR), unique archaeological resources (none of which have been identified in the Project area), or human remains (none of which have been identified in the Project area) that occur on non-federal land.

Table 7. Archaeological Sites within Project Boundaries

PRIMARY NUMBER	TRINOMIAL	NRHP/CRHR ELIGIBILITY	JURISDICTION	EFFECTS/IMPACTS RECOMMENDATION
Alternative 1				
No archaeological sites				No effect/impact
Northern Alternative				
P-33-017319	CA-RIV-9009	Recommended not eligible	BLM	No effect/impact
P-33-021130	CA-RIV-10962	Recommended not eligible	BLM	No effect/impact
P-33-021132	CA-RIV-10964	Recommended not eligible	BLM	No effect/impact
P-33-021133	CA-RIV-10965	Recommended not eligible	BLM	No effect/impact
Southern Alternative				
P-33-014150	CA-RIV-9100	Determined not eligible by SHPO 2/11/09	BLM/Private	No effect/impact
P-33-019682	CA-RIV-9997	Recommended not eligible	BLM	No effect/impact
P-33-019703	CA-RIV-10018	Recommended not eligible	BLM	No effect/impact
P-33-019714	CA-RIV-10028	Eligible pending further investigation	BLM	Possible effect/impact
P-33-019733	CA-RIV-10047	Recommended not eligible	BLM	No effect/impact
P-33-019736	CA-RIV-10050	Recommended not eligible	BLM	No effect/impact
P-33-019737	CA-RIV-10051	Recommended not eligible	BLM	No effect/impact
P-33-019739	CA-RIV-10053	Recommended not eligible	BLM	No effect/impact
P-33-019760	CA-RIV-10073	Eligible pending further investigation	BLM	Possible effect/impact
P-33-021131	CA-RIV-10963	Recommended not eligible	BLM	No effect/impact

4.2.1 Application of CEQA Significance Thresholds

A) Would the project cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?

For Alternative 1, no archaeological sites or historical resources were recorded and there would be no impact.

For the Northern Alternative, none of the four archaeological sites recorded have the potential to be found eligible to the NRHP or CRHR, and there would be no impact.

For the Southern Alternative, two archaeological sites recorded during the survey have the potential to be found eligible to the NRHP or CRHR pending further investigation. Both of these occur on BLM land and would be subject to evaluation under Section 106 of NHPA.

B) Would the project cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?

None of the archaeological sites recorded for Alternative 1, the Northern Alternative, and Southern Alternative qualify as unique archaeological resources and there would be no impact.

C) Would the project disturb any human remains, including those interred outside of formal cemeteries?

No human remains have been previously recorded or discovered during surveys for Alternative 1, the Northern Alternative, or the Southern Alternative and, as such, no impacts to this type of resource are anticipated. However, should human remains be discovered on private land at any time during implementation of the Project, construction in the vicinity will halt and the coroner will be contacted immediately (PRC 7050.5). If the coroner determines that the remains do not require an assessment of cause of death and are probably Native American, then the NAHC will be contacted to identify the most likely descendents. Other steps should be implemented according to the requirements of PRC 5097.98.

5.0 RECOMMENDATIONS

Specific cultural resource management recommendations have been developed in consultation with the Applicants and the County Archaeologist. These were developed as part of the CEQA process; mitigation measures to comply with Section 106 of the NHPA and with NEPA will be developed by the BLM and included in the environmental document.

These management recommendations are defined in the Conditions of Approval and pertain to the portion of the Project area that includes privately owned land. The Conditions of Approval include the following:

- Archaeological monitoring shall be conducted by a qualified county-approved Archaeologist who shall manage and oversee archaeological monitoring of all initial ground disturbing activities and excavations of each portion of the Project site.
- A Tribal Observer designated by the Agua Caliente Band of Cahuilla Indians or other designated Tribal representative shall be allowed on-site when the Project Archaeologist is present during all initial ground disturbing activities and excavations for each portion of the Project site.
- A Cultural Resources Monitoring and Mitigation Plan (CRMMP) shall be submitted to the County Archaeologist and the County Historic Preservation Officer (CHPO). The CRMMP shall address the details of all activities that must be completed in order to reduce the impacts to cultural and historical resources to a level that is less than significant. The CRMMP shall define the roles and responsibilities of cultural resource personnel and provides the timelines for the completion of the required mitigation.

During Project construction, if human remains are encountered on private land, the provisions of State Health and Safety Code Section 7050.5 will apply. This code section states that no further disturbance shall occur until the Riverside County Coroner has made a determination of origin and disposition pursuant to PRC Section 5097.98. If the remains are determined to be Native American in origin, the County Coroner will notify the NAHC, which will determine and notify a Most Likely Descendant (MLD). With the permission of the landowner and his/her authorized representative, the MLD may inspect the site of the discovery. The MLD shall complete the inspection within 48 hours of notification by the NAHC and granting of landowner permission. The MLD may recommend scientific removal and nondestructive analysis of human remains and items associated with Native American burials.

If human remains are discovered on BLM land, NAGPRA (25 U.S.C. 3001) provides a process for federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, or objects of cultural patrimony—to lineal descendants and culturally affiliated Indian tribes. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional excavation and unanticipated discovery of Native American cultural items on federal lands, and penalties for noncompliance and illegal trafficking. The Secretary of the Interior's implementing regulations are at 43 CFR part 10.

6.0 REFERENCES

Bischoff, M.C. 2000. *The Desert Training Center/California-Arizona Maneuver Area, 1942-1944: Historical and Archaeological Contexts.* Technical Series 75. Statistical Research, Inc., Tucson, Arizona.

Carper, M., and J. Farrell. 2009. Site Record, 33-14150 (CA-RIV9100). On file at the Eastern Information Center, University of California-Riverside, Riverside, California.

Carrico, R. and W. Eckhardt. 2005. Cultural Resource Inventory of the Proposed Blythe Energy Transmission Line Project, Riverside County, California. Prepared for the BLM, Palm Springs South Coast Field Office and Southern California Edison, Rosemead, California.

Carrico, R., K. Walker, and W. Eckhardt. 2004. Draft Cultural Resources Inventory of the Proposed Devers to Palo Verde II 500 kV Transmission Line, Riverside County, California

Eckhardt, W., and S.C. Jordan. 2008. Cultural Resource Inventory of the Proposed Midpoint DPVII Substation Project, Riverside County, California. Submitted to the BLM Desert District, Moreno Valley. On file at the Eastern Information Center, University of California-Riverside, Riverside, California.

Enright, E., and M. Mirro. 2011. Class III Cultural Resources Survey for the Colorado River Substation Alternatives Analysis, Unincorporated Riverside County, California. On file at the Eastern Information Center, University of California-Riverside, Riverside, CA.

Farrell, J., F. Buddinger and R. L. Carrico. 2009. Final Amendment to Cultural Resources Inventory of the Proposed Blythe Energy Project Transmission Line, Riverside County, California. Report prepared for the BLM, Palm Springs South Coast Field Office, On file at the Eastern Information Center, University of California-Riverside, Riverside, California. Jones and Stokes, San Diego, CA.

Horn, Jonathon C. 2005. *Historic Artifact Handbook.* Prepared for Alpine Archaeological Consultants, Inc. Montrose, CA.

Mitchell, P.C. 2010a. *Final Phase I Cultural Resource Assessment of the Proposed Blythe Airport Solar Project, Blythe, Riverside County, California.* KP Environmental, LLC, Cardiff By The Sea, California.

_____. 2010b. Site Record, Blythe Army Air Base Historic District P-33-18837. On file at the California Historical Resource Information System, Eastern Information Center, University of California, Riverside.

POWER Engineers, Inc. (POWER). 2013. Blythe Mesa Solar Project Cultural Resources Survey Report. Prepared for the BLM and Renewable Resources Group, LLC. POWER Engineers, Inc. Anaheim, California.

Rock, J.T. 1984. Cans in the Countryside. *Historical Archaeology* 18 (2).

Sharley, Ann. 2002. *Bleach Bottles as an Aid to Dating Historic Sites*. Paper presented at the 55Th Annual Northwest Anthropological Conference, Boise, Idaho.

Society for Historical Archaeology (SHA). n.d. *Historic Glass Bottle Identification & Information Website*. Stable URL accessed August 1, 2012: http://www.sha.org/bottle/index.htm

Torres, C. 2012. California Department of Parks and Recreation (DPR) 523 Site Form for P-33-20318. On file at the Eastern Information Center, University of California-Riverside, Riverside, California.

Toulouse, J.H. 1971. *Bottle Makers and Their Marks*. Thomas Nelson, New York.

U.S. Geological Survey. 1983. Roosevelt Mine, California [map]. 1:24,000 7.5 Minute Series. Reston, Virginia.

Whitten, D. n.d. Glass Bottle Marks. http://www.glassbottlemarks.com

Wilson, A. 2008. *Runways in the Sand: the History of Blythe Army Air Base in World War II.* Self Published, Blythe, California.

7.0 REPORT PREPARERS

POWER Engineers, Inc.

Gini Austerman, M.A., Archaeologist
Johanna Marty, B.A., Archaeologist
Jim Rudolph, Ph.D., Archaeologist

8.0 FIELD PERSONNEL

POWER Engineers, Inc.

Trish Webb
Johanna Marty
Rachel Valdes
Collin Nordal
Darren Schubert

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A (CONFIDENTIAL): PREVIOUSLY RECORDED CULTURAL RESOURCES WITHIN ONE MILE OF ALTERNATIVES

CONFIDENTIAL APPENDIX UNDER SEPARATE COVER

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B: GENERAL LAND OFFICE RECORDS WITHIN ONE MILE OF THE PROJECT

THIS PAGE INTENTIONALLY LEFT BLANK

BLM SERIAL #	NAME	ISSUE DATE	ACRES	ALIQUOT PARTS	SECTION/ BLOCK	AUTHORITY
T 7S, R 21E						
CACAAA 018296 03	State of California	6/13/1957	840.14	W½ SW¼	1	Conveyance Doc Correction 1954
CACAAA 018296 04	State of California	12/21/1953	1456.86	W½ SW¼, Lot/Trct 7	1	Indemnity Selections 1927
CACAAA 020122 01	State of California	7/6/1917	1901.86	SE¼, E½ SW¼	1	Indemnity Selections 1927
CALA 0043048	Russell D. Freeman	1/17/1928	158.38	S½ NW¼, Lot/Trct 5, Lot/Trct 6	1	Homestead Entry Act 1862
CALA 0040951	Edmond B. Kasold	9/20/1927	158.66	S½ NE¼, Lot/Trct 3, Lot/Trct 4	1	Homestead Entry Act 1862
CALA 0043961	William Egan, Kate Thomas, Roscoe Buckner	1/20/1928	120	W½ SW¼	2	Sale-Cash Entry 1820
None In Section 3					3	
CALA 0043923	Albert Edmiston	1/3/1930	316.19	S½ NW¼, Lot/Trct 5, Lot/Trct 6	4	Homestead Entry Act 1862
CALA 0043639	Starr Titus	6/22/1928	315.84	S½ NW¼, Lot/Trct 5, Lot/Trct 6	5	Homestead Entry Act 1862
CALA 0043962	Alice Wedeking, Margaret Kelo, Diedrich Wedeking	8/27/1929	149.55	N½ SW¼, N½ SE¼	5	Desert Land Act 1877
CALA 0043984	Myron T. Johnston	12/21/1931	317.88	Lot/Trct 5,6,11,12,13,14,19,20	6	Homestead Entry Act 1862
CALA 0044010	Steve Kostick	1/21/1931	253.59	Lot/Trct 7,8,9,10,15,16,17,18	6	Homestead Entry Act 1862
CACAAA 020122 01	Carl A. Benson	11/26/1913	160	NE¼	8	Sale-Cash Entry 1820
CALA 0011526	John L. Price	4/11/1928	154.5	N½ NW¼, SW¼ NW¼, SE¼ NW¼	8	Homestead Entry Act 1862
CALA 0043935	Josef Siebold	9/18/1913	160	SE¼	8	Sale-Cash Entry 1820
CALA 0011527	Perry A. Ball	10/30/1912	160	NW¼	9	Sale-Cash Entry 1820
CALA 0011525	Carl A. Benson	11/26/1913	160	NE¼	8	Sale-Cash Entry 1820
CACAAA 012277 02	State of California	11/23/1953	1991.63	SE¼	11	Indemnity Selections 1927
CACAAA 012277 03	State of California	6/10/1957	1297.17	SE¼	11	Conveyance Doc Correction 1954
CALA 0038266	Virginia L. Cunningham, William D. Hammell	5/29/1951	80	S½ SW¼	12	Desert Land Act 1877
CALA 0046019	Claude P. Kitchen	3/29/1930	160	SE¼	12	Homestead Entry Act 1862
CALA 0045611	John W. Kline	11/7/1931	160	NE¼	12	Homestead Entry Act 1862
1141347	Gerald A. Brinkman	10/29/1953	80	N 1/2	14	Desert Land Act 1877
CACAAA 018296 03	State of California	6/13/1957		NE 1/4	15	Conveyance Doc Correction 1954
1131523	Edwin L. Barnard	3/30/1951	120	N1/2NW1/4, SW1/4NW1/4	17	Desert Land Act 1877

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C (CONFIDENTIAL): ARCHAEOLOGICAL RESOURCES IN THE PROPOSED AND ALTERNATIVE APES

CONFIDENTIAL APPENDIX UNDER SEPARATE COVER

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D (CONFIDENTIAL): CALIFORNIA OFFICE OF HISTORIC PRESERVATION DPR-523 FORMS

CONFIDENTIAL APPENDIX UNDER SEPARATE COVER

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX E
LIMITED GEOTECHNICAL EVALUATION

THIS PAGE INTENTIONALLY LEFT BLANK

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

LIMITED GEOTECHNICAL EVALUATION
BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PREPARED FOR:
Power Engineers
731 East Ball Road, Suite 100
Anaheim, California 92805

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
5710 Ruffin Road
San Diego, California 92123

June 7, 2013
Project No. 107243003

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

June 7, 2013
Project No. 107243003

Mr. Thom Ryan
Power Engineers
731 East Ball Road, Suite 100
Anaheim, California 92805

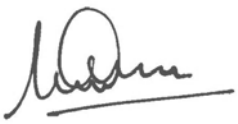
Subject: Limited Geotechnical Evaluation
Blythe Mesa Solar Project
Blythe, California

Dear Mr. Ryan:

In accordance with your authorization, we have performed a limited geotechnical evaluation for the proposed Blythe Mesa Solar Project in Blythe, California. This report presents our geologic findings, conclusions, and preliminary mitigation recommendations regarding the proposed project for inclusion in the Environmental Impact Report. This report incorporates responses to review comments from the County of Riverside. Our report was prepared in accordance with our proposal dated April 22, 2013.

We appreciate the opportunity to be of service on this project.

Sincerely,
NINYO & MOORE





Madan Chirumalla, PE
Project Engineer



Francis O. Moreland, PG, CEG
Senior Geologist







Gregory T. Farrand, PG, CEG
Principal Geologist

MAC/FOM/GTF/ER/gg

Distribution: (1) Addressee (via e-mail)

TABLE OF CONTENTS

Page

1. INTRODUCTION 1
2. SCOPE OF SERVICES 1
3. PROJECT AND SITE DESCRIPTION 1
4. SUBSURFACE EXPLORATION 2
5. LABORATORY TESTING 3
6. GEOLOGY AND SUBSURFACE CONDITIONS 3
   - 6.1. Regional and Geologic Setting 3
   - 6.2. Site Geology 3
     - 6.2.1. Fill 4
     - 6.2.2. Alluvium of Modern Washes 4
     - 6.2.3. Alluvium of the Modern Colorado River Flood Plain 4
     - 6.2.4. Eolian Sand 4
     - 6.2.5. Alluvial-Fan and Alluvial-Valley Deposits 5
     - 6.2.6. Alluvial Deposits of Palo Verde Mesa 5
   - 6.3. Surficial Soils 5
   - 6.4. Mineral Resources 5
   - 6.5. Groundwater 6
7. GEOLOGIC HAZARDS 6
   - 7.1. Faulting and Seismicity 6
     - 7.1.1. Strong Ground Motion 7
     - 7.1.2. Ground Surface Rupture 8
     - 7.1.3. Liquefaction and Seismically Induced Settlement 8
   - 7.2. Landslide and Debris Flows 9
   - 7.3. Slope Stability 9
   - 7.4. Flood Hazard 9
   - 7.5. Seiches 10
   - 7.6. Dam Inundation 10
   - 7.7. Settlement 10
   - 7.8. Hydro-consolidation or Soil Collapse 10
   - 7.9. Expansive Soils 11
   - 7.10. Erosion 11
   - 7.11. Regional Subsidence 12
8. CONCLUSIONS 12
9. RECOMMENDATIONS 13
   - 9.1. Strong Ground Motion 13
   - 9.2. Ground Surface Rupture 13
   - 9.3. Liquefaction and Seismically Induced Settlement 14
   - 9.4. Landsliding 15

AR061581

9.5. Flood Hazard 15
9.6. Settlement 15
9.7. Hydro-consolidation or Soil Collapse 16
9.8. Expansive Soils....16
9.9. Erosion....17
9.10. Regional Subsidence....17
9.11. Corrosion 18
10. LIMITATIONS....19
11. REFERENCES 20

Table

Table 1 – Principal Active Faults 7

Figures

Figure 1 – Site Location
Figure 2 – Boring Locations
Figure 3 – Geology
Figure 4 – Soils
Figure 4A – Regional Soils Legend
Figure 4B – Impacted Soils Legend
Figure 5 – Fault Locations

Appendix

Appendix A – Site Photographs
Appendix B – Boring Logs
Appendix C – Laboratory Testing

1. INTRODUCTION

In accordance with your request and our proposal dated April 22, 2013, we have performed a limited geotechnical evaluation for the proposed Blythe Mesa Solar Project located in Blythe, California (Figure 1). This report presents our findings, conclusions, and preliminary mitigation recommendations regarding the proposed project for inclusion in the Environmental Impact Report.

2. SCOPE OF SERVICES

Ninyo & Moore's scope of services for this project included review of pertinent background data, performance of a geologic reconnaissance, limited geotechnical evaluation, and analysis with regard to the proposed project. Specifically, we performed the following tasks:

- Reviewing background information including available geotechnical reports, topographic maps, geologic data, fault maps, stereoscopic aerial photographs, and information provided by the client.
- Performing a geologic reconnaissance of the site, including the observation and photo-documentation of existing geologic conditions across the site and an evaluation of possible geologic hazards which may impact the proposed project.
- Performing subsurface exploration consisting of drilling, logging, and sampling four exploratory borings using a truck-mounted drill rig. Representative bulk and in-place soil samples were collected at selected intervals and transported to our laboratory for testing.
- Performing geotechnical laboratory testing of representative samples to evaluate soil characteristics.
- Compiling and analyzing the data obtained.
- Preparing this report presenting our preliminary findings, conclusions, and preliminary mitigation recommendations for inclusion in the Environmental Impact Report.

3. PROJECT AND SITE DESCRIPTION

The Blythe Mesa Solar Project will consist of the construction and operation of a 485-megawatt (MW) solar photovoltaic (PV) electrical generation facility. The proposed project is located on Palo Verde Mesa, north and south of Interstate 10, west of State Route 89, and east of the Blythe Airport, in Riverside County (Figure 1). The 520-MW natural gas-fired Blythe Energy Center

and Buck Substation are present in the north portion of the site. Electrical transmission lines, other solar projects, ancillary agricultural facilities, and dirt roads are present in the site vicinity.

The proposed 3,660-acre site will consist of a PV solar array field, inverters/transformers, interior collection power lines, three on-site substations, two operation and maintenance buildings, access roads, and an 8.4-mile transmission line to the Colorado River Substation.

The review of referenced topographic maps, stereoscopic aerial photographs, and background data indicates the project is situated on the Palo Verde Mesa, south of the Big Maria Mountains, west of the Palo Verde Valley, and west of the Colorado River. The site area is located within the Colorado Desert geomorphic province (Norris & Webb). The project site slopes gently toward the southeast. Elevations range from approximately 390 feet above mean sea level (MSL) in the northwest portion of the site to approximately 335 feet MSL in the southeast portion. Some incised drainage courses in the bluff along the east edge of the Palo Verde Mesa extend down to the Palo Verde Valley. In general vegetation consists of agricultural fields and citrus groves, and open desert with sparse growth of grass and creosote brush.

During the site reconnaissance, the general geologic conditions were observed across the accessible portions of the site. Selected site photographs are attached in Appendix A (Photographs 1 through 8). As discussed, the Blythe Energy Center and related Buck Substation are the dominate features present on the site north of Interstate 10. Other features include current and past agricultural activities, and scattered concrete slabs, asphalt paved roads, and piles of construction debris. Our observations on the portion of the site south of Interstate 10 included an active citrus grove, plowed fields, and former vineyards. Some eolian (blow) sand and areas of gravel (due to wind deflation) were also observed across the site.

4. SUBSURFACE EXPLORATION

Ninyo & Moore's subsurface exploration was conducted on May 14, 2013, and consisted of the drilling, logging, and sampling of four small-diameter borings to depths of up to approximately 51.5 feet. The borings were drilled using a truck-mounted drill rig equipped with 8-inch-diameter

hollow-stem augers. The boring locations were selected based on the results of our background review and field reconnaissance. The approximate locations of the exploratory borings are presented on Figure 2. The logs for the borings are presented in Appendix B.

5. LABORATORY TESTING

Laboratory testing was performed on representative soil samples collected as part of this evaluation included tests to evaluate in-situ moisture content and dry density, gradation, consolidation, shear strength, and soil corrosivity (includes pH, electrical resistivity, chloride content and sulfate content). The results of moisture and density testing are presented on the Ninyo & Moore boring logs in Appendix B. Results of the other Ninyo & Moore laboratory tests are presented in Appendix C.

6. GEOLOGY AND SUBSURFACE CONDITIONS

The findings regarding regional and site geology and groundwater conditions at the subject site are provided in the following sections.

6.1. Regional and Geologic Setting

The project area is situated in the eastern edge of the Colorado Desert Geomorphic Province. Within California, this geomorphic province encompasses an area that extends from the Colorado River on the east, the eastern Transverse Ranges on the north, the Mexican border on the south, and the Peninsular Ranges on the west (Norris and Webb, 1990; Harden, 1998). This portion of the province is characterized by broad alluvial valleys separated by steep, discontinuous, sub-parallel mountain ranges that generally trend northwest-southeast.

6.2. Site Geology

Based on our literature review, including published geologic maps and reports, and our geologic field data the project site is underlain by minor fill material and Quaternary-age alluvium. Surficial deposits of eolian sand (blow sand) and gravels are also present across

portions of the site. Generalized descriptions of the units encountered are provided in the subsequent sections. A geologic map of the region is presented on Figure 3.

6.2.1. Fill

Fill soils associated with previous agricultural activities and road grading are anticipated across much of the site and were encountered in each of our borings from the ground surface extending to depths of approximately 2.5 feet. As encountered, the fill materials generally consist of light brown and brown, dry to damp, loose to medium dense, silty sand. Scattered gravel was encountered in the fill materials.

6.2.2. Alluvium of Modern Washes

Though not encountered in our borings, Holocene age alluvium associated with modern washes (designated Qw) has been mapped near the northeastern portion of the site (United States Geological Survey [USGS], 2006). These deposits are the result of erosion, transport, and deposition of sediments caused by winter storm systems or intense summer thunderstorms. The alluvial materials are generally expected to consist of fine to coarse sand with scattered to abundant gravel to cobble-size clasts.

6.2.3. Alluvium of the Modern Colorado River Flood Plain

Though not encountered in our borings, Holocene age alluvium of the modern Colorado River flood plain (designated Qr), is mapped near the eastern boundary of the project site. These deposits are associated with flood events associated with the Colorado River and are expected to consist of fine to coarse sand, silt, and clay. These deposits are mapped immediately east of the site.

6.2.4. Eolian Sand

Though not encountered in our borings, Holocene age Eolian Sand (designated Qs) is mapped near the western portion of the project under the western portion of the proposed transmission line, and consists of unconsolidated sand dunes and sheets. The dunes are partially stabilized by vegetation.

6.2.5. Alluvial-Fan and Alluvial-Valley Deposits

Though not encountered in our borings, Holocene age alluvial-fan and alluvial-valley deposits (designated Qa_6), are mapped under portions of the proposed transmission line. This unit is characterized by sand, pebbly sand, sandy gravel and occasional eolian sand deposits. These sediments lack desert varnish.

6.2.6. Alluvial Deposits of Palo Verde Mesa

Pleistocene age alluvial deposits Palo Verde Mesa (designated Qpv) were encountered in our borings underlying the fill materials to the total depths explored. As encountered, the alluvial deposits of Pale Verde Mesa generally consist of brown and light brown, dry to damp, loose to very dense, sand, sand with silt, silty sand, and sandy silt. Scattered gravel was encountered in the alluvial deposits.

6.3. Surficial Soils

Review of the referenced soil survey report (United States Department of Agriculture [USDA], 1968) indicates surficial soils are present in the region of the subject site. A map depicting the boundaries of these soils is shown on Figure 4, Soils. A legend and general description of these soils is included on Figure 4A, Regional Soils Legend. A list of the site specific or impact soils and their classifications are shown on Figure 4B, Impacted Soils Legend. As previously discussed, much of the site has been or is currently being utilized for agricultural purposes. It is expected that the upper 1 to 3 feet of soil have been disturbed as a result of agricultural activities.

6.4. Mineral Resources

The review of the report from the Riverside County Planning Department, entitled *Fast Track 2011-01, Blythe Mesa Solar Project*, indicates the site was located in an area classified as MRZ-4 for mineral resources (areas of unknown mineral resource significance), and is not designated as being of regional or statewide significance for mineral resources.

6.5. Groundwater

The static groundwater table is anticipated to be below the depth of proposed excavations. Based on our borings at the Blythe Energy Center (Ninyo & Moore, 1999a), the static water table was found to be in excess of 90 feet below the existing ground surface or an elevation of approximately 245 feet MSL. A static water table was not encountered in our on-site borings that extended to a depth of up to approximately 51.5 feet below the ground surface. According to well data in vicinity of the subject site (California Department of Water Resources, 2013), groundwater levels in the past 40 years have varied in elevation from approximately 240 to 250 feet MSL. Groundwater levels are influenced by seasonal variations, variations in ground surface topography, precipitation, irrigation practices, soil/rock types, groundwater pumping, and other factors and are subject to fluctuations. In addition, shallow perched groundwater or groundwater seepage may also be present, particularly in or near areas of active citrus groves or other agricultural activities. Shallow groundwater can impact ground stability, and foundation design and construction.

7. GEOLOGIC HAZARDS

In general, geologic hazards associated with seismic activity include ground surface rupture, strong ground motion, and liquefaction. These hazards and other geologic considerations such as landslides, debris flows, slope stability, flood hazards, seiches, dam inundation, settlement, collapsible soils, expansive soils, erosion, and regional subsidence are discussed in the following sections.

7.1. Faulting and Seismicity

The subject site is not located within a State of California Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone) (Hart and Bryant, 1997). The project area is situated within the Sonoran zone, which is a relatively stable tectonic region located in southeastern California, southwestern Arizona, southern Nevada, and Northern Mexico (Euge and Lam, 1992). As defined by the California Geological Survey (CGS), an active fault is one that has had surface displacement during the Holocene (roughly the last 11,000 years). Potentially active faults are those that show evidence of surface displacement during the Quaternary

(roughly the last 1.6 million years) but for which evidence of Holocene movement has not been established. An inactive fault is one that has not shown evidence of surface displacement during the Quaternary. The approximate locations of the principal active faults in the region and their geographic relationship to the study area are shown on Figure 5, Fault Locations.

Table 1 lists principal known active faults within 60 miles (100 kilometers) of the subject site, the approximate fault-to-site distances, and the maximum moment magnitudes (M_{max}) as published by Cao et al. (2003) for the CGS. The approximate fault-to-site distances were calculated using the computer program FRISKSP (Blake, 2001), and from our review of published geologic maps.

Table 1 – Principal Active Faults

Fault	Approximate Fault-to-Site Distance [1] miles (kilometers)	Maximum Moment Magnitude [2] (M_{max})
Brawley Seismic Zone	57.9 (93.1)	6.4
Elmore Ranch	58.4 (93.9)	6.6
San Andreas (Coachella)	58.4 (94.1)	7.2

Notes:
[1] Blake, 2001
[2] Cao et al., 2003

7.1.1. Strong Ground Motion

The 2010 California Building Code recommends that the design of structures be based on the peak horizontal ground acceleration (PGA) having a 2 percent probability of exceedance in 50 years which is defined as the Maximum Considered Earthquake (MCE). The statistical return period for PGA_{MCE} is approximately 2,475 years. In evaluating the seismic hazards associated with the project site, we have selected a Site Class D. The site modified PGA_{MCE} is an estimated 0.22g using the USGS (USGS, 2011) ground motion calculator (web-based). The design PGA was 0.15g using the USGS ground motion calculator. These estimates of ground motion do not include near-source factors that may be applicable to the design of structures on site.

AR061589

7.1.2. Ground Surface Rupture

As part of our study we have reviewed referenced geologic and fault location maps, 1959 stereoscopic aerial photographs, and relatively recent aerial photographs (2008). The photographs and fault location maps reviewed are listed in the References section of this report.

Our review of the referenced photographs (aerial and stereoscopic) included general analysis of geomorphic landforms within and adjacent to the subject site. Features evaluated included abrupt changes in topography, changes in vegetation, and possible lineaments. As discussed, the topography across the site is relatively flat, with a gentle slope to the southeast. Our review indicated no lineaments or other indications of fault related features across the site. In addition, based on our review of the referenced geologic data and fault location maps, there are no known active faults underlying the site. Accordingly, the potential for surface rupture and lurching or cracking of the ground surface as a result of a nearby seismic event is considered low.

7.1.3. Liquefaction and Seismically Induced Settlement

Liquefaction is the phenomenon in which loosely deposited granular soils and non-plastic silts located below the water table undergo rapid loss of shear strength when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid rise in pore water pressure, and causes the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet below ground surface. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking.

A review of Riverside County Integrated Project Figure S-3 indicates the site is mapped within a zone described as “moderately susceptible” liquefaction associated with deep groundwater. However, our borings at the site indicate that groundwater is at a depth

greater than 50 feet. Based on the lack of shallow groundwater, it is our opinion that liquefaction and seismically induced settlement at the site are not design considerations.

7.2. Landslide and Debris Flows

Landslides may be induced by strong vibratory motion produced by earthquakes. Research and historical data indicate that seismically induced landslides tend to occur in weak soil and rock on sloping terrain. The process for zoning earthquake-induced landslides incorporates expected future earthquake shaking, existing landslide features, slope gradient and strength of earth materials on the slope. Based on review of Riverside County Integrated Project Figure S-4 and on the relatively gentle slopes in areas underlain by alluvium and the relatively dense nature of the older alluvium, the potential for seismically induced landslides and debris flows at the site is not considered likely. In addition, no landslides, debris flows or rock falls are known to present on the site based on the site reconnaissance and review of referenced documents.

7.3. Slope Stability

The review of topographic maps and preliminary project plans indicates that the proposed project will be located adjacent to the descending bluff located along the east site boundary. A review of Riverside County Integrated Project, Figure S-5, indicated this slope have a low to locally moderate susceptibility to seismically induced landslides and rockfalls. A review of the available project documents suggest that proposed improvements are not anticipated to be constructed on or near to the bluff slope.

7.4. Flood Hazard

The subject site is located on relatively flat to gently sloping terrain, west of the Colorado River. Our review of data on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) website, and Riverside County Integrated Project Figure S-9, Flood Prone Areas, indicates that the site is not located within a 100- or 500-Year Flood Zone.

7.5. Seiches

Review of topographic maps and aerial photographs do not indicate the presence of relatively large bodies of water (lakes, reservoirs, oceans) in the vicinity of the site. Several small irrigation reservoirs are located in the orchard areas of the site. These reservoirs will be removed as a result of the proposed project. Accordingly, seiches are not a design consideration.

7.6. Dam Inundation

Parker Dam on the Colorado River is located approximately 50 miles north-northeast of the project site. Review of the Riverside County Integrated Project, Figure 10, indicates the proposed project is not within a Dam Hazard Zone. Further, a review of topographic maps indicates that the site is on the order of 75 feet above existing river levels. Based on the topographic elevation above the Colorado River and the relatively broad nature of the Palo Verde Valley, inundation due to a failure of the Parker Dam is not expected to affect the project site.

7.7. Settlement

Based on the review of the referenced geotechnical report for the Blythe Energy Center, our geologic reconnaissance, and our subsurface evaluation, the underlying alluvium is expected to consist of loose to dense layers of silty sands, sands, and gravel. The soil encountered in our borings in the upper 2.5 feet has been plowed and disturbed and is in a loose condition. In boring B-2 loose material was encountered to a depth of approximately 7.5 feet. Materials below these depths were found to be medium dense or denser. Accordingly, some settlement of the loose soils underlying the near surface is possible.

7.8. Hydro-consolidation or Soil Collapse

Hydro-consolidation or Soil Collapse typically occurs in recently deposited, Holocene (less than 10,000 years old) soils that were deposited in an arid or semi-arid environment. Soils prone to collapse are commonly associated with man-made fill, wind-laid sands and silts, and alluvial fan and mudflow sediments deposited during flash floods. These soils typically contain minute pores and voids. The soil particles may be supported by clay or silt, or

chemically cemented with carbonates. When saturated, collapsible soils undergo rearrangement of their grains, and the water removes the cohesive (or cementing) material, this results in rapid substantial settlement (Riverside County Integrated Project).

Based on our subsurface exploration and laboratory testing data, the hydro-consolidation potential of the soils is moderate. Additional hydro-consolidation tests should be performed to verify this during the design stages of the project.

7.9. Expansive Soils

Expansive soils generally result from specific clay minerals that have the capacity to shrink or swell in response to changes in moisture content. Based on a review of regional geologic maps and our subsurface exploration, the deposits underlying the project site consist of relatively granular alluvial deposits. It is expected that grading recommendations would likely be specified as granular. Therefore, the potential for near-surface expansive soils at the project is considered low.

7.10. Erosion

In general, erosion refers to the process by which soil or earth material is loosened or dissolved and removed from its original location. Erosion can occur by varying processes and may occur in the project area where bare soil (or rock) is exposed to wind or moving water (both rainfall and surface runoff). The processes of erosion are generally a function of material type, terrain steepness, rainfall or irrigation levels, surface drainage conditions, wind velocity, and general land use. Review of geologic maps and soil data indicate that surface soils are generally comprised of sand and gravels. Based on the gentle gradients across the site, the potential for water erosion is low. However, portions of the site situated along the east boundary may be subject to water erosion down the bluff face.

Our observations indicated areas of eolian deposits (wind deposited) and areas of deflation (coarse sand and gravel concentrated due to wind erosion of the fine-grain silts and sands) are present across portions of the site. The presence of eolian sand across the site indicates that the site has been historically subject to moderate to relatively high winds. Based on review of Riverside County Integrated Project Figure S-8, the project site is moderately to highly susceptible to wind erosion.

7.11. Regional Subsidence

Subsidence is characterized as the sudden or gradual downward settling of the ground surface relative to surrounding areas, and can generally occur where deep alluvial deposits are present in valley areas. Subsidence in alluvial valley areas is typically associated with groundwater withdrawal or other fluid withdrawal from the subsurface such as oil and natural gas. Extraction of these geologic components can cause subsidence, which can result in the development of surface ground cracks and fissures, particularly near valley margins. Cracks and earth fissures can cause damage to improvements including roads, transmission lines, foundations, structures and pipelines. Review of Riverside County Integrated Project Subsidence Zone map (Figure S-7), the project area is located in a "Susceptible Area" with regard to potential subsidence. However, our review of Figure S-7 indicates the site is located outside of "Areas of Documented Subsidence".

During our site reconnaissance, we did not observe ground cracks or earth fissures. We note however that the site is generally covered with a mantle of eolian sand, or active or plowed agricultural fields that may conceal underlying cracks or fissures.

8. CONCLUSIONS

Based on our the results of our study, it is our opinion that construction of the proposed Blythe Mesa Solar Project is feasible from a geologic standpoint provided that the recommendations of this report are incorporated into the preliminary design of the project. Prior to final project design, additional subsurface geotechnical evaluation should be performed to further evaluate site-specific geotechnical conditions.

9. RECOMMENDATIONS

The potential geologic and seismic impacts that may affect the Blythe Mesa Solar Project may be mitigated by employing sound engineering practice in the planning, design and construction of the new improvements proposed for the project. This practice includes performance of the following general and specific techniques as part of the design and construction of the subject project.

9.1. Strong Ground Motion

Site-specific evaluation of the potential ground-shaking hazard for the proposed project would be performed prior to final design and construction so that appropriate structural design and mitigation techniques can be implemented. This evaluation would involve the use of geotechnical software programs utilizing site latitudinal and longitudinal coordinates and general site geologic information to evaluate the potential levels of ground shaking at the project site. Where deemed appropriate during project design, site-specific geotechnical evaluations to assess the subsurface characteristics of the on-site earth materials with regard to ground shaking could be performed. Subsurface data could be obtained through exploratory excavations and laboratory testing of soils.

Mitigation of the potential impacts of seismic ground shaking can be achieved through project design. During the design phase, site-specific geotechnical evaluations would be performed to analyze the site-specific ground motion anticipated for the improvements. Site-specific evaluation of the potential ground shaking hazard would involve an evaluation to develop seismic design parameters for use by the project structural engineer. Structural elements can then be designed to resist or accommodate appropriate site-specific ground motions and to conform to the current seismic design standards.

9.2. Ground Surface Rupture

Based on the review of the referenced fault location maps, aerial photo review, and site reconnaissance, there are no known active faults underlying the proposed project site. Accordingly, the potential for surface rupture and lurching or cracking of the ground surface as a result of a nearby seismic event is considered low. However, should future data suggest

the presence of active faulting at the project site, a fault evaluation may be performed. Such an evaluation may include review of geologic and fault location maps, a geologic reconnaissance to observe the earth units and geomorphology, and performance of a subsurface exploration to evaluate fault locations and conditions. Subsurface exploration might include the excavation and detailed logging of exploratory trenches and/or borings, geophysical studies such as high resolution seismic reflection, seismic refraction, ground penetrating radar, gravity and/or magnetic profiling or other applicable methods.

Recommendations for mitigation of potential fault rupture hazard would typically include locating improvements away from the trace of an active fault, designing structures for an acceptable amount of movement, or implementing systems to maintain safety and that allow for displacement that could be repaired.

9.3. Liquefaction and Seismically Induced Settlement

Liquefaction is the phenomenon in which loosely deposited granular soils and non-plastic silts located below the water table undergo rapid loss of shear strength when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid rise in pore water pressure, and causes the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet below ground surface. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking.

Based on our borings at the site, groundwater is at a depth greater than 50 feet. Therefore, liquefaction is not a design consideration. However, liquefaction should be re-evaluated when additional subsurface geotechnical evaluation is performed prior to final design. In general, mitigation for construction in liquefaction zones may include in-situ ground modification, removal of liquefiable layers and replacement with compacted fill, or support of project improvements with piles at depths designed to mitigate damage from liquefaction.

9.4. Landsliding

The subject site is located on relatively flat terrain that is not subject to landslides. The background review did not indicate the presence of landslides on or near to the subject property. Therefore, potential for landslides is not a design consideration. Accordingly, no recommendations pertaining to this issue are warranted.

9.5. Flood Hazard

To evaluate the potential for flooding, additional review of available data including a detailed hydrologic evaluation could be performed to assess the risks and potential effects of flooding. An evaluation of the flood hazard potential would be performed prior to final design and construction.

Measures to mitigate the potential for flooding may include raising the elevation of the proposed site improvements to keep them elevated above the potential flood level, and construction of berms, levees, and drainage channels.

9.6. Settlement

As noted, the underlying alluvium is expected to consist of loose to dense layers of silty sands, sands, and gravel. The soil encountered in our borings in the upper 2.5 feet has been plowed and disturbed and is in a loose condition. In boring B-2 loose material was encountered to a depth of approximately 7.5 feet. Materials below these depths were found to be medium dense or denser. Accordingly, some settlement of the loose soils underlying the near surface is possible.

Examples of possible mitigation for loose soils with potential for settlement include removal of the loose soil layers and replacement with compacted fill or specialized foundation design including the use of deep foundation systems to support structures.

AR061597

9.7. Hydro-consolidation or Soil Collapse

Hydro-consolidation or Soil Collapse typically occurs in recently deposited, Holocene (less than 10,000 years old) soils that were deposited in an arid or semi-arid environment. Soils prone to collapse are commonly associated with man-made fill, wind-laid sands and silts, and alluvial fan and mudflow sediments deposited during flash floods. These soils typically contain minute pores and voids. The soil particles may be supported by clay or silt, or chemically cemented with carbonates. When saturated, collapsible soils undergo rearrangement of their grains, and the water removes the cohesive (or cementing) material, this results in rapid substantial settlement (Riverside County Integrated Project).

Based on our subsurface exploration and laboratory testing data, the hydro-consolidation potential of the soils is low. However, additional hydro-consolidation tests should be performed to verify this during the design stages of the project. The mitigation recommendations for hydro-consolidation may include removal of the collapsible soil layers and replacement with compacted fill or specialized foundation design including the use of deep foundation systems to support structures.

9.8. Expansive Soils

Based on a review of regional geologic maps and our subsurface exploration, the deposits underlying the project site consist of relatively granular alluvial deposits. It is expected that grading recommendations would likely be specified as granular. Therefore, the potential for near-surface expansive soils at the project is considered low.

However, further evaluation of the potential for expansive soils to affect the proposed project components should be performed prior to final design and construction so that, in the event the hazard exists, mitigation techniques can be implemented. Mitigation for expansive soils may include techniques such as overexcavation and replacement with non-expansive soil, moisture control, and/or specific structural design for expansive soil conditions developed during design of the project.

9.9. Erosion

Construction for the proposed project is anticipated to create the potential for soil erosion during excavation, grading, and trenching activities. With the implementation of prudent site practices during construction, water and wind related soil erosion can be reduced within construction site boundaries. Such procedures may include appropriate surface drainage measures for erosion due to water, the use of erosion prevention mats or geofabrics, silt fencing, sandbags and plastic sheeting, and temporary drainage devices. Positive surface drainage should be developed and maintained at project construction sites to provide surface runoff to flow away from site improvements, slope faces or other areas susceptible to erosion.

As discussed previously, the site soils will be subject to wind erosion. To mitigate wind-related erosion, wetting of soil surfaces and/or covering exposed ground areas and soil stockpiles could be considered during construction operations, as appropriate. In addition, the use of tackifiers may be considered to reduce the potential for water- and wind-related soil erosion.

Long-term erosion potential can be mitigated through prudent site design and maintenance practices. Design procedures can be performed to reduce soil erosion such as appropriate surface drainage and design of roadways to provide for positive surface runoff. Design would address reducing concentrated run-off conditions that could cause erosion rilling and affect the stability of project improvements. The use of erosion control fabrics and roadway drainage devices can be designed and maintained to reduce erosion processes. As appropriate, a Storm Water Pollution Prevention Plan that would include the use of Best Management Practices should be developed for the construction site.

9.10. Regional Subsidence

Subsidence is characterized as the sudden or gradual downward settling of the ground surface relative to surrounding areas, and generally occurs where deep alluvial deposits are present in valley areas. Based on our review of Riverside County Integrated Project Subsidence Zone map (Figure S-7), the project area is located in a "Susceptible Area" with regard to potential subsidence. However, our review of Figure S-7 indicates the site is located outside of "Areas of Documented Subsidence".

If additional data should become available regarding the potential for subsidence and/or the presence of earth fissures underlying the proposed project area, a geologic evaluation should be performed. Such an evaluation would include review of geologic and topographic maps, performance of a geologic reconnaissance to observe and map the geomorphology, review of groundwater well records and well pumping history, and performance of a subsurface exploration to evaluate possible fissures concealed by eolian or other surficial sediments. A subsurface evaluation might include the excavation and detailed logging of exploratory trenches and/or borings, geophysical studies such as high resolution seismic reflection, seismic refraction, ground penetrating radar, gravity and/or magnetic profiling or other applicable methods.

Mitigation of potential subsidence and earth fissure hazard would typically include locating improvements away from the trace of an active fissure, designing structures for an acceptable amount of movement, minimization of groundwater pumping to allow recovery of water table levels at or above historic levels, or implementing systems to allow for displacement that could be repaired.

9.11. Corrosion

Laboratory testing was performed on a representative sample of the on-site earth materials to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH and electrical resistivity tests were performed in accordance with California Test (CT) 643 and the sulfate and chloride content tests were performed in accordance with CT 417 and CT 422, respectively. These laboratory test results are presented in Appendix C.

The results of the corrosivity testing indicated an electrical resistivity of 660 ohm-cm, a soil pH of 8.5, a chloride content of 390 parts per million (ppm) and a sulfate content of 0.029 percent (i.e., 290 ppm). Based on the Caltrans corrosion (2012) criteria and ACI 318 the on-site soils would be classified as corrosive. Corrosive soils are defined as the soils with electrical resistivities less than 1,000 ohm-cm, more than 500 ppm chlorides, more than 0.1 percent sulfates, or a pH less than 5.5. Mitigation recommendations for corrosive soils would typically include designing the structural elements to resist corrosion.

10. LIMITATIONS

This report was prepared to evaluate geologic site constraints in support of the environment impact document. Prior to design, a site specific geotechnical evaluation should be performed which includes subsurface exploration. The field evaluation, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified, and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no controls.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

11. REFERENCES

American Concrete Institute (ACI), 2010, ACI 318 Building Code Requirements for Structural Concrete and Commentary.

Blake, T.F., 2001, FRISKSP (Version 4.00), A Computer Program for the Probabilistic Estimation of Peak Acceleration and Uniform Hazard Spectra Using 3-D Faults as Earthquake Sources.

California Building Standards Commission (CBSC), 2010, California Building Code (CBC), Title 24, Part 2, Volumes 1 and 2.

California Department of Conservation Geological Survey (CGS), 2010, Geologic Map of California, http://www.consrv.ca.gov/cgs/cgs_history/Pages/2010_geologicmap.aspx: accessed in June.

California Department of Transportation (Caltrans), 2012, Corrosion Guidelines (Version 2.0), Division of Engineering and Testing Services, Corrosion Technology Branch: dated November.

California Department of Water Resources, 2013, Water Data Library http://www.water.ca.gov/waterdatalibrary/: accessed in January.

Cao, T., Bryant, W. A., Rowshandel, B., Branum, D., and Willis, C. J., 2003, The Revised 2002 California Probabilistic Seismic Hazards Maps: California Geological Survey: dated June.

Engeo, 2010, Geologic Reconnaissance, Blythe Solar Project, Blythe, California: dated November 11.

Euge, K.M., and Lam, I.P., 1992, Development of Seismic Acceleration Contour Maps for Arizona, Final Report: Arizona Department of Transportation Report No. AZ92-344.

Google Earth, 2013, http://earth.google.com.

Jennings, C.W., 2010, Fault Activity Map of California and Adjacent Areas: California Geological Survey, California Geologic Data Map Series, Map No. 6, Scale 1:750,000.

Ninyo & Moore, 1999a, Geotechnical Engineering Evaluation, Blythe Energy Project, Blythe California: dated October 8.

Ninyo & Moore, 1999b, Geotechnical Reconnaissance Study, Proposed Natural Gas Pipeline for the Planned Blythe Energy Facility, Blythe California: dated October 22.

Ninyo & Moore, 2012, Response to Review Comments, County Geologic Report No. 2298, Geologic Reconnaissance Evaluation, Blythe Mesa I Solar Project, Blythe, California: dated October 25.

Ninyo & Moore, 2012, Geologic Reconnaissance Evaluation, Blythe Mesa I Solar Project, Blythe, California: dated February 10.

Norris, R. M. and Webb, R. W., 1990, Geology of California, Second Edition: John Wiley & Sons, Inc.

Public Works Standards, Inc., 2012, "Greenbook," Standard Specifications for Public Works Construction.

Riverside County Integrated Project, Chapter 6: Safety Element: http://www.rctlma.org/genplan/content/gp/chapter06.html.

Riverside County Planning Department, Fast Track, 2011-01, Blythe Mesa Solar I Project.

Riverside County Planning Department, 2012, Review Comments #2, County Geologic Report No. 2298, Geologic Reconnaissance Evaluation, Blythe Mesa Solar Project, California: dated December 11.

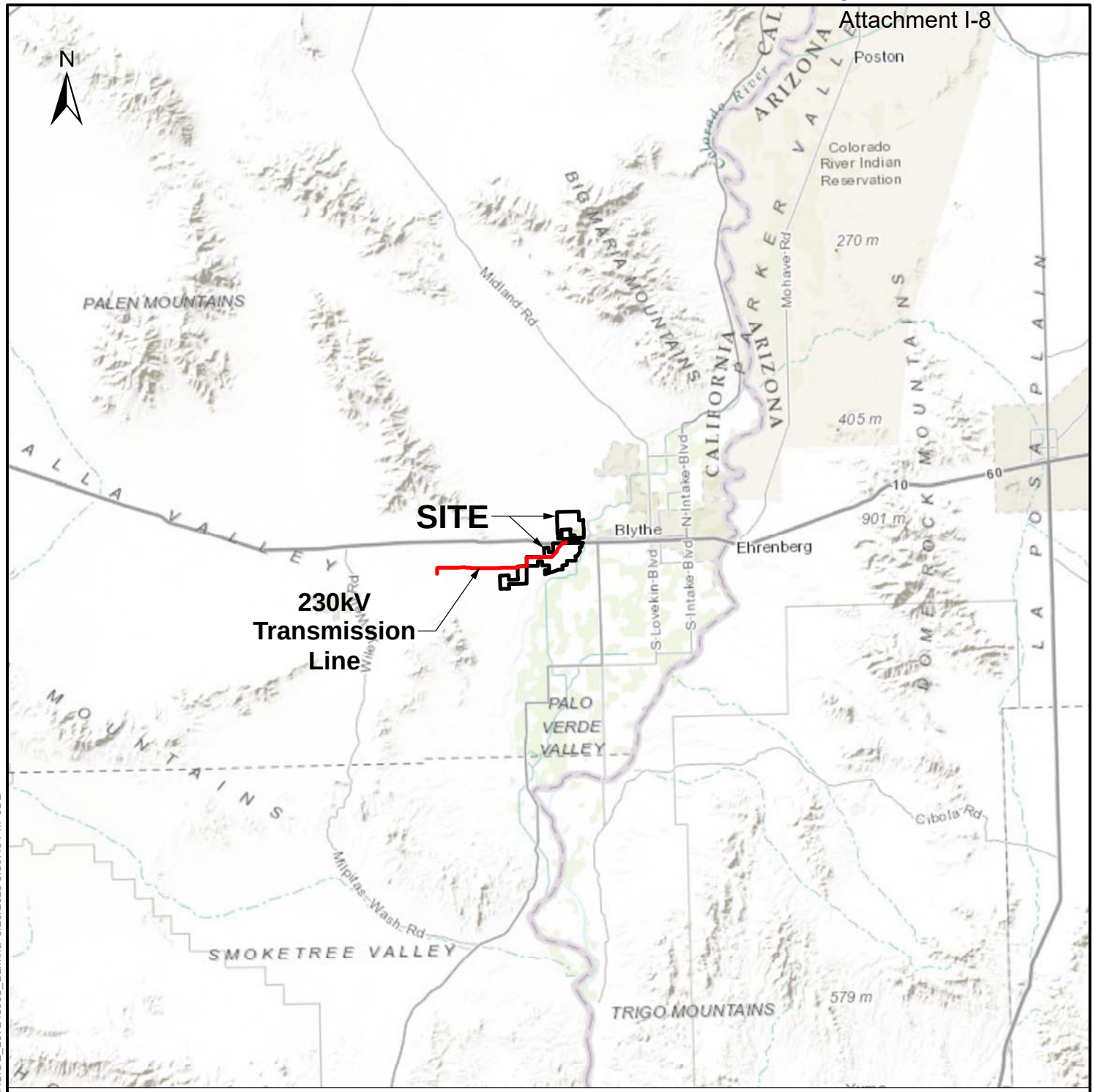
United States Department of Agriculture, Natural Resources Conservation Service, 1968, Soils - Non-MLRA Soil Survey Area CA681, Palo Verde Area California, 154500, Davis, CA: dated October 1.

United States Department of the Interior, Bureau of Reclamation, 1998, Engineering Geology Field Manual.

United States Geological Survey, 2006, Geologic Map of the West Half of the Blythe 30' by 60' Quadrangle, Riverside County, California, and La Paz County, Arizona: Scientific Investigations Map 2933, Scale 1:100,000.

United States Geological Survey, 2011, Ground Motion Parameter Calculator v. 5.1.0, World Wide Web, http://earthquake.usgs.gov/research/hazmaps/design/.

AERIAL PHOTOGRAPHS				
Source	**Date**	**Flight**	**Numbers**	**Scale**
USDA	6-9-1959	AXM 9W	79, 80, 81, 82	1:20,000
USDA	7-23-1959	AXM 9W	154, 155	1:20,000
USDA	9-7-1959	AXM 13W	3, 4, 5, 6	1:20,000
USDA	9-7-1959	AXM 13W	68, 69	1:20,000



SOURCE: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community



MAP INDEX

SCALE IN MILES

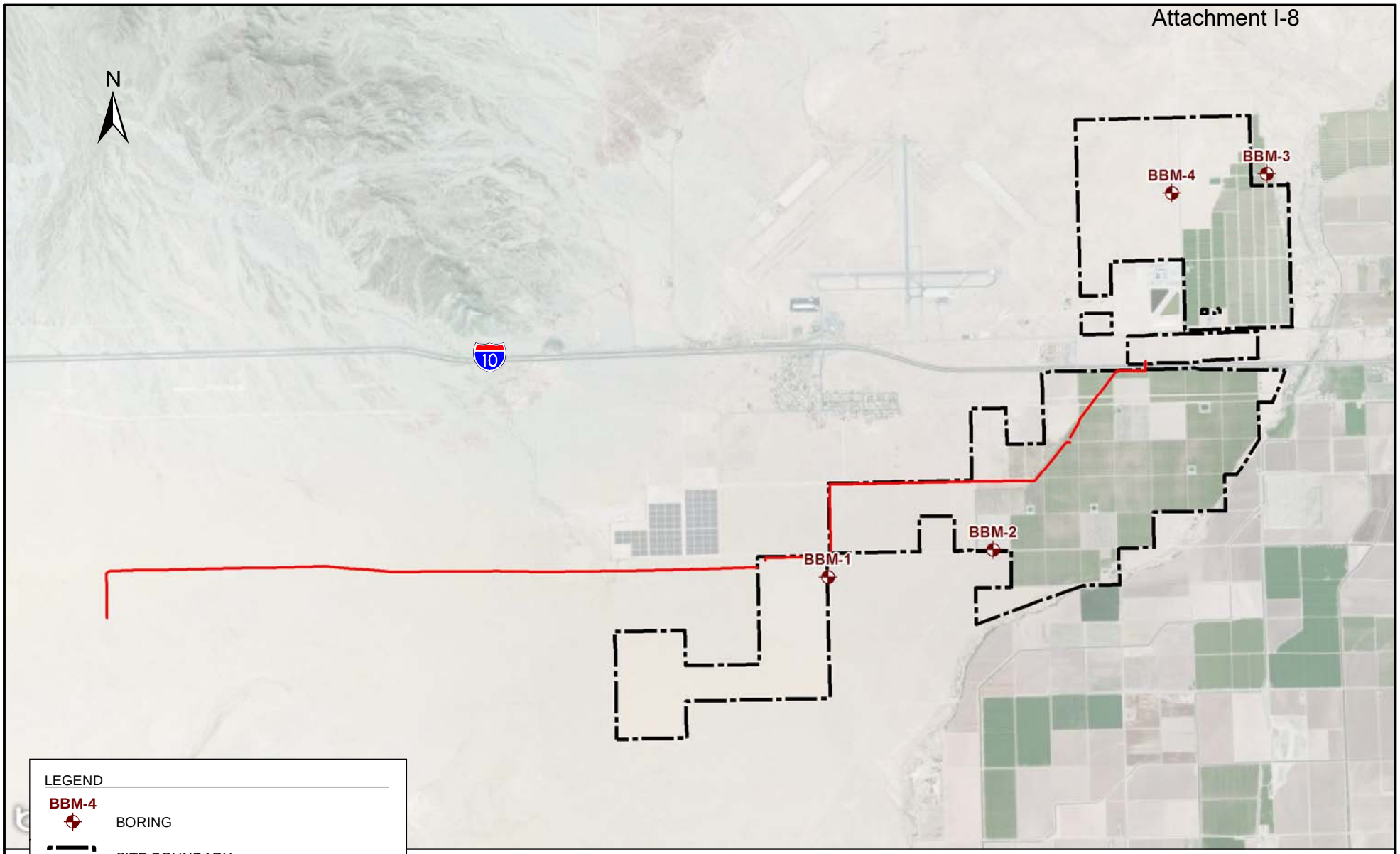
0 4 8 16

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	SITE LOCATION	FIGURE
PROJECT NO. / DATE	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	1
107243003 / 6/13		

AR061604

J:\Projects\1000000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\1_107243003_SL.mxd 5/20/2013 5:59:45 PM JDL



SOURCE: AERIAL PHOTO - © HARRIS CORP, EARTHSTAR GEOGRAPHICS LLC © 2013 MICROSOFT CORPORATION

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

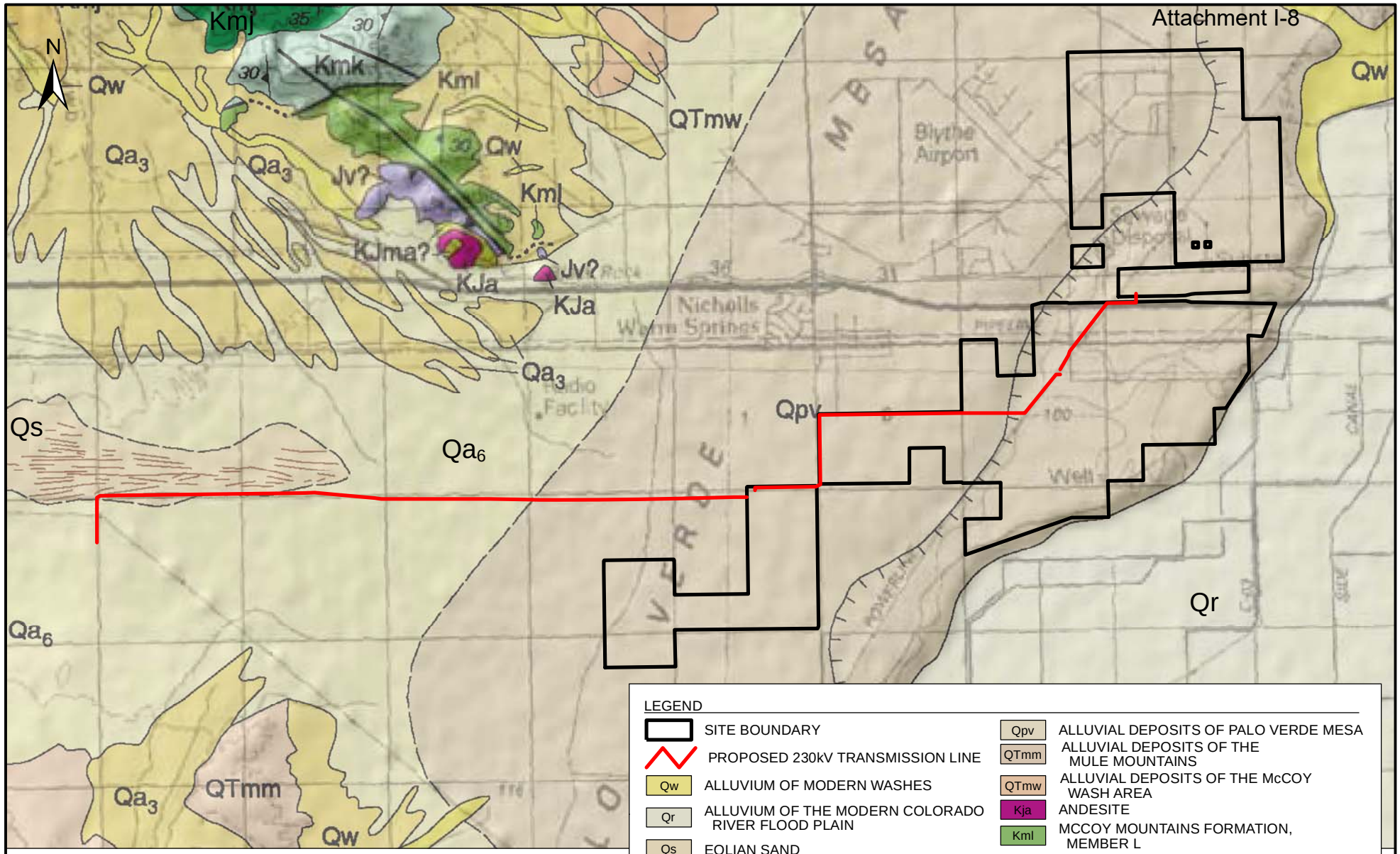
SCALE IN FEET

0 2,500 5,000 10,000

Ninyo & Moore	BORING LOCATIONS	FIGURE
PROJECT NO. / DATE	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	2
107243003 / 6/13		

AR061605

J:\Projects\100000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\2_107243003_BL.mxd 5/22/2013 6:33:18 PM JDL



SOURCE: STONE, P., 2006., GEOLOGIC MAP OF THE WEST HALF OF THE BLYTHE 30' BY 60' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA, AND LA PAZ COUNTY, ARIZONA

SCALE IN FEET

0 2,500 5,000 10,000

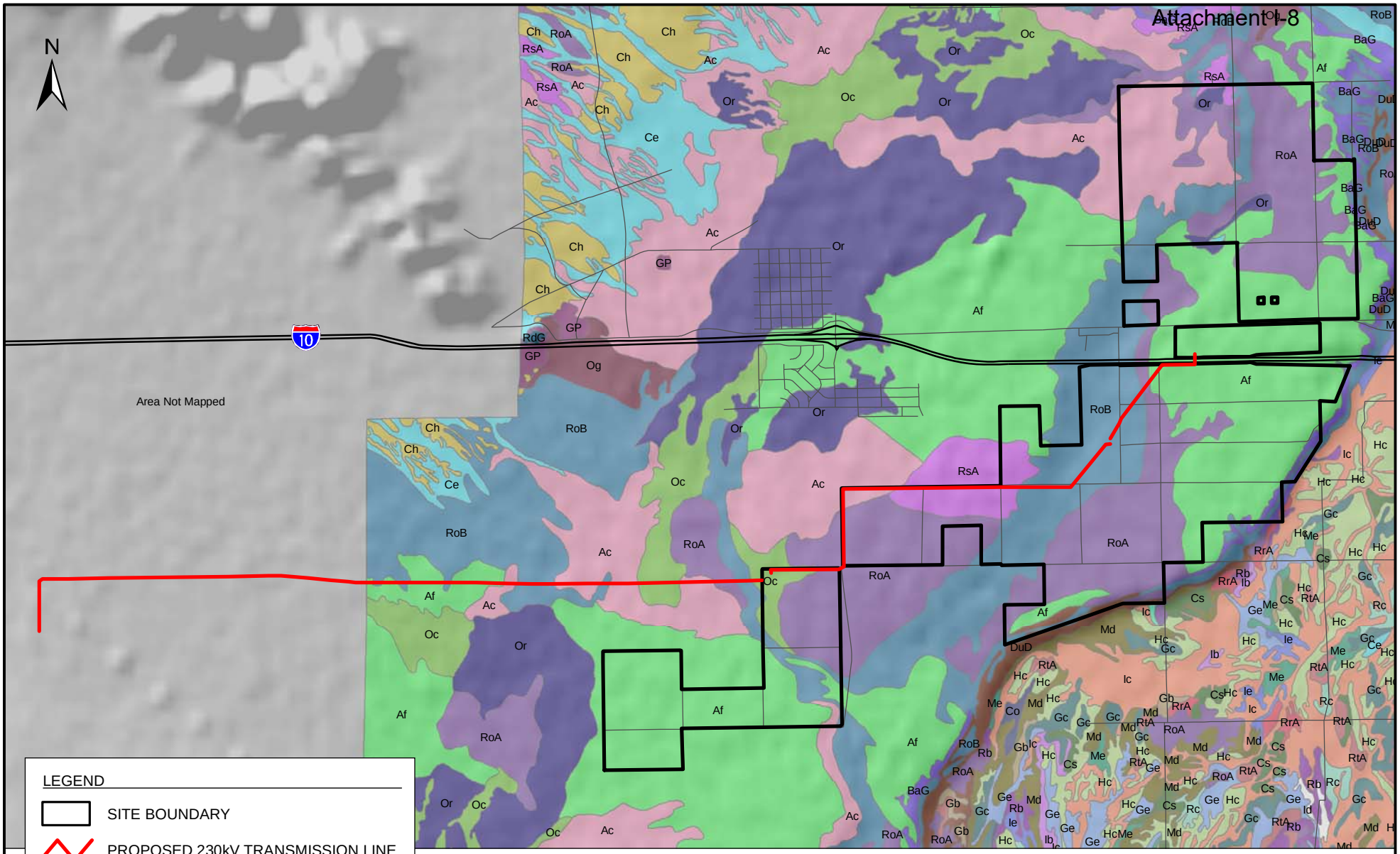
NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore		GEOLOGY	FIGURE
PROJECT NO.	DATE	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	3
107243003	6/13		

AR061606

J:\Projects\100000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\3_107243003_G.mxd 5/20/2013 6:02:37 PM JDL

Attachment I-8



SOURCE: Soils - Non-MLRA Soil Survey Area CA681, Palo Verde Area, California, 154500, Davis, CA, Detailed Soil Map Legend - Natural Resources Conservation Service 24000 10/01/1968, 14139

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore	SOILS	FIGURE
PROJECT NO. 107243003	DATE 6/13	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	4

J:\Projects\100000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\4_107243003_S.mxd 5/20/2013 6:05:07 PM JDL

LEGEND

NRCS SOILS (MU SYMBOL | DESCRIPTION)

- Ac - ACO GRAVELLY LOAMY SAND
- Af - ACO SANDY LOAM
- BaG - BADLAND
- Ce - CARRIZO GRAVELLY SAND
- Ch - CHUCKAWALLA VERY GRAVELLY SILT LOAM
- Co - CIBOLA FINE SANDY LOAM
- Cs - CIBOLA SILTY CLAY LOAM
- DuD - DUNELAND
- GP - GRAVEL PITS
- Gb - GILMAN FINE SANDY LOAM
- Gc - GILMAN SILTY CLAY LOAM
- Ge - GLENBAR SILTY CLAY LOAM
- Hb - HOLTVILLE FINE SANDY LOAM
- Hc - HOLTVILLE SILTY CLAY
- Ib - IMPERIAL FINE SANDY LOAM
- Ic - IMPERIAL SILTY CLAY
- Ie - INDIO SILTY CLAY LOAM
- Md - MELOLAND FINE SANDY LOAM
- Me - MELOLAND SILTY CLAY LOAM
- Oc - ORITA FINE SAND
- Og - ORITA GRAVELLY LOAMY SAND
- Or - ORITA GRAVELLY FINE SANDY LOAM
- Rb - RIPLEY VERY FINE SANDY LOAM
- Rc - RIPLEY SILTY CLAY LOAM
- RdG - ROCK LAND
- RoA - ROSITAS FINE SAND, 0 TO 2 PERCENT SLOPES
- RoB - ROSITAS FINE SAND, 2 TO 9 PERCENT SLOPES
- RrA - ROSITAS FINE SAND, WET, 0 TO 2 PERCENT SLOPES
- RsA - ROSITAS GRAVELLY LOAMY SAND, 0 TO 2 PERCENT SLOPES
- RtA - ROSITAS SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES
- NO DATA

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SOURCE: Soils - Non-MLRA Soil Survey Area CA681, Palo Verde Area, California, 154500, Davis, CA, Detailed Soil Map Legend - Natural Resources Conservation Service 24000 10/01/1968, 14139

Ninyo & Moore	REGIONAL SOILS LEGEND	FIGURE
PROJECT NO. / DATE	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	4A
107243003 / 6/13		

AR061608

J:\Projects\1000000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\4A_107243003_S_LEG.mxd 5/20/2013 6:06:21 PM JDL

LEGEND

NRCS SOILS (MU SYMBOL | LEP | CONCRETE/STEEL CORROSION LEVEL | DESCRIPTION)

- Af - NA | MODERATE/HIGH | ACO SANDY LOAM
- BaG - NA | NA/NA | BADLAND
- Ce - NA | LOW/HIGH | CARRIZO GRAVELLY SAND
- Cs - NA | LOW/HIGH | CIBOLA SILTY CLAY LOAM
- DuD - NA | NA/NA | DUNELAND
- Hb - 7.5% | LOW/HIGH | HOLTVILLE FINE SANDY LOAM
- Hc - 7.5% | LOW/HIGH | HOLTVILLE SILTY CLAY
- Ic - 7.5% | MODERATE/HIGH | IMPERIAL SILTY CLAY
- Md - 7.5% | MODERATE/HIGH | MELOLAND FINE SANDY LOAM
- Oc - 7.5% | LOW/HIGH | ORITA FINE SAND
- Or - 7.5% | LOW/HIGH | ORITA GRAVELLY FINE SANDY LOAM
- Rb - NA | LOW/HIGH | RIPLEY VERY FINE SANDY LOAM
- RoA - NA | LOW/HIGH | ROSITAS FINE SAND, 0 TO 2 PERCENT SLOPES
- RoB - NA | LOW/HIGH | ROSITAS FINE SAND, 2 TO 9 PERCENT SLOPES
- RrA - 7.5% | LOW/HIGH | ROSITAS FINE SAND, WET, 0 TO 2 PERCENT SLOPES
- RsA - NA | LOW/HIGH | ROSITAS GRAVELLY LOAMY SAND, 0 TO 2 PERCENT SLOPES
- NO DATA

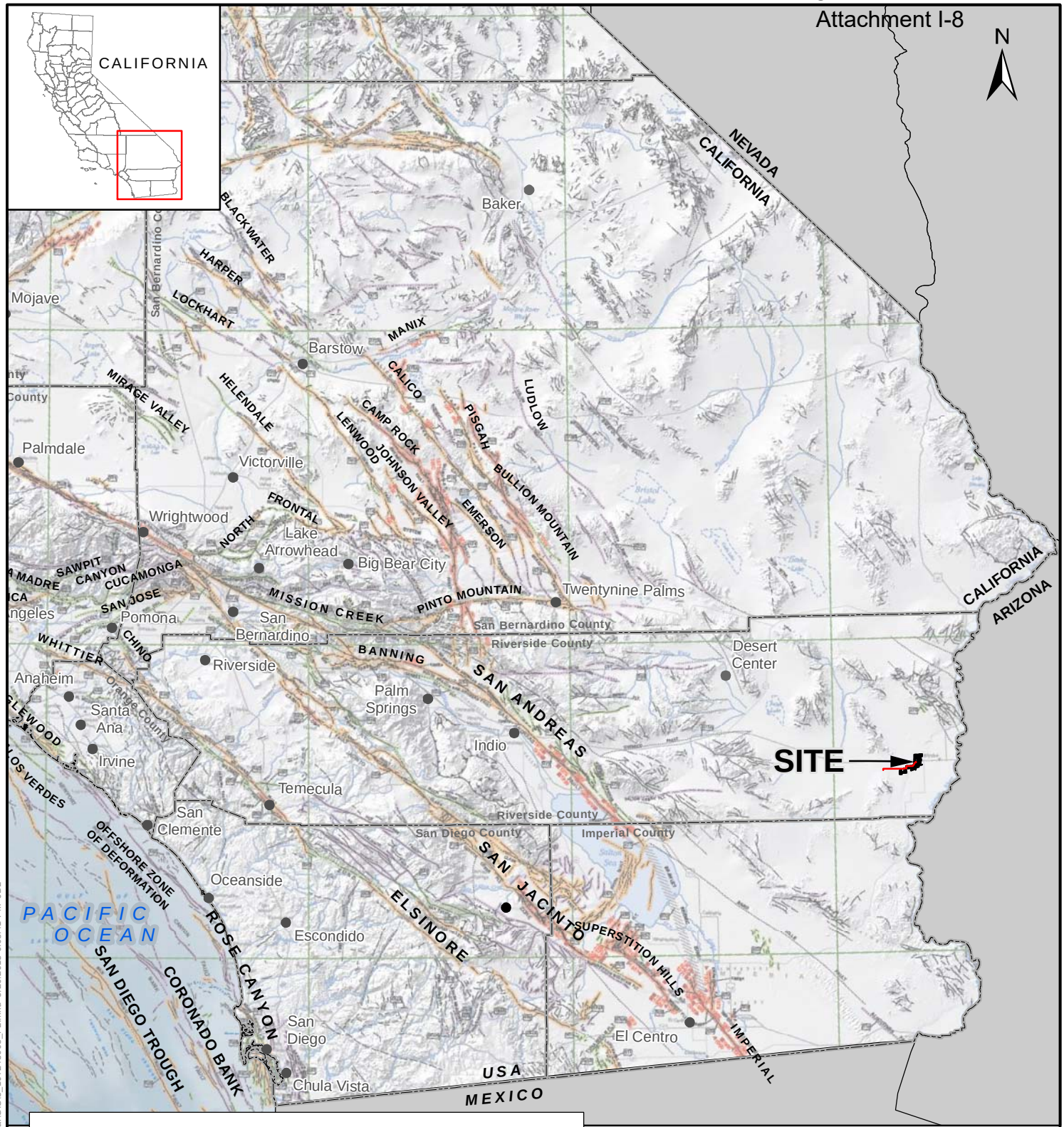
NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SOURCE: Soils - Non-MLRA Soil Survey Area CA681, Palo Verde Area, California, 154500, Davis, CA, Detailed Soil Map Legend - Natural Resources Conservation Service 24000 10/01/1968, 14139

Ninyo & Moore	IMPACTED SOILS LEGEND	FIGURE
PROJECT NO. / DATE	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	4B
107243003 / 6/13		

AR061609

J:\Projects\1000000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\MB_107243003_S_LEG.mxd 5/20/2013 6:07:09 PM JDL



LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

SOURCE: Fault Activity Map of California, 2010, Jennings, C.W., and Bryant, W.A., California Geological Survey.

SCALE IN MILES

0 30 60

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore	FAULT LOCATIONS	FIGURE
PROJECT NO. 107243003 / DATE 6/13	BLYTHE MESA SOLAR PROJECT BLYTHE, CALIFORNIA	5

AR061610

J:\Projects\100000_SD\107200_107249\107243\003_Blythe_Mesa_Solar\GIS\5_107243003_FL.mxd 5/20/2013 6:08:41 PM JDL

APPENDIX A

SITE PHOTOGRAPHS



Photograph 1: **Soils and sparse vegetation on site.**



Photograph 2: **Close-up of soils on site.**



Photograph 3: **Access road on site.**



Photograph 4: **View of typical low dunes and vegetation on site.**



Photograph 5: **Low dunes and sparse vegetation on site.**



Photograph 6: **Low dunes and sparse vegetation on site.**



Photograph 7: **Agricultural field on site.**



Photograph 8: **Agricultural field on site.**

APPENDIX B

BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

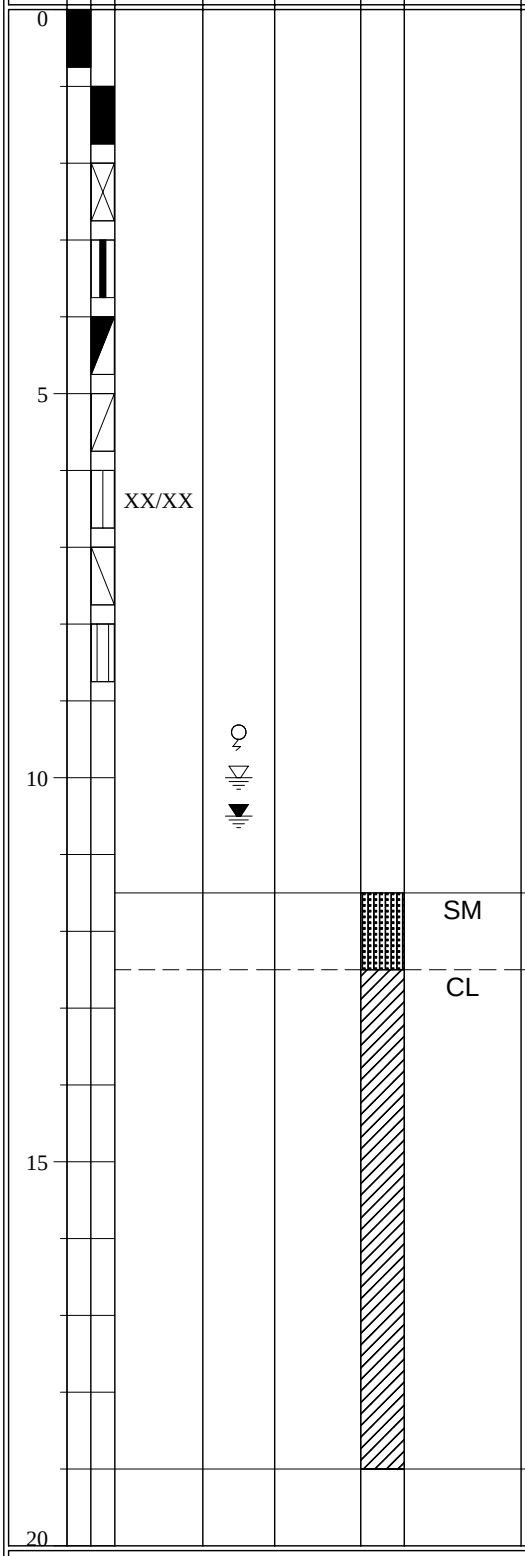
Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following methods.

The Modified Split-Barrel Drive Sampler

The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

BORING LOG EXPLANATION SHEET



DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
							CL	Dashed line denotes material change.
15								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
20								The total depth line is a solid line that is drawn at the bottom of the boring.

Ninyo & Moore

BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE
	Rev. 11/11	

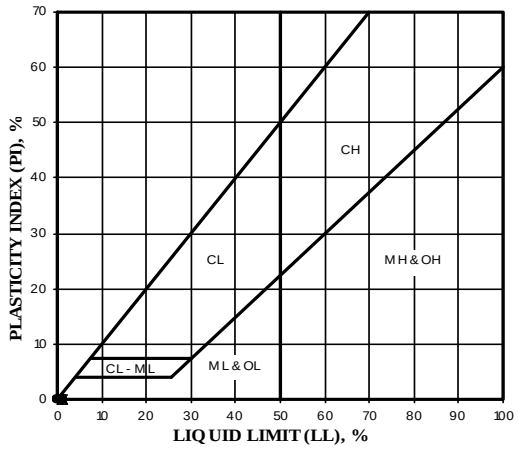
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil > No. 200 Sieve Size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

GRAIN SIZE CHART

CLASSIFICATION	RANGE OF GRAIN	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	306 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.075
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.420
Fine	No. 40 to No. 200	0.420 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

PLASTICITY CHART



Ninyo & Moore

U.S.C.S. METHOD OF SOIL CLASSIFICATION

AR061618

DATE DRILLED 5/14/13 BORING NO. B-1

GROUND ELEVATION 390' ± (MSL) SHEET 1 OF 2

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	AGRICULTURAL SOIL: Brown, damp, medium dense, silty SAND.
						SM	ALLUVIUM: Brown, dry to damp, medium dense, silty SAND.
5		21	1.4	108.7			
						SP	Light brown, dry to damp, medium dense, poorly graded SAND.
10		27					
15		40	0.7	97.8			
20							

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-1

DATE DRILLED 5/14/13 BORING NO. B-1

GROUND ELEVATION 390' ± (MSL) SHEET 2 OF 2

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	56			⁘	SP	ALLUVIUM: (Continued) Light brown, damp, dense, poorly graded SAND.
								Total Depth = 21.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil shortly after drilling on 5/14/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-2

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

DATE DRILLED 5/14/13 BORING NO. B-2

GROUND ELEVATION 325' ± (MSL) SHEET 1 OF 3

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	AGRICULTURAL SOIL: Brown, dry to damp, loose, silty SAND.
							SM	ALLUVIUM: Brown, damp, loose, silty SAND.
5			13					Scattered gravel.
							SP	Light grayish brown, damp, medium dense, poorly-graded SAND.
10			33	1.3	113.8			
15			39					
20								

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-3

AR061621

DATE DRILLED 5/14/13 BORING NO. B-2

GROUND ELEVATION 325' ± (MSL) SHEET 2 OF 3

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		29	2.7	105.6		SP	ALLUVIUM: (Continued) Light grayish brown, damp, medium dense, poorly-graded SAND; scattered gravel.
25		14				SP-SM	Light brown, damp, medium dense, poorly-graded SAND with silt.
30		20				SP	Light brown, damp, medium dense to dense, poorly-graded SAND.
35		30					Dense.
40							

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-4

DATE DRILLED 5/14/13 BORING NO. B-2

GROUND ELEVATION 325' ± (MSL) SHEET 3 OF 3

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40						SP	ALLUVIUM: (Continued) Light brown, damp, medium dense to dense, poorly-graded SAND.
		20					
45		40					Very dense.
50		29					Dense.
							Total Depth = 51.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil shortly after drilling on 5/14/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
55							
60							

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-5

DATE DRILLED 5/14/13 BORING NO. B-3

GROUND ELEVATION 350' ± (MSL) SHEET 1 OF 2

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	AGRICULTURAL SOIL: Light brown, dry to damp, medium dense, silty SAND; scattered gravel.
5		57				SM	ALLUVIUM: Light brown, dry to damp, dense, silty SAND.
10		21	20.8	95.0		ML	Brown, damp to moist, medium dense, fine sandy SILT.
15		32				SP-SM	Light brown, dry to damp, medium dense, poorly graded SAND with silt.
20							

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-6

AR061624

DATE DRILLED 5/14/13 BORING NO. B-3

GROUND ELEVATION 350' ± (MSL) SHEET 2 OF 2

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		26				SP-SM	ALLUVIUM: (Continued) Light brown, dry to damp, medium dense, poorly-graded SAND with silt.
							Total Depth = 21.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil shortly after drilling on 5/14/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
25							
30							
35							
40							

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-7

DATE DRILLED 5/14/13 BORING NO. B-4

GROUND ELEVATION 390' ± (MSL) SHEET 1 OF 2

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SW-SM	AGRICULTURAL SOIL: Light brown, dry to damp, medium dense, well-graded SAND with silt; scattered gravel.
							SW-SM	ALLUVIUM: Light brown, dry to damp, medium dense, well-graded SAND with silt; scattered gravel.
5			40	1.5			SP	Light brown, dry to damp, medium dense, poorly-graded SAND.
10			44					Dense.
15			27					Medium dense.
20								

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-8

AR061626

DATE DRILLED 5/14/13 BORING NO. B-4

GROUND ELEVATION 390' ± (MSL) SHEET 2 OF 2

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	75	1.1	100.6	▒	SP	ALLUVIUM: (Continued) Light brown, dry to damp, very dense, poorly graded SAND.
								Total Depth = 21.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil shortly after drilling on 5/14/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

BLYTHE MESA SOLAR PROJECT
BLYTHE, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107243003	6/13	B-9

APPENDIX C

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix B.

Moisture Content

The moisture content of a sample obtained from the exploratory boring was evaluated in accordance with ASTM D 2216. The test results are presented on the logs of the exploratory borings in Appendix B.

In-Place Moisture and Density Tests

The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix B.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain-size distribution curves are shown on Figures C-1 and C-2. These test results were utilized in evaluating the soil classifications in accordance with the Unified Soil Classification System (USCS).

Consolidation Tests

Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 2435. The samples were inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figures C-3 and C-4.

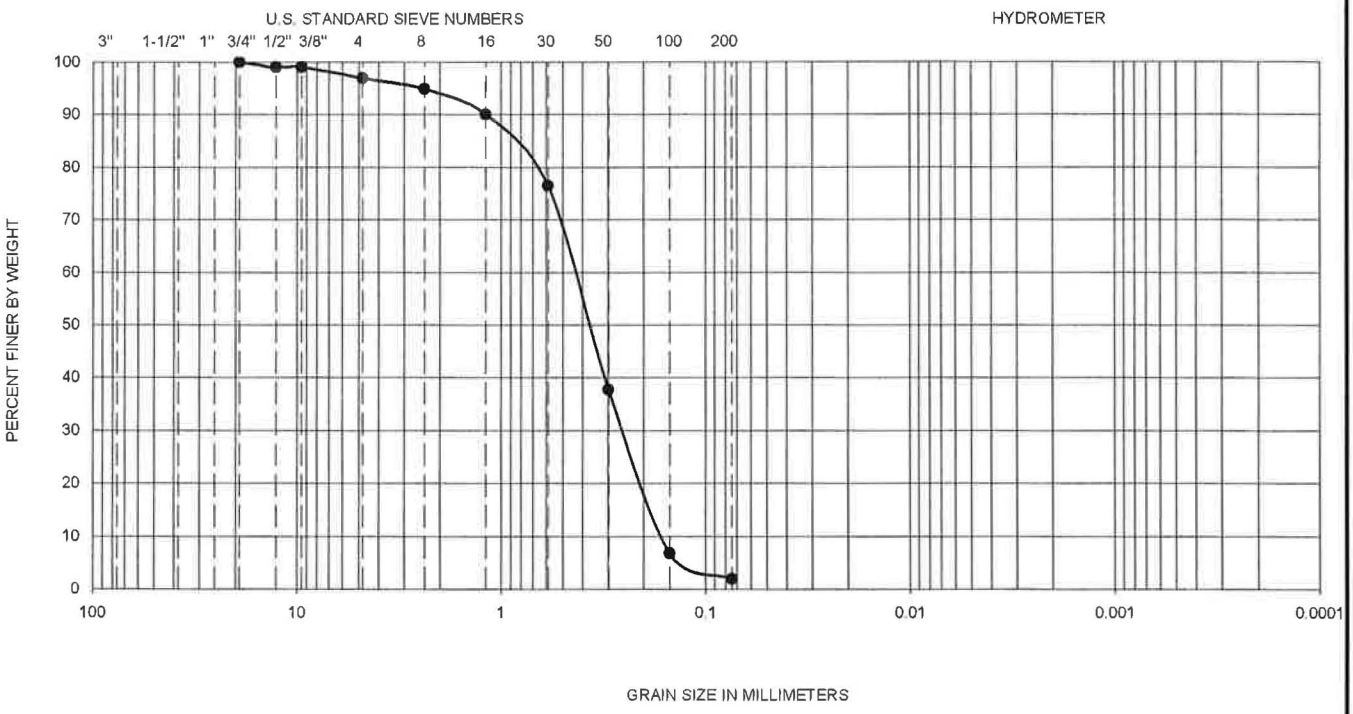
Direct Shear Tests

Direct shear tests were performed on relatively undisturbed samples in general accordance with ASTM D 3080 to evaluate the shear strength characteristics of selected materials. The samples were inundated during shearing to represent adverse field conditions. The results are shown on Figures C-5 and C-6.

Soil Corrosivity Tests

Soil pH, and resistivity tests were performed on representative samples in general accordance with California Test (CT) 643. The soluble sulfate and chloride content of selected samples were evaluated in general accordance with CT 417 and CT 422, respectively. The test results are presented on Figure C-7.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



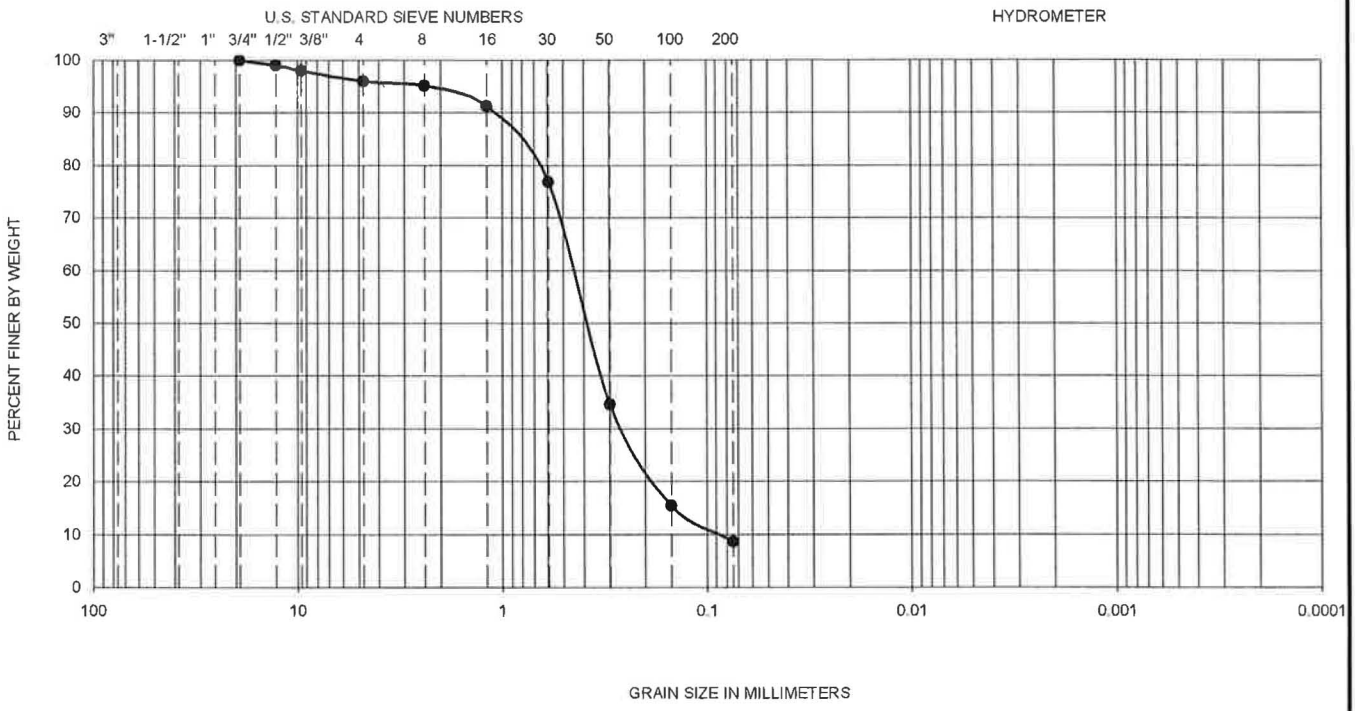
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-2	15.0-16.5	--	--	--	0.17	0.27	0.43	2.6	1.0	2	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	BLYTHE MESA SOLAR BLYTHE, CALIFORNIA	C-1
107243003 / 6/13		

107243003_SIEVE B-2 @ 15.0-16.5.xls

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

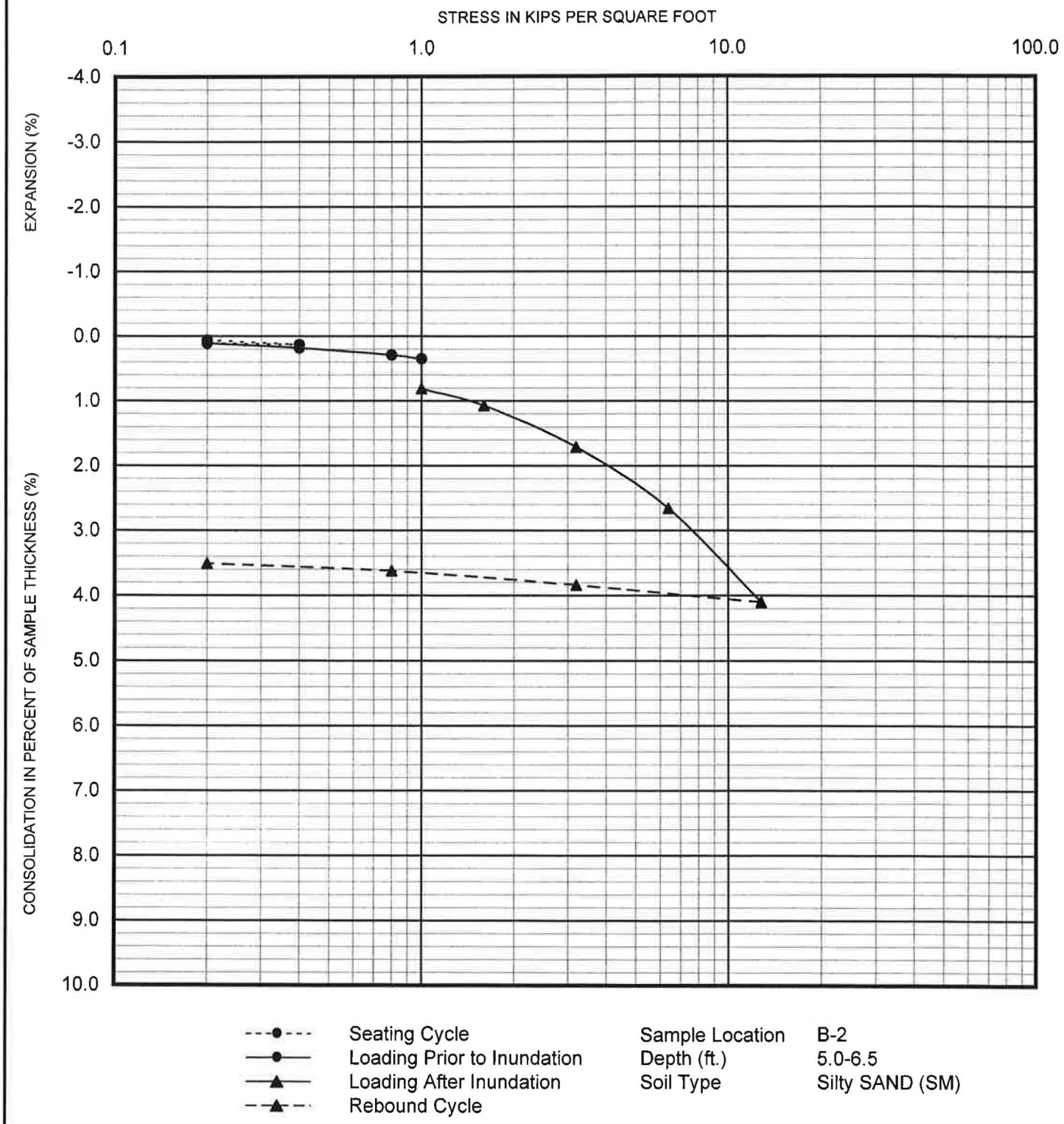


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-4	0.0-5.0	--	--	--	0.09	0.28	0.45	5.1	1.9	9	SW-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 107243003 / DATE 6/13	BLYTHE MESA SOLAR BLYTHE, CALIFORNIA	C-2

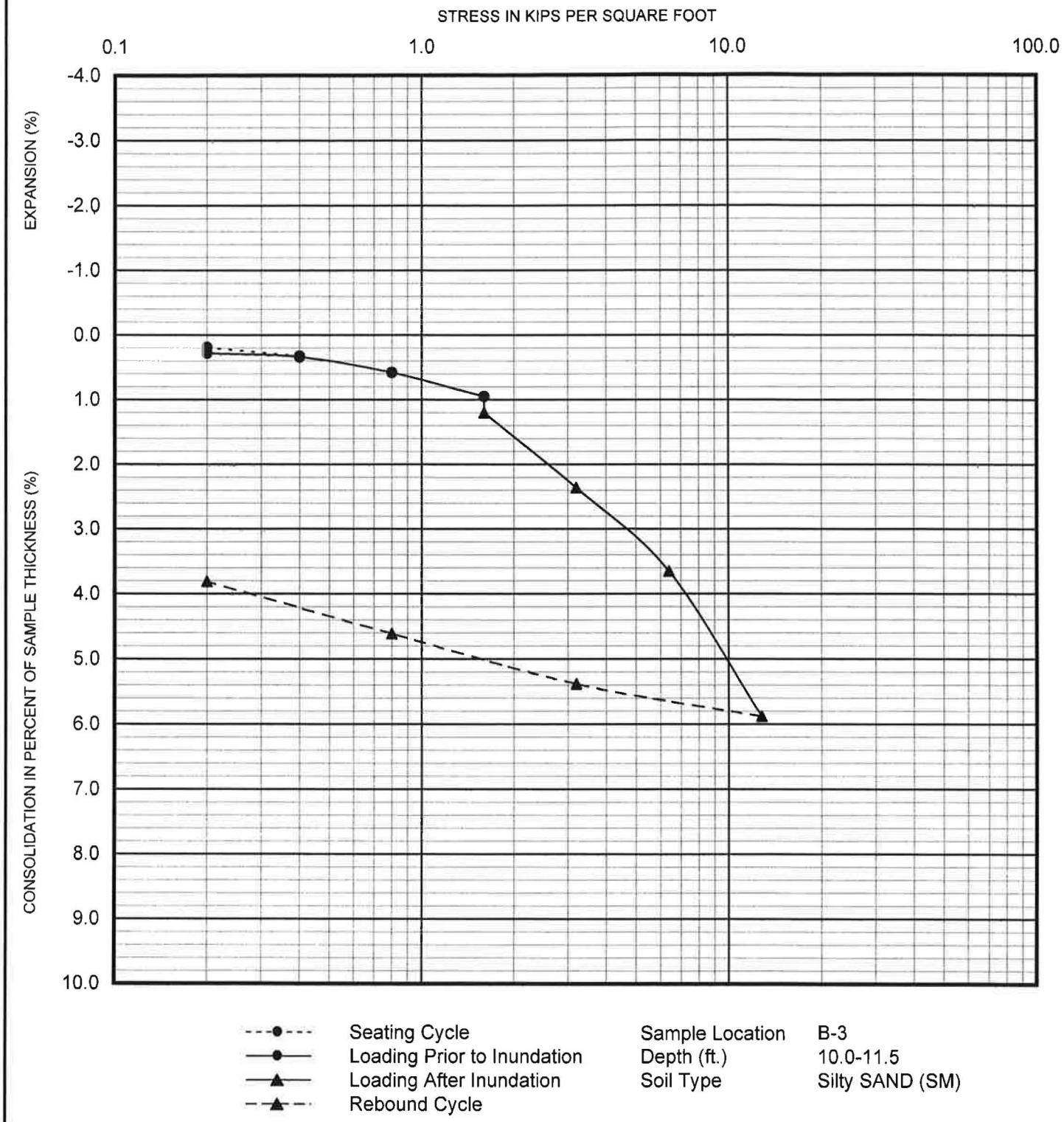
107243003_SIEVE B-4 @ 0.0-5.0.xls



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 107243003 / DATE 6/13	BLYTHE MESA SOLAR BLYHTE, CALIFORNIA	C-3

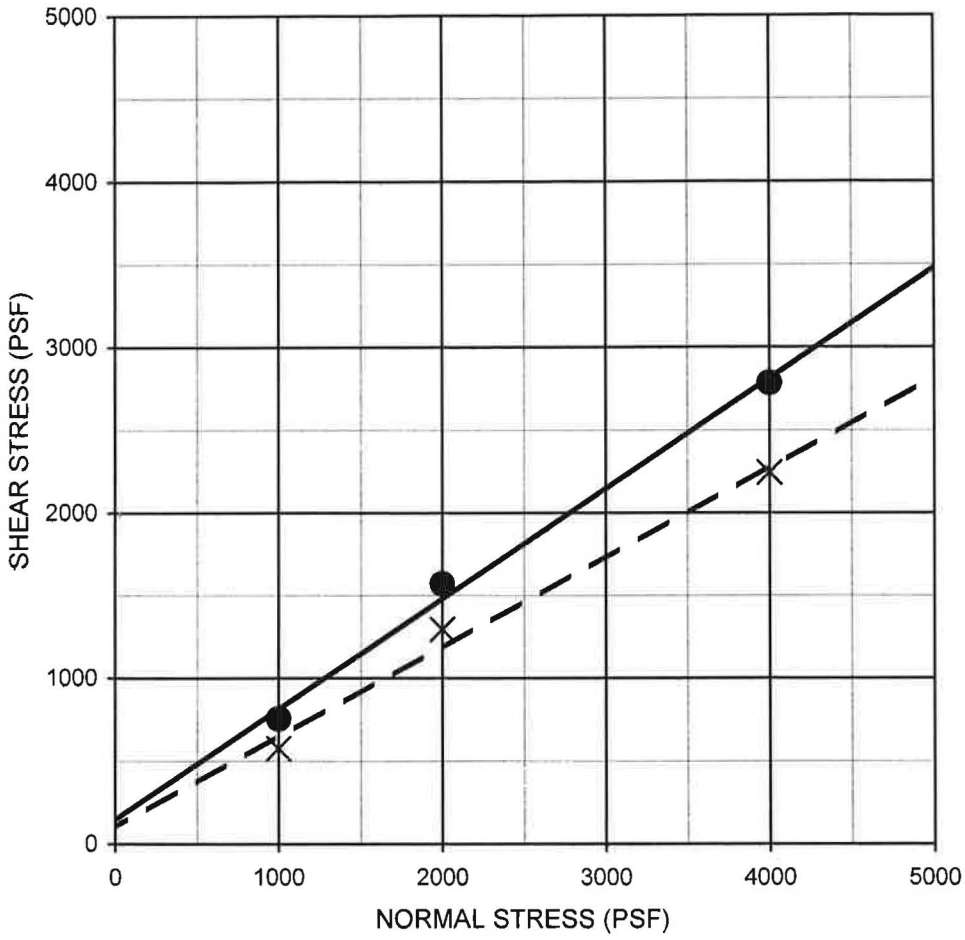
107243003_CONSOLIDATION B-2 @ 5.0-6.5.xls



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 107243003 / DATE 6/13	BLYTHE MESA SOLAR BLYHTE, CALIFORNIA	C-4

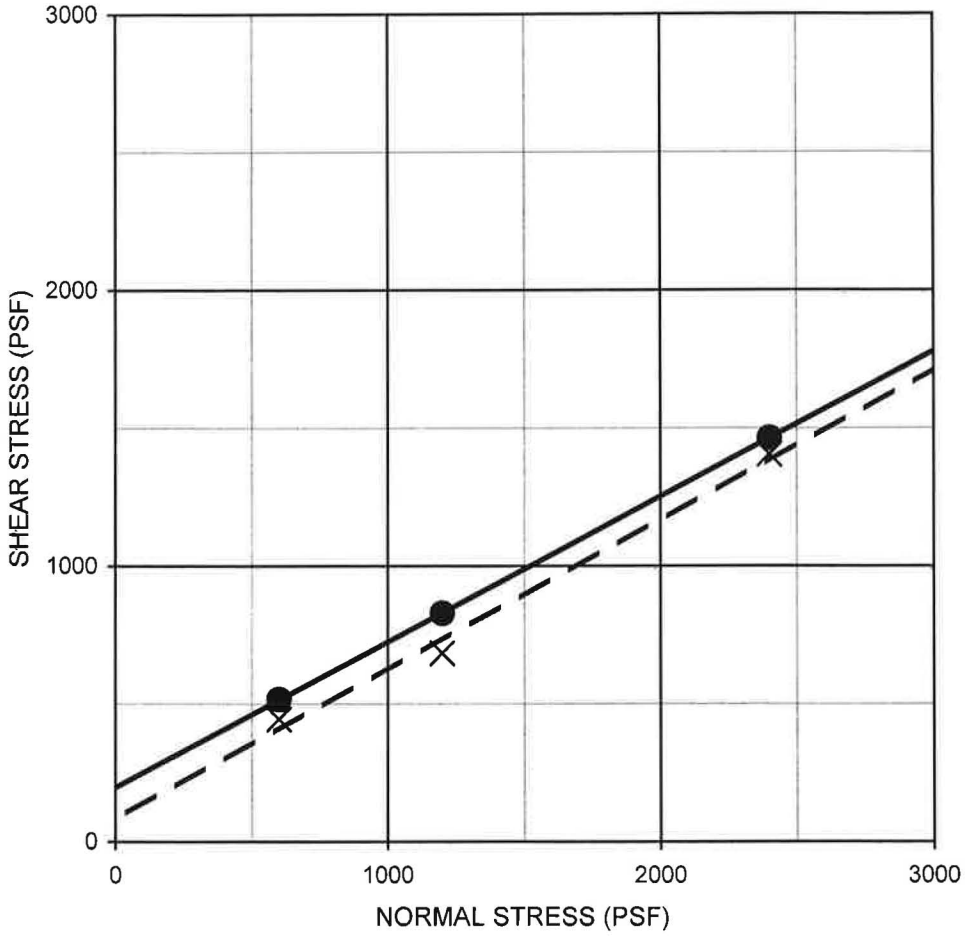
107243003_CONSOLIDATION B-3 @ 10.0-11.5.xls



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Soil Type
SAND	—●—	B-1	15.0-16.5	Peak	150	34	SP
SAND	- - X - -	B-1	15.0-16.5	Ultimate	100	29	SP

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

Ninyo & Moore	DIRECT SHEAR TEST RESULTS	FIGURE
PROJECT NO. 107243003 / DATE 6/13	BLYTHE MESA SOLAR BLYTHE, CALIFORNIA	C-5



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Soil Type
Silty SAND	—●—	B-3	5.0-6.5	Peak	200	28	SM
Silty SAND	- - x - -	B-3	5.0-6.5	Ultimate	90	28	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

Ninyo & Moore	DIRECT SHEAR TEST RESULTS	FIGURE
PROJECT NO. 107243003 / DATE 6/13	BLYTHE MESA SOLAR BLYTHE, CALIFORNIA	C-6

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH [1]	RESISTIVITY [1] (Ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-3	0.0-5.0	8.5	660	290	0.029	390

[1] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

Ninyo & Moore		CORROSIVITY TEST RESULTS	FIGURE
PROJECT NO.	DATE	BLYTHE MESA SOLAR BLYTHE, CALIFORNIA	C-7
107243003	6/13		

APPENDIX F
EDR DATA MAP

THIS PAGE INTENTIONALLY LEFT BLANK

Cocopah Nursery
Blythe, CA 92225

Inquiry Number: 3186188.1s
October 18, 2011

EDR DataMap™ Area Study

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

AR061639

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2006 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

EXECUTIVE SUMMARY

TARGET PROPERTY INFORMATION

ADDRESS

BLYTHE, CA 92225
BLYTHE, CA 92225

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records within the requested search area for the following databases:

FEDERAL RECORDS

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
Delisted NPL	National Priority List Deletions
NPL LIENS	Federal Superfund Liens
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
LIENS 2	CERCLA Lien Information
RCRA-TSDF	RCRA - Treatment, Storage and Disposal
RCRA-LQG	RCRA - Large Quantity Generators
RCRA-SQG	RCRA - Small Quantity Generators
RCRA-CESQG	RCRA - Conditionally Exempt Small Quantity Generator
US ENG CONTROLS	Engineering Controls Sites List
US INST CONTROL	Sites with Institutional Controls
ERNS	Emergency Response Notification System
HMIRS	Hazardous Materials Information Reporting System
DOT OPS	Incident and Accident Data
US CDL	Clandestine Drug Labs
US BROWNFIELDS	A Listing of Brownfields Sites
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
LUCIS	Land Use Control Information System
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
UMTRA	Uranium Mill Tailings Sites
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
ODI	Open Dump Inventory
MINES	Mines Master Index File
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System

EXECUTIVE SUMMARY

RADINFO	Radiation Information Database
RAATS	RCRA Administrative Action Tracking System
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
US HIST CDL	National Clandestine Laboratory Register
PCB TRANSFORMER	PCB Transformer Registration Database
FEDERAL FACILITY	Federal Facility Site Information listing
COAL ASH DOE	Sleam-Electric Plan Operation Data
FEMA UST	Underground Storage Tank Listing
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List

STATE AND LOCAL RECORDS

HIST Cal-Sites	Historical Calsites Database
CA BOND EXP. PLAN	Bond Expenditure Plan
SCH	School Property Evaluation Program
Toxic Pits	Toxic Pits Cleanup Act Sites
SWF/LF	Solid Waste Information System
WDS	Waste Discharge System
NPDES	NPDES Permits Listing
Cortese	"Cortese" Hazardous Waste & Substances Sites List
SWRCY	Recycler Database
CA FID UST	Facility Inventory Database
UST	Active UST Facilities
LIENS	Environmental Liens Listing
SWEEPS UST	SWEEPS UST Listing
LDS	Land Disposal Sites Listing
MCS	Military Cleanup Sites Listing
Notify 65	Proposition 65 Records
DEED	Deed Restriction Listing
VCP	Voluntary Cleanup Program Properties
DRYCLEANERS	Cleaner Facilities
WIP	Well Investigation Program Case List
CDL	Clandestine Drug Labs
ENF	Enforcement Action Listing
RESPONSE	State Response Sites
HAZNET	Facility and Manifest Data
EMI	Emissions Inventory Data
ENVIROSTOR	EnviroStor Database
HAULERS	Registered Waste Tire Haulers Listing
HWP	EnviroStor Permitted Facilities Listing
MWMP	Medical Waste Management Program Listing
PROC	Certified Processors Database
HWT	Registered Hazardous Waste Transporter Database

TRIBAL RECORDS

INDIAN RESERV	Indian Reservations
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land
INDIAN VCP	Voluntary Cleanup Priority Listing

EDR PROPRIETARY RECORDS

Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants

EXECUTIVE SUMMARY

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified.

Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

FEDERAL RECORDS

CERC-NFRAP: Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

A review of the CERC-NFRAP list, as provided by EDR, and dated 02/25/2011 has revealed that there are 2 CERC-NFRAP sites within the searched area.

Site	Address	Map ID	Page
FARMER AIR SERVICE	***17500 W HOBSON WAY***	***5***	***104***
WEST COAST FLYING SERVICE	***13-400 W 14TH SAVE***	***7***	***107***

CORRACTS: CORRACTS is a list of handlers with RCRA Corrective Action Activity. This report shows which nationally-defined corrective action core events have occurred for every handler that has had corrective action activity.

A review of the CORRACTS list, as provided by EDR, and dated 03/09/2011 has revealed that there are 2 CORRACTS sites within the searched area.

Site	Address	Map ID	Page
FARMER AIR SERVICE	***17500 W HOBSON WAY***	***5***	***104***
WEST COAST FLYING SERVICE	***13-400 W 14TH SAVE***	***7***	***107***

RCRA-NonGen: RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

A review of the RCRA-NonGen list, as provided by EDR, and dated 06/15/2011 has revealed that there are 2 RCRA-NonGen sites within the searched area.

Site	Address	Map ID	Page
FARMER AIR SERVICE	***17500 W HOBSON WAY***	***5***	***104***
WEST COAST FLYING SERVICE	***13-400 W 14TH SAVE***	***7***	***107***

EXECUTIVE SUMMARY

FINDS: The Facility Index System contains both facility information and "pointers" to other sources of information that contain more detail. These include: RCRIS; Permit Compliance System (PCS); Aerometric Information Retrieval System (AIRS); FATES (FIFRA [Federal Insecticide Fungicide Rodenticide Act] and TSCA Enforcement System, FTTS [FIFRA/TSCA Tracking System]; CERCLIS; DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes); Federal Underground Injection Control (FURS); Federal Reporting Data System (FRDS); Surface Impoundments (SIA); TSCA Chemicals in Commerce Information System (CICS); PADS; RCRA-J (medical waste transporters/disposers); TRIS; and TSCA. The source of this database is the U.S. EPA/NTIS.

A review of the FINDS list, as provided by EDR, and dated 04/14/2010 has revealed that there are 2 FINDS sites within the searched area.

Site	Address	Map ID	Page
FARMER AIR SERVICE	***17500 W HOBSON WAY***	***5***	***104***
WEST COAST FLYING SERVICE	***13-400 W 14TH SAVE***	***7***	***107***

STATE AND LOCAL RECORDS

WMUDS/SWAT: The Waste Management Unit Database System is used for program tracking and inventory of waste management units. The source is the State Water Resources Control Board.

A review of the WMUDS/SWAT list, as provided by EDR, and dated 04/01/2000 has revealed that there is 1 WMUDS/SWAT site within the searched area.

Site	Address	Map ID	Page
BLYTHE AIRPORT DUMP	***BLYTHE AIRPORT***	***2***	***3***

HIST CORTESE: The sites for the list are designated by the State Water Resource Control Board [LUST], the Integrated Waste Board [SWF/LS], and the Department of Toxic Substances Control [CALSITES].

A review of the HIST CORTESE list, as provided by EDR, and dated 04/01/2001 has revealed that there are 3 HIST CORTESE sites within the searched area.

Site	Address	Map ID	Page
SUNWORLD #1	***15550 WEST HOBSONWAY***	***3***	***6***
BLYTHE LEMON RANCH #41	15550 HOBSONEWAY	3	102
BLYTHE AIRPORT	***17240 HOBSONWAY***	***4***	***102***

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the State Water Resources Control Board Leaking Underground Storage Tank Information System.

A review of the LUST list, as provided by EDR, and dated 08/09/2011 has revealed that there are 4 LUST sites within the searched area.

Site	Address	Map ID	Page
SUNWORLD #1	***15550 WEST HOBSONWAY***	***3***	***6***
Status: Completed - Case Closed			
Status: Completed - Case Closed			

**Additional key fields are available in the Map Findings section*

EXECUTIVE SUMMARY

Site	Address	Map ID	Page
SUN WORLD	15550 W HOBSONWAY	3	101
SUNWORLD FACILITY Status: Completed - Case Closed	15550 EAST HOBSONWAY	3	101
BLYTHE AIRPORT Status: Completed - Case Closed	***17240 HOBSONWAY***	***4***	***102***

SLIC: SLIC Region comes from the California Regional Water Quality Control Board.

A review of the SLIC list, as provided by EDR, and dated 08/09/2011 has revealed that there is 1 SLIC site within the searched area.

Site	Address	Map ID	Page
WOTEN AVIATION - BLYTHE	17798 BLYTHE WAY	6	107

HIST UST: Historical UST Registered Database.

A review of the HIST UST list, as provided by EDR, and dated 10/15/1990 has revealed that there is 1 HIST UST site within the searched area.

Site	Address	Map ID	Page
BLYTHE RCAG	BLYTHE AFSFO	2	3

CHMIRS: The California Hazardous Material Incident Report System contains information on reported hazardous material incidents, i.e., accidental releases or spills. The source is the California Office of Emergency Services.

A review of the CHMIRS list, as provided by EDR, and dated 12/31/2010 has revealed that there is 1 CHMIRS site within the searched area.

Site	Address	Map ID	Page
BLYTHE AIRPORT DUMP	***BLYTHE AIRPORT***	***2***	***3***

AST: The Aboveground Storage Tank database contains registered ASTs. The data come from the State Water Resources Control Board's Hazardous Substance Storage Container Database.

A review of the AST list, as provided by EDR, and dated 08/01/2009 has revealed that there is 1 AST site within the searched area.

Site	Address	Map ID	Page
BLYTHE LEMON RANCH	10151 BUCK BLVD.	1	3

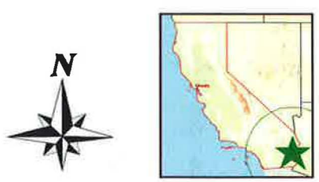
EXECUTIVE SUMMARY

Please refer to the end of the findings report for unmapped orphan sites due to poor or inadequate address information.

EDR DataMap® Area Study

Cocopah Nursery Update

- Listed Sites
- Earthquake Epicenters (Richter 5 or greater)
- Search Boundary
- Roads
- Major Roads
- Waterways
- Railroads
- Contour Lines
- Pipelines
- Powerlines
- Fault Lines
- Water
- Superfund Sites
- Federal DOD Sites
- Indian Reservations BIA



Blythe, CA

0 1/2 1

Scale in Miles

EDR® Environmental Data Resources, Inc

Copyright © 2011 EDR, Inc. © 2010 Tele Atlas Rel. 07/2009.

3188198.1s - 18 Oct 11

MAP FINDINGS SUMMARY

Database	Total Plotted
FEDERAL RECORDS	
NPL	0
Proposed NPL	0
Delisted NPL	0
NPL LIENS	0
CERCLIS	0
CERC-NFRAP	2
LIENS 2	0
CORRACTS	2
RCRA-TSDF	0
RCRA-LQG	0
RCRA-SQG	0
RCRA-CESQG	0
RCRA-NonGen	2
US ENG CONTROLS	0
US INST CONTROL	0
ERNS	0
HMIRS	0
DOT OPS	0
US CDL	0
US BROWNFIELDS	0
DOD	0
FUDS	0
LUCIS	0
CONSENT	0
ROD	0
UMTRA	0
DEBRIS REGION 9	0
ODI	0
MINES	0
TRIS	0
TSCA	0
FTTS	0
HIST FTTS	0
SSTS	0
ICIS	0
PADS	0
MLTS	0
RADINFO	0
FINDS	2
RAATS	0
SCRD DRYCLEANERS	0
US HIST CDL	0
PCB TRANSFORMER	0
FEDERAL FACILITY	0
COAL ASH DOE	0
FEMA UST	0
COAL ASH EPA	0
STATE AND LOCAL RECORDS	
HIST Cal-Sites	0

AR061648

MAP FINDINGS SUMMARY

Database	Total Plotted
CA BOND EXP. PLAN	0
SCH	0
Toxic Pits	0
SWF/LF	0
WDS	0
WMUDS/SWAT	1
NPDES	0
Cortese	0
HIST CORTESE	3
SWRCY	0
LUST	4
CA FID UST	0
SLIC	1
UST	0
HIST UST	1
LIENS	0
SWEEPS UST	0
CHMIRS	1
LDS	0
MCS	0
AST	1
Notify 65	0
DEED	0
VCP	0
DRYCLEANERS	0
WIP	0
CDL	0
ENF	0
RESPONSE	0
HAZNET	0
EMI	0
ENVIROSTOR	0
HAULERS	0
HWP	0
MWMP	0
PROC	0
HWT	0

TRIBAL RECORDS

INDIAN RESERV	0
INDIAN ODI	0
INDIAN LUST	0
INDIAN UST	0
INDIAN VCP	0

EDR PROPRIETARY RECORDS

Manufactured Gas Plants	0

NOTES:

Sites may be listed in more than one database

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
1	**BLYTHE LEMON RANCH** **10151 BUCK BLVD.** **BLYTHE, CA 92225**	**AST**	**A100339718** **N/A**

AST:
- Owner: SUN WORLD INTERNATIONAL LLC
- Total Gallons: 3,500
- Certified Unified Program Agencies: Riverside

2	**BLYTHE RCAG** **BLYTHE AFSFO** **BLYTHE, CA 92225**	**HIST UST**	**U001573612** **N/A**

HIST UST:
- Region: STATE
- Facility ID: 00000060256
- Facility Type: Other
- Other Type: AIRCRAFT AIR/GRD COU
- Total Tanks: 0001
- Contact Name: TED MILLS
- Telephone: 7143516709
- Owner Name: FEDERAL AVIATION ADMINISTRATIO
- Owner Address: 6961 FLIGHT RD.
- Owner City,St,Zip: RIVERSIDE, CA 92504

- Tank Num: 001
- Container Num: 25
- Year Installed: 1975
- Tank Capacity: 00000510
- Tank Used for: PRODUCT
- Type of Fuel: DIESEL
- Tank Construction: 12 gauge
- Leak Detection: Visual, Stock Inventor

2	**BLYTHE AIRPORT DUMP** **BLYTHE AIRPORT** **BLYTHE, CA 92225**	**WMUDS/SWAT** **CHMIRS**	**S103320645** **N/A**

WMUDS/SWAT:
- Edit Date: Not reported
- Complexity: Not reported
- Primary Waste: Not reported
- Primary Waste Type: Not reported
- Secondary Waste: Not reported
- Secondary Waste Type: Not reported
- Base Meridian: SB
- NPID: Not reported
- Tonnage: 0
- Regional Board ID: Not reported
- Municipal Solid Waste: False
- Superorder: False
- Open To Public: False
- Waste List: False
- Agency Type: Not reported
- Agency Name: AIRPORTS DEPT.
- Agency Department: Not reported
- Agency Address: Not reported
- Agency City,St,Zip: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

BLYTHE AIRPORT DUMP (Continued) **S103320645**

Agency Contact:	Not reported
Agency Telephone:	7147872494
Land Owner Name:	RIVERSIDE COUNTY
Land Owner Address:	PO BOX 1090
Land Owner City,St,Zip:	RIVERSIDE, CA 92501
Land Owner Contact:	Not reported
Land Owner Phone:	7147872669
Region:	7
Facility Type:	Not reported
Facility Description:	Not reported
Facility Telephone:	Not reported
SWAT Facility Name:	BLYTHE AIRPORT DUMP
Primary SIC:	Not reported
Secondary SIC:	Not reported
Comments:	Not reported
Last Facility Editors:	Not reported
Waste Discharge System:	False
Solid Waste Assessment Test Program:	True
Toxic Pits Cleanup Act Program:	False
Resource Conservation Recovery Act:	False
Department of Defence:	False
Solid Waste Assessment Test Program:	AIRPORTS DEPT.
Threat to Water Quality:	Not reported
Sub Chapter 15:	False
Regional Board Project Officer:	AA
Number of WMUDS at Facility:	1
Section Range:	06S22E32
RCRA Facility:	Not reported
Waste Discharge Requirements:	Not reported
Self-Monitoring Rept. Frequency:	Not reported
Waste Discharge System ID:	7B330118011
Solid Waste Information ID:	33-AA-0064

CHMIRS:

OES Incident Number:	01-4565
OES notification:	8/10/200107:24:53 AM
OES Date:	Not reported
OES Time:	Not reported
Incident Date:	Not reported
Date Completed:	**Not reported**
Property Use:	Not reported
Agency Id Number:	Not reported
Agency Incident Number:	Not reported
Time Notified:	Not reported
Time Completed:	Not reported
Surrounding Area:	Not reported
Estimated Temperature:	Not reported
Property Management:	Not reported
Special Studies 1:	Not reported
Special Studies 2:	Not reported
Special Studies 3:	Not reported
Special Studies 4:	Not reported
Special Studies 5:	Not reported
Special Studies 6:	Not reported
More Than Two Substances Involved?:	Not reported
Resp Agncy Personel # Of Decontaminated:	Not reported
Responding Agency Personel # Of Injuries:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

BLYTHE AIRPORT DUMP (Continued) **S103320645**

Responding Agency Personel # Of Fatalities:	Not reported
Others Number Of Decontaminated:	Not reported
Others Number Of Injuries:	Not reported
Others Number Of Fatalities:	Not reported
Vehicle Make/year:	Not reported
Vehicle License Number:	Not reported
Vehicle State:	Not reported
Vehicle Id Number:	Not reported
CA/DOT/PUC/ICC Number:	Not reported
Company Name:	Not reported
Reporting Officer Name/ID:	Not reported
Report Date:	Not reported
Comments:	Not reported
Facility Telephone:	Not reported
Waterway Involved:	No
Waterway:	Not reported
Spill Site:	Not reported
Cleanup By:	Reporting Party
Containment:	Not reported
What Happened:	Not reported
Type:	Not reported
Measure:	Not reported
Other:	Not reported
Date/Time:	Not reported
Year:	2001
Agency:	So Cal Edison
Incident Date:	8/10/200112:00:00 AM
Admin Agency:	Riverside County Environmental Health
Amount:	Not reported
Contained:	Yes
Site Type:	Airport
E Date:	Not reported
Substance:	Mineral oil with PCB
Quantity Released:	Not reported
BBLS:	0
Cups:	0
CUFT:	0
Gallons:	2
Grams:	0
Pounds:	0
Liters:	0
Ounces:	0
Pints:	0
Quarts:	0
Sheen:	0
Tons:	0
Unknown:	0.000000
Evacuations:	0
Number of Injuries:	0
Number of Fatalities:	0
Description:	Wind storm Knocked down transformer. Mineral oil was spilt. NOTE: PCB content of 200 Parts per million

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
3	**SUNWORLD #1** **15550 WEST HOBSONWAY** **BLYTHE, CA 92225**	**HIST CORTESE** **LUST**	**S103891543** **N/A**

CORTESE:

Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225087
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225043
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225050
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225069
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225066
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225065
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225067
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225068
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225063
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225064
Region:	CORTESE
Facility County Code:	33
Reg By:	LTNKA
Reg Id:	7T2225070

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225071

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225072

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225073

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225074

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225075

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225076

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225077

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225078

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225079

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225080

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225081

Region: CORTESE
Facility County Code: 33

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
	SUNWORLD #1 (Continued)		**S103891543**

Reg By: LTNKA
Reg Id: 7T2225082

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225083

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225084

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225085

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225086

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225088

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225089

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225090

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225091

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225092

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225093

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225094

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225095

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225096

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225097

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225098

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225099

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225100

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225101

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225103

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225104

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225105

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225106

Region: CORTESE
Facility County Code: 33

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Reg By: LTNKA
Reg Id: 7T2225107

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225108

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225109

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225110

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225111

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225112

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225113

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225114

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225115

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225116

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225117

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225118

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225119

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225120

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225121

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225122

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225123

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225124

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225125

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225126

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225127

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225128

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225129

Region: CORTESE
Facility County Code: 33

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Reg By: LTNKA
Reg Id: 7T2225131

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225132

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225133

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225134

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225135

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225136

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225137

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225138

Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225130

LUST:
Region: STATE
Global Id: T0606500822
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 08/13/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225084
LOC Case Number: Not reported
File Location: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500822
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500822
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500822
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500822
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500822
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500823
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 05/14/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225085
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500823
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500823
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500823
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500823
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500823
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500824
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 01/23/1997
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225086
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500824
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500824
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500824
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500824
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500824
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500825
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	01/23/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225087
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500825
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500825
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500825
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500825
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500825
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500826
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225088
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500826
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500826
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500826
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500826
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500826
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500827
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/30/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225089
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500827
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500827
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500827
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500827
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500827
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500828
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	01/23/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225090
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500828
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500828
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500828
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500828
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500828
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500829
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/02/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225091
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500829
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500829
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500829
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500829
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500829
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500830
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/18/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225092
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500830
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500830
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500830
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500830
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500830
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500831
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/22/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225093
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500831
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500831
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500831
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500831
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500831
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500832
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	01/23/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225094
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500832
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500832
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500832
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500832
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500832
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500833
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225095
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500833
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500833
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500833
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500833
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500833
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500834
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/22/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225096
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500834
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500834
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500834
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500834
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500834
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500840
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/02/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225102
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500840
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500840
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500840
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500840
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500840
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500841
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/18/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225103
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500841
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500841
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500841
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500841
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500841
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500842
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/18/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225104
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500842
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500842
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500842
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500842
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500842
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500843
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225105
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500843
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500843
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500843
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500843
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500843
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500845
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225107
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500845
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500845
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500845
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500845
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500845
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500846
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225108
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500846
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500846
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500846
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500846
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500846
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500847
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/02/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225109
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500847
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500847
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500847
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500847
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500847
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500848
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225110
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500848
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500848
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500848
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500848
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500848
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500849
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225111
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500849
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500849
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500849
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500849
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500849
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500850
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/30/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225112
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500850
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500850
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500850
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500850
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500850
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500851
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/30/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225113
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500851
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

Global Id:	T0606500851
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

LUST:

Global Id:	T0606500851
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500851
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500851
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500844
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/02/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225106
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500844
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500844
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500844
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500844
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500844
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500788
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	04/30/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225050
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500788
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500788
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500788
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500858
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225120
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500858
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Global Id: T0606500858
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500858
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500858
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500858
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500859
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 09/26/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225121
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500859
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500859
Contact Type: Local Agency Caseworker

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500859
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500859
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500859
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500860
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 09/26/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225122
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500860
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500860
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500860
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500860
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500860
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500861
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 08/13/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225123
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500861
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500861
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500861
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500861
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500861
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500862
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 07/22/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225124
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500862
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500862
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

LUST:
Global Id: T0606500862
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500862
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500862
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500863
Latitude: 33.6096253
Longitude: -114.697655
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 08/13/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225125
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500863
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500863
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500863

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery
Global Id:	T0606500863
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped
Global Id:	T0606500863
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported
Region:	STATE
Global Id:	T0606500864
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/18/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225126
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500864
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported
Global Id:	T0606500864
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500864
Action Type:	Other
Date:	1950-01-01 00:00:00

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Action: Leak Discovery

Global Id: T0606500864
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500864
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500865
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 01/23/1997
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225127
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500865
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500865
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500865
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Global Id:	T0606500865
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500865
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500866
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225128
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500866
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500866
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500866
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500866
Action Type:	Other

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Date:	1950-01-01 00:00:00
Action:	Leak Stopped
Global Id:	T0606500866
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported
Region:	STATE
Global Id:	T0606500867
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/23/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225129
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500867
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported
Global Id:	T0606500867
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500867
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery
Global Id:	T0606500867
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Global Id:	T0606500867
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500868
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	01/23/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225130
LOC Case Number:	91952
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500868
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500868
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500868
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500868
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500868
Action Type:	Other

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500869
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 08/13/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225131
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500869
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500869
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500869
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500869
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500869
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region:	STATE
Global Id:	T0606500801
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/14/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225063
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500801
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500801
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500801
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500801
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500801
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500802

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/14/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225064
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500802
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500802
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500802
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500802
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500802
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500803
Latitude:	33.611111
Longitude:	-114.694174

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	04/25/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225065
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500803
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500803
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500803
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500803
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500803
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500804
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Status Date:	04/25/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225066
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500804
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500804
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500804
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500804
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500804
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500805
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/18/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225067
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500805
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500805
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500805
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500805
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500805
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500852
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	10/11/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

RB Case Number: 7T2225114
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500852
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500852
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500852
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500852
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500852
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500853
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 08/26/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225115
LOC Case Number: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500853
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500853
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500853
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500853
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500853
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500854
Latitude: 33.611111
Longitude: -114.694174
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 01/23/1997
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225116
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500854
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500854
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500854
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500854
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500854
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

Region: STATE
Global Id: T0606500855
Latitude: 33.6096253
Longitude: -114.697655
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 01/23/1997
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225117
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500855
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500855
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500855
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500855
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500855
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500856
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/30/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225118
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500856
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500856
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500856
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500856
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500856
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500857
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/14/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225119
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500857
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500857
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500857
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500857
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500857
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500835
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	10/11/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225097
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Under Investigation
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500835
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500835
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500835
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500835
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500835
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500836
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/02/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225098
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500836
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500836
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500836
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500836
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500836
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500837
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	10/11/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225099
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500837
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500837
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500837
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500837
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500837
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500838
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225100
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500838
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500838
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500838
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500838
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500838
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500839
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225101
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500839
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500839
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500839
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500839
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500839
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500870
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	01/23/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225132
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Under Investigation
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500870
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500870
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500870
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500870
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500870
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500871
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225133
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500871
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500871
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500871
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500871
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500871
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500872
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225134
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500872
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500872
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500872
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500872
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500872
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500873
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225135
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500873
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

Global Id:	T0606500873
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

LUST:

Global Id:	T0606500873
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500873
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500873
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500874
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225136
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500874
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500874
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500874
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500874
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500874
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500875
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225137
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500875
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500875
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500875
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500875
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500875
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500876
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225138
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500876
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500876
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500876
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500876
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500876
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500806
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/09/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225068
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500806
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500806
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500806
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500806
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500806
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500807
Latitude:	33.6096253
Longitude:	-114.697655
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	04/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225069
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500807
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500807
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500807
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500807
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500807
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500808
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/22/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225070
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500808
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500808
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500808
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500808
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500808
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500809
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/22/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225071
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500809
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500809
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500809
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500809
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500809
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500810
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225072
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500810
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500810
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500810
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500810
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500810
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500811
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225073
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500811
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500811
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500811
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500811
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500811
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500812
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	07/22/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225074
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500812
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500812
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500812
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500812
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500812
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500813
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225075
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500813
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500813
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500813
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500813
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500813
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500814
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225076
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500814
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500814
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500814
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500814
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500814
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500815
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/03/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225077
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500815
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500815
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500815
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500815
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500815
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500818
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	08/13/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225080
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500818
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500818
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500818
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500818
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500818
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500820
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	09/26/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225082
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500820
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500820
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500820
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500820
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500820
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500821
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/14/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225083
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500821
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500821
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500821
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500821
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500821
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500819
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	01/23/1997
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225081
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Under Investigation
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500819
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500819
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500819
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500819
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500819
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500816
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/03/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225078
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500816
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500816
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500816
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500816
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500816
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

Region:	STATE
Global Id:	T0606500817
Latitude:	33.611111
Longitude:	-114.694174
Case Type:	LUST Cleanup Site
Status:	Completed - Case Closed
Status Date:	05/03/1996
Lead Agency:	COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker:	RSF
Local Agency:	RIVERSIDE COUNTY LOP
RB Case Number:	7T2225079
LOC Case Number:	Not reported
File Location:	Not reported
Potential Media Affect:	Soil
Potential Contaminants of Concern:	Gasoline
Site History:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Click here to access the California GeoTracker records for this facility:

LUST:

Global Id:	T0606500817
Contact Type:	Regional Board Caseworker
Contact Name:	RON FALKOWSKI
Organization Name:	COLORADO RIVER BASIN RWQCB (REGION 7)
Address:	73-720 FRED WARING DR. STE. 100
City:	PALM DESERT
Email:	rfalk@waterboards.ca.gov
Phone Number:	Not reported

Global Id:	T0606500817
Contact Type:	Local Agency Caseworker
Contact Name:	Riverside County LOP Closed Cases
Organization Name:	RIVERSIDE COUNTY LOP
Address:	PO Box 1280
City:	RIVERSIDE
Email:	Not reported
Phone Number:	9519558982

LUST:

Global Id:	T0606500817
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Discovery

Global Id:	T0606500817
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Stopped

Global Id:	T0606500817
Action Type:	Other
Date:	1950-01-01 00:00:00
Action:	Leak Reported

LUST REG 7:

Region:	7
Status:	9 - Case Closed
Case Num:	7T2225050
Substance:	Gasoline - Automotive
ID:	1176
Global ID:	T0606500788
Lead Agency:	Regional Board
Case Worker:	RT

Region:	7
Status:	9 - Case Closed
Case Num:	7T2225123
Substance:	Gasoline - Automotive
ID:	518
Global ID:	T0606500861
Lead Agency:	Regional Board
Case Worker:	RT

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225071
Substance: Gasoline - Automotive
ID: 462
Global ID: T0606500809
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225072
Substance: Gasoline - Automotive
ID: 463
Global ID: T0606500810
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225073
Substance: Gasoline - Automotive
ID: 464
Global ID: T0606500811
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225074
Substance: Gasoline - Automotive
ID: 465
Global ID: T0606500812
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225075
Substance: Gasoline - Automotive
ID: 466
Global ID: T0606500813
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225076
Substance: Gasoline - Automotive
ID: 467
Global ID: T0606500814
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225077

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Substance: Gasoline - Automotive
ID: 468
Global ID: T0606500815
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225078
Substance: Gasoline - Automotive
ID: 469
Global ID: T0606500816
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225079
Substance: Gasoline - Automotive
ID: 470
Global ID: T0606500817
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225080
Substance: Gasoline - Automotive
ID: 471
Global ID: T0606500818
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225063
Substance: Gasoline - Automotive
ID: 472
Global ID: T0606500801
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225081
Substance: Gasoline - Automotive
ID: 473
Global ID: T0606500819
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225082
Substance: Gasoline - Automotive
ID: 474
Global ID: T0606500820

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225083
Substance: Gasoline - Automotive
ID: 475
Global ID: T0606500821
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225084
Substance: Gasoline - Automotive
ID: 476
Global ID: T0606500822
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225085
Substance: Gasoline - Automotive
ID: 477
Global ID: T0606500823
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225086
Substance: Gasoline - Automotive
ID: 478
Global ID: T0606500824
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225087
Substance: Gasoline - Automotive
ID: 479
Global ID: T0606500825
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225088
Substance: Gasoline - Automotive
ID: 480
Global ID: T0606500826
Lead Agency: Regional Board
Case Worker: RT

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225089
Substance: Gasoline - Automotive
ID: 481
Global ID: T0606500827
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225090
Substance: Gasoline - Automotive
ID: 482
Global ID: T0606500828
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225064
Substance: Gasoline - Automotive
ID: 483
Global ID: T0606500802
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225091
Substance: Gasoline - Automotive
ID: 484
Global ID: T0606500829
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225092
Substance: Gasoline - Automotive
ID: 485
Global ID: T0606500830
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225093
Substance: Gasoline - Automotive
ID: 486
Global ID: T0606500831
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225094

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Substance: Gasoline - Automotive
ID: 487
Global ID: T0606500832
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225095
Substance: Gasoline - Automotive
ID: 488
Global ID: T0606500833
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225096
Substance: Gasoline - Automotive
ID: 489
Global ID: T0606500834
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225097
Substance: Gasoline - Automotive
ID: 490
Global ID: T0606500835
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225099
Substance: Gasoline - Automotive
ID: 491
Global ID: T0606500837
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225100
Substance: Gasoline - Automotive
ID: 492
Global ID: T0606500838
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225065
Substance: Gasoline - Automotive
ID: 493
Global ID: T0606500803

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225101
Substance: Gasoline - Automotive
ID: 494
Global ID: T0606500839
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225102
Substance: Gasoline - Automotive
ID: 495
Global ID: T0606500840
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225103
Substance: Gasoline - Automotive
ID: 496
Global ID: T0606500841
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225104
Substance: Gasoline - Automotive
ID: 497
Global ID: T0606500842
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225105
Substance: Gasoline - Automotive
ID: 498
Global ID: T0606500843
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225106
Substance: Gasoline - Automotive
ID: 499
Global ID: T0606500844
Lead Agency: Regional Board
Case Worker: RT

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225107
Substance: Gasoline - Automotive
ID: 500
Global ID: T0606500845
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225108
Substance: Gasoline - Automotive
ID: 501
Global ID: T0606500846
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225109
Substance: Gasoline - Automotive
ID: 502
Global ID: T0606500847
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225110
Substance: Gasoline - Automotive
ID: 503
Global ID: T0606500848
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225066
Substance: Gasoline - Automotive
ID: 504
Global ID: T0606500804
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225111
Substance: Gasoline - Automotive
ID: 505
Global ID: T0606500849
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225112

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Substance: Gasoline - Automotive
ID: 506
Global ID: T0606500850
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225113
Substance: Gasoline - Automotive
ID: 507
Global ID: T0606500851
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225114
Substance: Gasoline - Automotive
ID: 508
Global ID: T0606500852
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225115
Substance: Gasoline - Automotive
ID: 509
Global ID: T0606500853
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225116
Substance: Gasoline - Automotive
ID: 510
Global ID: T0606500854
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225117
Substance: Gasoline - Automotive
ID: 511
Global ID: T0606500855
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225118
Substance: Gasoline - Automotive
ID: 512
Global ID: T0606500856

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225119
Substance: Gasoline - Automotive
ID: 513
Global ID: T0606500857
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225120
Substance: Gasoline - Automotive
ID: 514
Global ID: T0606500858
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225067
Substance: Gasoline - Automotive
ID: 515
Global ID: T0606500805
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225121
Substance: Gasoline - Automotive
ID: 516
Global ID: T0606500859
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225122
Substance: Gasoline - Automotive
ID: 517
Global ID: T0606500860
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225124
Substance: Gasoline - Automotive
ID: 519
Global ID: T0606500862
Lead Agency: Regional Board
Case Worker: RT

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225125
Substance: Gasoline - Automotive
ID: 520
Global ID: T0606500863
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225126
Substance: Gasoline - Automotive
ID: 521
Global ID: T0606500864
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225127
Substance: Gasoline - Automotive
ID: 522
Global ID: T0606500865
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225128
Substance: Gasoline - Automotive
ID: 523
Global ID: T0606500866
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225129
Substance: Gasoline - Automotive
ID: 524
Global ID: T0606500867
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225130
Substance: Gasoline - Automotive
ID: 525
Global ID: T0606500868
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225068

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Substance: Gasoline - Automotive
ID: 526
Global ID: T0606500806
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225131
Substance: Gasoline - Automotive
ID: 527
Global ID: T0606500869
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225132
Substance: Gasoline - Automotive
ID: 528
Global ID: T0606500870
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225133
Substance: Gasoline - Automotive
ID: 529
Global ID: T0606500871
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225134
Substance: Gasoline - Automotive
ID: 530
Global ID: T0606500872
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225135
Substance: Gasoline - Automotive
ID: 531
Global ID: T0606500873
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225136
Substance: Gasoline - Automotive
ID: 532
Global ID: T0606500874

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

SUNWORLD #1 (Continued) **S103891543**

Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225137
Substance: Gasoline - Automotive
ID: 533
Global ID: T0606500875
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225138
Substance: Gasoline - Automotive
ID: 534
Global ID: T0606500876
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225069
Substance: Gasoline - Automotive
ID: 535
Global ID: T0606500807
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225070
Substance: Gasoline - Automotive
ID: 536
Global ID: T0606500808
Lead Agency: Regional Board
Case Worker: RT

Region: 7
Status: 9 - Case Closed
Case Num: 7T2225098
Substance: Gasoline - Automotive
ID: 537
Global ID: T0606500836
Lead Agency: Regional Board
Case Worker: RT

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

3 **SUN WORLD** **LUST** **S104970796**
15550 W HOBSONWAY **N/A**
BLYTHE, CA

RIVERSIDE CO. LUST:
Region: RIVERSIDE
Facility ID: 91952
Site Closed: Referred to Water Board
Date Closed: 10/25/1993
Case Type: Soil only

---

3 **SUNWORLD FACILITY** **LUST** **S106152993**
15550 EAST HOBSONWAY **N/A**
BLYTHE, CA 92225

LUST:
Region: STATE
Global Id: T0606500781
Latitude: 33.6105968
Longitude: -114.5851354
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 03/19/1996
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225043
LOC Case Number: Not reported
File Location: Not reported
Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500781
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500781
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500781
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.) | Site | Database(s) | EDR ID Number / EPA ID Number

SUNWORLD FACILITY (Continued) **S106152993**

Global Id: T0606500781
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500781
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

LUST REG 7:
Region: 7
Status: 9 - Case Closed
Case Num: 7T2225043
Substance: Gasoline - Automotive
ID: 1177
Global ID: T0606500781
Lead Agency: Regional Board
Case Worker: RT

---

3 **BLYTHE LEMON RANCH #41** **HIST CORTESE** **S105022809**
15550 HOBSONEWAY **N/A**
BLYTHE, CA 92225

CORTESE:
Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225102

---

4 **BLYTHE AIRPORT** **HIST CORTESE** **S105022819**
17240 HOBSONWAY **LUST** **N/A**
BLYTHE, CA 92225

CORTESE:
Region: CORTESE
Facility County Code: 33
Reg By: LTNKA
Reg Id: 7T2225153

LUST:
Region: STATE
Global Id: T0606500891
Latitude: 33.609605
Longitude: -114.711707
Case Type: LUST Cleanup Site
Status: Completed - Case Closed
Status Date: 01/17/2002
Lead Agency: COLORADO RIVER BASIN RWQCB (REGION 7)
Case Worker: RSF
Local Agency: RIVERSIDE COUNTY LOP
RB Case Number: 7T2225153
LOC Case Number: Not reported
File Location: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

BLYTHE AIRPORT (Continued) **S105022819**

Potential Media Affect: Soil
Potential Contaminants of Concern: Gasoline
Site History: Not reported

Click here to access the California GeoTracker records for this facility:

LUST:
Global Id: T0606500891
Contact Type: Regional Board Caseworker
Contact Name: RON FALKOWSKI
Organization Name: COLORADO RIVER BASIN RWQCB (REGION 7)
Address: 73-720 FRED WARING DR. STE. 100
City: PALM DESERT
Email: rfalk@waterboards.ca.gov
Phone Number: Not reported

Global Id: T0606500891
Contact Type: Local Agency Caseworker
Contact Name: Riverside County LOP Closed Cases
Organization Name: RIVERSIDE COUNTY LOP
Address: PO Box 1280
City: RIVERSIDE
Email: Not reported
Phone Number: 9519558982

LUST:
Global Id: T0606500891
Action Type: ENFORCEMENT
Date: 2001-09-04 00:00:00
Action: Staff Letter

Global Id: T0606500891
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Discovery

Global Id: T0606500891
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Stopped

Global Id: T0606500891
Action Type: Other
Date: 1950-01-01 00:00:00
Action: Leak Reported

LUST REG 7:
Region: 7
Status: 9 - Case Closed
Case Num: 7T2225153
Substance: Gasoline - Automotive
ID: 459
Global ID: T0606500891
Lead Agency: Regional Board
Case Worker: YO

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
5	**FARMER AIR SERVICE** **17500 W HOBSON WAY** **BLYTHE, CA 92225**	**CERC-NFRAP** **CORRACTS** **RCRA-NonGen** **FINDS**	**1000818170** **CAD980889216**

CERC-NFRAP:

Site ID:	0903526
Federal Facility:	Not a Federal Facility
NPL Status:	Not on the NPL
Non NPL Status:	NFRAP-Site does not qualify for the NPL based on existing information

CERCLIS-NFRAP Site Contact Details:

Contact Sequence ID:	13054216.00000
Person ID:	9271184.00000
Contact Sequence ID:	13060286.00000
Person ID:	9270048.00000
Contact Sequence ID:	13091025.00000
Person ID:	13002167.00000
Contact Sequence ID:	13176916.00000
Person ID:	9270438.00000

CERCLIS-NFRAP Assessment History:

Action:	DISCOVERY
Date Started:	Not reported
Date Completed:	12/01/1988
Priority Level:	Not reported
Action:	ARCHIVE SITE
Date Started:	Not reported
Date Completed:	08/31/1989
Priority Level:	Not reported
Action:	SITE INSPECTION
Date Started:	Not reported
Date Completed:	08/31/1989
Priority Level:	NFRAP-Site does not qualify for the NPL based on existing information
Action:	RESOURCE CONSERVATION AND RECOVERY ACT FACILITY ASSESSMENT
Date Started:	Not reported
Date Completed:	08/31/1989
Priority Level:	Not reported
Action:	PRELIMINARY ASSESSMENT
Date Started:	Not reported
Date Completed:	08/31/1989
Priority Level:	NFRAP-Site does not qualify for the NPL based on existing information

CORRACTS:

EPA ID:	CAD980889216
EPA Region:	09
Area Name:	ENTIRE FACILITY
Actual Date:	05/31/1989
Action:	CA075LO - CA Prioritization, Facility or area was assigned a low

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

FARMER AIR SERVICE (Continued) **1000818170**

corrective action priority
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD980889216
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 07/29/1992
Action: CA075LO - CA Prioritization, Facility or area was assigned a low corrective action priority
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

RCRA-NonGen:
Date form received by agency: 08/03/1992
Facility name: FARMERS AERIAL SVC
Facility address: 17500 W HOBSON WAY
BLYTHE, CA 92225
EPA ID: CAD980889216
Mailing address: W HOBSON WAY
BLYTHE, CA 92225
Contact: NONNOTIF NONNOTIF
Contact address: 17500 W HOBSON WAY
BLYTHE, CA 92225
Contact country: US
Contact telephone: Not reported
Contact email: Not reported
EPA Region: 09
Classification: Non-Generator
Description: Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:
Owner/operator name: FARMERS AERIAL SVC
Owner/operator address: 17500 W HOBSON WY
BLYTHE, CA 92225
Owner/operator country: Not reported
Owner/operator telephone: Not reported
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: Not reported
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

FARMER AIR SERVICE (Continued) **1000818170**

Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Corrective Action Summary:

Event date: 05/31/1989
Event: CA029WQ

Event date: 05/31/1989
Event: CA Prioritization, Facility or area was assigned a low corrective action priority.

Event date: 05/31/1989
Event: CA049PA

Event date: 08/31/1989
Event: CA049SI

Event date: 07/29/1992
Event: CA Prioritization, Facility or area was assigned a low corrective action priority.

Event date: 07/29/1992
Event: Stabilization Measures Evaluation,This facility is not amenable to stabilization activity at the present time for reasons other than 1- it appears to be technically infeasible or inappropriate (NF) or 2- there is a lack of technical information (IN). Reasons for this conclusion may be the status of closure at the facility, the degree of risk, timing considerations, the status of corrective action work at the facility, or other administrative considerations.

Event date: Not reported
Event: CA03192

Violation Status: No violations found

FINDS:

Registry ID: 110002675436

Environmental Interest/Information System
RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

MAP FINDINGS

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
6	**WOTEN AVIATION - BLYTHE** **17798 BLYTHE WAY** **BLYTHE, CA 92225**	**SLIC**	**S105756788** **N/A**

SLIC:

Region:	7
Responsible Party Name:	Woten Aviation Services
Facility Status:	Active
SLIC File Code:	WAB
Township / Range:	Not reported
Hydrologic Unit:	Colorado River
Groundwater Levels:	Not reported
Case Reference:	Not reported
Consultant ID:	27
Agency ID:	Not reported

7	**WEST COAST FLYING SERVICE** **13-400 W 14TH SAVE** **BLYTHE, CA 92225**	**CERC-NFRAP** **CORRACTS** **RCRA-NonGen** **FINDS**	**1000818157** **CAD067652156**

CERC-NFRAP:

Site ID:	0903527
Federal Facility:	Not a Federal Facility
NPL Status:	Not on the NPL
Non NPL Status:	Deferred to RCRA

CERCLIS-NFRAP Site Contact Details:

Contact Sequence ID:	13055257.00000
Person ID:	9271184.00000
Contact Sequence ID:	13061327.00000
Person ID:	9270048.00000
Contact Sequence ID:	13092067.00000
Person ID:	13002167.00000
Contact Sequence ID:	13174083.00000
Person ID:	9270438.00000

Program Priority:

Description:	RCRA Deferral Audit
Description:	RCRA Deferral - Lead Confirmed
Description:	RCRA Deferral - Further Superfund Assessment

CERCLIS-NFRAP Assessment History:

Action:	DISCOVERY
Date Started:	Not reported
Date Completed:	12/01/1988
Priority Level:	Not reported
Action:	ARCHIVE SITE
Date Started:	Not reported
Date Completed:	08/30/1989
Priority Level:	Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Action: SITE INSPECTION
Date Started: Not reported
Date Completed: 08/30/1989
Priority Level: Deferred to RCRA (Subtitle C)

Action: RESOURCE CONSERVATION AND RECOVERY ACT FACILITY ASSESSMENT
Date Started: Not reported
Date Completed: 08/30/1989
Priority Level: Not reported

Action: PRELIMINARY ASSESSMENT
Date Started: Not reported
Date Completed: 08/30/1989
Priority Level: NFRAP-Site does not qualify for the NPL based on existing information

CORRACTS:

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 02/12/1996
Action: CA190 - RFI Report Received
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 04/15/1996
Action: CA999 - Corrective Action Process Terminated
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 05/27/1989
Action: CA050RF - RFA Completed, Assessment was an RFA
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 05/27/1989
Action: CA050 - RFA Completed
NAICS Code(s): Not reported
Original schedule date: 05/27/1989
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Actual Date: 05/27/1989
Action: CA070YE - RFA Determination Of Need For An RFI, RFI is Necessary
NAICS Code(s): Not reported
Original schedule date: 05/27/1989
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 06/06/1995
Action: CA210 - CA Responsibility Referred To A Non-RCRA Federal Authority
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 08/30/1989
Action: CA075ME - CA Prioritization, Facility or area was assigned a medium corrective action priority
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 10/16/1994
Action: CA225YE - Stabilization Measures Evaluation, This facility ,is amenable to stabilization activity based on the, status of corrective action work at the facility, technical factors, the degree of risk, timing considerations and administrative considerations
NAICS Code(s): Not reported
Original schedule date: 10/16/1994
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 10/16/1994
Action: CA225YE - Stabilization Measures Evaluation, This facility ,is amenable to stabilization activity based on the, status of corrective action work at the facility, technical factors, the degree of risk, timing considerations and administrative considerations
NAICS Code(s): Not reported
Original schedule date: Not reported
Schedule end date: Not reported

EPA ID: CAD067652156
EPA Region: 09
Area Name: ENTIRE FACILITY
Actual Date: 10/16/1994
Action: CA075ME - CA Prioritization, Facility or area was assigned a medium corrective action priority
NAICS Code(s): Not reported
Original schedule date: Not reported

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Schedule end date: Not reported

RCRA-NonGen:
Date form received by agency: 07/01/1993
Facility name: WEST COAST FLYING SVC INC
Facility address: 13-400 WEST FOURTEENTH AVE
BLYTHE, CA 92225
EPA ID: CAD067652156
Mailing address: 13 FOURTH HUNDRED FOURTEENTH A
BLYTHE, CA 92225
Contact: Not reported
Contact address: Not reported
Not reported
Contact country: Not reported
Contact telephone: Not reported
Contact email: Not reported
EPA Region: 09
Land type: Private
Classification: Non-Generator
Description: Handler: Non-Generators do not presently generate hazardous waste

Owner/Operator Summary:
Owner/operator name: NONNOTIF
Owner/operator address: NONNOTIF
NONNOTIF, CA 92225
Owner/operator country: Not reported
Owner/operator telephone: (415) 555-1212
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: Not reported
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

Historical Generators:
Date form received by agency: 08/03/1992
Facility name: WEST COAST FLYING SVC INC
Classification: Not a generator, verified

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Corrective Action Summary:

Event date:	05/27/1989
Event:	RFA Completed
Event date:	05/27/1989
Event:	RFA Determination Of Need For An RFI, RFI is Necessary;
Event date:	05/27/1989
Event:	RFA Completed, Assessment was an RFA.
Event date:	08/30/1989
Event:	CA Prioritization, Facility or area was assigned a medium corrective action priority.
Event date:	08/30/1989
Event:	CA074ME
Event date:	08/30/1989
Event:	CA049PA
Event date:	08/30/1989
Event:	CA029WQ
Event date:	08/30/1989
Event:	CA049SI
Event date:	10/16/1994
Event:	Stabilization Measures Evaluation,This facility is amenable to stabilization activity based on the status of corrective action work at the facility, technical factors, the degree of risk, timing considerations and administrative considerations.
Event date:	10/16/1994
Event:	CA Prioritization, Facility or area was assigned a medium corrective action priority.
Event date:	10/16/1994
Event:	Stabilization Measures Evaluation,This facility is amenable to stabilization activity based on the status of corrective action work at the facility, technical factors, the degree of risk, timing considerations and administrative considerations.
Event date:	06/06/1995
Event:	CA Responsibility Referred To A Non-RCRA Federal Authority
Event date:	02/12/1996
Event:	RFI Report Received
Event date:	04/15/1996
Event:	Corrective Action Process Terminated
Event date:	Not reported
Event:	CA03192

Facility Has Received Notices of Violations:

Regulation violated:	FR - 262.50-60

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Area of violation: Generators - General
Date violation determined: 01/24/1995
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 01/24/1995
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 270
Area of violation: TSD - General
Date violation determined: 05/31/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 264.220-230.K
Area of violation: TSD - General
Date violation determined: 05/31/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 264.90-94.F
Area of violation: TSD IS-Ground-Water Monitoring
Date violation determined: 05/31/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 262.50-60
Area of violation: Generators - General

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Date violation determined: 05/31/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 264.220-230.K
Area of violation: TSD - General
Date violation determined: 05/24/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 264.90-94.F
Area of violation: TSD IS-Ground-Water Monitoring
Date violation determined: 05/24/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 262.50-60
Area of violation: Generators - General
Date violation determined: 05/24/1994
Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Regulation violated: F - 270
Area of violation: TSD - General
Date violation determined: 05/24/1994

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number | EPA ID Number

WEST COAST FLYING SERVICE (Continued) **1000818157**

Date achieved compliance: 06/06/1995
Violation lead agency: State
Enforcement action: WRITTEN INFORMAL
Enforcement action date: 05/31/1994
Enf. disposition status: Not reported
Enf. disp. status date: Not reported
Enforcement lead agency: State
Proposed penalty amount: 0
Final penalty amount: 0
Paid penalty amount: 0

Evaluation Action Summary:
Evaluation date: 12/21/1995
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Not reported
Date achieved compliance: Not reported
Evaluation lead agency: State

Evaluation date: 01/24/1995
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Generators - General
Date achieved compliance: 06/06/1995
Evaluation lead agency: State

Evaluation date: 05/17/1994
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Generators - General
Date achieved compliance: 06/06/1995
Evaluation lead agency: State

Evaluation date: 05/17/1994
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: TSD IS-Ground-Water Monitoring
Date achieved compliance: 06/06/1995
Evaluation lead agency: State

Evaluation date: 05/17/1994
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: TSD - General
Date achieved compliance: 06/06/1995
Evaluation lead agency: State

FINDS:

Registry ID: 110000609725

Environmental Interest/Information System
RCRAInfo is a national information system that supports the Resource Conservation and Recovery Act (RCRA) program through the tracking of events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste. RCRAInfo allows RCRA program staff to track the notification, permit, compliance, and corrective action activities required under RCRA.

Count: 33 records

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
BLYTHE	S105022791	SO CAL EDISON - BLYTHE SE	505 14TH	92225	HIST CORTESE
BLYTHE	S104156503	WEST COAST-CLAYTON HELI.88-098	13400 14TH AVE	92225	WMUDS/SWAT
BLYTHE	U001573653	MOBIL OIL	9021 HWY 60	92225	HIST UST
BLYTHE	U001573643	J. M. DE FOREST INC.	12300 HWY 60 W.	92225	HIST UST
BLYTHE	S101590339	J M DEFOREST INC	12300 HIGHWAY 60 W	92225	CA FID UST, SWEEPS UST
BLYTHE	1009393172	LOST LAKE RESORT	42500 HWY 95	92225	INDIAN UST
BLYTHE	1011843698	LOST LAKE RESORT	42500 HWY 95	92225	INDIAN LUST
BLYTHE	S109821522	BLYTHE AIRPORT DUMPSITE	ADJACENT TO EAST SIDE OF RUNWA		SWF/LF
BLYTHE	1009394143	WATER WHEEL RESORT	CHR 20 - 20900, HWY 95	92225	INDIAN LUST
BLYTHE	1009393129	WATER WHEEL RESORT	CHR 20 - 20900, HWY 95	92225	INDIAN UST
BLYTHE	S107735973	BURFORD BYPASS TRUST PROPERTY (A.K.A. EASTERN GATEWAY RETAIL	SW CORNER OF HOBSONWAY E & INTAKE BLVD	92225	VCP, ENVIROSTOR
BLYTHE	1009393171	TWIN PALMS RESORT	HCR 20, BOX 1600 18 1/2 MILE N. CA HWY 95	92225	INDIAN UST
BLYTHE	U001573662	S&R OIL COMPANY-BULK PLANT	9265 E. HIGHWAY 60	92225	HIST UST
BLYTHE	S101590287	S & R OIL COMPANY-BULK PLANT	9265 E HIGHWAY 60	92225	CA FID UST, SWEEPS UST
BLYTHE	U001573655	PALO VERDE EQUIPMENT CO	11390 WEST HIGHWAY 60	92225	HIST UST
BLYTHE	S109548312	FARMERS AERIAL SVC	17500 W HOBSON WAY	92225	ENVIROSTOR
BLYTHE	S105022814	JOY IVERSON HARTWICK TRU	120 HOBSONWAY	92225	HIST CORTESE
BLYTHE	U004151241	QUIK CHEK WEST- LARRY'S QUIK CHEK	3504 W HOBSONWAY	92225	UST
BLYTHE	1009393126	AHA QUIN RESORT	HRC 20, HWY 95 P.O. BOX 2400	92225	INDIAN UST
BLYTHE	U001573648	LOST LAKE RESORT	LOST LAKE (31 MI. N. OF BLYTHE	92225	HIST UST
BLYTHE	U001573617	BLYTHE UNION 76 AUTO/TRUCK STO	MESA DRIVE	92225	HIST UST
BLYTHE	U001573611	BLYTHE MUNICIPAL GOLF COURSE	NORTH MESA	92225	HIST UST
BLYTHE	1003878669	RIVERSIDE CO DUMP	1000 MIDLAND RD	92225	CERC-NFRAP
BLYTHE	1014387846	BLYTHE SOLAR POWER PROJECT	8 MILES W OF BLYTHE	92225	RCRA-SQG
BLYTHE	1005441389	SHEPWELLS CORPORATION	7 MI N OF BLYTHE	92225	RCRA-SQG, FINDS, HAZNET
BLYTHE	A100109560	PRATT APIARIES	13510 RIVERSIDE AVE.	92225	AST
COUNTY	S105022408	COATS AND COMPANY	435 HOBSONWAY	92225	HIST CORTESE
DESERT CENTER	S104816282	CALTRANS DESERT CENTER	129476 HWY 60	92239	LUST
DESERT CENTER	1000111574	EAGLE MOUNTAIN PUMPING PLANT	10 MI N OF DESERT CENTER 4 S	92239	RCRA-SQG, FINDS
DESERT CENTER	1003879899	KAISER EAGLE MOUNTAIN	N OF HWY 10 8M OFF KAISER RD.	92239	CERC-NFRAP
RIPLEY	1000886229	TOHSHIN TRADING INC	34100 HWY 78 PMP	92225	RCRA-SQG, FINDS
RIVERSIDE COUNTY	M300003149	ROBERT R. FORD TRUCKING, INC.	PACIFIC CLAY / FORD PIT		MINES
RIVERSIDE COUNTY	M300002452	PACIFIC CLAY PRODS CO	RIVERSIDE COUNTY PITS (5 OPERATIONS)		MINES

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

FEDERAL RECORDS

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 10/12/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 10/12/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

DELISTED NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 07/12/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 79

Source: EPA
Telephone: N/A
Last EDR Contact: 10/12/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 02/25/2011
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 09/01/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Quarterly

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Archived sites are sites that have been removed and archived from the inventory of CERCLIS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list this site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. This decision does not necessarily mean that there is no hazard associated with a given site; it only means that, based upon available information, the location is not judged to be a potential NPL site.

Date of Government Version: 02/25/2011
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA
Telephone: 703-412-9810
Last EDR Contact: 09/01/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Quarterly

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 09/09/2011
Date Data Arrived at EDR: 09/16/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 13

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 08/12/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

CORRACTS: Corrective Action Report

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 03/09/2011
Date Data Arrived at EDR: 03/15/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 91

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

RCRA-TSDF: RCRA - Treatment, Storage and Disposal

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/05/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Quarterly

RCRA-LQG: RCRA - Large Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/05/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/05/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/05/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Varies

RCRA-NonGen: RCRA - Non Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 06/15/2011
Date Data Arrived at EDR: 07/07/2011
Date Made Active in Reports: 08/08/2011
Number of Days to Update: 32

Source: Environmental Protection Agency
Telephone: (415) 495-8895
Last EDR Contact: 10/05/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 03/16/2011
Date Data Arrived at EDR: 03/25/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 81

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 03/16/2011
Date Data Arrived at EDR: 03/25/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 81

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Varies

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 07/05/2011
Date Data Arrived at EDR: 07/05/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 86

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 10/04/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Annually

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 07/05/2011
Date Data Arrived at EDR: 07/05/2011
Date Made Active in Reports: 09/30/2011
Number of Days to Update: 87

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 10/04/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Annually

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 01/12/2011
Date Data Arrived at EDR: 02/11/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 80

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 08/09/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Varies

US CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 06/08/2011
Date Data Arrived at EDR: 09/16/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 13

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 09/07/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: Quarterly

US BROWNFIELDS: A Listing of Brownfields Sites

Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: 06/27/2011
Date Data Arrived at EDR: 06/27/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 09/28/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Semi-Annually

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 07/22/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Semi-Annually

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 08/12/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 112

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Varies

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 12/09/2005
Date Data Arrived at EDR: 12/11/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 31

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 07/11/2011
Next Scheduled EDR Contact: 09/05/2011
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 06/01/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 41

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 10/03/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Varies

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 07/31/2011
Date Data Arrived at EDR: 09/14/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 15

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 09/14/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Annually

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 09/14/2010
Date Data Arrived at EDR: 10/21/2010
Date Made Active in Reports: 01/28/2011
Number of Days to Update: 99

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations

A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137

Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: No Update Planned

ODI: Open Dump Inventory

An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

MINES: Mines Master Index File

Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 09/08/2011
Date Made Active in Reports: 09/29/2011
Number of Days to Update: 21

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 09/08/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: Semi-Annually

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/17/2010
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 94

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 09/01/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Annually

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2006
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 64

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 09/27/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Every 4 Years

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing

A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing

A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40
Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77
Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 08/18/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System

The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 01/07/2011
Date Data Arrived at EDR: 01/21/2011
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 59
Source: Environmental Protection Agency
Telephone: 202-564-5088
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Quarterly

PADS: PCB Activity Database System

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 11/01/2010
Date Data Arrived at EDR: 11/10/2010
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 98
Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 07/22/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Annually

MLTS: Material Licensing Tracking System

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 06/21/2011
Date Data Arrived at EDR: 07/15/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 60
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Quarterly

RADINFO: Radiation Information Database

The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 01/11/2011
Date Data Arrived at EDR: 01/13/2011
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 34
Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 10/13/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 04/14/2010
Date Data Arrived at EDR: 04/16/2010
Date Made Active in Reports: 05/27/2010
Number of Days to Update: 41

Source: EPA
Telephone: (415) 947-8000
Last EDR Contact: 09/13/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Quarterly

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 03/01/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 62

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 09/01/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Biennially

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPAa??s Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 12/10/2010
Date Data Arrived at EDR: 01/11/2011
Date Made Active in Reports: 02/16/2011
Number of Days to Update: 36

Source: Environmental Protection Agency
Telephone: 703-603-8704
Last EDR Contact: 10/14/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Varies

US HIST CDL: National Clandestine Laboratory Register

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 09/01/2007
Date Data Arrived at EDR: 11/19/2008
Date Made Active in Reports: 03/30/2009
Number of Days to Update: 131

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 03/23/2009
Next Scheduled EDR Contact: 06/22/2009
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 01/01/2008
Date Data Arrived at EDR: 02/18/2009
Date Made Active in Reports: 05/29/2009
Number of Days to Update: 100
Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 08/05/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

COAL ASH DOE: Sleam-Electric Plan Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76
Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 07/18/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Varies

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 01/01/2010
Date Data Arrived at EDR: 02/16/2010
Date Made Active in Reports: 04/12/2010
Number of Days to Update: 55
Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 01/30/2012
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 08/17/2010
Date Data Arrived at EDR: 01/03/2011
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 77
Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 09/16/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Varies

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing
The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 03/07/2011
Date Data Arrived at EDR: 03/09/2011
Date Made Active in Reports: 05/02/2011
Number of Days to Update: 54
Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 07/15/2011
Next Scheduled EDR Contact: 11/07/2011
Data Release Frequency: Varies

STATE AND LOCAL RECORDS

HIST CAL-SITES: Calsites Database
The Calsites database contains potential or confirmed hazardous substance release properties. In 1996, California EPA reevaluated and significantly reduced the number of sites in the Calsites database. No longer updated by the state agency. It has been replaced by ENVIROSTOR.

Date of Government Version: 08/08/2005
Date Data Arrived at EDR: 08/03/2006
Date Made Active in Reports: 08/24/2006
Number of Days to Update: 21
Source: Department of Toxic Substance Control
Telephone: 916-323-3400
Last EDR Contact: 02/23/2009
Next Scheduled EDR Contact: 05/25/2009
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

CA BOND EXP. PLAN: Bond Expenditure Plan

Department of Health Services developed a site-specific expenditure plan as the basis for an appropriation of Hazardous Substance Cleanup Bond Act funds. It is not updated.

Date of Government Version: 01/01/1989
Date Data Arrived at EDR: 07/27/1994
Date Made Active in Reports: 08/02/1994
Number of Days to Update: 6

Source: Department of Health Services
Telephone: 916-255-2118
Last EDR Contact: 05/31/1994
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SCH: School Property Evaluation Program

This category contains proposed and existing school sites that are being evaluated by DTSC for possible hazardous materials contamination. In some cases, these properties may be listed in the CalSites category depending on the level of threat to public health and safety or the environment they pose.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 31

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/15/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Quarterly

TOXIC PITS: Toxic Pits Cleanup Act Sites

Toxic PITS Cleanup Act Sites. TOXIC PITS identifies sites suspected of containing hazardous substances where cleanup has not yet been completed.

Date of Government Version: 07/01/1995
Date Data Arrived at EDR: 08/30/1995
Date Made Active in Reports: 09/26/1995
Number of Days to Update: 27

Source: State Water Resources Control Board
Telephone: 916-227-4364
Last EDR Contact: 01/26/2009
Next Scheduled EDR Contact: 04/27/2009
Data Release Frequency: No Update Planned

SWF/LF (SWIS): Solid Waste Information System

Active, Closed and Inactive Landfills. SWF/LF records typically contain an inve ntory of solid waste disposal facilities or landfills. These may be active or i nactive facilities or open dumps that failed to meet RCRA Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 08/22/2011
Date Data Arrived at EDR: 08/24/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 40

Source: Department of Resources Recycling and Recovery
Telephone: 916-341-6320
Last EDR Contact: 08/24/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Quarterly

WMUDS/SWAT: Waste Management Unit Database

Waste Management Unit Database System. WMUDS is used by the State Water Resources Control Board staff and the Regional Water Quality Control Boards for program tracking and inventory of waste management units. WMUDS is composed of the following databases: Facility Information, Scheduled Inspections Information, Waste Management Unit Information, SWAT Program Information, SWAT Report Summary Information, SWAT Report Summary Data, Chapter 15 (formerly Subchapter 15) Information, Chapter 15 Monitoring Parameters, TPCA Program Information, RCRA Program Information, Closure Information, and Interested Parties Information.

Date of Government Version: 04/01/2000
Date Data Arrived at EDR: 04/10/2000
Date Made Active in Reports: 05/10/2000
Number of Days to Update: 30

Source: State Water Resources Control Board
Telephone: 916-227-4448
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

NPDES: NPDES Permits Listing

A listing of NPDES permits, including stormwater.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 08/23/2011
Date Data Arrived at EDR: 08/24/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 40

Source: State Water Resources Control Board
Telephone: 916-445-9379
Last EDR Contact: 08/24/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Quarterly

WDS: Waste Discharge System
Sites which have been issued waste discharge requirements.

Date of Government Version: 06/19/2007
Date Data Arrived at EDR: 06/20/2007
Date Made Active in Reports: 06/29/2007
Number of Days to Update: 9

Source: State Water Resources Control Board
Telephone: 916-341-5227
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Quarterly

CORTESE: "Cortese" Hazardous Waste & Substances Sites List
The sites for the list are designated by the State Water Resource Control Board (LUST), the Integrated Waste Board (SWF/LS), and the Department of Toxic Substances Control (Cal-Sites). This listing is no longer updated by the state agency.

Date of Government Version: 07/01/2011
Date Data Arrived at EDR: 07/01/2011
Date Made Active in Reports: 07/15/2011
Number of Days to Update: 14

Source: CAL EPA/Office of Emergency Information
Telephone: 916-323-3400
Last EDR Contact: 10/04/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Quarterly

HIST CORTESE: Hazardous Waste & Substance Site List
The sites for the list are designated by the State Water Resource Control Board [LUST], the Integrated Waste Board [SWF/LS], and the Department of Toxic Substances Control [CALSITES].

Date of Government Version: 04/01/2001
Date Data Arrived at EDR: 01/22/2009
Date Made Active in Reports: 04/08/2009
Number of Days to Update: 76

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 01/22/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SWRCY: Recycler Database
A listing of recycling facilities in California.

Date of Government Version: 06/01/2011
Date Data Arrived at EDR: 06/21/2011
Date Made Active in Reports: 07/15/2011
Number of Days to Update: 24

Source: Department of Conservation
Telephone: 916-323-3836
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

LUST: Geotracker's Leaking Underground Fuel Tank Report
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state. For more information on a particular leaking underground storage tank sites, please contact the appropriate regulatory agency.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/11/2011
Date Made Active in Reports: 09/12/2011
Number of Days to Update: 32

Source: State Water Resources Control Board
Telephone: see region list
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

LUST REG 1: Active Toxic Site Investigation
Del Norte, Humboldt, Lake, Mendocino, Modoc, Siskiyou, Sonoma, Trinity counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 02/01/2001
Date Data Arrived at EDR: 02/28/2001
Date Made Active in Reports: 03/29/2001
Number of Days to Update: 29

Source: California Regional Water Quality Control Board North Coast (1)
Telephone: 707-570-3769
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: No Update Planned

LUST REG 2: Fuel Leak List
Leaking Underground Storage Tank locations. Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma counties.

Date of Government Version: 09/30/2004
Date Data Arrived at EDR: 10/20/2004
Date Made Active in Reports: 11/19/2004
Number of Days to Update: 30

Source: California Regional Water Quality Control Board San Francisco Bay Region (2)
Telephone: 510-622-2433
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

LUST REG 3: Leaking Underground Storage Tank Database
Leaking Underground Storage Tank locations. Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Cruz counties.

Date of Government Version: 05/19/2003
Date Data Arrived at EDR: 05/19/2003
Date Made Active in Reports: 06/02/2003
Number of Days to Update: 14

Source: California Regional Water Quality Control Board Central Coast Region (3)
Telephone: 805-542-4786
Last EDR Contact: 07/18/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: No Update Planned

LUST REG 9: Leaking Underground Storage Tank Report
Orange, Riverside, San Diego counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 03/01/2001
Date Data Arrived at EDR: 04/23/2001
Date Made Active in Reports: 05/21/2001
Number of Days to Update: 28

Source: California Regional Water Quality Control Board San Diego Region (9)
Telephone: 858-637-5595
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: No Update Planned

LUST REG 5: Leaking Underground Storage Tank Database
Leaking Underground Storage Tank locations. Alameda, Alpine, Amador, Butte, Colusa, Contra Costa, Calveras, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Lassen, Madera, Mariposa, Merced, Modoc, Napa, Nevada, Placer, Plumas, Sacramento, San Joaquin, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba counties.

Date of Government Version: 07/01/2008
Date Data Arrived at EDR: 07/22/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 9

Source: California Regional Water Quality Control Board Central Valley Region (5)
Telephone: 916-464-4834
Last EDR Contact: 07/01/2011
Next Scheduled EDR Contact: 10/17/2011
Data Release Frequency: Quarterly

LUST REG 6L: Leaking Underground Storage Tank Case Listing
For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 09/09/2003
Date Data Arrived at EDR: 09/10/2003
Date Made Active in Reports: 10/07/2003
Number of Days to Update: 27

Source: California Regional Water Quality Control Board Lahontan Region (6)
Telephone: 530-542-5572
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: No Update Planned

LUST REG 6V: Leaking Underground Storage Tank Case Listing
Leaking Underground Storage Tank locations. Inyo, Kern, Los Angeles, Mono, San Bernardino counties.

Date of Government Version: 06/07/2005
Date Data Arrived at EDR: 06/07/2005
Date Made Active in Reports: 06/29/2005
Number of Days to Update: 22

Source: California Regional Water Quality Control Board Victorville Branch Office (6)
Telephone: 760-241-7365
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

LUST REG 7: Leaking Underground Storage Tank Case Listing
Leaking Underground Storage Tank locations. Imperial, Riverside, San Diego, Santa Barbara counties.

Date of Government Version: 02/26/2004
Date Data Arrived at EDR: 02/26/2004
Date Made Active in Reports: 03/24/2004
Number of Days to Update: 27

Source: California Regional Water Quality Control Board Colorado River Basin Region (7)
Telephone: 760-776-8943
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: No Update Planned

LUST REG 8: Leaking Underground Storage Tanks
California Regional Water Quality Control Board Santa Ana Region (8). For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 02/14/2005
Date Data Arrived at EDR: 02/15/2005
Date Made Active in Reports: 03/28/2005
Number of Days to Update: 41

Source: California Regional Water Quality Control Board Santa Ana Region (8)
Telephone: 909-782-4496
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Varies

LUST REG 4: Underground Storage Tank Leak List
Los Angeles, Ventura counties. For more current information, please refer to the State Water Resources Control Board's LUST database.

Date of Government Version: 09/07/2004
Date Data Arrived at EDR: 09/07/2004
Date Made Active in Reports: 10/12/2004
Number of Days to Update: 35

Source: California Regional Water Quality Control Board Los Angeles Region (4)
Telephone: 213-576-6710
Last EDR Contact: 09/06/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: No Update Planned

CA FID UST: Facility Inventory Database
The Facility Inventory Database (FID) contains a historical listing of active and inactive underground storage tank locations from the State Water Resource Control Board. Refer to local/county source for current data.

Date of Government Version: 10/31/1994
Date Data Arrived at EDR: 09/05/1995
Date Made Active in Reports: 09/29/1995
Number of Days to Update: 24

Source: California Environmental Protection Agency
Telephone: 916-341-5851
Last EDR Contact: 12/28/1998
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

SLIC: Statewide SLIC Cases
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/11/2011
Date Made Active in Reports: 09/12/2011
Number of Days to Update: 32

Source: State Water Resources Control Board
Telephone: 866-480-1028
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Varies

SLIC REG 1: Active Toxic Site Investigations
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 04/03/2003
Date Data Arrived at EDR: 04/07/2003
Date Made Active in Reports: 04/25/2003
Number of Days to Update: 18

Source: California Regional Water Quality Control Board, North Coast Region (1)
Telephone: 707-576-2220
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: No Update Planned

SLIC REG 2: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 09/30/2004
Date Data Arrived at EDR: 10/20/2004
Date Made Active in Reports: 11/19/2004
Number of Days to Update: 30

Source: Regional Water Quality Control Board San Francisco Bay Region (2)
Telephone: 510-286-0457
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

SLIC REG 3: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 05/18/2006
Date Data Arrived at EDR: 05/18/2006
Date Made Active in Reports: 06/15/2006
Number of Days to Update: 28

Source: California Regional Water Quality Control Board Central Coast Region (3)
Telephone: 805-549-3147
Last EDR Contact: 07/18/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Semi-Annually

SLIC REG 4: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 11/17/2004
Date Data Arrived at EDR: 11/18/2004
Date Made Active in Reports: 01/04/2005
Number of Days to Update: 47

Source: Region Water Quality Control Board Los Angeles Region (4)
Telephone: 213-576-6600
Last EDR Contact: 07/01/2011
Next Scheduled EDR Contact: 10/17/2011
Data Release Frequency: Varies

SLIC REG 5: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 04/01/2005
Date Data Arrived at EDR: 04/05/2005
Date Made Active in Reports: 04/21/2005
Number of Days to Update: 16

Source: Regional Water Quality Control Board Central Valley Region (5)
Telephone: 916-464-3291
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Semi-Annually

SLIC REG 6V: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 05/24/2005
Date Data Arrived at EDR: 05/25/2005
Date Made Active in Reports: 06/16/2005
Number of Days to Update: 22

Source: Regional Water Quality Control Board, Victorville Branch
Telephone: 619-241-6583
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Semi-Annually

SLIC REG 6L: SLIC Sites
The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 09/07/2004
Date Data Arrived at EDR: 09/07/2004
Date Made Active in Reports: 10/12/2004
Number of Days to Update: 35

Source: California Regional Water Quality Control Board, Lahontan Region
Telephone: 530-542-5574
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

SLIC REG 7: SLIC List

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 11/24/2004
Date Data Arrived at EDR: 11/29/2004
Date Made Active in Reports: 01/04/2005
Number of Days to Update: 36

Source: California Regional Quality Control Board, Colorado River Basin Region
Telephone: 760-346-7491
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: No Update Planned

SLIC REG 8: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 04/03/2008
Date Data Arrived at EDR: 04/03/2008
Date Made Active in Reports: 04/14/2008
Number of Days to Update: 11

Source: California Region Water Quality Control Board Santa Ana Region (8)
Telephone: 951-782-3298
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Semi-Annually

SLIC REG 9: Spills, Leaks, Investigation & Cleanup Cost Recovery Listing

The SLIC (Spills, Leaks, Investigations and Cleanup) program is designed to protect and restore water quality from spills, leaks, and similar discharges.

Date of Government Version: 09/10/2007
Date Data Arrived at EDR: 09/11/2007
Date Made Active in Reports: 09/28/2007
Number of Days to Update: 17

Source: California Regional Water Quality Control Board San Diego Region (9)
Telephone: 858-467-2980
Last EDR Contact: 08/08/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Annually

UST: Active UST Facilities

Active UST facilities gathered from the local regulatory agencies

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/11/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 29

Source: SWRCB
Telephone: 916-480-1028
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Semi-Annually

UST MENDOCINO: Mendocino County UST Database

A listing of underground storage tank locations in Mendocino County.

Date of Government Version: 09/23/2009
Date Data Arrived at EDR: 09/23/2009
Date Made Active in Reports: 10/01/2009
Number of Days to Update: 8

Source: Department of Public Health
Telephone: 707-463-4466
Last EDR Contact: 09/06/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: Annually

HIST UST: Hazardous Substance Storage Container Database

The Hazardous Substance Storage Container Database is a historical listing of UST sites. Refer to local/county source for current data.

Date of Government Version: 10/15/1990
Date Data Arrived at EDR: 01/25/1991
Date Made Active in Reports: 02/12/1991
Number of Days to Update: 18

Source: State Water Resources Control Board
Telephone: 916-341-5851
Last EDR Contact: 07/26/2001
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

LIENS: Environmental Liens Listing

A listing of property locations with environmental liens for California where DTSC is a lien holder.

Date of Government Version: 06/28/2011
Date Data Arrived at EDR: 06/29/2011
Date Made Active in Reports: 07/08/2011
Number of Days to Update: 9

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Varies

SWEEPS UST: SWEEPS UST Listing

Statewide Environmental Evaluation and Planning System. This underground storage tank listing was updated and maintained by a company contacted by the SWRCB in the early 1990's. The listing is no longer updated or maintained. The local agency is the contact for more information on a site on the SWEEPS list.

Date of Government Version: 06/01/1994
Date Data Arrived at EDR: 07/07/2005
Date Made Active in Reports: 08/11/2005
Number of Days to Update: 35

Source: State Water Resources Control Board
Telephone: N/A
Last EDR Contact: 06/03/2005
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

CHMIRS: California Hazardous Material Incident Report System

California Hazardous Material Incident Reporting System. CHMIRS contains information on reported hazardous material incidents (accidental releases or spills).

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 05/03/2011
Date Made Active in Reports: 06/15/2011
Number of Days to Update: 43

Source: Office of Emergency Services
Telephone: 916-845-8400
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

LDS: Land Disposal Sites Listing

The Land Disposal program regulates of waste discharge to land for treatment, storage and disposal in waste management units.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/11/2011
Date Made Active in Reports: 09/12/2011
Number of Days to Update: 32

Source: State Water Qualilty Control Board
Telephone: 866-480-1028
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

MCS: Military Cleanup Sites Listing

The State Water Resources Control Board and nine Regional Water Quality Control Boards partner with the Department of Defense (DoD) through the Defense and State Memorandum of Agreement (DSMOA) to oversee the investigation and remediation of water quality issues at military facilities.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/11/2011
Date Made Active in Reports: 09/12/2011
Number of Days to Update: 32

Source: State Water Resources Control Board
Telephone: 866-480-1028
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

AST: Aboveground Petroleum Storage Tank Facilities

Registered Aboveground Storage Tanks.

Date of Government Version: 08/01/2009
Date Data Arrived at EDR: 09/10/2009
Date Made Active in Reports: 10/01/2009
Number of Days to Update: 21

Source: State Water Resources Control Board
Telephone: 916-341-5712
Last EDR Contact: 10/11/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

NOTIFY 65: Proposition 65 Records

Listings of all Proposition 65 incidents reported to counties by the State Water Resources Control Board and the Regional Water Quality Control Board. This database is no longer updated by the reporting agency.

Date of Government Version: 10/21/1993
Date Data Arrived at EDR: 11/01/1993
Date Made Active in Reports: 11/19/1993
Number of Days to Update: 18

Source: State Water Resources Control Board
Telephone: 916-445-3846
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: No Update Planned

DEED: Deed Restriction Listing

Site Mitigation and Brownfields Reuse Program Facility Sites with Deed Restrictions & Hazardous Waste Management Program Facility Sites with Deed / Land Use Restriction. The DTSC Site Mitigation and Brownfields Reuse Program (SMBRP) list includes sites cleaned up under the program's oversight and generally does not include current or former hazardous waste facilities that required a hazardous waste facility permit. The list represents deed restrictions that are active. Some sites have multiple deed restrictions. The DTSC Hazardous Waste Management Program (HWMP) has developed a list of current or former hazardous waste facilities that have a recorded land use restriction at the local county recorder's office. The land use restrictions on this list were required by the DTSC HWMP as a result of the presence of hazardous substances that remain on site after the facility (or part of the facility) has been closed or cleaned up. The types of land use restriction include deed notice, deed restriction, or a land use restriction that binds current and future owners.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 24

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/13/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Semi-Annually

VCP: Voluntary Cleanup Program Properties

Contains low threat level properties with either confirmed or unconfirmed releases and the project proponents have request that DTSC oversee investigation and/or cleanup activities and have agreed to provide coverage for DTSC's costs.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 31

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/15/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Quarterly

DRYCLEANERS: Cleaner Facilities

A list of drycleaner related facilities that have EPA ID numbers. These are facilities with certain SIC codes: power laundries, family and commercial; garment pressing and cleaner's agents; linen supply; coin-operated laundries and cleaning; drycleaning plants, except rugs; carpet and upholster cleaning; industrial launderers; laundry and garment services.

Date of Government Version: 06/28/2011
Date Data Arrived at EDR: 07/21/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 21

Source: Department of Toxic Substance Control
Telephone: 916-327-4498
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Annually

WIP: Well Investigation Program Case List

Well Investigation Program case in the San Gabriel and San Fernando Valley area.

Date of Government Version: 07/03/2009
Date Data Arrived at EDR: 07/21/2009
Date Made Active in Reports: 08/03/2009
Number of Days to Update: 13

Source: Los Angeles Water Quality Control Board
Telephone: 213-576-6726
Last EDR Contact: 10/03/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Varies

ENF: Enforcement Action Listing

A listing of Water Board Enforcement Actions. Formal is everything except Oral/Verbal Communication, Notice of Violation, Expedited Payment Letter, and Staff Enforcement Letter.

Date of Government Version: 08/15/2011
Date Data Arrived at EDR: 08/23/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 41

Source: State Water Resoruces Control Board
Telephone: 916-445-9379
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

CDL: Clandestine Drug Labs

A listing of drug lab locations. Listing of a location in this database does not indicate that any illegal drug lab materials were or were not present there, and does not constitute a determination that the location either requires or does not require additional cleanup work.

Date of Government Version: 06/30/2011
Date Data Arrived at EDR: 08/11/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 29

Source: Department of Toxic Substances Control
Telephone: 916-255-6504
Last EDR Contact: 10/03/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Varies

RESPONSE: State Response Sites

Identifies confirmed release sites where DTSC is involved in remediation, either in a lead or oversight capacity. These confirmed release sites are generally high-priority and high potential risk.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 31

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/15/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Quarterly

HAZNET: Facility and Manifest Data

Facility and Manifest Data. The data is extracted from the copies of hazardous waste manifests received each year by the DTSC. The annual volume of manifests is typically 700,000 - 1,000,000 annually, representing approximately 350,000 - 500,000 shipments. Data are from the manifests submitted without correction, and therefore many contain some invalid values for data elements such as generator ID, TSD ID, waste category, and disposal method.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 07/19/2011
Date Made Active in Reports: 08/16/2011
Number of Days to Update: 28

Source: California Environmental Protection Agency
Telephone: 916-255-1136
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 01/30/2012
Data Release Frequency: Annually

EMI: Emissions Inventory Data

Toxics and criteria pollutant emissions data collected by the ARB and local air pollution agencies.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 09/29/2010
Date Made Active in Reports: 10/18/2010
Number of Days to Update: 19

Source: California Air Resources Board
Telephone: 916-322-2990
Last EDR Contact: 09/30/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Varies

ENVIROSTOR: EnviroStor Database

The Department of Toxic Substances Control's (DTSC's) Site Mitigation and Brownfields Reuse Program's (SMBRP's) EnviroStor database identifes sites that have known contamination or sites for which there may be reasons to investigate further. The database includes the following site types: Federal Superfund sites (National Priorities List (NPL)); State Response, including Military Facilities and State Superfund; Voluntary Cleanup; and School sites. EnviroStor provides similar information to the information that was available in CalSites, and provides additional site information, including, but not limited to, identification of formerly-contaminated properties that have been released for reuse, properties where environmental deed restrictions have been recorded to prevent inappropriate land uses, and risk characterization information that is used to assess potential impacts to public health and the environment at contaminated sites.

Date of Government Version: 08/09/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 31

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/15/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Quarterly

HAULERS: Registered Waste Tire Haulers Listing
A listing of registered waste tire haulers.

Date of Government Version: 05/24/2011
Date Data Arrived at EDR: 05/24/2011
Date Made Active in Reports: 06/15/2011
Number of Days to Update: 22

Source: Integrated Waste Management Board
Telephone: 916-341-6422
Last EDR Contact: 09/06/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Varies

HWP: EnviroStor Permitted Facilities Listing
Detailed information on permitted hazardous waste facilities and corrective action ("cleanups") tracked in EnviroStor.

Date of Government Version: 08/09/2010
Date Data Arrived at EDR: 08/11/2010
Date Made Active in Reports: 08/20/2010
Number of Days to Update: 9

Source: Department of Toxic Substances Control
Telephone: 916-323-3400
Last EDR Contact: 09/01/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Quarterly

HWT: Registered Hazardous Waste Transporter Database
A listing of hazardous waste transporters. In California, unless specifically exempted, it is unlawful for any person to transport hazardous wastes unless the person holds a valid registration issued by DTSC. A hazardous waste transporter registration is valid for one year and is assigned a unique registration number.

Date of Government Version: 07/18/2011
Date Data Arrived at EDR: 07/19/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 23

Source: Department of Toxic Substances Control
Telephone: 916-440-7145
Last EDR Contact: 07/19/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Quarterly

MWMP: Medical Waste Management Program Listing
The Medical Waste Management Program (MWMP) ensures the proper handling and disposal of medical waste by permitting and inspecting medical waste Offsite Treatment Facilities (PDF) and Transfer Stations (PDF) throughout the state. MWMP also oversees all Medical Waste Transporters.

Date of Government Version: 09/09/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/10/2011
Number of Days to Update: 27

Source: Department of Public Health
Telephone: 916-558-1784
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Varies

PROC: Certified Processors Database
A listing of certified processors.

Date of Government Version: 06/01/2011
Date Data Arrived at EDR: 06/21/2011
Date Made Active in Reports: 07/15/2011
Number of Days to Update: 24

Source: Department of Conservation
Telephone: 916-323-3836
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

TRIBAL RECORDS

INDIAN RESERV: Indian Reservations
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 12/08/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 34
Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 07/22/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Semi-Annually

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands
Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52
Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 08/08/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Varies

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 05/05/2011
Date Data Arrived at EDR: 08/02/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 42
Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 08/02/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 01/31/2011
Date Data Arrived at EDR: 02/01/2011
Date Made Active in Reports: 03/21/2011
Number of Days to Update: 48
Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 08/04/2011
Date Data Arrived at EDR: 08/05/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 39
Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 25
Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 02/16/2011
Date Data Arrived at EDR: 06/02/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 103
Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 08/02/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 05/10/2011
Date Data Arrived at EDR: 05/11/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 34

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 08/11/2011
Date Data Arrived at EDR: 08/12/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 32

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Semi-Annually

INDIAN UST R1: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 05/05/2011
Date Data Arrived at EDR: 08/08/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 36

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 08/02/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 05/10/2011
Date Data Arrived at EDR: 05/11/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 34

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Semi-Annually

INDIAN UST R7: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 04/01/2011
Date Data Arrived at EDR: 06/01/2011
Date Made Active in Reports: 06/14/2011
Number of Days to Update: 13

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 08/02/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land
The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 08/18/2011
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 25

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

INDIAN UST R9: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 08/04/2011
Date Data Arrived at EDR: 08/05/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 39

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 08/11/2011
Date Data Arrived at EDR: 08/12/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 32

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Semi-Annually

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 07/01/2011
Date Data Arrived at EDR: 08/26/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 18

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 08/04/2011
Date Data Arrived at EDR: 08/05/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 39

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

INDIAN VCP R1: Voluntary Cleanup Priority Listing

A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 05/05/2011
Date Data Arrived at EDR: 07/05/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 70

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 10/04/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Varies

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng

A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

EDR PROPRIETARY RECORDS

Manufactured Gas Plants: EDR Proprietary Manufactured Gas Plants

The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

COUNTY RECORDS

ALAMEDA COUNTY:

Contaminated Sites

A listing of contaminated sites overseen by the Toxic Release Program (oil and groundwater contamination from chemical releases and spills) and the Leaking Underground Storage Tank Program (soil and ground water contamination from leaking petroleum USTs).

Date of Government Version: 07/21/2011
Date Data Arrived at EDR: 07/21/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 21

Source: Alameda County Environmental Health Services
Telephone: 510-567-6700
Last EDR Contact: 10/03/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Semi-Annually

Underground Tanks

Underground storage tank sites located in Alameda county.

Date of Government Version: 07/21/2011
Date Data Arrived at EDR: 07/21/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 21

Source: Alameda County Environmental Health Services
Telephone: 510-567-6700
Last EDR Contact: 10/03/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Semi-Annually

BUTTE COUNTY:

CUPA Facility Listing

Cupa facility list.

Date of Government Version: 03/29/2011
Date Data Arrived at EDR: 04/20/2011
Date Made Active in Reports: 05/17/2011
Number of Days to Update: 27

Source: Public Health Department
Telephone: 530-538-7149
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 01/30/2012
Data Release Frequency: Varies

COLUSA COUNTY:

CUPA Facility List

Cupa facility list.

Date of Government Version: 12/01/2010
Date Data Arrived at EDR: 04/20/2011
Date Made Active in Reports: 05/17/2011
Number of Days to Update: 27

Source: Health & Human Services
Telephone: 530-458-0396
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Varies

CONTRA COSTA COUNTY:

Site List
List includes sites from the underground tank, hazardous waste generator and business plan/2185 programs.

Date of Government Version: 08/30/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 19

Source: Contra Costa Health Services Department
Telephone: 925-646-2286
Last EDR Contact: 08/09/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Semi-Annually

EL DORADO COUNTY:

CUPA Facility List
CUPA facility list.

Date of Government Version: 09/09/2011
Date Data Arrived at EDR: 09/09/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 24

Source: El Dorado County Environmental Management Department
Telephone: 530-621-6623
Last EDR Contact: 08/22/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Varies

FRESNO COUNTY:

CUPA Resources List
Certified Unified Program Agency. CUPA's are responsible for implementing a unified hazardous materials and hazardous waste management regulatory program. The agency provides oversight of businesses that deal with hazardous materials, operate underground storage tanks or aboveground storage tanks.

Date of Government Version: 07/18/2011
Date Data Arrived at EDR: 07/19/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 23

Source: Dept. of Community Health
Telephone: 559-445-3271
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 01/30/2012
Data Release Frequency: Semi-Annually

HUMBOLDT COUNTY:

CUPA Facility List
CUPA facility list.

Date of Government Version: 02/08/2011
Date Data Arrived at EDR: 03/03/2011
Date Made Active in Reports: 03/24/2011
Number of Days to Update: 21

Source: Humboldt County Environmental Health
Telephone: N/A
Last EDR Contact: 10/11/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

INYO COUNTY:

CUPA Facility List
Cupa facility list.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 20

Source: Inyo County Environmental Health Services
Telephone: 760-878-0238
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

KERN COUNTY:

Underground Storage Tank Sites & Tank Listing
Kern County Sites and Tanks Listing.

Date of Government Version: 08/31/2010
Date Data Arrived at EDR: 09/01/2010
Date Made Active in Reports: 09/30/2010
Number of Days to Update: 29

Source: Kern County Environment Health Services Department
Telephone: 661-862-8700
Last EDR Contact: 09/13/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

KINGS COUNTY:

CUPA Facility List
A listing of sites included in the county?s Certified Unified Program Agency database. California?s Secretary for Environmental Protection established the unified hazardous materials and hazardous waste regulatory program as required by chapter 6.11 of the California Health and Safety Code. The Unified Program consolidates the administration, permits, inspections, and enforcement activities.

Date of Government Version: 06/09/2011
Date Data Arrived at EDR: 06/09/2011
Date Made Active in Reports: 07/08/2011
Number of Days to Update: 29

Source: Kings County Department of Public Health
Telephone: 559-584-1411
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

LOS ANGELES COUNTY:

San Gabriel Valley Areas of Concern
San Gabriel Valley areas where VOC contamination is at or above the MCL as designated by region 9 EPA office.

Date of Government Version: 03/30/2009
Date Data Arrived at EDR: 03/31/2009
Date Made Active in Reports: 10/23/2009
Number of Days to Update: 206

Source: EPA Region 9
Telephone: 415-972-3178
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: No Update Planned

HMS: Street Number List
Industrial Waste and Underground Storage Tank Sites.

Date of Government Version: 07/28/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 24

Source: Department of Public Works
Telephone: 626-458-3517
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 01/30/2012
Data Release Frequency: Semi-Annually

List of Solid Waste Facilities
Solid Waste Facilities in Los Angeles County.

Date of Government Version: 07/25/2011
Date Data Arrived at EDR: 07/27/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 15
Source: La County Department of Public Works
Telephone: 818-458-5185
Last EDR Contact: 07/27/2011
Next Scheduled EDR Contact: 11/07/2011
Data Release Frequency: Varies

City of Los Angeles Landfills
Landfills owned and maintained by the City of Los Angeles.

Date of Government Version: 03/05/2009
Date Data Arrived at EDR: 03/10/2009
Date Made Active in Reports: 04/08/2009
Number of Days to Update: 29
Source: Engineering & Construction Division
Telephone: 213-473-7869
Last EDR Contact: 08/23/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Varies

Site Mitigation List
Industrial sites that have had some sort of spill or complaint.

Date of Government Version: 02/09/2011
Date Data Arrived at EDR: 02/09/2011
Date Made Active in Reports: 03/04/2011
Number of Days to Update: 23
Source: Community Health Services
Telephone: 323-890-7806
Last EDR Contact: 07/22/2011
Next Scheduled EDR Contact: 11/07/2011
Data Release Frequency: Annually

City of El Segundo Underground Storage Tank
Underground storage tank sites located in El Segundo city.

Date of Government Version: 02/03/2011
Date Data Arrived at EDR: 02/08/2011
Date Made Active in Reports: 03/03/2011
Number of Days to Update: 23
Source: City of El Segundo Fire Department
Telephone: 310-524-2236
Last EDR Contact: 07/25/2011
Next Scheduled EDR Contact: 11/07/2011
Data Release Frequency: Semi-Annually

City of Long Beach Underground Storage Tank
Underground storage tank sites located in the city of Long Beach.

Date of Government Version: 03/28/2003
Date Data Arrived at EDR: 10/23/2003
Date Made Active in Reports: 11/26/2003
Number of Days to Update: 34
Source: City of Long Beach Fire Department
Telephone: 562-570-2563
Last EDR Contact: 05/02/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Annually

City of Torrance Underground Storage Tank
Underground storage tank sites located in the city of Torrance.

Date of Government Version: 07/18/2011
Date Data Arrived at EDR: 07/21/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 21
Source: City of Torrance Fire Department
Telephone: 310-618-2973
Last EDR Contact: 10/17/2011
Next Scheduled EDR Contact: 01/30/2012
Data Release Frequency: Semi-Annually

MADERA COUNTY:

CUPA Facility List
A listing of sites included in the county?s Certified Unified Program Agency database. California?s Secretary for Environmental Protection established the unified hazardous materials and hazardous waste regulatory program as required by chapter 6.11 of the California Health and Safety Code. The Unified Program consolidates the administration, permits, inspections, and enforcement activities.

Date of Government Version: 09/13/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/04/2011
Number of Days to Update: 21

Source: Madera County Environmental Health
Telephone: 559-675-7823
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

MARIN COUNTY:

Underground Storage Tank Sites
Currently permitted USTs in Marin County.

Date of Government Version: 07/15/2011
Date Data Arrived at EDR: 07/25/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 17

Source: Public Works Department Waste Management
Telephone: 415-499-6647
Last EDR Contact: 10/11/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Semi-Annually

MERCED COUNTY:

CUPA Facility List
CUPA facility list.

Date of Government Version: 06/06/2011
Date Data Arrived at EDR: 06/06/2011
Date Made Active in Reports: 06/15/2011
Number of Days to Update: 9

Source: Merced County Environmental Health
Telephone: 209-381-1094
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

MONTEREY COUNTY:

CUPA Facility Listing
CUPA Program listing from the Environmental Health Division.

Date of Government Version: 07/07/2011
Date Data Arrived at EDR: 07/08/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 34

Source: Monterey County Health Department
Telephone: 831-796-1297
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

NAPA COUNTY:

Sites With Reported Contamination
A listing of leaking underground storage tank sites located in Napa county.

Date of Government Version: 07/09/2008
Date Data Arrived at EDR: 07/09/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 22

Source: Napa County Department of Environmental Management
Telephone: 707-253-4269
Last EDR Contact: 09/06/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: No Update Planned

Closed and Operating Underground Storage Tank Sites
Underground storage tank sites located in Napa county.

Date of Government Version: 01/15/2008
Date Data Arrived at EDR: 01/16/2008
Date Made Active in Reports: 02/08/2008
Number of Days to Update: 23

Source: Napa County Department of Environmental Management
Telephone: 707-253-4269
Last EDR Contact: 09/06/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: No Update Planned

NEVADA COUNTY:

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

CUPA Facility List
CUPA facility list.

Date of Government Version: 08/22/2011
Date Data Arrived at EDR: 08/23/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 27

Source: Community Development Agency
Telephone: 530-265-1467
Last EDR Contact: 08/22/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Varies

ORANGE COUNTY:

List of Industrial Site Cleanups
Petroleum and non-petroleum spills.

Date of Government Version: 08/01/2011
Date Data Arrived at EDR: 08/23/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 27

Source: Health Care Agency
Telephone: 714-834-3446
Last EDR Contact: 08/17/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Annually

List of Underground Storage Tank Cleanups
Orange County Underground Storage Tank Cleanups (LUST).

Date of Government Version: 08/02/2011
Date Data Arrived at EDR: 08/23/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 41

Source: Health Care Agency
Telephone: 714-834-3446
Last EDR Contact: 08/17/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

List of Underground Storage Tank Facilities
Orange County Underground Storage Tank Facilities (UST).

Date of Government Version: 08/01/2011
Date Data Arrived at EDR: 08/23/2011
Date Made Active in Reports: 09/16/2011
Number of Days to Update: 24

Source: Health Care Agency
Telephone: 714-834-3446
Last EDR Contact: 08/17/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

PLACER COUNTY:

Master List of Facilities
List includes aboveground tanks, underground tanks and cleanup sites.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/18/2011
Number of Days to Update: 35

Source: Placer County Health and Human Services
Telephone: 530-889-7312
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Semi-Annually

RIVERSIDE COUNTY:

Listing of Underground Tank Cleanup Sites
Riverside County Underground Storage Tank Cleanup Sites (LUST).

Date of Government Version: 07/14/2011
Date Data Arrived at EDR: 07/22/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 20

Source: Department of Environmental Health
Telephone: 951-358-5055
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Quarterly

Underground Storage Tank Tank List
Underground storage tank sites located in Riverside county.

Date of Government Version: 07/20/2011
Date Data Arrived at EDR: 07/22/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 20
Source: Department of Environmental Health
Telephone: 951-358-5055
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/26/2012
Data Release Frequency: Quarterly

SACRAMENTO COUNTY:

Toxic Site Clean-Up List
List of sites where unauthorized releases of potentially hazardous materials have occurred.

Date of Government Version: 05/02/2011
Date Data Arrived at EDR: 07/19/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 23
Source: Sacramento County Environmental Management
Telephone: 916-875-8406
Last EDR Contact: 10/07/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

Master Hazardous Materials Facility List
Any business that has hazardous materials on site - hazardous material storage sites, underground storage tanks, waste generators.

Date of Government Version: 05/02/2011
Date Data Arrived at EDR: 07/19/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 23
Source: Sacramento County Environmental Management
Telephone: 916-875-8406
Last EDR Contact: 10/07/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Quarterly

SAN BERNARDINO COUNTY:

Hazardous Material Permits
This listing includes underground storage tanks, medical waste handlers/generators, hazardous materials handlers, hazardous waste generators, and waste oil generators/handlers.

Date of Government Version: 08/26/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 19
Source: San Bernardino County Fire Department Hazardous Materials Division
Telephone: 909-387-3041
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

SAN DIEGO COUNTY:

Hazardous Materials Management Division Database
The database includes: HE58 - This report contains the business name, site address, business phone number, establishment 'H' permit number, type of permit, and the business status. HE17 - In addition to providing the same information provided in the HE58 listing, HE17 provides inspection dates, violations received by the establishment, hazardous waste generated, the quantity, method of storage, treatment/disposal of waste and the hauler, and information on underground storage tanks. Unauthorized Release List - Includes a summary of environmental contamination cases in San Diego County (underground tank cases, non-tank cases, groundwater contamination, and soil contamination are included.)

Date of Government Version: 09/09/2010
Date Data Arrived at EDR: 09/15/2010
Date Made Active in Reports: 09/29/2010
Number of Days to Update: 14
Source: Hazardous Materials Management Division
Telephone: 619-338-2268
Last EDR Contact: 09/16/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Quarterly

Solid Waste Facilities
San Diego County Solid Waste Facilities.

Date of Government Version: 10/01/2010
Date Data Arrived at EDR: 11/16/2010
Date Made Active in Reports: 01/25/2011
Number of Days to Update: 70
Source: Department of Health Services
Telephone: 619-338-2209
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Varies

Environmental Case Listing
The listing contains all underground tank release cases and projects pertaining to properties contaminated with hazardous substances that are actively under review by the Site Assessment and Mitigation Program.

Date of Government Version: 03/23/2010
Date Data Arrived at EDR: 06/15/2010
Date Made Active in Reports: 07/09/2010
Number of Days to Update: 24
Source: San Diego County Department of Environmental Health
Telephone: 619-338-2371
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: No Update Planned

SAN FRANCISCO COUNTY:

Local Oversite Facilities
A listing of leaking underground storage tank sites located in San Francisco county.

Date of Government Version: 09/19/2008
Date Data Arrived at EDR: 09/19/2008
Date Made Active in Reports: 09/29/2008
Number of Days to Update: 10
Source: Department Of Public Health San Francisco County
Telephone: 415-252-3920
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

Underground Storage Tank Information
Underground storage tank sites located in San Francisco county.

Date of Government Version: 11/29/2010
Date Data Arrived at EDR: 03/10/2011
Date Made Active in Reports: 03/15/2011
Number of Days to Update: 5
Source: Department of Public Health
Telephone: 415-252-3920
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Quarterly

SAN JOAQUIN COUNTY:

San Joaquin Co. UST
A listing of underground storage tank locations in San Joaquin county.

Date of Government Version: 06/27/2011
Date Data Arrived at EDR: 06/29/2011
Date Made Active in Reports: 07/08/2011
Number of Days to Update: 9
Source: Environmental Health Department
Telephone: N/A
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Semi-Annually

SAN LUIS OBISPO COUNTY:

CUPA Facility List
Cupa Facility List.

Date of Government Version: 09/12/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 24
Source: San Luis Obispo County Public Health Department
Telephone: 805-781-5596
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

SAN MATEO COUNTY:

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Business Inventory
List includes Hazardous Materials Business Plan, hazardous waste generators, and underground storage tanks.

Date of Government Version: 07/13/2011
Date Data Arrived at EDR: 07/15/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 27
Source: San Mateo County Environmental Health Services Division
Telephone: 650-363-1921
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/12/2012
Data Release Frequency: Annually

Fuel Leak List
A listing of leaking underground storage tank sites located in San Mateo county.

Date of Government Version: 06/20/2011
Date Data Arrived at EDR: 06/21/2011
Date Made Active in Reports: 07/15/2011
Number of Days to Update: 24
Source: San Mateo County Environmental Health Services Division
Telephone: 650-363-1921
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Semi-Annually

SANTA BARBARA COUNTY:

CUPA Facility Listing
CUPA Program Listing from the Environmental Health Services division.

Date of Government Version: 09/08/2011
Date Data Arrived at EDR: 09/09/2011
Date Made Active in Reports: 10/07/2011
Number of Days to Update: 28
Source: Santa Barbara County Public Health Department
Telephone: 805-686-8167
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

SANTA CLARA COUNTY:

HIST LUST - Fuel Leak Site Activity Report
A listing of open and closed leaking underground storage tanks. This listing is no longer updated by the county. Leaking underground storage tanks are now handled by the Department of Environmental Health.

Date of Government Version: 03/29/2005
Date Data Arrived at EDR: 03/30/2005
Date Made Active in Reports: 04/21/2005
Number of Days to Update: 22
Source: Santa Clara Valley Water District
Telephone: 408-265-2600
Last EDR Contact: 03/23/2009
Next Scheduled EDR Contact: 06/22/2009
Data Release Frequency: No Update Planned

LOP Listing
A listing of leaking underground storage tanks located in Santa Clara county.

Date of Government Version: 09/06/2011
Date Data Arrived at EDR: 09/13/2011
Date Made Active in Reports: 10/10/2011
Number of Days to Update: 27
Source: Department of Environmental Health
Telephone: 408-918-3417
Last EDR Contact: 09/06/2011
Next Scheduled EDR Contact: 12/19/2011
Data Release Frequency: Annually

Hazardous Material Facilities
Hazardous material facilities, including underground storage tank sites.

Date of Government Version: 09/01/2011
Date Data Arrived at EDR: 09/01/2011
Date Made Active in Reports: 10/03/2011
Number of Days to Update: 32
Source: City of San Jose Fire Department
Telephone: 408-535-7694
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: Annually

SANTA CRUZ COUNTY:

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

CUPA Facility List
CUPA facility listing.

Date of Government Version: 08/31/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 9

Source: Santa Cruz County Environmental Health
Telephone: 831-464-2761
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

SHASTA COUNTY:

CUPA Facility List
Cupa Facility List.

Date of Government Version: 08/31/2011
Date Data Arrived at EDR: 08/31/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 19

Source: Shasta County Department of Resource Management
Telephone: 530-225-5789
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Varies

SOLANO COUNTY:

Leaking Underground Storage Tanks
A listing of leaking underground storage tank sites located in Solano county.

Date of Government Version: 06/09/2011
Date Data Arrived at EDR: 06/29/2011
Date Made Active in Reports: 07/08/2011
Number of Days to Update: 9

Source: Solano County Department of Environmental Management
Telephone: 707-784-6770
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

Underground Storage Tanks
Underground storage tank sites located in Solano county.

Date of Government Version: 06/09/2011
Date Data Arrived at EDR: 07/01/2011
Date Made Active in Reports: 07/13/2011
Number of Days to Update: 12

Source: Solano County Department of Environmental Management
Telephone: 707-784-6770
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

SONOMA COUNTY:

Leaking Underground Storage Tank Sites
A listing of leaking underground storage tank sites located in Sonoma county.

Date of Government Version: 04/05/2011
Date Data Arrived at EDR: 04/06/2011
Date Made Active in Reports: 05/12/2011
Number of Days to Update: 36

Source: Department of Health Services
Telephone: 707-565-6565
Last EDR Contact: 10/03/2011
Next Scheduled EDR Contact: 01/16/2012
Data Release Frequency: Quarterly

SUTTER COUNTY:

Underground Storage Tanks
Underground storage tank sites located in Sutter county.

Date of Government Version: 06/13/2011
Date Data Arrived at EDR: 06/14/2011
Date Made Active in Reports: 07/13/2011
Number of Days to Update: 29

Source: Sutter County Department of Agriculture
Telephone: 530-822-7500
Last EDR Contact: 09/12/2011
Next Scheduled EDR Contact: 12/26/2011
Data Release Frequency: Semi-Annually

VENTURA COUNTY:

Business Plan, Hazardous Waste Producers, and Operating Underground Tanks

The BWT list indicates by site address whether the Environmental Health Division has Business Plan (B), Waste Producer (W), and/or Underground Tank (T) information.

Date of Government Version: 07/26/2011
Date Data Arrived at EDR: 08/26/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 24

Source: Ventura County Environmental Health Division
Telephone: 805-654-2813
Last EDR Contact: 08/23/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Quarterly

Inventory of Illegal Abandoned and Inactive Sites

Ventura County Inventory of Closed, Illegal Abandoned, and Inactive Sites.

Date of Government Version: 04/01/2011
Date Data Arrived at EDR: 04/07/2011
Date Made Active in Reports: 05/12/2011
Number of Days to Update: 35

Source: Environmental Health Division
Telephone: 805-654-2813
Last EDR Contact: 10/11/2011
Next Scheduled EDR Contact: 01/23/2012
Data Release Frequency: Annually

Listing of Underground Tank Cleanup Sites

Ventura County Underground Storage Tank Cleanup Sites (LUST).

Date of Government Version: 05/29/2008
Date Data Arrived at EDR: 06/24/2008
Date Made Active in Reports: 07/31/2008
Number of Days to Update: 37

Source: Environmental Health Division
Telephone: 805-654-2813
Last EDR Contact: 08/23/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Quarterly

Medical Waste Program List

To protect public health and safety and the environment from potential exposure to disease causing agents, the Environmental Health Division Medical Waste Program regulates the generation, handling, storage, treatment and disposal of medical waste throughout the County.

Date of Government Version: 07/26/2011
Date Data Arrived at EDR: 08/08/2011
Date Made Active in Reports: 09/09/2011
Number of Days to Update: 32

Source: Ventura County Resource Management Agency
Telephone: 805-654-2813
Last EDR Contact: 08/01/2011
Next Scheduled EDR Contact: 11/14/2011
Data Release Frequency: Quarterly

Underground Tank Closed Sites List

Ventura County Operating Underground Storage Tank Sites (UST)/Underground Tank Closed Sites List.

Date of Government Version: 05/25/2011
Date Data Arrived at EDR: 06/21/2011
Date Made Active in Reports: 07/13/2011
Number of Days to Update: 22

Source: Environmental Health Division
Telephone: 805-654-2813
Last EDR Contact: 09/20/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Quarterly

YOLO COUNTY:

Underground Storage Tank Comprehensive Facility Report
Underground storage tank sites located in Yolo county.

Date of Government Version: 08/15/2011
Date Data Arrived at EDR: 08/23/2011
Date Made Active in Reports: 09/16/2011
Number of Days to Update: 24

Source: Yolo County Department of Health
Telephone: 530-666-8646
Last EDR Contact: 10/11/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Annually

YUBA COUNTY:

CUPA Facility List
CUPA facility listing for Yuba County.

Date of Government Version: 08/23/2011
Date Data Arrived at EDR: 08/26/2011
Date Made Active in Reports: 09/19/2011
Number of Days to Update: 24

Source: Yuba County Environmental Health Department
Telephone: 530-749-7523
Last EDR Contact: 08/08/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data
Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 12/31/2007
Date Data Arrived at EDR: 08/26/2009
Date Made Active in Reports: 09/11/2009
Number of Days to Update: 16

Source: Department of Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 08/26/2011
Next Scheduled EDR Contact: 12/05/2011
Data Release Frequency: Annually

NJ MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 07/20/2011
Date Made Active in Reports: 08/11/2011
Number of Days to Update: 22

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 07/20/2011
Next Scheduled EDR Contact: 10/31/2011
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data
Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 08/01/2011
Date Data Arrived at EDR: 08/09/2011
Date Made Active in Reports: 09/16/2011
Number of Days to Update: 38

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 08/09/2011
Next Scheduled EDR Contact: 11/21/2011
Data Release Frequency: Annually

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2008
Date Data Arrived at EDR: 12/01/2009
Date Made Active in Reports: 12/14/2009
Number of Days to Update: 13

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 09/26/2011
Next Scheduled EDR Contact: 01/09/2012
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 06/24/2011
Date Made Active in Reports: 06/30/2011
Number of Days to Update: 6

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 08/31/2011
Next Scheduled EDR Contact: 12/12/2011
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2010
Date Data Arrived at EDR: 08/19/2011
Date Made Active in Reports: 09/15/2011
Number of Days to Update: 27

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 09/19/2011
Next Scheduled EDR Contact: 01/02/2012
Data Release Frequency: Annually

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Licensed Facilities
Source: Department of Social Services
Telephone: 916-657-4041

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 and 2005 from the U.S. Fish and Wildlife Service.

STREET AND ADDRESS INFORMATION

© 2010 Tele Atlas North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

Cocopah Nursery Update
Blythe, CA 92225

Inquiry Number: 3186188.1w
October 18, 2011

EDR DataMap™ Well Search Report

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
Toll Free: 800.352.0050
www.edrnet.com

AR061800

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, Inc. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. **NO WARRANTY EXPRESSED OR IMPLIED, IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT. ENVIRONMENTAL DATA RESOURCES, INC. SPECIFICALLY DISCLAIMS THE MAKING OF ANY SUCH WARRANTIES, INCLUDING WITHOUT LIMITATION, MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, INC. BE LIABLE TO ANYONE, WHETHER ARISING OUT OF ERRORS OR OMISSIONS, NEGLIGENCE, ACCIDENT OR ANY OTHER CAUSE, FOR ANY LOSS OF DAMAGE, INCLUDING, WITHOUT LIMITATION, SPECIAL, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES. ANY LIABILITY ON THE PART OF ENVIRONMENTAL DATA RESOURCES, INC. IS STRICTLY LIMITED TO A REFUND OF THE AMOUNT PAID FOR THIS REPORT.** Purchaser accepts this Report "AS IS". Any analyses, estimates, ratings, environmental risk levels or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only a Phase I Environmental Site Assessment performed by an environmental professional can provide information regarding the environmental risk for any property. Additionally, the information provided in this Report is not to be construed as legal advice.

Copyright 2006 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, Inc. or its affiliates. All other trademarks used herein are the property of their respective owners.

GEOCHECK VERSION 2.1
SUMMARY

FEDERAL DATABASE WELL INFORMATION

MAP ID	WELL ID
1	USGS3084233
2	USGS3084220
3	USGS3084398
4	USGS3084385
5	USGS3084315
6	USGS3084312
7	USGS3084509
8	USGS3084492
10	USGS3084491
9	USGS3084493
11	USGS3084489
11	USGS3084488
9	USGS3084484
12	USGS3084468
13	USGS3084469
14	USGS3084448
15	USGS3084445
16	USGS3084618
16	USGS3084617
16	USGS3084616
17	USGS3084619
18	USGS3084603
16	USGS3084602
19	USGS3084598
20	USGS3084591
21	USGS3084588
22	USGS3084589
23	USGS3084582
24	USGS3084563
25	USGS3084564
26	USGS3084548
25	USGS3084541
25	USGS3084521
27	USGS3084712
27	USGS3084706
27	USGS3084675
28	USGS3084674
29	USGS3084657
28	USGS3084646
29	USGS3084651
29	USGS3084650
29	USGS3084648
29	USGS3084649
28	USGS3084647
30	USGS3084634

GEOCHECK VERSION 2.1
SUMMARY

FEDERAL DATABASE WELL INFORMATION

MAP ID	WELL ID
30	USGS3084635
31	USGS3084624
31	USGS3084623
32	USGS3084626
33	USGS3084628
34	USGS3084625
32	USGS3084627
31	USGS3084819
32	USGS3084817
35	USGS3084816
32	USGS3084807
36	USGS3084802
37	USGS3084735
38	USGS3084794
39	USGS3084785
40	USGS3084777
41	USGS3084772
40	USGS3084762
40	USGS3084749
43	USGS3084751
42	USGS3084753
42	USGS3084752
44	USGS3084755
44	USGS3084754
40	USGS3084750
43	USGS3084732
42	USGS3084733
42	USGS3084734
43	USGS3084923
43	USGS3084925
43	USGS3084924
43	USGS3084922
45	USGS3084890
45	USGS3084881
45	USGS3084880
45	USGS3084882
45	USGS3084876
45	USGS3084874
45	USGS3084869
45	USGS3084868
45	USGS3084866
45	USGS3084867
46	USGS3084864
47	USGS3084861
46	USGS3084862
48	USGS3084858

GEOCHECK VERSION 2.1
SUMMARY

FEDERAL DATABASE WELL INFORMATION

MAP ID	WELL ID
49	USGS3084857
50	USGS3085023
51	USGS3085020
50	USGS3085008
52	USGS3085010
53	USGS3084995
54	USGS3084996
55	USGS3085009
55	USGS3084987
56	USGS3084972
57	USGS3084954
58	USGS3084950
59	USGS3084941
60	USGS3084938
61	USGS3084939
62	USGS3085079
63	USGS3085090
63	USGS3085080
64	USGS3085070
64	USGS3085069
65	USGS3085071
63	USGS3085068
66	USGS3085060
67	USGS3085061
63	USGS3085062
68	USGS3085163
69	USGS3085147
70	USGS3085260

STATE WATER WELL INFORMATION

MAP ID	WELL ID
1	CADW40000004869
5	CADW40000004813
7	CADW40000004805
8	CADW40000004800
9	CADW40000004799
11	CADW40000004795
11	CADW40000004794
9	CADW40000004789
12	CADW40000004781
13	CADW40000004780
14	CADW40000004768
15	CADW40000004765
16	CADW40000004727
16	CADW40000004726
17	CADW40000004725
18	CADW40000004718
18	CADW40000004717
21	CADW40000004707
20	CADW40000004702
24	CADW40000004692
25	CADW40000004691

GEOCHECK VERSION 2.1
SUMMARY

STATE WATER WELL INFORMATION

MAP ID	WELL ID
26	CADW40000004690
25	3301553
23	3301350
25	CADW40000004681
27	CADW40000004675
27	CADW40000004673
27	CADW40000004666
29	CADW40000004660
31	CADW40000004647
32	CADW40000004646
33	CADW40000004645
34	CADW40000004641
32	CADW40000004635
35	CADW40000004632
37	CADW40000004608
39	CADW40000004596
40	CADW40000004588
41	CADW40000004582
42	CADW40000004573
42	CADW40000004571
42	CADW40000004570
44	3310028
44	3310028
46	CADW40000004507
45	CADW40000004502
45	CADW40000004503
47	CADW40000004501
46	CADW40000004500
48	CADW40000004496
49	CADW40000004494
50	CADW40000004461
50	CADW40000004450
52	CADW40000004449
53	CADW40000004446
54	CADW40000004445
55	CADW40000004444
55	CADW40000004440
56	3310028
56	CADW40000004432
57	CADW40000004414
59	CADW40000004371
60	CADW40000004370
61	CADW40000004369
62	CADW40000004313
63	CADW40000004311
63	CADW40000004310
63	CADW40000004304
64	CADW40000004303
64	CADW40000004302
65	CADW40000004301
66	CADW40000004296
67	CADW40000004295
63	CADW40000004294
68	CADW40000004183

GEOCHECK VERSION 2.1
SUMMARY

STATE WATER WELL INFORMATION

MAP ID	WELL ID
69	CADW40000004175
70	CADW40000004041

PUBLIC WATER SUPPLY SYSTEM INFORMATION

NO WELLS FOUND

USGS TOPOGRAPHIC MAP(S)

33114-E6 RIPLEY, CA
33114-E7 ROOSEVELT MINE, CA
33114-F6 MCCOY WASH, CA

AREA RADON INFORMATION

Federal EPA Radon Zone for RIVERSIDE County: 2

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for RIVERSIDE COUNTY, CA

Number of sites tested: 12

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.117 pCi/L	100%	0%	0%
Living Area - 2nd Floor	0.450 pCi/L	100%	0%	0%
Basement	1.700 pCi/L	100%	0%	0%

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Water Well Information:

Map ID:	1		
Agency cd:	USGS	Site no:	333846114413201
Site name:	006S022E20A001S		
Latitude:	333846	EDR Site id:	USGS3084233
Longitude:	1144132	Dec lat:	33.64613448
Dec lon:	-114.69301551	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	395.79	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19670101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	250	Hole depth:	276
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1967-06-15
Water quality data end date:	1967-06-15	Water quality data count:	1
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	148.00	

Map ID:	2		
Agency cd:	USGS	Site no:	333836114405801
Site name:	006S022E21B001S		
Latitude:	333836.27	EDR Site id:	USGS3084220
Longitude:	1144058.70	Dec lat:	33.64343179
Dec lon:	-114.6837652	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	SWNWNES21 T06S R22E S
Location map:	MCCOY WASH	Map scale:	24000
Altitude:	373.9	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19660415
Date inventoried:	19660712	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	378.	Hole depth:	378.
Source of depth data:	driller	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1966-09-19
Water quality data end date:	1966-09-19	Water quality data count:	1
Ground water data begin date:	1966-04-28	Ground water data end date:	2000-01-25
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-01-25	122.12				
1971-07-23					
Note: The site was being pumped.					
1966-08-23	120.7		1966-04-28	117	

Map ID:	3		
Agency cd:	USGS	Site no:	333808114405701
Site name:	006S022E21K001S		
Latitude:	333807.81	EDR Site id:	USGS3084398
Longitude:	1144056.76	Dec lat:	33.63552644
Dec lon:	-114.6832262	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	SWNWSES21 T06S R22E S
Location map:	MCCOY WASH	Map scale:	24000
Altitude:	375.3	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19660504
Date inventoried:	19660712	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	323.	Hole depth:	323.
Source of depth data:	driller	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1966-06-00
Water quality data end date:	1966-06-00	Water quality data count:	1
Ground water data begin date:	1966-05-11	Ground water data end date:	2000-01-25
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-01-25					
Note: The well was destroyed (no water level is recorded).					

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, continued.

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1971-07-28	159.64				
Note: The site was being pumped.					
1966-08-24	121.3		1966-05-11	126	

Map ID:	4		
Agency cd:	USGS	Site no:	333803114423801
Site name:	006S022E19R001S		
Latitude:	333803.90	EDR Site id:	USGS3084385
Longitude:	1144241.98	Dec lat:	33.63444031
Dec lon:	-114.71245483	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NESESES19 T06S R22E S
Location map:	MCCOY WASH	Map scale:	24000
Altitude:	395.75	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19770707
Date inventoried:	19900923	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	300.	Hole depth:	300.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1977-09-17	Ground water data end date:	1999-09-15
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-09-15	147.11		1997-03-07	147.06	
1990-09-23	149.79		1977-09-17	150	

Map ID:	5		
Agency cd:	USGS	Site no:	333753114421701
Site name:	006S022E29D001S		
Latitude:	333753	EDR Site id:	USGS3084315
Longitude:	1144217	Dec lat:	33.63141263
Dec lon:	-114.7055157	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	394.2	Altitude method:	M
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19420101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	193	Hole depth:	268
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-15
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1971-07-15	145.18		1971-07-01	145.00	

Map ID:	6		
Agency cd:	USGS	Site no:	333752114410801
Site name:	006S022E28C001S		
Latitude:	333752.04	EDR Site id:	USGS3084312
Longitude:	1144108.34	Dec lat:	33.631146
Dec lon:	-114.6864429	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNENWS28 T06S R22E S
Location map:	MCCOY WASH	Map scale:	24000
Altitude:	392.2	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20000125	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	7		
Agency cd:	USGS	Site no:	333744114421501
Site name:	006S022E29C001S		
Latitude:	333743.84	EDR Site id:	USGS3084509
Longitude:	1144214.63	Dec lat:	33.62886825
Dec lon:	-114.70485731	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWNENWS29 T06S R22E S
Location map:	MCCOY WASH	Map scale:	24000
Altitude:	393.6	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-24	Ground water data end date:	1999-09-15
Ground water data count:	3		

Ground-water levels, Number of Measurements: 3

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-09-15	144.75		1992-02-15	146.99	
1990-09-24	147.81				

Map ID:	8		
Agency cd:	USGS	Site no:	333737114404601
Site name:	006S022E28H001S		
Latitude:	333737	EDR Site id:	USGS3084492
Longitude:	1144046	Dec lat:	33.62696834
Dec lon:	-114.68023711	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	355.00	Altitude method:	M
Altitude accuracy:	5.	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19650101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	300	Hole depth:	300
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1971-09-01
Ground water data end date: 1971-09-01
Ground water data count: 1

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-09-01	107.00	

Map ID: 10
Agency cd: USGS
Site no: 333737114403401
Site name: 006S022E28G001S
Latitude: 333737
EDR Site id: USGS3084491
Longitude: 1144034
Dec lat: 33.62696834
Dec lon: -114.67690368
Coor meth: M
Coor accr: S
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: Not Reported
Location map: Not Reported
Map scale: Not Reported
Altitude: 362.
Altitude method: M
Altitude accuracy: 5
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: 19650101
Date inventoried: Not Reported
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: 535.
Hole depth: 581.
Source of depth data: Not Reported
Project number: Not Reported
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 1966-02-09
Water quality data end date: 1966-02-09
Water quality data count: 1
Ground water data begin date: 0000-00-00
Ground water data end date: 0000-00-00
Ground water data count: 0

Ground-water levels, Number of Measurements: 0

Map ID: 9
Agency cd: USGS
Site no: 333737114415201
Site name: 006S022E29G001S
Latitude: 333737
EDR Site id: USGS3084493
Longitude: 1144152
Dec lat: 33.62696831
Dec lon: -114.69857099
Coor meth: M
Coor accr: S
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: Not Reported
Location map: Not Reported
Map scale: Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	392.5	Altitude method:	M
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19430101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	350	Hole depth:	375
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1947-01-08
Water quality data end date:	1947-01-08	Water quality data count:	1
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	142.00	

Map ID:	11		
Agency cd:	USGS	Site no:	333736114392502
Site name:	006S022E26E002S		
Latitude:	333736	EDR Site id:	USGS3084489
Longitude:	1143925	Dec lat:	33.6266906
Dec lon:	-114.65773644	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	270.00	Altitude method:	M
Altitude accuracy:	5.	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19670101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	21.0	Hole depth:	37.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1967-03-28
Water quality data end date:	1967-03-28	Water quality data count:	1
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, Number of Measurements: 3

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1971-07-01	17.00		1971-07-01	17.00	
1967-03-28	15.20				

Map ID:	11		
Agency cd:	USGS	Site no:	333736114392501
Site name:	006S022E26E001S		
Latitude:	333736	EDR Site id:	USGS3084488
Longitude:	1143925	Dec lat:	33.6266906
Dec lon:	-114.65773644	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	270.00	Altitude method:	M
Altitude accuracy:	5.	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19670101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	64.0	Hole depth:	121
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1967-03-28
Water quality data end date:	1967-03-28	Water quality data count:	1
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 3

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1971-07-01	18.00		1971-07-01	18.00	
1967-03-28	15.58				

Map ID:	9		
Agency cd:	USGS	Site no:	333734114415101
Site name:	006S022E29G002S		
Latitude:	333732.41	EDR Site id:	USGS3084484
Longitude:	1144150.95	Dec lat:	33.62569334
Dec lon:	-114.6982793	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESWNES29 T06S R22E S
Location map:	MCCOY WASH	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	391.9	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900923	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-23	Ground water data end date:	1999-09-15
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-09-15	142.15		1990-09-23	144.96	

Map ID:	12		
Agency cd:	USGS	Site no:	333729114392501
Site name:	006S022E26E003S		
Latitude:	333729	EDR Site id:	USGS3084468
Longitude:	1143925	Dec lat:	33.62474621
Dec lon:	-114.65773641	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	262.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19590101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	12.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

Map ID:	13		
Agency cd:	USGS	Site no:	333729114394101
Site name:	006S022E27H001S		
Latitude:	333729	EDR Site id:	USGS3084469
Longitude:	1143941	Dec lat:	33.6247462
Dec lon:	-114.66218099	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	264.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	14.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	12.00	

Map ID:	14		
Agency cd:	USGS	Site no:	333723114412901
Site name:	006S022E29J001S		
Latitude:	333723	EDR Site id:	USGS3084448
Longitude:	1144140	Dec lat:	33.62307953
Dec lon:	-114.69523751	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NWNESES29 T06S R22E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	390.	Altitude method:	M
Altitude accuracy:	2	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	194308
Date inventoried:	19610307	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	243.	Hole depth:	252.
Source of depth data:	owner	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1943-08-00	Ground water data end date:	1999-09-15
Ground water data count:	6		

Ground-water levels, Number of Measurements: 6

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-09-15					
Note: The well was destroyed (no water level is recorded).					
1990-09-23					
Note: The well was destroyed (no water level is recorded).					
1971-07-14	137.82		1966-11-16	133.02	
1961-06-09	134.96		1943-08	137.5	

Map ID:	15		
Agency cd:	USGS	Site no:	333721114423101
Site name:	006S022E29M001S		
Latitude:	333720.22	EDR Site id:	USGS3084445
Longitude:	1144232.99	Dec lat:	33.62230731
Dec lon:	-114.70995738	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWNWSWS29 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	393.6	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19790319
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	304.	Hole depth:	310.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1979-03-23	Ground water data end date:	1999-09-15
Ground water data count:	4		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-09-15	145.65		1997-03-07	146.18	
1990-09-24	148.33		1979-03-23	144	

Map ID:	16		
Agency cd:	USGS	Site no:	333703114394001
Site name:	006S022E27R002S		
Latitude:	333703	EDR Site id:	USGS3084618
Longitude:	1143940	Dec lat:	33.61752417
Dec lon:	-114.66190312	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	259.0	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19590101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	10.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	9.00	

Map ID:	16		
Agency cd:	USGS	Site no:	333703114393201
Site name:	006S022E27R001S		
Latitude:	333703	EDR Site id:	USGS3084617
Longitude:	1143932	Dec lat:	33.61752417
Dec lon:	-114.65968083	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	257.0	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	9.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	7.00	

Map ID:	16		
Agency cd:	USGS	Site no:	333703114392801
Site name:	006S022E27R003S		
Latitude:	333703	EDR Site id:	USGS3084616
Longitude:	1143928	Dec lat:	33.61752417
Dec lon:	-114.65856968	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	259.0	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19480101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	9.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	17		
Agency cd:	USGS	Site no:	333703114415901
Site name:	006S022E29Q001S		
Latitude:	333702.73	EDR Site id:	USGS3084619
Longitude:	1144158.91	Dec lat:	33.61744912
Dec lon:	-114.70049037	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWSWSES29 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	390.6	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19790312
Date inventoried:	19900923	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	306.	Hole depth:	310.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1979-03-19	Ground water data end date:	1999-09-14
Ground water data count:	5		

Ground-water levels, Number of Measurements: 5

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-09-14	142.11		1997-03-07	142.62	
1992-02-15	144.54		1990-09-23	144.28	
1979-03-19	141				

Map ID:	18		
Agency cd:	USGS	Site no:	333701114411301
Site name:	006S022E33C002S		
Latitude:	333701.18	EDR Site id:	USGS3084603
Longitude:	1144113.31	Dec lat:	33.61701859
Dec lon:	-114.68782332	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNENWS33 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	338.6	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030528	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	2003-05-28	Ground water data end date:	2003-05-28
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
2003-05-28		

Note: An obstruction was encountered in the well above the water surface (no water level recorded).

Map ID:	16		
Agency cd:	USGS	Site no:	333701114392501
Site name:	006S022E35D001S		
Latitude:	333701	EDR Site id:	USGS3084602
Longitude:	1143925	Dec lat:	33.61696863
Dec lon:	-114.65773632	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	258.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19360101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	19		
Agency cd:	USGS	Site no:	333700114395001
Site name:	006S022E34B001S		
Latitude:	333700	EDR Site id:	USGS3084598
Longitude:	1143950	Dec lat:	33.61669085
Dec lon:	-114.66468096	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NWNWNES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	257.2	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	1916
Date inventoried:	19711007	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-10-07	Ground water data end date:	1971-10-07
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-10-07		

Note: The well was destroyed (no water level is recorded).

Map ID:	20		
Agency cd:	USGS	Site no:	333655114411301
Site name:	006S022E33C001S		
Latitude:	333654.92	EDR Site id:	USGS3084591
Longitude:	1144113.41	Dec lat:	33.61527975
Dec lon:	-114.68785108	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWNENWS33 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	335.4	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030528	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 2003-05-28
Ground water data end date: 2003-05-28
Ground water data count: 1

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
2003-05-28	85.98	

Map ID: 21
Agency cd: USGS
Site no: 333652114395801
Site name: 006S022E34C001S
Latitude: 333652.64
EDR Site id: USGS3084588
Longitude: 1144000.21
Dec lat: 33.61464646
Dec lon: -114.66751713
Coor meth: D
Coor accr: H
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 04
State: 06
County: 065
Country: US
Land net: SENENWS34 T06S R22E S
Location map: RIPLEY
Map scale: 24000
Altitude: 338.0
Altitude method: D
Altitude accuracy: 0.1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: Not Reported
Date inventoried: 19900924
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: Not Reported
Hole depth: Not Reported
Source of depth data: Not Reported
Project number: CHI
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1990-09-24
Ground water data end date: 2000-01-24
Ground water data count: 2

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel
2000-01-24	88.38	
1990-09-24	89.26	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	22		
Agency cd:	USGS	Site no:	333652114405901
Site name:	006S022E33C003S		
Latitude:	333652.07	EDR Site id:	USGS3084589
Longitude:	1144059.26	Dec lat:	33.61448811
Dec lon:	-114.6839204	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SENENWS33 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	335.7	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030528	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	117.1	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	2003-05-28	Ground water data end date:	2003-05-28
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
2003-05-28	86.31	

Map ID:	23		
Agency cd:	USGS	Site no:	333648114392401
Site name:	006S022E35E001S		
Latitude:	333648	EDR Site id:	USGS3084582
Longitude:	1143924	Dec lat:	33.61335762
Dec lon:	-114.65745849	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	260.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19160101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	24		
Agency cd:	USGS	Site no:	333647114400901
Site name:	006S022E34F001S		
Latitude:	333647	EDR Site id:	USGS3084563
Longitude:	1144009	Dec lat:	33.61307983
Dec lon:	-114.66995885	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWSENWS34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	336.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	1974
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-24	Ground water data end date:	1992-03-29
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1992-03-29	91.38		1990-09-24	91.00	

Map ID:	25		
Agency cd:	USGS	Site no:	333647114421401
Site name:	006S022E32F001S		
Latitude:	333647	EDR Site id:	USGS3084564
Longitude:	1144214	Dec lat:	33.61307978
Dec lon:	-114.7046821	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	388.5	Altitude method:	M
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19430101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	230	Hole depth:	246
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1959-09-24
Water quality data end date:	1961-05-23	Water quality data count:	2
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	139.00	

Map ID:	26		
Agency cd:	USGS	Site no:	333646114431201
Site name:	006S022E31F001S		
Latitude:	333646.91	EDR Site id:	USGS3084548
Longitude:	1144311.66	Dec lat:	33.61305476
Dec lon:	-114.72069924	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NESENWS31 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	389.3	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-24	Ground water data end date:	1999-08-27
Ground water data count:	2		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-08-27	141.40				
Note: Foreign substance was present on the surface of the water.					
1990-09-24	155.31				

Map ID:	25		
Agency cd:	USGS	Site no:	333645114421801
Site name:	006S022E32F002S		
Latitude:	333645.22	EDR Site id:	USGS3084541
Longitude:	1144217.57	Dec lat:	33.61258535
Dec lon:	-114.70567379	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWSENWS32 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	388.6	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19731126
Date inventoried:	19990914	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	300.	Hole depth:	300.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1973-12-28	Ground water data end date:	1999-11-19
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1999-11-19	141.58		1999-11-19	141.58	
1999-09-14					
Note: The site was being pumped.					
1973-12-28	137				

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	25		
Agency cd:	USGS	Site no:	333644114421601
Site name:	006S022E32F003S		
Latitude:	333644.22	EDR Site id:	USGS3084521
Longitude:	1144215.83	Dec lat:	33.61230758
Dec lon:	-114.70519044	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWSENWS32 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	387.5	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	20020320
Date inventoried:	20020418	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	500.	Hole depth:	520.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	2002-03-25	Ground water data end date:	2002-04-18
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2002-04-18					
Note: The site was being pumped.					
2002-03-25	147				

Map ID:	27		
Agency cd:	USGS	Site no:	333643114410001
Site name:	006S022E33F003S		
Latitude:	333642.79	EDR Site id:	USGS3084712
Longitude:	1144100.00	Dec lat:	33.6119104
Dec lon:	-114.68412593	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENWS33 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	336.5	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	20020927
Date inventoried:	20030528	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	110.	Hole depth:	110.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	2003-05-28	Ground water data end date:	2003-05-28
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
2003-05-28	87.22	

Map ID:	27		
Agency cd:	USGS	Site no:	333642114410901
Site name:	006S022E33F002S		
Latitude:	333642.21	EDR Site id:	USGS3084706
Longitude:	1144108.83	Dec lat:	33.61174929
Dec lon:	-114.68657877	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWSENWS33 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	336.9	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	20020928
Date inventoried:	20030528	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	110.	Hole depth:	110.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	2003-05-28	Ground water data end date:	2003-05-28
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
2003-05-28	90.99	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	27		
Agency cd:	USGS	Site no:	333639114410201
Site name:	006S022E33F001S		
Latitude:	333639.95	EDR Site id:	USGS3084675
Longitude:	1144102.63	Dec lat:	33.61112153
Dec lon:	-114.68485649	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENWS33 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	334.9	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900926	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-26	Ground water data end date:	2000-01-26
Ground water data count:	3		

Ground-water levels, Number of Measurements: 3

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-01-26	86.68		1992-03-28	88.56	
1990-09-26	88.52				

Map ID:	28		
Agency cd:	USGS	Site no:	333639114392601
Site name:	006S022E34H001S		
Latitude:	333639.2	EDR Site id:	USGS3084674
Longitude:	1143926.2	Dec lat:	33.61091324
Dec lon:	-114.65806959	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	261.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041118	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: Not Reported
Water quality data begin date: Not Reported
Water quality data end date: Not Reported
Water quality data count: Not Reported
Ground water data begin date: Not Reported
Ground water data end date: Not Reported
Ground water data count: Not Reported

Ground-water levels, Number of Measurements: 0

Map ID:	29		
Agency cd:	USGS	Site no:	333637114395001
Site name:	006S022E34G001S		
Latitude:	333637	EDR Site id:	USGS3084657
Longitude:	1143950	Dec lat:	33.61030213
Dec lon:	-114.66468089	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	SWSWNES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	258.15	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19650724
Date inventoried:	19710713	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	14.	Hole depth:	14.
Source of depth data:	driller	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-13	Ground water data end date:	1971-07-13
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-13	9.90	

Map ID:	28		
Agency cd:	USGS	Site no:	333636114392501
Site name:	006S022E34J001S		
Latitude:	333636	EDR Site id:	USGS3084646
Longitude:	1143925	Dec lat:	33.61002437
Dec lon:	-114.65773623	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NENESES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	258.26	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	1917
Date inventoried:	19711005	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-10-05	Ground water data end date:	1971-10-05
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-10-05		

Note: The well was destroyed (no water level is recorded).

Map ID:	29		
Agency cd:	USGS	Site no:	333636114395701
Site name:	006S022E34L002S		
Latitude:	333636	EDR Site id:	USGS3084651
Longitude:	1143957	Dec lat:	33.61002436
Dec lon:	-114.66662538	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	256.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19460101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	29		
Agency cd:	USGS	Site no:	333636114395201
Site name:	006S022E34K001S		
Latitude:	333636	EDR Site id:	USGS3084650
Longitude:	1143952	Dec lat:	33.61002436
Dec lon:	-114.66523645	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NWNWSES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	258.82	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	1916
Date inventoried:	19711007	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-10-07	Ground water data end date:	1971-10-07
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-10-07		

Note: The well was destroyed (no water level is recorded).

Map ID:	29		
Agency cd:	USGS	Site no:	333636114395001
Site name:	006S022E34K004S		
Latitude:	333635.6	EDR Site id:	USGS3084648
Longitude:	1143950.4	Dec lat:	33.60991325
Dec lon:	-114.664792	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWSES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	260.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041118	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	29		
Agency cd:	USGS	Site no:	333636114395002
Site name:	006S022E34K005S		
Latitude:	333635.6	EDR Site id:	USGS3084649
Longitude:	1143950.4	Dec lat:	33.60991325
Dec lon:	-114.664792	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWSES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	260.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041118	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	28		
Agency cd:	USGS	Site no:	333636114392701
Site name:	006S022E34J002S		
Latitude:	333635.5	EDR Site id:	USGS3084647
Longitude:	1143926.7	Dec lat:	33.60988548
Dec lon:	-114.65820847	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENESES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	261.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030529	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	30		
Agency cd:	USGS	Site no:	333634114394101
Site name:	006S022E34K002S		
Latitude:	333633.7	EDR Site id:	USGS3084634
Longitude:	1143941.1	Dec lat:	33.60938549
Dec lon:	-114.66220858	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWSES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	260.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041118	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	37.	Hole depth:	Not Reported
Source of depth data:	owner	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	30		
Agency cd:	USGS	Site no:	333634114394102
Site name:	006S022E34K003S		
Latitude:	333633.7	EDR Site id:	USGS3084635
Longitude:	1143941.1	Dec lat:	33.60938549
Dec lon:	-114.66220858	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWSES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	260.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041118	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	31		
Agency cd:	USGS	Site no:	333633114391002
Site name:	006S022E35M004S		
Latitude:	333633.2	EDR Site id:	USGS3084624
Longitude:	1143909.7	Dec lat:	33.60924662
Dec lon:	-114.6534861	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWSWS35 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	259.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030529	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	31		
Agency cd:	USGS	Site no:	333633114391001
Site name:	006S022E35M001S		
Latitude:	333633	EDR Site id:	USGS3084623
Longitude:	1143910	Dec lat:	33.60919106
Dec lon:	-114.65356943	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	260.00	Altitude method:	M
Altitude accuracy:	5.	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19530101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	310	Hole depth:	328
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1962-02-07
Water quality data end date:	1962-02-07	Water quality data count:	1
Ground water data begin date:	0000-00-00	Ground water data end date:	0000-00-00
Ground water data count:	0		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1962-02-07	7	

Map ID:	32		
Agency cd:	USGS	Site no:	333633114420001
Site name:	006S022E32K002S		
Latitude:	333633	EDR Site id:	USGS3084626
Longitude:	1144200	Dec lat:	33.609191
Dec lon:	-114.70079305	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	371.8	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19710101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	173
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1971-04-12
Ground water data end date: 2000-01-26
Ground water data count: 4

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-01-26	124.89		1990-09-21	127.02	
1972-08-01	125.8		1971-04-12	124	

Map ID: 33
Agency cd: USGS
Site no: 333633114430301
Site name: 006S022E31K001S
Latitude: 333633
EDR Site id: USGS3084628
Longitude: 1144303
Dec lat: 33.60919098
Dec lon: -114.71829357
Coor meth: M
Coor accr: S
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: Not Reported
Location map: Not Reported
Map scale: Not Reported
Altitude: 387.7
Altitude method: M
Altitude accuracy: 0.1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: Not Reported
Date inventoried: Not Reported
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: Not Reported
Hole depth: Not Reported
Source of depth data: Not Reported
Project number: Not Reported
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1971-07-01
Ground water data end date: 2000-02-15
Ground water data count: 5

Ground-water levels, Number of Measurements: 5

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-15	141.45		1992-03-28	143.34	
1990-09-21	143.95		1971-07-15	139.56	
1971-07-01	140.00				

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	34		
Agency cd:	USGS	Site no:	333633114414701
Site name:	006S022E32K004S		
Latitude:	333632.72	EDR Site id:	USGS3084625
Longitude:	1144146.51	Dec lat:	33.60911323
Dec lon:	-114.69704572	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWSES32 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	329.7	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900921	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-22	Ground water data end date:	2000-01-26
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-01-26	82.63		2000-01-24	82.56	
1990-09-23	84.82		1990-09-22	84.92	

Map ID:	32		
Agency cd:	USGS	Site no:	333633114420002
Site name:	006S022E32K005S		
Latitude:	333631.91	EDR Site id:	USGS3084627
Longitude:	1144200.21	Dec lat:	33.60888823
Dec lon:	-114.70085138	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWSES32 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	371.8	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20000126	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	31		
Agency cd:	USGS	Site no:	333631114391701
Site name:	006S022E35M003S		
Latitude:	333631.2	EDR Site id:	USGS3084819
Longitude:	1143917.0	Dec lat:	33.60869107
Dec lon:	-114.65551393	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SENWSWS35 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	259.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030529	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	32		
Agency cd:	USGS	Site no:	333630114415801
Site name:	006S022E32K003S		
Latitude:	333630.38	EDR Site id:	USGS3084817
Longitude:	1144158.46	Dec lat:	33.60846324
Dec lon:	-114.70036525	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWSES32 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	365.5	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900921	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	382.
Source of depth data:	owner	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-21	Ground water data end date:	1990-09-21
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1990-09-21	121.07	

Map ID:	35		
Agency cd:	USGS	Site no:	333630114400101
Site name:	006S022E34L001S		
Latitude:	333630	EDR Site id:	USGS3084816
Longitude:	1144001	Dec lat:	33.60835773
Dec lon:	-114.66773651	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	330.	Altitude method:	M
Altitude accuracy:	5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19590101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	360.	Hole depth:	384.
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1961-05-25
Water quality data end date:	1961-05-25	Water quality data count:	1
Ground water data begin date:	1972-08-01	Ground water data end date:	1972-08-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1972-08-01	93.00	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	32		
Agency cd:	USGS	Site no:	333627114420001
Site name:	006S022E32K001S		
Latitude:	333627	EDR Site id:	USGS3084807
Longitude:	1144200	Dec lat:	33.60752438
Dec lon:	-114.70079303	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	362.8	Altitude method:	M
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19530101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	464	Hole depth:	500
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1954-03-12
Water quality data end date:	1967-00-00	Water quality data count:	8
Ground water data begin date:	1953-10-27	Ground water data end date:	2000-01-26
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-01-26					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1990-09-21	118.46		1961-05-23	117	
1953-10-27	112				

Map ID:	36		
Agency cd:	USGS	Site no:	333624114400401
Site name:	006S022E34L003S		
Latitude:	333624	EDR Site id:	USGS3084802
Longitude:	1144004	Dec lat:	33.60669111
Dec lon:	-114.66856984	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	256.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19460101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	12.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	37		
Agency cd:	USGS	Site no:	333609114441501
Site name:	007S021E01C001S		
Latitude:	333619.01	EDR Site id:	USGS3084735
Longitude:	1144414.84	Dec lat:	33.60530494
Dec lon:	-114.73824966	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNENWS01 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	389.02	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1992-11-17	Ground water data end date:	2000-02-16
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel
2000-02-16	144.39	
1992-11-17	145.59	
1992-11-17	145.58	
1992-11-17	145.58	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	38		
Agency cd:	USGS	Site no:	333618114432701
Site name:	006S022E31N001S		
Latitude:	333617.57	EDR Site id:	USGS3084794
Longitude:	1144327.15	Dec lat:	33.60490497
Dec lon:	-114.72500204	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWSWSWS31 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	388.1	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	20000731
Date inventoried:	20001017	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	400.	Hole depth:	415.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	39		
Agency cd:	USGS	Site no:	333615114413201
Site name:	006S022E32R001S		
Latitude:	333615	EDR Site id:	USGS3084785
Longitude:	1144132	Dec lat:	33.60419114
Dec lon:	-114.69301498	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESESES32 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	332.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	19470000
Date inventoried:	1971	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	560.	Hole depth:	560.
Source of depth data:	reporting agency (generally USGS)	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1961-05-23
Ground water data end date: 1990-09-22
Ground water data count: 42

Ground-water levels, Number of Measurements: 42

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1990-09-22	89.15		1971-07-01	86.00	
1964-12-02	81.29		1964-10-21	81.21	
1964-09-17	80.93		1964-08-19	81.04	
1964-07-21	81.30		1964-06-18	81.36	
1964-05-12	81.97		1964-04-15	82.15	
1964-03-10	82.66		1964-02-07	82.91	
1963-12-31	82.47		1963-11-27	81.78	
1963-10-29	81.46		1963-09-09	81.58	
1963-08-06	81.85		1963-07-11	82.00	
1963-06-03	82.15		1963-05-06	82.54	
1963-04-01	82.94		1963-03-04	83.24	
1963-02-04	83.29		1963-01-10	83.06	
1962-12-13	83.00		1962-11-08	82.71	
1962-10-11	82.52		1962-09-17	82.35	
1962-08-16	82.62		1962-07-19	82.57	
1962-06-20	82.56		1962-05-24	82.73	
1962-04-24	82.85		1962-03-26	83.15	
1962-02-19	83.35		1962-01-22	83.40	
1961-12-20	83.04		1961-11-21	82.67	
1961-10-18	82.16		1961-09-21	81.96	
1961-08-24	82.17		1961-05-23	82.70	

Map ID: 40
Agency cd: USGS
Site no: 333613114392501
Site name: 006S022E34R002S
Latitude: 333613
EDR Site id: USGS3084777
Longitude: 1143925
Dec lat: 33.60363565
Dec lon: -114.65773615
Coor meth: M
Coor accr: S
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: Not Reported
Location map: Not Reported
Map scale: Not Reported
Altitude: 257.00
Altitude method: L
Altitude accuracy: .1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flood plain
Site type: Ground-water other than Spring
Date construction: Not Reported
Date inventoried: Not Reported
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: Not Reported
Hole depth: 12.0
Source of depth data: Not Reported
Project number: Not Reported
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1971-07-01
Ground water data end date: 1971-07-01
Ground water data count: 1

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	9.00	

Map ID: 41
Agency cd: USGS
Site no: 333612114434001
Site name: 006S021E36R001S
Latitude: 333611.35
EDR Site id: USGS3084772
Longitude: 1144340.83
Dec lat: 33.60317723
Dec lon: -114.72880213
Coor meth: D
Coor accr: H
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: Not Reported
Location map: Not Reported
Map scale: Not Reported
Altitude: 389.09
Altitude method: D
Altitude accuracy: 0.1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: 19460101
Date inventoried: 19610523
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: 636.
Hole depth: 636
Source of depth data: driller
Project number: Not Reported
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 1954-07-15
Water quality data end date: 1964-05-14
Water quality data count: 3
Ground water data begin date: 1946-05-00
Ground water data end date: 2000-03-29
Ground water data count: 5

Ground-water levels, Number of Measurements: 5

Date	Feet below Surface	Feet to Sealevel
2000-03-29	144.47	
2000-02-23	144.62	
1946-05	138	
2000-02-23	144.62	
1990-09-27	146.64	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	40		
Agency cd:	USGS	Site no:	333611114392401
Site name:	006S022E35N001S		
Latitude:	333611	EDR Site id:	USGS3084762
Longitude:	1143924	Dec lat:	33.60308011
Dec lon:	-114.65745836	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	255.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19360101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	40		
Agency cd:	USGS	Site no:	333610114392401
Site name:	007S022E02D001S		
Latitude:	333610	EDR Site id:	USGS3084749
Longitude:	1143924	Dec lat:	33.60280234
Dec lon:	-114.65745836	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	256.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19180101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	43		
Agency cd:	USGS	Site no:	333610114394001
Site name:	006S022E34R001S		
Latitude:	333610	EDR Site id:	USGS3084751
Longitude:	1143940	Dec lat:	33.60280233
Dec lon:	-114.66190293	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	257.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19250101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	8.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	42		
Agency cd:	USGS	Site no:	333610114401401
Site name:	006S022E34N001S		
Latitude:	333610	EDR Site id:	USGS3084753
Longitude:	1144014	Dec lat:	33.60280232
Dec lon:	-114.67134766	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	255.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	9.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	7.00	

Map ID:	42		
Agency cd:	USGS	Site no:	333610114401001
Site name:	006S022E34P001S		
Latitude:	333610	EDR Site id:	USGS3084752
Longitude:	1144010	Dec lat:	33.60280232
Dec lon:	-114.67023651	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	254.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	44		
Agency cd:	USGS	Site no:	333610114430502
Site name:	007S022E06C002S		
Latitude:	333610	EDR Site id:	USGS3084755
Longitude:	1144305	Dec lat:	33.60280226
Dec lon:	-114.71884906	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	387.	Altitude method:	M
Altitude accuracy:	1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19590101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	44		
Agency cd:	USGS	Site no:	333610114430501
Site name:	007S022E06C001S		
Latitude:	333610	EDR Site id:	USGS3084754
Longitude:	1144305	Dec lat:	33.60280226
Dec lon:	-114.71884906	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	390.	Altitude method:	M
Altitude accuracy:	5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19690101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	340.	Hole depth:	344.
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	40		
Agency cd:	USGS	Site no:	333610114392601
Site name:	006S022E34R003S		
Latitude:	333609.8	EDR Site id:	USGS3084750
Longitude:	1143926.2	Dec lat:	33.60274678
Dec lon:	-114.65806949	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESESES34 T06S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	262.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	43		
Agency cd:	USGS	Site no:	333609114394301
Site name:	007S022E03B002S		
Latitude:	333609	EDR Site id:	USGS3084732
Longitude:	1143943	Dec lat:	33.60252456
Dec lon:	-114.66273629	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWNES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	257.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	42		
Agency cd:	USGS	Site no:	333609114401301
Site name:	007S022E03D001S		
Latitude:	333609	EDR Site id:	USGS3084733
Longitude:	1144013	Dec lat:	33.60252455
Dec lon:	-114.67106987	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWNWS03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	260.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	196703
Date inventoried:	19670330	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	49.	Hole depth:	121.
Source of depth data:	reporting agency (generally USGS)	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1967-03-30	Ground water data end date:	1972-08-02
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1972-08-02	6.9		1968-06-10	7.23	
1967-06-01	4.90		1967-03-30	5.41	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	42		
Agency cd:	USGS	Site no:	333609114401302
Site name:	007S022E03D002S		
Latitude:	333609	EDR Site id:	USGS3084734
Longitude:	1144013	Dec lat:	33.60252455
Dec lon:	-114.67106987	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWNWS03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	260.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19670300
Date inventoried:	19670330	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	20.	Hole depth:	26.
Source of depth data:	reporting agency (generally USGS)	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1967-03-30	Ground water data end date:	1972-08-02
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1972-08-02	11.0		1968-06-10	6.87	
1967-06-01	4.56		1967-03-30	5.13	

Map ID:	43		
Agency cd:	USGS	Site no:	333608114395601
Site name:	007S022E03B003S		
Latitude:	333608.3	EDR Site id:	USGS3084923
Longitude:	1143955.6	Dec lat:	33.60233012
Dec lon:	-114.66623639	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWNES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	261.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041119	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	43		
Agency cd:	USGS	Site no:	333608114395603
Site name:	007S022E03B005S		
Latitude:	333608.3	EDR Site id:	USGS3084925
Longitude:	1143955.6	Dec lat:	33.60233012
Dec lon:	-114.66623639	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWNES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	261.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041119	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	43		
Agency cd:	USGS	Site no:	333608114395602
Site name:	007S022E03B004S		
Latitude:	333608.3	EDR Site id:	USGS3084924
Longitude:	1143955.6	Dec lat:	33.60233012
Dec lon:	-114.66623639	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWNES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	261.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20041119	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	43		
Agency cd:	USGS	Site no:	333608114395001
Site name:	007S022E03B001S		
Latitude:	333607.9	EDR Site id:	USGS3084922
Longitude:	1143949.5	Dec lat:	33.60221901
Dec lon:	-114.66454189	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWNES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	261.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333556114392601
Site name:	007S022E03H011S		
Latitude:	333556	EDR Site id:	USGS3084890
Longitude:	1143926	Dec lat:	33.59891355
Dec lon:	-114.65801388	Coor meth:	M
Coor accr:	R	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	255.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333553114392702
Site name:	007S022E03H006S		
Latitude:	333553.4	EDR Site id:	USGS3084881
Longitude:	1143926.6	Dec lat:	33.59819135
Dec lon:	-114.65818054	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	252.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	45		
Agency cd:	USGS	Site no:	333553114392701
Site name:	007S022E03H005S		
Latitude:	333553.4	EDR Site id:	USGS3084880
Longitude:	1143926.6	Dec lat:	33.59819135
Dec lon:	-114.65818054	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	252.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333553114392703
Site name:	007S022E03H007S		
Latitude:	333553.4	EDR Site id:	USGS3084882
Longitude:	1143926.6	Dec lat:	33.59819135
Dec lon:	-114.65818054	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	252.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	2003-04-24	Ground water data end date:	2003-04-24
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
2003-04-24		

Note: An obstruction was encountered in the well above the water surface (no water level recorded).

Map ID:	45		
Agency cd:	USGS	Site no:	333550114392501
Site name:	007S022E03H004S		
Latitude:	333549.7	EDR Site id:	USGS3084876
Longitude:	1143925.3	Dec lat:	33.5971636
Dec lon:	-114.65781941	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	255.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333547114392501
Site name:	007S022E03H010S		
Latitude:	333547	EDR Site id:	USGS3084874
Longitude:	1143925	Dec lat:	33.59641362
Dec lon:	-114.65773606	Coor meth:	M
Coor accr:	R	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	255.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333546114393002
Site name:	007S022E03H013S		
Latitude:	333545.74	EDR Site id:	USGS3084869
Longitude:	1143929.68	Dec lat:	33.59606362
Dec lon:	-114.6590361	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	255.8	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030528	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	45		
Agency cd:	USGS	Site no:	333546114393001
Site name:	007S022E03H012S		
Latitude:	333545.73	EDR Site id:	USGS3084868
Longitude:	1143929.68	Dec lat:	33.59606085
Dec lon:	-114.6590361	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	255.8	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030528	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333546114392901
Site name:	007S022E03H008S		
Latitude:	333545.7	EDR Site id:	USGS3084866
Longitude:	1143928.6	Dec lat:	33.59605251
Dec lon:	-114.65873609	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	254.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	45		
Agency cd:	USGS	Site no:	333546114392902
Site name:	007S022E03H009S		
Latitude:	333545.7	EDR Site id:	USGS3084867
Longitude:	1143928.6	Dec lat:	33.59605251
Dec lon:	-114.65873609	Coor meth:	D
Coor accr:	1	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESENES03 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	254.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	20030424	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Unconfined single aquifer	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	46		
Agency cd:	USGS	Site no:	333545114403501
Site name:	007S022E04H002S		
Latitude:	333545	EDR Site id:	USGS3084864
Longitude:	1144035	Dec lat:	33.59585805
Dec lon:	-114.67718107	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	256.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19650101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	14.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

Map ID:	47		
Agency cd:	USGS	Site no:	333544114401101
Site name:	007S022E03L001S		
Latitude:	333544	EDR Site id:	USGS3084861
Longitude:	1144011	Dec lat:	33.59558029
Dec lon:	-114.67051421	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	257.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	12.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	46		
Agency cd:	USGS	Site no:	333544114402801
Site name:	007S022E04H001S		
Latitude:	333544	EDR Site id:	USGS3084862
Longitude:	1144028	Dec lat:	33.59558028
Dec lon:	-114.67523657	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	256.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	19470101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	12.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	11.00	

Map ID:	48		
Agency cd:	USGS	Site no:	333543114443901
Site name:	007S021E02J001S		
Latitude:	333543.31	EDR Site id:	USGS3084858
Longitude:	1144437.43	Dec lat:	33.59538853
Dec lon:	-114.74452472	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENESES02 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	388.80	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date:0000-00-00
Water quality data count: 0
Ground water data begin date: 1990-09-24
Ground water data end date: 1990-09-24
Ground water data count: 1

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1990-09-24	149.25	

Map ID: 49
Agency cd: USGS
Site no: 333543114430501
Site name: 007S022E06L001S
Latitude: 333543.13
EDR Site id: USGS3084857
Longitude: 1144305.45
Dec lat: 33.59533856
Dec lon: -114.71897396
Coor meth: D
Coor accr: H
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 04
State: 06
County: 065
Country: US
Land net: NENESWS06 T07S R22E S
Location map: RIPLEY
Map scale: 24000
Altitude: 389.9
Altitude method: D
Altitude accuracy: 0.1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: Not Reported
Date inventoried: 19900923
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: Not Reported
Hole depth: Not Reported
Source of depth data: Not Reported
Project number: CHI
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date:0000-00-00
Water quality data count: 0
Ground water data begin date: 1990-09-23
Ground water data end date: 2000-02-15
Ground water data count: 2

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel
2000-02-15		
	Note: An obstruction was encountered in the well above the water surface (no water level recorded).	
1990-09-23	147.57	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	50		
Agency cd:	USGS	Site no:	333522114410101
Site name:	007S022E04P001S		
Latitude:	333522	EDR Site id:	USGS3085023
Longitude:	1144101	Dec lat:	33.58946932
Dec lon:	-114.68440343	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	310.00	Altitude method:	M
Altitude accuracy:	5.	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19590101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	136	Hole depth:	150
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	1959-08-13
Water quality data end date:	1962-10-22	Water quality data count:	4
Ground water data begin date:	0000-00-00	Ground water data end date:	0000-00-00
Ground water data count:	0		

Ground-water levels, Number of Measurements: 17

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1963-01-09	58.61				
1962-12-13	60.03				
Note: The site was being pumped.					
1962-11-08	60.02				
Note: The site was being pumped.					
1962-10-11	59.86				
Note: The site was being pumped.					
1962-09-17	59.41				
Note: The site was being pumped.					
1962-08-16	59.53				
Note: The site was being pumped.					
1962-07-19	59.65				
Note: The site was being pumped.					
1962-06-21	60.00				
Note: The site was being pumped.					
1962-05-25	59.88				
Note: The site was being pumped.					
1962-04-23	59.87				
Note: The site was being pumped.					
1962-03-26	59.42				
Note: The site was being pumped.					
1962-02-19	59.75				
Note: The site was being pumped.					
1962-01-22	59.22				
Note: The site was being pumped.					
1961-12-20	57.90		1961-11-21	57.55	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, continued.

Date	Feet below Surface	Feet to Sealevel
1961-10-18	58.53	
Note: The site was being pumped.		
1961-09-25	58.57	
Note: The site was being pumped.		

Map ID:	51		
Agency cd:	USGS	Site no:	333521114413101
Site name:	007S022E05R001S		
Latitude:	333521	EDR Site id:	USGS3085020
Longitude:	1144131	Dec lat:	33.58919154
Dec lon:	-114.692737	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	329.	Altitude method:	M
Altitude accuracy:	5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	Not Reported	Daily flow data begin date:	Not Reported
Daily flow data end date:	Not Reported	Daily flow data count:	Not Reported
Peak flow data begin date:	Not Reported	Peak flow data end date:	Not Reported
Peak flow data count:	Not Reported	Water quality data begin date:	Not Reported
Water quality data end date:	Not Reported	Water quality data count:	Not Reported
Ground water data begin date:	Not Reported	Ground water data end date:	Not Reported
Ground water data count:	Not Reported		

Ground-water levels, Number of Measurements: 0

Map ID:	50		
Agency cd:	USGS	Site no:	333520114415601
Site name:	007S022E04Q001S		
Latitude:	333520	EDR Site id:	USGS3085008
Longitude:	1144056	Dec lat:	33.58891378
Dec lon:	-114.68301449	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWSES04 T07S R22E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	275.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	40.
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1961-05-25	Ground water data end date:	1962-09-17
Ground water data count:	17		

Ground-water levels, Number of Measurements: 18

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1962-09-17	22.62		1962-08-16	22.66	
1962-07-19	22.78		1962-06-21	22.60	
1962-05-25	23.03		1962-04-23	23.09	
1962-03-26	22.32		1962-02-19	22.54	
1962-01-22	22.68		1961-12-20	22.45	
1961-11-21	22.12		1961-10-18	23.26	
1961-09-25	21.76		1961-08-24	22.63	
1961-07-28	22.65		1961-07-06	22.68	
1961-05-25	22.44		1961-05-01	22.00	

Map ID:	52		
Agency cd:	USGS	Site no:	333520114445001
Site name:	007S022E04Q002S		
Latitude:	333520	EDR Site id:	USGS3085010
Longitude:	1144450	Dec lat:	33.5889137
Dec lon:	-114.7480164	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	255.0	Altitude method:	L
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flood plain		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	14.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

Map ID:	53		
Agency cd:	USGS	Site no:	333519114402501
Site name:	007S022E03N001S		
Latitude:	333519	EDR Site id:	USGS3084995
Longitude:	1144025	Dec lat:	33.58863602
Dec lon:	-114.67440312	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	254.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19180101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	10.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	9.00	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	54		
Agency cd:	USGS	Site no:	333519114413801
Site name:	007S022E05R002S		
Latitude:	333518.90	EDR Site id:	USGS3084996
Longitude:	1144137.78	Dec lat:	33.58860822
Dec lon:	-114.69462038	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESESES05 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	330.2	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	19960501
Date inventoried:	20000215	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	600.	Hole depth:	617.
Source of depth data:	driller	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1996-05-20	Ground water data end date:	2000-02-15
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-15	86.28		1996-05-20	88	

Map ID:	55		
Agency cd:	USGS	Site no:	333520114444001
Site name:	007S021E02R001S		
Latitude:	333518.71	EDR Site id:	USGS3085009
Longitude:	1144437.39	Dec lat:	33.58855538
Dec lon:	-114.74451352	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SESESES02 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	387.71	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1990-09-24
Ground water data end date: 2000-02-15
Ground water data count: 2

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-15	144.43		1990-09-24	146.22	

Map ID: 55
Agency cd: USGS
Site no: 333518114443701
Site name: 007S021E12D001S
Latitude: 333517.97
EDR Site id: USGS3084987
Longitude: 1144436.54
Dec lat: 33.58834983
Dec lon: -114.7442774
Coor meth: D
Coor accr: H
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: NWNWNWS12 T07S R21E S
Location map: RIPLEY
Map scale: Not Reported
Altitude: 387.58
Altitude method: D
Altitude accuracy: 0.1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: 19650802
Date inventoried: 19660128
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: 390.
Hole depth: 611.
Source of depth data: driller
Project number: Not Reported
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1965-09-03
Ground water data end date: 2000-02-15
Ground water data count: 6

Ground-water levels, Number of Measurements: 6

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-15					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1990-09-22					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1972-08-01	141		1966-10-20	139.46	
1966-01-28	139.15		1965-09-03	130	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	56		
Agency cd:	USGS	Site no:	333517114412501
Site name:	007S022E09D002S		
Latitude:	333516.68	EDR Site id:	USGS3084972
Longitude:	1144123.37	Dec lat:	33.58799157
Dec lon:	-114.69061748	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NWNWNWS09 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	332.18	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900924	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-24	Ground water data end date:	2000-02-18
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-18					
Note: The site was being pumped.					
1990-09-24	95.25				
Note: The site had been pumped recently.					

Map ID:	57		
Agency cd:	USGS	Site no:	333509114413301
Site name:	007S022E08A01S		
Latitude:	333509	EDR Site id:	USGS3084954
Longitude:	1144133	Dec lat:	33.58585829
Dec lon:	-114.69329253	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SENENES08 T07S R22E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	323.	Altitude method:	M
Altitude accuracy:	002	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Alluvial or marine terrace		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900922	Mean greenwich time offset:	PST

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-22	Ground water data end date:	1990-09-22
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1990-09-22	88.33	

Map ID:	58		
Agency cd:	USGS	Site no:	333505114412701
Site name:	007S022E09D001S		
Latitude:	333505	EDR Site id:	USGS3084950
Longitude:	1144127	Dec lat:	33.58474721
Dec lon:	-114.6916258	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	254.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19570101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	13.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	59		
Agency cd:	USGS	Site no:	333453114442701
Site name:	007S021E12E001S		
Latitude:	333453	EDR Site id:	USGS3084941
Longitude:	1144427	Dec lat:	33.58141391
Dec lon:	-114.74162723	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	SESWNWS12 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	380.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	1966
Date inventoried:	19720829	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1972-08-29	Ground water data end date:	1972-08-29
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1972-08-29		

Note: The well was destroyed (no water level is recorded).

Map ID:	60		
Agency cd:	USGS	Site no:	333452114415901
Site name:	007S022E08K001S		
Latitude:	333452	EDR Site id:	USGS3084938
Longitude:	1144159	Dec lat:	33.58113619
Dec lon:	-114.70051491	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	250.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19570101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	10.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	8.00	

Map ID:	61		
Agency cd:	USGS	Site no:	333452114421601
Site name:	007S022E08M001S		
Latitude:	333452	EDR Site id:	USGS3084939
Longitude:	1144216	Dec lat:	33.58113618
Dec lon:	-114.70523727	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	254.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19650101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	14.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	12.00	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	62		
Agency cd:	USGS	Site no:	333427114412601
Site name:	007S022E09N001S		
Latitude:	333427	EDR Site id:	USGS3085079
Longitude:	1144126	Dec lat:	33.57419194
Dec lon:	-114.69134788	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	252.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19360101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	12.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	9.00	

Map ID:	63		
Agency cd:	USGS	Site no:	333428114443701
Site name:	007S021E12N002S		
Latitude:	333426.68	EDR Site id:	USGS3085090
Longitude:	1144436.97	Dec lat:	33.57410299
Dec lon:	-114.74439666	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	SWSWSWS12 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	386.67	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900922	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-22	Ground water data end date:	2000-02-16
Ground water data count:	2		

Ground-water levels, Number of Measurements: 2

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-16					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1990-09-22					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					

Map ID:	63		
Agency cd:	USGS	Site no:	333427114443601
Site name:	007S021E12N001S		
Latitude:	333426.36	EDR Site id:	USGS3085080
Longitude:	1144437.02	Dec lat:	33.5740141
Dec lon:	-114.74441055	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	SWSWSWS12 T07S R21E S
Location map:	RIPLEY	Map scale:	Not Reported
Altitude:	385.85	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	191111
Date inventoried:	19610609	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	260.
Source of depth data:	driller	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1944-12-00	Ground water data end date:	2000-02-16
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-16	142.98		1990-09-22	145.03	
1971-07-21					
Note: The site was dry (no water level recorded).					
1944-12	140				

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	64		
Agency cd:	USGS	Site no:	333426114445501
Site name:	007S021E14B001S		
Latitude:	333426.03	EDR Site id:	USGS3085070
Longitude:	1144454.58	Dec lat:	33.57392243
Dec lon:	-114.74928847	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENWNES14 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	384.75	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19610609	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1944-00-00	Ground water data end date:	2000-02-16
Ground water data count:	16		

Ground-water levels, Number of Measurements: 16

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-16					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1990-09-22					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1983-05-26					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1971-07-21					
Note: The site was dry (no water level recorded).					
1963-01-09	139.82		1962-12-13	139.84	
1962-11-08	139.82		1962-10-11	139.82	
1962-09-17	139.70		1962-08-16	139.75	
1962-07-19	139.81		1962-06-20	139.90	
1962-05-24	139.80		1962-02-15	138.00	
1961-06-09	137.06		1944	140	

Map ID:	64		
Agency cd:	USGS	Site no:	333426114445001
Site name:	007S021E14B002S		
Latitude:	333426	EDR Site id:	USGS3085069
Longitude:	1144450	Dec lat:	33.5739141
Dec lon:	-114.74801621	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NENWNES14 T07S R21E S
Location map:	RIPLEY	Map scale:	24000

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Altitude:	385.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19720829	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1972-08-29	Ground water data end date:	1972-08-29
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1972-08-29		

Note: The well was destroyed (no water level is recorded).

Map ID:	65		
Agency cd:	USGS	Site no:	333426114454201
Site name:	007S021E15A001S		
Latitude:	333425.82	EDR Site id:	USGS3085071
Longitude:	1144540.18	Dec lat:	33.57386407
Dec lon:	-114.76195553	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	04
State:	06	County:	065
Country:	US	Land net:	NENENES15 T07S R21E S
Location map:	ROOSEVELT MINE	Map scale:	24000
Altitude:	390.8	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19900923	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	CHI
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1990-09-23	Ground water data end date:	2004-03-02
Ground water data count:	22		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Ground-water levels, Number of Measurements: 22

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2004-03-02	137.41		2004-03-02	137.40	
2003-11-05	137.25		2003-11-05	137.25	
2003-06-03	137.27		2003-06-03	137.28	
2002-10-02	137.33		2002-10-02	137.32	
2002-04-03	137.39		2002-04-03	137.39	
2001-11-07	137.63		2001-11-07	137.63	
2001-07-11	137.53		2001-07-11	137.53	
2001-04-17	137.50		2001-04-17	137.50	
2001-02-25	139.27		2000-12-14	137.60	
2000-10-04	137.46		2000-03-29	137.40	
1992-03-23	137.73		1990-09-23	137.81	

Map ID:	63		
Agency cd:	USGS	Site no:	333426114443801
Site name:	007S021E14A001S		
Latitude:	333425.76	EDR Site id:	USGS3085068
Longitude:	1144437.89	Dec lat:	33.57384744
Dec lon:	-114.74465222	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NENENES14 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	386.86	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19610215	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	354.
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1961-06-09	Ground water data end date:	2000-02-16
Ground water data count:	6		

Ground-water levels, Number of Measurements: 6

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
2000-02-16					
Note: The site was dry (no water level recorded).					
1990-09-22					
Note: An obstruction was encountered in the well above the water surface (no water level recorded).					
1971-07-01	141.00		1966-10-20	139.20	
1962-02-15	139.20		1961-06-09	139.66	

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	66		
Agency cd:	USGS	Site no:	333425114420101
Site name:	007S022E17C001S		
Latitude:	333425	EDR Site id:	USGS3085060
Longitude:	1144201	Dec lat:	33.57363638
Dec lon:	-114.70107038	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	252.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	13.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-07-01	Ground water data end date:	1971-07-01
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

Map ID:	67		
Agency cd:	USGS	Site no:	333425114423701
Site name:	007S022E18A001S		
Latitude:	333425	EDR Site id:	USGS3085061
Longitude:	1144237	Dec lat:	33.57363637
Dec lon:	-114.71107068	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	251.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	19650101
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	14.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1971-07-01
Ground water data end date: 1971-07-01
Ground water data count: 1

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	9.00	

Map ID:	63		
Agency cd:	USGS	Site no:	333425114443301
Site name:	007S021E13D001S		
Latitude:	333425	EDR Site id:	USGS3085062
Longitude:	1144433	Dec lat:	33.57363633
Dec lon:	-114.74329384	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	NWNWNWS13 T07S R21E S
Location map:	RIPLEY	Map scale:	24000
Altitude:	386.	Altitude method:	M
Altitude accuracy:	2.5	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	19720829	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	Not Reported
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1972-08-29	Ground water data end date:	1972-08-29
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1972-08-29		

Note: The well was destroyed (no water level is recorded).

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Map ID:	68		
Agency cd:	USGS	Site no:	333400114444701
Site name:	007S021E14H001S		
Latitude:	333400.06	EDR Site id:	USGS3085163
Longitude:	1144447.21	Dec lat:	33.56670874
Dec lon:	-114.74724109	Coor meth:	D
Coor accr:	H	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	SWSENES14 T07S R21E S
Location map:	RIPLEY	Map scale:	Not Reported
Altitude:	379.52	Altitude method:	D
Altitude accuracy:	0.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	196602
Date inventoried:	19660208	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	900.	Hole depth:	1386.
Source of depth data:	driller	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1966-03-01	Ground water data end date:	1990-09-22
Ground water data count:	4		

Ground-water levels, Number of Measurements: 4

Date	Feet below Surface	Feet to Sealevel	Date	Feet below Surface	Feet to Sealevel
1990-09-22	137.60		1972-08-01	134.00	
1966-10-20	132.90		1966-03-01	130	

Map ID:	69		
Agency cd:	USGS	Site no:	333359114424601
Site name:	007S022E18J001S		
Latitude:	333359	EDR Site id:	USGS3085147
Longitude:	1144246	Dec lat:	33.56641434
Dec lon:	-114.71357066	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	06
State:	06	County:	065
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	251.00	Altitude method:	L
Altitude accuracy:	.1	Altitude datum:	NGVD29
Hydrologic:	Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.		
Topographic:	Flat surface		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	PST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	Not Reported	Hole depth:	14.0
Source of depth data:	Not Reported	Project number:	Not Reported
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1971-07-01
Ground water data end date: 1971-07-01
Ground water data count: 1

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971-07-01	10.00	

Map ID: 70
Agency cd: USGS
Site no: 333322114452701
Site name: 007S021E23C001S
Latitude: 333327.09
EDR Site id: USGS3085260
Longitude: 1144521.51
Dec lat: 33.55755063
Dec lon: -114.75676904
Coor meth: D
Coor accr: H
Latlong datum: NAD27
Dec latlong datum: NAD83
District: 06
State: 06
County: 065
Country: US
Land net: SWNENWS23 T07S R21E S
Location map: ROOSEVELT MINE
Map scale: Not Reported
Altitude: 383.55
Altitude method: D
Altitude accuracy: 0.1
Altitude datum: NGVD29
Hydrologic: Imperial Reservoir. Arizona, California. Area = 3320 sq.mi.
Topographic: Flat surface
Site type: Ground-water other than Spring
Date construction: Not Reported
Date inventoried: 19611010
Mean greenwich time offset: PST
Local standard time flag: Y
Type of ground water site: Single well, other than collector or Ranney type
Aquifer Type: Not Reported
Aquifer: Not Reported
Well depth: Not Reported
Hole depth: 120.
Source of depth data: Not Reported
Project number: Not Reported
Real time data flag: 0
Daily flow data begin date: 0000-00-00
Daily flow data end date: 0000-00-00
Daily flow data count: 0
Peak flow data begin date: 0000-00-00
Peak flow data end date: 0000-00-00
Peak flow data count: 0
Water quality data begin date: 0000-00-00
Water quality data end date: 0000-00-00
Water quality data count: 0
Ground water data begin date: 1961-10-10
Ground water data end date: 2000-02-16
Ground water data count: 3

Ground-water levels, Number of Measurements: 3

Date	Feet below Surface	Feet to Sealevel
2000-02-16		
Note: The site was dry (no water level recorded).		
1990-09-23		
Note: The site was dry (no water level recorded).		
1961-10-10		
Note: The site was dry (no water level recorded).		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Water Well Information:

Longitude:	-114.693
Latiude:	33.6461
Stwellno:	06S22E20A001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004869

Longitude:	-114.7055
Latiude:	33.6314
Stwellno:	06S22E29D001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004813

Longitude:	-114.7049
Latiude:	33.6289
Stwellno:	06S22E29C001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004805

Longitude:	-114.6802
Latiude:	33.627
Stwellno:	06S22E28H001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004800

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.6986
Latiude:	33.627
Stwellno:	06S22E29G001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004799

Longitude:	-114.6577
Latiude:	33.6267
Stwellno:	06S22E26E002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004795

Longitude:	-114.6577
Latiude:	33.6267
Stwellno:	06S22E26E001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004794

Longitude:	-114.6983
Latiude:	33.6257
Stwellno:	06S22E29G002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004789

Longitude:	-114.6577
Latiude:	33.6248
Stwellno:	06S22E26E003S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004781

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.6622
Latiude:	33.6248
Stwellno:	06S22E27H001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004780

Longitude:	-114.6952
Latiude:	33.6231
Stwellno:	06S22E29J001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004768

Longitude:	-114.71
Latiude:	33.6223
Stwellno:	06S22E29M001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004765

Longitude:	-114.6597
Latiude:	33.6175
Stwellno:	06S22E27R001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004727

Longitude:	-114.6619
Latiude:	33.6175
Stwellno:	06S22E27R002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004726

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.7005
Latiude:	33.6175
Stwellno:	06S22E29Q001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004725

Longitude:	-114.6864
Latiude:	33.617
Stwellno:	06S22E33C005S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004718

Longitude:	-114.6871
Latiude:	33.6169
Stwellno:	06S22E33C004S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004717

Longitude:	-114.6675
Latiude:	33.6147
Stwellno:	06S22E34C001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004707

Longitude:	-114.6858
Latiude:	33.6145
Stwellno:	06S22E33C006S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004702

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.67
Latiude:	33.6131
Stwellno:	06S22E34F001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004692

Longitude:	-114.7047
Latiude:	33.6131
Stwellno:	06S22E32F001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004691

Longitude:	-114.7207
Latiude:	33.6131
Stwellno:	06S22E31F001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004690

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Water Wells:

Water System Information:

Map ID:	25		
Prime Station Code:	06S/22E-32F02 S	User ID:	WAT
FRDS Number:	3301553001	County:	Riverside
District Number:	14	Station Type:	WELL/AMBNT/MUN/INTAKE
Water Type:	Well/Groundwater	Well Status:	Active Raw
Source Lat/Long:	333647.0 1144217.0	Precision:	1,000 Feet (10 Seconds)
Source Name:	WELL 06		
System Number:	3301553		
System Name:	Blythe - Airport		
Organization That Operates System:			
	440 South Main Street Blythe, CA 92225		
Pop Served:	40	Connections:	13
Area Served:	Not Reported		

Water System Information:

Map ID:	23		
Prime Station Code:	06S/22E-34J01 S	User ID:	33C
FRDS Number:	3301350001	County:	Riverside
District Number:	63	Station Type:	WELL/AMBNT/MUN/INTAKE
Water Type:	Well/Groundwater	Well Status:	Active Raw
Source Lat/Long:	333646.0 1143929.0	Precision:	1,000 Feet (10 Seconds)
Source Name:	WELL 01		
System Number:	3301350		
System Name:	JUNCTION MOTEL		
Organization That Operates System:			
	Not Reported		
Pop Served:	Unknown, Small System	Connections:	Unknown, Small System
Area Served:	Not Reported		
Sample Collected:	12/01/2000	Findings:	2560. US
Chemical:	SPECIFIC CONDUCTANCE		

Longitude:	-114.7052
Latiude:	33.6123
Stwellno:	06S22E32F003S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004681

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.6833
Latiude:	33.6119
Stwellno:	06S22E33F003S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004675

Longitude:	-114.6858
Latiude:	33.6117
Stwellno:	06S22E33F002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004673

Longitude:	-114.6849
Latiude:	33.6111
Stwellno:	06S22E33F001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004666

Longitude:	-114.6647
Latiude:	33.6103
Stwellno:	06S22E34G001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004660

Longitude:	-114.6536
Latiude:	33.6092
Stwellno:	06S22E35M001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004647

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.7008
Latiude:	33.6092
Stwellno:	06S22E32K002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004646

Longitude:	-114.7183
Latiude:	33.6092
Stwellno:	06S22E31K001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004645

Longitude:	-114.6971
Latiude:	33.6091
Stwellno:	06S22E32K004S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004641

Longitude:	-114.7004
Latiude:	33.6085
Stwellno:	06S22E32K003S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004635

Longitude:	-114.6677
Latiude:	33.6084
Stwellno:	06S22E34L001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004632

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.7383
Latiude:	33.6053
Stwellno:	07S21E01C001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004608

Longitude:	-114.693
Latiude:	33.6042
Stwellno:	06S22E32R001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004596

Longitude:	-114.6577
Latiude:	33.6036
Stwellno:	06S22E34R002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004588

Longitude:	-114.7288
Latiude:	33.6032
Stwellno:	06S21E36R001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004582

Longitude:	-114.6714
Latiude:	33.6028
Stwellno:	06S22E34N001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004573

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.6711
Latiude:	33.6025
Stwellno:	07S22E03D002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004571

Longitude:	-114.6711
Latiude:	33.6025
Stwellno:	07S22E03D001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004570

Water System Information:

Map ID:	44		
Prime Station Code:	07S/22E-06C01 S	User ID:	WAT
FRDS Number:	3310028001	County:	Riverside
District Number:	14	Station Type:	WELL/AMBNT
Water Type:	Well/Groundwater	Well Status:	Standby Raw
Source Lat/Long:	333608.0 1144300.0	Precision:	100 Feet (one Second)
Source Name:	WELL 02 - STANDBY		
System Number:	3310028		
System Name:	Riverside CSA #122		
Organization That Operates System:			
	25871 NEIGHBORS BLVD. RIPLEY, CA 92272		
Pop Served:	1100	Connections:	363
Area Served:	Not Reported		
Sample Collected:	04/10/2006	Findings:	58. MG/L
Chemical:	NITRATE (AS NO3)		
Sample Collected:	04/10/2006	Findings:	116. PCI/L
Chemical:	GROSS ALPHA		
Sample Collected:	04/10/2006	Findings:	5.91 PCI/L
Chemical:	GROSS ALPHA COUNTING ERROR		
Sample Collected:	04/10/2006	Findings:	116. PCI/L
Chemical:	URANIUM (PCI/L)		
Sample Collected:	04/10/2006	Findings:	5.69 PCI/L
Chemical:	URANIUM COUNTING ERROR		
Sample Collected:	09/27/2006	Findings:	210. MG/L
Chemical:	ALKALINITY (TOTAL) AS CACO3		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Sample Collected:	09/27/2006	Findings:	250. MG/L
Chemical:	BICARBONATE ALKALINITY		
Sample Collected:	03/23/2010	Findings:	46. US
Chemical:	SPECIFIC CONDUCTANCE		
Sample Collected:	03/23/2010	Findings:	6.5
Chemical:	PH, LABORATORY		
Sample Collected:	03/23/2010	Findings:	18. MG/L
Chemical:	ALKALINITY (TOTAL) AS CACO3		
Sample Collected:	03/23/2010	Findings:	22. MG/L
Chemical:	BICARBONATE ALKALINITY		
Sample Collected:	03/23/2010	Findings:	10. MG/L
Chemical:	HARDNESS (TOTAL) AS CACO3		
Sample Collected:	03/23/2010	Findings:	3.4 MG/L
Chemical:	CALCIUM		
Sample Collected:	03/23/2010	Findings:	4.1 MG/L
Chemical:	SODIUM		
Sample Collected:	03/23/2010	Findings:	320. UG/L
Chemical:	IRON		
Sample Collected:	03/23/2010	Findings:	36. MG/L
Chemical:	TOTAL DISSOLVED SOLIDS		

Water System Information:

Map ID:	44		
Prime Station Code:	07S/22E-06C02 S	User ID:	WAT
FRDS Number:	3310028002	County:	Riverside
District Number:	14	Station Type:	WELL/AMBNT
Water Type:	Well/Groundwater	Well Status:	Destroyed
Source Lat/Long:	333607.0 1144305.0	Precision:	100 Feet (one Second)
Source Name:	WELL 03 - DESTROYED		
System Number:	3310028		
System Name:	Riverside CSA #122		
Organization That Operates System:			
	25871 NEIGHBORS BLVD.		
	RIPLEY, CA 92272		
Pop Served:	1100	Connections:	363
Area Served:	Not Reported		

Longitude:	-114.6772
Latiude:	33.5959
Stwellno:	07S22E04H002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004507

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.6577
Latiude:	33.5956
Stwellno:	07S22E03H001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004502

Longitude:	-114.6577
Latiude:	33.5956
Stwellno:	07S22E03H002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004503

Longitude:	-114.6705
Latiude:	33.5956
Stwellno:	07S22E03L001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004501

Longitude:	-114.6752
Latiude:	33.5956
Stwellno:	07S22E04H001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004500

Longitude:	-114.7445
Latiude:	33.5954
Stwellno:	07S21E02J001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004496

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.719
Latiude:	33.5953
Stwellno:	07S22E06L001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004494

Longitude:	-114.6844
Latiude:	33.5895
Stwellno:	07S22E04P001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004461

Longitude:	-114.683
Latiude:	33.5889
Stwellno:	07S22E04Q001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004450

Longitude:	-114.748
Latiude:	33.5889
Stwellno:	07S22E04Q002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004449

Longitude:	-114.6744
Latiude:	33.5886
Stwellno:	07S22E03N001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004446

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.6946
Latiude:	33.5886
Stwellno:	07S22E05R002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004445

Longitude:	-114.7445
Latiude:	33.5886
Stwellno:	07S21E02R001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004444

Longitude:	-114.7443
Latiude:	33.5884
Stwellno:	07S21E12D001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004440

Water System Information:

Map ID:	56		
Prime Station Code:	07S/22E-09D01 S	User ID:	WAT
FRDS Number:	3310028003	County:	Riverside
District Number:	14	Station Type:	WELL/AMBNT
Water Type:	Well/Groundwater	Well Status:	Active Raw
Source Lat/Long:	333517.0 1144125.0	Precision:	100 Feet (one Second)
Source Name:	WELL 04		
System Number:	3310028		
System Name:	Riverside CSA #122		
Organization That Operates System:			
	25871 NEIGHBORS BLVD. RIPLEY, CA 92272		
Pop Served:	1100	Connections:	363
Area Served:	Not Reported		
Sample Collected:	09/27/2006	Findings:	180. MG/L
Chemical:	ALKALINITY (TOTAL) AS CACO3		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Sample Collected:	09/27/2006	Findings:	220. MG/L
Chemical:	BICARBONATE ALKALINITY		
Sample Collected:	03/26/2007	Findings:	0.2 PCI/L
Chemical:	RADIUM 228 COUNTING ERROR		
Sample Collected:	03/26/2007	Findings:	0.54 PCI/L
Chemical:	GROSS ALPHA COUNTING ERROR		
Sample Collected:	06/25/2007	Findings:	0.158 PCI/L
Chemical:	RADIUM 226 COUNTING ERROR		
Sample Collected:	06/25/2007	Findings:	0.3 PCI/L
Chemical:	RADIUM 226 MDA95		
Sample Collected:	12/10/2007	Findings:	0.76 PCI/L
Chemical:	GROSS ALPHA COUNTING ERROR		
Sample Collected:	12/10/2007	Findings:	0.15 PCI/L
Chemical:	URANIUM COUNTING ERROR		
Sample Collected:	06/23/2008	Findings:	3. UNITS
Chemical:	COLOR		
Sample Collected:	06/23/2008	Findings:	1800. US
Chemical:	SPECIFIC CONDUCTANCE		
Sample Collected:	06/23/2008	Findings:	7.9
Chemical:	PH, LABORATORY		
Sample Collected:	06/23/2008	Findings:	150. MG/L
Chemical:	HARDNESS (TOTAL) AS CACO3		
Sample Collected:	06/23/2008	Findings:	48. MG/L
Chemical:	CALCIUM		
Sample Collected:	06/23/2008	Findings:	7.6 MG/L
Chemical:	MAGNESIUM		
Sample Collected:	06/23/2008	Findings:	350. MG/L
Chemical:	SODIUM		
Sample Collected:	06/23/2008	Findings:	280. MG/L
Chemical:	CHLORIDE		
Sample Collected:	06/23/2008	Findings:	2. MG/L
Chemical:	FLUORIDE (F) (NATURAL-SOURCE)		
Sample Collected:	06/23/2008	Findings:	3.1 UG/L
Chemical:	ARSENIC		
Sample Collected:	06/23/2008	Findings:	160. UG/L
Chemical:	IRON		
Sample Collected:	06/23/2008	Findings:	0.32 NTU
Chemical:	TURBIDITY, LABORATORY		
Sample Collected:	04/27/2009	Findings:	310. MG/L
Chemical:	SODIUM		
Sample Collected:	10/26/2010	Findings:	0.547 PCI/L
Chemical:	RADIUM 228 COUNTING ERROR		
Sample Collected:	10/26/2010	Findings:	0.294 PCI/L
Chemical:	RADIUM 228 MDA95		

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Sample Collected:	02/15/2011	Findings:	0.828 PCI/L
Chemical:	RADIUM 228 COUNTING ERROR		
Sample Collected:	02/15/2011	Findings:	0.295 PCI/L
Chemical:	RADIUM 228 MDA95		
Sample Collected:	05/17/2011	Findings:	0.517 PCI/L
Chemical:	RADIUM 228 COUNTING ERROR		
Sample Collected:	05/17/2011	Findings:	0.295 PCI/L
Chemical:	RADIUM 228 MDA95		

Longitude:	-114.6906
Latiude:	33.588
Stwellno:	07S22E09D002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004432

Longitude:	-114.6933
Latiude:	33.5859
Stwellno:	07S22E08A001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004414

Longitude:	-114.7416
Latiude:	33.5814
Stwellno:	07S21E12E001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004371

Longitude:	-114.7005
Latiude:	33.5811
Stwellno:	07S22E08K001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004370

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.7052
Latiude:	33.5811
Stwellno:	07S22E08M001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004369

Longitude:	-114.6914
Latiude:	33.5742
Stwellno:	07S22E09N001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004313

Longitude:	-114.7444
Latiude:	33.5741
Stwellno:	07S21E12N002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004311

Longitude:	-114.7444
Latiude:	33.574
Stwellno:	07S21E12N001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004310

Longitude:	-114.7447
Latiude:	33.5739
Stwellno:	07S21E14A001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004304

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.748
Latiude:	33.5739
Stwellno:	07S21E14B002S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004303

Longitude:	-114.7493
Latiude:	33.5739
Stwellno:	07S21E14B001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004302

Longitude:	-114.762
Latiude:	33.5739
Stwellno:	07S21E15A001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004301

Longitude:	-114.7011
Latiude:	33.5736
Stwellno:	07S22E17C001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004296

Longitude:	-114.7111
Latiude:	33.5736
Stwellno:	07S22E18A001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004295

GEOCHECK VERSION 2.1
STATE DATABASE WELL INFORMATION

Longitude:	-114.7433
Latiude:	33.5736
Stwellno:	07S21E13D001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004294

Longitude:	-114.7472
Latiude:	33.5667
Stwellno:	07S21E14H001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004183

Longitude:	-114.7136
Latiude:	33.5664
Stwellno:	07S22E18J001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004175

Longitude:	-114.7568
Latiude:	33.5576
Stwellno:	07S21E23C001S
Districtco:	3
Welluseco:	Z
Countyco:	33
Gwcode:	703900
Site id:	CADW40000004041

CALIFORNIA GOVERNMENT WELL RECORDS SEARCHED

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

State Database: CA Radon
Source: Department of Health Services
Telephone: 916-324-2208
Radon Database for California

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

Water Well Database
Source: Department of Water Resources
Telephone: 916-651-9648

California Drinking Water Quality Database
Source: Department of Health Services
Telephone: 916-324-2319
The database includes all drinking water compliance and special studies monitoring for the state of California since 1984. It consists of over 3,200,000 individual analyses along with well and water system information.

California Oil and Gas Well Locations
Source: Department of Conservation
Telephone: 916-323-1779
Oil and Gas well locations in the state.

STREET AND ADDRESS INFORMATION

© 2010 Tele Atlas North America, Inc. All rights reserved. This material is proprietary and the subject of copyright protection and other intellectual property rights owned by or licensed to Tele Atlas North America, Inc. The use of this material is subject to the terms of a license agreement. You will be held liable for any unauthorized copying or disclosure of this material.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX G
WATER SUPPLY ASSESSMENT

THIS PAGE INTENTIONALLY LEFT BLANK

February 2013

BLYTHE MESA SOLAR PROJECT

Water Supply Assessment

PREPARED BY:

POWER ENGINEERS

731 East Ball Road, Suite 100
Anaheim, CA 92805
(714) 507-2700

Water Supply Assessment

PREPARED FOR:

RENEWABLE RESOURCES GROUP, INC.
AND
SOLAR STAR BLYTHE MESA I, LLC

PREPARED BY:

GREG WITTMAN
POWER ENGINEERS, INC.

CONTENTS

1.0 INTRODUCTION 1

2.0 PROJECT DESCRIPTION 1

2.1 WATER REQUIREMENTS 1

3.0 SOURCES OF WATER SUPPLY 3

3.1 PALO VERDE GROUNDWATER BASIN 3
3.1.1 Basin Characteristics 3
3.1.2 Recharge and Storage Capacity 4
3.1.3 Historic Groundwater Trends 5
3.1.4 Water Budget and Safe Yield 7
3.1.5 Groundwater Irrigation Demand/Surface Outflow 7
3.1.6 Water Quality 8
3.1.7 Water Rights and Adjudication 8
3.1.8 Groundwater Management 8
3.2 PALO VERDE IRRIGATION DISTRICT SURFACE WATER 8

4.0 WATER SUPPLY PLANNING UNDER SB 610 9

4.2 PROJECT AND NON-PROJECT WATER DEMANDS 11

5.0 CONCLUSIONS 12

6.0 REFERENCES 13

APPENDIX A: DWR GUIDEBOOK FOR IMPLEMENTATION OF SENATE BILL 610 AND SENATE BILL 221 14

FIGURES

Figure 1. Project Location 2
Figure 2. 2000 Groundwater Contours 6

TABLES

Table 1. Water Budget for the Palo Verde Mesa Groundwater Basin 8
Table 2. Twenty-year Comparison of Groundwater Inflow and Loss of Recharge in Ac-ft/Yr for the PVMGB with Construction of the Blythe Mesa Solar Project 11
Table 3. Groundwater Supply and Demand Conditions in Ac-ft/Yr Comparing Normal Precipitation Recharge and Multiple Dry Years 11

1.0 INTRODUCTION

Senate Bill 610 (SB 610) was passed on January 1, 2002, amending the California Water Code to require detailed analysis of water supply availability for certain types of development projects. The primary purpose of SB 610 is to improve the linkage between water and land use planning by ensuring greater communication between water providers and local planning agencies, and ensuring that land use decisions for certain large development projects are fully informed as to whether sufficient water supplies are available to meet project demands. SB 610 requires the preparation of a Water Supply Assessment (WSA) for a project that is subject to the California Environmental Quality Act (CEQA) and meets certain requirements, each of which is discussed in detail in Section 4 of this WSA.

When a WSA is required per SB 610, it must examine the availability of an identified water supply under normal-year, single-dry-year, and multiple-dry-year conditions over a 20-year projection, accounting for the projected water demand of the proposed project in addition to other existing and planned future uses of the identified water supply, including agricultural and manufacturing uses.

The County of Riverside (as Lead Agency under CEQA) has determined that a WSA shall be prepared to provide full disclosure of potential water resources impacts. Therefore, this WSA for the proposed Blythe Mesa Solar Project (Project) has been prepared in compliance with the California Water Code as amended by SB 610. The steps followed to ensure compliance of this WSA with the California Water Code are described in Appendix A (*DWR Guidebook for Implementation of Senate Bill 610 and Senate Bill 221*).

2.0 PROJECT DESCRIPTION

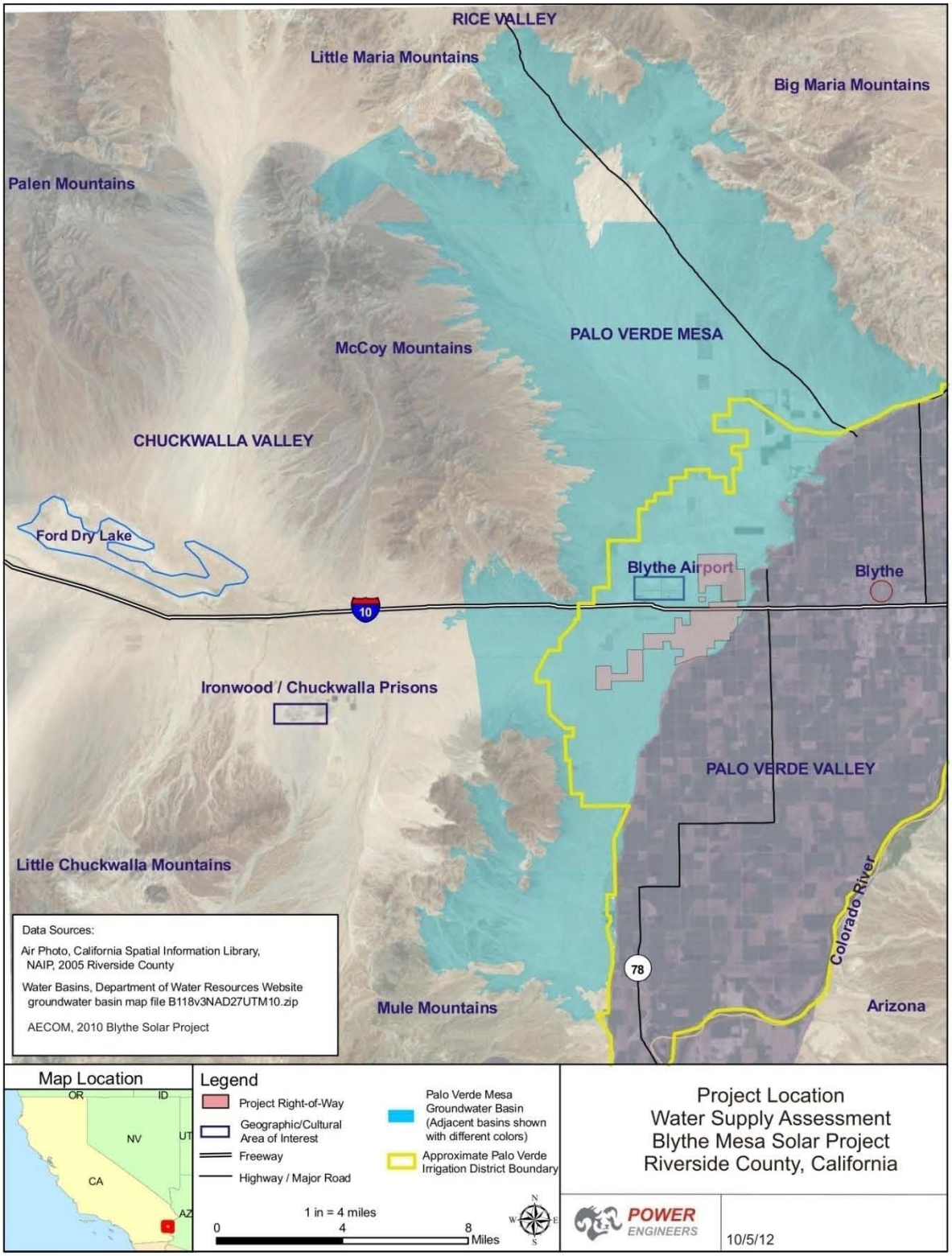
The proposed 485 megawatt (MW) solar photovoltaic (PV) electrical generating facility and associated infrastructure would be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 acres for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect (Figure 1). The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison Colorado River Substation, an approved new substation located south of Highway 10 and approximately four miles west of the Project site.

The solar panels, substations, and inverters, electrical equipment, and operations and maintenance (O&M) facilities would be located on lands in private ownership. The 230 kV transmission line would be located on private and public lands.

2.1 Water Requirements

The Project would use water during the construction and operation phases. During the 36-month (3-year) construction period for the proposed Project, approximately 1,354 acre-feet (ac-ft) of water (or about 451 ac-ft per year) would be required. Construction water (non-potable) would be used for dust suppression, concrete manufacturing, and fire safety. During operations, non-potable water would be used for solar array washing, fire water supply, and on-site maintenance activities (such as may be required for landscape maintenance to support dust control). Two O&M buildings would require a total of up to 150 gallons per day of potable water.

FIGURE 1. PROJECT LOCATION



The average total annual water usage for Project operations is estimated to be about 345 ac-ft per year (ac-ft/yr), which corresponds to an average flow rate of about 214 gallons per minute (gpm). Non-potable water for the Project would be taken from the Palo Verde Irrigation District (PVID), which supplies the current irrigation demands of agricultural operations on site. The Project would work with the Gila Farm Land, LLC (the landowner) and the PVID for non-potable water services and supply during construction and operation. The water supplies used for agricultural irrigation and the water supplies underlying the Project site (Palo Verde Mesa Groundwater Basin [PVMGB]) are under the jurisdiction of the PVID. Riverside County Community Service Area #122 (CSA #122) has issued a will-serve letter for the Project's limited potable water needs.

3.0 SOURCES OF WATER SUPPLY

3.1 Palo Verde Groundwater Basin

The basin is bounded by non-water-bearing rocks of the Big Maria and Little Maria Mountains on the north, of the McCoy and Mule Mountains on the west, of the Palo Verde Valley on the east, and of the Palo Verde Mountains on the south (DWR 1979; Jennings 1967). The northwest boundary and parts of the western boundary are drainage divides (Metzger 1973; Jennings 1967). The valley between the McCoy and Big Maria Mountains is drained by McCoy Wash, which flows into the western side of the Palo Verde Valley. Average annual precipitation ranges up to six inches.

3.1.1 Basin Characteristics

The primary source of groundwater in the basin is found in alluvial deposits of Quaternary age. The alluvium generally consists of lenticular beds of sand, gravel, silt, and clay, except near the mountains, where it consists principally of coarse-grained angular rock detritus (DWR 1979). Other water-bearing deposits at the site are the Bouse Formation and a fanglomerate deposit (Metzger 1973). The lithologies of the groundwater-bearing units are described below.

Alluvium. The alluvial deposits range in age from Pliocene to Holocene, compose the shallow floodplain aquifer, and are the principal source of groundwater in the basin (Owen-Joyce 1984). The alluvium is composed of sand, silt, and clay with lenses of gravel, and ranges in thickness from 160 to 600 feet. Most wells in the basin are screened in the coarser-grained alluvial deposits and have moderate to high yields (Metzger 1973).

Bouse Formation. The upper Miocene to Pliocene age Bouse Formation underlies the alluvial deposits. Few wells produce from the formation except near the City of Blythe. The upper Bouse Formation ranges from 500 to 600 feet below land surface and consists of interbedded clay, silt, and sand. The upper Bouse Formation is considered an aquifer, while the lower formation is considered an aquitard. Well yields can vary depending on the degree of formation consolidation and stratigraphic location of the perforations (Metzger 1973).

Fanglomerate. A Miocene (?) age fanglomerate is considered a water-bearing deposit, though no wells are known to have been completed in it because of its relative depth to other water-bearing deposits. Estimated depth to the top of the fanglomerate can be greater than 800 feet below land surface but varies widely throughout the basin (Metzger 1973).

Restrictive barriers have not been identified within the Palo Verde Mesa aquifer that would potentially inhibit groundwater flow (DWR 1979).

3.1.2 Recharge and Storage Capacity

Sources of recharge to the PVMGB are irrigation, precipitation, and underflow from adjacent areas, including the Rice and Chuckwalla Valleys (Metzger 1973). More recent information by the California Department of Water Resources (DWR) suggests that recharge of the basin is chiefly from percolation of runoff from the surrounding mountains, with percolation of precipitation to the valley floor and subsurface inflow as contributing additional sources of recharge (DWR 1979).

Subsurface inflow from the Chuckwalla Valley Groundwater Basin (CVGB) was estimated by Metzger (1973) to be 400 ac-ft/yr. This calculation was based on a cross-sectional profile of the boundary between the two basins derived using geophysical methods and regional data regarding groundwater gradients and hydraulic conductivity. Woodward Clyde (1986, as cited in the California Energy Commission [CEC] Revised Staff Assessment [RSA] for the Blythe Solar Power Project, June 2010) revised this estimate based on the results of pump testing at Chuckwalla State Prison and calculated the basin inflow from CVGB to be 870 ac-ft/yr. Engineering Science (1990, as cited in the CEC RSA 2010) updated this estimate to 1,162 ac-ft/yr, presumably as a result of return flow from prison wastewater disposal; however, the rationale for this adjustment was not provided. Using more recent gravity data, Wilson and Owens-Joyce (1994) found that the area through which discharge occurs is significantly more limited than previously thought due to the presence of a buried bedrock ridge. As a result, the most recent available water budget for the basin has adopted an inflow rate from the CVGB of 400 ac-ft/yr (Eagle Crest 2009).

Natural recharge in the basin was estimated to be approximately 800 ac-ft/yr (DWR 1975). Recharge from infiltration was estimated at 718 ac-ft/yr assuming an infiltration rate of 10% of runoff based on the 2010 CEC study for the Solar Millennium project. Infiltration directly by precipitation is likely limited due to evaporation as described by Metzger (1973). The recharge estimates of 800 and 718 ac-ft/yr are both over-estimates due to the extremely arid conditions and relationship between evaporation and infiltration. Direct recharge from rainfall is an insignificant amount compared to the amount that is recharged from runoff (Metzger 1973). Possible opportunity for recharge to the aquifer from runoff exists in the ephemeral washes during larger storm events. Much of the runoff from the mountains, upon leaving the bedrock, infiltrates into the sand and gravel; eventually, part of the water recharges the groundwater supply (Metzger 1973). It is more likely that only approximately one-third of the originally estimated 800 ac-feet/yr will be available for recharge.

Recharge from applied irrigation water diverted from the Colorado River through the Palo Verde Irrigation District is unknown; however, additional water for irrigation is allowed to be used for salt control in irrigation applications. The additional water for salt control is believed to percolate to groundwater as recharge.

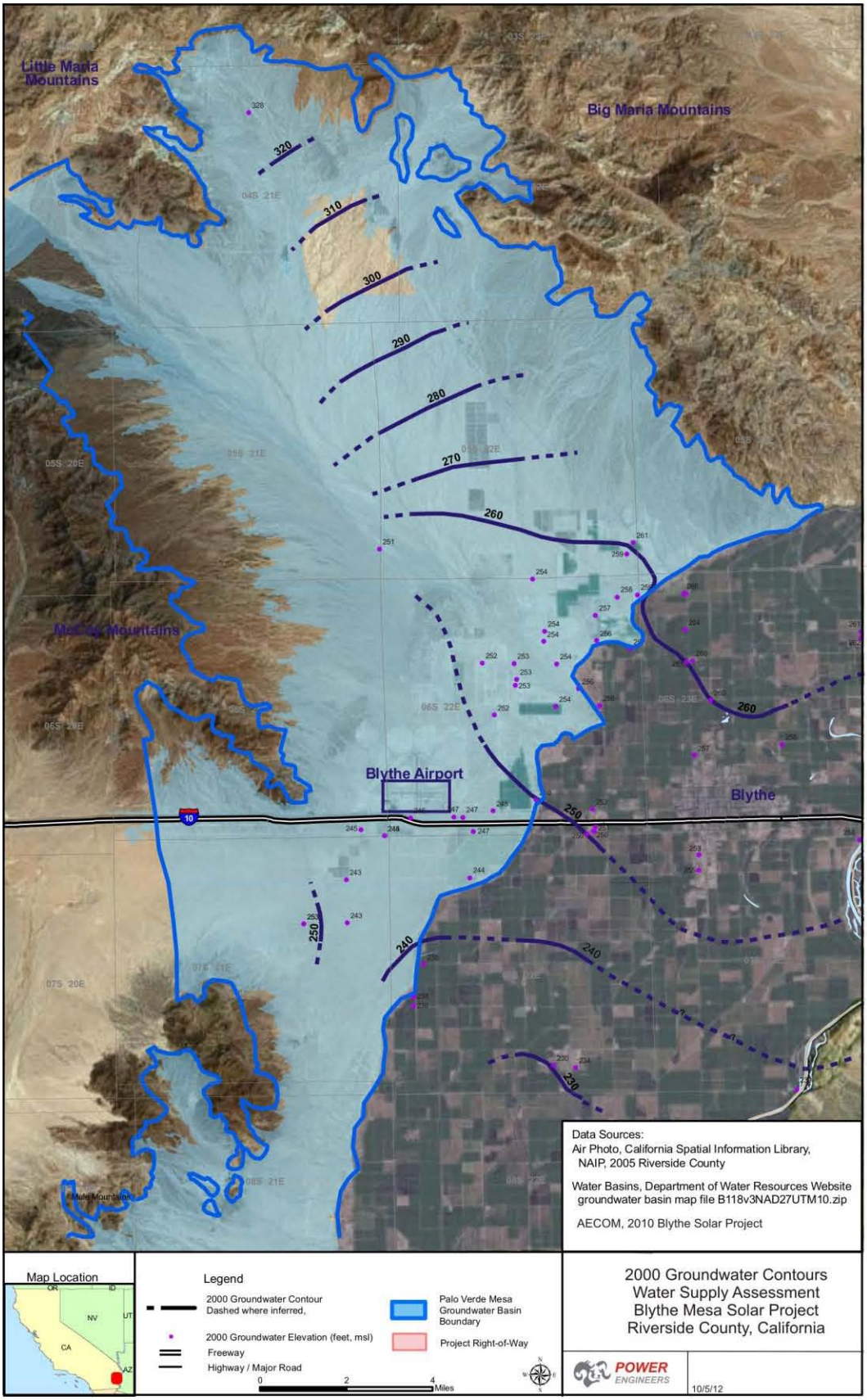
The estimated total groundwater storage capacity for the Palo Verde Mesa Groundwater Basin is estimated at 6,840,000 ac-ft (DWR 1975).

The actual discharge from the PVMGB is not known; however, it is reasonable to assume that the discharge for agriculture use has, in the past, exceeded the recharge from other sources. None of the wells located at or around the Project site are currently being used. Large cones of depression in the potentiometric surface under the Palo Verde Mesa have now recovered as the water table has rebounded with the lack of groundwater extraction. The absence of significant changes in water level data in the PVMGB over time suggests a buffering effect from another source of recharge. However, due to existing and planned extractions such as the Blythe Energy Project, the PVMGB may experience an overdraft condition.

3.1.3 Historic Groundwater Trends

Groundwater levels at the Project site historically range from 215 to 253 feet above mean sea level (approximately 150 feet below ground surface). Wells within and around the Project boundaries have sporadic water level records available from the U.S. Geological Survey (USGS) National Water Information System dating back to 1943. Figure 2 shows the contoured regional groundwater potentiometric surface based on USGS water levels collected during 2000. Groundwater measurements collected during 2000 provided the most complete areal data set for the PVMGB. The contoured data suggests that groundwater flows in a southeasterly direction to the north of the Project site. The groundwater flow direction changes to a southwesterly direction at the Project site roughly parallel to the Palo Verde Valley trend.

FIGURE 2. 2000 GROUNDWATER CONTOURS



3.1.4 Water Budget and Safe Yield

A "water budget" is the comparison of all inflow/recharge to all outflow/demand from a specified groundwater basin, while "safe yield" is the amount of groundwater that can be withdrawn on a sustained basis without impairing groundwater quality or otherwise resulting in environmental damage.

Surface-water diversions at Palo Verde Dam into the Palo Verde Valley for crop irrigation during 1981 through 1984 averaged about 1,000,000 ac-ft/yr (Owen-Joyce 1984). About half of this diverted water returned to the river by natural drainage or via a drainage system that is hydraulically connected to the shallow aquifer. The remaining diverted water is taken up by consumptive use, pumpage, infiltration, and evaporation (Owen-Joyce 1984).

3.1.5 Groundwater Irrigation Demand/Surface Outflow

In 2003, the PVID reported that 544 acres within its service area and an estimated 300 acres outside its service area irrigate with groundwater on the Palo Verde Mesa (CEC 2005). PVID reports that there were 3,911 ac-ft of water provided to irrigate 768 acres on the Palo Verde Mesa in 2010. For this analysis, it is assumed that most of the 3,911 ac-ft of water were used for the citrus trees and a portion of the irrigation water was lost through evaporation. The excess irrigation water not used by the crops and lost through evaporation is believed to percolate into the soils to help control salts and eventually infiltrate to groundwater. The volume of water that infiltrates to groundwater is relatively low based on the crop type and evaporation rates. It is assumed in this analysis that approximately 1.8% or 72 ac-ft of irrigation water will percolate to groundwater based on the citrus crops and the climate conditions.

The Blythe area receives precipitation ranging from 0 to 8.7 inches annually based on historic records from 1913 to 2012. The average annual precipitation rate is approximately 3.5 inches based on this time period. Direct recharge from rainfall is an insignificant amount compared to the amount that is recharged from runoff (Metzger 1973). The recharge from runoff will only occur during the larger storm events. A model to predict the amount of infiltration from runoff would be very complex, with a high amount of uncertainty. For this analysis, it is simply assumed that the recharge basin is approximately 130 square miles and receives an average of 3.5 inches of precipitation per year. The total estimated precipitation volume in the basin during a year would be approximately 24,266 ac-ft, assuming the total 3.5 inches of rain. It is assumed that only 1% (242 ac-ft) of this water will infiltrate to groundwater during the larger storm events mainly affecting the larger washes.

Subsurface inflow from the CVGB was estimated by Metzger (1973) to be 400 ac-ft/yr. This calculation was based on a cross-sectional profile of the boundary between the two basins derived using geophysical methods and regional data regarding groundwater gradients and hydraulic conductivity. Using more recent gravity data, Wilson and Owens-Joyce (1994) found that the area through which discharge occurs is significantly more limited than previously thought due to the presence of a buried bedrock ridge. As a result, the most recent available water budget for the basin has adopted an inflow rate from the CVGB of 400 ac-ft/yr (Eagle Crest 2009).

Subsurface inflow from the McCoy Wash drainage area has been estimated for this analysis using the Darcian flow through a cross-section area of the wash. A gradient of 0.001 and a hydraulic conductivity of 10 feet/day produced a generalized estimate of approximately 175 ac-ft/year as underflow.

There is currently no groundwater extraction from wells at the Project site. Groundwater is being extracted by Blythe Energy for use at the power plant located on Buck Road. The power plant has a

reported operational use of approximately 3,000 ac-ft/yr. Groundwater is being extracted from a well to provide water for the Mesa Bluff Village, the municipal golf course, and the community college on the eastern edge of the PVMGB. Groundwater pumping rates were not provided by the City of Blythe for this well. For this analysis, it is assumed that groundwater pumped from this well is being extracted mainly from the adjacent Palo Verde Valley Aquifer immediately to the east. Table 1 lists the total estimated inflow to the PVMGB minus the reported groundwater extraction on the mesa using the available estimated water volumes.

Table 1. Water Budget for the Palo Verde Mesa Groundwater Basin

BUDGET COMPONENTS	PALO VERDE MESA GROUNDWATER BASIN
Recharge from runoff infiltration (1%)	242 ac-ft/yr
Underflow from Chuckwalla Valley Groundwater Basin	400 ac-ft/yr
Underflow from McCoy Wash	175 ac-ft/yr
Irrigation Return Flow (1.8% of 3,911 ac-ft [2010])	72 ac-ft/yr
Total Inflow	***889*** ac-ft/yr
Groundwater Extraction (wells)	0 ac-ft/yr
Blythe Energy	3,000 ac-ft/yr
Total Outflow	***3,000*** ac-ft/yr
Budget Balance (Inflow-Outflow)	**-2,111** ac-ft/yr

3.1.6 Water Quality

Water quality data from local irrigation wells is not available. However, water quality information for wells serving the Blythe Energy Project located adjacent to the Project site show total dissolved solids (TDS) of about 1,010 milligrams per liter (mg/L). Hardness is about 140 mg/L and silica concentration is about 24 mg/L. The quality of water from these wells has been used in this preliminary evaluation. No information is available on arsenic concentrations from the sampled wells.

3.1.7 Water Rights and Adjudication

The Project site is in Riverside County and the Palo Verde Mesa in an area that has no perennial streams. All lands containing solar panels are privately held by the Applicant. A 4.5-mile portion of the 230 kV transmission line would be located on federal land, though no water use (outside of construction) would occur on the federal portion. A contract for irrigation water supply is held by the applicant and is currently used to grow citrus on the Project site.

3.1.8 Groundwater Management

The California Water Code allows any local public agency that provides water service, whose service area includes a groundwater basin or portion thereof that is not subject to groundwater management pursuant to a judgment or other order, to adopt and implement a groundwater management plan (California Water Code Sections 10750 et. seq.). Groundwater Management Plans often require reports of pumping and some restrictions on usage.

The City of Blythe, California, has an Urban Water Management Plan (UWMP). A small portion of the Project is within the City of Blythe. The Project site is also within the PVID.

3.2 Palo Verde Irrigation District Surface Water

A portion of the Mesa area lies within boundaries of the PVID. Colorado River water, supplied through PVID canals, is lifted onto the Mesa by private pumps to irrigate a portion of the acreage in the PVID. The remaining Mesa irrigated acreage is irrigated from deep wells developed by the

landowners. However, there are no wells supporting agricultural operations on the Project site. The predominant crop on the Mesa is citrus. Based on year 2010 data from PVID, approximately 12,000 ac-ft of water from the PVID surface delivery system was used to irrigate crops on the project site.

The PVID water supply is derived from its Colorado River contract. The PVID holds the Priority 1 rights to California's share of Colorado River water, and a shared portion of the Priority 3 rights, and their rights are not quantified by volume. Rather, the PVID's water use is defined by the irrigation water needed to serve a total of 104,500 acres in the Palo Verde Valley, and an additional 16,000 acres on the Palo Verde Mesa. The City of Blythe is within the PVID boundary and is using the PVID water rights to the Colorado River water.

4.0 WATER SUPPLY PLANNING UNDER SB 610

SB 610 was passed in 2002 and amended the California Water Code by requiring a WSA to be completed for certain projects subject to CEQA, as discussed below in Sections 4.1 and 4.2. California Water Code, as amended by SB 610, requires that when a WSA is required it must address the following questions:

- Is there a public water system that will service the proposed project (see Section 4.3);
- Is there a current UWMP that accounts for the project demand (see Section 4.4);
- Is groundwater a component of the supplies for the project (see Section 4.5); and
- Are there sufficient supplies to serve the project over the next twenty years (see Section 4.6)?

The primary question to be answered in a WSA is:

> *Will the total projected water supplies available during normal, single dry, and multiple dry water years during a 20-year projection meet the projected water demand of the proposed project, in addition to existing and planned future uses of the identified water supplies, including agricultural and manufacturing uses?*

The following sections address the SB 610 WSA questions as they relate to the proposed Project. Conclusions in Section 5 provide a detailed discussion of the steps followed in preparation of this WSA to ensure compliance with SB 610 and the California Water Code.

Is the proposed Project subject to CEQA?

California Water Code Section 10910(a) states that any city or county that determines that a project, as defined in Section 10912, is subject to CEQA, which applies to projects requiring an issuance of a permit by a public agency, projects undertaken by a public agency, or projects funded by a public agency. The proposed Project requires issuance of permits by a public agency and is, therefore, subject to CEQA.

Is the proposed project a "Project" under SB 610?

California Water Code Section 10912(a) states that any proposed action that meets the definition of "Project" under SB 610 is required to prepare a WSA to demonstrate whether sufficient water supplies are available to meet requirements of the proposed project under normal and drought conditions. SB 610 defines a "Project" as any one of six different development types with certain water use requirements, as specified in the Water Code revised by SB 610. Each identified development type and associated water requirement are addressed below. Any mixed-use project that incorporates one of the six development types described below is also defined as a "Project" under SB 610.

Residential Development
A proposed residential development of more than 500 dwelling units is defined as a "Project" under SB 610. The proposed Project is not a residential development.

Shopping Center or Business Establishment
A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space is defined as a "Project" under SB 610. The proposed Project is not a shopping center or residential development.

Commercial Office Building
A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space is defined as a "Project" under SB 610. The proposed Project is not a commercial office building.

Hotel or Motel
A proposed hotel or motel, or both, having more than 500 rooms is defined as a "Project" under SB 610. The proposed Project is not a hotel or motel.

Industrial, Manufacturing, or Processing Plant or Industrial Park
A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area, is defined as a "Project" under SB 610. Additionally, PV solar and wind energy projects are exempt from preparation of a WSA if they are less than 75 acres in size.

Based on the definition of "Project" as presented above, the proposed solar Project is both larger than 40 acres and meets the intent of the definition, and is greater than 75 acres and would not qualify for a SB 267 exemption. Consequently, the County of Riverside, as the CEQA Lead Agency for the proposed Project, has directed that a WSA for the proposed Project be prepared.

Equivalent Water Use
A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500-dwelling-unit project is defined as a "Project" under SB 610. Assuming that an average household of 3.5 people requires 1.2 ac-ft/yr (AVEK 2008), a 500-dwelling-unit project would require approximately 600 ac-ft/yr. As described in Section 2.1 (see "Water Requirements"), the proposed Project would require approximately 1,354 ac-ft (451 ac-ft/yr) during the three-year construction period and approximately 345 ac-ft/yr during operations and maintenance.

Is there a public water system that will service the proposed project?

No; the great majority of water for the proposed Project (i.e., all of the non-potable water) would not be delivered by a public water system or using public water system connections. The proposed Project would use existing water infrastructure that currently delivers irrigation water from the PVID. CSA #122 has provided a will-serve letter for the small amount (up to 150 gallons per day) of potable water for the two O&M buildings.

Is there a current UWMP that accounts for the project demand?

The City of Blythe, California has a UWMP, but this plan is potentially applicable to a small portion of the Project site that lies within the city limits.

Is groundwater a component of the supplies for the project?

No; groundwater is not a component of the supplies for the Project. The proposed Project would use Colorado River water diversions from the PVID water system.

Are there sufficient supplies to serve the project over the next twenty years?

Yes; as demonstrated through the data and discussions provided in this section, sufficient water supplies are available to serve the Project over a twenty-year future projection, including with consideration to average-year, single-dry year, and multiple-dry year (drought) conditions.

4.2 Project and Non-Project Water Demands

Water demands of the proposed Project, assuming the Project would utilize PVID surface water, are described below, in order to characterize water supply availability.

Project Demands (Groundwater)

This analyses looks specifically at the operational potable water supply demand that would be derived from groundwater sources. The Project use of PVID water for construction and operations is not expected to provide localized recharge to groundwater since most of the water would evaporate during and after use. The projected scenario using the PVID water source (potable water supplied through CSA #122) with no infiltration recharge rates for the Project is shown in Table 2. The estimated inflow for the PVMGB is compared to the past irrigation needs compared to the Project use for a 20-year period.

Table 2. Twenty-year Comparison of Groundwater Inflow and Loss of Recharge in Ac-ft/Yr for the PVMGB with Construction of the Blythe Mesa Solar Project

	2012[1]	2013	2014	2015	2016	2016-2033 ANNUALLY
SUPPLY						
PVMGB Total Inflow (acre feet)	**817**	**817**	**817**	**817**	**817**	**817**
Irrigation Recharge (*Based on 2010 Reported Volume*)	72	0	0	0	0	0
DEMAND						
Recharge from Blythe Mesa Solar Project		0	0	0	0	0
Blythe Energy	3,000	3,000	3,000	3,000	3,000	3,000
Blythe Mesa Solar Project Groundwater Use (potable demand)	0	0	0	0	<1	<1
Total Yearly Demand	3,000	3,000	3,000	3,000	3001	3001
Supply/Demand Difference (Inflow-Outflow)	***-2,183***	***-2,183***	***-2,183***	***-2,183***	***-2,184***	***-2,184***

[1] Groundwater inflow-outflow prior to start of project.

The Blythe Mesa Solar Project would only use groundwater for minimal potable uses; however, the Blythe Energy Center, located to the west of the Project site, reports the use of approximately 3,000 ac-ft/yr as outlined in the 2010 City of Blythe UWMP.

Table 3 shows groundwater demand during years with normal recharge from precipitation compared to three multiple years with no recharge from precipitation.

Table 3. Groundwater Supply and Demand Conditions in Ac-ft/Yr Comparing Normal Precipitation Recharge and Multiple Dry Years

	2016	2017	2018	2019	2020
SUPPLY	**SUPPLY NORMAL YEARS**		**DRY YEARS**		
PVMGWB Total Inflow	817	817	575	575	575
DEMAND					
Groundwater Recharge from Project Site	0	0	0	0	0
Blythe Mesa Solar Project Groundwater Use	<1	<1	<1	<1	<1

Blythe Energy	3,000	3,000	3,000	3,000	3,000
Supply/Demand Difference (Inflow-Outflow)	-2,184	-2,184	-2,426	-2,426	-2,426

The groundwater basin may have overdraft conditions caused by projects that plan to extract water for wells during multiple drought years. The extraction of 3,000 ac-ft/yr is likely developing a cone of depression that would change groundwater flow directions. Groundwater flow direction changes caused by groundwater extraction on the Palo Verde Mesa during drought conditions might redirect gradients to the extent that the Palo Verde Valley Aquifer to the east would possibly provide recharge along its western boundary.

Additional groundwater extraction rates of 3,289 ac-ft/yr are proposed for the Blythe Energy II project located adjacent to the existing Blythe Energy power plant. The Blythe Energy II project would, along with the existing power plant, use a combined total groundwater extraction rate of 6,289 ac-ft/yr.

Project Demands (Surface Water)

The proposed Project would use a fraction of the water supply that is presently used for irrigation demand on the Project site. The present use at the Project site of about 12,000 ac-ft/yr of water used to irrigate agriculture would be reduced to approximately 451 ac-ft/yr of non-potable use during the three-year construction period and 345 ac-ft/yr of non-potable use during operations. Since the existing water used under the PVID's water right would be used for the Project, no new source of water would be required. Therefore, the Project does not represent a new demand for water supply, but converts the existing agricultural irrigation use to the proposed solar Project. Based on the existing water right, sufficient supply is available to serve the Project over a 20-year period.

5.0 CONCLUSIONS

Based on the conditions described above, water supply from PVID sources is sufficient to meet requirements of the proposed Project, including the minor potable groundwater demand under average-year, single-dry year, and multiple-dry year conditions over a 20-year future projection. Conclusions regarding water supply availability are summarized below.

- The existing water supply that is delivered to the project site through the PVID delivery facilities would be used to meet future non-potable Project water demands, which would be much less than the current agricultural irrigation use of about 12,000 ac-ft/yr.

- Less than 1 ac-ft of groundwater per year would be required for potable use in the two Operations and Maintenance buildings. CSA #122 has substantiated its intention to provide this potable supply by issuing a will-serve letter.

- Anticipated water supply management strategies for the Project will ensure adequate supply availability for the Project's anticipated water needs.

This Water Supply Assessment is in compliance with the requirements of the California Water Code, as amended by Senate Bill 610. Appendix A provides a detailed description of the steps followed to prepare this WSA.

6.0 REFERENCES

AECOM. 2010. Hydrogeologic Investigation Report. Application for Certification Blythe Solar Power Project Riverside, California. Appendix J3 Data Response in Technical Area: Soil and Water Resources (AFC Sections 5.12 and 5.17). Response Date: January 6, 2010

California Department of Water Resources (DWR). 1954. Ground Water Occurrence and Quality, Colorado River Basin Region. Water Quality Investigations Report No. 4.

_____. 1975 California's Ground Water, Bulletin No. 118.

_____. 1979. Sources of Powerplant Cooling Water in the Desert Area of Southern California-Reconnaissance Study. Bulletin 91-24. 55 p.

California Energy Commission (CEC). 2005. California Geothermal Resources. CEC-500-2005-070. http://www.energy.ca.gov/2005publications/CEC-500- 2005-070/CEC-500-2005-070.PDF. Accessed April, 2008.

_____. 2010. Revised Staff Assessment for the Blythe Solar Power Project. Soil and Water. June 2010. http://www.energy.ca.gov/2010publications/CEC-700-2010-004/CEC-700-2010-004-REV1.PDF

City of Blythe. 2007. Blythe General Plan 2025 EIR, Chapter 3.10 Public Services and Utilities.

Clyde, Woodward. 1986. As cited in the CEC RSA, June 2010

Eagle Crest Energy Company (Eagle Crest). 2009. Responses to Deficiency of License Application and Additional Information Request. October 26, 2009.

Engineering Science. 1990. As cited in the CEC RSA, June 2010.

Jennings, C. W. 1967. *Geologic Map of California, Salton Sea Sheet*. Single Map Sheet, Scale 1:250,000.

Leake, S. A., W. Greer, D. Watt, and P. Weghorst. 2008. Use of Superposition Models to Simulate Possible Depletion of Colorado River Water by Ground-Water Withdrawal - Scientific Investigations Report 2008-5189 (Prepared in Cooperation with the Bureau of Reclamation): U.S Geological survey, Reston, Virginia, 25p.

Metzger, D. G. 1965. A Miocene (?) Aquifer in the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geological Survey Professional Paper 525-C.

Metzger, D.G. and others. 1973. Geohydrology of the Parker-Blythe-Ciboloa Area, Arizona and California. U.S. Geological Survey Professional Paper 486-G. 130 p.

Owen-Joyce, S.J. 1984. A Method for Estimating Ground-Water Return Flow to the Colorado River in the Palo Verde-Cibola Area, California and Arizona. U.S. Geological Survey. Water-Resources Investigations Report 84-4236. 48 p.

Wilson, R.P., and S.J. Owen-Joyce. 1994. Method to Identify Wells that Yield Water that will be replaced by Colorado River Water in Arizona, California, Nevada, and Utah.

APPENDIX A: DWR GUIDEBOOK FOR IMPLEMENTATION OF SENATE BILL 610 AND SENATE BILL 221

The Water Supply Assessment (WSA) for the proposed Blythe Mesa Solar Project (proposed Project) was prepared using guidance contained in the California Department of Water Resources' (DWR) *Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001* (DWR Guidebook). The California DWR prepared the Guidebook to assist water suppliers in preparation of the water assessments and the written verification of water supply availability required by Senate Bill 610 and SB 221; the DWR has no regulatory or permitting approval authority concerning water assessments or verifications of sufficient water supply, and provides the Guidebook purely as an assistance tool (DWR 2003). The following table provides a detailed description of how the DWR Guidebook was used in preparing the proposed Project's WSA.

DWR Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 (DWR, 2003*)

Guidelines Section Number and Title (DWR, 2003*)	Guidelines Direction	Relevant WSA Section and Response
Section 1 (page 2). Does SB 610 or SB 221 apply to the proposed project?	*Is the project subject to SB 610?* Is the project subject to CEQA (Water Code §10910(a))? If yes, continue.	WSA Section 4 Yes, the Project is subject to CEQA.
	Is it a "Project" as defined by Water Code §10912(a) or (b)? If yes, to comply with SB 610 go to Section 2, page 4.	WSA Section 4 Yes, the proposed Project is considered to meet the definition of "Project" per Water Code §10912(a) or (b). However, a WSA was prepared for the purpose of being conservative.
	Is the project subject to SB 221? Does the tentative map include a "subdivision" as defined by Government Code §66473.7(a)(1)? If no, stop.	No, the proposed Project does not include a "subdivision"; SB 221 does not apply to the proposed Project, and no further action relevant to SB 221 is required.
Section 2 (page 4). Who will prepare the SB 610 analysis?	*Is there a public water system ("water supplier") for the project (Water Code § 10910(b))? If no, go to Section 3, page 6.*	WSA Section 4 Yes, there is a public water system present that could be used to meet the proposed Project's small potable water supply requirements.
Section 3 (page 6). Has an assessment already been prepared that includes this project?	*Has this project already been the subject of an assessment (Water Code §10910(h))? If no, go to Section 4, page 8.*	No, the proposed Project has not been the subject of an assessment.
Section 4 (page 8). Is there a current Urban Water Management Plan?	*Is there an adopted urban water management plan (Water Code §10910(c))? If yes, continue. If yes, information from the UWMP related to the proposed water demand for the project may also be used for carrying out Section 5, Steps 1 and 2, and Section 7; proceed to Section 5, page 10 of the Guidelines.*	Yes, the City of Blythe, California has a UWMP, but it is not anticipated that the City will supply water to the Project.
	Is the projected water demand for the project accounted for in the most recent UWMP (Water Code §10910(c)(2))? If no, go to Section 5, page 10.	No. The water for the Project will come from the Palo Verde Irrigation District.
Section 5 (page 10). What information should be included in an assessment?	*Step One (page 13). Documenting wholesale water supplies.*	The proposed Project does not include the use of any wholesale water supplies.

Guidelines Section Number and Title (DWR, 2003*)	Guidelines Direction	Relevant WSA Section and Response
	Step Two (page 17). Documenting Supply if Groundwater is a Source.*	Groundwater extraction is not presently proposed as the Project's water supply.
	a) Specify if a groundwater management plan or any other specific authorization for groundwater management for the basin has been adopted and how it affects the water supplier's use of the basin.	WSA Section 3 No comprehensive groundwater management plan currently exists for the Palo Verde Mesa Groundwater Basin.
	b) The description of the groundwater basin may be excerpted from the groundwater management plan, from DWR Bulletin 118, California's Ground Water, or from some other document that has been published and that discusses the basin boundaries, type of rock that constitutes the aquifer, variability of the aquifer material, and total groundwater in storage (average specific yield times the volume of the aquifer).	WSA Chapter 3 (Palo Verde Mesa Groundwater Basin) of the WSA provides a description of the groundwater basin characteristics using all available resources.
	c) In an adjudicated basin the amount of water the urban supplier has the legal right to pump should be enumerated in the court decision.	WSA Chapter 3 The Palo Verde Mesa Groundwater Basin is currently non-adjudicated.
	d) The Department of Water Resources has projected estimates of overdraft, or "water shortage," based on projected amounts of water supply and demand (basin management), at the hydrologic region level in Bulletin 160, California Water Plan Update. Estimates at the basin or sub basin level will be projected for some basins in Bulletin 118. If the basin has not been evaluated by DWR, data that indicate groundwater level trends over a period of time should be collected and evaluated.	WSA Section 3 DWR Bulletin 118 has not projected estimates of overdraft specific to the Palo Verde Mesa Groundwater Basin; however, possible overdraft conditions should be investigated based on current groundwater extraction rates and changes in recharge from decreasing agricultural use
	e) If the evaluation indicates an overdraft due to existing groundwater extraction, or projected increases in groundwater extraction, describe actions and/or program designed to eliminate the long term overdraft condition	WSA Section 3 The evaluation does not indicate an overdraft condition due to existing groundwater extraction. Groundwater extraction proposed by other future projects (Blythe Energy) may stress the aquifer capabilities and develop overdraft conditions.
	f) If water supplier wells are plotted on a map, or are available from a geographic information system, the amount of water extracted by the water supplier for the past five years can be obtained from the Department of Health Services, Office of Drinking Water and Environmental Management.	Groundwater would supply less than an acre foot per year through CSA #122 facilities.

Guidelines Section Number and Title (DWR, 2003*)	Guidelines Direction	Relevant WSA Section and Response
	g) Description and analysis of the amount and location of groundwater pumped by the water supplier for the past five years. Include information on proposed pumping locations and quantities. The description and analysis is to be based on information that is reasonably available, including, but not limited to, historic use records from DWR.	Groundwater would supply less than an acre foot per year through CSA #122 facilities.
	h) Analysis of the location, amount, and sufficiency of groundwater that is projected to be pumped by the water supplier.	WSA Section 3
	Step 3 (page 21). Documenting project demand (Project Demand Analysis).	WSA Section 4.1
	Step 4 (page 26). Documenting dry year(s) supply.	WSA Section 4.1, see "Groundwater Supply Availability Projections" and Tables 2 and 3.
	Step 5 (page 31). Documenting dry year(s) demand.	WSA Section 4, see "Groundwater Supply Availability Projections" and Tables 2 and 3.
Section 6 (page 33). Is the projected water supply sufficient or insufficient for the proposed project?		WSA Section 5 (Conclusions) The projected water supply is sufficient for the proposed Project through water used from the PVID.
Section 7 (page 35). If the projected supply is determined to be insufficient.	*Does the assessment conclude that supply is "sufficient"? If no, continue.*	WSA Section 5 The WSA concludes the water supply is sufficient.
Section 8 (page 38). Final SB 610 assessment actions by lead agencies.	*The lead agency shall review the WSA and must decide whether additional water supply information is needed for its consideration of the proposed project. The lead agency "shall determine, based on the entire record, whether projected water supplies will be sufficient to satisfy the demands of the project, in addition to existing and planned future uses."*	

* DWR (California Department of Water Resources), 2003. Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001. [online]: http://www.water.ca.gov/pubs/use/sb_610_sb_221_guidebook/guidebook.pdf. Accessed April 7, 2011.

APPENDIX H
WASH FEATURE
SUMMARY OF FINDINGS

THIS PAGE INTENTIONALLY LEFT BLANK

May 28, 2013

RENEWABLE RESOURCES GROUP

Blythe Mesa CUP 03685 Wash Feature

Summary of Findings

PROJECT NUMBER:
123128

PROJECT CONTACT:
Michel Ybarrondo
EMAIL:
Michel.ybarrondo@powereng.com
PHONE:
208-288-6131

POWER ENGINEERS

THIS PAGE INTENTIONALLY LEFT BLANK

Study Description

The purpose of this study was to delineate the 100-year floodplain for the wash feature located within the property at the request of the county. The surface feature had been identified based on available topographic maps. Due to the feature's apparent slopes as indicated on the topographic maps, SunPower engineers had proposed to avoid placing tracker panels there.

Existing Site Description

Power Engineers visited the site and took photos at the location shown on Figure 1. This location was the topographic low along Mesa Drive in the vicinity of the map feature. The photos are shown in Figures 2-4 and are labeled with the facing direction.

Based on the site visit and review of aerial photos, the feature is a slight depression with no discernable channel as shown in Figure 2. Similarly, looking east from the photo location in Figures 3 and 4, there is no channel feature based on sediment, topography or vegetation noted.

Proposed Site Preparation

Since most of the site has nearly level to gently sloping topography, no mass grading would be required. Some of the parcels where facilities and arrays would be located would require light grubbing for leveling and trenching. Access roads would require minimal grading. After grubbing and light grading, construction of staging areas would occur. On-site pre-assembly of trackers would take place in the assembly area. **The construction of staging areas will not be in the location of the floodplain delineation.**

The PV system proposed for the site can operate on slopes up to nine percent in all directions. Fine grading would only be required for the development of site access.

Installation of the electrical collection system would require excavations to a depth of about three feet for underground electrical circuits and inverter. The O&M building foundations would also be excavated to a depth of about three feet. **The O&M building is not proposed to be located in the floodplain delineation area.**

Proposed Construction Activities

The Project would be constructed in the following phases, which would occur simultaneously on different portions of the site:

- Development of staging areas and assembly areas, and grading of site access roads.
- Construction of arrays including pile installation, assembly of trackers, mounting of PV panels, and trenching and installation of electrical equipment for arrays.
- Construction of electrical transmission facilities including the construction of three substations, the 230 kV gen-tie line, and two O&M buildings.

Staging Areas, Assembly Areas, and Access Roads

Construction staging and material lay-down would be distributed across the solar facility evenly to allow for efficient distribution of components to different parts of the Project. One staging and material lay-down area would typically be set up for every 100 acres of the Project site. These lay-down areas would be temporarily fenced and would cover approximately five acres each. Lay-down areas would be converted to solar arrays as work is completed in the general area. Within the solar field, 10-foot-wide access roads would also be constructed to allow access to and maintenance of the solar panels.

Array Assembly

Tracker assembly may include up to 25 small gas-powered generators to power welding machines to assemble trackers and construct tracker arrays. Support piles up would be driven into the ground to a depth of eight to twelve feet using a vibration technology to reduce noise impacts. Torque tubes, electrical wire trays, and panels would then be installed on the piles. Concrete foundations for the drive motors would be poured in place, and electrical equipment for the array would be set in place. A tracked backhoe would drive piles. No blasting or rock breaking is anticipated or proposed. Small truck-mounted cranes or grade-all forklifts would place trackers on support tiles. Tracker installation would include small all-terrain vehicles to transport materials and workers on access roads and array aisles.

Substations

Construction of the substations would involve site preparation, clearing of the switchrack sites, and installation of substructures and electrical equipment. Each site would first be cleared and graded, and then security-fenced for the duration of substation construction. Underground Service Alert would be contacted to mark the locations of existing buried utilities in the vicinity. Substation materials and equipment would be delivered to, and stored at, the substation site, as required, during construction. The sites would be graded to maintain current drainage patterns as much as possible.
Each substation would be constructed with conventional grading and construction equipment. Grading would establish the desired site grade, and minor excavation would provide concrete footings for the substation equipment. The substation sites would be graveled with crushed rock for grounding and employee safety purposes. **The project substations are not proposed to be located in the floodplain delineation area.**

O&M Buildings

The O&M building areas would be surveyed and staked. A concrete slab would be poured to the dimensions of each building. The prefabricated steel building structures would then be assembled. The exterior finish would be constructed as the mechanical and electrical systems are built inside. Interior finishing would follow, and final fixtures and equipment would be installed. **The O&M building is not proposed to be located in the floodplain delineation area.**

Gen-tie Line

The gen-tie line construction would involve the following activities: (1) construction of staging areas for trailers, office personnel, equipment, material staging, lay-down, and employee parking; (2) construction of access roads to the structure locations; (3) pole erection; (4) conductor installation; (5)

tension and pulling sites of conductors; and (6) installation of overhead ground/fiber optic communications systems. **Gen-tie lines are not proposed to be located in the floodplain delineation area.**

Design Flows

To determine the design flows for our models, we followed the methods outlined in the Riverside County Flood Control and Water Conservation District Hydrology Manual, 1978. Hydrologic calculations are shown in Appendix A. The calculated 100-year flow using the 3-hour 100-year storm is 3,220 cubic feet per second (cfs).

Topography

The survey used for the cross-sections was provided to POWER and has a resolution of 5-foot intervals.

Representation of Vegetation

In the model, the effects of vegetation on flow are represented by Manning's n values. These values were estimated by comparing the site conditions to photos of site conditions which were similar and have verified Manning's n values. Given the similar vegetation conditions within the washes and the large design flow, Manning's n through the cross-sections was kept constant at 0.03.

Scour Calculations

At the request of Riverside County Flood Control, we performed preliminary scour calculations using the HEC-RAS hydraulic model results. Hydraulic Engineering Center HEC-18 method was used and the equation is shown after Table 1 in Appendix C. Scour was calculated for the center of the channel, the left and right overbanks of the channel, and at points where arrays are shown in the calculated floodplain in Figure 1A. Due to the wide, flat nature of the area, water depths are shallow (2.85-ft maximum) and are generally less than or equal to 2 feet outside the proposed avoidance area. Stream velocities vary from 5.8 ft/s (4 mph) to an average of 2.4 ft/s (1.6 mph) outside of the main channel. Since minimal grading will be done as mentioned above in the Proposed Construction Activities section, it was assumed that no channelization or other variables that can increase scour depths will be present post-construction.

Results

Floodplain Delineation

The extents of the 100-year floodplains for the area are shown on Figure 1A. The floodplain is based on the predicted flow elevation for each cross-section and interpolation between them. Cross-sections can be found in Appendix B. The majority of the floodplain falls within the avoided area proposed. However, the arrays do encroach on the calculated floodplain in a couple of locations. This is due

to the relatively flat topography perpendicular to the flow direction in the area. If it is deemed necessary during final design, the panels and associated hardware can be elevated to provide additional clearance above the calculated floodplain water elevation.

Scour Calculations

Preliminary scour depths are shown in Table 1 in Appendix C and are also summarized for points of interest on Figure 1A. The maximum scour in the deepest part of the channel with the highest velocity is 16 inches which is minimal for a lightly loaded pier driven to a depth of 8-12 feet. Preliminary scour depths for the points highlighted in Figure 1A range from 14-7 inches. During final design, if it is deemed necessary by the foundation design engineer, the pier design will account for scouring.

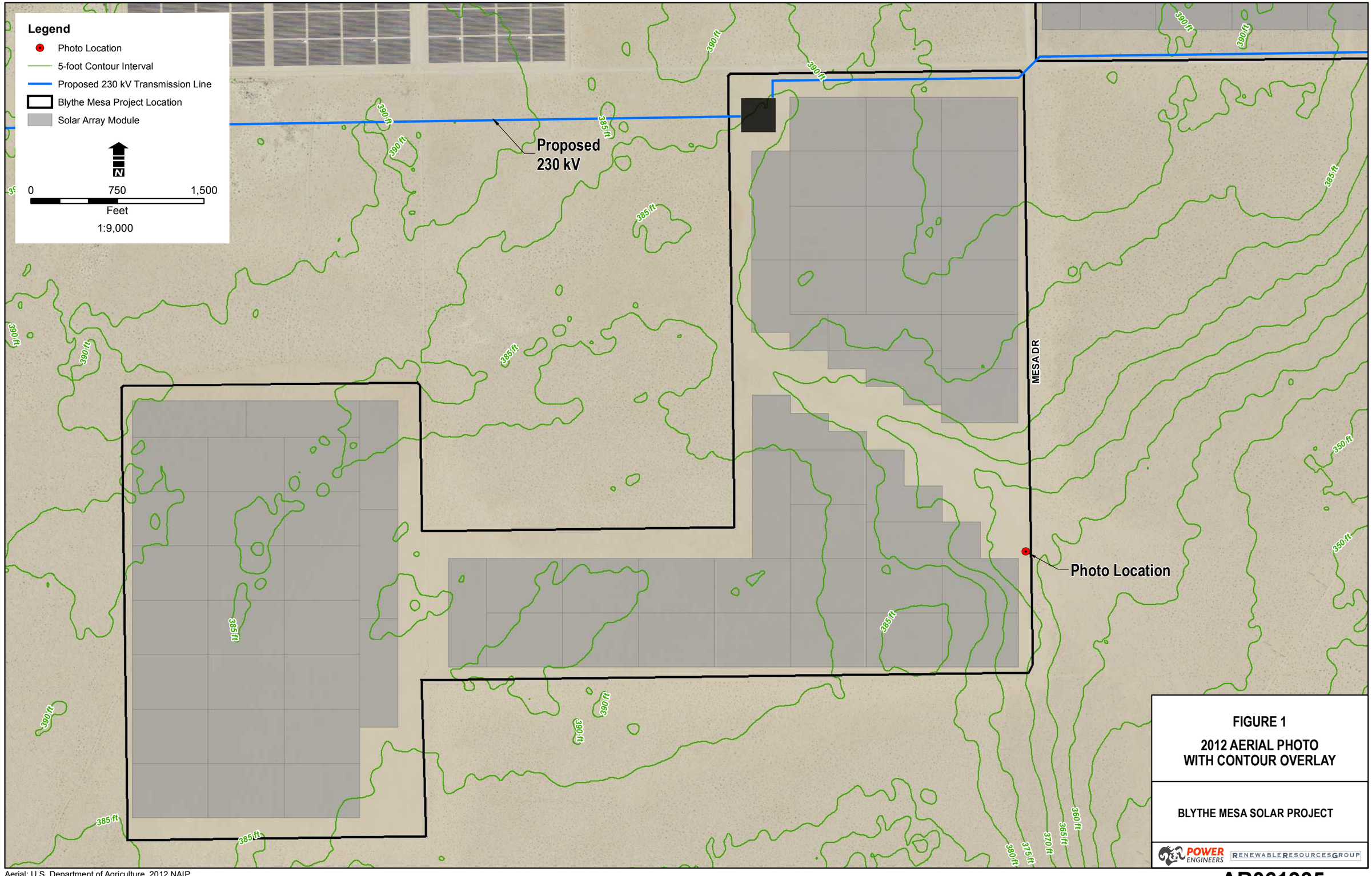


FIGURE 1

2012 AERIAL PHOTO WITH CONTOUR OVERLAY

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLE RESOURCES GROUP

Aerial: U.S. Department of Agriculture, 2012 NAIP.

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

- Photo Location
- Camera View and Direction
- Proposed 230 kV Transmission Line
- Blythe Mesa Project Location
- Solar Array Module

N

0 2,500 5,000

Feet

1:30,000

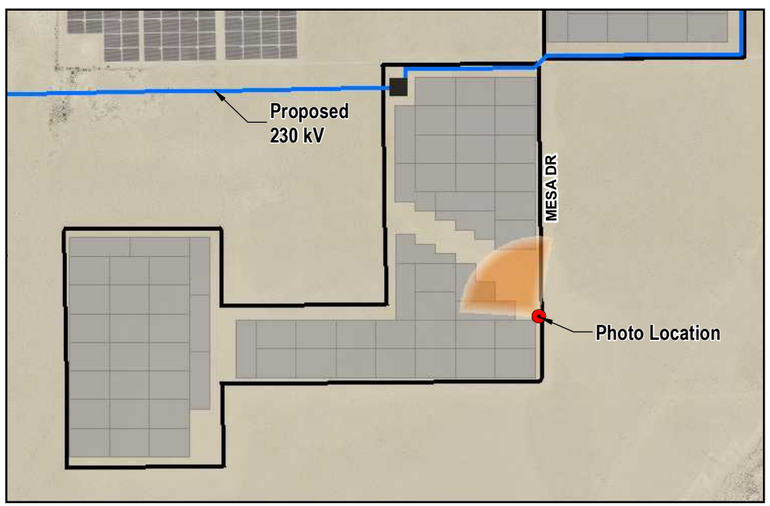


PHOTO LOCATION WITH CAMERA VIEW

FIGURE 2

SITE PHOTO FACING NORTHWEST

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

THIS PAGE INTENTIONALLY LEFT BLANK

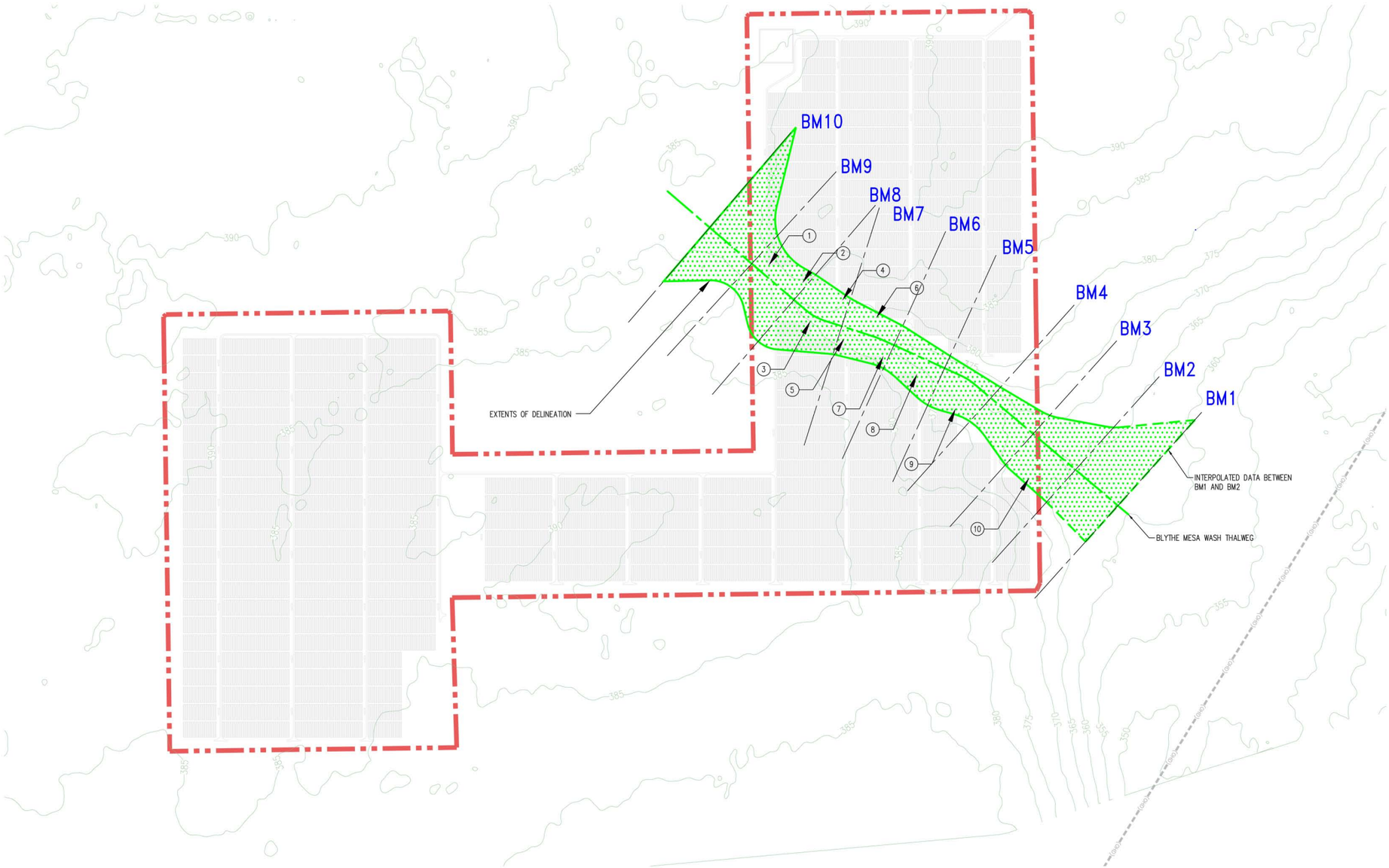
N

0 250 500 1000 1500 FEET
1" = 500'

LEGEND:

- PROPOSED PROJECT BOUNDARY
- 100 YEAR FLOODPLAIN DELINEATION
- EXISTING CONTOURS (5 FT INTERVALS)
- BLYTHE WASH THALWEG
- BM4 — SECTIONS/SECTION #'S

POINT	WATER DEPTH (FT)	VELOCITY (FT/S)	SCOUR (IN)
1	2.66	7.0	16
2	1.62	2.2	9
3	2.77	4.6	14
4	0.49	1.6	7
5	2.64	6.1	15
6	0.42	3.2	9
7	1.83	3.4	11
8	2.65	6.2	15
9	0.91	2.0	8
10	0.41	1.4	6



THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
D	ISSUED FOR REVIEW	06/17/13	PBK		MWY		
C	ISSUED FOR REVIEW	05/15/13	PBK		MWY		
B	ISSUED FOR REVIEW	02/13/13	PBK		MWY		
A	ISSUED FOR REVIEW	10/05/12	WBG			*	

DSGN
DRN WBG 10/05/12
CKD
SCALE: AS SHOWN

POWER ENGINEERS

RENEWABLE RESOURCES GROUP, INC.
BLYTHE MESA
BLYTHE, CA 92225
FIGURE 1A: BM SOLAR PROJECT 100 YR FLOODPLAIN FOR CONDITIONAL USE PERMIT

JOB NUMBER 124493
REV D
DRAWING NUMBER 1 OF 1

AR061939

123128_100YEAR-DEL.DWG

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

- Photo Location
- Camera View and Direction
- Proposed 230 kV Transmission Line
- Blythe Mesa Project Location
- Solar Array Module

N

0 2,500 5,000
Feet
1:30,000

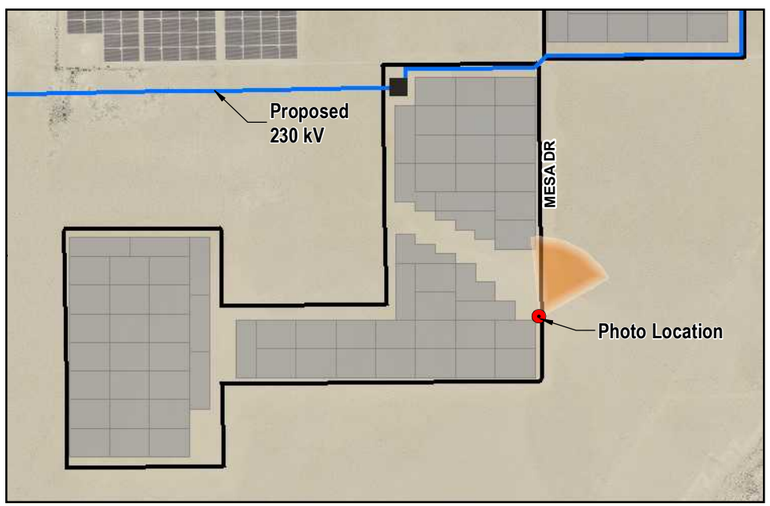


PHOTO LOCATION WITH CAMERA VIEW

FIGURE 3

**SITE PHOTO
FACING NORTHEAST**

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS | RENEWABLERESOURCESGROUP

THIS PAGE INTENTIONALLY LEFT BLANK



SITE PHOTO, FACING SOUTHEAST

Legend

- Photo Location
- Camera View and Direction
- Proposed 230 kV Transmission Line
- Blythe Mesa Project Location
- Solar Array Module

N

0 2,500 5,000

Feet

1:30,000

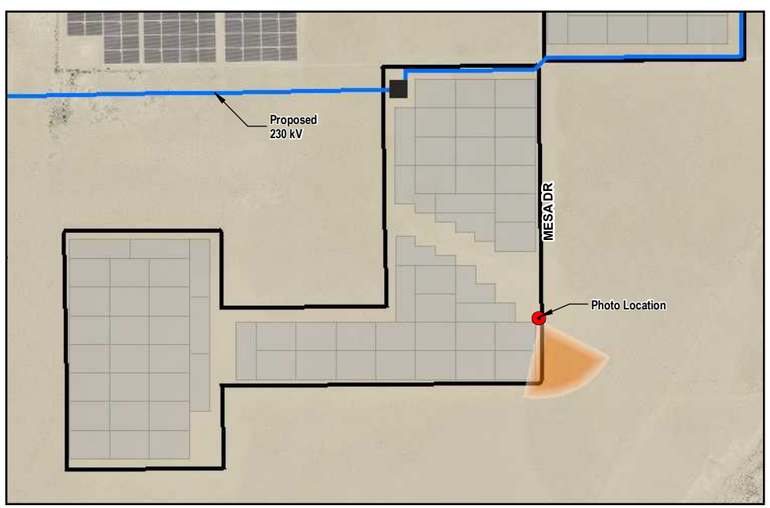


PHOTO LOCATION WITH CAMERA VIEW

FIGURE 4

SITE PHOTO FACING SOUTHEAST

BLYTHE MESA SOLAR PROJECT

POWER ENGINEERS RENEWABLERESOURCESGROUP

AR061943

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A

Hydrologic Calculations

The following pages are from the spreadsheet titled, "HydrologicAnalysis_BlytheMesa_3hr_050213.xlsx," which is also submitted electronically to facilitate review.

THIS PAGE INTENTIONALLY LEFT BLANK

Index

Project: Blythe Mesa
Project Number: 124493

Analyst: MWY
Latest Revision: 1/17/2013

Workbook Description

This workbook contains spreadsheets that:
- Calculate variables.
- Calculate synthetic unit hydrographs.
- Calculate adjusted point rainfall using NOAA data.
- Calculate Effective rainfall for HEC-HMS import.

Filename:

\\Boifs1\Civil\124493_123128\123128 Blythe Mesa I\Report_05-15-2013\Appendix A\[HydrologicAnalysis_BlytheMesa_3hr_050213.xlsx]Index

Sheet Titles:

Index
Streamstats
Variable Summary
S-Graph Values
NOAA Data
Adjusted Point Rainfall
Infiltration Rate
Unit Period Rainfall and Effective Rain
Flood Hydrograph Calculations
100-Year Flood Hydrograph, Blythe Mesa

THIS PAGE INTENTIONALLY LEFT BLANK

Streamstats

Project: Blythe Mesa **Analyst:** MWY

Project Number: 124493 **Latest Revision:** 1/17/2013

StreamStats Information



Basin Characteristics Report

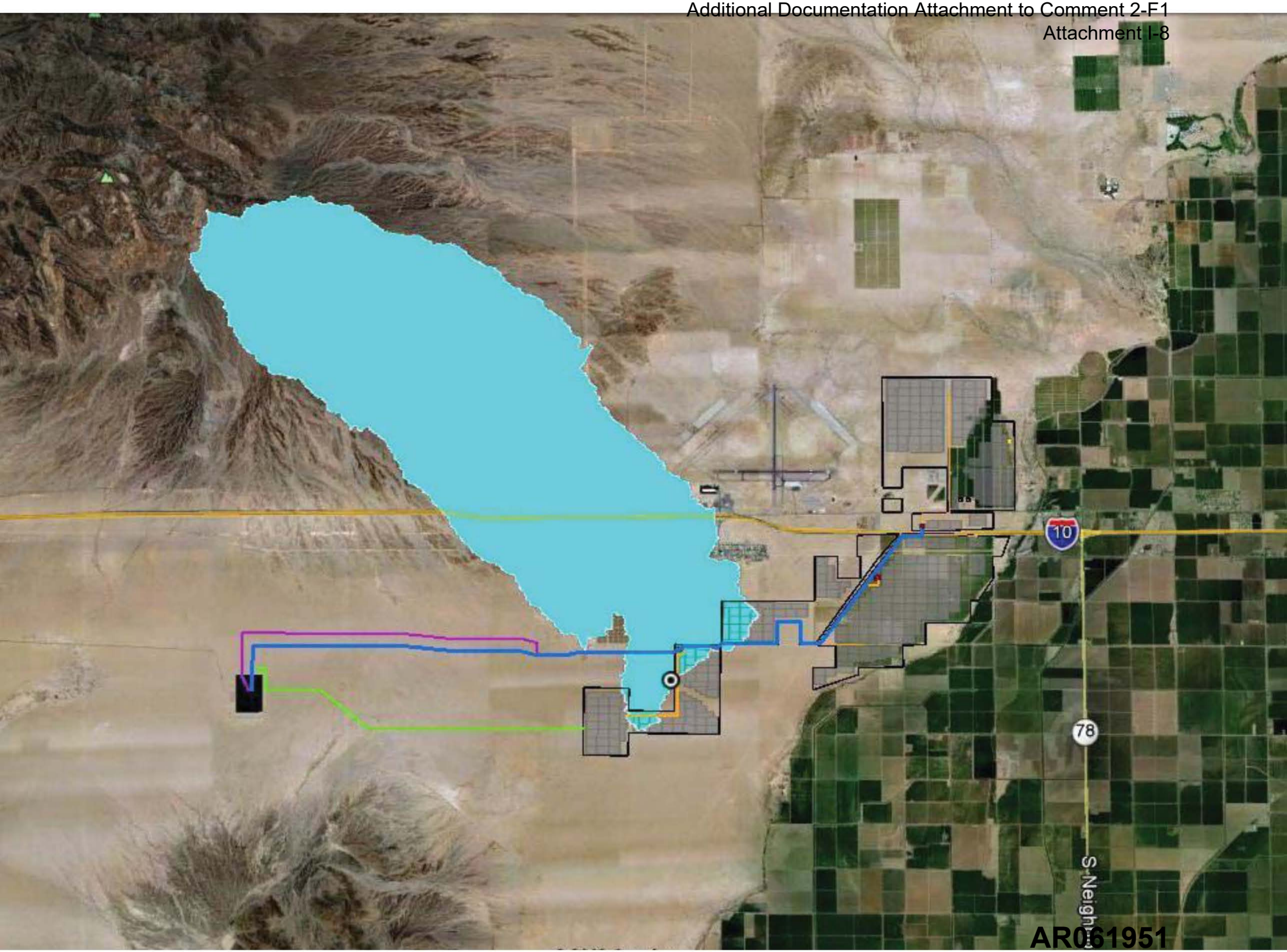
Date: Fri Jan 25 2013 10:13:34 Mountain Standard Time
NAD27 Latitude: 33.5829 (33 34 58)
NAD27 Longitude: -114.7356 (-114 44 08)
NAD83 Latitude: 33.5829 (33 34 59)
NAD83 Longitude: -114.7364 (-114 44 11)

Parameter	Value
Area, in square miles	14.6
Mean annual precipitation, in inches	4.21
Average maximum January temperature, in degrees Fahrenheit	66.5
Average minimum January temperature, in degrees Fahrenheit	41.7
Maximum elevation, in feet	1816
Minimum elevation, in feet	381
Relief, in feet	1435
Elevation at outlet, in feet	381
Average basin elevation, in feet	595
Relative relief - Basin relief divided by basin perimeter, in feet per mile	51.7
High Elevation Index - Percent of area above 6000 feet	0
Altitude Index, in thousands of feet. Estimated as 0.00083 times mean basin elevation.	0.49
Mean basin slope computed from 30 m DEM, in percent	11
Percentage of basin covered by forest	0
Percent of area covered by lakes and ponds	0
Percentage of impervious area determined from NLCD 2001 imperviousness dataset	1.4
X coordinate of the centroid, in map coordinates	-1718337.4
Y coordinate of the centroid, in map coordinates	1343212.0
Latitude of the outlet, NAD83	33.58292
X coordinate of the outlet, in map coordinates	-1716030.0
Y coordinate of the outlet, in map coordinates	1338090.0
Basin perimeter, in miles	27.8
Distance in miles from basin centroid to the coast	150
Length of the longest flow path in meters	15750
Elevation relief in meters	437

AR061949

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

THIS PAGE INTENTIONALLY LEFT BLANK


10
78
S Neighbors

THIS PAGE INTENTIONALLY LEFT BLANK

Variable Summary

Project: Blythe Mesa
Project Number: 124493
Analyst: MWY
Latest Revision: 1/17/2013

Spreadsheet Description:

- This spreadsheet summarizes input variables, lag calculations, and time period calculations.

Variables

Variable	Definition	Value	Source
A	Drainage Area (square miles)	14.6	StreamStats
K	Ultimate Discharge (CFS-hours/inch) =645*A	9417	
L	Length of longest Watercourse (miles)	9.8	StreamStats
Lca	Length along the longest watercourse, measured upstream to a point opposite the centroid of the area (miles)	4.9	StreamStats
H	Difference in elevation between the concentration point and the most remote point of the basin (feet)	1435	StreamStats
S	Overall slope of longest watercourse between headwaters and concentration point (feet per mile, S=H/L)	146.6	

Lag Calculation

Variable	Definition	Value	Source
Lag (hours)	24n(L x Lca/S^1/2)^0.38	1.2	
n	The visually estimated mean of the n (Mannings formula) values of all collection streams and channels within the watershed.	0.03	City of Riverside.

Unit Time Period Calculation

Variable	Definition	Value
25% of Lag Time	Ideal unit time period, unless the precipitation data is more detailed (minutes)	18.2
40% of Lag Time	Maximum time period (minutes)	29.1
Unit Time Period	25-40% of total Lag time (minutes)	15
Unit Time Period (% Lag)	This value is used in determination of the synthetic unit hydrograph	20.6

S-Graph Values

Project: Blythe Mesa
Project Number: 124493
Analyst: MWY
Latest Revision: 1/17/2013

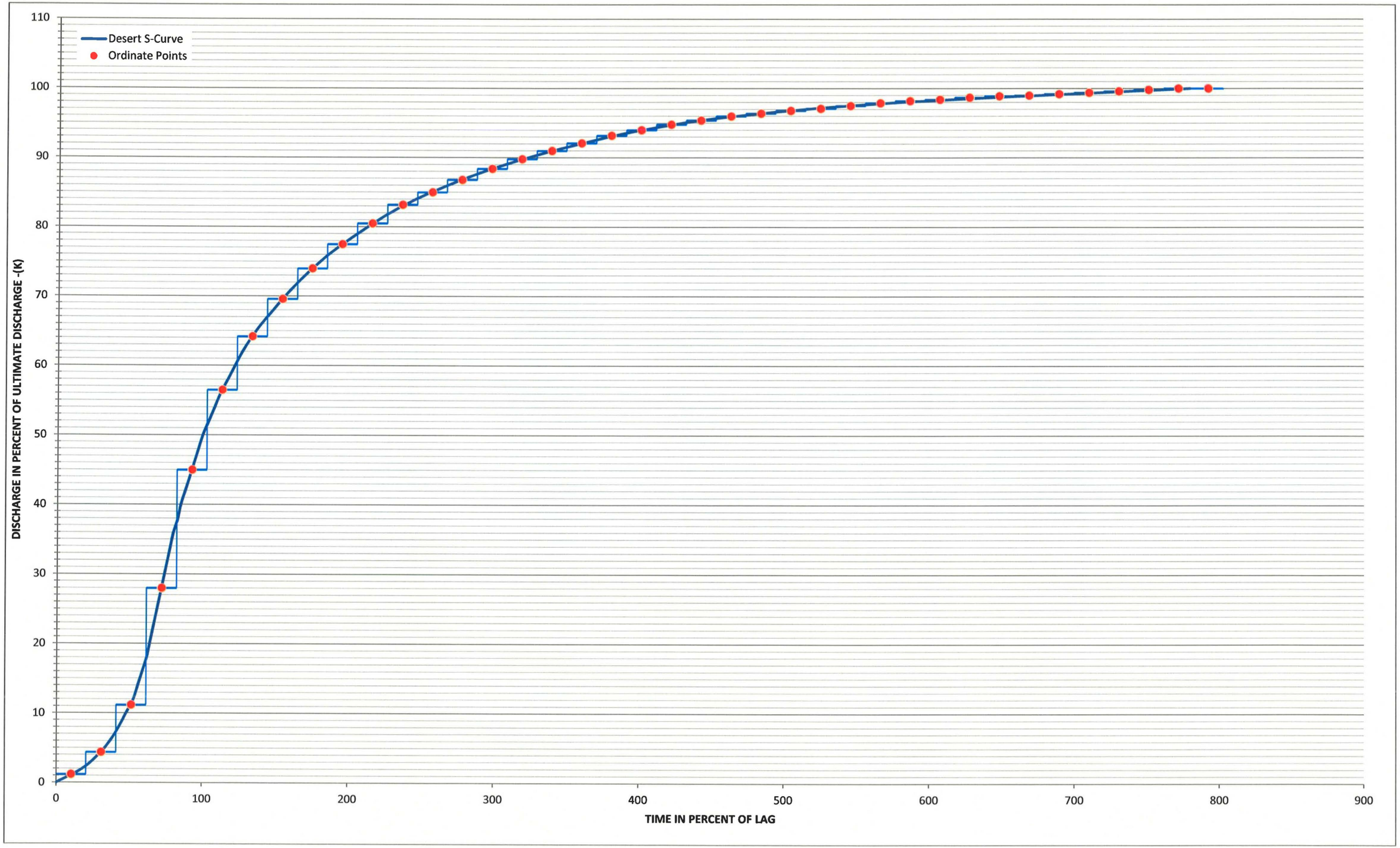
Spreadsheet Description:

- This spreadsheet is used to develop the S-graph values for use in HEC-HMS.
- Unit Time is calculated in the Variable Summary worksheet.
- For this project, the Desert S-Curve provided by Riverside County is used for calculations.
- The ordinate Midpoint is calculated as the midpoint between Unit Time Period adjusted for Time Percent of Lag.
- Discharge is adjusted to fit the S-Curve.

S-Graph Value Calculations

Unit Time (%)	20.6		
Ultimate Discharge (CFS-hours/Inches)	9417.0	From Variable Summary Worksheet	

[15]	[16]		[17]	[18]	[19]
Unit Time Period	Time percent of Lag (%)	Ordinate Midpoint (%)	Cumulative Average Percent of Ultimate Discharge (S-Graph) (%)	Distributed Graph Percent [17]m-[17]m-1	Unit Hydrograph (CFS-hours/Inches) ([4]*[18])/100
1	20.6	10.3	1.2	1.2	113.004
2	41.2	30.9	4.4	3.2	301.344
3	61.8	51.5	11.2	6.8	640.356
4	82.4	72.1	28	16.8	1582.056
5	103.0	92.7	45	17.0	1600.89
6	123.6	113.3	56.5	11.5	1082.955
7	144.1	133.8	64.2	7.7	725.109
8	164.7	154.4	69.6	5.4	508.518
9	185.3	175.0	74	4.4	414.348
10	205.9	195.6	77.5	3.5	329.595
11	226.5	216.2	80.5	3.0	282.51
12	247.1	236.8	83.2	2.7	254.259
13	267.7	257.4	85	1.8	169.506
14	288.3	278.0	86.8	1.8	169.506
15	308.9	298.6	88.4	1.6	150.672
16	329.5	319.2	89.8	1.4	131.838
17	350.1	339.8	91	1.2	113.004
18	370.7	360.4	92.1	1.1	103.587
19	391.2	381.0	93.2	1.1	103.587
20	411.8	401.5	94	0.8	75.336
21	432.4	422.1	94.8	0.8	75.336
22	453.0	442.7	95.4	0.6	56.502
23	473.6	463.3	96	0.6	56.502
24	494.2	483.9	96.4	0.4	37.668
25	514.8	504.5	96.8	0.4	37.668
26	535.4	525.1	97.1	0.3	28.251
27	556.0	545.7	97.5	0.4	37.668
28	576.6	566.3	97.9	0.4	37.668
29	597.2	586.9	98.2	0.3	28.251
30	617.8	607.5	98.4	0.2	18.834
31	638.4	628.1	98.7	0.3	28.251
32	658.9	648.7	98.9	0.2	18.834
33	679.5	669.2	99	0.1	9.417
34	700.1	689.8	99.2	0.2	18.834
35	720.7	710.4	99.4	0.2	18.834
36	741.3	731.0	99.6	0.2	18.834
37	761.9	751.6	99.8	0.2	18.834
38	782.5	772.2	100	0.2	18.834
39	803.1	792.8	100	0.0	0
				100.0	9417


Desert S-Curve
Ordinate Points
DISCHARGE IN PERCENT OF ULTIMATE DISCHARGE -(K)
TIME IN PERCENT OF LAG
0
10
20
30
40
50
60
70
80
90
100
110
0
100
200
300
400
500
600
700
800
900

THIS PAGE INTENTIONALLY LEFT BLANK

NOAA Data

Project: Blythe Mesa
Project Number: 124493
Analyst: MWY
Latest Revision: 1/17/2013

Spreadsheet Description:

- The data shown in the pasted pdf below provides point precipitation frequency estimates.
- These values are used to determine the adjusted point rainfall.

NOAA Atlas 14 Information

Double click on the window below to open the pdf document.

Value used: 24-hr duration with an average recurrence interval of 100 years--3.87 inches.

Notes: Numerous locations within the basin were compared. Variation between the different points was minimal. This location in the mid upper portion of the basin is not the highest, but is above the majority of the basin.

Precipitation Frequency Data Server — Page 1 of 5

NOAA Atlas 14, Volume 6, Version 2
Location name: Blythe, California, US*
Coordinates: 33.6213, -114.7739
Elevation: 691ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sarja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence interval

Duration	Average recurrence interval(years)							
	1	2	5	10	25	50	100	200
5-min	0.090 (0.075–0.108)	0.148 (0.124–0.179)	0.222 (0.185–0.269)	0.281 (0.232–0.343)	0.358 (0.286–0.452)	0.415 (0.325–0.536)	0.472 (0.360–0.626)	0.530 (0.393–0.722)
10-min	0.128 (0.108–0.155)	0.212 (0.178–0.256)	0.318 (0.265–0.385)	0.402 (0.333–0.491)	0.513 (0.410–0.648)	0.595 (0.466–0.769)	0.677 (0.517–0.897)	0.760 (0.563–1.04)
15-min	0.155 (0.130–0.187)	0.256 (0.215–0.310)	0.385 (0.321–0.466)	0.486 (0.402–0.594)	0.620 (0.496–0.784)	0.720 (0.563–0.930)	0.819 (0.625–1.09)	0.919 (0.681–1.25)
30-min	0.214 (0.179–0.258)	0.353 (0.296–0.426)	0.530 (0.442–0.641)	0.670 (0.554–0.818)	0.854 (0.683–1.08)	0.992 (0.776–1.28)	1.13 (0.860–1.49)	1.27 (0.937–1.73)
60-min	0.299 (0.250–0.360)	0.493 (0.413–0.595)	0.740 (0.617–0.895)	0.935 (0.774–1.14)	1.19 (0.953–1.51)	1.38 (1.08–1.79)	1.58 (1.20–2.09)	1.77 (1.31–2.41)
2-hr	0.414 (0.347–0.499)	0.644 (0.539–0.776)	0.938 (0.783–1.14)	1.17 (0.978–1.43)	1.48 (1.19–1.87)	1.72 (1.34–2.22)	1.95 (1.49–2.58)	2.19 (1.62–2.98)
3-hr	0.481 (0.403–0.579)	0.731 (0.612–0.882)	1.05 (0.878–1.27)	1.31 (1.08–1.60)	1.65 (1.32–2.09)	1.91 (1.50–2.47)	2.17 (1.66–2.87)	2.43 (1.80–3.32)
6-hr	0.577 (0.484–0.696)	0.859 (0.719–1.04)	1.22 (1.02–1.48)	1.52 (1.26–1.86)	1.92 (1.54–2.43)	2.23 (1.74–2.87)	2.53 (1.93–3.36)	2.85 (2.11–3.89)
12-hr	0.648 (0.543–0.781)	0.961 (0.805–1.16)	1.38 (1.15–1.67)	1.72 (1.42–2.10)	2.19 (1.75–2.77)	2.56 (2.00–3.31)	2.94 (2.24–3.89)	3.33 (2.47–4.54)
24-hr	0.814 (0.719–0.941)	1.21 (1.07–1.40)	1.75 (1.54–2.03)	2.21 (1.93–2.58)	2.84 (2.41–3.42)	3.34 (2.78–4.10)	3.87 (3.15–4.85)	4.43 (3.51–5.69)
2-day	0.889 (0.785–1.03)	1.33 (1.17–1.54)	1.92 (1.69–2.23)	2.42 (2.12–2.83)	3.13 (2.66–3.77)	3.70 (3.08–4.54)	4.30 (3.50–5.39)	4.93 (3.92–6.34)
3-day	0.935 (0.825–1.08)	1.40 (1.23–1.62)	2.03 (1.78–2.35)	2.56 (2.23–2.99)	3.31 (2.81–3.98)	3.91 (3.25–4.80)	4.54 (3.70–5.69)	5.22 (4.14–6.70)
4-day	0.991 (0.875–1.15)	1.48 (1.31–1.72)	2.15 (1.89–2.50)	2.72 (2.37–3.17)	3.51 (2.98–4.23)	4.15 (3.45–5.09)	4.82 (3.92–6.04)	5.53 (4.39–7.10)
7-day	1.03 (0.906–1.19)	1.55 (1.36–1.79)	2.25 (1.98–2.61)	2.83 (2.47–3.31)	3.65 (3.09–4.39)	4.30 (3.57–5.27)	4.97 (4.05–6.23)	5.68 (4.51–7.30)
10-day	1.06 (0.938–1.23)	1.60 (1.41–1.85)	2.32 (2.04–2.69)	2.92 (2.55–3.41)	3.75 (3.18–4.51)	4.41 (3.67–5.40)	5.09 (4.14–6.38)	5.81 (4.61–7.47)
20-day	1.18 (1.04–1.36)	1.74 (1.53–2.01)	2.49 (2.19–2.89)	3.12 (2.72–3.64)	3.99 (3.39–4.81)	4.69 (3.90–5.75)	5.41 (4.40–6.78)	6.17 (4.90–7.93)
30-day	1.29 (1.14–1.49)	1.88 (1.65–2.17)	2.66 (2.34–3.09)	3.32 (2.90–3.88)	4.24 (3.60–5.11)	4.98 (4.14–6.10)	5.75 (4.68–7.20)	6.57 (5.21–8.44)
45-day	1.45 (1.28–1.68)	2.07 (1.83–2.40)	2.91 (2.56–3.37)	3.61 (3.15–4.22)	4.61 (3.91–5.55)	5.41 (4.50–6.63)	6.25 (5.09–7.84)	7.17 (5.69–9.21)
60-day	1.61	2.26	3.13	3.88	4.95	5.81	6.73	7.74

http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_printpage.html?lat=33.6213&lon=-114.7739&dat... 1/29/2013

Adjusted Point Rainfall

Project: Blythe Mesa
Project Number: 124493

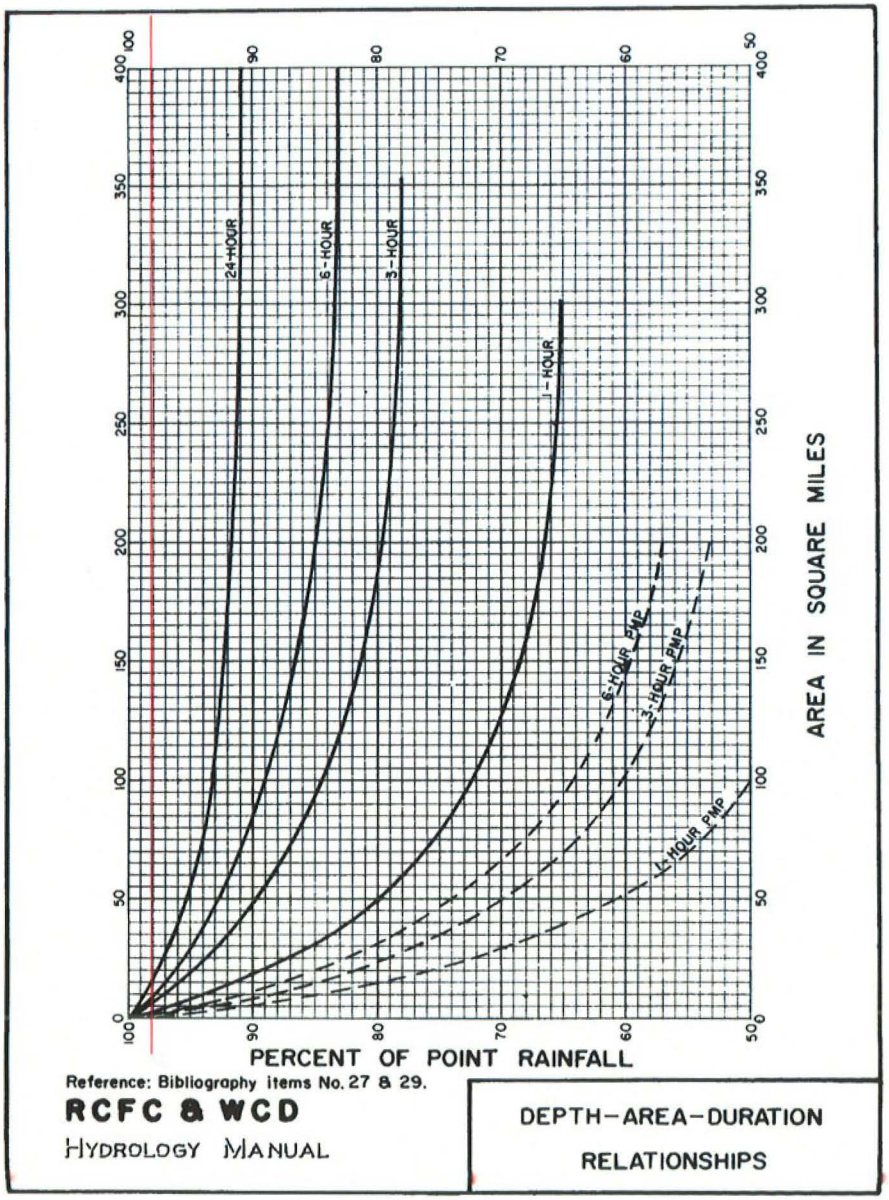
Analyst: MWY
Latest Revision: 1/17/2013

Spreadsheet Description:

- This spreadsheet determines the adjusted point rainfall.
- The red line over the plate can be selected and moved to determine the percentage of point rainfall.

Adjusted Point Rainfall

Point Rainfall 100-year, 24-hour storm (in)	3.87	From NOAA Atlas 14 Data in NOAA Data worksheet.
Percentage of Point Rainfall (%)	98	From Riverside Hydrology Manual, Plate E-5.8 below using a watershed area of 14.6 mi.
Adjusted Point Rainfall (in)	3.8	



Infiltration Rate

Project: Blythe Mesa
Project Number: 124493

Analyst: MWY
Latest Revision: 1/17/2013

Spreadsheet Description:

- This spreadsheet determines the infiltration rate.
- The red line over the plate can be selected and moved to determine infiltration rate.

Infiltration Rate

Runoff Index Number (RI)	80	Assumed and recommended by Riverside County.
AMC	II	
Infiltration Rate (in/hr)	0.248	

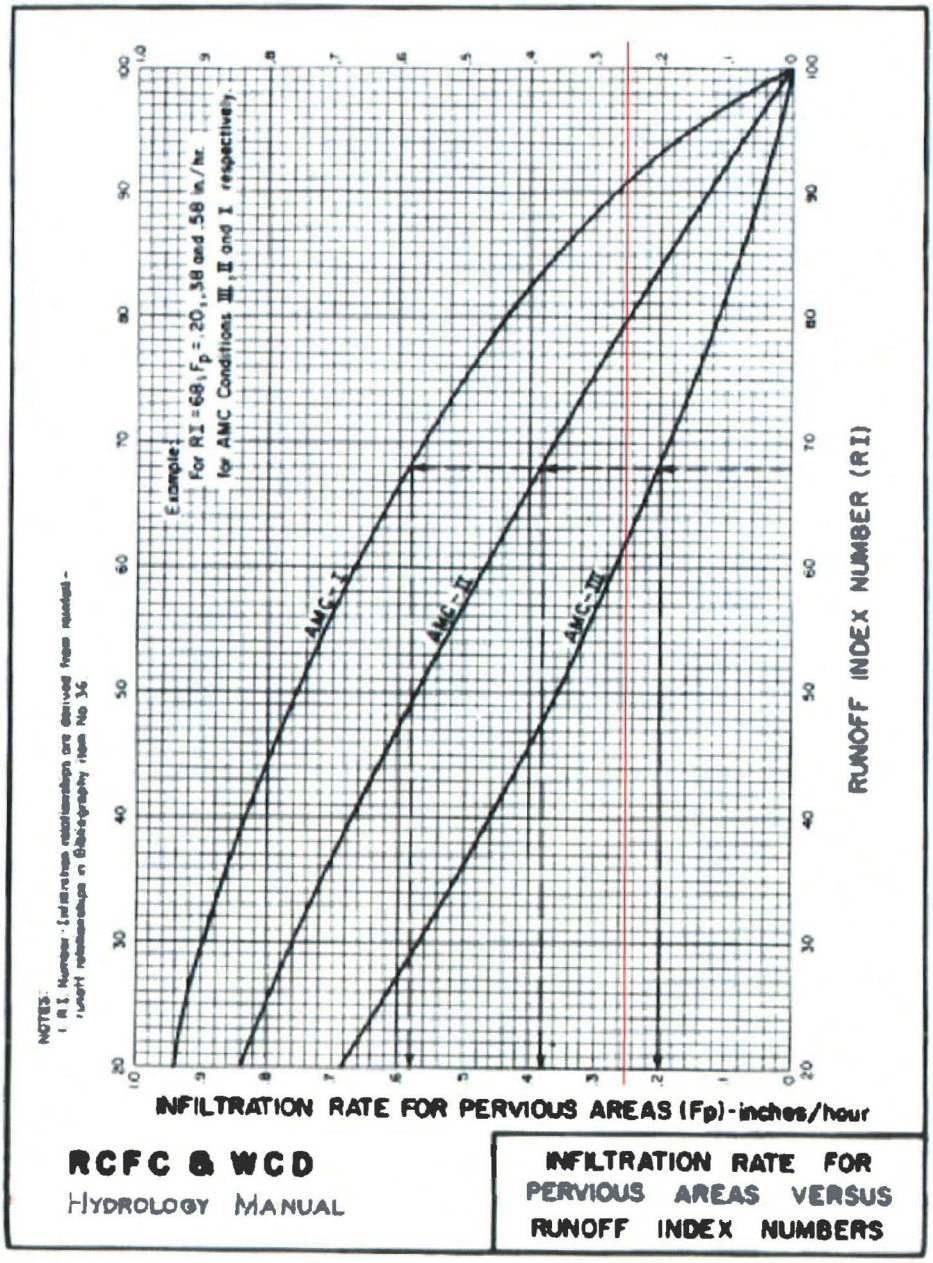


PLATE E-6.2

THIS PAGE INTENTIONALLY LEFT BLANK

Unit Period Rainfall and Effective Rain

Project: Blythe Mesa
Project Number: 124493

Analyst: MWY
Latest Revision: 1/17/2013

Spreadsheet Description:

- This spreadsheet is used to calculate the unit period rainfall and ultimately, the Effective Rain for import into HEC-HMS or for use in the calculation of the Flood Hydrograph.

Unit Period Rainfall

Adjusted Point Rainfall (inches)		**3.8**	Calculated on Adjusted Point Rainfall worksheet
Unit time (full), (min)		**15.0**	Calculated on Variable Summary worksheet

RI	Barren, Rockland, eroded and graded land	80	Assumed due to lack of soil information and confirmed with Riverside County.
Fp	Loss rate for pervious areas using the RI and Plate E-6.2 assuming AMC-II (in/hr)	0.248	Calculated on Infiltration Rate worksheet
Ai	Impervious area	0	Assumed based on lack of development. There is the highway and a small amount of development, but it is minimal.
Ft	Variable maximum loss rate for each time period (in/hr)	Variable. Calculated in the "Max Loss Rate (in/hr)" column in the table below.	
Fm	Minimum Value on loss rate curve, typically 50 to 75% of F (in/hr)	0.124	Assumed 50% of Fp
F	Adjusted loss rate (in/hr)	0.248	Adjusted for impervious area.
C	Defined as (F-Fm)/54	0.00230	
T	Time from beginning of storm.	The value shown here is the actual unit time period which is used for the calculation. The value used in the calculation is from the start of the storm to the middle of each unit time period, i.e., for a unit time of 30-minutes the maximum loss rate would be computed for T=15-minutes for period one, T=45-minutes for period two, etc.	

[15]	[20]	[21]	[22A]	[22B]	[23]
Unit of Time Period	**Pattern Percentages**	**Rainfall Rates (in/hr)**	**Max Loss Rate (in/hr)**	**Low Loss Rate (in/hr)**	**Effective Rain (in/hr)**
	Unit hydrograph values from "HMS S-Graphs" workbook received from Riverside County	**`=((Pattern Percentages*100)*Adjusted Point Rainfall*60)/(100*Unit Time)**	**`=C*(24-(Unit time Period*Unit time-Unit time/2)/60)^1.55+Fm**	**`=90% of Rainfall Rates**	**`=Rainfall rates- max loss rate unless answer is negative, then - min loss rates**
1	0.50%	0.076	0.438	0.068	**0.01**
2	0.70%	0.106	0.435	0.096	**0.01**
3	0.60%	0.091	0.433	0.082	**0.01**
4	0.70%	0.106	0.430	0.096	**0.01**
5	0.80%	0.121	0.428	0.109	**0.01**
6	1.00%	0.152	0.425	0.137	**0.02**
7	1.00%	0.152	0.423	0.137	**0.02**
8	1.10%	0.167	0.420	0.150	**0.02**
9	1.30%	0.197	0.418	0.177	**0.02**
10	1.50%	0.228	0.415	0.205	**0.02**
11	1.30%	0.197	0.413	0.177	**0.02**
12	1.60%	0.243	0.410	0.218	**0.02**
13	1.80%	0.273	0.408	0.246	**0.03**
14	2.00%	0.303	0.405	0.273	**0.03**
15	2.10%	0.319	0.403	0.287	**0.03**
16	2.50%	0.379	0.401	0.341	**0.04**
17	3.00%	0.455	0.398	0.410	**0.06**
18	3.30%	0.501	0.396	0.451	**0.10**
19	3.90%	0.592	0.393	0.532	**0.20**
20	4.30%	0.652	0.391	0.587	**0.26**
21	3.00%	0.455	0.388	0.410	**0.07**
22	4.00%	0.607	0.386	0.546	**0.22**
23	3.80%	0.576	0.384	0.519	**0.19**
24	3.50%	0.531	0.381	0.478	**0.15**
25	5.10%	0.774	0.379	0.696	**0.39**
26	5.70%	0.865	0.377	0.778	**0.49**
27	6.80%	1.032	0.374	0.928	**0.66**
28	4.60%	0.698	0.372	0.628	**0.33**
29	5.30%	0.804	0.370	0.724	**0.43**
30	5.10%	0.774	0.367	0.696	**0.41**
31	4.70%	0.713	0.365	0.642	**0.35**
32	3.80%	0.576	0.363	0.519	**0.21**
33	0.80%	0.121	0.360	0.109	**0.01**
34	0.60%	0.091	0.358	0.082	**0.01**
35	1.00%	0.152	0.356	0.137	**0.02**
36	0.90%	0.137	0.353	0.123	**0.01**
37	0.80%	0.121	0.351	0.109	**0.01**
38	0.50%	0.076	0.349	0.068	**0.01**
39	0.70%	0.106	0.347	0.096	**0.01**
40	0.50%	0.076	0.344	0.068	**0.01**
41	0.60%	0.091	0.342	0.082	**0.01**
42	0.50%	0.076	0.340	0.068	**0.01**
43	0.50%	0.076	0.338	0.068	**0.01**
44	0.50%	0.076	0.335	0.068	**0.01**
45	0.50%	0.076	0.333	0.068	**0.01**
46	0.40%	0.061	0.331	0.055	**0.01**
47	0.40%	0.061	0.329	0.055	**0.01**
48	0.40%	0.061	0.327	0.055	**0.01**
Totals-->>	**100.00%**				**5.0**

THIS PAGE INTENTIONALLY LEFT BLANK

Flood Hydrograph Calculations

Project: Blythe Mesa
Project Number: 124493
Analyst: MWY
Latest Revision: 1/17/2013

Spreadsheet Description:

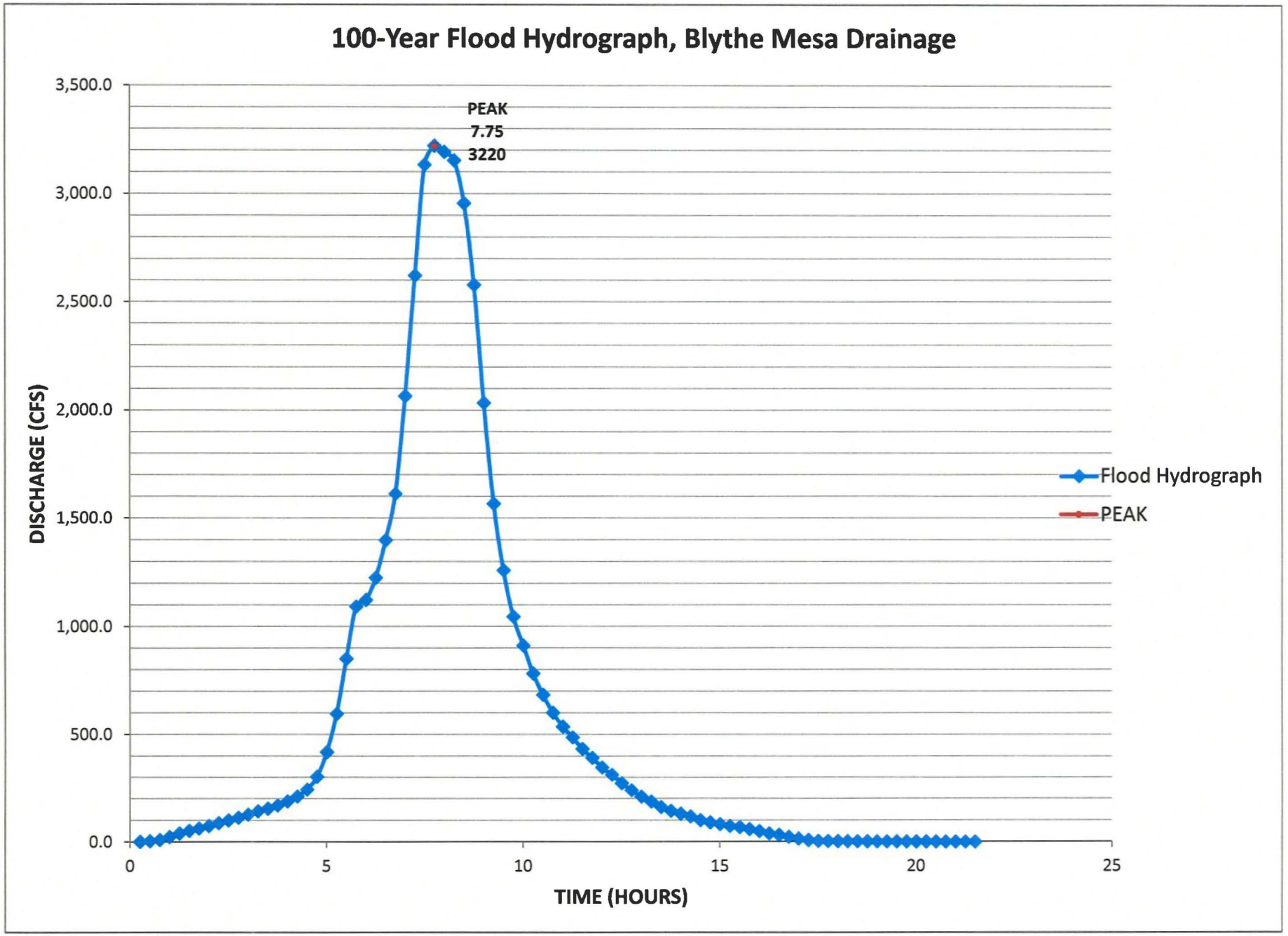
- This spreadsheet is used to calculate the Flood Hydrograph.
- Unit Time Period is calculated in the Variable Summary Worksheet.
- Effective Rain is calculated in the Unit Period Rainfall Worksheet.
- This is a digital reproduction of Plate E-2.3 from the Riverside Hydrology Manual.
- Peak flow is estimated using cells AY and AZ 105. This value and the calculated curve below is displayed graphically on the Flood Hydrograph Worksheet.

Flood Hydrograph Calculations

Unit Time Period (minutes)	15.0

Effective Rain (imported from Unit Period Rainfall Worksheet -->)		0.0076	0.0106	0.0091	0.0106	0.0121	0.0152	0.0152	0.0167	0.0197	0.0228	0.0197	0.0243	0.0273	0.0303	0.0319	0.0379	0.0570	0.1049	0.1984	0.2615	0.0666	0.2207	0.1928	0.1496	0.3947	0.4881	0.6574	0.3260	0.4345	0.4065	0.3481	0.2139	0.0121	0.0091	0.0152	0.0137	0.0121	0.0076	0.0106	0.0076	0.0091	0.0076	0.0076	0.0076	0.0076	0.0061	0.0061	0.0061		
Unit Graph (imported from S-Graph Values Worksheet)	**Unit Period (below and across)**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	**Flood Hydro-graph (cfs)**	**Time (hour)**
113.004	1	0.9																																																	0.9	0.25
301.344	2	2.3	1.2																																																3.5	0.5
640.356	3	4.9	3.2	1.0																																															9.1	0.75
1582.056	4	12.0	6.8	2.7	1.2																																														22.7	1
1600.89	5	12.1	16.8	5.8	3.2	1.4																																													39.3	1.25
1082.955	6	8.2	17.0	14.4	6.8	3.7	1.7																																												51.8	1.5
725.109	7	5.5	11.5	14.6	16.8	7.8	4.6	1.7																																											62.4	1.75
508.518	8	3.9	7.7	9.9	17.0	19.2	9.7	4.6	1.9																																										73.8	2
414.348	9	3.1	5.4	6.6	11.5	19.4	24.0	9.7	5.0	2.2																																									87.0	2.25
329.595	10	2.5	4.4	4.6	7.7	13.1	24.3	24.0	10.7	5.9	2.6																																									99.9	2.5
282.51	11	2.1	3.5	3.8	5.4	8.8	16.4	24.3	26.4	12.6	6.9	2.2																																								112.4	2.75
254.259	12	1.9	3.0	3.0	4.4	6.2	11.0	16.4	26.7	31.2	14.6	5.9	2.7																																								127.1	3
169.506	13	1.3	2.7	2.6	3.5	5.0	7.7	11.0	18.1	31.6	36.0	12.6	7.3	3.1																																							142.5	3.25
169.506	14	1.3	1.8	2.3	3.0	4.0	6.3	7.7	12.1	21.4	36.4	31.2	15.5	8.2	3.4																																							154.7	3.5
150.672	15	1.1	1.8	1.5	2.7	3.4	5.0	6.3	8.5	14.3	24.6	31.6	38.4	17.5	9.1	3.6																																							169.5	3.75
131.838	16	1.0	1.6	1.5	1.8	3.1	4.3	5.0	6.9	10.0	16.5	21.4	38.9	43.2	19.4	9.6	4.3																																							188.5	4
113.004	17	0.9	1.4	1.4	1.8	2.1	3.9	4.3	5.5	8.2	11.6	14.3	26.3	43.7	48.0	20.4	11.4	6.4																																							211.4	4.25
103.587	18	0.8	1.2	1.2	1.6	2.1	2.6	3.9	4.7	6.5	9.4	10.0	17.6	29.6	48.6	50.4	24.3	17.2	11.9																																							243.4	4.5
103.587	19	0.8	1.1	1.0	1.4	1.8	2.6	2.6	4.2	5.6	7.5	8.2	12.3	19.8	32.9	51.0	60.0	36.5	31.6	22.4																																							303.3	4.75
75.336	20	0.6	1.1	0.9	1.2	1.6	2.3	2.6	2.8	5.0	6.4	6.5	10.1	13.9	22.0	34.5	60.7	90.2	67.2	59.8	29.5																																							418.9	5
75.336	21	0.6	0.8	0.9	1.1	1.4	2.0	2.3	2.8	3.3	5.8	5.6	8.0	11.3	15.4	23.1	41.1	91.2	166.0	127.0	78.8	7.5																																							596.1	5.25
56.502	22	0.4	0.6	0.7	1.1	1.3	1.7	2.0	2.5	3.3	3.9	5.0	6.9	9.0	12.6	16.2	27.5	61.7	168.0	313.8	167.4	20.1	24.9																																							850.8	5.5
56.502	23	0.4	0.6	0.7	0.8	1.3	1.6	1.7	2.2	3.0	3.9	3.3	6.2	7.7	10.0	13.2	19.3	41.3	113.6	317.6	413.6	42.7	66.5	21.8																																							1092.9	5.75
37.668	24	0.3	0.6	0.5	0.8	0.9	1.6	1.6	1.9	2.6	3.4	3.3	4.1	6.9	8.6	10.5	15.7	29.0	76.1	214.8	418.6	105.4	141.3	58.1	16.9																																							1123.6	6
37.668	25	0.3	0.4	0.5	0.6	0.9	1.1	1.6	1.7	2.2	3.0	3.0	4.1	4.6	7.7	9.0	12.5	23.6	53.4	143.8	283.1	106.7	349.2	123.4	45.1	44.6																																							1226.3	6.25
28.251	26	0.2	0.4	0.3	0.6	0.7	1.1	1.1	1.7	2.0	2.6	2.6	3.7	4.6	5.1	8.1	10.7	18.8	43.5	100.9	189.6	72.2	353.4	305.0	95.8	119.0	55.2																																							1398.9	6.5
37.668	27	0.3	0.3	0.3	0.4	0.7	0.9	1.1	1.3	2.0	2.4	2.2	3.2	4.1	5.1	5.4	9.6	16.1	34.6	82.2	133.0	48.3	239.0	308.6	236.8	252.8	147.1	74.3																																							1612.1	6.75
37.668	28	0.3	0.4	0.3	0.4	0.5	0.9	0.9	1.3	1.5	2.4	2.0	2.7	3.6	4.6	5.4	6.4	14.5	29.6	65.4	108.3	33.9	160.1	208.8	239.6	624.5	312.6	198.1	36.8																																							2065.5	7
28.251	29	0.2	0.4	0.3	0.3	0.5	0.6	0.9	0.9	1.5	1.7	2.0	2.5	3.1	4.0	4.8	6.4	9.7	26.7	56.0	86.2	27.6	112.2	139.8	162.1	631.9	772.2	420.9	98.2	49.1																																							2622.9	7.25
18.834	30	0.1	0.3	0.3	0.4	0.3	0.6	0.6	0.9	1.1	1.7	1.5	2.5	2.8	3.4	4.2	5.7	9.7	17.8	50.4	73.9	22.0	91.5	98.0	108.5	427.5	781.4	1040.0	208.7	130.9	45.9																																							3132.8	7.5
28.251	31	0.2	0.2	0.3	0.4	0.5	0.4	0.6	0.6	1.1	1.3	1.5	1.8	2.8	3.1	3.6	5.0	8.6	17.8	33.6	66.5	18.8	72.8	79.9	76.1	286.2	528.6	1052.4	515.7	278.2	122.5	39.3																																							3220.4	7.75
18.834	32	0.1	0.3	0.2	0.3	0.5	0.6	0.4	0.6	0.7	1.3	1.1	1.8	2.1	3.1	3.3	4.3	7.5	15.8	33.6	44.3	16.9	62.4	63.5	62.0	200.7	353.9	711.9	521.8	687.4	260.3	104.9	24.2																																							3192.0	8
9.417	33	0.1	0.2	0.3	0.2	0.3	0.6	0.6	0.5	0.7	0.9	1.1	1.4	2.1	2.3	3.3	3.9	6.4	13.8	29.9	44.3	11.3	56.1	54.5	49.3	163.6	248.2	476.7	353.0	695.6	643.1	222.9	64.5	1.4																																							3152.8	8.25
18.834	34	0.1	0.1	0.2	0.3	0.2	0.4	0.6	0.6	0.6	0.9	0.7	1.4	1.5	2.3	2.4	3.9	5.9	11.9	26.2	39.4	11.3	37.4	49.0	42.3	130.1	202.3	334.3	236.4	470.5	650.7	550.7	137.0	3.7	1.0																																						2956.2	8.5
18.834	35	0.1	0.2	0.1	0.2	0.3	0.3	0.4	0.6	0.7	0.6	0.7	0.9	1.5	1.7	2.4	2.9	5.9	10.9	22.4	34.5	10.0	37.4	32.7	38.0	111.5	160.9	272.4	165.8	315.1	440.2	557.3	338.4	7.8	2.7	1.7																																						2579.4	8.75
18.834	36	0.1	0.2	0.2	0.1	0.2	0.4	0.3	0.5	0.7	0.9	0.6	0.9	1.0	1.7	1.8	2.9	4.3	10.9	20.5	29.5	8.8	33.3	32.7	25.4	100.4	137.9	216.7	135.1	220.9	294.7	377.0	342.4	19.2	5.8	4.6	1.5																																						2034.1	9
18.834	37	0.1	0.2	0.2	0.2	0.1	0.3	0.4	0.3	0.6	0.9	0.7	0.7	1.0	1.1	1.8	2.1	4.3	7.9	20.5	27.1	7.5	29.1	29.0	25.4	66.9	124.1	185.7	107.4	180.0	206.7	252.4	231.6	19.4	14.4	9.7	4.1	1.4																																							1565.7	9.25
18.834	38	0.1	0.2	0.2	0.2	0.2	0.1	0.3	0.5	0.4	0.6	0.7	0.9	0.8	1.1	1.2	2.1	3.2	7.9	14.9	27.1	6.9	24.9	25.4	22.5	66.9	82.7	167.1	92.1	143.2	168.4	177.0	155.1	13.1	14.6	24.0	8.7	3.7	0.9																																							1260.3	9.5
0	39	0.0	0.2	0.2	0.2	0.2	0.3	0.1	0.3	0.6	0.4	0.6	0.9	1.0	0.9	1.2	1.4	3.2	5.9	14.9	19.7	6.9	22.9	21.8	19.7	59.5	82.7	111.4	82.9	122.7	134.0	144.2	108.8	8.8	9.9	24.3	21.6	7.8	2.3	1.2																																							1045.6	9.75
	40		0.0	0.2	0.2	0.2	0.3	0.3	0.2	0.4	0.6	0.4	0.7	1.0	1.1	0.9	1.4	2.1	5.9	11.2	19.7	5.0	22.9	20.0	16.9	52.0	73.5	111.4	55.3	110.5	114.8	114.7	88.6	6.2	6.6	16.4	21.9	19.2	4.9	3.2	0.9																																							911.8	10
	41			0.0	0.2	0.2	0.3	0.3	0.3	0.2	0.4	0.6	0.5	0.8	1.1	1.2	1.1	2.1	4.0	11.2	14.8	5.0	16.6	20.0	15.5	44.6	64.4	99.0	55.3	73.6	103.4	98.3	70.5	5.0	4.6	11.0	14.8	19.4	12.0	6.8	2.3	1.0																																							782.4	10.25
	42				0.0	0.2	0.3	0.3	0.3	0.4	0.2	0.4	0.7	0.5	0.9	1.2	1.4	1.6	4.0	7.5	14.8	3.8	16.6	14.5	15.5	40.9	55.2	86.7	49.1	73.6	68.9	88.5	60.4	4.0	3.8	7.7	9.9	13.1	12.1	16.8	4.9	2.7	0.9																																							684.2	10.5
	43					0.0	0.3	0.3	0.3	0.4	0.4	0.2	0.5	0.8	0.6	0.9	1.4	2.1	3.0	7.5	9.8	3.8	12.5	14.5	11.3	40.9	50.6	74.3	43.0	65.5	68.9	59.0	54.4	3.4	3.0	6.3	6.9	8.8	8.2	17.0	12.0	5.8	2.3	0.9																																							601.6	10.75
	44						0.0	0.3	0.3	0.4	0.4	0.4	0.2	0.5	0.9	0.6	1.1	2.1	4.0	5.6	9.8	2.5	12.5	10.9	11.3	29.7	50.6	68.1	36.8	57.3	61.2	59.0	36.3	3.1	2.6	5.0	5.7	6.2	5.5	11.5	12.1	14.4	4.9	2.3	0.9																																							536.8	11
	45							0.0	0.3	0.4	0.4	0.4	0.4	0.5	0.3	0.6	0.9	0.7	1.6	4.0	7.5	7.4	2.5	8.3	10.9	8.5	29.7	36.8	68.1	33.8	49.1	53.6	52.5	36.3	2.1	2.3	4.3	4.5	5.0	3.9	7.7	8.2	14.6	12.0	4.9	2.3	0.9																																						487.3	11.25
	46								0.0	0.4	0.4	0.4	0.5	0.5	0.3	0.6	1.1	1.1	3.0	7.5	9.8	1.9	8.3	7.3	8.5	22.3	36.8	49.5	33.8	45.0	45.9	45.9	32.2	2.1	1.5	3.9	3.9	4.0	3.1	5.4	5.5	9.9	12.1	12.0	4.9	2.3	0.7																																					434.0	11.5
	47									0.0	0.4	0.4	0.5	0.5	0.6	0.3	0.7	1.6	2.0	5.6	9.8	2.5	6.2	7.3	5.6	22.3	27.6	49.5	24.6	45.0	42.1	39.3	28.2	1.8	1.5	2.6	3.5	3.4	2.5	4.4	3.9	6.6	8.2	12.1	12.0	4.9	1.8	0.7																																					392.6	11.75
	48										0.0	0.4	0.5	0.5	0.6	0.6	0.4	1.1	3.0	3.7	7.4	2.5	8.3	5.4	5.6	14.9	27.6	37.1	24.6	32.7	42.1	36.1	24.2	1.6	1.4	2.6	2.3	3.1	2.1	3.5	3.1	4.6	5.5	8.2	12.1	12.0	3.9	1.8	0.7																																					347.8	12
	49											0.0	0.5	0.5	0.6	0.6	0.7	0.5	2.0	5.6	4.9	1.9	8.3	7.3	4.2	14.9	18.4	37.1	18.4	32.7	30.6	36.1	22.2	1.4	1.2	2.3	2.3	2.1	1.9	3.0	2.5	3.8	3.9	5.5	8.2	12.1	9.6	3.9	1.8																																					313.4	12.25
	50												0.0	0.5	0.6	0.6	0.7	1.1	1.0	3.7	7.4	1.3	6.2	7.3	5.6	11.2	18.4	24.6	18.4	24.5	30.6	26.2	22.2	1.3	1.0	2.0	2.1	2.1	1.3	2.7	2.1	3.0	3.1	3.9	5.5	8.2	9.7	9.6	3.9																																					273.7	12.5
	51													0.0	0.6	0.6	0.7	1.1	2.0	1.9	4.9	1.9	4.2	5.4	5.6	14.9	13.8	24.6	12.3	24.5	23.0	26.2	16.1	1.3	0.9	1.7	1.8	1.8	1.3	1.8	1.9	2.6	2.5	3.1	3.9	5.5	6.6	9.7	9.6																																					240.4	12.75
	52														0.0	0.6	0.7	1.1	2.0	3.7	2.5	1.3	6.2	3.6	4.2	14.9	18.4	18.6	12.3	16.4	23.0	19.7	16.1	0.9	0.9	1.6	1.5	1.6	1.1	1.8	1.3	2.3	2.1	2.5	3.1	3.9	4.4	6.6	9.7																																					210.6	13
	53															0.0	0.7	1.1	2.0	3.7	4.9	0.6	4.2	5.4	2.8	11.2	18.4	24.8	9.2	16.4	15.3	19.7	12.1	0.9	0.7	1.6	1.4	1.4	1.0	1.6	1.3	1.5	1.9	2.1	2.5	3.1	3.1	4.4	6.6																																					187.6	13.25
	54																0.0	1.1	2.0	3.7	4.9	1.3	2.1	3.6	4.2	7.4	13.8	24.8	12.3	12.3	15.3	13.1	12.1	0.7	0.7	1.1	1.4	1.3	0.9	1.4	1.1	1.5	1.3	1.9	2.1	2.5	2.5	3.1	4.4																																					161.9	13.5
	55																	0.0	2.0	3.7	4.9	1.3	4.2	1.8	2.8	11.2	9.2	18.6	12.3	16.4	11.5	13.1	8.1	0.7	0.5	1.1	1.0	1.3	0.8	1.2	1.0	1.4	1.3	1.3	1.9	2.1	2.0	2.5	3.1																																					144.1	13.75
	56																		0.0	3.7	4.9	1.3	4.2	3.6	1.4	7.4	13.8	12.4	9.2	16.4	15.3	9.8	8.1	0.5	0.5	0.9	1.0	0.9	0.8	1.1	0.9	1.2	1.1	1.3	1.3	1.9	1.7	2.0	2.5																																					131.1	14
	57																			0.0	4.9	1.3	4.2	3.6	2.8	3.7	9.2	18.6	6.1	12.3	15.3	13.1	6.0	0.5	0.3	0.9	0.8	0.9	0.6	1.1	0.8	1.0	1.1	1.3	1.3	1.5	1.7	2.0																																					117.9	14.25
	58																				0.0	1.3	4.2	3.6	2.8	7.4	9.2	18.6	6.1	12.3	15.3	13.1	8.1	0.3	0.3	0.6	0.8	0.7	0.6	0.8	0.8	0.9	0.9	1.0	1.1	1.3	1.0	1.5	1.7																																					100.7	14.5
	59																					0.0	4.2	3.6	2.8	7.4	9.2	6.2	6.1	12.3	7.7	9.8	8.1	0.5	0.3	0.6	0.5	0.7	0.4	0.8	0.6	0.9	0.8	0.9	1.0	1.1	1.0	1.5																																					90.0	14.75
	60																						0.0	3.6	2.8	7.4	9.2	12.4	3.1	8.2	11.5	6.6	6.0	0.5	0.3	0.4	0.5	0.5	0.4	0.6	0.6	0.7	0.8	0.8	0.9	1.0	0.9	1.0	1.0																																					81.7	15
	61																							0.0	2.8	7.4	9.2	12.4	6.1	4.1	7.7	9.8	4.0	0.3	0.3	0.6	0.4	0.5	0.3	0.6	0.4	0.7	0.6	0.8	0.8	0.9	0.8	0.9	1.0																																					73.4	15.25
	62																								0.0	7.4	9.2	12.4	6.1	8.2	3.8	6.6	6.0	0.2	0.3	0.6	0.5	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.8	0.8	0.7	0.8	0.9																																					68.4	15.5
	63																									0.0	9.2	12.4	6.1	8.2	7.7	3.3	4.0	0.3	0.2	0.4	0.5	0.5	0.2	0.4	0.3	0.5	0.4	0.6	0.6	0.8	0.6	0.7	0.8																																					58.7	15.75
	64																										0.0	12.4	6.1	8.2	7.7	6.6	2.0	0.2	0.3	0.3	0.4	0.5	0.3	0.3	0.3	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.7																																					49.7	16
	65																											0.0	6.1	8.2	7.7	6.6	4.0	0.1	0.2	0.4	0.3	0.3	0.3	0.4	0.2	0.3	0.3	0.4	0.4	0.6	0.5	0.6	0.6																																					38.5	16.25
	66																												0.0	8.2	7.7	6.6	4.0	0.2	0.1	0.3	0.4	0.2	0.2	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6																																					31.8	16.5
	67																													0.0	7.7	6.6	4.0	0.2	0.2	0.1	0.3	0.3	0.1	0.3	0.3	0.3	0.2	0.3	0.3	0.4	0.3	0.5	0.5																																					22.9	16.75
	68																														0.0	6.6	4.0	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.5																																					14.8	17
	69																															0.0	4.0	0.2	0.2	0.3	0.3	0.1	0.1	0.3	0.1	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.3																																					7.9	17.25
	70										

THIS PAGE INTENTIONALLY LEFT BLANK


100-Year Flood Hydrograph, Blythe Mesa Drainage
PEAK
7.75
3220
3,500.0
3,000.0
2,500.0
2,000.0
1,500.0
1,000.0
500.0
0.0
DISCHARGE (CFS)
0
5
10
15
20
25
TIME (HOURS)
Flood Hydrograph
PEAK

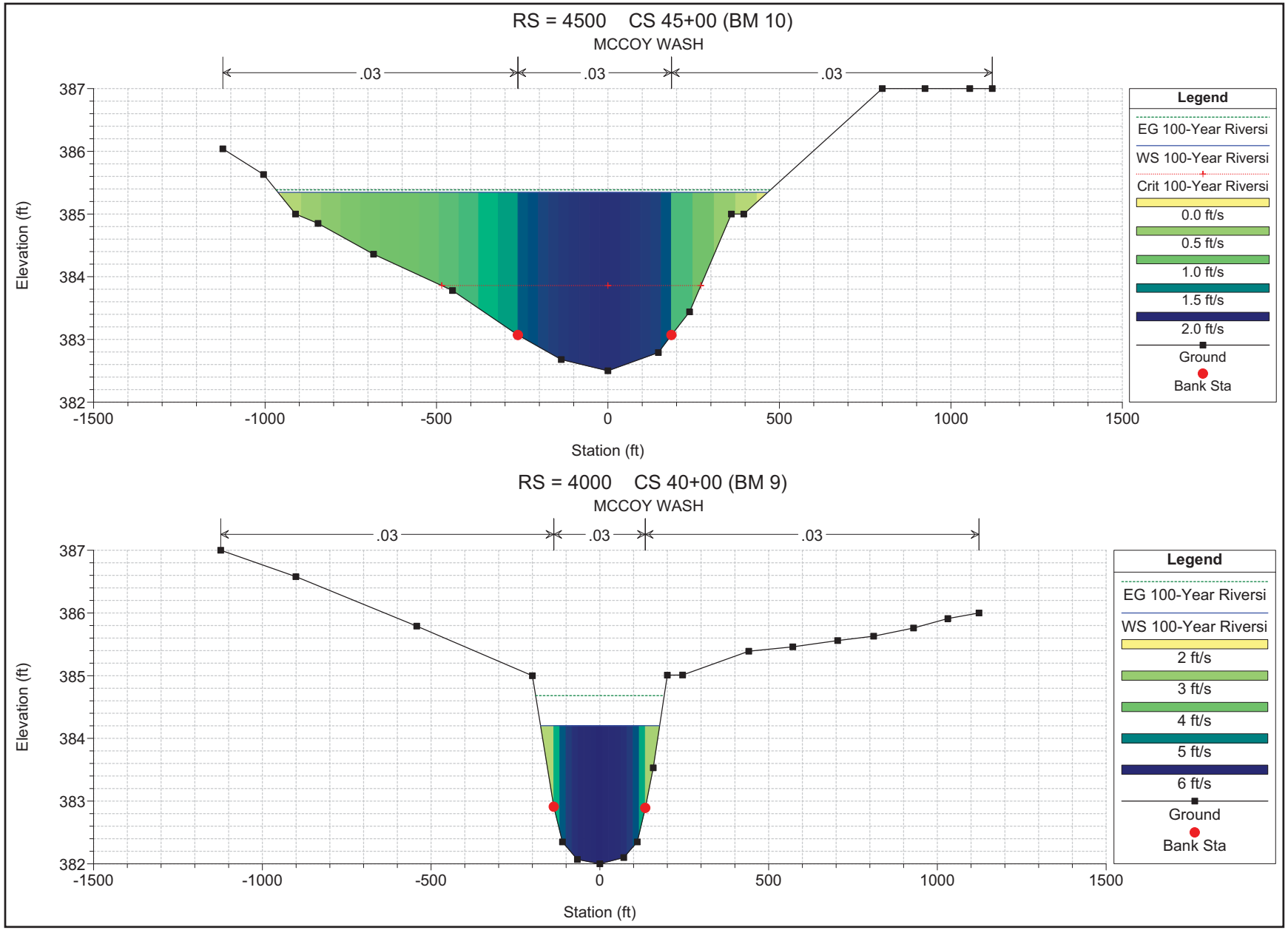
THIS PAGE INTENTIONALLY LEFT BLANK

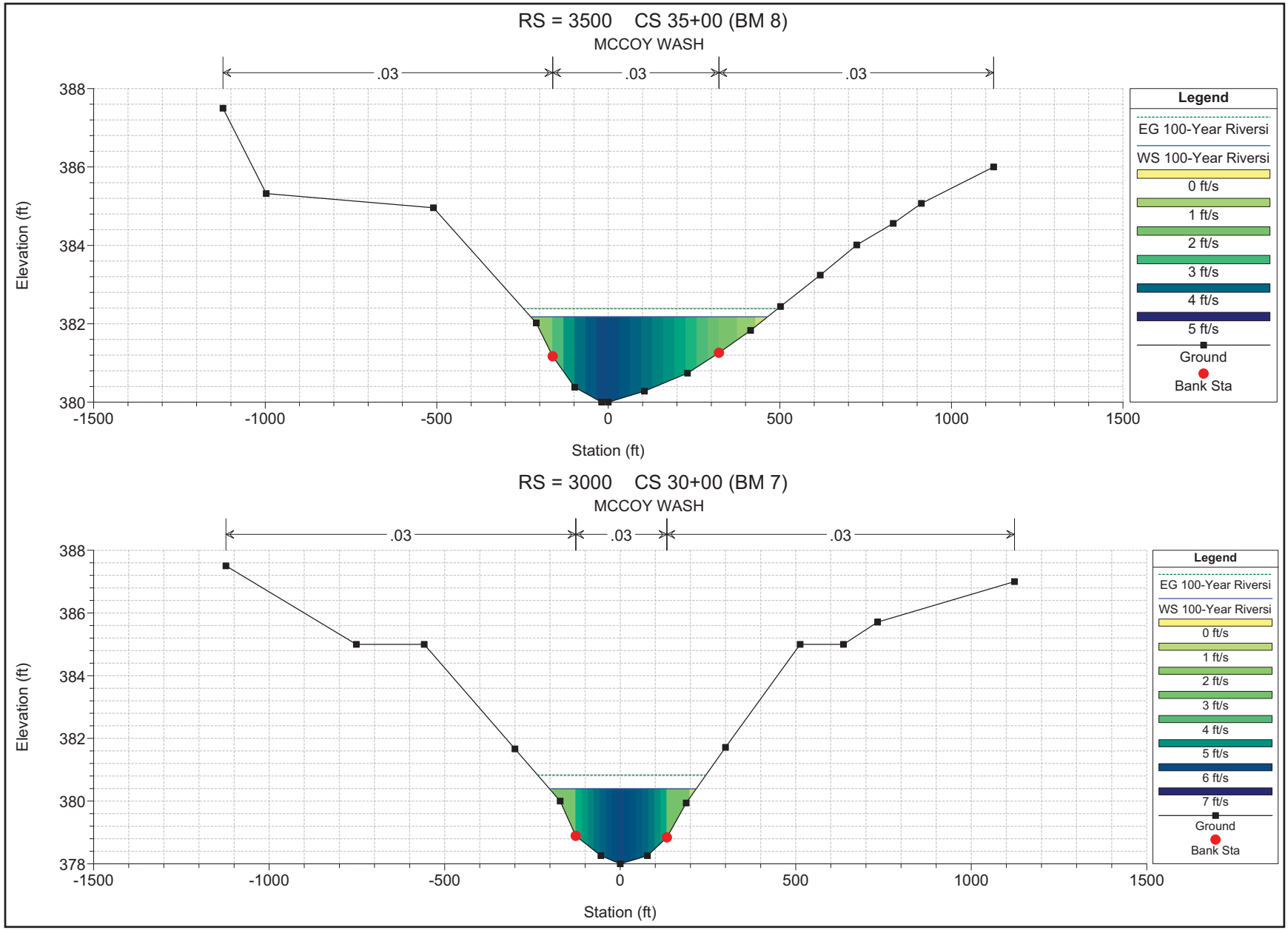
APPENDIX B

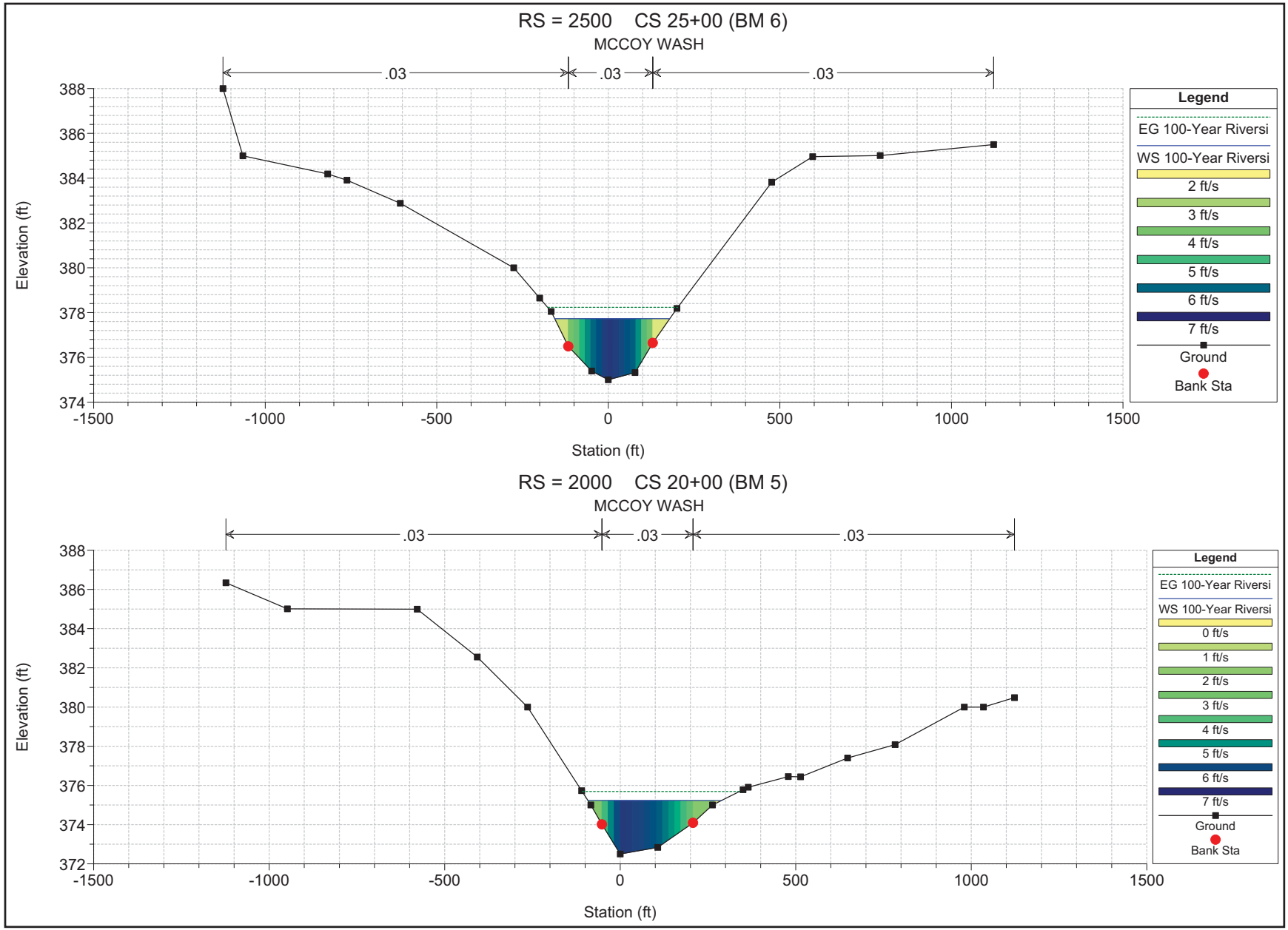
100-year Cross-Sections

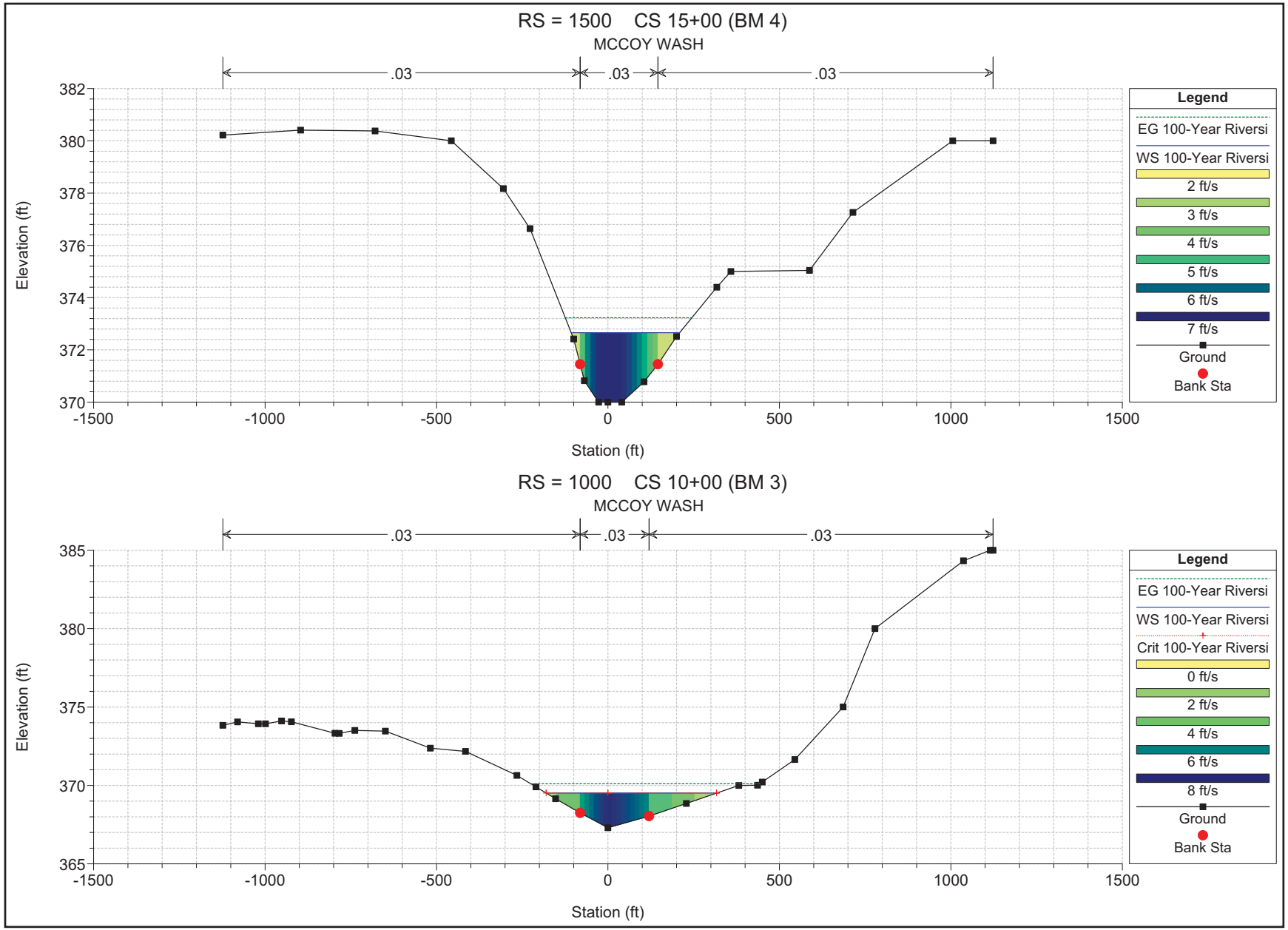
The following pages are from the HEC-RAS Model titled, “123128Wash3hr,” which is also submitted electronically to facilitate review.

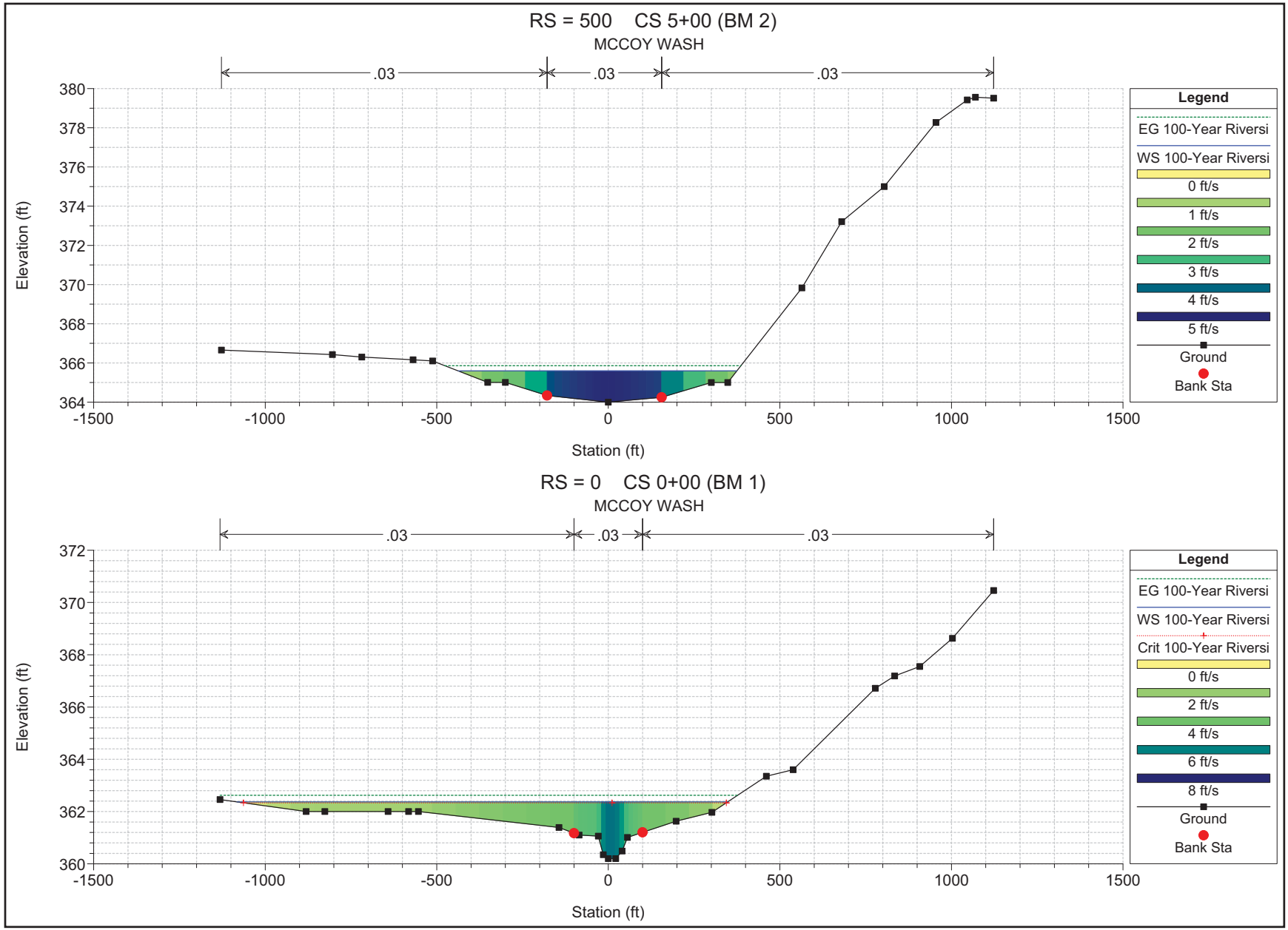
THIS PAGE INTENTIONALLY LEFT BLANK


RS = 4500 CS 45+00 (BM 10)
MCCOY WASH
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
Crit 100-Year Riversi
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
Ground
Bank Sta
RS = 4000 CS 40+00 (BM 9)
MCCOY WASH
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta


RS = 3500 CS 35+00 (BM 8)
MCCOY WASH
.03
.03
.03
Elevation (ft)
388
386
384
382
380
-1500
-1000
-500
0
500
1000
1500
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
Ground
Bank Sta
RS = 3000 CS 30+00 (BM 7)
MCCOY WASH
.03
.03
.03
Elevation (ft)
388
386
384
382
380
378
-1500
-1000
-500
0
500
1000
1500
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Bank Sta


RS = 2500 CS 25+00 (BM 6)
MCCOY WASH
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Bank Sta
RS = 2000 CS 20+00 (BM 5)
MCCOY WASH
.03
.03
.03
Elevation (ft)
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Bank Sta


RS = 1500 CS 15+00 (BM 4)
MCCOY WASH
.03
.03
.03
Elevation (ft)
382
380
378
376
374
372
370
-1500
-1000
-500
0
500
1000
1500
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
7 ft/s
Ground
Bank Sta
RS = 1000 CS 10+00 (BM 3)
MCCOY WASH
.03
.03
.03
Elevation (ft)
385
380
375
370
365
-1500
-1000
-500
0
500
1000
1500
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
Crit 100-Year Riversi
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta


RS = 500 CS 5+00 (BM 2)
MCCOY WASH
.03
.03
.03
Elevation (ft)
380
378
376
374
372
370
368
366
364
-1500
-1000
-500
0
500
1000
1500
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
Ground
Bank Sta
RS = 0 CS 0+00 (BM 1)
MCCOY WASH
.03
.03
.03
Elevation (ft)
372
370
368
366
364
362
360
-1500
-1000
-500
0
500
1000
1500
Station (ft)
Legend
EG 100-Year Riversi
WS 100-Year Riversi
Crit 100-Year Riversi
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX C
Scour Calculations

THIS PAGE INTENTIONALLY LEFT BLANK

Table 1: Preliminary Scour Analysis

Note: 1. Please refer to the "HEC-18 Description" Worksheet in this workbook for a complete description of the HEC-18 scour equation and a description of the associated variables.
2. Average depths in the left and right overbank areas is assumed for comparison purposes.

Calculation Table

HEC-18 Formula Variables-->		Left Fr1	Fr1	Right Fr1	Left y1	y1	Right y1	Left V1	Channel V1	Right V1	a	K1	K2	K3	Left ys	ys	Right ys
Reach	River Sta (ft)	Froude #, Left	Froude # Channel	Froude #, Right	Average Depth, Left (ft)	Max Channel Depth (ft)	Average Depth, Right (ft)	Average Velocity Left (ft/s)	Channel Velocity (ft/s)	Average Velocity Right (ft/s)	Pier Width (ft)	Pier Nose Correction Factor	Correction Factor for Angle of Attack	Correction Factor for Bed Condtion	Maximum Scour Left (ft)	Maximum Scour Channel (ft)	Maximum Scour Right (ft)
BM 10	4500	0.183276	0.19	0.162129	1	2.85	1	1.04	1.79	0.92	0.33	1	1	1.1	0.52	0.76	0.49
BM 9	4000	0.470526	0.69	0.308397	1	2.23	1	2.67	5.47	1.75	0.33	1	1	1.1	0.77	1.21	0.65
BM 8	3500	0.274914	0.51	0.281963	1	2.18	1	1.56	3.74	1.6	0.33	1	1	1.1	0.61	1.05	0.62
BM 7	3000	0.447616	0.68	0.489911	1	2.39	1	2.54	5.5	2.78	0.33	1	1	1.1	0.76	1.23	0.79
BM 6	2500	0.442329	0.69	0.405322	1	2.73	1	2.51	5.79	2.3	0.33	1	1	1.1	0.75	1.30	0.73
BM 5	2000	0.41942	0.67	0.373601	1	2.73	1	2.38	5.55	2.12	0.33	1	1	1.1	0.74	1.28	0.70
BM 4	1500	0.433518	0.73	0.449378	1	2.66	1	2.46	6.16	2.55	0.33	1	1	1.1	0.75	1.32	0.76
BM 3	1000	0.597409	0.89	0.659088	1	2.22	1	3.39	6.77	3.74	0.33	1	1	1.1	0.86	1.35	0.89
BM 2	500	0.47405	0.68	0.549828	1	1.59	1	2.69	4.6	3.12	0.33	1	1	1.1	0.78	1.07	0.83
BM 1	0	0.421182	0.73	0.509296	1	2.17	1	2.39	5.15	2.89	0.33	1	1	1.1	0.74	1.23	0.80
Arrays																	
Point 1	4000	0.68196			2.02			5.5			0.33	1	1	1.1	1.16		
Point 2	3000			0.597303			2.09			4.9	0.33	1	1	1.1			1.11
Point 3	3000			0.657236			1.87			5.1	0.33	1	1	1.1			1.11
Point 4	2500			0.391839			1.07			2.3	0.33	1	1	1.1			0.73
Point 5	2500			0.55642			1.3			3.6	0.33	1	1	1.1			0.91
Point 6	500			0.643489			0.3			2	0.33	1	1	1.1			0.58

Scour Summary Table

Maximum Scour Left (in)	Maximum Scour Channel (in)	Maximum Scour Right (in)
6	9	6
9	14	8
7	13	7
9	15	9
9	16	9
9	15	8
9	16	9
10	16	11
9	13	10
9	15	10
14		
		13
		13
		9
		11
		7

THIS PAGE INTENTIONALLY LEFT BLANK

HEC-18 Pier Scour Equation

Reference: Hydraulic Engineering Circular No. 18, "Evaluating Scour at Bridges, Fifth Edition" U.S. Department of Transportation, Federal Highway Administration, April 2012

7.2 HEC-18 PIER SCOUR EQUATION

The HEC-18 pier scour equation (based on the CSU equation) is recommended for both live-bed and clear-water pier scour. The equation predicts maximum pier scour depths. Basic applications include simple pier substructure configurations and riverine flow situations in alluvial sand-bed channels. The equation can be adapted for wide pier applications (Section 7.4), more complex (3-element) substructure configurations (Section 7.5), multiple columns skewed to the flow (Section 7.6), estimating scour from debris on piers (Section 7.7), and scour in tidal waterways (Chapter 9). An alternative approach that represents the complexity of the bridge pier scour flow field and the full range of pier geometries (narrow, transition and wide as described in Section 3.6.2) is presented in Section 7.3.

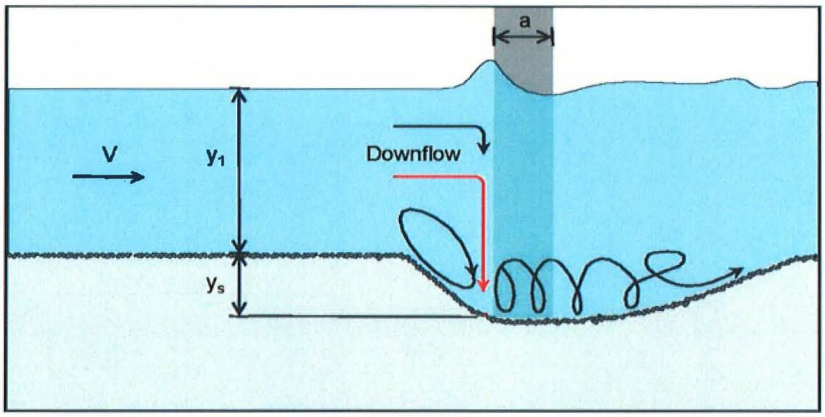


Figure 7.2. Definition sketch for pier scour.

The HEC-18 equation is:

$$\frac{y_s}{y_1} = 2.0\, K_1\, K_2\, K_3 \left(\frac{a}{y_1}\right)^{0.65} Fr_1^{0.43} \qquad (7.1)$$

As a Rule of Thumb, the maximum scour depth for round nose piers aligned with the flow is:

$y_s \leq 2.4$ times the pier width (a) for $Fr \leq 0.8$
$y_s \leq 3.0$ times the pier width (a) for $Fr > 0.8$ (7.2)

In terms of y_s/a, Equation 7.1 is:

$$\frac{y_s}{a} = 2.0\, K_1\, K_2\, K_3 \left(\frac{y_1}{a}\right)^{0.35} Fr_1^{0.43} \qquad (7.3)$$

where:

y_s	=	Scour depth, ft (m)
y_1	=	Flow depth directly upstream of the pier, ft (m)
K_1	=	Correction factor for pier nose shape from Figure 7.3 and Table 7.1
K_2	=	Correction factor for angle of attack of flow from Table 7.2 or Equation 7.4
K_3	=	Correction factor for bed condition from Table 7.3
a	=	Pier width, ft (m)
L	=	Length of pier, ft (m)
Fr_1	=	Froude Number directly upstream of the pier = $V_1/(gy_1)^{1/2}$
V_1	=	Mean velocity of flow directly upstream of the pier, ft/s (m/s)
g	=	Acceleration of gravity (32.2 ft/s^2) (9.81 m/s^2)

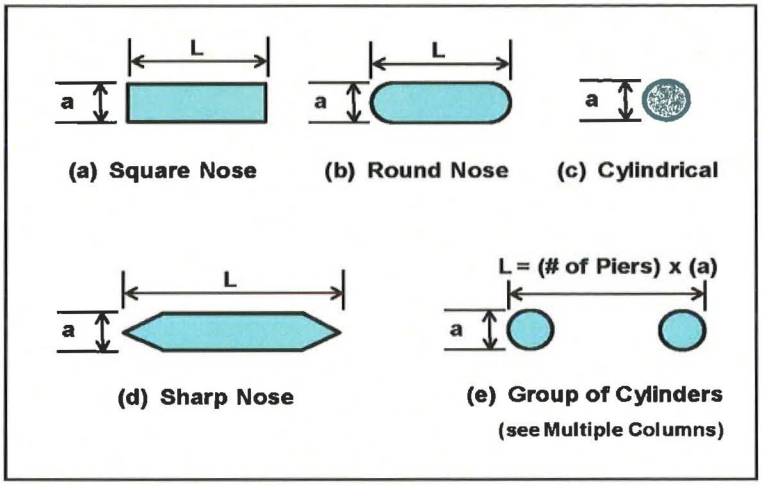


Figure 7.3. Common pier shapes.

The correction factor, K_2, for angle of attack of the flow, 2, is calculated using the following equation:

$$K_2 = (\text{Cos } \theta + \frac{L}{a} \text{ Sin } \theta)^{0.65} \qquad (7.4)$$

If L/a is larger than 12, use L/a = 12 as a maximum in Equation 7.4 and Table 7.2. Table 7.2 illustrates the magnitude of the effect of the angle of attack on local pier scour.

Table 7.1. Correction Factor, K_1, for Pier Nose Shape.

Shape of Pier Nose	K_1
(a) Square nose	1.1
(b) Round nose	1.0
(c) Circular cylinder	1.0
(d) Group of cylinders	1.0
(e) Sharp nose	0.9

Table 7.2. Correction Factor, K_2, for Angle of Attack, 2, of the Flow.

Angle	L/a=4	L/a=8	L/a=12
0	1.0	1.0	1.0
15	1.5	2.0	2.5
30	2.0	2.75	3.5
45	2.3	3.3	4.3
90	2.5	3.9	5.0

Angle = skew angle of flow
L = length of pier

Table 7.3. Increase in Equilibrium Pier Scour Depths, K_3, for Bed Condition.		
Bed Condition	Dune Height ft	K_3
Clear-Water Scour	N/A	1.1
Plane bed and Antidune flow	N/A	1.1
Small Dunes	$10 > H \geq 2$	1.1
Medium Dunes	$30 > H \geq 10$	1.2 to 1.1
Large Dunes	$H \geq 30$	1.3

Notes:

1. The correction factor K_1 for pier nose shape should be determined using Table 7.1 for angles of attack up to 5 degrees. **For greater angles, K_2 dominates and K_1 should be considered as 1.0**. If L/a is larger than 12, use the values for L/a = 12 as a maximum in Table 7.2 and Equation 7.4.

2. The values of the correction factor K_2 should be applied only when the field conditions are such that the entire length of the pier is subjected to the angle of attack of the flow. Use of this factor will result in a significant over-prediction of scour if (1) a portion of the pier is shielded from the direct impingement of the flow by an abutment or another pier; or (2) an abutment or another pier redirects the flow in a direction parallel to the pier. For such cases, judgment must be exercised to reduce the value of the K_2 factor by selecting the effective length of the pier actually subjected to the angle of attack of the flow. **Equation 7.4 should be used for evaluation and design**. Table 7.2 is intended to illustrate the importance of angle of attack in pier scour computations and to establish a cutoff point for K_2 (i.e., a maximum value of 5.0).

3. The correction factor K_3 results from the fact that for plane-bed conditions, which is typical of most bridge sites for the flood frequencies employed in scour design, the maximum scour may be 10 percent greater than computed with Equation 7.1. In the **unusual** situation where a dune bed configuration **with large dunes** exists at a site during flood flow, the maximum pier scour may be 30 percent greater than the predicted equation value. This may occur on very large rivers, such as the Mississippi. For smaller streams that have a dune bed configuration at flood flow, the dunes will be smaller and the maximum scour may be only 10 to 20 percent larger than equilibrium scour. For antidune bed configuration the maximum scour depth may be 10 percent greater than the computed equilibrium pier scour depth.

4. Piers set close to abutments (for example at the toe of a spill through abutment) must be carefully evaluated for the angle of attack and velocity of the flow coming around the abutment.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX I
PALEONTOLOGICAL RESOURCES SURVEY REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

BLYTHE MESA I SOLAR PROJECT,
PALEONTOLOGICAL RESOURCES SURVEY REPORT,
Riverside County, California

by

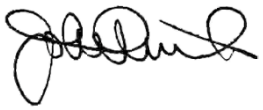
John Minch and Associates, Inc.
26623 Sierra Vista
Mission Viejo, California 92692-3337
jminch@jma-ca.com
(949) 367-1000

Prepared for

POWER Engineers, Inc.
731 E. Ball Road
Anaheim, CA 92805
(714) 507-2700

September 20, 2011
Revised January 5, 2012

The undersigned certifies that the attached report is a true and accurate description of the results of a paleontological assessment described herein.



John A. Minch, PhD.
Principal Investigator
CA Professional Geologist#3269

TABLE OF CONTENTS

	PAGE
EXECUTIVE SUMMARY	i
INTRODUCTION	1
METHODOLOGY OF LITERATURE AND RECORDS SEARCH	5
RESULTS OF LITERATURE AND RECORDS SEARCH	5
GEOLOGY/BIOSTRATIGRAPHY	6
GEOLOGIC UNITS ON SITE	6
PALEONTOLOGIC RESOURCES ON AND NEAR THE PROJECT SITE	8
REGIONAL PALEONTOLOGICAL RESOURCES OF SITE UNITS	8
SENSITIVITY AND SIGNIFICANCE OF POTENTIAL PALEONTOLOGICAL RESOURCES	9
IMPACTS TO POTENTIAL PALEONTOLOGICAL RESOURCES.	9
CONCLUSIONS AND RECOMMENDATIONS FOR MITIGATION MEASURES	10
ANALYSIS OF ENVIRONMENTAL IMPACTS	12
REFERENCES	13

FIGURES

Figure 1. Regional Location Map. 2

Figure 2. Study area 3

Figure 3. Geologic Map of study area. (Stone, 2006). 4

EXECUTIVE SUMMARY

This Paleontological Resources Survey Report documents the findings of a paleontological study conducted by John Minch and Associates, Inc. for the Blythe Mesa I Solar Project, Palo Verde Mesa region, Riverside County, California. The 3,660-acre Project site is located in eastern Riverside County in the Palo Verde Mesa region, approximately 5 miles west of Blythe, California.

The investigation study included: a literature review, records search at the San Bernardino County Museum (SBCM) and databases from the University of California Berkeley Museum of Paleontology (UCMP), and this report which were completed using currently accepted paleontologic methods that satisfy mitigation requirements for paleontological resources. This survey investigation was performed in order to: 1) evaluate existing paleontological resources, 2) determine the impact to identified and/or anticipated paleontological resources resulting from the proposed project, and 3) to determine appropriate mitigation measures necessary to minimize anticipated adverse impacts, if any, to paleontological resources resulting from construction of the project.

The majority of the project site is underlain by Pleistocene alluvium of the Palo Verde Mesa (= unit Qpv) and locally Quaternary Alluvium of Holocene age. The Qpv/Qoa on site has a high potential to contain significant paleontological resources. No recorded fossil localities are known from the project site. It is recommended that a qualified vertebrate paleontologist be retained to develop a Paleontological Mitigation Plan (PMP) to mitigate any impacts to significant nonrenewable paleontological resources

INTRODUCTION

At the request of Power Engineers, Inc. and Renewable Resources Group, Inc. , John Minch and Associates, Inc. [JMA] has undertaken a Paleontological Resources Survey Report for the proposed Blythe Mesa I Solar Project, Riverside County, California. (Figure 1). The purpose of this Study is to identify the potential paleontological resource impacts associated with the proposed Blythe Mesa I Solar Project (Project) on 3,660 acres in eastern Riverside County (County). This study has been prepared in conformance with the California Environmental Quality Act (CEQA) Guidelines (Guidelines) that implement CEQA and the County's implementation procedures for CEQA. The survey was performed in order to: (1) evaluate existing paleontological resources of the site and surrounding area, (2) determine if the proposed Project poses any significant adverse impact to existing paleontological resources, and (3) to outline appropriate mitigation measures (if any) in order to minimize adverse impacts to the paleontological resources.

The 3,660-acre Project site is located in eastern Riverside County in the Palo Verde Mesa region, approximately 5 miles west of Blythe, north and south of Interstate 10 and west of State Route 89 and Highway 95 (see Figure 1). The site occupies the eastern part of the broad and relatively flat Palo Verde Mesa bounded to the east by a low 30 to 50 bluff that descends to the Colorado River Valley. Specifically, the Project is located on the McCoy Wash, California (1951 edition, photorevised 1970), the Ripley, California (1952 edition, photorevised 1970), and the Roosevelt Mine, California (1983 provisional edition) 7.5' United States Geological Survey topographic quadrangle maps (Figure 2).

AR061988

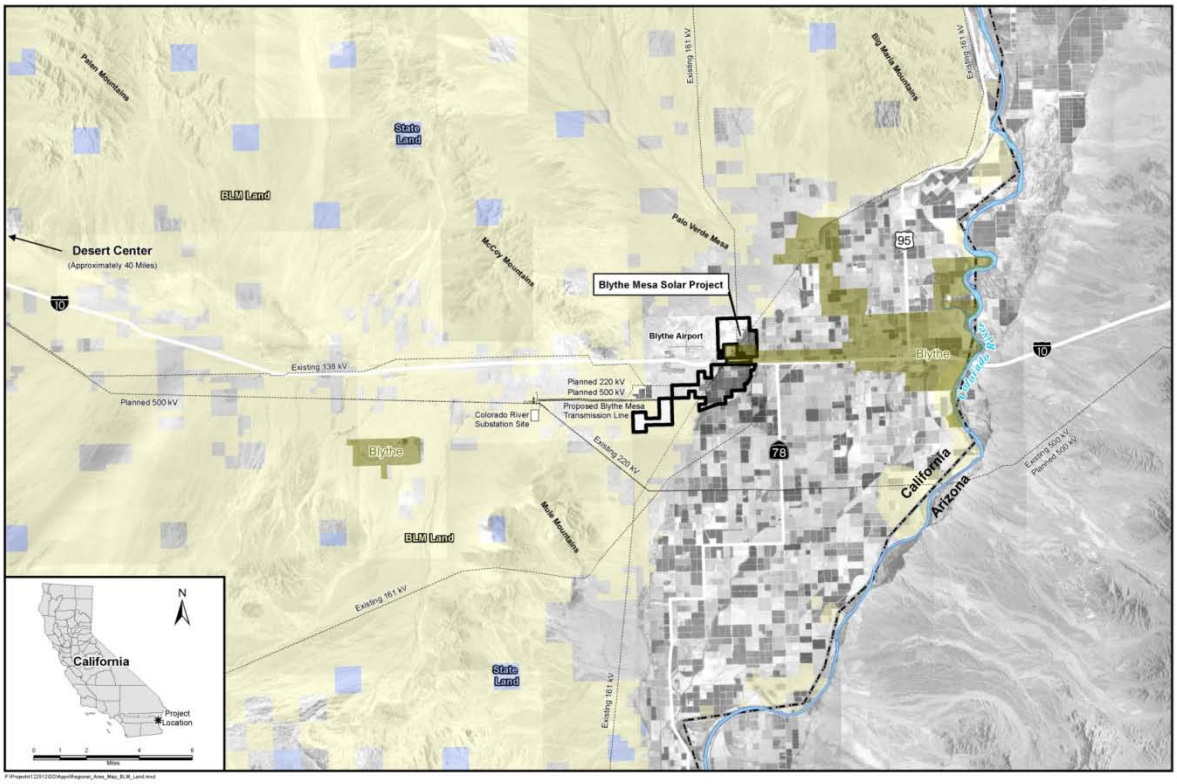


Figure 1. - Regional Location Map

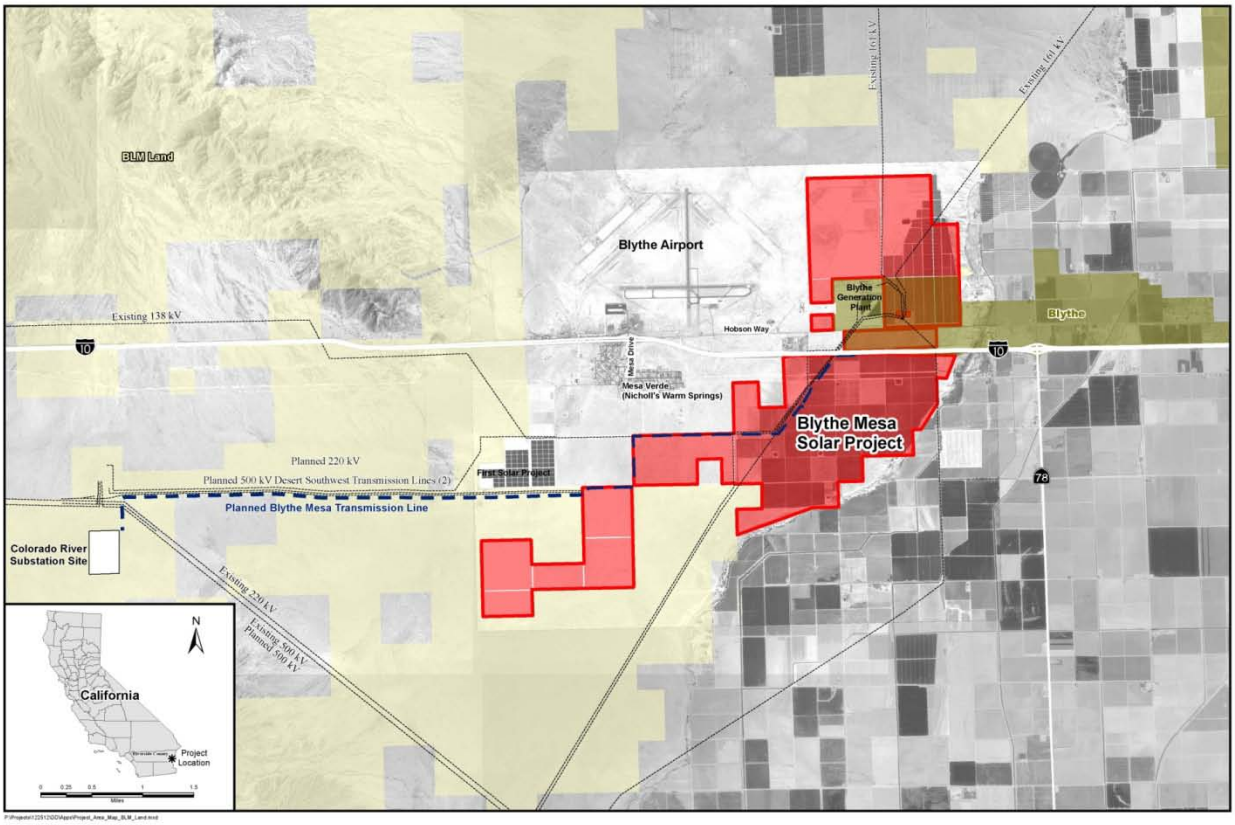


Figure 2. - Study Area.

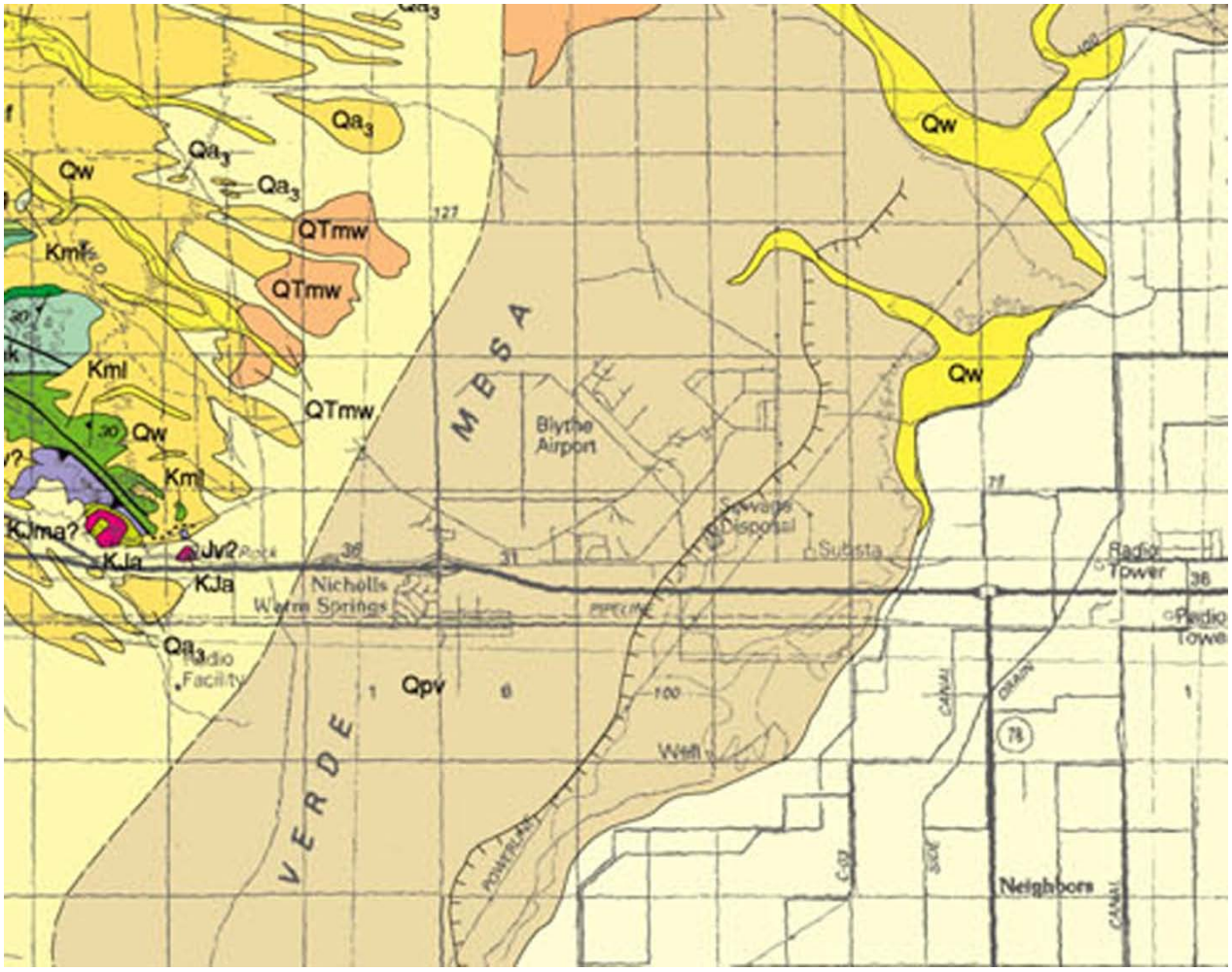


Figure 3. Geologic Map of Project area. (Stone, 2006)

Qpv = Alluvial sediments of Palo Verde Mesa

Qw = Alluvium of modern washes

METHODOLOGY OF LITERATURE AND RECORDS SEARCH

Tasks completed during literature search:

- Review of available geologic and paleontologic literature pertinent to the site, including existing lists of fossils and fossil localities.
- Review of available environmental impact and/or geotechnical reports pertinent to development of the site.
- Review of records searches at the San Bernardino County Museum (SBCM) and databases from the University of California Berkeley Museum of Paleontology (UCMP).

RESULTS OF LITERATURE AND RECORDS SEARCH

Available literature considered pertinent to the site, including previously recorded lists of fossils and paleontological fossil localities recorded for the general site vicinity, was reviewed. The purpose of the literature search was to determine: (1) pertinent geologic and paleontologic site information, and (2) the paleontologic sensitivity of identified and/or anticipated geologic units underlying the site.

The literature search included a review of all available data pertinent to the site, including environmental reports, professional geological publications, paleontological consultant reports, and other unpublished documents related to regional and/or detailed geologic studies. The review also included the location of geologic maps delineating the geology of the rock formations underlying the project site (Stone, 2006).

Records searches at the San Bernardino County Museum (SBCM) and review of databases from the University of California Berkeley Museum of Paleontology (UCMP) provided additional data and insured that the JMA review of the literature and records was complete. Pertinent sections of this literature and records review report are included in this document. For security purposes the specific locations of the fossil localities is not included in this report.

No recorded fossil localities were located within the boundaries of the project site during the review of the SBCM and UCMP records, fossil lists, published and unpublished literature.

GEOLOGY/BIOSTRATIGRAPHY

The geology of the Blythe area has been described by Stone (2006) at a scale of 1:100,000. This 2006 map was modified from Stone (1990) which was compiled primarily from Hamilton (1964, 1984), Tosdal (1988), Stone and Pelka (1989), and Ballard (1990).

As delineated on the Blythe 30' by 60' geologic map (Stone, 2006) (Figure 3) the majority of the project site is underlain by unit Qpv. Qpv is defined as the Alluvial Deposits of the Palo Verde Mesa of Pleistocene age. Minor amounts of Alluvium (Qa) of Holocene (Recent) age underlies a small area in the NE part of the site. No construction is planned in the areas underlain by Qa. The Quaternary Alluvium and the Alluvial Deposits of the Palo Verde Mesa are discussed in this section. For completeness these units, which do not outcrop on the Project a brief discussion of the relationships of the Latest Tertiary and Quaternary Surficial Deposits is included here (abstracted from Stone, 2006).

Latest Tertiary and Quaternary Surficial Deposits

Alluvial-fan and alluvial-valley deposits (Holocene to Miocene)

These deposits consist of angular to subangular gravel and sand derived from local mountain ranges. Mostly unconsolidated to weakly consolidated, the oldest deposits are locally well consolidated. The deposits are divided into six units distinguished by contrasting surficial and geomorphic characteristics.

These surficial deposits form most of the land surface west of Blythe. Most of these deposits are composed of alluvium derived from local mountain ranges. These locally derived middle Pleistocene to Holocene alluvial-fan deposits are divided based on their surface morphology and their appearance on aerial photographs. They are interpreted as the products of aggradation events that took place during interglacial climatic

environments (Bull, 1991). The youngest locally derived alluvium occupies modern washes incised into the older alluvial-fan deposits.

AR061994

Alluvial deposits of the ancestral Colorado River (Pleistocene and Pliocene)

These are unconsolidated to well consolidated alluvial deposits of moderately to well sorted clay, silt, sand, and gravel derived from distant sources and deposited by the ancestral Colorado River; exposed primarily along bluffs and mesas bordering the modern Colorado River flood plain. Clay, silt, and sand deposits are light in color, commonly well laminated, and typically friable; gravels and conglomerates consist of rounded pebbles and cobbles of resistant lithology, primarily quartzite and other siliceous rock types. As mapped, some units also include locally derived alluvial-fan deposits.

These alluvium units deposited by the Colorado River are concentrated along the margins of the Colorado River flood plain, where they interfinger with locally derived alluvium. These high-standing units represent one or more major aggradational events when the ancestral Colorado River flowed across the area at much higher elevations than the modern river. Metzger and others (1973) recognized two major pre-Holocene aggradations, one of probable Pliocene-Pleistocene age and the other probably middle to late Pleistocene, each of which was followed by a period of degradation. The last degradation was followed by Holocene aggradation that has deposited the sediments of the modern flood plain (Metzger and others, 1973).

GEOLOGIC UNITS ON SITE

Alluvium of modern washes - Qw (Holocene, 11,000 to present)

These units are unconsolidated**,** angular to subangular gravel and sand, locally derived and grade downstream into pebbly and sandy distal deposits. Mapped areas include McCoy Wash and closely spaced smaller washes. Wash deposits grade laterally and downstream into young alluvial sand and gravel.

Alluvial deposits of Palo Verde Mesa - Qpv (middle to late Pleistocene)

The alluvial deposits of the Palo Verde Mesa are composed of unconsolidated sand and pebbly sand containing a mixture of local and river pebbles are moderately to poorly exposed on the Palo Verde Mesa. These unconsolidated of weakly consolidated

sediments are locally well exposed along the scarp of Palo Verde Mesa, which bounds the flood plain of the Colorado River. Scarp exposures typically consist of an upper, slope-forming unit of tan to light-gray, sandy and pebbly alluvium and a lower, cliff-forming unit of light-reddish-brown, interbedded fine- grained sand, silt, and clay. Exposures of Qpv to the Northeast are overlain by, and may interfinger with alluvial-fan deposits. The Qpv Deposits are interpreted to be fluvial river deposits of probable middle to late Pleistocene age. (Stone, 2006)

PALEONTOLOGIC RESOURCES ON AND NEAR THE PROJECT SITE

The review of the LACM and UCMP records, fossil lists, published and unpublished literature indicated that no known paleontologic resource localities are recorded from the study area. However, Jefferson (1991) listed one locality, UCMP V60004, from the Blythe area. Pleistocene Colorado River alluvium in the Needles area, has yielded the remains of an extinct mammoth (Mammuthus sp.) (Agenbroad and others, 1992), and Colorado River delta deposits in northwestern Sonora have yielded thousands of vertebrate fossils (Shaw, 1981; Croxen and others, 2007).

REGIONAL PALEONTOLOGICAL RESOURCES OF SITE UNITS

The SBCM records search results also indicate that similar river alluvium elsewhere in the eastern Mojave, in Arizona, and in Sonora, Mexico, has reliably and consistently yielded vertebrate fossil remains (Shaw, 1981; Jefferson, 1991; Agenbroad and others, 1992).

Older Alluvium (Qoa) Alluvial deposits of Palo Verde Mesa - Qpv

Older Pleistocene alluvial sediments, mapped as Qa and Qoa, elsewhere in California (principally in southern California) have been reported to yield significant fossils of extinct animals from the Ice Age (Jefferson, 1991; Reynolds and Reynolds, 1991; Woodburne, 1991; Springer and Scott, 1994; Scott, 1997; Springer and others, 1998, 2007), as well as fossil plants (Reynolds and Reynolds, 1991; Anderson and others, 2002). Fossils vertebrates recovered from these Pleistocene sediments represent

extinct taxa including mammoths, mastodons, ground sloths, dire wolves, short-faced bears, saber-toothed cats, large and small horses, large and small camels, and bison (Jefferson, 1991; Reynolds and Reynolds, 1991; Woodburne, 1991; Springer and Scott, 1994; Scott, 1997; Springer and others, 1998, 2007).

Recent Alluvium (Qa/Qw)

Recent Alluvium is less than 11,000 years and is not considered to contain paleontological resources. However; it is often difficult to distinguish Recent Alluvium from Older Alluvium when deposition was continuous and many areas mapped as Qa are really Qoa.

SENSITIVITY AND SIGNIFICANCE OF POTENTIAL PALEONTOLOGICAL RESOURCES

Known sedimentary units of Late Pleistocene to Recent age are exposed at the site. Older Alluvium underlies the majority of the area covered by the project. The Older alluvial sediments of the area are considered to be of high paleontologic sensitivity and are known to contain significant fossils in other parts of southern California. There is a high potential for significant paleontological resources on the portion of the site underlain by Quaternary Alluvium

Older Alluvium - Alluvial deposits of Palo Verde Mesa

The fossils recovered from this unit are considered to be significant and of high scientific value. The sediments of the Older Alluvium are assigned a high paleontologic sensitivity.

Recent Alluvium

This alluvium has low potential to contain significant nonrenewable paleontologic resources subject to adverse impact by development-related excavation, and so is assigned low paleontologic sensitivity. However, this unit is typically thin and can overlie units of moderate or high paleontologic sensitivity.

IMPACTS TO POTENTIAL PALEONTOLOGICAL RESOURCES

Grading and excavation in conjunction with development would have high potential to adversely impact significant nonrenewable paleontologic resources that may be present within the boundaries of the project property, depending upon the lithology of the Pleistocene older alluvial sediments present. These operations potentially would result in significant and adverse impacts to fossil resources unless proper mitigation measures are implemented.

CONCLUSIONS AND RECOMMENDATIONS FOR MITIGATION MEASURES

A qualified vertebrate paleontologist shall develop a Paleontologic Mitigation Program/Plan to mitigate impacts and to guide the recovery of any significant nonrenewable paleontologic resources. This PMP shall be consistent with the provisions of the California Environmental Quality Act (Scott and Springer, 2003), as well as with regulations currently implemented by the County of Riverside and the proposed guidelines of the Society of Vertebrate Paleontology. This program shall include, but not be limited to:

1. The qualified vertebrate paleontologist who is a Registered Professional Geologist should direct paleontologic monitoring, by a qualified paleontologic monitor, during excavations in areas underlain by geologic units identified as having a high paleontologic sensitivity and likely to contain paleontologic resources. Areas of concern include all previously- undisturbed paleontologic sensitive sediments of the fossiliferous Pleistocene Palo Verde Mesa Alluvium.

2. Paleontologic monitors shall be equipped to salvage fossils as unearthed, to avoid construction delays, and to remove samples of sediments likely to contain the remains of small fossil invertebrates and vertebrates. Monitors shall be empowered to temporarily halt or divert equipment to allow removal of abundant or large specimens.

3. Preparation of recovered specimens to a point of identification and permanent

preservation, including washing of sediments to recover small invertebrates and vertebrates. Preparation and stabilization of all recovered fossils are essential in order to fully mitigate adverse impacts to the resources (Scott and others, 2004).

4. Identification and curation of specimens into an established, accredited museum repository with permanent retrievable paleontologic storage. These procedures are also essential steps in effective paleontologic mitigation (Scott and others, 2004) and CEQA compliance (Scott and Springer, 2003). The paleontologist should have a written repository agreement in hand prior to the initiation of mitigation activities. Mitigation of adverse impacts to significant paleontologic resources is not complete until such curation into an established museum repository has been fully completed and documented.

5. Preparation of a report of findings with an appended itemized inventory of specimens. The report and inventory, when submitted to the appropriate Lead Agency along with confirmation of the curation of recovered specimens into an established, accredited museum repository, would signify completion of the program to mitigate impacts to paleontologic resources.

RESULTS OF ANALYSIS OF ENVIRONMENTAL IMPACTS

Significant Impact Which Cannot be Avoided or Mitigated

(Section 15126(b) of CEQA Guidelines)

Not applicable; Impact on paleontological resources are considered significant but mitigable.

Significant Impact Which Can be Avoided or Mitigated

Development of the site may have an impact on paleontological resources that cannot be avoided. Impacts to these paleontological resources can however, be mitigated by implementation of all mitigation measures recommended above.

Cumulative Impacts

Impacts to paleontological resources at the site are considered to be non-Cumulative.

Residual Impacts After Mitigation (If Any)

There will be no Residual Impacts after Mitigation.

Alternatives Analysis

There is no need to consider alternatives to the project as impacts to the paleontological resources will be reduced to insignificant levels if mitigation measures are employed.

PERTINENT REFERENCES

Agenbroad, L.D., J.I. Mead and S.F.B. Reynolds, 1992. Mammoths in the Colorado River Corridor, in J. Reynolds, *ed.*, Old routes to the Colorado. SBCM Association Special Publication 92- 2, p. 104-106.

Ballard, S.N., 1990, The Mesozoic structural evolution of the Little Maria Mountains, Riverside County, California: Santa Barbara, University of California, Ph.D. dissertation, 380 p.

Croxen, F.W. III, C.A. Shaw, and D.R. Sussman, 2007, Pleistocene geology and paleontology of the Colorado River delta at Golfo de Santa Clara, Sonora, Mexico, in S.F.B. Reynolds, *ed*., Wild, scenic, and rapid - a trip down the Colorado River trough. 2007 Desert Symposium field guide, Desert Studies Consortium, p. 84-89.

Hamilton, Warren, 1964, Geologic map of the Big Maria Mountains NE quadrangle, Riverside County, California and Yuma County, Arizona: U.S. Geological Survey Geologic Quadrangle Map GQ-350, scale 1:24,000.

Hamilton, Warren, 1984, Generalized geologic map of the Big Maria Mountains region, northeastern Riverside County, southeastern California: U.S. Geological Survey Open-File Report 84-407, scale 1:48,000, 7 p.

Jefferson, G.T., 1991, A catalogue of late Quaternary vertebrates from California: Part Two, mammals. Natural History Museum of Los Angeles County Tech. Report, No. 7.

Metzger, D.G., Loeltz, O.J., and Irelna, Burdge, 1973, Geohydrology of the Parker-Blythe-Cibola area, Arizona and California: U.S. Geological Survey Professional Paper 486-G, 130 p.

Reynolds, S.F.B. and R.L. Reynolds, 1991, The Pleistocene beneath our feet: near-surface Pleistocene fossils in inland southern California basins, *in* Inland Southern California: the last 70 million years, M.O. Woodburne, S.F.B. Reynolds, and D.P. Whistler, *eds*. Redlands, San Bernardino County Museum Special Publication 38(3&4), p. 41-43.

Reynolds, S.F.B. and R.L. Reynolds, 1992. Pleistocene faunas in the Bristol-Danby trough, in J. Reynolds (ed.), Old routes to the Colorado. SBCM Association Special Publication 92-2, p. 83-86.

Scott, E. and K. Springer, 2003. CEQA and fossil preservation in southern California. The Environmental Monitor, Fall 2003, p. 4-10, 17.

Scott, E., K. Springer and J.C. Sagebiel, 2004. Vertebrate paleontology in the Mojave Desert: the continuing importance of “follow-through” in preserving paleontologic resources. In M.W. Allen and J. Reed (eds.) The human journey and ancient life in California’s deserts: Proceedings from the 2001 Millennium Conference. Ridgecrest:

Maturango Museum Publication No. 15, p. 65-70.

Shaw, C.A., 1981. The middle Pleistocene El Golfo local fauna from northwestern Sonora, Mexico. Unpublished masters thesis, California State University, Long Beach.

Springer, K.B. and E. Scott, 1994, First record of late Pleistocene vertebrates from the Domenigoni Valley, Riverside County, California. Journal of Vertebrate Paleontology 14 (3): 47A.

Springer, K., E. Scott, J.C. Sagebiel, and L.K. Murray, 2007, The Diamond Valley Lake Local Fauna: late Pleistocene vertebrates from inland southern California. Journal of Vertebrate Paleontology 27(3): 151A.

Springer, K.B., E. Scott, J.C. Sagebiel and K.M. Scott, 1999, A late Pleistocene lake edge vertebrate assemblage from the Diamond Valley, Riverside County, California. Journal of Vertebrate Paleontology 19(3): 77-A.

Stone, Paul, 1990, Preliminary geologic map of the Blythe 30’ by 60’ quadrangle, California and Arizona: U.S. Geological Survey Open-File Report 90-497, scale 1:100,000.

Stone, P., 2006. Geologic map of the west half of the Blythe 30' by 60' quadrangle, Riverside County, California and La Paz County, Arizona. United States Geological Survey Scientific Investigations Map 2922.

Stone, Paul, and Pelka, G.J., 1989, Geologic map of the Palen-McCoy Wilderness Study Area and vicinity, Riverside County, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2092, scale 1:62,500.

SVP (Society of Vertebrate Paleontology), 1995, Assessment and mitigation of adverse impacts to nonrenewable paleontological resources: standard guidelines: Society of Vertebrate Paleontology New Bulletin, No. 163. pp. 22-27.

SVP (Society of Vertebrate Paleontology), 1996, Conditions of receivership for paleontological salvage collections: Society of Vertebrate Paleontology News Bulletin, No. 166, pp. 31-32.

Tosdal, R.M., 1988, Mesozoic rock units along the Late Cretaceous Mule Mountains thrust system, southeastern California and southwestern Arizona: Santa Barbara, University of California, Ph.D. dissertation, 365 p.

UCMP Database, 2010, on line

APPENDIX J
TRAFFIC IMPACT STUDY REPORT

THIS PAGE INTENTIONALLY LEFT BLANK

TRAFFIC IMPACT STUDY REPORT

BLYTHE MESA SOLAR PROJECT

May 2013

KOA CORPORATION
PLANNING & ENGINEERING
www.koacorporation.com

TRAFFIC IMPACT STUDY REPORT

BLYTHE MESA SOLAR PROJECT

May 2013

Prepared for:
Power Engineers, Inc

Prepared by:
KOA Corporation
3190 C Shelby Street
Ontario, CA 91764
T: 909.890.9693
F: 909.890.9694



KOA Job No.: JB14038

AR062006

List of Figures

FIGURE 1.1 – PROJECT REGIONAL LOCATION....2
FIGURE 1.2 – PROJECT STUDY AREA....3
FIGURE 3.1 – EXISTING GEOMETRIES....13
FIGURE 3.2 – EXISTING TRAFFIC VOLUMES - AM PEAK HOUR....14
FIGURE 3.3 – EXISTING TRAFFIC VOLUMES - PM PEAK HOUR....15
FIGURE 4-2A – TRUCK PROJECT TRIP DISTRIBUTION....23
FIGURE 4-2B – EMPLOYEE PROJECT TRIP DISTRIBUTION....24
FIGURE 4-3 – PROJECT-RELATED CONSTRUCTION TRAFFIC VOLUMES – AM PEAK HOUR....25
FIGURE 4-4 – PROJECT-RELATED CONSTRUCTION TRAFFIC VOLUMES – PM PEAK HOUR....26
FIGURE 5.1 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITHOUT PROJECT - AM PEAK HOUR....29
FIGURE 5.2 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITHOUT PROJECT - PM PEAK HOUR....30
FIGURE 5.3 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITH PROJECT - AM PEAK HOUR....31
FIGURE 5.4 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITH PROJECT - PM PEAK HOUR....32
FIGURE 6.1 – CUMULATIVE TRAFFIC VOLUMES WITHOUT PROJECT - AM PEAK HOUR....40
FIGURE 6.2 – CUMULATIVE TRAFFIC VOLUMES WITHOUT PROJECT - PM PEAK HOUR....41
FIGURE 6.3 – CUMULATIVE TRAFFIC VOLUMES WITH PROJECT - AM PEAK HOUR....42
FIGURE 6.4 – CUMULATIVE TRAFFIC VOLUMES WITH PROJECT - PM PEAK HOUR....43

List of Tables

TABLE 2-1 INTERSECTION LEVELS OF SERVICE DEFINITIONS....5
TABLE 2-2A TRAFFIC AND TRANSPORTATION LAWS, ORDINANCES, REGULATIONS, AND STANDARDS....8
TABLE 2-2B TRAFFIC AND TRANSPORTATION LAWS, ORDINANCES, REGULATIONS, AND STANDARDS....9
TABLE 3-1 EXISTING INTERSECTION CONDITIONS....12
TABLE 3-2 SCHOOL BUS CHARACTERISTICS IN THE PROJECT VICINITY....17
TABLE 5-1 PROJECT CONSTRUCTION INTERSECTION CONDITIONS....27
TABLE 6-1A CUMULATIVE PROJECTS INCLUDED IN ANALYSIS....34
TABLE 6-1B CUMULATIVE PROJECTS CONSIDERED....35
TABLE 6-1B CUMULATIVE PROJECTS CONSIDERED (CONTINUED)....36
TABLE 6-2 CUMULATIVE INTERSECTION CONDITIONS....38
TABLE 6-3 CUMULATIVE PROJECT TRIP AND PERCENTAGE CONTRIBUTION*....39
TABLE 7-1 INTERSECTION ANALYSIS SUMMARY....44
TABLE 8-1 POTENTIAL CUMULATIVE TRIP PERCENTAGE REDUCTION....47
TABLE 8-2 CUMULATIVE INTERSECTIONS WITHOUT THREE SOLAR PROJECTS AND STAGGERED TRIPS....48

Appendices

APPENDIX A TRAFFIC COUNT DATA
APPENDIX B EXISTING INTERSECTION ANALYSIS WORKSHEETS
APPENDIX C PROJECT CONSTRUCTION ANALYSIS WORKSHEETS
APPENDIX D CUMULATIVE INTERSECTION ANALYSIS WORKSHEET
APPENDIX E SCOPING AGREEMENT
APPENDIX F STAGGERED TRIP SCENARIOS

List of Figures

FIGURE 1.1 – PROJECT REGIONAL LOCATION....2
FIGURE 1.2 – PROJECT STUDY AREA....3
FIGURE 3.1 – EXISTING GEOMETRIES....13
FIGURE 3.2 – EXISTING TRAFFIC VOLUMES - AM PEAK HOUR....14
FIGURE 3.3 – EXISTING TRAFFIC VOLUMES - PM PEAK HOUR....15
FIGURE 4-2A – TRUCK PROJECT TRIP DISTRIBUTION....23
FIGURE 4-2B – EMPLOYEE PROJECT TRIP DISTRIBUTION....24
FIGURE 4-3 – PROJECT-RELATED CONSTRUCTION TRAFFIC VOLUMES – AM PEAK HOUR....25
FIGURE 4-4 – PROJECT-RELATED CONSTRUCTION TRAFFIC VOLUMES – PM PEAK HOUR....26
FIGURE 5.1 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITHOUT PROJECT - AM PEAK HOUR....29
FIGURE 5.2 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITHOUT PROJECT - PM PEAK HOUR....30
FIGURE 5.3 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITH PROJECT - AM PEAK HOUR....31
FIGURE 5.4 – PROJECT CONSTRUCTION TRAFFIC VOLUMES WITH PROJECT - PM PEAK HOUR....32
FIGURE 6.1 – CUMULATIVE TRAFFIC VOLUMES WITHOUT PROJECT - AM PEAK HOUR....40
FIGURE 6.2 – CUMULATIVE TRAFFIC VOLUMES WITHOUT PROJECT - PM PEAK HOUR....41
FIGURE 6.3 – CUMULATIVE TRAFFIC VOLUMES WITH PROJECT - AM PEAK HOUR....42
FIGURE 6.4 – CUMULATIVE TRAFFIC VOLUMES WITH PROJECT - PM PEAK HOUR....43

List of Tables

TABLE 2-1 INTERSECTION LEVELS OF SERVICE DEFINITIONS....5
TABLE 2-2A TRAFFIC AND TRANSPORTATION LAWS, ORDINANCES, REGULATIONS, AND STANDARDS....8
TABLE 2-2B TRAFFIC AND TRANSPORTATION LAWS, ORDINANCES, REGULATIONS, AND STANDARDS....9
TABLE 3-1 EXISTING INTERSECTION CONDITIONS....12
TABLE 3-2 SCHOOL BUS CHARACTERISTICS IN THE PROJECT VICINITY....17
TABLE 5-1 PROJECT CONSTRUCTION INTERSECTION CONDITIONS....27
TABLE 6-1A CUMULATIVE PROJECTS INCLUDED IN ANALYSIS....34
TABLE 6-1B CUMULATIVE PROJECTS CONSIDERED....35
TABLE 6-1B CUMULATIVE PROJECTS CONSIDERED (CONTINUED)....36
TABLE 6-2 CUMULATIVE INTERSECTION CONDITIONS....38
TABLE 6-3 CUMULATIVE PROJECT TRIP AND PERCENTAGE CONTRIBUTION*....39
TABLE 7-1 INTERSECTION ANALYSIS SUMMARY....44
TABLE 8-1 POTENTIAL CUMULATIVE TRIP PERCENTAGE REDUCTION....47
TABLE 8-2 CUMULATIVE INTERSECTIONS WITHOUT THREE SOLAR PROJECTS AND STAGGERED TRIPS....48

Appendices

APPENDIX A TRAFFIC COUNT DATA
APPENDIX B EXISTING INTERSECTION ANALYSIS WORKSHEETS
APPENDIX C PROJECT CONSTRUCTION ANALYSIS WORKSHEETS
APPENDIX D CUMULATIVE INTERSECTION ANALYSIS WORKSHEET
APPENDIX E SCOPING AGREEMENT

CHAPTER 1
INTRODUCTION

PROJECT DESCRIPTION

The proposed Blythe Mesa Solar Project (Project) consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison Colorado River Substation, an approved new substation located south of Highway 10 and approximately four miles west of the Project site. The Project has secured a California Independent System Operator (CAISO) interconnection queue position sufficient for the size of the Project. The Project would produce enough energy to power approximately 180,000 households and progress the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state.

The project regional location is shown in Figure 1-1. The Project study area is shown in Figure 1-2.

AR062009

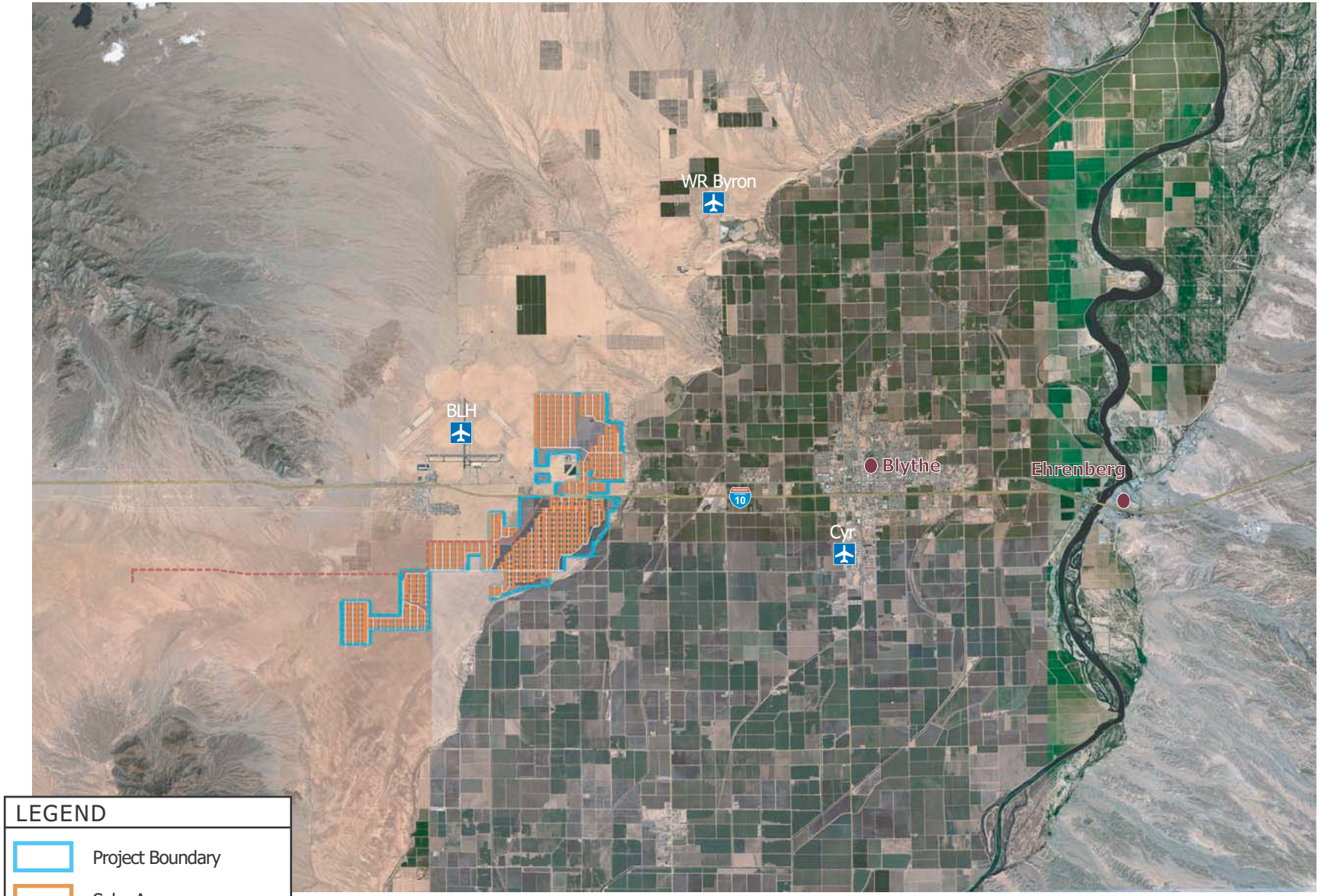
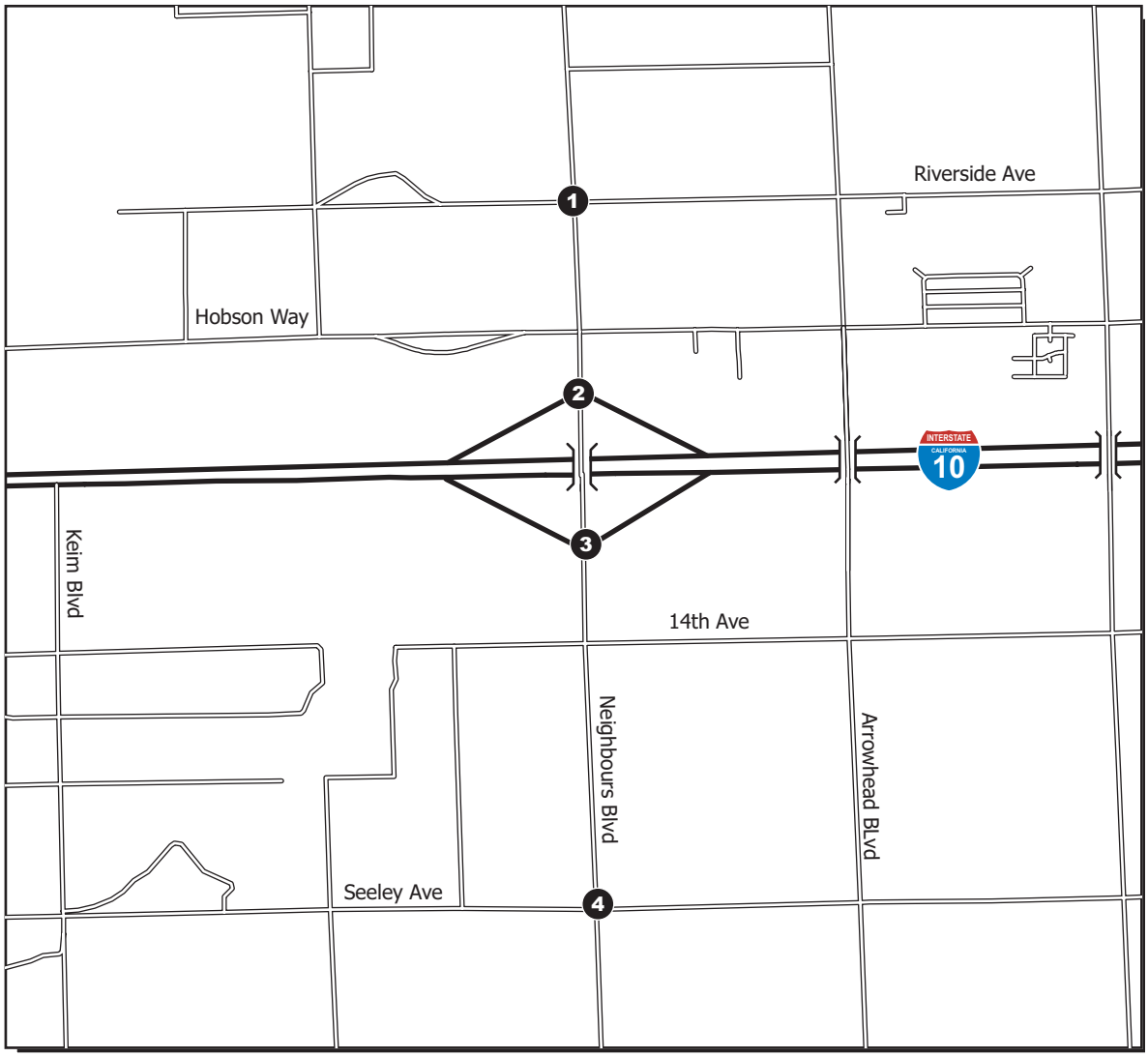


Figure 1-1
Project Regional Location

AR062010



LEGEND

1 Study Intersection Locations

Figure 1.2
Project Study Area

N
Not To Scale

AR062011

CHAPTER 2
METHODOLOGIES

This chapter documents the methodologies and assumptions used to conduct the traffic impact analysis for the Project. The study methodology and analysis was conducted in accordance with the County of Riverside guidelines. These guidelines are used to determine potential significant impacts of the Project. This section contains the following background information:

- Study scenarios
- Study area descriptions
- Analysis methodology

STUDY SCENARIOS

This report presents an analysis of the intersection operating conditions during the morning and evening peak hours for the following anticipated timeframes:

- Existing Conditions (2011)
- Future Conditions (2015)

STUDY AREA DESCRIPTION

A total of 4 intersections are potentially impacted by the access points identified and analyzed as they relate to the proposed substations and operation/maintenance facilities. Traffic data and other transportation system information were obtained from daily and peak-hour counts, site visits, maps, aerial photos, and communication with County staff. The study area consists of the following intersections:

- Neighbours Boulevard and Riverside Drive
- Neighbours Boulevard and I-10 Westbound Ramps
- Neighbours Boulevard and I-10 Eastbound Ramps
- Neighbours Boulevard and Seeley Avenue

ANALYSIS METHODOLOGY

This section presents a brief overview of traffic analysis methodologies and concepts used in this study. These methodologies are found in the *Highway Capacity Manual (HCM*). Level of service is a report-card scale used to indicate the quality of traffic flow on roadway segments and at intersections. Level of service (LOS) ranges from Level of Service A (free flow, little congestion) to Level of Service F (forced flow, extreme congestion).

Level of Service Criteria

Level of service for signalized intersections is based upon the average time (seconds) that vehicles approaching an intersection are delayed. There is a specific delay and level of service associated with each approach and an overall average delay for all movements. The overall level of service for the intersection is based upon the overall average delay.

Unsignalized intersection level of service is also based upon the control delay, but delay is only assessed for those traffic movements that are stopped or must yield to through traffic. Some movements, including cross traffic on the minor street or left turns onto the major street, can be subject to long delays, however through traffic and right turns from the major street will not experience any delays at stopped intersections. When delay for cross traffic is severe (Level of Service F) the intersection should be evaluated further for possible improvement with traffic signals. In some cases, this analysis determines that the delay is being experienced by a very low number of vehicles and traffic signals are not warranted. In other cases, the number of stopped vehicles is substantial and traffic signals may be justified as a mitigation measure, additional analysis is required to determine the need and justification for the installation of a traffic signal.

Table 2-1 shows the relationship between level of service and the performance measures for signalized and unsignalized intersections and lists the HCM delay criteria for signalized intersections.

Table 2-1
Intersection Levels of Service Definitions

Level of Service	Signalized Intersection Control Delay (in sec/veh)	Unsignalized Intersection Control Delay (in sec/veh)
A	0 – 10	0 – 10
B	10.1 – 20	10.1 – 15
C	20.1 – 35	15.1 – 25
D	35.1 – 55	25.1 – 35
E	55.1 – 80	35.1 – 50
F	80.1 or more	50.1 or more

Source: Highway Capacity Manual 2000, Exhibits 16.2 and 17-2

The County of Riverside General Plan Policy C 2.1 has identified the following countywide target Levels of Service:

LOS "C" along all County maintained roads and conventional state highways. As an exception, LOS "D" may be allowed in Community Development areas, only at intersections of any combination of Secondary Highways, Major Highways, Arterials, Urban Arterials, and Expressways, conventional state highways or freeway ramp intersections.

LOS "E" may be allowed in designated community centers to the extent that it would support transit-oriented development and walk-able communities.

Caltrans has identified a target LOS at the transition between LOS “C” and LOS “D” on State highway facilities, however, Caltrans acknowledges that this may not always be feasible and recommends that the lead agency consult with Caltrans to determine the appropriate target LOS.

The Riverside County Transportation Commission whom is in charge of the Riverside County Congestion Management Program has approved a minimum traffic LOS standard of "E." In no case shall the LOS standards established be below the level of service E or the current level, whichever is farthest from level of service A.

For this analysis contained in this report, mitigation measures should be considered when traffic conditions are forecasted to decline below LOS “D”.

Significance Threshold

The following types of traffic impacts are considered to be "significant" under CEQA:

- When existing traffic conditions (Existing Traffic) exceed the General Plan target LOS.
- When project traffic, when added to existing traffic (Project Completion), will deteriorate the LOS to below the target LOS, and impacts cannot be mitigated through project conditions of approval.
- When cumulative traffic (Cumulative) exceeds the target LOS, and impacts cannot be mitigated through the TUMF (*Transportation Uniform Mitigation Fee)* network (or other funding mechanism), project conditions of approval, or other implementation mechanisms.

Intersection Capacity Analysis

The analysis of peak hour intersection conditions was conducted using the TRAFFIX software. The following peak hours were selected for analysis to coincide with normal weekday peak traffic periods:

- Weekday a.m. peak hour (between 7:00 and 9:00 a.m.)
- Weekday p.m. peak hour (between 4:00 and 6:00 p.m.)

All unsignalized intersections were analyzed based on the "operational analysis" procedure for signalized intersections, as defined in the 2000 Highway Capacity Manual (HCM). Local practice uses 1,900 passenger cars per hour of green per lane (pcphgpl) as the maximum saturation flow of a single lane at an intersection for existing and future scenarios. This saturation flow rate is adjusted to account for lane width, on-street parking, conflicting pedestrian flow, traffic composition, (i.e., percent of trucks) and shared lane movements (e.g., through and right-turn movements from the same lane). Level of service for signalized intersections is based on the average time (seconds) that vehicles entering an intersection are delayed. Table 2-1 lists the HCM delay criteria for signalized intersections. Occasionally an intersection will exhibit an overflow condition when the average arrival rate of cars exceeds capacity, which results oversaturation of the intersection. This can occur when an area experiences a high increase of traffic demand and cannot handle all the traffic causing excessive delay for movements. When the intersection is oversaturated, the system is in a non-equilibrium state, and the queue length increases constantly. This is assuming a constant arrival rate and capacity.

In addition, a peak hour factor was added to all of the volumes, to analyze the peak hour. Traffic volumes may fluctuate from minute to minute within the peak periods, so a peak hour factor increases the hourly volume, to simulate the higher 15 minute peak period for the entire peak period. The existing peak hour factor (ranging from 0.0 to 1.0) was obtained from existing traffic count information and applied to all intersections for the existing and future scenarios.

Regulatory Framework

Traffic study details are defined by guidelines and requirements published by the federal, state, and local reviewing agencies. Typical traffic studies are based on specific proposed project locations that would generate a specific number of trips to and from a site within a defined time period.

In addition, construction and operating plans will need to be developed in accordance with federal, state, and local regulations and standards that promote safety and efficient use of public roadways.

Federal

The Code of Federal Regulations (CFR) provides guidelines for regulations as it relates to the movement of hazardous materials via the Federal Motor Carrier Safety Administration. Under the

Federal Aviation Administration guidelines, regulations are provided for aviation activities during the construction and post-construction periods.

State

The California Vehicle Code (CVC) along with the California Streets and Highway Code outline regulations as pertains to the transportation of hazardous waste within the state.

Local

Separate traffic study guidelines are published by County of Riverside (via the Transportation Department).

Encroachment permits may be required by local jurisdictions that lie within the project study area for the construction activities associated with the project. These jurisdictions include but limited to Bureau of Land Management (BLM), Caltrans, County of Riverside, and City of Blythe.

Table 2-2 provides specific codes and a general description of adopted federal, state, and local laws, ordinances, regulations and standards (LORS) pertaining to general traffic and transportation safety and operational issues that would relate to construction and operations of the proposed project.

Table 2-2A
Traffic and Transportation Laws, Ordinances, Regulations, and Standards

Applicable Law	Description
Federal	
Objects Affecting the Navigable Air Space: Title 14 CFR Part 77	Describes the criteria used to determine the need for an FAA "Notice of Proposed Construction or Alteration" in cases of potential obstruction hazards and requires applicant to submit form for construction near airport.
CFR Title 14 Aeronautics and Space, Part 77 Objects Affecting Navigable Airspace (14 CFT 77)	This regulation establishes standards for determining physical obstructions to navigable airspace; sets noticing and hearing requirements; and provides for aeronautical studies to determine the effect of physical obstructions to the safe and efficient use of airspace
Proposed Construction and/or Alteration of Objects that May Affect the Navigable Air Space: FAA Advisory Circular No. 70/7460-2K	Describes FAA Standards for marking and lighting of obstructions identified by Title 14 CFR Part 77.
CRR Title 47 Section 15.2524	Prohibits operation of devices that can interfere with radio-frequency communication.
CFR, Title 49, Subtitle B	Includes procedures and regulations pertaining to interstate and intrastate transport (including hazardous materials program procedures) and provides safety measures for motor carriers and motor vehicles that operate on public highways.
State	
CVC Section 353	Defines hazardous materials
CVC Sections 2500-2505	Authorizes the issuance of licenses for the transport of hazardous materials
CVC, Div 2, Chapter 2.5; Div 6; Chap. 7; Div 13; Chap. 5; Div. 14.1; Chap 1 & 2; Div. 14.8; Div. 15	Includes regulations pertaining to licensing, size, weight, and load of vehicles operated on highways; safe operation of vehicles; and the transportation of hazardous materials
California Streets and Highway Code, Div 1, Chap 3; Div 2 Chap 5.5	Includes regulations for the care and protection of state and county highways and provisions for the issuance of written permits
CVC Sections 13369, 15275 and 15278	Address the licensing of drivers and the classification of licenses required for the operation of particular types of vehicles; also require certificates permitting operation of vehicles transporting hazardous materials.
CVC Sections 31303-31309	Regulates the highway transport of hazardous materials, the routes used, and restrictions on those facilities.
CVC Sections 35780	Requires permits for any load exceeding Caltrans weight, length, or width standards for public roadways.
CVC Sections 31600-31620	Regulate the transportation of explosive materials.
CVC Sections 32100-32109	Establish special requirements for the transportation of inhalation hazards and poisonous gases.

Table 2-2B
Traffic and Transportation Laws, Ordinances, Regulations, and Standards

Applicable Law	Description
State – *continued*	
CVC Sections 32000-32053	Regulates the licensing of carriers of hazardous materials including noticing requirements.
CVC Sections 34000-34121	Establish special requirements for the transportation of flammable and combustible liquids over public roads and highways.
CVC Section 34500 et seq.	Regulate the safe operation of vehicles, including those that are used for the transportation of hazardous materials.
California Health and Safety Code Section 25160 et seq.	Requires that an authorized representative of the generator or facility operator that is responsible for loading hazardous waste into a transport vehicle shall, prior to loading, ensure that the driver of the transport vehicle is in possession of the appropriate class of driver's license and any endorsements required to operate the transport vehicle with the intended load.
California Streets and Highways Code Sections 117, 660-695, and 700-711	Regulates right-of-way (ROW) encroachment and the granting of permits for encroachments on State Highways and freeways.
California Streets and Highways Code Sections 1450, 1460 et seq., and 1480 et seq.	Regulates ROW encroachment and the granting of permits for encroachments on county roads.
California Government Code Sections 65352, 65940, and 65944	Requires evaluation of compatibility with military activities for any land use proposal located near a military installation or airspace.
Local	
Riverside County General Plan Circulation Element and Palo Verde Valley Area Plan	Specifies long-term planning goals and procedures for transportation infrastructure system quality; standards and procedures for air transportation; and transportation safety in Riverside County
Riverside County General Plan Circulation Element	System Design, Construction, and Maintenance portion specifies standards for new road construction and future extensions of existing streets.
Riverside County General Plan Circulation Element	Level of Service (LOS) standards are used to assess the performance of a street or highway system and the capacity of a roadway.
Riverside County Municipal Code Title 10, Chapter 10.08, Sections 10.08.010 – 10.08.180	Establishes requirements and permits for oversize and overweight vehicles.
Riverside County Ordinance No. 460	All work shall conform to the requirements of the Riverside County Transportation Department Subdivision Regulations
Riverside County Ordinance No. 461	All work shall conform to the requirements of the Riverside County Transportation Department Road Improvement Standards and Specifications
City of Blythe General Plan Circulation Element	Sets City street design criteria consistent with the Palo Verde Valley Area Plan of the County of Riverside General Plan.
City of Blythe Municipal Code, Title 10, Article 19, Section 19.1	Establishes permit requirements for moving heavy loads or equipment on city streets.

TRIP GENERATION

Project Trip Generation Development Process

Construction of the project would result in a temporary increase in traffic volumes on the regional and local roadways due to construction related activities. Traffic that would be generated by construction worker commuter trips and deliveries would temporarily increase the existing traffic volumes in the study area. Project construction is expected to take place over approximately 36 months with 24 months of peak construction period.

For the purposes of estimating the project's trip generation, additional assumptions were considered. These assumptions were coordinated with the applicant in an effort to provide the expected number of trips generated by the construction of this project. The AM project peak hour is expected to occur with the arrival of construction personnel to the job sites at or before 7:00AM. This does not coincide with the AM peak hour of the adjacent street system, which generally occurs between 7:00 AM and 9:00 AM. The PM project peak hour is expected to occur with the departure of all personnel between the hours of 4:00 PM and 6:00PM.

During the AM peak hour of adjacent street traffic, the project is also expected to generate trips related to the delivery of supplies. The delivery of supplies will be transported via multi-axle trucks to the project site randomly over a 10-hour workday period. Riverside County has not established PCE standards; therefore, at the request of the Riverside County staff, PCE conversion factors from the San Bernardino Associated Governments (SANBAG) Congestion Management Plan (CMP) were used. The traffic impacts of multi-axle trucks at street intersections are normally addressed by converting heavy vehicles into "passenger car equivalents" (PCEs). For the purposes of this study, it is assumed that all multi-axle truck traffic is best represented by PCE factors of 1.5, 2.0, and 3.0 depending on the number of axles associated with delivery truck.

PROJECT TRIP DISTRIBUTION

Trip distribution is the process of identifying the probable destinations, directions, or traffic routes that will be utilized by project traffic. The potential interaction between the proposed land use and surrounding regional access routes are considered to identify the routes along which the project traffic will distribute. For the purpose of developing project trip distribution patterns, construction crews would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region. Anticipated average daily material deliveries would consist of about 20 truck deliveries per day for the peak 24 month period. Workers and delivery trucks will access the site using Neighbours Boulevard ramps off Interstate 10 (I-10).

Project Access

Access to the project construction sites will be provided via the following:

- Neighbours Boulevard freeway ramps off Interstate I-10;
- Riverside Drive; and
- Seeley Avenue.

CHAPTER 3
EXISTING TRAFFIC CONDITIONS (2011)

TRAFFIC VOLUMES

Existing Circulation Network

The local roadway facilities in the vicinity of the project area include Neighbours Boulevard, Riverside Drive and Seeley Avenue.

Neighbours Boulevard is a two-lane roadway running on a north/south alignment connecting to I-10 via an existing interchange. It provides one travel lane per direction and is divided by a double yellow center line. Land uses along this roadway in the project vicinity are mostly residential uses with vacant lots and some commercial, farming land and industrial land uses.

Riverside Drive is a two-lane roadway running on an east/west alignment connecting to Neighbours Boulevard. It provides one travel lane per direction with no centerline delineation. Land uses along this roadway in the project vicinity are mostly residential uses with vacant lots and some farming land and industrial land uses.

Seeley Avenue is a two-lane roadway running on an east/west alignment connecting to Neighbours Boulevard. It provides one travel lane per direction with no centerline delineation. Land uses along this roadway in the project vicinity are mostly residential uses with vacant lots and some farming land and industrial land uses.

Regional Roadway Facilities

Interstate 10 **(I-10)** is the nearest freeway to the project site. It provides regional east/west throughout the State, beginning in Los Angeles and continuing west past the California state border to Arizona and beyond. In the project area, it has two lanes per direction. Neighbours Boulevard provides a full interchange with this freeway.

Intersection turning movement classification counts were performed during the weekday morning peak period from 7:00 AM to 9:00 AM and during the weekday evening peak period from 4:00 PM to 6:00 PM in September 2011. Intersection classification counts provide vehicle classification (cars, pickups, buses, trucks, etc) data in addition to the individual vehicle movements. Due to the nature of this project PCE (passenger car equivalent) factors were used in order to accurately evaluate the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. The traffic impacts of heavy trucks at intersections are normally addressed by converting heavy vehicles into “passenger car equivalents’ (PCE’s). Studies have indicated that each truck has a similar traffic impact that ranges between 1.5 to 3 passenger vehicles at intersections. Riverside County has not established PCE standards; therefore, at the request of the Riverside County staff, PCE conversion factors from the San Bernardino Associated Governments (SANBAG) Congestion Management Plan (CMP) were used. A PCE factor of 3.0 for 4-axle trucks, 2.0 for 3 -axle trucks, and 1.5 for 2-axle trucks were applied to classification counts. Existing peak-hour volume counts with PCE adjustments are included in **Appendix A**.

Intersections

As shown in Table 3-1, all intersections within the study area of the proposed project are operating at an acceptable level of service. Figures 3-2 and 3-3 illustrate the existing peak hour traffic volumes during the AM and PM peak hours. For both AM and PM peak hours, most of the traffic originates from the south towards the ramps and Hobson Way with a very limited amount of traffic heading towards Riverside Avenue. Most of this traffic can be attributed to the heavy agriculture activities located south of Interstate 10 heading to and from the City of Blythe. The higher volumes heading northbound and southbound from Seeley Avenue cause a higher delay at the intersection however; all of the intersections still operate at a LOS of A. Figure 3-1 shows the existing intersection geometries.

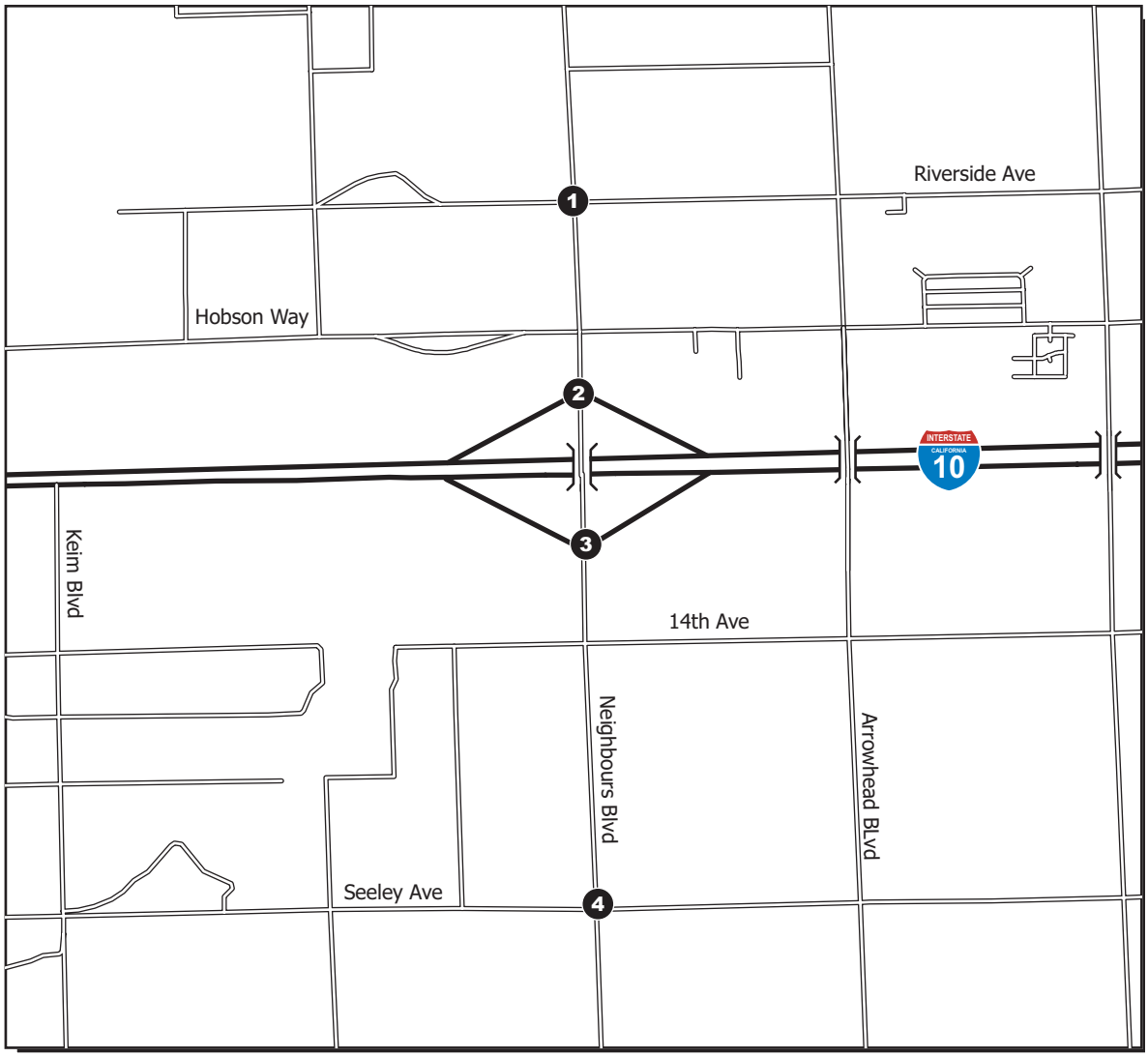
Appendix B contains the analysis worksheets for existing intersection conditions.

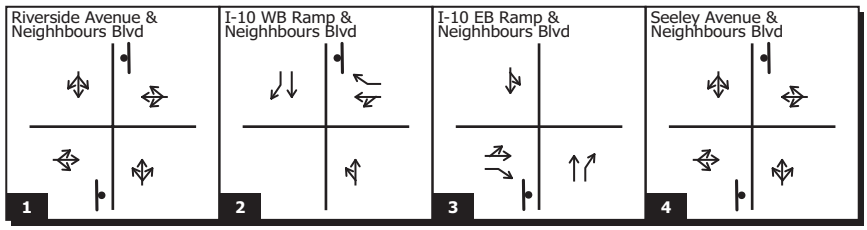
Table 3-1
Existing Intersection Conditions

Intersection	Without Project	
	Delay (sec/veh)	LOS
AM Peak Hour		
1. Riverside Dr & Neighbours Blvd*	9.0	A
2. I-10 WB Ramp & Neighbours Blvd*	9.0	A
3. I-10 EB Ramp & Neighbours Blvd*	9.2	A
4. Seeley Ave & Neighbours Blvd*	9.4	A
PM Peak Hour		
1. Riverside Dr & Neighbours Blvd*	8.6	A
2. I-10 WB Ramp & Neighbours Blvd*	9.5	A
3. I-10 EB Ramp & Neighbours Blvd*	9.5	A
4. Seeley Ave & Neighbours Blvd*	9.8	A

Note: *Unsignalized Intersection

Based on the existing conditions analysis, all intersections are operating at LOS A which represents a free-flow operation. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.



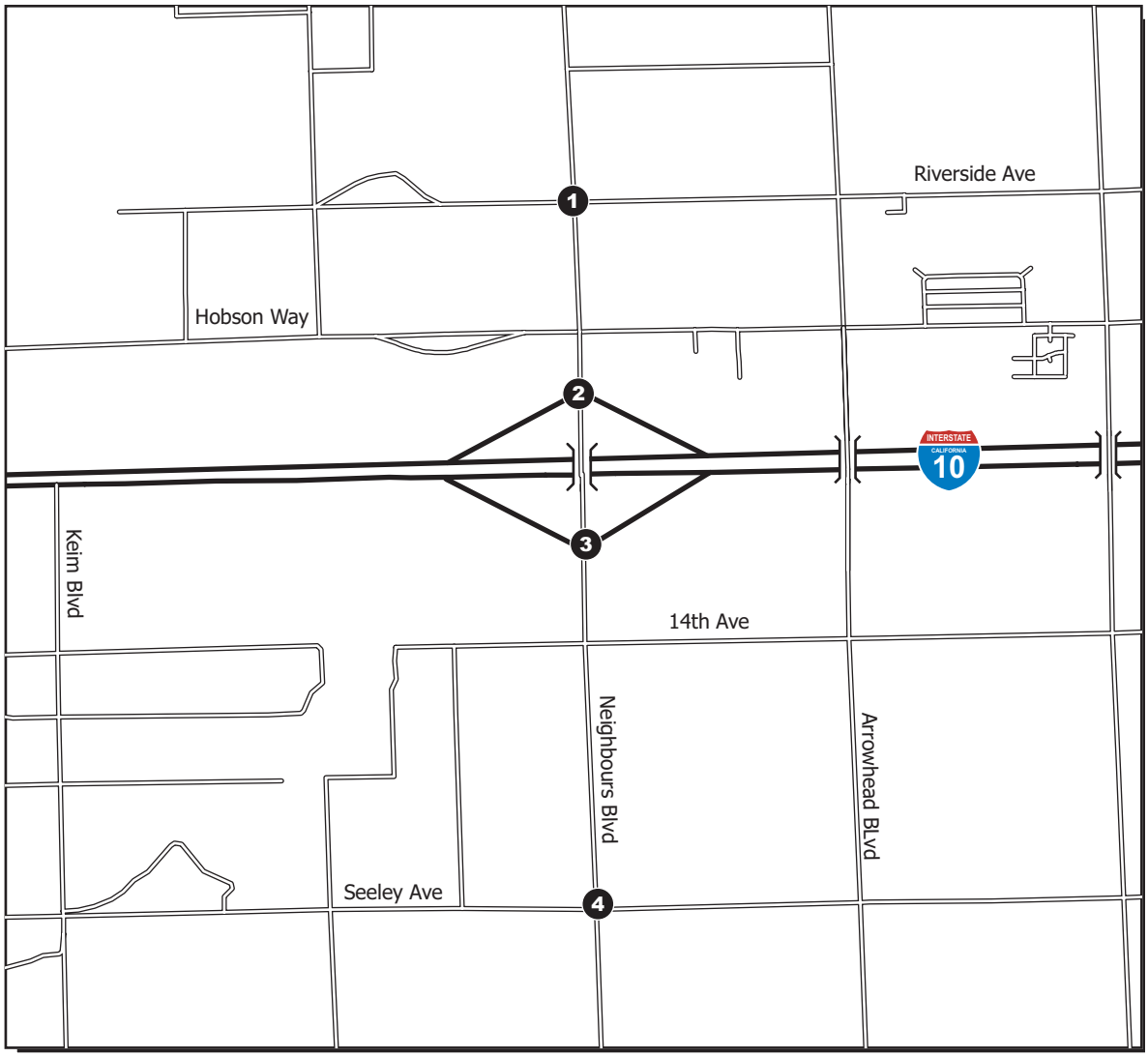


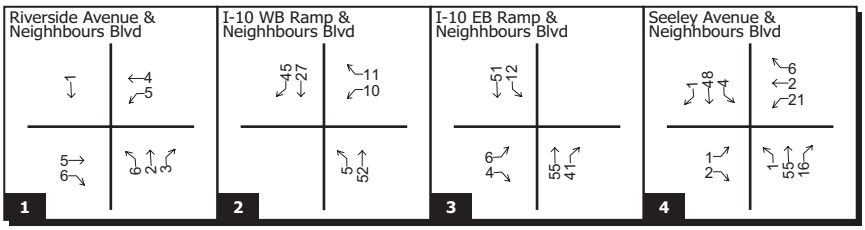
LEGEND	
	Geomteric Configuration
	Stop Sign

Figure 3.1
Existing Geometries

N
Not To Scale

AR062021



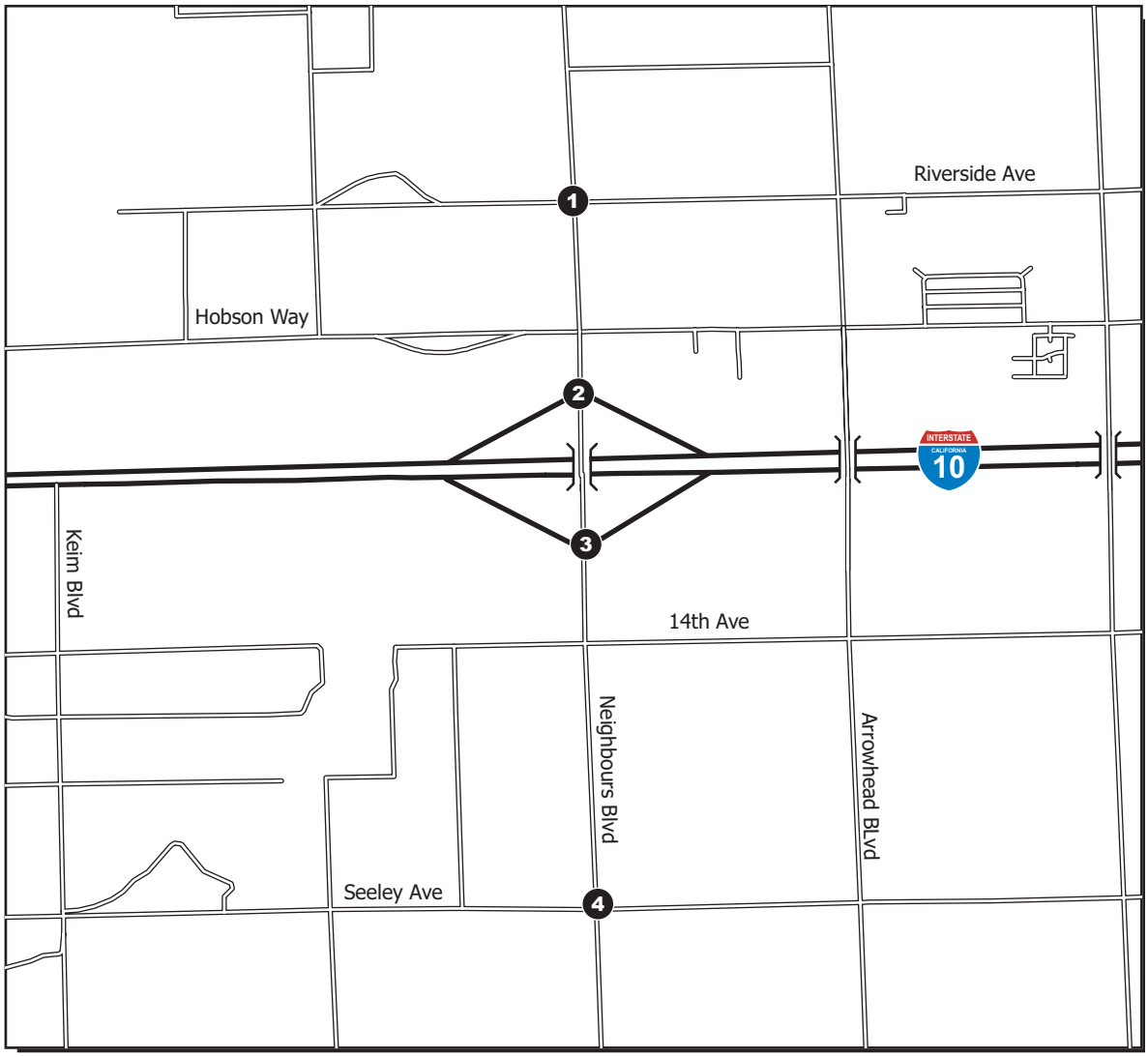


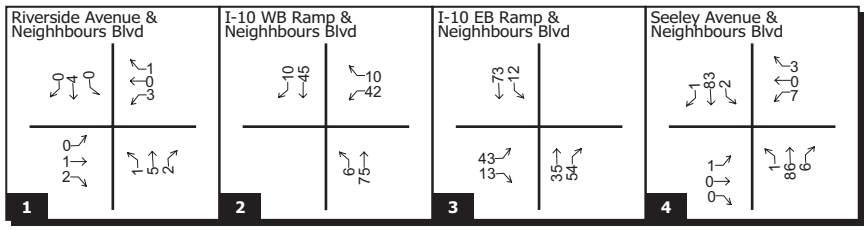
LEGEND	
10 ↙	AM Peak Hour Traffic

Figure 3.2
Existing Traffic Volumes - AM Peak Hour

N
Not To Scale

AR062022





LEGEND

10 PM Peak Hour Traffic

Figure 3.3
Existing Traffic Volumes - PM Peak Hour

N
Not To Scale

AR062023

Pedestrian

Pedestrian facilities currently do not exist throughout the proposed Blythe Mesa Solar Project study area. The existing pedestrian network does not currently provide sidewalk connecting adjoining land uses along Neighbours Boulevard, Riverside Drive and Seeley Avenue.

Transit and Rail

Bus Service

Bus service is offered by the Palo Verde Valley Transit Agency (PVVTA) along Neighbours Boulevard north and south of I-10. Routes 3, 4, and 5 travel along Hobson Way which pass through the project location and heads west towards Mesa Verde. There is a stop located adjacent to the project at the intersection of Hobson Way and Buck Boulevard. Routes 3 and 5 run along Neighbours Boulevard towards Ripley with stops on the corner of Hobson Way and 14th Avenue along Neighbours Boulevard, The project will not directly affect the ability of transit to use any of their existing routes or stops. In the event that an existing bus stop is temporarily affected by construction within an existing street right of way that has transit service, the contractor shall coordinate with PVVTA to temporarily relocate the affected transit stop location. Otherwise, the service would not be affected since road closures and detours are not a feature of any of the studied access points.

Rail Service

Blythe is served in rail by the Arizona and California Railroad but currently suspends service in the Blythe branch due to the quality of the tracks.

Airport Service

Blythe Airport (BLH) is a public airport located six miles west of Blythe and 2 miles west of the project, serving Riverside County. The airport has two runways and is mostly used for general aviation. W R Byron Airport is a private airport located within city limits, approximately 4 miles northwest of central Blythe and 4.5 miles northeast of the project. Cyr Airport is a private airport with two runways that is located 2 miles south from the center of Blythe and 5 miles east of the project site. See Figure 1.1 for the locations of the airports.

Bicycle

No bicycle facilities currently exist in the proposed Blythe Mesa Solar Project study area. The existing transportation network does not currently provide bike lanes connecting adjoining land uses along Neighbours Boulevard, Riverside Drive and Seeley Avenue.

Parking

Construction workers will park personal vehicles on site where adequate parking space will be provided. The anticipated construction activities will not temporarily eliminate any existing parking spaces that would result in parking deficiencies. Heavy equipment will be parked and maintained at construction sites and all utility trucks will park in the construction yards. Therefore, there would be no impact on the public parking inventory associated with the construction of the project since sufficient parking for all employees, visitors, service vehicles, and contractors will be provided and occur on-site during the construction of the project.

School

It is understood that the potential impacts of traffic, namely construction truck traffic, may have some effect on school children in the area (children being picked up or dropped off on local roads near the proposed project site). Blythe area public elementary and secondary schools comprise the Palo Verde Unified School District, which contains 3 elementary schools, 1 middle school, 1 high school, and continuation/adult education school. Palo Verde Community College District is part of the California Community College system and includes Palo Verde Community College, a campus in Blythe, a center in Needles and an extension for Adult Basic education and non-credit classes located on Spring Street in downtown Blythe.

The following table indicates schools, their locations, bus routes, and distance from the project site.

Table 3-2
School Bus Characteristics in the Project Vicinity

School Name	Distance From Project Site	Bus Routes
Palo Verde College	2.5 miles north of the project site	Palo Verde Valley Transit Route 2
Palo Verde Unified School District		
Palo Verde High School	3.75 miles east of the project site	PVUSD Bus Routes A,B,C,D,E,F,G,H,I,J,L,M
Blythe Middle School	3.75 miles east of the project site	PVUSD Bus Routes A,B,C,D,E,F,G,H,I,J,L,M
Twin Palms Continuation School	3.75 miles east of the project site	PVUSD Bus Routes E,
Margaret White Elementary School	4.25 miles east of the project site	PVUSD Bus Routes C,F,G
Felix J. Appleby Elementary School	4.5 miles east of the project site	PVUSD Bus Routes A,B,C,D,J
Ruth Brown Elementary School	4.75 miles east of the project site	PVUSD Bus Routes C,E,F,H,J,L

CHAPTER 4
THE PROJECT

Once construction of the project is completed, the project would require 12 permanent full-time employees for operation, which would not generate a significant number of trips above those already generated by the exiting project site. However, the construction phase of the project will include trips generated by construction workers and supplies delivered by trucks to the project site. As such, this traffic analysis focuses on the traffic impacts that could occur during construction of the solar project.

This section focuses on the characteristics of the construction of proposed project.

Project Description

The proposed Blythe Mesa Solar Project (Project) consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison Colorado River Substation, an approved new substation located south of Highway 10 and approximately four miles west of the Project site. The Project has secured a California Independent System Operator (CAISO) interconnection queue position sufficient for the size of the Project. The Project would produce enough energy to power approximately 180,000 households and progress the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state

Project Construction Trip Generation Forecast

The project is expected to generate a maximum of 20 truck deliveries per day for the 24 month peak construction period. Transport truck deliveries include material and equipment deliveries. The calculations below account for heavier vehicles types (trucks) by converting truck trips to “passenger car equivalents”. SANBAG CMP passenger car equivalents (PCEs) per truck trip were implemented in this analysis. Passenger car equivalents (PCEs) are used in roadway capacity analysis to convert a mixed vehicle flow into an equivalent passenger car flow. This calculation is relevant to capacity and level of service determination, lane requirements, and determining the effect of traffic on roadway operations.

In addition, based on information obtained from the project proponent, the project site will employ a workforce of approximately 300-500 workers. Construction of the project will take approximately 36 months with 24 months of peak construction period. The project will require an average construction workforce of 40 workers at the beginning of construction and a peak of 500 workers during the 24 month peak construction period of the solar array, substations, operation and maintenance buildings and the installation of 230 kV transmission line and fiber optic cable with a tapering of fewer employees thereafter. The workforce vehicle trips associated with construction were calculated based upon these assumptions. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region.

Construction of the project will require the use and installation of heavy equipment and associated systems. Heavy equipment will be delivered via truck, using Neighbours Boulevard from I-10 to the north and south utilizing Riverside Drive and Seeley Avenue. Anticipated average daily material deliveries would consist of about 20 truck deliveries per day for the peak 24 month construction period.

Peak Hour Trip Generation Forecast

For purposes of forecasting future peak hour trip generation, it is assumed that the majority of the daily project trips will occur during daylight hours. It is assumed that each employee arrives during the AM peak hour and departs during the PM peak hour and that some miscellaneous trips occur during this time. It is also assumed that truck trips will occur randomly over a 10-hour workday. Based on these assumptions, a daily and peak hour trip generation calculation is provided below.

Employee Trips

It is estimated that 500 employees will work on the site during the peak construction period. To evaluate a worst-case scenario, it is assumed that 300 employees arrive alone and 200 employees will carpool. In addition it is assumed that approximately 42 employees go to lunch or run some other errand during the day creating additional daily trips.

- 300 employees will drive alone = 300 inbound trips in the AM and 300 outbound trips in the PM
- 200 employees carpool (assumed 2 in a carpool) = 100 inbound trips in the AM and 100 outbound trips in the PM
- 42 employees go to lunch/run errands = 42 additional inbound and 42 additional outbound trips during the day

AM Peak Hour: 400 inbound employee trips

PM Peak Hour: 400 outbound employee trips

Total daily employee trips = (400*2) + (42*2) = 884 daily employee trips

On-site work hours would be from 7:00 a.m. to 7:00 p.m. During the installation period, construction workers are projected to be onsite five days per week, year round. Due to weather or other major type delays, times may shift to start as early as 5:00 a.m. and end as late as 8:00 p.m., as well as continue into the weekends. The construction PM peak hour for the project would be expected to occur with the departure of personnel at, 7:00PM. This does not coincide with the PM peak hour of the adjacent street, which occurs between 4PM and 6PM; however to be conservative, the project PM peak hour trip generation will be analyzed during the PM peak hour of the adjacent street traffic.

Additionally, trips generated from normal construction activities including activities of supervisors, activities of construction representatives, and delivery of supplies and equipment will also be analyzed during the PM peak hour of the adjacent street traffic.

Truck Trips

For the purposes of forecasting, it is assumed that 20 trucks per day will arrive and depart the site per day to deliver materials and equipment. This mix of fleet was provided by Power Engineers based on their experience with similar construction projects. Riverside County has not established PCE standards; therefore, at the request of the Riverside County staff, PCE conversion factors from the San Bernardino Associated Governments (SANBAG) Congestion Management Plan (CMP) were used. These trips will likely occur randomly during the day, assuming a 10-hour day.

- 40 daily two-way truck trips

Mix of fleet

Light Duty Truck: 18% (7 trucks)

Medium Duty Truck: 18% (7 trucks)

Heavy Duty Truck: 64% (26 trucks)

PCE Factors

Light Duty Truck (1.5 PCE): 11 trucks

Medium Duty Truck (2.0 PCE): 14 trucks

Heavy Duty Truck (3.0 PCE): 78 trucks

- 103 PCE truck trips / 10-hour day = 11 PCE truck trips during the AM peak hour and 11 PCE truck trips during the PM peak hour.

AM Peak Hour: 6 inbound and 5 outbound truck PCE trips

PM Peak Hour: 6 inbound and 5 outbound truck PCE trips

Additional Work Related Trips

For the purposes of forecasting, it is assumed that other trips associated with the activities of supervisors, inspectors and vendors would be equal to 20% of the employee trips and would occur randomly over a 10-hour work day.

- 884 daily employee trips x 0.20 = 177 ancillary daily trips
- 177 ancillary trips daily trips / 10-hour day = 18 trips during the AM peak hour and 18 during the PM peak hour.

AM Peak Hour: 9 inbound and 9 outbound ancillary trips

PM Peak Hour: 9 inbound and 9 outbound ancillary trips

Table 4-1 shows the traffic generation expected from the project based on the information provided by Power Engineers.

Table 4-1
Project Construction Traffic Generation Forecast

Type of Trips	Daily	AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Employee Trips*	884	400	400	0	400	0	400
Truck Trips	103	11	6	5	11	6	5
Ancillary Trips	177	18	9	9	18	9	9
NET Project Trips (PCEs)	**1,164**	**429**	**415**	**14**	**429**	**15**	**414**

Note: PM Peak Hour does not coincide with the departure time of employees but to be conservative was assumed in the analysis

PCE: Passenger Car Equivalent

The project will generate a total of 1,164 trips daily, including 429 trips during the AM peak hour and 429 trips during the PM peak hour.

Project Trip Distribution

Trip distribution is the process of identifying the probable destinations, directions or traffic routes that will be utilized by project traffic. The potential interaction between the proposed land use and surrounding regional access routes are considered to identify the route where the project traffic will distribute.

The workforce vehicle trips associated with construction were calculated based upon these assumptions. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region. Construction of the project will require the use and installation of heavy equipment and associated systems. Heavy equipment will be delivered via truck, using Neighbours Boulevard from I-10 to the north and south utilizing Riverside Drive and Seeley Avenue. The project location is presented on Figure 4-1.

Figures 4-2a and 4-2b indicate the anticipated distribution for the truck deliveries and employee draw. The regional traffic distribution is anticipated to include 70% of the truck traffic approaching Neighbors Boulevard and I-10 interchange from the west and 30% approaching from the east. The regional approach for the construction workers is anticipated to include 30% approaching from the west and 70% approaching from the east. The local traffic distribution anticipates 60% of the traffic using Seeley Avenue access point and 40% using Riverside Avenue access point. Figures 4-3 and 4-4 illustrate the (truck and employee) project-related construction traffic volumes expected at locations within the study area, including use of local access routes. These figures indicate the proportion of project traffic which will use the street segments and turning movements indicated.

AR062029

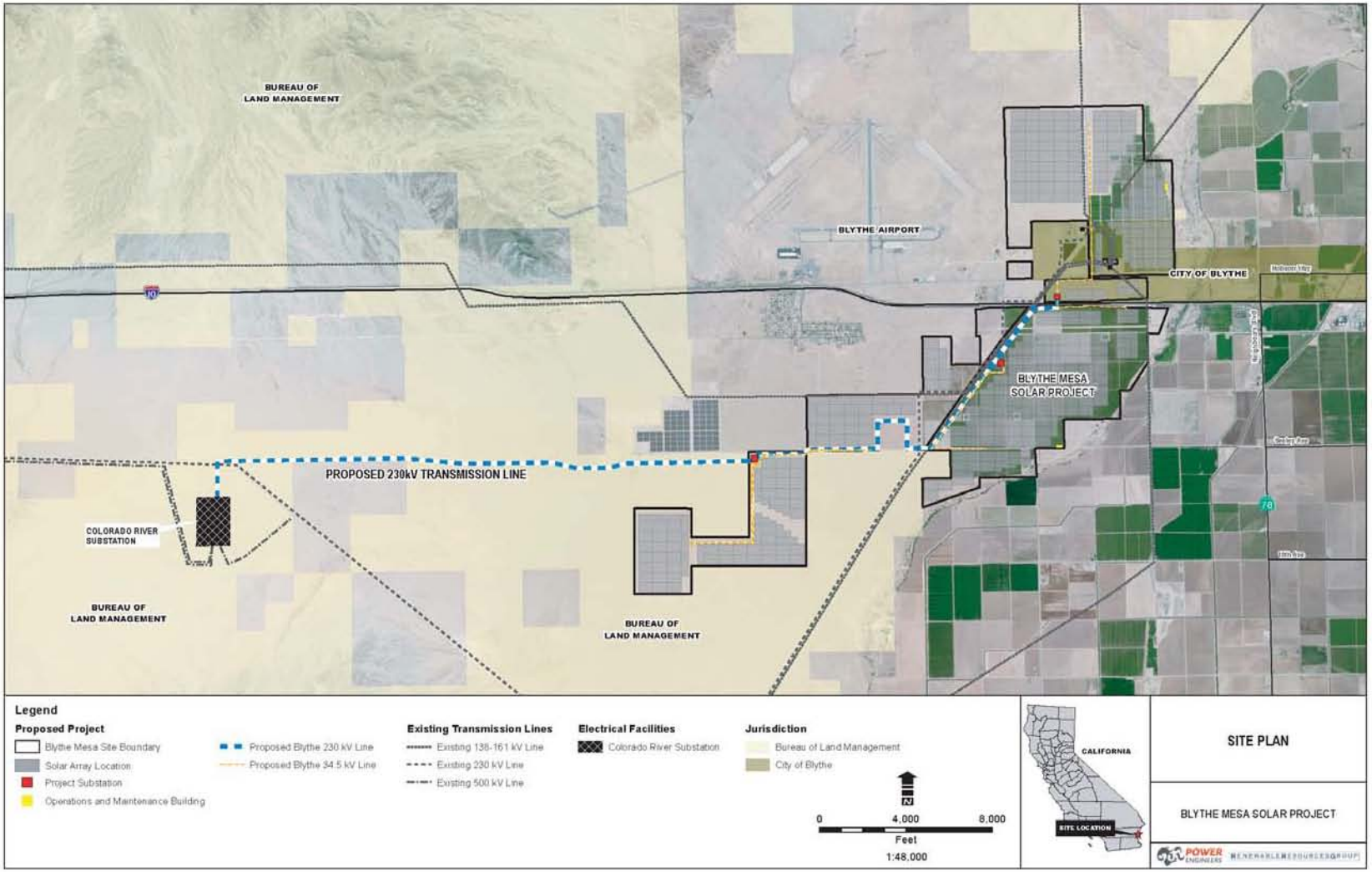
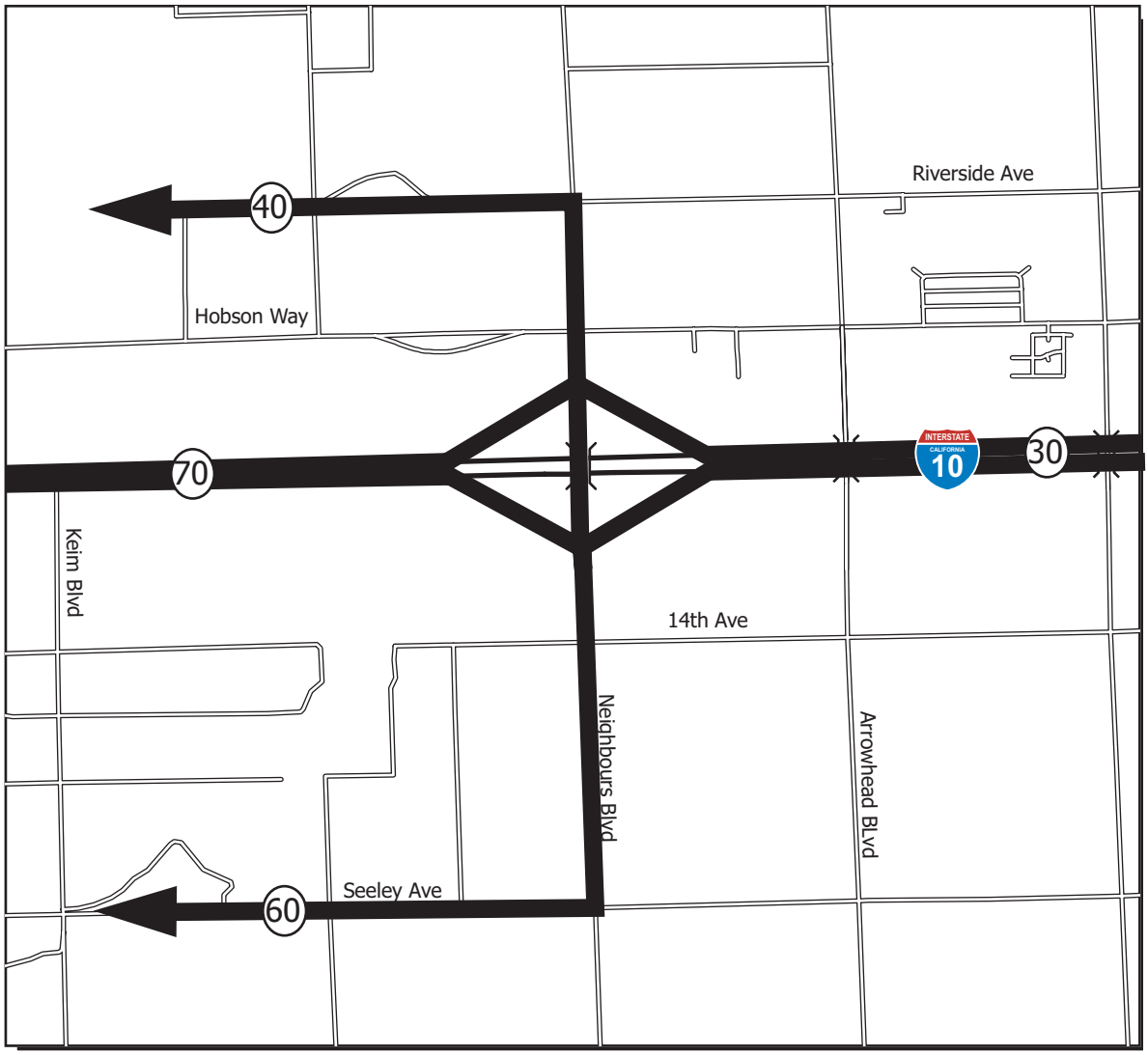


Figure 4-1
Project Site



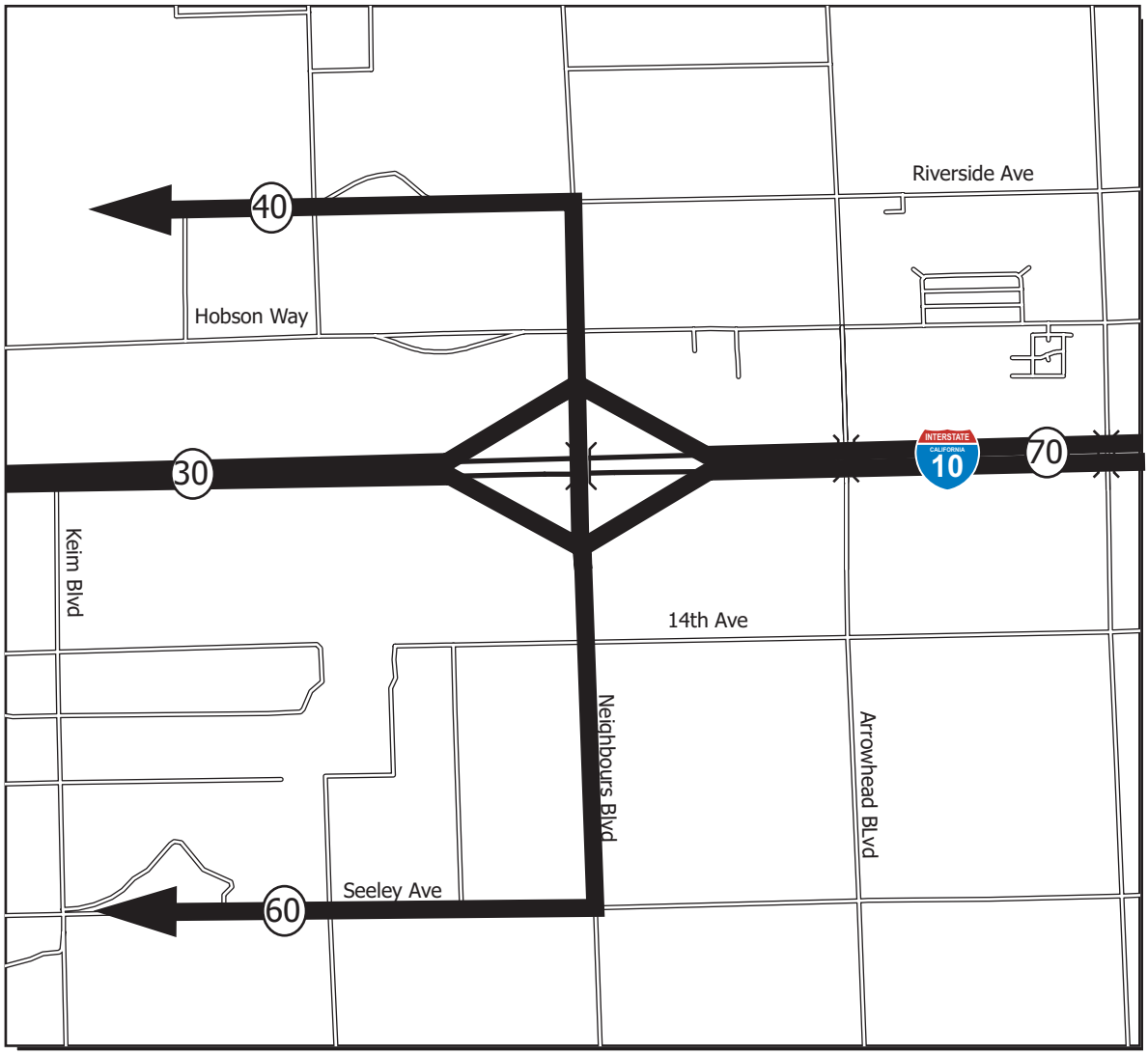
LEGEND

60 Truck Trip Distribution

Figure 4.2A
Truck Project Trip Distribution

N
Not To Scale

AR062031



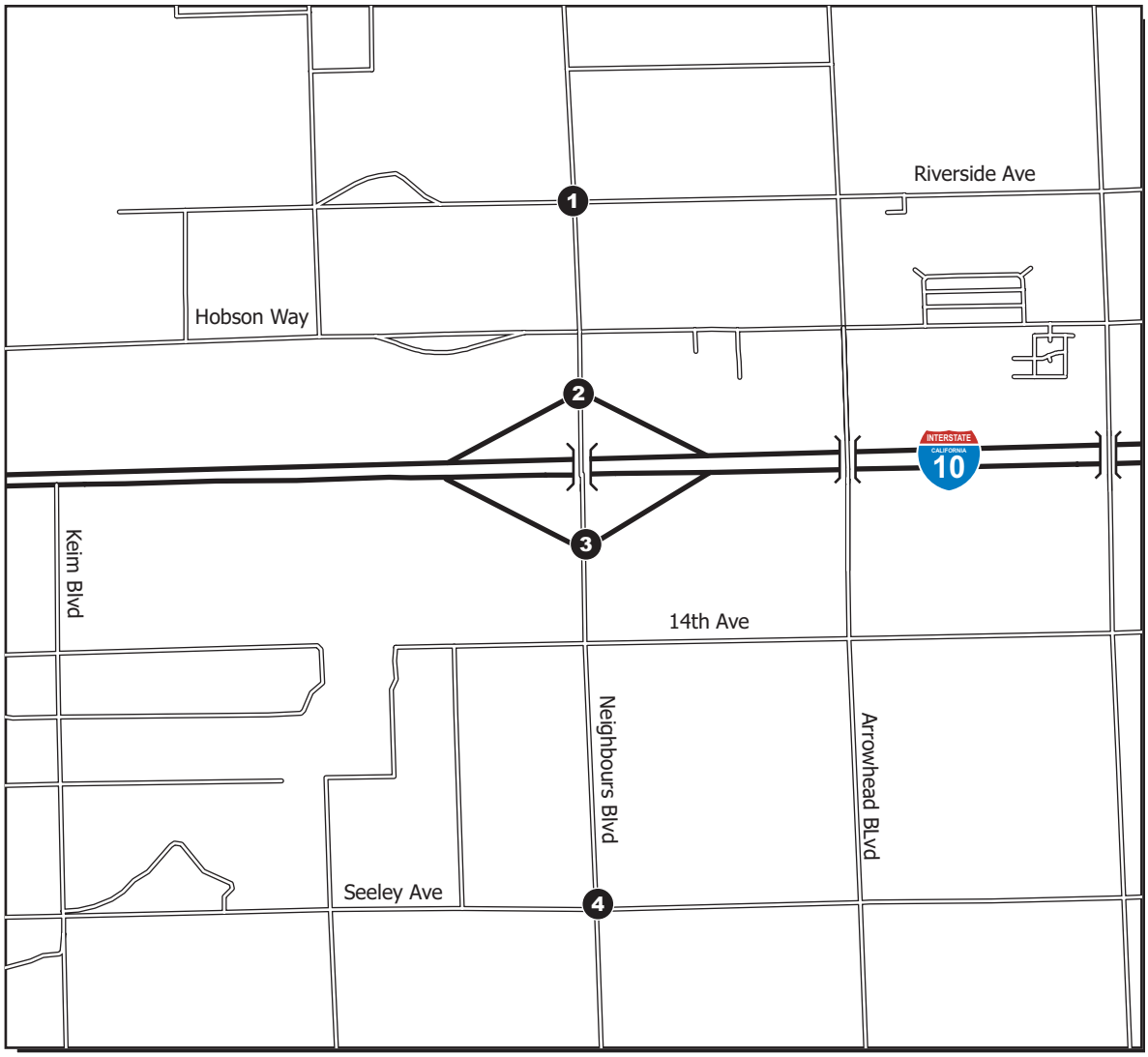
LEGEND

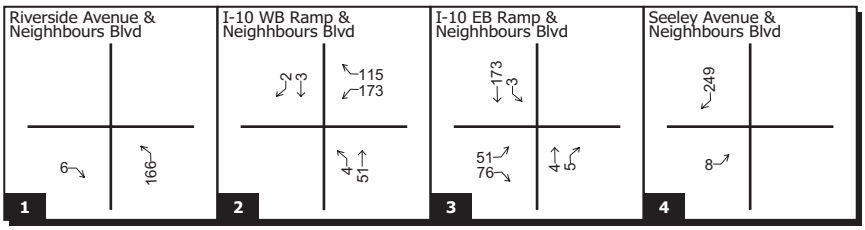
60 Employee Trip Distribution

Figure 4.2B
Employee Project Trip Distribution

N
Not To Scale

AR062032



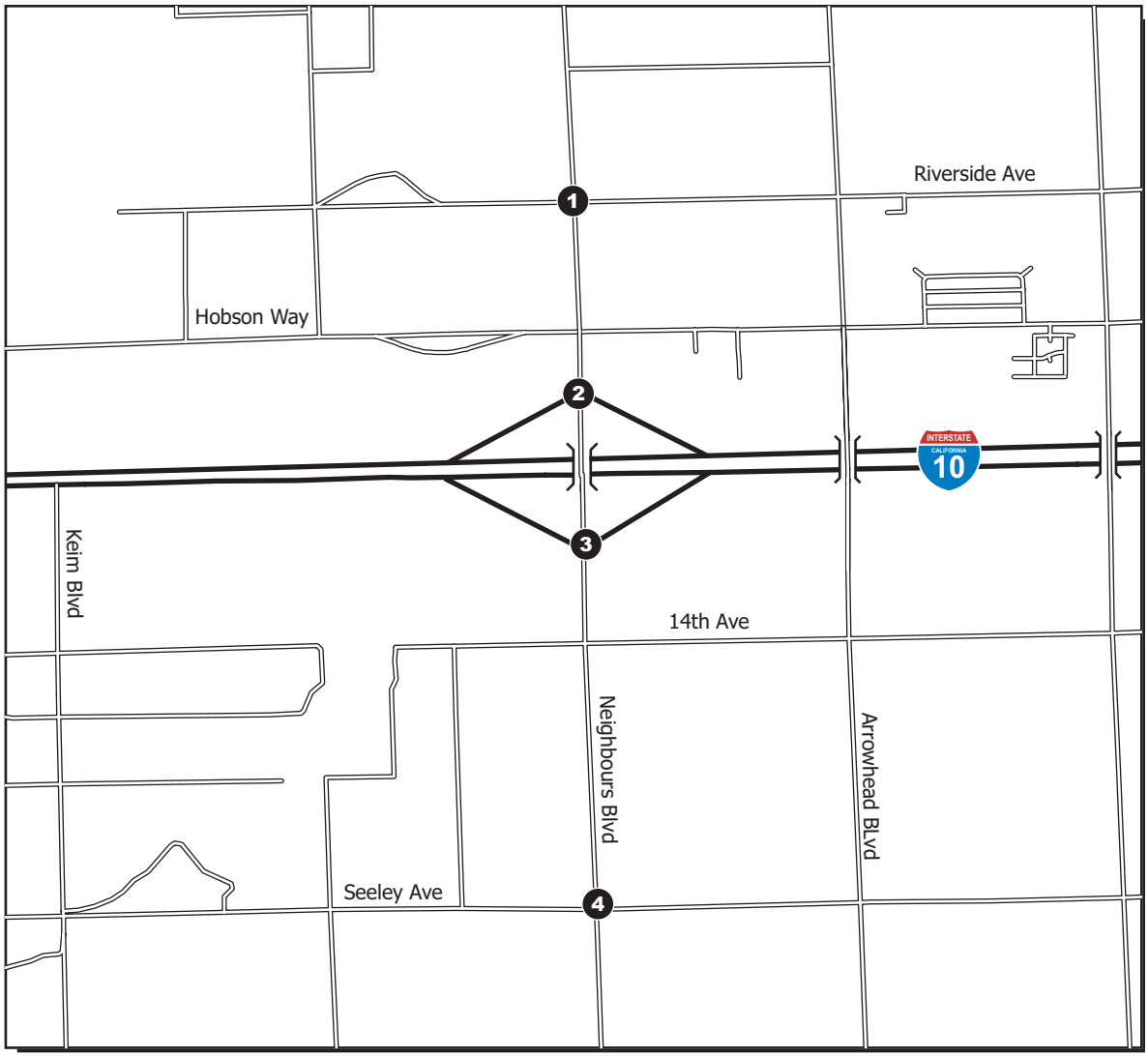


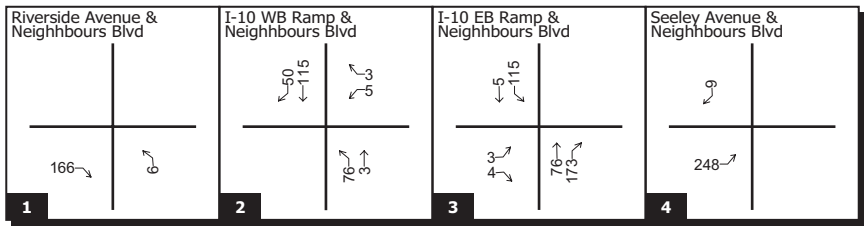
LEGEND

10 AM Peak Hour Trips

Figure 4.3
Project Related Construction Traffic Volumes - AM Peak Hour

N
Not To Scale





LEGEND

10 PM Peak Hour Trips

Figure 4.4
Project Related Construction Traffic Volumes - PM Peak Hour

N
Not To Scale

AR062034

CHAPTER 5
PROJECT CONSTRUCTION
(EXISTING + AMBIENT + PROJECT)

This chapter develops future traffic conditions in the study area with ambient growth added without the proposed project construction trips. The Year 2015 was selected for analysis based on correspondence with the applicant regarding the project's construction. It should be noted that the AM project peak hour is expected to occur with the arrival of construction personnel to the job sites at or before 7:00AM. This does not coincide with the AM peak hour of the adjacent street system, which generally occurs between 7:00 AM and 9:00 AM. The PM project peak hour is expected to occur with the departure of all personnel between the hours of 4:00 PM and 6:00PM.

Future Growth

Based on discussions with the County of Riverside, it has been established that traffic in the study area has historically increased at a rate of about 2% per year. Future increases in the background traffic volumes due to regional growth are expected to continue at this rate in the vicinity of the project. Assuming a completion date within 4 years, the existing traffic volumes were adjusted upward by 8% to reflect area wide growth.

Intersections

Based on the project analysis without project construction, all intersections are operating at LOS A which represents a free-flow operation. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The addition of project construction traffic will increase the delay and cause the intersections in the AM peak hour to operate at an LOS B or better for the PM peak hour. LOS B still represents reasonably free-flow operation where the ability to maneuver within the traffic stream is slightly restricted but it is still an acceptable condition. Table 5-1 below documents the without and with project analysis results.

Appendix C contains the analysis worksheets for project construction intersection conditions.

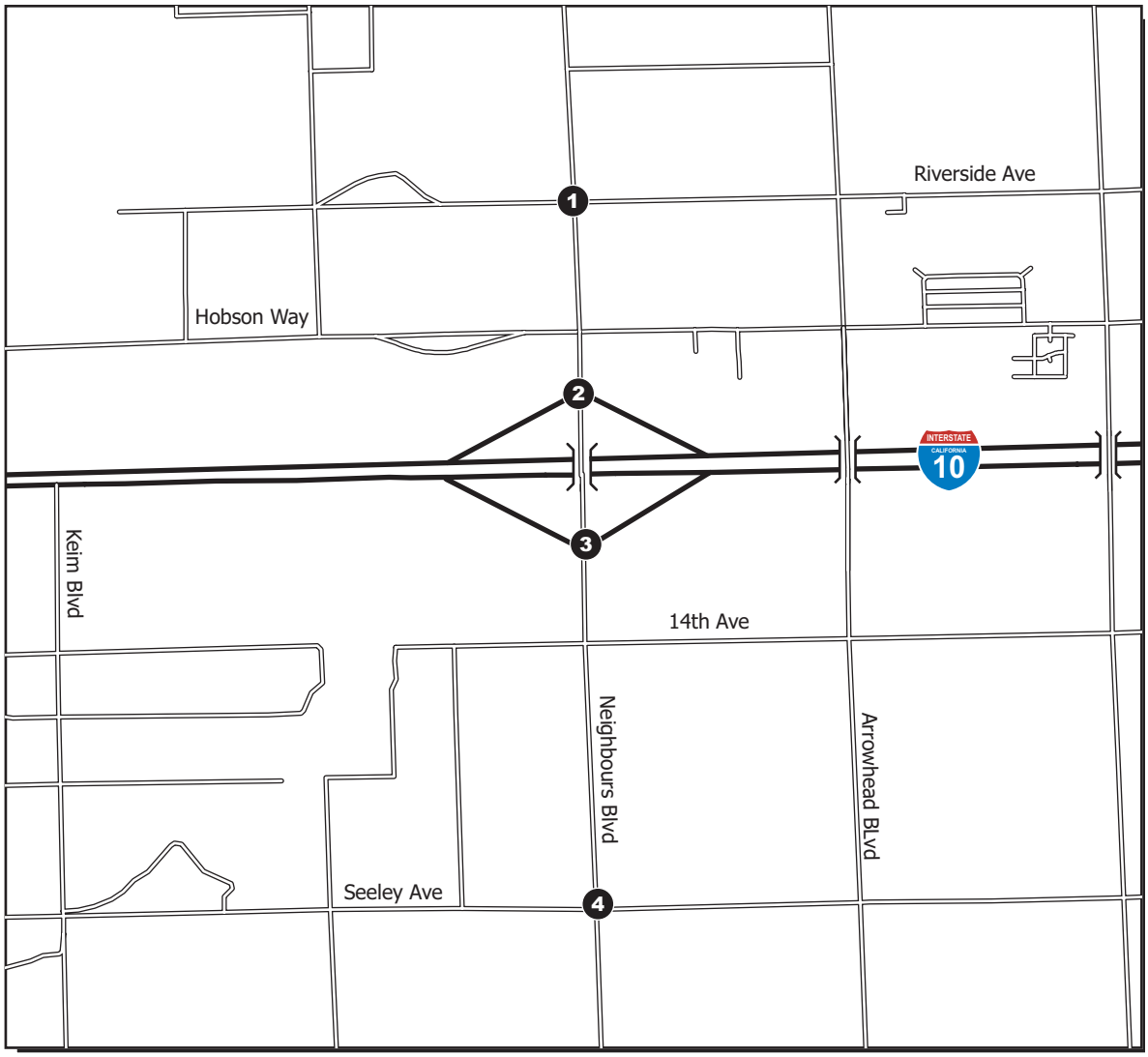
Table 5-1
Project Construction Intersection Conditions

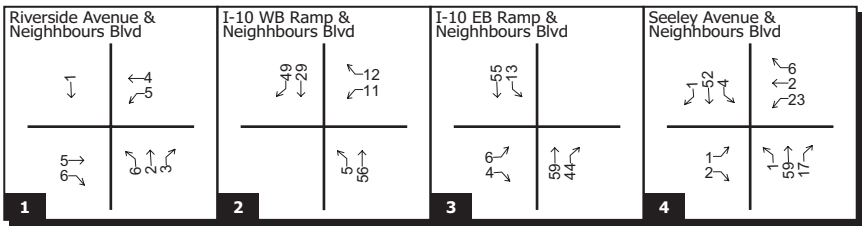
Intersection	Without Project		With Project		Δ Delay	Potential Impact
	Delay	LOS	Delay	LOS		
AM Peak Hour						
1. Riverside Dr & Neighbours Blvd*	9.0	A	16.4	C	7.4	No
2. I-10 WB Ramp & Neighbours Blvd*	9.0	A	11.1	B	2.1	No
3. I-10 EB Ramp & Neighbours Blvd*	9.2	A	11.2	B	2.0	No
4. Seeley Ave & Neighbours Blvd*	9.5	A	10.6	B	1.1	No
PM Peak Hour						
1. Riverside Dr & Neighbours Blvd*	8.6	A	10.2	B	1.6	No
2. I-10 WB Ramp & Neighbours Blvd*	9.5	A	12.5	B	3.0	No
3. I-10 EB Ramp & Neighbours Blvd*	9.6	A	13.8	B	4.2	No
4. Seeley Ave & Neighbours Blvd*	9.9	A	12.9	B	3.0	No

Note: *Unsignalized Intersection

As shown in Table 5-1, all intersections within the study area of the proposed project are operating at an acceptable level of service without and with the project.

Figures 5-1 and 5-4 illustrate the project construction peak hour traffic volumes with and without the project during the AM and PM peak hours.





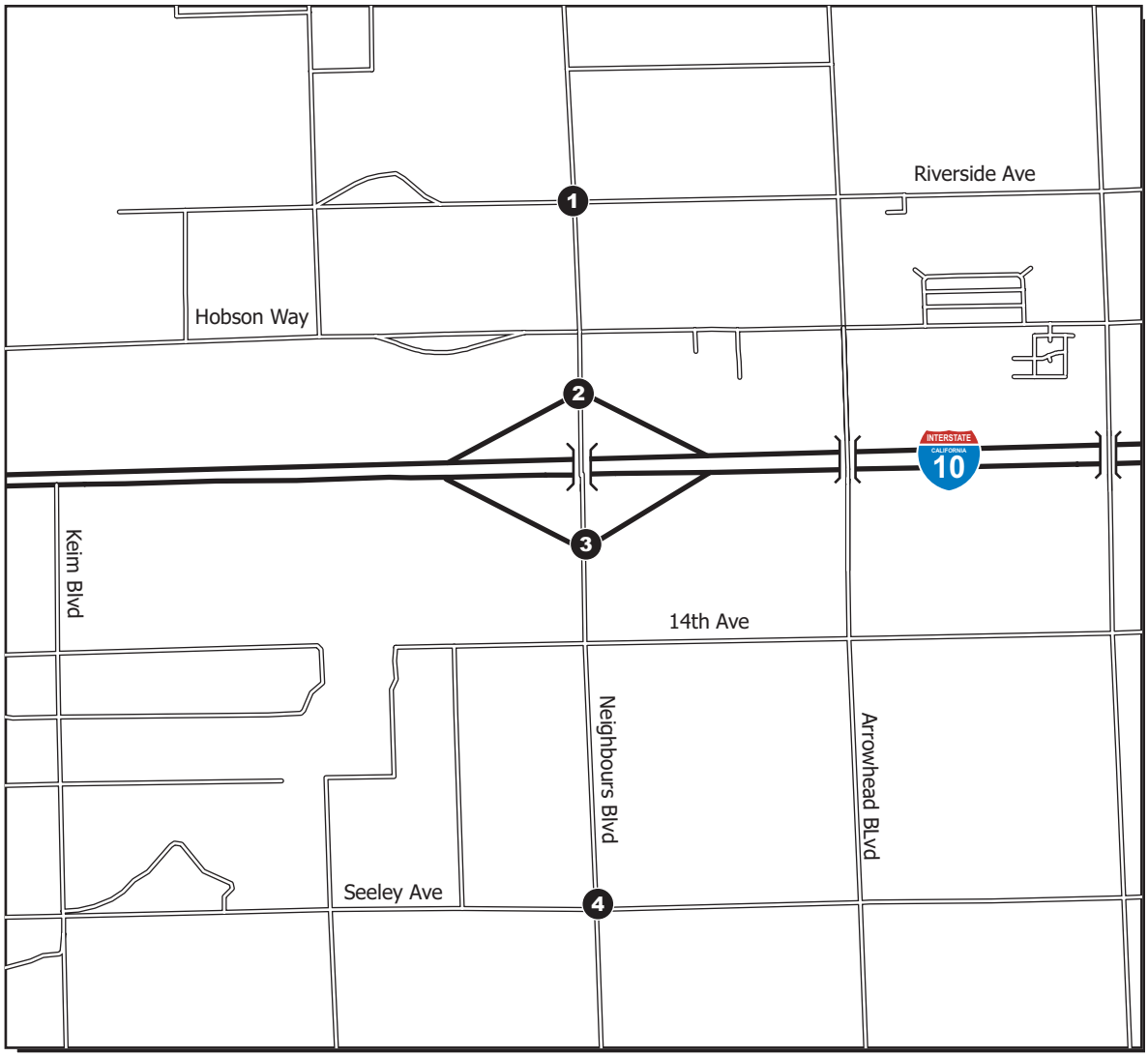
LEGEND

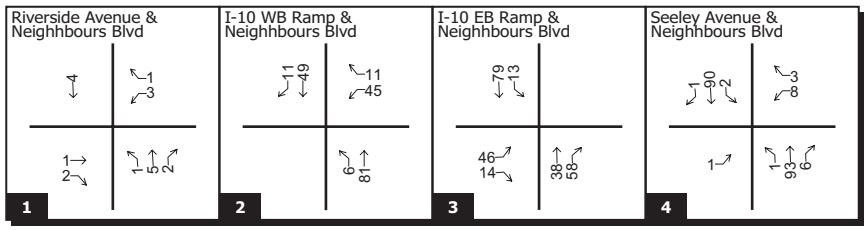
10 AM Peak Hour Traffic

Figure 5.1
Project Construction Traffic Volumes Without Project - AM Peak Hour

N
Not To Scale

AR062037





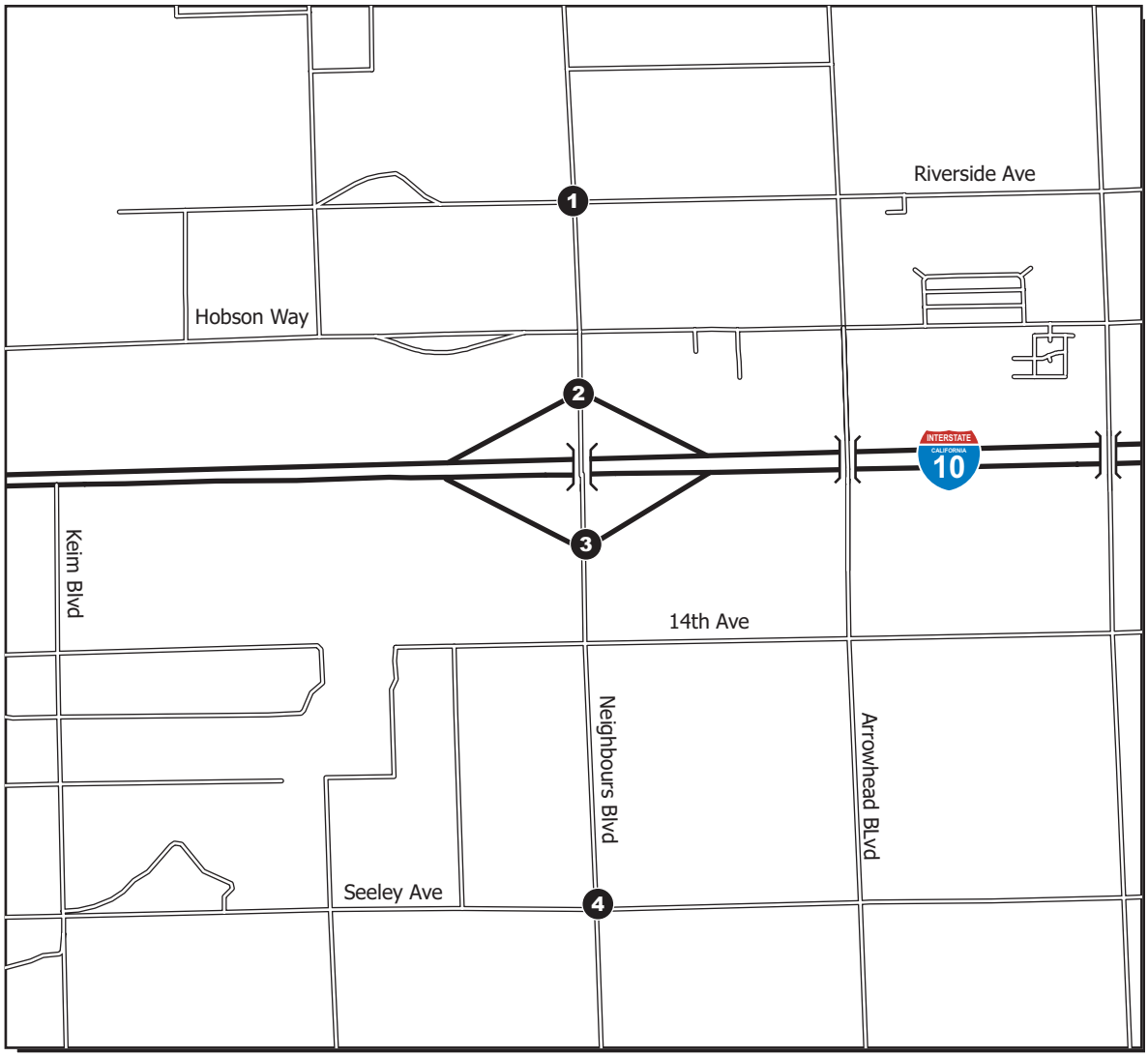
LEGEND

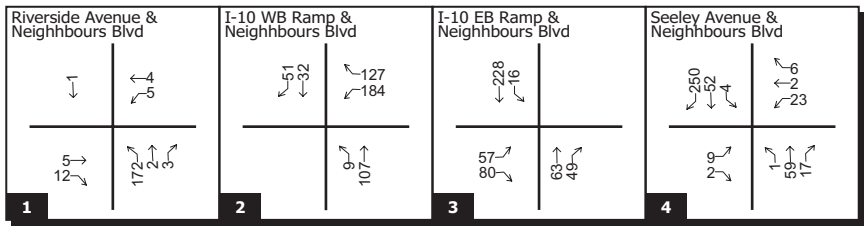
10 PM Peak Hour Traffic

Figure 5.2
Project Construction Traffic Volumes Without Project - PM Peak Hour

N
Not To Scale

AR062038





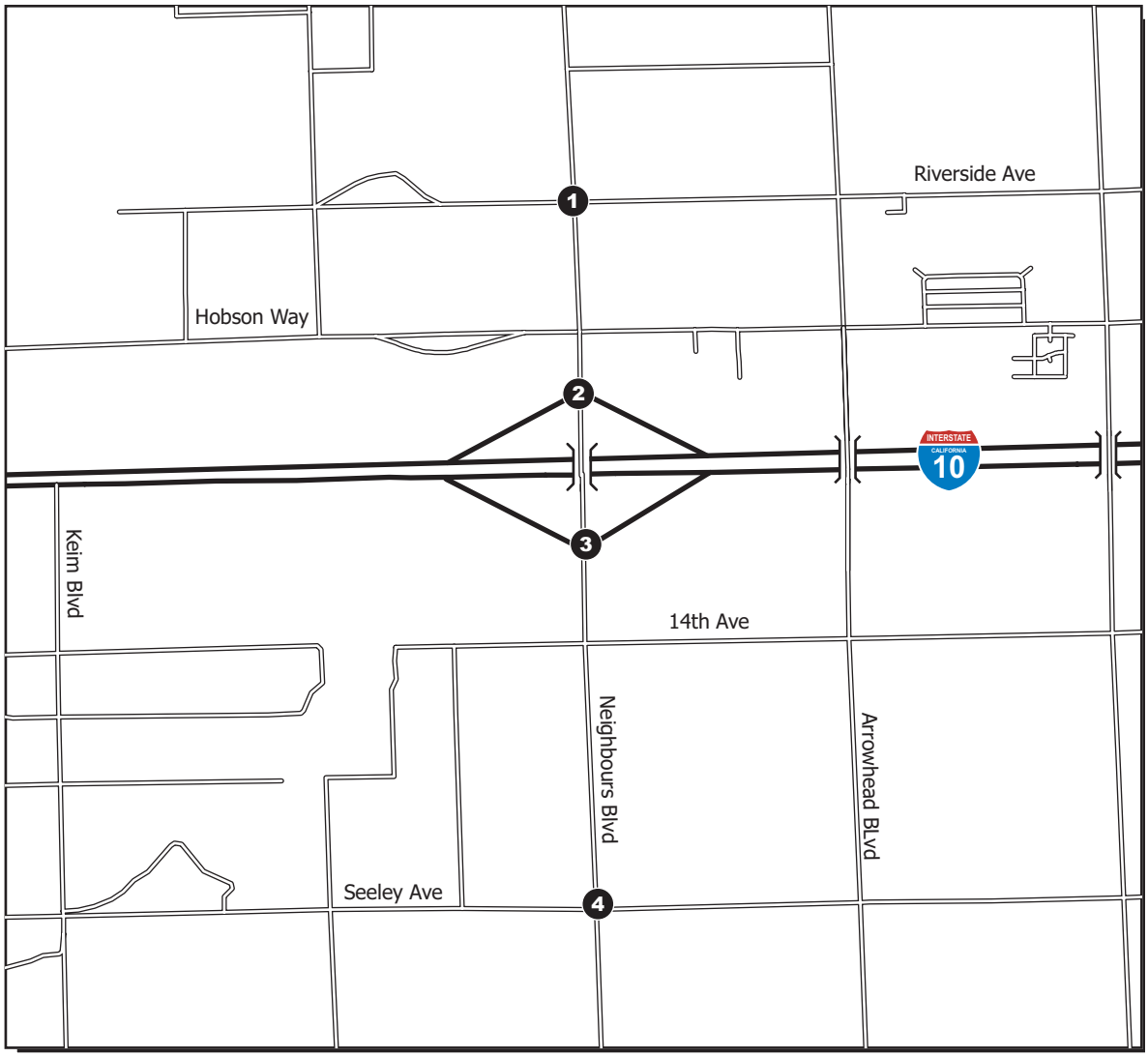
LEGEND

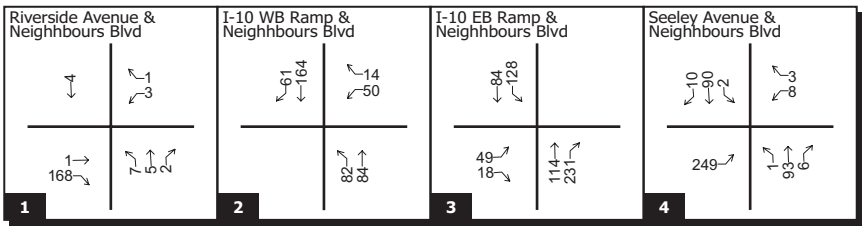
10 AM Peak Hour Traffic

Figure 5.3
Project Construction Traffic Volumes With Project - AM Peak Hour

N
Not To Scale

AR062039





LEGEND

10 PM Peak Hour Traffic

Figure 5.4
Project Construction Traffic Volumes With Project - PM Peak Hour

N
Not To Scale

AR062040

CHAPTER 6
CUMULATIVE
(EXISTING + AMBIENT + PROJECT + CUMULATIVE)

This chapter develops future traffic conditions in the study area with ambient growth added and cumulative projects without the proposed project construction trips. The Year 2015 was selected for analysis based on correspondence with the applicant regarding the project's construction timeline.. For our analysis we made reasonable assumptions using the best information available to us at the time. The cumulative condition presented below is the **"worst- case scenario**.**"**

Future Growth

Based on discussions with the County of Riverside, it has been established that traffic in the study area has historically increased at a rate of about 2% per year. Future increases in the background traffic volumes due to regional growth are expected to continue at this rate in the vicinity of the project. Assuming a completion date within 4 years, the existing traffic volumes were adjusted upward by 8% to reflect area wide growth.

Cumulative Projects

The cumulative scenario should also consider additional traffic that may be generated by other developments that have been planned or approved. The City of Blythe did not identify any development projects that would add traffic to the intersections analyzed in the study. In coordination with Riverside County Transportation Department representative, potential cumulative projects within the Project vicinity were identified. Approved traffic studies in the vicinity of the Project site were reviewed to eliminate projects that would not contribute traffic to the study area. The cumulative scenario accounts for construction of multiple large energy projects along the I-10 corridor and developments in the City of Blythe. The County of Riverside identified six proposed renewable energy projects listed below that could conceivably be constructed during the year 2015. Table 6-1A lists cumulative projects that would have the potential to contribute to cumulative impacts. Table 6-1B lists the cumulative projects that were considered, but eliminated, because they would not contribute traffic impacts to the four study intersections. For example, the approved Rio Mesa Solar Electric Generating Facility would utilize the Mesa Interchange; therefore it would not impact the four study intersections.

Table 6-1A
Cumulative Projects Included in Analysis

PROJECT NAME/APPLICANT	PROJECT DESCRIPTION	STATUS
Solar Cumulative Projects		
Blythe Airport Solar I Project/ • U.S. Solar EA # 42340	100 MW photovoltaic power plan on 640 acres in five- 20 MW phases that includes a 3,200 ft long 33 kV generation tie.	Approved November 2010
Blythe Solar Power Project/ • Solar Millennium CACA 48811	Concentrated solar thermal electric generating facility, using solar parabolic trough technology, with four adjacent and independent units of 250 MW nominal capacity each for a total nominal capacity of 1,000 MW.	Suspension issued August 2011
Blythe Energy Project II	520 MW combined-cycle power plant located entirely within the Blythe Energy Project site boundary. Blythe Energy Project II will interconnect with the Buck Substation constructed by WAPA as part of the Blythe Energy Project. Project is designed on 20 acres of a 76-acre site.	Approved 2005 Request for Construction commencement 2011-2016
Palo Verde Mesa Solar Project	437 MW PV solar plant that includes a 14-mile long transmission line to the Colorado River Substation.	Planned NOP issued August 2012
Rio Mesa Solar Electric Generating Facility • BrightSource Energy, Inc • 2011-AFC-04 • CACA 53138	Consists of three 250 MW solar concentration thermal power plants (750 MW total). Each plant requires about 1,850 acres (or 2.9 square miles) of land to operate. A 119 acre common area will include a combined administration, control, and maintenance facilities. The total area, including shared facilities, is approximately 5,750 acres.	Suspension issued January 2013
Desert Quartzite/ • First Solar Development, Inc • CACA 49397	600 MW, Photovoltaic, 7,245 acres disturbed, no transmission line	Planned
County of Riverside Projects		
PM33797	Schedule H: Divide 2.14 acres into 2 single family residential parcels	Planned
PM34400	Schedule H: Divide 80 acres into 2 single family residential	Planned
PM34759	Schedule H: Divide 34 acres into 3 parcels	Planned
PP23885	Church with accessory outdoor recreation/amphitheater 8,890 square feet Church	Planned

Table 6-1B
Cumulative Projects Considered

PROJECT NAME/APPLICANT	PROJECT DESCRIPTION
Solar/Transmission Line Projects	
Blythe Solar Power Generation Station 1, LLC	A planned 4.76 MW solar PV facility, on 29.4 acres, consisting of 69 PV panels that stand approximately 50-feet tall an d 72-feet wide, a 200 square foot equipment building, and a twenty-foot perimeter fire access road.
Brightsource Energy CACA 51967	Solar energy facility to occupy a total of 12,269 acres.
Genesis Solar Energy Project	The project consists of two independent solar electric generating facilities with a nominal net electrical output of 125 megawatts (MW) each, for a total net electrical output of 250 MW.
Wiley's Well Communication Tower	The site is located adjacent to an existing communication tower, approximately 0.25 mile south of Interstate 10 and immediately west of Wiley Well Road, approximately 18 miles west of Blythe. The proposed project will place a tower and equipment shelter at the site.
Ridgeline Energy, LLC	50-100 MW solar PV or concentrated PV energy facility. The project would include a solar panel array, a maintenance building, an administration building, a raw water storage tank, a demineralized water tank, a potable water tank, and a 230 kV or lower transmission line and substation (Ridgeline Energy, LLC, 2010a).
Mule Mountain Solar Project/ • Bullfrog Green Energy, LLC • CAC 49097	Photovoltaic, 500 MW, project includes a transmission line, 6,600 acres disturbed
Mule Mountain Soleil Project/ • enXco • CACA 49488	200 MW solar PV that would disturb approximately 1,600 acres. Withdrawal request letter sent 4/16/11
Desert Southwest Transmission Line	118-mile 500 kV transmission line from new substation/switching station near Blythe Energy Project to the existing Devers Substation. Located adjacent to SCE's existing 500 kV Devers – Palo Verde 1 transmission line. Approximately 4,290 acres of ROW. Plans for development are being finalized with construction commencing soon.
Devers – Palo Verde 2 Transmission Line •CUPC A. 05-04-015 • CACA 048771	41.6-mile Devers-Valley No. 2 transmission line, an alternative to the West of Devers portion of the DPV2 project proposed by SCE. Devers-Valley No. 2 will be a second 500 kV transmission line between the Devers substation and SCE's Valley Construction anticipated for 4th quarter 2011 and in-service 3rd quarter 2013.
McCoy Solar Energy Project • McCoy Solar, LLC CACA 48728	Up to a 750 MW PV solar power plant using photovoltaic technology. MW, solar thermal, 7,700 acres disturbed. Approximately 16 mile long 230 kV generation-tie and switchyard that will connect to SCE's Colorado River Substation.
Mc Coy Soleil Project • enXco, Inc CACA 49490	300 MW PV solar plant, 20,484. POD submitted
Colorado River Substation Expansion	Proposed to be expanded as a 500/230 kV substation and would be constructed in an area approximately 1,000 feet by 1,900 feet, permanently disturbing approximately 90 acres. The 500 kV switching station would include buses, circuit breakers, and disconnect switches. The switchyard would be equipped with 108-foot-high dead-end structures. Outdoor night lighting would be designed to illuminate the switchrack when manually switched on.

Table 6-1B
Cumulative Projects Considered (continued)

PROJECT NAME/APPLICANT	PROJECT DESCRIPTION
County of Riverside Projects	
PAR01198	Subdivide 33.83 Parcels Into 46 1/2 Acre Lots
PM35085R1	Divide 55 Acres Into 4 Industrial Lots
CUP02042R1	Extend Life & Add 3 Tanks To Existing Facility
CUP03187	Batch Plant, Manfg Pre-Cast Concrete & Wooden Pall
CUP03223	Gas Station, Fast Food,Motel, Conv.Store-'Fast Track
CUP03302	Auto Wrecking And Recycling Yard
CUP03602	Install 21 Megawatt Photovoltaic Array Facility
PAR00281	Parcel Map
PM35085R1	Par Review To Divide 10.4 Acres Four Lots
PM26557	To Divide Approx. 130 Acres Into 3 Parcels W/40 Ac
PM28239	Divide 14 Acres Into 4 Parcels
PM35085	Divide 51 Acres Into 30 Parcels - Schedule "E"
PM36025	Divide 34 Ac Into Three Parcels - Schedule "H" See Pp23885
PP16258	Telecommunications 110 Ft Monopole & Equip.
PP18264	Permit Existing Liquid Fertilizer Tank Farm
PP18990	Boat And Trailer Storage Facility
PP19016	Auto Body Repair Shop Expansion, Inc. Paint Booth
PUP00731	Recovery Ranch For Substance Abuse Treatment

Cumulative Analysis

Should the peak construction schedules of the cumulative projects listed in Table 6-1A overlap, construction traffic from these projects would result in increased traffic within several miles or more along I-10 and regional roadways. For the analysis, the best information available was used to create reasonable assumptions. Although it is very unlikely that the peak construction periods of multiple projects would coincide, as a conservative analysis, the cumulative conditions represented in Table 6-2 analyze the worst-case scenario**.** In doing this we address any uncertainty; such exists with the current suspension of the Blythe Solar Power Project and Rio Mesa Solar Electric Generating Facility; as such, these two projects would likely not be constructed at the same time as the project. However, there may still be some overlap in overall construction schedules (peak and non-peak) for a few cumulative projects. Traffic from these cumulative projects were added to 2015 projected traffic.

Table 6-2 lists the anticipated delays and LOS conditions that would result with the addition of the cumulative projects. Figures 6-1 and 6-2 illustrate the cumulative peak hour traffic volumes without the project during the AM and PM peak hours. With the addition of the cumulative projects, the 2015-year cumulative conditions analysis without the Project would result in two study intersections operating at an acceptable LOS and the two locations mentioned below operating an unacceptable LOS. Table 6-3 lists each solar project's contribution (number of trips and percentage) to the cumulative scenario. In addition to the project, the major cumulative contributors to traffic impacts include the Rio Mesa Solar Electric Generating Facility, Desert Quartzite and Palo Verde Mesa Solar Project.

- Neighbours Boulevard and I-10 Westbound Ramps
    - During the p.m. peak hours would operate at LOS F with a delay of 4.29 minutes (257.1seconds). The major contributors to the cumulative scenario include the Rio Mesa Solar Electric Generating Facility, Desert Quartzite, and Palo Verde Mesa Solar Project.
- Neighbours Boulevard and I-10 Eastbound Ramps
    - During the a.m. peak hour would operate at LOS D with an intersection delay of 34.7 seconds; during the p.m. peak hour would operate at an LOS F with an intersection delay of 4.9 minutes (294.0 seconds). The major contributors to the cumulative scenario include the Rio Mesa Solar Electric Generating Facility, Desert Quartzite, and Palo Verde Mesa Solar Project.

As shown in Table 6-2, the addition of the project traffic and cumulative trips generated by other projects located within the study area will cause deterioration in LOS at the four intersections; only the Riverside Drive and Neighbours Boulevard intersection during the p.m. peak hour would operate at an acceptable LOS. The cumulative scenario intersection delays from with and without project construction would increase approximately 3.2 seconds to 190.4 seconds (3.2 minutes); in some instances will experience “overflow conditions” which is described below. Figures 6-3 and 6-4 illustrate the cumulative peak hour traffic volumes with the project during the AM and PM peak hours.

- Neighbours Boulevard and Riverside Drive
    - During the a.m. peak hour would reduce from LOS B to LOS E with an intersection delay increase of 25.9 seconds, because the project would contribute 53.6 percent of the cumulative traffic and the Palo Verde Mesa Solar Project would contribute 53 percent. The p.m. peak hour would continue to operate at an LOS B with an intersection delay increase 3.2 seconds
- Neighbours Boulevard and I-10 Westbound Ramps
    - During the a.m. peak hour would reduce from LOS C to LOS F with an intersection delay increase of 51.4 seconds, because the major contributors to cumulative traffic include the Palo Verde Mesa Solar Project (35.0 percent), the project (28.4 percent), and Rio Mesa Electric Generating Facility (13.9 percent,. During the p.m. peak hour would reduce from LOS F to overflow condition, because the major contributors to cumulative traffic include Palo Verde Mesa Solar Project (34.4 percent), the project (20.2 percent), and Rio Mesa Electric Generating Facility (18.7 percent), Desert Quartzite (15 percent).
- Neighbours Boulevard and I-10 Eastbound Ramps
    - During the a.m. peak hour would reduce from LOS D to LOS F with an intersection delay increase of 2.15 minutes (129.2 seconds), because the major contributors to cumulative traffic include the Rio Mesa Electric Generating Facility (34.1 percent), Desert Quartzite (27.3 percent), the project (24.9 percent), and Palo Verde Mesa Solar Project (10.8 percent), During the p.m. peak hour would reduce from LOS F to overflow condition, because the major contributors to cumulative traffic include the Rio Mesa Electric Generating Facility (34.1 percent), Desert Quartzite (27.3 percent), the project (24.9 percent), and Palo Verde Mesa Solar Project (10.8 percent)

- Neighbours Boulevard and Seeley Avenue
    - During the a.m. peak hour would reduce from LOS C to LOS D with an intersection delay increase of 6.1 seconds, because the major contributors to cumulative traffic include the Rio Mesa Solar electric Generating Facility (40.4 percent), Desert Quartzite (32.3 percent), and the project (24.3 percent). During the p.m. peak hour would reduce from LOS C to LOS D with an intersection delay increase of 3.17 minutes (190.4 seconds), because the major contributors to cumulative traffic include the Rio Mesa Solar Electric Generating Facility (38.9 percent), Desert Quartzite (31.2 percent), and the project (26.2 percent).

The 2015 cumulative scenario with project construction results in two intersections operating at "overflow conditions" during the p.m. peak hours. An intersection will exhibit an overflow condition when the average arrival rate of vehicles exceeds capacity of the roadway. This can occur when an area experiences a high increase in traffic demand and cannot handle the excessive delay for movements. The intersection is then oversaturated and results in a system operating at a non-equilibrium state. Assuming a constant arrival rate and capacity, the queue length at the intersection increases constantly.

Appendix D contains the analysis worksheets for cumulative intersection conditions.

Table 6-2
Cumulative Intersection Conditions

Intersection	Without Project		With Project		Δ Delay	Potential Impact
	Delay	LOS	Delay	LOS		
AM Peak Hour						
1. Riverside Dr & Neighbours Blvd*	14.2	B	40.1	E	25.9	Yes
2. I-10 WB Ramp & Neighbours Blvd*	19.2	C	70.6	F	51.4	Yes
3. I-10 EB Ramp & Neighbours Blvd*	34.7	D	163.9	F	129.2	Yes
4. Seeley Ave & Neighbours Blvd*	23.3	C	29.4	D	6.1	Yes
PM Peak Hour						
1. Riverside Dr & Neighbours Blvd*	10.0	B	13.2	B	3.2	No
2. I-10 WB Ramp & Neighbours Blvd*	257.1	F	Overflow	F	-	Yes
3. I-10 EB Ramp & Neighbours Blvd*	294.0	F	Overflow	F	-	Yes
4. Seeley Ave & Neighbours Blvd*	21.8	C	212.2	F	190.4	Yes

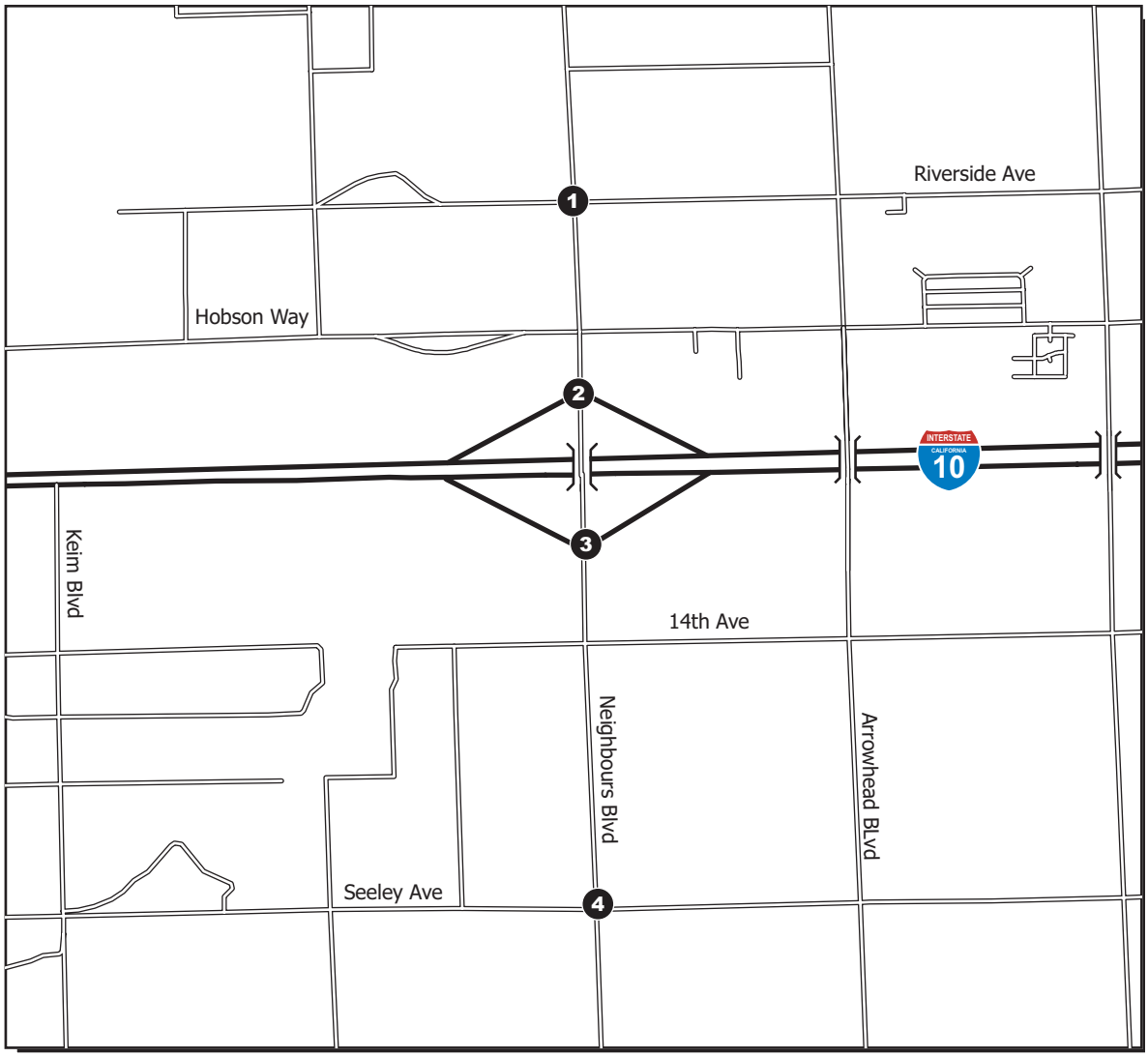
Note: *Unsignalized Intersection

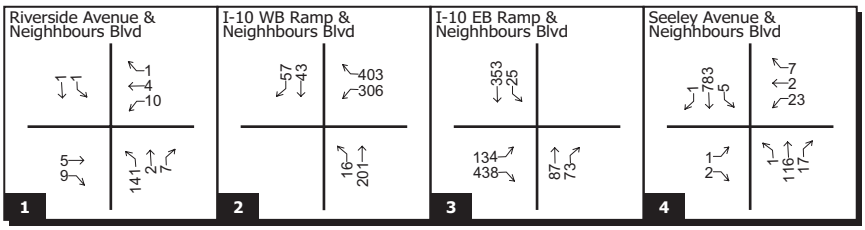
The impacts discussed above are related to the construction of numerous solar projects, which is considered temporary. The operational trips related to the solar projects are significantly less than construction. For example, the proposed Blythe Mesa Solar project, will require 12 permanent full-time employees in comparison to the anticipated 500 workers required for peak construction. Therefore, it is anticipated that the LOS for all four study intersection will be restored back to preconstruction conditions once construction of these projects are completed.

Table 6-3
Cumulative Project Trip and Percentage Contribution*

Intersection	Blythe Mesa		Blythe Solar		Rio Mesa		Desert Quartzite		Palo Verde		Blythe Energy		Blythe Airport Solar		Other Cumulative Projects.		Ambient Growth		Total
	Trips	% of Total	Trips	% of Total	Trips	% of Total	Trips	% of Total	Trips	% of Total	Trips	% of Total	Trips	% of Total	Trips	% of Total	Trips	% of Total	
AM Peak Hour																			
1. Riverside Dr & Neighbours Blvd	172	53.6%	0	0.0%	0	0.0%	0	0.0%	138	43.0%	0	0.0%	3	0.9%	8	2.6%	0	0.0%	321
2. I-10 WB Ramp & Neighbours Blvd	348	28.4%	45	3.7%	170	13.9%	136	11.1%	429	35.0%	75	6.1%	2	0.2%	7	0.6%	13	1.1%	1225
3. I-10 EB Ramp & Neighbours Blvd	312	24.9%	15	1.2%	427	34.1%	342	27.3%	135	10.8%	3	0.2%	2	0.1%	5	0.4%	12	1.0%	1253
4. Seeley Ave & Neighbours Blvd	257	24.3%	15	1.4%	427	40.4%	342	32.3%	0	0.0%	0	0.0%	2	0.1%	5	0.4%	11	1.0%	1058
PM Peak Hour																			
1. Riverside Dr & Neighbours Blvd	172	53.3%	0	0.0%	0	0.0%	0	0.0%	138	42.7%	0	0.0%	3	1.0%	10	3.0%	0	0.0%	323
2. I-10 WB Ramp & Neighbours Blvd	252	20.2%	45	3.6%	233	18.7%	187	15.0%	429	34.4%	75	6.0%	3	0.2%	9	0.7%	15	1.2%	1248
3. I-10 EB Ramp & Neighbours Blvd	376	25.0%	45	3.0%	382	25.4%	306	20.4%	295	19.7%	72	4.8%	2	0.1%	5	0.3%	18	1.2%	1501
4. Seeley Ave & Neighbours Blvd	257	26.2%	15	1.5%	382	38.9%	306	31.2%	0	0.0%	0	0.0%	2	0.2%	5	0.5%	15	1.5%	981

* The cumulative contribution percentages for the projects were rounded; therefore, the sum of the percentages may not equal 100 percent.





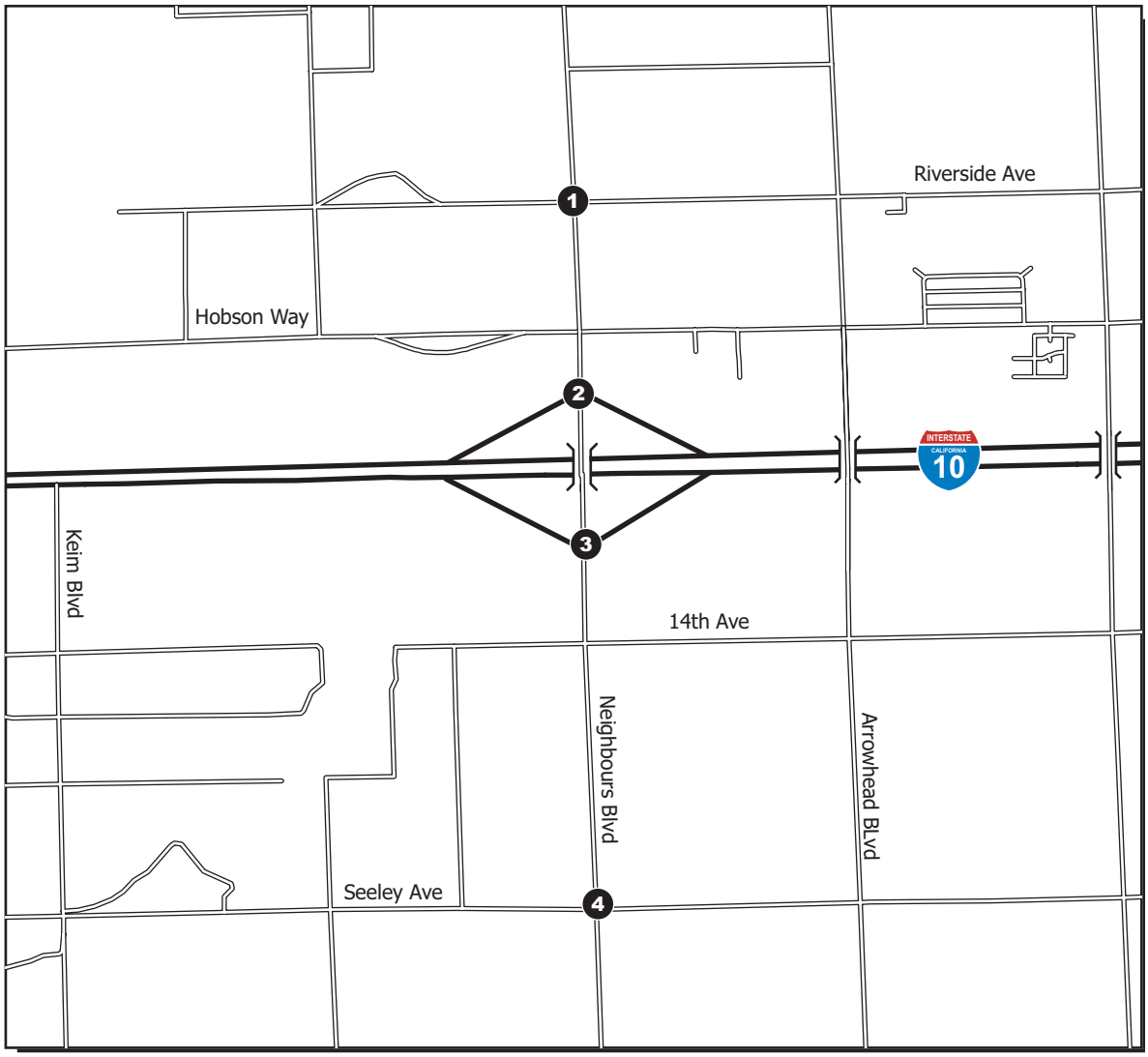
LEGEND

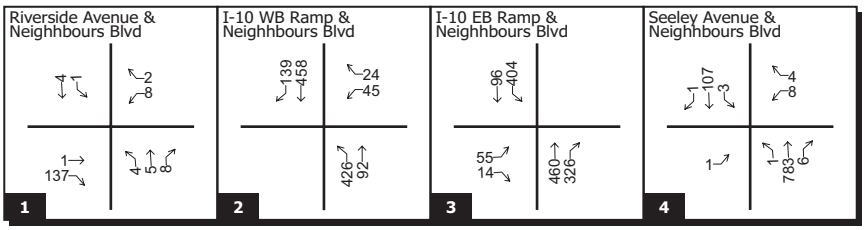
10 AM Peak Hour Traffic

Figure 6.1
Cumulative Traffic Volumes Without Project - AM Peak Hour

N
Not To Scale

AR062048





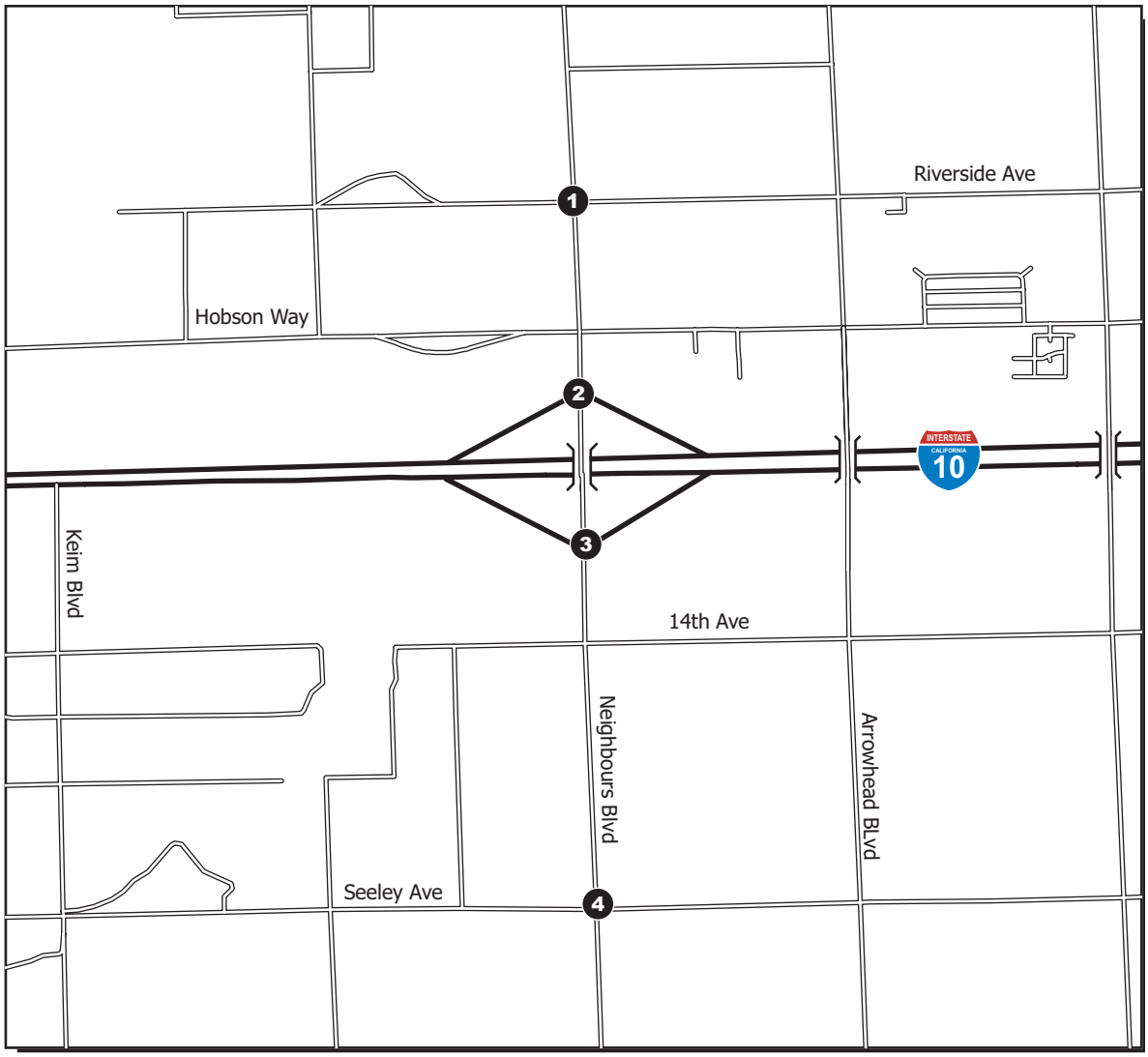
LEGEND

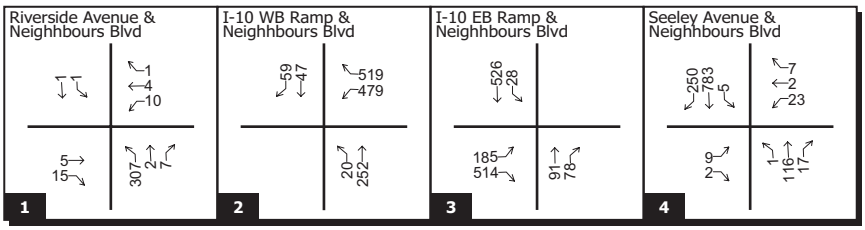
10 PM Peak Hour Traffic

Figure 6.2
Cumulative Traffic Volumes Without Project - PM Peak Hour

N
Not To Scale

AR062049





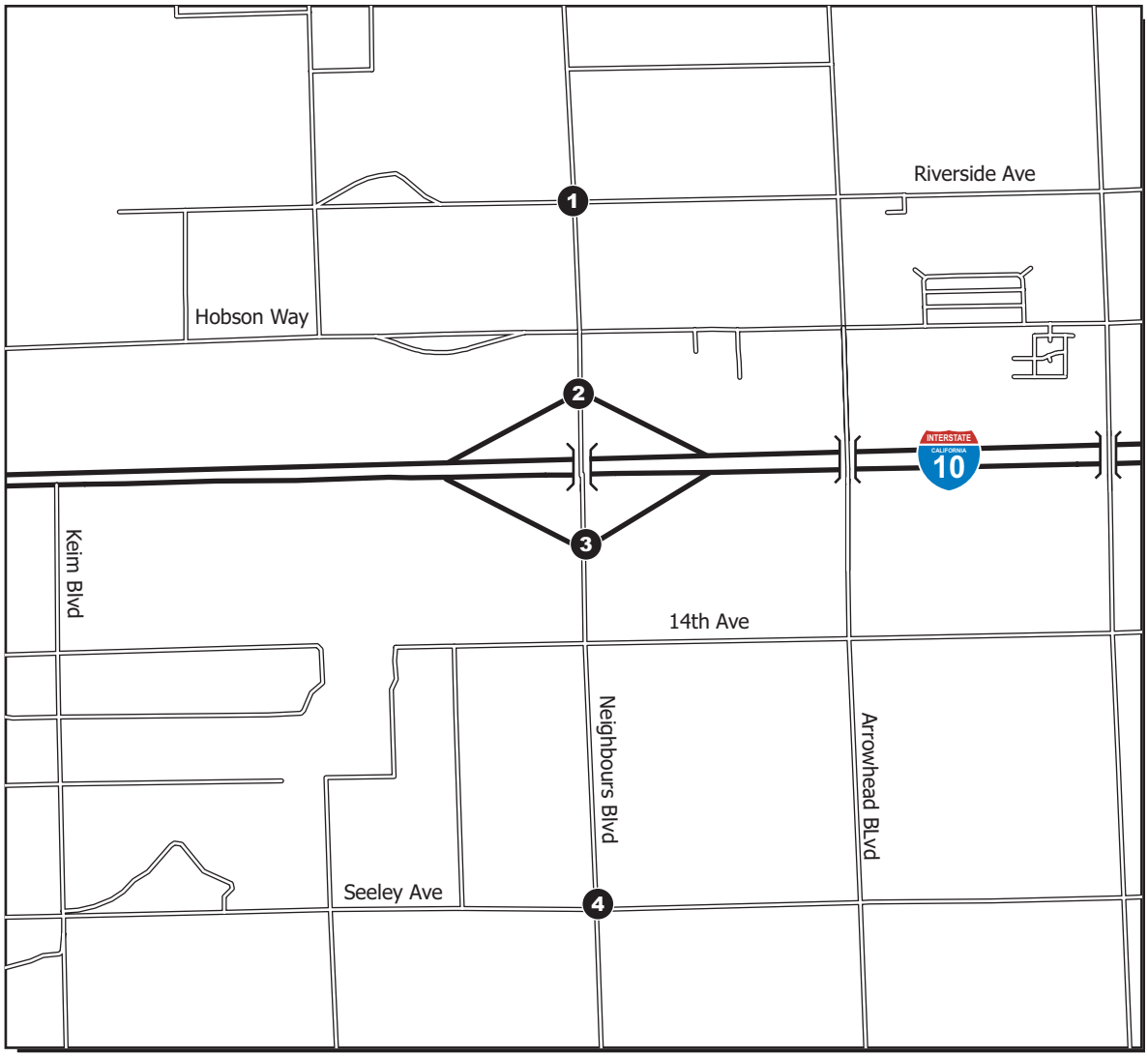
LEGEND

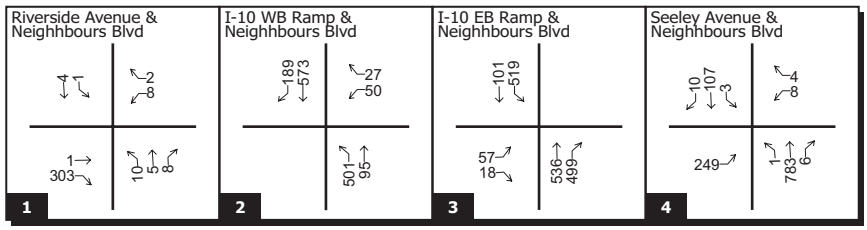
10 AM Peak Hour Traffic

Figure 6.3
Cumulative Traffic Volumes With Project - AM Peak Hour

N
Not To Scale

AR062050





LEGEND

10 PM Peak Hour Traffic

Figure 6.4
Cumulative Traffic Volumes With Project - PM Peak Hour

N
Not To Scale

AR062051

CHAPTER 7
SUMMARY OF ANALYSIS

This chapter summarizes the anticipated changes from the existing conditions (2011), projected 2015 Conditions (existing plus ambient growth), and Cumulative Conditions (existing plus ambient growth plus cumulative projects). Tables 7-1 show the summary of intersection conditions for each scenario for AM and PM peak periods, respectively.

Table 7-1
Intersection Analysis Summary

	Existing Conditions (2011)		**Anticipated 2015 Conditions** *(Existing + Ambient)*				**Cumulative Conditions** *(Existing + Ambient +Cumulative)*			
	Without Project		Without Project		With Project		Without Project		With Project	
Intersection	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
AM Peak Hour										
1. Riverside Dr & Neighbours Blvd*	9.0	A	9.0	A	16.4	C	14.2	B	40.1	E
2. I-10 WB Ramp & Neighbours Blvd*	9.0	A	9.0	A	11.1	B	19.2	C	70.6	F
3. I-10 EB Ramp & Neighbours Blvd*	9.2	A	9.2	A	11.2	B	34.7	D	163.9	F
4. Seeley Ave & Neighbours Blvd*	9.4	A	9.5	A	10.6	B	23.3	C	29.4	D
PM Peak Hour										
1. Riverside Dr & Neighbours Blvd*	8.6	A	8.6	A	10.2	B	10.0	B	13.2	B
2. I-10 WB Ramp & Neighbours Blvd*	9.5	A	9.5	A	12.5	B	257.1	F	Overflow	F
3. I-10 EB Ramp & Neighbours Blvd*	9.5	A	9.6	A	13.8	B	294.0	F	Overflow	F
4. Seeley Ave & Neighbours Blvd*	9.8	A	9.9	A	12.9	B	21.8	C	212.2	F

Note: *Unsignalized Intersection

As shown in Table 7-1, with the addition of more project trips, the LOS reduces and delays at each of the four study intersections increases. With the addition of peak construction trips from three of four major solar projects, it further deteriorates the LOS and increases the delays at each of the study intersections. In the existing conditions (2011) scenario all intersections are operating an LOS A with intersection delays ranging from 8.6 seconds to 9.8 seconds. With the addition of ambient growth, the anticipated 2015 conditions without project scenario will still operate at an LOS A and experience intersection delays ranging from 8.6 to 9.9 seconds. The 2015 plus project scenario, which will add approximately 429 trips, will result in all study intersections operating at an LOS B, with the exception of Riverside Drive and Neighbours Boulevard intersection which will operate at an LOS C during the a.m. peak hour. The intersection delays would range from 10.2 seconds to 16.4 seconds. During the cumulative scenario without project (addition of approximately 149 to 1107 cumulative trips), two intersections will operate at an acceptable LOS (LOS B or C); the I-10 Westbound Ramp and Neighbours Boulevard intersection would operate at an LOS C during the a.m. peak hours, but operate at an LOS F during the p.m. peak hours; and the I-10 Eastbound Ramp and Neighbours Boulevard intersection would operate at unacceptable LOS (LOS D and F).The intersection delays for the cumulative without project will range from 10.0 seconds to 294.0 seconds (4.9 minutes). The cumulative conditions with project scenario (addition of approximately 321 to 1501 cumulative trips), all intersections would operate at unacceptable LOS (LOS D to F), with the exception of the Riverside Drive and Neighbours Boulevard intersection during the p.m. peak hours will operate at an LOS B. The cumulative with project scenario will experience intersection delays ranging from 13.2 seconds to overflow conditions.

Of the four study intersections, Intersection 1 (Riverside Drive and Neighbours Boulevard) will receive the smallest increase in cumulative traffic (321 trips in the a.m. peak hour and 323 trips in the p.m. peak hour). North and south movements on Neighbours Boulevard are free flowing. East and Westbound movements on Riverside Avenue are stop controlled. It would operate at an acceptable LOS during the p.m. peak hour, because as illustrated in Figure 6.4, most of the traffic (approximately 303 vehicles) from Riverside Drive is headed southbound (right turn) onto Neighbours Boulevard. These vehicles will need to stop, but would experience minimal interruption from northbound (5 trips) and southbound (4 trips) vehicles on Neighbours Boulevard, and 8 vehicles from Riverside Drive will head southbound onto Neighbours Boulevard. Therefore, traffic during the p.m. peak hour will experience approximately 13.2 second delays. During the a.m. peak hour, Intersection 1 would experience greater delays, because most of the traffic (approximately 307 vehicles) from Neighbours Boulevard will make a left turn onto Riverside Drive. Westbound and eastbound vehicles on Riverside Drive are stop controlled and need to wait for large gaps to make a movement. This results in greater delays for the 10 vehicles from Riverside Drive headed southbound onto Neighbours Boulevard and 5 vehicles traveling eastbound on Riverside Drive. At stop controlled intersections, left turn movements are considered critical movements. When the free flowing movements, such as Neighbours Boulevard, have a very high volume the critical movements will experience longer delays in order to find a suitable gap in the traffic to make their turn. Therefore, these vehicles would experience delays approximately 40.1 seconds long and result in an LOS E (unacceptable level).

Intersection 3 (1-10 Eastbound Ramp and Neighbours Boulevard) would receive the highest cumulative trips of the four intersections. It would operate at LOS A during 2015 Conditions. With the addition of Project construction traffic (ranging from 172 to 367 trips), this intersection will reduce from an LOS A to LOS B with a 2.0-to-4.2 second delay increase. For the 2015 Cumulative without Project scenario (the addition of 929 trips in the a.m. and 1107 trips in the p.m.), the a.m. peak hour would increase from LOS A to LOS D with a 34.7-second delay; during the p.m. peak hour, it would increase from LOS A to LOS F with a 4.9-minute (294.0-second) delay. The 2015 Cumulative condition with Project construction (addition of 1253 trips in the a.m. and 1501 trips in the p.m.) would reduce from LOS B to LOS F and experience a 2.7-minute (163.9-second) delay during the a.m. peak hours and overflow conditions during the p.m. peak hours. The Project's cumulative contribution towards the 2015 Cumulative scenario would be approximately 25 percent during the a.m. and p.m. peak.

CHAPTER 8
DETERMINATION OF SIGNIFICANT IMPACTS AND MITIGATIONS

Traffic impacts are identified if the proposed project will result in a significant change in traffic conditions on a roadway or intersection. A significant impact is normally defined when project related traffic would cause level of service to deteriorate to below the minimum acceptable level by a measurable amount. Impacts may also be significant if the location is already below the minimum acceptable level and project related traffic causes a further decline.

The County of Riverside considers the following types of traffic impacts are to be "significant" under CEQA:

- When a project traffic is added to existing traffic (Project Completion), and results in deterioration of the LOS to below the target LOS, and impacts cannot be mitigated through project conditions of approval.
- When a project's cumulative traffic contribution exceeds the target LOS, and impacts cannot be mitigated through the TUMF network (or other funding mechanism), project conditions of approval, or other implementation mechanisms.

Project Construction Conditions Scenario Impacts

The 2015 Scenario with the addition ambient growth and project construction traffic does not cause a significant change in level of service when compared to the level of service experienced in the existing conditions (Year 2011); therefore, the project would not create significant impacts to the four study intersections.

Cumulative Conditions Scenario Impacts

Although very unlikely to occur, Chapter 6 describes the worst case scenario with the peak construction of multiple large energy projects and developments in the City of Blythe. As described in Chapter 7, during cumulative scenario without project (addition of approximately 149 to 1107 cumulative trips), during the a.m. peak hours, three intersections would operate at acceptable LOS levels (LOS B or C) and Intersection 3 (I-10 Eastbound Ramp and Neighbours Boulevard) would operate at an unacceptable LOS (LOS D). During the p.m. peak hours, two intersections would operate at acceptable LOS levels (LOS B and C) and two intersections would operate at LOS F.

As illustrated in the cumulative plus project scenarios (Tables 6-2, 6-3, and 7-1), the project would be a temporary cumulatively considerable contributor to traffic. The increased vehicle trips would result in increased traffic along the regional roadways analyzed and all four study intersections will operate at unacceptable LOS levels (LOS D to F), except Intersection 1 (Riverside Drive and Neighbours Boulevard) which would operate at an LOS B during the pm. peak hour.

As described in Chapter 6, in addition to the project, the major contributors to cumulative traffic impacts at the four study intersections are Rio Mesa Solar Electric Generating Facility, Desert Quartzite, and Palo Verde Mesa Solar Projects. The project would contribute approximately 20.2 to 53.6 percent of the cumulative trips. The Rio Mesa Solar Electric Generating will not contribute to cumulative traffic for Intersection 1, but will contribute approximately 13.9 to 40.4 percent of the cumulative traffic trips at intersections 2 through 4. Desert Quartzite will not contribute to cumulative impacts to Intersection 1, but will contribute approximately 11.0 to 32.3 percent of the cumulative impacts to intersections 2 through 4. The Palo Verde Mesa Solar Project will not contribute to cumulative impacts to intersection 4, but will contribute approximately 10.8 to 43.0 percent of the

cumulative impacts to intersections 1 through 3. Details for each projects contribution towards cumulative impacts is listed in Table 6-3.

Construction of multiple cumulative projects listed in Table 6-1A can occur simultaneously with the project, but it is unlikely that peak construction of all six solar projects will occur. The Rio Mesa Solar Electrical Generating Facility has been suspended and it is very unlikely that construction of this project and the proposed project will occur at the same time. It is anticipated that the Desert Quartzite project, which is similar in size and scope as the proposed project, will require the preparation of an environmental document. To date, the Desert Quartzite project has not issued a Notice of Intent or Notice of Preparation. After issuance of a notice, preparation of an environmental document may take approximately 12 to 18 months; therefore, peak construction of Desert Quartzite and project is very unlikely. In addition, the Blythe Solar Power Project has been suspended and peak construction will likely not occur at the same time as the project. Table 8-1 lists the potential cumulative trip reduction with the removal of the three solar projects.

Table 8-1
Potential Cumulative Trip Percentage Reduction

Intersection	Rio Mesa % Contribution	Blythe Solar % Contribution	Desert Quartzite % Contribution	TOTAL
AM Peak Hour				
1. Riverside Dr & Neighbours Blvd	0.0%	0.0%	0.0%	0.0 %
2. I-10 WB Ramp & Neighbours Blvd	13.9%	3.7%	11.1%	28.70%
3. I-10 EB Ramp & Neighbours Blvd	34.1%	1.2%	27.3%	62.60%
4. Seeley Ave & Neighbours Blvd	40.4%	1.4%	32.3%	74.10%
PM Peak Hour				
1. Riverside Dr & Neighbours Blvd	0.0%	0.0%	0.0%	0.0 %
2. I-10 WB Ramp & Neighbours Blvd	18.7%	3.6%	15.0%	37.30%
3. I-10 EB Ramp & Neighbours Blvd	25.4%	3.0%	20.4%	48.80%
4. Seeley Ave & Neighbours Blvd	38.9%	1.5%	31.2%	71.60%

Construction traffic would increase delays at intersections, which would impact public transit routes during a.m. and p.m. peak hours however, the with implementation of Traffic Mitigation Measure -1, the Project's contribution to cumulative impacts would be less than significant

Table 8-2 lists the anticipated trips, LOS, and delays of a cumulative scenario without the three solar projects mentioned above (Rio Mesa, Desert Quartzite, and Blythe Solar Power Project); this scenario takes into account the peak construction of the remaining projects. The table also illustrates the anticipated delays and LOS that would occur when 20, 30 and 40 percent, as well as none, of the remaining project trips are staggered to off-peak hours. If no trips were staggered, during the a.m. peak hour, two intersections will operate at LOS B and the other two will operate at an LOS D and E. During the p.m. peak hour, two intersections operate at an LOS B, one intersection operates at LOS C, and the remaining intersection will operate at an LOS F. If 25 percent of the remaining cumulative trips were staggered, all intersections would be operating at an acceptable LOS (LOS B or C), except Intersection 3 (I-10 Eastbound Ramp and Neighbours Boulevard) during the p.m. peak hour which would operate at an LOS E. Of the 768 cumulative trips, the project will contribute 376 trips (48.0 percent) and the Palo Verde Mesa Solar Project will contribute 295 trips (37.7 percent). The vehicles on Neighbours Boulevard turning left headed eastbound onto the 1-10 will experience greater delays, because of northbound vehicles on Neighbours Boulevard. The greatest delay will occur to vehicles coming off the 1-10 freeway headed northbound on Neighbours Boulevard. These vehicles are at stop controlled intersection, and left turn movements are considered critical movements; therefore, they will experience longer delays to find a suitable gap in the traffic to make their turn. In order for

Intersection 3 during the p.m. peak hours to operate at an acceptable LOS, approximately 40 percent of the cumulative traffic trips will need to be staggered to off-peak hours.

Appendix F contains the analysis worksheets for staggered scenarios.

Table 8-2
Cumulative Intersections Without Three Solar Projects and Staggered Trips

Intersection	Trips	Cumulative with Project without Rio Mesa, Desert Quartzite and Blythe Solar							
		0% Staggered Trips		25% Staggered Trips		30% Staggered Trips		40% Staggered Trips	
		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
AM Peak Hour									
1. Riverside Dr & Neighbours Blvd	321	E	40.1	C	22.9	C	20.7	C	17.6
2. I-10 WB Ramp & Neighbours Blvd	874	D	26.2	C	15.1	B	14.1	B	12.6
3. I-10 EB Ramp & Neighbours Blvd	469	B	14.6	B	12.5	B	12.1	B	11.5
4. Seeley Ave & Neighbours Blvd	274	B	10.6	B	10.3	B	10.2	B	10.1
PM Peak Hour									
1. Riverside Dr & Neighbours Blvd	323	B	13.2	B	11.5	B	11.2	B	10.7
2. I-10 WB Ramp & Neighbours Blvd	783	C	20.0	C	15.5	C	14.9	B	13.8
3. I-10 EB Ramp & Neighbours Blvd	768	F	126.5	E	37.2	D	30.8	C	23.4
4. Seeley Ave & Neighbours Blvd	278	B	13.1	B	12.0	B	11.8	B	11.4

Cumulative Impact Mitigation Measures

As described in above, the project will contribute to significant cumulative impacts at all four study intersections, except Intersection 1 during the a.m. peak hour. If the three solar projects are not constructed, the project will contribute significant cumulative impacts at Intersection 2 during the a.m. peak hour and Intersection 3 during the p.m. peak hour. With implementation of Traffic Mitigation Measures 1 through 3, the proposed project's temporary significant cumulative impacts from project construction will be minimized to less than significant levels.

Traffic Mitigation Measure-1

The Project owner will develop and implement a construction phase Traffic Management Plan (TMP) in consultation with Bureau of Land Management (BLM), Caltrans, County of Riverside, and City of Blythe for the roadway network potentially affected by construction activities at the Project site and offsite linear facilities. The Traffic Management Plan will include a plan to split the workforce and stagger arrival times during peak construction periods and a traffic LOS and queue monitoring program. Other approaches could be considered such as requiring contractors to arrange employee busing, park and ride, carpooling, etc. that achieve similar substantial reductions in peak hour traffic.

Traffic Mitigation Measure-2

The Project owner will conduct construction activities in accordance with Caltrans and other applicable limitations on vehicle sizes and weights, Construction Excavation Permits obtained from the Riverside County, Encroachment Permits from Caltrans, as well as permits and licenses from the California Highway Patrol and Caltrans for the transport of hazardous substances.

Traffic Mitigation Measure-3

The Project owner will coordinate with applicable traffic management agencies (e.g., Caltrans, Riverside County, and City of Blythe) as well as California Energy Commission (CEC) Compliance Project Manger (CPM) and BLM representative, and as appropriate and necessary, with other proponents of renewable energy project in the I-10 corridor, to address issues related to cumulative traffic associated with the possible concurrent construction of several large projects with large work forces for a few years beginning roughly in 2012.

With implementation of mitigation measures stated above, impacts to traffic and transportation would be minimized. Implementation of Traffic Mitigation Measure-1 (Traffic Management Plan) would reduce impacts from the proposed Project. Implementation of Mitigation Measure Traffic-3 (coordinate the construction traffic schedules from multiple large-scale generation projects) would further reduce the impacts to traffic and transportation.

Therefore, the Project's contribution show in Table 8.1 below towards temporary significant cumulative impacts during Project construction would be reduced at the four intersections to less than significant levels.

Operation and Maintenance

The operational project impacts are expected to be nominal (12 permanent full-time employees). Based on this analysis, the project construction and project itself are not expected to have long term significant traffic impacts on the transportation network. Construction related impacts are considered temporary during construction phases and LOS will be restored back to preconstruction conditions once the construction phase is completed. No road closures are anticipated for the Project; however, Seeley Avenue and Riverside Drive would be improved for emergency vehicle access.

Decommissioning

Decommissioning impacts from the Project would have similar impacts as construction. It is very unlikely that decommissioning of all cumulative projects would occur at the same time; however, it is assumed that decommissioning impacts from the cumulative projects would be similar to construction, but would be less intense and of a shorter duration. Therefore, the Project would not result in cumulatively considerable significant impacts.

Residual Impacts After Mitigation

With implementation of the Traffic Mitigation Measures-1 through-3, impacts to traffic would be reduced to a less than significant level.

References

California Energy Commission large Solar Energy Projects

Available at: http://www.energy.ca.gov/siting/solar/

US Department of the Interior Bureau of Land Management Project List

Available at: http://www.blm.gov/wo/st/en/prog/energy/solar_energy.html

Riverside County Transportation Department, 2011. Congestion Management Program

Riverside County General Plan, 2008. General Plan Circulation Element

Caltrans, 2002. Guide for the preparation of traffic impact studies,

Available at: http://www.dot.ca.gov/hq/tpp/offices/ocp/igr_ceqa_files/tisguide.pdf

Palo Verde Unified School District, Ben Tackett – Transportation Supervisor.

http://www.pvusd.us/

National Research Council, Transportation Research Board, 2000. Highway Capacity Manual

Palo Verde Valley Transit Agency, Route http://pvvta.com/ Maps. Available at : http://pvvta.com/

Riverside County Transportation Department, 2008. Traffic Impact Analysis Preparation Guide

Available at:
http://www.tlma.co.riverside.ca.us/trans/documents/pamphlets/traffic_impact_anaylsis.pdf

San Bernardino County CMP, 2005 Update. Appendix C: Guidelines for CMP Traffic Impact Analysis in San Bernardino County

Available at: http://www.sanbag.ca.gov/planning/cmp/cmp_app-c_02-09.pdf

Prepared By:

KOA Corporation

Principal in Charge: Mujib Ahmed, Principal Engineer

Project Manager: Arnold Torma, Principal Engineer

Supporting Staff: Roger Pelayo, Assistant Transportation Planner

APPENDIX A
TRAFFIC COUNT DATA

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

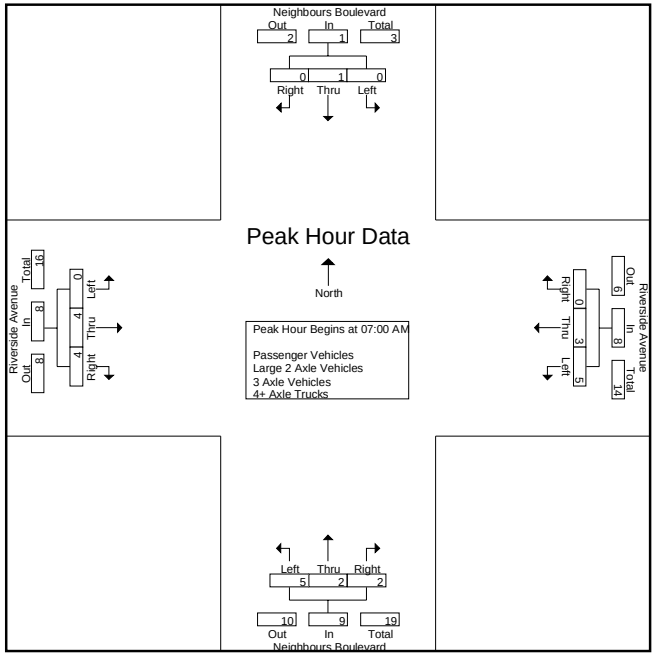
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	1	0	1	2	1	0	3	0	0	0	0	0	0	1	1	5
07:15 AM	0	0	0	0	2	0	0	2	1	1	1	3	0	1	0	1	6
07:30 AM	0	0	0	0	0	2	0	2	3	1	1	5	0	2	2	4	11
07:45 AM	0	0	0	0	1	0	0	1	1	0	0	1	0	1	1	2	4
Total	0	1	0	1	5	3	0	8	5	2	2	9	0	4	4	8	26
08:00 AM	0	0	0	0	1	0	0	1	1	0	1	2	0	0	0	0	3
08:15 AM	0	1	0	1	1	0	0	1	0	0	0	0	0	1	1	2	4
08:30 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	2
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	2	0	0	2	1	0	2	3	0	1	2	3	9
Grand Total	0	2	0	2	7	3	0	10	6	2	4	12	0	5	6	11	35
Apprch %	0	100	0		70	30	0		50	16.7	33.3		0	45.5	54.5		
Total %	0	5.7	0	5.7	20	8.6	0	28.6	17.1	5.7	11.4	34.3	0	14.3	17.1	31.4	
Passenger Vehicles	0	2	0	2	7	2	0	9	4	2	3	9	0	4	4	8	28
% Passenger Vehicles	0	100	0	100	100	66.7	0	90	66.7	100	75	75	0	80	66.7	72.7	80
Large 2 Axle Vehicles	0	0	0	0	0	0	0	0	2	0	0	2	0	1	1	2	4
% Large 2 Axle Vehicles	0	0	0	0	0	0	0	0	33.3	0	0	16.7	0	20	16.7	18.2	11.4
3 Axle Vehicles	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
% 3 Axle Vehicles	0	0	0	0	0	33.3	0	10	0	0	25	8.3	0	0	16.7	9.1	8.6
4+ Axle Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% 4+ Axle Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	**1**	0	**1**	**2**	1	0	**3**	0	0	0	0	0	0	1	1	5
07:15 AM	0	0	0	0	2	0	0	2	1	**1**	**1**	3	0	1	0	1	6
07:30 AM	0	0	0	0	0	**2**	0	2	**3**	1	1	**5**	0	**2**	**2**	**4**	**11**
07:45 AM	0	0	0	0	1	0	0	1	1	0	0	1	0	1	1	2	4
Total Volume	0	1	0	1	5	3	0	8	5	2	2	9	0	4	4	8	26
% App. Total	0	100	0		62.5	37.5	0		55.6	22.2	22.2		0	50	50		
PHF	.000	.250	.000	.250	.625	.375	.000	.667	.417	.500	.500	.450	.000	.500	.500	.500	.591

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:15 AM				07:00 AM			
+0 mins.	0	**1**	0	**1**	**2**	1	0	**3**	1	**1**	**1**	3	0	0	1	1
+15 mins.	0	0	0	0	2	0	0	2	**3**	1	1	**5**	0	1	0	1
+30 mins.	0	0	0	0	0	**2**	0	2	1	0	0	1	0	**2**	**2**	**4**
+45 mins.	0	0	0	0	1	0	0	1	1	0	1	2	0	1	1	2
Total Volume	0	1	0	1	5	3	0	8	6	2	3	11	0	4	4	8
% App. Total	0	100	0		62.5	37.5	0		54.5	18.2	27.3		0	50	50	
PHF	.000	.250	.000	.250	.625	.375	.000	.667	.500	.500	.750	.550	.000	.500	.500	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

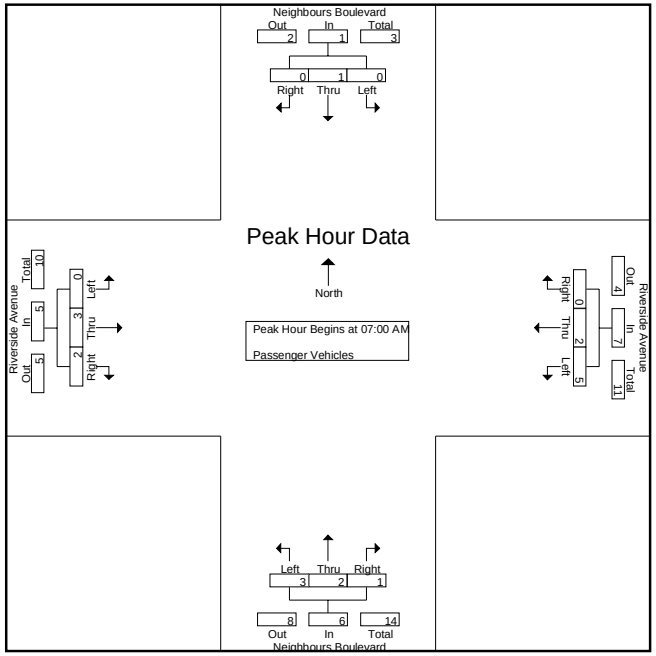
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	1	0	1	2	1	0	3	0	0	0	0	0	0	1	1	5
07:15 AM	0	0	0	0	2	0	0	2	1	1	0	2	0	1	0	1	5
07:30 AM	0	0	0	0	0	1	0	1	2	1	1	4	0	1	0	1	6
07:45 AM	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	2	3
Total	0	1	0	1	5	2	0	7	3	2	1	6	0	3	2	5	19
08:00 AM	0	0	0	0	1	0	0	1	1	0	1	2	0	0	0	0	3
08:15 AM	0	1	0	1	1	0	0	1	0	0	0	0	0	1	1	2	4
08:30 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	2
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	2	0	0	2	1	0	2	3	0	1	2	3	9
Grand Total	0	2	0	2	7	2	0	9	4	2	3	9	0	4	4	8	28
Apprch %	0	100	0		77.8	22.2	0		44.4	22.2	33.3		0	50	50		
Total %	0	7.1	0	7.1	25	7.1	0	32.1	14.3	7.1	10.7	32.1	0	14.3	14.3	28.6	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	**1**	0	**1**	**2**	**1**	0	**3**	0	0	0	0	0	0	**1**	1	5
07:15 AM	0	0	0	0	2	0	0	2	1	**1**	0	2	0	**1**	0	1	5
07:30 AM	0	0	0	0	0	1	0	1	**2**	1	**1**	**4**	0	1	0	1	**6**
07:45 AM	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	**2**	3
Total Volume	0	1	0	1	5	2	0	7	3	2	1	6	0	3	2	5	19
% App. Total	0	100	0		71.4	28.6	0		50	33.3	16.7		0	60	40		
PHF	.000	.250	.000	.250	.625	.500	.000	.583	.375	.500	.250	.375	.000	.750	.500	.625	.792

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	**1**	0	**1**	**2**	**1**	0	**3**	0	0	0	0	0	0	**1**	1
+15 mins.	0	0	0	0	2	0	0	2	1	**1**	0	2	0	**1**	0	1
+30 mins.	0	0	0	0	0	1	0	1	**2**	1	**1**	**4**	0	1	0	1
+45 mins.	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	**2**
Total Volume	0	1	0	1	5	2	0	7	3	2	1	6	0	3	2	5
% App. Total	0	100	0		71.4	28.6	0		50	33.3	16.7		0	60	40	
PHF	.000	.250	.000	.250	.625	.500	.000	.583	.375	.500	.250	.375	.000	.750	.500	.625

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

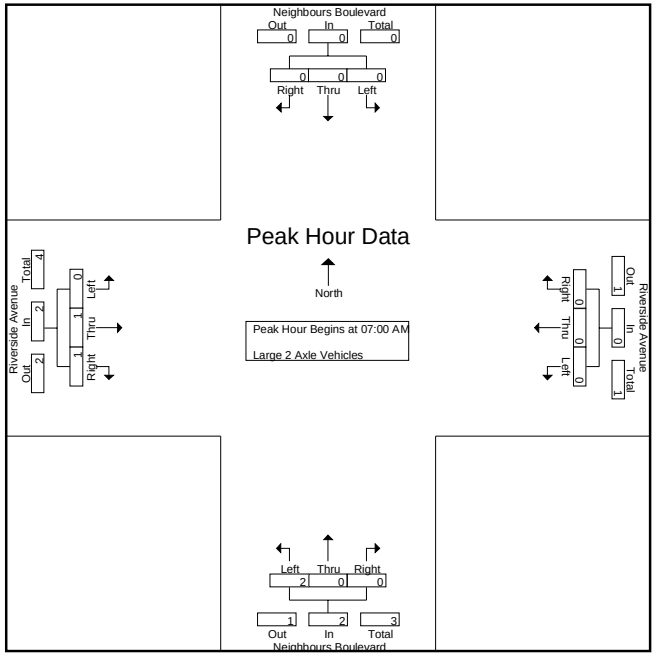
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	2	3
07:45 AM	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1
Total	0	0	0	0	0	0	0	0	2	0	0	2	0	1	1	2	4
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	2	0	0	2	0	1	1	2	4
Apprch %	0	0	0		0	0	0		100	0	0		0	50	50		
Total %	0	0	0	0	0	0	0	0	50	0	0	50	0	25	25	50	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	**1**	0	0	**1**	0	**1**	**1**	**2**	**3**
07:45 AM	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1
Total Volume	0	0	0	0	0	0	0	0	2	0	0	2	0	1	1	2	4
% App. Total	0	0	0		0	0	0		100	0	0		0	50	50		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.500	.000	.000	.500	.000	.250	.250	.250	.333

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	**1**	0	0	**1**	0	**1**	**1**	**2**
+45 mins.	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	2	0	0	2	0	1	1	2
% App. Total	0	0	0		0	0	0		100	0	0		0	50	50	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.500	.000	.000	.500	.000	.250	.250	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

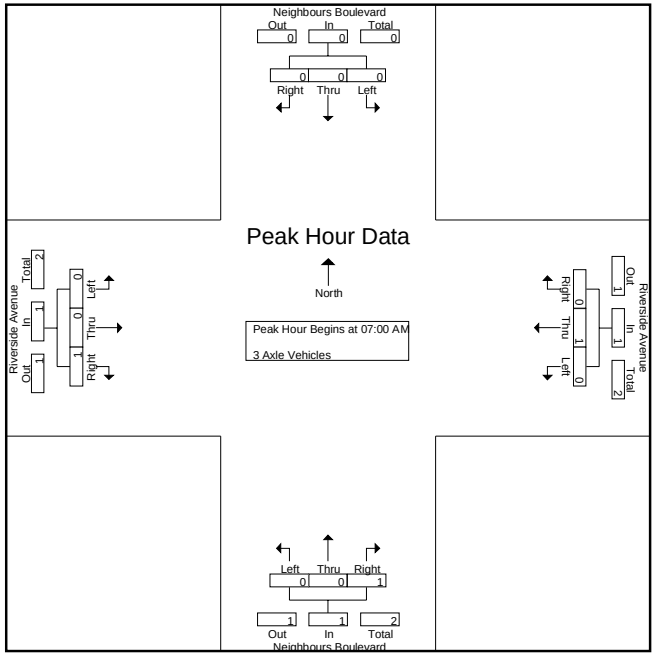
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
07:30 AM	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
Apprch %	0	0	0		0	100	0		0	0	100		0	0	100		
Total %	0	0	0	0	0	33.3	0	33.3	0	0	33.3	33.3	0	0	33.3	33.3	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0	0	0	1
07:30 AM	0	0	0	0	0	**1**	0	**1**	0	0	0	0	0	0	**1**	**1**	**2**
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
% App. Total	0	0	0		0	100	0		0	0	100		0	0	100		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.250	.250	.000	.000	.250	.250	.375

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0	0	0
+30 mins.	0	0	0	0	0	**1**	0	**1**	0	0	0	0	0	0	**1**	**1**
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1
% App. Total	0	0	0		0	100	0		0	0	100		0	0	100	
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.250	.250	.000	.000	.250	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

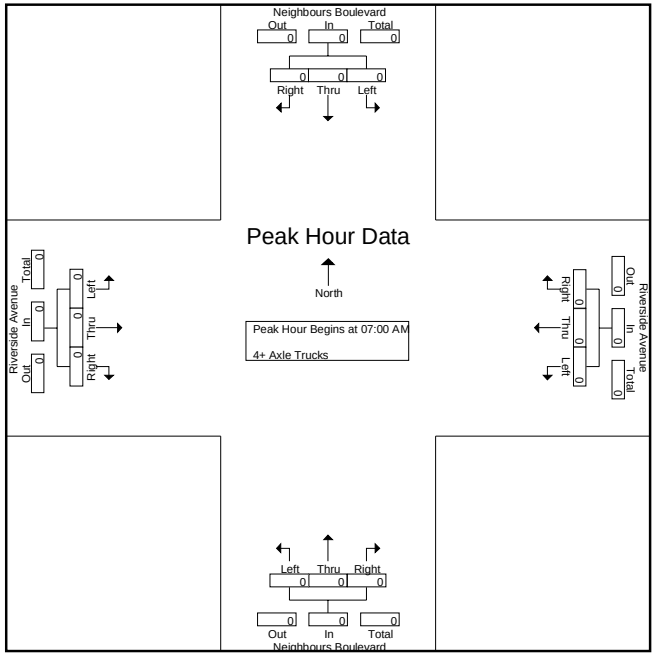
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0		
Total %																	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

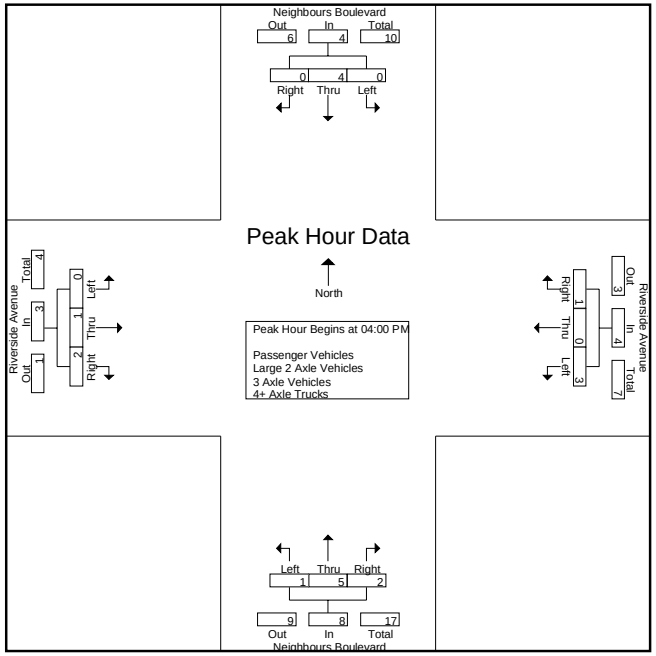
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	1	0	1	1	0	0	1	0	1	1	2	0	0	1	1	5
04:15 PM	0	3	0	3	0	0	1	1	1	1	0	2	0	0	1	1	7
04:30 PM	0	0	0	0	2	0	0	2	0	3	0	3	0	1	0	1	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total	0	4	0	4	3	0	1	4	1	5	2	8	0	1	2	3	19
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
05:15 PM	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
05:30 PM	0	2	0	2	0	1	0	1	1	1	0	2	0	0	1	1	6
05:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
Total	0	3	0	3	0	2	0	2	1	1	1	3	0	0	3	3	11
Grand Total	0	7	0	7	3	2	1	6	2	6	3	11	0	1	5	6	30
Apprch %	0	100	0		50	33.3	16.7		18.2	54.5	27.3		0	16.7	83.3		
Total %	0	23.3	0	23.3	10	6.7	3.3	20	6.7	20	10	36.7	0	3.3	16.7	20	
Passenger Vehicles	0	7	0	7	3	2	1	6	2	6	3	11	0	1	5	6	30
% Passenger Vehicles	0	100	0	100	100	100	100	100	100	100	100	100	0	100	100	100	100
Large 2 Axle Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Large 2 Axle Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Axle Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% 3 Axle Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4+ Axle Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% 4+ Axle Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	1	0	1	1	0	0	1	0	1	**1**	2	0	0	**1**	**1**	5
04:15 PM	0	**3**	0	**3**	0	0	**1**	1	**1**	1	0	2	0	0	1	1	**7**
04:30 PM	0	0	0	0	**2**	0	0	**2**	0	**3**	0	**3**	0	**1**	0	1	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total Volume	0	4	0	4	3	0	1	4	1	5	2	8	0	1	2	3	19
% App. Total	0	100	0		75	0	25		12.5	62.5	25		0	33.3	66.7		
PHF	.000	.333	.000	.333	.375	.000	.250	.500	.250	.417	.500	.667	.000	.250	.500	.750	.679

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	1	0	1	1	0	0	1	0	1	**1**	2	0	0	**1**	**1**
+15 mins.	0	**3**	0	**3**	0	0	**1**	1	**1**	1	0	2	0	0	1	1
+30 mins.	0	0	0	0	**2**	0	0	**2**	0	**3**	0	**3**	0	**1**	0	1
+45 mins.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Total Volume	0	4	0	4	3	0	1	4	1	5	2	8	0	1	2	3
% App. Total	0	100	0		75	0	25		12.5	62.5	25		0	33.3	66.7	
PHF	.000	.333	.000	.333	.375	.000	.250	.500	.250	.417	.500	.667	.000	.250	.500	.750

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

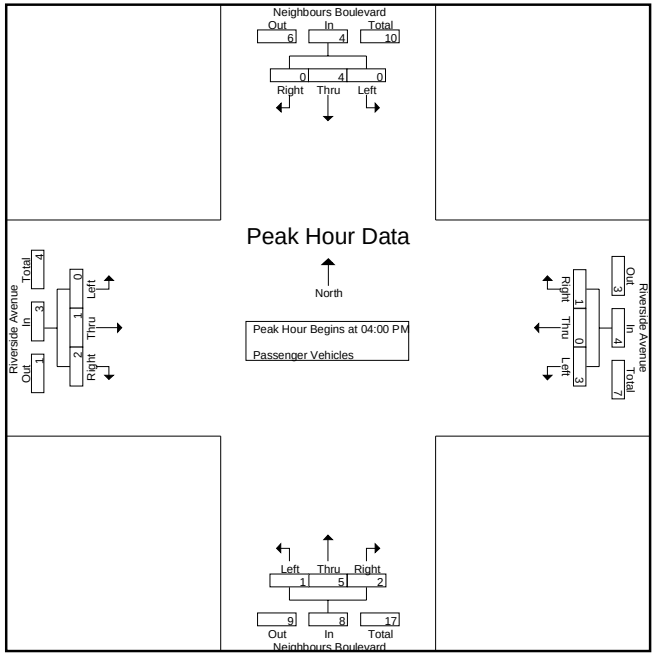
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	1	0	1	1	0	0	1	0	1	1	2	0	0	1	1	5
04:15 PM	0	3	0	3	0	0	1	1	1	1	0	2	0	0	1	1	7
04:30 PM	0	0	0	0	2	0	0	2	0	3	0	3	0	1	0	1	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total	0	4	0	4	3	0	1	4	1	5	2	8	0	1	2	3	19
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
05:15 PM	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
05:30 PM	0	2	0	2	0	1	0	1	1	1	0	2	0	0	1	1	6
05:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
Total	0	3	0	3	0	2	0	2	1	1	1	3	0	0	3	3	11
Grand Total	0	7	0	7	3	2	1	6	2	6	3	11	0	1	5	6	30
Apprch %	0	100	0		50	33.3	16.7		18.2	54.5	27.3		0	16.7	83.3		
Total %	0	23.3	0	23.3	10	6.7	3.3	20	6.7	20	10	36.7	0	3.3	16.7	20	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	1	0	1	1	0	0	1	0	1	**1**	2	0	0	**1**	**1**	5
04:15 PM	0	**3**	0	**3**	0	0	**1**	1	**1**	1	0	2	0	0	1	1	**7**
04:30 PM	0	0	0	0	**2**	0	0	**2**	0	**3**	0	**3**	0	**1**	0	1	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total Volume	0	4	0	4	3	0	1	4	1	5	2	8	0	1	2	3	19
% App. Total	0	100	0		75	0	25		12.5	62.5	25		0	33.3	66.7		
PHF	.000	.333	.000	.333	.375	.000	.250	.500	.250	.417	.500	.667	.000	.250	.500	.750	.679

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	1	0	1	1	0	0	1	0	1	**1**	2	0	0	**1**	**1**
+15 mins.	0	**3**	0	**3**	0	0	**1**	1	**1**	1	0	2	0	0	1	1
+30 mins.	0	0	0	0	**2**	0	0	**2**	0	**3**	0	**3**	0	**1**	0	1
+45 mins.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Total Volume	0	4	0	4	3	0	1	4	1	5	2	8	0	1	2	3
% App. Total	0	100	0		75	0	25		12.5	62.5	25		0	33.3	66.7	
PHF	.000	.333	.000	.333	.375	.000	.250	.500	.250	.417	.500	.667	.000	.250	.500	.750

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

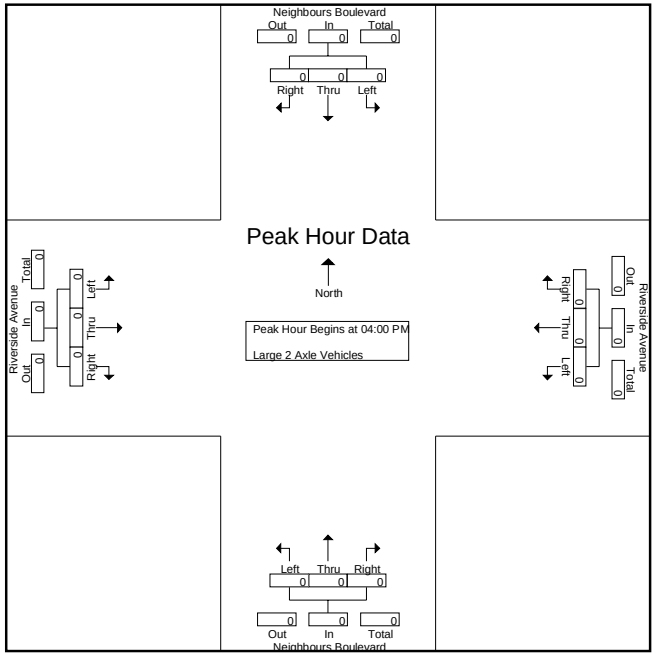
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0		
Total %																	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

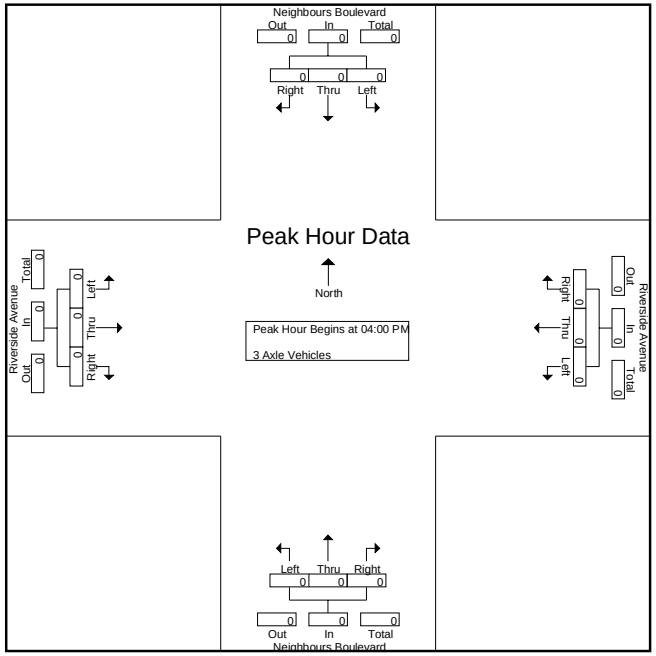
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0		
Total %																	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

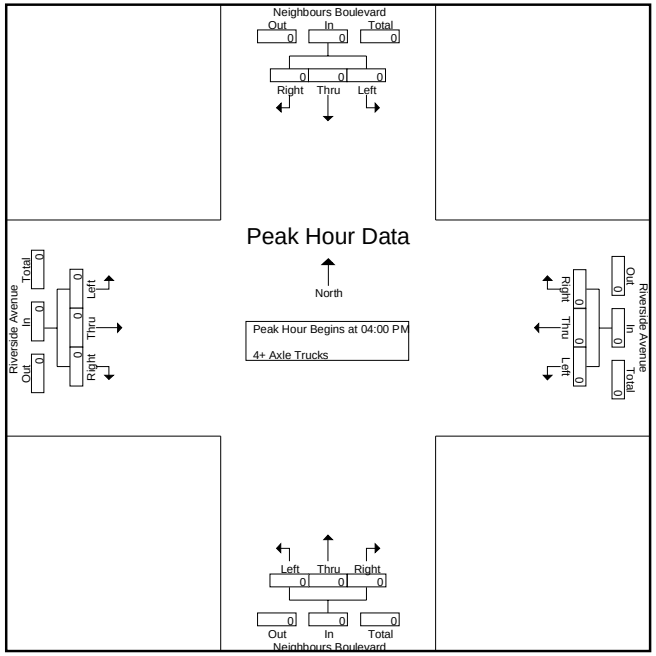
	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apprch %	0	0	0		0	0	0		0	0	0		0	0	0		
Total %																	

	Neighbours Boulevard Southbound				Riverside Avenue Westbound				Neighbours Boulevard Northbound				Riverside Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Riverside Avenue
Weather: Sunny

File Name : CRVNERIPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	1	0	2	1	0	0	0	0	0	0	1
07:15 AM	0	0	0	2	0	0	1	1	0	0	1	0
07:30 AM	0	0	0	0	1	0	2	1	1	0	1	0
07:45 AM	0	0	0	1	0	0	0	0	0	0	1	1
08:00 AM	0	0	0	1	0	0	1	0	1	0	0	0
08:15 AM	0	1	0	1	0	0	0	0	0	0	1	1
08:30 AM	0	0	0	0	0	0	0	0	1	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:00 AM	0	1	0	5	2	0	3	2	1	0	3	2

SUMMARY WITH PCE

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Hour 07:00 AM	0	1	0	5	4	0	6	2	3	0	5	6

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	1	0	0	0	1	1
07:45 AM	0	0	0	0	0	0	1	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:00 AM	0	0	0	0	0	0	2	0	0	0	1	1
PCE 1.5	0	0	0	0	0	0	3	0	0	0	2	2

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	1	0	0	0
07:30 AM	0	0	0	0	1	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:00 AM	0	0	0	0	1	0	0	0	1	0	0	1
PCE 2.0	0	0	0	0	2	0	0	0	2	0	0	2

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
PCE 3.0	0	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	1	0	1	0	0	0	1	1	0	0	1
04:15 PM	0	3	0	0	0	1	1	1	0	0	0	1
04:30 PM	0	0	0	2	0	0	0	3	0	0	1	0
04:45 PM	0	0	0	0	0	0	0	0	1	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	2
05:15 PM	0	1	0	0	0	0	0	0	1	0	0	0
05:30 PM	0	2	0	0	1	0	1	1	0	0	0	1
05:45 PM	0	0	0	0	1	0	0	0	0	0	0	0
Peak Hour 04:00 PM	0	4	0	3	0	1	1	5	2	0	1	2

SUMMARY WITH PCE

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Hour 04:00 PM	0	4	0	3	0	1	1	5	2	0	1	2

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
PCE 1.5	0	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
PCE 2.0	0	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNERIPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Riverside Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Riverside Avenue Westbound			Neighbours Boulevard Northbound			Riverside Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
PCE 3.0	0	0	0	0	0	0	0	0	0	0	0	0

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

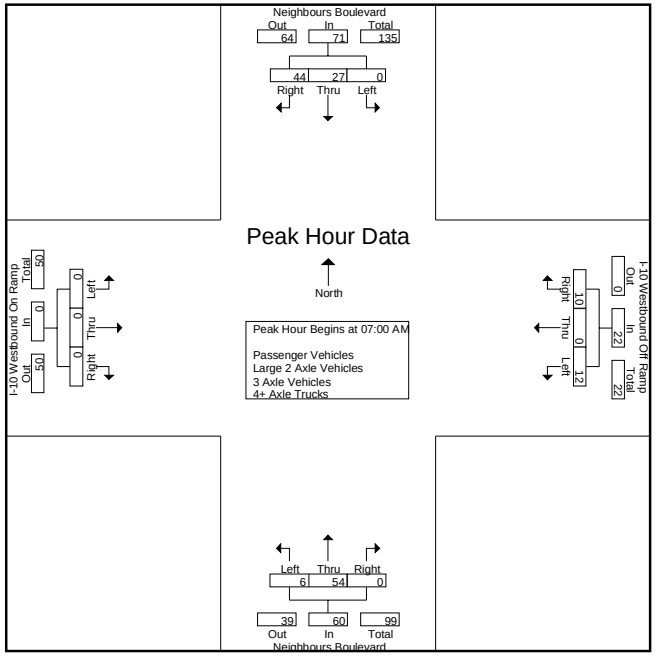
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	6	8	14	2	0	3	5	0	14	0	14	0	0	0	0	33
07:15 AM	0	8	16	24	2	0	3	5	1	13	0	14	0	0	0	0	43
07:30 AM	0	9	14	23	3	0	3	6	5	15	0	20	0	0	0	0	49
07:45 AM	0	4	6	10	5	0	1	6	0	12	0	12	0	0	0	0	28
Total	0	27	44	71	12	0	10	22	6	54	0	60	0	0	0	0	153
08:00 AM	0	5	7	12	7	2	1	10	0	5	0	5	0	0	0	0	27
08:15 AM	0	8	3	11	7	0	2	9	7	5	0	12	0	0	0	0	32
08:30 AM	0	9	1	10	6	0	1	7	0	8	0	8	0	0	0	0	25
08:45 AM	0	6	1	7	2	0	1	3	2	9	0	11	0	0	0	0	21
Total	0	28	12	40	22	2	5	29	9	27	0	36	0	0	0	0	105
Grand Total	0	55	56	111	34	2	15	51	15	81	0	96	0	0	0	0	258
Apprch %	0	49.5	50.5		66.7	3.9	29.4		15.6	84.4	0		0	0	0		
Total %	0	21.3	21.7	43	13.2	0.8	5.8	19.8	5.8	31.4	0	37.2	0	0	0	0	
Passenger Vehicles	0	48	50	98	26	1	12	39	6	74	0	80	0	0	0	0	217
% Passenger Vehicles	0	87.3	89.3	88.3	76.5	50	80	76.5	40	91.4	0	83.3	0	0	0	0	84.1
Large 2 Axle Vehicles	0	3	4	7	3	0	2	5	2	1	0	3	0	0	0	0	15
% Large 2 Axle Vehicles	0	5.5	7.1	6.3	8.8	0	13.3	9.8	13.3	1.2	0	3.1	0	0	0	0	5.8
3 Axle Vehicles	0	1	0	1	0	0	0	0	0	2	0	2	0	0	0	0	3
% 3 Axle Vehicles	0	1.8	0	0.9	0	0	0	0	0	2.5	0	2.1	0	0	0	0	1.2
4+ Axle Trucks	0	3	2	5	5	1	1	7	7	4	0	11	0	0	0	0	23
% 4+ Axle Trucks	0	5.5	3.6	4.5	14.7	50	6.7	13.7	46.7	4.9	0	11.5	0	0	0	0	8.9

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	6	8	14	2	0	**3**	5	0	14	0	14	0	0	0	0	33
07:15 AM	0	8	**16**	**24**	2	0	3	5	1	13	0	14	0	0	0	0	43
07:30 AM	0	**9**	14	23	3	0	3	**6**	**5**	**15**	0	**20**	0	0	0	0	**49**
07:45 AM	0	4	6	10	**5**	0	1	6	0	12	0	12	0	0	0	0	28
Total Volume	0	27	44	71	12	0	10	22	6	54	0	60	0	0	0	0	153
% App. Total	0	38	62		54.5	0	45.5		10	90	0		0	0	0		
PHF	.000	.750	.688	.740	.600	.000	.833	.917	.300	.900	.000	.750	.000	.000	.000	.000	.781

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:45 AM				07:00 AM				07:00 AM			
+0 mins.	0	6	8	14	5	0	1	6	0	14	0	14	0	0	0	0
+15 mins.	0	8	**16**	**24**	**7**	**2**	1	**10**	1	13	0	14	0	0	0	0
+30 mins.	0	**9**	14	23	7	0	**2**	9	**5**	**15**	0	**20**	0	0	0	0
+45 mins.	0	4	6	10	6	0	1	7	0	12	0	12	0	0	0	0
Total Volume	0	27	44	71	25	2	5	32	6	54	0	60	0	0	0	0
% App. Total	0	38	62		78.1	6.2	15.6		10	90	0		0	0	0	
PHF	.000	.750	.688	.740	.893	.250	.625	.800	.300	.900	.000	.750	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

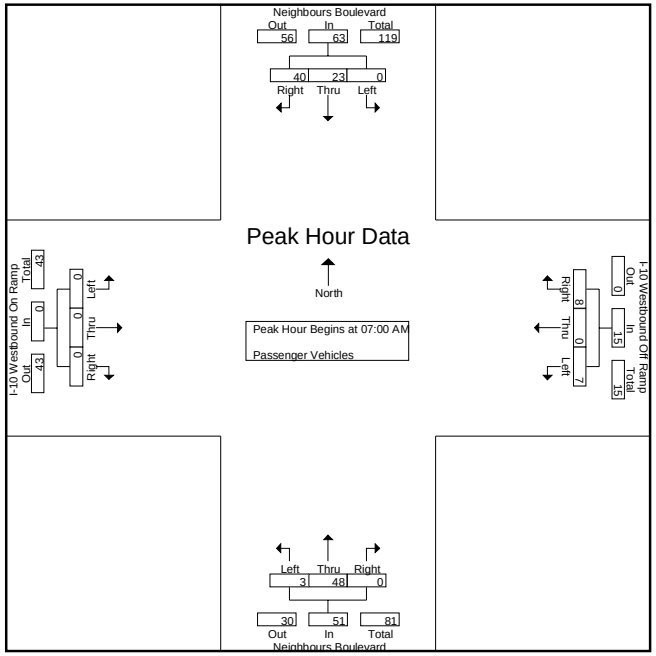
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	6	8	14	2	0	2	4	0	12	0	12	0	0	0	0	30
07:15 AM	0	6	13	19	1	0	2	3	1	11	0	12	0	0	0	0	34
07:30 AM	0	7	14	21	2	0	3	5	2	14	0	16	0	0	0	0	42
07:45 AM	0	4	5	9	2	0	1	3	0	11	0	11	0	0	0	0	23
Total	0	23	40	63	7	0	8	15	3	48	0	51	0	0	0	0	129
08:00 AM	0	5	7	12	5	1	1	7	0	5	0	5	0	0	0	0	24
08:15 AM	0	7	2	9	7	0	1	8	3	5	0	8	0	0	0	0	25
08:30 AM	0	8	1	9	6	0	1	7	0	8	0	8	0	0	0	0	24
08:45 AM	0	5	0	5	1	0	1	2	0	8	0	8	0	0	0	0	15
Total	0	25	10	35	19	1	4	24	3	26	0	29	0	0	0	0	88
Grand Total	0	48	50	98	26	1	12	39	6	74	0	80	0	0	0	0	217
Apprch %	0	49	51		66.7	2.6	30.8		7.5	92.5	0		0	0	0		
Total %	0	22.1	23	45.2	12	0.5	5.5	18	2.8	34.1	0	36.9	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	6	8	14	**2**	0	2	4	0	12	0	12	0	0	0	0	30
07:15 AM	0	6	13	19	1	0	2	3	1	11	0	12	0	0	0	0	34
07:30 AM	0	**7**	**14**	**21**	2	0	**3**	**5**	**2**	**14**	0	**16**	0	0	0	0	**42**
07:45 AM	0	4	5	9	2	0	1	3	0	11	0	11	0	0	0	0	23
Total Volume	0	23	40	63	7	0	8	15	3	48	0	51	0	0	0	0	129
% App. Total	0	36.5	63.5		46.7	0	53.3		5.9	94.1	0		0	0	0		
PHF	.000	.821	.714	.750	.875	.000	.667	.750	.375	.857	.000	.797	.000	.000	.000	.000	.768

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	6	8	14	**2**	0	2	4	0	12	0	12	0	0	0	0
+15 mins.	0	6	13	19	1	0	2	3	1	11	0	12	0	0	0	0
+30 mins.	0	**7**	**14**	**21**	2	0	**3**	**5**	**2**	**14**	0	**16**	0	0	0	0
+45 mins.	0	4	5	9	2	0	1	3	0	11	0	11	0	0	0	0
Total Volume	0	23	40	63	7	0	8	15	3	48	0	51	0	0	0	0
% App. Total	0	36.5	63.5		46.7	0	53.3		5.9	94.1	0		0	0	0	
PHF	.000	.821	.714	.750	.875	.000	.667	.750	.375	.857	.000	.797	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

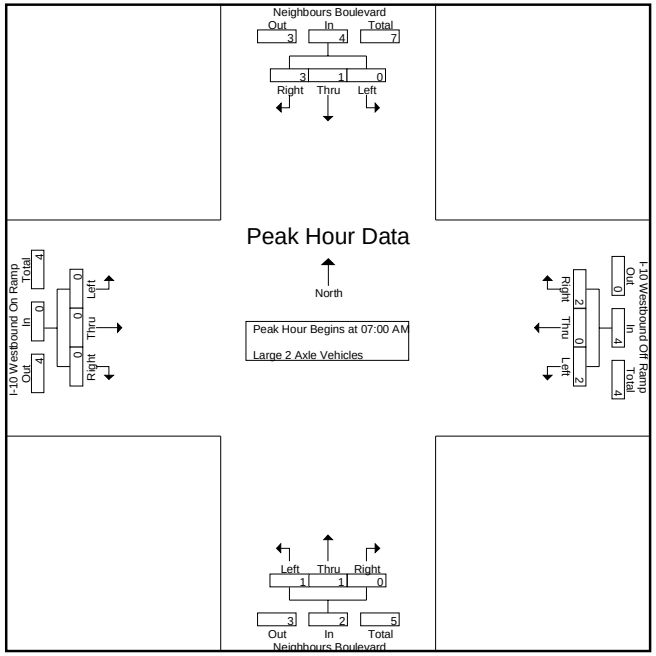
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	2
07:15 AM	0	1	3	4	1	0	1	2	0	0	0	0	0	0	0	0	6
07:30 AM	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	3	4	2	0	2	4	1	1	0	2	0	0	0	0	10
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	1	1	2	0	0	0	0	1	0	0	1	0	0	0	0	3
08:30 AM	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
08:45 AM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Total	0	2	1	3	1	0	0	1	1	0	0	1	0	0	0	0	5
Grand Total	0	3	4	7	3	0	2	5	2	1	0	3	0	0	0	0	15
Apprch %	0	42.9	57.1		60	0	40		66.7	33.3	0		0	0	0		
Total %	0	20	26.7	46.7	20	0	13.3	33.3	13.3	6.7	0	20	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	**1**	1	0	**1**	0	**1**	0	0	0	0	2
07:15 AM	0	**1**	**3**	**4**	**1**	0	1	**2**	0	0	0	0	0	0	0	0	**6**
07:30 AM	0	0	0	0	1	0	0	1	**1**	0	0	1	0	0	0	0	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	3	4	2	0	2	4	1	1	0	2	0	0	0	0	10
% App. Total	0	25	75		50	0	50		50	50	0		0	0	0		
PHF	.000	.250	.250	.250	.500	.000	.500	.500	.250	.250	.000	.500	.000	.000	.000	.000	.417

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	0	0	0	0	0	**1**	1	0	**1**	0	**1**	0	0	0	0
+15 mins.	0	**1**	**3**	**4**	**1**	0	1	**2**	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	1	0	0	1	**1**	0	0	1	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	3	4	2	0	2	4	1	1	0	2	0	0	0	0
% App. Total	0	25	75		50	0	50		50	50	0		0	0	0	
PHF	.000	.250	.250	.250	.500	.000	.500	.500	.250	.250	.000	.500	.000	.000	.000	.000

AR062077

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

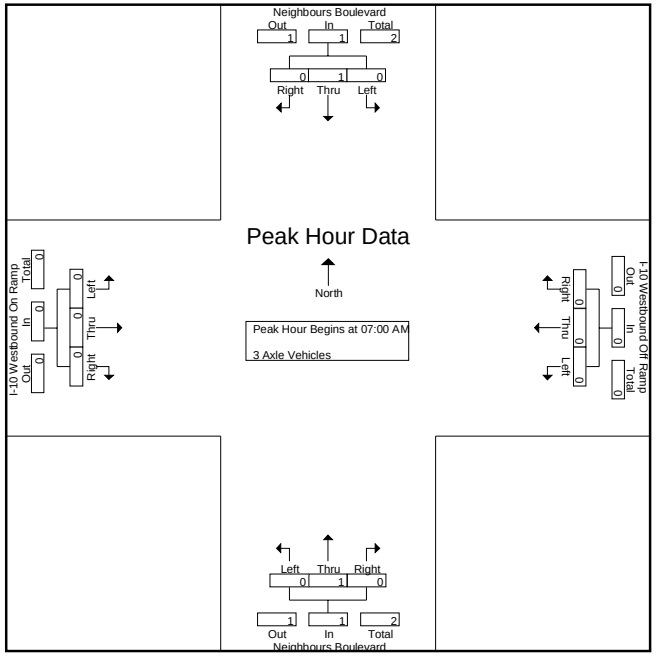
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
07:30 AM	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
Total	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
Grand Total	0	1	0	1	0	0	0	0	0	2	0	2	0	0	0	0	3
Apprch %	0	100	0		0	0	0		0	100	0		0	0	0		
Total %	0	33.3	0	33.3	0	0	0	0	0	66.7	0	66.7	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	**1**	0	**1**	0	0	0	0	**1**
07:30 AM	0	**1**	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	**1**	0	**1**	0	0	0	0
+30 mins.	0	**1**	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0	
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

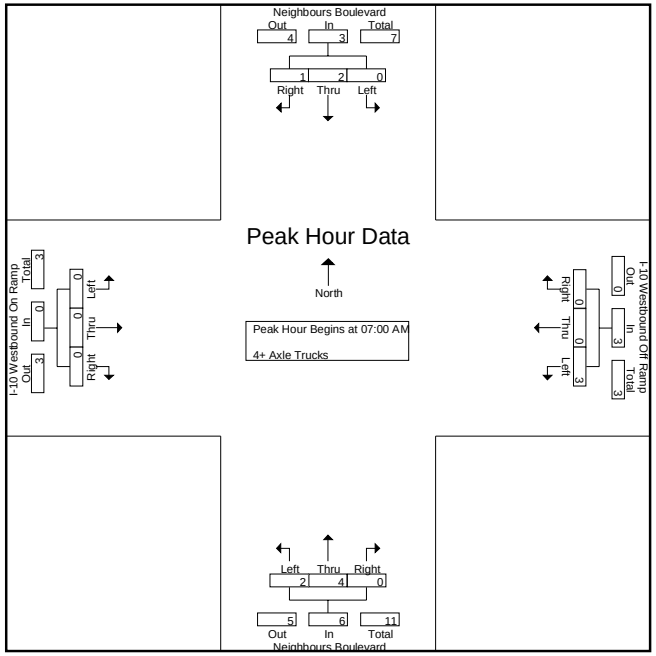
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
07:15 AM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
07:30 AM	0	1	0	1	0	0	0	0	2	1	0	3	0	0	0	0	4
07:45 AM	0	0	1	1	3	0	0	3	0	1	0	1	0	0	0	0	5
Total	0	2	1	3	3	0	0	3	2	4	0	6	0	0	0	0	12
08:00 AM	0	0	0	0	2	1	0	3	0	0	0	0	0	0	0	0	3
08:15 AM	0	0	0	0	0	0	1	1	3	0	0	3	0	0	0	0	4
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	1	1	2	0	0	0	0	2	0	0	2	0	0	0	0	4
Total	0	1	1	2	2	1	1	4	5	0	0	5	0	0	0	0	11
Grand Total	0	3	2	5	5	1	1	7	7	4	0	11	0	0	0	0	23
Apprch %	0	60	40		71.4	14.3	14.3		63.6	36.4	0		0	0	0		
Total %	0	13	8.7	21.7	21.7	4.3	4.3	30.4	30.4	17.4	0	47.8	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	0	0	0	0	0	0	0	0	0	**1**	0	1	0	0	0	0	1
07:15 AM	0	**1**	0	**1**	0	0	0	0	0	1	0	1	0	0	0	0	2
07:30 AM	0	1	0	1	0	0	0	0	**2**	1	0	**3**	0	0	0	0	4
07:45 AM	0	0	**1**	1	**3**	0	0	**3**	0	1	0	1	0	0	0	0	**5**
Total Volume	0	2	1	3	3	0	0	3	2	4	0	6	0	0	0	0	12
% App. Total	0	66.7	33.3		100	0	0		33.3	66.7	0		0	0	0		
PHF	.000	.500	.250	.750	.250	.000	.000	.250	.250	1.000	.000	.500	.000	.000	.000	.000	.600

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 07:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:00 AM				07:00 AM				07:00 AM				07:00 AM			
+0 mins.	0	0	0	0	0	0	0	0	0	**1**	0	1	0	0	0	0
+15 mins.	0	**1**	0	**1**	0	0	0	0	0	1	0	1	0	0	0	0
+30 mins.	0	1	0	1	0	0	0	0	**2**	1	0	**3**	0	0	0	0
+45 mins.	0	0	**1**	1	**3**	0	0	**3**	0	1	0	1	0	0	0	0
Total Volume	0	2	1	3	3	0	0	3	2	4	0	6	0	0	0	0
% App. Total	0	66.7	33.3		100	0	0		33.3	66.7	0		0	0	0	
PHF	.000	.500	.250	.750	.250	.000	.000	.250	.250	1.000	.000	.500	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

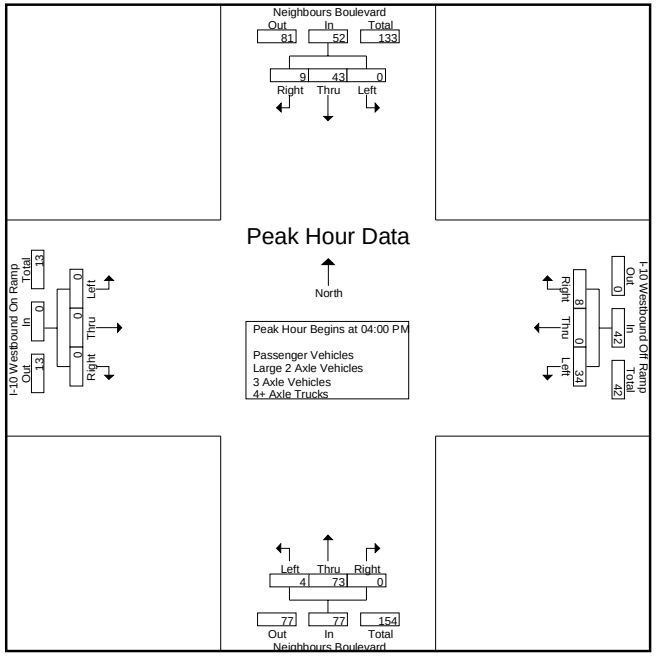
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	11	1	12	11	0	1	12	0	18	0	18	0	0	0	0	42
04:15 PM	0	8	5	13	9	0	3	12	3	23	0	26	0	0	0	0	51
04:30 PM	0	10	1	11	6	0	2	8	0	19	0	19	0	0	0	0	38
04:45 PM	0	14	2	16	8	0	2	10	1	13	0	14	0	0	0	0	40
Total	0	43	9	52	34	0	8	42	4	73	0	77	0	0	0	0	171
05:00 PM	0	12	0	12	15	0	1	16	0	8	0	8	0	0	0	0	36
05:15 PM	0	10	0	10	6	0	3	9	0	13	0	13	0	0	0	0	32
05:30 PM	0	3	3	6	13	0	3	16	0	10	0	10	0	0	0	0	32
05:45 PM	0	6	1	7	4	0	2	6	0	9	0	9	0	0	0	0	22
Total	0	31	4	35	38	0	9	47	0	40	0	40	0	0	0	0	122
Grand Total	0	74	13	87	72	0	17	89	4	113	0	117	0	0	0	0	293
Apprch %	0	85.1	14.9		80.9	0	19.1		3.4	96.6	0		0	0	0		
Total %	0	25.3	4.4	29.7	24.6	0	5.8	30.4	1.4	38.6	0	39.9	0	0	0	0	
Passenger Vehicles	0	71	12	83	54	0	16	70	3	108	0	111	0	0	0	0	264
% Passenger Vehicles	0	95.9	92.3	95.4	75	0	94.1	78.7	75	95.6	0	94.9	0	0	0	0	90.1
Large 2 Axle Vehicles	0	1	1	2	3	0	0	3	0	2	0	2	0	0	0	0	7
% Large 2 Axle Vehicles	0	1.4	7.7	2.3	4.2	0	0	3.4	0	1.8	0	1.7	0	0	0	0	2.4
3 Axle Vehicles	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
% 3 Axle Vehicles	0	0	0	0	1.4	0	0	1.1	0	0	0	0	0	0	0	0	0.3
4+ Axle Trucks	0	2	0	2	14	0	1	15	1	3	0	4	0	0	0	0	21
% 4+ Axle Trucks	0	2.7	0	2.3	19.4	0	5.9	16.9	25	2.7	0	3.4	0	0	0	0	7.2

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	11	1	12	**11**	0	1	**12**	0	18	0	18	0	0	0	0	42
04:15 PM	0	8	**5**	13	9	0	**3**	12	**3**	**23**	0	**26**	0	0	0	0	**51**
04:30 PM	0	10	1	11	6	0	2	8	0	19	0	19	0	0	0	0	38
04:45 PM	0	**14**	2	**16**	8	0	2	10	1	13	0	14	0	0	0	0	40
Total Volume	0	43	9	52	34	0	8	42	4	73	0	77	0	0	0	0	171
% App. Total	0	82.7	17.3		81	0	19		5.2	94.8	0		0	0	0		
PHF	.000	.768	.450	.813	.773	.000	.667	.875	.333	.793	.000	.740	.000	.000	.000	.000	.838

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	11	1	12	**11**	0	1	**12**	0	18	0	18	0	0	0	0
+15 mins.	0	8	**5**	13	9	0	**3**	12	**3**	**23**	0	**26**	0	0	0	0
+30 mins.	0	10	1	11	6	0	2	8	0	19	0	19	0	0	0	0
+45 mins.	0	**14**	2	**16**	8	0	2	10	1	13	0	14	0	0	0	0
Total Volume	0	43	9	52	34	0	8	42	4	73	0	77	0	0	0	0
% App. Total	0	82.7	17.3		81	0	19		5.2	94.8	0		0	0	0	
PHF	.000	.768	.450	.813	.773	.000	.667	.875	.333	.793	.000	.740	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

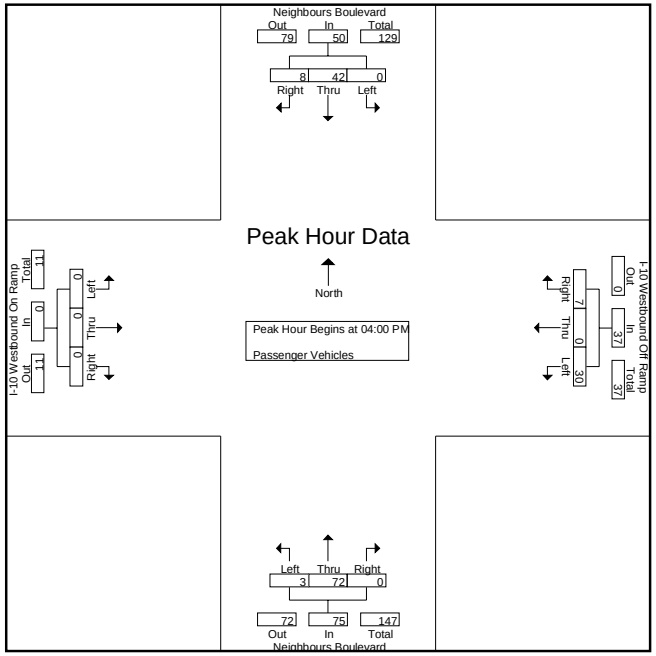
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	11	1	12	9	0	0	9	0	18	0	18	0	0	0	0	39
04:15 PM	0	8	5	13	9	0	3	12	2	23	0	25	0	0	0	0	50
04:30 PM	0	10	1	11	6	0	2	8	0	19	0	19	0	0	0	0	38
04:45 PM	0	13	1	14	6	0	2	8	1	12	0	13	0	0	0	0	35
Total	0	42	8	50	30	0	7	37	3	72	0	75	0	0	0	0	162
05:00 PM	0	12	0	12	9	0	1	10	0	8	0	8	0	0	0	0	30
05:15 PM	0	8	0	8	4	0	3	7	0	13	0	13	0	0	0	0	28
05:30 PM	0	3	3	6	8	0	3	11	0	6	0	6	0	0	0	0	23
05:45 PM	0	6	1	7	3	0	2	5	0	9	0	9	0	0	0	0	21
Total	0	29	4	33	24	0	9	33	0	36	0	36	0	0	0	0	102
Grand Total	0	71	12	83	54	0	16	70	3	108	0	111	0	0	0	0	264
Apprch %	0	85.5	14.5		77.1	0	22.9		2.7	97.3	0		0	0	0		
Total %	0	26.9	4.5	31.4	20.5	0	6.1	26.5	1.1	40.9	0	42	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	11	1	12	**9**	0	0	9	0	18	0	18	0	0	0	0	39
04:15 PM	0	8	**5**	13	9	0	**3**	**12**	**2**	**23**	0	**25**	0	0	0	0	**50**
04:30 PM	0	10	1	11	6	0	2	8	0	19	0	19	0	0	0	0	38
04:45 PM	0	**13**	1	**14**	6	0	2	8	1	12	0	13	0	0	0	0	35
Total Volume	0	42	8	50	30	0	7	37	3	72	0	75	0	0	0	0	162
% App. Total	0	84	16		81.1	0	18.9		4	96	0		0	0	0		
PHF	.000	.808	.400	.893	.833	.000	.583	.771	.375	.783	.000	.750	.000	.000	.000	.000	.810

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	11	1	12	**9**	0	0	9	0	18	0	18	0	0	0	0
+15 mins.	0	8	**5**	13	9	0	**3**	**12**	**2**	**23**	0	**25**	0	0	0	0
+30 mins.	0	10	1	11	6	0	2	8	0	19	0	19	0	0	0	0
+45 mins.	0	**13**	1	**14**	6	0	2	8	1	12	0	13	0	0	0	0
Total Volume	0	42	8	50	30	0	7	37	3	72	0	75	0	0	0	0
% App. Total	0	84	16		81.1	0	18.9		4	96	0		0	0	0	
PHF	.000	.808	.400	.893	.833	.000	.583	.771	.375	.783	.000	.750	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

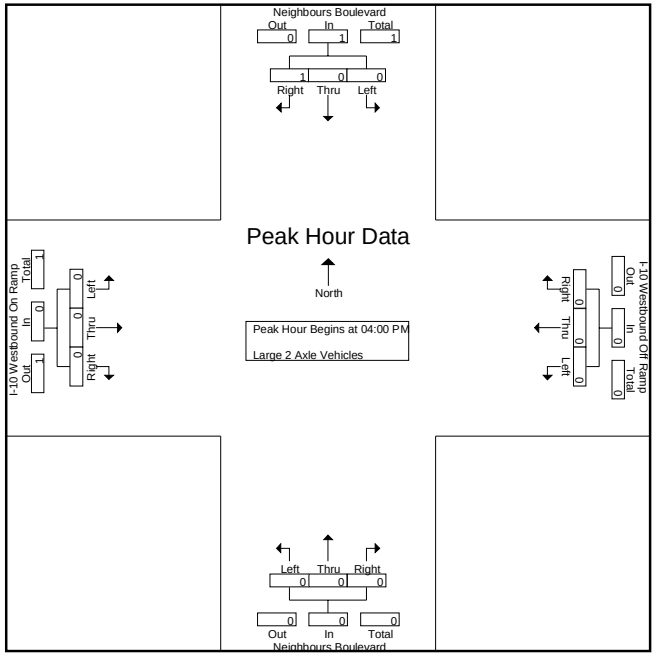
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	2
05:15 PM	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	2
05:45 PM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Total	0	1	0	1	3	0	0	3	0	2	0	2	0	0	0	0	6
Grand Total	0	1	1	2	3	0	0	3	0	2	0	2	0	0	0	0	7
Apprch %	0	50	50		100	0	0		0	100	0		0	0	0		
Total %	0	14.3	14.3	28.6	42.9	0	0	42.9	0	28.6	0	28.6	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	**1**	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**1**
Total Volume	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% App. Total	0	0	100		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.250	.250	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	**1**	**1**	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	100		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.250	.250	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

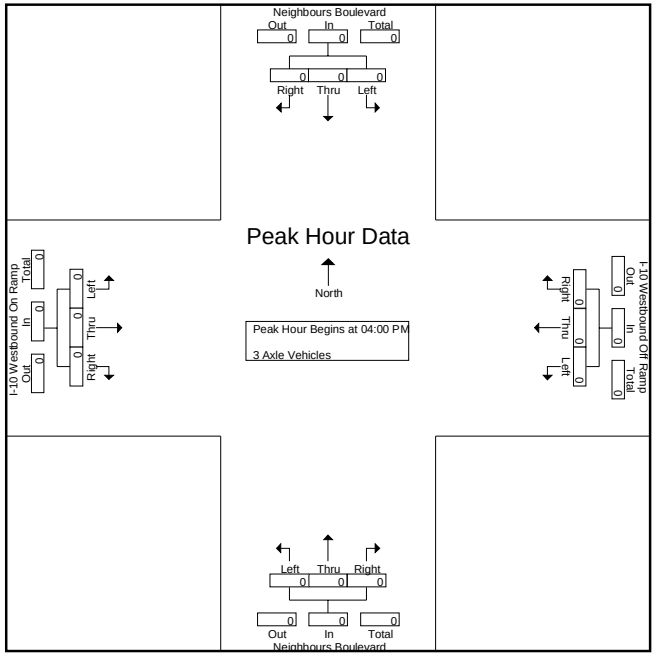
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Grand Total	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
Apprch %	0	0	0		100	0	0		0	0	0		0	0	0		
Total %	0	0	0	0	100	0	0	100	0	0	0	0	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

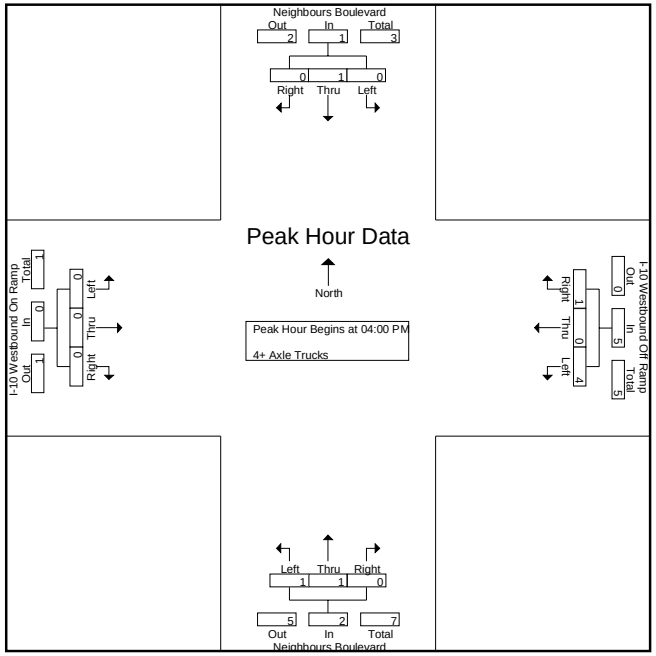
	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	2	0	1	3	0	0	0	0	0	0	0	0	3
04:15 PM	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	1	0	1	2	0	0	2	0	1	0	1	0	0	0	0	4
Total	0	1	0	1	4	0	1	5	1	1	0	2	0	0	0	0	8
05:00 PM	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	3
05:15 PM	0	1	0	1	2	0	0	2	0	0	0	0	0	0	0	0	3
05:30 PM	0	0	0	0	5	0	0	5	0	2	0	2	0	0	0	0	7
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	10	0	0	10	0	2	0	2	0	0	0	0	13
Grand Total	0	2	0	2	14	0	1	15	1	3	0	4	0	0	0	0	21
Apprch %	0	100	0		93.3	0	6.7		25	75	0		0	0	0		
Total %	0	9.5	0	9.5	66.7	0	4.8	71.4	4.8	14.3	0	19	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Westbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Westbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	**2**	0	**1**	**3**	0	0	0	0	0	0	0	0	3
04:15 PM	0	0	0	0	0	0	0	0	**1**	0	0	**1**	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	**1**	0	**1**	2	0	0	2	0	**1**	0	1	0	0	0	0	**4**
Total Volume	0	1	0	1	4	0	1	5	1	1	0	2	0	0	0	0	8
% App. Total	0	100	0		80	0	20		50	50	0		0	0	0		
PHF	.000	.250	.000	.250	.500	.000	.250	.417	.250	.250	.000	.500	.000	.000	.000	.000	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Westbound Ramps
Weather: Sunny

File Name : CRVNE10WPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	**2**	0	**1**	**3**	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	**1**	0	0	**1**	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	**1**	0	**1**	2	0	0	2	0	**1**	0	1	0	0	0	0
Total Volume	0	1	0	1	4	0	1	5	1	1	0	2	0	0	0	0
% App. Total	0	100	0		80	0	20		50	50	0		0	0	0	
PHF	.000	.250	.000	.250	.500	.000	.250	.417	.250	.250	.000	.500	.000	.000	.000	.000

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: City of
Comment 2: N/S:
Comment 3: E/W:
Comment 4: Weather:

	Southbound			Westbound			Northbound			Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
7:00 AM	0	6	8	2	0	2	0	12	0	0	0	0
07:15 AM	0	6	13	1	0	2	1	11	0	0	0	0
07:30 AM	0	7	14	2	0	3	2	14	0	0	0	0
07:45 AM	0	4	5	2	0	1	0	11	0	0	0	0
08:00 AM	0	5	7	5	1	1	0	5	0	0	0	0
08:15 AM	0	7	2	7	0	1	3	5	0	0	0	0
08:30 AM	0	8	1	6	0	1	0	8	0	0	0	0
08:45 AM	0	5	0	1	0	1	0	8	0	0	0	0
Peak 07:00 AM	0	23	40	7	0	8	3	48	0	0	0	0

TOTAL SUMMARY WITH PCE

	Southbound			Westbound			Northbound			Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak 07:00 AM	0	27	45	10	0	11	5	52	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: City of
Comment 2: N/S:
Comment 3: E/W:
Comment 4: Weather:

	Southbound			Westbound			Northbound			Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
7:00 AM	0	0	0	0	0	1	0	1	0	0	0	0
07:15 AM	0	1	3	1	0	1	0	0	0	0	0	0
07:30 AM	0	0	0	1	0	0	1	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	1	1	0	0	0	1	0	0	0	0	0
08:30 AM	0	1	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	1	0	0	0	0	0	0	0	0
Peak 07:00 AM	0	1	3	2	0	2	1	1	0	0	0	0
With PCE 1.5	0	2	5	3	0	3	2	2	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: City of
Comment 2: N/S:
Comment 3: E/W:
Comment 4: Weather:

	Southbound			Westbound			Northbound			Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	1	0	0	0	0
07:30 AM	0	1	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	1	0	0	0	0
Peak 07:00 AM	0	1	0	0	0	0	0	1	0	0	0	0
With PCE 2.0	0	2	0	0	0	0	0	2	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: City of
Comment 2: N/S:
Comment 3: E/W:
Comment 4: Weather:

	Southbound			Westbound			Northbound			Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak 07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
With PCE 3.0	0	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Westbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Westbound Off Ramp Westbound			Neighbours Boulevard Northbound			I-10 Westbound On Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	11	1	9	0	0	0	18	0	0	0	0
04:15 PM	0	8	5	9	0	3	2	23	0	0	0	0
04:30 PM	0	10	1	6	0	2	0	19	0	0	0	0
04:45 PM	0	13	1	6	0	2	1	12	0	0	0	0
05:00 PM	0	12	0	9	0	1	0	8	0	0	0	0
05:15 PM	0	8	0	4	0	3	0	13	0	0	0	0
05:30 PM	0	3	3	8	0	3	0	6	0	0	0	0
05:45 PM	0	6	1	3	0	2	0	9	0	0	0	0
Peak Hour 04:00 PM	0	42	8	30	0	7	3	72	0	0	0	0

TOTAL SUMMARY WITH PCE

	Neighbours Boulevard Southbound			I-10 Westbound Off Ramp Westbound			Neighbours Boulevard Northbound			I-10 Westbound On Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Hour 04:00 PM	0	45	10	42	0	10	6	75	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Westbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Westbound Off Ramp Westbound			Neighbours Boulevard Northbound			I-10 Westbound On Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	1	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	2	0	0	0	0	0	0	0	0
05:15 PM	0	1	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	2	0	0	0	0
05:45 PM	0	0	0	1	0	0	0	0	0	0	0	0
Peak Hour 04:0	0	0	1	0	0	0	0	0	0	0	0	0
PCE 1.5	0	0	2	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Westbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Westbound Off Ramp Westbound			Neighbours Boulevard Northbound			I-10 Westbound On Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	1	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:0	0	0	0	0	0	0	0	0	0	0	0	0
PCE 2.0	0	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10WPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Westbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Westbound Off Ramp Westbound			Neighbours Boulevard Northbound			I-10 Westbound On Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	2	0	1	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	1	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	1	0	2	0	0	0	1	0	0	0	0
05:00 PM	0	0	0	3	0	0	0	0	0	0	0	0
05:15 PM	0	1	0	2	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	5	0	0	0	2	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:00 PM	0	1	0	4	0	1	1	1	0	0	0	0
PCE 3.0	0	3	0	12	0	3	3	3	0	0	0	0

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

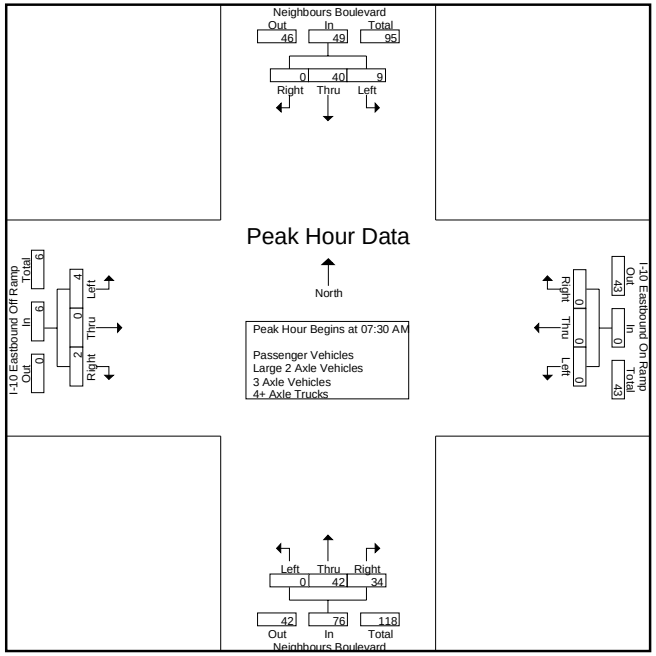
	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	1	7	0	8	0	0	0	0	0	10	4	14	4	0	0	4	26
07:15 AM	5	5	0	10	0	0	0	0	0	9	4	13	5	0	1	6	29
07:30 AM	5	7	0	12	0	0	0	0	0	18	8	26	2	0	1	3	41
07:45 AM	1	8	0	9	0	0	0	0	0	10	11	21	1	0	0	1	31
Total	12	27	0	39	0	0	0	0	0	47	27	74	12	0	2	14	127
08:00 AM	2	11	0	13	0	0	0	0	0	4	11	15	1	0	0	1	29
08:15 AM	1	14	0	15	0	0	0	0	0	10	4	14	0	0	1	1	30
08:30 AM	3	12	0	15	0	0	0	0	0	6	6	12	2	0	1	3	30
08:45 AM	4	4	0	8	0	0	0	0	0	8	3	11	3	0	0	3	22
Total	10	41	0	51	0	0	0	0	0	28	24	52	6	0	2	8	111
Grand Total	22	68	0	90	0	0	0	0	0	75	51	126	18	0	4	22	238
Apprch %	24.4	75.6	0		0	0	0		0	59.5	40.5		81.8	0	18.2		
Total %	9.2	28.6	0	37.8	0	0	0	0	0	31.5	21.4	52.9	7.6	0	1.7	9.2	
Passenger Vehicles	18	57	0	75	0	0	0	0	0	64	39	103	13	0	3	16	194
% Passenger Vehicles	81.8	83.8	0	83.3	0	0	0	0	0	85.3	76.5	81.7	72.2	0	75	72.7	81.5
Large 2 Axle Vehicles	0	6	0	6	0	0	0	0	0	2	3	5	1	0	0	1	12
% Large 2 Axle Vehicles	0	8.8	0	6.7	0	0	0	0	0	2.7	5.9	4	5.6	0	0	4.5	5
3 Axle Vehicles	1	0	0	1	0	0	0	0	0	1	2	3	1	0	0	1	5
% 3 Axle Vehicles	4.5	0	0	1.1	0	0	0	0	0	1.3	3.9	2.4	5.6	0	0	4.5	2.1
4+ Axle Trucks	3	5	0	8	0	0	0	0	0	8	7	15	3	0	1	4	27
% 4+ Axle Trucks	13.6	7.4	0	8.9	0	0	0	0	0	10.7	13.7	11.9	16.7	0	25	18.2	11.3

	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	**5**	7	0	12	0	0	0	0	0	**18**	8	**26**	**2**	0	**1**	**3**	**41**
07:45 AM	1	8	0	9	0	0	0	0	0	10	**11**	21	1	0	0	1	31
08:00 AM	2	11	0	13	0	0	0	0	0	4	11	15	1	0	0	1	29
08:15 AM	1	**14**	0	**15**	0	0	0	0	0	10	4	14	0	0	1	1	30
Total Volume	9	40	0	49	0	0	0	0	0	42	34	76	4	0	2	6	131
% App. Total	18.4	81.6	0		0	0	0		0	55.3	44.7		66.7	0	33.3		
PHF	.450	.714	.000	.817	.000	.000	.000	.000	.000	.583	.773	.731	.500	.000	.500	.500	.799

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:45 AM				07:00 AM				07:30 AM				07:00 AM			
+0 mins.	1	8	0	9	0	0	0	0	0	**18**	8	**26**	4	0	0	4
+15 mins.	2	11	0	13	0	0	0	0	0	10	**11**	21	**5**	0	**1**	**6**
+30 mins.	1	**14**	0	**15**	0	0	0	0	0	4	11	15	2	0	1	3
+45 mins.	**3**	12	0	15	0	0	0	0	0	10	4	14	1	0	0	1
Total Volume	7	45	0	52	0	0	0	0	0	42	34	76	12	0	2	14
% App. Total	13.5	86.5	0		0	0	0		0	55.3	44.7		85.7	0	14.3	
PHF	.583	.804	.000	.867	.000	.000	.000	.000	.000	.583	.773	.731	.600	.000	.500	.583

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

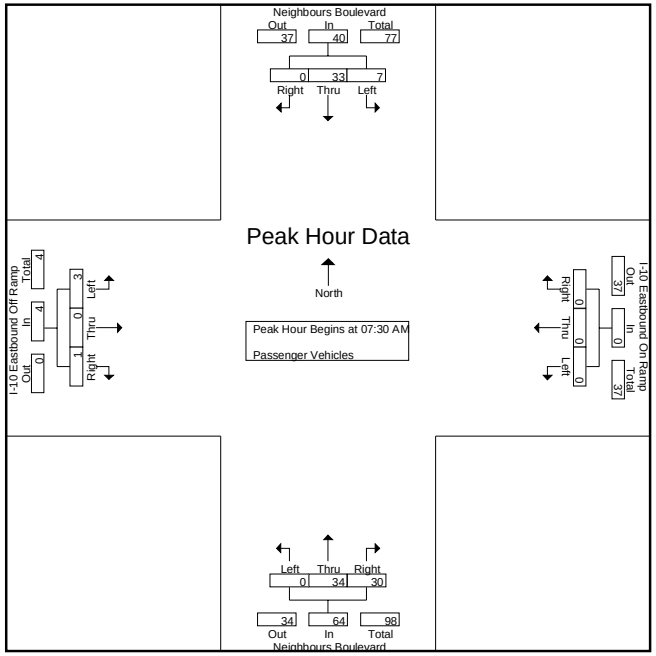
	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	1	7	0	8	0	0	0	0	0	10	4	14	2	0	0	2	24
07:15 AM	4	3	0	7	0	0	0	0	0	8	1	9	4	0	1	5	21
07:30 AM	3	6	0	9	0	0	0	0	0	15	7	22	1	0	1	2	33
07:45 AM	1	5	0	6	0	0	0	0	0	9	10	19	1	0	0	1	26
Total	9	21	0	30	0	0	0	0	0	42	22	64	8	0	2	10	104
08:00 AM	2	9	0	11	0	0	0	0	0	4	11	15	1	0	0	1	27
08:15 AM	1	13	0	14	0	0	0	0	0	6	2	8	0	0	0	0	22
08:30 AM	3	11	0	14	0	0	0	0	0	6	3	9	2	0	1	3	26
08:45 AM	3	3	0	6	0	0	0	0	0	6	1	7	2	0	0	2	15
Total	9	36	0	45	0	0	0	0	0	22	17	39	5	0	1	6	90
Grand Total	18	57	0	75	0	0	0	0	0	64	39	103	13	0	3	16	194
Apprch %	24	76	0		0	0	0		0	62.1	37.9		81.2	0	18.8		
Total %	9.3	29.4	0	38.7	0	0	0	0	0	33	20.1	53.1	6.7	0	1.5	8.2	

	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	**3**	6	0	9	0	0	0	0	0	**15**	7	**22**	**1**	0	**1**	**2**	**33**
07:45 AM	1	5	0	6	0	0	0	0	0	9	10	19	1	0	0	1	26
08:00 AM	2	9	0	11	0	0	0	0	0	4	**11**	15	1	0	0	1	27
08:15 AM	1	**13**	0	**14**	0	0	0	0	0	6	2	8	0	0	0	0	22
Total Volume	7	33	0	40	0	0	0	0	0	34	30	64	3	0	1	4	108
% App. Total	17.5	82.5	0		0	0	0		0	53.1	46.9		75	0	25		
PHF	.583	.635	.000	.714	.000	.000	.000	.000	.000	.567	.682	.727	.750	.000	.250	.500	.818

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	**3**	6	0	9	0	0	0	0	0	**15**	7	**22**	**1**	0	**1**	**2**
+15 mins.	1	5	0	6	0	0	0	0	0	9	10	19	1	0	0	1
+30 mins.	2	9	0	11	0	0	0	0	0	4	**11**	15	1	0	0	1
+45 mins.	1	**13**	0	**14**	0	0	0	0	0	6	2	8	0	0	0	0
Total Volume	7	33	0	40	0	0	0	0	0	34	30	64	3	0	1	4
% App. Total	17.5	82.5	0		0	0	0		0	53.1	46.9		75	0	25	
PHF	.583	.635	.000	.714	.000	.000	.000	.000	.000	.567	.682	.727	.750	.000	.250	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011

Groups Printed- Large 2 Axle Vehicles

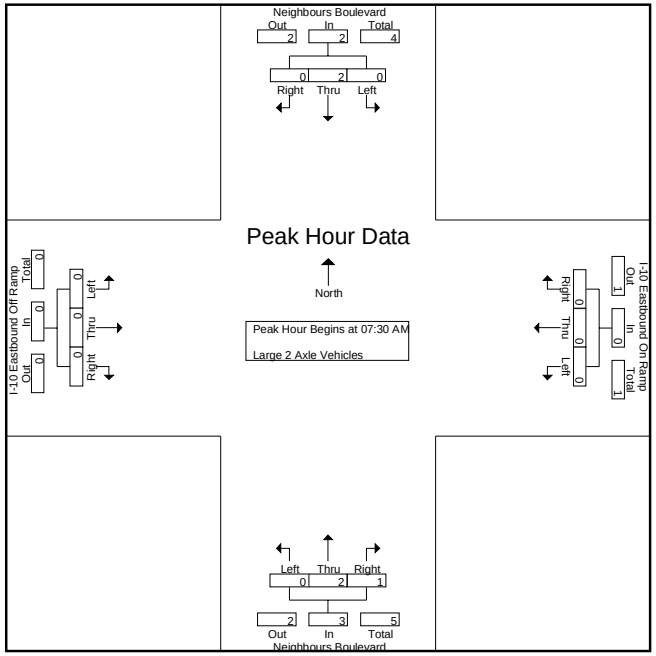
	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
07:15 AM	0	2	0	2	0	0	0	0	0	0	1	1	0	0	0	0	3
07:30 AM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total	0	3	0	3	0	0	0	0	0	1	2	3	1	0	0	1	7
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
08:30 AM	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
08:45 AM	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	3	0	3	0	0	0	0	0	1	1	2	0	0	0	0	5
Grand Total	0	6	0	6	0	0	0	0	0	2	3	5	1	0	0	1	12
Apprch %	0	100	0		0	0	0		0	40	60		100	0	0		
Total %	0	50	0	50	0	0	0	0	0	16.7	25	41.7	8.3	0	0	8.3	

	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	**1**	0	**1**	0	0	0	0	0	**1**	0	**1**	0	0	0	0	**2**
07:45 AM	0	0	0	0	0	0	0	0	0	0	**1**	1	0	0	0	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
Total Volume	0	2	0	2	0	0	0	0	0	2	1	3	0	0	0	0	5
% App. Total	0	100	0		0	0	0		0	66.7	33.3		0	0	0		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.500	.250	.750	.000	.000	.000	.000	.625

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	0	**1**	0	**1**	0	0	0	0	0	**1**	0	**1**	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	**1**	1	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0
Total Volume	0	2	0	2	0	0	0	0	0	2	1	3	0	0	0	0
% App. Total	0	100	0		0	0	0		0	66.7	33.3		0	0	0	
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.500	.250	.750	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

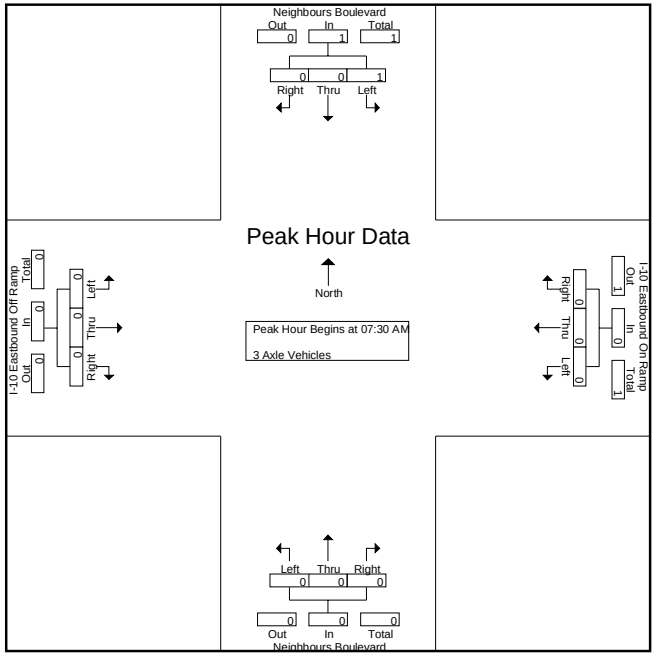
	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
07:30 AM	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	2
Total	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	1	3
Grand Total	1	0	0	1	0	0	0	0	0	1	2	3	1	0	0	1	5
Apprch %	100	0	0		0	0	0		0	33.3	66.7		100	0	0		
Total %	20	0	0	20	0	0	0	0	0	20	40	60	20	0	0	20	

	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	**1**	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	**1**
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
% App. Total	100	0	0		0	0	0		0	0	0		0	0	0		
PHF	.250	.000	.000	.250	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	**1**	0	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	100	0	0		0	0	0		0	0	0		0	0	0	
PHF	.250	.000	.000	.250	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

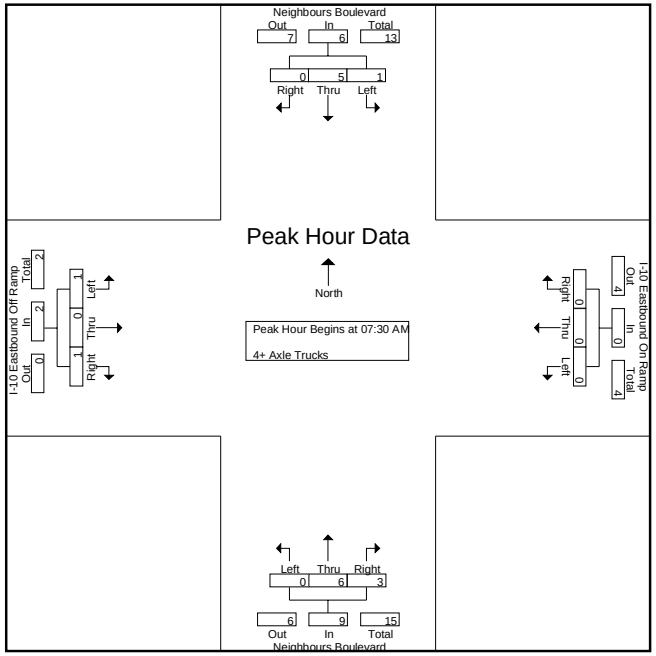
	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
07:15 AM	1	0	0	1	0	0	0	0	0	0	2	2	1	0	0	1	4
07:30 AM	1	0	0	1	0	0	0	0	0	2	1	3	1	0	0	1	5
07:45 AM	0	3	0	3	0	0	0	0	0	1	0	1	0	0	0	0	4
Total	2	3	0	5	0	0	0	0	0	3	3	6	3	0	0	3	14
08:00 AM	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
08:15 AM	0	0	0	0	0	0	0	0	0	3	2	5	0	0	1	1	6
08:30 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
08:45 AM	1	0	0	1	0	0	0	0	0	2	1	3	0	0	0	0	4
Total	1	2	0	3	0	0	0	0	0	5	4	9	0	0	1	1	13
Grand Total	3	5	0	8	0	0	0	0	0	8	7	15	3	0	1	4	27
Apprch %	37.5	62.5	0		0	0	0		0	53.3	46.7		75	0	25		
Total %	11.1	18.5	0	29.6	0	0	0	0	0	29.6	25.9	55.6	11.1	0	3.7	14.8	

	Neighbours Boulevard Southbound				I-10 Eastbound On Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound Off Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	**1**	0	0	1	0	0	0	0	0	2	1	3	**1**	0	0	**1**	5
07:45 AM	0	**3**	0	**3**	0	0	0	0	0	1	0	1	0	0	0	0	4
08:00 AM	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
08:15 AM	0	0	0	0	0	0	0	0	0	**3**	**2**	**5**	0	0	**1**	1	**6**
Total Volume	1	5	0	6	0	0	0	0	0	6	3	9	1	0	1	2	17
% App. Total	16.7	83.3	0		0	0	0		0	66.7	33.3		50	0	50		
PHF	.250	.417	.000	.500	.000	.000	.000	.000	.000	.500	.375	.450	.250	.000	.250	.500	.708

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: Sunny

File Name : CRVNE10EAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	**1**	0	0	1	0	0	0	0	0	2	1	3	**1**	0	0	**1**
+15 mins.	0	**3**	0	**3**	0	0	0	0	0	1	0	1	0	0	0	0
+30 mins.	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	**3**	**2**	**5**	0	0	**1**	1
Total Volume	1	5	0	6	0	0	0	0	0	6	3	9	1	0	1	2
% App. Total	16.7	83.3	0		0	0	0		0	66.7	33.3		50	0	50	
PHF	.250	.417	.000	.500	.000	.000	.000	.000	.000	.500	.375	.450	.250	.000	.250	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

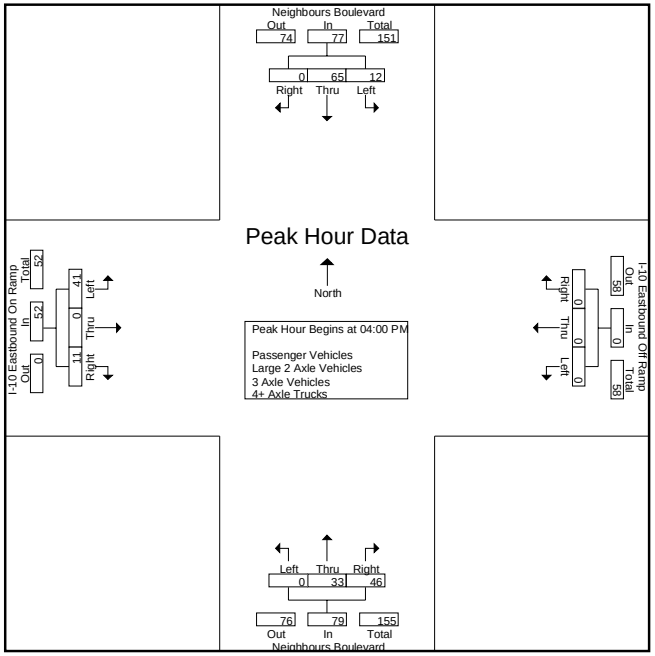
	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	4	18	0	22	0	0	0	0	0	9	12	21	11	0	6	17	60
04:15 PM	3	16	0	19	0	0	0	0	0	5	13	18	17	0	3	20	57
04:30 PM	3	14	0	17	0	0	0	0	0	11	14	25	8	0	2	10	52
04:45 PM	2	17	0	19	0	0	0	0	0	8	7	15	5	0	0	5	39
Total	12	65	0	77	0	0	0	0	0	33	46	79	41	0	11	52	208
05:00 PM	4	21	0	25	0	0	0	0	0	7	14	21	4	0	2	6	52
05:15 PM	1	15	0	16	0	0	0	0	0	7	6	13	4	0	0	4	33
05:30 PM	3	11	0	14	0	0	0	0	0	7	8	15	3	0	1	4	33
05:45 PM	3	8	0	11	0	0	0	0	0	7	16	23	2	0	0	2	36
Total	11	55	0	66	0	0	0	0	0	28	44	72	13	0	3	16	154
Grand Total	23	120	0	143	0	0	0	0	0	61	90	151	54	0	14	68	362
Apprch %	16.1	83.9	0		0	0	0		0	40.4	59.6		79.4	0	20.6		
Total %	6.4	33.1	0	39.5	0	0	0	0	0	16.9	24.9	41.7	14.9	0	3.9	18.8	
Passenger Vehicles	21	104	0	125	0	0	0	0	0	58	73	131	51	0	13	64	320
% Passenger Vehicles	91.3	86.7	0	87.4	0	0	0	0	0	95.1	81.1	86.8	94.4	0	92.9	94.1	88.4
Large 2 Axle Vehicles	1	3	0	4	0	0	0	0	0	0	10	10	2	0	0	2	16
% Large 2 Axle Vehicles	4.3	2.5	0	2.8	0	0	0	0	0	0	11.1	6.6	3.7	0	0	2.9	4.4
3 Axle Vehicles	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
% 3 Axle Vehicles	0	0.8	0	0.7	0	0	0	0	0	0	1.1	0.7	0	0	0	0	0.6
4+ Axle Trucks	1	12	0	13	0	0	0	0	0	3	6	9	1	0	1	2	24
% 4+ Axle Trucks	4.3	10	0	9.1	0	0	0	0	0	4.9	6.7	6	1.9	0	7.1	2.9	6.6

	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	**4**	**18**	0	**22**	0	0	0	0	0	9	12	21	11	0	**6**	17	**60**
04:15 PM	3	16	0	19	0	0	0	0	0	5	13	18	**17**	0	3	**20**	57
04:30 PM	3	14	0	17	0	0	0	0	0	**11**	**14**	**25**	8	0	2	10	52
04:45 PM	2	17	0	19	0	0	0	0	0	8	7	15	5	0	0	5	39
Total Volume	12	65	0	77	0	0	0	0	0	33	46	79	41	0	11	52	208
% App. Total	15.6	84.4	0		0	0	0		0	41.8	58.2		78.8	0	21.2		
PHF	.750	.903	.000	.875	.000	.000	.000	.000	.000	.750	.821	.790	.603	.000	.458	.650	.867

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	3	16	0	19	0	0	0	0	0	9	12	21	11	0	**6**	17
+15 mins.	3	14	0	17	0	0	0	0	0	5	13	18	**17**	0	3	**20**
+30 mins.	2	17	0	19	0	0	0	0	0	**11**	**14**	**25**	8	0	2	10
+45 mins.	**4**	**21**	0	**25**	0	0	0	0	0	8	7	15	5	0	0	5
Total Volume	12	68	0	80	0	0	0	0	0	33	46	79	41	0	11	52
% App. Total	15	85	0		0	0	0		0	41.8	58.2		78.8	0	21.2	
PHF	.750	.810	.000	.800	.000	.000	.000	.000	.000	.750	.821	.790	.603	.000	.458	.650

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

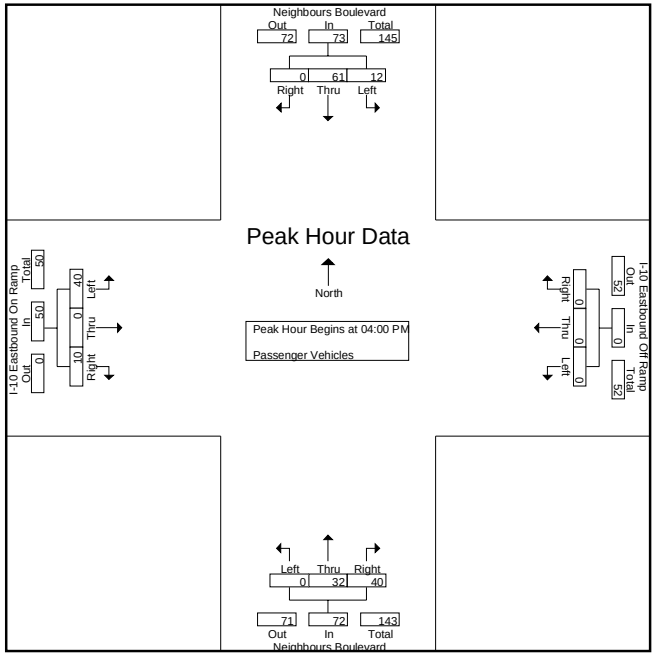
	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	4	16	0	20	0	0	0	0	0	9	10	19	11	0	6	17	56
04:15 PM	3	16	0	19	0	0	0	0	0	4	11	15	17	0	2	19	53
04:30 PM	3	14	0	17	0	0	0	0	0	11	13	24	8	0	2	10	51
04:45 PM	2	15	0	17	0	0	0	0	0	8	6	14	4	0	0	4	35
Total	12	61	0	73	0	0	0	0	0	32	40	72	40	0	10	50	195
05:00 PM	4	15	0	19	0	0	0	0	0	7	10	17	4	0	2	6	42
05:15 PM	1	12	0	13	0	0	0	0	0	7	6	13	4	0	0	4	30
05:30 PM	2	8	0	10	0	0	0	0	0	5	5	10	1	0	1	2	22
05:45 PM	2	8	0	10	0	0	0	0	0	7	12	19	2	0	0	2	31
Total	9	43	0	52	0	0	0	0	0	26	33	59	11	0	3	14	125
Grand Total	21	104	0	125	0	0	0	0	0	58	73	131	51	0	13	64	320
Apprch %	16.8	83.2	0		0	0	0		0	44.3	55.7		79.7	0	20.3		
Total %	6.6	32.5	0	39.1	0	0	0	0	0	18.1	22.8	40.9	15.9	0	4.1	20	

	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	**4**	**16**	0	**20**	0	0	0	0	0	9	10	19	11	0	**6**	17	**56**
04:15 PM	3	16	0	19	0	0	0	0	0	4	11	15	**17**	0	2	**19**	53
04:30 PM	3	14	0	17	0	0	0	0	0	**11**	**13**	**24**	8	0	2	10	51
04:45 PM	2	15	0	17	0	0	0	0	0	8	6	14	4	0	0	4	35
Total Volume	12	61	0	73	0	0	0	0	0	32	40	72	40	0	10	50	195
% App. Total	16.4	83.6	0		0	0	0		0	44.4	55.6		80	0	20		
PHF	.750	.953	.000	.913	.000	.000	.000	.000	.000	.727	.769	.750	.588	.000	.417	.658	.871

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	**4**	**16**	0	**20**	0	0	0	0	0	9	10	19	11	0	**6**	17
+15 mins.	3	16	0	19	0	0	0	0	0	4	11	15	**17**	0	2	**19**
+30 mins.	3	14	0	17	0	0	0	0	0	**11**	**13**	**24**	8	0	2	10
+45 mins.	2	15	0	17	0	0	0	0	0	8	6	14	4	0	0	4
Total Volume	12	61	0	73	0	0	0	0	0	32	40	72	40	0	10	50
% App. Total	16.4	83.6	0		0	0	0		0	44.4	55.6		80	0	20	
PHF	.750	.953	.000	.913	.000	.000	.000	.000	.000	.727	.769	.750	.588	.000	.417	.658

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

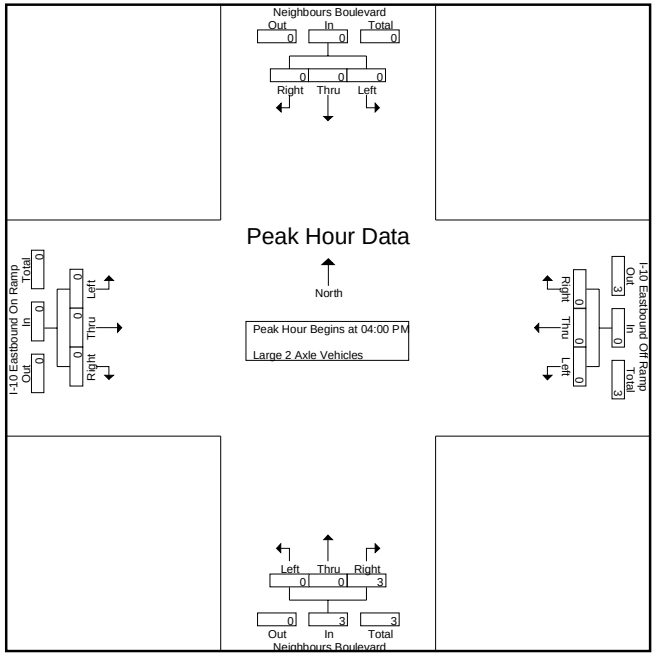
	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	3
05:00 PM	0	2	0	2	0	0	0	0	0	0	1	1	0	0	0	0	3
05:15 PM	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	0	0	0	0	0	0	3	3	2	0	0	2	5
05:45 PM	1	0	0	1	0	0	0	0	0	0	3	3	0	0	0	0	4
Total	1	3	0	4	0	0	0	0	0	0	7	7	2	0	0	2	13
Grand Total	1	3	0	4	0	0	0	0	0	0	10	10	2	0	0	2	16
Apprch %	25	75	0		0	0	0		0	0	100		100	0	0		
Total %	6.2	18.8	0	25	0	0	0	0	0	0	62.5	62.5	12.5	0	0	12.5	

	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0	0	0	**1**
04:15 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	3
% App. Total	0	0	0		0	0	0		0	0	100		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.750	.750	.000	.000	.000	.000	.750

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	100		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.750	.750	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

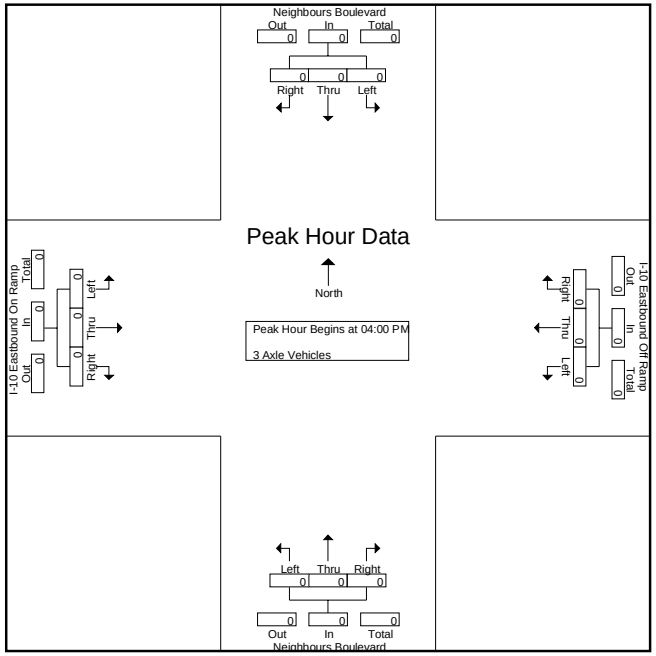
	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
Grand Total	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
Apprch %	0	100	0		0	0	0		0	0	100		0	0	0		
Total %	0	50	0	50	0	0	0	0	0	0	50	50	0	0	0	0	

	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0		0	0	0		0	0	0		0	0	0	
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

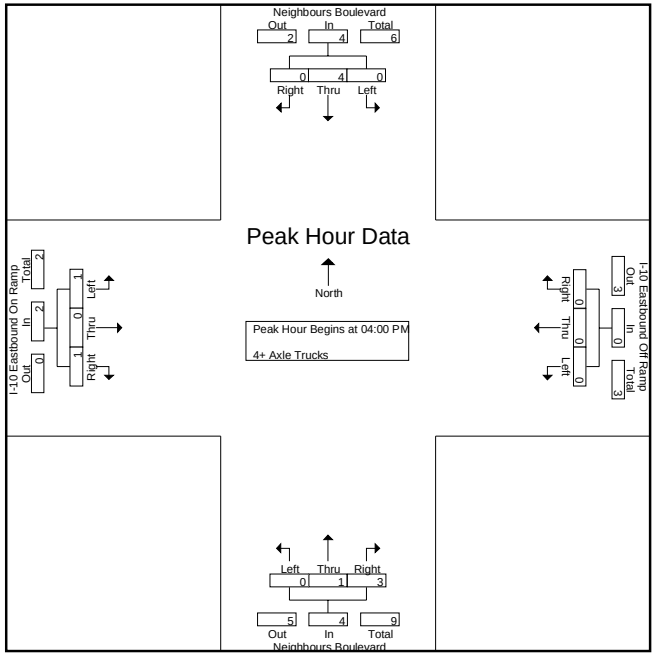
	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	2	0	2	0	0	0	0	0	0	1	1	0	0	0	0	3
04:15 PM	0	0	0	0	0	0	0	0	0	1	1	2	0	0	1	1	3
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	2	0	2	0	0	0	0	0	0	1	1	1	0	0	1	4
Total	0	4	0	4	0	0	0	0	0	1	3	4	1	0	1	2	10
05:00 PM	0	3	0	3	0	0	0	0	0	0	2	2	0	0	0	0	5
05:15 PM	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
05:30 PM	1	3	0	4	0	0	0	0	0	2	0	2	0	0	0	0	6
05:45 PM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
Total	1	8	0	9	0	0	0	0	0	2	3	5	0	0	0	0	14
Grand Total	1	12	0	13	0	0	0	0	0	3	6	9	1	0	1	2	24
Apprch %	7.7	92.3	0		0	0	0		0	33.3	66.7		50	0	50		
Total %	4.2	50	0	54.2	0	0	0	0	0	12.5	25	37.5	4.2	0	4.2	8.3	

	Neighbours Boulevard Southbound				I-10 Eastbound Off Ramp Westbound				Neighbours Boulevard Northbound				I-10 Eastbound On Ramp Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:00 PM																	
04:00 PM	0	**2**	0	**2**	0	0	0	0	0	0	**1**	1	0	0	0	0	3
04:15 PM	0	0	0	0	0	0	0	0	0	**1**	1	**2**	0	0	**1**	**1**	3
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	2	0	2	0	0	0	0	0	0	1	1	**1**	0	0	1	**4**
Total Volume	0	4	0	4	0	0	0	0	0	1	3	4	1	0	1	2	10
% App. Total	0	100	0		0	0	0		0	25	75		50	0	50		
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.250	.750	.500	.250	.000	.250	.500	.625

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: I-10 Eastbound Ramps
Weather: sUNNY

File Name : CRVNE10EPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 04:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:00 PM				04:00 PM				04:00 PM				04:00 PM			
+0 mins.	0	**2**	0	**2**	0	0	0	0	0	0	**1**	1	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	**1**	1	**2**	0	0	**1**	**1**
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	2	0	2	0	0	0	0	0	0	1	1	**1**	0	0	1
Total Volume	0	4	0	4	0	0	0	0	0	1	3	4	1	0	1	2
% App. Total	0	100	0		0	0	0		0	25	75		50	0	50	
PHF	.000	.500	.000	.500	.000	.000	.000	.000	.000	.250	.750	.500	.250	.000	.250	.500

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramps Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramps Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	1	7	0	0	0	0	0	10	4	2	0	0
07:15 AM	4	3	0	0	0	0	0	8	1	4	0	1
7:30 AM	3	6	0	0	0	0	0	15	7	1	0	1
07:45 AM	1	5	0	0	0	0	0	9	10	1	0	0
08:00 AM	2	9	0	0	0	0	0	4	11	1	0	0
08:15 AM	1	13	0	0	0	0	0	6	2	0	0	0
08:30 AM	3	11	0	0	0	0	0	6	3	2	0	1
08:45 AM	3	3	0	0	0	0	0	6	1	2	0	0
Peak Hour 07:30 AM	7	33	0	0	0	0	0	34	30	3	0	1

SUMMARY WITH PCE

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramps Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramps Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
7:30 AM	12	51	0	0	0	0	0	55	41	6	0	4

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramps Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramps Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	1	0	0
07:15 AM	0	2	0	0	0	0	0	0	1	0	0	0
07:30 AM	0	1	0	0	0	0	0	1	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	1	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	1	0	0	0	0	0	1	0	0	0	0
08:30 AM	0	1	0	0	0	0	0	0	1	0	0	0
08:45 AM	0	1	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:30 AM	0	2	0	0	0	0	0	0	2	1	0	0
PCE 1.5	0	3	0	0	0	0	0	3	2	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramps Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramps Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	1	0	0	0	0
07:30 AM	1	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	1	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	1	1	0	0
Peak Hour 07:30 AM	1	0	0	0	0	0	0	0	0	0	0	0
PCE 2.0	2	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramps Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramps Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	1	0	0
07:15 AM	1	0	0	0	0	0	0	0	2	1	0	0
07:30 AM	1	0	0	0	0	0	0	2	1	1	0	0
07:45 AM	0	3	0	0	0	0	0	1	0	0	0	0
08:00 AM	0	2	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	3	2	0	0	1
08:30 AM	0	0	0	0	0	0	0	0	1	0	0	0
08:45 AM	1	0	0	0	0	0	0	2	1	0	0	0
Peak Hour 07:30 AM	1	5	0	0	0	0	0	6	3	1	0	1
PCE 3.0	3	15	0	0	0	0	0	18	9	3	0	3

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: sUNNY

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramp Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	4	16	0	0	0	0	0	9	10	11	0	6
04:15 PM	3	16	0	0	0	0	0	4	11	17	0	2
04:30 PM	3	14	0	0	0	0	0	11	13	8	0	2
04:45 PM	2	15	0	0	0	0	0	8	6	4	0	0
05:00 PM	4	15	0	0	0	0	0	7	10	4	0	2
05:15 PM	1	12	0	0	0	0	0	7	6	4	0	0
05:30 PM	2	8	0	0	0	0	0	5	5	1	0	1
05:45 PM	2	8	0	0	0	0	0	7	12	2	0	0
Peak Hour 04:00 PM	12	61	0	0	0	0	0	32	40	40	0	10

Total SUMMARY WITH PCE

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramp Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	12	73	0	0	0	0	0	35	54	43	0	13

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: sUNNY

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramp Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	1	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	1	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	1	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	2	0	0	0	0	0	0	1	0	0	0
05:15 PM	0	1	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	3	2	0	0
05:45 PM	1	0	0	0	0	0	0	0	3	0	0	0
Peak Hour 04:00 PM	0	0	0	0	0	0	0	0	3	0	0	0
PCE 1.5	0	0	0	0	0	0	0	0	5	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: sUNNY

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramp Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	1	0	0	0	0	0	0	1	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
PCE 2.0	0	0	0	0	0	0	0	0	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNE10EPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: I-10 Eastbound Ramps
Comment 4: Weather: sUNNY

	Neighbours Boulevard Southbound			I-10 Eastbound On Ramp Westbound			Neighbours Boulevard Northbound			I-10 Eastbound Off Ramp Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	2	0	0	0	0	0	0	1	0	0	0
04:15 PM	0	0	0	0	0	0	0	1	1	0	0	1
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	2	0	0	0	0	0	0	1	1	0	0
05:00 PM	0	3	0	0	0	0	0	0	2	0	0	0
05:15 PM	0	2	0	0	0	0	0	0	0	0	0	0
05:30 PM	1	3	0	0	0	0	0	2	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	1	0	0	0
Peak Hour 04:00 PM	0	4	0	0	0	0	0	1	3	1	0	1
PCE 3.0	0	12	0	0	0	0	0	3	9	3	0	3

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

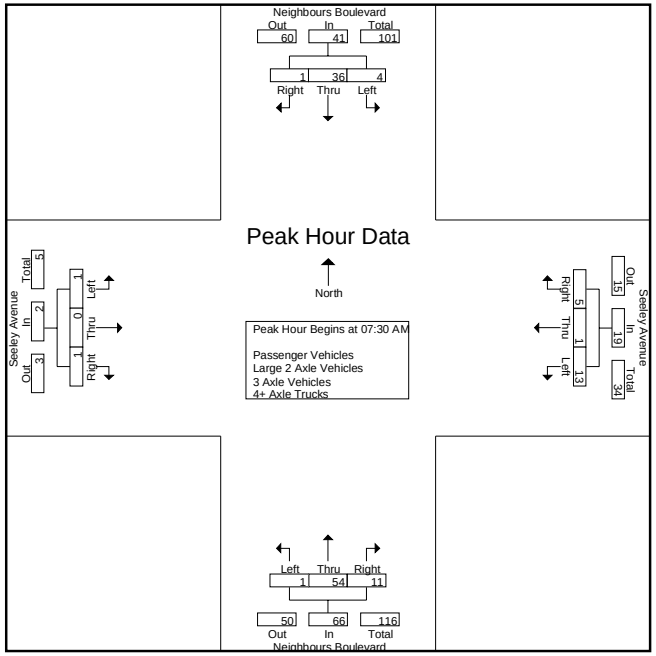
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	5	1	6	2	0	0	2	0	11	1	12	0	0	0	0	20
07:15 AM	1	5	0	6	4	0	1	5	0	9	5	14	0	0	0	0	25
07:30 AM	2	6	1	9	4	1	1	6	0	19	3	22	0	0	1	1	38
07:45 AM	1	7	0	8	3	0	2	5	1	17	1	19	0	0	0	0	32
Total	4	23	2	29	13	1	4	18	1	56	10	67	0	0	1	1	115
08:00 AM	0	10	0	10	3	0	2	5	0	12	4	16	0	0	0	0	31
08:15 AM	1	13	0	14	3	0	0	3	0	6	3	9	1	0	0	1	27
08:30 AM	0	11	0	11	4	0	2	6	1	6	4	11	0	0	0	0	28
08:45 AM	0	6	0	6	2	0	1	3	0	4	2	6	0	0	0	0	15
Total	1	40	0	41	12	0	5	17	1	28	13	42	1	0	0	1	101
Grand Total	5	63	2	70	25	1	9	35	2	84	23	109	1	0	1	2	216
Apprch %	7.1	90	2.9		71.4	2.9	25.7		1.8	77.1	21.1		50	0	50		
Total %	2.3	29.2	0.9	32.4	11.6	0.5	4.2	16.2	0.9	38.9	10.6	50.5	0.5	0	0.5	0.9	
Passenger Vehicles	5	51	2	58	15	0	6	21	2	83	16	101	1	0	0	1	181
% Passenger Vehicles	100	81	100	82.9	60	0	66.7	60	100	98.8	69.6	92.7	100	0	0	50	83.8
Large 2 Axle Vehicles	0	6	0	6	2	0	3	5	0	1	2	3	0	0	0	0	14
% Large 2 Axle Vehicles	0	9.5	0	8.6	8	0	33.3	14.3	0	1.2	8.7	2.8	0	0	0	0	6.5
3 Axle Vehicles	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
% 3 Axle Vehicles	0	0	0	0	0	100	0	2.9	0	0	4.3	0.9	0	0	100	50	1.4
4+ Axle Trucks	0	6	0	6	8	0	0	8	0	0	4	4	0	0	0	0	18
% 4+ Axle Trucks	0	9.5	0	8.6	32	0	0	22.9	0	0	17.4	3.7	0	0	0	0	8.3

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	**2**	6	**1**	9	**4**	**1**	1	**6**	0	**19**	3	**22**	0	0	**1**	**1**	**38**
07:45 AM	1	7	0	8	3	0	**2**	5	**1**	17	1	19	0	0	0	0	32
08:00 AM	0	10	0	10	3	0	2	5	0	12	**4**	16	0	0	0	0	31
08:15 AM	1	**13**	0	**14**	3	0	0	3	0	6	3	9	**1**	0	0	1	27
Total Volume	4	36	1	41	13	1	5	19	1	54	11	66	1	0	1	2	128
% App. Total	9.8	87.8	2.4		68.4	5.3	26.3		1.5	81.8	16.7		50	0	50		
PHF	.500	.692	.250	.732	.813	.250	.625	.792	.250	.711	.688	.750	.250	.000	.250	.500	.842

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:45 AM				07:15 AM				07:15 AM				07:30 AM			
+0 mins.	**1**	7	0	8	**4**	0	1	5	0	9	**5**	14	0	0	**1**	**1**
+15 mins.	0	10	0	10	4	**1**	1	**6**	0	**19**	3	**22**	0	0	0	0
+30 mins.	1	**13**	0	**14**	3	0	**2**	5	**1**	17	1	19	0	0	0	0
+45 mins.	0	11	0	11	3	0	2	5	0	12	4	16	**1**	0	0	1
Total Volume	2	41	0	43	14	1	6	21	1	57	13	71	1	0	1	2
% App. Total	4.7	95.3	0		66.7	4.8	28.6		1.4	80.3	18.3		50	0	50	
PHF	.500	.788	.000	.768	.875	.250	.750	.875	.250	.750	.650	.807	.250	.000	.250	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

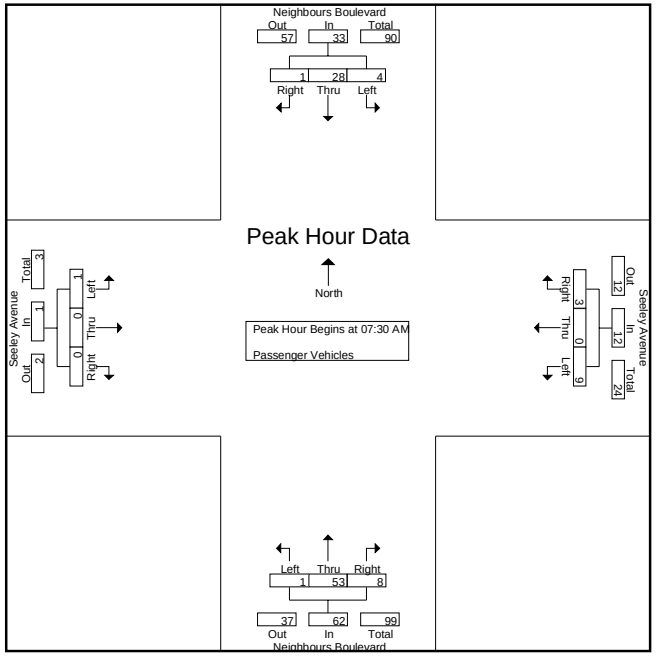
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	5	1	6	1	0	0	1	0	11	1	12	0	0	0	0	19
07:15 AM	1	4	0	5	2	0	1	3	0	9	2	11	0	0	0	0	19
07:30 AM	2	5	1	8	2	0	0	2	0	19	2	21	0	0	0	0	31
07:45 AM	1	4	0	5	3	0	2	5	1	16	1	18	0	0	0	0	28
Total	4	18	2	24	8	0	3	11	1	55	6	62	0	0	0	0	97
08:00 AM	0	8	0	8	2	0	1	3	0	12	3	15	0	0	0	0	26
08:15 AM	1	11	0	12	2	0	0	2	0	6	2	8	1	0	0	1	23
08:30 AM	0	10	0	10	1	0	1	2	1	6	3	10	0	0	0	0	22
08:45 AM	0	4	0	4	2	0	1	3	0	4	2	6	0	0	0	0	13
Total	1	33	0	34	7	0	3	10	1	28	10	39	1	0	0	1	84
Grand Total	5	51	2	58	15	0	6	21	2	83	16	101	1	0	0	1	181
Apprch %	8.6	87.9	3.4		71.4	0	28.6		2	82.2	15.8		100	0	0		
Total %	2.8	28.2	1.1	32	8.3	0	3.3	11.6	1.1	45.9	8.8	55.8	0.6	0	0	0.6	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	**2**	5	**1**	8	2	0	0	2	0	**19**	2	**21**	0	0	0	0	**31**
07:45 AM	1	4	0	5	**3**	0	**2**	**5**	**1**	16	1	18	0	0	0	0	28
08:00 AM	0	8	0	8	2	0	1	3	0	12	**3**	15	0	0	0	0	26
08:15 AM	1	**11**	0	**12**	2	0	0	2	0	6	2	8	**1**	0	0	**1**	23
Total Volume	4	28	1	33	9	0	3	12	1	53	8	62	1	0	0	1	108
% App. Total	12.1	84.8	3		75	0	25		1.6	85.5	12.9		100	0	0		
PHF	.500	.636	.250	.688	.750	.000	.375	.600	.250	.697	.667	.738	.250	.000	.000	.250	.871

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	**2**	5	**1**	8	2	0	0	2	0	**19**	2	**21**	0	0	0	0
+15 mins.	1	4	0	5	**3**	0	**2**	**5**	**1**	16	1	18	0	0	0	0
+30 mins.	0	8	0	8	2	0	1	3	0	12	**3**	15	0	0	0	0
+45 mins.	1	**11**	0	**12**	2	0	0	2	0	6	2	8	**1**	0	0	**1**
Total Volume	4	28	1	33	9	0	3	12	1	53	8	62	1	0	0	1
% App. Total	12.1	84.8	3		75	0	25		1.6	85.5	12.9		100	0	0	
PHF	.500	.636	.250	.688	.750	.000	.375	.600	.250	.697	.667	.738	.250	.000	.000	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

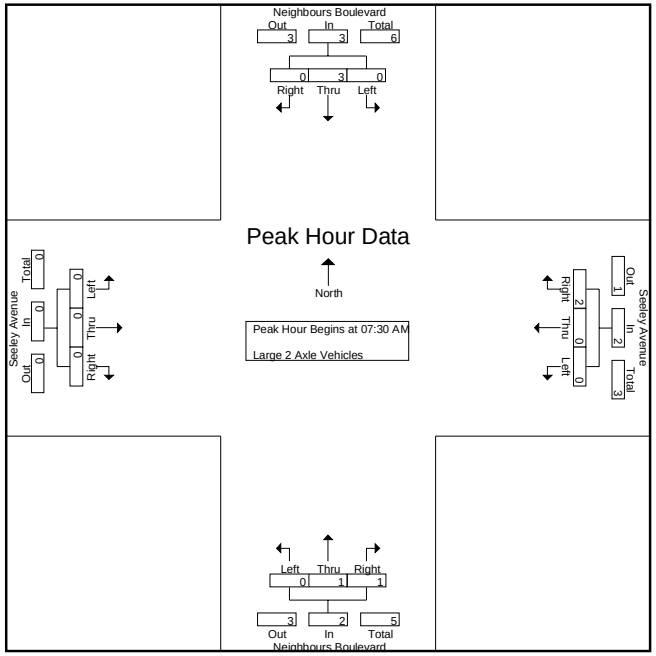
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	1	0	1	1	0	0	1	0	0	1	1	0	0	0	0	3
07:30 AM	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	2
07:45 AM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
Total	0	3	0	3	1	0	1	2	0	1	1	2	0	0	0	0	7
08:00 AM	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1
08:15 AM	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	2
08:30 AM	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	2
08:45 AM	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	0	3	0	3	1	0	2	3	0	0	1	1	0	0	0	0	7
Grand Total	0	6	0	6	2	0	3	5	0	1	2	3	0	0	0	0	14
Apprch %	0	100	0		40	0	60		0	33.3	66.7		0	0	0		
Total %	0	42.9	0	42.9	14.3	0	21.4	35.7	0	7.1	14.3	21.4	0	0	0	0	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	**1**	0	**1**	0	0	**1**	**1**	0	0	0	0	0	0	0	0	**2**
07:45 AM	0	1	0	1	0	0	0	0	0	**1**	0	**1**	0	0	0	0	2
08:00 AM	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1
08:15 AM	0	1	0	1	0	0	0	0	0	0	**1**	1	0	0	0	0	2
Total Volume	0	3	0	3	0	0	2	2	0	1	1	2	0	0	0	0	7
% App. Total	0	100	0		0	0	100		0	50	50		0	0	0		
PHF	.000	.750	.000	.750	.000	.000	.500	.500	.000	.250	.250	.500	.000	.000	.000	.000	.875

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	0	**1**	0	**1**	0	0	**1**	**1**	0	0	0	0	0	0	0	0
+15 mins.	0	1	0	1	0	0	0	0	0	**1**	0	**1**	0	0	0	0
+30 mins.	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
+45 mins.	0	1	0	1	0	0	0	0	0	0	**1**	1	0	0	0	0
Total Volume	0	3	0	3	0	0	2	2	0	1	1	2	0	0	0	0
% App. Total	0	100	0		0	0	100		0	50	50		0	0	0	
PHF	.000	.750	.000	.750	.000	.000	.500	.500	.000	.250	.250	.500	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

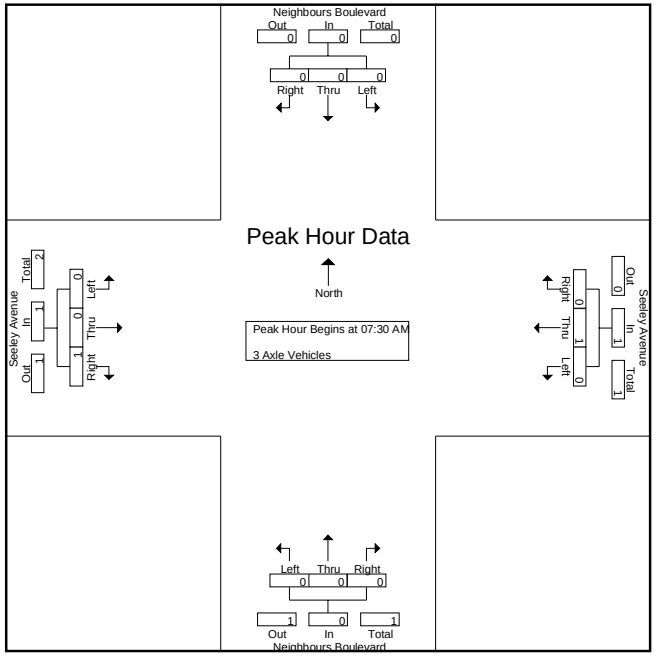
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
07:30 AM	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	1	0	1	0	0	1	1	0	0	1	1	3
Apprch %	0	0	0		0	100	0		0	0	100		0	0	100		
Total %	0	0	0	0	0	33.3	0	33.3	0	0	33.3	33.3	0	0	33.3	33.3	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	0	**1**	0	**1**	0	0	0	0	0	0	**1**	**1**	**2**
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	2
% App. Total	0	0	0		0	100	0		0	0	0		0	0	100		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.000	.000	.250	.250	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	0	0	0	0	0	**1**	0	**1**	0	0	0	0	0	0	**1**	**1**
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1
% App. Total	0	0	0		0	100	0		0	0	0		0	0	100	
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.000	.000	.250	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

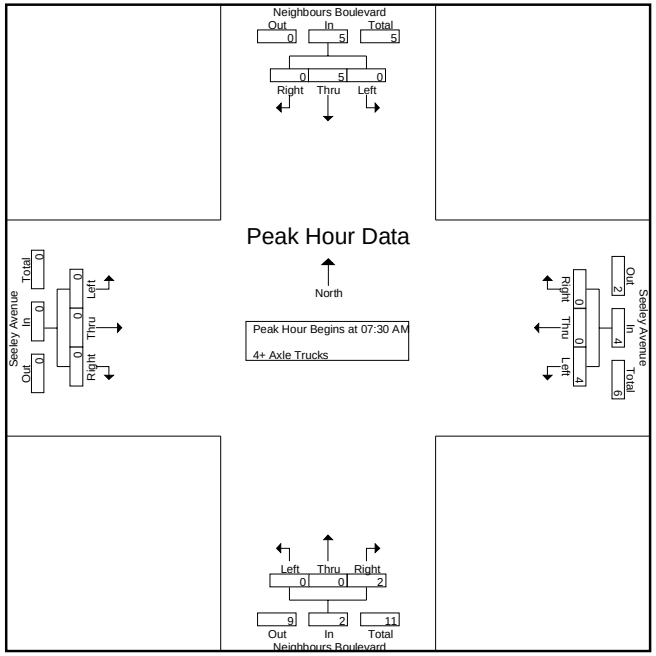
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
07:00 AM	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1
07:15 AM	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	2
07:30 AM	0	0	0	0	2	0	0	2	0	0	1	1	0	0	0	0	3
07:45 AM	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	0	2	0	2	4	0	0	4	0	0	2	2	0	0	0	0	8
08:00 AM	0	2	0	2	1	0	0	1	0	0	1	1	0	0	0	0	4
08:15 AM	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	2
08:30 AM	0	1	0	1	2	0	0	2	0	0	1	1	0	0	0	0	4
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	4	0	4	4	0	0	4	0	0	2	2	0	0	0	0	10
Grand Total	0	6	0	6	8	0	0	8	0	0	4	4	0	0	0	0	18
Apprch %	0	100	0		100	0	0		0	0	100		0	0	0		
Total %	0	33.3	0	33.3	44.4	0	0	44.4	0	0	22.2	22.2	0	0	0	0	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	0	0	0	0	**2**	0	0	**2**	0	0	**1**	**1**	0	0	0	0	3
07:45 AM	0	**2**	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0	2
08:00 AM	0	2	0	2	1	0	0	1	0	0	1	1	0	0	0	0	**4**
08:15 AM	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	2
Total Volume	0	5	0	5	4	0	0	4	0	0	2	2	0	0	0	0	11
% App. Total	0	100	0		100	0	0		0	0	100		0	0	0		
PHF	.000	.625	.000	.625	.500	.000	.000	.500	.000	.000	.500	.500	.000	.000	.000	.000	.688

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEAM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 07:30 AM to 08:15 AM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	07:30 AM				07:30 AM				07:30 AM				07:30 AM			
+0 mins.	0	0	0	0	**2**	0	0	**2**	0	0	**1**	**1**	0	0	0	0
+15 mins.	0	**2**	0	**2**	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	2	0	2	1	0	0	1	0	0	1	1	0	0	0	0
+45 mins.	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0
Total Volume	0	5	0	5	4	0	0	4	0	0	2	2	0	0	0	0
% App. Total	0	100	0		100	0	0		0	0	100		0	0	0	
PHF	.000	.625	.000	.625	.500	.000	.000	.500	.000	.000	.500	.500	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles - Large 2 Axle Vehicles - 3 Axle Vehicles - 4+ Axle Trucks

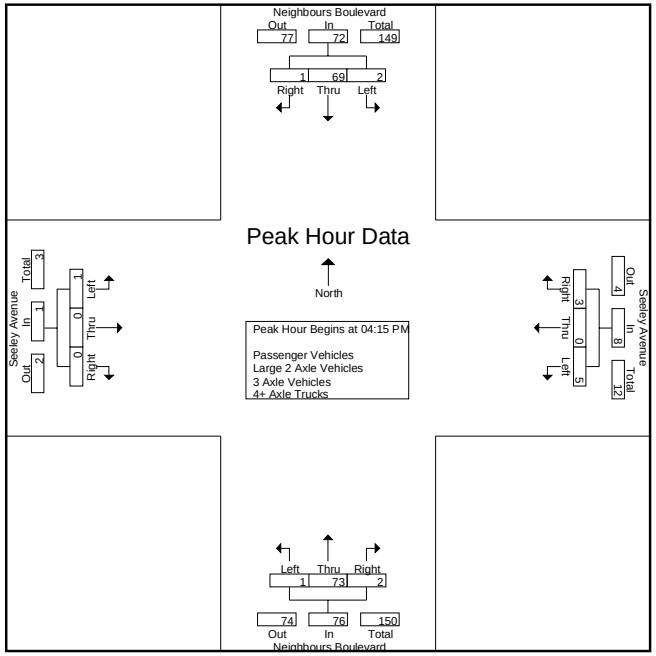
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	19	0	19	0	0	0	0	0	19	0	19	0	0	0	0	38
04:15 PM	0	17	1	18	1	0	1	2	0	16	1	17	0	0	0	0	37
04:30 PM	1	16	0	17	1	0	0	1	1	23	0	24	0	0	0	0	42
04:45 PM	0	14	0	14	1	0	1	2	0	16	1	17	1	0	0	1	34
Total	1	66	1	68	3	0	2	5	1	74	2	77	1	0	0	1	151
05:00 PM	1	22	0	23	2	0	1	3	0	18	0	18	0	0	0	0	44
05:15 PM	2	13	1	16	0	0	0	0	1	12	0	13	0	0	0	0	29
05:30 PM	0	10	0	10	1	0	2	3	0	12	0	12	0	0	0	0	25
05:45 PM	0	6	0	6	0	0	0	0	0	19	0	19	0	0	0	0	25
Total	3	51	1	55	3	0	3	6	1	61	0	62	0	0	0	0	123
Grand Total	4	117	2	123	6	0	5	11	2	135	2	139	1	0	0	1	274
Apprch %	3.3	95.1	1.6		54.5	0	45.5		1.4	97.1	1.4		100	0	0		
Total %	1.5	42.7	0.7	44.9	2.2	0	1.8	4	0.7	49.3	0.7	50.7	0.4	0	0	0.4	
Passenger Vehicles	4	101	2	107	5	0	4	9	2	116	0	118	1	0	0	1	235
% Passenger Vehicles	100	86.3	100	87	83.3	0	80	81.8	100	85.9	0	84.9	100	0	0	100	85.8
Large 2 Axle Vehicles	0	2	0	2	0	0	1	1	0	9	0	9	0	0	0	0	12
% Large 2 Axle Vehicles	0	1.7	0	1.6	0	0	20	9.1	0	6.7	0	6.5	0	0	0	0	4.4
3 Axle Vehicles	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
% 3 Axle Vehicles	0	0.9	0	0.8	0	0	0	0	0	0.7	0	0.7	0	0	0	0	0.7
4+ Axle Trucks	0	13	0	13	1	0	0	1	0	9	2	11	0	0	0	0	25
% 4+ Axle Trucks	0	11.1	0	10.6	16.7	0	0	9.1	0	6.7	100	7.9	0	0	0	0	9.1

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	17	**1**	18	1	0	**1**	2	0	16	**1**	17	0	0	0	0	37
04:30 PM	**1**	16	0	17	1	0	0	1	**1**	**23**	0	**24**	0	0	0	0	42
04:45 PM	0	14	0	14	1	0	1	2	0	16	1	17	**1**	0	0	**1**	34
05:00 PM	1	**22**	0	**23**	**2**	0	1	**3**	0	18	0	18	0	0	0	0	**44**
Total Volume	2	69	1	72	5	0	3	8	1	73	2	76	1	0	0	1	157
% App. Total	2.8	95.8	1.4		62.5	0	37.5		1.3	96.1	2.6		100	0	0		
PHF	.500	.784	.250	.783	.625	.000	.750	.667	.250	.793	.500	.792	.250	.000	.000	.250	.892

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM				04:15 PM				04:00 PM				04:00 PM			
+0 mins.	0	17	**1**	18	1	0	**1**	2	0	19	0	19	0	0	0	0
+15 mins.	**1**	16	0	17	1	0	0	1	0	16	**1**	17	0	0	0	0
+30 mins.	0	14	0	14	1	0	1	2	**1**	**23**	0	**24**	0	0	0	0
+45 mins.	1	**22**	0	**23**	**2**	0	1	**3**	0	16	1	17	**1**	0	0	**1**
Total Volume	2	69	1	72	5	0	3	8	1	74	2	77	1	0	0	1
% App. Total	2.8	95.8	1.4		62.5	0	37.5		1.3	96.1	2.6		100	0	0	
PHF	.500	.784	.250	.783	.625	.000	.750	.667	.250	.804	.500	.802	.250	.000	.000	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Passenger Vehicles

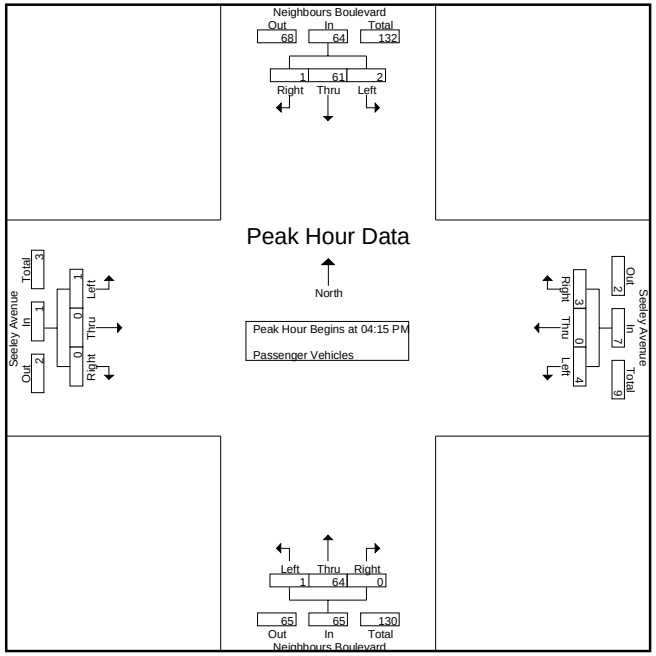
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	18	0	18	0	0	0	0	0	17	0	17	0	0	0	0	35
04:15 PM	0	16	1	17	1	0	1	2	0	13	0	13	0	0	0	0	32
04:30 PM	1	15	0	16	0	0	0	0	1	22	0	23	0	0	0	0	39
04:45 PM	0	12	0	12	1	0	1	2	0	14	0	14	1	0	0	1	29
Total	1	61	1	63	2	0	2	4	1	66	0	67	1	0	0	1	135
05:00 PM	1	18	0	19	2	0	1	3	0	15	0	15	0	0	0	0	37
05:15 PM	2	9	1	12	0	0	0	0	1	11	0	12	0	0	0	0	24
05:30 PM	0	7	0	7	1	0	1	2	0	8	0	8	0	0	0	0	17
05:45 PM	0	6	0	6	0	0	0	0	0	16	0	16	0	0	0	0	22
Total	3	40	1	44	3	0	2	5	1	50	0	51	0	0	0	0	100
Grand Total	4	101	2	107	5	0	4	9	2	116	0	118	1	0	0	1	235
Apprch %	3.7	94.4	1.9		55.6	0	44.4		1.7	98.3	0		100	0	0		
Total %	1.7	43	0.9	45.5	2.1	0	1.7	3.8	0.9	49.4	0	50.2	0.4	0	0	0.4	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	16	**1**	17	1	0	**1**	2	0	13	0	13	0	0	0	0	32
04:30 PM	**1**	15	0	16	0	0	0	0	**1**	**22**	0	**23**	0	0	0	0	**39**
04:45 PM	0	12	0	12	1	0	1	2	0	14	0	14	**1**	0	0	**1**	29
05:00 PM	1	**18**	0	**19**	**2**	0	1	**3**	0	15	0	15	0	0	0	0	37
Total Volume	2	61	1	64	4	0	3	7	1	64	0	65	1	0	0	1	137
% App. Total	3.1	95.3	1.6		57.1	0	42.9		1.5	98.5	0		100	0	0		
PHF	.500	.847	.250	.842	.500	.000	.750	.583	.250	.727	.000	.707	.250	.000	.000	.250	.878

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM				04:15 PM				04:15 PM				04:15 PM			
+0 mins.	0	16	**1**	17	1	0	**1**	2	0	13	0	13	0	0	0	0
+15 mins.	**1**	15	0	16	0	0	0	0	**1**	**22**	0	**23**	0	0	0	0
+30 mins.	0	12	0	12	1	0	1	2	0	14	0	14	**1**	0	0	**1**
+45 mins.	1	**18**	0	**19**	**2**	0	1	**3**	0	15	0	15	0	0	0	0
Total Volume	2	61	1	64	4	0	3	7	1	64	0	65	1	0	0	1
% App. Total	3.1	95.3	1.6		57.1	0	42.9		1.5	98.5	0		100	0	0	
PHF	.500	.847	.250	.842	.500	.000	.750	.583	.250	.727	.000	.707	.250	.000	.000	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- Large 2 Axle Vehicles

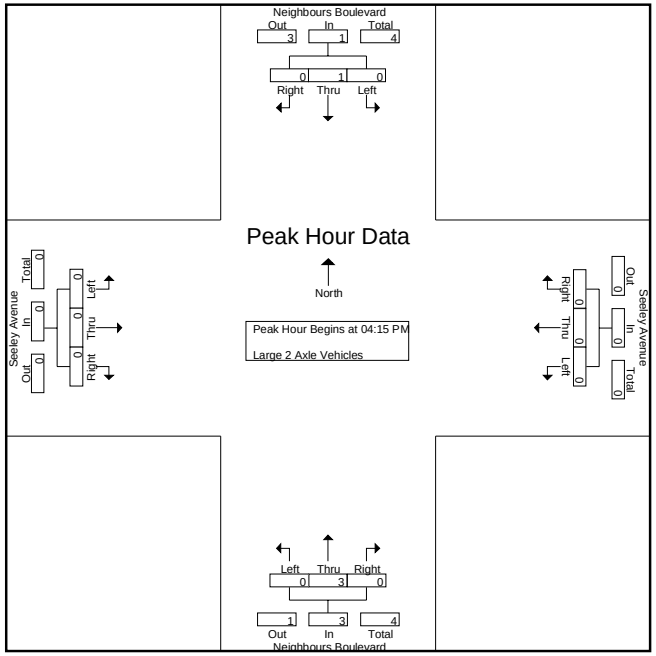
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	2
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
Total	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	0	4
05:00 PM	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
05:15 PM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
05:30 PM	0	0	0	0	0	0	1	1	0	2	0	2	0	0	0	0	3
05:45 PM	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	2
Total	0	2	0	2	0	0	1	1	0	5	0	5	0	0	0	0	8
Grand Total	0	2	0	2	0	0	1	1	0	9	0	9	0	0	0	0	12
Apprch %	0	100	0		0	0	100		0	100	0		0	0	0		
Total %	0	16.7	0	16.7	0	0	8.3	8.3	0	75	0	75	0	0	0	0	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	0	0	0	0	0	0	0	0	**2**	0	**2**	0	0	0	0	**2**
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
05:00 PM	0	**1**	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Volume	0	1	0	1	0	0	0	0	0	3	0	3	0	0	0	0	4
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.375	.000	.375	.000	.000	.000	.000	.500

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM				04:15 PM				04:15 PM				04:15 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	**2**	0	**2**	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
+45 mins.	0	**1**	0	**1**	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	0	1	0	0	0	0	0	3	0	3	0	0	0	0
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0	
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.375	.000	.375	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 3 Axle Vehicles

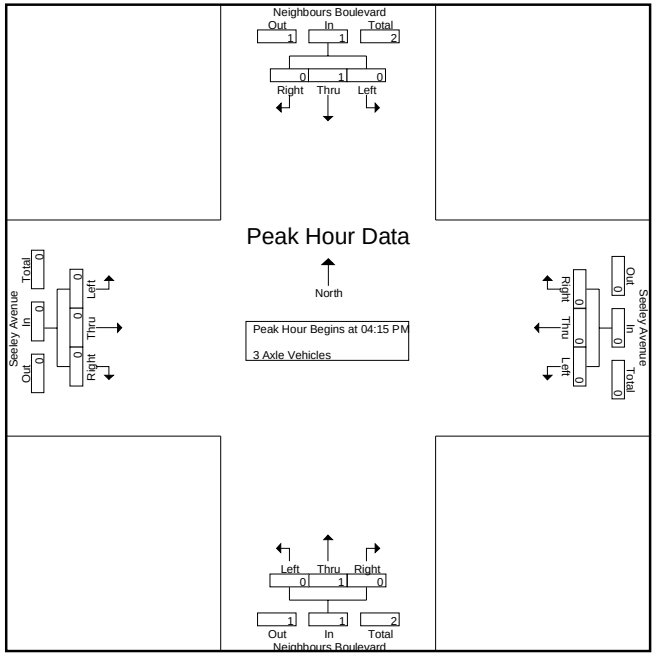
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
Grand Total	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
Apprch %	0	100	0		0	0	0		0	100	0		0	0	0		
Total %	0	50	0	50	0	0	0	0	0	50	0	50	0	0	0	0	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	**1**	0	**1**	0	0	0	0	0	**1**	0	**1**	0	0	0	0	**2**
Total Volume	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0		
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.250

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM				04:15 PM				04:15 PM				04:15 PM			
+0 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+15 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	0	**1**	0	**1**	0	0	0	0	0	**1**	0	**1**	0	0	0	0
Total Volume	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0
% App. Total	0	100	0		0	0	0		0	100	0		0	0	0	
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 1

Groups Printed- 4+ Axle Trucks

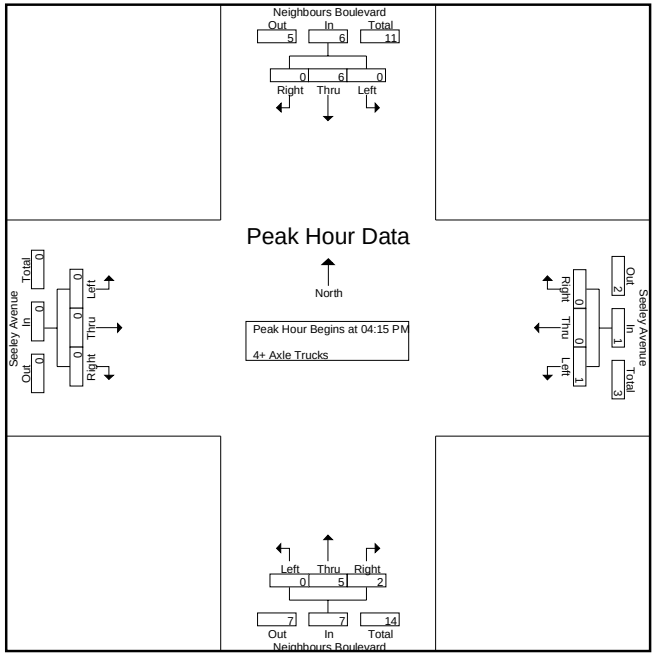
	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	2
04:15 PM	0	1	0	1	0	0	0	0	0	1	1	2	0	0	0	0	3
04:30 PM	0	1	0	1	1	0	0	1	0	1	0	1	0	0	0	0	3
04:45 PM	0	2	0	2	0	0	0	0	0	1	1	2	0	0	0	0	4
Total	0	5	0	5	1	0	0	1	0	4	2	6	0	0	0	0	12
05:00 PM	0	2	0	2	0	0	0	0	0	2	0	2	0	0	0	0	4
05:15 PM	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
05:30 PM	0	3	0	3	0	0	0	0	0	2	0	2	0	0	0	0	5
05:45 PM	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
Total	0	8	0	8	0	0	0	0	0	5	0	5	0	0	0	0	13
Grand Total	0	13	0	13	1	0	0	1	0	9	2	11	0	0	0	0	25
Apprch %	0	100	0		100	0	0		0	81.8	18.2		0	0	0		
Total %	0	52	0	52	4	0	0	4	0	36	8	44	0	0	0	0	

	Neighbours Boulevard Southbound				Seeley Avenue Westbound				Neighbours Boulevard Northbound				Seeley Avenue Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	1	0	1	0	0	0	0	0	1	**1**	**2**	0	0	0	0	3
04:30 PM	0	1	0	1	**1**	0	0	**1**	0	1	0	1	0	0	0	0	3
04:45 PM	0	**2**	0	**2**	0	0	0	0	0	1	1	2	0	0	0	0	**4**
05:00 PM	0	2	0	2	0	0	0	0	0	**2**	0	2	0	0	0	0	4
Total Volume	0	6	0	6	1	0	0	1	0	5	2	7	0	0	0	0	14
% App. Total	0	100	0		100	0	0		0	71.4	28.6		0	0	0		
PHF	.000	.750	.000	.750	.250	.000	.000	.250	.000	.625	.500	.875	.000	.000	.000	.000	.875

Counts Unlimited Inc.
PO Box 1178
Corona, CA 92878
(951) 268-6268

County of Riverside
N/S: Neighbours Boulevard
E/W: Seeley Avenue
Weather: Sunny

File Name : CRVNESEPM
Site Code : 00000001
Start Date : 9/22/2011
Page No : 2



Peak Hour Analysis From 04:15 PM to 05:00 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	04:15 PM				04:15 PM				04:15 PM				04:15 PM			
+0 mins.	0	1	0	1	0	0	0	0	0	1	**1**	**2**	0	0	0	0
+15 mins.	0	1	0	1	**1**	0	0	**1**	0	1	0	1	0	0	0	0
+30 mins.	0	**2**	0	**2**	0	0	0	0	0	1	1	2	0	0	0	0
+45 mins.	0	2	0	2	0	0	0	0	0	**2**	0	2	0	0	0	0
Total Volume	0	6	0	6	1	0	0	1	0	5	2	7	0	0	0	0
% App. Total	0	100	0		100	0	0		0	71.4	28.6		0	0	0	
PHF	.000	.750	.000	.750	.250	.000	.000	.250	.000	.625	.500	.875	.000	.000	.000	.000

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	5	1	1	0	0	0	11	1	0	0	0
07:15 AM	1	4	0	2	0	1	0	9	2	0	0	0
07:30 AM	2	5	1	2	0	0	0	19	2	0	0	0
07:45 AM	1	4	0	3	0	2	1	16	1	0	0	0
08:00 AM	0	8	0	2	0	1	0	12	3	0	0	0
08:15 AM	1	11	0	2	0	0	0	6	2	1	0	0
08:30 AM	0	10	0	1	0	1	1	6	3	0	0	0
08:45 AM	0	4	0	2	0	1	0	4	2	0	0	0
Peak Hour 07:30 AM	4	28	1	9	0	3	1	53	8	1	0	0

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Hour 07:30 AM	4	48	1	21	2	6	1	55	16	1	0	2

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	1	0	1	0	0	0	0	1	0	0	0
07:30 AM	0	1	0	0	0	1	0	0	0	0	0	0
07:45 AM	0	1	0	0	0	0	0	1	0	0	0	0
08:00 AM	0	0	0	0	0	1	0	0	0	0	0	0
08:15 AM	0	1	0	0	0	0	0	0	1	0	0	0
08:30 AM	0	0	0	1	0	1	0	0	0	0	0	0
08:45 AM	0	2	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:30 AM	0	3	0	0	0	2	0	1	1	0	0	0
PCE 1.5	0	5	0	0	0	3	0	2	2	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	1	0	0	0
07:30 AM	0	0	0	0	1	0	0	0	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:30 AM	0	0	0	0	1	0	0	0	0	0	0	1
PCE 2.0	0	0	0	0	2	0	0	0	0	0	0	2

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEAM.ppd
Start Date: 9/22/2011
Start Time: 7:00:00 AM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
07:00 AM	0	0	0	1	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	1	0	0	0	0	1	0	0	0
07:30 AM	0	0	0	2	0	0	0	0	1	0	0	0
07:45 AM	0	2	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	2	0	1	0	0	0	0	1	0	0	0
08:15 AM	0	1	0	1	0	0	0	0	0	0	0	0
08:30 AM	0	1	0	2	0	0	0	0	1	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 07:30 AM	0	5	0	4	0	0	0	0	2	0	0	0
PCE 3.0	0	15	0	12	0	0	0	0	6	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	18	0	0	0	0	0	17	0	0	0	0
04:15 PM	0	16	1	1	0	1	0	13	0	0	0	0
04:30 PM	1	15	0	0	0	0	1	22	0	0	0	0
04:45 PM	0	12	0	1	0	1	0	14	0	1	0	0
05:00 PM	1	18	0	2	0	1	0	15	0	0	0	0
05:15 PM	2	9	1	0	0	0	1	11	0	0	0	0
05:30 PM	0	7	0	1	0	1	0	8	0	0	0	0
05:45 PM	0	6	0	0	0	0	0	16	0	0	0	0
Peak Hour 04:15 PM	2	61	1	4	0	3	1	64	0	1	0	0

SUMMARY WITH PCE

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Hour 04:15 PM	2	83	1	7	0	3	1	86	6	1	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	1	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	2	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	1	0	0	0	0
05:00 PM	0	1	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	1	0	0	0	0	0	1	0	0	0	0
05:30 PM	0	0	0	0	0	1	0	2	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	2	0	0	0	0
Peak Hour 04:15 PM	0	1	0	0	0	0	0	3	0	0	0	0
PCE 1.5	0	2	0	0	0	0	0	5	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	1	0	0	0	0	0	1	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour 04:15 PM	0	1	0	0	0	0	0	1	0	0	0	0
PCE 2.0	0	2	0	0	0	0	0	2	0	0	0	0

File Name: X:\Jobs Folder\11Q3\041-11222\CRVNESEPM.ppd
Start Date: 9/22/2011
Start Time: 4:00:00 PM
Site Code: 00000001
Comment 1: County of Riverside
Comment 2: N/S: Neighbours Boulevard
Comment 3: E/W: Seeley Avenue
Comment 4: Weather: Sunny

	Neighbours Boulevard Southbound			Seeley Avenue Westbound			Neighbours Boulevard Northbound			Seeley Avenue Eastbound		
Start Time	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
04:00 PM	0	1	0	0	0	0	0	1	0	0	0	0
04:15 PM	0	1	0	0	0	0	0	1	1	0	0	0
04:30 PM	0	1	0	1	0	0	0	1	0	0	0	0
04:45 PM	0	2	0	0	0	0	0	1	1	0	0	0
05:00 PM	0	2	0	0	0	0	0	2	0	0	0	0
05:15 PM	0	3	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	3	0	0	0	0	0	2	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	1	0	0	0	0
Peak Hour 04:15 PM	0	6	0	1	0	0	0	5	2	0	0	0
PCE 3.0	0	18	0	3	0	0	0	15	6	0	0	0

APPENDIX B

EXISTING INTERSECTION ANALYSIS WORKSHEETS

Scenario Report

Scenario:	Existing AM
Command:	Existing AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	none
Trip Distribution:	none
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.010	A	9.0	0.010	+ 0.000 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.015	A	9.0	0.015	+ 0.000 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.010	A	9.2	0.010	+ 0.000 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.4	0.030	A	9.4	0.030	+ 0.000 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 6.9 Worst Case Level Of Service: A[9.0]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1!	0	0	0 0	1	0 0	0 0	0	1 0	0	1	0 0 0
Volume Module:												
Base Vol:	6	2	3	0	1	0	0	5	6	5	4	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	6	2	3	0	1	0	0	5	6	5	4	0
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	6	2	3	0	1	0	0	5	6	5	4	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
PHF Volume:	10	3	5	0	2	0	0	8	10	8	7	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	10	3	5	0	2	0	0	8	10	8	7	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	xxxxx
Capacity Module:												
Cnflict Vol:	2	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	30	2	37	28	xxxxx
Potent Cap.:	1634	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	866	1089	973	869	xxxxx
Move Cap.:	1634	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	861	1089	952	864	xxxxx
Volume/Cap:	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.01	0.01	0.01	0.01	xxxx
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	972	911	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	0.1	0.1	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.8	9.0	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	A	A	*	*
ApproachDel:	xxxxxx			xxxxxx			8.8			9.0		
ApproachLOS:	*			*			A			A		

Note: Queue reported is the number of cars per lane.

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 1.5 Worst Case Level Of Service: A[9.0]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1	0	0 0	0 0	1	0 1	0 0	0	0 0	0	1	0 0 1
Volume Module:												
Base Vol:	5	52	0	0	27	45	0	0	0	10	0	11
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	5	52	0	0	27	45	0	0	0	10	0	11
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	5	52	0	0	27	45	0	0	0	10	0	11
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
PHF Volume:	6	67	0	0	35	58	0	0	0	13	0	14
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	6	67	0	0	35	58	0	0	0	13	0	14
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	35	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	143	114	67
Potent Cap.:	1590	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	855	780	1003
Move Cap.:	1590	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	852	777	1003
Volume/Cap:	0.00	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.02	0.00	0.01
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.0
Control Del:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.6
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	852	xxxx	xxxxx
SharedQueue:	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx
Shrd ConDel:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	9.3	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	A	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			9.0		
ApproachLOS:	*			*			*			A		

Note: Queue reported is the number of cars per lane.

```
Existing AM                Fri Feb 8, 2013 10:01:06                  Page 5-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      1.1       Worst Case Level Of Service: A[  9.2]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:        0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0   55    41    12   51     0     6    0     4     0    0     0
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   55    41    12   51     0     6    0     4     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   69    51    15   64     0     8    0     5     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   69    51    15   64     0     8    0     5     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    69 xxxx xxxxx   188  163    64  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1545 xxxx xxxxx   805  733  1006  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1545 xxxx xxxxx   799  726  1006  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.01 xxxx  xxxx  0.01 0.00  0.00  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx   0.0  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx   8.6 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   799 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx   9.5 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     A    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx              9.2           xxxxxx
ApproachLOS:         *                *                A                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```



```
Existing AM                Fri Feb 8, 2013 10:01:06                  Page 6-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      2.1       Worst Case Level Of Service: A[  9.4]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0 1! 0  0    0  0 1! 0  0    0  0 1! 0  0    0  0 1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    1   55    16     4   48     1     1    0     2    21    2     6
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   55    16     4   48     1     1    0     2    21    2     6
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   65    19     5   57     1     1    0     2    25    2     7
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   65    19     5   57     1     1    0     2    25    2     7
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   58 xxxx xxxxx    84 xxxx xxxxx   149  154    58   145  145    75
Potent Cap.: 1559 xxxx xxxxx  1525 xxxx xxxxx   823  742  1014   828  750   992
Move Cap.:   1559 xxxx xxxxx  1525 xxxx xxxxx   813  739  1014   824  747   992
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.00 0.00  0.00  0.03 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.3 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  937 xxxxx  xxxx  847 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx xxxxx  0.1 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  8.9 xxxxx xxxxx  9.4 xxxxx
Shared LOS:     *    *     *     *    *     *     *    A     *     *    A     *
ApproachDel:    xxxxxx           xxxxxx              8.9              9.4
ApproachLOS:         *                *                A                A
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```

APPENDIX C
PROJECT CONSTRUCTION ANALYSIS WORKSHEETS

Scenario Report

Scenario:	Existing Plus Ambient AM
Command:	Existing Plus Ambient AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	A	9.0	0.011	+ 0.000 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	A	9.0	0.016	+ 0.000 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	A	9.2	0.011	+ 0.000 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	A	9.5	0.033	+ 0.000 D/V

```
Existing Plus Ambient AM   Fri Feb 8, 2013 10:09:40                  Page 3-1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
*******************************************************************************
Average Delay (sec/veh):      6.9       Worst Case Level Of Service: A[  9.0]
*******************************************************************************
Street Name:          Neighbours Blvd                    Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1! 0  0    0  0  1  0  0    0  0  0  1  0    0  1  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6    2     3     0    1     0     0    5     6     5    4     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6    2     3     0    1     0     0    5     6     5    4     0
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    6    2     3     0    1     0     0    5     6     5    4     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59
PHF Volume:    11    4     5     0    2     0     0    9    11     9    7     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   11    4     5     0    2     0     0    9    11     9    7     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5 xxxxx
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0 xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    2 xxxx xxxxx  xxxx xxxx xxxxx  xxxx   33     2    40   30 xxxxx
Potent Cap.: 1634 xxxx xxxxx  xxxx xxxx xxxxx  xxxx  864  1088   969  867 xxxxx
Move Cap.:   1634 xxxx xxxxx  xxxx xxxx xxxxx  xxxx  858  1088   946  861 xxxxx
Volume/Cap:  0.01 xxxx  xxxx  xxxx xxxx  xxxx  xxxx 0.01  0.01  0.01 0.01  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A     *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   970   906 xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   0.1   0.1 xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   8.8   9.0 xxxx xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     A     A    *     *
ApproachDel:    xxxxxx           xxxxxx             8.8              9.0
ApproachLOS:         *                *               A                A
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

 Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Existing Plus Ambient AM   Fri Feb 8, 2013 10:09:40                  Page 4-1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
*******************************************************************************
Average Delay (sec/veh):      1.5       Worst Case Level Of Service: A[  9.0]
*******************************************************************************
Street Name:          Neighbours Blvd                    I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Channel          Include          Channel
Lanes:        0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       5   52     0     0   27    45     0    0     0    10    0    11
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    5   56     0     0   29    49     0    0     0    11    0    12
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    5   56     0     0   29    49     0    0     0    11    0    12
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78
PHF Volume:     7   72     0     0   37    62     0    0     0    14    0    15
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    7   72     0     0   37    62     0    0     0    14    0    15
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   37 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   154  123    72
Potent Cap.: 1586 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   842  771   996
Move Cap.:   1586 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   839  768   996
Volume/Cap:  0.00 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.02 0.00  0.02
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   0.0
Control Del:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   8.7
LOS by Move:    A     *     *     *    *     *     *    *     *     *    *     A
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   839 xxxx xxxxx
SharedQueue:  0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   0.1 xxxx xxxxx
Shrd ConDel:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   9.4 xxxx xxxxx
Shared LOS:     A    *     *     *    *     *     *    *     *     A    *     *
ApproachDel:    xxxxxx           xxxxxx             xxxxxx             9.0
ApproachLOS:         *                *                  *               A
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

 Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Existing Plus Ambient AM   Fri Feb 8, 2013 10:09:40                  Page 5-1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      1.1       Worst Case Level Of Service: A[  9.2]
******************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:        0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   59    44    13   55     0     6    0     4     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   74    55    16   69     0     8    0     5     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   74    55    16   69     0     8    0     5     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    74 xxxx xxxxx   203  176    69  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1538 xxxx xxxxx   790  721  1000  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1538 xxxx xxxxx   783  714  1000  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.01 xxxx  xxxx  0.01 0.00  0.01  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx   0.0  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx   8.6 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   783 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx   9.6 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     A    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx              9.2           xxxxxx
ApproachLOS:         *                *                A                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```



```
Existing Plus Ambient AM   Fri Feb 8, 2013 10:09:40                  Page 6-1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      2.2       Worst Case Level Of Service: A[  9.5]
******************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0 1! 0  0    0  0 1! 0  0    0  0 1! 0  0    0  0 1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   59    17     4   52     1     1    0     2    23    2     6
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   71    21     5   62     1     1    0     3    27    3     8
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   71    21     5   62     1     1    0     3    27    3     8
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   63 xxxx xxxxx    91 xxxx xxxxx   161  166    62   157  156    81
Potent Cap.: 1553 xxxx xxxxx  1517 xxxx xxxxx   809  730  1008   814  739   985
Move Cap.:   1553 xxxx xxxxx  1517 xxxx xxxxx   798  727  1008   809  736   985
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.00 0.00  0.00  0.03 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.3 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  927 xxxxx  xxxx  834 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx xxxxx  0.1 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  8.9 xxxxx xxxxx  9.5 xxxxx
Shared LOS:     *    *     *     *    *     *     *    A     *     *    A     *
ApproachDel:    xxxxxx           xxxxxx              8.9              9.5
ApproachLOS:         *                *                A                A
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

Scenario Report

Scenario:	Existing Plus Ambient PM
Command:	Existing Plus Ambient PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	A	8.6	0.005	+ 0.000 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	A	9.5	0.066	+ 0.000 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	A	9.6	0.068	+ 0.000 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	A	9.9	0.011	+ 0.000 D/V

```
Existing Plus Ambient PM   Fri Feb 8, 2013 10:18:00                  Page 3-1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
*******************************************************************************
Average Delay (sec/veh):      3.5       Worst Case Level Of Service: A[  8.6]
*******************************************************************************
Street Name:          Neighbours Blvd                    Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1! 0  0    0  0  1  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1    5     2     0    4     0     0    1     2     3    0     1
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1    5     2     0    4     0     0    1     2     3    0     1
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1    5     2     0    4     0     0    1     2     3    0     1
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.68 0.68  0.68  0.68 0.68  0.68  0.68 0.68  0.68  0.68 0.68  0.68
PHF Volume:     2    8     3     0    6     0     0    2     3     5    0     2
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    2    8     3     0    6     0     0    2     3     5    0     2
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    6 xxxx xxxxx  xxxx xxxx xxxxx  xxxx   21     6    21   19    10
Potent Cap.: 1628 xxxx xxxxx  xxxx xxxx xxxxx  xxxx  877  1082   996  879  1078
Move Cap.:   1628 xxxx xxxxx  xxxx xxxx xxxxx  xxxx  876  1082   991  878  1078
Volume/Cap:  0.00 xxxx  xxxx  xxxx xxxx  xxxx  xxxx 0.00  0.00  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx  1004  xxxx 1012 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   0.0 xxxxx  0.0 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   8.6 xxxxx  8.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     A     *    A     *
ApproachDel:    xxxxxx           xxxxxx             8.6              8.6
ApproachLOS:         *                *               A                A
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************
```



```
Existing Plus Ambient PM   Fri Feb 8, 2013 10:18:00                  Page 4-1
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
*******************************************************************************
Average Delay (sec/veh):      2.9       Worst Case Level Of Service: A[  9.5]
*******************************************************************************
Street Name:          Neighbours Blvd                    I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Channel          Include          Channel
Lanes:        0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6   75     0     0   45    10     0    0     0    42    0    10
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6   81     0     0   49    11     0    0     0    45    0    11
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    6   81     0     0   49    11     0    0     0    45    0    11
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     8   97     0     0   58    13     0    0     0    54    0    13
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    8   97     0     0   58    13     0    0     0    54    0    13
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   58 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   177  170    97
Potent Cap.: 1559 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   818  727   965
Move Cap.:   1559 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   815  723   965
Volume/Cap:  0.00 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.07 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   0.0
Control Del:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   8.8
LOS by Move:    A    *     *     *    *     *     *    *     *     *    *     A
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   815 xxxx xxxxx
SharedQueue:  0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   0.2 xxxx xxxxx
Shrd ConDel:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   9.7 xxxx xxxxx
Shared LOS:     A    *     *     *    *     *     *    *     *     A    *     *
ApproachDel:    xxxxxx           xxxxxx             xxxxxx             9.5
ApproachLOS:         *                *                  *               A
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************
```

```
Existing Plus Ambient PM   Fri Feb 8, 2013 10:18:00                  Page 5-1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      2.7       Worst Case Level Of Service: A[  9.6]
******************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:        0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   35    54    12   73     0    43    0    13     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   38    58    13   79     0    46    0    14     0    0     0
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   38    58    13   79     0    46    0    14     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87
PHF Volume:     0   44    67    15   91     0    54    0    16     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   44    67    15   91     0    54    0    16     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    44 xxxx xxxxx   198  164    91  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1578 xxxx xxxxx   795  732   972  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1578 xxxx xxxxx   789  725   972  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.01 xxxx  xxxx  0.07 0.00  0.02  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx   0.1  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.3 xxxx xxxxx xxxxx xxxx   8.8 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   789 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx   0.2 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.3 xxxx xxxxx   9.9 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     A    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx              9.6           xxxxxx
ApproachLOS:         *                *                A              *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```



```
Existing Plus Ambient PM   Fri Feb 8, 2013 10:18:00                  Page 6-1
------------------------------------------------------------------------------
------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      0.7       Worst Case Level Of Service: A[  9.9]
******************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0 1! 0  0    0  0 1! 0  0    1  0  0  0  0    0  0 1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   86     6     2   83     1     1    0     0     7    0     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   93     6     2   90     1     1    0     0     8    0     3
Added Vol:      0    0     0     0    0     0     0    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   93     6     2   90     1     1    0     0     8    0     3
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89
PHF Volume:     1  104     7     2  100     1     1    0     0     8    0     4
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  104     7     2  100     1     1    0     0     8    0     4
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1 xxxx xxxxx   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5 xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  102 xxxx xxxxx   111 xxxx xxxxx   218 xxxx xxxxx   216  217   108
Potent Cap.: 1503 xxxx xxxxx  1491 xxxx xxxxx   743 xxxx xxxxx   745  685   952
Move Cap.:   1503 xxxx xxxxx  1491 xxxx xxxxx   738 xxxx xxxxx   743  683   952
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.01 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.4 xxxx xxxxx   7.4 xxxx xxxxx   9.9 xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     A    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  796 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  9.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     *     *    A     *
ApproachDel:    xxxxxx           xxxxxx              9.9              9.6
ApproachLOS:         *                *                A                A
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

With Project

Scenario Report

Scenario:	Existing Plus Ambient AM
Command:	Existing Plus Ambient AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

With Project

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	C	16.4	0.179	+ 7.399 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	B	11.1	0.312	+ 2.052 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	B	11.2	0.133	+ 1.934 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	B	10.6	0.042	+ 1.064 D/V

Existing Plus Ambient AM Fri Feb 8, 2013 10:46:22 Page 3-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 8.1 Worst Case Level Of Service: C[16.4]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1!	0	0	0 0	1	0 0	0 0	0	1 0	0	1	0 0 0
Volume Module:												
Base Vol:	6	2	3	0	1	0	0	5	6	5	4	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	2	3	0	1	0	0	5	6	5	4	0
Added Vol:	166	0	0	0	0	0	0	0	6	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	172	2	3	0	1	0	0	5	12	5	4	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
PHF Volume:	292	4	5	0	2	0	0	9	21	9	7	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	292	4	5	0	2	0	0	9	21	9	7	0
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	xxxxx
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	xxxxx
Capacity Module:												
Cnflict Vol:	2	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	595	2	607	592	xxxxx
Potent Cap.:	1634	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	420	1088	411	422	xxxxx
Move Cap.:	1634	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	331	1088	330	332	xxxxx
Volume/Cap:	0.18	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.03	0.02	0.03	0.02	xxxx
Level Of Service Module:												
2Way95thQ:	0.6	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	643	331	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	0.1	0.2	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	10.9	16.4	xxxx	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	B	C	*	*
ApproachDel:	xxxxxx			xxxxxx			10.9			16.4		
ApproachLOS:	*			*			B			C		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Existing Plus Ambient AM Fri Feb 8, 2013 10:46:22 Page 4-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 6.9 Worst Case Level Of Service: B[11.1]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1	0	0 0	0 0	1	0 1	0 0	0	0 0	0	1	0 0 1
Volume Module:												
Base Vol:	5	52	0	0	27	45	0	0	0	10	0	11
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	5	56	0	0	29	49	0	0	0	11	0	12
Added Vol:	4	51	0	0	3	2	0	0	0	173	0	115
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	9	107	0	0	32	51	0	0	0	184	0	127
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
PHF Volume:	12	137	0	0	41	65	0	0	0	235	0	162
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	12	137	0	0	41	65	0	0	0	235	0	162
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	41	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	235	202	137
Potent Cap.:	1581	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	758	697	917
Move Cap.:	1581	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	753	692	917
Volume/Cap:	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.31	0.00	0.18
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.6
Control Del:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	9.8
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	753	xxxx	xxxxx
SharedQueue:	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	1.3	xxxx	xxxxx
Shrd ConDel:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	11.9	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	B	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			11.1		
ApproachLOS:	*			*			*			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Existing Plus Ambient AM   Fri Feb 8, 2013 10:46:22                  Page 5-1
------------------------------------------------------------------------------
                              With Project
------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      3.4       Worst Case Level Of Service: B[ 11.2]
******************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0    4     5     3  173     0    51    0    76     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   63    49    16  228     0    57    0    80     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   79    62    20  285     0    72    0   101     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   79    62    20  285     0    72    0   101     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    79 xxxx xxxxx   436  405   285  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1532 xxxx xxxxx   582  538   758  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1532 xxxx xxxxx   576  531   758  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.01 xxxx  xxxx  0.12 0.00  0.13  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx   0.5  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx  10.5 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     B     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   576 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx   0.4 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx  12.1 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     B    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            11.2           xxxxxx
ApproachLOS:         *                *               B                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```



```
Existing Plus Ambient AM   Fri Feb 8, 2013 10:46:22                  Page 6-1
------------------------------------------------------------------------------
                              With Project
------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      1.1       Worst Case Level Of Service: B[ 10.6]
******************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0    0     0     0    0   249     8    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   59    17     4   52   250     9    0     2    23    2     6
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   71    21     5   62   297    11    0     3    27    3     8
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   71    21     5   62   297    11    0     3    27    3     8
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  359 xxxx xxxxx    91 xxxx xxxxx   309  314   210   305  452    81
Potent Cap.: 1211 xxxx xxxxx  1517 xxxx xxxxx   648  605   835   651  506   985
Move Cap..:  1211 xxxx xxxxx  1517 xxxx xxxxx   638  602   835   647  504   985
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.02 0.00  0.00  0.04 0.01  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  8.0 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  668 xxxxx  xxxx  682 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.1 xxxxx xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 10.5 xxxxx xxxxx 10.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    B     *     *    B     *
ApproachDel:    xxxxxx           xxxxxx            10.5           10.6
ApproachLOS:         *                *               B                B
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

With Project

Scenario Report

Scenario:	Existing Plus Ambient PM
Command:	Existing Plus Ambient PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

With Project

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	10.2	0.229	+ 1.637 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	B	12.5	0.124	+ 2.925 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	B	13.8	0.144	+ 4.148 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	B	12.9	0.381	+ 3.021 D/V

Existing Plus Ambient PM Fri Feb 8, 2013 10:48:36 Page 3-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 8.7 Worst Case Level Of Service: B[10.2]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1!	0	0	0 0	1	0 0	0 0	0	1 0	0 0	1!	0 0
Volume Module:												
Base Vol:	1	5	2	0	4	0	0	1	2	3	0	1
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	5	2	0	4	0	0	1	2	3	0	1
Added Vol:	6	0	0	0	0	0	0	0	166	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	7	5	2	0	4	0	0	1	168	3	0	1
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
PHF Volume:	10	8	3	0	6	0	0	2	248	5	0	2
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	10	8	3	0	6	0	0	2	248	5	0	2
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	6	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	38	6	161	37	10
Potent Cap.:	1628	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	858	1082	808	860	1078
Move Cap.:	1628	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	852	1082	619	854	1078
Volume/Cap:	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.00	0.23	0.01	0.00	0.00
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	1080	xxxx	693	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	0.9	xxxxx	0.0	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	9.3	xxxxx	10.2	xxxxx
Shared LOS:	*	*	*	*	*	*	*	A	*	B	*	
ApproachDel:	xxxxxx			xxxxxx			9.3			10.2		
ApproachLOS:	*			*			A			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Existing Plus Ambient PM Fri Feb 8, 2013 10:48:36 Page 4-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 3.2 Worst Case Level Of Service: B[12.5]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1	0	0 0	0 0	1	0 1	0 0	0	0 0	0 1	0	0 1
Volume Module:												
Base Vol:	6	75	0	0	45	10	0	0	0	42	0	10
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	81	0	0	49	11	0	0	0	45	0	11
Added Vol:	76	3	0	0	115	50	0	0	0	5	0	3
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	82	84	0	0	164	61	0	0	0	50	0	14
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
PHF Volume:	98	100	0	0	195	73	0	0	0	60	0	16
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	98	100	0	0	195	73	0	0	0	60	0	16
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	195	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	529	492	100
Potent Cap.:	1390	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	514	480	961
Move Cap.:	1390	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	485	444	961
Volume/Cap:	0.07	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.12	0.00	0.02
Level Of Service Module:												
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.1
Control Del:	7.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.8
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	485	xxxx	xxxxx
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.4	xxxx	xxxxx
Shrd ConDel:	7.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	13.5	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	B	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			12.5		
ApproachLOS:	*			*			*			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Existing Plus Ambient PM   Fri Feb 8, 2013 10:48:36                  Page 5-1
------------------------------------------------------------------------------
                              With Project
------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      3.1       Worst Case Level Of Service: B[ 13.8]
******************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   35    54    12   73     0    43    0    13     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   38    58    13   79     0    46    0    14     0    0     0
Added Vol:      0   76   173   115    5     0     3    0     4     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0  114   231   128   84     0    49    0    18     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87
PHF Volume:     0  131   267   148   97     0    57    0    21     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  131   267   148   97     0    57    0    21     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   131 xxxx xxxxx   657  523    97  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1466 xxxx xxxxx   433  461   965  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1466 xxxx xxxxx   397  411   965  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.10 xxxx  xxxx  0.14 0.00  0.02  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.3 xxxx xxxxx  xxxx xxxx   0.1  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.7 xxxx xxxxx xxxxx xxxx   8.8 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   397 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.3 xxxx xxxxx   0.5 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.7 xxxx xxxxx  15.6 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     C    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            13.8           xxxxxx
ApproachLOS:         *                *               B                *
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```



```
Existing Plus Ambient PM   Fri Feb 8, 2013 10:48:36                  Page 6-1
------------------------------------------------------------------------------
                              With Project
------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
******************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
******************************************************************************
Average Delay (sec/veh):      7.2       Worst Case Level Of Service: B[ 12.9]
******************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    1  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   86     6     2   83     1     1    0     0     7    0     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   93     6     2   90     1     1    0     0     8    0     3
Added Vol:      0    0     0     0    0     9   248    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   93     6     2   90    10   249    0     0     8    0     3
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89
PHF Volume:     1  104     7     2  100    11   279    0     0     8    0     4
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  104     7     2  100    11   279    0     0     8    0     4
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1 xxxx xxxxx   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5 xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  112 xxxx xxxxx   111 xxxx xxxxx   223 xxxx xxxxx   221  227   108
Potent Cap.: 1491 xxxx xxxxx  1491 xxxx xxxxx   737 xxxx xxxxx   739  676   952
Move Cap.:   1491 xxxx xxxxx  1491 xxxx xxxxx   733 xxxx xxxxx   738  674   952
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.38 xxxx  xxxx  0.01 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx   1.8 xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.4 xxxx xxxxx   7.4 xxxx xxxxx  12.9 xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     B    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  791 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  9.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     *     *    A     *
ApproachDel:    xxxxxx           xxxxxx            12.9            9.6
ApproachLOS:         *                *               B                A
******************************************************************************
Note: Queue reported is the number of cars per lane.
******************************************************************************
```

APPENDIX D
CUMULATIVE INTERSECTION ANALYSIS WORKSHEET

Scenario Report

Scenario:	Ex Plus Am Plus CP AM
Command:	Existing Plus Am+ CP AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	B	14.2	0.147	+ 5.130 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	C	19.2	0.656	+10.153 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	D	34.7	0.885	+25.485 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	C	23.3	0.142	+13.769 D/V

```
Ex Plus Am Plus CP AM      Thu May 2, 2013 12:56:16                  Page 3-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      8.0       Worst Case Level Of Service: B[ 14.2]
********************************************************************************
Street Name:          Neighbours Blvd                   Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1! 0  0    0  1  0  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6    2     3     0    1     0     0    5     6     5    4     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6    2     3     0    1     0     0    5     6     5    4     0
Added Vol:    135    0     4     1    0     0     0    0     3     5    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  141    2     7     1    1     0     0    5     9    10    4     1
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59
PHF Volume:   239    4    12     2    2     0     0    9    16    18    7     2
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:  239    4    12     2    2     0     0    9    16    18    7     2
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    2 xxxx xxxxx    16 xxxx xxxxx  xxxx  500     2   506  494    10
Potent Cap.: 1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  476  1088   480  479  1078
Move Cap.:   1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  395  1088   404  398  1078
Volume/Cap:  0.15 xxxx  xxxx  0.00 xxxx  xxxx  xxxx 0.02  0.01  0.04 0.02  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.5 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.6 xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A     *     *    A     *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   665  xxxx  419 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx   0.1 xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx  10.6 xxxxx 14.2 xxxxx
Shared LOS:     *    *     *     A     *     *     *    *     B     *     B     *
ApproachDel:    xxxxxx           xxxxxx            10.6             14.2
ApproachLOS:         *                *               B                B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```



```
Ex Plus Am Plus CP AM      Thu May 2, 2013 12:56:17                  Page 4-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     13.3       Worst Case Level Of Service: C[ 19.2]
********************************************************************************
Street Name:          Neighbours Blvd                   I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Channel          Include          Channel
Lanes:        0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       5   52     0     0   27    45     0    0     0    10    0    11
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    5   56     0     0   29    49     0    0     0    11    0    12
Added Vol:     11  145     0     0   14     8     0    0     0   295    0   391
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   16  201     0     0   43    57     0    0     0   306    0   403
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78
PHF Volume:    21  258     0     0   55    72     0    0     0   392    0   516
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   21  258     0     0   55    72     0    0     0   392    0   516
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   55 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   391  355   258
Potent Cap.: 1563 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   617  574   786
Move Cap.:   1563 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   611  566   786
Volume/Cap:  0.01 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.64 0.00  0.66
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   5.0
Control Del:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx  17.9
LOS by Move:    A     *     *    A     *     *     *    *     *     *    *     C
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   611 xxxx xxxxx
SharedQueue:  0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   4.6 xxxx xxxxx
Shrd ConDel:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx  20.8 xxxx xxxxx
Shared LOS:     A    *     *     *    *     *     *    *     *     C     *     *
ApproachDel:    xxxxxx           xxxxxx            xxxxxx           19.2
ApproachLOS:         *                *                 *              C
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```

```
Ex Plus Am Plus CP AM      Thu May 2, 2013 12:56:17                  Page 5-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     18.1       Worst Case Level Of Service: D[ 34.7]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:        0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0   28    29    12  298     0   128    0   434     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   87    73    25  353     0   134    0   438     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0  109    92    31  442     0   168    0   549     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  109    92    31  442     0   168    0   549     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   109 xxxx xxxxx   660  614   442  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1494 xxxx xxxxx   431  410   620  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1494 xxxx xxxxx   424  401   620  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.02 xxxx  xxxx  0.40 0.00  0.89  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.1 xxxx xxxxx  xxxx xxxx  10.6  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.5 xxxx xxxxx xxxxx xxxx  39.6 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     E     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   424 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.1 xxxx xxxxx   1.9 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.5 xxxx xxxxx  19.0 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     C    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            34.7           xxxxxx
ApproachLOS:         *                *               D                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```



```
Ex Plus Am Plus CP AM      Thu May 2, 2013 12:56:17                  Page 6-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      0.9       Worst Case Level Of Service: C[ 23.3]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0   57     0     1  731     0     0    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1  116    17     5  783     1     1    0     2    23    2     7
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1  138    21     6  930     1     1    0     3    27    3     9
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  138    21     6  930     1     1    0     3    27    3     9
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  931 xxxx xxxxx   159 xxxx xxxxx  1100 1104   930  1095 1095   149
Potent Cap.:  743 xxxx xxxxx  1433 xxxx xxxxx   191  213   327   193  216   904
Move Cap.:    743 xxxx xxxxx  1433 xxxx xxxxx   187  211   327   190  214   904
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.01 0.00  0.01  0.14 0.01  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  9.9 xxxx xxxxx   7.5 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  261 xxxxx  xxxx  235 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx xxxxx  0.6 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 19.0 xxxxx xxxxx 23.3 xxxxx
Shared LOS:     *    *     *     *    *     *     *    C     *     *    C     *
ApproachDel:    xxxxxx           xxxxxx            19.0           23.3
ApproachLOS:         *                *               C                C
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```

Scenario Report

Scenario:	Ex Plus Am Plus CP PM
Command:	Existing Plus Am+ CP PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	10.0	0.187	+ 1.413 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	F	257.1	1.288	+247.509 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	F	294.0	1.306	+284.397 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	C	21.8	0.039	+11.932 D/V

```
Ex Plus Am Plus CP PM      Thu May 2, 2013 14:17:10                  Page 3-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      8.2       Worst Case Level Of Service: B[ 10.0]
********************************************************************************
Street Name:          Neighbours Blvd                    Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0  1! 0  0    0  1  0  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1    5     2     0    4     0     0    1     2     3    0     1
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1    5     2     0    4     0     0    1     2     3    0     1
Added Vol:      3    0     6     1    0     0     0    0   135     5    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    4    5     8     1    4     0     0    1   137     8    0     2
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.68 0.68  0.68  0.68 0.68  0.68  0.68 0.68  0.68  0.68 0.68  0.68
PHF Volume:     6    8    12     1    6     0     0    2   202    12    0     3
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    6    8    12     1    6     0     0    2   202    12    0     3
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    6 xxxx xxxxx    20 xxxx xxxxx  xxxx   41     6   137   35    14
Potent Cap.: 1628 xxxx xxxxx  1609 xxxx xxxxx  xxxx  855  1082   838  861  1072
Move Cap.:   1628 xxxx xxxxx  1609 xxxx xxxxx  xxxx  851  1082   679  857  1072
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  xxxx 0.00  0.19  0.02 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.2 xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx  1080  xxxx  733 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx   0.7 xxxxx  0.1 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx   9.1 xxxxx 10.0 xxxxx
Shared LOS:     *    *     *     A    *     *     *    *     A     *     B     *
ApproachDel:    xxxxxx           xxxxxx             9.1             10.0
ApproachLOS:         *                *               A                B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```



```
Ex Plus Am Plus CP PM      Thu May 2, 2013 14:17:10                  Page 4-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     19.3       Worst Case Level Of Service: F[257.1]
********************************************************************************
Street Name:          Neighbours Blvd                    I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Channel          Include          Channel
Lanes:        0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6   75     0     0   45    10     0    0     0    42    0    10
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6   81     0     0   49    11     0    0     0    45    0    11
Added Vol:    420   11     0     0  409   128     0    0     0     0    0    13
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  426   92     0     0  458   139     0    0     0    45    0    24
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:   509  110     0     0  546   166     0    0     0    54    0    28
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:  509  110     0     0  546   166     0    0     0    54    0    28
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  546 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1757 1674   110
Potent Cap.: 1033 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    94   97   949
Move Cap.:   1033 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    42   30   949
Volume/Cap:  0.49 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  1.29 0.00  0.03
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    2.8 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   0.1
Control Del: 11.8 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   8.9
LOS by Move:    B    *     *     *    *     *     *    *     *     *    *     A
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    42 xxxx xxxxx
SharedQueue:  2.8 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   5.3 xxxx xxxxx
Shrd ConDel: 11.8 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx 387.3 xxxx xxxxx
Shared LOS:     B    *     *     *    *     *     *    *     *     F    *     *
ApproachDel:    xxxxxx           xxxxxx             xxxxxx           257.1
ApproachLOS:         *                *                *                F
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```

```
Ex Plus Am Plus CP PM      Thu May 2, 2013 14:17:10                  Page 5-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     18.4       Worst Case Level Of Service: F[294.0]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:        0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   35    54    12   73     0    43    0    13     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   38    58    13   79     0    46    0    14     0    0     0
Added Vol:      0  422   268   391   17     0     9    0     0     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0  460   326   404   96     0    55    0    14     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87
PHF Volume:     0  530   376   466  111     0    64    0    16     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  530   376   466  111     0    64    0    16     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   530 xxxx xxxxx  1761 1573   111  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1047 xxxx xxxxx    94  111   948  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1047 xxxx xxxxx    49   44   948  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.44 xxxx  xxxx  1.31 0.00  0.02  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   2.3 xxxx xxxxx  xxxx xxxx   0.1  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx  11.2 xxxx xxxxx xxxxx xxxx   8.9 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     B    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx    49 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   2.3 xxxx xxxxx   5.9 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx  11.2 xxxx xxxxx 366.2 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     B    *     *     F    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           294.0           xxxxxx
ApproachLOS:         *                *             F                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```



```
Ex Plus Am Plus CP PM      Thu May 2, 2013 14:17:10                  Page 6-1
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
                  Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      0.3       Worst Case Level Of Service: C[ 21.8]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:        0  0 1! 0  0    0  0 1! 0  0    1  0  0  0  0    0  0 1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   86     6     2   83     1     1    0     0     7    0     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   93     6     2   90     1     1    0     0     8    0     3
Added Vol:      0  690     0     1   17     0     0    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1  783     6     3  107     1     1    0     0     8    0     4
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89
PHF Volume:     1  878     7     4  120     1     1    0     0     8    0     5
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  878     7     4  120     1     1    0     0     8    0     5
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1 xxxx xxxxx   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5 xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  121 xxxx xxxxx   885 xxxx xxxxx  1013 xxxx xxxxx  1011 1012   881
Potent Cap.: 1479 xxxx xxxxx   773 xxxx xxxxx   219 xxxx xxxxx   220  241   349
Move Cap.:   1479 xxxx xxxxx   773 xxxx xxxxx   215 xxxx xxxxx   219  240   349
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.01 xxxx  xxxx  0.04 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.4 xxxx xxxxx   9.7 xxxx xxxxx  21.8 xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     C    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  253 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 20.0 xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     *     *    C     *
ApproachDel:    xxxxxx           xxxxxx           21.8           20.0
ApproachLOS:         *                *             C              C
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```

With Project

Scenario Report

Scenario:	Ex Plus Am Plus CP AM
Command:	Existing Plus Am+ CP AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

With Project

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	E	40.1	0.318	+31.071 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	F	70.6	1.122	+61.616 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	F	163.9	1.377	+154.620 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	D	29.4	0.179	+19.876 D/V

```
Ex Plus Am Plus CP AM      Thu May 2, 2013 14:20:34                  Page 3-1
--------------------------------------------------------------------------------
                                With Project
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
              2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      9.9       Worst Case Level Of Service: E[ 40.1]
********************************************************************************
Street Name:         Neighbours Blvd                    Riverside Dr
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  1  0  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6    2     3     0    1     0     0    5     6     5    4     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6    2     3     0    1     0     0    5     6     5    4     0
Added Vol:    301    0     4     1    0     0     0    0     9     5    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  307    2     7     1    1     0     0    5    15    10    4     1
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59
PHF Volume:   520    4    12     2    2     0     0    9    26    18    7     2
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:  520    4    12     2    2     0     0    9    26    18    7     2
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    2 xxxx xxxxx    16 xxxx xxxxx  xxxx 1062     2  1073 1056    10
Potent Cap.: 1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  225  1088   200  227  1078
Move Cap.:   1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  124  1088   120  125  1078
Volume/Cap:  0.32 xxxx  xxxx  0.00 xxxx  xxxx  xxxx 0.07  0.02  0.15 0.06  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    1.4 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  8.2 xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A     *     *    A     *     *     *     *     *     *     *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   362  xxxx  129 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx   0.3 xxxxx  0.7 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx  16.0 xxxxx 40.1 xxxxx
Shared LOS:     *     *     *    A     *     *     *     *     C     *     E     *
ApproachDel:    xxxxxx           xxxxxx             16.0             40.1
ApproachLOS:         *                *                C                E
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```



```
Ex Plus Am Plus CP AM      Thu May 2, 2013 14:20:34                  Page 4-1
--------------------------------------------------------------------------------
                                With Project
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
              2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     51.3       Worst Case Level Of Service: F[ 70.6]
********************************************************************************
Street Name:         Neighbours Blvd                    I-10 WB Ramp
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Channel          Include          Channel
Lanes:       0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       5   52     0     0   27    45     0    0     0    10    0    11
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    5   56     0     0   29    49     0    0     0    11    0    12
Added Vol:     15  196     0     0   18    10     0    0     0   468    0   507
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   20  252     0     0   47    59     0    0     0   479    0   519
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78
PHF Volume:    26  323     0     0   60    75     0    0     0   613    0   664
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   26  323     0     0   60    75     0    0     0   613    0   664
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   60 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   473  435   323
Potent Cap.: 1556 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   553  517   723
Move Cap.:   1556 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   546  508   723
Volume/Cap:  0.02 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  1.12 0.00  0.92
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.1 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx  12.6
Control Del:  7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx  40.7
LOS by Move:    A     *     *     *     *     *     *     *     *     *     *     E
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   546 xxxx xxxxx
SharedQueue:  0.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx  19.9 xxxx xxxxx
Shrd ConDel:  7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx 103.0 xxxx xxxxx
Shared LOS:     A     *     *     *     *     *     *     *     *     F     *     *
ApproachDel:    xxxxxx           xxxxxx           xxxxxx             70.6
ApproachLOS:         *                *                *                F
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************
```

```
Ex Plus Am Plus CP AM      Thu May 2, 2013 14:20:34                  Page 5-1
--------------------------------------------------------------------------------
                                With Project
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     80.7       Worst Case Level Of Service: F[163.9]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0   32    34    15  471     0   179    0   510     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   91    78    28  526     0   185    0   514     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0  114    98    35  658     0   232    0   644     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  114    98    35  658     0   232    0   644     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   114 xxxx xxxxx   892  843   658  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1487 xxxx xxxxx   315  303   468  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1487 xxxx xxxxx   309  295   468  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.02 xxxx  xxxx  0.75 0.00  1.38  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.1 xxxx xxxxx  xxxx xxxx  30.1  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.5 xxxx xxxxx xxxxx xxxx 206.8 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     F     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   309 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.1 xxxx xxxxx   5.7 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.5 xxxx xxxxx  44.6 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     E    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           163.9           xxxxxx
ApproachLOS:         *                *                F                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Thu May 2, 2013 14:20:35                  Page 6-1
--------------------------------------------------------------------------------
                                With Project
--------------------------------------------------------------------------------
                      Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      1.1       Worst Case Level Of Service: D[ 29.4]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound      East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign        Stop Sign
Rights:           Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0   57     0     1  731   249     8    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1  116    17     5  783   250     9    0     2    23    2     7
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1  138    21     6  930   297    11    0     3    27    3     9
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  138    21     6  930   297    11    0     3    27    3     9
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: 1227 xxxx xxxxx   159 xxxx xxxxx  1248 1252  1078  1243 1390   149
Potent Cap.:  575 xxxx xxxxx  1433 xxxx xxxxx   152  174   268   153  144   904
Move Cap.:    575 xxxx xxxxx  1433 xxxx xxxxx   147  173   268   150  143   904
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.07 0.00  0.01  0.18 0.02  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del: 11.3 xxxx xxxxx   7.5 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    B    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  161 xxxxx  xxxx  186 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.3 xxxxx xxxxx  0.8 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 29.3 xxxxx xxxxx 29.4 xxxxx
Shared LOS:     *    *     *     *    *     *     *    D     *     *    D     *
ApproachDel:    xxxxxx           xxxxxx           29.3           29.4
ApproachLOS:         *                *            D              D
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project

Scenario Report

Scenario:	Ex Plus Am Plus CP PM
Command:	Existing Plus Am+ CP PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Ex Plus Am Plus CP PM Thu May 2, 2013 15:35:08 Page 2-1

With Project

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	13.2	0.413	+ 4.617 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	F	OVRFL	XXXXX	+3506.453 D/
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	F	OVRFL	7.110	+2682.176 D/
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	F	212.2	1.307	+202.334 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Thu May 2, 2013 15:35:08 Page 3-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 10.1 Worst Case Level Of Service: B[13.2]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0	1! 0	0	0	1 0	0 0	0	0 0	1 0	0	0 1!	0 0
Volume Module:												
Base Vol:	1	5	2	0	4	0	0	1	2	3	0	1
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	5	2	0	4	0	0	1	2	3	0	1
Added Vol:	9	0	6	1	0	0	0	0	301	5	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	10	5	8	1	4	0	0	1	303	8	0	2
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
PHF Volume:	15	8	12	1	6	0	0	2	446	12	0	3
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	15	8	12	1	6	0	0	2	446	12	0	3
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	6	xxxx	xxxxx	20	xxxx	xxxxx	xxxx	59	6	277	53	14
Potent Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	836	1082	679	842	1072
Move Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	827	1082	395	834	1072
Volume/Cap:	0.01	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	0.00	0.41	0.03	0.00	0.00
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.2	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	1081	xxxx	453	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	2.1	xxxxx	0.1	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	10.7	xxxxx	13.2	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	B	*	B	*
ApproachDel:	xxxxxx			xxxxxx			10.7			13.2		
ApproachLOS:	*			*			B			B		

Note: Queue reported is the number of cars per lane.

Ex Plus Am Plus CP PM Thu May 2, 2013 15:35:08 Page 4-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 194.6 Worst Case Level Of Service: F[3516.0]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1	0 0	0	0	0 1	0 1	0	0 0	0 0	0	1 0	0 1
Volume Module:												
Base Vol:	6	75	0	0	45	10	0	0	0	42	0	10
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	81	0	0	49	11	0	0	0	45	0	11
Added Vol:	495	14	0	0	524	178	0	0	0	5	0	16
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	501	95	0	0	573	189	0	0	0	50	0	27
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
PHF Volume:	598	113	0	0	683	225	0	0	0	60	0	32
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	598	113	0	0	683	225	0	0	0	60	0	32
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	683	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	2106	1994	113
Potent Cap.:	919	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	57	61	945
Move Cap.:	919	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	6	2	945
Volume/Cap:	0.65	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	10.26	0.00	0.03
Level Of Service Module:												
2Way95thQ:	5.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.1
Control Del:	15.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.9
LOS by Move:	C	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT	LT	LTR	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	6	xxxx xxxxx
SharedQueue:	5.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	9.2	xxxx	xxxxx
Shrd ConDel:	15.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	5382	xxxx	xxxxx
Shared LOS:	C	*	*	*	*	*	*	*	*	F	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			3516.0		
ApproachLOS:	*			*			*			F		

Note: Queue reported is the number of cars per lane.

Ex Plus Am Plus CP PM Thu May 2, 2013 15:35:08 Page 5-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #3 I-10 EB Ramp & Neighbours Blvd

Average Delay (sec/veh): 121.8 Worst Case Level Of Service: F[2691.8]

Street Name:	Neighbours Blvd						I-10 EB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Channel			Include			Channel			Include		
Lanes:	0 0 1	0 1		0 1	0 0 0		0 1	0 0 1		0 0	0 0 0	
Volume Module:												
Base Vol:	0	35	54	12	73	0	43	0	13	0	0	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	38	58	13	79	0	46	0	14	0	0	0
Added Vol:	0	498	441	506	22	0	11	0	4	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	536	499	519	101	0	57	0	18	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
PHF Volume:	0	618	576	599	116	0	66	0	21	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	0	618	576	599	116	0	66	0	21	0	0	0
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	6.4	6.5	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	618	xxxx	xxxxx	2219	1931	116	xxxx	xxxx	xxxxx
Potent Cap.:	xxxx	xxxx	xxxxx	972	xxxx	xxxxx	49	67	941	xxxx	xxxx	xxxxx
Move Cap.:	xxxx	xxxx	xxxxx	972	xxxx	xxxxx	9	5	941	xxxx	xxxx	xxxxx
Volume/Cap:	xxxx	xxxx	xxxx	0.62	xxxx	xxxx	7.11	0.00	0.02	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	4.4	xxxx	xxxxx	xxxx	xxxx	0.1	xxxx	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	14.5	xxxx	xxxxx	xxxxx	xxxx	8.9	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	B	*	*	*	*	A	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	9	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	4.4	xxxx	xxxxx	9.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	14.5	xxxx	xxxxx	3534	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	B	*	*	F	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			2691.8			xxxxxx		
ApproachLOS:	*			*			F			*		

Note: Queue reported is the number of cars per lane.

Ex Plus Am Plus CP PM Thu May 2, 2013 15:35:08 Page 6-1

With Project

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #4 Seeley Ave & Neighbours Blvd

Average Delay (sec/veh): 45.4 Worst Case Level Of Service: F[212.2]

Street Name:	Neighbours Blvd						Seeley Ave					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0	0		0 0 1! 0	0		1 0	0 0 0		0 0	1! 0	0
Volume Module:												
Base Vol:	1	86	6	2	83	1	1	0	0	7	0	3
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	93	6	2	90	1	1	0	0	8	0	3
Added Vol:	0	690	0	1	17	9	248	0	0	0	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	1	783	6	3	107	10	249	0	0	8	0	4
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
PHF Volume:	1	878	7	4	120	11	279	0	0	8	0	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	1	878	7	4	120	11	279	0	0	8	0	5
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.1	xxxx	xxxxx	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	131	xxxx	xxxxx	885	xxxx	xxxxx	1018	xxxx	xxxxx	1016	1022	881
Potent Cap.:	1467	xxxx	xxxxx	773	xxxx	xxxxx	217	xxxx	xxxxx	218	238	349
Move Cap.:	1467	xxxx	xxxxx	773	xxxx	xxxxx	214	xxxx	xxxxx	217	237	349
Volume/Cap:	0.00	xxxx	xxxx	0.00	xxxx	xxxx	1.31	xxxx	xxxx	0.04	0.00	0.01
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	15.1	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.5	xxxx	xxxxx	9.7	xxxx	xxxxx	212.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	F	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	251	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.2	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	20.1	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	C	*
ApproachDel:	xxxxxx			xxxxxx			212.2			20.1		
ApproachLOS:	*			*			F			C		

Note: Queue reported is the number of cars per lane.

APPENDIX E
SCOPING AGREEMENT

Exhibit B

SCOPING AGREEMENT FOR TRAFFIC IMPACT STUDY

This letter acknowledges the Riverside County Transportation Department requirements for traffic impact analysis of the following project. The analysis must follow the Riverside County Transportation Department Traffic Study Guidelines dated February 2005.

Case No. Environment Impact Report No. S29 / Conditional Use Permit No. 3670 / Public Use Permit No. 913 / Blythe Mesa I Solar Project

Related Cases -
SP No.
EIR No. S29
GPA No. N/A
CZ No. N/A

Project Name: Blythe Mesa I Solar Project

Project Address: APNS: 821-110-004,821-120-025,821-120-026

Project Description: The Blythe Mesa Solar Project consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility.

	Consultant	Developer
Name:	KOA Corporation	Renewable Resource Group
Address:	3190 C Shelby Street	5700 Wilshire Blvd Suite 330
	Ontario, CA 91764	Los Angeles CA 90036
Telephone:	909-890-9693	
Fax:	909-890-9694	

A. Trip Generation Source: (ITE 8th Edition or other)

Current GP Land Use	W-2-10, W-2-5, A-1-10, A-2-10	Proposed Land Use	N/A
Current Zoning	Controlled Development Areas	Proposed Zoning	N/A

Current Trip Generation	In	Out	Total	Proposed Trip Generation	In	Out	Total
AM Trips	0	0	0		~~412~~ 415	~~11~~ 14	~~423~~ 429
PM Trips	0	0	0		~~12~~ 15	~~411~~ 414	~~423~~ 429

Internal Trip Allowance ☐ Yes ☒ No (0 % Trip Discount)
Pass-By Trip Allowance ☐ Yes ☒ No (0 % Trip Discount)

A passby trip discount of 25% is allowed for appropriate land uses. The passby trips at adjacent study area intersections and project driveways shall be indicated on a report figure.

B. Trip Geographic Distribution: (attach exhibit for detailed assignment)

N - % S - % E - % W - %

See Attachment

C. Background Traffic

Project Build-out Year: 2015 Annual Ambient Growth Rate: 2 %

Phase Year(s) Not Applicable
Other area projects to be analyzed: List developed with Kevin Tsang

Model/Forecast methodology growth rate per year from existing counts

Exhibit B – Scoping Agreement – Page 2

D. Study intersections: (NOTE: Subject to revision after other projects, trip generation and distribution are determined, or comments from other agencies.)

1. Riverside Dr & Neighbours Blvd
2. I-10 WB Ramps & Neighbours Blvd
3. I-10 EB Ramps & Neighbours Blvd
4. Seeley Ave & Neighbours Blvd
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

E. Study Roadway Segments: (NOTE: Subject to revision after other projects, trip generation and distribution are determined, or comments from other agencies.)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

E. Other Jurisdictional Impacts

Is this project within a City's Sphere of Influence or one-mile radius of City boundaries? ☒ Yes ☐ No

If so, name of City Jurisdiction: City of Blythe

F. Site Plan (please attach reduced copy)

G. Specific issues to be addressed in the Study (in addition to the standard analysis described in the Guideline) (To be filled out by Transportation Department)
(NOTE: If the traffic study states that "a traffic signal is warranted" (or "a traffic signal appears to be warranted," or similar statement) at an existing unsignalized intersection under existing conditions, 8-hour approach traffic volume information must be submitted in addition to the peak hourly turning movement counts for that intersection.)

_____

H. Existing Conditions

Traffic count data must be new or recent. Provide traffic count dates if using other than new counts.
Date of counts September 2011

NOTE Traffic Study Submittal Form and appropriate fee must be submitted with, or prior to submittal of this form. Transportation Department staff will not process the Scoping Agreement prior to receipt of the fee.

Recommended by:

George Ghossain — 5-15-2012
Consultant's Representative — Date

Approved Scoping Agreement:

_____ — 05/22/2012
Riverside County Transportation Department — Date

Scoping Agreement Submitted on 5-15-2012

Revised on 5-16-2012

Project Description

The proposed Blythe Mesa I Solar Project (Project) consists of construction and operation of a 485 megawatt (MW) alternating current solar photovoltaic (PV) electrical generating facility and associated infrastructure to provide site access and connection to the statewide electricity transmission grid. The Project is proposed to be located on approximately 3,660 acres in the Palo Verde Mesa region of Riverside County—3,587 for the solar field and 73 acres for the 230 kilovolt (kV) transmission line interconnect. The power produced by the Project would be conveyed to the local power grid via interconnection to the Southern California Edison Colorado River Substation, an approved new substation located south of Highway 10 and approximately four miles west of the Project site. The Project has secured a California Independent System Operator (CAISO) interconnection queue position sufficient for the size of the Project. The Project would produce enough energy to power approximately 180,000 households and progress the goals of the California Renewable Portfolio Standard (RPS) and other similar renewable programs in the state

Project Construction Trip Generation Forecast

The project is expected to generate a maximum of 20 truck deliveries per day for the 24 month peak construction period. Transport truck deliveries include material deliveries and equipments. The calculations below account for the heavier vehicles types such as trucks by converting truck trips to "passenger car equivalents". SANBAG CMP passenger car equivalents (PCEs) per truck trip was used in this analysis. Passenger car equivalents (PCEs) are used in roadway capacity analysis to convert a mixed vehicle flow into an equivalent passenger car flow. This calculation is relevant to capacity and level of service determination, lane requirements, and determining the effect of traffic on roadway operations.

In addition, based on information obtained from the project proponent, the project site will employ a workforce of approximately 300-500 workers. Construction of the project will take approximately 36 months with 24 months of peak construction period. The project will require an average construction workforce of 40 workers at the beginning of construction and a peak of 500 workers during the 24 month peak construction period of the solar array, substations, operation and maintenance buildings and the installation of 230 kV transmission line and fiber optic cable with a tapering of fewer employees thereafter. The workforce vehicle trips associated with construction were calculated based upon these assumptions. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region.

Construction of the project will require the use and installation of heavy equipment and associated systems. Heavy equipment will be delivered via truck, using Neighbours Boulevard from I-10 to the north and south utilizing Riverside Drive and Seeley Avenue. Anticipated average daily material deliveries would consist of about 20 truck deliveries per day for the peak 24 month construction period.

Peak Hour Trip Generation Forecast

For purposes of forecasting future peak hour trip generation, it is assumed that the majority of the daily project trips will occur during daylight hours. It is assumed that each employee arrives during the AM peak hour and departs during the PM peak hour and that some miscellaneous trips occur during this time. It is also assumed that truck trips will occur randomly over a 10-hour workday. Based on these assumptions, a daily and peak hour trip generation calculation is provided below.

Employee Trips

It is estimated that 500 employees will work on the site during the peak construction period. To evaluate a worst-case scenario, it is assumed that 300 employees arrive alone and 200 employees will carpool. In addition it is assumed that approximately 42 employees go to lunch or run some other errand therefore creating additional trips.

- 300 employees will drive alone = 300 inbound trips in the AM and 300 outbound trips in the PM
- 200 employees carpool (assumed 2 in a carpool) = 100 inbound trips in the AM and 100 outbound trips in the PM
- 42 employees go to lunch/run errands = 42 additional inbound and 42 additional outbound trips during the day

AM Peak Hour: 400 inbound employee trips

PM Peak Hour: 400 outbound employee trips

Total trips = (400*2) + (42*2) = 884 daily employee trips

On-site work hours would be from 7:00 a.m. to 7:00 p.m. During the installation period, construction workers are projected to be onsite five days per week, year round. Due to weather or other major type delays, times may shift to start as early as 5:00 a.m. and end as late as 8:00 p.m., as well as continue into the weekends. The construction PM peak hour for the project would be expected to occur with the departure of personnel at, 7:00PM. This does not coincide with the PM peak hour of the adjacent street, which occurs between 4PM and 6PM; however to be conservative, the project PM peak hour trip generation will be analyzed during the PM peak hour of the adjacent street traffic.

Additionally, trips generated from normal construction activities including activities of supervisors, activities of construction representatives, and delivery of supplies and equipment will also be analyzed during the PM peak hour of the adjacent street traffic.

Truck Trips

For the purposes of forecasting, it is assumed that 20 trucks per day will arrive and depart the site per day to deliver materials and equipment. These trips will likely occur randomly during the day, assuming a 10-hour day.

- 40 daily two-way truck trips

Mix of fleet
Light Duty Truck: 18% (7 trucks)
Medium Duty Truck: 18% (7 trucks)
Heavy Duty Truck: 64% (26 trucks)

} cite the source for the truck mix

PCE Factors
Light Duty Truck (1.5 PCE): 11 trucks
Medium Duty Truck (2.0 PCE): 14 trucks
Heavy Duty Truck (3.0 PCE): 78 trucks

- 103 PCE truck trips / 10-hour day = 11 PCE truck trips during the AM peak hour and 11 PCE truck trips during the PM peak hour.

AM Peak Hour: 6 inbound and 5 outbound truck PCE trips
PM Peak Hour: 6 inbound and 5 outbound truck PCE trips

Additional Work Related Trips

For the purposes of forecasting, it is assumed that other trips associated with the activities of supervisors, inspectors and vendors would be equal to 20% of the employee trips and would occur randomly over a 10-hour work day.

- 884 daily employee trips x 0.20 = 177 ancillary trips daily trips

- 177 ancillary trips daily trips / 10-hour day = 18 trips during the AM peak hour and 18 during the PM peak hour.

AM Peak Hour: 9 inbound and 9 outbound ancillary trips

PM Peak Hour: 9 inbound and 9 outbound ancillary trips

Table 4-1
Project Construction Traffic Generation Forecast

Type of Trips	Daily	AM Peak Hour			PM Peak Hour		
		Total	In	Out	Total	In	Out
Employee Trips*	884	400	400	0	400	0	400
Truck Trips	103	11	6	5	11	6	5
Ancillary Trips	177	18	9	9	18	9	9
NET Project Trips (PCEs)	**1,164**	**429**	**415**	**14**	**429**	**15**	**414**

Note: PM Peak Hour does not coincide with the departure time of employees but to be conservative was assumed in the analysis

PCE: Passenger Car Equivalent

The project will generate a total of 1,164 trips daily, including 429 trips during the AM peak hour and 429 trips during the PM peak hour.

Project Trip Distribution

Trip distribution is the process of identifying the probable destinations, directions or traffic routes that will be utilized by project traffic. The potential interaction between the proposed land use and surrounding regional access routes are considered to identify the route where the project traffic will distribute.

The workforce vehicle trips associated with construction were calculated based upon these assumptions. It is anticipated that most workers would be drawn from the Blythe/Palo Verde Valley region and the Desert Center region, with a smaller portion drawn from the Imperial Valley or Eastern Riverside County region. Construction of the project will require the use and installation of heavy equipment and associated systems. Heavy equipment will be delivered via truck, using Neighbours Boulevard from I-10 to the north and south utilizing Riverside Drive and Seeley Avenue. The anticipated trip distribution for the proposed development is presented in the attached figures. These figures indicate the proportion of project traffic which will use the street segments and turning movements indicated.

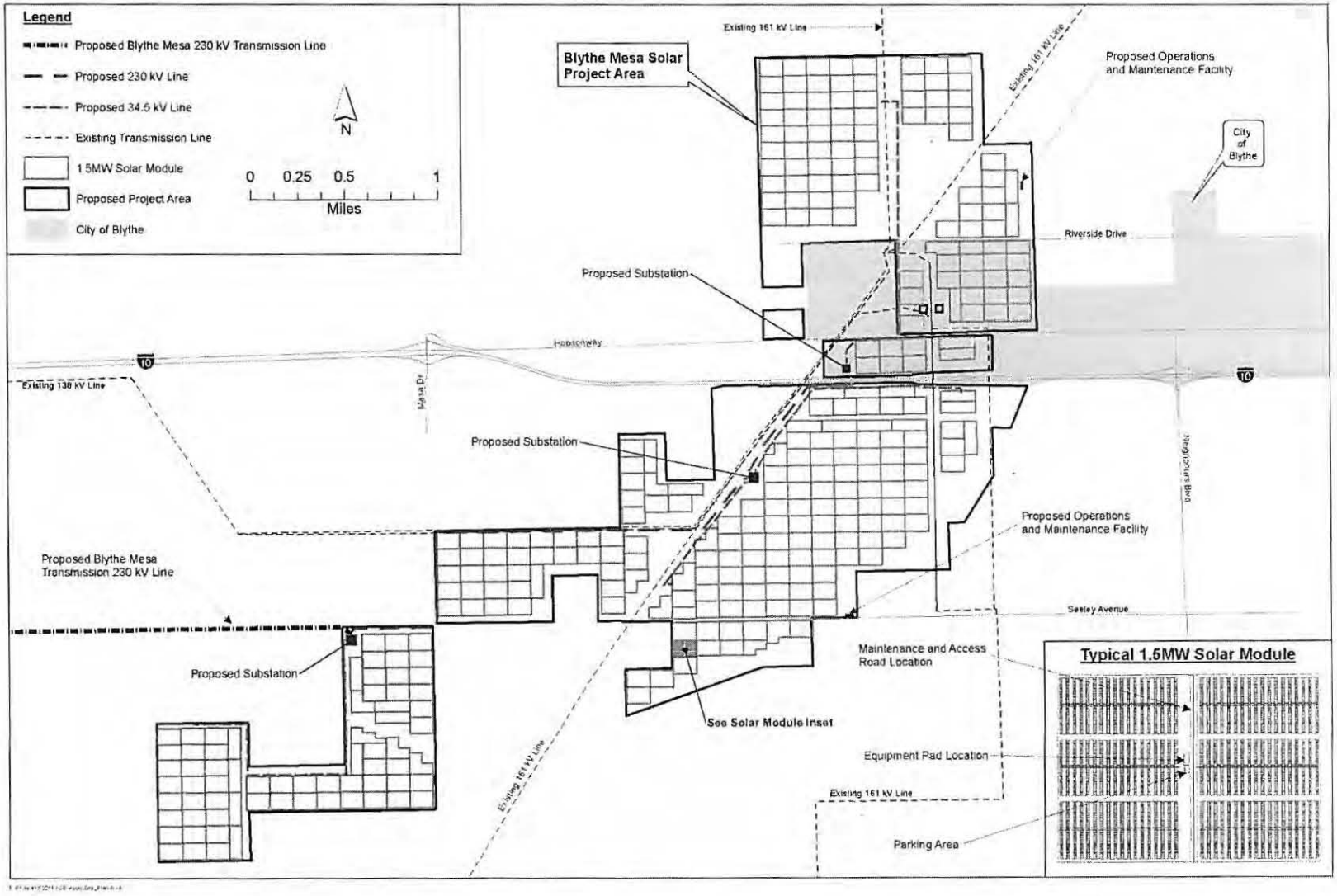
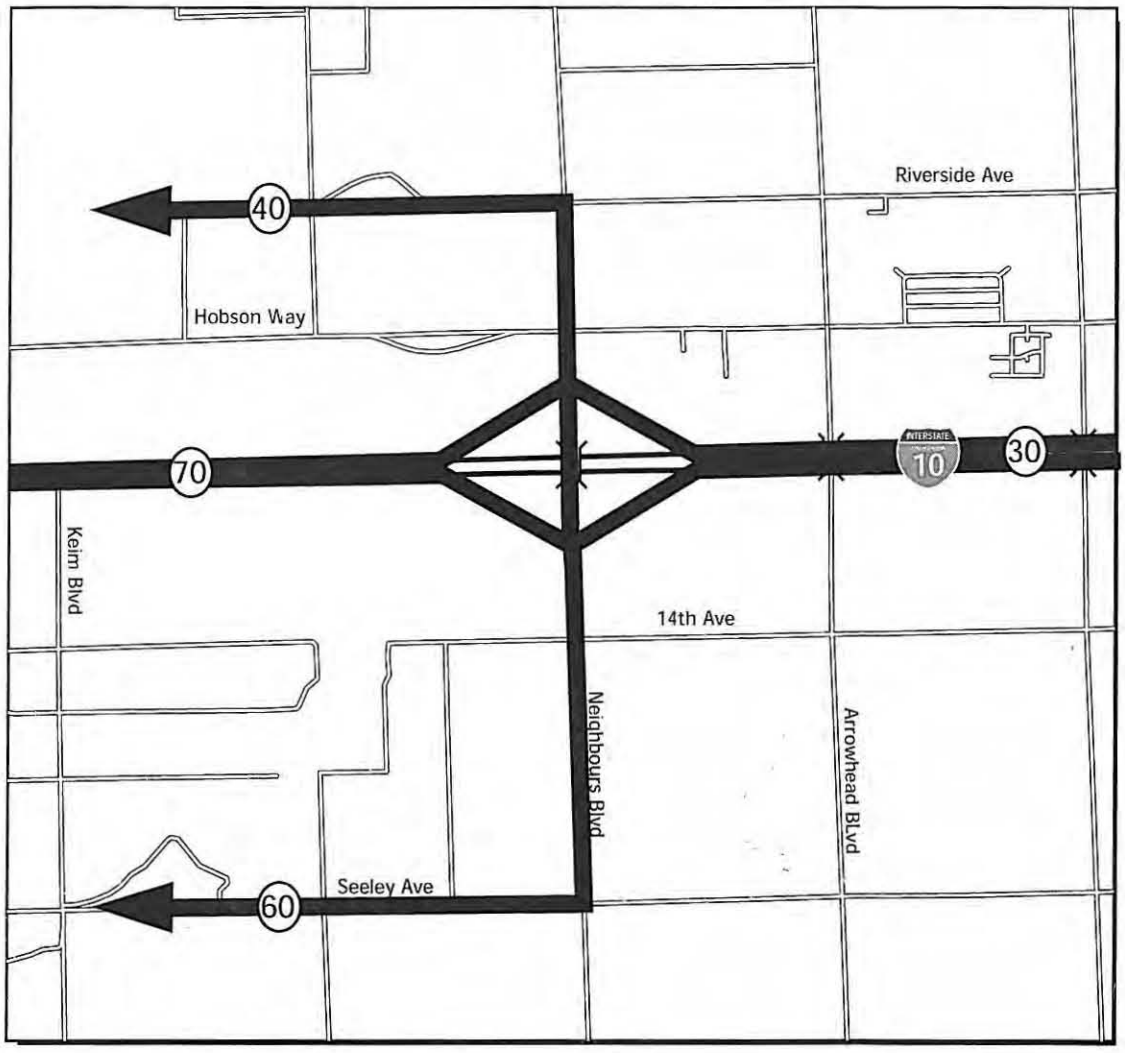


Figure 4-1
Project Site

AR062154

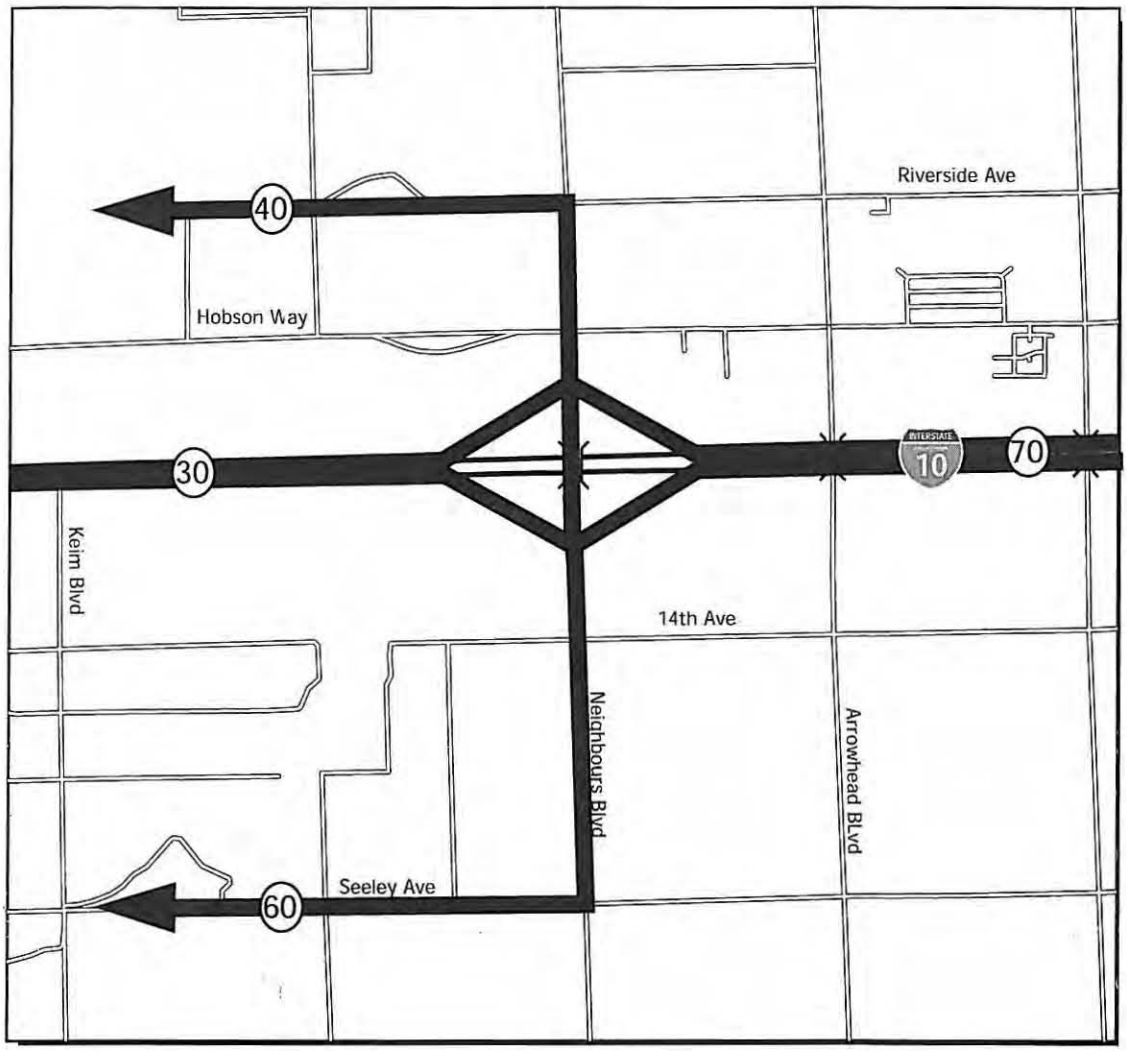


LEGEND

60 Truck Trip Distribution

Figure 4.2A
Truck Project Trip Distribution

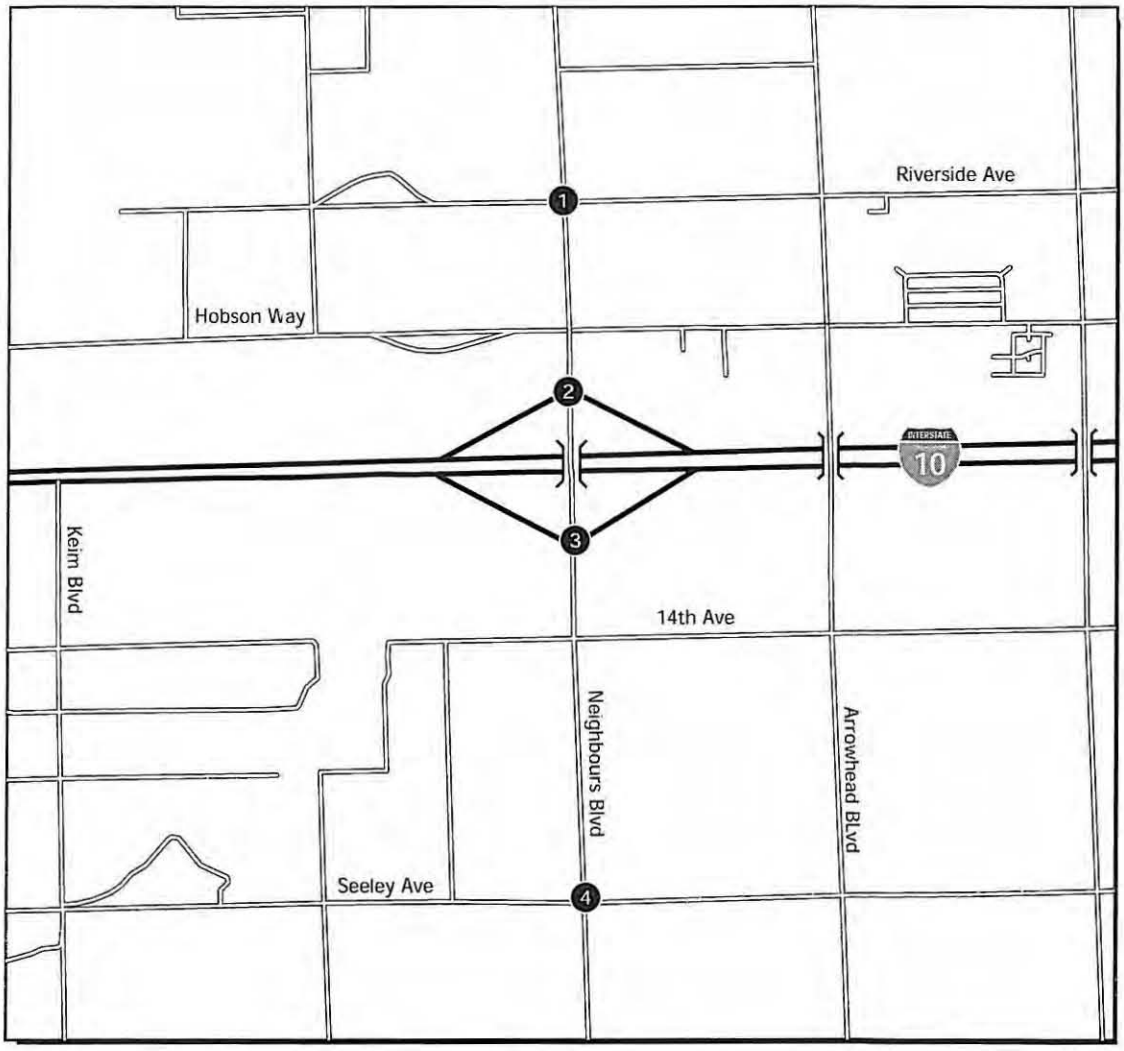
N
Not To Scale

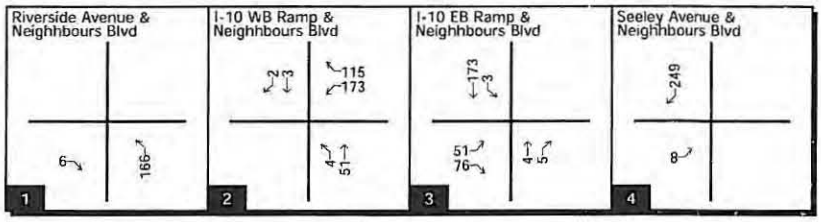


LEGEND	
60	Employee Trip Distribution

Figure 4.2B
Employee Project Trip Distribution

N
Not To Scale

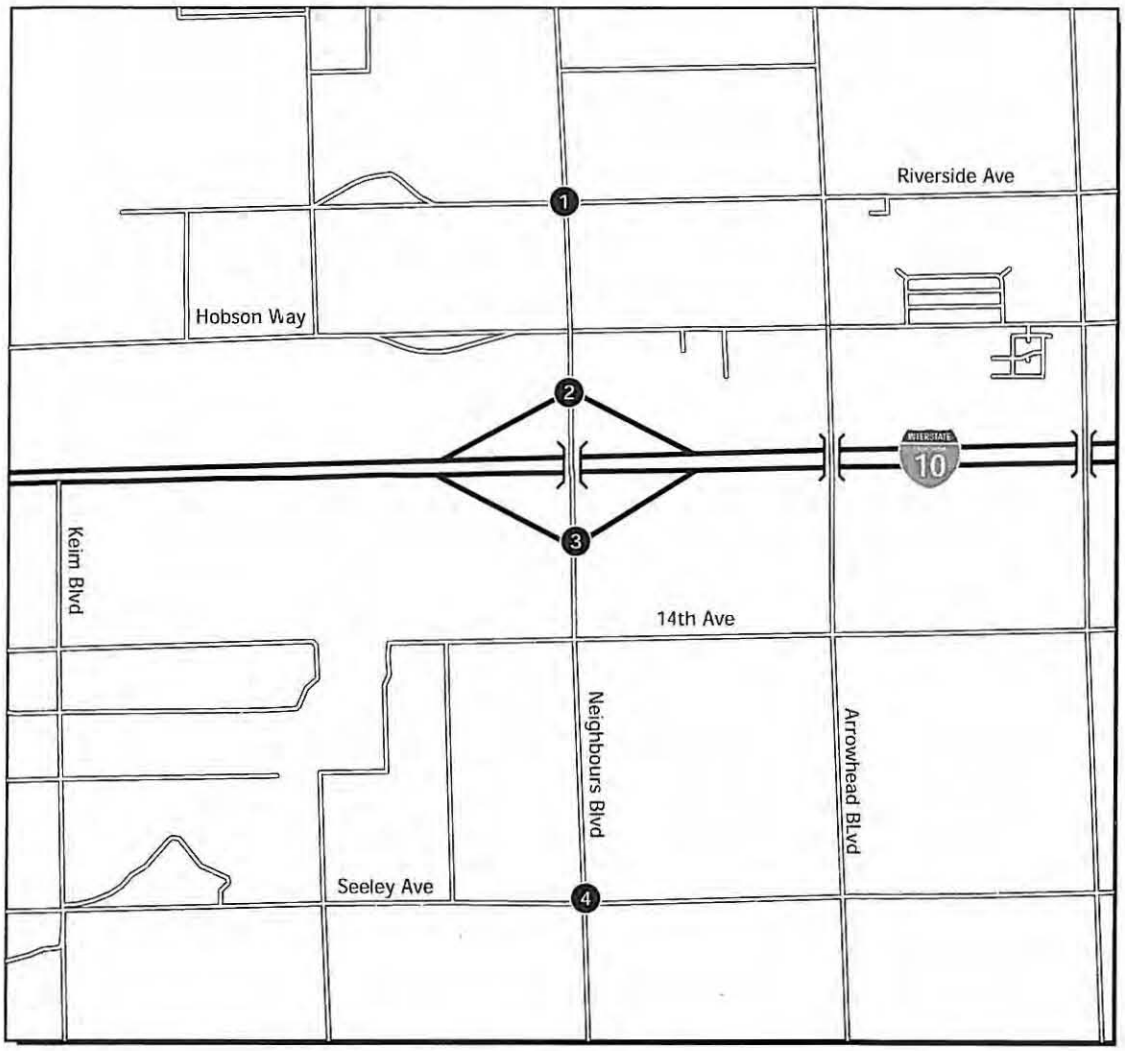


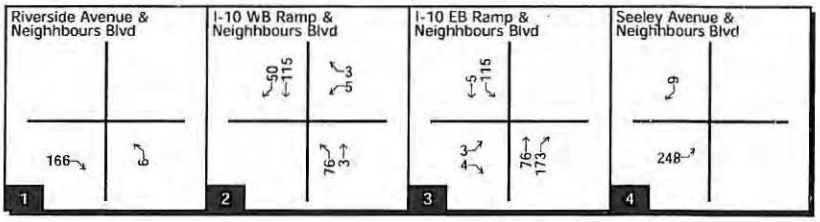


LEGEND
10 AM Peak Hour Trips

Figure 4.3
Project Related Construction Traffic Volumes - AM Peak Hour

N
Not To Scale





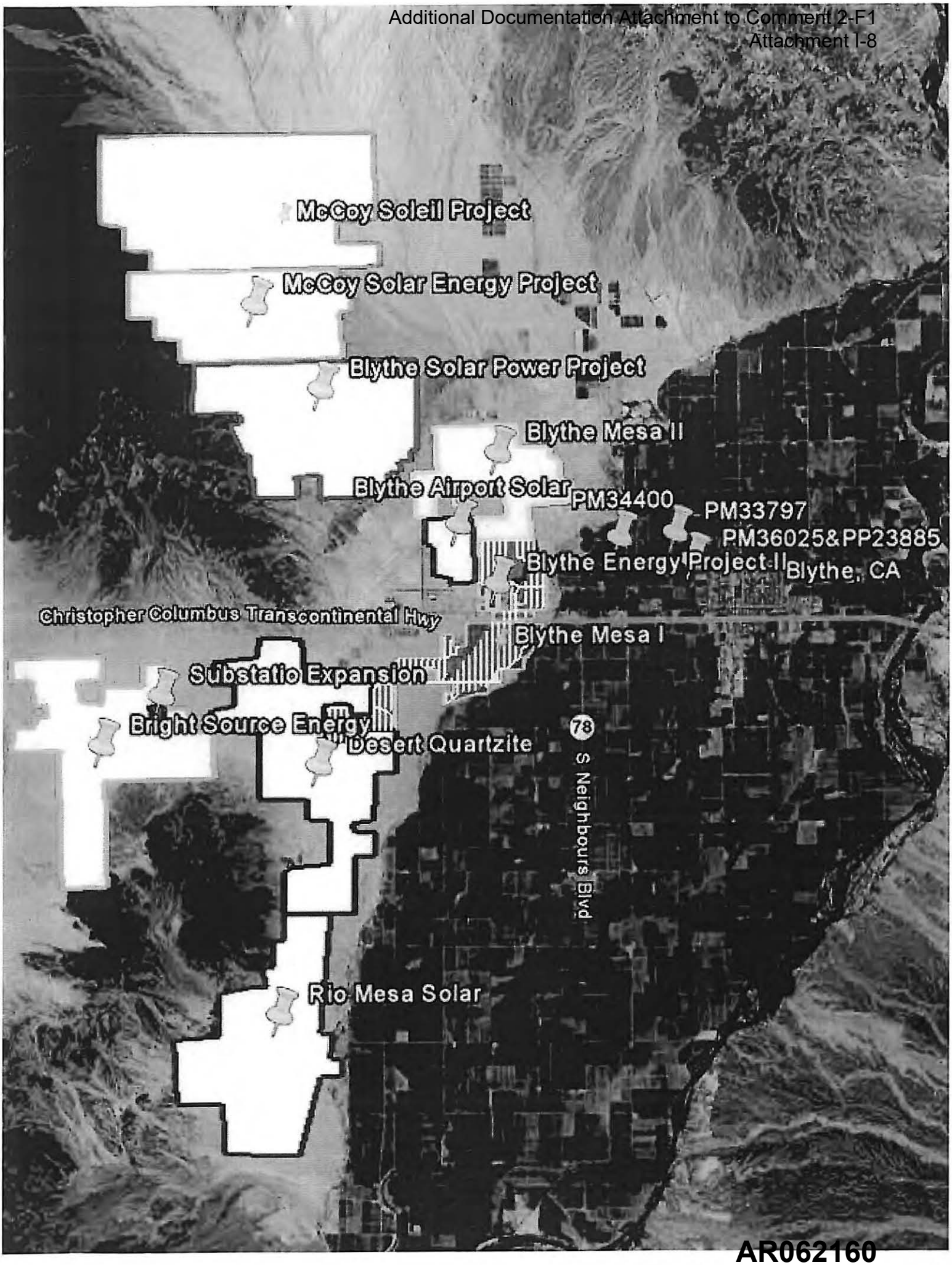
LEGEND

10 PM Peak Hour Trips

Figure 4.4
Project Related Construction Traffic Volumes - PM Peak Hour

N
Not To Scale

PROJECT NAME/APPLICANT	LOCATION	STATUS	Years of Construction	Number of Workers	PROJECT DESCRIPTION
Solar					
Blythe Airport Solar I Project/ • U.S. Solar • EA # 42340	Northeast of Blythe Municipal Airport	Approved			100 MW photovoltaic power plan on 640 acres in five- 20 MW phases that includes a 3,200 ft long 33 kV generation tie
Blythe Solar Power Project/ • Solar Millennium • CACA 48811	8 miles west of the City of Blythe	CEC Approved September 2010; BLM Approved October 2010; Temporary Suspension Issued 8/23/11	Approximately 69 months	1,044 during peak construction 221 permanent, full-time jobs during operation	Concentrated solar thermal electric generating facility, using solar parabolic trough technology, with four adjacent and independent units of 250 MW nominal capacity each for a total nominal capacity of 1,000 MW. Project includes a double circuit 230 kV generation-tie line to interconnect with SCE's Colorado River substation as well as a 9.8 mile long natural gas pipeline connecting the project to the existing Southern California Gas (SCG) pipeline. Project would disturb 5,950 acres and occupy 7,025 acres.
Blythe Energy Project II	Blythe, CA. Near Blythe Airport and I-10	Approved by BLM in 2006; Notice of decision regarding petition to extend the deadline for commencement of construction-2011; Petition to Amend presented April 2012	N/A	N/A	520 MW combined-cycle power plant located entirely within the Blythe Energy Project site boundary Blythe Energy Project II will interconnect with the Buck Substatio constructed by WAPA as part of the Blythe Energy Project. Project is designed on 20 acres of a 76-acre site.
Blythe Mesa II Solar Project	5 miles northwest of City of Blythe	Planned	Approximately 3 years	-300-500 daily during construction -12 permanent, full-time jobs during operation	437 MW PV solar plant that includes a 14-mile long transmission line to the Colorado River Substation. The project would occupy approximately 3,237 acres total.
McCoy Solar Energy Project • McCoy Solar, LLC • CACA 48728	13 miles northwest of Blythe	Planned NOI published 8/29/11	N/A	N/A	Up to a 750 MW PV solar power plant using photovoltaic technology. MW, solar thermal, 7,700 acres disturbed. Approximately 16 mile long 230 kV generation-tie and switchyard that will connect to SCE's Colorado River Substation. Peak workforce of approximately 750 people with up to 20 permanent workers.
Rio Mesa Solar Electric Generating Facility • BrightSource Energy, Inc • 2011-AFC-04 • CACA 53138	13 miles southwest of Blythe	Planned	N/A	N/A	Consists of three 250 MW solar concentration thermal power plants (750 MW total). Each plant requires about 1,850 acres (or 2.9 square miles) of land to operate. A 119 acre common area will include a combined administration, control, and maintenance facilities. The total area, including shared facilities, is approximately 5,750 acres.
Desert Quartzite/ • First Solar Development, Inc • CACA 49397	8 miles southwest of Blythe	Planned POD Submitted	N/A	N/A	600 MW, Photovoltaic, 7,245 acres disturbed, no transmission line
Mc Coy Soleil Project (different from the McCoy Solar Project CACA 48728) • enXco, Inc • CACA 49490		Pending			300 MW PV solar plant, 20,484. POD submitted
Colorado River Substation Expansion	10 miles southwest of Blythe	Approved July 2011	N/A	N/A	Proposed to be expanded as a 500/230 kV substation and would be constructed in an area approximately 1,000 feet by 1,900 feet, permanently disturbing approximately 90 acres. The 500 kV switching station would include buses, circuit brakers, and disconnect switches. The switchyard would be equipped with 108-foot-high dead-end structures. Outdoor night lighting would be designed to illuminate the switchrack when manuall switched on.
Blythe Solar Power Generation Station 1, LLC	Blythe, CA	Approved. Estimated online date June 2013	N/A	N/A	A planned 4.76 MW solar PV facility, on 29.4 acres, consisting of 69 PV panels that stand approximately 50-feet tall an d 72-feet wide, a 200 square foot equipment building, and a twenty-foot perimeter fire access road.
CACA 51967 –Brightsource Energy	12 miles west of Blythe	Case sent to California Desert District August 2011	N/A	N/A	Solar energy facility to occupy a total of 12,269 acres.
Blythe Cumulative					
PM33797		Approved	N/A	N/A	SCHED H DIVISION OF 2.14 AC INTO 2 SFR PARCELS.
PM34400		Approved	N/A	N/A	DIVIDE 80 AC INTO 2 SFR LOTS - SCHUDLE "H"
PM34759		Approved	N/A	N/A	DIVIDE 5.74 AC INTO 4 SFR LOTS - SCH "H"
PP23885		Approved	N/A	N/A	CHURCH W/ACCESSORY OUTDOOR RECREATION/AMPHITHEATER 8,890 SF CHURCH


McCoy Soleil Project
McCoy Solar Energy Project
Blythe Solar Power Project
Blythe Mesa II
Blythe Airport Solar
PM34400
PM33797
PM36025&PP23885
Blythe Energy Project II
Blythe, CA
Christopher Columbus Transcontinental Hwy
Blythe Mesa I
Substatio Expansion
Bright Source Energy
Desert Quartzite
78
S Neighbours Blvd
Rio Mesa Solar

APPENDIX F
STAGGERED TRIP SCENARIOS

With Project
0% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP AM
Command:	Existing Plus Am+ CP AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

With Project
0% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	E	40.1	0.318	+31.071 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	D	26.2	0.845	+17.203 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	B	14.6	0.426	+ 5.384 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	B	10.6	0.042	+ 1.066 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:23:48                  Page 3-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      9.9       Worst Case Level Of Service: E[ 40.1]
********************************************************************************
Street Name:         Neighbours Blvd                  Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  1  0  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6    2     3     0    1     0     0    5     6     5    4     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6    2     3     0    1     0     0    5     6     5    4     0
Added Vol:    301    0     4     1    0     0     0    0     9     5    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  307    2     7     1    1     0     0    5    15    10    4     1
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59
PHF Volume:   520    4    12     2    2     0     0    9    26    18    7     2
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:  520    4    12     2    2     0     0    9    26    18    7     2
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    2 xxxx xxxxx    16 xxxx xxxxx  xxxx 1062     2  1073 1056    10
Potent Cap.: 1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  225  1088   200  227  1078
Move Cap.:   1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  124  1088   120  125  1078
Volume/Cap:  0.32 xxxx  xxxx  0.00 xxxx  xxxx  xxxx 0.07  0.02  0.15 0.06  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    1.4 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  8.2 xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   362  xxxx  129 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx   0.3 xxxxx  0.7 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx  16.0 xxxxx 40.1 xxxxx
Shared LOS:     *    *     *     A    *     *     *    *     C     *    E     *
ApproachDel:    xxxxxx           xxxxxx            16.0             40.1
ApproachLOS:         *                *                C                E
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:23:48                  Page 4-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     17.3       Worst Case Level Of Service: D[ 26.2]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Channel          Include          Channel
Lanes:       0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       5   52     0     0   27    45     0    0     0    10    0    11
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    5   56     0     0   29    49     0    0     0    11    0    12
Added Vol:      4  181     0     0   18    10     0    0     0   173    0   477
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    9  237     0     0   47    59     0    0     0   184    0   489
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78
PHF Volume:    12  304     0     0   60    75     0    0     0   235    0   626
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   12  304     0     0   60    75     0    0     0   235    0   626
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   60 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   426  388   304
Potent Cap.: 1556 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   589  550   741
Move Cap.:   1556 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   586  545   741
Volume/Cap:  0.01 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.40 0.00  0.84
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   9.7
Control Del:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx  30.3
LOS by Move:    A    *     *     *    *     *     *    *     *     *    *     D
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   586 xxxx xxxxx
SharedQueue:  0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   1.9 xxxx xxxxx
Shrd ConDel:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx  15.2 xxxx xxxxx
Shared LOS:     A    *     *     *    *     *     *    *     *     C    *     *
ApproachDel:    xxxxxx           xxxxxx            xxxxxx            26.2
ApproachLOS:         *                *                *                D
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:23:48                  Page 5-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      6.4       Worst Case Level Of Service: B[ 14.6]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled       Stop Sign         Stop Sign
Rights:            Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0    6     5    15  175     0   179    0    76     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   65    49    28  230     0   185    0    80     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   82    62    35  288     0   232    0   101     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   82    62    35  288     0   232    0   101     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    82 xxxx xxxxx   471  440   288  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1528 xxxx xxxxx   555  514   756  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1528 xxxx xxxxx   545  502   756  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.02 xxxx  xxxx  0.43 0.00  0.13  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.1 xxxx xxxxx  xxxx xxxx   0.5  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx  10.5 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     B     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   545 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.1 xxxx xxxxx   2.1 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx  16.4 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     C    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            14.6           xxxxxx
ApproachLOS:         *                *                B                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:23:48                  Page 6-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      1.2       Worst Case Level Of Service: B[ 10.6]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled       Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0    1     0     1    2   249     8    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   60    17     5   54   250     9    0     2    23    2     7
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   72    21     6   64   297    11    0     3    27    3     9
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   72    21     6   64   297    11    0     3    27    3     9
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  361 xxxx xxxxx    92 xxxx xxxxx   315  320   212   311  458    82
Potent Cap.: 1209 xxxx xxxxx  1515 xxxx xxxxx   641  600   833   646  502   983
Move Cap.:   1209 xxxx xxxxx  1515 xxxx xxxxx   630  597   833   641  500   983
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.02 0.00  0.00  0.04 0.01  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  8.0 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  661 xxxxx  xxxx  683 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.1 xxxxx xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 10.6 xxxxx xxxxx 10.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    B     *     *    B     *
ApproachDel:    xxxxxx           xxxxxx             10.6             10.6
ApproachLOS:         *                *                B                B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project
0% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP PM
Command:	Existing Plus Am+ CP PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:24:13 Page 2-1

With Project
0% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	13.2	0.413	+ 4.617 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	C	20.0	0.259	+10.432 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	F	126.5	0.873	+116.882 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	B	13.1	0.386	+ 3.184 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Ex Plus Am Plus CP PM      Wed May 8, 2013 07:24:13                  Page 3-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     10.1       Worst Case Level Of Service: B[ 13.2]
********************************************************************************
Street Name:         Neighbours Blvd                  Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  1  0  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1    5     2     0    4     0     0    1     2     3    0     1
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1    5     2     0    4     0     0    1     2     3    0     1
Added Vol:      9    0     6     1    0     0     0    0   301     5    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   10    5     8     1    4     0     0    1   303     8    0     2
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.68 0.68  0.68  0.68 0.68  0.68  0.68 0.68  0.68  0.68 0.68  0.68
PHF Volume:    15    8    12     1    6     0     0    2   446    12    0     3
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   15    8    12     1    6     0     0    2   446    12    0     3
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    6 xxxx xxxxx    20 xxxx xxxxx  xxxx   59     6   277   53    14
Potent Cap.: 1628 xxxx xxxxx  1609 xxxx xxxxx  xxxx  836  1082   679  842  1072
Move Cap.:   1628 xxxx xxxxx  1609 xxxx xxxxx  xxxx  827  1082   395  834  1072
Volume/Cap:  0.01 xxxx  xxxx  0.00 xxxx  xxxx  xxxx 0.00  0.41  0.03 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.2 xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx  1081  xxxx  453 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx   2.1 xxxxx  0.1 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx  10.7 xxxxx 13.2 xxxxx
Shared LOS:     *    *     *     A    *     *     *    *     B     *    B     *
ApproachDel:    xxxxxx           xxxxxx            10.7             13.2
ApproachLOS:         *                *               B                B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP PM      Wed May 8, 2013 07:24:13                  Page 4-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      2.4       Worst Case Level Of Service: C[ 20.0]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Channel          Include          Channel
Lanes:       0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6   75     0     0   45    10     0    0     0    42    0    10
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6   81     0     0   49    11     0    0     0    45    0    11
Added Vol:     76   14     0     0  479   178     0    0     0     5    0    16
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:   82   95     0     0  528   189     0    0     0    50    0    27
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:    98  113     0     0  630   225     0    0     0    60    0    32
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   98  113     0     0  630   225     0    0     0    60    0    32
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  630 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1052  940   113
Potent Cap.:  962 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   253  266   945
Move Cap.:    962 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   232  237   945
Volume/Cap:  0.10 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.26 0.00  0.03
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.3 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   0.1
Control Del:  9.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx   8.9
LOS by Move:    A    *     *     *    *     *     *    *     *     *    *     A
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   232 xxxx xxxxx
SharedQueue:  0.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   1.0 xxxx xxxxx
Shrd ConDel:  9.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx  25.9 xxxx xxxxx
Shared LOS:     A    *     *     *    *     *     *    *     *     D    *     *
ApproachDel:    xxxxxx           xxxxxx            xxxxxx           20.0
ApproachLOS:         *                *                 *              C
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP PM      Wed May 8, 2013 07:24:13                  Page 5-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):     14.0       Worst Case Level Of Service: F[126.5]
********************************************************************************
Street Name:         Neighbours Blvd                    I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Channel          Include         Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   35    54    12   73     0    43    0    13     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   38    58    13   79     0    46    0    14     0    0     0
Added Vol:      0   79   173   476    7     0    11    0     4     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0  117   231   489   86     0    57    0    18     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87
PHF Volume:     0  135   267   564   99     0    66    0    21     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  135   267   564   99     0    66    0    21     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   135 xxxx xxxxx  1495 1362    99  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1462 xxxx xxxxx   137  149   962  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1462 xxxx xxxxx    76   65   962  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.39 xxxx  xxxx  0.87 0.00  0.02  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   1.9 xxxx xxxxx  xxxx xxxx   0.1  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   9.0 xxxx xxxxx xxxxx xxxx   8.8 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx    76 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   1.9 xxxx xxxxx   4.4 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   9.0 xxxx xxxxx 163.5 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     F    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           126.5           xxxxxx
ApproachLOS:         *                *               F                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP PM      Wed May 8, 2013 07:24:13                  Page 6-1
--------------------------------------------------------------------------------
                              With Project
                              0% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      7.3       Worst Case Level Of Service: B[ 13.1]
********************************************************************************
Street Name:         Neighbours Blvd                    Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include         Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    1  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   86     6     2   83     1     1    0     0     7    0     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   93     6     2   90     1     1    0     0     8    0     3
Added Vol:      0    2     0     1    2     9   248    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   95     6     3   92    10   249    0     0     8    0     4
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89
PHF Volume:     1  106     7     4  103    11   279    0     0     8    0     5
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  106     7     4  103    11   279    0     0     8    0     5
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1 xxxx xxxxx   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5 xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  114 xxxx xxxxx   114 xxxx xxxxx   230 xxxx xxxxx   228  234   110
Potent Cap.: 1488 xxxx xxxxx  1488 xxxx xxxxx   729 xxxx xxxxx   732  670   949
Move Cap.:   1488 xxxx xxxxx  1488 xxxx xxxxx   724 xxxx xxxxx   730  668   949
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.39 xxxx  xxxx  0.01 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx   1.8 xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.4 xxxx xxxxx   7.4 xxxx xxxxx  13.1 xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     B    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  796 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.1 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  9.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     *     *    A     *
ApproachDel:    xxxxxx           xxxxxx           13.1             9.6
ApproachLOS:         *                *               B                A
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project
25% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP AM
Command:	Existing Plus Am+ CP AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

With Project
25% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	C	22.9	0.241	+13.805 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	C	15.1	0.595	+ 6.075 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	B	12.5	0.298	+ 3.257 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	B	10.3	0.040	+ 0.778 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:26:34                  Page 3-1
--------------------------------------------------------------------------------
                              With Project
                              25% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #1 Riverside Dr & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      8.8       Worst Case Level Of Service: C[ 22.9]
********************************************************************************
Street Name:         Neighbours Blvd                  Riverside Dr
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  1  0  0  0    0  0  0  1  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       6    2     3     0    1     0     0    5     6     5    4     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    6    2     3     0    1     0     0    5     6     5    4     0
Added Vol:    226    0     4     1    0     0     0    0     7     5    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:  232    2     7     1    1     0     0    5    13    10    4     1
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59  0.59 0.59  0.59
PHF Volume:   393    4    12     2    2     0     0    9    23    18    7     2
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:  393    4    12     2    2     0     0    9    23    18    7     2
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx xxxxx  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx xxxxx  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:    2 xxxx xxxxx    16 xxxx xxxxx  xxxx  808     2   818  802    10
Potent Cap.: 1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  317  1088   297  320  1078
Move Cap.:   1634 xxxx xxxxx  1615 xxxx xxxxx  xxxx  219  1088   215  221  1078
Volume/Cap:  0.24 xxxx  xxxx  0.00 xxxx  xxxx  xxxx 0.04  0.02  0.08 0.03  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.9 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.9 xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   510  xxxx  228 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx   0.2 xxxxx  0.4 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx  12.5 xxxxx 22.9 xxxxx
Shared LOS:     *    *     *     A    *     *     *    *     B     *    C     *
ApproachDel:    xxxxxx           xxxxxx            12.5             22.9
ApproachLOS:         *                *               B                C
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:26:34                  Page 4-1
--------------------------------------------------------------------------------
                              With Project
                              25% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #2 I-10 WB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      9.6       Worst Case Level Of Service: C[ 15.1]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 WB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Channel          Include          Channel
Lanes:       0  1  0  0  0    0  0  1  0  1    0  0  0  0  0    0  1  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       5   52     0     0   27    45     0    0     0    10    0    11
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    5   56     0     0   29    49     0    0     0    11    0    12
Added Vol:      3  137     0     0   14     8     0    0     0   130    0   358
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    8  193     0     0   43    57     0    0     0   141    0   370
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78  0.78 0.78  0.78
PHF Volume:    11  247     0     0   55    72     0    0     0   180    0   474
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:   11  247     0     0   55    72     0    0     0   180    0   474
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.4  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:   55 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   360  324   247
Potent Cap.: 1563 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   643  597   796
Move Cap.:   1563 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   639  593   796
Volume/Cap:  0.01 xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.28 0.00  0.59
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx   4.0
Control Del:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx  15.9
LOS by Move:    A    *     *     *    *     *     *    *     *     *    *     C
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   639 xxxx xxxxx
SharedQueue:  0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   1.2 xxxx xxxxx
Shrd ConDel:  7.3 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx  12.8 xxxx xxxxx
Shared LOS:     A    *     *     *    *     *     *    *     *     B    *     *
ApproachDel:    xxxxxx           xxxxxx            xxxxxx           15.1
ApproachLOS:         *                *                 *                C
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:26:34                  Page 5-1
--------------------------------------------------------------------------------
                              With Project
                              25% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      5.2       Worst Case Level Of Service: B[ 12.5]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0    5     4    12  132     0   135    0    57     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   64    48    25  187     0   141    0    61     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   81    60    31  234     0   177    0    77     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   81    60    31  234     0   177    0    77     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    81 xxxx xxxxx   407  377   234  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1530 xxxx xxxxx   604  558   810  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1530 xxxx xxxxx   594  546   810  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.02 xxxx  xxxx  0.30 0.00  0.09  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.1 xxxx xxxxx  xxxx xxxx   0.3  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx   9.9 xxxxx xxxx xxxxx
LOS by Move:    *    *      *     A    *      *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   594 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.1 xxxx xxxxx   1.2 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx  13.6 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *      *     A    *      *     B    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            12.5           xxxxxx
ApproachLOS:         *                *               B                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:26:34                  Page 6-1
--------------------------------------------------------------------------------
                              With Project
                              25% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      1.3       Worst Case Level Of Service: B[ 10.3]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0    1     0     1    2   187     7    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   60    17     5   54   188     8    0     2    23    2     7
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   72    21     6   64   223    10    0     3    27    3     9
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   72    21     6   64   223    10    0     3    27    3     9
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  287 xxxx xxxxx    92 xxxx xxxxx   279  283   176   274  385    82
Potent Cap.: 1286 xxxx xxxxx  1515 xxxx xxxxx   678  629   873   682  552   983
Move Cap.:   1286 xxxx xxxxx  1515 xxxx xxxxx   667  626   873   678  549   983
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.01 0.00  0.00  0.04 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.8 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *      *     A    *      *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  702 xxxxx  xxxx  718 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.1 xxxxx xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 10.2 xxxxx xxxxx 10.3 xxxxx
Shared LOS:     *    *      *     *    *      *     *    B     *     *    B     *
ApproachDel:    xxxxxx           xxxxxx             10.2            10.3
ApproachLOS:         *                *               B                B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project
25% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP PM
Command:	Existing Plus Am+ CP PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:26:56 Page 2-1

With Project
25% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	11.5	0.311	+ 2.886 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	C	15.5	0.184	+ 5.987 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	E	37.2	0.431	+27.584 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	B	12.0	0.291	+ 2.109 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:26:56 Page 3-1

With Project
25% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 9.2 Worst Case Level Of Service: B[11.5]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 1 0 0 0			0 0 0 1 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	1	5	2	0	4	0	0	1	2	3	0	1
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	5	2	0	4	0	0	1	2	3	0	1
Added Vol:	7	0	6	1	0	0	0	0	226	5	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	8	5	8	1	4	0	0	1	228	8	0	2
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
PHF Volume:	12	8	12	1	6	0	0	2	336	12	0	3
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	12	8	12	1	6	0	0	2	336	12	0	3
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	6	xxxx	xxxxx	20	xxxx	xxxxx	xxxx	53	6	216	47	14
Potent Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	842	1082	745	848	1072
Move Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	835	1082	510	841	1072
Volume/Cap:	0.01	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	0.00	0.31	0.02	0.00	0.00
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.2	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	1081	xxxx	570	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	1.3	xxxxx	0.1	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	9.8	xxxxx	11.5	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	A	*	B	*
ApproachDel:	xxxxxx			xxxxxx			9.8			11.5		
ApproachLOS:	*			*			A			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:26:56 Page 4-1

With Project
25% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 2.1 Worst Case Level Of Service: C[15.7]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1 0 0 0			0 0 1 0 1			0 0 0 0 0			0 1 0 0 1		
Volume Module:												
Base Vol:	6	75	0	0	45	10	0	0	0	42	0	10
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	81	0	0	49	11	0	0	0	45	0	11
Added Vol:	57	12	0	0	360	134	0	0	0	4	0	13
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	63	93	0	0	409	145	0	0	0	49	0	24
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
PHF Volume:	76	111	0	0	488	173	0	0	0	59	0	28
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	76	111	0	0	488	173	0	0	0	59	0	28
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	488	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	836	750	111
Potent Cap.:	1086	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	340	342	948
Move Cap.:	1086	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	321	317	948
Volume/Cap:	0.07	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.18	0.00	0.03
Level Of Service Module:												
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.1
Control Del:	8.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.9
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	321	xxxx	xxxxx
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.7	xxxx	xxxxx
Shrd ConDel:	8.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	18.7	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	C	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			15.5		
ApproachLOS:	*			*			*			C		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:26:56 Page 5-1

With Project
25% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #3 I-10 EB Ramp & Neighbours Blvd

Average Delay (sec/veh): 7.2 Worst Case Level Of Service: E[37.2]

Street Name:	Neighbours Blvd						I-10 EB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Channel			Include			Channel			Include		
Lanes:	0 0 1	0	1	0 1	0	0	0 1	0	1	0 0	0	0
Volume Module:												
Base Vol:	0	35	54	12	73	0	43	0	13	0	0	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	38	58	13	79	0	46	0	14	0	0	0
Added Vol:	0	60	130	358	6	0	10	0	3	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	98	188	371	85	0	56	0	17	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
PHF Volume:	0	113	217	428	98	0	65	0	20	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	0	113	217	428	98	0	65	0	20	0	0	0
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	6.4	6.5	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	113	xxxx	xxxxx	1175	1066	98	xxxx	xxxx	xxxxx
Potent Cap.:	xxxx	xxxx	xxxxx	1489	xxxx	xxxxx	214	224	964	xxxx	xxxx	xxxxx
Move Cap.:	xxxx	xxxx	xxxxx	1489	xxxx	xxxxx	151	140	964	xxxx	xxxx	xxxxx
Volume/Cap:	xxxx	xxxx	xxxx	0.29	xxxx	xxxx	0.43	0.00	0.02	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	1.2	xxxx	xxxxx	xxxx	xxxx	0.1	xxxx	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	8.4	xxxx	xxxxx	xxxxx	xxxx	8.8	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	A	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	151	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	1.2	xxxx	xxxxx	1.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	8.4	xxxx	xxxxx	45.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	A	*	*	E	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			37.2			xxxxxx		
ApproachLOS:	*			*			E			*		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:26:56 Page 6-1

With Project
25% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #4 Seeley Ave & Neighbours Blvd

Average Delay (sec/veh): 5.9 Worst Case Level Of Service: B[12.0]

Street Name:	Neighbours Blvd						Seeley Ave					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1!	0	0	0 0 1!	0	0	1 0	0	0	0 0 1!	0	0
Volume Module:												
Base Vol:	1	86	6	2	83	1	1	0	0	7	0	3
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	93	6	2	90	1	1	0	0	8	0	3
Added Vol:	0	2	0	1	2	7	187	0	0	0	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	1	95	6	3	92	8	188	0	0	8	0	4
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
PHF Volume:	1	106	7	4	103	9	211	0	0	8	0	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	1	106	7	4	103	9	211	0	0	8	0	5
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.1	xxxx	xxxxx	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	112	xxxx	xxxxx	114	xxxx	xxxxx	229	xxxx	xxxxx	227	231	110
Potent Cap.:	1491	xxxx	xxxxx	1488	xxxx	xxxxx	730	xxxx	xxxxx	733	672	949
Move Cap.:	1491	xxxx	xxxxx	1488	xxxx	xxxxx	725	xxxx	xxxxx	731	670	949
Volume/Cap:	0.00	xxxx	xxxx	0.00	xxxx	xxxx	0.29	xxxx	xxxx	0.01	0.00	0.01
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	1.2	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.4	xxxx	xxxxx	7.4	xxxx	xxxxx	12.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	B	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	797	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.1	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	9.6	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	A	*
ApproachDel:	xxxxxx			xxxxxx			12.0			9.6		
ApproachLOS:	*			*			B			A		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

With Project
30% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP AM
Command:	Existing Plus Am+ CP AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

With Project
30% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	C	20.7	0.224	+11.675 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	B	14.1	0.547	+ 5.069 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	B	12.1	0.272	+ 2.891 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	B	10.2	0.039	+ 0.720 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP AM Wed May 8, 2013 07:29:33 Page 3-1

With Project
30% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 8.6 Worst Case Level Of Service: C[20.7]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	- T	- R	L	- T	- R	L	- T	- R	L	- T	- R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0	0 1! 0	0	0	1 0	0 0	0	0 0 1	0	0	0 1! 0	0
Volume Module:												
Base Vol:	6	2	3	0	1	0	0	5	6	5	4	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	2	3	0	1	0	0	5	6	5	4	0
Added Vol:	210	0	4	1	0	0	0	0	6	5	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	216	2	7	1	1	0	0	5	12	10	4	1
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
PHF Volume:	366	4	12	2	2	0	0	9	21	18	7	2
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	366	4	12	2	2	0	0	9	21	18	7	2
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	2	xxxx	xxxxx	16	xxxx	xxxxx	xxxx	754	2	763	748	10
Potent Cap.:	1634	xxxx	xxxxx	1615	xxxx	xxxxx	xxxx	341	1088	324	344	1078
Move Cap.:	1634	xxxx	xxxxx	1615	xxxx	xxxxx	xxxx	245	1088	241	247	1078
Volume/Cap:	0.22	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	0.04	0.02	0.07	0.03	0.00
Level Of Service Module:												
2Way95thQ:	0.9	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.8	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	533	xxxx	255	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	0.2	xxxxx	0.3	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	12.2	xxxxx	20.7	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	B	*	C	*
ApproachDel:	xxxxxx			xxxxxx			12.2			20.7		
ApproachLOS:	*			*			B			C		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP AM Wed May 8, 2013 07:29:33 Page 4-1

With Project
30% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 8.8 Worst Case Level Of Service: B[14.1]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	- T	- R	L	- T	- R	L	- T	- R	L	- T	- R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0	1 0	0	0	0 1	0 1	0	0 0	0	0	1 0	0 1
Volume Module:												
Base Vol:	5	52	0	0	27	45	0	0	0	10	0	11
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	5	56	0	0	29	49	0	0	0	11	0	12
Added Vol:	3	127	0	0	13	8	0	0	0	121	0	334
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	8	183	0	0	42	57	0	0	0	132	0	346
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
PHF Volume:	11	235	0	0	54	72	0	0	0	169	0	443
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	11	235	0	0	54	72	0	0	0	169	0	443
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	54	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	346	310	235
Potent Cap.:	1564	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	655	608	810
Move Cap.:	1564	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	651	604	810
Volume/Cap:	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.26	0.00	0.55
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	3.4
Control Del:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	14.7
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	B
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	651	xxxx	xxxxx
SharedQueue:	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	1.0	xxxx	xxxxx
Shrd ConDel:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	12.5	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	B	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			14.1		
ApproachLOS:	*			*			*			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:29:33                  Page 5-1
--------------------------------------------------------------------------------
                              With Project
                              30% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      4.9       Worst Case Level Of Service: B[ 12.1]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0    5     3    11  123     0   125    0    53     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   64    47    24  178     0   131    0    57     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   81    59    30  223     0   165    0    72     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   81    59    30  223     0   165    0    72     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    81 xxxx xxxxx   393  363   223  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1530 xxxx xxxxx   615  568   822  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1530 xxxx xxxxx   606  556   822  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.02 xxxx  xxxx  0.27 0.00  0.09  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.1 xxxx xxxxx  xxxx xxxx   0.3  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx   9.8 xxxxx xxxx xxxxx
LOS by Move:    *    *      *     A    *      *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   606 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.1 xxxx xxxxx   1.1 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx  13.1 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *      *     A    *      *     B    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            12.1           xxxxxx
ApproachLOS:         *                *               B                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:29:33                  Page 6-1
--------------------------------------------------------------------------------
                              With Project
                              30% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      1.3       Worst Case Level Of Service: B[ 10.2]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0    1     0     1    2   174     6    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   60    17     5   54   175     7    0     2    23    2     7
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   72    21     6   64   208     8    0     3    27    3     9
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   72    21     6   64   208     8    0     3    27    3     9
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  272 xxxx xxxxx    92 xxxx xxxxx   271  275   168   266  369    82
Potent Cap.: 1303 xxxx xxxxx  1515 xxxx xxxxx   686  635   881   690  563   983
Move Cap.:   1303 xxxx xxxxx  1515 xxxx xxxxx   675  632   881   686  561   983
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.01 0.00  0.00  0.04 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.8 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *      *     A    *      *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  714 xxxxx  xxxx  726 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 10.1 xxxxx xxxxx 10.2 xxxxx
Shared LOS:     *    *      *     *    *      *     *    B     *     *    B     *
ApproachDel:    xxxxxx           xxxxxx             10.1            10.2
ApproachLOS:         *                *                B               B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project
30% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP PM
Command:	Existing Plus Am+ CP PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

With Project
30% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	11.2	0.289	+ 2.573 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	B	14.9	0.169	+ 5.372 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	D	30.8	0.367	+21.181 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	B	11.8	0.271	+ 1.910 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:30:03 Page 3-1

With Project
30% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 9.0 Worst Case Level Of Service: B[11.2]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0	1! 0	0	0 1	0 0	0	0 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	1	5	2	0	4	0	0	1	2	3	0	1
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	5	2	0	4	0	0	1	2	3	0	1
Added Vol:	6	0	6	1	0	0	0	0	210	5	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	7	5	8	1	4	0	0	1	212	8	0	2
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
PHF Volume:	10	8	12	1	6	0	0	2	312	12	0	3
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	10	8	12	1	6	0	0	2	312	12	0	3
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	6	xxxx	xxxxx	20	xxxx	xxxxx	xxxx	50	6	201	44	14
Potent Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	845	1082	762	852	1072
Move Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	839	1082	538	845	1072
Volume/Cap:	0.01	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	0.00	0.29	0.02	0.00	0.00
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.2	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	1081	xxxx	598	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	1.2	xxxxx	0.1	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	9.7	xxxxx	11.2	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	A	*	B	*
ApproachDel:	xxxxxx			xxxxxx			9.7			11.2		
ApproachLOS:	*			*			A			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:30:03 Page 4-1

With Project
30% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 2.1 Worst Case Level Of Service: B[14.9]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1	0 0	0	0 0	1 0	1	0 0	0 0	0	0 1	0 0	1
Volume Module:												
Base Vol:	6	75	0	0	45	10	0	0	0	42	0	10
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	81	0	0	49	11	0	0	0	45	0	11
Added Vol:	53	11	0	0	336	126	0	0	0	3	0	11
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	59	92	0	0	385	137	0	0	0	48	0	22
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
PHF Volume:	71	110	0	0	459	163	0	0	0	58	0	26
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	71	110	0	0	459	163	0	0	0	58	0	26
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	459	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	792	711	110
Potent Cap.:	1113	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	361	361	949
Move Cap.:	1113	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	342	337	949
Volume/Cap:	0.06	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.17	0.00	0.03
Level Of Service Module:												
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.1
Control Del:	8.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.9
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	342	xxxx	xxxxx
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.6	xxxx	xxxxx
Shrd ConDel:	8.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	17.6	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	C	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			14.9		
ApproachLOS:	*			*			*			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

```
Ex Plus Am Plus CP PM      Wed May 8, 2013 07:30:03                  Page 5-1
--------------------------------------------------------------------------------
                              With Project
                              30% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      6.5       Worst Case Level Of Service: D[ 30.8]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   35    54    12   73     0    43    0    13     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   38    58    13   79     0    46    0    14     0    0     0
Added Vol:      0   56   121   334    6     0     8    0     3     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   94   179   347   85     0    54    0    17     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87  0.87 0.87  0.87
PHF Volume:     0  108   207   400   98     0    63    0    20     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0  108   207   400   98     0    63    0    20     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx   108 xxxx xxxxx  1110 1006    98  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1495 xxxx xxxxx   234  243   964  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1495 xxxx xxxxx   171  159   964  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.27 xxxx  xxxx  0.37 0.00  0.02  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   1.1 xxxx xxxxx  xxxx xxxx   0.1  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   8.3 xxxx xxxxx xxxxx xxxx   8.8 xxxxx xxxx xxxxx
LOS by Move:    *    *     *     A    *     *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   171 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   1.1 xxxx xxxxx   1.6 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   8.3 xxxx xxxxx  37.7 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     E    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            30.8           xxxxxx
ApproachLOS:         *                *               D                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP PM      Wed May 8, 2013 07:30:03                  Page 6-1
--------------------------------------------------------------------------------
                              With Project
                              30% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      5.6       Worst Case Level Of Service: B[ 11.8]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    1  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   86     6     2   83     1     1    0     0     7    0     3
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   93     6     2   90     1     1    0     0     8    0     3
Added Vol:      0    2     0     1    2     6   174    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   95     6     3   92     7   175    0     0     8    0     4
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89  0.89 0.89  0.89
PHF Volume:     1  106     7     4  103     8   196    0     0     8    0     5
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1  106     7     4  103     8   196    0     0     8    0     5
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1 xxxx xxxxx   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5 xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  111 xxxx xxxxx   114 xxxx xxxxx   229 xxxx xxxxx   226  230   110
Potent Cap.: 1492 xxxx xxxxx  1488 xxxx xxxxx   731 xxxx xxxxx   733  673   949
Move Cap.:   1492 xxxx xxxxx  1488 xxxx xxxxx   725 xxxx xxxxx   732  671   949
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.27 xxxx  xxxx  0.01 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx   1.1 xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.4 xxxx xxxxx   7.4 xxxx xxxxx  11.8 xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *     *     A    *     *     B    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  797 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.1 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  9.6 xxxxx
Shared LOS:     *    *     *     *    *     *     *    *     *     *    A     *
ApproachDel:    xxxxxx           xxxxxx            11.8            9.6
ApproachLOS:         *                *               B                A
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project
40% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP AM
Command:	Existing Plus Am+ CP AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	AM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

With Project
40% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	9.0	0.011	C	17.6	0.193	+ 8.517 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.0	0.016	B	12.6	0.458	+ 3.621 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.2	0.011	B	11.5	0.228	+ 2.312 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.5	0.033	B	10.1	0.038	+ 0.611 D/V

Ex Plus Am Plus CP AM Wed May 8, 2013 07:32:21 Page 3-1

With Project
40% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 8.3 Worst Case Level Of Service: C[17.6]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	- T	- R	L	- T	- R	L	- T	- R	L	- T	- R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0	0 1! 0	0	0	1 0	0 0	0	0 0 1	0	0	0 1! 0	0
Volume Module:												
Base Vol:	6	2	3	0	1	0	0	5	6	5	4	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	2	3	0	1	0	0	5	6	5	4	0
Added Vol:	180	0	4	1	0	0	0	0	5	5	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	186	2	7	1	1	0	0	5	11	10	4	1
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
PHF Volume:	316	4	12	2	2	0	0	9	19	18	7	2
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	316	4	12	2	2	0	0	9	19	18	7	2
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	2	xxxx	xxxxx	16	xxxx	xxxxx	xxxx	652	2	660	646	10
Potent Cap.:	1634	xxxx	xxxxx	1615	xxxx	xxxxx	xxxx	390	1088	379	393	1078
Move Cap.:	1634	xxxx	xxxxx	1615	xxxx	xxxxx	xxxx	298	1088	298	301	1078
Volume/Cap:	0.19	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	0.03	0.02	0.06	0.02	0.00

Level Of Service Module:												
2Way95thQ:	0.7	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.7	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	589	xxxx	313	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	0.2	xxxxx	0.3	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	11.4	xxxxx	17.6	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	B	*	C	*
ApproachDel:	xxxxxx			xxxxxx			11.4			17.6		
ApproachLOS:	*			*			B			C		

Note: Queue reported is the number of cars per lane.

Ex Plus Am Plus CP AM Wed May 8, 2013 07:32:21 Page 4-1

With Project
40% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 7.7 Worst Case Level Of Service: B[12.6]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	- T	- R	L	- T	- R	L	- T	- R	L	- T	- R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0	1 0	0	0	0 1	0 1	0	0 0	0	0	1 0	0 1
Volume Module:												
Base Vol:	5	52	0	0	27	45	0	0	0	10	0	11
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	5	56	0	0	29	49	0	0	0	11	0	12
Added Vol:	2	110	0	0	12	7	0	0	0	104	0	286
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	7	166	0	0	41	56	0	0	0	115	0	298
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
PHF Volume:	9	213	0	0	53	71	0	0	0	147	0	381
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	9	213	0	0	53	71	0	0	0	147	0	381
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	53	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	320	284	213
Potent Cap.:	1566	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	678	628	832
Move Cap.:	1566	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	674	624	832
Volume/Cap:	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.22	0.00	0.46

Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	2.4
Control Del:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	12.9
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	B
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	674	xxxx	xxxxx
SharedQueue:	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.8	xxxx	xxxxx
Shrd ConDel:	7.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	11.8	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	B	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			12.6		
ApproachLOS:	*			*			*			B		

Note: Queue reported is the number of cars per lane.

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:32:21                  Page 5-1
--------------------------------------------------------------------------------
                              With Project
                              40% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #3 I-10 EB Ramp & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      4.5       Worst Case Level Of Service: B[ 11.5]
********************************************************************************
Street Name:         Neighbours Blvd                  I-10 EB Ramp
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Channel          Include          Channel          Include
Lanes:       0  0  1  0  1    0  1  0  0  0    0  1  0  0  1    0  0  0  0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0   55    41    12   51     0     6    0     4     0    0     0
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    0   59    44    13   55     0     6    0     4     0    0     0
Added Vol:      0    4     3     9  106     0   108    0    46     0    0     0
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    0   63    47    22  161     0   114    0    50     0    0     0
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80  0.80 0.80  0.80
PHF Volume:     0   79    59    27  202     0   143    0    63     0    0     0
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    0   79    59    27  202     0   143    0    63     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx   4.1 xxxx xxxxx   6.4  6.5   6.2 xxxxx xxxx xxxxx
FollowUpTim:xxxxx xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3 xxxxx xxxx xxxxx
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx    79 xxxx xxxxx   366  336   202  xxxx xxxx xxxxx
Potent Cap.: xxxx xxxx xxxxx  1532 xxxx xxxxx   638  588   844  xxxx xxxx xxxxx
Move Cap.:   xxxx xxxx xxxxx  1532 xxxx xxxxx   629  577   844  xxxx xxxx xxxxx
Volume/Cap:  xxxx xxxx  xxxx  0.02 xxxx  xxxx  0.23 0.00  0.07  xxxx xxxx  xxxx
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx   0.1 xxxx xxxxx  xxxx xxxx   0.2  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx   9.6 xxxxx xxxx xxxxx
LOS by Move:    *    *      *     A    *      *     *    *     A     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx   629 xxxx xxxxx  xxxx xxxx xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.1 xxxx xxxxx   0.9 xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.4 xxxx xxxxx  12.4 xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *      *     A    *      *     B    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx            11.5           xxxxxx
ApproachLOS:         *                *               B                *
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

```
Ex Plus Am Plus CP AM      Wed May 8, 2013 07:32:21                  Page 6-1
--------------------------------------------------------------------------------
                              With Project
                              40% Staggered
--------------------------------------------------------------------------------
                    Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
********************************************************************************
Intersection #4 Seeley Ave & Neighbours Blvd
********************************************************************************
Average Delay (sec/veh):      1.4       Worst Case Level Of Service: B[ 10.1]
********************************************************************************
Street Name:         Neighbours Blvd                  Seeley Ave
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled      Stop Sign         Stop Sign
Rights:            Include          Include          Include          Include
Lanes:       0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       1   55    16     4   48     1     1    0     2    21    2     6
Growth Adj:  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08  1.08 1.08  1.08
Initial Bse:    1   59    17     4   52     1     1    0     2    23    2     6
Added Vol:      0    1     0     1    2   149     5    0     0     0    0     1
PasserByVol:    0    0     0     0    0     0     0    0     0     0    0     0
Initial Fut:    1   60    17     5   54   150     6    0     2    23    2     7
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84  0.84 0.84  0.84
PHF Volume:     1   72    21     6   64   178     7    0     3    27    3     9
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:    1   72    21     6   64   178     7    0     3    27    3     9
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:  4.1 xxxx xxxxx   4.1 xxxx xxxxx   7.1  6.5   6.2   7.1  6.5   6.2
FollowUpTim:  2.2 xxxx xxxxx   2.2 xxxx xxxxx   3.5  4.0   3.3   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol:  242 xxxx xxxxx    92 xxxx xxxxx   256  261   153   252  339    82
Potent Cap.: 1336 xxxx xxxxx  1515 xxxx xxxxx   701  648   898   706  585   983
Move Cap.:   1336 xxxx xxxxx  1515 xxxx xxxxx   690  644   898   701  582   983
Volume/Cap:  0.00 xxxx  xxxx  0.00 xxxx  xxxx  0.01 0.00  0.00  0.04 0.00  0.01
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:    0.0 xxxx xxxxx   0.0 xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:  7.7 xxxx xxxxx   7.4 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    A    *      *     A    *      *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx  735 xxxxx  xxxx  740 xxxxx
SharedQueue:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx  0.0 xxxxx xxxxx  0.2 xxxxx
Shrd ConDel:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx 10.0 xxxxx xxxxx 10.1 xxxxx
Shared LOS:     *    *      *     *    *      *     *    A     *     *    B     *
ApproachDel:    xxxxxx           xxxxxx             10.0             10.1
ApproachLOS:         *                *                A                B
********************************************************************************
Note: Queue reported is the number of cars per lane.
********************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

With Project
40% Staggered

Scenario Report

Scenario:	Ex Plus Am Plus CP PM
Command:	Existing Plus Am+ CP PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	PM
Trip Distribution:	ALL
Paths:	Default Path
Routes:	Default Route
Configuration:	Default Configuration

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:34:03 Page 2-1

With Project
40% Staggered

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Riverside Dr & Neighbours Blvd	A	8.6	0.005	B	10.7	0.248	+ 2.069 D/V
# 2 I-10 WB Ramp & Neighbours Blvd	A	9.5	0.066	B	13.8	0.148	+ 4.213 D/V
# 3 I-10 EB Ramp & Neighbours Blvd	A	9.6	0.068	C	23.4	0.287	+13.760 D/V
# 4 Seeley Ave & Neighbours Blvd	A	9.9	0.011	B	11.4	0.232	+ 1.565 D/V

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:34:03 Page 3-1

With Project
40% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #1 Riverside Dr & Neighbours Blvd

Average Delay (sec/veh): 8.7 Worst Case Level Of Service: B[10.7]

Street Name:	Neighbours Blvd						Riverside Dr					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1! 0 0			0 1 0 0 0			0 0 0 1 0			0 0 1! 0 0		
Volume Module:												
Base Vol:	1	5	2	0	4	0	0	1	2	3	0	1
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	5	2	0	4	0	0	1	2	3	0	1
Added Vol:	5	0	6	1	0	0	0	0	180	5	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	6	5	8	1	4	0	0	1	182	8	0	2
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
PHF Volume:	9	8	12	1	6	0	0	2	268	12	0	3
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	9	8	12	1	6	0	0	2	268	12	0	3
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	6	xxxx	xxxxx	20	xxxx	xxxxx	xxxx	47	6	176	41	14
Potent Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	848	1082	791	855	1072
Move Cap.:	1628	xxxx	xxxxx	1609	xxxx	xxxxx	xxxx	843	1082	591	849	1072
Volume/Cap:	0.01	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	0.00	0.25	0.02	0.00	0.00
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.2	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	1080	xxxx	650	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	1.0	xxxxx	0.1	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	7.2	xxxx	xxxxx	xxxxx	xxxx	9.4	xxxxx	10.7	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	A	*	B	*
ApproachDel:	xxxxxx			xxxxxx			9.4			10.7		
ApproachLOS:	*			*			A			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:34:03 Page 4-1

With Project
40% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 I-10 WB Ramp & Neighbours Blvd

Average Delay (sec/veh): 2.1 Worst Case Level Of Service: B[13.8]

Street Name:	Neighbours Blvd						I-10 WB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Channel			Include			Channel		
Lanes:	0 1 0 0 0			0 0 1 0 1			0 0 0 0 0			0 1 0 0 1		
Volume Module:												
Base Vol:	6	75	0	0	45	10	0	0	0	42	0	10
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	6	81	0	0	49	11	0	0	0	45	0	11
Added Vol:	45	11	0	0	288	107	0	0	0	3	0	10
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	51	92	0	0	337	118	0	0	0	48	0	21
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
PHF Volume:	61	110	0	0	402	141	0	0	0	58	0	25
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	61	110	0	0	402	141	0	0	0	58	0	25
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.4	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	402	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	705	634	110
Potent Cap.:	1168	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	406	399	949
Move Cap.:	1168	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	389	377	949
Volume/Cap:	0.05	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.15	0.00	0.03
Level Of Service Module:												
2Way95thQ:	0.2	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	0.1
Control Del:	8.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	8.9
LOS by Move:	A	*	*	*	*	*	*	*	*	*	*	A
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	389	xxxx	xxxxx
SharedQueue:	0.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	0.5	xxxx	xxxxx
Shrd ConDel:	8.3	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	15.9	xxxx	xxxxx
Shared LOS:	A	*	*	*	*	*	*	*	*	C	*	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			13.8		
ApproachLOS:	*			*			*			B		

Note: Queue reported is the number of cars per lane.

Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK

Ex Plus Am Plus CP PM Wed May 8, 2013 07:34:03 Page 5-1

With Project
40% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #3 I-10 EB Ramp & Neighbours Blvd

Average Delay (sec/veh): 5.8 Worst Case Level Of Service: C[23.4]

Street Name:	Neighbours Blvd						I-10 EB Ramp					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Channel			Include			Channel			Include		
Lanes:	0 0 1	0	1	0 1	0	0	0 1	0	1	0 0	0	0
Volume Module:												
Base Vol:	0	35	54	12	73	0	43	0	13	0	0	0
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	0	38	58	13	79	0	46	0	14	0	0	0
Added Vol:	0	48	103	286	5	0	8	0	3	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	86	161	299	84	0	54	0	17	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
PHF Volume:	0	99	186	345	97	0	63	0	20	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	0	99	186	345	97	0	63	0	20	0	0	0
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	6.4	6.5	6.2	xxxxx	xxxx	xxxxx
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	xxxxx	xxxx	xxxxx
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	99	xxxx	xxxxx	978	885	97	xxxx	xxxx	xxxxx
Potent Cap.:	xxxx	xxxx	xxxxx	1507	xxxx	xxxxx	280	286	965	xxxx	xxxx	xxxxx
Move Cap.:	xxxx	xxxx	xxxxx	1507	xxxx	xxxxx	219	205	965	xxxx	xxxx	xxxxx
Volume/Cap:	xxxx	xxxx	xxxx	0.23	xxxx	xxxx	0.29	0.00	0.02	xxxx	xxxx	xxxx
Level Of Service Module:												
2Way95thQ:	xxxx	xxxx	xxxxx	0.9	xxxx	xxxxx	xxxx	xxxx	0.1	xxxx	xxxx	xxxxx
Control Del:	xxxxx	xxxx	xxxxx	8.1	xxxx	xxxxx	xxxxx	xxxx	8.8	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	A	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	219	xxxx	xxxxx	xxxx	xxxx	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.9	xxxx	xxxxx	1.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	8.1	xxxx	xxxxx	28.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Shared LOS:	*	*	*	A	*	*	D	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			23.4			xxxxxx		
ApproachLOS:	*			*			C			*		

Note: Queue reported is the number of cars per lane.

Ex Plus Am Plus CP PM Wed May 8, 2013 07:34:03 Page 6-1

With Project
40% Staggered

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #4 Seeley Ave & Neighbours Blvd

Average Delay (sec/veh): 5.1 Worst Case Level Of Service: B[11.4]

Street Name:	Neighbours Blvd						Seeley Ave					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 0 1!	0	0	0 0 1!	0	0	1 0	0	0	0 0 1!	0	0
Volume Module:												
Base Vol:	1	86	6	2	83	1	1	0	0	7	0	3
Growth Adj:	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Initial Bse:	1	93	6	2	90	1	1	0	0	8	0	3
Added Vol:	0	2	0	1	2	5	149	0	0	0	0	1
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	1	95	6	3	92	6	150	0	0	8	0	4
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
PHF Volume:	1	106	7	4	103	7	168	0	0	8	0	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
FinalVolume:	1	106	7	4	103	7	168	0	0	8	0	5
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.1	xxxx	xxxxx	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	xxxx	xxxxx	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	110	xxxx	xxxxx	114	xxxx	xxxxx	228	xxxx	xxxxx	226	229	110
Potent Cap.:	1493	xxxx	xxxxx	1488	xxxx	xxxxx	731	xxxx	xxxxx	734	674	949
Move Cap.:	1493	xxxx	xxxxx	1488	xxxx	xxxxx	726	xxxx	xxxxx	732	672	949
Volume/Cap:	0.00	xxxx	xxxx	0.00	xxxx	xxxx	0.23	xxxx	xxxx	0.01	0.00	0.01
Level Of Service Module:												
2Way95thQ:	0.0	xxxx	xxxxx	0.0	xxxx	xxxxx	0.9	xxxx	xxxxx	xxxx	xxxx	xxxxx
Control Del:	7.4	xxxx	xxxxx	7.4	xxxx	xxxxx	11.4	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	B	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	798	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.1	xxxxx
Shrd ConDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	9.6	xxxxx
Shared LOS:	*	*	*	*	*	*	*	*	*	*	A	*
ApproachDel:	xxxxxx			xxxxxx			11.4			9.6		
ApproachLOS:	*			*			B			A		

Note: Queue reported is the number of cars per lane.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX K
GLARE AND REFLECTION STUDY

THIS PAGE INTENTIONALLY LEFT BLANK

9/29/2011

RENEWABLE RESOURCES GROUP

Renewable Resources Group

Blythe Mesa Solar Project

Glare Study

PROJECT NUMBER:
121317
PROJECT CONTACT:
Jason Pfaff
EMAIL:
jason.pfaff@powereng.com
PHONE:
509-758-6029

POWER ENGINEERS

BLYTHE MESA SOLAR PROJECT
Glare Study

PREPARED FOR: *RENEWABLE RESOURCES GROUP*
PREPARED BY: *POWER ENGINEERS*

TABLE OF CONTENTS

GLARE STUDY FOR THE BLYTHE MESA SOLAR PROJECT 4

1.0 INTRODUCTION 4
1.1 DEFINITIONS AND DESCRIPTIONS 4
1.2 METHODOLOGY 7
1.2.1 POTENTIAL GLARE ISSUES – LANDING APPROACHES 7
1.2.2 CHARACTERIZE GLARE BEHAVIOR - SINGLE AXIS SOLAR TRACKER 10
1.2.3 GLARE EVALUATION - 3D GEOMETRIC ANALYSIS 13
1.3 RESULTS 15
1.4 DISCUSSION AND CONCLUSIONS 17
1.4.1 IMPACTS TO LANDING APPROACHES (RELATING TO GLARE) 17
1.5 SOURCES 18

APPENDIX A –TABULAR GLARE RESULTS A-1

INSERTS/FIGURES:

Insert 1 – Single Axis Solar Tracker 4
Insert 2 – Examples of Glare 5
Figure 1 – Vicinity Map 6
Figure 2 – Landing Approaches 9
Figure 3 – Single Axis Solar Tracker Positioning 12
Figure 4 – Backtracking 12
Figure 5 – Landing Approach Study Area 14
Figure 6 – Cone of Vision 14

GLARE STUDY FOR THE BLYTHE MESA SOLAR PROJECT

1.0 INTRODUCTION

POWER Engineers, Inc. (POWER) has prepared a Glare Study for Renewable Resources Group's (RRG) Blythe Mesa Solar Project (Project). The Project is located east of the community of Blythe, California and immediately adjacent to and southeast of the Blythe Municipal Airport (See Figure 1). The facility will consist of a multiple arrays of Photovoltaic (PV) solar panels fixed to a single axis solar tracker. Specifically, this study answers the following questions:

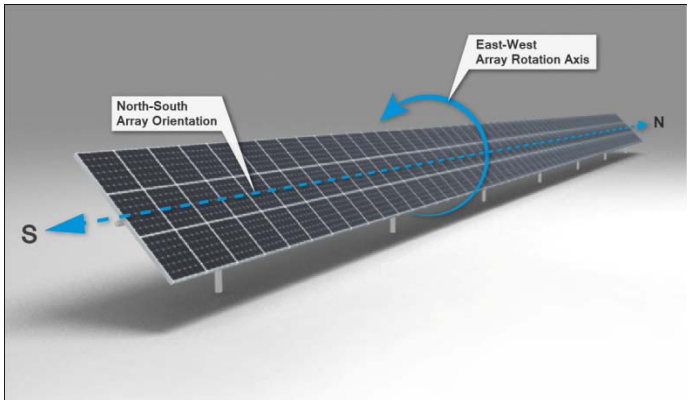
- Will glare from the PV panels be visible to pilots upon their approach on runways 8, 35, 17, 26 and the planned future expansion of Runway 8?
- If the glare is visible, how long will it occur and when will it occur?
- If a glare is visible, will it be in the pilots focused view (60 degree intense focus view or the distorted view 60 degrees to 120 degrees)?
- If the glare is visible, what is it comparable to?

1.1 DEFINITIONS AND DESCRIPTIONS

The following definitions and descriptions are important to understanding the methodology and results of the study:

- **Photovoltaic Panel** – Photovoltaic panels, also known as PV panels, are deigned to absorb solar energy and retain as much of the solar spectrum as possible in order to produce electricity.

- **Single Axis Solar Tracker** - Single axis trackers are designed to maximize the efficiency of a solar operation. PV Panels rotate around a fixed axis, tracking the sun's east/west position throughout the day (See Insert 1)**.**



INSERT 1 – SINGLE AXIS SOLAR TRACKER

- **Glare -** A continuous source of brightness, relative to diffuse or surface scattered lighting. This is also referred to as the suns reflection (see Insert 2).



INSERT 2 – EXAMPLES OF GLARE

- **3D Geometric Analysis** – A computer simulation incorporating a 3D terrain model, 3D solar equipment, single axis solar tracker behavior and a solar algorithm to determine the date, time and duration of glare which may be visible during the landing approach.

- **Landing Approach** – The path of decent of an aircraft relative to the runway.



AR062194

BLYTHE MESA SOLAR SITE

FIG. 1 - VICINITY MAP

Proposed Solar Panels | Proposed Project Boundary | Blythe Airport Runway

1.2 METHODOLOGY

POWER used the following methodology to determine if glare will be visible:

1. *Identify Potential Glare Issues* – POWER studied the landing approach for all four runways utilized at the Blythe Municipal Airport. Additionally, POWER studied the proposed lengthened section of Runway 8, and any potential glare issues that may present themselves. POWER prepared the study based on these locations (see Section 1.2.1).

2. *Characterize Glare Behavior* – At each landing approach, 3D simulations were developed to accurately create and study glare based on the behavior of the SunPower single axis solar tracker (See Section 1.2.2). 3D elements within the digital scene included terrain models, cone of vision, runway GPS coordinates, 3D solar equipment and a 3D sun system. This information was assembled in a 3D computer program to create an accurate virtual representation of the Project and surrounding area (see Section 1.2.3).

3. *Evaluate* – Visual analysts studied the 3D simulations under different lighting conditions, and at different times of the year. These simulations were used to evaluate and document when glare may be visible along the various landing approaches. Results of this evaluation can be found in Section 1.3.

1.2.1 Potential Glare Issues – Landing Approaches

Potential solar operations were studied along the six landing approach scenarios (see Figure 2). Riverside County Airport Land Use Commission's (ALUC) Planning Staff, as the lead permitting agency, provided the team with a document titled "*45-Vol.3 Blythe Municipal.pdf*" which was used in developing our 3D geometry of the landing approaches. POWER used the information derived from the aforementioned document to develop the glare analysis to perform the Glare Study (see Results, Appendix A). Each landing approach is described below:

- **Runway 35:** Northbound approach
  - Length: 5,820 feet
  - Visual Approach Aid: Rotating Beacon
  - Approach: 3 degrees

- **Runway 8 - existing:** Eastbound approach
  - Length: 6,562 feet
  - Visual Approach Aid: Rotating Beacon
  - Approach: 3 degrees

- **Runway 8 – proposed extension:** Eastbound approach and its associated extension of roughly 3,500 lineal feet.

- **Runway 17:** Southbound approach
  - Length: 5,820 feet
  - Visual Approach Aid: Rotating Beacon
  - Approach: 3 degrees

- **Runway 26:** Westbound approach
    - Length: 6,562 feet
    - Visual Approach Aid: Rotating Beacon
    - Approach: 3 degrees
    - Instrument Approach Procedures:
        - Circling Approach: 8.4 degrees

- **Runway 26 – Alternate Approach Angle:** Westbound runway with alternate 25-degree offset, right of center.
    - Length: 6,562 feet
    - Visual Approach Procedures:
        - Rotating Beacon for Visual Aid
        - Approach: 3 degrees
    - Instrument Approach Procedures:
        - Straight-in Approach:
            - Approach: 6.9 degrees
            - Approach course aligned 25 degrees right of runway centerline
        - Circling Approach: 8.4 degrees

FIG. 2 - LANDING APPROACHES

BLYTHE MESA SOLAR SITE

1.2.2 Characterize Glare Behavior - Single Axis Solar Tracker

In order to characterize glare behavior, POWER created a 3D representation of the site, the sun and the single axis solar trackers. The 3D Model allowed analysts to accurately determine when and where glare may be visible to pilots. Specifically, the 3D Model incorporated the following:

- **3D Terrain Models** – RRG provided 5-foot contours of the Project site. This information was converted into a 3D surface model and used for placement and elevation of the proposed solar arrays.

- **Runway GPS Coordinates** – ALUC's aforementioned document provided GPS coordinates for each of the runways.

- **Solar Sun System** – The 3D computer simulations incorporated an accurate, solar algorithm based on the latitude and longitude of the actual Project. All calculations were performed using 3D software, designed for calculating and animating solar cycles. Sun calculations and results were based on hours of operational daylight and solar clocks for the following times of year:

    - Summer Solstice (June 21st, 2011) – Where the length of sunlight hours are at its peak and the sun has reached its northernmost extremes.
    - Winter Solstice (December 22nd, 2011) – Where the length of sunlight hours are at its lowest and the sun has reached its southernmost extremes.
    - Fall Equinox (September 23rd, 2011) – Where the day and night are equal in length.
    - Spring Equinox (March 20th, 2011) – Where the day and night are equal in length.

- **3D Solar Equipment** – RRG provided electronic CAD data for the location of the proposed solar arrays. Additional CAD information collected included panel design, panel height, panel orientation, backtracking and tilt (-45/+45 degrees). It is important to note the 3D geometric analysis does not measure the intensity of glare, and is focused specifically on the location, duration and conditions in which glare may occur (please refer to Section 1.4 Discussion and Conclusions, regarding solar panel glare intensity).

  SunPower's Single Axis Solar Tracker has three primary positions: tracking, backtracking, and stow positions. In addition to the three primary positions, trackers also have a 'wake up' procedure that brings the tracker out of the stow position and into alignment with the sun to begin tracking. These are characterized by the graphic (see Figure 3) and by the following descriptions:

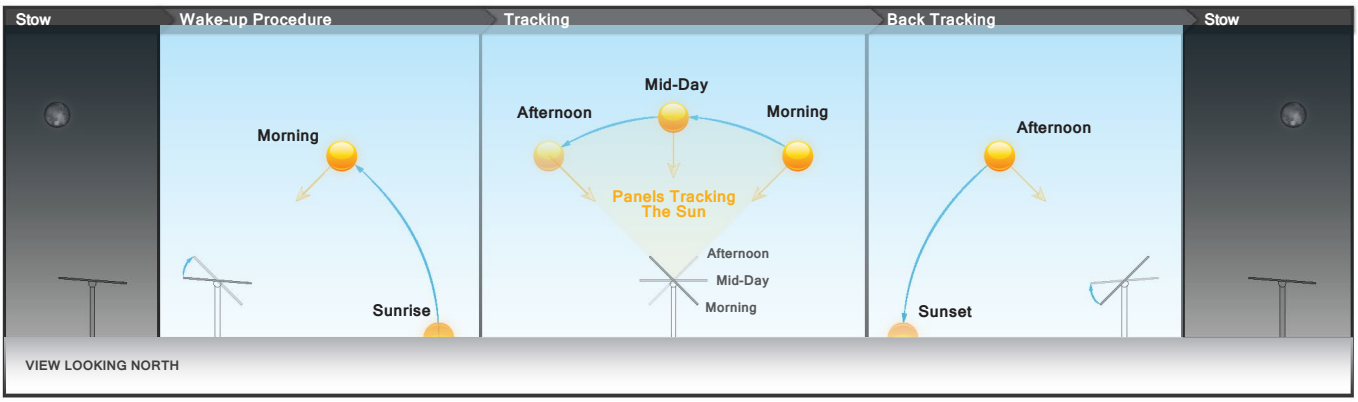
    - **Tracking** – The process by which the solar array maintains a 90 degree relationship with the angle of the sun.

    - **Backtracking** – Backtracking is the process by which solar arrays rotate away from 90 degrees relative to the sun to ensure shading of the adjacent array is not occurring. This occurs at the beginning and end of the day when the sun is low on the horizon (see Figure 4).

- **Stow –** During evening hours and high wind conditions (in excess of 90 miles per hour) the solar arrays move into a position of five to ten degrees off of parallel to the ground surface.

Additionally, the general behavior of SunPower's single axis solar tracker, used for our study purposes is as such:

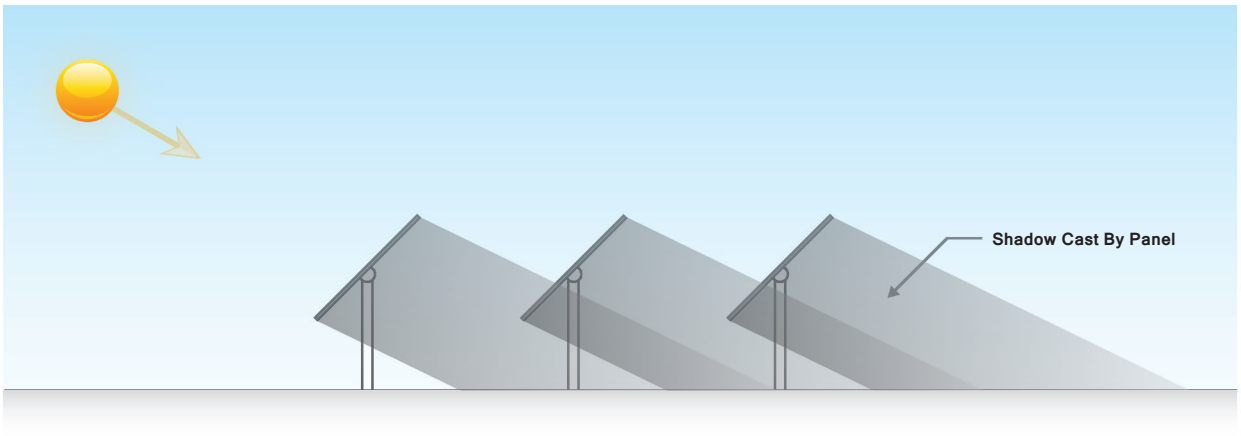
- The full range of motion of the panels will be -45 degrees to +45 degrees.
- Once the sun rises, the trackers will slowly rotate into a +45 degree angle, facing east.
- They are not moved into a +45 degree east facing angle prior to the sun rising to prevent panel shading.
- When the sun is perpendicular (90 degrees) to the panels, they will begin to track the sun throughout the day.
- When the panels reach a -45 degree angle, facing west, they will stop tracking the sun and slowly start to rotate back to a five to ten degree east facing angle.



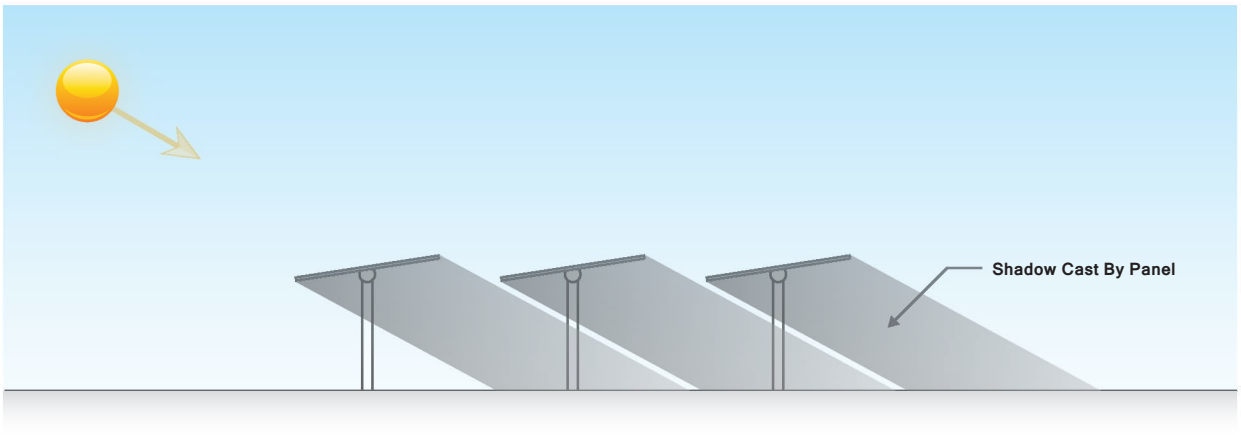
BLYTHE MESA SOLAR SITE

FIG. 3 - SINGLE AXIS SOLAR TRACKER POSITIONING

Panels *without* Back Tracking



Panels *with* Back Tracking



BLYTHE MESA SOLAR SITE

FIG. 4 - BACK TRACKING

1.2.3 Glare Evaluation - 3D Geometric Analysis

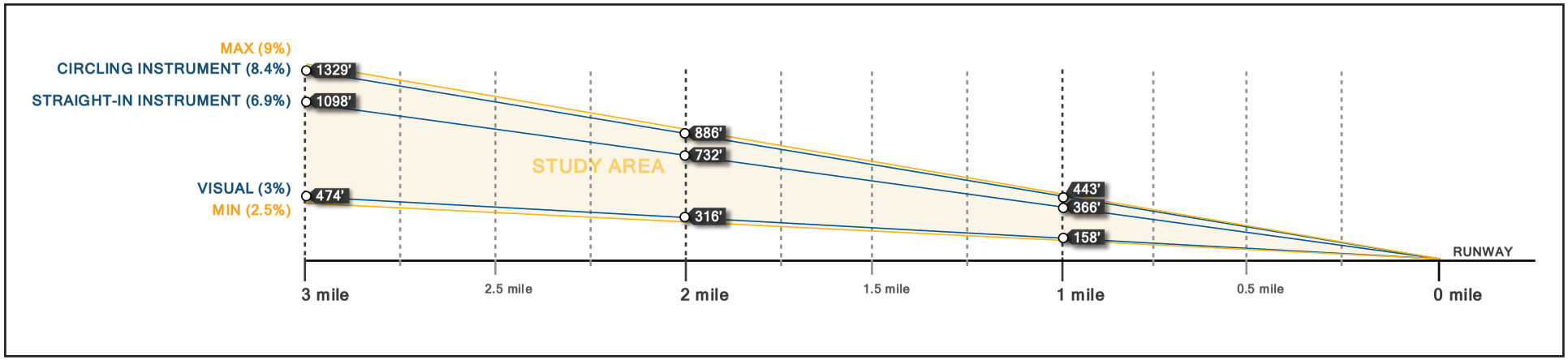
Once the 3D site was assembled, analysts animated the movement of the sun, and the behavior of the single axis trackers. Studying the occurrence of glare is essentially a geometric analysis, which takes into account the position of the sun in relation to the angle of the solar panels to emit a path of glare. Each landing approach was studied to determine if glare would cross into the pilots view. This was done for each landing approach for a full day during spring, summer, fall and winter.

In addition to location, time and duration of glare, analysts also recorded the location within our cone of vision, along the landing approach path, where glare may be experienced. Analysts studied multiple landing approach scenarios, with air traffic potentially landing at an angle of 2.5% to 9% relative to the runway surface. This encompasses the three approach scenarios outlined in ALUC's aforementioned document of a visual approach (VOR), straight-in instrument approach (DME/GPS), or circling instrument approach (see Figure 5).

The human eye has two primary cones of vision; the intense focus view, and the distorted view (see Figure 6**)**.

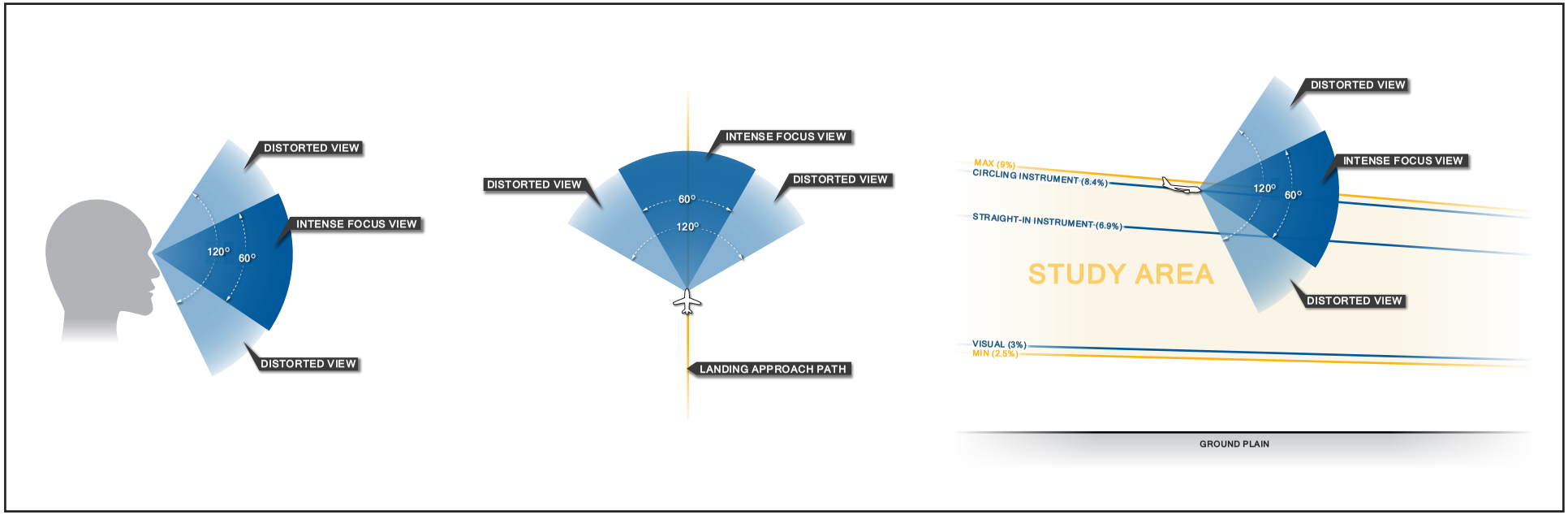
- Intense Focus View: 30 degrees left, right, top and bottom of center (total of 60 degree viewing area). Focal vision provides high resolution, detailed vision for identifying and evaluating important information, such as hazards.

- Distorted View: Outside of the Intense Focus View, another 60 degrees is the distorted view (or peripheral view). Items in this area of the viewer's vision do not affect the viewer's sight with the same intensity as those within the Intense Focus View. Distorted vision provides information on motion, locations and locomotion. If something catches our attention from the periphery system, we turn our eyes to focus on its details.



BLYTHE MESA SOLAR SITE

FIG. 5 - APPROACH SLOPE STUDY AREA



BLYTHE MESA SOLAR SITE

FIG. 6 - CONE OF VISION

AR062202

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

1.3 RESULTS

Glare Results: Review of the 3D geometric analysis determined glare will be limited to those with westerly views (Runway 26), and northerly views (Runway 35). For Runway 26, glare may be present mid-morning and just before sunset, year round with varying lengths of duration. Duration of glare ranged from 1/2 hour to 4 1/2 hours, depending on angle of decent, and angle of approach relative to the runway's orientation. Glare for air traffic approaching Runway 35 is limited to one hour or less at sunrise, and one hour or less at sunset during summer months only. The following is a detailed description of glare results along each landing approach (see Appendix A for Tabular results).

- **Runway 35 (looking north):** Pilots may experience glare during summer months in a northeasterly direction between the hours of 5:00 a.m. and 6:00 a.m., and again in a northwesterly direction between the hours of 7:00 p.m. and 8:00 p.m. Glare will be limited to distorted views only, and would be visible from 1.0 mile to 2.5 miles away.
- **Runway 17 (looking south):** No glare is anticipated
- **Runway 8 – existing conditions (looking east):** No glare is anticipated
- **Runway 8 – proposed lengthening (looking east):** No glare is anticipated
- **Runway 26 (looking west):** Pilots may experience brief periods of glare throughout the year. Glare will be experienced from the following:
    - **Spring -** Glare may be experienced at 8:30 a.m. to 11:00 a.m. in the pilots distorted view within 1.25 to 2.5 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 6:30 p.m. in the focused view within 1.5 to 2.5 miles away from the runway.
    - **Summer –** Glare may be experienced at 7:00 a.m. to 10:00 a.m. in the pilots distorted view within 1.25 to 2.0 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 7:30 p.m. in the focused view within 1.5 to 2.0 miles away from the runway.
    - **Fall** - Glare may be experienced at 8:00 a.m. to 10:30 a.m. in the pilots distorted view within 1.25 to 2.0 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 6:00 p.m. to 6:30 p.m. in the distorted and focused views within 1.5 to 2.5 miles away from the runway.
    - **Spring –** Glare may be experienced at 9:30 a.m. in the pilots distorted view from 1.25 to 2.5 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 6:30 p.m. in the focused view from 1.5 to 2.5 miles away from the runway.
- **Runway 26 approach with 25 degree offset (looking west by south-west):** Pilots may experience brief periods of glare throughout the year. Glare will be experienced during the following periods.
    - **Spring -** Glare may be experienced at 7:00 a.m. to 11:00 a.m. in the pilots distorted view within 1.5 to 2.0 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 6:30 p.m. in the focused view within 0.5 to 2.5 miles away from the runway.

- **Summer –** Glare may be experienced at 7:00 a.m. to 10:00 a.m. in the pilots distorted view within 0.5 to 2.0 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 7:30 p.m. in the distorted view within 0.5 to 2.0 miles away from the runway.
- **Fall -** Glare may be experienced at 8:00 a.m. to 11:30 a.m. in the pilots distorted view within 1.25 to 2.0 miles from the runway. Pilots may experience approximately one hour of glare from 6:00 p.m. to 7:00 p.m. in the focused views within 0.5 to 2.5 miles away from the runway.
- **Spring –** Glare may be experienced at 7:00 a.m. to 11:00 a.m. in the pilots distorted view from 0.5 to 2.25 miles from the runway. Pilots may experience approximately 0.5 hour of glare at 4:00 p.m. to 5:00 p.m. within the focused view from 0.5 to 3.0 miles away from the runway.

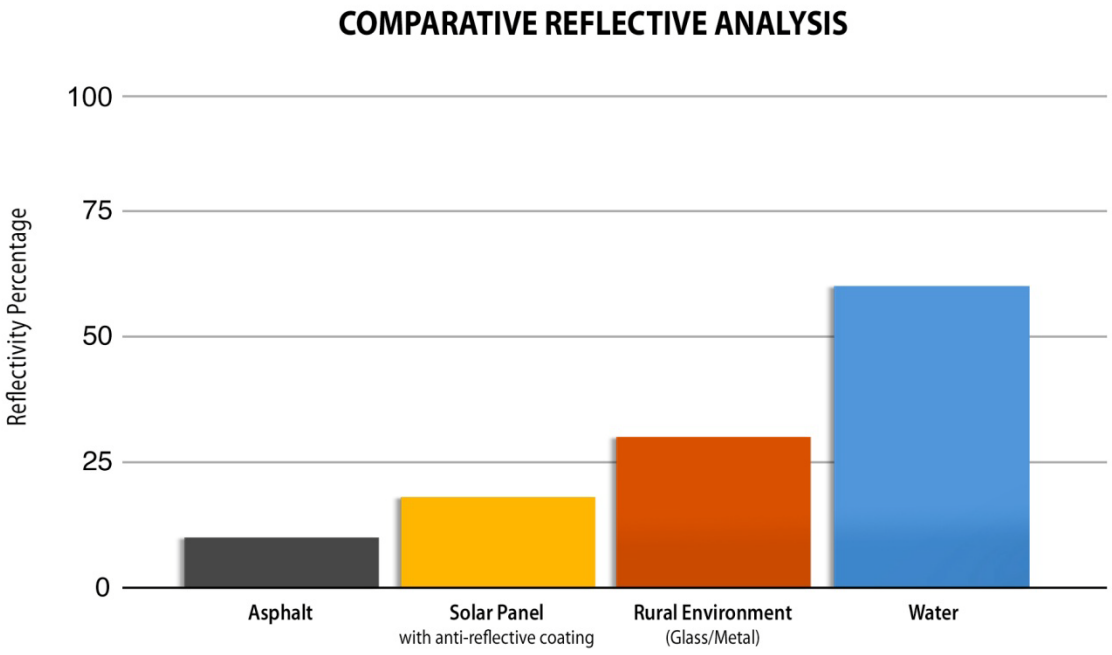
1.4 DISCUSSION AND CONCLUSIONS

1.4.1 Impacts to Landing Approaches (Relating to Glare)

Glare resulting from the sun's reflection on PV panels is often times perceived as being a distraction for motorists or air traffic, and may cause eye damage resulting from prolonged exposure. However, a PV panel is designed to absorb approximately 70% of solar energy and convert it directly to electricity, resulting in reflectance levels much lower than that of other common reflective surfaces.

As determined in a recent technical notification, completed by SunPower Corporation, September 29, 2009 regarding glare and reflectance levels from PV systems, "The glare and reflectance levels from a given PV system are decisively lower than the glare and reflectance generated by standard glass and other common reflective surfaces." The graph below compares the percentage of reflected energy from common reflective surfaces to that of a solar panel.

The geometric analysis shows that during certain times of the year, glare will intersect landing approach on Runway 35 and Runway 26. Most glare is limited to early morning or late evening landings, located in the pilots' distorted view and beyond 0.5 mile of the end of the runway. This glare is not concentrated, and would be similar to or less in intensity to that experienced by pilots making airport approaches or takeoffs over bodies of water.



SunPower Corporation, (2009) SunPower Solar Module Glare And Reflectance

1.5 SOURCES

Riverside County ALUCP. 2004. *East County Airports Background Data. October 2004. (Chapter E3.)*

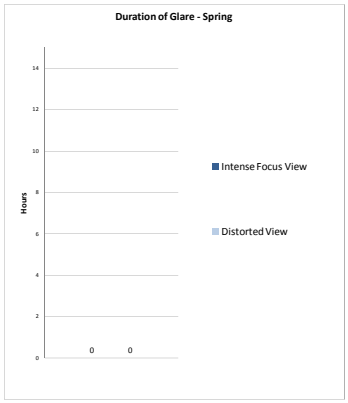
SunPower Corporation. 2009. *SunPower Solar Module Glare and Reflectance Report. September 2009.*

APPENDIX A –TABULAR GLARE RESULTS

RUNWAY 35 APPROACH - GLARE ANALYSIS - SPRING

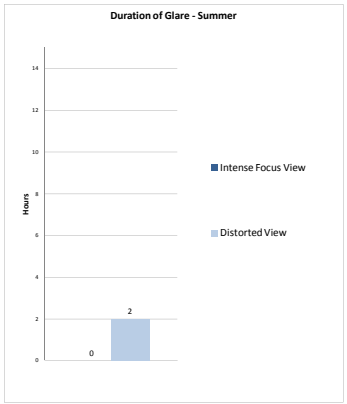
APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																														
2 1/4 to 2 1/2 Miles																														
2 to 2 1/4 Miles																														
1 3/4 to 2 Miles																														
1 1/2 to 1 3/4 Mile																														
1 1/4 to 1 1/2 Mile																														
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														

NO GLARE OBSERVED



RUNWAY 35 APPROACH - GLARE ANALYSIS - SUMMER

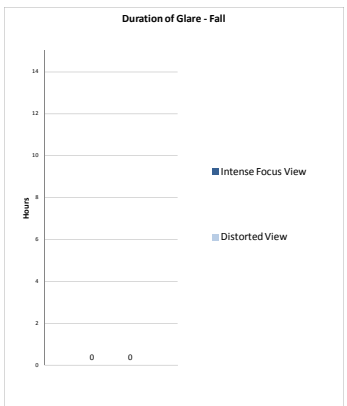
APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles	NE																													
2 1/4 to 2 1/2 Miles	NE																													
2 to 2 1/4 Miles	NE																													
1 3/4 to 2 Miles	NE																													
1 1/2 to 1 3/4 Mile	NE	NE																										NW	NW	
1 1/4 to 1 1/2 Mile	NE	NE																										NW	NW	
1 to 1 1/4 Mile	NE	NE																												
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



RUNWAY 35 APPROACH - GLARE ANALYSIS - FALL

APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																														
2 1/4 to 2 1/2 Miles																														
2 to 2 1/4 Miles																														
1 3/4 to 2 Miles																														
1 1/2 to 1 3/4 Mile																														
1 1/4 to 1 1/2 Mile																														
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														

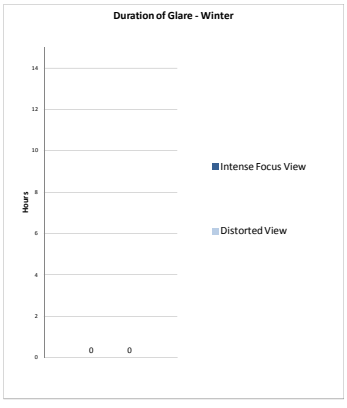
NO GLARE OBSERVED



RUNWAY 35 APPROACH - GLARE ANALYSIS - WINTER

APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																														
2 1/4 to 2 1/2 Miles																														
2 to 2 1/4 Miles																														
1 3/4 to 2 Miles																														
1 1/2 to 1 3/4 Mile																														
1 1/4 to 1 1/2 Mile																														
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														

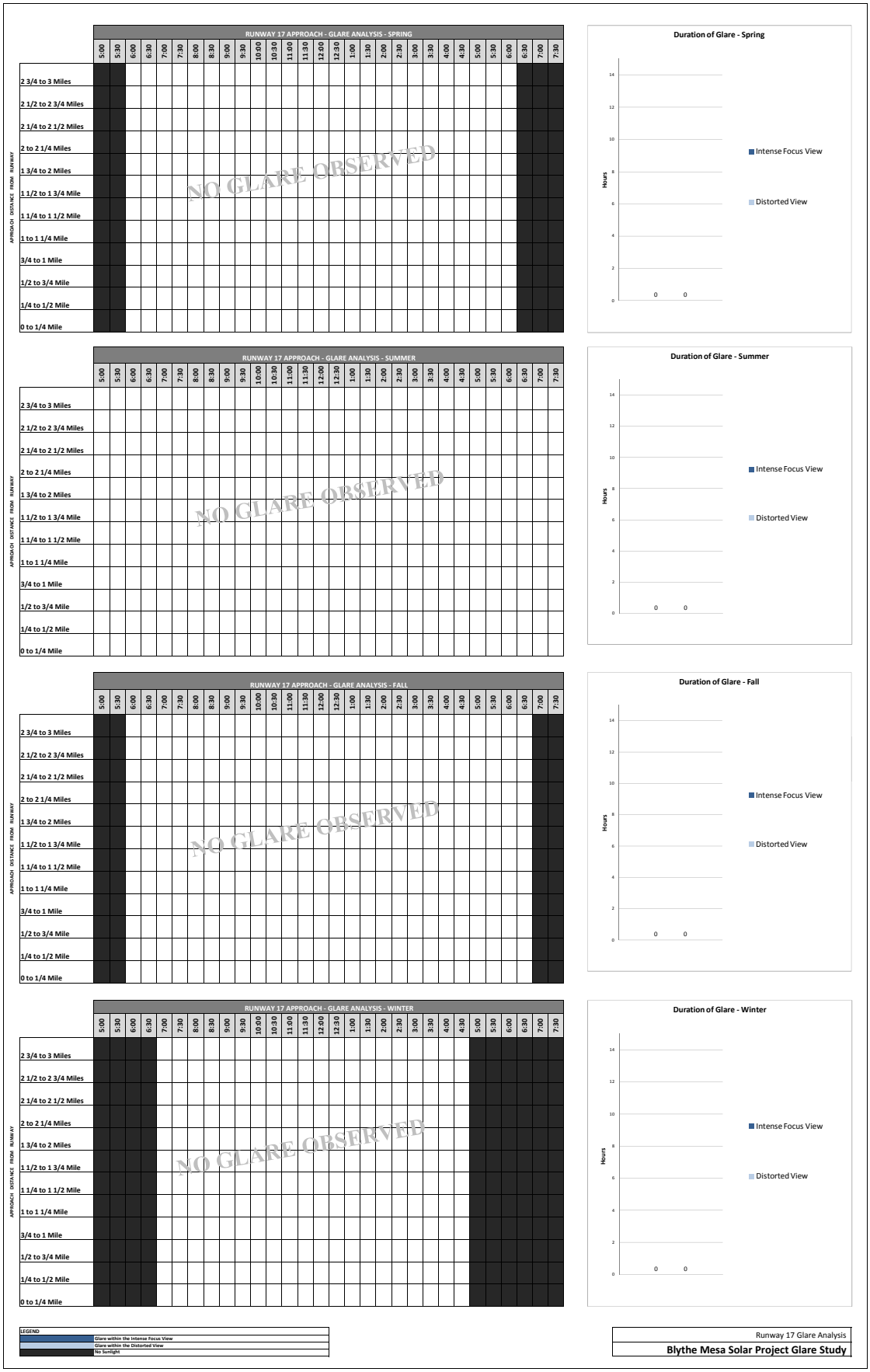
NO GLARE OBSERVED



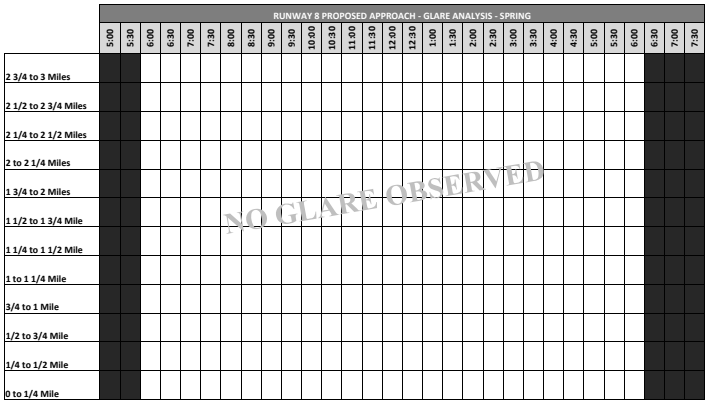
LEGEND	
	Glare within the Intense Focus View
	Glare within the Distorted View
	No Sunlight

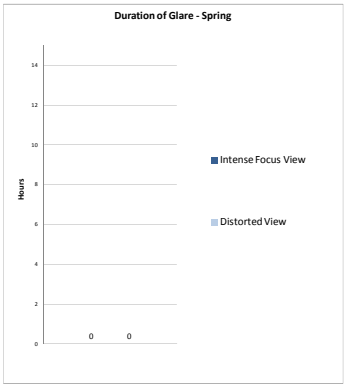
Runway 26 Alternate Approach Angle Glare Analysis

Blythe Mesa Solar Project Glare Study

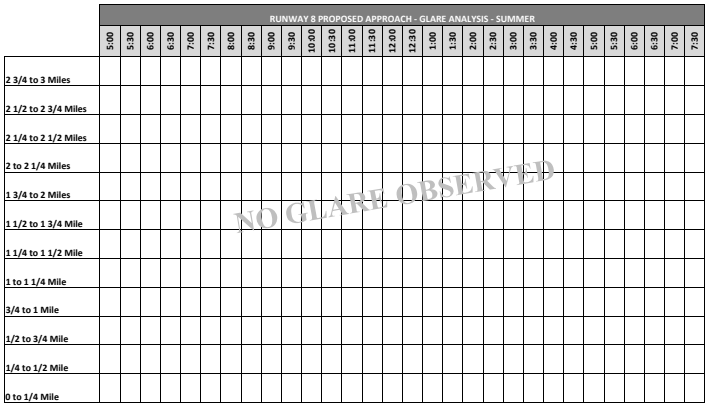

RUNWAY 17 APPROACH - GLARE ANALYSIS - SPRING
RUNWAY 17 APPROACH - GLARE ANALYSIS - SUMMER
RUNWAY 17 APPROACH - GLARE ANALYSIS - FALL
RUNWAY 17 APPROACH - GLARE ANALYSIS - WINTER
APPROACH DISTANCE FROM RUNWAY
5:00 5:30 6:00 6:30 7:00 7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00 11:30 12:00 12:30 1:00 1:30 2:00 2:30 3:00 3:30 4:00 4:30 5:00 5:30 6:00 6:30 7:00 7:30
2 3/4 to 3 Miles
2 1/2 to 2 3/4 Miles
2 1/4 to 2 1/2 Miles
2 to 2 1/4 Miles
1 3/4 to 2 Miles
1 1/2 to 1 3/4 Mile
1 1/4 to 1 1/2 Mile
1 to 1 1/4 Mile
3/4 to 1 Mile
1/2 to 3/4 Mile
1/4 to 1/2 Mile
0 to 1/4 Mile
NO GLARE OBSERVED
Duration of Glare - Spring
Duration of Glare - Summer
Duration of Glare - Fall
Duration of Glare - Winter
Hours
Intense Focus View
Distorted View
0 0
LEGEND
Glare within the Intense Focus View
Glare within the Distorted View
No Sunlight
Runway 17 Glare Analysis
Blythe Mesa Solar Project Glare Study

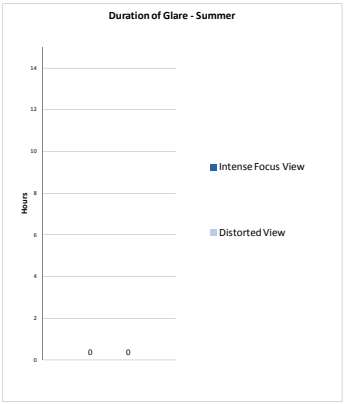
RUNWAY 8 PROPOSED APPROACH - GLARE ANALYSIS - SPRING



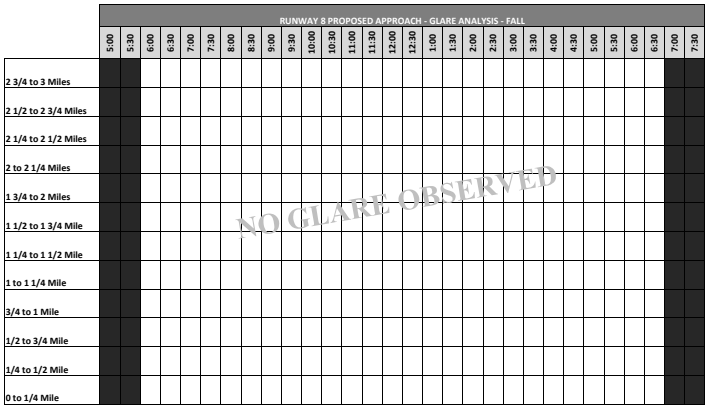


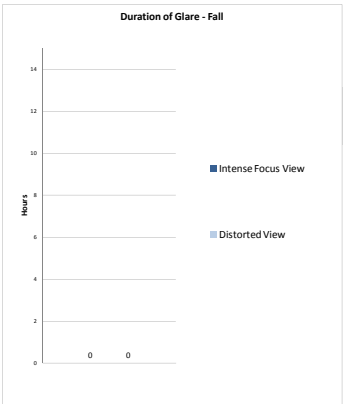
RUNWAY 8 PROPOSED APPROACH - GLARE ANALYSIS - SUMMER



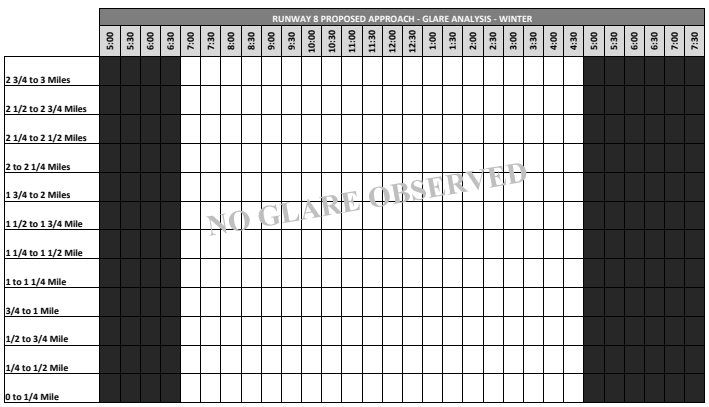


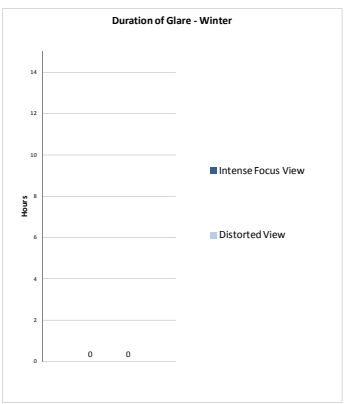
RUNWAY 8 PROPOSED APPROACH - GLARE ANALYSIS - FALL





RUNWAY 8 PROPOSED APPROACH - GLARE ANALYSIS - WINTER

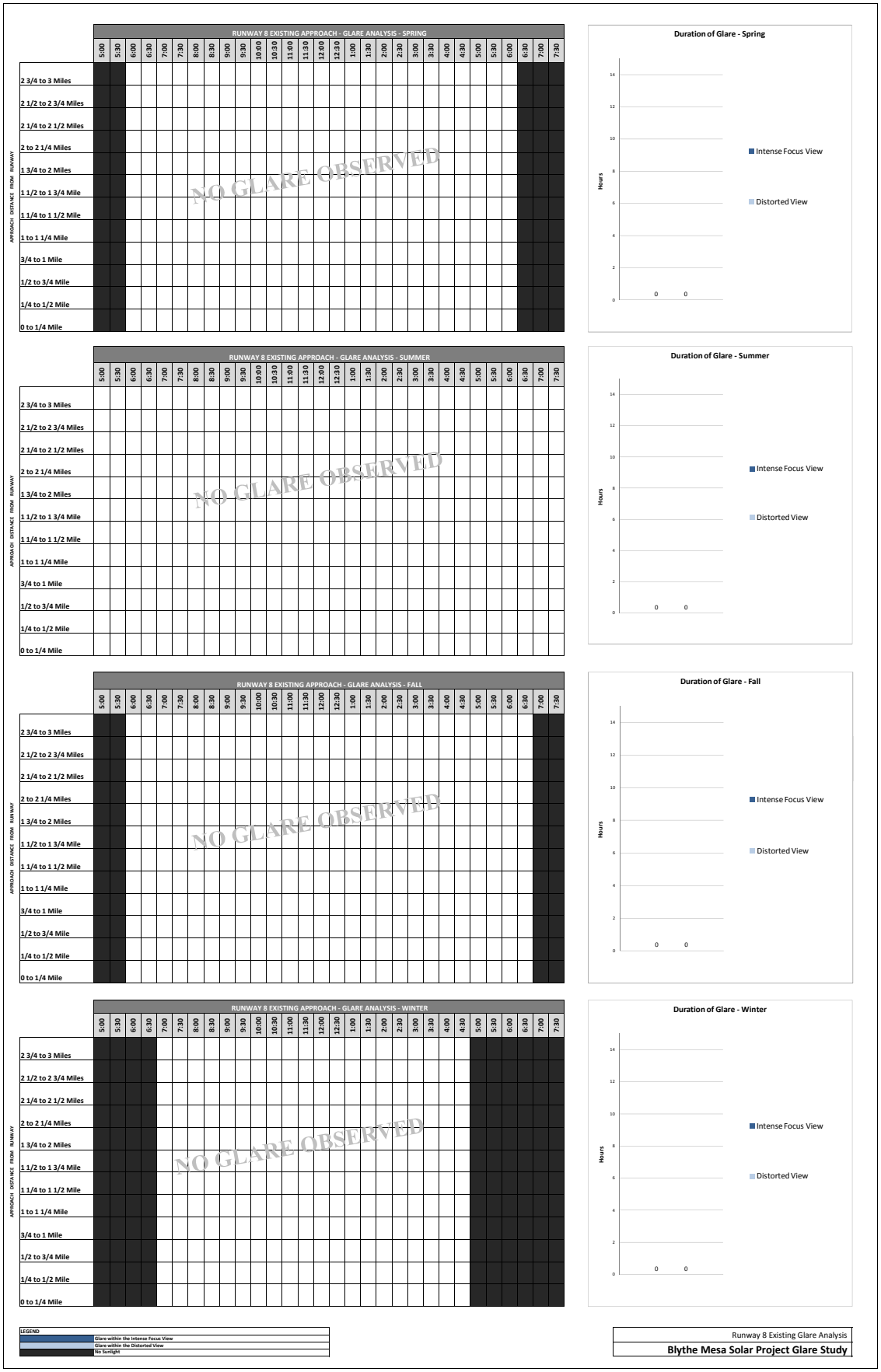




LEGEND	
	Glare within the Intense Focus View
	Glare within the Distorted View
	No Sunlight

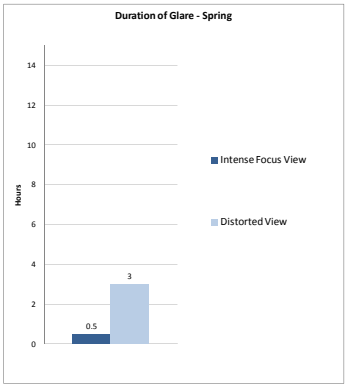
Runway 8 Proposed Extension Glare Analysis

Blythe Mesa Solar Project Glare Study


RUNWAY 8 EXISTING APPROACH - GLARE ANALYSIS - SPRING
APPROACH DISTANCE FROM RUNWAY
2 3/4 to 3 Miles
2 1/2 to 2 3/4 Miles
2 1/4 to 2 1/2 Miles
2 to 2 1/4 Miles
1 3/4 to 2 Miles
1 1/2 to 1 3/4 Mile
1 1/4 to 1 1/2 Mile
1 to 1 1/4 Mile
3/4 to 1 Mile
1/2 to 3/4 Mile
1/4 to 1/2 Mile
0 to 1/4 Mile
NO GLARE OBSERVED
Duration of Glare - Spring
Hours
Intense Focus View
Distorted View
RUNWAY 8 EXISTING APPROACH - GLARE ANALYSIS - SUMMER
NO GLARE OBSERVED
Duration of Glare - Summer
RUNWAY 8 EXISTING APPROACH - GLARE ANALYSIS - FALL
NO GLARE OBSERVED
Duration of Glare - Fall
RUNWAY 8 EXISTING APPROACH - GLARE ANALYSIS - WINTER
NO GLARE OBSERVED
Duration of Glare - Winter
LEGEND
Glare within the Intense Focus View
Glare within the Distorted View
No Sunlight
Runway 8 Existing Glare Analysis
Blythe Mesa Solar Project Glare Study

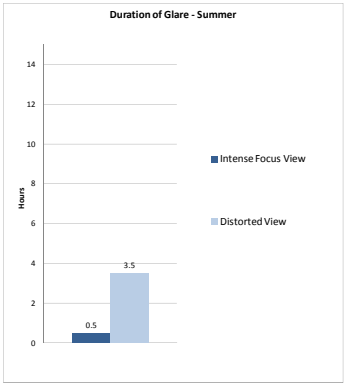
RUNWAY 26 APPROACH - GLARE ANALYSIS - SPRING

APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																														
2 1/4 to 2 1/2 Miles																												W		
2 to 2 1/4 Miles								SW	SW	SW	SW	SW	SW															W		
1 3/4 to 2 Miles								SW	SW	SW	SW	SW	SW															W		
1 1/2 to 1 3/4 Mile								SW	SW	SW	SW	SW	SW															W		
1 1/4 to 1 1/2 Mile										SW	SW	SW	SW																	
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



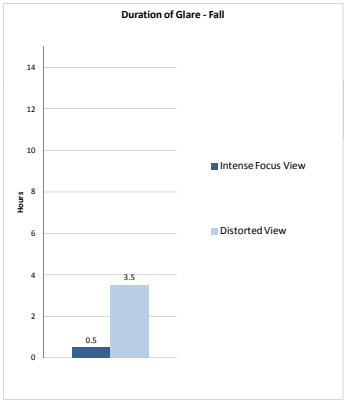
RUNWAY 26 APPROACH - GLARE ANALYSIS - SUMMER

APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																														
2 1/4 to 2 1/2 Miles																														
2 to 2 1/4 Miles							NW	NW	W	W	W	W	SW																	NW
1 3/4 to 2 Miles							NW	NW	W	W	W	W	SW																	NW
1 1/2 to 1 3/4 Mile							NW	NW	W	W	W	W	SW																	NW
1 1/4 to 1 1/2 Mile																														
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



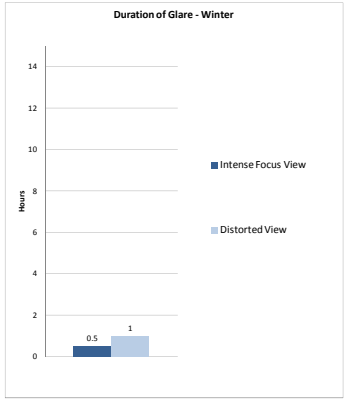
RUNWAY 26 APPROACH - GLARE ANALYSIS - FALL

APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																												W		
2 1/2 to 2 3/4 Miles																												W		
2 1/4 to 2 1/2 Miles																												W		
2 to 2 1/4 Miles							SW	SW	SW	SW	SW	SW															W	W		
1 3/4 to 2 Miles							SW	SW	SW	SW	SW	SW															W	W		
1 1/2 to 1 3/4 Mile							SW	SW	SW	SW	SW	SW															W	W		
1 1/4 to 1 1/2 Mile							SW	SW	SW	SW	SW	SW																		
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



RUNWAY 26 APPROACH - GLARE ANALYSIS - WINTER

APPROACH DISTANCE FROM RUNWAY	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	0:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																								SW						
2 1/2 to 2 3/4 Miles																							SW	SW						
2 1/4 to 2 1/2 Miles																							SW	SW						
2 to 2 1/4 Miles										SW													SW	SW						
1 3/4 to 2 Miles										SW													SW	SW						
1 1/2 to 1 3/4 Mile										SW													SW	SW						
1 1/4 to 1 1/2 Mile										SW													SW							
1 to 1 1/4 Mile																														
3/4 to 1 Mile																														
1/2 to 3/4 Mile																														
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



LEGEND	
	Glare within the Intense Focus View
	Glare within the Distorted View
	No Sunlight

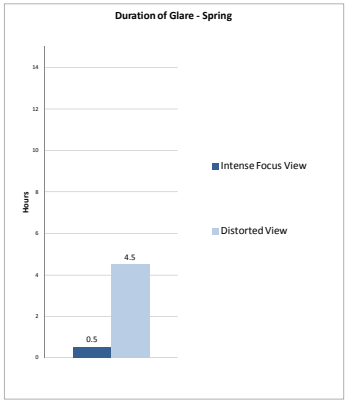
Runway 26 Glare Analysis

Blythe Mesa Solar Project Glare Study

RUNWAY 26 ALTERNATE APPROACH ANGLE - GLARE ANALYSIS - SPRING

APPROACH DISTANCE FROM RUNWAY

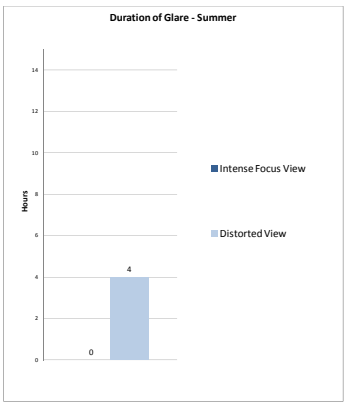
	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																												W		
2 1/4 to 2 1/2 Miles																												W		
2 to 2 1/4 Miles								SW	SW	SW	SW	SW																W		
1 3/4 to 2 Miles							SW	SW	SW	SW	SW	SW	SW	SW														W		
1 1/2 to 1 3/4 Mile							SW	SW	SW	SW	SW	SW	SW	SW														W		
1 1/4 to 1 1/2 Mile							SW	SW	SW	SW	SW	SW	SW	SW														W		
1 to 1 1/4 Mile							SW	SW	SW	SW	SW	SW	SW	SW														W		
3/4 to 1 Mile							SW	SW	SW	SW	SW	SW	SW	SW														W		
1/2 to 3/4 Mile							SW	SW	SW	SW	SW	SW	SW	SW														W		
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



RUNWAY 26 ALTERNATE APPROACH ANGLE - GLARE ANALYSIS - SUMMER

APPROACH DISTANCE FROM RUNWAY

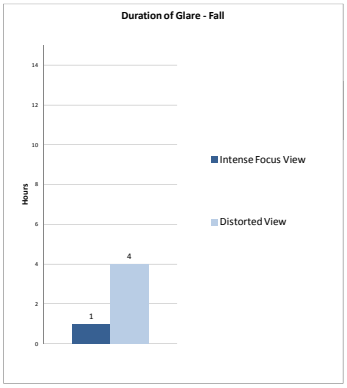
	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																														
2 1/4 to 2 1/2 Miles																														
2 to 2 1/4 Miles																														NW
1 3/4 to 2 Miles						SW	SW	SW	SW	SW	SW	SW																		NW
1 1/2 to 1 3/4 Mile						SW	SW	SW	SW	SW	SW	SW																		NW
1 1/4 to 1 1/2 Mile						SW	SW	SW	SW	SW	SW	SW																		NW
1 to 1 1/4 Mile						SW	SW	SW	SW	SW	SW	SW																		NW
3/4 to 1 Mile						SW	SW	SW	SW	SW	SW	SW																		NW
1/2 to 3/4 Mile						SW	SW	SW	SW	SW	SW	SW																		NW
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



RUNWAY 26 ALTERNATE APPROACH ANGLE - GLARE ANALYSIS - FALL

APPROACH DISTANCE FROM RUNWAY

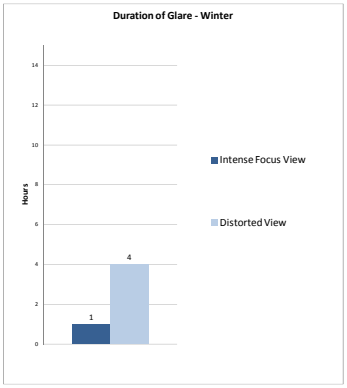
	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																														
2 1/2 to 2 3/4 Miles																											W	W		
2 1/4 to 2 1/2 Miles																											W	W		
2 to 2 1/4 Miles									SW	SW	SW	SW															W	W		
1 3/4 to 2 Miles								SW	SW	SW	SW	SW	SW	SW	S												W	W		
1 1/2 to 1 3/4 Mile								SW	SW	SW	SW	SW	SW	SW	S												W	W		
1 1/4 to 1 1/2 Mile								SW	SW	SW	SW	SW	SW	SW	S												W	W		
1 to 1 1/4 Mile								SW	SW	SW	SW	SW	SW	SW	S												W	W		
3/4 to 1 Mile								SW	SW	SW	SW	SW	SW	SW	S												W	W		
1/2 to 3/4 Mile								SW	SW	SW	SW	SW	SW	SW	S												W	W		
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



RUNWAY 26 ALTERNATE APPROACH ANGLE - GLARE ANALYSIS - WINTER

APPROACH DISTANCE FROM RUNWAY

	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30
2 3/4 to 3 Miles																								SW						
2 1/2 to 2 3/4 Miles																								SW						
2 1/4 to 2 1/2 Miles																							SW	SW						
2 to 2 1/4 Miles								SW	SW	SW	SW	S	S										SW	SW						
1 3/4 to 2 Miles						SW	SW	SW	SW	SW	SW	S	S										SW	SW						
1 1/2 to 1 3/4 Mile						SW	SW	SW	SW	SW	SW	S	S										SW	SW						
1 1/4 to 1 1/2 Mile						SW	SW	SW	SW	SW	SW	S	S										SW	SW						
1 to 1 1/4 Mile						SW	SW	SW	SW	SW	SW	S	S										SW	SW						
3/4 to 1 Mile						SW	SW	SW	SW	SW	SW	S	S										SW	SW						
1/2 to 3/4 Mile						SW	SW	SW	SW	SW	SW	S	S										SW	SW						
1/4 to 1/2 Mile																														
0 to 1/4 Mile																														



LEGEND

	Glare within the Intense Focus View
	Glare within the Distorted View
	No Sunlight

Runway 26 Alternate Approach Angle Glare Analysis

Blythe Mesa Solar Project Glare Study

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX L
LAND EVALUATION AND SITE ASSESSMENT

THIS PAGE INTENTIONALLY LEFT BLANK

D R A F T

BLYTHE MESA SOLAR PROJECT LAND EVALUATION AND SITE ASSESSMENT

Renewable Resources Group, Inc.
5700 Wilshire Blvd., Suite 330
Los Angeles, CA 90036

URS Project No. 27652075.00100

Darin Neufeld
Environmental Planner

Jennifer Wu
Senior Environmental Scientist

September 2012

URS

4225 Executive Square, Suite 1600
La Jolla, CA 92037
858.812.9292 Fax: 858.812.9293

TABLE OF CONTENTS

Section 1 Introduction 1-1

Section 2 Project Description 2-1

2.1 Environmental Setting 2-1

Section 3 LESA Evaluation 3-1

3.1 Land Evaluation 3-1
3.2 Site Assessment Factors 3-4

Section 4 Summary 4-1

Section 5 References 5-1

List of Tables and Figures

Tables

Table 1 California LESA Model Scoring Thresholds
Table 2 Soil Suitability – Map Symbol Mapping Unit Capability
Table 3 Land Capability Classification (LCC) and Storie Index Score
Table 4 Project Size Score
Table 5 Water Resource Availability
Table 6 Surrounding Agricultural and Protected Lands
Table 7 Final LESA Score Sheet Summary

Figures

Figure 1 Soils Map
Figure 2 Surrounding Land

SECTION 1 INTRODUCTION

Appendix G of the California Environmental Quality Act (CEQA) Guidelines were amended to identify the California Land Evaluation and Site Assessment (LESA) Model as an optional methodology to access impacts on agriculture and farmland. Based on the current use of the Blythe Mesa Solar Project site as both active and inactive agriculture, the LESA Model was prepared for the Blythe Mesa Solar Project (or Project).

The LESA model provides an approach for rating the relative quality of land resources based upon specific measurable features. The LESA Model is composed of six different factors. Two Land Evaluation factors (Land Use Capability Classification and Storie Index) are based upon measures of soil resource quality. Four Site Assessment factors provide measures of a project's size, water resource availability, surrounding agricultural lands, and surrounding protected resource lands. Each of these factors is combined, resulting in several numeric scores. The factors are then weighted relative to one another so that 50 percent of the total LESA score is derived from the Land Evaluation factors, and 50 percent from the Site Assessment factors. The weighted total results in a single numeric score, with a maximum attainable score of 100 points (California DOC, 1997). This project score can be used as a basis for making a determination of a project's significance on agriculture and farmland, based upon a range of established scoring thresholds. Table 1 presents the LESA Model scoring thresholds.

Table 1
California LESA Model Scoring Thresholds

Total LESA Score	Scoring Decision
0 to 39 Points	Not Considered Significant
40 to 59 Points	Considered Significant only if Land Evaluation and Site Assessment subscores are each greater than or equal to 20 points
60 to 79 Points	Considered Significant unless either Land Evaluation or Site Assessment subscore is less than 20 points
80 to 100 Points	Considered Significant

Source: California Department of Conservation, 1997.

SECTION 2 PROJECT DESCRIPTION

2.1 ENVIRONMENTAL SETTING

The Project site is located on approximately 3,613 acres of privately owned land zoned for agricultural production in eastern Riverside County. The Project site is located in the Palo Verde Valley area of the County, which is an intensively farmed agricultural region. A portion of the Project transmission line is located onsite, and the offsite portion (approximately five miles) is located on Bureau of Land Management (BLM) administered lands designated as a Utility Corridor. The offsite portion of the transmission line is proposed within an existing/developed transmission line corridor, and is therefore not included in the Project site assessment considered in the LESA analysis. The soil resources for the Project site are illustrated on Figure 1.

The Palo Verde Valley is served by the Palo Verde Irrigation District (PVID). The PVID occupies about 189 square miles of service area in Riverside and Imperial counties, California. The PVID contains approximately 131,298 acres, 26,798 acres of which are on the Palo Verde Mesa. The Mesa lies just west of the Palo Verde Valley. The Colorado River forms the eastern and southern boundaries of the PVID (PVID, 2011). The majority of cultivated areas on the Mesa are irrigated with water from the Colorado River aquifer, supplied from the PVID or from domestic wells. Colorado River water is supplied through PVID canals and laterals, and lifted onto the Mesa by private pumps to irrigate a portion of the farmland in the PVID. There are also irrigation ditches that are owned and operated by water users in the PVID. The remaining Palo Verde Mesa irrigated acreage is irrigated from deep wells developed by the landowners.

Situated approximately five miles west of the City of Blythe, California, and directly east of the Blythe Airport, the Project site is composed of 1,707 acres of Farmland, as designated by the California Department of Conservation's (DOC) Farmland Mapping and Monitoring Program (FMMP). Of this total, 1,681 acres are Prime Farmland, 16 acres are Unique Farmland, and 10 acres are Farmland of Statewide Importance. The remainder of the 3,613-acre Project site are designated Farmland of Local Importance by Riverside County; however, none of this farmland is currently cultivated. The primary crop on the Palo Verde Mesa is citrus (PVID, 2011). Primary agricultural uses near the City of Blythe include alfalfa, cotton, hay, orchards, and field crops. The public land managed by the BLM through which the transmission line traverses to the Colorado River Substation (CRS) and a portion of the Project site, is designated in the California Desert Conservation Area Plan as Utility Corridor J and K and Department of Energy Section 368 Corridor 30-52, which overlap (see inset on Figure 2).

The Project site is zoned Light Agriculture with ten-acre minimum development (A-1-10) and Controlled Development with five- and ten-acre minimum development (W-2-5 and W-2-10) according to Riverside County Ordinance 348. The A-1 Zone and W-2 Zone permit the growing of field crops, vegetable gardening, tree crops, greenhouses, orchards, aviaries, and apiaries on a commercial scale; noncommercial keeping of horses and pigs; and grazing of cattle, horses, sheep, goats or other farm stock or animals for noncommercial purposes. The Blythe Municipal Airport directly west of the northernmost portion of the Project site is zoned Manufacturing-Heavy (M-H). Agriculture is not a permitted use in the M-H Zone. A portion of the Project site is zoned as Agriculture (A) by the City of Blythe.

The Riverside County land use designations for the Project site are Agriculture, City, and Rural Community-Estate Density Residential. The Riverside County General Plan Open Space and Land Use elements include agricultural policies for lands throughout the County. The majority of the planning area within the Palo Verde Valley is also regulated by the Palo Verde Valley Area Plan (PVVAP). The PVVAP provides policies related to agricultural lands.

SECTION 3 LESA EVALUATION

The following sections evaluate the quality and availability of agricultural resources for the Project site. The two Land Evaluation and four Site Assessment factors were measured to identify whether the Project would meet the threshold criteria as a significant impact to Agricultural Resources under CEQA Guidelines.

3.1 LAND EVALUATION

The Land Evaluation portion of the LESA Model focuses on two main components that are separately rated:

1. The Land Capability Classification (LCC) Rating: The LCC indicates the suitability of soils for most kinds of crops. Soils are rated from Class I to Class VIII, with soils having the fewest limitations receiving the highest rating (Class I). Specific subclasses are also utilized to further characterize soils.

2. The Storie Index Rating: The Storie Index provides a numeric rating (based upon a 100 point scale) of the relative degree of suitability or value of a given soil for intensive agriculture. The rating is based upon soil characteristics only.

The United State Department of Agriculture (USDA) survey identified 15 soil types on the Project site. These include: Aco gravelly loamy sand; Aco sandy loam; badland; Carrizo gravelly sand; Cibola silty clay loam; duneland; Imperial silty clay; Meloland fine sandy loam; Orita fine sand; Orita gravelly fine sandy loam; Ripley very fine sandy loam; Rositas fine sand 0 to 2 percent slopes and 2 to 9 percent slopes; Rositas fine sand, wet, 0 to 2 percent slopes; and Rositas gravelly loamy sand, 0 to 2 percent slopes. Figure 1 depicts the distribution of soil types on the Project site. Table 2 details the varieties of soils found on the Project site, with their Land Capability Class and Storie Index Rating.

Table 2
Soil Suitability – Map Symbol Mapping Unit Capability

Map Symbol	Mapping Unit	Land Capability Class		California Revised Storie Index	
		Non-Irrigated	Irrigated	Revised Storie Index Grade	Storie Index Rating
Ac	Aco gravelly loamy sand	7e	2s	3 – Fair	42
Af	Aco sandy loam	7e	2s	1 – Excellent	84
BaG	Badland	8e	--	Not rated	Not rated
Ce	Carrizo gravelly sand	8s	4s	4 – Poor	20
Cs	Cibola silty clay loam	7s	2s	3 - Fair	49
DuD	Duneland	8e	--	Not rated	Not rated
Ic	Imperial silty clay	7s	3s	4 – Poor	26

Table 2
Soil Suitability – Map Symbol Mapping Unit Capability

Map Symbol	Mapping Unit	Land Capability Class		California Revised Storie Index	
		Non-Irrigated	Irrigated	Revised Storie Index Grade	Storie Index Rating
Md	Meloland fine sandy loam	7s	3w	5 – Very poor	15
Oc	Orita fine sand	7s	2s	3 – Fair	51
Or	Orita gravelly fine sandy loam	7s	2s	Not Rated	Not rated
Rb	Ripley very fine sandy loam	7s	2s	1 – Excellent	82
RoA	Rositas fine sand, 0 to 2 percent slopes	7s	3s	2 – Good	68
RoB	Rositas fine sand, 2 to 9 percent slopes	7s	3s	3 – Fair	46
RrA	Rositas fine sand, wet, 0 to 2 percent slopes	7s	3w	5 – Very poor	16
RsA	Rositas gravelly loamy sand, 0 to 2 percent slopes	7s	4s	4 – Poor	35

Source: California Department of Conservation, 1997; NRCS, 2012.

Notes:

2s capability rating indicates soils with moderate limitations that reduce the choice of plants or require moderate conservation practices.

The soils also have limitations within the rooting zone, such as shallowness of the rooting zone, stones, low moisture-holding capacity, low fertility that is difficult to correct, and salinity or sodium content.

3w capability rating indicates that soils have severe limitations that reduce the choice of plants or require special conservation practices. Excess water is the dominant hazard or limitation affecting the use of the soil. Poor soil drainage, wetness, a high water table, and overflow are the factors that affect soils in this subclass.

3s capability rating indicates that soils have severe limitations that reduce the choice of plants or require special conservation practices. The soils also have limitations within the rooting zone, such as shallowness of the rooting zone, stones, low moisture-holding capacity, low fertility that is difficult to correct, and salinity or sodium content.

4s capability rating indicates that soils have very severe limitations that restrict the choice of plants or require very careful management, or both. Additionally, soils have limitations within the rooting zone, such as shallowness of the rooting zone, stones, low moisture-holding capacity, low fertility that is difficult to correct, and salinity or sodium content.

7e capability rating indicates soils that have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife. Soil susceptibility to erosion is the dominant problem or hazard affecting their use. Erosion susceptibility and past erosion damage are the major soil factors that affect soils in this subclass.

7s capability rating indicates soils that have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife. Soils also have limitations within the rooting zone, such as shallowness of the rooting zone, stones, low moisture-holding capacity, low fertility that is difficult to correct, and salinity or sodium content.

8e capability rating indicates soils and miscellaneous areas that have limitations precluding their use for commercial plant production and limiting their use to recreation, wildlife, or water supply or for esthetic purposes. The soils also display susceptibility to erosion as the dominant problem or hazard affecting their use. Erosion susceptibility and past erosion damage are the major soil factors that affect soils in this subclass.

Table 3
Land Capability Classification (LCC) and Storie Index Score

A	B	C	D	E	F	G	H
Map Symbol - Soil	Acres*	Portion of the Project Area***	LCC	LCC Rating	LCC Score	Storie Index	Storie Score
Ac – Aco gravelly loamy sand	258.64	7.16%	7e	10	0.72	42	3.01
Af – Aco sandy loam (Irrigated)	937.28	25.93%	2s	80	20.74	84	21.78
Af – Aco sandy loam (Non-Irrigated)	449.40	12.43%	7e	10	1.25	84	10.44
BaG – Badland	22.90	0.63%	8e	0	0	Not rated	--
Ce – Carrizo gravelly sand	2.20	0.06%	8s	0	0	20	0.01
Cs – Cibola silty clay loam	0.01	0%***	7s	10	0	49	0.00
DuD – Duneland	19.88	0.55%	8e	0	0	Not rated	--
Ic – Imperial silty clay	0.23	0.01%	3s	60	0.01	26	0.00
Md – Meloland fine sandy loam	0**	0%***	3w	60	0	15	0.00
Oc – Orita fine sand	46.74	1.29%	7s	10	0.13	51	0.66
Or – Orita gravelly fine sandy loam (Irrigated)	12.87	0.36%	2s	80	0.29	Not rated	--
Or – Orita gravelly fine sandy loam (Non-Irrigated)	21.11	0.58%	7s	10	0.06	Not rated	--
Rb – Ripley very fine sandy loam	0.64	0.02%	2s	80	0.02	82	0.01
RoA – Rositas fine sand, 0 to 2 percent slopes (Irrigated)	695.01	19.23%	3s	60	11.54	68	13.08
RoA – Rositas fine sand, 0 to 2 percent slopes (Non-Irrigated)	475.48	13.16%	7s	10	1.32	68	8.95
RoB – Rositas fine sand, 2 to 9 percent slopes (Irrigated)	333.55	9.23%	3s	60	5.54	46	4.25
RoB – Rositas fine sand, 2 to 9 percent slopes (Non-Irrigated)	215.43	5.96%	7s	10	0.60	46	2.74
RrA – Rositas fine sand, wet, 0 to 2 percent slopes	0.54	0.01%	3w	60	0.01	16	0.00
RsA – Rositas gravelly loamy sand, 0 to 2 percent slopes (Irrigated)	38.00	1.05%	4s	40	0.42	35	0.37
RsA – Rositas gravelly loamy sand, 0 to 2 percent slopes (Non-Irrigated)	84.51	2.34%	7s	10	0.23	35	0.82
TOTALS	3,614.42*	100%	--	--	42.86	--	66.12

Source: California Department of Conservation, 1997; NRCS, 2012.

*Acreages are rounded and approximate. Due to rounding, approximate acreages appear higher than approximation of 3,613 total Project site acres.

**Soil type was included because there are less than 0.01 acres on the Project site. When rounded, this totals 0.

***When rounded, percentage equals 0.

3.2 SITE ASSESSMENT FACTORS

The California LESA Model includes four Site Assessment factors that are separately rated:

1. The Project Size Rating
2. The Water Resources Availability Rating
3. The Surrounding Agricultural Land Rating
4. The Surrounding Protected Resource Land Rating

Project Size Rating

The Project Size Rating relies upon acreage figures tabulated under the Land Capability Classification Rating in Table 3. The Project Size Rating is based upon identifying acreage figures for three separate groupings of soil classes within the Project site, and then determining which grouping generates the highest Project Size score (California DOC, 1997).

To measure agricultural productivity, the size of a farming operation can be considered not just from its total acreage, but the acreage of different quality lands that comprise the operation. Lands with higher quality soils lend themselves to greater management and cropping flexibility and have the potential to provide a greater economic return per acre unit. Instead of relying on a single acreage figure, the Project is divided into three acreage groupings based on the Land Capability Classification ratings presented in Table 3. Relatively fewer acres of high quality soils are required to achieve a maximum Project Size score. Alternatively, a maximum score on lesser quality soils could be derived, provided there is a sufficiently large acreage present. This approach accounts for the significance of high quality agricultural land as well as lesser quality agricultural lands of large area.

The Project Size score is allocated 100 points for the respective grouping when: the total acres of Class I and Class II type soils is 80 acres or more; the total acres of Class III soils is 160 acres or more; or the total acres of Class IV and lower is 320 acres or more. As shown in Table 4, the Project site receives the maximum acres in each grouping; therefore, the final score for the Project Size is 100 points.

Table 4
Project Size Score

Map Symbol - Soil	Acres*	LCC	LCC Class I or II	LCC Class III	LCC Class IV-VIII
Ac – Aco gravelly loamy sand	258.64	7e			258.64
Af – Aco sandy loam (Irrigated)	937.28	2s	937.28		
Af – Aco sandy loam (Non-Irrigated)	449.40	7e			449.40
BaG – Badland	22.90	8e			22.90
Ce – Carrizo gravelly sand	2.20	8s			2.2

Table 4
Project Size Score

Map Symbol - Soil	Acres*	LCC	LCC Class I or II	LCC Class III	LCC Class IV-VIII
Cs – Cibola silty clay loam	0.01	7s			0.01
sDuD – Duneland	19.88	8e			19.88
Ic – Imperial silty clay	0.23	3s		0.23	
Md – Meloland fine sandy loam	0**	3w		0.0	
Oc – Orita fine sand	46.74	7s			46.74
Or – Orita gravelly fine sandy loam (Irrigated)	12.87	2s	12.87		
Or – Orita gravelly fine sandy loam (Non-Irrigated)	21.11	7s			21.11
Rb – Ripley very fine sandy loam	0.64	2s	0.64		
RoA – Rositas fine sand, 0 to 2 percent slopes (Irrigated)	695.01	3s		695.01	
RoA – Rositas fine sand, 0 to 2 percent slopes (Non-Irrigated)	475.48	7s			475.48
RoB – Rositas fine sand, 2 to 9 percent slopes (Irrigated)	333.55	3s		333.55	
RoB – Rositas fine sand, 2 to 9 percent slopes (Non-Irrigated)	215.43	7s			215.43
RrA – Rositas fine sand, wet, 0 to 2 percent slopes	0.54	3w		0.54	
RsA – Rositas gravelly loamy sand, 0 to 2 percent slopes (Irrigated)	38.00	4s			38.00
RsA – Rositas gravelly loamy sand, 0 to 2 percent slopes (Non-Irrigated)	84.51	7s			84.51
TOTAL ACRES	3,614.42*		950.79	1029.33	1634.30
PROJECT SIZE SCORES			100	100	100
HIGHEST SCORE			100		

Source: California Department of Conservation, 1997.

*Acreages are rounded and approximate. Due to rounding, approximate acreages appear higher than approximation of 3,613 total Project site acres.

**Soil type was included because there are less than 0.01 acres on the Project site. When rounded, this totals 0.

Water Resources Availability Rating

The Water Resources Availability Rating is based upon identifying the various water sources that may supply a given property, and then determining whether different restrictions in supply are likely to take place in years that are characterized as being periods of drought and non-drought (California DOC, 1997). The Project site, located on Palo Verde Mesa, is underlain by the Palo Verde Mesa Groundwater Basin (PVMGB).

The majority of the Project site is either served by Palo Verde Irrigation District surface infrastructure or domestic groundwater wells, contains either active or fallow farmland, and is located in desert climate

conditions. As a result, these areas (approximately 2,971.5 acres, or 82.2 percent of the Project site) received a Water Resource Availability Rating of 90, based on the availability of water delivery potentially provided to these areas. The remainder of the Project site, which consists of the southwestern-most portion of the site (approximately 641.9 acres, or 17.8 percent of the Project site) has not been developed and is not currently served by water supply facilities.

Development of water supply facilities within the southwestern-most portion of the Project site would be expected to encounter physical and economic restrictions due to the complex Colorado River system apportionment/entitlement and priority system affecting the PVID service area, and lack of current water supply infrastructure. Use of groundwater may also be subject to the proposed Lower Colorado River Accounting System (LCRAS) and the Accounting Surface, administered by the United States Bureau of Reclamation (USBR). The Accounting Surface extends to the margins of the Colorado River Aquifer which currently includes the PVMGB. Wells that have static water-levels equal to or below the Accounting Surface are presumed to yield water that will be replaced by water from the Colorado River, and therefore are subject to accounting and require an entitlement to use or divert river water. Pumping of additional water for agricultural use could result in water level drawdowns, such that the elevation of the water table could be below the Accounting Surface. For these reasons, the southwestern-most portion of the Project site received the lowest Water Resource Availability rating.

Table 5 illustrates the two portions and water sources to determine a water availability score for the Project.

Table 5
Water Resource Availability

Project Portion	Water Source	Proportion of Project Area	Water Availability Score	Weighted Availability Score
1	Irrigation District and/or domestic wells	82.2%	90	74.0
2	Not irrigated at all	17.8%	0	0
Totals		100.0		74.0

Source: California Department of Conservation, 1997.

Surrounding Agricultural Land Rating

The Surrounding Agricultural Land Rating is designed to provide a measurement of the level of agricultural land use for lands near the Project site. Determination of the surrounding agricultural land use rating is based upon the identification of a "Zone of Influence" (ZOI), which is defined as that land near a given project, both directly adjoining and within a defined distance away, that is likely to influence, and be influenced by, the agricultural land use of the Project site. The ZOI is the amount of surrounding lands up to a minimum of one-quarter mile from the Project site boundary. Parcels that are intersected by the quarter-mile buffer are included in their entirety (see Figure 2 Surrounding Land). The LESA Model rates the potential significance of the conversion of an agricultural parcel that has a large proportion of

surrounding land in agricultural production more highly than one that has a relatively small percentage of surrounding land in agricultural production (California DOC, 1997).

Lands used for agricultural production within 0.25 mile of the site are located in the Palo Verde Valley to the east and south of the Project site. Because the percentage of agricultural land is less than 40 percent of the ZOI, the Surrounding Agricultural Land Rating score is zero, and is provided in Table 6.

Table 6
Surrounding Agricultural and Protected Lands

Total Acres within "Zone of Influence"*	Acres in Agricultural Production*	Acres of Protected Resource Land	Percent in Agriculture	Percent Protected Resources Land	Surrounding Agricultural Land Score	Surrounding Protected Resource Land Score
7,377	1,951.3	282.2	26.45%	3.82%	0	0

Source: California Department of Conservation, 1997.

*Zone of Influence is the amount of surrounding lands up to a maximum of one-quarter mile from the Project site boundary. Parcels that are intersected by the quarter-mile buffer are included in their entirety. Acreage calculations reflect the entire parcel intersected by the quarter-mile buffer and within the quarter-mile buffer itself.

Surrounding Protected Resource Land Rating

The Surrounding Protected Resource Land Rating is essentially an extension of the Surrounding Agricultural Land Rating, and is scored in a similar manner. The ZOI is the amount of surrounding lands up to a minimum of one-quarter mile from the Project site boundary. Parcels that are intersected by the quarter-mile buffer are included in their entirety (see Figure 2 Surrounding Land).

Protected resource lands are those lands with long term use restrictions that are compatible with or supportive of agricultural uses of land (California DOC, 1997). Included are the following:

- Williamson Act contracted lands;
- Publicly owned land maintained as park, forest, or watershed resources; and
- Lands with agricultural, wildlife habitat, open space, or other natural resource easements that restrict the conversion of such land to urban or industrial uses.

The Project will not be located within an agriculture preserve, nor on land under a Williamson Act contract. However, the ZOI quarter-mile buffer, and all parcels intersected by the quarter-mile buffer, intersects 282.2 acres of lands under Williamson Act contract. Because the percentage of protected lands is less than 40 percent of the ZOI, the Surrounding Protected Resource Land Rating is zero.

SECTION 4 SUMMARY

The California LESA Model is weighted such that 50 percent of the total LESA score of a project is derived from the Land Evaluation (LE) factors, and 50 percent from the Site Assessment (SA) factors. Individual factor weights are listed below in Table 7, with the sum of the factored weights required to equal 100 percent.

Table 7
Final LESA Score Sheet Summary

	Factor Rating (0 – 100 Points)	Factor Weighting (Total = 100 Points)	Weighted Factor Rating
Land Evaluation			
1. Land Capability Classification (25%)	42.88	0.25	10.7
2. Storie Index Rating (25%)	66.12	0.25	16.5
		Land Evaluation Subscore	27.2
Site Assessment			
1. Project Size Rating (15%)	100	0.15	15
2. Water Resource Availability Rating (15%)	74.0	0.15	11.1
3. Surrounding Agricultural Land Rating (15%)	0	0.15	0
4. Surrounding Protected Resource Lands Rating (5%)	0	0.05	0
		Site Assessment Subscore	26.1
		TOTAL	53.3

Source: California Department of Conservation, 1997, pages 29-31.

As showing in Table 7, the LE subscore is 27.2, and the SA subscore is 26.1. As shown in Table 1, a final LESA score between 40 to 59 points is considered significant only if the LE and SA subscores are greater than or equal to 20 points. Therefore, with both subscores greater than 20, the Project is considered to have significant impact on agricultural resources.

SECTION 5 REFERENCES

California Department of Conservation, 1997. California Agricultural Land Evaluation and Site Assessment Model, *Instruction Manual*. Prepared by the California Department of Conservation, Office of Land Conservation, 1997.

Palo Verde Irrigation District (PVID), 2011 http://www.pvid.org. Accessed on September 3, 2012.

United States Department of Agriculture, 1981. *Soil Survey of Riverside County California, Palo Verde area*. Prepared by the United States Department of Agriculture Soil Conservation Service in cooperation with the University of California.

Figures

Blythe Mesa Solar Site
Zone of Influence 1/4 Mile Buffer
Parcel Boundary

Soils Classification

- Ac-Aco gravelly loamy sand
- Af-Aco sandy loam
- BaG-Badland
- Ce-Carrizo gravelly sand
- Co-Cibola fine sandy loam
- Cs-Cibola silty clay loam
- DuD-Duneland
- Gb-Gilman fine sandy loam
- Gc-Gilman silty clay loam
- Ge-Glenbar silty clay loam
- Hb-Holtville fine sandy loam
- Hc-Holtville silty clay
- Ib-Imperial fine sandy loam
- Ic-Imperial silty clay
- Ie-Indio silty clay loam
- Md-Meloland fine sandy loam
- Me-Meloland silty clay laom
- Oc-Orita fine sand
- Og-Orita gravelly loamy sand
- Or-Orita gravelly fine sandy loam
- Rb-Ripley very fine sandy loam
- Rc-Ripley silty clay loam
- RoA-Rositas fine sand, 0 to 2 percent slopes
- RoB-Rositas fine sand, 2 to 9 percent slopes
- RrA-Rositas fine sand, wet, 0 to 2 percent slopes
- RsA-Rositas gravelly loamy sand, 0 to 2 percent slopes
- RtA-Rositas silty clay loam, 0 to 2 percent slopes

* Note: The ZOI is the amount of surrounding lands up to a maximum of one-quarter mile from the Project site boundary. Parcels that are intersected by the quarter-mile buffer are included in their entirety.

Blythe Airport

OVERVIEW MAP



SOURCES:
Parcels (Riverside County, 2010).
Project Site (Renewable Resources Group, 2012).
Aerial Imagery (NAIP, 5-25-2010).
Soils (NRCS, 2012).

SOILS MAP
BLYTHE MESA SOLAR SITE

URS

1500 0 1500 3000 Feet
SCALE: 1" = 3,000' (1:36,000)
SCALE CORRECT WHEN PRINTED AT 11X17

CREATED BY: CM	DATE: 9/10/2012	FIG. NO: 1
PM: AL	PROJ. NO: 27652075.00000	

Path: G:\gis\projects\15771\27652075\mxd_docs\mxd\Soils.mxd, Colin_Mattison, 9/10/2012, 12:22:18 PM

Blythe Mesa Solar Site
Proposed Transmission Line
Zone of Influence 1/4 Mile Buffer
Parcel Boundary

Existing Substations
161 kV
230 kV
500 kV

Existing Transmission Lines
161 kV
220 kV
500 kV

Land Ownership
US Bureau of Land Management
Unclassified

Farmland of Importance
Statewide
Prime
Unique
Local

Protected Resources Lands
California Williamson Act Lands (282.2 ac.)

* Note: The ZOI is the amount of surrounding lands up to a maximum of one-quarter mile from the Project site boundary. Parcels that are intersected by the quarter-mile buffer are included in their entirety.

Utility Corridors

Project Site

Utility Corridors
BLM Corridor J
BLM Corridor J/K
BLM Corridor K
Department of Energy Utility Corridor

McCoy Mountains

Blythe Airport

Mule Mountains ACEC

10

78

SOURCES:
Project Site (Renewable Resource Group, 2012).
Aerial Imagery (NAIP, 2010).
Land Ownership (BLM, 3-03-2011).
Existing Transmission Lines, Existing Substations (Platts, 2009).
Utility Corridors (BLM, 10-7-2011).

SURROUNDING LAND
BLYTHE MESA SOLAR SITE

URS

1750 0 1750 3500 Feet
SCALE: 1" = 3,500' (1:42,000)
SCALE CORRECT WHEN PRINTED AT 11X17

CREATED BY: CM	DATE: 9/10/2012	FIG. NO: 2
PM: AL	PROJ. NO: 27651006.50509	

Path: G:\gis\projects\1577\27652075\map_docs\mxd\SurroundingLand.mxd, Colin_Mattison, 9/10/2012, 10:27:57 AM

APPENDIX M
FISH AND WILDLIFE SERVICE
INFORMAL CONSULTATION MEMO

THIS PAGE INTENTIONALLY LEFT BLANK

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Palm Springs Fish and Wildlife Office
777 East Tahquitz Canyon Way, Suite 208
Palm Springs, California 92262

In Reply Refer To:
FWS-ERIV-12B0299-12I0497

NOV 14 2012

Memorandum

To: Field Manager, Palm Springs Field Office, Bureau of Land Management
Palm Springs, California

From: Assistant Field Supervisor, Palm Springs Fish and Wildlife Office
Palm Springs, California

Subject: Informal Consultation for Renewables Resource Group Blythe Mesa I Solar Project, Riverside County, California

This memorandum responds to your July 16, 2012, memorandum, received by our office July 18, 2012, requesting our concurrence pursuant to section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*) that the proposed 485-megawatt Blythe Mesa I Solar Project is not likely to adversely affect the federally threatened Mojave desert tortoise (*Gopherus agassizii*). The Bureau of Land Management (BLM) proposes to issue a right-of-way (ROW) grant to Renewable Resources Group to construct, operate, and maintain a 230-kilovolt transmission line from the proposed project site to the Colorado River Substation.

The transmission line ROW covers approximately 73 acres of BLM-administered land. The solar generation facility would be on approximately 3,587 acres of private land west of Blythe, California, in unincorporated Riverside County, California. The project area is bisected by Interstate 10, and includes several disjunct parcels. Approximately 70 percent of the project area is actively cultivated agricultural land, 24 percent is previously disturbed by agricultural or military activities, and 6 percent undisturbed desert land.

The majority of the project site is disturbed land and marginal desert tortoise habitat. The approximately 220 acres of undisturbed land is too sandy to support desert tortoise burrows, and supports vegetation too sparse to be good foraging habitat for desert tortoises. Numerous desert tortoise surveys have been conducted within the previous 2 years along and near the proposed transmission route, in association with other projects proposed in the vicinity. No desert tortoises or tortoise sign were detected.

Based on coordination between our respective staffs, the following conservation measures would be implemented as part of the proposed project:

1. **Qualified Biologist**: In the following measures, a "qualified biologist" is defined as a person with appropriate education, training, and experience to conduct tortoise surveys, monitor project activities, provide worker education programs, and supervise or perform other implementing actions. The person must demonstrate an acceptable knowledge of tortoise biology, desert tortoise impact minimization techniques, habitat requirements, sign identification techniques, and survey procedures. Evidence of such knowledge may include work as a compliance monitor on a project in desert tortoise habitat, work on desert tortoise trend plot or transect surveys, conducting surveys for desert tortoise, or other research or field work on desert tortoise. Attendance at a training course endorsed by the agencies (e.g., Desert Tortoise Council tortoise training workshop) is a supporting qualification.

   A qualified biologist will be on-site during all construction. The qualified biologist shall conduct a pre-construction clearance survey of the project area, watch for tortoises wandering into the construction areas, check under vehicles, and examine excavations and other potential pitfalls for entrapped animals. The qualified biologist will be responsible for overseeing compliance with desert tortoise protective measures and for coordination with the Field Contact Representative (FCR) (described below). The qualified biologist shall have the authority to halt all project activities that are in violation of these measures or that may result in the take of a tortoise. The qualified biologist shall have a copy of this letter when work is being conducted on the site. The qualified biologist is not authorized to handle or relocate desert tortoises as part of this project.

2. **Preconstruction Clearance Survey**: The qualified biologist shall conduct a pre-construction clearance survey of the project area. Transects for clearance surveys will be spaced 15 feet apart. Clearance will be considered complete after two successive surveys have been conducted without finding any desert tortoises. Clearance surveys must be conducted during the active season for desert tortoises (April through May or September through October). The qualified biologist is not authorized to handle or relocate desert tortoises as part of this project. If a tortoise or tortoise burrow is located during clearance surveys, the U.S. Fish and Wildlife Service (Service) will be contacted for direction on how to proceed.

3. **Field Contact Representative**: The project proponent will designate a FCR who will be responsible for overseeing compliance with desert tortoise protective measures and for coordination with the Service. The FCR will have the authority to halt all project activities that are not in compliance with the measures in this letter. The FCR will have a copy of this letter when work is being conducted on the site. The FCR may be an agent for the company, the site manager, any other project employee, a biological monitor, or other contracted biologist. Any incident occurring during the project activities that is considered by the qualified biologist to be in non-compliance with these measures will be documented immediately by the qualified biologist. The FCR will ensure that appropriate corrective action is taken. Corrective actions will be documented by the qualified

biologist. The following incidents will require immediate cessation of the project activities causing the incident: (1) location of a desert tortoise within the exclusion fencing; (2) imminent threat of injury or death to a desert tortoise; (3) unauthorized handling of a desert tortoise, regardless of intent; (4) operation of construction equipment or vehicles outside a project area cleared of desert tortoise, except on designated roads; and (5) conducting any construction activity without a biological monitor where one is required.

4. **Worker Training**: Prior to the onset of construction activities, a desert tortoise education program will be presented by the FCR or qualified biologist to all personnel who will be present on work areas within the project area. Following the onset of construction, any new employee will be required to formally complete the tortoise education program prior to working on site. At a minimum, the tortoise education program will cover the following topics:

    a) A detailed description of the desert tortoise, including color photographs;

    b) The distribution and general behavior of the desert tortoise;

    c) Sensitivity of the species to human activities;

    d) The protection the desert tortoise receives under the Act, including prohibitions and penalties incurred for violation of the Act;

    e) The protective measures being implemented to conserve the desert tortoise during construction activities; and

    f) Procedures and a point of contact if a desert tortoise is observed on site.

5. **Site Fencing**: Desert tortoise exclusion fencing will be installed around the project area. The fence will adhere to Service design guidelines, available at: http://www.fws.gov/ventura/species_information/protocols_guidelines/docs/dt/DT_Exclusion-Fence_2005.pdf. The qualified biologist will conduct a clearance survey before the tortoise fence is enclosed to ensure no tortoises are on the project site. If a tortoise is found, all construction activity will halt and the Service contacted for direction on how to proceed. Once installed, exclusion fencing will be inspected at least monthly and following all rain events, and corrective action taken if needed to maintain the integrity of the tortoise barrier.

    Fencing around the project site will include a desert tortoise exclusion gate. This gate will remain closed at all times, except when vehicles are entering or leaving the project site. If it is deemed necessary to leave the gate open for extended periods of time (e.g.,

during high traffic periods), the gate may be left open as long as a qualified biologist is present to monitor for tortoise activity in the vicinity.

Sites with potential hazards to desert tortoise (e.g., auger holes, steep-sided depressions) that are outside of the desert tortoise exclusion fencing will be fenced by installing exclusionary fencing, or not left unfilled overnight.

6. **Refuse Disposal**: All trash and food items shall be promptly contained within closed, raven-proof containers. These will be regularly removed from the project site to reduce the attractiveness of the area to common ravens and other desert predators. The FCR will be responsible for ensuring that trash is removed regularly from the site such that containers do not overflow, and that the trash containers are kept securely closed when not in use.

7. **Tortoises under vehicles**: Underneath vehicles parked outside of desert tortoise exclusion fencing will be inspected immediately prior to the vehicle being moved. If a tortoise is found beneath a vehicle, the vehicle will not be moved until the desert tortoise leaves of its own accord.

8. **Tortoises on roads**: If a tortoise is observed on or near the road accessing the project site, vehicular traffic will stop and the tortoise will be allowed to move off the road on its own.

9. **Tortoise Observations**: No handling of desert tortoise or burrow excavation is allowed as part of the proposed action. If a tortoise is observed outside of exclusion fencing, construction will stop and the tortoise allowed to move out of the area on its own. If a tortoise or tortoise burrow is observed within the exclusion fencing, all construction will stop, and the Service contacted for direction on how to proceed.

   The following activities are not authorized and will require immediate cessation of the construction activities causing the incident: (1) location of a desert tortoise within the exclusion fencing; (2) imminent threat of injury or death to a desert tortoise; (3) unauthorized handling of a desert tortoise, regardless of intent; (4) operation of construction equipment or vehicles outside a project area cleared of desert tortoise, except on designated roads; and (5) conducting any construction activity without a biological monitor where one is required.

10. **Dead or Injured Specimens**: Upon locating a dead or injured tortoise, the project proponent or agent is to immediately notify the Palm Springs Fish and Wildlife Office by telephone within 3 days of the finding. Written notification must be made within 5 days of the finding, both to the appropriate Service field office and to the Service's Division of Law Enforcement. The information provided must include the date and time of the

finding or incident (if known), location of the carcass or injured animal, a photograph, cause of death, if known, and other pertinent information.

Based on the information provided and the agreed upon avoidance and minimization measures listed above, we concur that the proposed project is not likely to incidentally take or otherwise adversely affect desert tortoise. Should project plans change, if a listed species is detected on-site, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered and formal consultation or conference may be required.

Although this letter satisfies BLM's requirements under Section 7(a)(2) of the Act with regards to desert tortoise, this project raises several other resource concerns that should be adequately addressed in any National Environmental Policy Act (NEPA) documents. For example, the southwestern parcel of the proposed project is in the sand transport corridor that stretches from north of Palen Solar Energy Project to the edge of the agricultural fields by the Colorado River. This corridor is part of the preliminary plan-wide biological reserve system of the Desert Renewable Energy Conservation Plan. Therefore we recommend that the NEPA document include adequate avoidance measures and mitigation for sand transport corridors. As such, we recommend inclusion of an alternative in which the parcel in the sand transport corridor is removed from development.

If you have any questions regarding this consultation, please contact Fish and Wildlife Biologist Nisa Marks of this office at 760-322-2070, extension 208.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX N
AIRPORT LAND USE COMMISSION DEVELOPMENT REVIEW

THIS PAGE INTENTIONALLY LEFT BLANK

AIRPORT LAND USE COMMISSION
RIVERSIDE COUNTY

CHAIR
Simon Housman
Rancho Mirage

VICE CHAIRMAN
Rod Ballance
Riverside

COMMISSIONERS

Arthur Butler
Riverside

John Lyon
Riverside

Glen Holmes
Hemet

Greg Pettis
Cathedral City

Richard Stewart
Moreno Valley

STAFF

Director
Ed Cooper

John Guerin
Russell Brady
Barbara Santos

County Administrative Center
4080 Lemon St., 14th Floor.
Riverside, CA 92501
(951) 955-5132

www.rcaluc.org

April 25, 2012

Jay Olivas, Urban Regional Planner IV
Riverside County Planning Department
4080 Lemon Street, Twelfth Floor
Riverside CA, 92501
HAND DELIVERY

RE: AIRPORT LAND USE COMMISSION (ALUC) DEVELOPMENT REVIEW
File No.: ZAP1007BL11
Related File No.: CUP03670 (Conditional Use Permit)
APNs: See attached list.

Dear Mr. Olivas:

On April 12, 2012, the Riverside County Airport Land Use Commission (ALUC), by a 4-2 vote, found Conditional Use Permit No. 3670 (CUP03670) proposing to construct a 485 megawatt solar photovoltaic electric generating facility and associated facilities on 3,645 acres, including three electrical substations, two operations and maintenance buildings, inverters, transformers, 34.5 kV distribution lines, 230 kV transmission lines, and associated switchgear **CONSISTENT** with the 2004 Blythe Airport Land Use Compatibility Plan, subject to the following conditions:

CONDITIONS:

1. The following uses shall be prohibited:

   (a) Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA-approved navigational signal light or visual approach slope indicator.

   (b) Any use which would cause sunlight to be reflected towards an aircraft engaged in an initial straight climb following takeoff or towards an aircraft engaged in a straight final approach towards a landing at an airport.

   (c) Any use which would generate smoke or water vapor or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within the area.

   (d) Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.

2. Any outdoor lighting installed shall be hooded and shielded to prevent either the spillage of lumens or reflection into the sky.

3. If the panels are mounted on a framework, said framework shall have a flat or matte finish so as to minimize reflection of sunlight.

4. Prior to issuance of building permits for any structures or panels on those parcels located wholly or partially within Airport Compatibility Zone B1, the landowner shall convey an avigation easement to the County of Riverside as owner of Blythe Airport.

5. The attached notice shall be provided to all potential purchasers, and shall be recorded as a deed notice for those parcels within the project located wholly or partially within Airport Compatibility Zones C and D.

6. All photovoltaic panels installed on the project shall have received an anti-reflective coating to minimize the potential for hazardous glare to occur to aircraft.

7. In the event that any incidence of glint, glare, or flash affecting the safety of air navigation occurs as a result of project operation, upon notification to the airport operator of an incidence, the airport operator shall notify the project operator in writing. Within 30 days of written notice, the project operator shall be required to promptly take all measures necessary to eliminate such glint, glare, or flash. An "incidence" includes any situation that results in an accident, incident, "near-miss," or specific safety complaint regarding an in-flight experience to the airport operator or to federal, state, or county authorities responsible for the safety of air navigation. The project operator shall work with the airport operator to prevent recurrence of the incidence. Suggested measures may include, but are not limited to, reprogramming the alignment of the panels at the time of day when incidences of glare occur to diminish or eliminate the source of the glint, glare, or flash. For each such incidence made known to the project operator, the necessary remediation shall only be considered to have been fulfilled when the airport operator states in writing that the situation has been remediated to the airport operator's satisfaction.

8. In the event that any incidence of electrical interference affecting the safety of air navigation occurs as a result of project operation, upon notification to the airport operator of an incidence, the airport operator shall notify the project operator in writing. Within 30 days of written notice, the project operator shall be required to promptly take all measures necessary to eliminate such interference. An "incidence" includes any situation that results in an accident, incident, "near-miss," report by airport personnel, or specific safety complaint to the airport operator or to federal, state, or county authorities responsible for the safety of air navigation. The project operator shall work with the airport operator to prevent recurrence of the incidence. For each such incidence made known to the project operator, the necessary remediation shall only be considered to have been fulfilled when the airport operator states in writing that the situation has been remediated to the airport operator's satisfaction.

9. The Federal Aviation Administration (FAA) has conducted aeronautical studies (Aeronautical Study Nos. 2012-AWP-551-OE, 2012-AWP-552-OE, 2012-AWP-562-OE, 2012-AWP-566-OE through 2012-AWP-571-OE, 2012-AWP-573-OE, 2012-AWP-1712-OE through 2012-AWP-1725-OE) and has determined that neither marking nor lighting of the proposed structures are necessary for aviation safety. However, if marking and/or lighting for aviation safety are accomplished on a voluntary basis, any such lighting shall be installed in accordance with FAA Advisory Circular 70/7460-1 K Change 2. Such lighting shall be maintained in accordance therewith for the life of the project.

10. The maximum height of the proposed structure, including all mounted appurtenances and aviation safety lighting (if any), shall not exceed the heights as noted in each

Determination of No Hazard to Air Navigation for each respective structure.

11. In accordance with the Determinations of No Hazard to Air Navigation issued for the subject structures, the determinations do include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated in each respective determination. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

12. The specific coordinates, height, top point elevation, power, and frequencies of the proposed facility shall not be amended without further review by the Airport Land Use Commission and the Federal Aviation Administration; provided, however, that reduction in structure height or elevation shall not require further review by the Airport Land Use Commission.

13. Within five (5) days after construction reaches its greatest height, the permittee shall complete Form 7460-2, Notice of Actual Construction or Alteration, and submit said form to the Federal Aviation Administration Southwest Regional Office Obstruction Evaluation Service at 2601 Meacham Boulevard, Fort Worth, TX 76137 or online at www.oeaaa.faa.gov. This requirement is also applicable in the event the project is abandoned.

If you have any questions, please contact Russell Brady, ALUC Contract Planner, at (951) 955-0549 or John Guerin, ALUC Principal Planner, at (951) 955-0982.

Sincerely,
RIVERSIDE COUNTY AIRPORT LAND USE COMMISSION

Edward C. Cooper, Director

RB:bks

Attachments: Notice of Airport in Vicinity
FAA Aeronautical Study Nos. 2012-AWP-551-OE, 2012-AWP-552-OE, 2012-AWP-562-OE, 2012-AWP-566-OE through 2012-AWP-571-OE, 2012-AWP-573-OE, 2012-AWP-1712-OE through 2012-AWP-1725-OE

cc: Rupal Patel, Renewable Resources Group, Inc.
Thomas Ryan, POWER Engineers
Jason Pfaff, POWER Engineers
Scott Kaminski, SunPower Corp.
Philip Crimmins, CALTRANS Division of Aeronautics
Chad Davies, Riverside County EDA – Aviation Division
Robert Eppers, California Pilots Association
Andy Wilson, California Pilots Association
ALUC Staff

Y:\AIRPORT CASE FILES\Blythe\ZAP1007BL11.LTR - Riv Co.doc

From: Fraser, Jody
To: Pete Sorensen; Tera Baird; Ken Corey
Subject: Fwd: DSL Avian Mortality 6/24
Date: Tuesday, June 24, 2014 10:02:15 PM
Attachments: COLO_062414_1.JPG
COLO_062414_8.JPG
WEGR_062414_2.JPG
WEGR_062414_5.JPG

---------- Forwarded message ----------
From: **brian sandstrom** <bjerome30@hotmail.com>
Date: Tue, Jun 24, 2014 at 3:34 PM
Subject: DSL Avian Mortality 6/24
To: "eduardo_nieves@fws.gov" <eduardo_nieves@fws.gov>, "jody_fraser@fws.gov" <jody_fraser@fws.gov>, "cperry@blm.gov" <cperry@blm.gov>, "fmcmenimen@blm.gov" <fmcmenimen@blm.gov>, "thomas_dietsch@fws.gov" <thomas_dietsch@fws.gov>
Cc: brooks hart <brooks@corvusecological.com>, crissy slaughter <criffy@hotmail.com>, kathy simon <kathy@ironwoodconsultinginc.com>, therese carpenter <therese.carpenter@firstsolar.com>, "pksharpgarcia@gmail.com" <pksharpgarcia@gmail.com>, "admin@corvusecological.com" <admin@corvusecological.com>, amanda beck <abeck@firstsolar.com>

Hello everyone,

Two avian mortalities were documented at DSL today:

1. Western Grebe - carcass was found intact in Block 1, Array 19, row 27. It was collected and stored in the biology freezer.
2. Common Loon - carcass was found in Block 1, array 16, row 37. The entire body had been scavenged by Raven, kit fox, and Turkey Vulture. The head, neck and wings were intact. It was also collected and stored in the biology freezer.

If you have any questions please contact me.

Thanks,

Brian Sandstrom
949-423-8770
bjerome30@hotmail.com

--
Jody Fraser, Biologist
Palm Springs Fish and Wildlife Office
U.S. Fish and Wildlife Service
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262

760.322.2070 ph x207
760.322.4648 fax
jody_fraser@fws.gov

From:	Lehong Chow
To:	eduardo_nieves@fws.gov; jody_fraser@fws.gov; cperry@blm.gov; fmcmenimen@blm.gov; thomas_dietsch@fws.gov; Chris Bedwell
Cc:	brooks@corvusecological.com; criffy@hotmail.com; kathy@ironwoodconsultinginc.com; therese.carpenter@firstsolar.com; pksharpgarcia@gmail.com; admin@corvusecological.com; abeck@firstsolar.com; bjerome30@hotmail.com
Subject:	DSL avian incident 7/14
Date:	Monday, July 14, 2014 5:43:08 PM
Attachments:	MALL_07142014_1.jpg MALL_07142014_2.jpg MALL_07142014_3.jpg MALL_07142014_4.jpg

Hello,

Over the weekend, on Saturday morning, at Desert Sunlight, a predated mallard was found along the North Service Road by security staff directly across from the north security gate in block 9 . The carcass was in the middle of the road near the fence line and somewhat near the installed solar framework. The carcass was retrieved and identified today – it is now stored in our freezer. Photos of the carcass close-up and the area post-removal are attached.

Please let me know if you have further inquiries – I am filling in as the Designated Biologist at Desert Sunlight today and tomorrow.

Thanks,
Lehong

Lehong Chow
Biologist
Ironwood Consulting, Inc
Subcontractor

P: (909)798-0330 ext. 5
C: (626)375-1064
E: lchow@ironwoodbio.com

From:	Lehong Chow
To:	eduardo_nieves@fws.gov; jody_fraser@fws.gov; cperry@blm.gov; fmcmenimen@blm.gov; thomas_dietsch@fws.gov; Chris Bedwell
Cc:	brooks@corvusecological.com; criffy@hotmail.com; kathy@ironwoodconsultinginc.com; therese.carpenter@firstsolar.com; pksharpgarcia@gmail.com; admin@corvusecological.com; bjerome30@hotmail.com
Subject:	DSL avian incident BHGR 8/20/14
Date:	Wednesday, August 20, 2014 5:07:37 PM
Attachments:	BHGR_20140820_1.jpg BHGR_20140820_2.jpg BHGR_20140820_3.jpg BHGR_20140820_4.jpg BHGR_20140820_6.jpg

---

Hello,

The carcass of a hatching year female black-headed grosbeak was found at Desert Sunlight in block 9, array 8 by construction personnel this morning. The carcass was located along the northern perimeter road near the perimeter fence - about 100 meters from solar arrays and about 25 meters from a dry retention basin. Cause of death is unknown.

Please let me know if you have further inquiries regarding this mortality. I will be filling in as Designated Biologist at Desert Sunlight for the next two weeks.

Thanks,
Lehong

Lehong Chow
Biologist
Ironwood Consulting, Inc
Subcontractor

P: (909)798-0330 ext. 5
C: (626)375-1064
E: lchow@ironwoodbio.com

From:	Lehong Chow
To:	eduardo_nieves@fws.gov; jody_fraser@fws.gov; cperry@blm.gov; fmcmenimen@blm.gov; thomas_dietsch@fws.gov
Cc:	brooks@corvusecological.com; criffy@hotmail.com; kathy@ironwoodconsultinginc.com; therese.carpenter@firstsolar.com; pksharpgarcia@gmail.com; admin@corvusecological.com; bjerome30@hotmail.com
Subject:	DSL avian incident PAJA 8/21/14
Date:	Thursday, August 28, 2014 7:09:53 PM
Attachments:	PAJA_20140828_1.jpg PAJA_20140828_2.jpg PAJA_20140828_3.jpg PAJA_20140828_7.jpg

---

Hello,

The disarticulated carcass of a parasitic jaeger was found in block 8, near array 4 by the perimeter road. The closest project component is the perimeter fencing, which was about 50m away while the closest solar panels are about 120m away. It is suspected that the carcass was predated. Photos are attached.

Please contact me if you have additional inquiries regarding this avian mortality.

Thanks,

Lehong Chow
Biologist
Ironwood Consulting, Inc
Subcontractor

P: (909)798-0330 ext. 5
C: (626)375-1064
E: lchow@ironwoodbio.com

From: Pagel, Joel
To: Thomas Dietsch
Subject: more pics
Date: Friday, September 19, 2014 1:20:29 PM
Attachments: bioblitz 2013 desert sunlight 030.JPG
bioblitz 2013 desert sunlight 031.JPG
bioblitz 2013 desert sunlight 032.JPG
DSC05129.JPG
DSC05130.JPG
DSC05132.JPG

From: Pagel, Joel
To: Thomas Dietsch
Subject: last batch
Date: Friday, September 19, 2014 1:25:12 PM
Attachments: DSC05138.JPG
bioblitz 2013 desert sunlight 034.JPG
DSC05124.JPG
DSC05136.JPG
bioblitz 2013 desert sunlight 006.JPG
ivanpaugh 085.JPG
ivanpaugh 084.JPG
ivanpaugh 088.JPG

---

088 is from about 13 miles away...

From: Thomas Dietsch
To: Amy Fesnock
Cc: Amedee Brickey
Subject: Follow-up on today"s Desert Sunlight call.
Date: Tuesday, October 14, 2014 6:10:33 PM
Attachments: DS_Carcass Persistence Trials - Round 1 Results.pdf
Genesis Bird and Bat Conservation Strategy_3-17-14_clean.pdf
Genesis Bird and Bat Conservation Strategy_USFWS_Comments_TVD 2014_05_01.docx

---

Hi Amy,

Attached is the first round of Desert Sunlight Carcass Persistence Trial results. Also, here is the protocol summary for the Sunrise Powerlink transmission line surveys. They were focused on testing the effectiveness of line marking and tower lighting in reducing mortality. In addition to this component, there was also a special tower protocol for the lighting question. I couldn't find anything detailing the length of transects, so I have requested additional information. I think the study was based on tower to tower spans rather than a fixed distance. When I get more info, I'll let you know.

> "Searches were conducted in teams composed of three biologists. On each team, one person walked directly beneath the center phase of the three-phase transmission line while searching for carcasses between the two outer phases, and two people walked just outside each of the outer phases searching for carcasses from the outer phases to 50 feet beyond the outer phases. Any time an intact avian carcass or partially scavenged avian carcass (collectively called "events") was identified, searchers recorded the location and species. The distance from the event to the center phase and nearest tower was subsequently calculated, and the presence of line marking and lighting on the nearest span and tower was recorded."

I've also attached the a clean version of the Genesis BBCS with figures and the version with the USFWS comments. I'll send out a doodle poll for an agency meeting on Genesis prior to the Oct 24th meeting with the company.

Please let me know if you have any questions or if there is anything else I can do to help.

Thanks, Tom

****

Thomas Dietsch, PhD.
Migratory Bird Biologist
US Fish and Wildlife Service, Region 8
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, CA 92008
(760) 431-9440 Ext. 214

****

From:	Kalish, John
To:	ken_corey@FWS.gov; john_kalish@blm.gov; Marshall, Paul@Energy; Lesh, Geoff@Energy; Fooks, Brett@Energy; Ali, Anwar@Energy; Watson, Carol@Energy; German, Charles; Townsend-Hough, Ellie@Energy; Conway, Mike@Energy; Marxen, Chris@Energy; Knight, Eric@Energy; Wylie, Doug@Waterboards; Vaccaro, Kourtney@Energy; Johnson, Roger@Energy; Pete Sorensen; Tera Baird; Thomas Dietsch; Rodriguez, Magdalena@Wildlife; Jody Fraser; kmarsden@blm.gov
Subject:	Fwd: Genesis Photos #1
Date:	Friday, October 17, 2014 2:03:52 PM
Attachments:	20141016_152834.jpg 20141016_152846.jpg 20141016_153128.jpg 20141016_153139.jpg 20141016_153254.jpg 20141016_153425.jpg

---

---------- Forwarded message ----------
From: **Perry, Cedric** <cperry@blm.gov>
Date: Fri, Oct 17, 2014 at 1:36 PM
Subject: Genesis Photos #1
To: John Kalish <jkalish@blm.gov>

Cedric C. Perry

Project Manager

Bureau of Land Management (BLM)

22835 Calle San Juan De Los Lagos

Moreno Valley, Ca. 92553

Office # 951-697-5388

Cell Ph # 951-208-5794

--
John R. Kalish, Field Manager
Bureau of Land Management
Palm Springs-South Coast Field Office
1201 Bird Center Dr
Palm Springs, CA 92262
760-833-7100

From:	Kalish, John
To:	ken_corey@FWS.gov; john_kalish@blm.gov; Marshall, Paul@Energy; Lesh, Geoff@Energy; Fooks, Brett@Energy; Ali, Anwar@Energy; Watson, Carol@Energy; German, Charles; Townsend-Hough, Ellie@Energy; Conway, Mike@Energy; Marxen, Chris@Energy; Knight, Eric@Energy; Wylie, Doug@Waterboards; Vaccaro, Kourtney@Energy; Johnson, Roger@Energy; Pete Sorensen; Tera Baird; Thomas Dietsch; Rodriguez, Magdalena@Wildlife; Jody Fraser; kmarsden@blm.gov
Subject:	Fwd: Genesis photos #3
Date:	Friday, October 17, 2014 2:03:09 PM
Attachments:	20141016_153915.jpg 20141016_153919.jpg 20141016_153923.jpg

---

---------- Forwarded message ----------
From: **Perry, Cedric** <cperry@blm.gov>
Date: Fri, Oct 17, 2014 at 1:41 PM
Subject: Genesis photos #3
To: John Kalish <jkalish@blm.gov>

Cedric C. Perry

Project Manager

Bureau of Land Management (BLM)

22835 Calle San Juan De Los Lagos

Moreno Valley, Ca. 92553

Office # 951-697-5388

Cell Ph # 951-208-5794

--
John R. Kalish, Field Manager
Bureau of Land Management
Palm Springs-South Coast Field Office
1201 Bird Center Dr
Palm Springs, CA 92262
760-833-7100

From: Thomas Dietsch
To: Pedro Ramirez
Subject: RE: HDPE Bird Balls
Date: Tuesday, October 21, 2014 3:56:35 PM
Attachments: DSC02113.JPG
DSC02110.JPG
Solar.Site 3.Genesis (14).JPG
Solar.Site 3.Genesis (15).JPG

Hi Pete,

Here's a few photos of the ponds with the nets in place during our visit in July before the nets were damaged. This was a super hot day in late July. The Kestral wasn't tangled but seemed anxious to get into the pond. The other bird is a deceased loon that had apparently landed on the top of the net and couldn't take off again.

You can find the Project on Google by searching for "Wiley's Well Rest Area, Blythe, CA", which is an exit off of the I-10. If you follow the road to the Northeast from the exit, you will see the project or part of it. One portion is still an older photo in construction, but you can see the two ponds next to each other between the two phases of the project.

Let me know if you have any further thoughts.

Thanks, Tom

From: Pedro Ramirez [mailto:pedro_ramirez@fws.gov]
Sent: Tuesday, October 21, 2014 2:26 PM
To: Thomas Dietsch
Subject: Re: HDPE Bird Balls

Hmmmm...don't know how that would work. Before you recommend anything specific, please consult with your LE special agent. If you recommend something & they have mortality then LE cannot pursue MBTA investigation.

Let me think about it. Can you send me jpgs of evap pond? Or Google Earth aerial image of facility & pond(s) if available?

Thanks

Sent from my iPhone
Pedro 'Pete' Ramirez
Environmental Contaminants Specialist
USFWS-NWRS

On Oct 21, 2014, at 2:52 PM, Thomas Dietsch <thomas_dietsch@fws.gov> wrote:

> Hi Pete,
>
> Thanks for the suggestions. Do you think with a smaller mesh size on the side and larger on top that birds may enter from the top and be unable to escape? The concept reminds me a little bit of a cowbird trap. In any case, it may be better and they can add

the smaller mesh over the larger mesh so it is stronger. This would also allow greater evaporation, which the company has raised as an issue when I've brought this up previously.

Thanks, Tom

From: Ramirez, Pedro [mailto:pedro_ramirez@fws.gov]
Sent: Tuesday, October 21, 2014 12:58 PM
To: Dietsch, Thomas
Subject: Re: FW: HDPE Bird Balls

I found that birds typically entered a netted pond or pit through holes in the netting or through the side netting. The mesh size on the sides should be smaller to exclude passerine songbirds.
If snow-loading is not an issue then the mesh size of the entire net can be much smaller.

If the pond is larger than one acre then I could see problems in maintaining the netting. Some facilities construct long and narrow evap ponds so that the span across one dimension of the pond is not too large to support the netting.

Here's information from a net installation company that I posted on our oil pits web site:

http://www.fws.gov/mountain-prairie/contaminants/contaminants1c.html

Effective Net Installation

The effectiveness of netting oil pits to exclude birds and other wildlife depends on its installation. Effective installation requires a design allowing for snow-loading and one that also prevents ground entry by small mammals and birds. According to a professional net installation contractor, a maximum mesh size of 1 1/2 inches will allow for snow-loading and will exclude most birds. Netting should be suspended a minimum of 4 to 5 feet from the surface of the pond to prevent the net from sagging into the oil-covered pond during heavy snow-loads. Three-inch steel tubing can be used for support posts and are set a maximum of 7 feet apart. These are buried a minimum of 7 feet in depth and set in concrete. Three-inch steel tubing is also used as a top rail to connect the posts. Cable is strung across this frame at 7-foot intervals along the y-axis and the x-axis to form a grid of 7-foot squares by the cable. The netting is draped over this cable grid. Netting should be wide enough to drape down the sides of the frame to prevent ground entry by wildlife. A bottom perimeter cable strung along the bottom of the posts at ground level is used to attach the bottom of the net. Cables are strung over the net at 7-foot intervals to prevent the wind from whipping the net back and forth. Proper maintenance should be performed to repair holes in the netting and to re-stretch sagging nets after heavy snow-loads.

Hope this helps.

Pete

Everything is Connected
****
Pedro 'Pete' Ramirez, Jr.
USFWS - National Wildlife Refuge System
Wildlife Resources - Energy Program

Mailing Address
Natural Resource Program Center
1201 Oakridge Drive - Suite 320
Fort Collins, CO 80525

Pedro_Ramirez@fws.gov

970-266-2946 (office)
970-214-2195 (cell)
****

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela

On Tue, Oct 21, 2014 at 10:40 AM, Dietsch, Thomas <thomas_dietsch@fws.gov> wrote:
Hi Pete,

I have another question, though I'm not sure if you have many ponds that use netting exclosures. One of the solar trough projects, which is required by the California Energy Commission to use netting, had an oil spill of their heat transfer fluid. Unfortunately, their netting was blown down in a heavy wind storm in August so there have been about 50 dead birds found so far. Included in this total are a number of passerines that may have gotten into the ponds before the netting came down. Currently the net mesh size requirement is 1.5 inches. I've been asked if we have a recommended mesh size that will reduce the likelihood that smaller birds can get into the exclosure. Do you have any suggestions? Do any of the oil wastewater ponds use netting for excluding birds?

Any suggestions would be welcome.

Thanks, Tom

On Thu, Oct 9, 2014 at 9:34 PM, Ramirez, Pedro <pedro_ramirez@fws.gov> wrote:
One oilfield wastewater disposal facility in WY deployed bird balls and they have had no mortality. If the balls or hexagonal "discs" completely cover the pond then birds more than likely will not land there.

Another vendor is Phoenix Disc (www.phnxplastics.com)

Trona mines tried different colored dyes in their evap pond water but that had no effect on deterring birds.
For a 5-acre pond a radar-activated deterrent system may be the best bet coupled with frequent monitoring to ensure that birds do not land on the ponds.

See attached report.

Everything is Connected
****
Pedro 'Pete' Ramirez, Jr.
USFWS - National Wildlife Refuge System
Wildlife Resources - Energy Program

Mailing Address
Natural Resource Program Center
1201 Oakridge Drive - Suite 320
Fort Collins, CO 80525

Pedro_Ramirez@fws.gov

970-266-2946 (office)
970-214-2195 (cell)
****

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela

On Thu, Oct 9, 2014 at 5:17 PM, Thomas Dietsch <thomas_dietsch@fws.gov> wrote:

Hi Pedro,

Thank you for the information. The ponds are to hold the output from the distilling operation and the effluent from the steam generator blowdowns. So, the most hazardous chemicals probably come from the steam generator, including as I understand operations mostly phosphates and other chemicals for maintaining pH, but also other more toxic chemicals. We have a list of potential chemicals, but don't have any water quality reports yet, so it's difficult to say exactly what's in or will be in the water. It's too bad the balls aren't more readily available in other colors, we've had problems with waterbirds being attracted to the solar facilities due to a lake effect, so I've suggested that we may want to camouflage the ponds to make them less attractive. I think the dark color of ponds and solar panels may have the appearance of water against the normal sand colored background.

The ponds are about 5 acres. Do you know how many facilities are using this approach in Region 6? Are the results consistently that there are no or few mortalities at the ponds?

Thanks, Tom

From: Ramirez, Pedro [mailto:pedro_ramirez@fws.gov]
Sent: Thursday, October 09, 2014 3:24 PM
To: Thomas Dietsch
Subject: Re: HDPE Bird Balls

Several manufacturers sell "bird balls" that are liquid-filled so that they are not as likely to get blown off the pond by strong winds.
Sprayers need to be monitored as aerial drift may cause salt deposition in areas outside of the facility and damage soils and vegetation.
If they use sprayers they should have an auto-shutoff capability that is triggered by wind speed & direction.

Just about all the "bird balls" I have seen are black as that makes them more resistent to UV degradation.
It's very expensive. One oil company spent $175,000 to cover a 1-acre pond.

http://cicball.thomasnet.com/product/hollow-plastic-balls/bird-deterrent-floating-balls

http://www.awtti.com/armor_balls_cover.php

http://www.lemnatechnologies.com/floatingDiscSystem.php

How big are the ponds? What are the chemicals in the pond?

Radar-activated deterrents reduce mortality by quite a bit but do not eliminate it completely.

http://www.detect-inc.com/bird_control_radar.html

http://www.accipiterradar.com/page/bird-protection-applications

Everything is Connected
****
Pedro 'Pete' Ramirez, Jr.
USFWS - National Wildlife Refuge System
Wildlife Resources - Energy Program

Mailing Address
Natural Resource Program Center
1201 Oakridge Drive - Suite 320
Fort Collins, CO 80525

Pedro_Ramirez@fws.gov

970-266-2946 (office)

970-214-2195 (cell)
****

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela

On Thu, Oct 9, 2014 at 3:46 PM, Thomas Dietsch <thomas_dietsch@fws.gov> wrote:
Hi Pedro,

I'm working with several utility-scale projects here in California that are using evaporation ponds. These ponds contain chemicals produced by the steam generators used to produce electricity. BLM and the California Energy Commission have required monitoring for avian mortality and adaptive management including the use of exclusionary devices. One of the companies has proposed using "bird balls", combined with spraying to increase evaporation. In your 2010 paper in Environmental Management, you indicated that one oil field wastewater facility had success with the use of HDPE bird balls. I was wondering if you have had any further experience to further support this technique. Have any of the facilities figured out how to contain the balls during high wind events? Do you have any thoughts on what colors the balls should be?

Also, we have another facility using netting, but they've had problems with birds getting tangled in the netting and high winds recently tore the netting apart requiring an expensive repair. That company may be interested in alternatives.

Any other suggestions you might have would be welcome.

Thanks, Tom

****
Thomas Dietsch, PhD.
Migratory Bird Biologist
US Fish and Wildlife Service, Region 8
Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, CA 92008
(760) 431-9440 Ext. 214
****

--
****
Thomas Dietsch, PhD
Migratory Bird Biologist

US Fish and Wildlife Service, Region 8
Carlsbad Fish and Wildlife Office
2177 Salk Ave, Suite 250
Carlsbad, CA 92008
(760) 431-9440 Ext. 214
****

From: Corey, Ken
To: Pete Sorensen; Jody Fraser; Joel Pagel; Thomas Dietsch; Bradd Bridges
Subject: Fwd: Slideshow on Avian Impacts at Solar Facilities
Date: Monday, December 01, 2014 8:21:44 AM
Attachments: Solar Avian Impacts 11_28_2014.pptx

For your review. I am confused by the timing of this for comments by Christmas as I thought the flyway meeting was next week. Ken

---------- Forwarded message ----------
From: **Davis, Eric** <eric_davis@fws.gov>
Date: Fri, Nov 28, 2014 at 3:31 PM
Subject: Slideshow on Avian Impacts at Solar Facilities
To: Amedee Brickey <amedee_brickey@fws.gov>, Thomas Dietsch <thomas_dietsch@fws.gov>, Chris Nicolai <chris_nicolai@fws.gov>, Rob Doster <rob_doster@fws.gov>, Heather Beeler <heather_beeler@fws.gov>, Daniel Crum <daniel_crum@fws.gov>, Jana Affonso <jana_affonso@fws.gov>, Asleigh Blackford <ashleigh_blackford@fws.gov>, Greg Hughes <greg_m_hughes@fws.gov>, Greg Yarris <greg_yarris@fws.gov>, Rebecca Fris <rebecca_fris@fws.gov>, Clint Riley <clint_riley@fws.gov>, Mendel Stewart <mendel_stewart@fws.gov>, Ken Corey <ken_corey@fws.gov>, Steve Henry <steve_henry@fws.gov>, Michael Senn <michael_senn@fws.gov>, Ted Koch <ted_koch@fws.gov>, Michael Green <michael_green@fws.gov>
Cc: Alex Pitts <alexandra_pitts@fws.gov>, Scott Flaherty <scott_flaherty@fws.gov>, Darrin Thome <darrin_thome@fws.gov>, Mike Fris <mike_fris@fws.gov>, Diane Elam <diane_elam@fws.gov>

All,

I have taken advantage of the slow day to try to put together a single slideshow on this issue. I largely merged 2 put together by Amedee and Mike Green. Feel free to forward to others in FWS (ES PLs: pls fwd to your staff). I would like to have one master presentation that anyone in the Region can use to give a presentation. Of course, a master presentation must have a single person responsible for the content and for updates. I would like to see that person be Amedee Brickey. I foresee that for any particular presentation, several slides would be hidden. I plan to give this talk to AFWA and to the Pacific Flyway. **Please send any edits to me by Christmas**, and I will finalize it by New Year's Day. Thanks!

Eric Davis
Assistant Regional Director, Region 8
Migratory Birds and State Programs
916-978-6189

Let us celebrate the 50th anniversary of the Wilderness Act of 1964.
Let us learn from the 100th anniversary of the death of the last passenger pigeon in 1914.

--
Kennon Corey
Assistant Field Supervisor

Palm Springs Fish and Wildlife Office
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
(760) 322 2070 ext 201

http://www.fws.gov/carlsbad/

From: Fraser, Jody
To: Joel Pagel
Subject: Re: Quartzite Solar Bio Meeting Request
Date: Wednesday, February 04, 2015 1:32:25 PM
Attachments: 20140129_Quartzite Draft BRTR Jan 2014.pdf

Jody Fraser, Biologist
Palm Springs Fish and Wildlife Office
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
760.322.2070 ph x207
jody_fraser@fws.gov

On Thu, Jan 29, 2015 at 8:29 AM, Fraser, Jody <jody_fraser@fws.gov> wrote:

> Here's what we're (the agencies) are meeting about on the 4th. If I didn't invite you and you want to attend, let me know. There are too many meetings to keep track of, so sorry if I neglected to forward.
> Jody

Jody Fraser, Biologist
Palm Springs Fish and Wildlife Office
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
760.322.2070 ph x207
jody_fraser@fws.gov

---------- Forwarded message ----------
From: **Tonya Moore** <tonya@ironwoodbio.com>
Date: Fri, Jan 16, 2015 at 1:48 PM
Subject: Quartzite Solar Bio Meeting Request
To: "Magdalena.Rodriguez@wildlife.ca.gov" <Magdalena.Rodriguez@wildlife.ca.gov>, "jody_fraser@fws.gov" <jody_fraser@fws.gov>, "Marsden, Kim" <kmarsden@blm.gov>
Cc: "Roy.Skinner@firstsolar.com" <Roy.Skinner@firstsolar.com>

Howdy Kim, Jody and Magdalena,

Hope this New Year finds you well and in good spirits. Let me apologize in advance for the length of this email. Action items in email: (1) set up a meeting, (2) determine if additional presence/absence desert tortoise surveys are recommended.

The Quartzite Solar project is moving along and we have started drafting permits,

management plans and other environmental documents that require mitigation measures. Thus, the Quartzite team believes that it is time to have an in person meeting to discuss the various biological issues on the project.

We want to present the completed, ongoing or proposed bio surveys, the mitigation measures proposed, potential issues we foresee related to bio and get your general feedback.

On your part, we would like your agency's recommendations on:

1. additional surveys you might suggest;
2. Any issues as a group we may not agree upon, at this stage;
3. additional mitigation measures your agency would recommend and/or;
4. how we should proceed to make this process more efficient.

Since this would be the initial meeting for us to discuss biology issues as group, I propose keeping it to a minimum number of people and no more than three hours. Later we can have additional meetings with project development personnel, specialty biologists and attorneys or meetings specific to a certain topic, if needed.

I know you are all overworked and I understand that agencies may require some time to have between agencies discussions, reviewing the BRTR that was sent and reviewing the 2014 bird summary report that I will sending out soon prior to meeting. Thus, I propose having the meeting the second or third week in **March** on a Tuesday, Wednesday or Thursday. If the suggested time frame is acceptable and all three of you are available on the same day, please give me the date(s) and I will put an agenda together. If you would like the meeting held at your location, please inform me.

One topic I would like to discuss, prior to the meeting, is additional desert tortoise surveys. We are aware that surveys are only valid for one-year and the last protocol surveys for the site were in 2013. However, the Quartzite team has determined that although there was no live desert tortoise found on the site in the surveys there was sign and thus there is potential that tortoise(s) may be affected by the project. The team anticipates obtaining ITPs for desert tortoise. Thus, the Quartzite team was <u>not</u> anticipating performing additional protocol level presence /absence surveys for desert tortoise including on the private historical farm lands that were just added to the project but of course we will be

doing protocol clearance surveys prior to any project ground disturbance. However, this method will only work if we all agree the following statements are a true:

- the 2013 100% percent surveys were performed correctly
- the environment has not changed
- the density of tortoises on site is presumed very low (and we assume low densities on the private lands due to historical disturbance and initial biological surveys)
- there is enough information to process the ITPs (or CDFW consistency Determination)

Jodi, would current Service protocol allow us to proceed this way? Magdalena and Kim, do either of you have any concerns that your agency might have with this approach?

Note last year a desert tortoise, outside the project action area about 1.3 km from the southern boundary, "visited" the surveyors on one of the offsite avian transects. Therefore, we are aware tortoises are in the vicinity.

As always, I am here to ensure the project is meeting your agency's biological requirements and that we all move as a team through this process. So, please feel free to get in touch with me to express any concerns or comments that you might have.

Have a wonderful weekend. Enjoy life! Talk to you soon.

Tonya Moore

Ironwood Consulting, Inc.

tonya@ironwoodbio.com

(760) 646-6477

"Love, laughter and sunshine!"

From:	Tonya Moore
To:	Marsden, Kim; Fraser, Jody; Rodriguez, Magdalena@Wildlife
Cc:	Roy.Skinner@firstsolar.com
Subject:	Quartzite Work Plan 2015 Avian Surveys
Date:	Thursday, February 12, 2015 3:15:16 PM
Attachments:	2015 Quartzite Avian Work Plan_021015.docx DESERT QUARTZITE AVIAN SURVEY SUMMARY 021215.docx

Howdy Kim, Jody and Magdalena,

Attached is the draft 2015 Work Plan for Avian Surveys for the Desert Quartzite Solar Project. I have also attached the summary of which avian surveys have occurred to this point. I hope that you find it helpful.

We are currently processing a large amount of data and are still collecting data that will be used to give a more complete picture of various species of avian that are utilizing the site. We understand your need to obtain the avian survey data from 2014 in order to make important management decisions. We are compiling that information for you with the utmost attention to detail to ensure the data is accurate and presented in the best manner(s) possible to interpret such data for various needs. We anticipate getting a summary to you soon.

If you have any questions or comments on either of the attached documents, please feel to give me call. I look forward to seeing each of you in person at our March meeting.

Have a terrific Tuesday. Enjoy life!

Tonya Moore
Ironwood Consulting, Inc
(760) 646-6477
tonya@ironwoodbio.com

"Love, laughter and sunshine!"

From:	Marsden, Kim
To:	Tonya Moore
Cc:	Fraser, Jody; Rodriguez, Magdalena@Wildlife; Roy.Skinner@firstsolar.com
Subject:	Re: Quartzite Work Plan 2015 Avian Surveys
Date:	Friday, February 13, 2015 9:41:49 AM
Attachments:	2015 Quartzite Avian Work Plan_021015 KMarsden comments.docx

Here are BLM's edits on the Work Plan

On Thu, Feb 12, 2015 at 3:13 PM, Tonya Moore <tonya@ironwoodbio.com> wrote:

> Howdy Kim, Jody and Magdalena,
>
> Attached is the draft 2015 Work Plan for Avian Surveys for the Desert Quartzite Solar Project. I have also attached the summary of which avian surveys have occurred to this point. I hope that you find it helpful.
>
> We are currently processing a large amount of data and are still collecting data that will be used to give a more complete picture of various species of avian that are utilizing the site. We understand your need to obtain the avian survey data from 2014 in order to make important management decisions. We are compiling that information for you with the utmost attention to detail to ensure the data is accurate and presented in the best manner(s) possible to interpret such data for various needs. We anticipate getting a summary to you soon.
>
> If you have any questions or comments on either of the attached documents, please feel to give me call. I look forward to seeing each of you in person at our March meeting.
>
> Have a terrific Tuesday. Enjoy life!
>
> Tonya Moore
>
> **Ironwood Consulting, Inc**
>
> (760) 646-6477
>
> tonya@ironwoodbio.com

> *"Love, laughter and sunshine!"*

--

Kim Marsden
Natural Resource Specialist
Bureau of Land Management
California Desert District
Renewable Energy Coordinating Office
22835 Calle San Juan de los Lagos
Moreno Valley, CA 92553
951-697-5223

> *In spring at the end of the day you should smell like dirt~ Margaret Atwood*

From:	Fraser, Jody
To:	Thomas Dietsch; Joel Pagel; Pete Sorensen
Subject:	Fwd: Quartzite Work Plan 2015 Avian Surveys
Date:	Tuesday, February 17, 2015 2:43:00 PM
Attachments:	2015 Quartzite Avian Work Plan_021015.docx DESERT QUARTZITE AVIAN SURVEY SUMMARY 021215.docx

FYI -- in prep for our bio meeting in March.

Jody Fraser, Biologist
Palm Springs Fish and Wildlife Office
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
760.322.2070 ph x207
jody_fraser@fws.gov

---------- Forwarded message ----------
From: **Tonya Moore** <tonya@ironwoodbio.com>
Date: Thu, Feb 12, 2015 at 3:13 PM
Subject: Quartzite Work Plan 2015 Avian Surveys
To: "Marsden, Kim" <kmarsden@blm.gov>, "Fraser, Jody" <jody_fraser@fws.gov>,
"Rodriguez, Magdalena@Wildlife" <Magdalena.Rodriguez@wildlife.ca.gov>
Cc: "Roy.Skinner@firstsolar.com" <Roy.Skinner@firstsolar.com>

Howdy Kim, Jody and Magdalena,

Attached is the draft 2015 Work Plan for Avian Surveys for the Desert Quartzite Solar Project. I have also attached the summary of which avian surveys have occurred to this point. I hope that you find it helpful.

We are currently processing a large amount of data and are still collecting data that will be used to give a more complete picture of various species of avian that are utilizing the site. We understand your need to obtain the avian survey data from 2014 in order to make important management decisions. We are compiling that information for you with the utmost attention to detail to ensure the data is accurate and presented in the best manner(s) possible to interpret such data for various needs. We anticipate getting a summary to you soon.

If you have any questions or comments on either of the attached documents, please feel to give me call. I look forward to seeing each of you in person at our March meeting.

Have a terrific Tuesday. Enjoy life!

Tonya Moore

Ironwood Consulting, Inc

(760) 646-6477

tonya@ironwoodbio.com

“Love, laughter and sunshine!”

From: Fraser, Jody
To: Mark Massar
Cc: Magdalena Rodriguez; Thomas Dietsch; Joel Pagel; Pete Sorensen; Kim Marsden
Subject: Re: Desert Quartzite -- what to review
Date: Wednesday, March 11, 2015 10:40:20 AM
Attachments: 20140129_Quartzite Draft BRTR Jan 2014.pdf

And one more thing...

Jody Fraser, Biologist
Palm Springs Fish and Wildlife Office
777 E. Tahquitz Canyon Way, Suite 208
Palm Springs, CA 92262
760.322.2070 ph x207
jody_fraser@fws.gov

On Wed, Mar 11, 2015 at 10:26 AM, Fraser, Jody <jody_fraser@fws.gov> wrote:

> Hi everyone,
> Mark is attending the Quartzite meeting tomorrow as the BLM rep, so I thought I'd consolidate all of the things that we're on the hook for reviewing so he can get up to speed. Most importantly, we should look over the agenda so we can focus our review. I plan to get to Ontario early tomorrow so Mags and I can go over some things. Mark, you should feel free to join us. I'll shoot for 8:30 or so.
> Let me know if you have any questions.
> Jody
>
> Jody Fraser, Biologist
> Palm Springs Fish and Wildlife Office
> 777 E. Tahquitz Canyon Way, Suite 208
> Palm Springs, CA 92262
> 760.322.2070 ph x207
> jody_fraser@fws.gov

Nevada Comprehensive Bird Conservation Plan

Version 1.0, December 2010



Nevada's state bird, the Mountain Bluebird, *Sialia mexicana*. Photo by Martin Meyers.

Prepared by the Great Basin Bird Observatory

Suggested Citation: GBBO (Great Basin Bird Observatory). 2010. Nevada Comprehensive Bird Conservation Plan, ver. 1.0. Great Basin Bird Observatory, Reno, NV. Available online at **www.gbbo.org/bird_conservation_plan.html**

Front Cover Art: Christina Robinson-Swett

Back Cover Art: Christina Robinson-Swett

All photographs in this document are copyrighted and may not be used without prior permission by the photographer for any purpose other than reproduction of entire chapters or sections of this document.

This Page Intentionally Left Blank

Table of Contents

Each major section (underlined) corresponds to the tabs in the plan binder.

Page Number (Prefix)

Funding and Project Partners viii
Plan Preparers viii
Other Acknowledgements ix
Introduction ..... Introduction
  Plan Conception and Objectives 1
  Using the Plan 4
  Relationship with Other Planning Efforts 4
  New Products in the Plan and Future Updates 5
Birds of Nevada ..... Birds of Nevada
  Overview 1
  Priority Species 1
  Important Bird Areas of Nevada 2
Conservation Concerns ..... Conservation Concerns
  Overview 1
  Assessing Conservation Concerns 1
  Habitat Concerns 3
    Land Management Practices 3
      Fire Suppression 3
      Fuels Reduction 3
      Domestic Livestock 3
      Wild Horses and Burros 3
      Wild Ungulates 4
      Biocontrol 4
    Increased Fire Intensity or Frequency 4
    Climate Change 5
      Change in Precipitation and Snowmelt 5
      Increased Temperature 5
      Long-term Concerns 6
    Water Management 6
      Surface Water Diversions and Impoundments 6
      Groundwater Pumping 6
      Flood Control 7
    Agricultural, Industrial, and Urban Development 7
      Agricultural Practices 7
      Energy Development 7
      Mining 8
      Urban, Suburban, and Industrial Development 8

Recreation 8
Motorized Vehicles 8
Trails and Camping (Non-Motorized Recreation) 9
Invasive Plants 9
Invasive Weeds 9
Conifer Encroachment 9
Plant Diseases and Pests 9
Insect Outbreaks 9
Plant Pathogens 10
Species Concerns 10
Habitat Fragmentation 10
Direct Mortality 10
Electrocution and Collision 10
Introduced and Human-Subsidized Predators 11
Illegal Take 11
Ecotoxicology 11
Pesticides and Herbicides 11
Mercury 12
Disease and Parasitism 12
West Nile Virus 12
Botulism and Avian Cholera 12
Brown-headed Cowbird Parasitism 12
Introduction to Habitat Accounts ....Introduction to Habitat Accounts
Overview 1
Conservation Profile 1
Key Bird-Habitat Attributes 2
Habitat Map 2
Overview Section 2
Main Concerns and Challenges 2
Habitat Diagram 3
Conservation Strategies 3
Habitat Accounts
Agriculture Hab-1
Alpine Hab-2
Aspen Hab-3
Cliff Hab-4
Coniferous Forest Hab-5
Ephemeral Wetland and Playa Hab-6
Great Basin Lowland Riparian Hab-7
Joshua Tree Hab-8
Marsh Hab-9
Mesquite-Acacia Hab-10
Mojave Lowland Riparian Hab-11
Mojave Scrub Hab-12
Montane Riparian Hab-13
Montane Shrubland Hab-14

Open Water Hab-15
Pinyon-Juniper Hab-16
Sagebrush Hab-17
Salt Desert Scrub Hab-18
Springs Hab-19
Wet Meadow Hab-20
Introduction to Species Accounts ..... Introduction to Species Accounts
Overview 1
Layout 1
Conservation Profile 3
Habitat Use Profile 4
Natural History Profile 5
Range Map 6
Overview Section 7
Abundance and Occupancy by Habitat 7
Nevada-Specific Studies and Analyses 7
Main Threats and Challenges 8
Conservation Strategies 8
Log of Changes 8
Species Accounts
Trumpeter Swan Spp-1
Tundra Swan Spp-2
Cinnamon Teal Spp-3
Northern Pintail Spp-4
Canvasback Spp-5
Redhead Spp-6
Lesser Scaup Spp-7
Greater Sage-Grouse Spp-8
Sooty and Dusky Grouse Spp-9
Sharp-tailed Grouse Spp-10
Mountain Quail Spp-11
Gambel's Quail Spp-12
Common Loon Spp-13
Eared Grebe Spp-14
Western Grebe Spp-15
Clark's Grebe Spp-16
American White Pelican Spp-17
Least Bittern Spp-18
Snowy Egret Spp-19
White-faced Ibis Spp-20
Bald Eagle Spp-21
Northern Goshawk Spp-22
Swainson's Hawk Spp-23
Ferruginous Hawk Spp-24
Golden Eagle Spp-25
Peregrine Falcon Spp-26

Prairie Falcon Spp-27
Clapper Rail Spp-28
Sandhill Crane Spp-29
Snowy Plover Spp-30
Black-necked Stilt Spp-31
American Avocet Spp-32
Willet Spp-33
Long-billed Curlew Spp-34
Marbled Godwit Spp-35
Western Sandpiper Spp-36
Least Sandpiper Spp-37
Long-billed Dowitcher Spp-38
Wilson's Phalarope Spp-39
Red-necked Phalarope Spp-40
Franklin's Gull Spp-41
Black Tern Spp-42
Band-tailed Pigeon Spp-43
Yellow-billed Cuckoo Spp-44
Flammulated Owl Spp-45
Burrowing Owl Spp-46
Spotted Owl Spp-47
Short-eared Owl Spp-48
Common Poorwill Spp-49
White-throated Swift Spp-50
Costa's Hummingbird Spp-51
Calliope Hummingbird Spp-52
Rufous Hummingbird Spp-53
Lewis's Woodpecker Spp-54
Williamson's Sapsucker Spp-55
White-headed Woodpecker Spp-56
Gilded Flicker Spp-57
Olive-sided Flycatcher Spp-58
Willow Flycatcher Spp-59
Gray Flycatcher Spp-60
Bell's Vireo Spp-61
Gray Vireo Spp-62
Pinyon Jay Spp-63
Sage Thrasher Spp-64
Bendire's Thrasher Spp-65
Le Conte's Thrasher Spp-66
Virginia's Warbler Spp-67
Lucy's Warbler Spp-68
Hermit Warbler Spp-69
Grace's Warbler Spp-70
Green-tailed Towhee Spp-71
Abert's Towhee Spp-72

Brewer's Sparrow Spp-73
Black-chinned Sparrow Spp-74
Sage Sparrow Spp-75
Tricolored Blackbird Spp-76
Black Rosy-Finch Spp-77
Conclusions ..... Conclusions
Overview 1
Research, Planning, and Monitoring Strategies 1
Outreach Strategies 5
Habitat Strategies 7
Literature Cited ..... Literature Cited
Glossary ..... Glossary
Acronyms ..... Acronyms
Appendices
Appendix 1: Methods App-1
Selection of Priority Species App-1-1
Sources of Information App-1-2
Habitat Types App-1-7
Spatial Habitat Data App-1-11
Analytical and Statistical Methods App-1-13
Range Maps App-1-18
Threats Determination and Conservation Strategies App-1-19
Appendix 2: Bird Species of Nevada App-2
Appendix 3: Statistical Results App-3
Appendix 4: Population Size Estimates App-4
Appendix 5: Habitat Use of Priority Species App-5
Appendix 6: Important Bird Areas App-6

Funding and Project Partners

Funding for the data analyses, research, and preparation of this plan was provided by the Nevada Division of State Lands through Question 1 Bond Issue funds for Habitat Conservation Planning awarded to the Great Basin Bird Observatory and the Nevada Department of Wildlife. All of the Nevada Partners in Flight working group partners contributed significant in-kind support to the preparation of this plan. The data generated by the Nevada Bird Count program and the Nevada Breeding Bird Atlas project (Floyd et al. 2007) were heavily used in the preparation of this plan. The following entities have been major funding or in-kind supporters of these two projects (in alphabetical order): Clark County Desert Conservation Program; Lahontan and Red Rock Audubon Societies; National Fish and Wildlife Foundation; National Park Service; Nevada Department of Wildlife; Nevada Important Bird Areas Program (Audubon Society); Nevada Natural Heritage Program; Nevada Partners in Flight; Otis Bay Environmental Consultants; Southern Nevada Water Authority; The Nature Conservancy; University of Nevada, Reno; U.S. Bureau of Land Management; U.S. Bureau of Reclamation; U.S. Department of Defense; U.S. Department of Energy; USDA Forest Service; U.S. Fish and Wildlife Service; and U.S. Geological Survey.

Plan Preparers

The preparation of this plan was a team effort. The individuals most involved with creating and drafting plan content were (in alphabetical order):

Elisabeth Ammon, Great Basin Bird Observatory (ammon@gbbo.org) (overall document, habitat accounts)
Jennifer Ballard, Great Basin Bird Observatory (ballard@gbbo.org) (Nevada Bird Count and bird monitoring coordination, data management and analysis)
John Boone, Great Basin Bird Observatory (boone@gbbo.org) (overall document, species accounts, population and density estimates, habitat maps, species range maps)
Shawn Espinosa, Nevada Department of Wildlife (sespinosa@ndow.org) (upland game bird species accounts)
Dana Hartley, Great Basin Bird Observatory (hartley@gbbo.org) (Nevada Bird Count and Nevada Breeding Bird Atlas project data management, web content management)
Larry Neel, Nevada Department of Wildlife (neel@ndow.org) (shorebird/waterbird species accounts, range maps, population objectives, population size estimates, species priority determination, conservation strategies)
Ralph Phenix, Nevada Department of Wildlife and Great Basin Bird Observatory (ralphphenix@yahoo.com) (habitat maps, range maps, spatial data, NBC data analysis)
Robin Powell, Audubon Society (rpowell@audubon.org) (threats assessments, habitat accounts, and Important Bird Areas)
Jock Young, Great Basin Bird Observatory (young@gbbo.org) (overall document, statistical analyses, species accounts, habitat accounts, literature review)



Snowy Plovers. Photo by Zachary Smith.

Other Acknowledgements

A large group of scientists, resource managers, and conservation planners, many of whom are members of the Nevada Partners in Flight working group, made invaluable contributions to this plan. This planning group worked together on the overall conceptualization of the plan, determining priority bird species and priority habitat types, and identifying conservation concerns and strategies. Additionally, these individuals reviewed many draft sections of the plan and provided insight, expertise, and Nevada-specific details about the ecology and conservation needs of Nevada's birds that were often unavailable from other sources. The group's collaborative process involved a series of working meetings that began in November 2007. Five two-day meetings of the full NVPIF group were held over the next 21 months, along with ten full or half-day meetings of committees assigned to evaluate priority species and threats. The people who specifically contributed to this process, in addition to the plan preparers listed above, were (in alphabetical order):

Susan Abele, The Nature Conservancy
Aaron Ambos, Southern Nevada Water Authority
Anna Laura Averill-Murray, U.S. Fish and Wildlife Service, Nevada Field Office
Brad Baumann, Nevada Department of Wildlife, Winnemucca Office
Susan Bickmore, Clark County Desert Conservation Program
Pete Bradley, Nevada Department of Wildlife, Elko Office
Sandra Brewer, U.S. Bureau of Land Management, Nevada Field Office
Kevin DesRoberts, U.S. Fish and Wildlife Service, Las Vegas Office

Maureen Easton, U.S. Forest Service, Humboldt-Toiyabe District
Jim Eidel, Great Basin Bird Observatory
Dawn Fletcher, Public Lands Institute and Lake Mead NRA
Paul Greger, Nevada Test Site, NSTEC
Derek Hall, Nevada Test Site, NSTEC
Matt Hamilton, Clark County Desert Conservation Program
Jon Paul Kiel, Nevada Division of State Lands
Jeri Krueger, U.S Fish and Wildlife Service, Las Vegas Office
Amy Leist, Great Basin Bird Observatory
Carl Lundblad, U.S. Fish and Wildlife Service, Ash Meadows NWR
Elroy Masters, U.S. Bureau of Land Management, Nevada Field Office
Larry Mata, Clark County Desert Conservation Program
Rachel Mazur, U.S. Forest Service, Humboldt-Toiyabe District State Office
Craig Mortimore, Nevada Department of Wildlife
Jennifer Newmark, Nevada Natural Heritage Program
Adam Ryba, U.S. Forest Service Humboldt-Toiyabe District, Austin Ranger District
Beth Sabin, U.S. Bureau of Reclamation, Lower Colorado Region
Amelia Savage, U.S. Bureau of Land Management, Las Vegas Office
Teri Slatauski, Nevada Department of Wildlife, Tonopah Office
John Swett, U.S. Bureau of Reclamation, Lower Colorado Region
Leilani Takano, U.S. Fish and Wildlife Service, Las Vegas Office
Cris Tomlinson, Nevada Department of Wildlife, Las Vegas Office
Debbie VanDooremolen, Southern Nevada Water Authority
Genny Wilson, U.S. Forest Service, Humboldt-Toiyabe District

In addition to those listed above, the following individuals (in alphabetical order) made contributions to various sections of the plan and/or provided valuable reviews of draft materials:

Steve Abele
Bob Altman
Janet Bair
Joe Barnes
Peter Brussard
Dave Catalano
Cali Crampton
Chris Dodge
Todd Esqute
Ted Floyd
Murrelet Haltermann
John Hiatt
Aaron Holmes
Gary Ivey
Joe Kahl
Christy Klinger
Jeri Krueger
Jeff Mackay
Christiana Manville
Cameron McQuivey
Martin Meyers
Willie Molini
Chris Nicolai
Barb Raulston
Terry Rich
Laura Richards
Greg Scyphers
Laurie Simons
Peter Sullins
Larry Teske
Anne Thomas
Peter Weisberg
Donna Withers

Finally, we thank the many skilled and creative wildlife photographers who made their work available for this plan. They are individually acknowledged in each photo caption.



Sandhill Cranes. Photo by Larry Neel.

This Page Intentionally Left Blank

AR062607

Plan Conception and Objectives

The *Nevada Comprehensive Bird Conservation Plan* represents a concerted effort to summarize the best current knowledge about the conservation status of Nevada's birds and their habitats, to assess their conservation concerns, and to present effective conservation strategies. The plan is intended for an audience of resource managers, land owners, and other Nevada stakeholders in wildlife conservation. Because the plan was developed for a wide variety of agency and private partners, we intentionally focused on defining the most important bird conservation needs and effective strategies for any partner willing to engage in conservation implementation, rather than assigning roles and responsibilities to stakeholders.

Nevada is famously the driest state of the union, with an average of only 9 inches of precipitation annually, and its human population has been among the fastest-growing in the nation for most of the past two decades. These two facts conspire to generate significant pressure on our natural ecosystems, which are often more fragile and slow to recover from disturbances than is the case in more mesic regions. However, because 87 percent of Nevada's lands are publically owned and managed by federal and state agencies, Nevada also has unique opportunities for statewide conservation of birds and their habitats. Along with these opportunities comes the challenge of balancing conservation objectives with mandates for economic and recreational uses of public lands. This plan provides managers with a critical tool to assist them in addressing this challenge effectively.



Immature Northern Goshawk.
Photo by Fred Petersen.

This *Nevada Comprehensive Bird Conservation Plan* was first conceived in 2007, when the Nevada Working Group of Partners in Flight (NV-PIF) recognized the need for a revision of the original *Nevada Partners in Flight Bird Conservation Plan* (Neel 1999). The 1999 plan represented the first formal consensus among all major resource management agencies and other stakeholders regarding priority landbird species and habitat-based strategies for their management and conservation. However, at the time the original plan was written, information about the distribution and status of many of Nevada's landbird species was limited by the lack of comprehensive inventory and monitoring programs. Within the past ten years, however, several new datasets (described fully in *Appendix 1: Methods*) have become available that add significant knowledge to those previously available. Other planning tools, such as the *Partners in Flight North American Landbird Conservation Plan* (Rich et al. 2004) and the *Nevada Wildlife Action Plan* (Nevada

Introduction

Wildlife Action Plan Team 2006), along with updated landcover maps and other spatial data, have also become available. Further highlighting the need for an updated plan are the significant changes in Nevada's landscape that have occurred over the last decade as a result of widespread fires, weed invasions, energy development projects, water projects, and other factors.

For developing this plan, a planning team was formed that consisted of representatives from the Great Basin Bird Observatory (GBBO), Nevada Department of Wildlife (NDOW), and the entire Nevada PIF Working Group (see *Acknowledgements*). At an early stage in the plan revision process, the planning team decided to expand the plan's scope beyond its original focus on non-game landbirds. Thus, this plan is truly comprehensive in that it includes upland gamebirds, waterfowl, waterbirds, and shorebirds. In expanding the plan's scope, we drew upon many data sources and conservation initiatives that were not available in the original 1999 plan.

The first major objective of the planning team was to identify the priority bird species to be covered in the plan. This process, along with all other methods used in the preparation of this plan, is described in *Appendix 1: Methods*, and the outcome of the priority species assessment is shown in *Appendix 2*. A second major task for the planning team was to formally define the goals of the plan. These goals were as follows:

a) Summarize, analyze, and integrate all relevant and reliable information about the conservation status, distribution, abundance, and habitat requirements of conservation priority birds in Nevada
b) Assess important threats and conservation issues affecting these birds, emphasizing those that can be addressed through management practices
c) Stress habitat management as the primary mechanism for bird conservation, recognizing that most threats to Nevada's birds are linked to habitat
d) Make this information available to resource managers in a concise, organized, standardized, and user-friendly format
e) Periodically update the plan as new information becomes available, and make updates readily available online



American Avocet. Photo by Larry Neel

The time period addressed by this plan is the ten years following its release (2011 – 2021). We recognize that effective short-term conservation strategies are not always identical to effective long-term strategies, which is why we envision this plan as a continually evolving product.

Habitat-based conservation strategies are heavily stressed in this plan, but we also present strategies involving research, monitoring, planning, public

outreach, and education. Habitat-based strategies are particularly important for bird conservation in Nevada, because overwhelming evidence indicates that most bird declines are linked to habitat change. We intentionally present only a moderate list of strategies that we believe will be the most effective for conservation of Nevada bird populations, rather than providing a long list of all activities that could be of possible benefit. Furthermore, we generally refrain from providing "best management practices" for habitats, and instead focus on the desired condition of a habitat type. For instance, we leave the particulars of grazing plans, fire management practices, riparian restoration practices, methods of weed control, and so forth, to our conservation partners, because they generally have the expertise required to create detailed and site-appropriate implementation plans. Instead, our recommendations provide guidance regarding the desired outcome of implementation efforts, such as "avoid removal of herbaceous understory", "increase cover of riparian woodlands and floodplain wetlands", "protect areas of tree recruitment", etc., which leave the options of how to accomplish these outcomes open to the conservation practitioner. In addition, although conservation goals are often pursued through the mechanisms of political advocacy, such strategies are not included in this plan. Similarly, we do not make recommendations regarding agency structure, operations, coordination, or administration, as these are within the purview of the agencies' planning processes.

Finally, we present birds not only as conservation targets in this plan, but also as tools to inform us about what constitutes "intact" habitat. In many cases, the presence or absence of conservation priority bird species alone is an effective way to evaluate habitat integrity. In other habitat types, carefully chosen "indicator" species can be used to gauge ecosystem health even when conservation priority species are absent. In general, birds are easier to monitor and survey than other wildlife groups, and many birds respond sensitively and quickly to habitat change. For these reasons, it is our premise that bird-focused conservation planning is one of the most practical and cost-effective ways of achieving general wildlife and habitat conservation goals.



Yellow Warbler, an Indicator species for healthy lowland riparian habitat. Photo by Martin Meyers.

Using the Plan

The plan's main sections include:

a) *Birds of Nevada*: An overview of Nevada's bird life
b) *Conservation Concerns*: A discussion of the major issues that affect Nevada's birds and their habitats
c) *Introduction to Habitat Accounts,* and *Habitat Accounts*: Habitat-based overviews and conservation strategies based on current knowledge of bird habitat requirements and threats. The introduction explains the content of the accounts, and should be consulted first
d) *Introduction to Species Accounts,* and *Species Accounts*: Species-based overviews and conservation strategies. The introduction explains the content of the accounts and should be consulted first
e) *Conclusions*: A summary and distillation of the most important bird conservation strategies
f) *Appendices*: A series of appendices that provide details on all methods used in the preparation of this plan, along with a series of tables providing useful information to support the species accounts and habitat accounts

We encourage all users of the plan to consult the *Conclusions* section, which highlights recurring conservation themes and overall priorities for bird conservation in Nevada. Resource managers responsible for large landscapes that contain many habitat types may find the *Conclusions* and the *Habitat Accounts* most useful for informing their own planning efforts. The strategies outlined in these sections have the advantage of benefitting a large number of priority bird species (and non-priority species) without requiring the resource manager to sort through the particular habitat requirements and conservation issues of each species. However, bird species do vary in their distributions, population status, particular habitat needs, and susceptibility to various threats, so the *Species Accounts* allow resource managers to customize their management activities towards particular species that are likely to occur in their areas of responsibility.

Relationship with other Planning Efforts

This plan was at first conceived with the goal of a revision of the earlier *Nevada Partners in Flight Bird Conservation Plan* (Neel 1999). Beyond this goal, the *Nevada Comprehensive Bird Conservation Plan* attempts to integrate, rather than duplicate, other bird conservation planning efforts in our region. However, there are circumstances in which resource managers should refer to other plans that cover additional perspectives, cover other wildlife taxa, or offer a more complete picture of agency-specific issues.

Introduction


Peregrine Falcon. Photo by Bob Goodman

Nevada-specific plans that fall within this group include NDOW's *Nevada Wildlife Action Plan* (Nevada Wildlife Action Plan Team 2006), which presents a broad range of information and conservation strategies not only for birds, but also for other terrestrial vertebrates. The *Nevada Department of Wildlife Upland Game Species Management Plan* (NDOW 2008) provides a comprehensive source of distributional and management information for the upland gamebirds. The Nevada Sage-Grouse Conservation Team (2004) published the *Greater Sage-Grouse Conservation Plan for Nevada and Eastern California* which provides much more detail than we can provide here on the distribution, local management issues, and conservation opportunities associated with this high-priority bird. The two largest land management agencies in Nevada, the U.S. Forest Service (USFS) and the U.S. Bureau of Land Management (BLM) also prepare and regularly update detailed management plans that for the lands they administer. The USFS is currently preparing the 20-year revision of the *Humboldt-Toiyabe Forest Health Plan* and has already published the *Sierra Nevada Strategy and Framework* (USFS 2001) which provides extensive information for the Sierra Nevada region.

Nevada resource managers may also draw upon regional and continental plans by multi-lateral bird conservation initiatives, including the *Partners in Flight Plan North American Landbird Conservation Plan* (Rich et al. 2004), the *Intermountain West Regional Shorebird Plan* (Oring et al. 2007), the *Intermountain West Waterbird Conservation Plan* (Ivey and Herziger 2006) and the *North American Waterfowl Management Plan* (USFWS 1986, 1998), along with the Pacific Flyway Council's species-specific management plans at http://www.pacificflyway.gov. These regional and national plans were consulted when selecting priority species for the Nevada region (*Appendices 1 and 2*).

New Products and Future Updates

The *Nevada Comprehensive Bird Conservation Plan* incorporates a very wide array of bird data from Nevada, much of it gathered only in the last 10 – 15 years. This plan therefore presents a number of products that were not available in the original PIF plan (Neel 1999), including:

a) Detailed distribution maps for all conservation priority birds, created by combining data sets from major monitoring and survey efforts, NDOW databases, and other sources (see *Appendix 1*)

Introduction

b) Statistical analyses of landbird-habitat relationships (*Appendix 3*), using data from the Nevada Bird Count (NBC) and GIS landcover maps (*Appendix 1*)
c) Newly-calculated Nevada population size estimates for landbirds (*Appendices 1 and 4*), based on NBC data
d) Newly-calculated density estimates by habitat type for landbirds, based on NBC data (*Appendix 1*)
e) An improved GIS habitat map that draws from several different landcover products (*Appendix 1*)
f) A formal habitat-based threats analysis (*Conservation Concerns* section and *Appendix 1*)

The wealth of information that has become available only in the last 15 years serves to highlight the fact that our understanding of bird ecology and conservation is constantly improving. Other new products, such as eBird (www.ebird.org), are also becoming more widely available, allowing conservation practitioners to better visualize and understand large volumes of data. For these reasons, it is our intention to maintain this plan as an electronic document that will be updated on a regular basis as new information becomes available. GBBO will maintain the platform for online access to this plan and its periodic revisions at

www.gbbo.org/bird_conservation_plan.html

The online version of the plan will incorporate a log of changes that allows the user to see at a glance what information has recently been added or revised. Links to this webpage by resource management agencies and other stakeholders are encouraged. We will also provide a mechanism at this web site for managers, researchers, and birders to submit verified sightings and other data that can be used to update this plan.



Western Grebe. Photo by Larry Neel.

Birds of Nevada

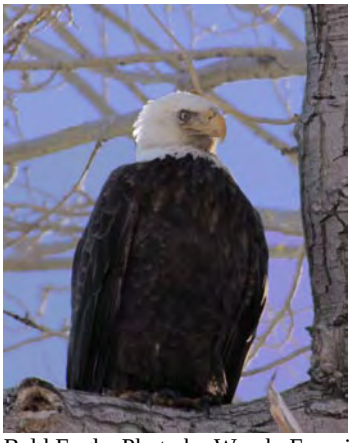
Overview

A total of over 480 species of birds have been recorded in Nevada (Nevada Bird Records Committee, *pers. comm.*), and of these, 300 species have either nested, or are estimated to occur with some regularity, in the state (*Appendix 2*). Of these 300 species, 252 are currently known to nest (Floyd et al. 2007), and 46 are not. The two remaining birds are special cases: the Elf Owl, a historical breeder that is extirpated in Nevada, and the Sharp-tailed Grouse, once extirpated and then reintroduced in Nevada. The majority of Nevada's breeding birds are landbirds, but a large percentage of the Priority species we identified are shorebirds and waterbirds, reflecting the importance of water bodies in a desert state. Nevada's mesic habitats, such as riparian, marsh, open water, aspen, wet meadows, and agricultural areas, support the majority of bird species in Nevada, but a small number of species with urgent conservation issues primarily occur in upland habitats, for example the Greater Sage-Grouse, Bendire's Thrasher, and Pinyon Jay. A complete summary of habitat use by our 78 Priority species in Nevada is provided in *Appendix 5*.

Conservation Profile

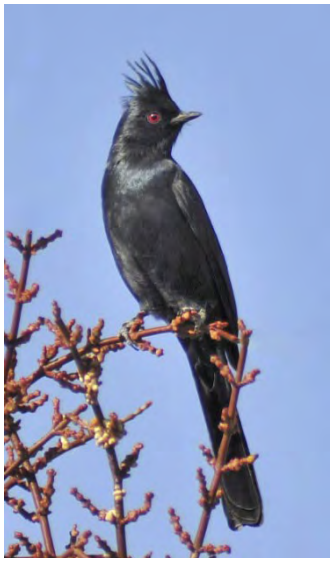
Total Number of Regularly Occurring Bird Species	300
Total Number of Birds Recorded To Date	482
Total Number of Priority Species	78
Habitat Types Most Commonly Used by Birds (% of all Nevada species)	Great Basin Lowland Riparian (38%) Mojave Lowland Riparian (33%) Marshes (27%) Open Water (24%) Agricultural (24%) Montane Riparian (22%) Aspen (20%)
Number of Important Bird Areas (IBAs)	40

Priority Species


Bald Eagle. Photo by Wendy Francis

Through our ranking process, we identified 78 Priority species. These were subdivided into 70 Conservation Priority species, five Stewardship species, and three Special Status species (see *Appendix 1: Methods*, and *Appendix 2* for a complete listing, definitions of these categories, and the selection process). The 70 Conservation Priority species were identified primarily by the fact that they were ranked as high priorities in one or more regional bird conservation initiatives. Most Conservation Priority species were designated as such by regional initiatives because of population declines, significant threats, dependence on restricted or threatened habitats, or small population size. Three species that were not ranked by regional initiatives (Northern Goshawk, Ferruginous Hawk, and Golden Eagle) were included as Conservation Priority species based on current concerns in Nevada and agency priorities. These birds were thought by the planning group's expert opinion to have "fallen between the cracks" in previous regional planning efforts.

Birds of Nevada



Phainopepla, an Indicator species for Mojave Lowland Riparian and Mesquite-Acacia habitats. Photo by Scott Page

Interestingly, the Conservation Priority species were divided fairly equally between those that tend to occur in clusters as a result of their dependence on restricted habitat types (such as marshes or aspen woodlands) and those that are distributed over large landscapes dominated by shrubland or woodland habitats. Five Stewardship species were identified (Prairie Falcon, Common Poorwill, Gray Flycatcher, Green-tailed Towhee, and Sage Thrasher) because Nevada is estimated to support more than 20% of their global population. Several Conservation Priority species also exceeded this threshold (although most did not), and in these cases, the Conservation Priority ranking took precedence over the Stewardship ranking.

Three birds were designated as Special Status species, either because of their federal recovery status (Bald Eagle and Peregrine Falcon), or because conservation concerns are suspected, but additional research is needed in Nevada (Burrowing Owl).

Conservation Priority, Stewardship, and Special Status species are all considered to be Priority species in this plan, and all are treated in individual species accounts. Indicator species, in contrast, are not regarded as Priority species and are therefore not treated in individual species accounts. They are instead listed in the pertinent habitat accounts, where they serve the purpose of providing a tool for evaluation of habitat integrity for the habitat types that only have few, rare, or geographically restricted Priority species.

Important Bird Areas of Nevada



Carson Valley IBA. Photo by Anne Thomas

Important Bird Areas (IBAs) have been designated by the Audubon Society to highlight the most important conservation landscapes for bird diversity in the state, with emphasis on species of conservation priority. IBA-specific conservation plans, active partnerships, volunteer activities, monitoring, and outreach are being implemented by Audubon to increase public appreciation and participation, and to aid in conservation implementation for these hotspots. Therefore, the IBA program is a key partner in focusing Nevada bird conservation efforts on those landscapes that contain the greatest local densities and diversity of priority species. *Appendix 6* lists the occurrence of priority species in designated IBAs of Nevada.

Birds of Nevada

We encourage our partners to take advantage of IBA program services, as well as site-specific conservation planning undertaken by the U.S. Fish and Wildlife Service for Nevada's National Wildlife Refuges, Nevada Department of Wildlife for Nevada Wildlife Management Areas and gamebird management, National Park Service for National Parks and Recreation Areas, Bureau of Land Management for Nevada BLM districts, U.S. Forest Service for Forest units and ranger districts, and by other agencies and organizations. These site-specific conservation efforts are extraordinarily useful for birds that tend to occur in clusters within particular sites or restricted habitat types.



Eared Grebe. Photo by Scott Page

Birds of Nevada



Western Grebe. Photo by Fred Petersen

Conservation Concerns

Overview

Bird conservation planning requires us to consider a wide variety of factors that can contribute to the decline of bird species. These factors are often described as "threats," “stressors,” or “agents of change” in conservation planning, but in this plan we have gathered them under the more general term of "conservation concerns.” After much discussion in the Nevada Partners in Flight working group, we felt this term to be a better fit for emphasizing the diverse, often indirect, and often contingent effects of these factors. For example, agricultural practices can benefit wildlife when they generates wet meadow habitat, flooded fields, and buffer areas, but may be a concern when pesticides are used intensively, or when large-scale impacts to ground nests occur. Many other land use practices may be harmful, neutral, or beneficial depending on their location, scale, intensity, and timing, and their effects likely vary among bird species. To simply label these practices as universal “threats” was thought by the group to be too inaccurate a concept. When we do use the term “threats”, we refer to specific cases and contexts where a particular scenario has been deemed to be harmful to a bird or to one or more habitat types.

The conservation concerns discussed in this chapter follow the basic categories of habitat and species concerns. Habitat concerns (for example, invasive weeds) act on birds indirectly, by affecting their habitats in some manner. Species concerns (for example, diseases) act on birds directly by affecting their survival or reproduction. For most of Nevada’s birds, the most important concerns are habitat-based. Species-based concerns, such as illegal takes and pesticides, still exist and are discussed in the species accounts, but we focus much of our attention in this plan on habitat concerns, where we believe to be the most far-reaching opportunities for resource managers to make contributions to bird conservation.

Assessing Conservation Concerns

The planning group assigned a committee to undertake a formal assessment of both habitat and species conservation concerns. The committee adapted the Conservation Action Planning (CAP) framework developed by The Nature Conservancy (TNC 2007) for this purpose, and held six meetings to generate this assessment. The process was organized primarily by habitat type, and the outcomes from the assessment were used to identify conservation concerns for habitats and species and to develop conservation strategies.

Although the CAP framework provided a useful formal structure for assessing conservation concerns, it was decided in our final committee meetings that, for the purposes of this plan, it would be preferable to focus on the broad outcomes of the CAP process rather than the detailed ranking procedures that fed into it. This decision was reached for several reasons. First, detailed rankings were difficult to apply uniformly, as the makeup of the committee was not always consistent throughout the assessment process. Second, given that we were applying the CAP framework to the entire state of Nevada, it was sometimes difficult to select a single ranking when the level of a

particular concern varied greatly among different geographical regions. In many cases, there was also uncertainty as to the severity of new threats, and thus many rankings were based on our most realistic predictions of upcoming threats. Finally, the group discussed the issue of separating ongoing impacts of past threats from new ones. For example, issues such as new energy developments, additional urban encroachment, and climate change are recent additions to our list of concerns, but historical, and in some cases irreversible, practices such as construction of major water diversions also continue to affect birds. In the end, both ongoing and new impacts to bird conservation concerns were considered in our rankings based on their estimated severity, geographic scope, and irreversibility.

Despite these sources of ambiguity, the committee felt that the CAP process was successful in formally identifying the most important conservation concerns affecting Nevada's birds and their habitats. We focused in this plan on those concerns that may lead to significant declines in Priority species over the next 10 years (2010 - 2020), and on those that apply broadly throughout Nevada. Conversely, we de-emphasized some concerns that may be locally significant, but have relatively little regional or statewide impact on bird populations.



Dark-phase Swainson's Hawk.
Photo by Martin Meyers

The sections below present the conservation concerns that were identified as important during the CAP assessment process, and they describe the nature and bird conservation context of each concern. Other potential conservation concerns were discussed by the committee, but through the CAP assessment process it became clear that some (e.g., commercial timber harvest or military activity) did not pose serious threats to Nevada's priority birds.

Habitat Concerns

Land Management Practices

Fire Suppression

Fire suppression, or the attempt to exclude all fires, can alter habitats in several ways (Keane et al. 2002). It may allow a buildup of fuels that eventually shift the fire regime from frequent, low-intensity fires to infrequent, high-intensity fires (Covington et al. 1994). It may increase encroachment of one habitat type into another, such as conifer trees into aspen stands or sagebrush. It may also contribute to changes in the overall structure of a habitat type, as has been proposed for pinyon-juniper woodland expansion

(Miller et al. 2008). Fire suppression is not highly prevalent in most of Nevada's non-residential landscapes, although in sensitive areas, such as those occupied by Greater Sage-Grouse, it is actually a key conservation strategy for protecting high-priority sites. Fire suppression is, in fact, clearly warranted in cases of sensitive habitats that may take centuries to recover after catastrophic fires, or may not recover in time to preserve bird populations. However, there are cases where fire suppression strategies that accomplish short-term habitat protection goals, but may have less desirable long-term effects in terms of habitat regeneration and maintenance. This conservation concern is therefore a good example of where case-by-case evaluation of the short-term and long-term strategies for managing a site or region is needed.

Fuels Reduction

Fuels reduction is related to fire suppression in that it is an attempt to reduce stand density that has increased from having fewer low-intensity fires (Graham et al. 2004). Fuels reduction is usually implemented in areas where protection of human settlements is a priority (e.g., Safford et al. 2009) or, in some cases, in areas where the risk of catastrophic fires is deemed to be high. Usually, these practices include removal of highly flammable shrubs, thinning of young and old trees, weed control, and creation of open buffer areas as fire breaks. Fuels reduction projects can inadvertently remove habitat components that are important to some bird species, such as dense underbrush, woody debris, or certain tree age classes. Usually these impacts are fairly limited, since fuels reduction activities are concentrated around the margins of human settlements in most cases.

Domestic Livestock

Domestic livestock (cattle and sheep) are a long-established component of most publicly managed lands in Nevada, except in Clark County, with varying levels of use in different habitat types and different regions of the state. Riparian, wetland, and other mesic habitat types, where they are accessible to livestock, typically receive the most intense use due to their higher-quality forage and access to water. Therefore, riparian and wetland bird communities may be particularly vulnerable to livestock impacts (Szaro 1991).

Livestock grazing, however, is not invariably harmful to birds, and it may sometimes be beneficial for achieving particular management objectives. To identify the subset of scenarios in which livestock grazing does present a potential concern, we use the term "overgrazing." In the context of this plan, overgrazing may involve the removal of understory vegetation at sensitive times, prevention of re-growth of important vegetation (e.g., willow, aspen, forbs), chronic changes in soil or water conditions, or permanent changes in vegetation composition and structure.

Wild Horses and Burros

Wild horses and burros occur in various densities on all public lands of Nevada, and in many respects, their impacts on birds and their habitats are similar to those of domestic

livestock. These feral grazers generally make more intensive use of the more productive, mesic habitat types (Beever et al. 2008), but burros are also known to graze on very dry vegetation (Abella 2008). Also, as with domestic livestock, the level of impact is directly related to the number of animals present in sensitive habitats, particularly during the growing season and plant establishment periods, and the duration and frequency of grazing activity.

Wild Ungulates

Occasionally, elk may have local impacts on bird habitats (Kaye et al. 2005). This usually occurs when elk concentrate in aspen stands and browse young stems or damage bark with antler rubbing. Elk are uncommon in Nevada, managed as a game species, so the level of threat that they pose to birds and habitats is overall considered low in the state.

Biocontrol Activities

This conservation concern was identified due to the introduction and range expansion of the saltcedar (tamarisk) leaf beetle, *Diorhabda elongata*. This species was introduced to the western region to combat saltcedar invasion in riparian areas. Where established, the beetle fully defoliates saltcedar over a large geographic scale, but its desired positive effects on recovery of native riparian vegetation have not yet been established (Hultine et al. 2009). Affected saltcedar trees survive defoliation for several years, during which time they cannot provide suitable nesting habitat for most riparian songbirds. Over the next ten years, it is likely that beetle defoliation will outpace any active revegetation efforts in riparian areas in Nevada. Because saltcedar provides one of the primary nesting substrates for several riparian Priority species, the beetle presents a concern for species such as Southwestern Willow Flycatcher, Lucy's Warbler, and Bell's Vireo.

Increased Fire Intensity or Frequency

This conservation concern was identified to acknowledge that fire intensity and/or frequency has increased over historic levels in several habitat types (e.g., Hunt and Stiver 2000), including particularly in conifer forests of the Sierra Nevada (Miller et al. 2009) and sagebrush shrublands. Causes for these changes vary widely, and may include fuel buildup due to fire suppression, invasive plants that increase fire frequency, new fire sources from public uses, climate change effects, and carryover from fires in other habitat types. Increased fire frequency raises the concern that vegetation communities may be unable to reach late-successional stages before the next burn, which can be detrimental to several Priority species (e.g., Sage Thrasher and Gray Flycatcher in sagebrush habitats). Increased fire intensity in forests may result in conversion of forest stands that are naturally maintained by low-intensity fires (e.g., ponderosa pine that is important to Priority species such as the Flammulated Owl and Grace's Warbler) to denser, younger stands as a result of stand-replacement fires (Covington et al. 1994). Fires generally increase the probability of weed invasion, which can result in a positive feed-back loop for a continuing increase in fire frequency.

Conservation Concerns



Sandhill Cranes in a riparian transitional zone. Photo by Bob Goodman

Climate Change

Change in Precipitation and Snowmelt

Most climate change models predict overall decreased winter precipitation in Nevada and adjoining regions (Seager et al. 2007), and Nevada's local climates may change in complex ways (Ackerly et al. 2010). Most of Nevada's wetlands and other mesic habitat types receive the majority of their year-round water from snowmelt, which makes them obvious candidates for conservation concern based on climate change effects. A generally-held assumption is that many habitat types and bird species will shift their ranges northward and upward in elevation over time as a result of climate change. However, in the deserts of Nevada, these predictions may not be as straightforward as they appear. Some habitat types used by priority species have very long successional processes (e.g., about 200 years for Joshua tree woodlands), and their successional time may influence their ability to undergo northward and elevational range shifts. This issue is also compounded by the facts that many drought-adapted plants require events of greater-than-normal moisture to become established, and that native plants must contend with invasive weeds when they colonize new areas. In addition, the recovery time of some habitat types affects not only their ability to colonize, but also their ability to recover from secondary effects of climate change, such as prolonged droughts, large catastrophic fires, and insect outbreaks (West et al. 2009).

Increased Temperature

Increased temperatures are expected to cause shifts in seasonal prey availability for birds and change the phenology of breeding or migration of Priority species. Also, increased temperatures may favor the establishment of invasive weeds, which increases the threat

of catastrophic fires. Increasing temperature effects are difficult to separate conceptually from effects of decreased water availability, but at least in some cases, increased temperature alone poses threats to birds and habitats (Ackerly et al. 2010). For instance, recent research has shown earlier spring migration onset and a northward shift in wintering grounds for some birds (van Buskirk et al. 2009). Another widely-recognized concern tied to increasing temperatures is disruption to the synchronicity between landbird nesting and invertebrate production. If increased temperatures lead to earlier seasonal peaks in invertebrate production, landbird breeding seasons may become decoupled from the period of highest food availability. The overall consequences of changing migration and wintering patterns and changing food availability are not known for migrant birds.

Long-Term Climate Concerns

The impacts of climate change, including potential range shifts and extirpations (Carey 2009), are expected to occur beyond the ten-year scope of this document. Mitigating these impacts may require even more emphasis on landscape-scale approaches and adaptive management than has previously been the case (West et al. 2009). Updated information regarding the impacts of climate change and recommended land management responses should be incorporated into future revisions of this plan.

Water Management

Surface Water Diversions and Impoundments

Multiple demands for limited water always present conservation challenges in arid environments (Lemly 1994b). Surface water diversions refer to all infrastructure used to convey water away from its natural outflow system to agricultural and municipal uses. Most of this infrastructure has been in place for many decades in Nevada, but its conservation impacts continue in the form of dewatered rivers and streams, loss of floodplains and terminal wetlands, and degraded or fragmented riparian habitat. These structures continue to limit the potential for recovering species, but they also provide a significant opportunity for habitat restoration. As demonstrated by recent projects throughout Nevada and the West, riparian and wetland habitats can often be recovered by returning sufficient water to natural channels, creating the geomorphic or hydrological conditions that support regeneration and growth of mesic plants, and controlling weeds during the early recovery stages (e.g., Maguire and Hadley 2010).

Impoundments are generally installed along rivers or streams for upstream water storage. They often result in habitat conversion in downstream areas (Graf et al. 2002), but they also create habitat for species that favor large open-water bodies.

Groundwater Pumping

Unlike surface water diversions, groundwater pumping refers to all subsurface water retrieval for municipal and agricultural uses. It is a concern, if it occurs at levels that

significantly reduce water availability to habitats that depend on groundwater (Deacon et al. 2007). Groundwater pumping can lower water tables and reduce spring outflow if it occurs at unsustainable levels (e.g., Trammell et al. 2009). If water tables are lowered sufficiently, plants that require access to subsurface water may be negatively impacted (Brand et al. 2010a). The impact of groundwater pumping obviously depends on its rate, extent, and local recharge rates, which could also be affected in coming decades by climate change.

Flood Control

Flood control measures may include bank stabilization (rip-rapping, grading, installation of concrete) and channelization. As with surface water diversions, most of these measures were implemented in the past and are less often implemented during the present time. However, impacts of past flood control measures on riparian habitats and wetlands are expected to persist. Most flood control measures are restricted to larger rivers and streams that are near inhabited areas. In some areas (e.g., the Truckee River downstream from Reno-Sparks), river restoration projects have been implemented as an alternative to traditional flood control measures, which demonstrate opportunities for bird conservation implementation that may recover past bird population losses.

Agricultural, Industrial, and Urban Development

Agricultural Practices

Although the conversion of native habitat to cropland likely impacted birds historically, other birds have adapted to agricultural landscapes and benefit from their presence. Among beneficial agricultural practices are flood irrigation, wildlife-friendly harvest practices, and maintenance of shelterbelt areas. Conservation concerns that may occur in agricultural landscapes include applications of pesticides or herbicides if used intensively, and use of heavy machinery during sensitive nesting periods. As in most of North America, the trend toward replacing small, often family-operated ranch operations with industrial agriculture generally leads to negative impacts on birds, as trees, shelterbelts, return-flow wetlands, flooded fields, and native forbs and grasses are often sacrificed in the interests of operational efficiency.

Energy Development

This category includes all large-scale solar, wind, hydroelectric and geothermal energy projects, as well as traditional oil and gas, and their associated infrastructure. These energy developments have a large footprint on the landscape, result in a network of new access roads, and sometimes have high water requirements. Several large-scale renewable energy projects are currently being planned in Nevada (Devoe 2008), and they have the potential to negatively impact birds through habitat conversion and fragmentation, along with direct mortality from collisions. Research is still insufficient to understand the overall effects of wind farms on bird populations (Kuvlesky et al. 2007), but there are ways of lowering the risk of direct mortality by careful siting that avoids major flyways.

Conservation Concerns

Mining

Generally, impacts from mining are similar those from energy development, but mining operations are not as limited to valley bottom areas and typically occur across a larger number of bird habitats. Mining operations also require water, and mine tailings and other soils around mining operations can impact water quality in surrounding habitats (Henny et al. 1994). Finally, mining claim markers have traditionally been left uncapped, which causes direct mortality in birds that attempt to roost in them and get trapped. Nevada is the largest U.S. supplier of gold, and a significant number of new mining applications are expected in the next ten years. Mine reclamation projects that involve significant habitat restoration can help mitigate impacts from mining operations.

Urban, Suburban, and Industrial Development

Primary threats from development lie in habitat conversion and edge impacts to adjoining habitats (Hansen et al. 2005, Schlesinger 2008). Indirect effects may occur as a result of other activities that are often associated with urban development, such as fuel reduction, fire suppression, introduced and human-subsidized predators (feral cats and others), invasive plants, and increased use for motorized recreation.

Recreation

Motorized Recreation

Dirt bikes, small all-terrain vehicles, and other four-wheel drive vehicles operating off of established roads may destroy vegetation, disturb burrows or nest sites, introduce weeds, cause erosion, and introduce a significant human disturbance into previously undisturbed habitats and into remote areas that may support the more sensitive bird species. In areas where off-highway vehicle (OHV) use is intense, new networks of informal trails may appear rapidly, causing habitat fragmentation (Ouren et al. 2007). Evidence of direct effects of OHV disturbance on bird abundance and nest success has been reported by Barton and Holmes (2007), but the greatest concern involves habitat impacts. Motorized recreation in the form of boating is also present in some open water habitats of Nevada, and effects on birds of this type of recreation are largely unknown.



Short-eared Owl.
Photo by Bob Goodman

Conservation Concerns

Trails and Camping (Non-Motorized Recreation)

While generally considered low-impact, non-motorized recreation may result in small-scale habitat conversion from trails, campgrounds, and access roads. These impacts, however, often occur in areas such as aspen stands or along streams, which are particularly important to birds. Near heavily-used camping areas, understory vegetation may be cleared or trampled, and firewood removal may degrade habitat. Many opportunities exist to minimize potential impacts of non-motorized recreation through careful trail planning, camping site placement, and public education.

Invasive Plants

Invasive Weeds

Invasive weeds include a large variety of annual, perennial, and shrubby species that may or may not be classified as noxious. All habitat-altering species, such as perennial pepperweed, cheatgrass, red brome, medusahead, hoary cress, Russian knapweed, saltcedar, and many others are included in this concern category, and they can be significant threats in areas where they are aggressive invaders and are difficult to control (Dukes and Mooney 2004). Most of the problematic invasive plants in the Great Basin and Mojave Desert regions first established their presence in the state in the latter part of the 20th century. As a general rule, invasive weeds increase fire frequency and susceptibility in the habitat type they have invaded (Brooks et al. 2004), and thus, weed control can be a critical fire prevention measure and conservation strategy. In areas with significant infestations, invasive weeds often reduce both plant and wildlife diversity, and they can alter important ecosystem functions such as water availability and native plant recruitment. Most of the habitat types covered in this plan already have various degrees of weed invasion, and sagebrush in particular is vulnerable to local habitat conversion where weeds become the dominant vegetation.

Conifer Encroachment

Several habitat types are vulnerable to conifer encroachment in Nevada, particularly sagebrush and aspen. It is widely thought that conifer invasion is the result of decreased fire frequency, but the causal chain leading to conifer invasion may be multi-faceted and may also involve variations in long-term weather and climate patterns. In any case, conifer invasion into aspen stands is probably a process that is very distinct from pinyon-juniper invasion into sagebrush, and both have management implications that deserve further study.

Plant Disease and Pests

Insect Outbreaks

Spontaneous insect outbreaks may be a result of prolonged drought or of natural cycles in insect populations. This concern category does not include biocontrol measures, but

rather insect outbreaks that happen unintentionally. Currently, most insect outbreaks affect coniferous woodlands and sagebrush. The immediate effects of insect outbreaks on birds include loss of habitat components they require, for example dense tree or shrub canopies, and an increase in dry fuel load. Some bird species benefit in the short-term from natural outbreaks, if they are locally contained, but insect outbreaks are expected to increase in scale and frequency with a warming climate and greater vulnerability of drought-stressed vegetation, particularly in coniferous habitat types (Waring et al. 2009).

Plant Pathogens

Pathogens that have widespread impacts on their host plants may affect bird habitat in some cases (Kliejunas et al. 2009). For instance, recent aspen clone die-offs in the Great Basin region have been attributed to fungus infections. Pathogen outbreaks are expected to increase in the future with warming temperatures and reduced water availability that can lead to plant stress. Other than for aspen woodlands, plant pathogen effects on entire habitat types have, to our knowledge, not been studied in great detail in our region (although white pine blister rust has recently been found in Nevada; Smith et al. 2000).

Species Concerns

Habitat Fragmentation

This topic is intentionally presented in the Species Concerns section, because we distinguish between habitat loss and degradation, which affect all species that occupy that habitat type, and the additional needs of species that require large intact landscapes. Examples include the Greater Sage-Grouse, Golden Eagle, and Northern Goshawk, birds with large home ranges that are vulnerable not only to changes in local habitat condition, but to a significant degree on the compounding of multiple threats across the landscape. Other species, such as Sage Sparrow, may not have large home ranges in comparison to a raptor, but they are most abundant in areas where large habitat tracts remain unfragmented.

Direct Mortality

Electrocution and Collision

Some species are particularly vulnerable to mortality from collisions with infrastructure (e.g., windmills, towers, powerlines; Bevanger 1994) or from electrocution by powerlines (Lehman 2001). Guidelines exist that can reduce mortality from these sources (e.g., APLIC 2006).



Black-necked Stilt. Photo by Larry Neel

Introduced and Human-Subsidized Predators

In Nevada, most introduced predators that pose threats to birds are free-ranging pets or feral descendants of pets, particularly cats (Hilty et al. 2006). Near human population centers and rural settlements, both pet cats and feral cats can cause substantial mortality to nearby bird populations. Particularly vulnerable are ground- and near-ground nesters, but any species with a vulnerable fledgling stage may be affected. Human-subsidized native predators, such as Common Ravens, coyotes, or raccoons may also pose local threats in some areas (Kristan and Boarman 2007), but overall, human-subsidized predators are a lower concern than introduced predators.

Illegal Take

This category includes all illegal shooting, baiting, or other direct killing of birds, as well as illegal take of nestlings for falconry. Shooting and baiting was historically a concern for a number of species, but presently it is an issue primarily for raptors that are erroneously perceived as a threat to livestock or pets. The current impact of illegal take of raptors for falconry is not well documented, but the opinion of the committee was that it still presents a tangible threat to some species.

Ecotoxicology

Pesticides and Herbicides

Pesticides and herbicides are probably less of a concern in Nevada than in states with more extensive agricultural development, but local threats may exist. Some bird die-offs have occurred in the Great Basin as a result of pesticide use, for example in a population of sage-grouse in southern Idaho (Blus and Henny 1997). Although DDT has been

banned in the U.S. for decades, it can still be detected in some aquatic birds in Nevada, probably as a result of exposure on their wintering grounds (Yates et al. 2010).

Mercury

Mercury contamination is a legacy of mining in some areas of Nevada, especially where large mining operations exist in catchment basins of waterways, and mercury has been shown to have at least some effect on bird reproduction (Custer et al. 2007). Interactions with other physiological stressors likely exist (Hill et al. 2008), which can either mitigate or compound mercury effects on birds. Mercury contamination and bioaccumulation is a concern particularly for aquatic birds that feed on fish.

Disease and Parasitism

West Nile Virus

West Nile Virus has been shown to cause mortality in a variety of raptor species, corvids, and in Greater Sage-Grouse (Naugle et al. 2005). It is a mosquito-mediated disease that has been confirmed to be present throughout Nevada. It is currently not known how large a contribution this disease makes to species-specific bird mortality in Nevada.

Botulism and Avian Cholera

Several species are known to be vulnerable to outbreaks of these diseases, primarily waterfowl, colonial waterbirds, shorebirds, and marshbirds (Friend et al. 2001). As with West Nile Virus, the relative contribution of these diseases to bird mortality is currently unknown, but their incidence in Nevada is thought to be lower than in other nearby regions, including the Great Salt Lake. Outbreaks of botulism and avian cholera are usually associated with persistent stagnant conditions in water bodies used for staging and wintering.

Brown-headed Cowbird Parasitism

Cowbird parasitism was considered a major concern for many songbirds in recent decades. Cowbirds are a native species, but they have spread into new regions and habitat types, and have greatly increased in abundance in many areas (Rothstein 1994). Research on the impacts of cowbird parasitism on host nest success have shown mixed results, and as a result, concerns about cowbird impacts have been somewhat downgraded in recent years. Although some Priority species experience high nest parasitism rates in certain locations (especially Bell's Vireo and Southwestern Willow Flycatcher), it is unclear whether this represents a true limiting factor for their populations. In the case of the Willow Flycatcher in southern Nevada, cowbird control efforts had mixed results in terms of increasing nest success rates (e.g., Laymon and Halterman 1998). Parasitism impacts likely decline if patch sizes of intact habitat can be increased, since cowbirds utilize habitat edges and other open areas to visually search for nests to parasitize.

Introduction to Habitat Accounts

Overview

In the habitat accounts, we summarize the basic conservation and management information that addresses the habitat needs of the Priority bird species that are associated with each habitat type. As in the species accounts, the first page represents a concise summary of pertinent information, drawn primarily from bird conservation data, in a tabular format. We encourage the user to make use of that page to gain a basic understanding of:

1) Habitat and landscape features that are important to birds
2) Priority species potentially found within the habitat type
3) The conservation concerns relevant to the habitat type
4) Regions of greatest conservation interest
5) Important Bird Areas that contain significant amounts of the habitat type

Below we describe the information that can be found in each habitat account.

Conservation Profile

Estimated Cover in Nevada: Estimate of total area covered by the habitat type, based on our GIS habitat map (described in *Appendix 1: Methods*).

Landownership Breakdown: Breakdown of the habitat type by owner / managing agency.

Priority Bird Species: Priority species that use the habitat type to a significant degree. Species at the bottom on the list may be listed in parentheses, which indicate that the bird uses the habit occasionally, seasonally, or opportunistically, but is not primarily dependent upon it. This list allows the reader to easily consult those species accounts that may be relevant to a given habitat type.

Indicator Species: Species that are not Priority species in this plan, but can provide an index of habitat integrity based on their presence or abundance. Indicator species are listed here if: 1) Priority species are rare or infrequent enough that they cannot be relied upon as a gauge of habitat integrity, or 2) Priority species only encompass certain aspects of habitat integrity. **Indicator species should primarily be used for monitoring the effectiveness of conservation implementation**. We selected species that we expect to respond positively and relatively quickly to substantive habitat improvements.

Most Important Conservation Concerns: List of concerns and challenges that were identified by the threat committee as being relevant to the habitat type within the next 10 years.

Habitat Recovery Time: Estimated time needed to restore this habitat type from complete destruction to the seral stages that are suitable for its Priority species. This information was often not formally available to us. Therefore, we did our best to estimate recovery times based on recent restoration projects, historic information, and the life history of the oldest plant forms in the seral stages needed by priority species.

Introduction to Habitat Accounts

Regions of Greatest Conservation Interest: List of regions in Nevada where conservation action for this habitat type would be most beneficial.

Important Bird Areas: List of Important Bird Areas as identified by the Nevada IBA program that support significant amounts of this habitat type and its associated priority species.

Key Bird-Habitat Attributes

This table includes habitat parameters that were identified as important to the conservation of Priority species in that habitat type, and to the integrity of the habitat type itself. In general, we looked for commonalities among the habitat needs of the Priority birds associated with each habitat type. The table is customized for each habitat type to best reflect those habitat and landscape parameters that are deemed most important for bird conservation. We emphasize the entry for "**Ideal Scale for Conservation Action**", which reflects our best estimate of how much land would be ideally used for management implementation to accommodate the full suite of priority species.

Habitat Map

We display a map that shows approximately how each habitat type is distributed in Nevada (see *Appendix 1:Methods* for details). We encourage readers to use this map as an indication of **how prevalent a habitat type is within a particular region,** but caution that the map should not be assumed to be precise at increasingly finer resolutions. Many important bird habitat types occur in patches that are too small to visualize in the maps, or that simply are not mapped accurately.

Overview Section

In the overview section, we summarize relevant information about the **history, natural history, and conservation issues** of each habitat type as it relates to bird conservation. Because our expertise encompasses primarily birds, we tend to focus on the habitat factors that are relevant to birds, rather than attempting to present an in-depth review of all habitat conservation issues.

Main Concerns and Challenges

In this section, we provide a summary of **main concerns and challenges** for the habitat type, as were determined by a committee comprised of members from the plan revision working group. We only list those concerns ranked relatively high for each habitat type

.

Introduction to Habitat Accounts

Habitat Diagram

To aid in communicating our vision for habitat conservation, we include a diagram **of an idealized landscape** that summarizes the features important for bird conservation within each habitat. This diagram compresses various habitat features into a single view, but in reality the habitat elements displayed in the diagrams may co-occur only within relatively large areas.



The pinyon-juniper / sagebrush interface near McGill,
White Pine County. Photo by John Boone.

Conservation Strategies

Finally, we present the **conservation strategies** that we believe are most effective for bird conservation in each habitat type, subdivided into strategies that focus on: 1) habitat, 2), research, planning, and monitoring, and 3) public outreach. Conservation strategies were developed to accommodate the shared needs of Priority species within each habitat type. For complete conservation planning, **we encourage plan users to consult the species accounts and conservation strategies for each of the species that occur in their planning area**. For this, we recommend first reviewing the range maps of each of the species listed in the Conservation Profile table on the first page, and then reviewing the full accounts of the species that are likely to occur in a planning area. The species accounts will provide greater detail on the conservation needs of each species than can be summarized in the habitat accounts.

Introduction to Habitat Accounts



Cottonwood gallery forest on the Lower Truckee River
near Wadsworth. Photo by John Boone.

Agriculture



Agricultural area south of Lovelock, Pershing County. Photo by Elisabeth Ammon.

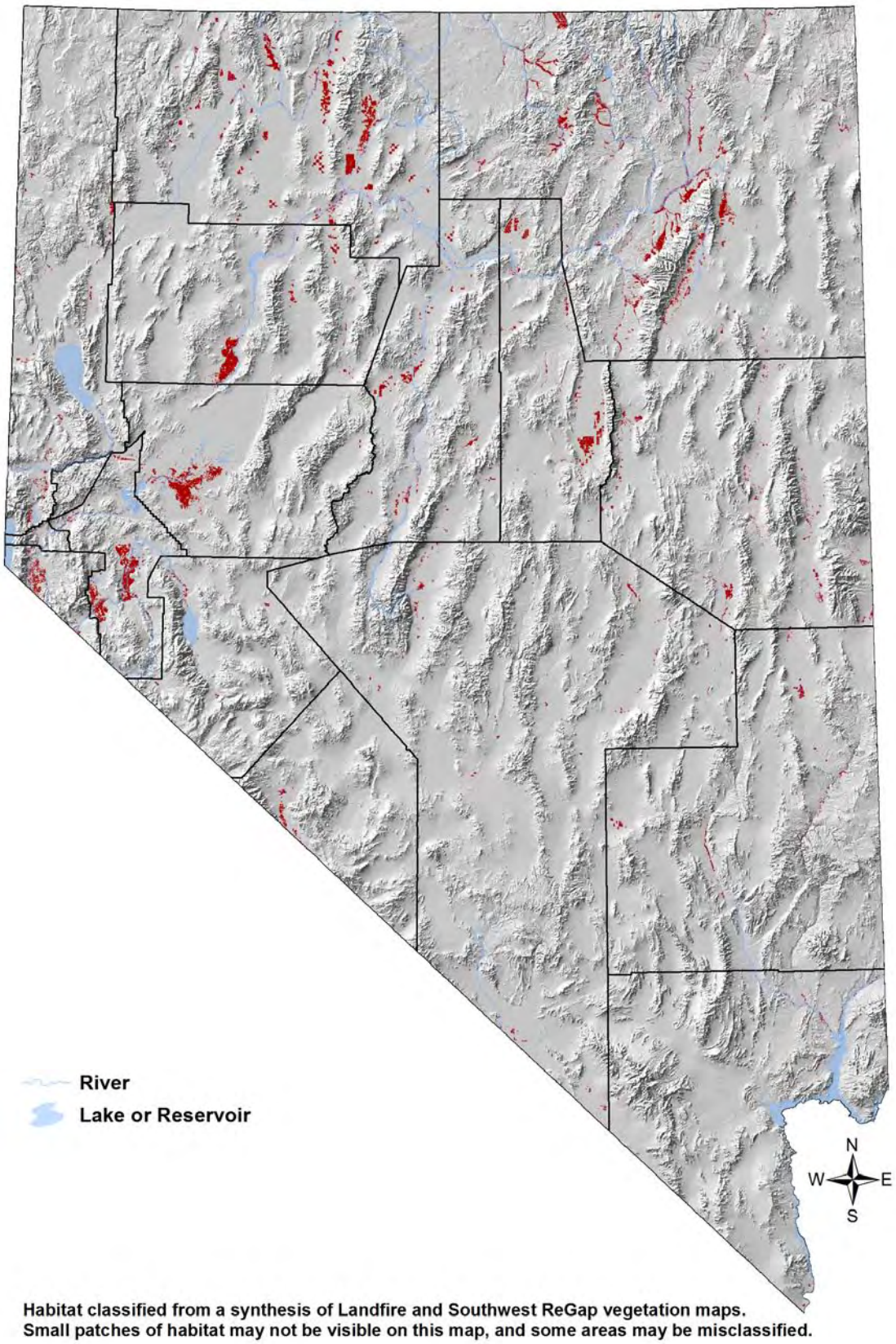
Key Bird-Habitat Attributes

Plant Species Composition	Multi-species mixtures ideal for grass; crops including barley, corn, wheat and similar large-seeded crops good for fall migrants; alfalfa suitable for Greater Sage-Grouse
Ideal Scale for Conservation Action	Whole field and border habitats
Crop Management	Haying schedules that avoid the main breeding season (May – mid-June) most suitable; flush-bars on agricultural equipment extremely beneficial
Trees	Old-growth deciduous trees desirable for nesting and perching of raptors and owls
Windbreaks and Hedgerows	Rows of native willows, alders , and other shrubs along ditches and streams particularly suitable for some species
Mosaic	Adjacent or imbedded wetlands, wet meadows, and riparian areas increase habitat value for Priority species
Other Features	Protection of nearby streams, springs, rivers from chemical and livestock impacts enhances overall wildlife value of agricultural lands Establishment of feral cats should be discouraged

Conservation Profile

Estimated Cover in Nevada	323,600 ha [800,000 ac] 1.1% of state
Landownership Breakdown	Private = 89% BLM = 5% Tribal = 3% Other = 3%
Priority Bird Species	Gambel's Quail White-faced Ibis Swainson's Hawk Sandhill Crane Long-billed Curlew (Cinnamon Teal) (Greater Sage-Grouse) (Snowy Egret) (Bald Eagle) (Prairie Falcon) (Franklin's Gull) (Short-eared Owl) (Abert's Towhee) (Tricolored Blackbird)
Indicator Species	Bobolink (in northern and NE Nevada) Winter raptors (Rough-legged Hawk, Ferruginous Hawk, and others)
Most Important Conservation Concerns	Climate change (change in precipitation and temperature) Groundwater pumping Change in agricultural practices Urban, suburban, and industrial development Invasive weeds
Habitat Recovery Time	2 years
Regions of Greatest Conservation Interest	Oasis, Overton, and Pahranagat Valley areas in the south; Lahontan, Smith, Mason, Ruby, Paradise, Kings River, Quinn River, and Humboldt River valleys in the north
Important Bird Areas	Boyd Humboldt Valley Wetlands Carson Valley Lahontan Valley Wetlands Lower Muddy River Meadow Valley Wash North Ruby Valley Oasis Valley Pahranagat Valley Complex Virgin River

Agriculture



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Agriculture

Overview

Agriculture in Nevada centers in most cases around livestock production, with grasses, alfalfa, irrigated pastures, and a variety of grains being grown on the majority of active farmlands. For the purpose of this plan, we refer to agricultural lands as actively irrigated crop lands, although many of our conservation recommendations also apply to non-irrigated pastures and hayfields. Irrigated agricultural lands are geographically restricted in Nevada, comprising only about one percent of total land cover, yet they support several Priority bird species in Nevada, which in some cases use agricultural lands year-round. The beginning of irrigation season in April features such species as White-faced Ibis, Sandhill Crane, and Long-billed Curlew, which seek out flood-irrigated fields to probe and glean for invertebrates after arrival from migration. These species often end up nesting on the ground in or near agricultural fields in many parts of the state, usually from May through early July. Other species, such as Swainson's Hawk and Short-eared Owl, hunt for rodents in croplands. Greater Sage-Grouse occasionally bring their broods into agricultural fields for cover, forage, and night-roosting. During the fall migration season, waterfowl and waterbirds (including Sandhill Cranes) forage on crop waste and tilled fields to fuel up for migration and wintering.

Crops such as winter-wheat, rye, and corn are important resources for migrating, staging, and wintering waterfowl, and wheat and barley crops often support waterfowl at other times of year (Kadlec and Smith 1989). Old, deciduous border trees support raptor nests and roosts, and other native buffer zones around fields are often used by ground-nesters, such as Cinnamon Teal and Short-eared Owl. Nearby wetlands are also beneficial for birds in agricultural settings, because they provide additional foraging opportunities for species that rely on aquatic invertebrates and pond vegetation. Adjoining wet meadows with high species richness in grasses, sedges, rushes, and forbs increase overall habitat value for several species, including the Indicator species Bobolink. In Figure Hab-1-1, we illustrate an idealized agricultural landscape consisting of a hayfield or pasture with adjoining buffer areas.

Main Concerns and Challenges

The following eight concerns were identified in our planning sessions for Agriculture habitat in Nevada:

- Urban, suburban, and industrial development
- Change in agricultural practices (loss of traditional methods)
- Pesticides, insecticides, and herbicides
- Change in precipitation and snowmelt resulting from climate change
- Change in temperature resulting from climate change
- Groundwater pumping
- Invasive weeds
- Introduced or human-subsidized predators

The primary concerns for agricultural areas are habitat conversion for urban and other uses, and changes in agricultural practices from relatively small-scale operations to mechanically intensive industrial agriculture. Small-scale family-owned operations usually feature most of the habitat

Agriculture

elements that maintain Priority bird species, particularly native buffer areas around fields, light applications of pesticides, retention of trees and shelterbelts, and allowing return-flow wetlands to persist. If herbicides, insecticides, and rodenticides are used intensively, they may inadvertently affect birds that ingest food items containing these chemicals.

We also included climate change effects (changes in precipitation, snowmelt, and temperature) in our list of concerns for agricultural lands. Because of the economic significance of agricultural lands of Nevada, water allocations will likely mitigate for these effects as long as it is feasible to sustain a given agricultural operation. However, in the longer term, our concerns are that climate change will have a compounding effect on other conservation concerns (e.g., increased groundwater pumping, reduction of nearby wetlands and shelterbelts, increased pressure toward water and crop efficiency), and that it will eventually threaten the sustainability of some agricultural operations.

Invasive weeds affect agricultural areas (especially native buffer zones and shelterbelts) in similar ways as wet meadow and riparian areas, by reducing habitat suitability for birds. Therefore, weed control for invasive species may not only benefit the agricultural operation, but also help to retain suitable habitat for Priority bird species. However, aggressive application of herbicides can have unintended effects on birds through toxicity and reduction in nest success.

Introduced or subsidized predators are a concern in agricultural areas, particularly feral cat colonies that are often associated with human settlement. Even if artificial food supplies are provided, feral cats can cause significant mortality rates in birds, particularly those that nest on or near the ground, or use ground vegetation for cover. Human-subsidized predators, such as raccoons, coyotes, and ravens, take advantage of increased rodent populations, crop waste, and livestock feed that is often available near agricultural operations, and in turn, they may engage heavily in nestling predation. This is why we recommend removing such subsidies as much as is feasible. Finally, one conservation concern that occurs occasionally in agricultural operations is the perception of raptors as a threat to livestock or pets, which is largely unfounded. Most raptors that occur in agricultural areas prey on rodents and rabbits that occur in open fields, and are therefore generally beneficial to the goals of agriculture.

Agriculture



Figure Hab-1-1: Idealized agricultural landscape to maximize the number of agriculture associated Priority species.

Agriculture

Conservation Strategies

Habitat Strategies

- **Manage at the scale of one or multiple irrigated fields**, ideally with each field having a buffer of native vegetation, and the entire area having a 100 m [330 ft] buffer of mostly native vegetation (but may include maintenance roads, ditches, fences, or trails). **Single old trees** or tree stands are beneficial to several species and attract species that feed on rodents. Bordering windbreaks and **hedgerows** should ideally consist of native species such as willow, alder, rose, etc.
- If **wetlands** are nearby, any measures to protect water quality are beneficial to birds. Shorelines buffers (≥ 100 m [330 ft]) are important for ground-nesting species.
- Removal of **invasive plants** should be followed by **active restoration** of agricultural crops or native vegetation in the removal sites, as weedy species often take advantage of disturbed soils and become more easily re-established in the absence of competition.
- The majority of priority bird species nest between May 1 and July 15, and some of them are particularly sensitive to nest disturbance. We recognize that necessary agricultural operations also occur in this time period, but **recommend delaying harvest or other vegetation removal**, ideally through mid-June. The most sensitive period for ground-nesting species is the beginning of the nesting season (**1 May – June 15**), and any effort to defer removal of groundcover during all or even some of this period will be extremely beneficial for these species.
- Installation of **flush-bars** on agricultural equipment, **escape ramps** for livestock waterholes, **perch sites** for rodent-hunting raptors, and **wildlife-friendly fencing** are all extraordinarily valuable for reducing inadvertent bird mortality and attracting birds. Recommendations for these and for **wildlife-friendly shelterbelt plants** can be obtained through the Nevada Important Bird Area program and other partners.

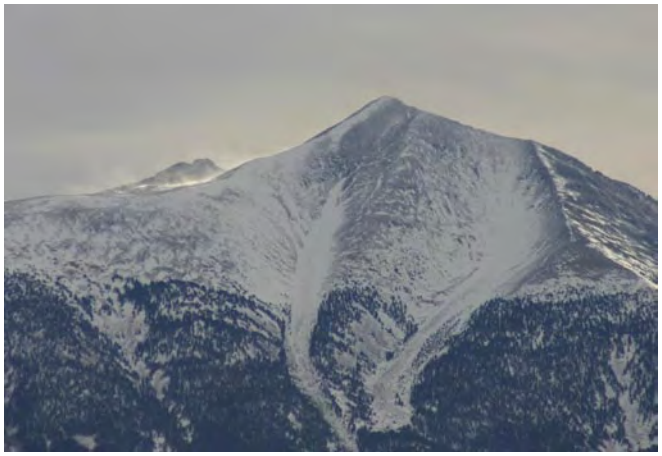
Research, Planning, and Monitoring Strategies

- As losses of crop lands to **habitat conversion** continue, **mitigation** for these losses should be actively planned through open space, conservation easements, or other assistance programs for agricultural lands, particularly in **Important Bird Areas**.
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count.
- Consider **expansion of statewide monitoring** to assess status and habitat use of migrating and wintering species of agricultural areas.

Public Outreach Strategies

- **Promote pride of landowners in wildlife** attracted to their property. Outreach may include pocket field guides to birds, tips on agricultural practices and habitat features that enhance habitat value to birds, and natural history related “fun facts.”
- **Provide educational materials** on threats from domestic and feral cats to birds, benefits of birds to agricultural operation (control of rodents), and on wildlife-compatible crop management, grazing practices, and weed control.

Alpine



Alpine habitat on Wheeler Peak, White Pine County.
Photo by Elisabeth Ammon.

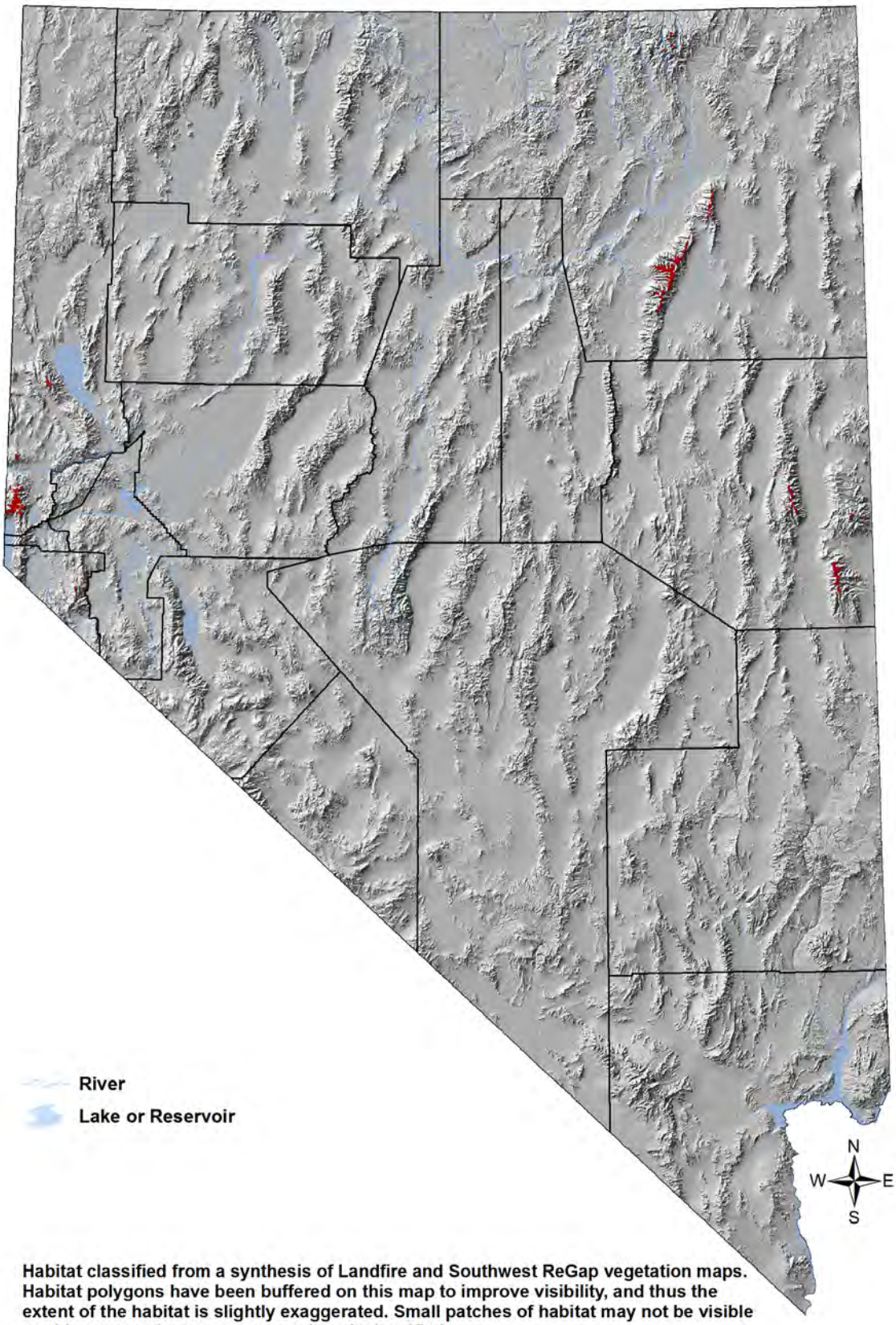
Key Bird-Habitat Attributes

Plant Species Composition	Low-growing shrubs of multiple species, flowering forbs, graminoids; interspersed with snowpockets, cliffs, and talus
Ideal Scale for Conservation Action	Whole patch
Vegetation Structure	Mostly low-growing shrubs, but horizontal diversity (mosaic of different patches) increases value; forbs particularly beneficial
Mosaic	Nearby mesic areas (snowpocket aspen, willows, and streams) increase habitat value Adjacent or embedded cliffs may increase habitat value
Other Features	Abandoned mineshafts, tall cliffs (>30 m [100 ft]), and talus fields add habitat value

Conservation Profile

Estimated Cover in Nevada	789 ha [1,950 ac] < 0.01% of state
Landownership Breakdown	USFS = 70% NPS = 21% BLM = 7% Other = 2%
Priority Bird Species	Black Rosy-Finch
Indicator Species	None
Most Important Conservation Concerns	Climate change (change in precipitation and temperature)
Habitat Recovery Time	50-100 years
Regions of Greatest Conservation Interest	Northeastern and eastern Nevada mountain ranges, Carson Range, Spring Mountains
Important Bird Areas	Carson Range Goshute Mountains Great Basin National Park Jarbidge Mountains Mount Grant Northern Snake Range Ruby Mountains Spring Mountains Toiyabe Range

Alpine



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Alpine

Overview

Alpine birds and their habitats have been studied very little in Nevada and, therefore, not much is known about their conservation needs. Traditionally, few land uses have occurred in Nevada's alpine zone due to difficult access, long periods of snowpack, and low productivity of alpine vegetation. Similarly, major disturbance regimes such as fire play little or no role in maintaining alpine vegetation. As a result of its short growing season and cold temperatures, alpine vegetation requires an enormous recovery time after destruction, which is estimated here at 50-100 years. A well-developed layer of forbs and grasses is probably critical to wildlife using alpine areas, which either depend on these plants directly, or depend indirectly on the insects supported by them. Alpine areas in Nevada are fairly small and isolated in comparison to some other western states. The only Priority species designated for this habitat, the Black Rosy-Finch, is documented from only the larger alpine patches, and thus our emphasis for monitoring and conservation are Nevada's larger alpine areas, specifically those that occur in the Carson Range, the Ruby Mountains, the Snake and Schell Creek ranges, and the Jarbidge Range. However, it is worth noting that smaller alpine areas in central Nevada have received very little monitoring effort, a situation that should be rectified. To a large degree, Alpine habitat is naturally protected by its relative inaccessibility, but some areas may be used for recreation and mining activities, which should be monitored to determine whether conservation action is necessary. The primary threat that we currently recognize is climate change, which threatens to eliminate alpine areas due to warming trends. The Black Rosy-Finch is the only Priority species whose nesting is restricted to the alpine tundra, and it is therefore an often-cited bellwether species for gauging the impacts of climate change in the West.

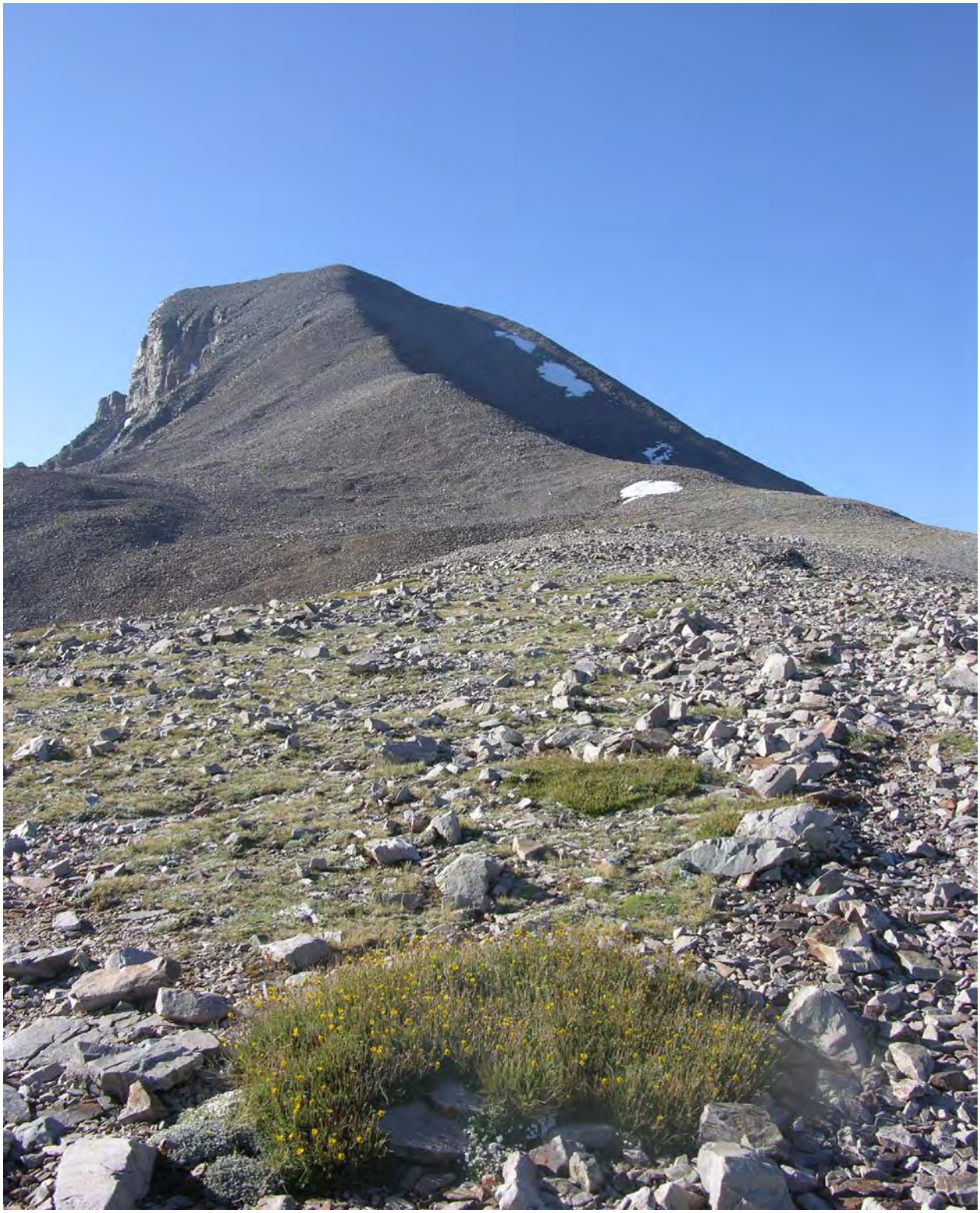
Main Concerns and Challenges

The following top two concerns were identified in our planning sessions for Alpine habitat in Nevada:

- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change

Because alpine tundra is adapted to long snowpack periods and very short growing seasons, an increase in temperature and reduction in snowfall are clear threats to this vegetation and to the bird species that are most closely tied to it. In contrast to other habitat types in Nevada, alpine zones do not have the potential recourse of shifting their distribution upward in elevation. The only local actions that are possible to mitigate this threat are to avoid compounding threats (such as heavy recreational uses) where possible.

Alpine



Alpine habitat, Wheeler Peak, White Pine County. Photo by John Boone.

Alpine

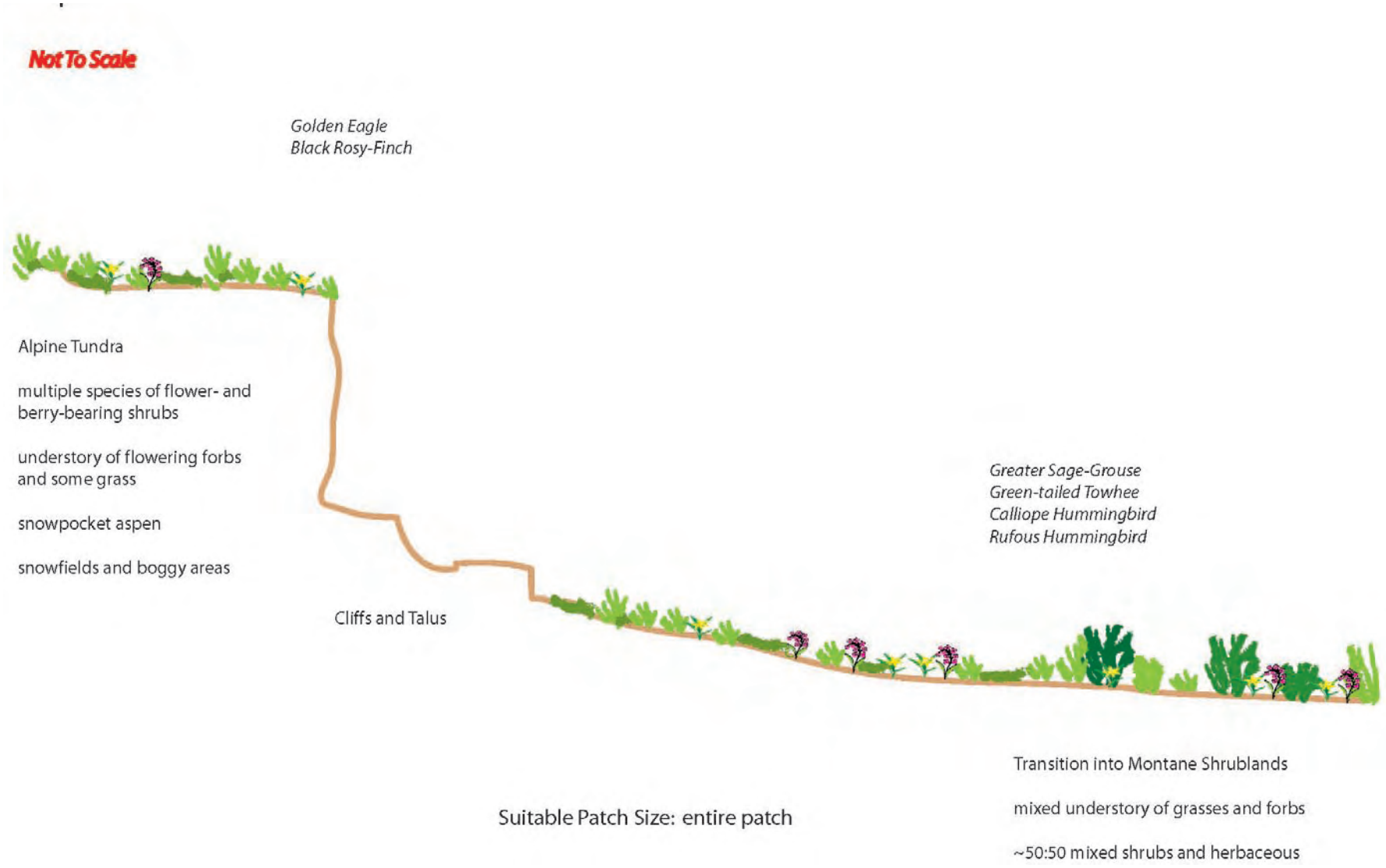


Figure Hab-2-1: Idealized alpine landscape to maximize the number of alpine associated priority bird species.

Alpine

Conservation Strategies

Habitat Strategies

- **Manage at the scale** of the whole mountaintop's alpine zone, if possible, with connectivity to adjacent habitat types (Coniferous Forest, Montane Shrubland, Montane Riparian, Aspen). High shrub species diversity, high patch type diversity that includes talus, snowpocket wetlands, and snowfields, and a healthy forb, grass, moss, and lichen component all benefit priority bird species and their prey
- Proximity to **water** (riparian areas, springs, wet meadows), and presence of **cliffs** (> 30 m [100 ft]) tall raise the priority level of a site for bird conservation

Research, Planning, and Monitoring Strategies

- **Monitor changes** in Nevada's alpine communities in a changing climate. Mitigation options are probably very limited in Nevada, but research and planning that explores mitigation opportunities, particularly in a regional context, is a high priority
- **Expand the Nevada Bird Count program** to include coverage of alpine tundra for long-term monitoring of climate change effects

Public Outreach Strategies

- **Promote public understanding of climate change** effects through additional outreach, using alpine tundra landscapes and the Black Rosy-Finch as bellwether cases.
- Encourage **low-impact recreational uses** of alpine tundra

Aspen



Aspen patch in the Great Basin (Peavine Peak, Washoe County).
Photo by John Boone.

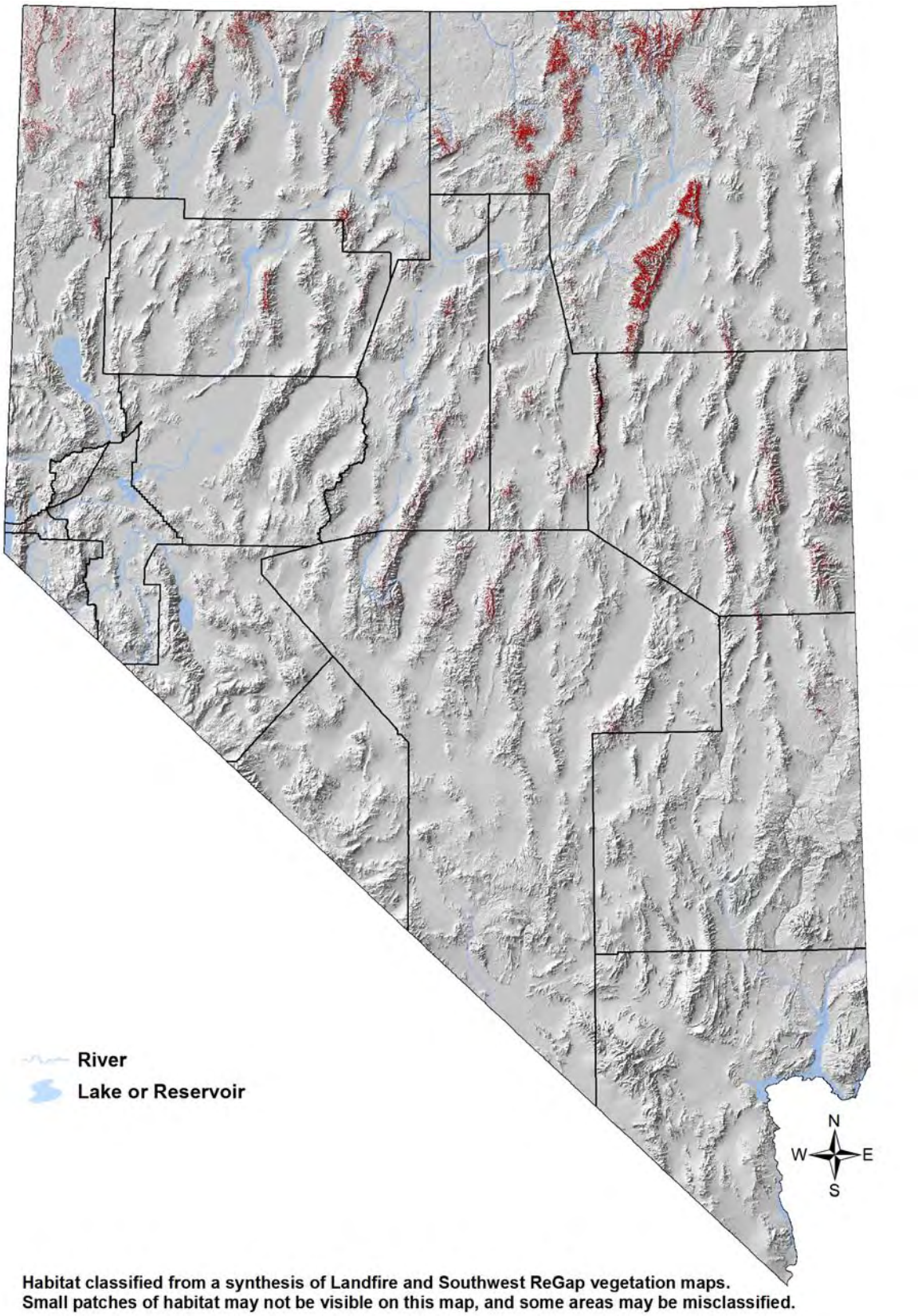
Key Bird-Habitat Attributes

Stand Structure	Aspen of various age classes, with understory of mesic shrubs, grasses, and flowering forbs Canopy closure ~ 30 – 40% ideal Understory cover > 50% ideal Large standing snags > 30 cm [12 in] dbh
Ideal Scale for Conservation Action	Whole stand
Plant Species Composition	Aspen, wild rose, currant, and other mesic species, flowering forbs and native graminoids
Understory	Intact graminoid and flowering forb understory important Understory cover > 50% ideal
Mosaic	Juxtaposed or interspersed Montane Riparian and Montane Shrubland habitat beneficial (except where bordered by Coniferous Forest)
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	274,000 ha [677,200 ac] 1% of state
Landownership Breakdown	USFS = 51% BLM = 31% Private = 14% Other = 4%
Priority Bird Species	Sooty Grouse Dusky Grouse Mountain Quail Northern Goshawk Flammulated Owl Calliope Hummingbird Rufous Hummingbird Lewis's Woodpecker Williamson's Sapsucker Green-tailed Towhee (Greater Sage-Grouse)
Indicator Species	Dusky Flycatcher Orange-crowned Warbler MacGillivray's Warbler Red-naped Sapsucker
Most Important Conservation Concerns	Livestock and wild horse grazing Conifer encroachment Changes in fire regimes Motorized and non- motorized recreation Climate change (change in precipitation and temperature) Plant pathogens Insect outbreaks Invasive weeds Mining
Recovery Time	30 years
Regions of Greatest Conservation Interest	Elko, Humboldt, Washoe, White Pine, Lander, Eureka, and northern Nye counties
Important Bird Areas	Bilk Creek-Montana Mountains Carson Range Great Basin National Park Jarbidge Mountains Northern Snake Range Ruby Mountains Sheldon NWR Spring Mountains Toiyabe Range

Aspen



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Aspen

Overview

Quaking aspen (*Populus tremuloides*) is the most widely distributed native tree in North America (Rogers et al. 2007), but it covers only about one percent of Nevada's landscape. These limited patches of aspen rank among Nevada's most important wildlife habitats (Flack 1976, Dobkin et al. 1995), and also among the most threatened. From our observations during Nevada Bird Count surveys, the majority of Nevada's aspen stands are small, and they are most often associated with an obvious water source, such as alpine snowpockets, montane riparian systems, montane springs, and ephemeral snowmelt drainages. The majority of scientific literature about aspen comes from studies of larger, "upland" stands that are common in the Rocky Mountain states (e.g., Flack 1976). In Nevada, however, large non-riparian stands are mostly restricted to areas with higher-than-average precipitation, such as the Ruby Mountains. Therefore, more study is needed of small stands of aspen in more arid settings, especially in the central Great Basin.

Aspen woodlands invariably draw the attention of hikers, campers, riders, and passing sightseers, and they are also sought out by grazing animals for forage and shade. Aspen stands are likewise a magnet for birds for several reasons. They are associated with relatively moist, rich soils, and are therefore more productive than uplands (Rogers et al. 2007). Aspen also stand out in their propensity to become infected with heartrot fungi (primarily *Phellinus tremulae*) while still alive, with up to 20% of trees infected by 100 years of age (Hart and Hart 2001). This makes them ideal for the construction of nest cavities by birds. The heartwood is easily excavated while the sapwood remains intact, allowing a tree to be used for years, if not decades, before it finally dies (Hart and Hart 2001). Because a dead aspen usually falls within a few years, more cavities can typically be found in live aspens than in dead ones. The cavities created by woodpeckers also benefit many secondary cavity nesters, such as House Wrens, swallows, chickadees, bluebirds, and small owls (Dobkin et al. 1995).

Aspen is unusual in that it is a clonal species, with short-lived (generally < 150 years) genetically identical trees arising from the parental root system (Rogers et al. 2007). Most aspen reproduction in the American West is vegetative, with suckers arising from nodes on the roots. Sexual reproduction via seed is extremely rare in this region, and the modern climate is believed to be mostly unsuitable for seeds to germinate and establish. Romme et al. (2001) argued, however, that while vegetative reproduction is effective for maintaining aspen in a stable climate, occasional seedling establishment is necessary for aspen to adapt to changing environmental conditions and to colonize new patches. While some stands remain stable over long periods (Mueggler 1985), most stands occasionally require a stand-replacing disturbance, such as fire, in order to persist over the long term. When the overstory trees are killed in a healthy stand, growth suppressants produced in the leaves no longer reach the roots, and new stems resprout profusely throughout the clone (Schier et al. 1985).

Aspen stands typically have high bird abundance and richness, and thus it is critical for avian conservation to protect as many existing aspen stands as possible (Griffis-Kyle and Beier 2003). Figure Hab-3-1 illustrates an idealized aspen stand in a typical Nevada setting with the habitat elements required by Priority bird species.

Aspen

Main Concerns and Challenges

The following top conservation concerns were identified for aspen in our planning sessions:

- Persistent overgrazing by domestic livestock and feral horses
- Conifer encroachment (primarily in western Nevada)
- Changes in fire regimes
- Motorized and non-motorized recreation
- Change in precipitation and snowmelt resulting from climate change
- Change in temperature resulting from climate change
- Plant pathogens
- Insect outbreaks
- Invasive weeds
- Mining (where habitat conversion occurs)

Most researchers and forest managers have concluded that a large proportion of the aspen stands across Nevada and much of the west are in decline (Brown et al. 2006). In many regions, it is easy to locate sites of stands that are now extirpated, or in imminent danger of extirpation, due to lack of vegetative regeneration. Causes of decline vary by region, but commonly-attributed factors include sustained overgrazing (which we define to include over-browsing in the context of Aspen habitat), reduced fire return intervals, invasion of aspen stands by conifers, climate change effects, plant disease, and heavy recreational use. These factors can conspire to prevent or discourage vegetative recruitment and, when sustained for long periods of time, lead to stand senescence and eventual death. Additionally, they often result in degradation or destruction of the understory layer. Threats may be compounded, for example, when fire removes the overstory trees and overgrazing eliminates the post-fire regeneration (Mueggler 1985, Schier et al. 1985). Large-scale mortality of aspen also has been increasing in recent years in a phenomenon known as “Aspen Dieback” (or Sudden Aspen Decline). This not only causes stem die-off, but also kills much or all of the root systems of aspen clones. Stand maturation, drought, elevation, aspect, and secondary agents, such as cankers, bark beetles, borers, all appear to play a role (Worrall et al. 2008), but the phenomenon is still poorly understood.

In western Nevada, conifer invasion is perhaps the most immediate threat to persistence of aspen stands, but in many other parts of Nevada, sustained grazing that discourages the establishment of young trees has emerged as a leading concern (Kay 2001). Low elevation aspen stands are particularly vulnerable because of their accessibility. When overgrazing continues over many years or decades, aspen clones eventually become physiologically exhausted, lose their ability to produce new growth, and die out. Aspen stands at risk for this outcome have a distinctive appearance – they consist exclusively of older trees with relatively little understory vegetation. In fact, degraded aspen woodlands have become so prevalent in Nevada that they are assumed by many to represent the normal condition. However, if successful stem regeneration is allowed to occur occasionally (by providing occasional rest periods from grazing pressure), young aspen stems should become well enough established to rejuvenate the stand.

Aspen

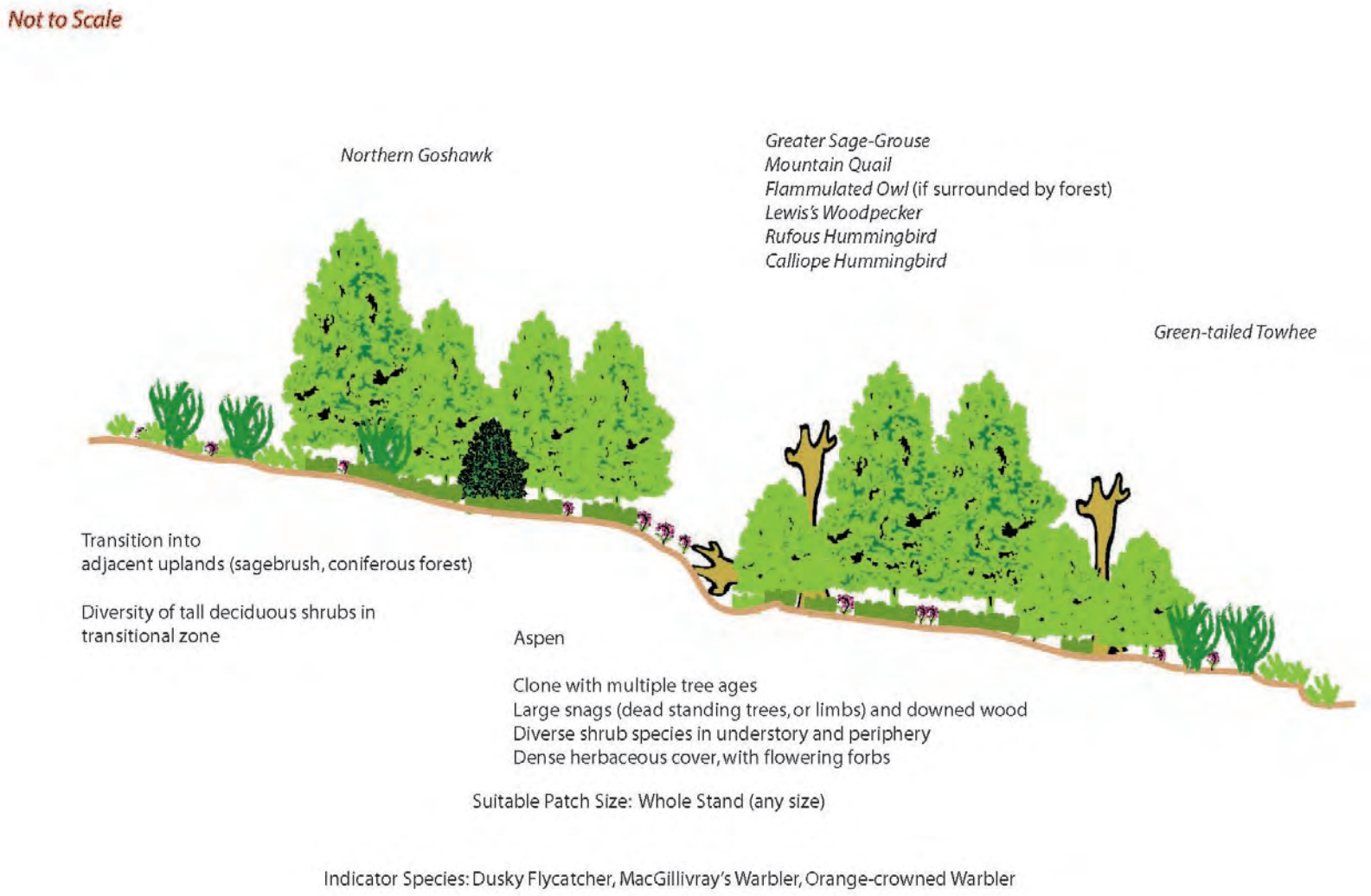


Figure Hab-3-1: Idealized aspen woodland landscape to maximize the number of aspen associated priority bird species.

Aspen

Conservation Strategies

Habitat Strategies

- **Manage at the scale of a whole aspen stand** if possible
- A **diversity of age and size classes, active recruitment of root sprouts, preservation of snags, and intact forb understory** are keys habitat values for all Priority species (see parameters above in Key Bird–Habitat Attributes table). Any land uses that chronically reduce aspen recruitment and native understory vegetation inside the stand and in adjacent areas should be minimized
- **Stand replacement by fire** may be used as a management tool to encourage aspen regeneration; however, sites where large individual trees or snags provide nesting opportunities for Priority species (Northern Goshawk, Lewis's Woodpecker) may need to be excluded from such treatments
- **Restoration efforts**, especially livestock exclosures, grazing rest periods, or conifer thinning, can be effective in allowing heavily impacted stands to recover
- **Recreational uses** should be actively managed in areas that are popular. Alternate shade structures, trail planning to avoid aspen recruitment and understory patches, and discouragement of wood carvings are priorities

Research, Planning, and Monitoring Strategies

- The **Nevada Aspen Working Group** (http://www.aspensite.org/Nevada.html) should continue to conduct inventories and research, publicize aspen conservation values, and raise funds for protection and restoration. Aspen stands have, to date, not been fully inventoried in the state, particularly stands that are too small to be reflected in remote sensing maps. The lack of a **comprehensive aspen inventory** prevents us from monitoring losses and implementing adaptive management in light of climate change effects.
- A **Western Aspen Alliance** is being developed between The Forest Service Rocky Mountain Research Station and Utah State University to address aspen issues that occur in the west (http://www.western-aspen-alliance.org/)
- Continue **long-term monitoring of landbirds** in Nevada aspen stands through the Nevada Bird Count.

Public Outreach Strategies

- Distribution of **public education materials**, such as the "Aspen: Oasis in the Desert" poster of the **Nevada Aspen Working Group**, should be pursued to promote appreciation of, and prevention of unintentional damage to, Nevada's aspen. Additional materials may be prepared for popular trail heads to encourage recreationists to practice low-impact use of aspen stands
- **Workshops** for land managers and private landowners, such as those held by the **Nevada Aspen Working Group**, should continue in order to educate people about the unique values of, and threats to, aspen stands
- **Outreach to landowners and land managers** through the IBA program and partner agencies should continue to be pursued to assist with specific conservation actions in high-priority aspen areas.

Cliff



Peregrine Falcon nest cliff near Lake Mead, Clark County. Photo by Elisabeth Ammon.

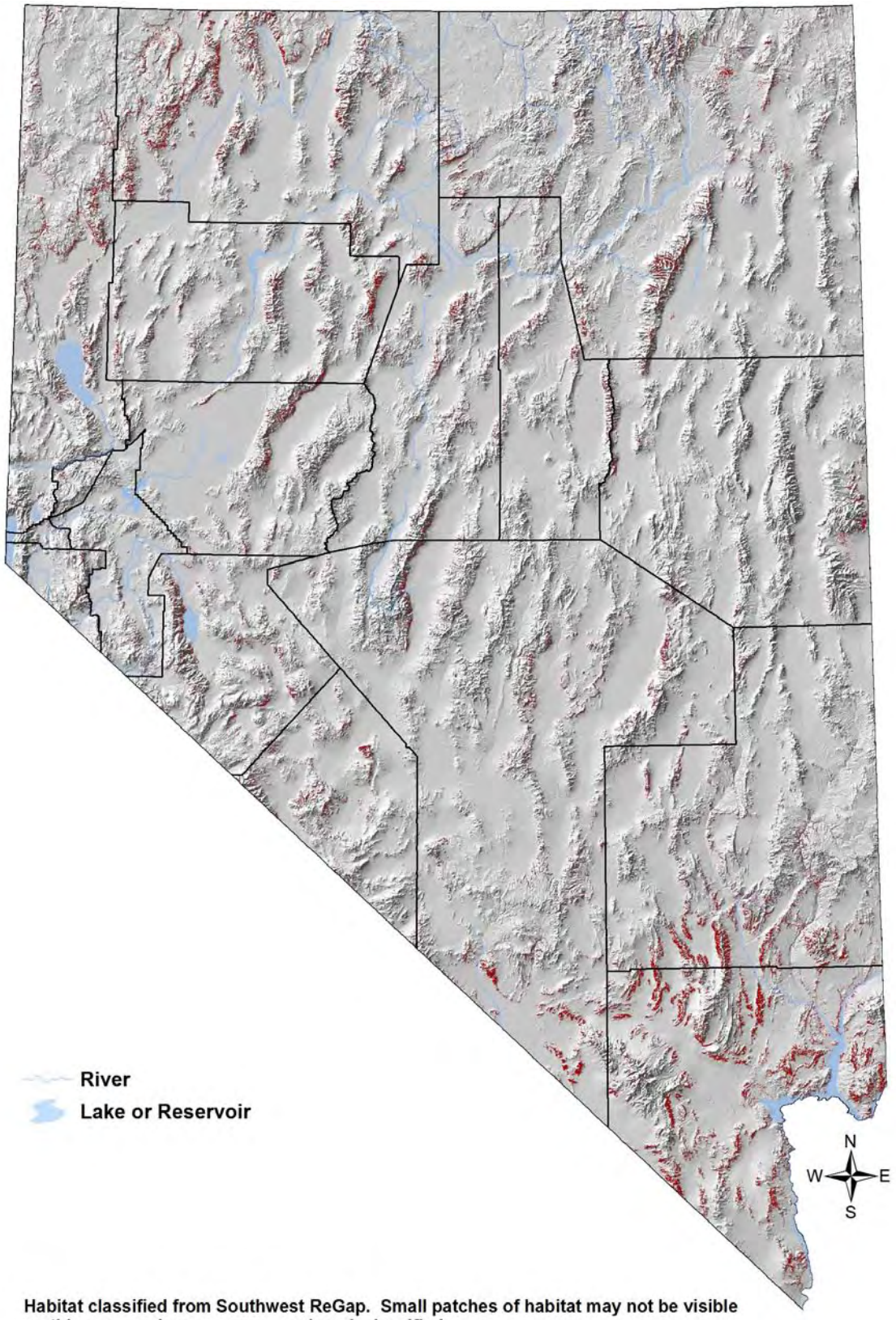
Key Bird-Habitat Attributes

Physical Structure	Golden Eagle: 25.5 (± 14.8) m [80 ± 50 ft];; multiple ledges preferred Peregrine Falcon: 12 – 200 m [40 – 640 ft] tall, mean height 100 m [330 ft] tall, with ledges ~ 1/3 down, usually oriented to north or west; some overhead cover preferred Prairie Falcon: 25 m [80 ft] to 100 m [325 ft], usually ~ 30 m [100 ft] White-throated Swift: Estimated at ≥ 40 m [130 ft]
Ideal Scale for Conservation Action	Whole cliff and surrounding lands within 10 km [6 mi] or more for prey populations
Mosaic	Cliffs with undisturbed adjacent landscapes most suitable, including sagebrush, salt desert, riparian, open water, marsh, or wet meadows
Distance to Water	Proximity to water increases habitat value
Other Features	Cliffs that are at least 1 km [0.6 mi] away from regular anthropogenic disturbances most suitable

Conservation Profile

Estimated Cover in Nevada (Cliffs and Talus)	455,000 ha [1,123,000 ac] 1.6% of state
Landownership Breakdown	BLM = 62% USFS = 10% USFWS = 7% DOD = 7% Private = 6% NPS = 3% Other = 5%
Priority Bird Species	Golden Eagle Peregrine Falcon Prairie Falcon White-throated Swift
Most Important Current Threats	Human disturbance Mining Climate change (temperature change)
Habitat Recovery Time	N/A
Regions of Greatest Conservation Interest	All suitable cliff habitat near sagebrush, Mojave scrub, or salt desert shrublands, or rivers, marshes, lakes, or meadows
Important Bird Areas	Bilk Creek-Montana Mountains Carson Range Goshute Mountains Great Basin National Park High Rock Resource Area Jarbidge Mountains Lake Mead Mount Grant Northern Snake Range Ruby Mountains Sheldon NWR Spring Mountains Toiyabe Range Wellington-Pine Grove Hills

Cliff



Habitat classified from Southwest ReGap. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Cliff

Overview

Besides being a spectacular part of the Nevada landscape, cliffs also provide essential habitat elements for several Priority bird species. Peregrine Falcons, Prairie Falcons, and Golden Eagles nest almost exclusively on cliffs, and availability of these sites may limit some populations of Golden Eagles and Prairie Falcons (Suter and Joness 1981). White-throated Swifts nest in large colonies on cliffs overlooking rivers or reservoirs. In addition to nest sites, cliffs also provide many bird species with protection from predators and weather extremes, and suitable thermal conditions for soaring (Ward and Anderson 1998).

Few land uses affect cliffs directly, but human disturbance may cause nest abandonment, render a nest site less productive, or prevent a nest site from being occupied. Rock climbing is one of the most proximal disturbances (Camp and Knight 1998), but industrial noise or motorized recreation in the immediate area of a cliff nest may cause similar problems. All cliff-nesting birds also require access to adjacent foraging areas where prey is sufficiently abundant, and they often range far from their nest or roost site while hunting. For our large birds of prey, this may include hundreds of square miles of rangeland, and healthy prey populations in the surrounding landscape may be more important in nest site selection that the physical attributes of the cliff itself (Grebence and White 1989). In Nevada, the highest Golden Eagle densities have been observed in long stretches of cliffs located along river systems (Herron et al. 1985), and Peregrine Falcons in Nevada are concentrated around the Lake Mead NRA, where they nest on earthen and rock cliffs. Figure Hab-4-1 illustrates an example of a cliff landscape that includes surrounding habitat types that are suitable for some Priority species. Others are more likely to be found in more mesic landscapes that include wet meadows, open water, and riparian vegetation.

Main Concerns and Challenges

The following top three conservation concerns were identified in our planning sessions for Cliff habitat in Nevada:

- Human disturbance (non-motorized and motorized recreation, industrial operations)
- Change in temperature due to climate change
- Mining

Cliff nesters are potentially vulnerable to human disturbances, either from recreational activities or from motorized equipment or vehicle traffic operating nearby. Although some cliff nesters appear to tolerate highways and dirt road traffic, they are generally less tolerant of unexpected disturbances, such as off-road-vehicle traffic, new infrastructure development, and recreational visitors. Increasing temperature is a conservation concern for cliff nesters because they generally select nest site ledges based at least in part on thermal conditions. We expect that birds could mitigate increased temperatures to some degree by selecting cooler sites, but these responses

Cliff

should be monitored for developing adaptive management strategies. Finally, in some cases mining activity could directly alter cliff habitat, although those situations appear to be relatively infrequent.

As a general rule, we expect that the conservation concerns associated with surrounding habitats that support prey populations are more important to cliff nesting birds than the conservation concerns affecting the cliffs directly. These concerns are outlined in the habitat accounts for the Montane Shrubland, Sagebrush, Salt Desert Scrub, Wet Meadow, Great Basin and Mojave Lowland Riparian and Montane Riparian, and Open Water habitat types.



Cliff in the Spring Mountains. Photo by John Boone.

Cliff

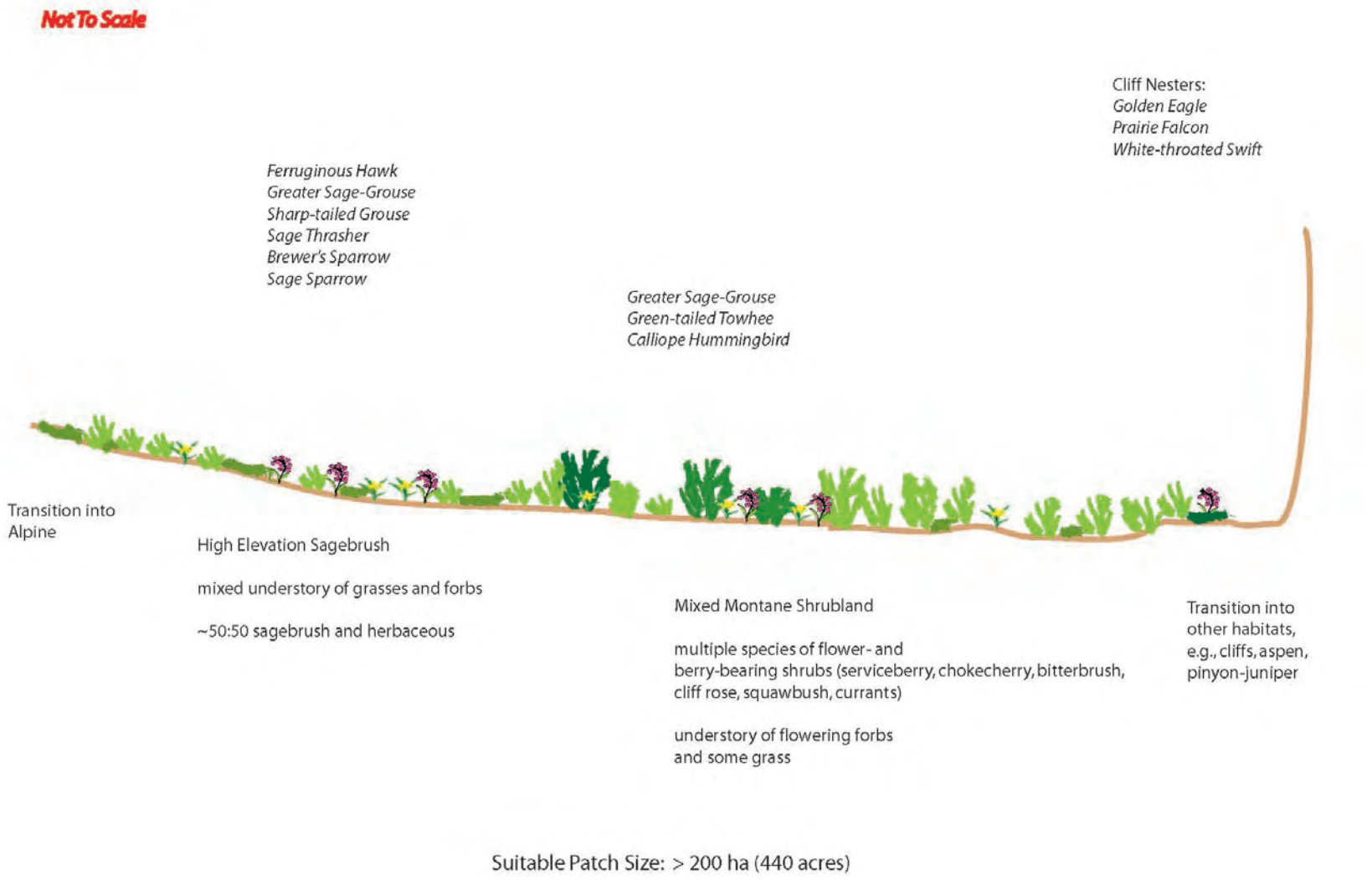


Figure Hab-4-1: Idealized cliffs landscape for some cliff nesters using the example of montane shrublands. Other types of landscape mosaics containing cliffs (which may include open water, wet meadows, riparian areas, sagebrush, or salt desert shrubland) may be more suitable for other cliff nesters.

Cliff

Conservation Strategies

Habitat Strategies

- **Manage at a landscape scale (1,000 ha [2,500 ac])** that includes relatively undisturbed adjacent habitat types (montane shrublands, riparian areas, sagebrush, wet meadows, open water) with sufficiently abundant prey populations (jackrabbits, cottontails, ground squirrels, small rodents for raptors, flying insects for swifts) in proximity to potential nesting cliffs that are > 30 m [100 ft] high
- Consult **conservation strategies of adjacent habitat types** for management practices that benefit foraging habitats of cliff nesters
- At actual or potential cliff nest sites, establish **disturbance-free buffer zones of 1 km [0.6 miles]** where possible (Suter and Joness 1981); unexpected disturbances (off-road activities of any sort) are of particular concern
- The majority of priority bird species nest between **April 1 and July 15**, during which disturbances should be avoided

Research, Planning, and Monitoring Strategies

- Research on Nevada **landscape and habitat requirements of all cliff-nesters** is needed. Most of the literature on cliff-nesters is from other regions, and nesting habits and foraging habitats have not been studied in great detail in the central Great Basin
- Spatial modeling or **inventory of cliffs** suitable for nesting by Priority species is needed for Nevada

Public Outreach Strategies

- **Public outreach to rock climbing and OHV groups** would be beneficial for raising awareness of disturbances to cliff-nesting species. Seasonal closures in popular recreation areas may also be needed to protect nest sites, if priority species are nesting.

Coniferous Forest



Coniferous Forest near Mt. Charleston, Spring Mountains, Clark County. Photo by John Boone.

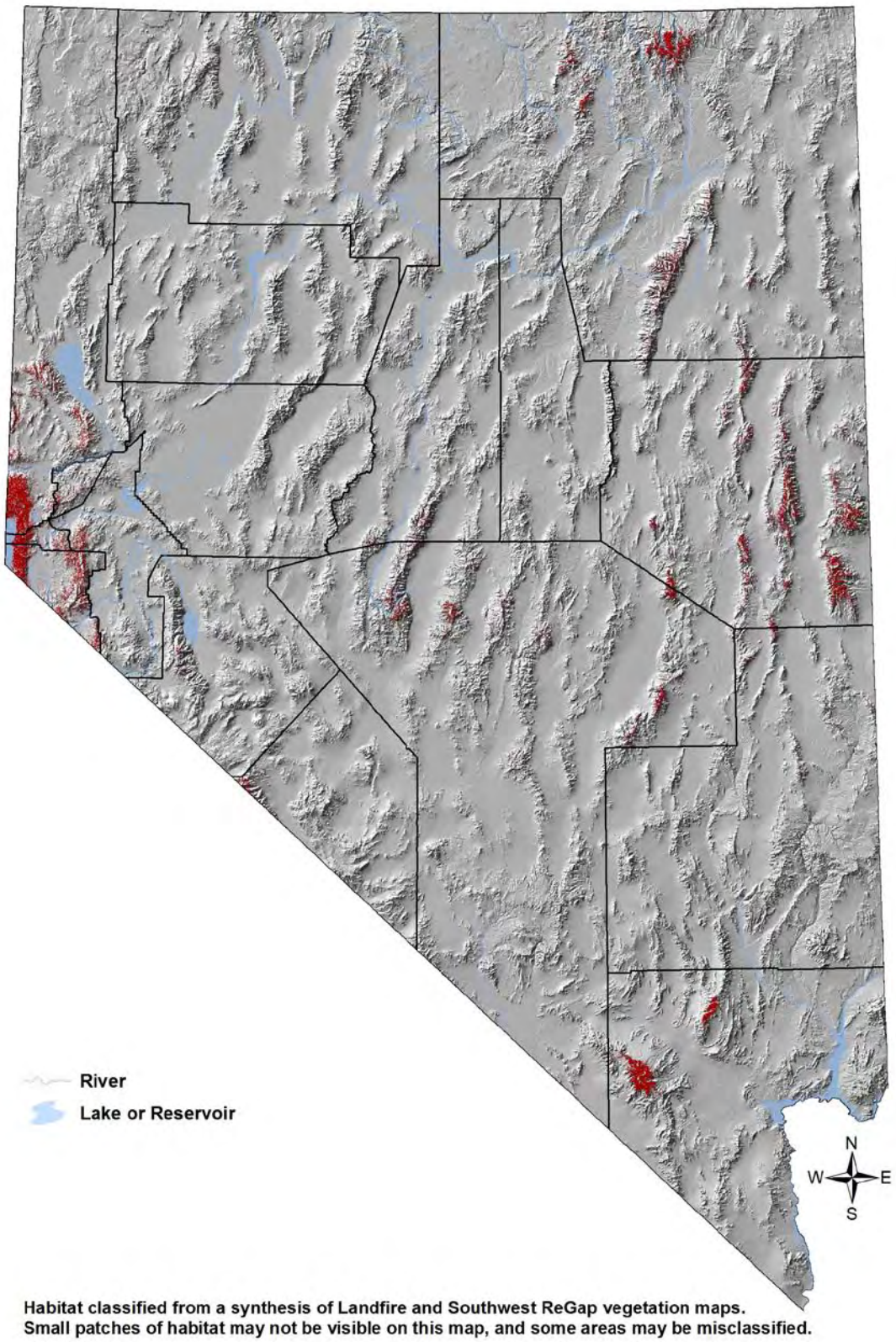
Key Bird-Habitat Attributes

Stand Structure	Multi-aged stands with mosaic of open canopy patches with shrub understory, small aspen patches, and dense-canopy groves; patch size within forest mosaic vary from 2-5 ha scale or larger, except for openings which may be relatively small
Ideal Scale for Conservation Action	500 ha [1,200 ac] or more
Plant Species Composition	Stands with 3 or more coniferous species (e.g., white pine, white fir, Jeffrey pine, lodgepole pine, and limber pine) better than monotypic stands; large-seeded conifers particularly valuable to birds; forbs, deciduous shrubs, and multiple species of xeric shrubs in the understory or in openings
Plant Condition	Healthy trees with seed crops beneficial; snags (> 30 cm [12 in] dbh) of conifers and deciduous trees important
Distance to Riparian/Spring Habitats	Proximity of water-dependent habitat increases value to birds
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	222,500 ha (550,000 acres) 0.8% of state
Landownership Breakdown	USFS = 58% BLM = 20% Private = 13% Other = 9%
Priority Bird Species	Sooty Grouse Dusky Grouse Mountain Quail Northern Goshawk Band-tailed Pigeon Flammulated Owl Spotted Owl Calliope Hummingbird Williamson's Sapsucker White-headed Woodpecker Olive-sided Flycatcher Hermit Warbler Grace's Warbler (Bald Eagle) (Lewis's Woodpecker)
Indicator Species	None needed
Most Important Conservation Concerns	Increased fire frequency or intensity Insect outbreaks Plant pathogens Climate change (change in precipitation and temperature) Urban, suburban, and industrial development Non-motorized recreation
Recovery Time	50-100 years
Regions of Greatest Conservation Interest	Carson, Jarbidge, Ruby, Snake, Schell Creek ranges, Spring Mountains, Sheep Range
Important Bird Areas	Carson Range Goshute Mountains Great Basin National Park Jarbidge Mountains Mount Grant Northern Snake Range Ruby Mountains Spring Mountains Toiyabe Range Wellington-Pine Grove Hills

Coniferous Forest



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Coniferous Forest

Overview

Coniferous forests (excluding pinyon-juniper) are relatively scattered on the Nevada landscape, accounting for less than one percent of its total land area. Coniferous forests tend to occur in fairly small patches throughout the state above the pinyon-juniper zone, although in the Carson Range of western Nevada and in some other ranges, they do occur in larger stands. Forest types vary greatly with elevation and local climate. Some Priority bird species are restricted to the more productive mixed-conifer forests of the Sierra Nevada, while others occur in the more isolated mountain ranges of the central Great Basin. Yet another group of species makes use of the ponderosa pine stands of southern and eastern Nevada.

The many Priority species that rely on Coniferous Forest habitat have a diverse set of requirements, and therefore maintenance of heterogeneity across the forested landscape will be of key importance in conserving them all. That said, the Flammulated Owl's (p. Spp-45-1) habitat requirements capture most of this diversity, and it therefore serves fairly well as a single species "model" for coniferous forest management. Its preferences include mixed species / mixed age stands, a deciduous tree presence, snags, and forest openings with a well developed understory. Major forest components (such as different age classes of trees, or stands with different amounts of canopy closure) should occur in patches of 2 ha [5 ac] or larger (and at least occasionally in much larger patches), although forest openings will often be much smaller. This formula, applied over large landscapes, will generally meet the needs of more specialized species, including those requiring larger stands of closed-canopy forest (Spotted Owl and Hermit Warbler), those requiring forest openings (Olive-sided Flycatcher), those requiring large snags and/or deciduous trees (the woodpeckers), and those requiring open park-like stands of old pines with an understory (Grace's Warbler). Figure Hab-5-1 summarizes an idealized forest mosaic.

It should be noted that fire management, including use of prescribed fire where appropriate, is a critical element in managing forests to sustain this landscape diversity. Specific fire management tactics, however, will vary with forest type, size, and geographical location.

Main Concerns and Challenges

The following top seven conservation concerns were identified for coniferous forests in our planning sessions:

- Increased fire frequency or intensity
- Insect outbreaks
- Plant pathogens
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Urban, suburban, and industrial development
- Non-motorized recreation

In contrast to most western states, Nevada has very little of the timbering activity that often dominates forest conservation issues in other regions. However, we share with other western

Coniferous Forest

states an increase in the frequency of large intense fires, especially in the Sierra Nevada (Miller et al. 2009). This may be in part due to fuel buildup from fire suppression, which also allows shade-tolerant species such as white fir to increase the stand density of otherwise more open pine stands (Raumann and Cablk 2008). Climate change is expected to further increase the likelihood of extensive crown fires due to lower precipitation and earlier snowmelt (Westerling et al. 2006). Although some bird species benefit from local fires (e.g., Olive-sided Flycatcher), others do not, and a primary management challenge is to maintain an appropriate balance of fire on the landscape in light of an increased frequency of catastrophic fires.

Fuels reduction is one tool used to slow fire spread and reduce fire intensity, especially near human settlements (Reinhardt et al. 2008). Although it is questionable whether it can be a universal remedy for managing fires (Schoennagel et al. 2004), some successes are reported from the Lake Tahoe basin (Safford et al. 2009). More study is needed on the effects fuel reduction on wildlife (Elliot et al. 2010). In general, however, we expect that fuels reduction benefits birds that prefer more open forests, but its effects on species that need dense forest stands and dead wood are poorly documented. To integrate fuels reduction treatments with wildlife conservation goals (Lehmkuhl et al. 2007), we therefore recommend assessing which Priority species are present in a stand, or are expected to be present, and attempting to accommodate their habitat requirements (see respective species accounts) within the fuels reduction plan where possible.

Local insect outbreaks or pathogen infections are natural occurrences in coniferous forests and even beneficial to many bird species, especially woodpeckers (Drever and Martin 2010). However, recent outbreaks have become more extensive and uncontrollable than they appear to have been historically. This may be in part due to the increasing density of stands in some areas (Smith et al. 2005), or due to the homogenization of forests from past logging (Drever et al. 2006). Climate change effects are expected to increase the severity and longevity of insect outbreaks even more (Waring et al. 2009). Given that climate change is also expected to increase the likelihood of crown fires, maintaining diverse healthy forests that meet the habitat requirements of a diverse suite of bird species will probably become more challenging. The combined effects of all these factors on bird populations should be studied on an ongoing basis for adaptive management.

In some parts of the state, urban or suburban encroachment into Coniferous Forest habitat is a concern, especially in the Spring Mountains near Las Vegas and in the Lake Tahoe basin (Raumann and Cablk 2008, Heckman et al. 2008). Habitat loss or degradation as a result of development of infrastructure, as well as direct human disturbance, is expected to impact bird populations (Schlesinger et al. 2008) in these areas. Indirect effects of urban development, such as intensive fuels reduction, introduced predators, fire suppression, and artificial ignition sources are also concerns.

Coniferous Forest

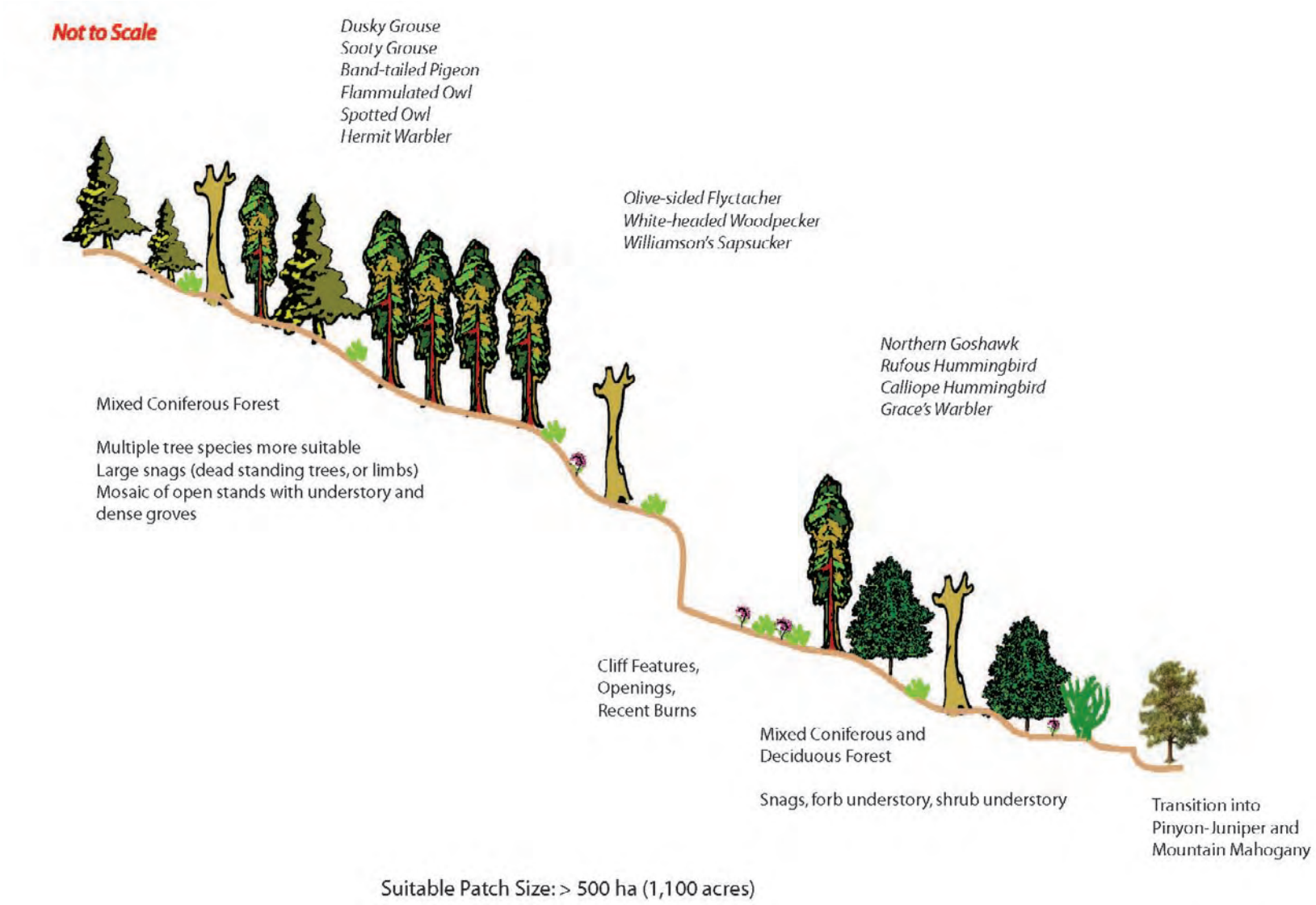


Figure Hab-5-1: Idealized coniferous forest landscape to maximize the number of coniferous forest associated Priority bird species.

Coniferous Forest

Conservation Strategies

Habitat Strategies

- Manage at **landscape scale (> 500 ha [1,200 ac])** with the goal of maintaining a diverse mosaic of mixed-age, -size, and -density tree stands, large snags, deciduous tree components (especially aspen and willow), and forest openings
- Priority for conservation action should be given to sites where mosaics of **mixed-age conifer forest, deciduous woodland, and shrubland** either already exist or can be achieved
- **Protect even small patches of aspen or willow** that are interspersed within the conifer forest matrix (Griffis-Kyle and Beier 2003)
- Protect mature coniferous forest in the Carson Range, with focus on closed-canopy stands of > 50 ha [125 ac]
- **Design fuels reduction projects** to retain older and mixed-age stands, large-diameter trees and snags, and to create moderate canopy closure at the recommended patch sizes, where possible
- Fuels reduction that **thins smaller trees** to reduce fuel ladders can help to protect important older stands from catastrophic fire
- **Fire management** should generally encourage small-scale, patchy fires that increase diversity of the forest mosaic and create forest openings. Active reforestation with native species, particularly those that help increase tree species diversity. may be desirable
- Proximity to **water** (riparian areas, springs, wet meadows), **cliffs** (> 30 m [100 ft] tall, or **abandoned mines** (which may be gated) raise the importance of a site for bird conservation
- The majority of Priority bird species nest between **May 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when intensive treatments or potentially disruptive activities should be avoided when possible

Research, Planning, and Monitoring Strategies

- Conduct additional research to better **determine habitat and patch size requirements, and the importance of riparian habitat within the forested landscape** for species such as Grace's Warbler, Williamson's Sapsucker, and White-headed Woodpecker
- Investigate the **role of fire intensity, scale, and frequency** in providing suitable habitat for various species; review fire management strategies accordingly
- **Continue and expand forest bird monitoring** as part of the Nevada Bird Count program to better assess population trends of a complex suite of species

Public Outreach Strategies

- **Promote public appreciation** of the wildlife values provided by a healthy coniferous forest, including education about the role of fire
- Encourage "**responsible recreation,**" including use of maintained trails to protect understory, avoiding disturbance to sensitive nest and roost sites, etc.

Ephemeral Wetland and Playa



Ephemeral wetland in Churchill County.
Photo by Steve Ting.

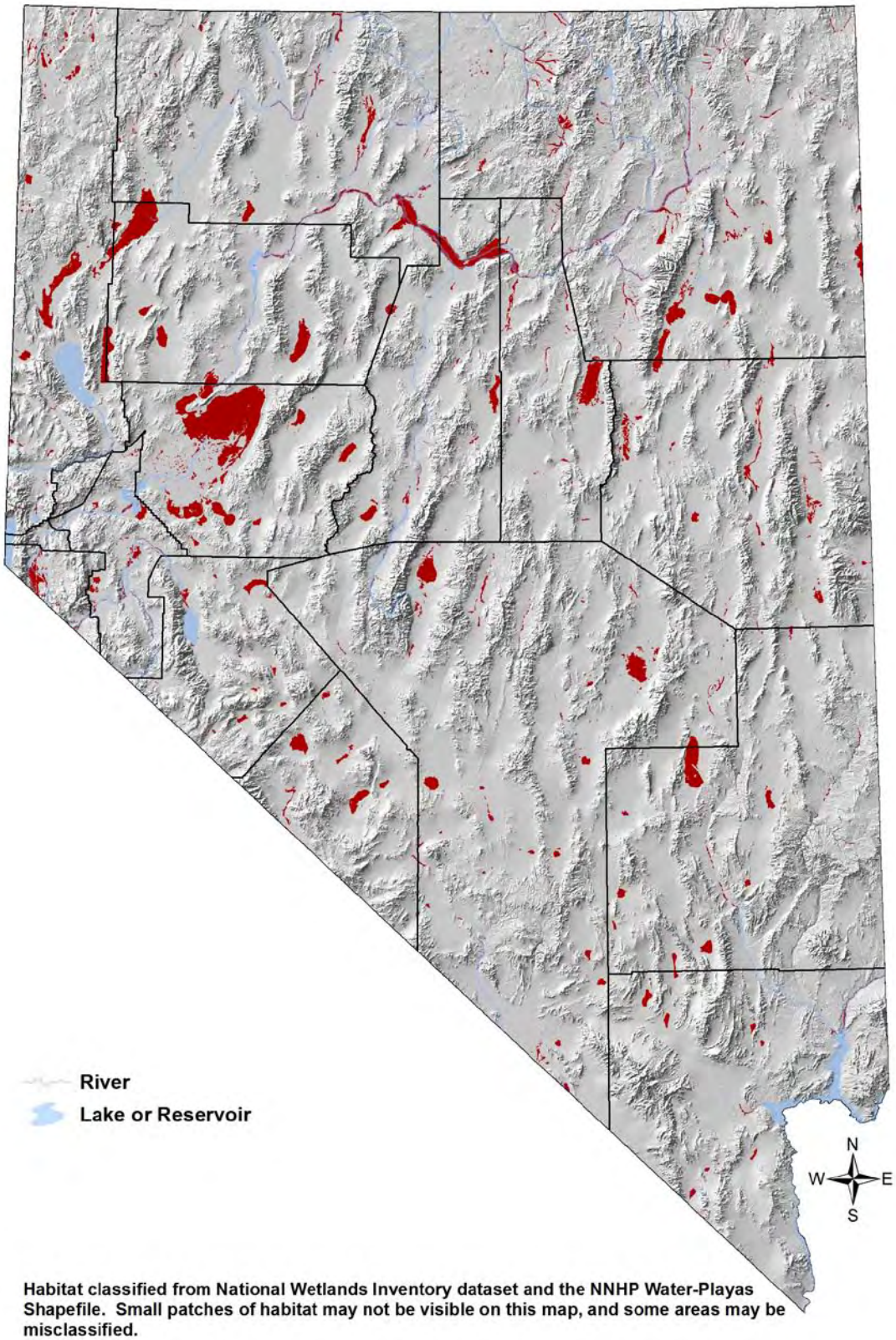
Key Bird-Habitat Attributes

Plant Species Composition	Playa wetlands are often sparsely vegetated, but may have rushes and sedges when wet, especially in areas where inundation is relatively frequent; adjacent areas may have saltgrass, greasewood, creosote bush, and salt bush, or be relatively barren
Ideal Scale for Conservation Action	Entire high-water perimeter and adjacent shoreline
Land Uses	Few land use impacts; when water is present, OHV use may damage playa beds and could possibly reduce its ability to retain water
Other Features	Natural environment includes very sparse vegetation and embedded rocks that may be important to nest site selection of some priority species

Conservation Profile

Estimated Cover in Nevada	490,000 ha [1.2 million ac] 1.7% of state
Landownership Breakdown	BLM = 60% USBR = 10% Private = 10% DOD = 8% Other = 12%
Priority Bird Species	Snowy Plover Black-necked Stilt American Avocet Western Sandpiper Least Sandpiper Long-billed Dowitcher Wilson's Phalarope Red-necked Phalarope (Cinnamon Teal) (Marbled Godwit)
Indicator Species	None needed
Most Important Conservation Concerns	Surface water diversions, impoundments Climate change (change in precipitation and temperature) Motorized recreation
Habitat Recovery Time	1 year
Regions of Greatest Conservation Interest	Northwestern, central, and southern Nevada
Important Bird Areas	Ash Meadows NWR Franklin Lake Gridley Lake High Rock Resource Area Lahontan Valley Wetlands Monitor Valley Oasis Valley Sheldon NWR Swan Lake Washoe Valley

Ephemeral Wetland and Playa



Habitat classified from National Wetlands Inventory dataset and the NNHP Water-Playas Shapefile. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Ephemeral Wetland and Playa

Overview

Ephemeral wetlands and playas are characteristic features of the Great Basin and Mojave Desert regions that come alive during wet years when water covers the flat valley-bottoms. Birds that depend on ephemeral wetlands have adapted to annual variation in water conditions, and are known for their flexible annual distribution patterns. Recent research indicates that these birds rely on a large network of playas and other wetlands that extend over hundreds of miles, selecting each year from among the subset of sites that are sufficiently wet (Robinson and Oring 1996; see also American Avocet species account, p. Spp-32-1). Therefore, while one particular ephemeral wetland is likely not critical to the conservation of a Priority species, a regional wetland network is critical.

Ephemeral wetland environments are characterized by short, infrequent, and unpredictable water availability, which determines if and when birds are present. The majority of Great Basin playas and associated wetlands are fed by snowmelt runoff, and unless other water sources are available, the amount of snowmelt and summer temperatures determine how long water stays within the wetland. In the Mojave Desert region, ephemeral wetlands may also receive water through snowmelt channeled down ephemeral washes, but many receive water only from occasional heavy rain events that occur during the monsoon season. Some ephemeral wetlands are located on the periphery of a permanent or semi-permanent water source (such as a spring, a terminal marsh, or agricultural return flows) and may consequently receive more frequent and predictable inflows. These sites can be particularly important for conservation, as they serve as insurance that at least some birds have access to suitable habitat during long drought periods. The key habitat feature for many of the Priority species that specialize on ephemeral wetlands is the availability of very shallow shoreline areas (< 2.3 cm [6 in] water depth) and mudflats. Most Priority species using these sites probe and peck for invertebrates that inhabit the shallows and the wet shorelines. Figure Hab-7-1 illustrates habitat elements of typical ephemeral wetlands that are used by Priority species.

We mostly associate Ephemeral Wetland and Playa habitat with shorebirds like the Snowy Plover, American Avocet, and Black-necked Stilt. However, anecdotal evidence suggests that ephemeral wetlands also provide important stopover opportunities for a large variety of species. The playa lake of Eldorado Valley (Dry Lake, south of Boulder City in Clark County) only has water from winter rains once every five years, on average. In September of 1997, sixty Sandhill Cranes, a Red Knot, several Snowy Plovers, a Pectoral Sandpiper, several Semipalmated Plovers, several Baird’s Sandpipers, a Black-bellied Plover, several Greater and Lesser Yellowlegs, and a few Solitary Sandpipers and Marbled Godwits were among the hundreds of birds stopping over at Dry Lake after a recent downpour (Meyers et al. 1998). These sites may only have water for a few weeks, but if they are located in a migratory pathway and are flooded at the right time, they may provide much-needed invertebrate resources and resting opportunities for migrating shorebirds on their journey across the desert.

Ephemeral Wetland and Playa

Main Concerns and Challenges

The following top four conservation concerns were identified in our planning sessions for ephemeral wetlands or playas in Nevada:

- Surface water diversion, impoundments
- Change in precipitation and snowmelt resulting from climate change
- Change in temperature resulting from climate change
- Motorized recreation

Playas are among the least economically productive habitat types and are therefore not used heavily. Perhaps the most immediate threat to ephemeral wetlands is the diversion of water that would otherwise flow into the playa bed. The extent to which this actually reduces wetland extent and availability has not been closely studied outside of major management areas, but it seems reasonable to suspect that the effect can be considerable. Therefore, opportunities for restoration exist whenever it would be possible to make water runoff more available to playa beds in historical wetland sites.

In the longer term, changes in precipitation and temperature that are predicated as the result of climate change are even larger concerns. The fauna of ephemeral wetlands operates close to its physiological limits even in “normal” climate conditions, with invertebrates routinely going into dormancy through years of drought and birds wandering through the region in search of wetlands. Limits on viability of invertebrate prey and on bird persistence in these extreme environments are poorly understood, particularly when climate change is factored in. However, the conservative view is that such thresholds are more likely to be reached if temperatures warm and snowpacks decrease.

Groundwater pumping was listed as a concern for the case of ephemeral wetlands that receive inflows from springs or groundwater sources. It was not clear how frequently this situation might occur, so we recommend that this concern be evaluated on a case-by-case basis.

Finally, we listed motorized recreation as the only active land use of concern of which we are aware. The concern lies in the potential for motorized vehicles to damage the waterproof sediment layer of the wetland bed that helps to retain ephemeral water. If this layer is broken, water may seep into deeper soil layers and become more rapidly lost.

Ephemeral Wetland and Playa

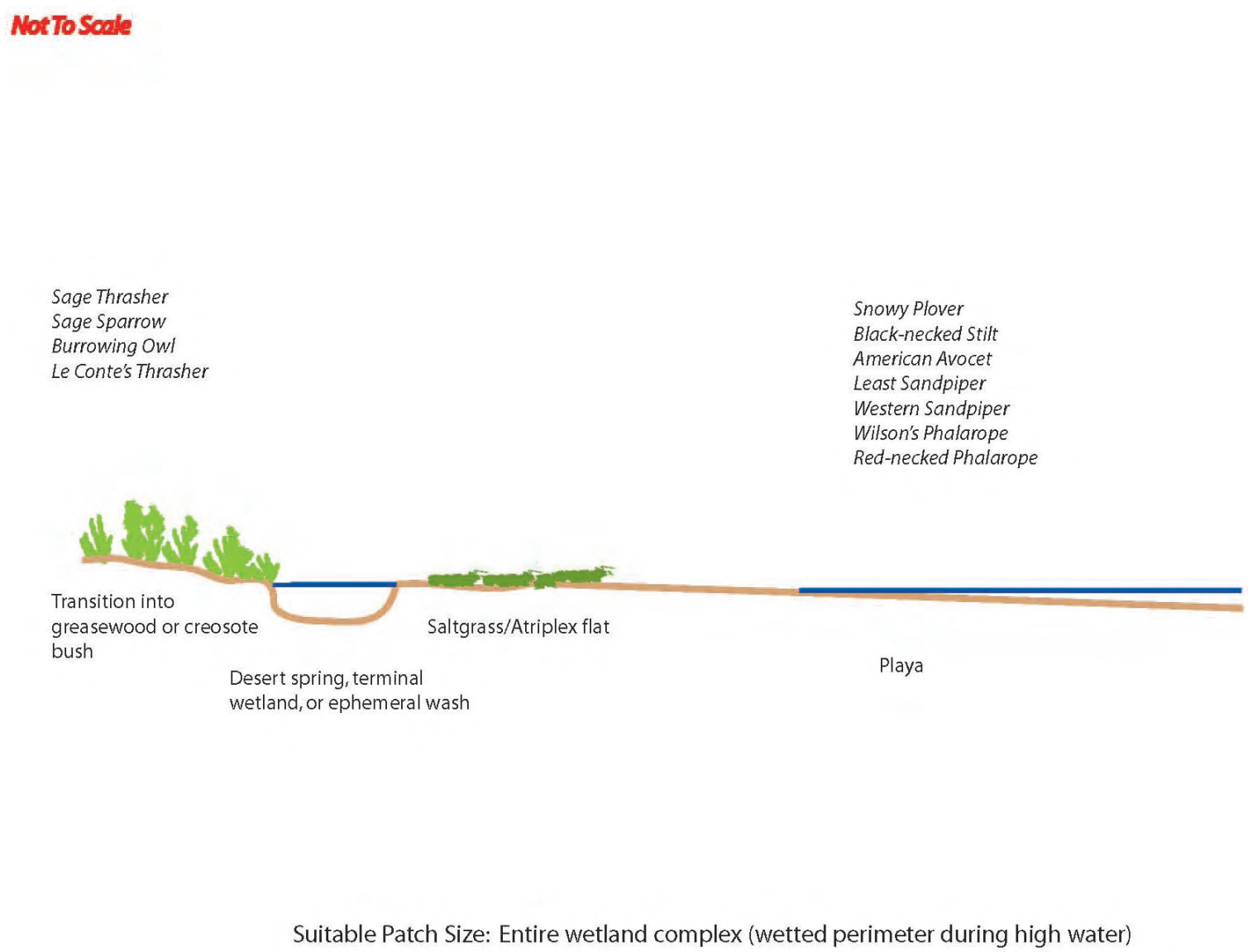


Figure Hab-6-1: Idealized ephemeral wetland and playa landscape to maximize the number of ephemeral wetland associated priority bird species.

Ephemeral Wetland and Playa

Conservation Strategies

Habitat Strategies

- Manage at the scale of the **entire playa and wetland complex**. In wet conditions, the wetted perimeter of the complex and the sparsely vegetated playa shore should be protected from all significant disturbances, including heavy OHV use
- Where opportunities exist to **reduce surface water diversion** to allow additional snowmelt flow into an ephemeral wetlands, this measure is a valuable conservation strategy, particularly in major migration corridors
- If the wetland complex is supported by **groundwater**, limit pumping to levels that do not cause habitat conversion

Research, Planning, and Monitoring Strategies

- Planning and research should identify a **minimum-sized regional network of ephemeral wetlands** necessary to provide sufficient breeding and migratory habitat for Priority species. Prior to this research, planning could also determine opportunities for having at least some ephemeral wetlands in a regional network flooded at any given time during the seasonal periods most important to Priority birds
- A statewide **monitoring plan for migratory and breeding shorebirds** of ephemeral wetlands needs to be developed and implemented. This would likely involve a statistical sampling scheme, not complete coverage, of ephemeral systems in the state

Public Outreach Strategies

- **Promote public appreciation** of ephemeral wetlands through promotional materials, birding trips, and school classes (e.g., using dormant invertebrates as educational material, field trips to ephemeral wetlands).

Great Basin Lowland Riparian



Lowland riparian corridor along the Lower Truckee River, Washoe County. Photo by Stewart Rood.

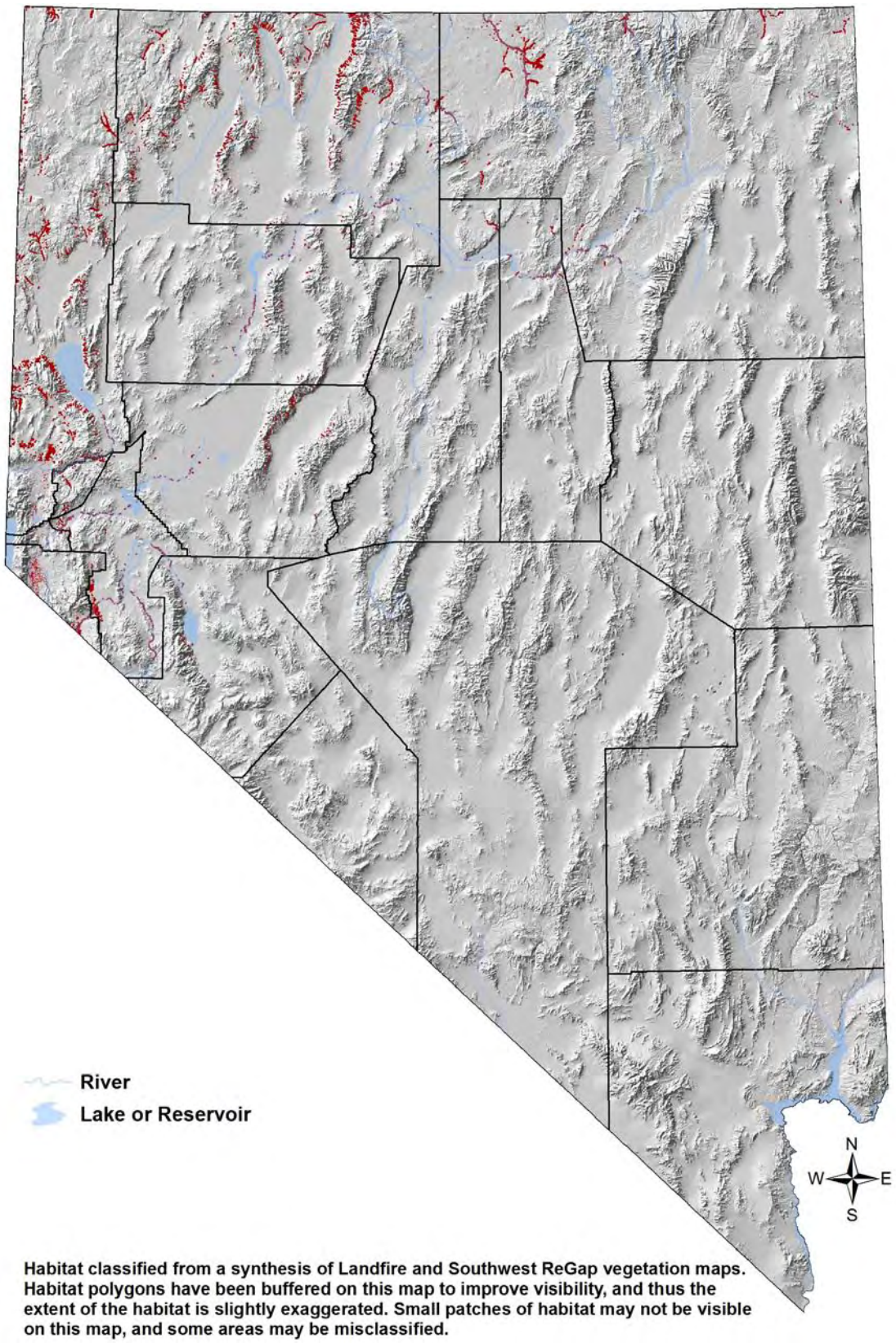
Key Bird-Habitat Attributes

Stand Structure	Multi-aged tree stands with riparian shrub understory, interspersed with groves of dense riparian shrubs (willows and others) and floodplain wetlands
Ideal Scale for Conservation Action	50 ha [125 ac] or more
Plant Species Composition	Mixed stands of cottonwood and tree willow with multiple species of shrubs as understory; tree willows especially productive for birds
Plant Condition	Connection to groundwater critical for riparian woodlands; dying off of shrubs or young trees often first sign that connection to water is being lost
Mosaic	Patches with saturated soils and presence of river-associated wetlands are highly beneficial
Connectivity with Uplands	A buffer of 500 m [1,600 ft] or more is desirable around riparian corridors to accommodate transitional habitats (e.g. buffaloberry) and access by upland bird species
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	15,500 ha [38,300 ac] 0.05% of state
Landownership Breakdown	Private = 77% BLM = 12% Tribal = 3% Other = 8%
Priority Bird Species	Snowy Egret Bald Eagle Swainson's Hawk Sandhill Crane Yellow-billed Cuckoo White-throated Swift Rufous Hummingbird Willow Flycatcher (Cinnamon Teal) (Northern Pintail) (Greater Sage-Grouse) (American White Pelican) (Willet) (Short-eared Owl)
Indicator Species	Yellow Warbler (breeding) Wilson's Warbler (migration)
Most Important Conservation Concerns	Surface water diversions, impoundments Flood control Livestock, wild horse and burro grazing Invasive weeds Urban, suburban, and industrial development Biocontrol activities Climate change (change in precipitation and temperature) Groundwater pumping
Habitat Recovery Time	25 years
Regions of Greatest Conservation Interest	Truckee, Carson, Walker, and Humboldt rivers, and multiple smaller streams and rivers, such as Mary's, Reese, Little Humboldt, Quinn and King's rivers
Important Bird Areas	Boyd Humboldt Valley Wetlands Carson River Delta Carson Valley Lahontan Valley Wetlands Mary's River Monitor Valley North Ruby Valley Washoe Valley

Great Basin Lowland Riparian



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Great Basin Lowland Riparian

Overview

Although they only cover about one-half percent of the Nevada landscape, lowland riparian woodlands in the Great Basin have historically supported a large proportion of its bird species. Riparian-obligate breeding birds are most often thought of in this context, but it should also be noted that riparian woodlands are perhaps the most important migration stop-over habitat for many other landbird species that pass through the Great Basin. Riparian habitat, in addition, provides benefits to some upland birds, such as Greater Sage-Grouse, Rufous Hummingbird, and Brewer's Sparrow, in the form of sheltering and foraging opportunities. Additionally, upland vegetation located adjacent to riparian zones may be more "lush" than normal because it can access groundwater, and may therefore be especially suitable for some upland birds. Finally, the rivers that support significant fish populations are important for birds such as American White Pelican, Snowy Egret, and Bald Eagle, that wander throughout the Great Basin during the post-breeding, migration, or winter seasons in search of productive fishing areas.

Great Basin Lowland Riparian habitat is distinct in several ways from Mojave Lowland Riparian habitat, which is treated separately (p. Hab-11-1). Dominant tree species in Great Basin systems include Fremont cottonwood (*Populus fremontii*), narrowleaf cottonwood (*P. angustifolia*), and various willows (*Salix* spp.). Other riparian shrubs, trees and a large variety of sedges, rushes, grasses and forbs are also found in intact systems, and a diverse plant species composition is likely important for maintaining the richest possible bird community. Recent reviews of the historic changes in the bird communities of the lower Truckee and Carson Rivers (Ammon 2002, Ketner and Ketner 2002) indicate that the widespread loss of riparian woodland that occurred over the last century severely impacted riparian birds. These reviews, along with recent data from the Walker River (GBBO unpublished data), also indicate that the loss of riparian-associated wetlands, such as oxbows, backwaters, and sloughs, is a major cause of reduced bird species richness. Therefore, the restoration of riparian shrub thickets, gallery forests, and floodplain wetlands are all critical for optimizing habitat for Nevada's riparian birds.

The key feature of intact, healthy lowland riparian habitats is a high diversity of microhabitats, including old-tree groves, shrub thickets, shrub willow, early-successional woodlands, sedge and forb meadows, oxbows and backwaters, and transitional mesic shrubs along the periphery of the riparian corridor. In combination, these elements support birds with a diverse array of habitat needs and food requirements (Figure Hab-8-1). Fortunately, if a river system has a natural or semi-natural hydrological regime, sufficient water flows, and is not channelized, it can usually generate and maintain a desirable microhabitat mosaic as a result of natural dynamic processes. Achieving these prerequisites, however, is challenging in many settings.

Great Basin Lowland Riparian

Main Concerns and Challenges

The following top nine conservation concerns were identified in our planning sessions for Great Basin lowland riparian habitats in Nevada:

- Surface water diversions, impoundments
- Flood control
- Overgrazing by livestock, wild horses and burros
- Invasive weeds
- Urban, suburban, and industrial development
- Biocontrol activities
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Groundwater pumping

Historical losses of riparian habitat throughout the West have been well-documented (Ohmart 1994), and Nevada is no exception. For instance, along the lower Truckee River corridor, an estimated 80% of the original riparian habitat cover has been lost (Otis Bay Environmental Consultants, *pers. comm.*) to surface water diversions, impoundments, channelization, and habitat conversion to agricultural and urban uses, and we suspect this pattern is fairly typical of other major rivers in the state. Continued demands on water, particularly given the prospect of a warmer climate with less winter precipitation, will continue to pose significant challenges to resource managers. In addition, riparian habitats are susceptible to compounded threats. For instance, water diversions and flood control engineering often disconnect the river channel from its floodplain, leaving riparian vegetation "high and dry", and creating conditions largely unsuitable for germination of seedlings. At the same time, overgrazing may further degrade remaining habitat, while urban or agriculture development converts it.

Habitat protection efforts (ensuring sustainable grazing levels, engaging in weed control, revegetation with native species, etc.) are probably best directed towards riparian reaches where floodplain connectivity and hydrological dynamics are still relatively intact, or where they can potentially be restored. Significant riparian restoration efforts of this sort are underway along the Truckee River and other riparian systems in Nevada, and careful planning and implementation of similar projects may lead to some recoveries of historic bird habitat.

One new concern has only recently surfaced related to a biocontrol agent, the tamarisk beetle, that has been deployed to combat tamarisk (saltcedar) invasion. The beetle, which defoliates large stands of saltcedar, has been released throughout riparian areas in the Great Basin portion of Nevada. While saltcedar control is an understandable objective of riparian management, our concern lies in the apparent lack of recovery of native riparian vegetation following defoliation of saltcedar. The treated sites appear to remain dominated by dead or dying saltcedar "skeletons", which render the site unsuitable for most riparian associated birds. In the affected areas, active revegetation with plantings will likely be necessary to recover native habitat in a reasonable time frame.

Great Basin Lowland Riparian

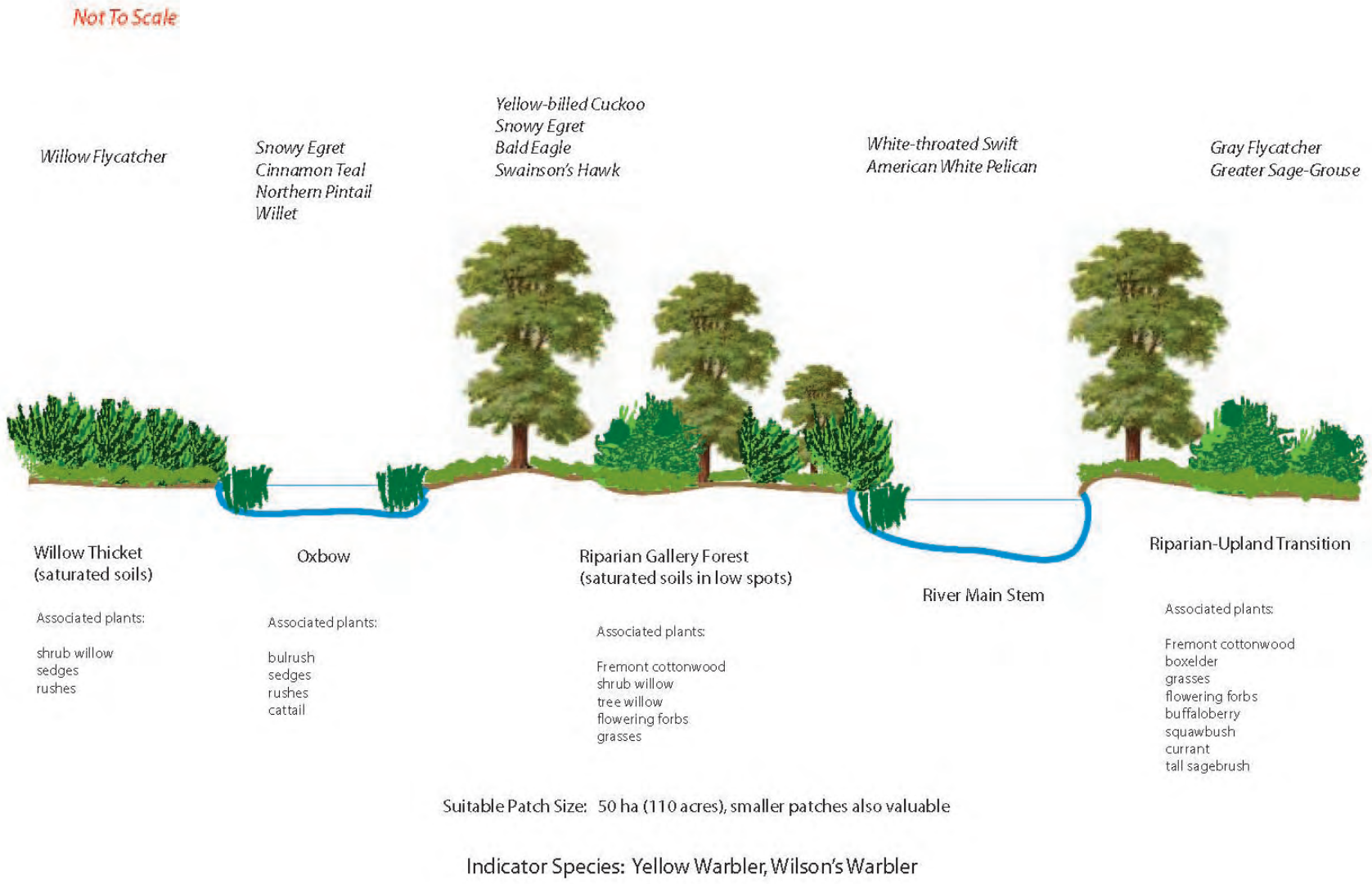


Figure Hab-7-1: Idealized Great Basin lowland riparian landscape to maximize the number of riparian associated priority bird species.

Great Basin Lowland Riparian

Conservation Strategies

Habitat Strategies

- **Manage at a landscape scale (> 50 ha or [125 ac]),** but smaller patches are also valuable if intact. Maintain or restore a mosaic of open, mixed-age tree canopy, riparian shrub thickets, flowering shrubs and forbs, and interspersed floodplain wetlands. High species richness in plants and presence of willows are particularly beneficial. Patch sizes within the mosaic may be small (0.1 – 0.4 ha [0.25 - 1 ac]), but the overall riparian and wetland corridor should be contiguous.
- Old-growth trees are important to several Priority species, but the overall value of a patch is most often improved by adding a **native riparian shrub and wetland** component
- Riparian areas near urban or rural settlements in particular attract feral cats and other predators. Strategic plantings of particularly **impenetrable shrubs** (e.g., wild rose) are useful for discouraging opportunistic predators and cowbirds.
- Presence of nearby **cliffs** (> 30 m, [100 ft]) tall raises the value of a site for bird conservation
- Removal of invasive plants, such as tamarisk (salt cedar), Russian olive, or tall whitetop, should be immediately followed by **active restoration of native riparian vegetation** in treatment areas, as weedy species often take advantage of recently disturbed soils
- Maintain **grazing activity** at levels that do not permanently impact the shrub and forb understory or cause soils to be exposed
- The majority of Priority bird species nest between **May 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when intensive treatments or potentially disruptive activities should be largely avoided

Research, Planning, and Monitoring Strategies

- Given the value of any riparian patch to overall species conservation, **habitat restoration opportunities** should be aggressively explored, in collaborative efforts between agency and private partners, for **all regions and all stream sizes.** In particular, the Humboldt River system and its smaller tributaries appears to have significant restoration potential

Public Outreach Strategies

- **Promote public appreciation** of healthy lowland riparian habitat and its bird communities, particularly with regard to native understory vegetation and their potential impacts. Outreach through fishing and other outdoor-recreation groups, as well as through urban open space planning, may be particularly effective

Joshua Tree



Joshua tree and *Yucca* landscape,
Esmeralda County.
Photo by Elisabeth Ammon.

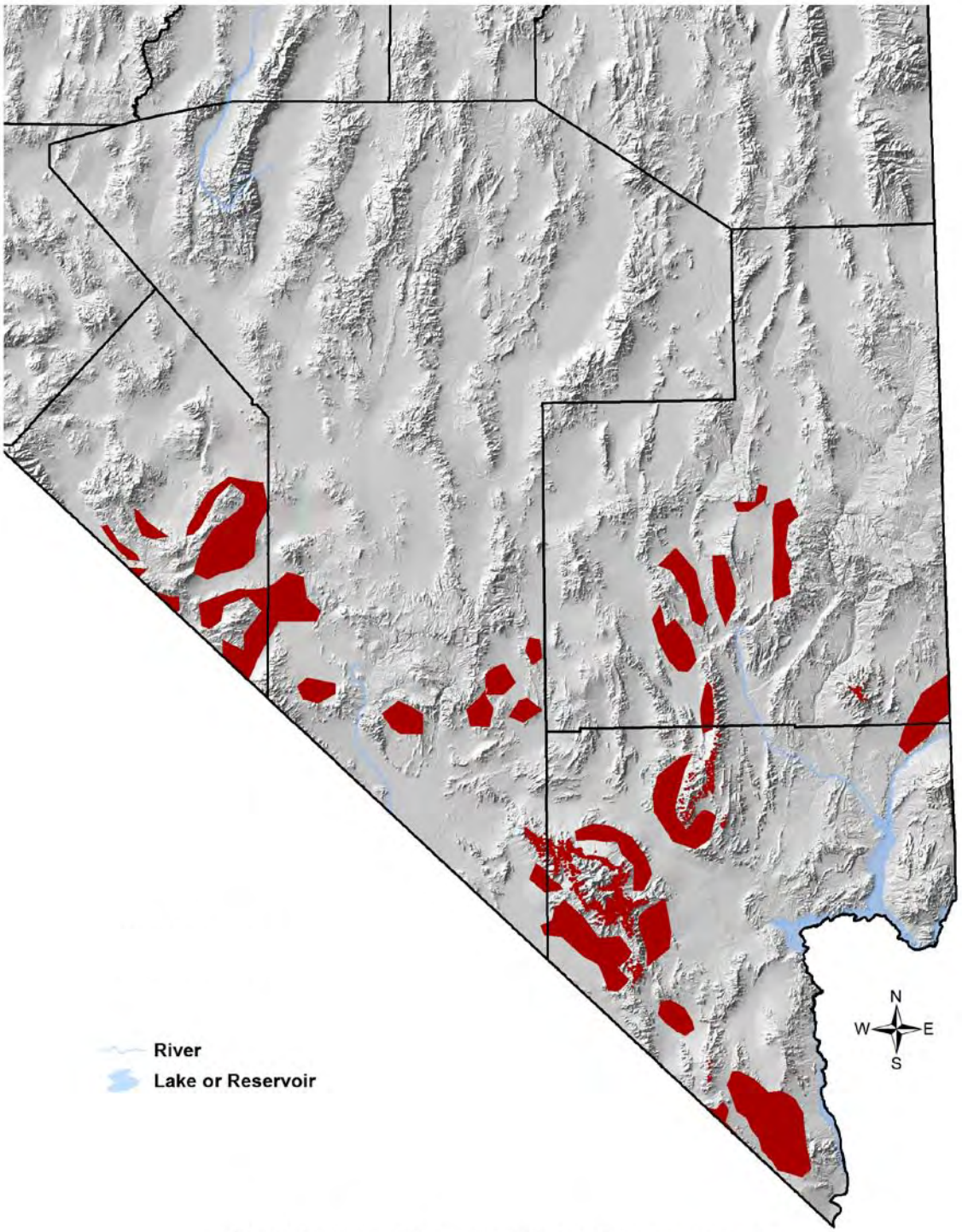
Key Bird-Habitat Attributes

Stand Structure	Multiple species of shrubs in a park-like setting; Joshua trees and other *Yuccas*; older larger Joshua trees and *Yuccas* useful to some Priority species; healthy shrub understory and litter layer for foraging opportunities
Ideal Scale for Conservation Action	> 200 ha [500 ac]
Understory and Invasive Species	Species-rich shrub understory, ideally with flowering forbs and shrubs; invasive plants detrimental
Fire Regime; Invasive Plants	Fire prevention important; invasive plants increase risk of fire and should be managed aggressively in this habitat type
Distance to Riparian/Spring Habitats	Proximity of water features increases habitat value to birds
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	626,000 ha [1,547,000 ac] 2.2% of state
Landownership Breakdown	BLM = 72% FWS = 10% DOD = 7% DOE = 5% Other = 6%
Priority Bird Species	Costa's Hummingbird Gilded Flicker Bendire's Thrasher Le Conte's Thrasher Black-chinned Sparrow (Golden Eagle) (Prairie Falcon) (Burrowing Owl)
Indicator Species	Cactus Wren Scott's Oriole
Most Important Conservation Concerns	Climate change (change in precipitation temperature) Increased fire frequency/intensity Invasive plants Urban, suburban, and industrial development Motorized recreation Livestock, wild horse, and burro grazing
Habitat Recovery Time	150-200 years
Regions of Greatest Conservation Interest	Clark, Esmeralda, and southern Nye, Lincoln counties
Important Bird Areas	Lake Mead Pahranagat Valley Complex Spring Mountains Desert NWR Wee Thump Joshua Tree Forest

Joshua Tree



Habitat classified by from broad-scale Joshua Tree maps provided by USGS (Todd Esque, pers. comm.). Some areas may be misclassified.

Joshua Tree

Overview

In this plan, Joshua Tree (*Yucca brevifolia*) habitat includes all Mojave mid-elevation mixed scrub that supports Joshua trees, other *Yucca* species, and cactuses. The overriding conservation challenge associated with this habitat type is its long recovery time (150-200 years), meaning that once habitat is destroyed, it is unlikely to be recovered within time frames relevant to ongoing conservation planning. Any loss of Joshua Tree habitat should therefore be considered functionally irreversible, and should be avoided whenever possible. Of particular concern are invasive plants that increase vulnerability to fire (particularly red brome, *Bromus rubens*), and ignition of fires by humans (Brooks and Matchett 2006). Particular areas of interest for protection include the McCullough and Newberry Mountains in southern Clark County, because they contain the full suite of Priority species for this habitat type (Beason and Jentsch 2001). Other Joshua tree areas have not yet been as well-inventoried as these two mountain ranges, but likely contain areas of bird conservation interest, as well.

A few Nevada species are very strongly associated with Joshua Tree habitat, including two Priority species, Bendire's Thrasher and the very rare Gilded Flicker. For both of these species, Joshua trees, *Yucca*s, and cactuses need to have reached a mature or old-growth stage before they are suitable for nesting. Black-chinned Sparrows occur at the upper elevation range of Joshua Tree habitat where it interfaces with the pinyon-juniper zone and provides a diverse shrub understory. Costa's Hummingbird and Le Conte's Thrasher are additional Priority species that use this habitat type, especially if it occurs in close proximity to ephemeral washes, springs, or riparian areas. The two Indicator species Cactus Wren and Scott's Oriole were selected because they are relatively common birds than can reliably be found in intact, healthy Joshua Tree habitat even when the Priority species are absent. Figure Hab-9-1 illustrates an idealized and compressed version of the Joshua tree landscapes that favor Priority bird species.

Main Concerns and Challenges

The following top seven conservation concerns were identified in our planning sessions for Joshua Tree habitat in Nevada:

- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Increased fire frequency or intensity
- Invasive weeds
- Urban, suburban, and industrial development
- Motorized recreation
- Livestock/wild horse and burro grazing

Traditional concerns for Joshua Tree habitat include loss to development and impacts from motorized recreation, domestic livestock, wild horses, and burros. However, habitat-destroying

Joshua Tree

fire and changes in precipitation and temperature are far more threatening for this habitat type over the longer term. Even though Joshua trees and *Yuccas* are drought-adapted, they require relatively wet conditions for establishment of young plants, which grow very slowly even in ideal conditions (Vamstad and Rotenberry 2010). Survival of young plants, even after establishment, may be greatly compromised by prolonged droughts (DeFalco et al. 2010). Invasion by annual weeds is a compounding threat for this habitat type, mostly because it increases the risk of large fires, which usually eliminate young Joshua trees and reduce survival of older trees (DeFalco et al. 2010). Furthermore, fires are likely to occur more frequently in weed-infested areas, which may keep native plants from ever reaching the late-successional stages (Vamstad and Rotenberry 2010) required by Bendire's Thrasher and Gilded Flicker. Several large fires destroyed significant amounts of Joshua Tree habitat in the mid-2000's, and efforts should be made to prevent further losses wherever possible.



Nevada Bird Count transect in Joshua Tree habitat. Photo by Jen Ballard.

Joshua Tree

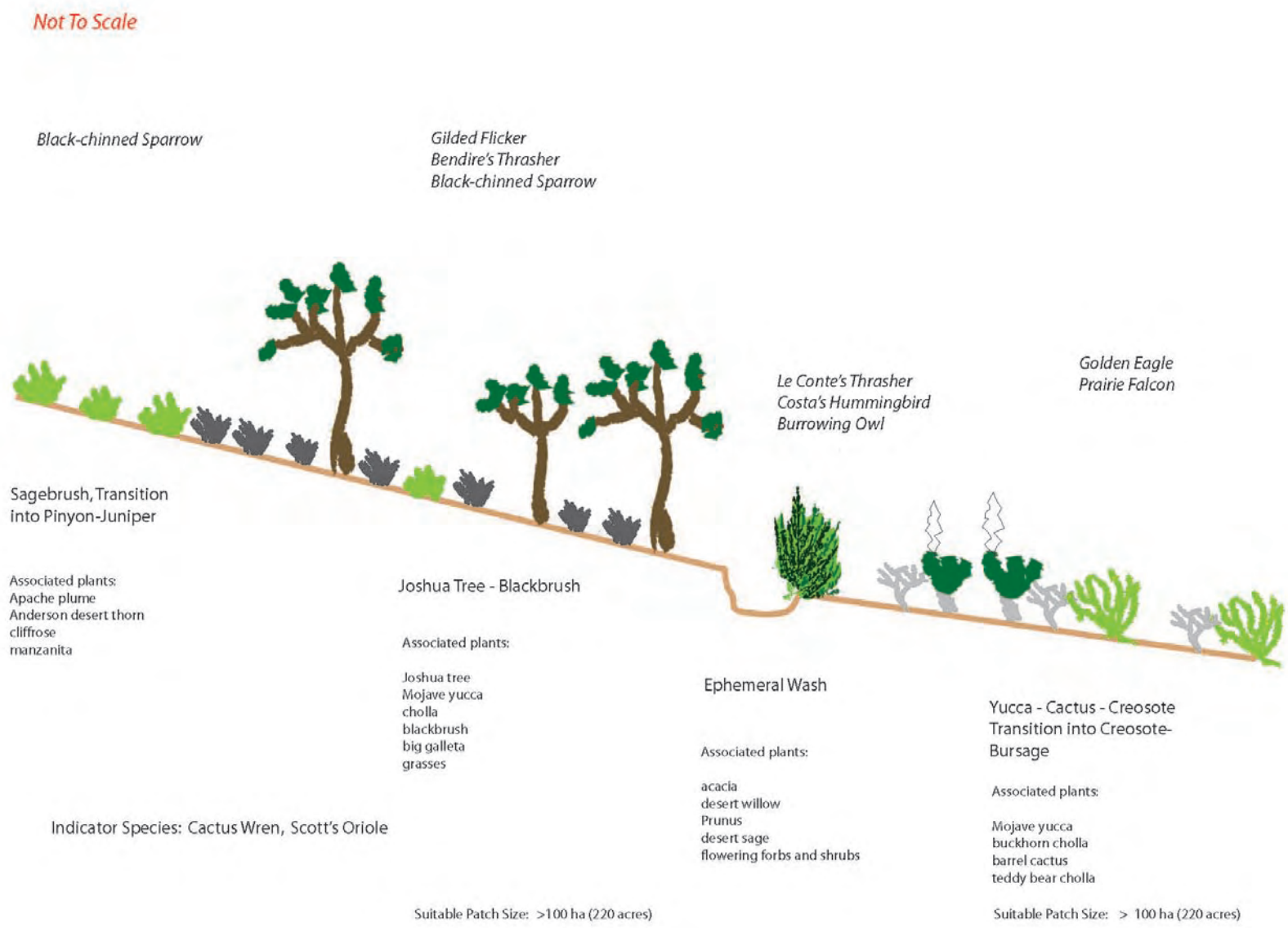


Figure Hab-8-1: Idealized Joshua tree landscape to maximize the number of Joshua tree associated Priority bird species.

Joshua Tree

Conservation Strategies

Habitat Strategies

- **Manage at landscape scale (> 200 ha [500 ac])**. High species richness in shrubs, old-growth *Yucca* spp., and cholla cactuses are particularly suitable for birds
- **Aggressive fire prevention** and **weed control** in Joshua Tree habitat are currently the most important stop-gap measures for habitat loss. Fire management and invasive weed control may be coordinated across agencies to be most effective
- Proximity to **ephemeral washes or springs**, presence of **cliffs** > 30 m [100 ft] tall, or **abandoned mines** (which may be gated) raise the priority level of a site for bird conservation. However, due to the long habitat recovery time, we recommend avoiding **all** future losses of Joshua Tree habitat to the maximum extent possible
- Where removal of Joshua trees, Yuccas, and cactuses cannot be avoided, we strongly recommend that they be **replanted in suitable sites**, such as recently-burned Joshua tree areas
- The majority of Priority bird species nest between **April 1 and July 1**, and some of them are sensitive to nest disturbance, which should be minimized when possible

Research, Planning, and Monitoring Strategies

- Joshua tree stands in Nevada are not fully mapped yet. We recommend that Clark County's Desert Conservation Program's current effort to map these habitats in Clark County be expanded into Nye and Esmeralda counties through a multi-agency inventory effort, and further that other Joshua Tree mapping efforts underway by USGS be used to generate the best possible GIS maps of Joshua tree occurrence, density, and condition
- **Monitoring stand conditions and habitat loss** will be critical for effective adaptive management efforts in light of climate change and increased fire frequency. Therefore, we recommend that a comprehensive monitoring plan for Joshua Tree habitats, perhaps similar to forestry monitoring practices, be developed and implemented
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count
- **Research the effects of new threats**, such as new invasive weeds, motorized recreation, and climate change to determine the most effective management strategies

Public Outreach Strategies

- **Promote public appreciation** of healthy Joshua Tree – *Yucca* landscapes and bird communities, particularly with regard to native understory vegetation and threats from off-road vehicle recreation

Marsh



Marsh along the Lower Truckee River, Washoe County. Photo by Elisabeth Ammon.

Key Bird-Habitat Attributes

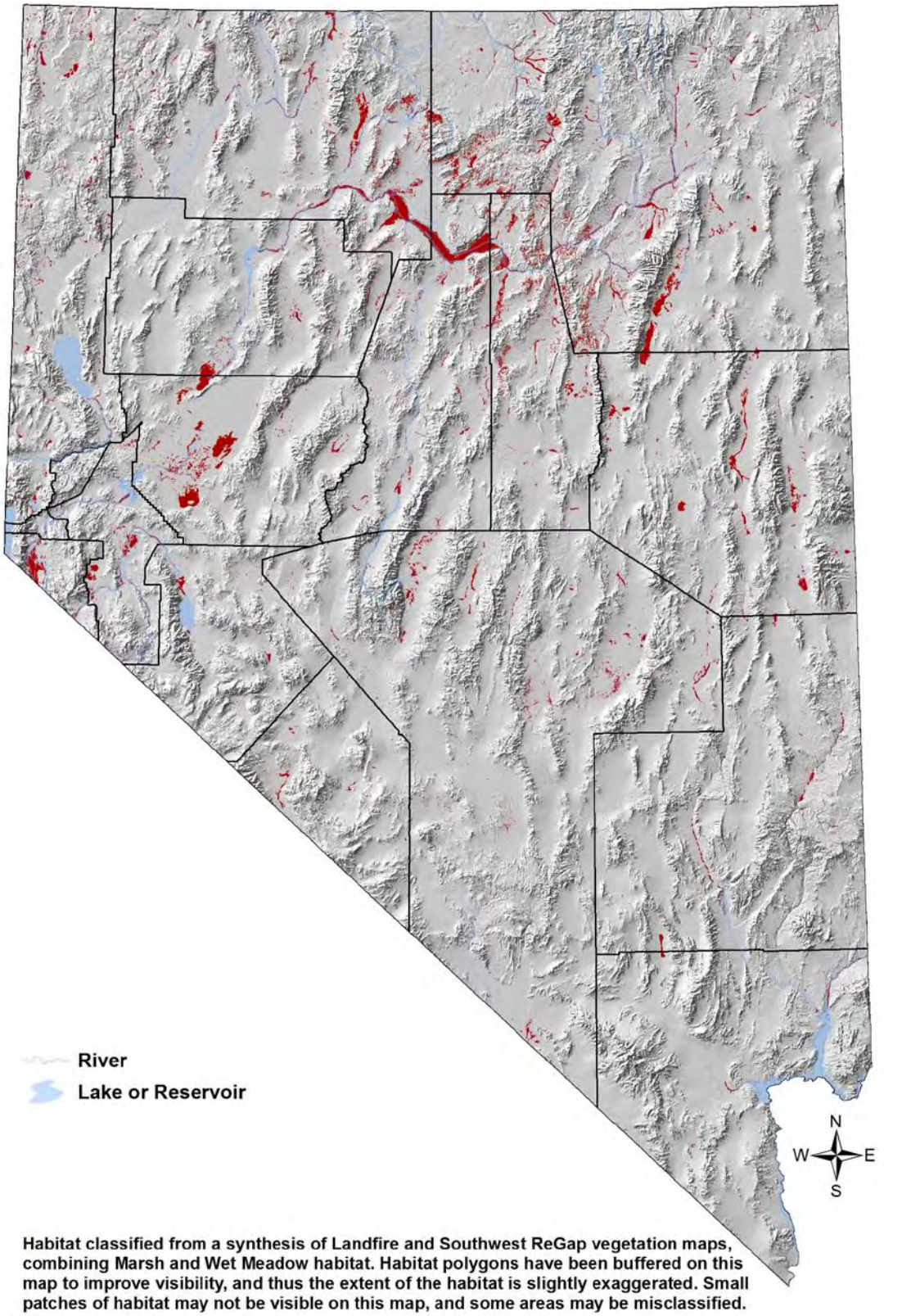
Plant Species Composition	Multi-species emergent and submerged vegetation, particularly with bulrush in deep sections and rushes and sedges at shorelines
Ideal Scale for Conservation Action	Marsh complexes > 5 ha [12 ac] ideal, but 1 ha [2.5 ac] and smaller patches useful also; > 100 m buffer of native vegetation around most shorelines ideal
Emergent Vegetation Cover	Mosaic of approximately 1:1 ratio of open water and emergent vegetation (hemi-marsh), with more open water in deeper sections
Hydrology	Marshes with inflow and outflow system ideal, but terminal marshes also valuable; permanent water ideal, or seasonal flooding during much of the year
Other Features	Islands particularly beneficial, especially in larger wetlands; sedge islands (semi-submerged) and islands with dry vegetation both useful

Conservation Profile

Estimated Cover in Nevada	35,500 ha [87,800 ac] 0.1% of state
Landownership Breakdown	Private = 41% Undesignated waterbodies = 18% BLM = 12% BOR = 11% Other = 18%
Priority Bird Species	Trumpeter Swan Tundra Swan Cinnamon Teal Northern Pintail Canvasback Redhead Lesser Scaup Eared Grebe Least Bittern (Mojave) Snowy Egret White-faced Ibis Clapper Rail (Mojave) Sandhill Crane Willet Marbled Godwit (western Nevada) Long-billed Dowitcher Wilson's Phalarope Franklin's Gull Black Tern Tricolored Blackbird (Carson Valley) (Willow Flycatcher and four other Priority species use marshes secondarily)
Indicator Species	None needed
Most Important Conservation Concerns	Surface water diversion and impoundments Groundwater pumping Climate change (change in precipitation and temperature) Livestock, wild horse and burro grazing Recreation
Habitat Recovery Time	5-10 years
Regions of Greatest Conservation Interest	Churchill, Humboldt, Washoe, Elko, Clark counties; Nye and Lincoln counties
Important Bird Areas	Carson Valley, Boyd Humboldt Valley Wetlands, Ruby Lake, North Ruby Valley, Boyd Humboldt Valley Wetlands, Franklin Lake, Lahontan Valley Wetlands, Carson River Delta, Washoe Valley, Swan Lake, Mary's River, Monitor Valley, Ash Meadows NWR, Pahranagat Valley Complex, Moapa Valley, Virgin River, Oasis Valley

Marsh

Map shows <u>combined</u> extent of Marsh and Wet Meadow habitat types



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps, combining Marsh and Wet Meadow habitat. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Marsh

Overview

Marshes with emergent vegetation and permanent water occupy just a tiny fraction of Nevada, but, along with open water bodies, they support more Priority species than any other habitat type, as can be readily determined by examining the Conservation Profile table. Many of the Priority waterfowl species use marshes and their shorelines for nesting, and then shift to larger open water bodies for migration and wintering. In addition to the large number of Priority species that are wetland obligates, many upland birds also use marshes periodically for foraging, shelter, or access to water. Riparian / marsh landscape complexes are critical strongholds for birds in Nevada and should therefore be considered among the overall highest priorities for habitat conservation. In the marsh setting, intact emergent vegetation such as alkali and hardstem bulrush, sedges, and rushes are major determinates of bird-habitat value. Also, sago, horned, and Richardson's pondweeds, water buttercup, milfoil, widgeon grass, pickleweed, Olney three-square and other aquatic and emergent vegetation are important to some Priority species, particularly waterfowl (Kadlec and Smith 1989).

An "ideal" marsh for birds consists of approximately equal proportions of open water and emergent vegetation, and aquatic bird usually prefer that emergent vegetation stands contain patchy open water inclusions. Islands are especially valuable for nesting and resting for many species because they are free of terrestrial predators. Therefore, restored or artificial wetlands should be designed, where possible, to incorporate emergent or dry islands near the center of the marsh, surrounded by relatively deep water (Picman et al. 1993). Our patch size recommendation for marsh conservation is ≥ 5 ha [11 ac] (Brown and Dinsmore 1986), although smaller marshes also have bird habitat value, particularly in more arid areas where they may be a critical resource for upland birds. In a landscape context, connectivity of marshes with other mesic habitats, including additional marshes, open waterbodies, wet meadows, riparian areas, and agricultural areas is very desirable, and should factor into conservation prioritization and restoration design. In Figure Hab-10-1, we illustrate an idealized marsh landscape that shows important habitat features that support conservation priority species.

The hydrology of a marsh can be critical for bird conservation. Ideally, a marsh will be fully inundated and have a stable water level during the period when most birds are nesting, and water levels will remain reasonably high throughout the fall migration period. However, where marshes become overgrown due to lack of natural disturbances, or where invasive plants are a problem, occasional water draw-downs, mowing, or prescribed fire, followed by re-inundation (> 20 cm [8 in] depth) can be effective treatments (Kadlec and Smith 1989). We also encourage land mangers to actively pursue opportunities for creating shrub willow habitat in saturated wetland soils (recommended patch size > 0.4 ha [1 ac], but smaller patches are useful, too), as this habitat element has been historically lost to agricultural uses in many wetland sites. The Willow Flycatcher's dramatic decline in historic times, both in the southwest and the Great Basin, is most likely attributable to widespread losses of this habitat feature.

Marsh

Main Concerns and Challenges

The following top six conservation concerns were identified in our planning sessions for marshes in Nevada:

- Surface water diversion and impoundments
- Groundwater pumping
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Livestock, wild horse and burro grazing
- Recreation

Marshes, of course, require water in order to function as marshes, and therefore the first four conservation concerns are all related to maintaining sufficient water supplies. They include water diversions, which were mostly engineered long ago but which continue to impact the amount of water available to marshes, as well as more recently developing concerns about the impacts that climate change may have on the overall water supply. All of these factors are related to one another, and collectively they will determine the amount of water that eventually finds its way into marshes. Unfortunately, this amount of water will be limited, and therefore it is important to determine how to prioritize our efforts to conserve and restore marshes. Our conservation recommendation is to focus protection and enhancement efforts on sites that can be sustained in the long term. Additionally, although all marshes are valuable, the greatest conservation return can be realized by adding effective acreage to existing wetland or wetland/riparian complexes, as opposed to protecting or restoring smaller, more isolated marshes.

Where overgrazing occurs, it can have detrimental effects on marsh vegetation and local impacts on breeding birds, but this issue is less of a concern than it is in riparian areas. Likewise, recreational use may have impacts, but these are usually local in nature.

Marshes, along with riparian woodlands, differ from most other focal habitat types in two important ways that bear consideration. First, they are largely privately owned. Although Nevada's most productive marsh complexes are already protected in NWR's and WMA's, there is significant potential to conserve birds by engaging in a concerted and sustained effort to form partnerships and stewardship agreements with private landowners. The Tricolored Blackbird's only regular Nevada breeding location, which is privately owned and not formally protected, is a case in point. Partnerships can be accomplished through vehicles like the Nevada Important Bird Areas program, or the public outreach offices of resource management agencies. Second, marshes respond quickly and positively to well-planned enhancement or restoration efforts. Ideally, these would occur in high priority landscapes, as described above, but there is also value in seizing opportunities to create (or re-create) marshes wherever water supplies become available.

Marsh

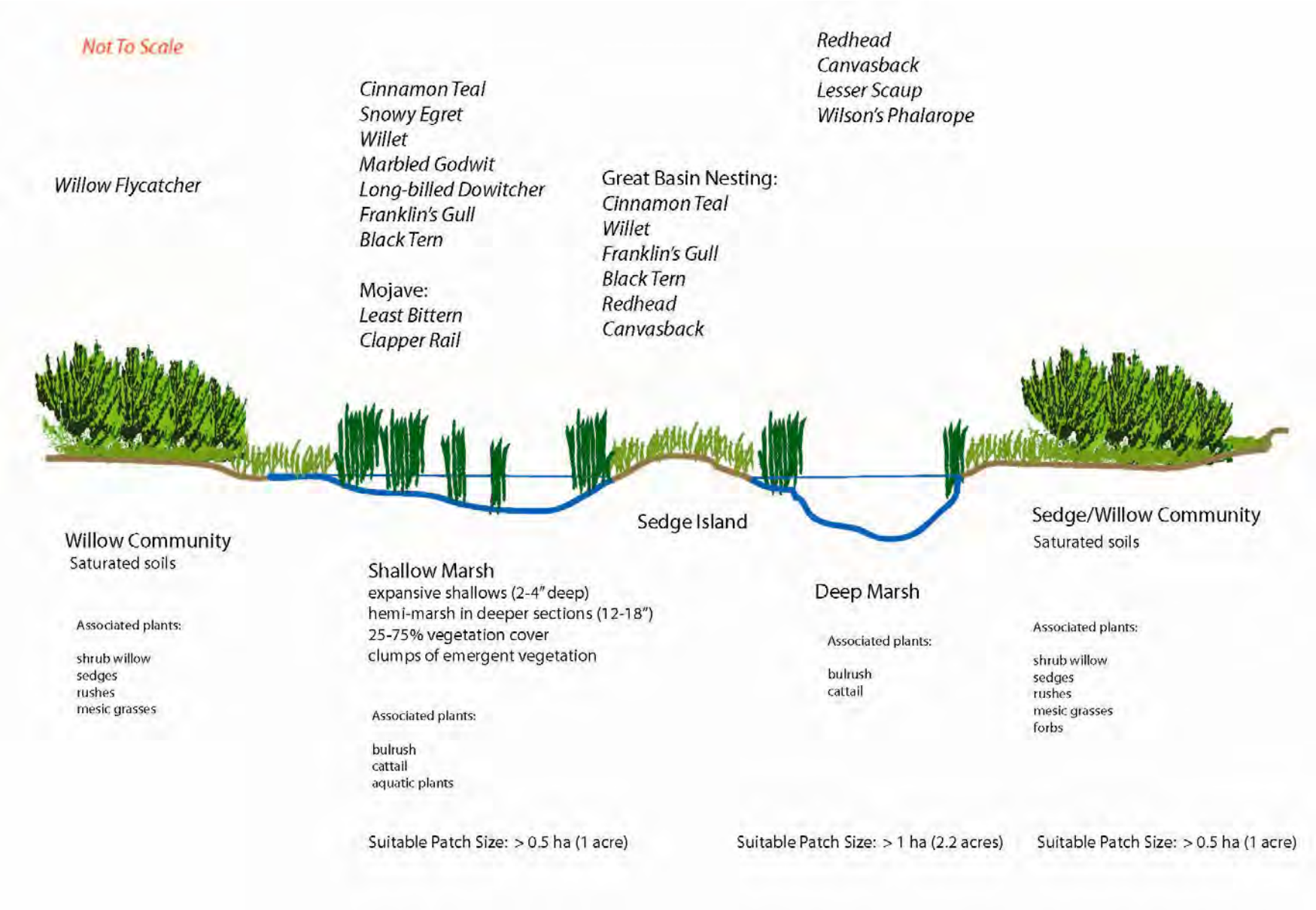


Figure Hab-9-1: Idealized marsh landscape to maximize the number of marsh associated Priority bird species.

Marsh

Conservation Strategies

Habitat Strategies

- **Manage at the scale of the entire wetland or wetland complex** that can be supported by available water. Small patches are also valuable, but ideal patch sizes exceed 1 ha [2.5 ac]. Buffers of native vegetation around marshes are beneficial for many bird species
- **Islands** are particularly valuable in marsh complexes and should be protected from disturbances during the breeding season, and possibly during migration
- **Intensive agricultural practices**, such as sustained grazing and heavy pesticide use, should be avoided because they increase the risk of weed invasion and negatively impact water quality
- Proximity to **other marshes, open water, riparian areas, springs, wet meadows** and **cliffs** > 30 m [100 ft] tall raise the priority level of a site for bird conservation.
- Hydrology of the wetland ideally features **year-round (or near year-round) inundation** with an **inflow/outflow system,** but terminal marshes that are semi-permanent from spring runoff are also valuable
- The majority of priority bird species nest between **May 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when intensive treatments or heavy land uses should be largely avoided, and when water levels should remain stable whenever possible

Research, Planning, and Monitoring Strategies

- Develop a comprehensive, statewide wetlands conservation strategy that seeks out **all opportunities** for protecting existing wetlands (particularly in **Important Bird Areas**), and expanding wetland acreage in areas where these can be sustained in the long term. **Close coordination** among resource management agencies, private landowners, and other organizations will be necessary for maximum effectiveness.
- A comprehensive **inventory of all wetland systems** of Nevada, including small habitat patches, has not been completed in recent times, and will be necessary for documenting wetland losses and effects of climate change.
- Continue and increase **long-term monitoring of aquatic birds, shorebirds, and marshbirds** statewide through existing programs (NWR and WMA counts, NDOW and USFWS aerial waterfowl, shorebird, and colonial waterbird surveys, and the Aquatic Bird Count program), and explore mechanisms to share and integrate data produced by different monitoring programs

Public Outreach Strategies

- **Promote wildlife-friendly wetland practices** with **private landowners** and agencies. Highlight wetland protection and enhancement as one of the most important overall bird conservation measures that can be implemented in Nevada
- **Promote low-impact recreational uses** to raise public appreciation of wetland resources, using careful outreach and recreational infrastructure planning, including trail design, board walks and observation decks, hunting blinds, and educational material available to visitors.

Mesquite-Acacia



Mesquite bosque near Corn Creek, Clark County.
Photo by Elisabeth Ammon.

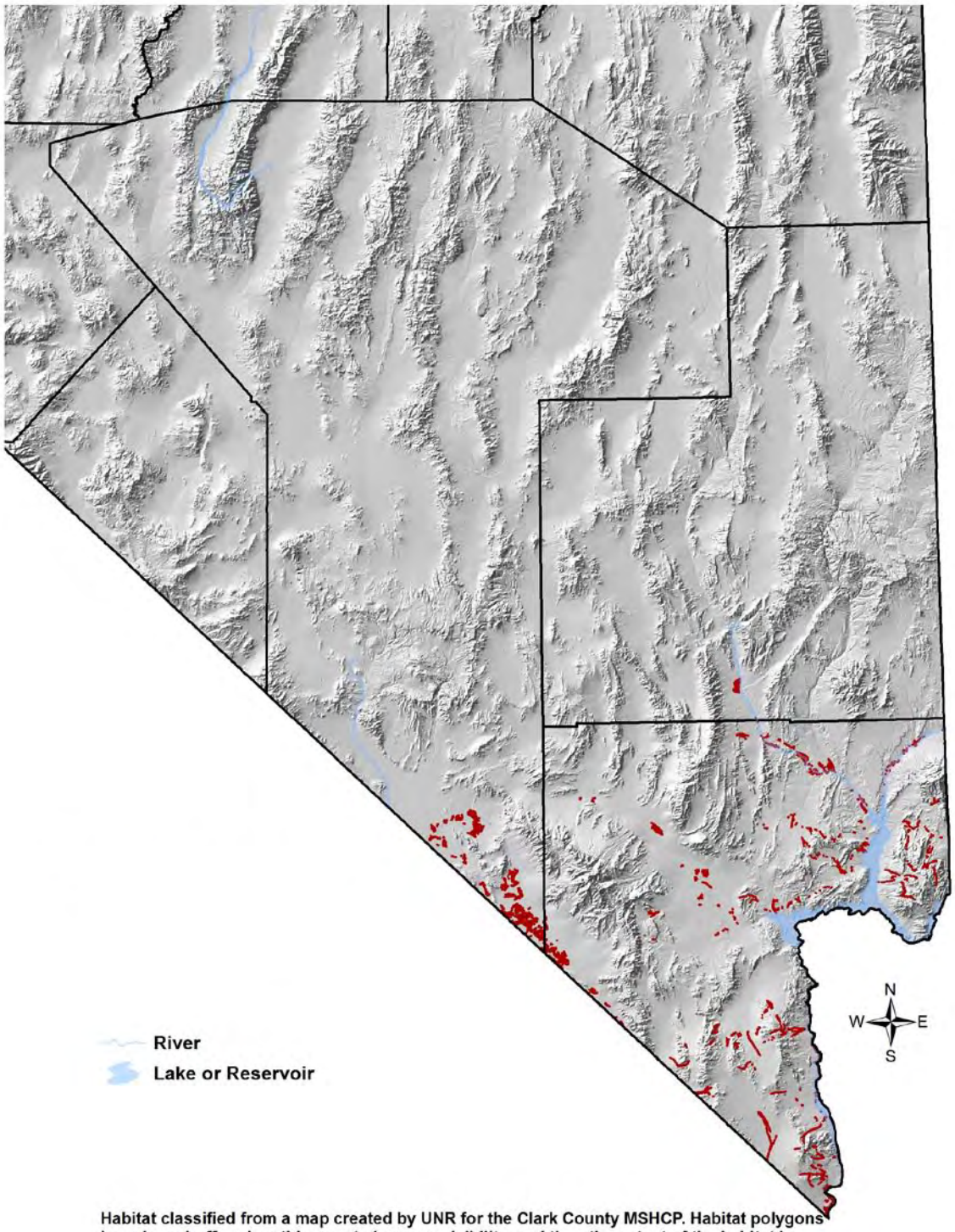
Key Bird-Habitat Attributes

Stand Structure	Multi-aged, open stands of mesquite, acacia, or both, with forb understory
Ideal Scale for Conservation Action	Whole stand (usually 16 – 32 ha [40-60 ac] or more)
Plant Species Composition	Both species of mesquite are useful, areas with tall-growing trees encouraged; mistletoe infections particularly beneficial
Plant Condition	Healthy trees that support mistletoe most useful; shrub and forb understory should be intact, particularly hummingbird plants
Distance to Riparian/Spring Habitats	Proximity of water-dependent habitat increases value to birds
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	11,400 ha [28,200 acres] 0.04% of state
Landownership Breakdown	BLM = 56% Private = 27% FWS = 8% NPS = 7% Other = 2%
Priority Bird Species	Gambel's Quail Costa's Hummingbird Bendire's Thrasher Le Conte's Thrasher Lucy's Warbler Abert's Towhee (Rufous Hummingbird) (Bell's Vireo)
Indicator Species	Phainopepla
Most Important Conservation Concerns	Urban, suburban, and industrial development Invasive weeds Climate change (change in precipitation and temperature) Motorized recreation Livestock, wild horse and burro grazing Increased fire frequency or intensity
Habitat Recovery Time	25 years
Regions of Greatest Conservation Interest	Southern Nye County, Sandy Valley, Las Vegas Valley, southern Clark County
Important Bird Areas	Ash Meadows NWR Catclaw Washes Lake Mead Moapa Valley Virgin River

Mesquite-Acacia



Habitat classified from a map created by UNR for the Clark County MSHCP. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Mesquite-Acacia

Overview

In Nevada, Mesquite-Acacia habitat occurs in generally small patches scattered around the Mojave Desert region. For the purpose of this plan, we do not include mesquite stands that are associated with lowland riparian corridors, which are covered in the Mojave Lowland Riparian account. Most non-riparian Mesquite-Acacia habitat occurs either within ephemeral washes or in "bosques" where trees can access upwelling groundwater. Both types of mesquite-acacia stands are important to a set of Priority species, including Gambel's Quail, Costa's Hummingbird, and Abert's Towhee. Additionally birds that are primarily shrubland inhabitants may benefit from the shelter and foraging opportunities provided by nearby mesquite-acacia stands. Of all birds, however, the Phainopepla, an Indicator species in this plan, is perhaps the best-known avian associate of Mesquite-Acacia habitat. Probably the largest historical concentration of mesquite-acacia in Nevada occurred in Las Vegas Valley, where it has been converted to urban developments in all but a few remnant areas (Krueger 2000). Therefore, preserving remaining patches of non-riparian mesquite-acacia is a high priority. A critical element in determining the value of a mesquite-acacia patch for birds appears to be the presence of mistletoe infections. Birds use mistletoes directly for their berries and for nesting substrate, and they may also take advantage of increased prey density that is likely associated with them. Figure Hab-11-1 illustrates the habitat features that we believe are most important to mesquite-acacia Priority species.

Main Concerns and Challenges

The following top eight conservation concerns were identified in our planning sessions for Mesquite-Acacia habitat in Nevada:

- Urban, suburban, and industrial development
- Groundwater pumping
- Invasive weeds
- Change in precipitation and snowmelt
- Change in temperature
- Motorized recreation
- Livestock, wild horse and burro grazing
- Increased fire frequency or intensity

None of these concerns were ranked very highly, except direct loss of habitat to development. Groundwater pumping was a moderate concern, in that it could reduce the upwellings upon which mesquite bosques rely. Invasive weeds and fire can have local impacts, as can grazing, but these have not been well documented for this habitat type. Off-highway vehicle (OHV) use and firewood gathering may also cause localized habitat degradation. Climate change was listed as a concern, given that non-riparian mesquite-acacia stands exist only where they have access to elevated subsurface moisture. Under a changing climate, subsurface moisture associated with occasional flash flooding events (ephemeral washes) and groundwater upwellings could decline.

Mesquite-Acacia

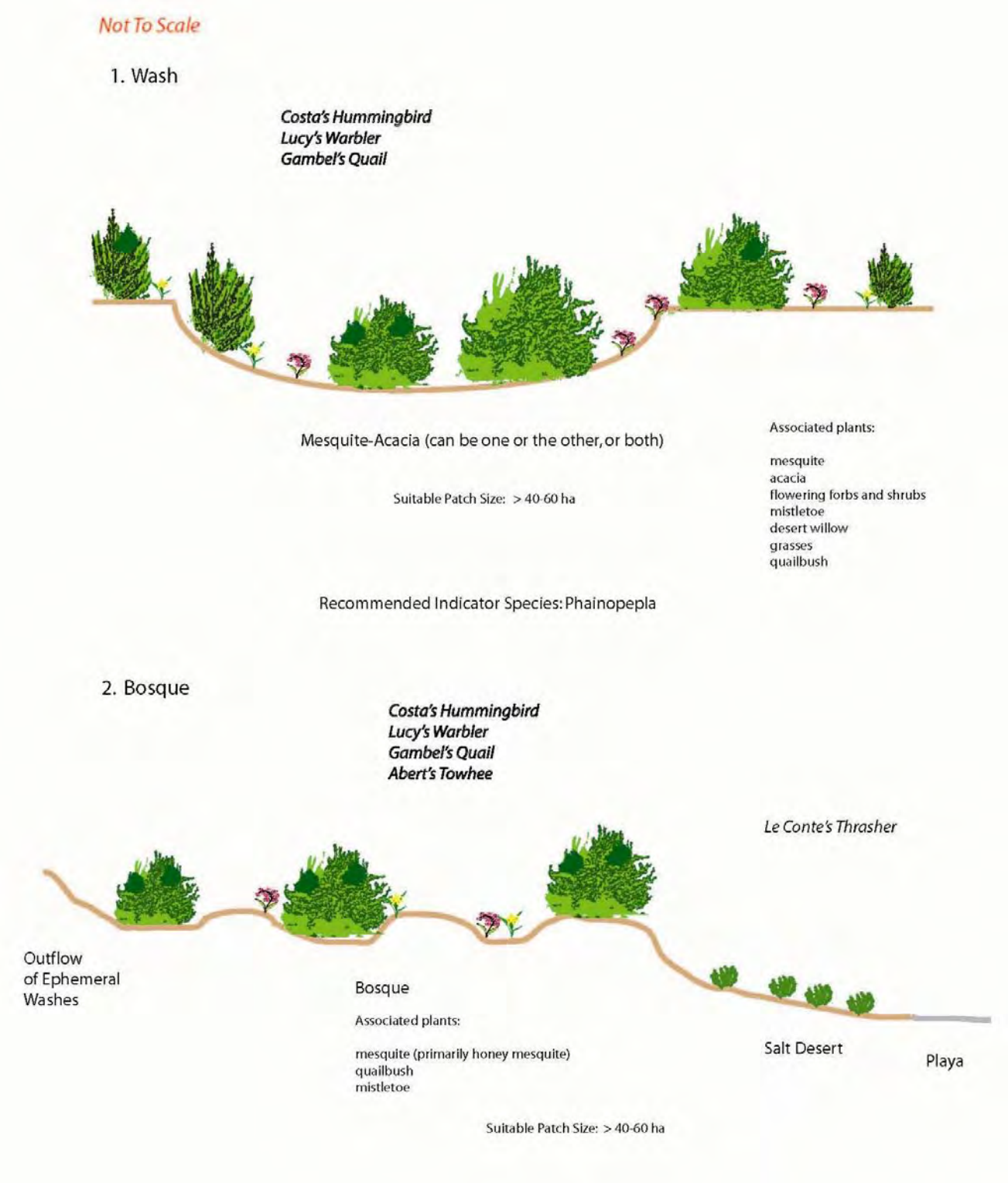


Figure Hab-10-1: Idealized mesquite-acacia landscapes to maximize the number of mesquite-acacia associated Priority bird species.

Mesquite-Acacia

Conservation Strategies

Habitat Strategies

- **Manage at the scale of a whole stand** (usually about 20 ha [50 ac], but larger patches are more valuable) with the goal of maintaining healthy trees, mistletoe infections, and intact understory plants, particularly forbs and shrubs that provide hummingbird resources
- **Prevent habitat conversion** to the extent possible in remaining mesquite-acacia stands
- **Recreation** should be managed to keep motorized uses away from mesquite-acacia stands to the extent possible. Established trails may be placed to avoid the healthiest stands, and alternate shade opportunities may be provided
- Evaluate effects of **local groundwater pumping** on mesquite-acacia viability and pursue opportunities to keep it at non-impact levels
- Urban or rural settlements attract **feral cats and other subsidized predators**. Feral cat colonies should be discouraged in mesquite-acacia areas where possible
- Proximity to **water** (riparian areas, desert springs, wet meadows) and presence of **cliffs** > 30 m [100 ft] tall raise the priority level of a site for bird conservation
- Management of **invasive plants** is useful for this habitat type, as they degrade habitat integrity and may increase fire risk
- Maintain **grazing and OHV use** at levels that do not permanently impact the shrub and forb understory or cause soils to be unnaturally exposed
- The majority of priority bird species nest between **April 1 and July 1**, and some of them are particularly sensitive to nest disturbance. This is the time period when disturbances should be minimized

Research, Planning, and Monitoring Strategies

- **Mitigation opportunities** should be sought throughout the historic range of mesquite-acacia, both for future impacts and for past habitat conversions
- **Monitor mesquite-acacia stands** for adaptive management in light of climate change effects and increased demands on groundwater
- Study **effects of OHV use** on priority landbirds and habitat integrity
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count

Public Outreach Strategies

- **Promote responsible OHV uses and low-impact recreation**, such as hiking, bird-watching, and photography

Mesquite-Acacia



Female Phainopepla. Photo by Scott Page.

Mojave Lowland Riparian



Mojave Lowland Riparian habitat along Lake Mohave, Clark County. Photo by Elisabeth Ammon.

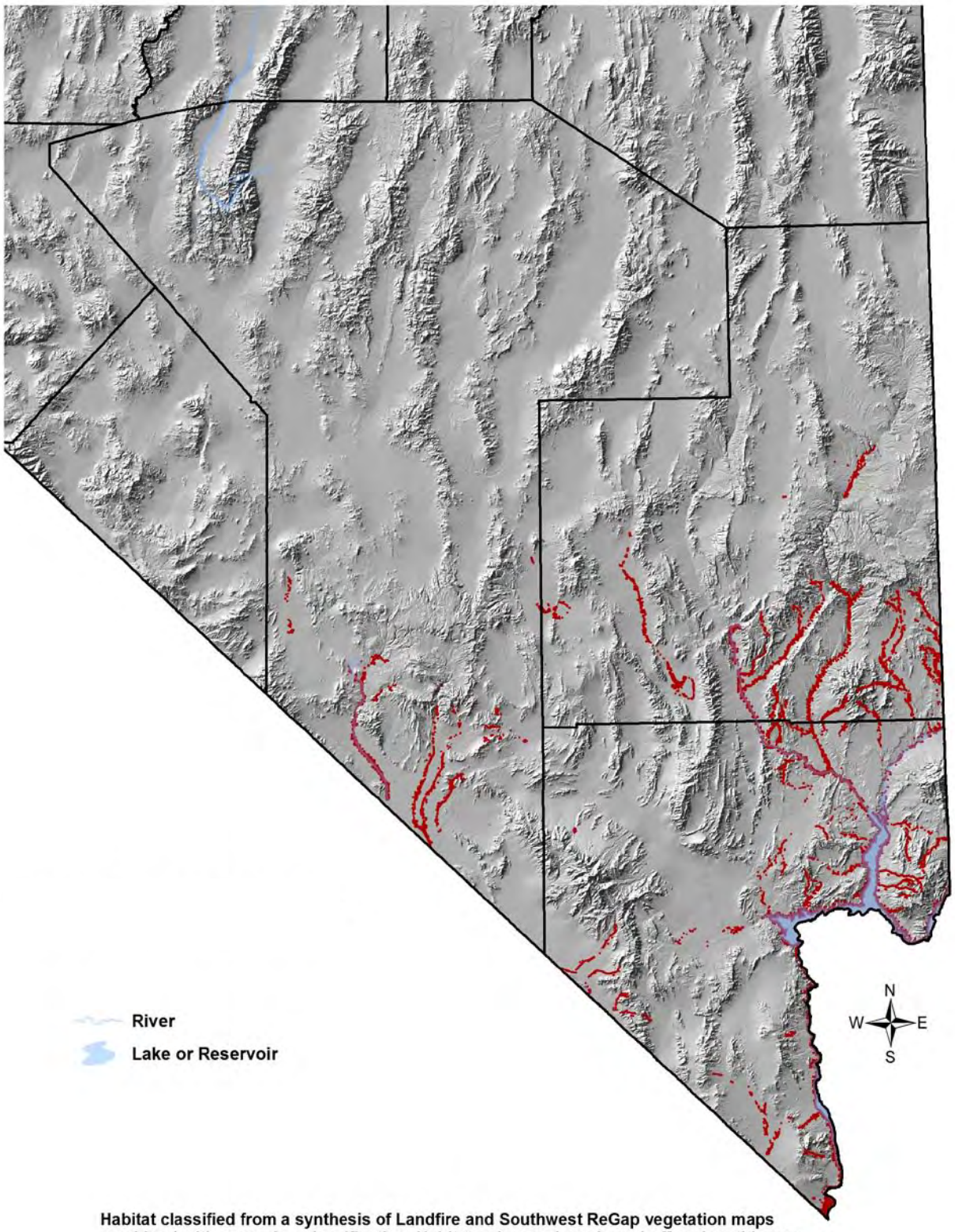
Key Bird-Habitat Attributes

Stand Structure	Multi-aged tree stands with riparian shrub understory, interspersed with groves of dense riparian shrubs (willows and others) and floodplain wetlands
Ideal Scale for Conservation Action	50 ha [125 ac] or more
Plant Species Composition	Mixed stands of cottonwood and tree willow with multiple species of shrubs as understory, with emphasis on willows; tree willows especially productive for birds; saturated soils or patchy wetlands particularly valuable
Snags	Old-growth riparian trees, including snags and large dead branches add nesting opportunities for several Priority species
Salt Cedar	Removal of saltcedar should be followed by immediate revegetation, to the extent possible; tamarisk beetle invasion should be closely monitored and loss of large stands mitigated to the extent possible with revegetation
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	16,150 ha [39,900 ac] 0.06% of state
Landownership Breakdown	BLM = 40% NPS = 36% Private = 8% State Lands = 5% Tribal = 4% FWS = 2% Other = 5%
Priority Bird Species	Gambel's Quail Snowy Egret Swainson's Hawk Yellow-billed Cuckoo White-throated Swift Costa's Hummingbird Rufous Hummingbird Willow Flycatcher Bell's Vireo Lucy's Warbler Abert's Towhee (Least Bittern) (Clapper Rail)
Indicator Species	Yellow Warbler (breeding) Wilson's Warbler (migration)
Most Important Conservation Concerns	Surface water diversion, impoundments, and flood control Invasive plants Biocontrol activities Urban,suburban, and industrial development Groundwater pumping Climate change (change in precipitation and temperature) Livestock, wild horse and burro grazing Increase in fire frequency or intensity Motorized recreation
Habitat Recovery Time	25 years
Regions of Greatest Conservation Interest	Virgin and Muddy Rivers, Lake Mojave and Big Bend of Colorado River, Meadow Valley Wash, Pahranagat Valley, Ash Meadows NWR, and many small spring systems
Important Bird Areas	Ash Meadows NWR Lake Mead Lower Muddy River Meadow Valley Wash Moapa Valley Oasis Valley Pahranagat Valley Complex Virgin River

Mojave Lowland Riparian



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps combined with manual re-classification. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Mojave Lowland Riparian

Overview

Mojave lowland riparian areas have been historical strongholds of bird species richness in Nevada, even though they only cover less than one percent of the Nevada landscape. Ideally, their complex mix of gallery forest, shrub willows, and floodplain wetlands can provide oases of food-rich, cool environments in the desert landscape, and checklists of over 200 bird species are not unheard of for relatively intact sites. Dominant woody species include Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and various species of shrub willows (*Salix* spp.), and, in higher elevations, velvet ash (*Fraxinus velutina*). Other riparian shrubs and trees, such as honey mesquite (*Prosopis glandulosa*), and a variety of native herbaceous plants are also found in intact systems, and their presence is important for Priority species such as Lucy's Warbler. Mojave Lowland Riparian habitats are home to some of the birds of greatest conservation concern in Nevada, such as the Southwestern Willow Flycatcher and Yellow-billed Cuckoo. Additionally, the Elf Owl was historically found in old-growth riparian woodlands at the southern tip of Nevada (Rosenberg et al. 1991) and may be poised for a return as it was recently recorded just outside Nevada in Utah's Washington County (Floyd 2000).

Ideal Mojave lowland riparian landscapes consist of a mosaic of dense shrub willow thickets, groves of riparian trees, backwaters and oxbow wetlands, a dynamic floodplain that maintains different successional stages, and a buffer of intact transitional habitat types, such as quailbush, mesquite, and flowering shrubs (Fig. Hab-12-1). These conditions are most often achieved along streams or rivers that have natural flow regimes, or flows that mimic natural regimes. If flows are significantly altered, the probability of native riparian plant loss and weed invasion, particularly by saltcedar, increases (Merritt and Poff 2010). All rivers in the Mojave Desert of Nevada have been altered to various degrees through surface water diversions, channelization, impoundments, and resulting invasive plants. However, careful weed control efforts, water management, and habitat restoration programs can re-create close-to-historic conditions even in these altered riparian systems, as has occurred (or is occurring) in Ash Meadows NWR, Pahranagat NWR, Key Pittman WMA, and along parts of the Lower Colorado River (LCR MSCP 2004). In addition to pursuing active intensive restoration, we also encourage planners and resource managers to seek out opportunities for natural recovery of riparian habitat patches in smaller, free-flowing systems, such as spring outflows and small tributaries, wherever feasible. Generally this will require that stream flows remain in a semi-natural state, or that these flows can be re-established.

Main Concerns and Challenges

The following top conservation concerns were identified in our planning sessions for Mojave Lowland Riparian habitat in Nevada:

- Surface water diversion, impoundments, and flood control
- Invasive weeds
- Biocontrol activities
- Urban, suburban, and industrial development
- Groundwater pumping
- Change in precipitation and snowmelt related to climate change

Mojave Lowland Riparian

- Change in temperature related to climate change
- Overgrazing by livestock, wild horses and burros
- Flood control
- Increase in fire frequency or intensity
- Motorized recreation

The list of conservation concerns associated with Mojave Lowland Riparian habitat is long and challenging. Given that riparian areas support a disproportionate share of bird diversity, and that they provide crucial migration stopover habitat for landbirds, we are very concerned about any further losses of this habitat, which has already been greatly diminished from historic water development projects and agricultural uses. Several of the top conservations concerns are related in one way or another to maintaining or re-establishing sufficient water flows. Accomplishing this will require concerted effort given the multiple demands on water, along with increasing temperatures and the possibility of reduced precipitation and more frequent droughts.

Starting in the 1970s, lowland riparian areas of the southwest were invaded by saltcedar (tamarisk), following major habitat perturbations such as channelization, impoundments, and surface water diversion (Stromberg et al. 2009). Much has been reported on the relatively low habitat value of saltcedar compared to native vegetation it replaced (e.g., Brand et al. 2008), and as a result, conservation literature for the southwest from the 1980-90s often focused on saltcedar eradication. However, several Priority species, including Southwestern Willow Flycatcher, Bell's Vireo, and Lucy's Warbler, have since colonized saltcedar as nesting habitat, and today, often rely on mixed or pure saltcedar stands over large reaches of river (Walker 2006). In the mid-2000s, the tamarisk beetle *Diorhabda* was released in the Lower Colorado River system as a biocontrol agent for eradicating saltcedar (Hultine et al. 2010). The beetle defoliates saltcedar, but does not necessarily kill it right away, leaving large stands without a canopy and, thus, unsuitable for birds. More details on this threat are described in the Willow Flycatcher species account (p. Spp-59-1). Recent research suggests that saltcedar eradication alone is often ineffective in restoring native riparian vegetation (Harms and Hiebert 2006), and active revegetation is generally required to achieve optimal restoration benefits for wildlife. Therefore, revegetation using native riparian plants is a key strategy for restoration areas that can sustain native plants.

The invasion by saltcedar and alteration of floodplains has also contributed to increased fire frequency in Mojave Lowland Riparian habitat. Because saltcedar and drought-stressed native vegetation are highly flammable, the fires that occur due to human ignitions or lightning strikes can be catastrophic for sites that are occupied by Priority species. While the recovery time of this habitat type is relatively short, it usually requires active restoration measures to prevent the site from being converted to weeds or upland vegetation. Therefore, we recommend that areas occupied by the highest-priority bird species receive full efforts for protection from fire, in the form of prevention efforts, response planning, and dedication of adequate firefighting resources.

Mojave Lowland Riparian

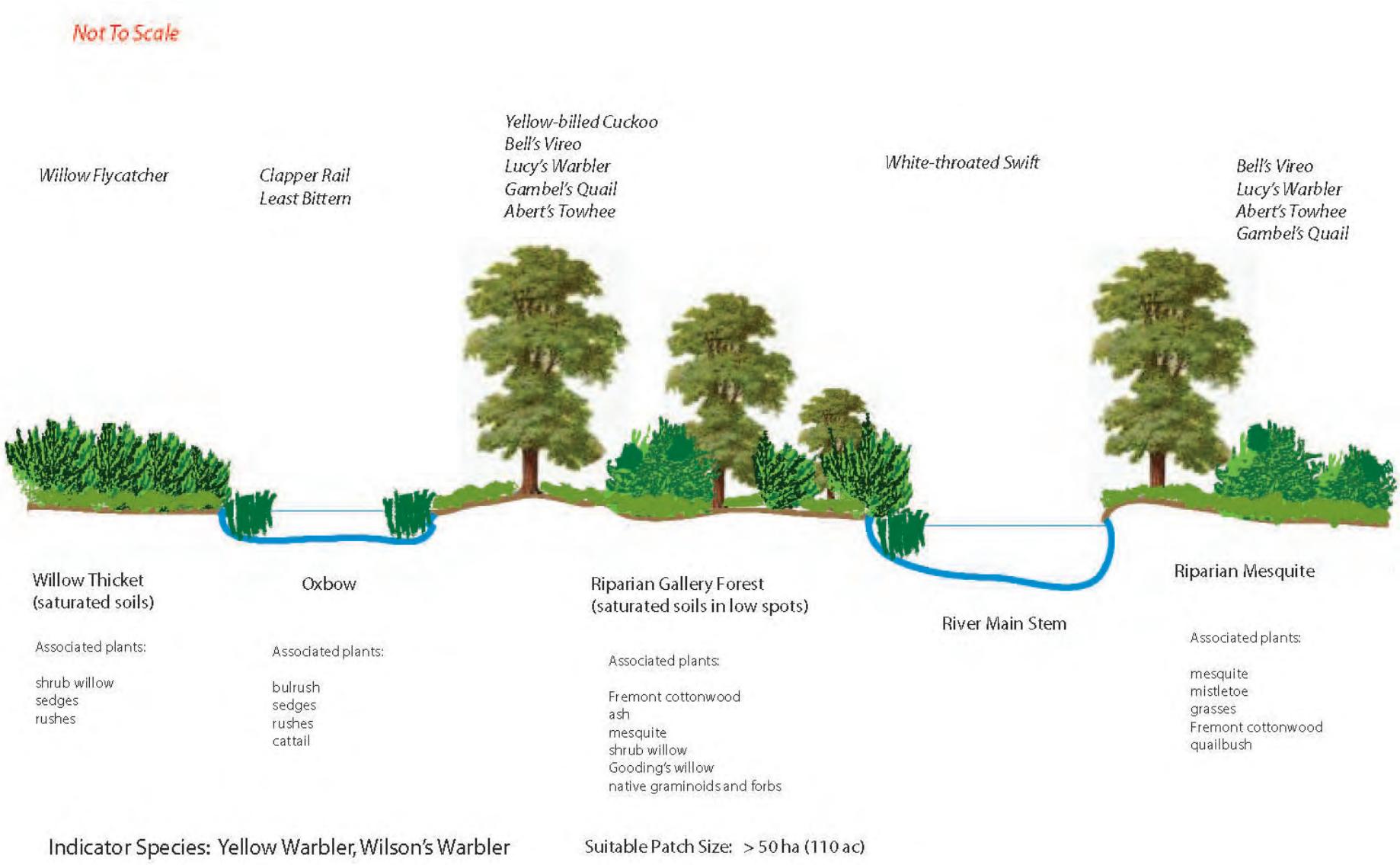


Figure Hab-11-1: Idealized Mojave lowland riparian landscape to maximize the number of riparian associated Priority bird species.

Mojave Lowland Riparian

Conservation Strategies

Habitat Strategies

- **Manage at landscape scale (> 50 ha [110 ac]**, but smaller patches are also valuable if intact) with the goal of maintaining mosaic of open, mixed-age tree canopy, riparian shrub thickets, flowering shrubs and forbs, and interspersed floodplain wetlands. High species richness in plants and presence of willows are particularly suitable for birds. Patch sizes within the mosaic may be small (< 0.4 ha [1 ac], but the overall riparian woodland corridor should be contiguous
- **Old-growth trees** are important to several Priority species, but in sites that already have trees, the value of a patch is likely most improved by adding a **native riparian shrub and wetland** component
- **Opportunities to restore channels with natural flow regimes**, or flows that mimic natural regimes, should be aggressively pursued
- **Active revegetation** should be done in all areas where saltcedar is eradicated and native vegetation can be supported
- Maintain **grazing and OHV use** at levels that do not permanently impact the shrub and forb understory or cause soils to be unnaturally exposed
- The majority of priority bird species nest between **April 1 and July 1**, and some of them are particularly sensitive to nest disturbance. This is the time period when intensive treatments or heavy land uses should be largely avoided
- Riparian areas near urban or rural settlements may attract **feral cats and other subsidized predators**. Strategic plantings of impenetrable shrubs (e.g., wild rose) are useful for discouraging opportunistic predators and cowbirds. Feral cat colonies should be moved away from riparian areas

Research, Planning, and Monitoring Strategies

- Planning that allows for **opportunistic habitat restoration** in places that become available may be key to maintaining riparian resources. Even small patches of intact riparian habitat are highly beneficial to nesting and migrating landbirds
- **Fire** prevention, immediate response planning, and management of fire-prone recreational activities are critical for areas that support high-priority conservation species
- **Monitoring of riparian resources** throughout the region and **effectiveness monitoring of restoration activities** are high priorities
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count, and continue species specific monitoring programs for species of special concern, such as Southwestern Willow Flycatcher and Yellow-billed Cuckoo
- Monitor status of **invasive weeds, including saltcedar, and the tamarisk beetle** to assess threat level and to implement adaptive management
- Encourage **low-impact recreation** in riparian areas, move trails away from sensitive areas, and provide observation decks, boardwalks, and educational materials along trails

Mojave Lowland Riparian

Conservation Strategies - continued

Public Outreach Strategies

- **Promote public appreciation** of intact lowland riparian areas with carefully planned recreational opportunities that raise public profile without impacting vegetation (bird-watching, photography, fishing, nature walks, etc.)
- **Promote public stewardship** of riparian areas through educational materials that explain the threats from feral and domestic cats, fire dangers, and value of native riparian vegetation to migrating songbirds
- **Promote low-impact recreation activities** to aid in public appreciation and stewardship of high-priority sites, particularly in river reaches that are accessible from urban areas



Saltcedar in bloom. Photo by Jen Ballard.

Mojave Lowland Riparian



Small patch of Mojave Lowland Riparian habitat with nearby cliff.
Photo by Jen Ballard.

Mojave Scrub



Mojave Scrub habitat in Esmeralda County. Photo by Elisabeth Ammon.

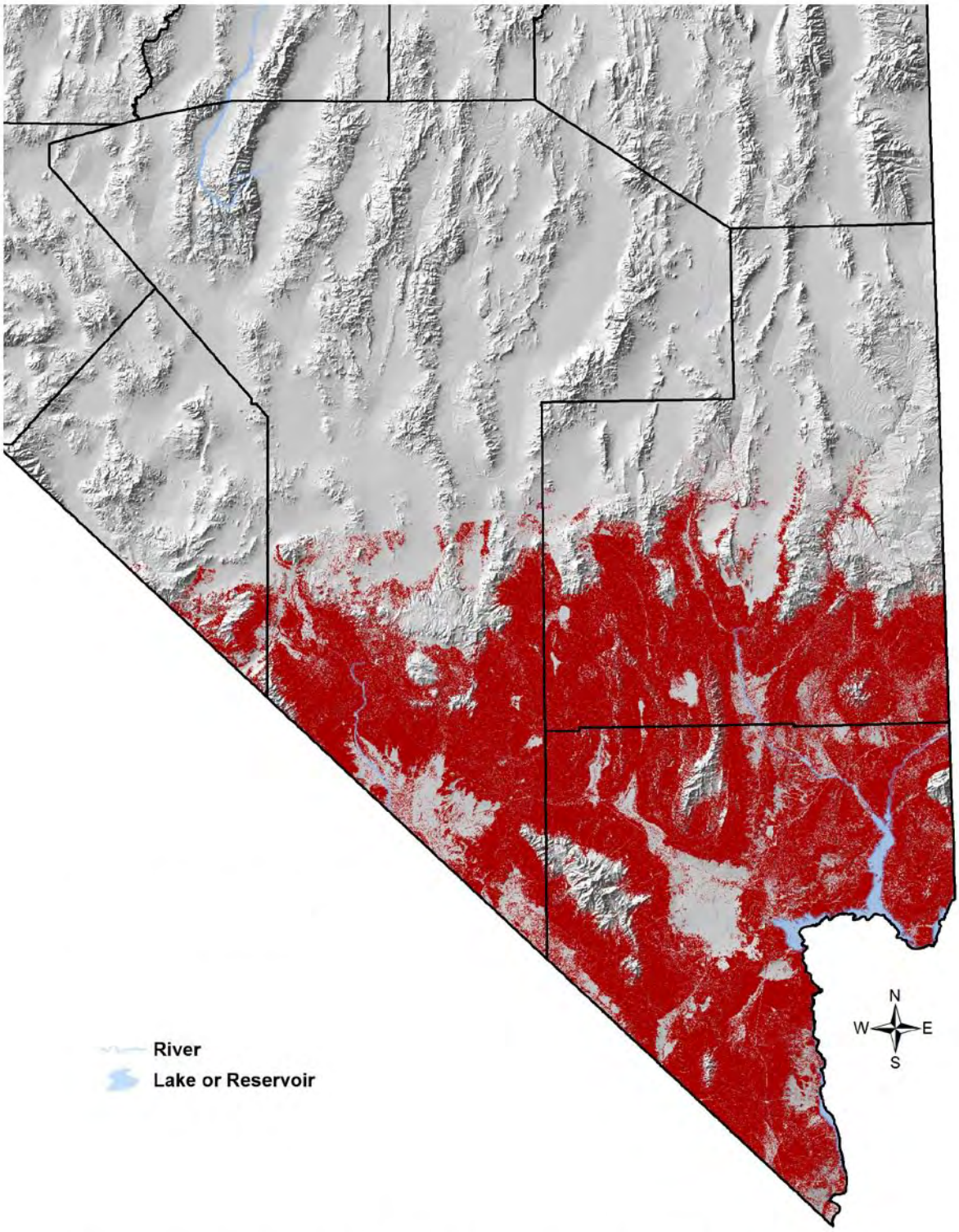
Key Bird-Habitat Attributes

Stand Structure	Mixed creosote-bursage stands at natural densities including other xeric shrub species; plant litter, cryptobiotic soils, and forb understory important
Ideal Scale for Conservation Action	1,000 ha [2,500 ac] or larger
Distance to Riparian/Spring Habitats and Ephemeral Washes	Proximity of mesic habitat types, springs, or presence of ephemeral washes increases value to birds
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	3,120,000 ha ([,706,000 ac] 11% of state
Landownership Breakdown	BLM = 55% DOD = 17% DOE = 8% NPS = 6% Private = 4% Other = 10%
Priority Bird Species	Prairie Falcon Costa's Hummingbird Le Conte's Thrasher (Golden Eagle) (Peregrine Falcon) (Burrowing Owl) (Common Poorwill) (Bendire's Thrasher)
Indicator Species	Black-throated Sparrow
Most Important Conservation Concerns	Energy development Urban, suburban, and industrial development Climate change (change in precipitation and temperature) Mining Motorized recreation Invasive weeds Increased fire frequency or intensity Grazing by wild horses and burros
Habitat Recovery Time	25-50 years
Regions of Greatest Conservation Interest	Clark, Nye, and Lincoln counties
Important Bird Areas	Ash Meadows NWR Catclaw Washes Lake Mead Moapa Valley Oasis Valley Virgin River Wee Thump Joshua Tree Forest

Mojave Scrub



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Some areas may be misclassified.

Mojave Scrub

Overview

Mojave Scrub habitat covers most of southern Nevada. Yet, the Priority species that specialize on this habitat are sparsely distributed on the landscape, and their local presence is often unpredictable from year to year (e.g., Le Conte's Thrasher, Burrowing Owl, and Golden Eagle). The majority of the Mojave scrub landscape is dominated by the creosote-bursage (*Larrea - Ambrosia*) shrub assembly, but can also include blackbrush (*Coleogyne ramosissima*) at higher elevations and in the transitional zone with the Great Basin. Minor occurrences of Joshua trees and other *Yucca* species are sometimes present, but where these are common, we classify them as Joshua Tree habitat for the purpose of this plan. Thorny vegetation components, such as cholla cactuses and low-growing, dense scrubs, are also sometimes present, and are particularly valuable for some Priority species. Finally a suite of native understory plants and cryptobiotic soils are important for several Priority species, including litter probers such as Le Conte's Thrasher, and the Costa's Hummingbird that seeks out flowering plants.

Birds in the Mojave Scrub environment are generally thought to be living at the edge of their physiological limits, particularly with regard to obtaining sufficient water and thermal cover. Resources used by these birds are often ephemeral and unpredictable in this environment and, because of this, most Mojave Scrub specialist species are known to be somewhat nomadic in their year-to-year movements. For instance, Le Conte's Thrashers search for arthropods in the sparse litter around live shrubs, but the presence of arthropods in any given location is not highly predictable from year to year. Similarly, Golden Eagle and Prairie Falcon depend on terrestrial vertebrates that undergo significant population fluctuations in the desert environment. Therefore, we recommend targeting very large patch sizes (> 900 ha [2,200 ac]) for effective conservation and land management. Especially useful are areas that feature tall and semi-mesic shrubs, such those found along ephemeral washes. Similarly, areas that are located within 2 km [1.2 mi] of springs, wetlands, or riparian areas, which provide reliable resources to birds even in difficult years, are a priority. Figure Hab-12-1 illustrates the landscape features of Mojave Scrub habitat that, to the best of our knowledge, promote its Priority species, at least if they occur at a sufficiently large spatial scale.

Mojave Scrub habitat is not the subject of active management efforts in most cases, although some high-priority areas are protected as ACECs (Areas of Critical Environmental Concern) by the BLM, and domestic livestock have been removed from Clark County public lands. Still, large expanses of scrubland are at risk of loss to urban and suburban developments, energy development, and mining. Therefore, our recommendations for conservation focus primarily on avoidance of habitat conversion where possible (or failing that, minimizing fragmentation that results from habitat conversion), and minimizing major soil disturbances (e.g., OHV use) by channeling recreational activities into appropriate designated areas.

Mojave Scrub

Main Concerns and Challenges

The following top conservation concerns were identified in our planning sessions for Mojave Scrub habitat in Nevada:

- Energy development
- Urban, suburban, and industrial development
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Mining
- Motorized recreation
- Invasive weeds
- Increased fire frequency or intensity
- Wild horses and burros

This long list of concerns highlights the challenge of managing lands that are subject to a variety of demands, many of which stem from urban development associated with the metropolitan area of Las Vegas. Most important, perhaps, is the recognition that many plants and animals are likely to be near their physiological limits in this very arid and hot environment. Climate change effects (increased temperature and reduced winter/spring precipitation) are expected to exacerbate natural drought effects, leading to reduced plant vigor and recruitment even in these drought-adapted communities. Of particular concern are secondary effects on arthropod and vertebrate prey communities that depend on healthy vegetation and intact soils. Energy development (particularly new, renewable energy projects), urban and industrial development, and mining are a particular concern for this habitat type. Additive impacts from many of these developments scattered across the landscape result in significant habitat loss and fragmentation, which are problematic given our large recommended patch size for conservation in this habitat type.

Motorized recreation, invasive weeds, and increased fire frequency are also conservation concerns in Mojave Scrub habitat, and they are generally most intense near urban areas. Off-highway-vehicle (OHV) recreation, among the most popular outdoor activities in the Mojave Desert, generates networks of dirt roads, disturbs soils and burrows, damages cryptobiotic soils, reduces vegetation cover, and increases soil erosion (Brooks and Lair 2005). It also concerns us because of introduction of invasive weeds (particularly red brome) into vulnerable sites, which increase the flammability of the vegetation and thereby increase the chances of large fires.

Livestock use has been reduced significantly since Clark County removed domestic livestock from most lands in the county. However, horses and burros continue to use this habitat and pose a concern in high-use areas (Abella 2008).

Mojave Scrub

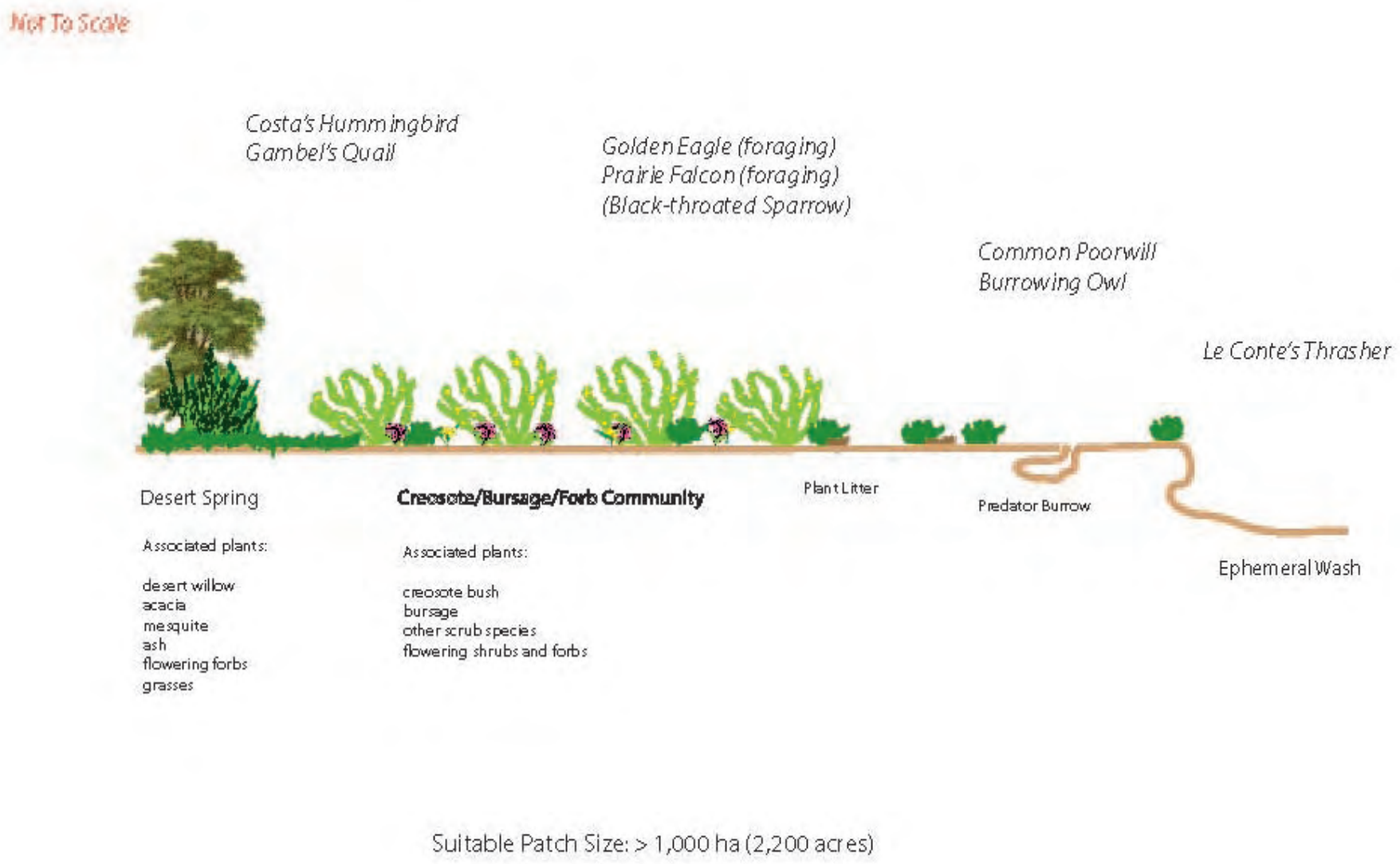


Figure Hab-12-1: Idealized Mojave warm desert scrub landscape to maximize the number of associated priority bird species.

Mojave Scrub

Conservation Strategies

Habitat Strategies

- **Manage at a large landscape scale** (> 1,000 ha [2,500 ac] with the goal of maintaining **natural shrub densities, cryptobiotic soils, understory and litter**. Areas with ephemeral washes and nearby wetland, spring, or riparian habitats are of particular importance
- Proximity to **water** (riparian areas, desert springs, wet meadows), presence of **cliffs** > 30 m [100 ft] tall, or **abandoned mines** (which may be gated) raise the priority level of a site for bird conservation
- **Invasive plants** should be controlled to the extent possible to avoid impacts on fire frequency and integrity of native understory.
- Recreational uses, particularly **OHV recreation**, should be managed to avoid sensitive areas, which include ephemeral washes, and areas adjacent to mesic habitats and tall cliffs. Large patches of creosote-bursage that are currently occupied by Priority species may be fully excluded from off-road motorized recreation
- The majority of priority bird species nest between **April 1 and July 1**, and some of them are particularly sensitive to nest disturbance. This is the time period when disturbances should be minimized

Research, Planning, and Monitoring Strategies

- **Map suitable habitat** for Mojave Scrub Priority species at the recommended patch scale for effective conservation planning and impact avoidance
- **Monitor invasive weeds and OHV trails** for adaptive management
- Study **effects of OHV use** on Priority landbirds and habitat integrity
- Continue **long-term monitoring of landbirds** statewide through Nevada Bird Count

Public Outreach Strategies

- **Promote public appreciation** of fragile desert environments, their bird communities, and threats from off-road vehicle recreation and weed invasion. This may be done through brochures, nature trails, and promotion of other low-impact outdoors activities.

Montane Riparian



Montane Riparian habitat at China Creek in the Montana Range, Humboldt County. Photo by Elisabeth Ammon.

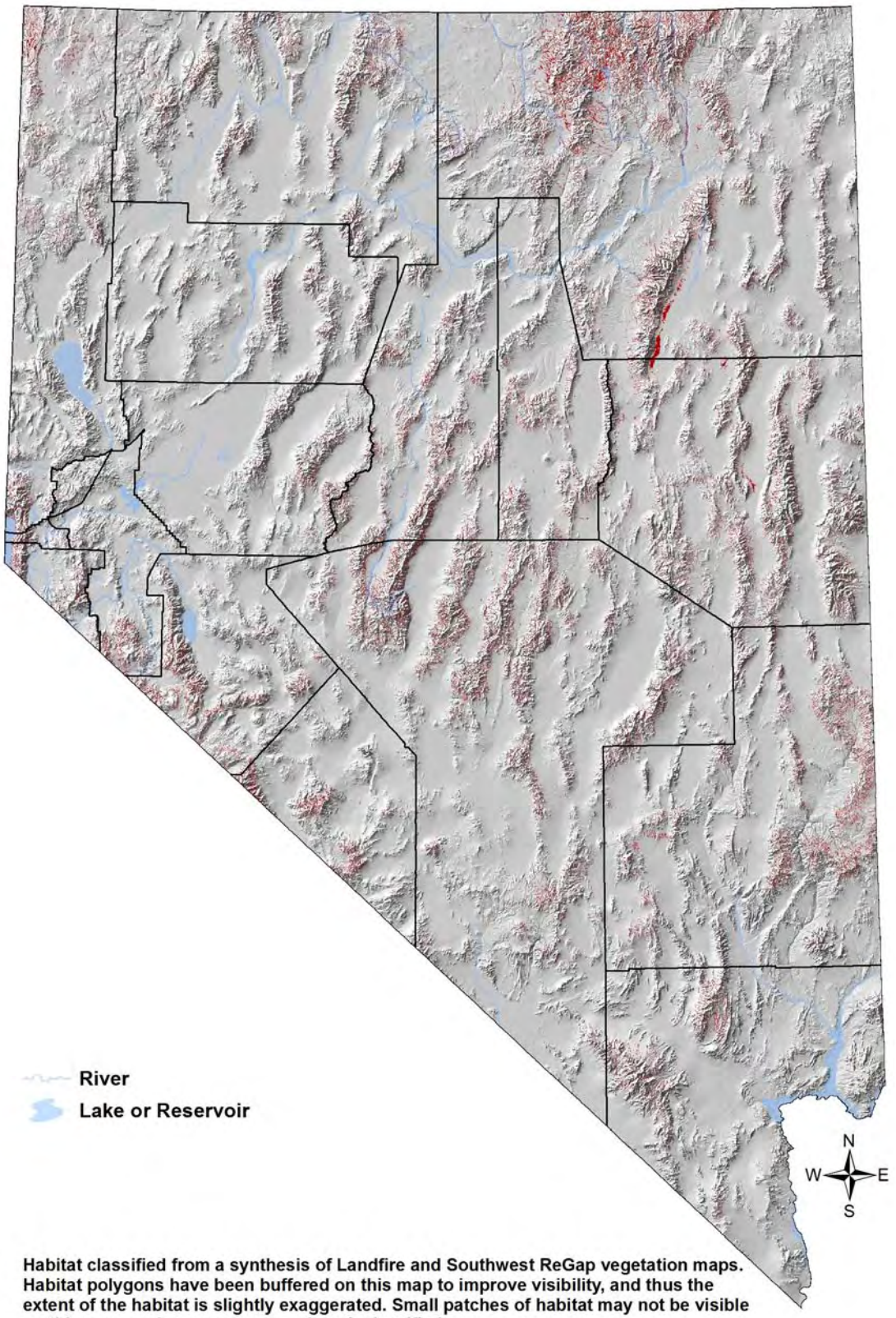
Key Bird-Habitat Attributes

Stand Structure	Dense, dwarf trees and shrubs of mesic species, with grass and flowering forb understory, transition into montane shrublands with additional deciduous shrub species
Ideal Scale for Conservation Action	10 ha [25 ac] or more, or minimum of 0.6 – 3 km [1-5 mi] of linear stream distance
Plant Species Composition	Aspen, shrub willows, water birch, alder, wild rose, currant, and other mesic species
Aspen and Cottonwood	Single trees or small stands of old aspen or cottonwood add particular value for some Priority species
Understory	Closed-canopy shrub thickets interspersed with natural meadow openings ideal
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	188,000 ha [466,000 ac] 0.7% of state
Landownership Breakdown	BLM = 39% USFS = 33% Private = 18% Other = 10%
Priority Bird Species	Sharp-tailed Grouse Mountain Quail Calliope Hummingbird Rufous Hummingbird Lewis's Woodpecker Willow Flycatcher Virginia's Warbler Green-tailed Towhee (Greater Sage-Grouse) (White-throated Swift) (Grace's Warbler)
Indicator Species	Cooper's Hawk MacGillivray's Warbler Yellow Warbler Wilson's Warbler Yellow-breasted Chat
Most Important Conservation Concerns	Livestock, wild horse and burro grazing Surface water diversion, impoundments Climate change (change in precipitation and temperature) Motorized recreation Non-motorized recreation Increased fire frequency or intensity Plant pathogens
Recovery Time	> 20 years
Regions of Greatest Conservation Interest	Elko, Humboldt, Washoe, White Pine, Lander, Eureka, and Clark counties
Important Bird Areas	Bilk Creek – Montana Mountains Carson Range David E. Moore Bird and Wildlife Sanctuary Goshute Mountains Great Basin National Park High Rock Resource Area Jarbidge Mountains Monitor Valley Mount Grant North Ruby Valley Northern Snake Range Ruby Mountains Spring Mountains Toiyabe Range Wellington-Pine Grove Hills

Montane Riparian



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Montane Riparian

Overview

Montane Riparian habitat is scarce on Nevada's landscape, and is often so restricted that our land cover maps do not effectively capture them. In the past, montane riparian areas were often the lifeblood for homesteads and outlying ranches, because in many areas they provided the only source of water. Therefore, riparian areas were altered during early settlement for diverting water and for sustaining livestock, and as a result, many montane riparian areas have undergone channel downcutting, loss of riparian vegetation, soil compaction, and reduction of instream flows.

Riparian zones are also the lifeblood of important ecosystems and a major contributor to biodiversity, and at least half of the bird species in some western regions are estimated to depend on riparian habitats (Knopf et al. 1988). Typically, an intact montane riparian area supports narrow stands of willows, some aspen pockets, and a variety of mesic groundcovers throughout the year (Smith et al. 1995, Dickson et al. 2009). At higher elevations, conifer species such as white fir (*Abies concolor*) and Engelmann spruce (*Picea engelmannii*) may be present (Smith et al. 1995). For montane birds, these mesic environments become particularly important during the hottest part of the year, where they provide thermal cover, protection from predators, access to water and, most importantly, foraging opportunities for forbs and insects (e.g., brood-rearing Greater Sage-Grouse, Mountain Quail, and a variety of songbirds). Mist-netting of birds in these riparian habitats has documented a surprisingly large number of upland species, aside from the expected suite of riparian birds (e.g., Heath and Ballard 2003). In Figure Hab-14-1, we illustrate an idealized landscape that features habitat elements required by montane riparian bird species.

Main Concerns and Challenges

The following top conservation concerns were identified in our planning sessions for Montane Riparian habitat in Nevada:

- Overgrazing by livestock, wild horses and burros
- Surface water diversion, impoundments
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Motorized recreation
- Non-motorized recreation
- Increased fire frequency or intensity
- Plant pathogens

Montane Riparian

Both riparian vegetation and bird communities change along elevational gradients (e.g., Dobkin and Wilcox 1986, Dickson et al. 2009), and their distributions are therefore expected to change with climate. Because of the vertical linearity and topographic complexity of montane riparian habitats, the effects of climate change will probably not be as simple as moving up or down in elevation (Fleishman et al. 2001), but increases or decreases in the timing or amount of water availability will affect entire stream courses. Riparian ecosystems are naturally resilient, provide linear habitat connectivity, and create thermal refugia for wildlife, all of which could contribute to mitigation of climate change effects (Seavy et al. 2009). Riparian areas could provide critical buffering of climate change effects for riparian birds and birds of adjacent habitats (Ackerly et al. 2010). Conservation and restoration planners should therefore consider options for how they can enhance the resilience of riparian ecosystems to climate change (Seavy et al. 2009).

Today, past impacts still leave their mark on Nevada's Montane Riparian habitats, and are compounded by new threats, such as climate change, prolonged droughts, and motorized recreation. Overgrazing by livestock, wild horse and burros, and stream diversions are the two primary disturbance factors affecting montane riparian vegetation, and either one can prevent riparian systems from reaching their ecological potential (Smith et al. 1995). Prolonged overgrazing impacts riparian areas through physical removal of vegetation and simplification of structure, hydrological changes from soil compaction, and channel alteration (Belsky et al. 1999), and negative effects of grazing on riparian bird populations have been well documented (Saab et al. 1995). In some cases, these impacts are a result of increased nest predation that occurs after grazing opens up vegetation structure and reduces nest concealment (Ammon and Stacey 1997). Impacts to riparian vegetation also occur from stream downcutting caused by prolonged road development, livestock use, or natural runoff events (Green et al. 2003).

Fortunately, montane riparian plant communities respond readily to restoration and enhancement efforts if sufficient water is available (Stromberg 2001). Many areas that are no longer critical for other land uses can be relatively easily restored, as has been demonstrated by multiple protection and restoration projects conducted on lands managed by BLM and the USFS, where sections of stream corridor have been fenced off to allow for passive recovery. These projects create substantial conservation returns in exchange for relatively modest expenditures, and are therefore one of our main recommended conservation actions for Montane Riparian habitat.

Montane Riparian

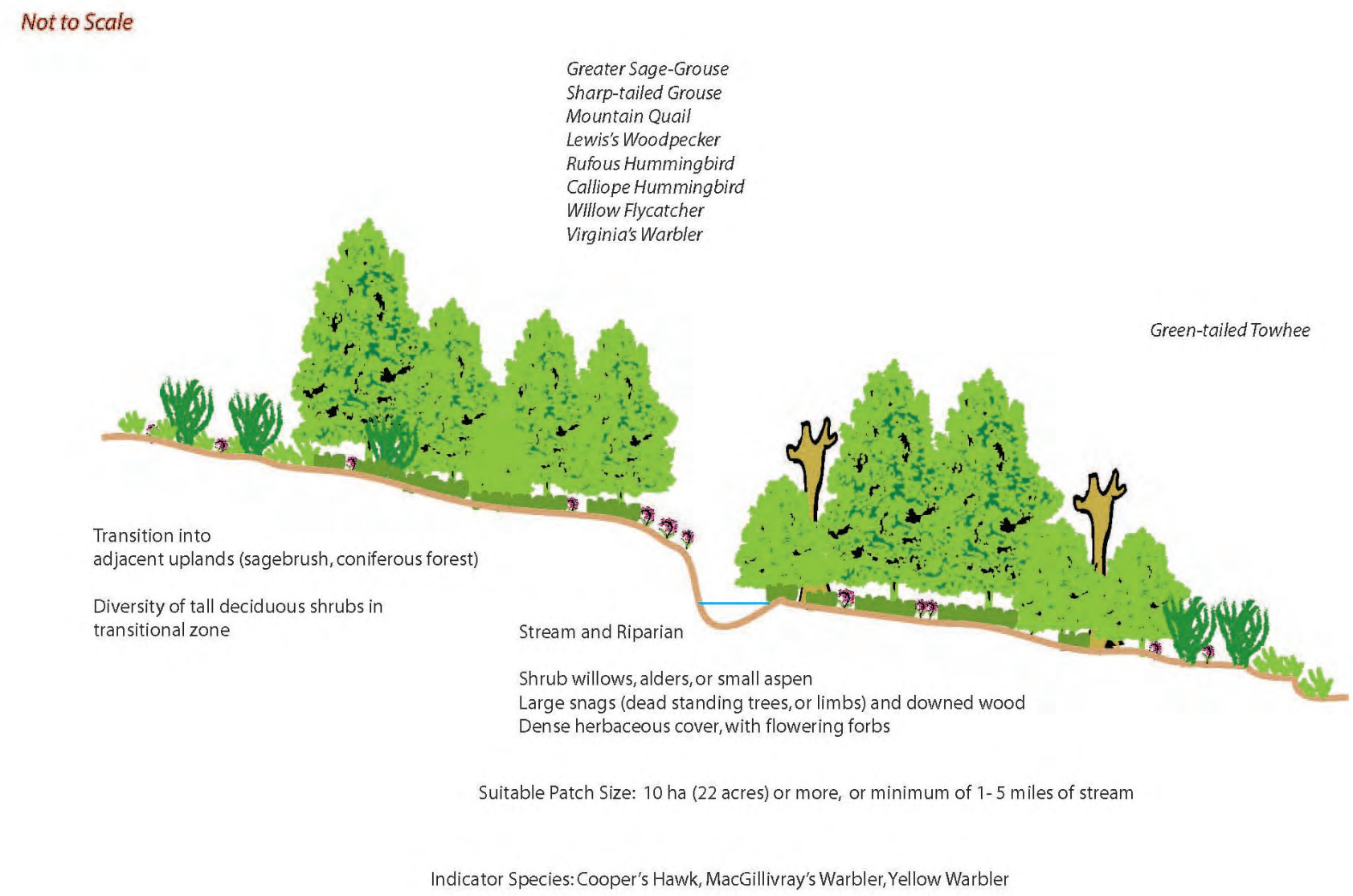


Figure Hab-13-1: Idealized montane riparian landscape to maximize the number of riparian associated Priority bird species.

Montane Riparian

Conservation Strategies

Habitat Strategies

- Manage at a relatively small scale, if necessary, of **10 ha [25 ac], or 1.6 – 8 km [1-5 mi]** of stream, with preference given to larger areas, wider riparian corridors, or more miles of stream. Even small patches are valuable, but the desired mesic conditions are better achieved with larger overall patch sizes
- Important habitat components include **dense shrub thickets** (willow, alder, wild rose, or other mesic species) with patches of herbaceous cover interspersed. Land uses that have impacts to these vegetation components, such as prolonged overgrazing and recreation, may be excluded by fencing and providing alternate access to water and shade
- Single **large trees**, or small stands, and **large snags** provide important resources for some Priority species, and should therefore be protected from loss and disturbance to the extent possible
- Presence of **cliffs** > 30 m [100 ft] tall raises the priority level of a site for bird conservation
- Mitigation for past or current losses may include **restoration of historic stream channels and associated floodplains**. The primary requirement is sufficient water, and if no source vegetation is available, plantings of native species will significantly accelerate restoration
- Maintain **grazing and OHV use** at levels that do not permanently impact the shrub and forb understory or cause soils to be exposed
- The majority of priority bird species nest between **May 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when disturbances should be minimized

Research, Planning, and Monitoring Strategies

- Narrow riparian areas are badly under-inventoried throughout the state, because available land cover maps often misclassify or omit them. One of the highest statewide priorities for riparian planning is to **generate a comprehensive, accurate map** of riparian habitats and springs
- Mapping of Montane Riparian should include a **stand condition assessment** characterizing the habitat elements that support Priority bird species. This inventory, which would ideally be an interagency effort, could then be turned into a periodic (e.g., every 10 years) monitoring effort of riparian areas.
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count
- Monitor status of **invasive weeds** to assess threat level locally and statewide

Public Outreach Strategies

- **Promote the value and important features** of riparian habitat to private landowners and the public (e.g. Schenk and Goldblatt 2005). Materials may include tips on avoiding unintentional impacts to riparian resources

Montane Shrubland



Montane Shrubland habitat in the Santa Rosa Range, Humboldt County. Photo by Elisabeth Ammon.

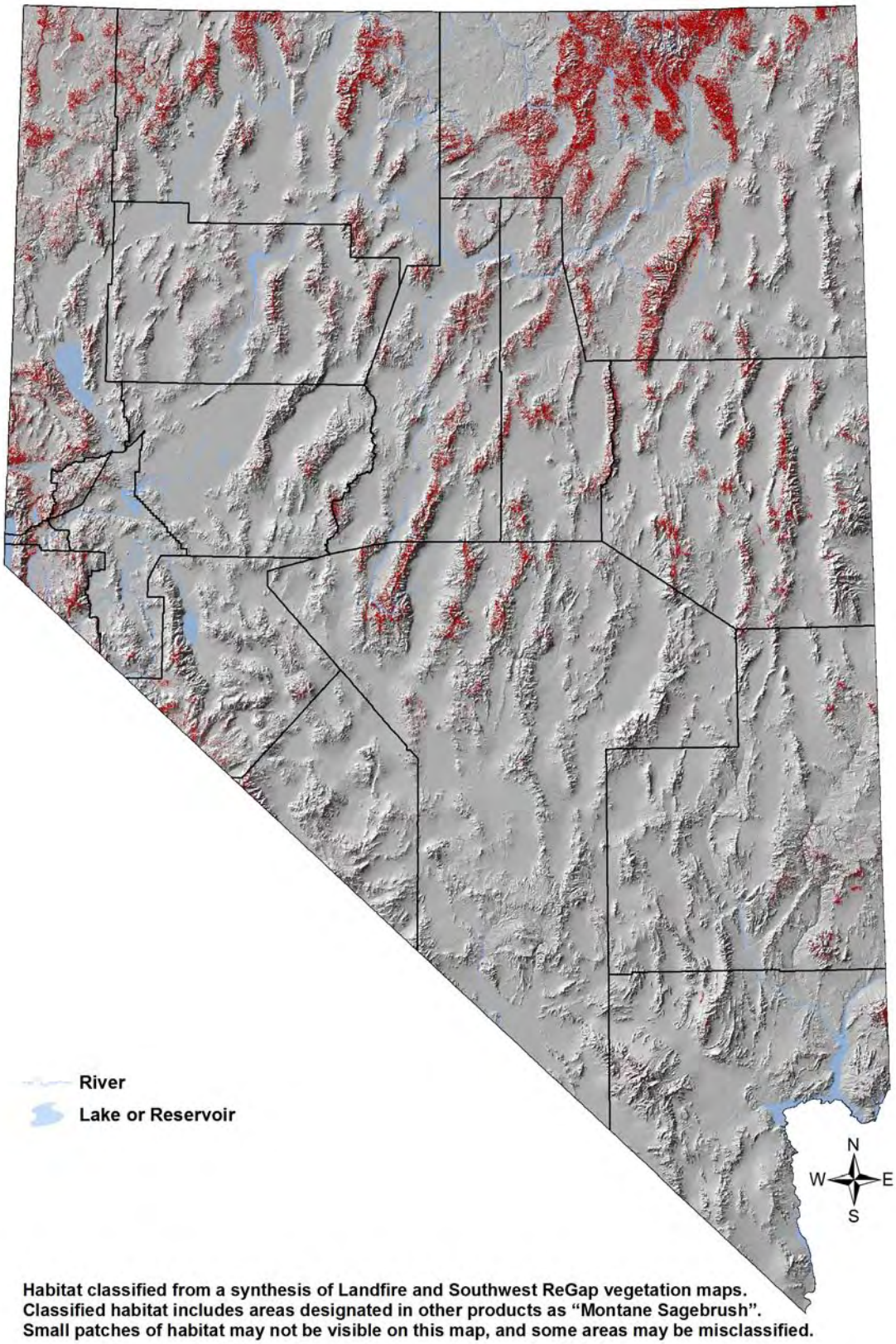
Key Bird-Habitat Attributes

Vegetation Composition	Diverse species of deciduous shrubs, sage, and herbaceous components (mostly perennial bunchgrasses and forbs); mountain big sagebrush, manzanita, snowberry, currants, serviceberry, chokecherry, buckbrush, bitterbrush, cliffrose, hawthorn, and similar flower and berry-producing shrubs increase habitat value significantly; flowering forbs critical to several Priority species
Ideal Scale for Conservation Action	200 ha [500 ac] or larger to accommodate different patch types and avoid fragmentation
Vegetation Structure	Mostly low-growing shrubs, 20-40% cover, with herbaceous layer up to 60-80% and at least 8-12 inches [20-30 cm] high (for sharp-tailed grouse); horizontal diversity (mosaic of different patches) increases value
Plant Species	Multiple shrub and forb species increase habitat value for birds
Distance to Water	Mesic habitats (riparian, wetland, open water, springs) within 1,000 m [3,300 ft] increase habitat value
Other Features	Abandoned mineshafts and cliffs >30 m [100 ft] tall add habitat value for some species

Conservation Profile

Estimated Cover in Nevada	1,055,000 ha [2,608,000 ac] 3.7% of state
Landownership Breakdown	BLM = 48% USFS = 30% Private = 18% Other = 4%
Priority Bird Species	Greater Sage-Grouse Sooty Grouse Dusky Grouse Sharp-tailed Grouse Mountain Quail Common Poorwill Calliope Hummingbird Gray Flycatcher Sage Thrasher Virginia's Warbler Green-tailed Towhee Brewer's Sparrow Black-chinned Sparrow (Black Rosy-Finch)
Indicator Species	None needed
Most Important Conservation Concerns	Changes in fire frequency or intensity Climate change (change in precipitation and temperature) Livestock, wild horse and burro grazing Motorized recreation Invasive weeds Conifer encroachment
Habitat Recovery Time	25-50 years
Regions of Greatest Conservation Interest	Northern, northeastern, eastern, and central Nevada
Important Bird Areas	Bilk Creek – Montana Mountains Carson Range Goshute Mountains Great Basin National Park High Rock Resource Area Jarbidge Mountains Monitor Valley Mount Grant Northern Snake Range Ruby Mountains Sheldon NWR Spring Mountains Toiyabe Range Wellington-Pine Grove Hills

Montane Shrubland



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Classified habitat includes areas designated in other products as "Montane Sagebrush".
Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Montane Shrubland

Overview

Montane Shrubland habitat includes several shrub communities within and above the pinyon-juniper zone, with the most common one being montane sagebrush. Other shrublands of montane areas include mixes of species such as snowberry, serviceberry, bitterbrush, and sumac. Sage steppe and montane riparian plant communities are interspersed in these landscapes, and the diversity of shrubland types makes accurate land cover mapping difficult. In the Sierra Nevada ecoregion, successional shrublands in forest openings are often dominated by buckbrush (*Ceanothus velutinus*), green-leaf manzanita (*Arctostaphylos patula*), and currants, which can form a particularly dense shrub cover with little understory. Montane shrublands are among the more species-rich bird habitats of Nevada. For instance, in an elevational assessment of bird communities in Great Basin National Park, both bird abundance and bird species richness were reported to be highest in plots with a substantial component of mountain big sagebrush (Medin et al. 2000).

Montane sagebrush is similar to lowland sagebrush in many ways, but it often has higher shrub cover and higher forb productivity (Davies and Bates 2010). Historical fire return intervals are thought to have been relatively frequent (10–25 years) in more mesic communities (Knick et al. 2005), but in drier sites, sagebrush could probably not have been maintained with such frequent disturbance (Welch and Criddle 2003). Unlike in lowland sagebrush, fire intervals may have lengthened in some montane shrublands in recent times due to removal of fine fuels by grazing, and to a lesser extent, fire suppression (Miller and Rose 1999).

Both a healthy shrub canopy and an intact herbaceous understory are important elements for montane shrubland birds (Figure Hab-14-1). A diversity of shrub species is important to some bird species, such as Green-tailed Towhee and Sharp-tailed Grouse, but more homogeneous stands of montane sagebrush are heavily used by Brewer's Sparrows. A healthy forb layer is especially important in montane sagebrush to species such as Greater Sage-Grouse that rely on forbs in late summer, when forb understories in the lowlands begin to dry up.

Main Concerns and Challenges

The following top seven conservation concerns were identified in our planning sessions for Montane Shrubland in Nevada:

- Changes in fire frequency or intensity
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Livestock, wild horse and burro grazing
- Motorized recreation
- Invasive weeds
- Conifer encroachment

These concerns are somewhat difficult to rank, since none of them are thought to be exceptionally severe at the present time.

Montane Shrubland

Mountain big sagebrush communities generally are more resilient to disturbance and recover more rapidly than either basin or Wyoming big sagebrush because of greater precipitation and possibly longer seed viability (Provencher et al. 2007). Some montane shrub species may be favored over montane sagebrush by fire in the long term, because they can resprout from the roots when fire removes competing shrubs.

In some areas, altered fire regimes along with other factors have resulted in conifer expansion into Montane Shrubland habitat. Hypotheses for the expansion of pinyon-juniper woodlands over the last century include altered fire regimes, grazing, natural dynamic processes, recovery from past impacts, and a changing climate (Romme et al. 2009). In the Sierra Nevada, montane shrublands are predisposed to recurring fires that have been observed to perpetuate shrub cover on sites otherwise suited for trees, so the artificial exclusion of fire has caused the total montane shrubland area to shrink by over 60%, and the heterogeneity of montane landscapes has been correspondingly reduced (Nagel and Taylor 2005). Fire can promote growth of desirable shrubs and control conifer encroachment, but it can also lead to sagebrush declines and promote invasive weeds or undesirable shrubs (Giesen and Connelly 1993). Fire can enhance native perennial forbs and grasses (e.g., Holmes 2007), particularly where sagebrush is abundant and exotic species are limited. In some mountain big sagebrush communities, where shrub canopy cover exceeds 35%, perennial forbs can increase 2-3 fold following fire (Crawford et al. 2004). However, the response of perennial forbs and grasses following fire is highly variable (Nelle et al. 2000). A patchwork of small disturbances is probably required to maintain a balance between shrubs and forbs.

Great Basin shrubland plant species are not well adapted to intense, continuous grazing pressure (Mack and Thompson 1982), but livestock or feral horse grazing can be accommodated without unacceptable conservation consequences as long as herbaceous understories are preserved. That said, grazing pressure sometimes exceeds this threshold. For example, chronic grazing pressure from horses has been correlated with reduced plant species richness in some areas (Beever et al. 2008), and grouse species that consume forbs during parts of their seasonal cycle often select areas that are the least modified by grazing (Saab and Marks 1992). Other studies of grazing effects on shrubland birds have shown mixed results (Page et al. 1978, Saab et al. 1995).

Exotic annual grasses, such as cheatgrass, usually do not greatly affect relatively mesic and cool montane shrublands dominated by mountain big sagebrush (Crawford et al. 2004). However, this threat could increase with climate change (Bradley 2009). Likely effects of climate change on montane shrublands have not been systematically evaluated. However, they exhibit sharply reduced productivity in drought years (Bradley and Mustard 2008), and reduced precipitation likely reduces the productivity and diversity of the forb community that is so critical to several Priority bird species. Changing temperatures and altered fire regimes could also affect the rate of conifer encroachment (Fleishman and Dobkin 2009). Invasive species will become more of a threat as higher elevation sites become warmer. The incidence of sustained grazing and its associated impacts are also expected to increase with a warmer and drier climate (Provencher et al. 2007).

Montane Shrubland

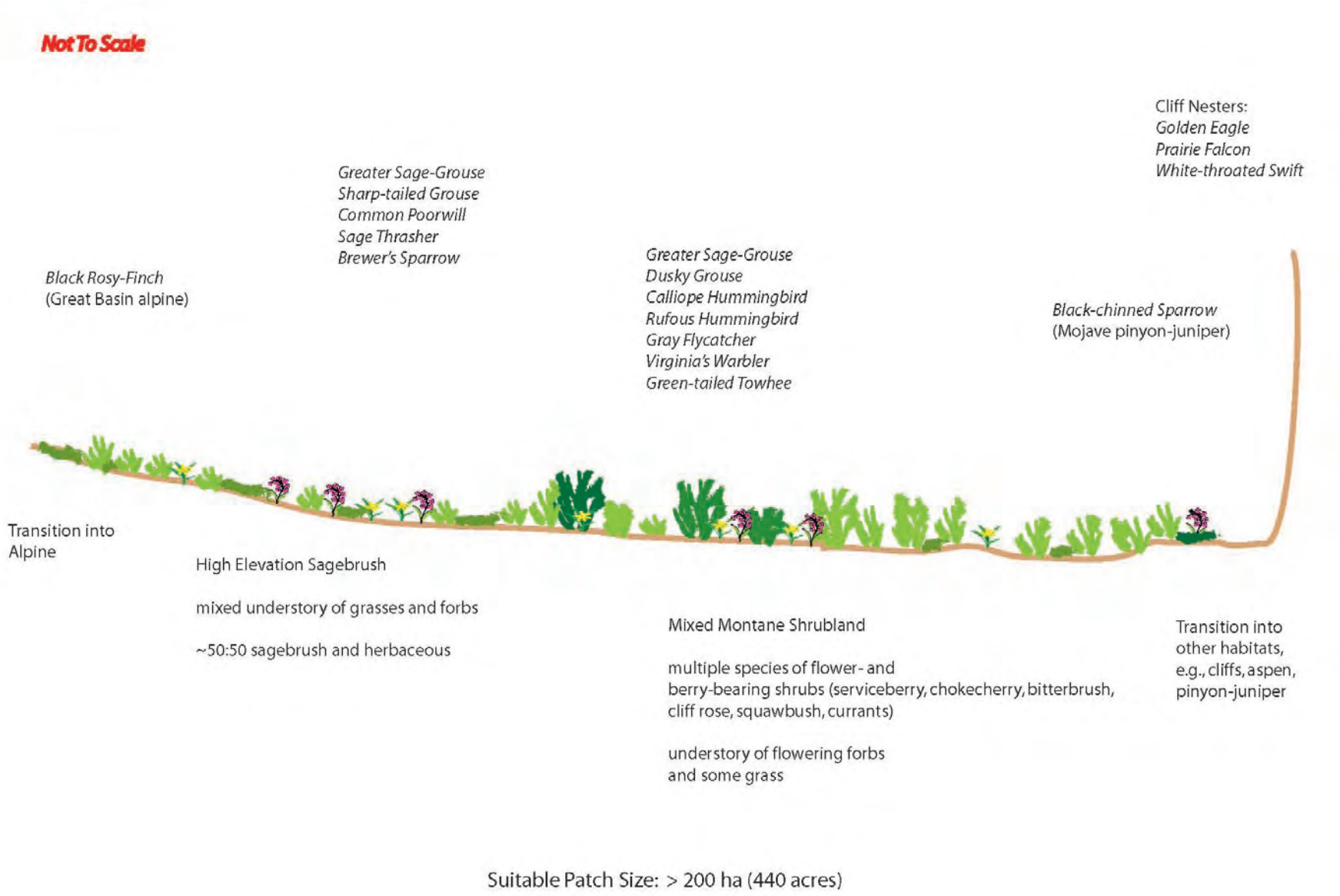


Figure Hab-14-1: Idealized montane shrubland landscape to maximize the number of montane shrubland associated Priority bird species.

Montane Shrubland

Conservation Strategies

Habitat Strategies

- **Manage at a landscape scale of 200 ha [500 ac]** or larger, if possible. Where grouse occur, conservation strategies from grouse initiatives and species accounts should be implemented at the recommended spatial scales. Montane shrubland landscapes without a significant sagebrush component ideally would vary in shrub size classes, densities, and amount of understory with a patch size of approximately 2-10 ha [5 – 25 ac] depending on soil conditions and fire history. High shrub species diversity, high patch type diversity, and a healthy forb component all benefit Priority bird species.
- Where possible, concentrate grazing activity within the plants' dormant season and **protect current season's growth** through the bird nesting season (**May 15 – July 15**), to preserve at least 50% of annual growth (Paige and Ritter 1999).
- **Highest priority for protection are more mesic areas** that have high cover of succulent forbs and provide high-quality late-summer brood rearing areas for Priority upland game species (Atamain et al. 2010).
- Adjacent habitat types, such as tall cliffs, aspen, pinyon-juniper, montane riparian, and snow pockets increase the potential value of a particular site to Priority species. We recommend that disruptive land uses are avoided to the extent possible within **1,000 m [3,300 ft] or more** of these complex habitat interface zones.
- **Abandoned mine entrances** can provide important winter habitat for Black Rosy-Finches. Before closing mines, winter surveys should be conducted to determine rosy-finch use, and if they are present, gating is preferable.

Research, Planning, and Monitoring Strategies

- Study the relationships between montane shrub birds and the landscape patterns and habitat changes that result from **altered fire regimes** (Donovan et al. 2002).
- Investigate **effects of OHV use** on Priority landbirds and habitat integrity.
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count.

Public Outreach Strategies

- Bird conservation initiatives may increase outreach to land managers by holding **workshops on montane birds** and their habitat needs, providing "best management practices" tools, and helping to review siting plans for development.

Open Water



Stone Mother on Pyramid Lake, Washoe County, with waterbirds in the foreground. Photo by Elisabeth Ammon.

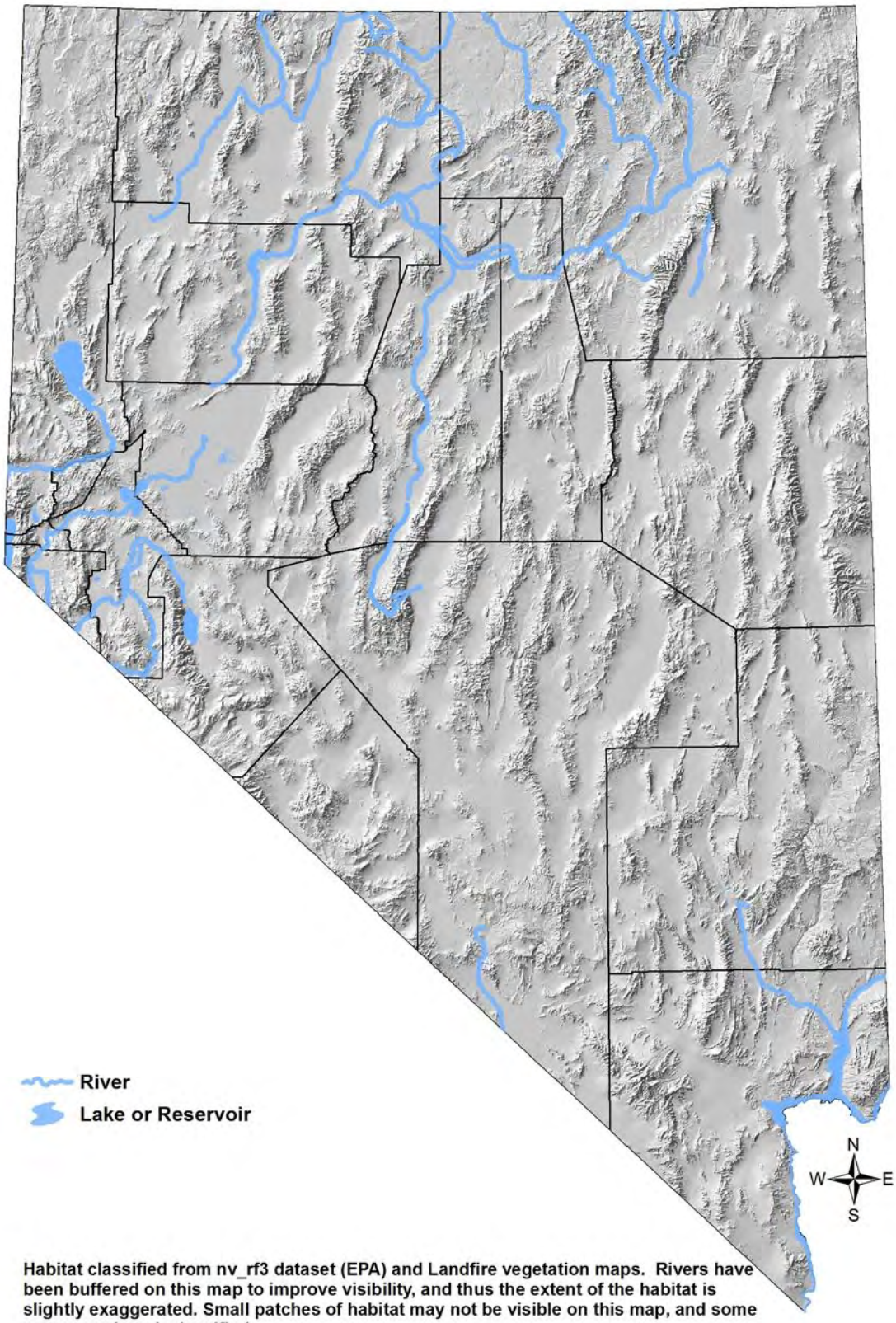
Key Bird-Habitat Attributes

Aquatic Habitats	A variety of water depths ranging from shallow (< 2 m [6 ft]) to deep sections (> 6 m [20 ft]) and an overall bathymetry that allows for ample aquatic vegetation and fish populations; shallow, sparsely-vegetated mudflats (water depth < 15 cm [6 in]) on shorelines benefit shorebirds
Ideal Scale for Conservation Action	Overall waterbody sizes of > 150 ha [370 ac] best for many migrants
Vegetation Cover	Emergent vegetation along shorelines and shallow sections desirable, but should remain a minor component; patches of dense submerged aquatic vegetation desirable
Fish	Fish populations required by several Priority species in various size classes, particularly smaller fish (5 – 20 cm [2 – 8 in])
Other Features	Islands particularly beneficial to colony nesters, both sparsely vegetated upland islands, and densely vegetated wetland islands; ideally, these are located at a distance from the shorelines, with deep water between island and shore

Conservation Profile

Estimated Cover in Nevada	137,500 ha [340,000 ac] 0.5% of state
Landownership Breakdown	Undesignated waterbodies = 63% NPS = 30% Other = 7%
Priority Bird Species	Trumpeter Swan Tundra Swan Cinnamon Teal Northern Pintail Canvasback Redhead Lesser Scaup Common Loon Eared Grebe Western Grebe Clark's Grebe American White Pelican Bald Eagle Black-necked Stilt American Avocet Marbled Godwit Western Sandpiper Least Sandpiper Long-billed Dowitcher Wilson's Phalarope Red-necked Phalarope Franklin's Gull Black Tern (Snowy Egret) (Snowy Plover)
Indicator Species	None needed
Most Important Conservation Concerns	Surface water diversion, impoundment Climate change (change in precipitation and temperature) Mining Flood control
Habitat Recovery Time	2-5 years
Regions of Greatest Conservation Interest	Pyramid Lake, Walker Lake, Lahontan Valley, Rye Patch Reservoir, East Fork Reservoir, Pahranagat Valley, Lake Mead, Lake Mohave
Important Bird Areas	Carson River Delta Franklin Lake Lahontan Valley Wetlands Lake Mead Pahranagat Valley Complex Pyramid Lake Ruby Lake Swan Lake Walker Lake Washoe Valley

Open Water



Habitat classified from nv_rf3 dataset (EPA) and Landfire vegetation maps. Rivers have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Open Water

Overview

Open Water habitats are far less abundant in Nevada than in many other western states, but they host a very high proportion of our Priority bird species, which are most abundant during migration stopover and wintering periods. Open Water sites include natural lakes, such as Pyramid and Walker, but the majority of our Open Water habitat is provided by reservoirs (including Lahontan and Rye Patch reservoirs and Lakes Mead and Mohave). Nevada's larger rivers are also included in this habitat type, although generally, only the fish-rich rivers support appreciable numbers of waterbirds.

Most Priority species prefer large, ice-free water bodies over small ones, and depending on their foraging strategy (shallow divers/submerged vegetation, deep divers and fish-eaters, dabblers and skimmers), require a variety of water depths and food items during their season of use (Figure Hab-16-1). Islands are extraordinarily valuable, as they not only provide nesting opportunities for colonial species, but are also preferred as roosting and resting sites by many migrants. Isolation from land predators, such as coyotes, appears to be the driving force behind bird use of islands, and even islands near the shore are heavily utilized if the surrounding water is sufficiently deep to discourage predators. For instance, Virginia Lake in Reno is a small artificial water body with a central island that attracts a surprisingly large variety and abundance of aquatic birds during migration periods and in the winter, despite high recreational use of the area and many potential predators (dogs, raccoons, etc.) along its shores.

Although migration and winter is a time of particular abundance of aquatic birds, there are also significant breeding populations of Priority ducks, grebes, and shorebirds associated with open water, most notably American White Pelicans that breed on Anaho Island in Pyramid Lake. Most of these species, when not nesting on protected islands, need at least some vegetation cover at the nest site, which may be located in emergent vegetation along shorelines, on floating mats of vegetation, or in adjacent uplands. There are exceptions, however, including most notably the Snowy Plover, which nests in very sparse vegetation cover. Only two of the open water Priority species regularly use mature trees, the Snowy Egret and the Bald Eagle. Both prefer small groves of older larger trees adjacent to a water body that has abundant fish populations. Shorebirds require a variety of vegetation cover densities, so the emphasis on shoreline management should be to provide, where possible, a mosaic of different patches (emergent vegetation, mudflats, sparse grass cover, dense ground cover, and occasional groves of trees) to accommodate the greatest variety of species (Figure Hab-16-1). Disturbance-free buffers along shorelines are important in areas where nesting of Priority species is confirmed.

Water bodies in Nevada receive very different levels of bird monitoring depending on their ownership status. Lake Mead for instance, is regularly monitored by the US Park Service, and lakes with significant fish populations and/or migratory bird populations are monitored by NDOW and the USFWS. However, as a rule, non-game bird species that cannot be easily surveyed by aircraft receive notable incomplete statewide monitoring coverage at the present time. The effects of recreational activities, such as jet-skiing, boating, and shoreline camping, have not been comprehensively studied for possible impacts during sensitive periods.

Open Water

Main Concerns and Challenges

The following top five conservation concerns were identified in our planning sessions for Open Water habitats in Nevada:

- Surface water diversion and impoundment
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Mining
- Flood control

The main threat to Open Water habitats is reduction or loss of critical inflows to maintain water levels and water quality. This most often occurs because water is diverted to agricultural or municipal use. Walker Lake provides a case study for this dilemma, as discussed in the Common Loon species account (p. Spp-13-1). Reduced inflows lead to decreased lake depth (which is harmful to some fish), reduced lake surface area, increased salinity, which has a host of secondary effects, and altered shoreline profiles that in some cases are unsuitable for shorebirds that prefer broad mud flats. In extreme cases, islands may become accessible to predators by land bridges, which make them unsuitable for roosting and nesting by many species. The increased temperatures and reduced precipitation that are projected as a result of climate change will tend to compound these problems, as will increasing water demands associated with additional residential or agricultural development. Clearly the solutions to these problems involve a large measure of political and societal effort, preferably in a collaborative framework.

Water quality problems in Nevada tend to be localized rather than systemic. Mercury contamination from mining has been documented in a number of water bodies in Nevada, and fish-eating birds can be harmed by repeatedly ingesting contaminated fish. Botulism and avian cholera can cause large die-offs in waterbird populations, typically in smaller water bodies that can become stagnant or warm for extended periods.

Finally, Nevada waters have recently been invaded by exotic mollusks, particularly the quagga mussel (*Dreissena bugensis*) that was first found in the Lake Mead National Recreational Area in 2007. The mussel's population has increased dramatically in Lakes Mead and Mohave, significantly reduced fine algae, and it is easily transmitted to other water bodies through boats. Effects on bird populations are currently unknown.

Open Water

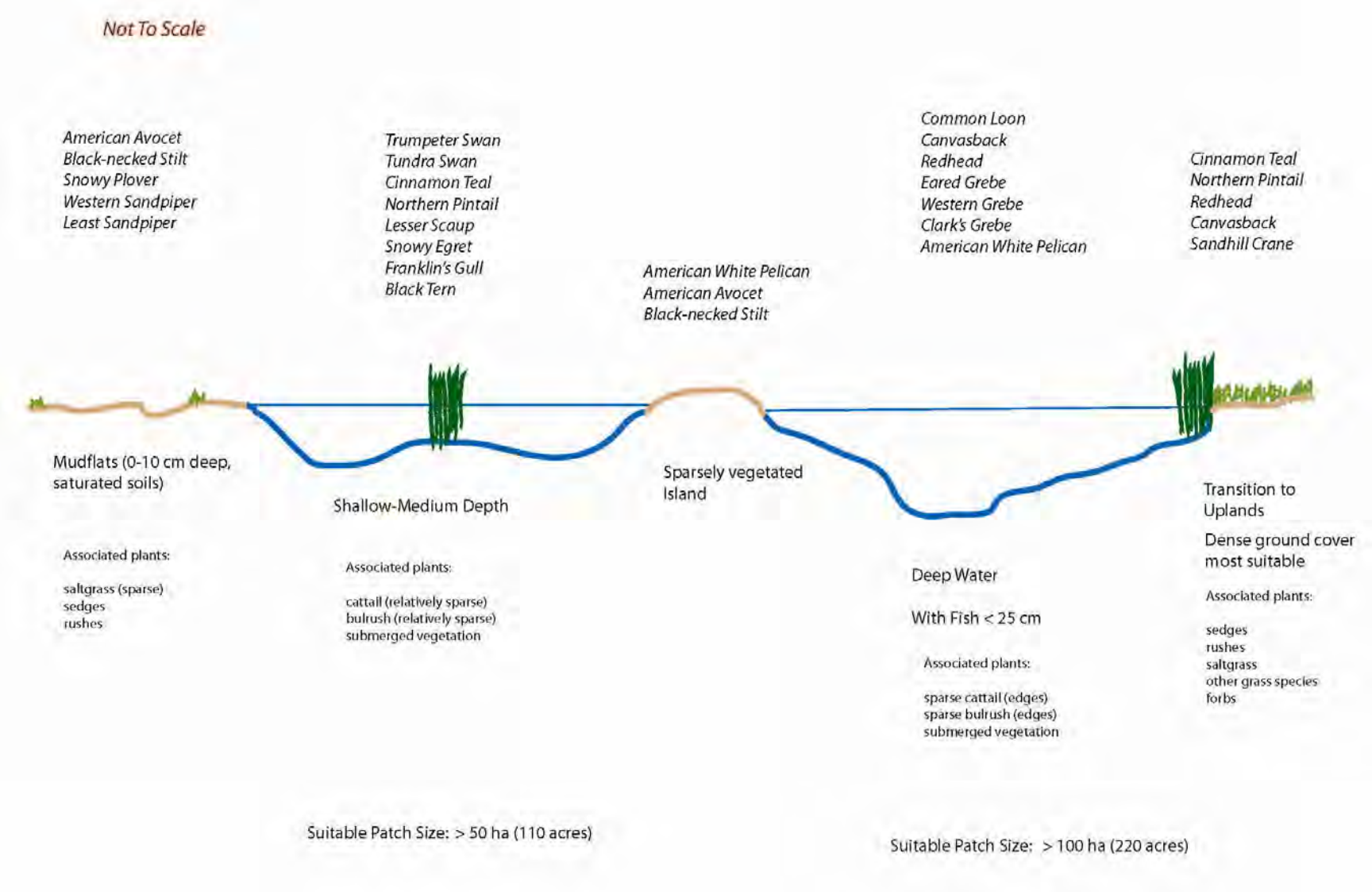


Figure Hab-15-1: Idealized open water landscape to maximize the number of open water dependent priority bird species.

Open Water

Conservation Strategies

Habitat Strategies

- **Manage at the scale of the entire waterbody** and surrounding areas that provide shoreline mudflats or vegetated shores. Most existing waterbodies cannot be easily reshaped, but if new ones are created, **islands and varying water depths** that allow for a **diversity of fish, invertebrates, and submerged vegetation** are important. Fish are desirable, particularly if a diversity of size classes (especially those < 25 cm [10 in]) can be provided
- **Excessive fluctuation and drops of lake levels** should be avoided in managed water bodies to the extent possible, in order to maintain vegetation and fish habitat in relatively shallow areas (< 6 m [20 ft]). If managed lakes need to be dried up for maintenance, this should ideally be done during low-use seasons of the Priority species that regularly use the site
- **Water quality** should be managed to minimize contaminants, sediment disturbance, and stagnant conditions. Prescribed burns along adjacent shorelines are generally well-tolerated by open water birds, although we recommend avoiding all burns of emergent vegetation during the primary breeding season (**May 1 through July 15**)

Research, Planning, and Monitoring Strategies

- **Expand monitoring coverage** of aquatic birds in under-surveyed areas, particularly for those species that are poorly represented in aerial surveys. The Aquatic Bird Count program provides a framework for this effort, and high priority sites for expanded coverage need to be identified
- When circumstances do not allow for the maintenance of desirable water levels in some water bodies, planning for **mitigation of habitat loss** may be necessary, particularly in **Important Bird Areas**.
- Monitor and research **effects of invasive mollusks** on bird habitat quality and habitat use of open water birds.
- Monitor and research **effects of lake recreational uses** on aquatic birds to be better able to plan for protection of sensitive areas.

Public Outreach Strategies

- **Promote year-round birding** on important water bodies, such as Walker Lake, Pyramid Lake, East Fork Reservoir, and Rye Patch Reservoir. This may be achieved through promotion of eBird maps that show under-birded areas, active outreach to Audubon chapters, IBA volunteer projects, and production of checklists and brochures for the under-birded areas / seasons.
- **Promote sustainable recreational use** of open water sites, including avoidance of sensitive areas by boaters, providing alternate camping options in areas where shorelines need to be protected, and preventing the spread of quagga mussels.

Pinyon-Juniper



Pinyon-Juniper habitat on the east slope of Wheeler Peak, White Pine County. Photo by Elisabeth Ammon.

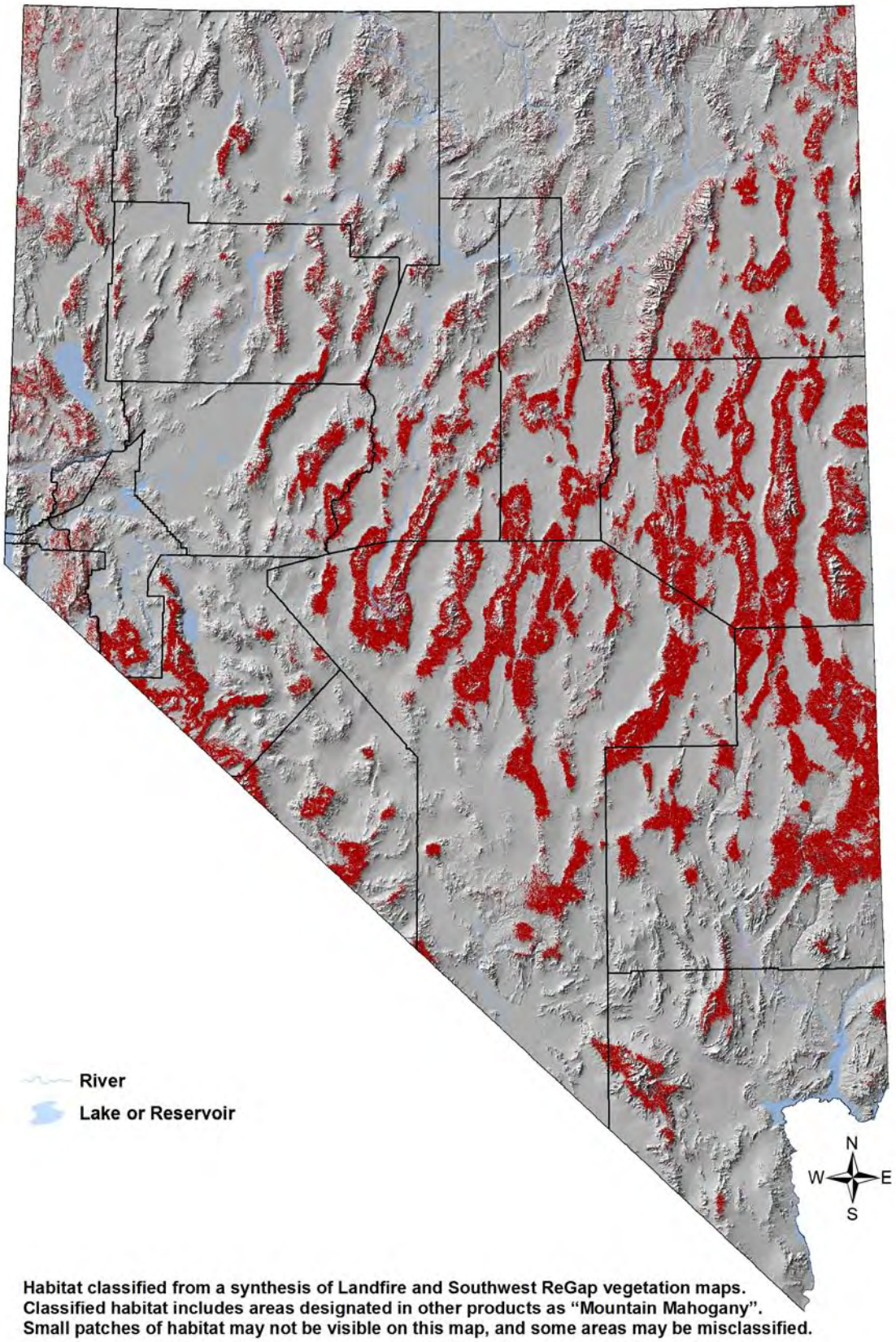
Key Bird-Habitat Attributes

Stand Structure	Multi-aged stands with shrub understory (parkland setting), frequent shrubby openings, and occasional dense-canopy stands
Ideal Scale for Conservation Action	1,400 ha [3,500 ac] or more
Plant Species Composition	Mixed stands of pinyon pine, juniper spp., mountain mahogany (where these can grow), with multiple species of shrubs (often sagebrush) as understory; forbs and flowering shrubs beneficial
Plant Condition	Pine nut and juniper berry crops important to birds; old trees provide snags for cavities; localized insect outbreaks pose little threat, but may create problems if widespread
Distance to Riparian/Spring Habitats	Proximity of water-dependent habitat increases value to birds
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds
Other Features	Abandoned mine shafts increases value to birds; may be gated

Conservation Profile

Estimated Cover in Nevada	3,695,000 ha [9,130,000 acres] 13% of state
Landownership Breakdown	BLM = 64% USFS = 26% Private = 5% Other = 5%
Priority Bird Species	Ferruginous Hawk Common Poorwill Gray Flycatcher Gray Vireo Pinyon Jay Virginia's Warbler Green-tailed Towhee Black-chinned Sparrow (Northern Goshawk) (Golden Eagle) (White-throated Swift)
Indicator Species	Juniper Titmouse Black-throated Gray Warbler
Most Important Conservation Concerns	Changes in fire intensity / frequency Insect outbreaks Livestock grazing Climate change (changes in precipitation) Urban, suburban, and industrial development Motorized recreation Invasive weeds
Recovery Time	75 years
Regions of Greatest Conservation Interest	White Pine, Lincoln, Lander, Clark, and northern Nye counties
Important Bird Areas (McIvor 2005)	Carson Range D.E.M. Bird and Wildlife Sanctuary Goshute Mountains Great Basin National Park Jarbidge Mountains Monitor Valley Mount Grant Northern Snake Range Ruby Mountains Spring Mountains Toiyabe Range Wellington-Pine Grove Hills

Pinyon-Juniper



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Classified habitat includes areas designated in other products as "Mountain Mahogany".
Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Pinyon-Juniper

Overview

Pinyon pine and juniper woodlands currently cover 12% of Nevada, approximately 3.5 million ha [9.1 million ac], accounting for an estimated 15% of their range-wide distribution (Mitchell and Roberts 1999). Nevada contains several juniper species, but Utah juniper (*Juniperus osteosperma*) is predominant. Of the two species of pinyon pines found within the Great Basin, only the single-leaf pinyon (*Pinus monophylla*) is known to occur in Nevada (Charlet 1996). Over the past 150 years, pinyon-juniper woodlands throughout the West and in Nevada have expanded into other habitat types and increased in density (Miller et al. 1995, Bauer and Weisberg 2009). The reasons for this range expansion and stand infill are speculated to include altered fire regimes, grazing, natural range expansion, recovery from past impacts, and a changing climate (Romme et al. 2009). Regardless of underlying mechanisms, which are undoubtedly complex, the changes in pinyon-juniper woodlands cause two main concerns to the wildlife manager: 1) the conversion of other high-priority habitat types (e.g., sagebrush) into woodlands, and 2) impacts of increasingly dense stand conditions on pinyon-juniper associated wildlife species, and its possible role in increasing the risk of large-scale destructive fires.

Ironically, despite the increased amount of Pinyon-Juniper habitat on the landscape, species such as Pinyon Jay, Western Scrub-Jay, and Mountain Chickadee are undergoing steep and significant population declines in the pinyon-juniper biome (Sauer et al. 2008). As non-migratory seed-eaters, these species represent a suite of birds that rely almost exclusively on pinyon-juniper woodlands. Therefore, significant bird conservation concerns exist not only for habitat types that are being encroached upon by pinyon-juniper, but for Pinyon-Juniper habitat itself.

From a bird conservation perspective, the ideal pinyon-juniper woodland has a mostly open canopy with a significant shrub understory (Fig. Hab-16-1). Based on Nevada Bird Count data, the Priority bird species associated with pinyon-juniper woodland are more abundant in these types of stands than in predominantly closed-canopy stands. Small groves of high-density trees interspersed in the woodland landscape are tolerated, and may in fact be beneficial for some species or for a subset of life history requirements. More generally, trees of diverse ages should be present within large pinyon-juniper landscapes, with at least some mature, seed-bearing trees (Gillihan 2006). The preferred open canopy structure is most often observed in two situations; 1) old-growth stands on rocky ridges and ravines, and 2) early-mid successional woodland stages that typify the pinyon-juniper “expansion” zones.

Currently, pinyon-juniper management typically focuses on removal of trees in so-called Phase I and II stands, which equate to the early and mid-successional encroachment sites that appear to be most valuable to birds (Miller et al. 2008). The goal of these treatments is often to reclaim sagebrush habitat, but the result of these treatments is often the removal of perhaps the most biologically valuable part of the pinyon-juniper woodland. Phase III stands (late-successional stands with high canopy closure), which are bird-poor and which have the potential to carry fire over long distances, are rarely targeted for tree removal projects because they are less accessible and are not perceived to be a threat to sagebrush. It is our recommendation that the processes that promote woodland infill, the ecology of pinyon-juniper expansion, and the inter-relationship of these factors with fire regimes and fire risk need to be carefully evaluated in order to determine the most beneficial management actions within the pinyon-juniper / sagebrush interface zone.

Pinyon-Juniper

Minimally, pinyon-juniper projects seeking to reclaim sagebrush habitat should try to avoid creating sharp habitat edges between reclaimed shrubland and dense, closed-canopy woodland

Main Concerns and Challenges

The following top seven conservation concerns were identified in our planning sessions for Pinyon-Juniper habitat in Nevada:

- Changes in fire regimes and intensity
- Insect outbreaks
- Livestock, wild horse and burro grazing
- Change in precipitation and snowmelt related to climate change
- Urban, suburban, and industrial development
- Motorized recreation
- Invasive weeds

In the near term, the main challenge associated with managing pinyon-juniper woodlands is that there are different perceptions within the resource management community about the nature of current pinyon-juniper dynamics, different interpretations of desirable condition, and different priorities regarding the most pressing issues to address. Pinyon-Juniper woodland distribution is inherently unstable, given the evolution of dispersal mechanisms (seed caching by birds and rodents) that result in variable local colonization events. The differing opinions about how to best intercede in this system to facilitate beneficial wildlife outcomes and manage fire risk reflect the complexity of the interrelated mechanisms that determine woodland distribution and structure.

Interestingly, research on past and current fire regimes shows mixed results, and the notion that low-intensity, frequent fires maintained pinyon-juniper woodlands historically is not necessarily supported (Baker and Shinneman 2004). Instead, fires in pinyon-juniper woodlands were likely severe, with long average return intervals of > 400 years (Baker and Shinneman 2004, Bauer and Weisberg 2009). Therefore, fire exclusion, which is often cited as a factor in pinyon-juniper expansion, likely occurred primarily in adjacent shrublands rather than in woodlands (Bauer and Weisberg 2009).

Most of the other conservation concerns tend to be fairly localized in scope and modest in severity. The impacts of climate change, in contrast, are difficult to predict and could be systemic. Growth of pinyon pines decreases with decreased winter/spring precipitation and increased June temperatures, and their regeneration may be threatened by increasingly long droughts (Barger et al. 2009). Prolonged droughts are also considered a significant contributor to insect outbreaks that can kill large stands of trees (Breshears et al. 2005).

Pinyon-Juniper

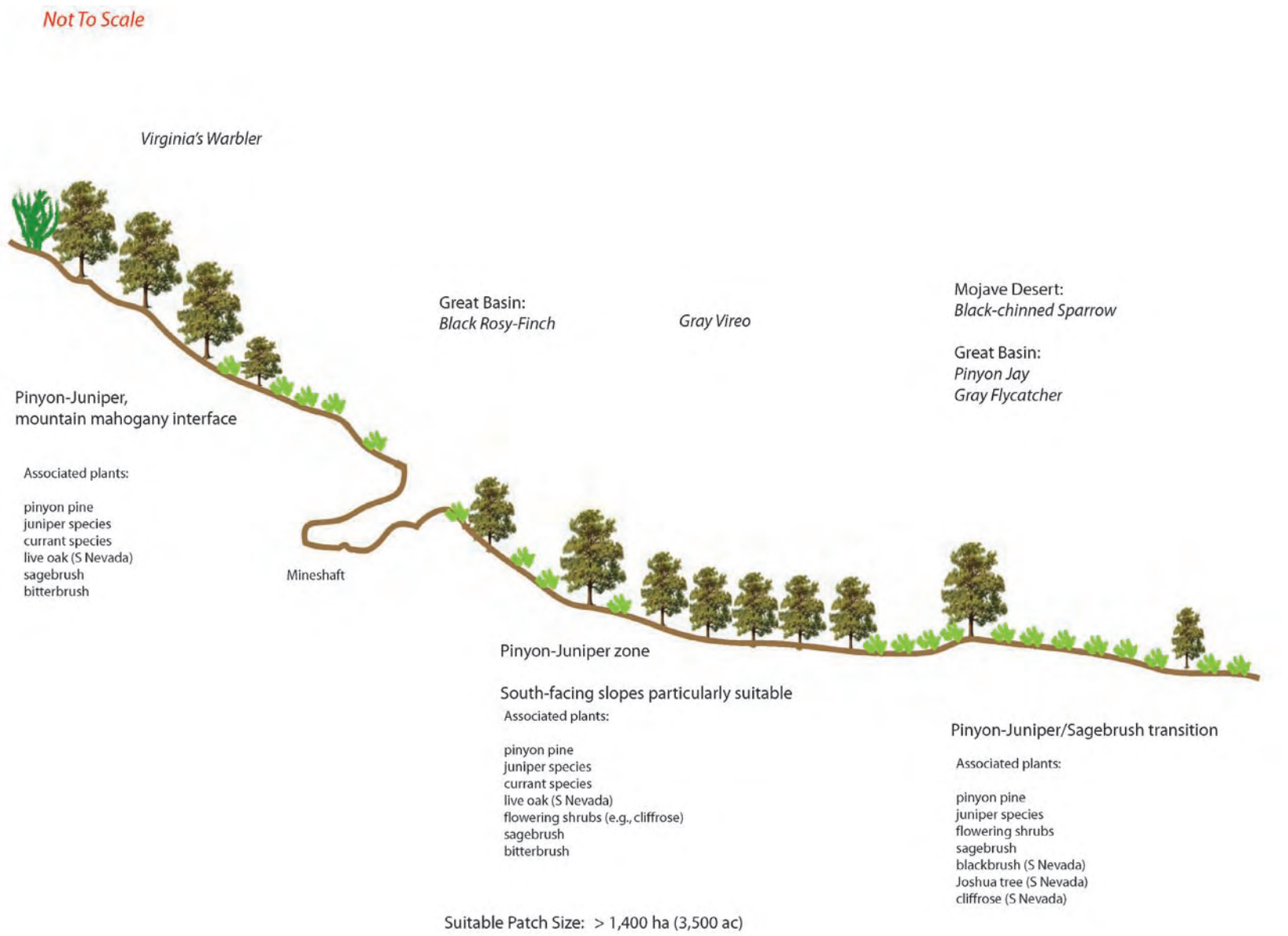


Figure Hab-16-1: Idealized pinyon-juniper woodland landscape to maximize the number of pinyon-juniper associated Priority bird species.

Pinyon-Juniper

Conservation Strategies

Habitat Strategies

- **Manage at landscape scale** (> 1,400 ha [3,500 ac]) with the goal of maintaining predominantly **open woodlands with xeric shrub understory**, including flowering shrubs and forbs, and a variety of tree ages, including cone-bearing trees. Multiple overstory species (pinyon pine, juniper spp., mountain mahogany), and **high plant species richness** in the understory, where environmental conditions exist to support them, are particularly desirable for Priority bird species
- Proximity to **water** (riparian areas, springs, wet meadows), presence of **cliffs** > 30 m [100 ft]) tall, or **abandoned mines** (which may be gated) raise the priority level of a site for bird conservation
- When implementing pinyon-juniper control measures, creation of sharp woodland edges should be avoided. Instead, **feathering of the woodland / shrubland edge preferred,** with the goal of creating a varied transition zones is recommended. Treatments that generate patchiness within dense extensive stands would likely benefit most Priority species
- Maintain **grazing and OHV use** at levels that do not permanently impact the shrub and forb understory or cause soils to be unnaturally exposed
- The majority of priority bird species nest between **May 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when disturbances should be avoided whenever possible
- In the **southern regions** of Nevada (primarily Clark, Lincoln, and Nye counties), protect old-growth stands on **rocky ridges and ravines**, and at the **interface with Joshua Tree woodlands** from impacts to habitat integrity in order to preserve Gray Vireo and Black-chinned Sparrow strongholds.

Research, Planning, and Monitoring Strategies

- Encourage **experimental treatments** of mid-elevation pinyon-juniper that is overgrown to determine whether open woodlands with sufficient shrub understory can be restored in the interior of woodlands, away from the pinyon-sagebrush edge
- **Monitor effects of pinyon-juniper treatments** for effectiveness and bird responses, and monitor habitat variables important to Priority species
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count

Public Outreach Strategies

- **Promote public appreciation** of healthy pinyon-juniper woodlands, their bird community, aesthetics of trees, sustainable pine nut harvest, importance of native understory vegetation, and threats from off-road vehicle recreation and weed invasion.

Sagebrush



Sagebrush habitat in Duck Creek Valley, White Pine County. Photo by Elisabeth Ammon.

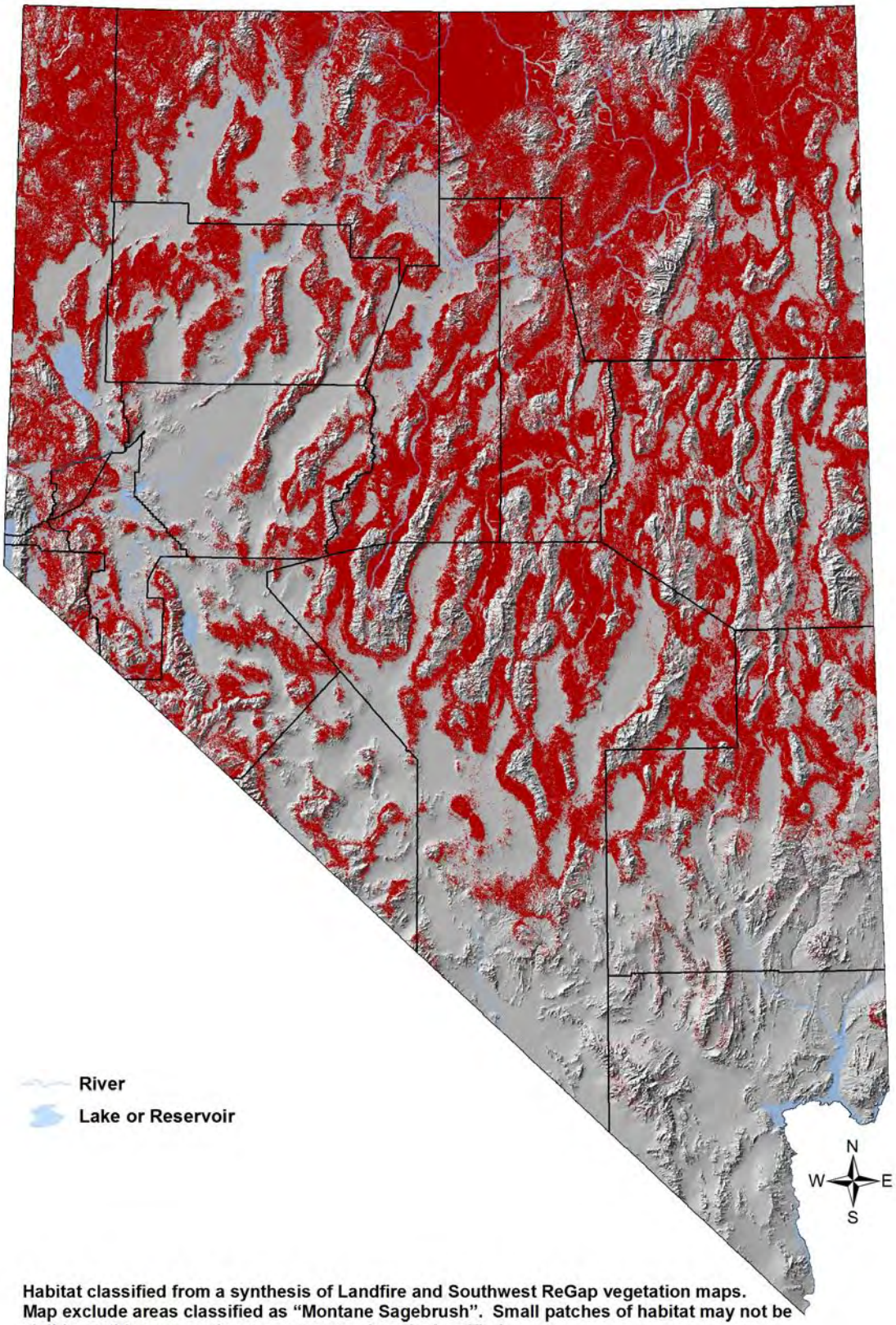
Key Bird-Habitat Attributes

Plant Composition	In sagesteppe (northern NV), about a 1:1 ratio of sagebrush and herbaceous vegetation (mostly perennial bunchgrasses and forbs); in sagebrush shrublands (central and eastern NV), multiple size classes of sagebrush with lesser component of herbaceous understory including forbs
Ideal Scale for Conservation Action	200 ha [500 ac] or larger to accommodate different patch types and avoid fragmentation
Vegetation Structure	Taller sagebrush (~ 1 m [3.3 feet]) are the most valuable, but large landscapes should contain different shrub canopy heights; understory and bare ground preferences vary among Priority species, so maintaining landscape diversity is important
Plant Species	Multiple shrub and forb species increase habitat value for birds
Distance to Water	Water-associated habitats (riparian, marsh, open water, springs) within 1000 m [3,300 ft] increase habitat value
Other Features	Mammal burrows, mineshafts, cliffs, and ephemeral washes add significant value for some priority species

Conservation Profile

Estimated Cover in Nevada	10,450,000 ha [25,800,000 ac] 37% of state
Landownership Breakdown	BLM = 76% Private = 13% USFS = 5% Other = 6%
Priority Bird Species	Greater Sage-Grouse Swainson's Hawk Ferruginous Hawk Golden Eagle Prairie Falcon Burrowing Owl Common Poorwill Gray Flycatcher Sage Thrasher Brewer's Sparrow Sage Sparrow (Sharp-tailed Grouse) (Short-eared Owl) (Pinyon Jay) (Black Rosy-Finch)
Indicator Species	None needed
Most Important Conservation Concerns	Increased fire frequency or intensity Invasive weeds Livestock, wild horse and burro grazing Energy development Conifer encroachment Climate change (change in precipitation and temperature) Urban, suburban, and industrial development Motorized recreation Mining
Habitat Recovery Time	25-100 years
Regions of Greatest Conservation Interest	Northern, northeastern, eastern, and central Nevada
Important Bird Areas	Bilk Creek – Montana Mountains Goshute Mountains Great Basin National Park High Rock Resource Area Jarbidge Mountains Monitor Valley North Ruby Valley Northern Snake Range Ruby Mountains Sheldon NWR Toiyabe Range Washoe Valley Wellington – Pine Grove Hills

Sagebrush



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps. Map exclude areas classified as "Montane Sagebrush". Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Sagebrush

Overview

Of all habitat types in this plan, sagebrush covers the largest portion of Nevada. It occurs primarily in the mid-to-low elevations of the Great Basin portion of the state and in smaller patches at high elevations in the Mojave portion. In this plan, we include only lowland sagebrush communities (< 1,800 m [5,900 ft]) within the Sagebrush habitat type, whereas montane sagebrush is included within the Montane Shrub habitat type. In northern and northwestern Nevada, sagebrush steppe ("sagesteppe") is characterized by a significant understory of grasses and forbs. In eastern and central Nevada, "Great Basin sagebrush" is often denser and taller, but has relatively little herbaceous understory.

Despite being so widespread, sagebrush shrublands have been degraded to the point that many sagebrush bird species are clearly declining (Rich et al. 2005). The combined effects of altered fire regimes, grazing, and invasive weeds, particularly cheatgrass (*Bromus tectorum*), have stressed large areas beyond their ability to naturally recover (Knick et al. 2003). The vast scale of the problem requires that habitat restoration efforts be carefully planned to address synergistic threats (e.g., Forbis et al. 2006).

Lowland sagebrush canopy cover is typically 6-20% (Davies et al. 2006), with many sagebrush birds preferring the upper end of this range. Tall, dense sagebrush is required by several priority species, but more open, low-growing shrubs or grassy areas are used by others. Understory requirements likewise vary by species, although in general, presence of an understory layer is beneficial both to birds and to increased resilience against invasive weeds (Anderson and Inouye 2001). Most plants that are characteristic of Sagebrush habitats are not well-adapted to continuous grazing pressure (Mack and Thompson 1982), but grazing can be sustainable as long as herbaceous understories are preserved. Studies of grazing effects on sagebrush birds have shown mixed results (Page et al. 1978, Saab et al. 1995).

The role of fire in Nevada's shrublands, both historically and in a modern context, is complex and deserving of continued study study (Donovan et al. 2002). Fire is thought to have been relatively common historically in sagesteppe landscapes, but was apparently far less frequent in Great Basin sagebrush, probably due to the relative lack of fine fuels (Paige and Ritter 1999). Fire is thought to have played some role in shaping the sagebrush / pinyon-juniper interface zone. However, sagebrush is readily killed by fire, and most ecotypes do not resprout from roots and can only regenerate from seed. This suggests that, in general, sagebrush is not well-adapted to fire (BLM 2002). Recovery times for sagebrush stands can be 25 to 100 years or more, and there is little evidence that fire was historically more frequent than in modern times; in fact the opposite could be true. Therefore, fire suppression likely has had little effect in most lowland sagebrush areas (Baker 2006).

In the modern era, the appearance of invasive weeds, sustained grazing by domestic livestock and wild horses, and direct human impacts on fire frequency and intensity have fundamentally altered fire regimes in Great Basin shrublands. Given these new realities, it is imperative to determine how to best manage fire to protect key wildlife habitat in the short-term, while still ensuring long-term habitat viability (BLM 2002).

Sagebrush

Main Concerns and Challenges

The following top conservation concerns were identified in our planning sessions for Sagebrush habitat in Nevada:

- Increased fire frequency or intensity
- Invasive weeds
- Overgrazing by livestock, wild horses and burros
- Energy development
- Conifer encroachment
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Urban, suburban, and industrial development
- Motorized recreation
- Mining

The variety of threats to sagebrush ecosystems have been well reviewed (Paige and Ritter 1999, Dobkin and Sauder 2004, Suring 2005, Chambers et al. 2008, Miller et al. 2011). The most serious threats to lowland sagebrush in Nevada involve the interrelated problems of invasive grasses, increased fire frequency, sustained grazing, and climate change (Knapp 1996, Hunt and Stiver 2000, Neilson et al. 2005, Baker 2006, Chambers et al. 2007, Bradley 2010). Almost one million acres in Nevada, mostly consisting of sagebrush, have been invaded by cheatgrass, and over six million acres of sagebrush have burned since 1999 (23% of total sagebrush cover; NDOW *pers. comm.*). Cheatgrass invasion across this vast landscape, especially in northern Nevada, has increased fire frequency to the point that native shrubsteppe plants cannot re-establish naturally in many places (Whisenant 1990). Therefore, to maintain and restore habitat for sagebrush-dependent species, fire suppression has been recommended for areas where there is a threat of cheatgrass invasion (WAFWA 2009). Fire is likely to be detrimental if intact sagebrush ecosystems have not had time to fully recover from previous disturbances, or if it destroys native understory plants beyond recovery (Baker 2006). For these cases, fire prevention and green-stripping are likely needed as stop-gap measures (Pellant 1994).

Livestock grazing is the most widespread land use on sagebrush ecosystems throughout the Great Basin (Knick et al. 2003), and should be carefully managed to prevent further loss of native herbaceous understories. Sustained heavy grazing by livestock and wild horses can be detrimental when it chronically removes understory vegetation and seedlings, and affects soil integrity (Young 1994, Saab et al. 1995). Additionally, it may compound the problems discussed above by helping to facilitate cheatgrass invasion. Pinyon-juniper expansion into sagebrush is also considered a problem statewide (Suring et al. 2005, Miller et al. 2008), though we believe this concern deserves additional study as discussed in the Pinyon-Juniper habitat account (p. Hab-16-1).

Several sagebrush Priority species are more likely to occur in large patches of sagebrush than in small ones (Knick and Rotenberry 2002), and others are vulnerable to landscape fragmentation (e.g., Greater Sage-Grouse; Knick and Rotenberry 2002). For this reason, the scale at which we recommend managing sagebrush is fairly large, but even larger landscapes that include high-

Sagebrush

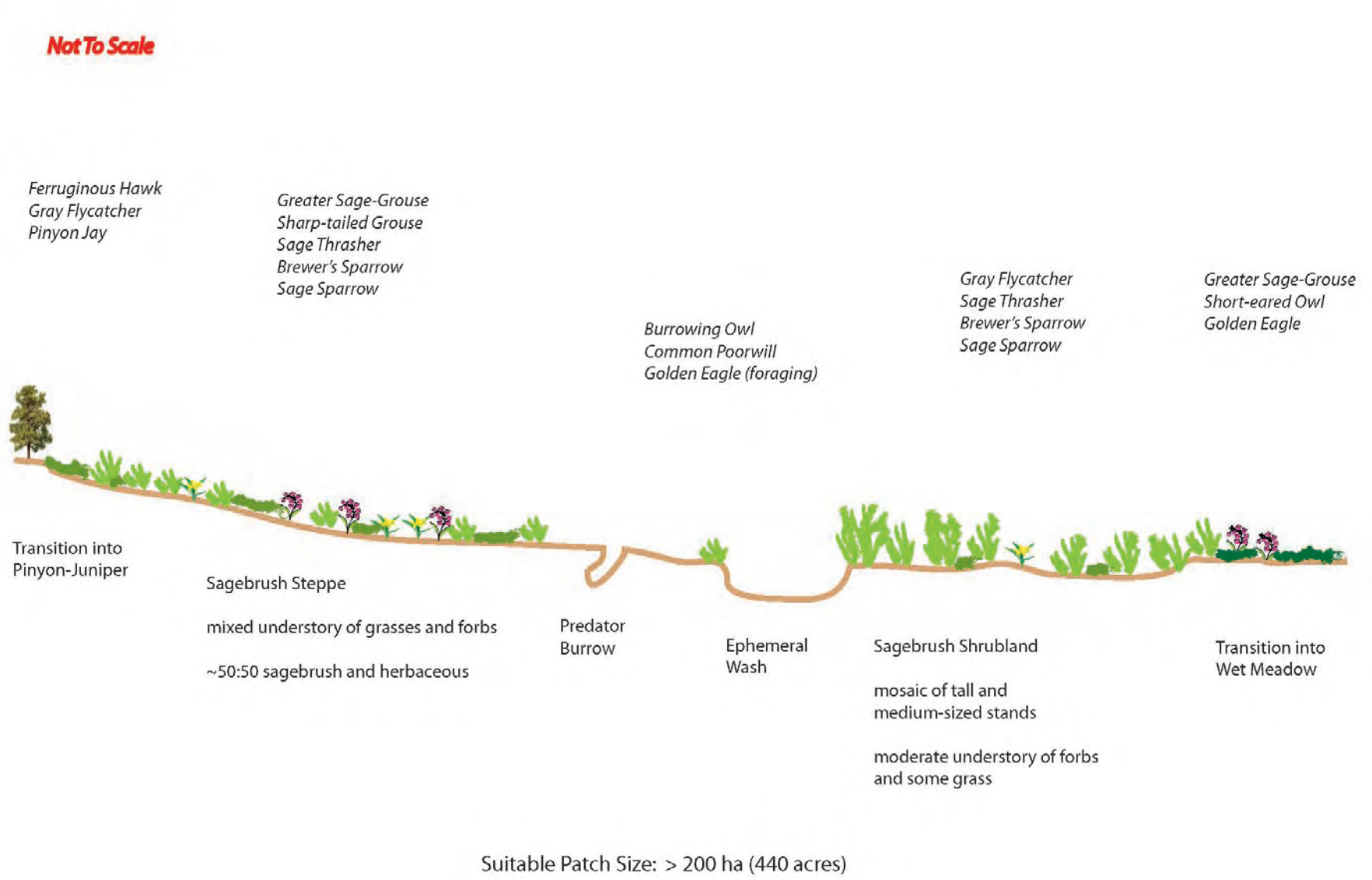


Figure Hab-17-1: Idealized sagebrush landscape to maximize the number of sagebrush associated Priority bird species.

Sagebrush

elevation and mesic habitats are required to maintain some species, especially Greater Sage-Grouse. Details on sage-grouse requirements should be based on more specific recommendations provided by the Nevada Sage-Grouse Conservation Team (2004). Habitat conversion and fragmentation from agriculture and development is a concern in many western states (Vander Haegen 2007, Leu et al. 2008), but in Nevada fragmentation of high-quality sagebrush more often occurs as a result of fire or habitat degradation. Similarly, habitat conversion from urban, industrial and energy development can be locally a significant concern (Torregrosa and Devoe 2008, Walston et al. 2009), particularly where high-priority conservation areas such as sage-grouse leks are concerned. Intensive OHV recreational uses can impact sagebrush birds through destruction of herbaceous understory, fragmentation of the landscape, increased fire danger, and introduction of invasive weeds (Barton and Holmes 2007, Ouren et al. 2007).

Climate change is of concern because it may further accelerate the spread of invasive weeds, and establish conditions where fires become more likely. Bradley (2010) predicted that climate change is most likely to negatively impact sagebrush ecosystems in southern Nevada first.



Sagebrush habitat in North Spring Valley,
White Pine County. Photo by John Boone.

Sagebrush

Conservation Strategies

Habitat Strategies

- **Manage at a landscape scale of 200 ha [500 ac])** or larger, if possible. The sagebrush landscape should be allowed to vary in size classes, shrub densities, and amount of understory at a natural scale, depending on soil conditions and fire history. Fragmentation through habitat conversion should be avoided to the extent possible. Because adjacent habitats, especially **mesic areas**, are beneficial to Priority species, impacts should largely be avoided in areas within 1,000 m [3,300 ft] of these features
- Where **Greater Sage-Grouse** occur, species-specific conservation strategies (Spp-8-1) should be implemented at the recommended spatial scales. The majority of these strategies favor other sagebrush-associated species, as well.
- **Native grass and forb understories** should be protected wherever possible. Grazing impacts can be decreased by focusing it on the plants' dormant season and by protecting current season's growth through the nesting season. Manage for at least 50% of annual vegetative growth to remain (Paige and Ritter 1999)
- **Fire prevention and green-stripping** may be a necessary stop-gap measure in areas of critical importance to sage-grouse (e.g., Montana, Bilk Creek, Santa Rosa ranges), but interagency **fire response planning** is needed to ensure long-term maintenance of high-quality sagebrush
- Proximity to **water** (riparian areas, desert springs, wet meadows), presence of **cliffs** > 30 m [100 ft] tall, or **abandoned mines** (which may be gated) raise the priority level of a site for bird conservation. Cliffs and abandoned mines should be surveyed for cliff-nesting Priority species and Black Rosy-Finches in proposed development projects site (see also Hab-4-1)
- The majority of priority bird species nest between **May 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when disturbances should be avoided to the extent possible

Research, Planning, and Monitoring Strategies

- Interagency planning of fire management, livestock management, and cheatgrass prevention efforts may be expanded into a **climate-change effects response network** emphasizing increased drought effects (Chambers et al. 2008, 2009)
- **Monitor effects of pinyon-juniper treatments** for effectiveness, and monitor habitat variables important to Priority species, as well as bird responses
- Study **effects of OHV use** on Priority landbirds and habitat integrity
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count
- Monitor status of **invasive weeds** to assess threat level locally and statewide.

Sagebrush

Conservation Strategies - continued

Public Outreach Strategies

- Increase public outreach that emphasizes the **fragility and beauty of intact sagebrush** expanses, with emphasis on responsible off-highway-vehicle use, fire prevention, control of invasive plants, and appreciation of sagebrush birds. Help debunk the notion that sagebrush are "weeds."
- Increase **outreach to land managers** by holding workshops on sagebrush birds and their habitat needs, providing "best management practices" tools (e.g. *Birds in a Sagebrush Sea*; *Pocket Guide to Sagebrush Birds*: http://www.sagestep.org/pubs/birdguide.html), and helping review project plans.



Sagebrush habitat in Duck Creek Valley,
White Pine County. Photo by John Boone.

Salt Desert Scrub



Salt Desert Scrub vista, with playa in the foreground and sand dune in the background, Churchill County. Photo by Elisabeth Ammon.

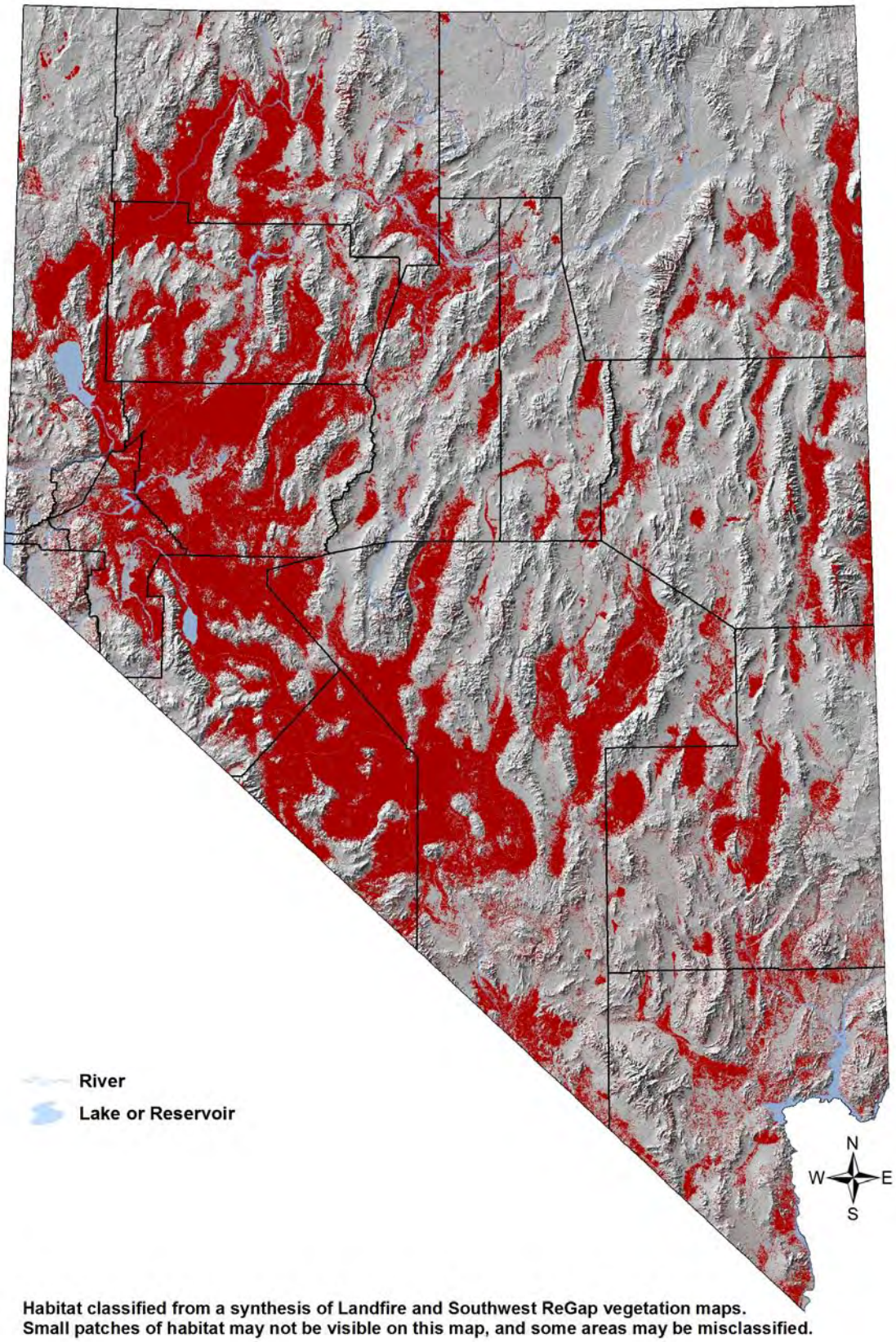
Key Bird-Habitat Attributes

Stand Structure	Open scrub stands with several shrub species and varying heights and densities, usually based on available soils and water; understory usually sparse, but important where present; sparsely vegetated and bare patches also important to some priority species
Ideal Scale for Conservation Action	> 200 ah [500 ac], preferably much larger
Plant Species Composition	Saltbush and associated shrubs, often with saltgrass; some Great Basin areas almost pure greasewood, which are important if they are tall
Plant Condition and Ephemeral Washes	Plants located in ephemeral washes have access to additional moisture, and provide important resources for birds during drought periods
Distance to Riparian/Spring Habitats	Proximity of water-dependent habitats increases value to birds
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	6,022,000 ha [14,880,000 ac] 21% of state
Landownership Breakdown	BLM = 75% Private = 11% DOD = 7% Other = 7%
Priority Bird Species	Prairie Falcon Burrowing Owl Sage Thrasher Le Conte's Thrasher Brewer's Sparrow Sage Sparrow (Ferruginous Hawk) (Golden Eagle) (Common Poorwill)
Indicator Species	Black-throated Sparrow
Most Important Conservation Concerns	Energy development Motorized recreation Livestock, wild horse and burro grazing Invasive weeds Urban development
Habitat Recovery Time	25-50 years
Regions of Greatest Conservation Interest	Washoe, Humboldt, Churchill, Lincoln, and Clark counties
Important Bird Areas	Ash Meadows NWR Catclaw Washes Franklin Lake Gridley Lake High Rock Resource Area Lahontan Valley Wetlands Moapa Valley North Ruby Valley Oasis Valley Pahranagat Valley Complex Pyramid Lake Swan Lake Walker Lake Washoe Valley

Salt Desert Scrub



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps.
Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Salt Desert Scrub

Overview

At first glance, the Priority species list for the driest of Nevada's habitats, Salt Desert Scrub, seems relatively impressive. However, large expanses of salt desert have very limited bird life. The salt desert is one of the most difficult western environments for both plants and wildlife. Vegetation consists primarily of drought-adapted plants such as saltbush, shadscale, budsage, and several forb species. For the purpose of this plan, we also include in this habitat type greasewood-dominated plant communities that usually occur near playas or in other locations where they can access groundwater. As in Mojave Scrub habitats, birds that can tolerate living in the salt desert generally have large home ranges within which they forage for sparse and ephemeral resources, and they are often attracted to features that interrupt the salt desert landscape, such as cliffs, ephemeral washes, burrows, sandy areas, or patches of dense, tall shrubs (Figure Hab-19-1-a and b).

Despite its foreboding nature, Salt Desert Scrub is one of the primary habitats for Le Conte's Thrasher in Nevada. As recent work has shown (D. Fletcher *pers. comm.*, Floyd et al. 2007), Le Conte's Thrasher occurs in a spotty and seemingly unpredictable pattern across the Mojave region's salt deserts, likely because its food resources naturally occur in an ephemeral pattern over space and time. This pattern conjures the image of salt desert birds "living on the edge" ecologically, and it is likely that impacts to their habitat have effects in similarly unpredictable ways.

Main Concerns and Challenges

The following top five conservation concerns were identified in our planning sessions for Salt Desert Scrub habitat in Nevada:

- Energy development
- Motorized recreation
- Livestock, wild horse and burro grazing
- Invasive weeds
- Urban, suburban, and industrial development

Land uses of the salt desert are generally light because of their relative lack of desirable resources. Cattle grazing is widespread throughout most of Nevada, but where salt deserts are part of the livestock range, they typically experience light use unless springs or other mesic habitats are interspersed in the landscape. However, in the Mojave region, burro use continues to be a concern, as burros appear more adept at foraging in very dry vegetation than other types of livestock (Abella 2008). OHV recreation, accelerating energy development, and invasive plants pose threats of more recent genesis to this habitat type. Groundwater pumping may also pose a threat to greasewood stands that depend on access to ground water near playas or where upwelling occurs.

Salt Desert Scrub



Figure Hab-18-1-a: Idealized Mojave salt desert landscape to maximize the number of salt desert associated Priority bird species.

Salt Desert Scrub

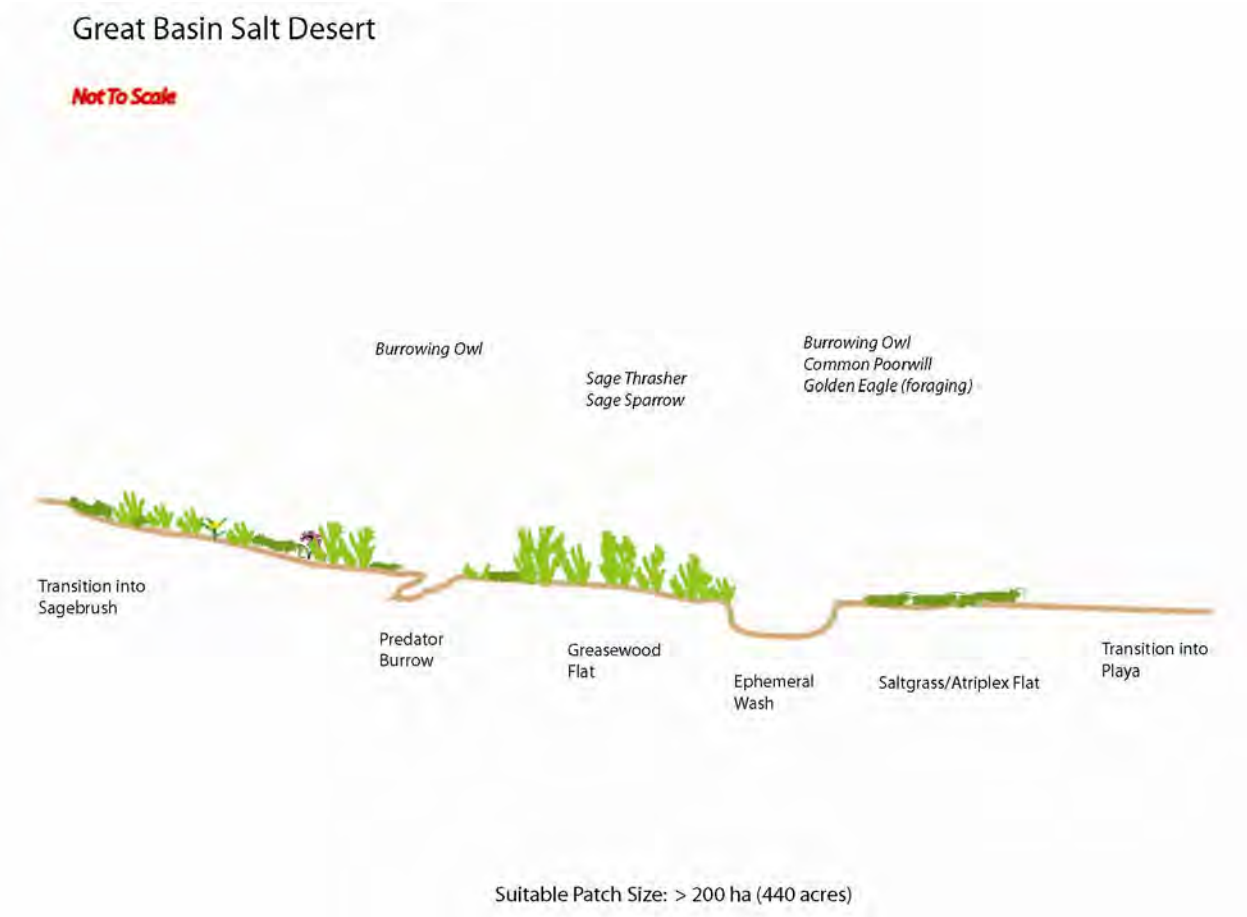


Figure Hab-18-1-b: Idealized Great Basin salt desert landscape to maximize the number of salt desert associated Priority bird species.

Salt Desert Scrub

Conservation Strategies

Habitat Strategies

- **Manage at a landscape scale (> 200 ha [500 ac])** with the goal of maintaining a natural mosaic of stand types, size classes, and different densities and understories. If other habitats are interspersed, for example cliffs > 30 m [100 ft] tall, springs, playas with ephemeral water, or ephemeral washes, conservation efforts should focus on these areas by avoiding habitat conversion and degradation within a radius of > 1,000 m [3,300 ft] from these features
- **Weed control** is recommended where invasive annuals are becoming established, because they change fire regimes and are largely unsuitable for Priority species
- **Wild horses, burros, and domestic livestock** should be managed to minimize their use of high priority areas, particularly those occupied by Le Conte's Thrasher
- Maintain **grazing and OHV use** at levels that do not permanently impact the shrub layer or forb understory
- The majority of priority bird species nest between **April 1 and July 15**, and some of them are particularly sensitive to nest disturbance. This is the time period when disturbances should be minimized

Research, Planning, and Monitoring Strategies

- **Clarify habitat requirements** of species that may rely on ephemeral resources, such as Le Conte's Thrasher, Prairie Falcon, Golden Eagle, and Burrowing Owl. Particularly needed is information on **patch size requirements and landscape variables** that need to be considered in effective conservation planning
- Study **effects of OHV use** on Priority landbirds and habitat integrity
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count
- Monitor status of **invasive weeds** to assess threat level locally and statewide

Public Outreach Strategies

- **Promote responsible OHV uses**, such as avoiding nesting areas of Priority species

Springs



A spring in Washoe County.
Photo by Elisabeth Ammon.

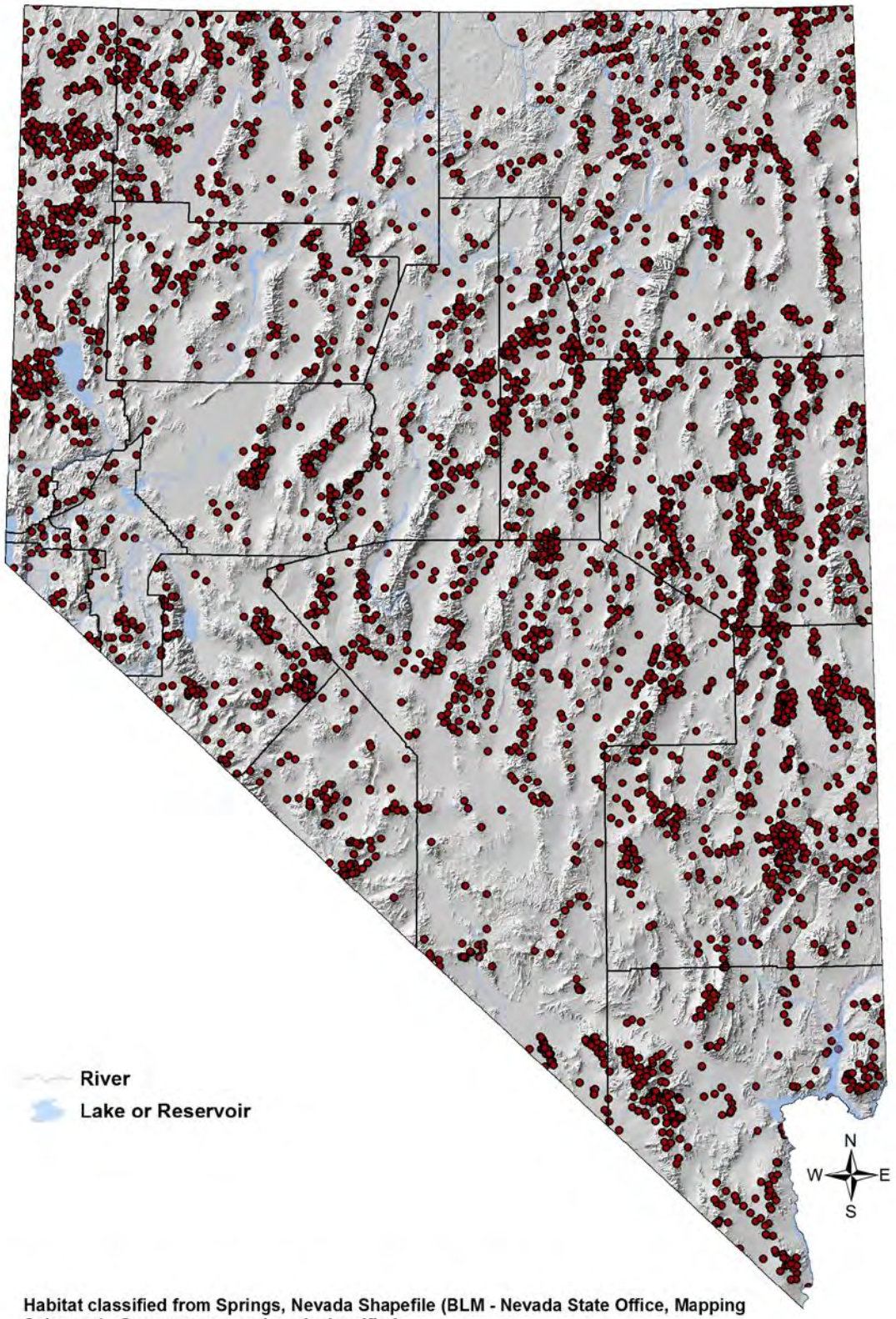
Key Bird-Habitat Attributes

Stand Structure	Dense, often small deciduous trees, mesic shrubs, and grass and flowering forb understory; transition into upland often with other deciduous shrub species
Ideal Scale for Conservation Action	10 ha [25 ac] or more, including a minimum of 2 km [1 mi] of outflow stream where applicable
Plant Species Composition	For larger springs, willow, mesquite, baccharis, quailbush, alder, aspen, water birch, wild rose, currant, and other mesic species; for smaller springs, saltgrass, rushes, sedges, and aquatic (submerged) plants
Understory	Closed-canopy shrub thickets interspersed with natural meadow openings ideal
Presence of Cliffs > 30 m [100 ft] Tall	Presence of tall cliffs increases value to birds

Conservation Profile

Estimated Cover in Nevada	4,179 individual springs (Great Basin: 3,752; Mojave: 427)
Landownership Breakdown (% of springs)	BLM = 60% Private = 21% USFS = 12% Other = 7%
Priority Bird Species	Gambel's Quail Costa's Hummingbird Calliope Hummingbird Rufous Hummingbird Willow Flycatcher (SWFL) Abert's Towhee (Greater Sage-Grouse) (Mountain Quail) (Northern Goshawk) (Yellow-billed Cuckoo) (Lucy's Warbler)
Indicator Species	Yellow Warbler
Most Important Conservation Concerns	Livestock, wild horse and burro grazing Surface water diversion and impoundments Groundwater pumping Invasive weeds Climate change (change in precipitation and temperature) Motorized recreation
Recovery Time	15-20 years (with available water)
Regions of Greatest Conservation Interest	Southern Nevada (Clark, Nye, Lincoln counties), northwestern and central Nevada
Important Bird Areas	Ash Meadows NWR Bilk Creek – Montana Mountains Great Basin National Park Lahontan Valley Wetlands Lake Mead Moapa Valley Monitor Valley North Ruby Valley Oasis Valley Pahranagat Valley Complex Sheldon NWR Spring Mountains Toiyabe Range

Springs



Habitat classified from Springs, Nevada Shapefile (BLM - Nevada State Office, Mapping Sciences). Some areas may be misclassified.

Springs

Overview

Springs occur throughout Nevada, from valley bottoms to high mountains. Montane springs are often the result of water surfacing from seasonal underground sources (e.g., snowmelt seeping into rocky slopes), while valley springs are often the result of groundwater upwells. For this plan, springs are defined as surface water bodies generated by an upwelling, along with their associated mesic vegetation and outflow channels. Springs usually occur in patches too small to reliably support riparian or aquatic obligate bird populations, although larger patches of Springs habitat and smaller patches of riparian woodland by be functionally equivalent. Springs are thought to provide valuable shelter, water, and foraging opportunities for many upland bird species, particularly in an arid state like Nevada. Greater Sage-Grouse, for instance, seek out wetter areas rich in forbs and insects during critical periods of their annual cycle, and springs may often provide these resources. Other upland species, such as Brewer's Sparrow, are more likely to occur where surface water is nearby (p. Spp-73-1). Therefore, while smaller springs may not support significant bird populations by themselves, they may greatly increase the abundance and diversity of birds in upland landscapes within which the springs occur.

Research quantifying the role of springs in sustaining bird communities is limited. Richardson et al. (2007) recently studied bird responses to high-elevation springs of the Spring Mountains. They found that 34 species became less abundant with increasing distance from the spring, up to a distance of 500 m [1,600 ft]. The importance of lowland desert springs to birds has been largely unstudied, although expert opinion of the planning group was that springs and transitional areas were critical for several Mojave Desert Priority species, including Costa's Hummingbird, Gambel's Quail, and Abert's Towhee. We encourage research that evaluates the use of springs by upland Priority species throughout the state. In Figure Hab-19-1, we illustrate the Springs habitat elements that are important to Priority species.

In addition to being understudied, springs are badly under-inventoried throughout the state. They are often misclassified or simply missing from land cover maps, and even where springs are correctly plotted, few of their attributes are classified, and their associated mesic vegetation cover is usually too limited in extent to even register on the map. With over 4,000 springs that were originally mapped in Nevada, one of our strongest conservation recommendations is therefore to conduct a comprehensive inventory of historic spring sites to determine how many have been lost or altered, and how many are intact. We further recommend developing a formal sampling effort to monitor springs for signs of change in discharge or in mesic habitat cover, which may be attributable to climate change and increased demands on water.

Main Concerns and Challenges

The following top seven conservation concerns were identified in our planning sessions for Spring habitat in Nevada:

- Overgrazing by livestock, wild horses and burros
- Surface water diversion, impoundments
- Groundwater pumping

Springs

- Invasive weeds
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Motorized recreation

Springs are vulnerable to many of the same impacts as riparian areas (pp. Hab-7-1, Hab-11-1, and Hab-13-1), including overgrazing, water diversions, and invasive weeds. Wet areas invariably draw attention from grazing animals, and because spring patches are typically so small, they can be degraded more quickly than larger riparian zones. Invasive weeds, facilitated by disturbance, may then take hold. For the same reason, even relatively small changes in water availability can significantly alter a spring's hydrology and outflow. Climate change is therefore a significant concern, since many springs depend on snowpack and precipitation for their discharge. Climate change may affect spring systems earlier and more severely than other mesic habitat types that occur in larger patches and have access to more abundant water supplies. Given that little is known about how birds depend on access to springs, especially in desert regions, it is not possible to estimate how the loss of springs or the degradation of their associated mesic vegetation might affect bird conservation. As mentioned above, a significant effort is needed to inventory and monitor springs and their associated bird communities throughout Nevada in order to better understand these issues.

The upside of springs conservation is that restoration efforts can often be very effective in a fairly short time span, and for relatively moderate costs, as long as spring outflows are still present. Several successful spring restoration projects have been conducted in Nevada by management agencies (e.g., Ash Meadows NWR), which benefitted not only the spring itself but associated wetlands and riparian areas. Restoration projects may involve creating exclosures, altering the timing of grazing activity, providing alternative water and shade sources for domestic livestock, conducting weed control, and even re-engineering of the spring itself. Assuming that the spring and its associated mesic vegetation are in good condition, it is also important to manage adjacent upland areas to maximize their habitat quality. Both suitable uplands and intact springs are required to realize their full synergistic benefits to birds.

Springs

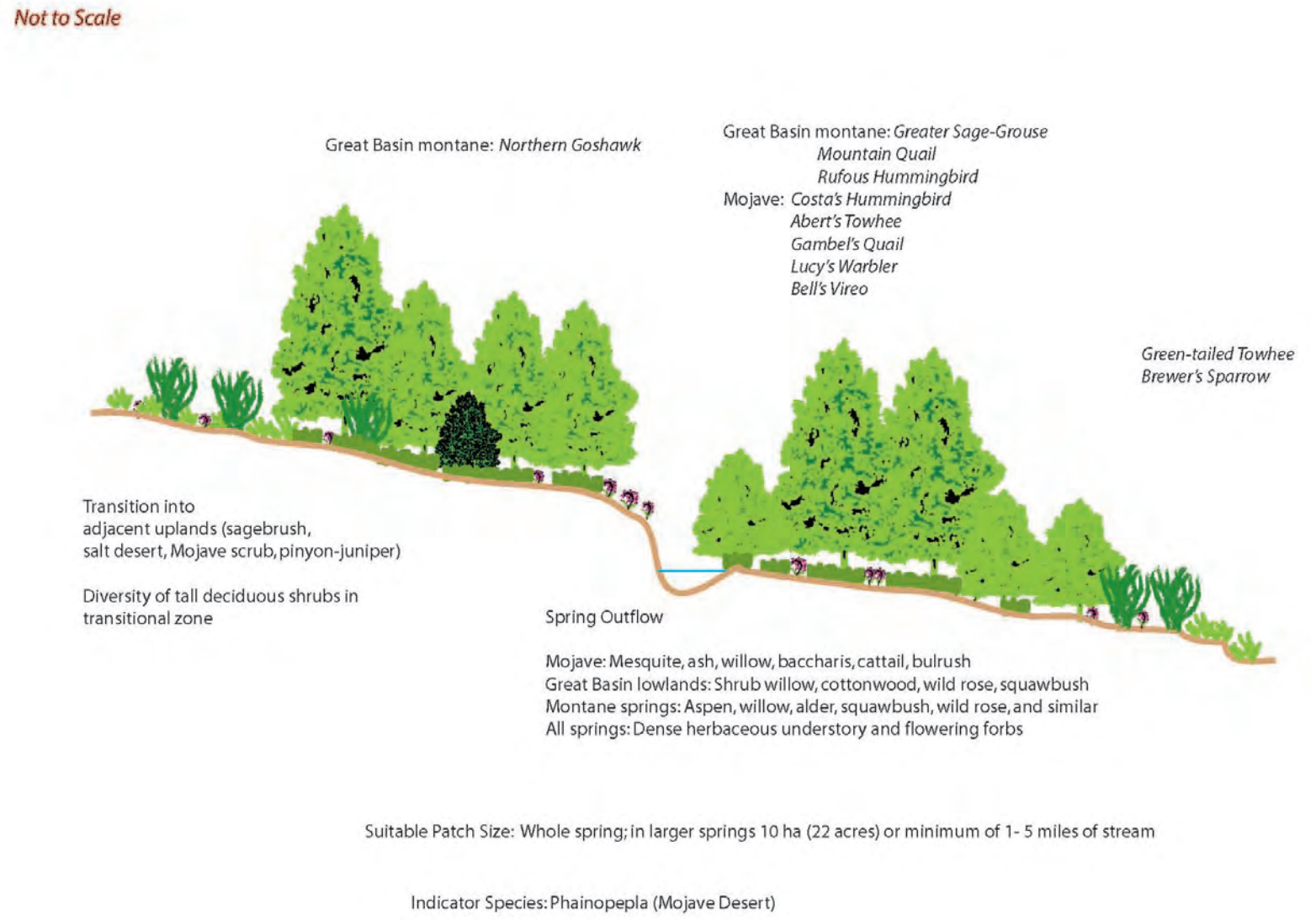


Figure Hab-19-1: Idealized springs landscape to maximize the number of springs-associated Priority bird species.

Springs

Conservation Strategies

Habitat Strategies

- Manage **whole spring** or, for larger springs, **10 ha [25 ac] and/or 2-3 km [1 – 5 mi] of outflow channel and associated floodplain**, with preference given to larger areas, wider outflow corridors, or more linear distance of outflow stream. Even small spring patches are valuable, but the desired mesic conditions are better realized with larger overall patch sizes. Sufficient **buffers** (up to 1 km [0.6 mi]) of adjacent transitional and upland habitat types are desirable to provide connectivity for upland birds
- Protect, to the extent possible, the **water source** of springs, particularly for larger, perennial springs
- Critical habitat components include **dense shrub thickets** (mesquite, willow, alder, wild rose, or other mesic species) with patches of **mesic herbaceous cover** interspersed. Sites that cannot support deciduous woodlands are also important if native herbaceous cover and access to water exists. Potentially detrimental land uses, such as prolonged livestock, wild horse, or burro grazing and motorized recreation, may be controlled by fencing and providing alternate access to water and shade
- Single **large trees**, small groves, and large snags provide important opportunities for some Priority species, and should therefore be protected to the extent possible.
- **Restoration of historic outflow channels** and associated floodplains is a high priority for larger springs that have been altered for water diversion. The primary requirement is sufficient water, and if no source vegetation is available, plantings of native woodlands will significantly accelerate restoration.

Research, Planning, and Monitoring Strategies

- One of the highest statewide priorities for Spring habitat conservation planning is to **inventory historic spring sites**, determine condition of remaining springs, and to develop a **monitoring plan that can capture trends associated with changing climate or changing water supplies**
- Expand current efforts of **long-term monitoring of landbirds** through the Nevada Bird Count to better capture Spring habitat sites

Public Outreach Strategies

- **Promotional materials** that convey the value of springs to wildlife and ways to avoid unintentional impacts should be made available to private landowners, managers, and the general public.

Wet Meadow



Wet meadow in south Steptoe Valley, White Pine County. Photo by Elisabeth Ammon.

Key Bird-Habitat Attributes

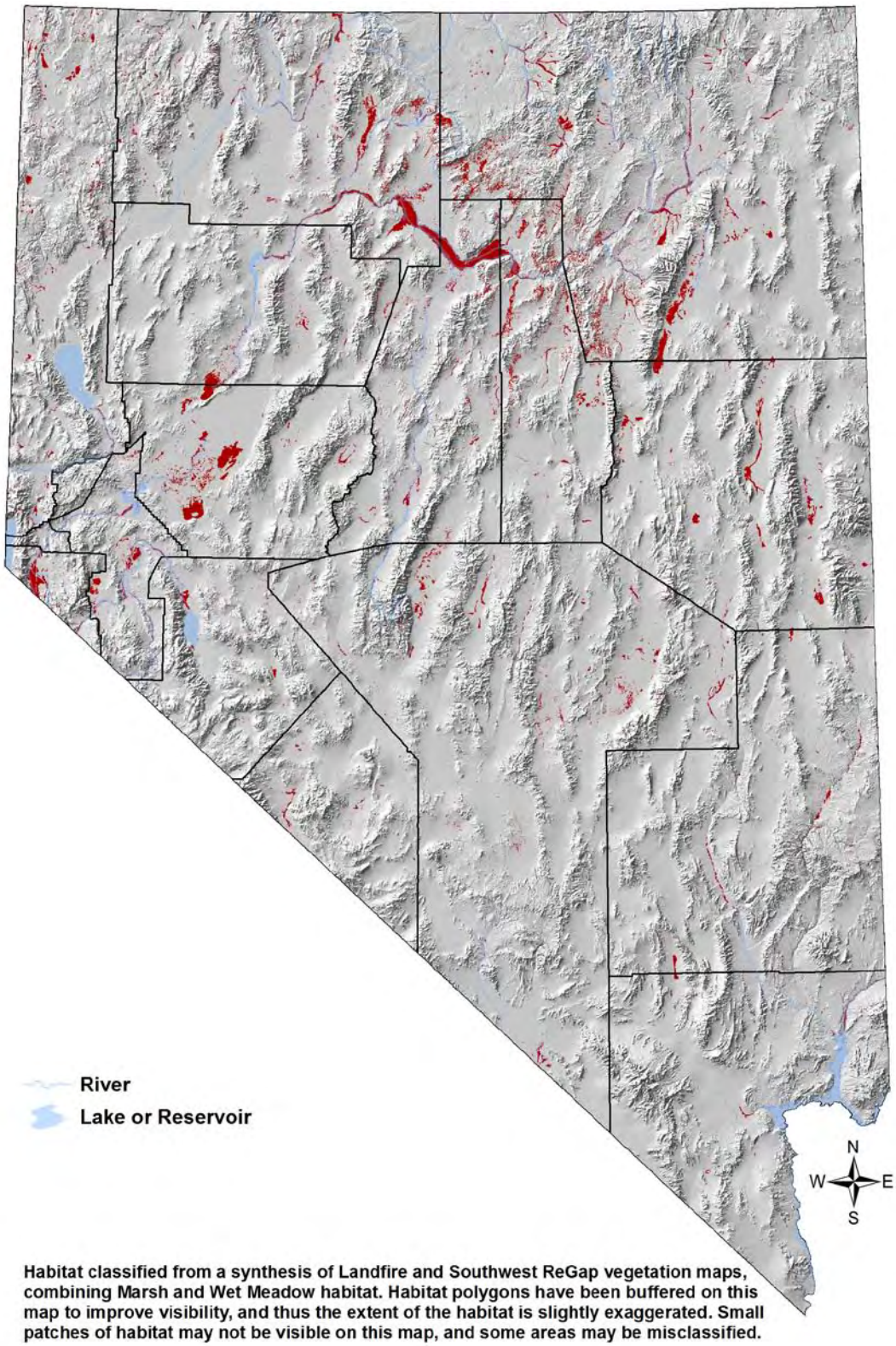
Plant Species Composition	Multi-species mixtures of graminoids and forbs ideal
Ideal Scale for Conservation Action	Whole meadow and border habitats
Land Uses	Haying schedules that avoid the main breeding season (May – mid-June) most suitable; flush-bars on agricultural equipment extremely beneficial; grazing practices that avoid creation of bare soil
Windbreaks and Hedgerows	Rows of native willows, alders , and other shrubs along ditches and streams particularly suitable for some species
Other Features	Protection of nearby streams, springs, rivers from chemical and livestock impacts enhances overall wildlife value; feral cat colonies should be discouraged

Conservation Profile

Estimated Cover in Nevada	222,100 ha [549,000 ac] 0.8% of state
Landownership Breakdown	BLM = 46% Private = 43% Other = 11%
Priority Bird Species	Greater Sage-Grouse White-faced Ibis Sandhill Crane Willet Long-billed Curlew Short-eared Owl Rufous Hummingbird (Lesser Scaup) (Swainson's Hawk) (Golden Eagle) (Prairie Falcon) (Wilson's Phalarope)
Indicator Species	Bobolink (in northern and NE Nevada)
Most Important Conservation Concerns	Change in agricultural practices Surface water diversion, impoundments Groundwater pumping Invasive weeds Climate change (change in precipitation and temperature) Livestock and wild horse grazing Motorized recreation
Habitat Recovery Time	5-10 years
Regions of Greatest Conservation Interest	Northeastern and eastern Nevada
Important Bird Areas	Boyd Humboldt Valley Wetlands Carson Valley Franklin Lake High Rock Resource Area Lahontan Valley Wetlands Meadow Valley Wash Monitor Valley North Ruby Valley Oasis Valley Pahranagat Valley Complex Sheldon NWR Washoe Valley

Wet Meadow

Map shows <u>combined</u> extent of Marsh and Wet Meadow habitat types



Habitat classified from a synthesis of Landfire and Southwest ReGap vegetation maps, combining Marsh and Wet Meadow habitat. Habitat polygons have been buffered on this map to improve visibility, and thus the extent of the habitat is slightly exaggerated. Small patches of habitat may not be visible on this map, and some areas may be misclassified.

Wet Meadow

Overview

Wet Meadow habitat supports a number of Priority bird species in Nevada, most notably the Long-billed Curlew and Sandhill Crane. Greater Sage-Grouse also make use of wet meadows in the brood-rearing period, especially as shrubland forbs start to dry out as the summer progresses. For the purpose of this plan, we define Wet Meadow habitat as non-irrigated areas that are dominated by herbaceous vegetation. Most wet meadows receive water from spring runoff, near-surface groundwater, spring outflows, or by virtue of proximity to floodplain wetlands, lakes, and marshes. Although not intentionally irrigated, many wet meadows develop along the paths of water runoff from agricultural areas

Wet meadows are not very common in Nevada, and most are managed by the BLM and private landowners. As is the case with most "wet" habitats, wet meadows may enhance landscape quality for birds that are primarily associated with drier habitats. For instance, Short-eared Owls typically nest in uplands, but focus their hunting efforts in nearby wet meadows where voles are far more abundant. High-quality Wet Meadow habitat is characterized by dense, uninterrupted groundcover comprised of a diversity of grasses, sedges, rushes, and forbs (Figure Hab-20-1). Plant species diversity is important, as it maximizes foraging value for birds that feed on forbs, insects, or rodents. Old, deciduous border trees are rare in native wet meadows in Nevada, but as in agricultural lands, if they are present, they may support raptor nests and roosts. Nearby wetlands and riparian areas add significant landscape value for birds, many of which are most abundant where these different habitat types are juxtaposed.

Main Concerns and Challenges

The following top eight conservation concerns were identified in our planning sessions for Wet Meadow habitat in Nevada:

- Change in agricultural practices
- Surface water diversion, impoundments
- Groundwater pumping
- Invasive weeds
- Change in precipitation and snowmelt related to climate change
- Change in temperature related to climate change
- Overgrazing by livestock, wild horses and burros
- Motorized recreation

The most serious concerns are those that could deprive wet meadows of their water source. Climate change is among these in that it could reduce some sources of moisture for wet meadows. Locally intensive grazing may be harmful to birds if it exposes bare soils and facilitates invasive weeds. However, grazing can also benefit some wet meadow birds, notably the Long-billed Curlew, if properly managed (p. Spp-34-1), and wet meadows can recover

Wet Meadow

rapidly if they are rested from overgrazing. Weeds and soil erosion are also a concern where OHV traffic is intensive, particularly in areas that have water-saturated soils.



Wet meadow complex in Spring Valley, White Pine County.
Photo by John Boone.

Wet Meadow

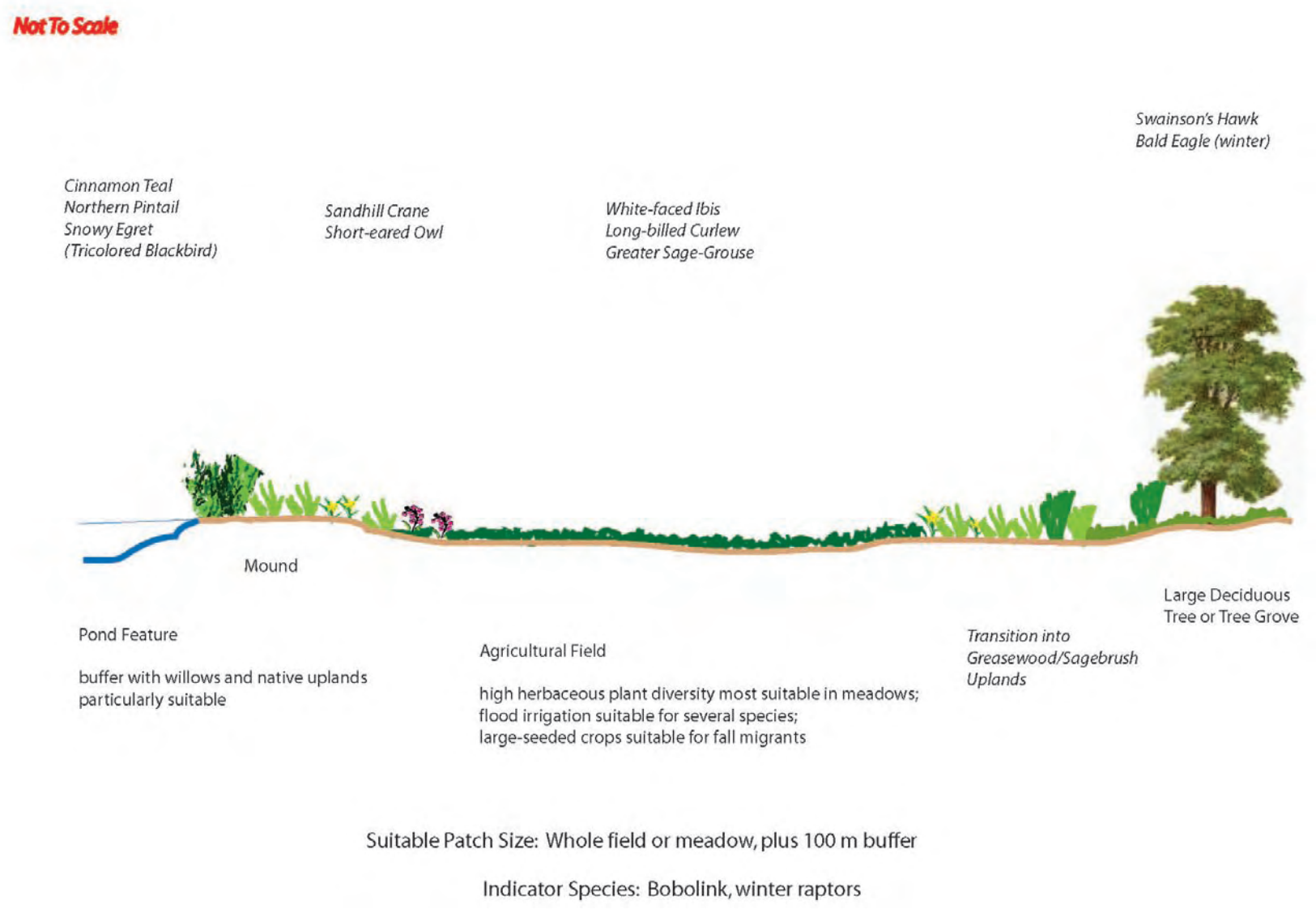


Figure Hab-20-1: Idealized wet meadow landscape to maximize the number of wet meadow associated Priority bird species.

Wet Meadow

Conservation Strategies

Habitat Strategies

- Manage at the scale of the **whole wet meadow or meadow complex**, ideally with each unit having a buffer of native vegetation, and the entire area having a 100 m [330 ft] buffer of mostly native vegetation (but may include maintenance roads, fences, or trails)
- Grazing should be managed to avoid permanently reducing vegetation cover or plant species diversity
- Organize **grazing and haying schedules** leave some wet meadow areas undisturbed during the main nesting period (**1 April – 1 July**), and other areas undisturbed during the brood rearing period (July – early September), especially if Greater Sage-Grouse use the area
- If a wet meadow is supported by groundwater, **maintain pumping levels** that do not cause habitat conversion
- Removal of invasive plants should be followed by **active restoration of native vegetation** in the removal sites, as weedy species often take advantage of disturbed soils and become more easily re-established in the absence of competition
- Proximity to **water** (riparian areas, springs, marshes, etc.) and presence of **cliffs** > 30 m [100 ft] tall raise the priority level of a site for bird conservation.
- Maintain **OHV use** at levels that does not permanently impact the grass and forb layer or cause soils to be exposed

Research, Planning, and Monitoring Strategies

- **Map and monitor extent and condition of wet meadows** statewide in light of climate change, and develop an adaptive management strategy
- Continue **long-term monitoring of landbirds** statewide through the Nevada Bird Count
- Monitor status of **invasive weeds** to assess threat level locally and statewide

Public Outreach Strategies

- **Promote pride of landowners and ranchers in wildlife** attracted to their lands. Outreach may include tips on agricultural practices and habitat features that enhance habitat value to birds
- **Provide educational materials** on threats from domestic and feral cats to birds, benefits of birds to agricultural operation (control of rodents), and on wildlife-compatible grazing practices and weed control.

Introduction to Species Accounts

Overview

The following species accounts contain information we think the reader needs when planning conservation actions that may affect Priority bird species. We picture a resource manager or decision-maker consulting these species accounts with a particular project or management area in mind, which may involve habitat enhancements, restoration actions, weed control, grazing plans, recreation plans, energy projects, development of infrastructure, or anything else that may affect the birds that live in a particular area. For projects designed to benefit many different bird species simultaneously, **we recommend first consulting the habitat accounts for the major habitat types that are present in the project area**. The habitat accounts have a list of the Priority bird species that are characteristic of each habitat type, and they describe habitat-specific conservation strategies that benefit these Priority species and the bird community as a whole. Conservation strategies presented within the species accounts are designed to be consistent with strategies presented in the habitat accounts, but they are typically more detailed and species-specific, particularly with regard to needed research and monitoring actions. All users can benefit from reviewing the species accounts, but they will be most critical for those that have a special interest in one species or a small number of species. The species accounts are structured using a uniform layout, which makes it easier for users to locate the information they need.

Layout

We chose to present the most critical information about each Priority species in summary tabular format on the first page of each species account. Only information that we considered critical to conservation planning was included on this page. This table page for each species account includes:

1) A **Conservation Profile** that characterizes the level of urgency for conservation action
2) A **Habitat Use Profile** that details the key habitat features that the species is known or likely to require in Nevada
3) A **Natural History Profile** that summarizes a few critical ecological and life history parameters

Because space is limited on most table pages, sources of information are indicated in the form of footnote superscripts, and the corresponding footnote key containing brief citation information (author and year) appears at the end of each account. For consistency, the footnote citation format necessitated by the table page is retained throughout the species accounts. Full citations are available in the *Literature Cited* section. The **abbreviation "EO" (= expert opinion) is used where important information was not available in the published literature and we relied on overwhelming expert opinion** from reviewers, members of the planning group, and other bird conservation professionals.

We also provide **confidence rankings** for key habitat parameters, historical and recent trends, population size estimates, and range maps, using symbols that are explained in the footer section of the first page. These subjective rankings represent the degree of confidence we have in a given piece of information. "High" confidence means we are almost certain that the information is

reasonably accurate. “Low” confidence means that we regard the information as either incomplete or somewhat conjectural. “Moderate”, which is the most commonly applied ranking, indicates an intermediate level of confidence.

On the following pages of each account, we present:

1) A summary of distribution and seasonal presence in the form of a **range map** (see pp. App-1:18-19, for details). Our knowledge of true distributions varies greatly among species, which we indicated with a confidence ranking on each species map
2) An **Overview** summarizing the key factors about each bird’s conservation issues
3) Quantitative data on **abundance and occupancy by habitat** and **Nevada-specific studies and analyses,** where available (see pp. App-1:13-14 for details)
4) A list of the **Main Threats and Challenges** for the species in Nevada
5) **Conservation Strategies** that represent our best knowledge of the most actions that will most effectively preserve the species in Nevada

In the remainder of this chapter, we provide important definitions, sources of information, methods, and recommended uses regarding the specific information presented in each species account.



Trumpeter Swans. Photo by Martin Meyers

Introduction to Species Accounts

Conservation Profile

***Priority Status*:** Identifies whether the species is a Conservation Priority, Stewardship, or Special Status Species (see pp. Birds of Nevada 1-2; App-1:1-2; and *Appendix 2* for details). Generally, we recommend treating all three types of Priority birds as categories with equal conservation concern.

***Species Concerns*:** This is a summary of the main concerns that led to conservation ranking of the species by regional initiatives, which was the basis for species inclusion in this plan. Concerns may include:

1) Known or likely declines in populations, either in historical times or more recently
2) Restricted species distributions or small population sizes
3) Dependence on threatened or restricted habitat type(s)
4) Known or likely habitat threats
5) Listed as threatened or endangered under Endangered Species Act (ESA), or a candidate for listing
6) High stewardship responsibility due to a significant portion of the species' global population being present in Nevada

***Other Rankings*:** This item provides rankings by regional conservation initiatives and government agencies with significant responsibilities for bird conservation. For more details on these rankings, please consult the sources listed here:

1) *Partners in Flight Continental Plan (PIF)*: http://www.partnersinflight.org/cont_plan/
2) *Audubon Watchlist*: http://birds.audubon.org/species-by-program/watchlist
3) *Nevada Natural Heritage Program's state rankings*: http://heritage.nv.gov/spelists.htm
4) *U.S. Fish and Wildlife Service's rankings under the ESA*: http://www.fws.gov/endangered/species/us-species.html
5) *U.S. Fish and Wildlife Service Birds of Conservation Concern*: http://library.fws.gov/Bird_Publications/BCC2008.pdf
6) *U.S. Fish and Wildlife Service's ranking under the Migratory Bird Treaty Act*: http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/mbtintro.html
7) *U.S. Bureau of Land Management*: Internal "Sensitive Species" list. http://www.blm.gov/nv/st/en/info/state_directory.html
8) *U.S. Forest Service*: Internal Humboldt-Toiyabe Forest "Sensitive Species" list http://www.fs.fed.us/r4/resources/wildlife/index.shtml
9) *Nevada Department of Wildlife / Nevada Wildlife Action Plan*: http://www.ndow.org/wild/conservation/cwcs/
10) *Intermountain West Shorebird Conservation Plan*: http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/IMWEST4.doc
11) *Intermountain West Waterbird Conservation Plan*: http://www.pwrc.usgs.gov/nacwcp/pdfs/regional/MainTextV12nocover.pdf
12) *Pacific Flyway Council (various documents)*: http://www.pacificflyway.gov/Management.asp
13) Various habitat conservation plans, as cited in individual accounts

Introduction to Species Accounts

***Trends*:** This section lists historical (pre-1970s) and recent (post-1970) population trends to the best of current knowledge. Population trends were obtained from analyses of BBS data (Sauer et al. 2008), regional bird conservation initiatives, *Birds of North America* species accounts (Poole and Gill 1992-2002, http://bna.birds.cornell.edu/bna/), and other published sources. Wherever possible, we focus on Nevada-specific trends, but in many cases (as noted in the species accounts), we were forced to rely on regional trends due to lack of information in Nevada.

Population Size Estimate: Nevada population size estimates for most landbirds were obtained from NBC data analyses, or alternately from an unpublished analysis of BBS data (Rich et al. 2004) (for details see pp. App-1:14-18, and *Appendix 4*). These sources are indicated parenthetically in the table, either (NBC) or (BBS). For shorebirds, waterbirds, waterfowl, and marshbirds, population estimates were obtained from regional management plans (Ivey and Herziger 2006, Oring et al. 2000), from survey data collected by Larry Neel of the Nevada Department of Wildlife, or from other published sources. Population estimates for remaining species groups (some owls, raptors, hummingbirds) were obtained from various published sources, or in some cases were simply not available. For global population size estimates, we consulted national and continental conservation plans by the major bird conservation initiatives, as indicated in the citations.

Population Objective: The entry identifies how much change in population trend is needed to achieve the desired conservation status. The objectives were largely based on continental objectives of the major bird conservation initiatives, as indicated in the citations, but in some cases the objectives were amended by expert opinion based on Nevada-specific considerations.

***Monitoring Coverage*:** Here, we list the Nevada programs (Source) under which the species is currently monitored, and our opinion of how adequately the species is surveyed by these monitoring efforts (Coverage in NV). In cases where Coverage in Nevada is ranked “Fair” or “Poor”, additional monitoring efforts are needed.

***Key Conservation Areas*:** This section lists the general regions, valleys, mountain ranges, or habitat types in which we estimate that conservation action will be most effective. It is divided into Protection, which refers to species stronghold areas that need continuing or expanded protection, and Restoration, which refers to areas where population could be increased if restoration actions were undertaken. This table entry does not necessarily represent *all* worthy Protection or Restoration areas in Nevada; rather it simply provides our recommendations of areas, in which conservation action may be most effective.

Habitat Use Profile

***Habitats Used in Nevada*:** This section allows the user to quickly determine the **habitat accounts** that are relevant to the species. It lists all major habitat types (as defined on pp. App-1:7-12) regularly used by the species in Nevada, roughly in order of importance. Habitat types shown in parentheses are used less regularly, or more locally, than the others. In all cases, we recommend that these habitat accounts be used in tandem with the species accounts, as they cover opportunities for habitat conservation that benefits multiple species.

Introduction to Species Accounts

***Key Habitat Use Parameters*:** This section identifies the key habitat features needed by the species. Many subcategories are used for various species, which cover plant species composition, plant density and structure, landscape mosaic (i.e. mixtures of different habitat types or resources over large areas), and other parameters. We only list those habitat features that may be affected by threats, and that a resource manager can potentially address through conservation action. Habitat features that cannot be influenced by management actions are generally excluded.

***Area Requirements*:** This section lists estimated **area requirements for effective conservation**, including minimum patch size (if known), recommended patch size for maintaining a sustainable population, and territory and/or home range sizes. In all cases, we would refer conservation planners to the **recommended patch size**, as this is the minimum area that we estimate is needed to maintain a functional *population*, rather than just individual birds.

Natural History Profile

***Seasonal Presence in Nevada*:** This section identifies the seasons during which the bird is primarily present in Nevada. Migrant populations are only mentioned if Nevada is known to provide significant stopover habitat for a species, if migrants have a notable presence in an area of the state where they are otherwise absent, or if some particular conservation concern is associated with migrant populations. In some cases, this entry is subdivided to refer to different regions of the state (for instance, a bird may have only a breeding presence in northern Nevada, but may be present year-round in southern Nevada). We frequently consulted eBird (www.ebird.org) to fine-tune our understanding of seasonal presence in Nevada.

***Known Breeding Dates in Nevada*:** Breeding phenologies were derived largely from the Nevada Breeding Bird Atlas project, supplemented by published sources and by expert opinion from the planning group. The range of dates broadly describes the **complete breeding season**, including mating, nest building, incubation, and brood-rearing.

***Nesting Habits*:** This section describes the species' habits for nest placement and site fidelity. **Nest Placement** refers to microsite requirements (e.g., dense shrub branches, tall tree, or vicinity to wetland edge) that need to be provided for successful nesting and brood rearing. **Site Fidelity** describes in simple categorical terms how rigid individuals are in terms of re-using their nest site, breeding territory, or habitat patch location over multiple years. This information is useful for land managers who need to estimate how likely a species is to use alternate habitat or colonize a newly-restored habitat patch. For non-breeding birds, Site Fidelity is sometimes used to indicate the likelihood of repeated annual use of key wintering or migratory stopover sites.

***Food Requirements*:** This section describes the mode by which a bird gathers food (Basic), the food items most important to the species (Primary Diet), and the most common alternate or seasonal food items (Secondary Diet). This information is particularly relevant for species such as the Golden Eagle, where many conservation goals can be accomplished by managing for healthy prey populations.

Introduction to Species Accounts

Range Map

The range maps were carefully designed to represent our best knowledge of the current distributions of birds in Nevada. They represent a compromise between simply reporting known locations as dots on a map, and the most inclusive approach of field guides that block out wide regions to indicate a range. Here, we settled on an intermediate approach, which – in most cases – provides us with sufficient resolution to **describe a species' distribution accurately without underestimating the extent of its range based on spotty survey coverage**. Details on map construction and data sources are covered on pp. App-1:18-19, and readers with an interest in the range maps are encouraged to review this section carefully.



Rufous Hummingbird. Photo by Jacque Lowery

It is important to note that the maps are only reliable within the bounds set by their intrinsic mapping scale (whole basin or range, whole waterbodies). This means that **a species will not *necessarily* be present at all locations within areas that are highlighted as known range**. At these finer scales, the maps are only useful to indicate that a species *may* be present in a particular site, but **will almost certainly be absent in inappropriate habitat types** (e.g., a riparian associated species will only occur in riparian patches in the indicated region). Likewise, it should not be assumed that a bird is *necessarily* absent in all areas not highlighted in the map (see confidence ranking).

As described on pp. App-1:18-19, the basic mapping units for landbirds are **whole mountain ranges or basins**, for waterbirds, waterfowl, shorebirds, and marshbirds **major waterbodies, marsh complexes, and rivers,** and for ephemeral wetland species, **waterbodies and playas**. In the case of a few very rare landbirds, however, we departed from the basin and mountain range

scheme because it over-represented the very limited geographical range of these rare species. The mapping units used for these birds are explained in the footnotes.

On the range maps, different colors are associated with different seasonal periods, as indicated on the map legends. **Solid, dark** versions of these colors indicate areas where **presence has been confirmed by data. Paler, semi-transparent** versions of these same colors indicate the broader areas in which **we expect the species to occur within suitable habitat types**, although we had no data to confirm it.

Determining when and how to illustrate a species' migratory presence in the state was difficult. On the one hand, all of Nevada's bird that are not year-round residents have a migratory presence, but attempting to plot this distinctly on the maps would have been difficult, and would have distracted from more important map elements. We therefore decided to **combine migratory and winter range for most birds**. In part, this decision was based on the fact that many of Nevada's breeding birds that migrate south for the winter maintain small (and usually poorly-documented) wintering populations in southern Nevada. Where it was possible or important to clearly distinguish between migratory and winter range, we do so. We also chose to highlight migratory range for some species that are primarily or exclusively present in the state during their migratory stopovers.

Finally, we note that the range maps were prepared and included in this plan not only to illustrate our current knowledge, but also to encourage managers, researchers, and birders to focus their survey efforts in areas where our knowledge of distributions may be inadequate. **We encourage submissions of verified sightings to GBBO that can be used to improve these maps** (see pp. Introduction, 5-6).

Overview Section

The Overview section summarizes issues of conservation interest for each species, along with any important information that does not fit well into the tables on the first page. It characterizes the key issues relevant for managing the species, but does not repeat in detail the information listed in the tables on the first page of the account.

Abundance and Occupancy by Habitat

For landbirds that are well-sampled by the Nevada Bird Count (NBC), this section includes our estimates of **habitat-specific densities**, as described in detail on p. App-1-14. In some cases, we report densities for birds that were not well-surveyed by NBC based on other sources.

Nevada-Specific Studies and Analyses

This section focuses primarily on statistical analyses of **bird-habitat relationships in Nevada**. Most of these analyses were based on datasets derived from NBC and GIS habitat maps, as described in detail on p. App-1-13. In some cases, analyses from other datasets were available in the published literature. We present only statistical analyses based on Nevada data, or from data that are clearly relevant to Nevada.

Introduction to Species Accounts

Main Threats and Challenges

This section lists the specific threats and management challenges that apply to the species, based on published literature and the deliberation and review of experts in the planning group. We focus only on threats that are known or likely to apply in Nevada, and further on threats that can be influenced by management actions. We distinguish between habitat-based threats and challenges presented by lack of adequate monitoring, research, or planning.

Conservation Strategies

Conservation strategies are in many ways the most important output of this plan. They were developed collaboratively by the planning group during a series of meetings and review cycles, and were informed by numerous published sources and agency reports. As described in the *Introduction* (pp. 2-3), we stress habitat-based strategies, along with strategies that call for gathering more conservation data through research and monitoring. We do not attempt to prescribe strategies that would usurp the interagency planning process, nor strategies involving political action or advocacy. Conservation strategies were categorized as follows:

***Established Strategies*:** For some species, successful conservation strategies have already been developed to meet regulatory requirements, or have been successfully implemented by previous conservation plans. We highlight the most important elements of these established strategies, and refer the reader to the original sources for further detail.

***Habitat Strategies*:** These include strategies for management, protection, or restoration of habitat. We used the Habitat Use and Natural History Profile tables from the first page of each account to derive a vision for desired habitat conditions for the species, and then determined the strategies needed to achieve this vision in the face of known and likely habitat threats.

***Research, Planning, and Monitoring Strategies*:** For many species, we need to gather more information about threats, trends, status, distribution, habitat requirements, or basic biology in order to identify the most effective approaches to conservation. Collecting this information may require additional research studies, planning activities, or monitoring efforts. We tended not to focus much on future planning in this section, but planning strategies are discussed in greater depth in the habitat accounts.

***Public Outreach Strategies*:** These strategies involve educating the public, seeking to increase public support for conservation objectives, or conducting outreach to modify public activities.

Log of Changes

The online version of this plan, maintained at **www.gbbo.org/bird_conservation_plan.html,** will include a Log of Changes section for each species account that will list all changes and additions associated with each revision of the species account. This log will enable a user to quickly determine whether or not a more recent version of a given species account contains information that is of interest.

Trumpeter Swan

Cygnus buccinator



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, willows, submerged aquatic vegetation
Plant Density	Varying densities of emergent vegetation[3]
Mosaic	Irregular shorelines with patches of emergent vegetation (hemi-marsh), areas with significant aquatic vegetation, and areas of open water; presence of islands surrounded by deep water highly desirable[3]
Water Depth	> 50 cm [20 in] around nest site; < 130 cm [51 in] for foraging[3]
Water Quality	Low salinity, little or no pollution [EO]
Hydrology	Minimal daily fluctuation in stage during nesting [EO]
Response to Vegetation Removal	Probably negative [EO]
Area Requirements ◑	
Minimum Patch Size	5 ha [12.3 ac] [EO], including ≥ 2 ha [4.9 ac] of unobstructed open water[3]
Recommended Patch Size	> 150 ha [370 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Habitat threats Historical declines	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S1b
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	None
Pacific Flyway Council	High
Trends	
Historical ●	Nearly extinct south of Canada by 1935; subsequently, slowly recovering[3, 4]
Recent ○	Probably stable in Nevada[3, 5]
Population Size Estimates	
Nevada ◑	≤ 30 (breeding)[5]
Global ◑	16,000 [3]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NWR surveys, NDOW aerial surveys
Coverage in NV	Good at Ruby Lake; Fair / Poor elsewhere
Key Conservation Areas	
Protection	Ruby Valley
Restoration	Ruby Valley

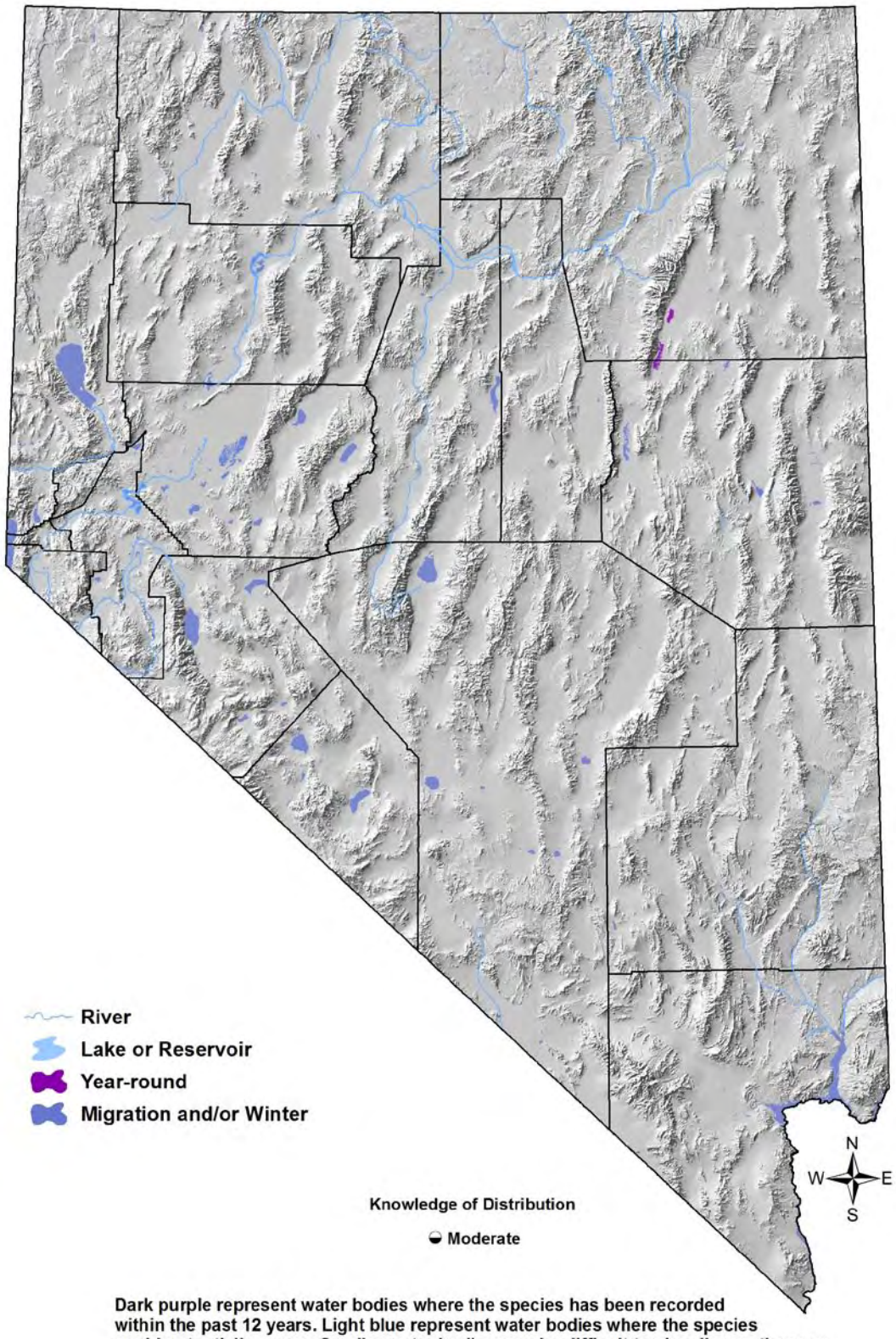
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Early May – mid-August[1]	
Nest and Nesting Habits	
Nest Placement	Nests on islands, hummocks, or floating vegetation[3]
Site Fidelity	High for breeding sites[3]
Food Habits	
Basic	Dabbler
Primary Diet	Submerged and emergent vegetation[3]
Secondary Diet	Cygnets: aquatic invertebrates[3]

Confidence in Available Data: ●High ◑Moderate ○ Low

Trumpeter Swan

Cygnus buccinator



Dark purple represent water bodies where the species has been recorded within the past 12 years. Light blue represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Trumpeter Swan

Cygnus buccinator

Overview

Nevada's small breeding population of Trumpeter Swans at Ruby Lake is the result of a successful reintroduction of the species in the 1940's-50's, following its earlier extirpation from the state. While persistent, this breeding population is very small and highly disjunct from other breeding populations farther to the north and east, and it appears to have become sedentary and abandoned migration.[3] Reintroduction of additional breeding populations elsewhere in the state is possible, but it is not a current priority for management agencies.[5] Given that Trumpeter Swan breeding populations to the east of Nevada are increasing in abundance (T. Floyd, *pers. comm.*), natural expansion of Nevada's breeding population seems possible as well. There is limited information on non-breeding occurrence of this species outside of Ruby Valley, and it is speculated that wintering birds, presumably individuals from populations that breed farther to the north, are found widely, albeit rarely, across the state.[2]

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat and Other Threats

- Sensitive to water pollution and vulnerable to changes in water level during the incubation period[3]
- Sensitive to nest-site disturbances[3]
- Cygnets at Ruby Lake suffer high predation rate,[5] although the relative levels of depradation by coyotes, Common Ravens, and other predators is not clear
- Nevada's breeding population is small, disjunct, and may have minimal genetic interchange with other breeding populations[3]

Research, Planning, and Monitoring Challenges

- Post-breeding and winter occurrence and habitat use in Nevada not well documented

Trumpeter Swan

Cygnus buccinator

Conservation Strategies

Established Strategies

- Ruby Lake NWR management plan and monitoring program
- Pacific Flyway Council oversees the monitoring of regional and continental populations, and sets or recommends policies and regulations related to harvest, management, and conservation (http://www.pacificflyway.gov/)

Habitat Strategies

- Open Water (p. Hab-15-1) and Marsh (p. Hab-9-1) habitat conservation strategies benefit this species
- Ruby Lake NWR population is carefully and effectively managed; implement similar management policies if other breeding populations are established, including the following:
    - Protect water quality
    - Maintain water level during incubation period
    - Protect nest sites from human disturbance

Research, Planning, and Monitoring Strategies

- Continue current Ruby Lake NWR monitoring program
- Conduct more intensive statewide surveys to determine post-breeding, migration, and winter presence and distribution of Trumpeter Swans in Nevada

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Ivey (1990); [3]Mitchell and Eichholz (2010); [4]Shea et al. (2002); [5](C. Mortimore, *pers. comm.*); [EO] Expert opinion

Tundra Swan

Cygnus columbianus



Photo by Fred Petersen

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, sago pondweed; and other aquatic vegetation; agricultural crops
Plant Density	Mostly open water with scattered emergent vegetation; dense aquatic (submerged) vegetation preferred[2, 4]
Mosaic	Mostly open, relatively shallow water, fringed by patches of emergent vegetation[2]
Water Depth	< 100 cm [39 in] for foraging[2]
Water Quality	Tolerates variety of salinities [EO]
Response to Vegetation Removal	Probably neutral for emergent vegetation, but negative for submerged vegetation [EO]
Area Requirements ◑	
Minimum Patch Size	130 ha [320 ac] for migration stopover water bodies[2]
Recommended Patch Size	> 150 ha [370 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats Moderate stewardship responsibility (wintering)	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	None
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	None; Gamebird
Pacific Flyway Council	High/Medium
Trends	
Historical ●	Rangewide declines[2]
Recent ○	Stable to increasing[2, EO]
Population Size Estimates	
Nevada ◑	1,000 –10,000 (wintering), possibly more[4, EO]
Global ◑	150,000 [2]
Percent of Global	~ 4% of global population; ~ 8% of Western population[2]
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	USWFS winter surveys, NDOW aerial surveys, NWR and WMA counts
Coverage in NV	Good
Key Conservation Areas	
Protection	Lahontan Valley, Ruby Valley
Restoration	All open water and marsh complexes

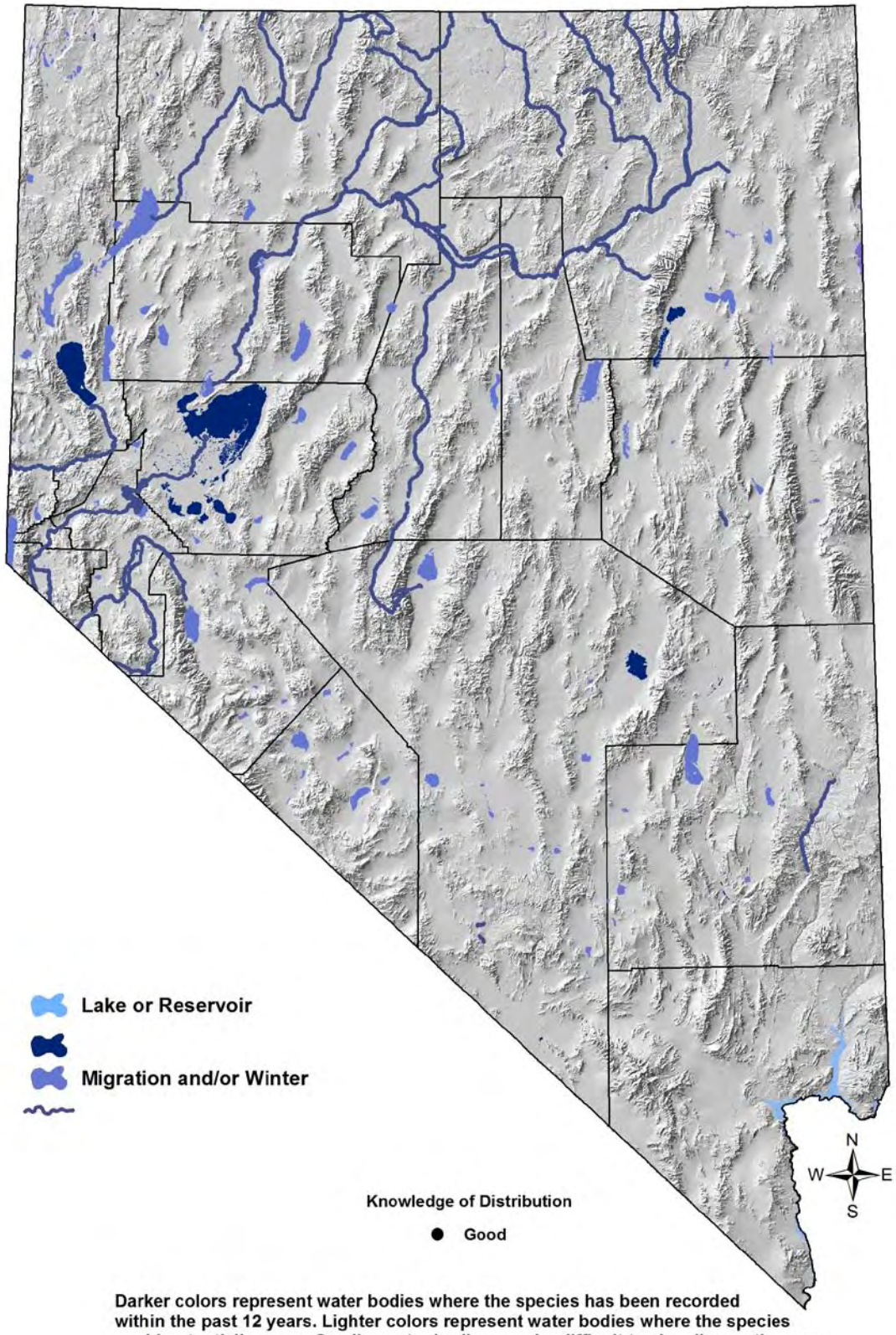
Natural History Profile

Seasonal Presence in Nevada	
Fall – Winter	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Site Fidelity	High for wintering sites[2]
Food Habits	
Basic	Dabbler
Primary Diet	Aquatic and emergent vegetation[2]
Secondary Diet	Agricultural crops, aquatic invertebrates[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Tundra Swan

Cygnus columbianus



Tundra Swan

Cygnus columbianus

Overview

The Tundra Swan breeds in the Arctic, and occurs in Nevada only through the winter and during migration. The species is divided into a "Western population" and "Eastern population" based on the location of wintering grounds.[2] The western population of Tundra Swans nests in western and northwestern Alaska and winters in the Western United States and coastal British Columbia. The number of swans in the western population has been increasing since the 1950s. Managers intend to maintain a western population of at least 60,000 swans.[3]

Nevada hosts nearly 10% of the Western population's wintering swans. About 35,000 – 40,000 Tundra Swans migrate through the entire Great Basin, which represents about half of the swans using the Pacific Flyway.[1] Variations in weather substantially affect the distribution of swans during fall migration and winter. The abundance of fall and winter water in the west has a marked effect on annual distribution of swans. The distribution of snow- and ice-free habitats also can significantly alter the phenology of migration and winter distribution of swans among Pacific Flyway states.[3] Current management appears sufficient to maintain Nevada's wintering populations, but their water-dependent habitats are potentially subject to a variety of threats that merit further investigation.

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- No threats specific to Tundra Swans were identified, but more general threats to Open Water (p. Hab-15-1) and Marsh (p. Hab-10-1) habitat are potential concerns

Research, Planning, and Monitoring Challenges

- Additional research is needed to determine if significant habitat threats exist
- Emphasis should be directed towards detecting avian cholera and applying methods to minimize losses from this disease.[3]

Tundra Swan

Cygnus columbianus

Conservation Strategies

Established Strategies

- Pacific Flyway Council oversees the monitoring of regional and continental populations, and sets or recommends policies and regulations related to harvest, management, and conservation (http://www.pacificflyway.gov/)[3]

Habitat Strategies

- Open water (p. Hab-15-1) and Marsh (p. Hab-9-1) habitat conservation strategies benefit this species
- Manage wintering and migration habitat to encourage healthy growth of sago pond-weed[4]

Research, Planning, and Monitoring Strategies

- Conduct additional research on Tundra Swan distribution, abundance, and habitat use to better determine the nature and severity of any habitat threats

Public Outreach Strategies

- None identified

References: [1]Kadlec and Smith (1989); [2]Limpert and Earnst (1994); [3]Pacific Flyway Council. (2001); [4](C. Mortimore, *pers. comm.*); [EO] Expert opinion

Cinnamon Teal

Anas cyanoptera



Photo by Steve Ting

Habitat Use Profile

Habitats Used in Nevada
Marsh Open Water (Ephemeral Wetland and Playa) (Great Basin Lowland Riparian (oxbows)) (Agriculture)

Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, rushes, willows, submerged aquatic vegetation
Plant Density	Patches of high density emergent vegetation[1]
Mosaic	Shallow marsh or waterbody with variable stem densities of emergent vegetation, interspersed with dry spots, mudflats, open water[1]
Water Depth	< 20 cm [8 in] along vegetated shorelines for foraging[1]
Water Quality	Tolerant of moderately saline conditions[1]
Hydrology	Permanent or ephemeral wetland, as long as vegetation is present[1]
Response to Vegetation Removal	Probably negative [EO]

Area Requirements ○	
Minimum Patch Size	Unknown, but uses relatively small water bodies, including farm ponds
Recommended Patch Size	> 15 ha [37 ac] [EO]
Home Range	< 10 ha [25 ac], overlapping[1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats High stewardship responsibility (especially migration)	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S5b
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority, Gamebird
Pacific Flyway Council	Medium
Trends	
Historical ○	Unknown
Recent ○	Probably stable[6, 7]
Population Size Estimates	
Nevada ○	> 10,000 (breeding)[4]
Global ◑	~ 300,000 [1, 5, 8]
Percent of Global	> 3 %
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW aerial counts, NWR and WMA counts, NV Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Ruby Valley, Lahontan Valley, Ash Meadows NWR, Lake Mead, Key-Pittman WMA
Restoration	Degraded marshes

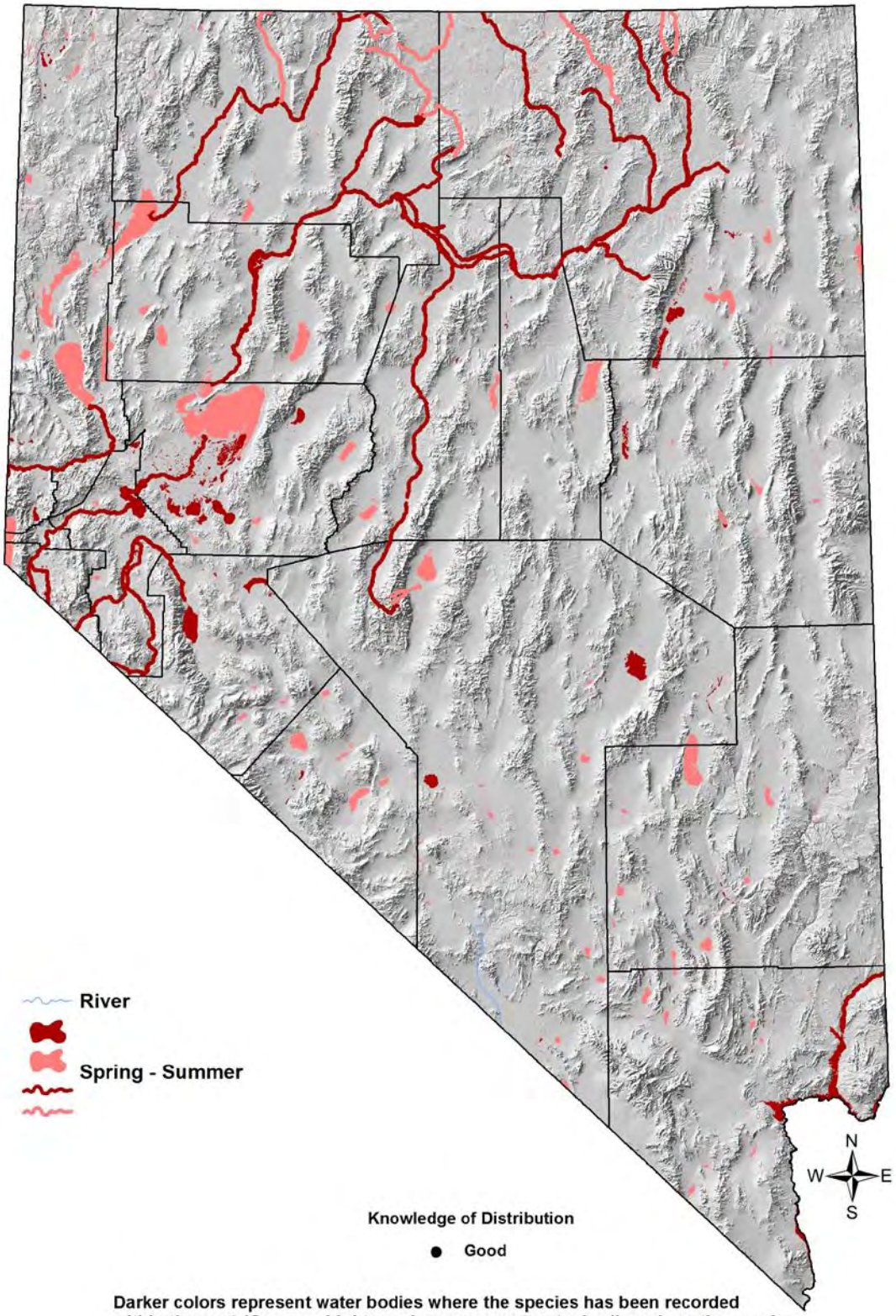
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer Fall (migration, March-April peak) Spring (migration, August-September peak)	
Known Breeding Dates in Nevada	
May – August[2]	
Nest and Nesting Habits	
Nest Placement	Near shoreline or over water in dense vegetation < 60 cm [23 in] tall[1]
Site Fidelity	Moderate to high for breeding site[1]
Other	Multiple nests, re-nesting, moves eggs[1]
Food Habits	
Basic	Dabbler
Primary Diet	Aquatic vegetation, aquatic invertebrates, zooplankton[1]
Secondary Diet	N/A

Confidence in Available Data: ●High ◑Moderate ○ Low

Cinnamon Teal

Anas cyanoptera



Darker colors represent water bodies where the species has been recorded within the past 12 years. Lighter colors represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Cinnamon Teal

Anas cyanoptera

Overview

The Cinnamon Teal is one of Nevada's most common nesting ducks, but at the continental scale it is one of least abundant dabbling ducks of North America.[1] Consequently, Nevada has a substantial stewardship responsibility for this species, especially during migration, when the number of Cinnamon Teals in Nevada swells markedly, probably exceeding 100,000 birds.[3] Thus, many of the areas delineated in the map above as "Spring – Summer" range may be equally, or more, important as migratory habitat. Some Cinnamon Teals are present in southern and western Nevada during the winter months (www.ebird.org), but it is not clear whether these birds are stragglers, or instead representative of a real, if small, overwintering presence.

Much of the Cinnamon Teal's continental breeding range lies outside of major waterfowl survey areas, so population size estimates are somewhat conjectural. Survey coverage in Nevada, however, is relatively good, and current management efforts appear to be successful in maintaining stable populations. As with other waterfowl, population trends are closely monitored and harvest limits adjusted as needed by NDOW and Pacific Flyway Council.

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat and Other Threats

- Loss and degradation of marsh, open water, and ephemeral wetland habitat due to water diversions, declines in water quality, or development[1]
- Although many Cinnamon Teal use managed wetlands, many also use smaller wetlands on private lands
- Susceptible to botulism type C, especially in shallow Great Basin wetlands[1]

Research, Planning, and Monitoring Challenges

- None identified

Cinnamon Teal

Anas cyanoptera

Conservation Strategies

Established Strategies

- Annual harvest rates are set by NDOW in consultation with the Pacific Flyway Council

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. hab-15-1) habitat conservation strategies benefit this species.
- Manage for steady water levels during breeding period (1 May – 1 July)
- Preserve wide bands of emergent vegetation and wet meadow buffers around nesting wetlands

Research, Planning, and Monitoring Strategies

- Continue current monitoring programs

Public Outreach Strategies

- Work with private landowners to promote conservation of small private ponds and wetlands used by Cinnamon Teals

References: [1]Gammonley (1996); [2]GBBO unpublished Atlas data; [3]Kadlec and Smith (1989); [4]Nevada Wildlife Action Plan Team (2006); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]USFWS (1998); [EO] Expert opinion

Northern Pintail

Anas acuta



Photo by Chris Nicolai

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water (Great Basin Lowland Riparian (oxbows))	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, rushes, saltgrass, submerged aquatic vegetation, agricultural crops
Plant Density	Spring-Fall: Patches of varying emergent stem densities and ample aquatic vegetation; Winter: sparse emergent vegetation[1]
Mosaic	Shallow marsh or water body with patches of emergent vegetation interspersed with open water, buffered by shrubland, grassland, or agriculture[1, 2]
Water Depth	< 30 cm [12 in] for foraging[1]
Hydrology	Large variety of water regimes tolerated[1]
Response to Vegetation Removal	Probably negative in breeding habitat [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown, but uses moderately small water bodies [EO]
Recommended Patch Size	> 15 ha [37 ac] for water body, buffered by > 3 km [1.9 mi] of uplands [EO]
Home Range	Up to 500 ha [1,240 ac][1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent population declines Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S5
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority, Gamebird
Pacific Flyway Council	High Priority
Trends	
Historical ●	Rangewide declines of 50% [1, 8]
Recent ◑	Continuing declines[1, 8]
Population Size Estimates	
Nevada ◑	5,000 (breeding), annually variable[4]
Global ◑	3,000,000, annually variable[1, 8]
Percent of Global	< 1%
Population Objective	
Increase by 100% [EO]	
Monitoring Coverage	
Source	NDOW aerial surveys, NWR and WMA counts, NDOW harvest counts, NV Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Lahontan and Ruby valleys, Humboldt River system
Restoration	Degraded marsh and open water

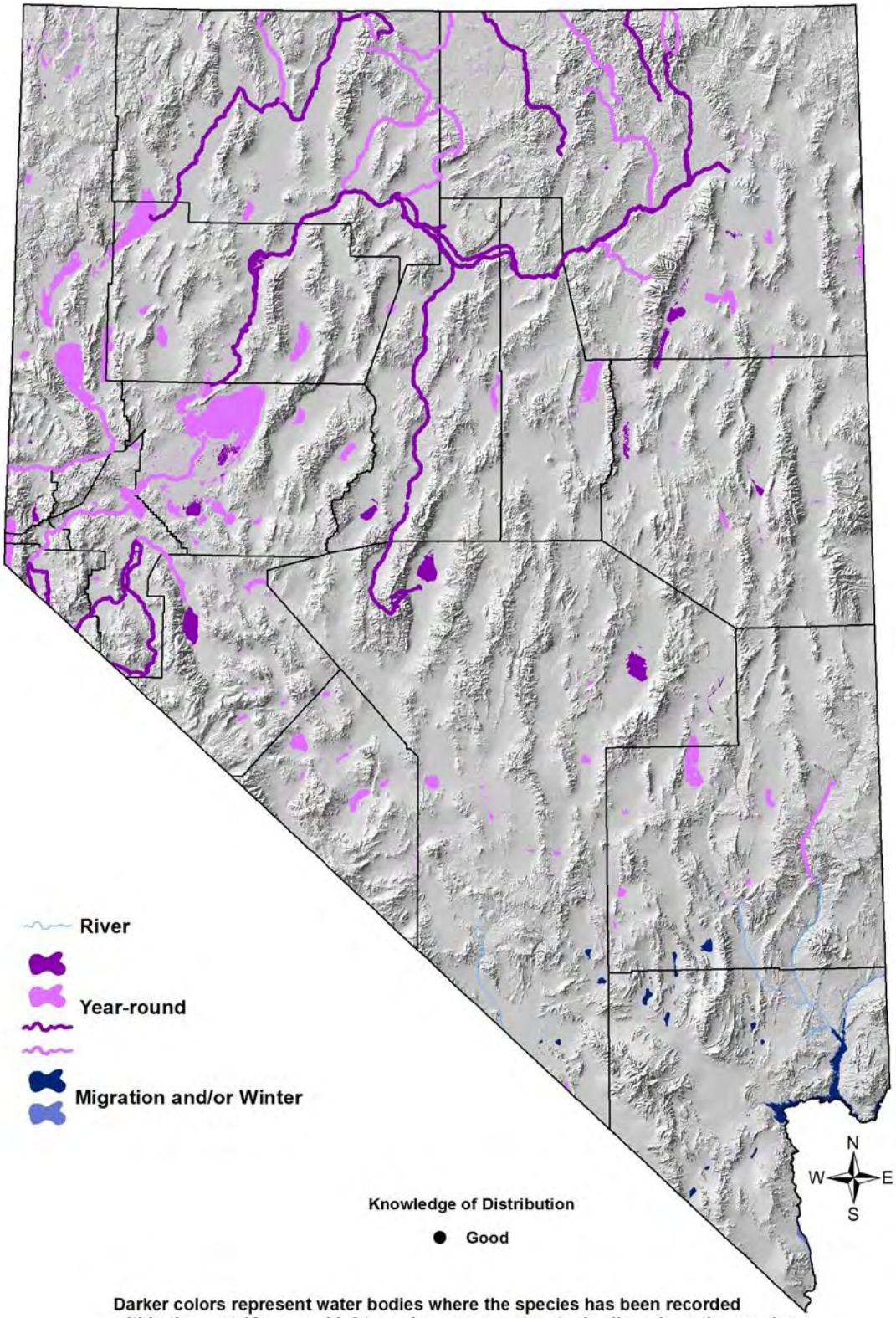
Natural History Profile

Seasonal Presence in Nevada	
Year-round (northern Nevada) Winter (southern Nevada) Fall (migration, statewide, October peak) Spring (migration, statewide, March peak)	
Known Breeding Dates in Nevada	
Late April – mid-August[3]	
Nest and Nesting Habits	
Nest Placement	On ground in dense upland vegetation up to 3 km [1.9 mi] from water[1]
Site Fidelity	High for post-breeding habitat;[1] moderate for wintering[6]
Food Habits	
Basic	Dabbler
Primary Diet	Aquatic invertebrates and plant material[1]
Secondary Diet	N/A

Confidence in Available Data: ●High ◑Moderate ○ Low

Northern Pintail

Anas acuta



Darker colors represent water bodies where the species has been recorded within the past 12 years. Lighter colors represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Northern Pintail

Anas acuta

Overview

The Northern Pintail is one of the west's most conspicuous and numerous ducks, but it has suffered sustained declines for several decades. Pintails are popular gamebirds, but current harvest rates are not believed to impact population trends.[5,6] The underlying causes of ongoing declines are not fully understood, but probably involve habitat issues on the main breeding grounds far to the north. The current North American population objective is 5.6 million birds,[8] approximately twice the current number.

In Nevada, numbers of Northern Pintails swell greatly during spring and fall migration, and winter populations also appear to exceed summer populations by a noticeable margin (www.ebird.org), although specific seasonal population estimates are currently not available. The main seasonal difference in the habitat requirements of Northern Pintails is that during the breeding season, they require a sizable buffer of upland vegetation or other suitable habitat (such as traditional agricultural fields) around waterbodies for nesting.[1] Despite our traditional focus on the breeding season, Nevada's main contribution to Northern Pintail conservation probably occurs during migration and wintering seasons. As with other waterfowl, population trends are closely monitored and harvest limits adjusted as needed by NDOW and the Pacific Flyway Council.

Abundance and Occupancy by Habitat

- Breeding density positively correlated with wetland acreage[1]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat and Other Threats

- Loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development[1]
- Haying and other inadvertent agricultural disturbances in upland breeding sites during the nesting period[1]
- Predation on nesting females can be substantial in some areas[1]
- Susceptibility to avian botulism and cholera[1]

Northern Pintail

Anas acuta

Research, Planning, and Monitoring Challenges

- Causes of sustained declines are not well understood
- Migration and wintering sites may need additional study to estimate Nevada population sizes, habitat threats, and habitat requirements

Conservation Strategies

Established Strategies

- Annual harvest rates are set by NDOW in consultation with the Pacific Flyway Council

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- Disturbances and disruptive land uses should be minimized within a 3 km [1.9 mi] wide upland strip surrounding marshes and lakes used by breeding pintails during the nesting period (15 April – 15 July)
- Pintails readily use restored marshes and other wetlands, so restoration projects should benefit the species during all seasons

Research, Planning, and Monitoring Strategies

- Winter and migration habitat use, specific habitat threats, and population size estimation may be addressed in additional studies
- Continue post- and pre- breeding season banding studies conducted by NDOW in cooperation with the California Department of Fish and Game, the California Waterfowl Association, and the Yukon Delta NWR

Public Outreach Strategies

- In areas where pintails nest on privately owned agricultural areas, encourage landowners to avoid haying or other disruptive activities during the nesting period (15 April – 15 July)

References: [1]Austin and Miller (1995); [2]Fleskes et al. (2003); [3]GBBO unpublished Atlas data; [4]Nevada Wildlife Action Plan Team (2006); [5]Nicolai et al. (2005); [6]Rice et al. (2010); [7]Robertson and Cooke (1999); [8]USFWS (1998); [EO] Expert opinion

Canvasback

Aythya valisineria



Photo by Chris Nicolai

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, submerged aquatic plants[5]
Plant Density	100 – 400 stems / m^2 [9 – 37 / ft^2] of emergent plants for breeding[3]
Mosaic	Breeding: Shallow marsh with variable emergent plant stem densities, interspersed with open water; Winter: open water with aquatic plants[5]
Water Depth	40 – 80 cm [16 – 31 in] for nest;[3] up to 5 m [16 ft] for foraging[5]
Hydrology	Minimal daily stage fluctuations during nesting[3]
Response to Vegetation Removal	Probably negative for breeding [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	Breeding: > 50 ha [125 ac]; Migration: > 100 ha [250 ac]; Winter: large open water bodies[3, 4, EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3, S4
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority, Gamebird
Pacif. Flyway Council	High
Trends	
Historical ●	Rangewide declines[7]
Recent ◑	Stable[6, 8]
Population Size Estimates	
Nevada ○	4,600 (excluding migrants)[6]
Global ◑	580,000 – 740,000 [5, 8]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW aerial surveys, NWR and WMA counts, NDOW hunter surveys, NV Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Ruby Valley and Lahontan Valley
Restoration	Degraded marshes and open water

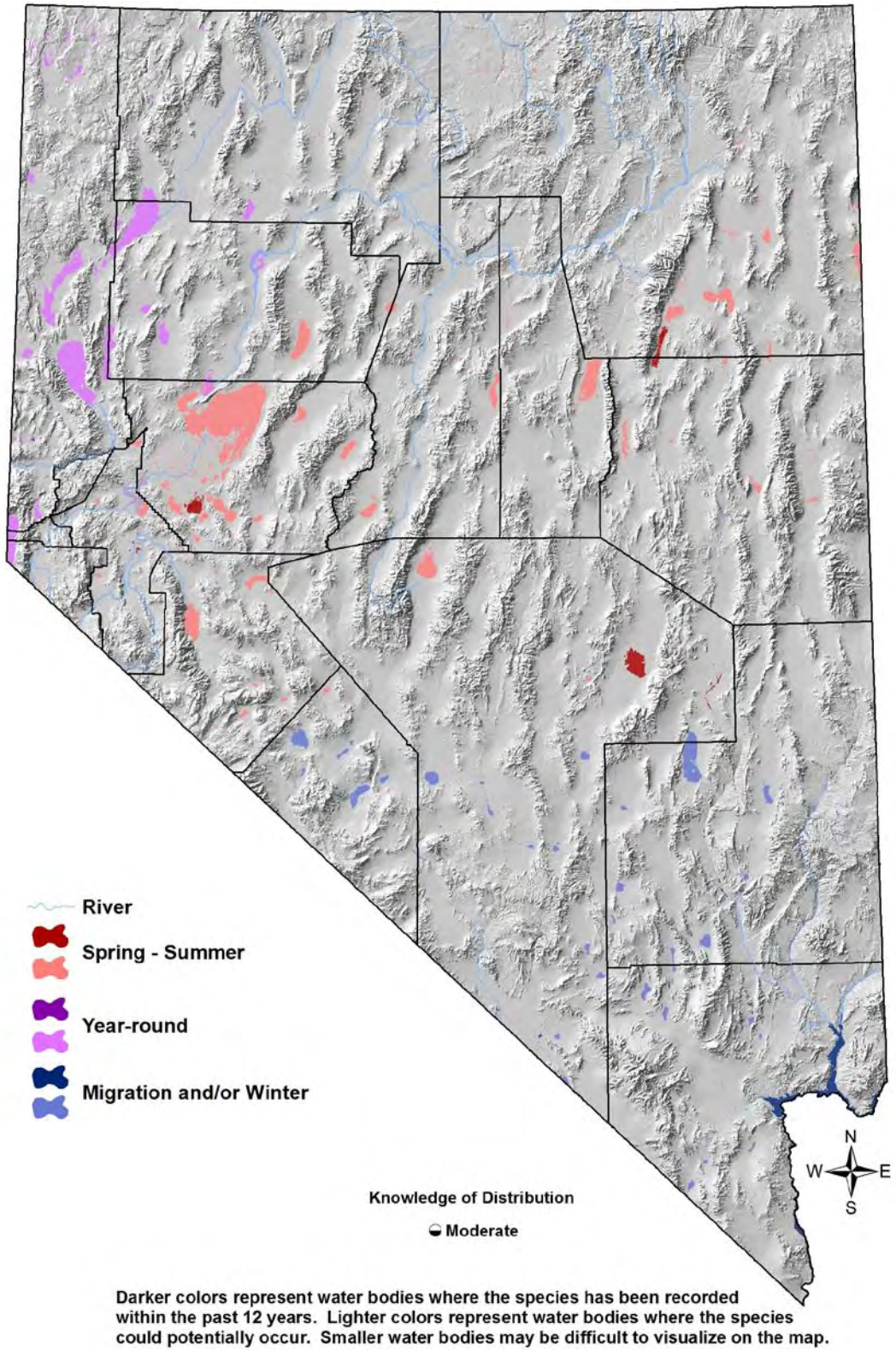
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (northern Nevada) Winter (southern and northwestern Nevada) Spring (migration, statewide, March peak) Fall (migration, statewide, October peak)	
Known Breeding Dates in Nevada	
May – July[1]	
Nest and Nesting Habits	
Nest Placement	Over water, on platform in emergent vegetation[2]
Site Fidelity	Probably high for breeding territory,[5] moderate for wintering sites[7]
Food Habits	
Basic	Diver
Primary Diet	Aquatic plants and aquatic invertebrates[5]
Secondary Diet	N/A

Confidence in Available Data: ●High ◑Moderate ○ Low

Canvasback

Aythya valisineria



Canvasback

Aythya valisineria

Overview

Although it is one of North America's less numerous ducks, the Canvasback has been intensively studied and monitored, perhaps due to its popularity as a game bird. Canvasbacks have complicated patterns of season abundance and distribution in Nevada. They are well-established, if not particularly numerous, as breeders, and Ruby Lake and Lahontan Valley support the species' most southerly large breeding populations.[3] Canvasback numbers increase greatly during spring and fall migration (www.ebird.org), and many of the areas shown in the map above as "Spring – Summer" range may be equally or more important as migration habitat. Approximately 50,000 Canvasbacks are estimated to migrate through the Great Basin region,[2] although the Nevada portion of this total has not been determined. Canvasbacks also winter in Nevada, primarily in the far west and south, with significant numbers having been recorded by the Nevada Aquatic Bird Count in Pahranagat NWR and Ash Meadows NWR, among other locations. It is not clear whether there are individual birds that remain within Nevada year round, but it seems most likely that there are distinctive seasonal cohorts. For example, birds from the Ruby Valley breeding population are known to winter in central and southern California.[4]

Canvasbacks have distinctive seasonal habitat use patterns. They place their nests over water on matted-down emergent vegetation, and their foraging activity during the breeding season necessarily occurs within these emergent marshes. In migration and winter, however, Canvasbacks frequent large bodies of open water with relatively little emergent vegetation.

Canvasback populations appear to be stable, and current management actions and protocols are probably adequate. As with other waterfowl, population trends are closely monitored and harvest limits adjusted as needed by NDOW and Pacific Flyway Council.

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

Kruse et al.[3, 4]

At Ruby Lake, average nest success was 50%. In comparison to failed nests, successful nests were located over shallower water, but were further from shore, and in wider bands of emergent vegetation with lower stem densities. Successful nest tended to be located 4 – 25 m [13 – 82 ft] from the shoreline. Unusual fluctuations in water level also reduced nest success.

Canvasback

Aythya valisineria

Main Threats and Challenges

Habitat and Other Threats

- Loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development[5]
- May abandon breeding efforts during years of drought,[5] or suffer nest failure in high water years[3]

Research, Planning, and Monitoring Challenges

- Key migration and wintering sites need to be better identified

Conservation Strategies

Established Strategies

- Annual harvest rates are set by NDOW in consultation with the Pacific Flyway Council

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- In breeding marshes, maintain a consistent water level during the nesting period (1 May – 15 July)
- Open water migration and wintering habitat should be managed to maintain the presence of submerged aquatic plants up at depths up to 5m [16ft]

Research, Planning, and Monitoring Strategies

- Important winter and migration sites need to be better identified, though improved inventory and monitoring efforts

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Kadlec and Smith (1989); [3]Kruse et al. (2003a); [4]Kruse et al. (2003b); [5]Mowbray (2002); [6]Nevada Wildlife Action Plan Team (2006); [7]Robertson and Cooke (1999); [8]USFWS (1998); [EO] Expert opinion

Redhead

Aythya americana



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, rushes, submerged aquatic vegetation
Plant Density	Patches of high-density emergent vegetation[8]
Mosaic	Hemi-marsh, with patches of emergent vegetation > 1 m [3.3 ft] high, ~ 75% open water, and some water > 1 m [3.3. ft] deep[6, 8]
Water Depth	20 – 200 cm [8 – 80 in] throughout most of water body, ~ 1 -2 m [3.3 – 6.6 ft] in primary foraging areas[6, 8]
Hydrology	Little fluctuation in stage where nesting[8]
Response to Vegetation Removal	Unknown
Area Requirements ○	
Minimum Patch Size	> 4 ha [9.9 ac] for breeding[6, 8]
Recommended Patch Size	> 100 ha [250 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4b
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority; Gamebird
Pacific Flyway Council	High
Trends	
Historical ●	Rangewide declines prior to 1960's [8]
Recent ◑	Stable or increasing[7]
Population Size Estimates	
Nevada ◑	4,500, annually variable[4]
Global ◑	1,200,000, annually variable[7]
Percent of Global	1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW aerial surveys, NWR and WMA counts, NDOW hunter surveys, Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Lahontan Valley, Ruby Valley, Humboldt system, Pahranagat NWR, Ash Meadows NWR
Restoration	Degraded marshes

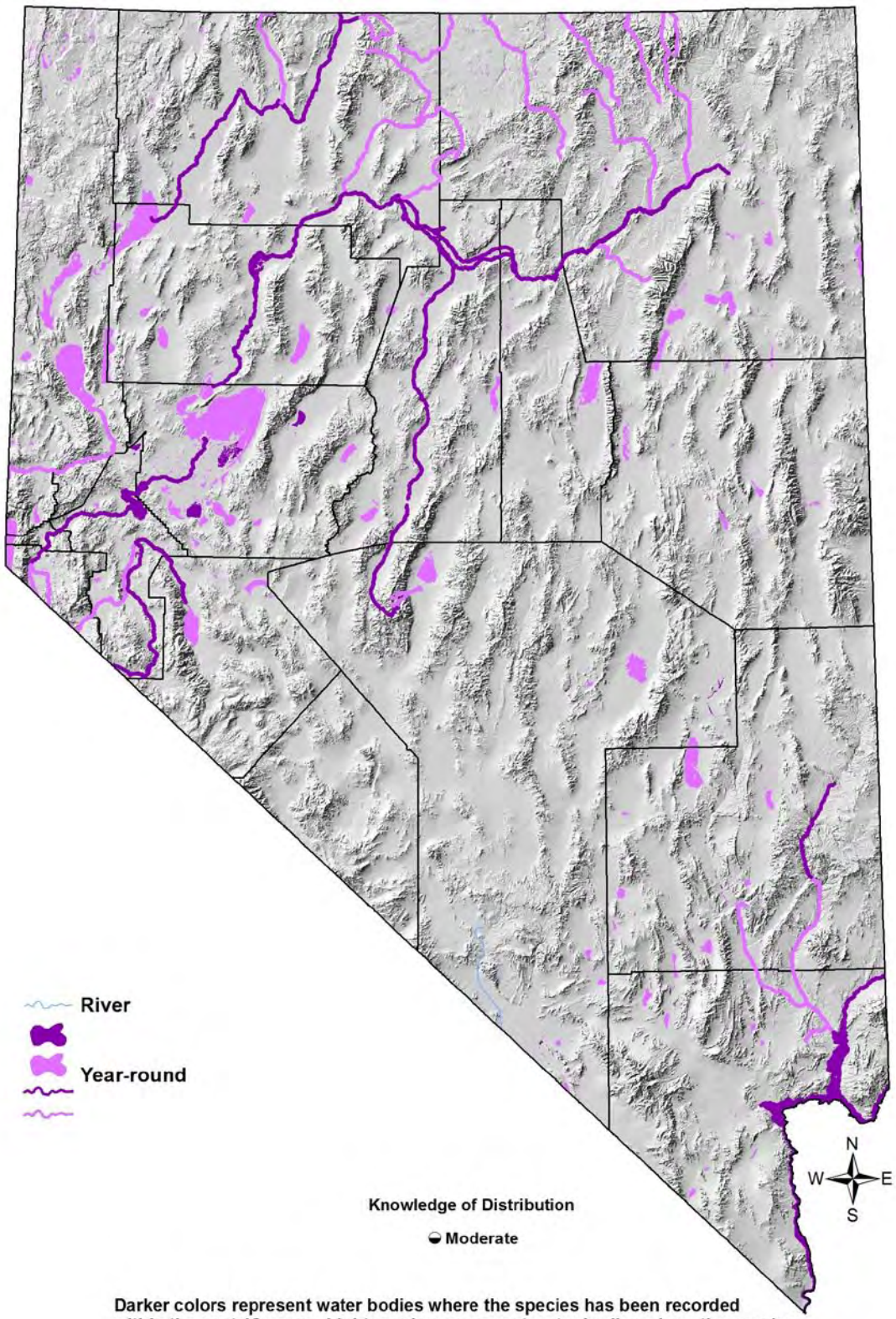
Natural History Profile

Seasonal Presence in Nevada	
Year-round (migration peaks in April, October)	
Known Breeding Dates in Nevada	
Late April – July[2, 8]	
Nest and Nesting Habits	
Nest Placement	Over water 20 -50 cm [8 – 20 in] deep, in dense emergent vegetation, or on ground (sometimes islands) within 3 m [10 ft] of water edge[8]
Site Fidelity	Unknown
Food Habits	
Basic	Diver (shallow)
Primary Diet	Submerged aquatic plants [6, 8]
Secondary Diet	Aquatic invertebrates;[6] and fish eggs[5]

Confidence in Available Data: ●High ◑Moderate ○ Low

Redhead

Aythya americana



Darker colors represent water bodies where the species has been recorded within the past 12 years. Lighter colors represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Redhead

Aythya americana

Overview

The Redhead has its breeding stronghold in the Prairie Pothole region of central North America, but nevertheless it is reported to be the second most common breeding duck in Nevada (C. Mortimore, *pers. comm.*). Nevada has a small but meaningful stewardship responsibility for the species, particularly during migration, when numbers are substantially higher than in the breeding season (www.ebird.org). Up to 200,000 Redheads may migrate through the Great Basin region, although the proportion of these passing through Nevada is not known.[3] Redheads are a year-round bird in most parts of Nevada, although the breeding distribution in southern Nevada is much spottier than in the north.[1] Seasonal cohorts are probably different, although this has not been conclusively shown. There is little evidence about differences (if any) in seasonal habitat use patterns, and seasonally-specific population estimates for Nevada are not available.

In a Canadian study, most females nested in small, semi-permanent wetlands and were successful in wetlands with large bands of emergent cover. Success was associated with water depth at the nest and distance between the nest and dry land. Brood-rearing females switched from smaller wetlands used for nesting to larger, semi-permanent wetlands. These results support a landscape approach to wetland management and emphasize the need for plans that reduce impact to wetland margins.[9]

Redhead populations appear fairly stable and close to population targets.[7] Because Redheads are relatively flexible in their habitat use, habitat management strategies that benefit other ducks are likely to benefit Redheads as well. However, their requirement for relatively deep summer water (>1 m; [3 ft]) does make then vulnerable to changes in water levels.[6, 8] As with other waterfowl, population trends are closely monitored and harvest limits adjusted as needed by NDOW and Pacific Flyway Council.

Abundance and Occupancy by Habitat

- 6 – 12 pairs / 100 ha [2.4 – 4.8 / 100 ha] in suitable habitat[8]

Nevada-Specific Studies and Analyses

No information

Redhead

Aythya americana

Main Threats and Challenges

Habitat Threats

- Loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development[6]
- Drought and low water conditions adversely affect breeding success and increase predation pressure[8]

Research, Planning, and Monitoring Challenges

- Key migration and wintering sites need to be better identified

Conservation Strategies

Established Strategies

- Annual harvest rates are set by NDOW in consultation with the Pacific Flyway Council

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- In breeding marshes, maintain a consistent water level during the nesting period (1 May – 15 July)

Research, Planning, and Monitoring Strategies

- Important winter and migration sites need to be better identified, though improved inventory and monitoring efforts

Public Outreach Strategies

- None identified

References: [1]Floyd et al. (2007); [2]GBBO unpublished Atlas data; [3]Kadlec and Smith (1989); [4]Nevada Wildlife Action Plan Team (2006); [5]Noyes (1985); [6]Shuford and Gardali (2008); [7]USFWS (1998); [8]Woodin and Michot (2002); [9]Yerkes (2000); [EO] Expert opinion

Lesser Scaup

Aythya affinis



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water (Wet Meadow)	
Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges, wet meadow grasses
Plant Density	For breeding, overhead cover of 36 – 45%, height 20 – 60 cm [8 – 23 in][1]
Mosaic	Water bodies with shallows for foraging and sufficiently dense shoreline or upland vegetation cover for nests[1]
Water Depth	< 3 m [10 ft] in open-water foraging areas[1]
Water Quality	Uses fresh to moderately saline water[1]
Response to Vegetation Removal	Negative for breeding [EO]
Area Requirements ○	
Minimum Patch Size	Unknown, but may breed in small lakes or marshes[1]
Recommended Patch Size	> 10 ha [25 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Recent declines Habitat threats Possibly small population size	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S1B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Gamebird
Pacific Flyway Council	High
Trends	
Historical ○	Unknown
Recent ◑	Declining[1, 2, 3]
Population Size Estimates	
Nevada ○	~ 650 (breeding), annually variable[4, EO]
Global ◑	4,500,000 [1, 3]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW aerial surveys, NWR and WMA counts, NDOW hunter surveys, Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Ruby Lake NWR
Restoration	Degraded marshes

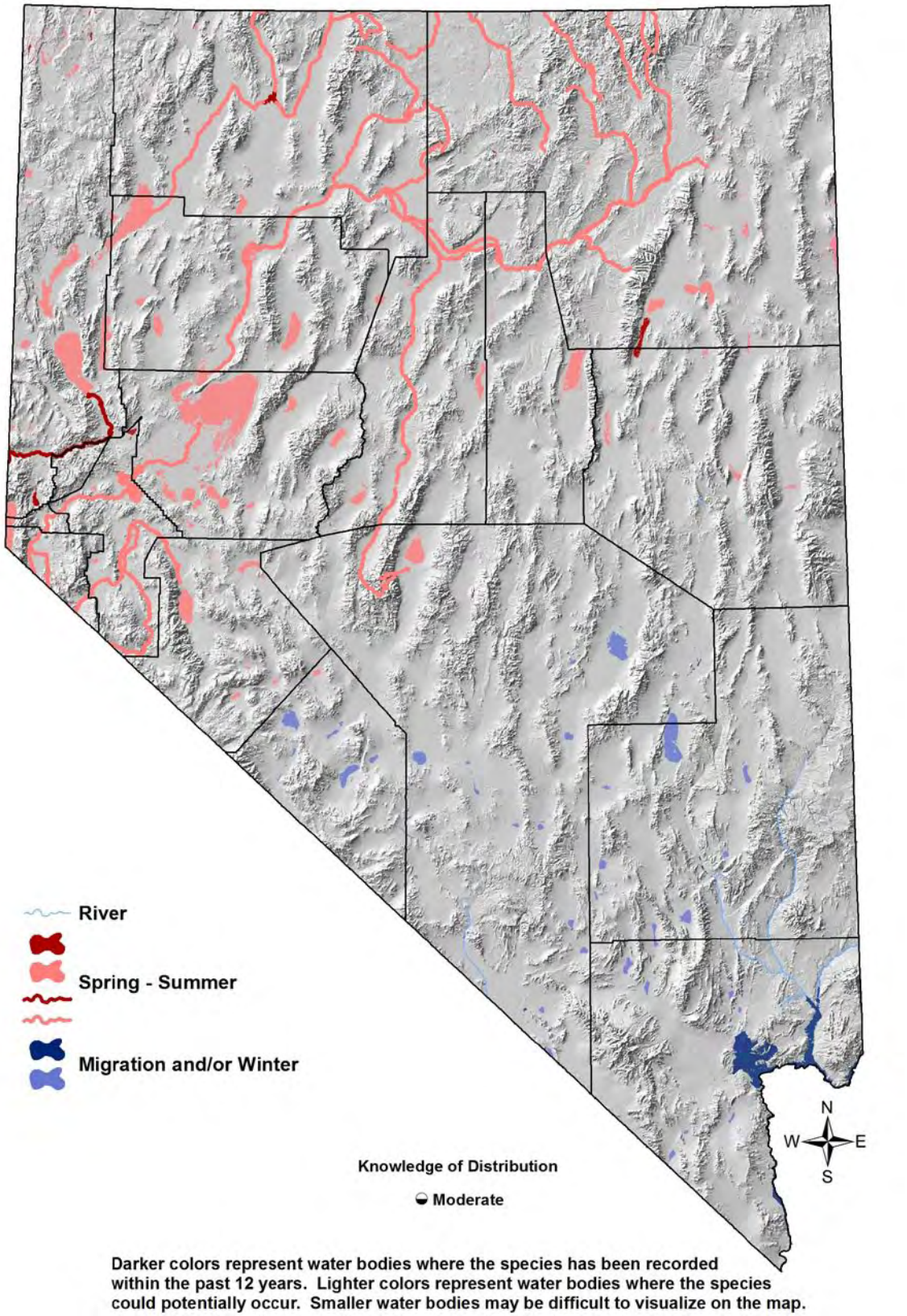
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (northern Nevada) Winter (southern Nevada) Spring (migration, statewide, April-May peak) Fall (migration, statewide, October peak)	
Known Breeding Dates in Nevada	
May – August[1]	
Nest and Nesting Habits	
Nest Placement	Usually on ground near water or on uplands < 160 m [525 ft] from water edge, under dense vegetation cover[1]
Site Fidelity	Unknown
Food Habits	
Basic	Diver
Primary Diet	Aquatic invertebrates, including molluscs[1]
Secondary Diet	Plant material[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Lesser Scaup

Aythya affinis



Lesser Scaup

Aythya affinis

Overview

The Lesser Scaup is the most widespread and abundant diving duck in North America,[1] but in Nevada it is breeding at the far southern margin of its continental breeding range. As such, Scaup are present in small numbers and distributed sporadically across the northern part of the state, with a concentration in northeastern Nevada and one clear breeding "hotspot" at Ruby Lakes NWR.[5] Interestingly, Lesser Scaup are either absent or rare as breeders in Lahontan Valley, in contrast to our other waterfowl. They are also very late spring migrants, and nesting does not begin until late May.[1]

Lesser Scaup are present in Nevada in substantially greater numbers during migration, but no seasonally-specific population estimates are available. Therefore many of the areas shown in the map above as "Spring – Summer" range may be equally or more important as migration habitat. Scaup have been confirmed to winter in southern Nevada, and there is possibly scattered wintering in the north as well (www.ebird.org), although evidence of this is less compelling.

In most respects, Lesser Scaup are not well studied despite their relative continental ubiquity.[1] They accept a fairly wide range of water conditions and wetland sizes, but for nesting, they require the presence of dense terrestrial vegetation near the shoreline, with wet meadows being especially suitable. Breeders tend to gravitate towards small ephemeral or semi-permanent wetlands.[1] Winter and migration distribution and habitat requirements are not as well known, although like many other ducks Lesser Scaup use larger and more open water bodies during the non-breeding season.

Ongoing regional declines are a concern, and continental population remain well below the goal of 6.3 million set by USFWS.[3] In Nevada, key strategies are the protection of major breeding areas, conservation of smaller semi-permanent wetlands, and learning more about seasonal status and needs. As with other waterfowl, population trends are closely monitored and harvest limits adjusted as needed by NDOW and Pacific Flyway Council.

Abundance and Occupancy by Habitat

- Average count at Ruby Lake NWR is 400 birds, with high annual variability[1, 4]
- Nevada breeding population estimate is based on Ruby Lake NWR estimate plus a smaller number for other areas of the state

Nevada-Specific Studies and Analyses

No information

Lesser Scaup

Aythya affinis

Main Threats and Challenges

Habitat Threats

- Loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development
- Reduction of shoreline cover or trampling during nesting season due to livestock grazing[1]

Research, Planning, and Monitoring Challenges

- Key migration and wintering sites need to be better identified

Conservation Strategies

Established Strategies

- Annual harvest rates are set by NDOW in consultation with the Pacific Flyway Council

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- Protect shoreline vegetation in breeding sites by deferring grazing or other disruptive activities during the nesting period (15 May – 1 August)
- Manage smaller semi-permanent wetlands to maintain water through August, and for intact shoreline vegetation

Research, Planning, and Monitoring Strategies

- Important winter and migration sites need to be better identified, though improved inventory and monitoring efforts

Public Outreach Strategies

- In areas where small breeding wetlands are located on private lands, encourage landowners to defer grazing and potentially disruptive land uses along shoreline areas until after the nesting period (15 May – 1 August)

References: [1]Austin et al. (1998); [2]Austin et al. (2000); [3]USFWS (1998); [4]USFWS (2001); [5]Floyd et al. (2007); [EO] Expert opinion

Greater Sage-Grouse

Centrocercus urophasianus



Photo by Steve Ting

Habitat Use Profile

Habitats Used in Nevada
Sagebrush Montane Shrubland Wet Meadow (Agriculture, Springs) (Montane Riparian, Aspen) (Great Basin Lowland Riparian)

Key Habitat Parameters ●	
Plant Composition	All sagebrush species (esp. Wyoming big sagebrush, mountain big sagebrush, and low sagebrush[EO]), flowering forbs, agricultural crops (particularly alfalfa), variety of montane shrubs, aspen, alder, willow
Plant Seasonal Composition, Mosaic, Density, & Height[6, 24]	Winter: dense sagebrush that reaches above snow Lek: open areas near good nesting habitat Nest: 15-38% sagebrush cover, 36 - 79 cm [14 – 31 in] shrub height, with significant herbaceous understory Brood: dense forb layer in wet meadows or agricultural lands Pre- and post-breeding: montane shrubs and meadows with forbs
Response to Fragmentation	Very sensitive to fragmentation of habitats[24]
Distance to Water	Proximity to water probably important for brood-rearing and post-breeding season[24]
Response to Vegetation Removal	Negative [EO]

Confidence in Available Data: ●High ◑Moderate ○ Low

Conservation Profile

Priority Status
Conservation Priority Species
Species Concerns
ESA listing: Candidate Species Historical and recent declines Habitat threats High stewardship responsibility

Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3S4
USFWS	Candidate Species, Bird of Conservation Concern
BLM	Sensitive Species
USFS	Sensitive Species
NDOW	Conservation Priority, Gamebird
NV Upland Game Management Plan	Very High Concern

Trends	
Historical ●	Large declines and range contraction[24]
Recent ◑	Continuing declines, but possibly stabilized in some areas[5]

Population Size Estimates	
Nevada ◑	68,000-88,000 [18]
Global ◑	150,000 [23, 24]
Percent of Global	~ 50%

Population Objective
Increase by 100%[23]

Monitoring Coverage	
Source	NDOW lek counts; intensive research
Coverage in NV	Good

Key Conservation Areas	
Protection	Montana, Bilk Creek, Santa Rosa, and Jarbidge ranges; Sheldon NWR; n. Washoe, Humboldt, and Elko counties
Restoration	Meadow, riparian, and sagebrush habitat throughout Great Basin

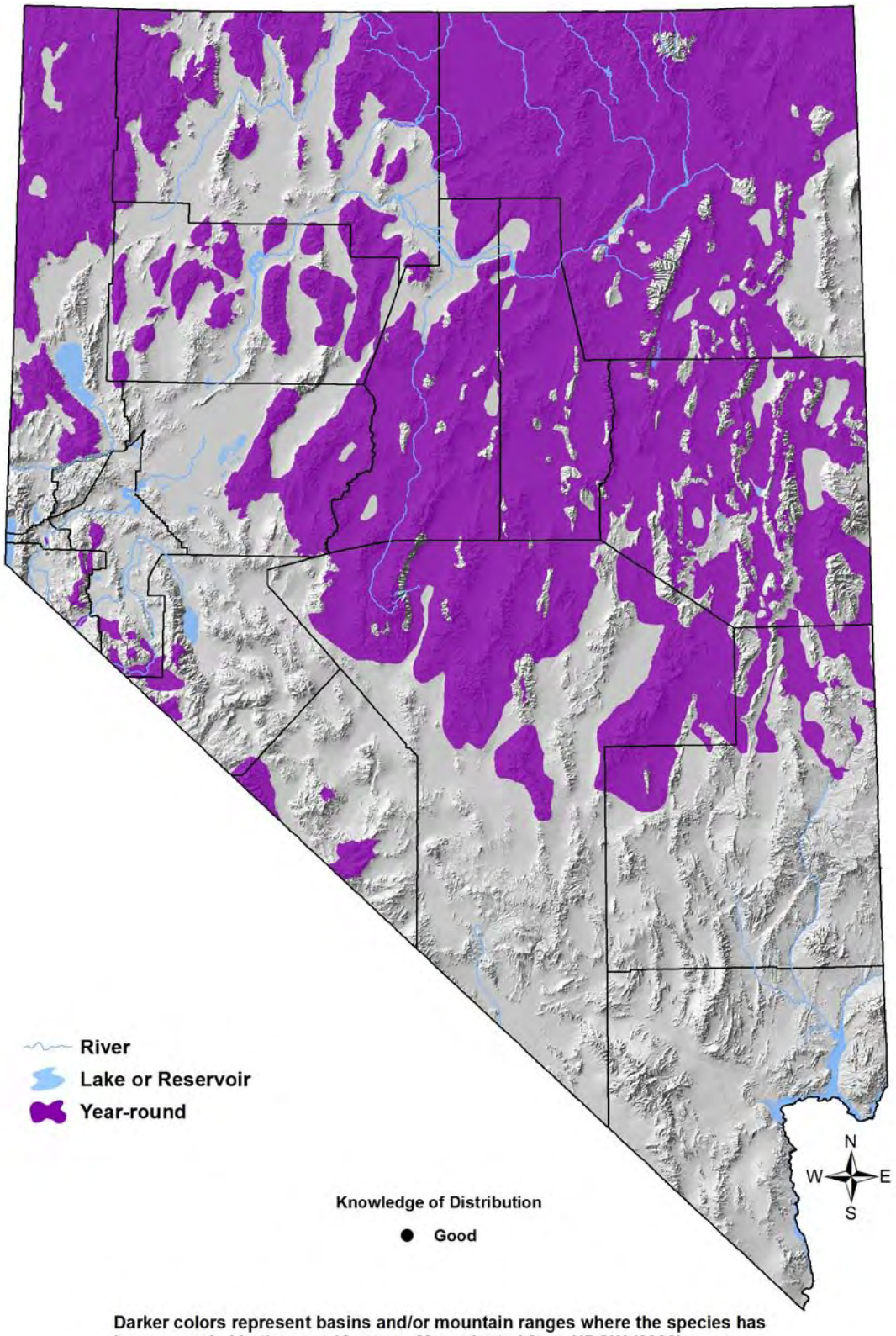
Habitat Use Profile - continued

Area Requirements ●	
Minimum Patch Size	Unknown; but > 4,000 ha [10,000 ac][6]
Recommended Patch Size	1,500 km² [580 mi²][EO]
Home Range	Up to 442 km² [170 mi²] over annual cycle for most populations,[24] but up to 2,700 km² [1,000 mi²] for some[4]

Natural History Profile - see p. Spp-8-3

Greater Sage-Grouse

Centrocercus urophasianus



Darker colors represent basins and/or mountain ranges where the species has been recorded in the past 12 years. Map adapted from NDOW (2008).

Greater Sage-Grouse

Centrocercus urophasianus

Natural History Profile

Seasonal Presence in Nevada	
Year-round (substantial seasonal movements)	
Known Breeding Dates in Nevada	
Early March – mid May (nesting), through late July (broods)[24, EO]	
Nest and Nesting Habits	
Nest Placement	On ground under shrub, with adequate herbaceous cover[6]
Site Fidelity	High for lek and nesting areas[24]
Other	Lek sites, nest and brood areas all important for conservation
Food Habits	
Basic	Forages from ground, primarily herbivorous
Primary Diet	Sagebrush leaves, buds, and flowers of forbs in fall through spring[24]
Secondary Diet	Insects and forbs during breeding and brood rearing[24]

Overview

Because of its persistent population declines, well-documented threats, and ESA candidate status, no other bird within our state has probably been the subject of greater study or conservation interest than the Greater Sage-Grouse. Nevada still has many intact sagebrush landscapes and hosts roughly half of the global sage-grouse population, but the continuing loss, degradation, and fragmentation of high-quality habitat to fire and other threats in recent years is cause for concern.[10] In an effort to stabilize and recover populations, the Nevada Department of Wildlife and its partners have pursued a strategy of proactive management and monitoring, which is organized into 62 Population Management Units and draws upon many ongoing research projects and local conservation efforts.[18] The bi-state population of sage-grouse in the Mono Basin area of California and adjacent portions of Nevada has been recognized by the USFWS as a Distinct Population Segment (DPS), and is itself a candidate for ESA protection. Given that this DPS is relatively isolated and may have distinctive habitat requirements, it is covered by its own local conservation plan under the *Greater Sage-Grouse Conservation Plan for Nevada and Eastern California*. [13,18]

Sage-grouse require the presence of several distinct landscape components, as described in the Habitat Profile table above. Over the course of an annual cycle, they can travel long distances across large elevational ranges in order to reach seasonally-appropriate habitat.[26] Thus, interspersion and juxtaposition of required habitats, or the lack thereof, are likely to have a substantial influence on landscape quality as it relates to sage-grouse.[6] Efforts to conserve, recover, or restore any one required habitat component are unlikely to be fully effective for sage-grouse conservation if they occur in landscapes where other critical habitat components are absent or degraded.[8]

Greater Sage-Grouse
Centrocercus urophasianus

Even within sagebrush habitat, sage-grouse exhibit temporally-variable structural preferences. Preferred shrub height ranges from 25–80 cm [9 – 31 in] seasonally, and shrub canopy cover ranges from 12–43%.[6] For nesting, presence of adequate herbaceous cover may be as important as shrub density in determining nest success,[6] and chick survival is directly linked to availability of food (forbs and insects) and cover of short grasses.[11,21] High quality brood-rearing habitat, where forbs remain green through late summer, may be a limiting factor in much of Nevada.[2] Although sage-grouse have a high reproductive potential, it is not realized in most years,[7] and large recruitment spikes, presumably associated with high-precipitation years, may be important for long-term population persistence.[27] For this reason, the effects of climate change on precipitation levels in Nevada are of concern to sage-grouse conservation.

On a landscape scale, the long-term persistence of sage-grouse populations requires at least 25% cover (preferably 65%) of good-quality sagebrush within a given 30 km [19 mi] radius.[1] Fires, particularly in recent years, have pushed many areas below this threshold.[10,16] For this reason, the Western Association of Fish and Wildlife Agencies (WAFWA) recommends that managers avoid burning Wyoming big sagebrush as a habitat management measure, but instead implement alternative treatments to maintain sagebrush cover.[28] Burning may be beneficial in mountain sagebrush systems with high shrub cover (> 35%), conifer encroachment, and few invasive weeds, but should probably not be used where sagebrush cover is in danger of falling beneath the 25% minimum cover threshold.[7]

This overview can only briefly summarize the wealth of material available on sage-grouse ecology, management, and conservation. Resource managers should consult the references listed below in the Nevada Specific Studies and Analysis section for additional detail.

Abundance and Occupancy by Habitat

No comprehensive assessment for many seasonal habitats was available for Nevada in this plan version, but NDOW collects and maintains a long-term, statewide database for lek attendance

Nevada-Specific Studies and Analyses

Key findings from several important Nevada-focused studies are briefly summarized as follows:

- Atamian et al. (2010):[2] During the late brood rearing period, high-quality brood habitat on which sage-grouse chicks were successfully reared represented 0.3% of the study area and was highly restricted in spatial distribution. This suggests that availability of suitable brood-rearing habitat may be a critical limiting resource for sage-grouse in some areas

Greater Sage-Grouse
Centrocercus urophasianus

- Coates and Delehanty (2010):[3] Increased raven numbers have negative effects on sage-grouse nest success, especially in areas with relatively low shrub canopy cover
- Lammers et al. (2007):[14] Golden Eagle predation appears to play only a minor role in sage-grouse population dynamics, even where eagles have artificial perch sites available
- Rebholz (2007):[21] Increasing amounts of grass cover beneath the nest shrub improved the likelihood of nest success. Conversely, grass cover at early brood sites was negatively associated with chick survival, while greater forb cover was associated with a higher probability of chick survival
- Van Kooten et al. (2007):[27] Long-term variation in population data from Elko County showed strong effects of yearly climate variation, a possible weak effect of cattle stocking rates, and no apparent effect of predator control. It was not possible to discern an overall population trend

In addition, the following resources provide critical information about sage-grouse conservation and management, although several have a regional, rather than a statewide, focus:

- SAGEMAP - A GIS Database for Sage-Grouse and Shrubsteppe Management in the Intermountain West: http://sagemap.wr.usgs.gov/index.aspx
- Nevada Department of Wildlife Sage-Grouse Conservation site: http://www.ndow.org/wild/conservation/sg/index.shtm
- Nevada Upland Game Species Management Plan[17]
- Greater Sage-Grouse Conservation Plan for Nevada and Eastern California:[18] http://www.ndow.org/wild/conservation/sg/plan/index.shtm
- Energy and Infrastructure Development Standards to Conserve Greater Sage-Grouse Populations and their Habitats in Nevada" [19] http://www.ndow.org/wild/conservation/sg/resources/nevada_energy_standards_for_sage-grouse_2010.pdf
- Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats:[5] http://www.ndow.org/wild/conservation/sg/resources/assessment.shtm
- Ecology and Conservation of Greater Sage-Grouse: a Landscape Species and its Habitats:[12] http://sagemap.wr.usgs.gov/monograph.aspx
- Sage-Grouse Habitat Restoration Symposium Proceedings:[25] http://www.fs.fed.us/rm/pubs/rmrs_p038.html
- Greater Sage-Grouse Comprehensive Conservation Strategy:[26] http://www.wafwa.org/documents/pdf/GreaterSage-grouseConservationStrategy2006.pdf

Greater Sage-Grouse
Centrocercus urophasianus

Finally, established monitoring protocols are covered in:

- Monitoring Populations of Sage-Grouse. Proceedings of a Symposium:[22] http://sgrp.usu.edu/files/uploads/grouseProcdngs4.pdf
- Nevada Department of Wildlife Lek Survey Protocol: http://www.ndow.org/wild/conservation/sg/plan/SGPlan063004_G.pdf

Main Threats and Challenges

Habitat and Other Threats

- As presented in the *Greater Sage-Grouse Management Plan for Nevada and Eastern California*,[18] the greatest threats are:
  - Loss of habitat to:
    - Fire
    - Pinyon-juniper encroachment
  - Decline in habitat quality due to:
    - Invasive plants
    - Inadequate grazing management systems, which can particularly impact brood-rearing meadows[7]
- Other threats that have been identified include:
  - Fragmentation of landscapes and simplification of the flora across landscapes. This process can reduce availability of, or connectivity between, seasonally important habitats
  - Energy (solar and wind) development[9]
  - Raven predation of eggs and young may be high in some areas[3]
  - Sage-grouse are vulnerable to adult mortality from West Nile virus,[15] but the disease's overall impacts in Nevada are not yet known

Research, Planning, and Monitoring Challenges

- Further research is needed to determine the best management strategies for the pinyon-juniper / sagebrush interface zone for multi-species benefits
- Although short-term fire management strategies are established, further research and planning is needed to clarify the most beneficial longer-term fire management strategies

Greater Sage-Grouse

Centrocercus urophasianus

Conservation Strategies

Established Strategies

- Detailed management strategies for the Greater Sage-Grouse already exist in several of the sources identified above.[18,26,30] Key strategies presented in the *Greater Sage-Grouse Management Plan for Nevada and Eastern California*[18] include:
    - Protect key habitat from wildlife by emphasizing importance of these areas to federal firefighting personnel
    - Improve grazing management systems to better protect important brood-rearing habitat and other seasonally important habitats
    - Undertake appropriate pinyon-juniper management projects in encroached areas
    - Pursue opportunities to restore large crested wheatgrass plantings to native grasses and forbs where feasible
    - Expand efforts to restore former habitat impacted by recent fires, especially in areas formerly dominated by Wyoming big sagebrush, mountain big sagebrush, and low sagebrush
- *Energy and Infrastructure Development Standards to Conserve Greater Sage-Grouse Populations and their Habitats in Nevada* [19] provides additional strategies relevant to energy development projects

Habitat Strategies

- Sagebrush (p. Hab-17-1), Montane Shrubland (p. Hab-14-1), and Wet Meadow (p. Hab-20-1) habitat conservation strategies benefit this species.
- In addition, we recommend that pinyon-juniper management projects consider the importance of maintaining a natural, interspersed interface zone between sagebrush shrublands and pinyon-juniper woodlands, as discussed in the Pinyon-Juniper habitat account (p. Hab-16-1)
- Prescribed burning should be avoided unless restoration of native vegetation can be expected on a particular site.[28] Prescribed burns > 50 ha [124 ac], or that burn > 20% of an area used by sage-grouse during winter, or that are within a period shorter than local sagebrush habitat recovery time may be problematic[4]
- Manage livestock grazing and other land uses to minimize damage to perennial herbaceous cover and to minimize invasive weeds

Research, Planning, and Monitoring Strategies

- Identify and map high-quality sagebrush habitat and landscapes, which are characterized by availability of patches with:
    - 15 – 25% sagebrush canopy cover
    - Perennial herbaceous cover > 18 cm [7 in] high, with 15% canopy cover of grasses and 10% cover of diverse forbs[4]

continued

Greater Sage-Grouse
Centrocercus urophasianus

Conservation Strategies (continued)

- A landscape that contains at the recommended patch size (see Habitat Profile table, above):
  - Multi-aged sagebrush shrubland with structurally-diverse patches as quantified above
  - Brood-rearing areas with sufficient perennial herbaceous cover, and preferably with sufficient moisture to allow persistence of green forbs until late summer
  - Suitable fall/winter habitat, which may vary among different regions
  - Historical lek sites
- Conduct additional research to determine how to pinyon-juniper management projects can both benefit sage-grouse and the larger suite of birds that use the pinyon-juniper / sagebrush interface zone (see p. Hab-16-1)
- Conduct additional research and planning to generate a fire-management strategy balancing the need for short-term protection and the need for long-term habitat viability
- Further study of the relative impacts of grazing by livestock, horses, and burros on habitat quality
- Investigate the possible impacts of losses of traditional water sources on sage-grouse such as springs, wet meadows, and other wetlands

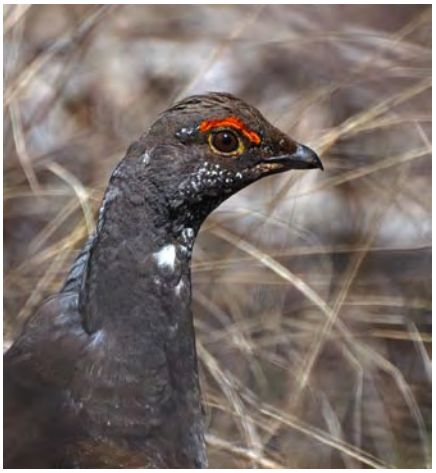
Public Outreach Strategies

- Continue outreach to diverse stakeholders, as exemplified by the Nevada Governor's Sage-Grouse Conservation Team[18,19]

References: [1]Aldridge et al. (2008); [2]Atamian et al. (2010); [3]Coates and Delehanty (2010); [4]Connelly et al. (2000); [5]Connelly et al. (2004); [6]Connelly et al. (2011; *in press*); [7]Crawford et al. 2004); [8]Doherty et al. (2010); [9]Drew and Espinosa (2008); [10]Espinosa and Phenix (2008); [11]Gregg and Crawford (2009); [12]Knick and Connelly (2011; *in press*); [13]Kolada et al. (2009); [14]Lammers et al. (2007); [15]Naugle et al. (2005); [16]Nelle et al. (2000); [17]NDOW (2008); [18]Nevada Governor's Sage-Grouse Conservation Team (2004); [19]Nevada Governor's Sage-Grouse Conservation Team (2010); [20]Paige and Ritter (1999); [21]Rebholz (2007); [22]Reese and Bowyer (2007); [23]Rich et al. (2004); [24]Schroeder et al. (1999); [25]Shaw et al. (2005); [26]Stiver et al. (2006); [27]Van Kooten (2007); [28]WAFWA (2009); [29]Wisdom et al. (2002); [EO] Expert opinion

Sooty Grouse and Dusky Grouse ("Blue" Grouse)

Dendragapus fuliginosus and *D. obscurus*



Sooty Grouse. Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest Aspen Montane Shrubland	
Key Habitat Parameters ●	
Plant Composition	Mixed conifers, including white and red fir, ponderosa, limber, and Jeffrey pine, Douglas fir; also aspen, willow, mountain mahogany, serviceberry, currants, rose and other montane shrubs
Plant Density	Dense shrub and/or herbaceous understory (30 – 60% cover); open, dry forest mixed with shrubs are typical[6, EO]
Mosaic	Mixture of coniferous and deciduous woodlands near waterways[6]
Distance to Water	Nest: 10 – 800 m [33 – 2600 ft][6]
Response to Vegetation Removal	Probably negative, especially removal of understory [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 150 ha [370 ac][EO]
Home Range	Up to 42 ha [104 ac], depending on season[6]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Recent declines Habitat threats	
Other Rankings	
Continental PIF	Sooty: Watch List; Dusky: None
Audubon Watchlist	Sooty: Yellow; Dusky: None
NV Natural Heritage	"Blue": S3
USFWS	None
BLM	None
USFS	None
NDOW	Conservation Priority
NV Upland Game Plan	High Concern
Trends	
Historical ○	Probable declines in Nevada[1]
Recent ◑	Declined 50% in western U.S. since 1960s; declines continue[5, 6]
Population Size Estimates	
Nevada ◑	Unknown (annual harvest ~ 1,700) [2]
Global ◑	2,600,000 [4]
Percent of Global	Unknown
Population Objective	
Increase by 100% [4, EO]	
Monitoring Coverage	
Source	Not systematically monitored
Coverage in NV	Poor
Key Conservation Areas	
Protection	Carson Range, coniferous forest and aspen habitat within occupied ranges (see map below)
Restoration	Same, especially degraded aspen stands

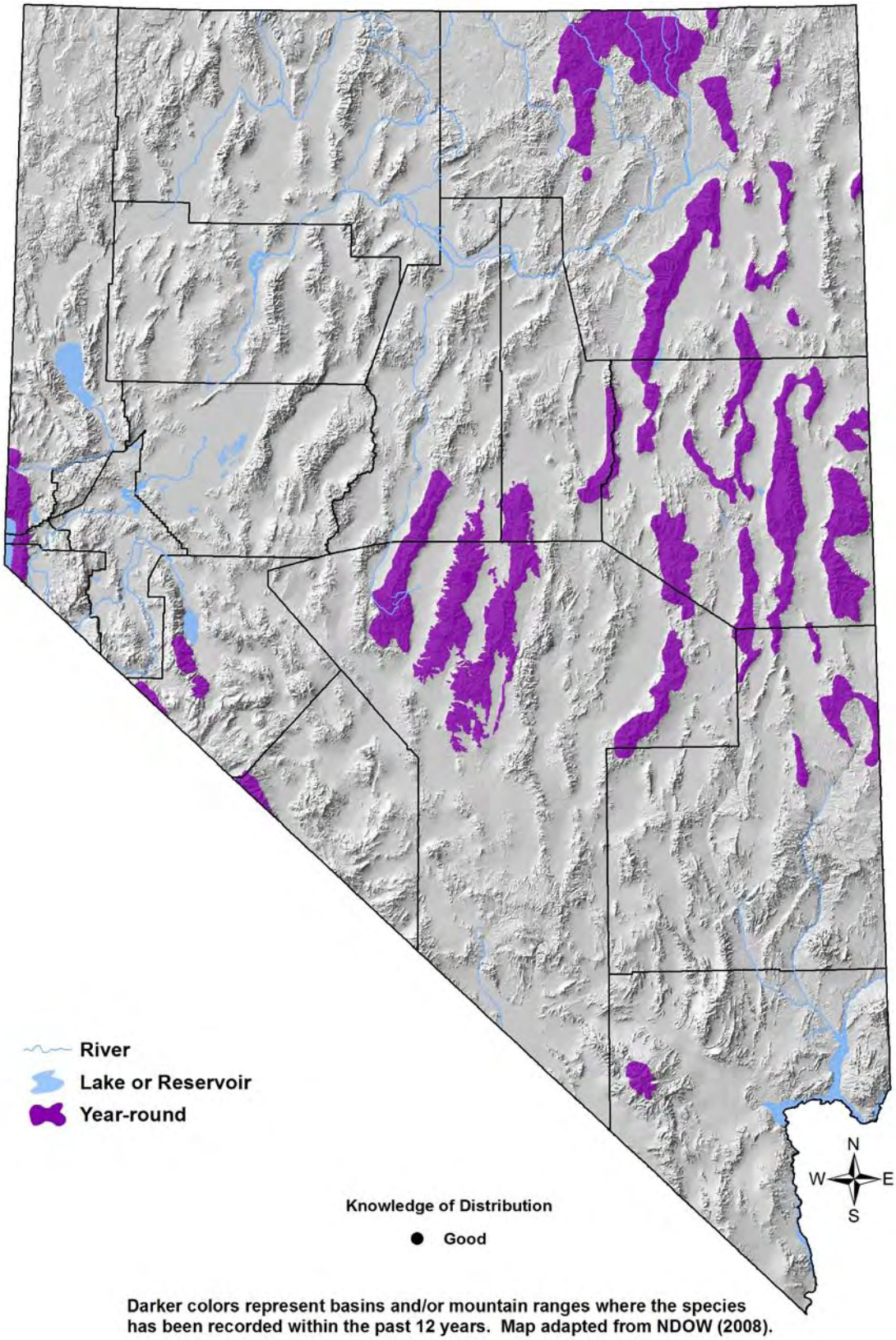
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Mid-April – July[3]	
Nest and Nesting Habits	
Nest Placement	On ground under dense cover[6]
Site Fidelity	High for breeding territory[6]
Food Habits	
Basic	Ground forager
Primary Diet	Leaves, flowers, fruit year-round; conifer needles in winter[6]
Secondary Diet	Terrestrial invertebrates during breeding[6]

Confidence in Available Data: ●High ◑Moderate ○ Low

Sooty Grouse and Dusky Grouse ("Blue" Grouse)

Dendragapus fuliginosus and *D. obscurus*



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Map adapted from NDOW (2008).

Sooty Grouse and Dusky Grouse ("Blue" Grouse)

Dendragapus fuliginosus and *D. obscurus*

Overview

The Dusky and Sooty Grouse were, until 2007, regarded as a single species, the "Blue" Grouse. They are treated together here because most of the available data and information do not distinguish between the two species. In Nevada, the Sooty Grouse occurs in the Carson Range, and the Dusky Grouse occurs in all other locations to the east and south of the Carson Range, with the possible exception of Esmeralda and Mineral counties, where records of "Blue" Grouse have not yet been ascribed to either species. Dusky Grouse populations in Nevada are patchy and isolated, and disconnected from larger population centers to the east and north.

Sooty and Dusky Grouse are montane birds, and in Nevada they appear to require the availability of aspen and montane riparian woodlands (where riparian shrubs and insect communities provide the spring and summer diet), along with coniferous forest (which provides important winter forage).[6] Dusky Grouse are more inclined than Sooty Grouse to leave the woodlands, ranging up to 2 km [1.2 mi] from the forest edge into areas dominated by sagebrush, montane shrubs, and mountain mahogany, especially in late fall and early winter.[2,EO] Both species move upward in elevation to denser forests for the winter.[2,6] The most immediate conservation need is to better determine the respective habitat needs and conservation issues for these two grouse, which may still be declining in Nevada.

Abundance and Occupancy by Habitat

Sooty or Dusky Grouse were detected on 14 of 248 NBC transects that were located within montane habitats. The table below summarizes the percentage of different cover types (as defined in NBC; Montane Sagebrush is subsumed by Montane Shrubland in this plan, and Mt. Mahogany is subsumed by Pinyon-Juniper) present on occupied transects versus unoccupied transects.

Habitat Type (GIS classified)	Occupied Transects (% cover)	Unoccupied Transects (% cover)
Aspen	15.3	6.9
Coniferous Forest	27.5	9.3
Montane Riparian	7.9	6.3
Montane Sagebrush	7.2	11.4
Montane Shrubland	4.7	0.7
Mt. Mahogany	12.2	4.3
Pinyon-Juniper	13.3	27.8

Nevada-Specific Studies and Analyses

- George Barrowclough (American Museum of Natural History) collected DNA samples from Sooty and Dusky Grouse in Nevada. Results of this research, which are currently pending, may improve or knowledge of the true geographical ranges of the two species

Sooty Grouse and Dusky Grouse ("Blue" Grouse)

Dendragapus fuliginosus and *D. obscurus*

Main Threats and Challenges

Habitat Threats

- Little information exists about specific threats to Dusky or Sooty Grouse. It is probable that threats to Aspen (p. Hab-3-1), Montane Riparian (p. Hab-13-1), and Coniferous Forest (p. Hab-5-1) habitats affect both species. Heavy grazing and large fires in particular are likely threats

Research, Planning, and Monitoring Challenges

- Lack of knowledge about specific threats, and about the distinctions between the habitat needs and conservation status of the two species

Conservation Strategies

Established Strategies

- As for all managed game birds, NDOW has developed detailed conservation and management priorities for Dusky and Sooty Grouse,[2] with key elements including:
  - Develop survey protocols to determine distribution of both species in Nevada
  - Improve data gathering from harvested grouse
  - Conduct research to better determine ecological needs of both species
  - Conduct research on possible impacts of West Nile virus

Habitat Strategies

- Aspen (p. Hab-3-1), Montane Riparian (p. Hab-13-1), and Coniferous Forest (p. Hab-5-1) habitat conservation strategies benefit this species
- Give conservation priority to montane mosaics of mixed-age conifer forest, deciduous woodland, and shrubland

Research, Planning, and Monitoring Strategies

- Conduct research to better identify important threats to each species, and to better map the distribution of each species

Public Outreach Strategies

- None identified

References: [1]Alcorn (1988); [2]NDOW (2008); [3]Nevada Wildlife Action Plan Team (2006); [4]Rich et al. (2004); [5]Sauer et al. (2008); [6]Zwickel (1992); [EO] Expert opinion

Sharp-tailed Grouse

Tympanuchus phasianellus



Photo by Joe Williams

Habitat Use Profile

Habitats Used in Nevada	
Montane Shrubland Aspen (winter) Montane Riparian (winter) (Sagebrush)	
Key Habitat Parameters ◑	
Plant Composition	Diverse montane shrubs including sagebrush; high plant species richness preferred; [2] avoids cheatgrass [EO]
Plant Density	Dense shrub and grass/forb cover with structural complexity preferred[2]
Mosaic	Floristically diverse montane shrublands near aspen stands or montane riparian woodlands[2]
Distance to Water	Unknown, but require montane riparian or aspen habitat for wintering
Response to Vegetation Removal	Negative [EO]
Area Requirements ●	
Minimum Patch Size	3,000 ha [7,400 ac][2, 3]
Recommended Patch Size	> 3,000 ha [7,400 ac] [EO]
Home Range	≤ 200 ha [500 ac][2]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Habitat threats	
Other Rankings	
Continental PIF	Stewardship Species
Audubon Watchlist	None
NV Natural Heritage	S1
USFWS	None
BLM	None
USFS	None
NDOW	Conservation Priority
NDOW Upland Game Plan	High
Trends	
Historical ●	50% decline rangewide; extirpated in Nevada in 1952 [2]
Recent ◑	Reintroduced in Nevada in late 1990s, apparently stable[3]
Population Size Estimates	
Nevada ◑	226 (number introduced)[3]
Global ◑	1,200,000 (includes all subspecies)[9]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW lek surveys
Coverage in NV	Good
Key Conservation Areas	
Protection	Snake Mountains in Elko County
Restoration	Elko County

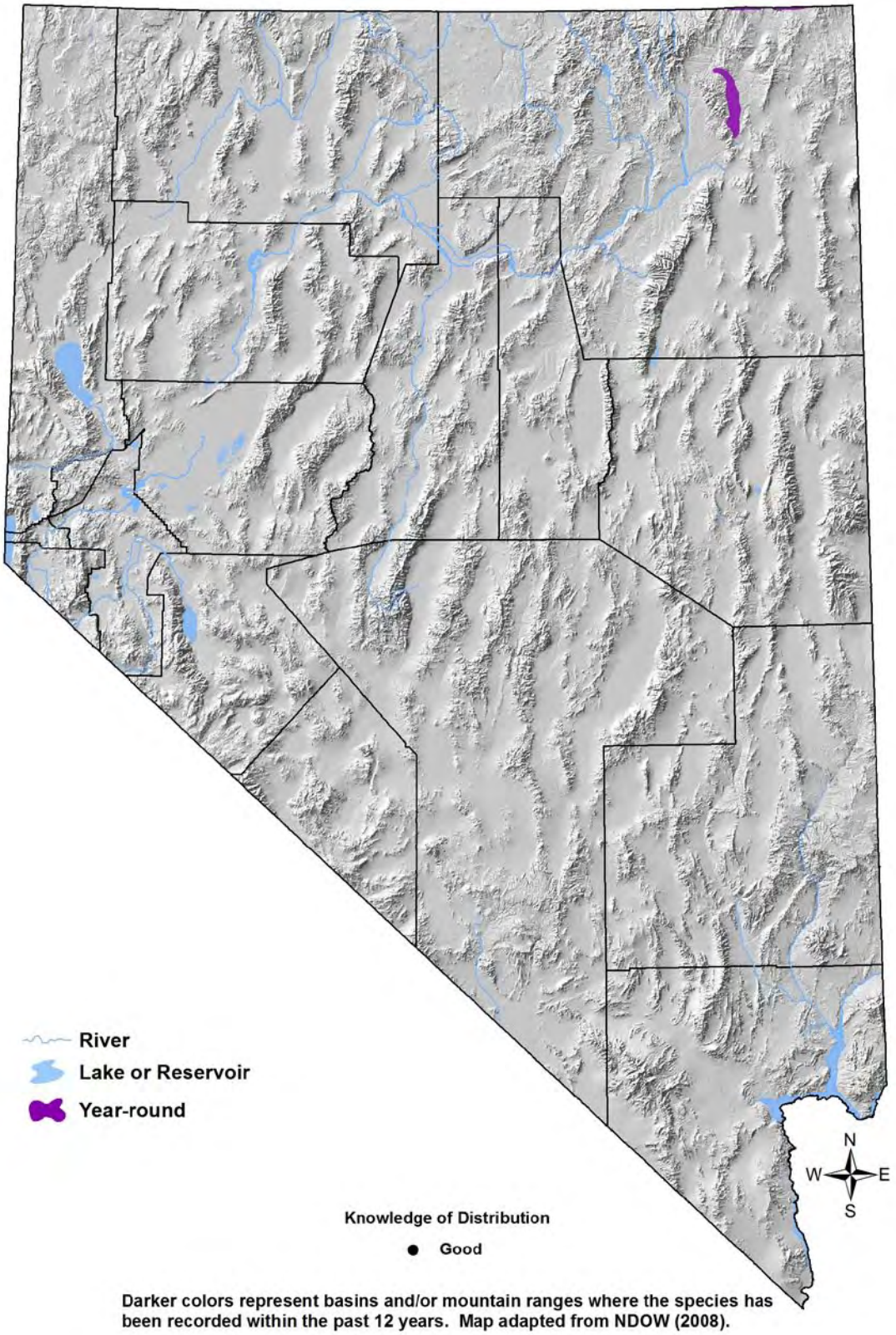
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
April – early August[2]	
Nest and Nesting Habits	
Nest Placement	On ground under dense shrub or small tree[2]
Site Fidelity	High for lek sites; possibly high for nesting sites[2]
Food Habits	
Basic	Ground forager and gleaner
Primary Diet	Forbs, fruits, seeds, buds year-round[2]
Secondary Diet	Terrestrial arthropods during breeding[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Sharp-tailed Grouse

Tympanuchus phasianellus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Map adapted from NDOW (2008).

Sharp-tailed Grouse

Tympanuchus phasianellus

Overview

The western subspecies of the Sharp-tailed Grouse (Columbian, *T. p. columbianus*) has declined precipitously throughout its U.S. range. These declines have been attributed to a number of factors, including habitat losses to agriculture, habitat fragmentation, excessive livestock grazing, and fire. In Nevada, the Columbian Sharp-tailed Grouse was extirpated by 1952. In 1999-2002, birds captured in Idaho were reintroduced to Nevada.[1] The Snake Mountains in Elko County were selected as the initial reintroduction site because of their large expanses of higher-elevation shrubland habitat adjoining lower-elevation sagebrush with relatively well-developed bunchgrass component.[3]

Sharp-tailed Grouse fare best in large intact tracts of montane shrubland with well-developed herbaceous and shrub cover.[2] Nesting areas tend to be selected where a mix of grasses, forbs, and shrubs provide structural diversity and good cover.[2,10] One study demonstrated that nest success increased with vegetation cover and structural diversity as far as 50 m [160 ft] from the nest site, and decreased when agricultural lands (and their associated populations of ravens and other nest predators) were closer than 1,600 m [1 mi] to the nest.[6] Columbian Sharp-tailed Grouse, at least in some areas where they have been studied, are heavily dependent on riparian and upland deciduous plant species (e.g. serviceberry, snowberry, chokecherry, hawthorn, aspen) for winter cover and food, and may move substantial distances to reach them in the winter.[2,4,7]

Nevada's single population of Sharp-tailed Grouse is well-monitored by NDOW, is not hunted, and is probably safe from major threats at this time, although catastrophic fires remain a concern. The main need is a better understanding of the factors promoting the species' long-term persistence (within both its current range and potential new translocation sites), along with protection of its current range from fragmentation.

Abundance and Occupancy by Habitat

No information for Nevada

Nevada-Specific Studies and Analyses

- Coates[1] conducted a Master's Thesis study on the movements, survivorship, and reproductive behaviors of Sharp-tailed Grouse translocated into Nevada

Main Threats and Challenges

Habitat and Other Threats

- In Nevada, energy development and large destructive fires are the most important threats; conifer encroachment could also be a local issue

Sharp-tailed Grouse

Tympanuchus phasianellus

- The small size and isolation of the Nevada population renders it vulnerable to episodic "survival filters," such as unusually severe winters, etc.

Research, Planning, and Monitoring Challenges

- The parameters of fire regimes that promote long-term population persistence are not well defined

Conservation Strategies

Established Strategies

- NDOW has developed detailed conservation and management priorities for the Sharp-tailed Grouse as a managed game bird,[7] with key elements including:
  - Continue current monitoring and study of the existing population
  - Evaluate other areas as potential reintroduction sites, and conduct reintroductions where appropriate
  - Manage habitat to maintain healthy shrub cover with well-developed grass component in minimum patch sizes of several thousand acres
  - Seek to limit agricultural interspersion into occupied habitat[8]
  - Development activities should avoid known lek sites; all human activity should be curtailed within 800 m [0.5 mi] of an active lek (March – June)[8]

Habitat Strategies

- Montane Shrubland (p. Hab-14-1), Montane Riparian (p. Hab-13-1), and Aspen (p. Hab-3-1) habitat conservation strategies benefit this species

Research, Planning, and Monitoring Strategies

- Conduct additional study of winter habitat use in Nevada
- Determine parameters of fires that potentially benefit the species versus those that should be aggressively controlled

Public Outreach Strategies

- None identified

References: [1]Coates (2001); [2]Coates et al. (2006); [3]Connelly et al. (1998); [4]Giesen and Connelly (1993); [5]Manzer and Hannon (2005); [6]Marks and Marks (1988); [7]NDOW (2008); [8]Paige and Ritter (1999); [9]Rich et al. (2004); [10]Saab and Marks (1992); [EO] Expert opinion

Mountain Quail

Oreortyx pictus



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Montane Riparian Aspen Montane Shrubland Coniferous Forest (Springs)	
Key Habitat Parameters ●	
Plant Composition	Ponderosa, Jeffrey and pinyon pines; juniper, aspen, currants, willows, squawbush, bitterbrush, sagebrush, variety of other montane shrubs and forbs
Plant Density	Dense shrub cover, well-developed forb understory[4, EO]
Mosaic	Tall and dense shrubs close to drinking water and escape cover (rock formations, ravines)[1]
Distance to Water	< 200 m [650 ft][4]
Slope	Steep slopes preferred[4]
Movement Corridor	Seasonal movements ≤ 25 km [16 mi] along streams to lower elevation winter grounds[4]
Other	Uses guzzlers[2]
Response to Vegetation Removal	Negative [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 25 km [16 mi] of intact stream corridor[4, EO]
Home Range	In summer, 140 ha [345 ac][9]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Small population size Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3
USFWS	None
BLM	Sensitive Species
USFS	Sensitive Species
NDOW	Conservation Priority
NV Upland Game Plan	High Concern
Trends	
Historical ●	Rangewide declines[4]
Recent ◑	In Nevada, significant declines[4]
Population Size Estimates	
Nevada (BBS) ◑	840
Global ◑	160,000 [9]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [9, EO]	
Monitoring Coverage	
Source	NDOW surveys, Nevada Bird Count
Coverage in NV	Good / Fair
Key Conservation Areas	
Protection	Carson, Pine Nut, Desatoya, Clan Alpine, Wassuk, and White Mountain ranges
Restoration	Same as above

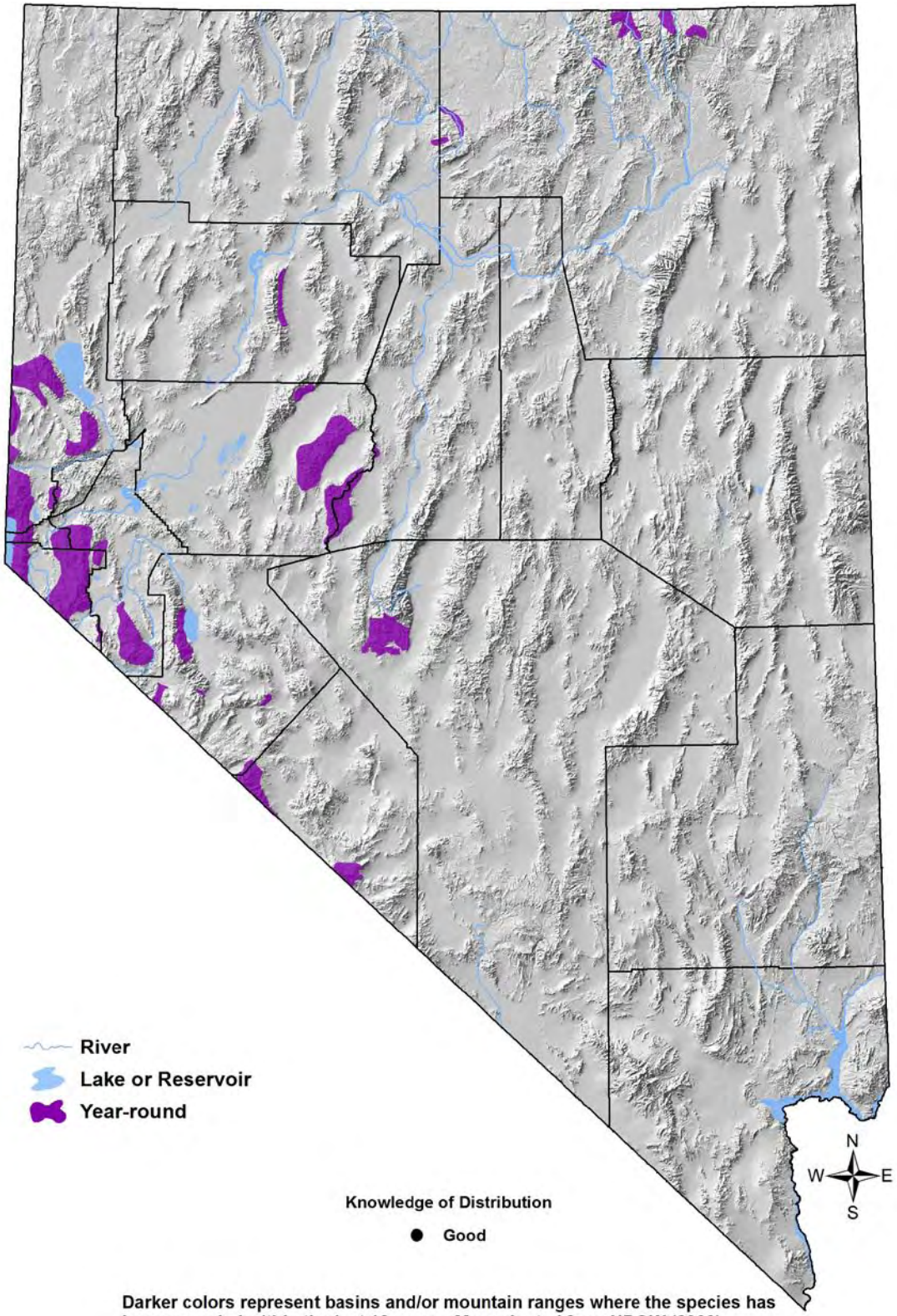
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
April – July[3]	
Nest and Nesting Habits	
Nest Placement	On ground under dense shrub or tree cover[4]
Site Fidelity	Unknown
Food Habits	
Basic	Ground forager
Primary Diet	Seeds, fruits, flowers[4]
Secondary Diet	Terrestrial arthropods during nesting season[4]

Confidence in Available Data: ●High ◑Moderate ○ Low

Mountain Quail

Oreortyx pictus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the last 12 years. Map adapted from NDOW (2008).

Mountain Quail

Oreortyx pictus

Overview

Mountain Quail are patchily distributed in montane areas of western Nevada. The species is known to be native to the Carson Range, but other scattered populations have been reported.[5] Regardless, several of Nevada's fragmented populations were likely extirpated by the 1940s,[6] and declines have apparently continued since that time. Mountain Quail are not closely tied to any particular habitat type, but instead are strongly associated with dense montane shrub and forb cover. Steep landscapes, where intact coniferous forests, deciduous woodlands, and montane shrublands exist in close proximity to a stream probably represent ideal conditions.[7] Degradation of streamside habitat due to chronic livestock grazing is a known threat to the species. The role of fire in Mountain Quail management is complicated; fire may be beneficial by maintaining a landscape mosaic of different seral stages, but large, intense fires may also threaten the survival of isolated populations.

Abundance and Occupancy by Habitat

- 3.6 – 12 individuals / 40 ha [0.04 – 0.12 / ac] across range, but not directly measured in Nevada[4]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Degradation of montane riparian and shrubland habitats due to:[4]
  - Sustained livestock grazing
  - Large, intense fires
  - Invasive plants
  - Water diversions
  - Fuel reduction projects

Research, Planning, and Monitoring Challenges

- Although Mountain Quail are thought to be declining, rates of decline are not well-quantified
- Winter habitat requirements and the factors affecting winter survival have not been well-studied
- Some expert opinion suggests that Nevada population size is significantly larger than the estimate derived from NBC data

Mountain Quail

Oreortyx pictus

Conservation Strategies

Established Strategies

- As a managed game bird, detailed conservation and management priorities for the Mountain Quail have been developed by NDOW [5] and the *Western Quail Management Plan*,[10] with key elements including:
  - Improving monitoring and inventory protocols, and current distribution map
  - Introducing birds into suitable unoccupied habitat where appropriate
  - Reviewing hunting season dates to improve winter survival
  - Promoting management of montane riparian zones to ensure availability of early-successional, shrub-dominated habitat, and to maintain a patchy landscape mosaic of different successional stages and structural classes
  - Protecting water sources, and developing artificial water sources where appropriate

Habitat Strategies

- In addition to the strategies listed above, Montane Riparian (p. Hab-13-1), Aspen (p. Hab-3-1), Montane Shrubland (p. Hab-13-1), and Coniferous Forest (p. Hab-5-1) habitat conservation strategies benefit this species
- Manage livestock grazing to prevent chronic degradation of aspen and montane shrubland habitats

Research, Planning, and Monitoring Strategies

- Identify and map large montane areas exhibiting the desired habitat parameters and mosaic and prioritize these for conservation efforts
- Winter habitat requirements should receive additional study
- Additional research and monitoring to quantify apparent declines and better define their causes would be beneficial
- Implement monitoring protocols that have been recently tested[8]
- Develop fire management plans that maintain a diverse montane habitat mosaic

Public Outreach Strategies

- None identified

References: [1]Brennan et al. (1987); [2]Delehanty et al. (2004); [3]GBBO unpublished Atlas data; [4]Gutierrez and Delehanty (1999); [5]NDOW (2008); [6]Nevada Wildlife Action Plan Team (2006); [7]Reese et al. (2005); [8]Heekin and Reese (2007); [9]Rich et al. (2004); [10]Zornes and Bishop (2009); [EO]Expert opinion

Gambel's Quail

Callipepla gambelii



Photo by Amy Leist

Habitat Use Profile

Habitats Used in Nevada
Mesquite-Acacia Mojave Lowland Riparian Springs Agriculture

Key Habitat Parameters ●	
Plant Composition	Mesquite, acacia, salt cedar, willow, saltbush, prickly pear, cholla, desert thorn
Plant Density	Variable-density shrub and/or ground cover required (roost above ground)[1, 7]
Mosaic	Shrubby patches near riparian, dry washes, or agriculture[1, 7]
Distance to Water	< 1,000 m [0.6 mi][1, EO]
Other	Attracted to wildlife guzzlers
Response to Vegetation Removal	Negative, but exotic weed control encouraged [EO]

Area Requirements ◑	
Minimum Patch Size	~ 10 ha [25 ac] [EO]
Recommended Patch Size	> 80 ha [200 ac] [EO]
Home Range	8 - 38 ha [20 – 94 ac][1, 7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats Possible high stewardship responsibility	
Other Rankings	
Continental PIF	Stewardship Species
Audubon Watchlist	None
NV Natural Heritage	None
USFWS	None
BLM	None
USFS	None
NDOW	Upland Gamebird
NDOW Upland Game Plan	High Concern
Trends	
Historical ●	Rangewide declines and contractions[1]
Recent ◑	Stable, but high annual variability[1]
Population Size Estimates	
Nevada (NBC) ○	260,000
Global ◑	1,100,000 [6]
Percent of Global	Up to 24%, but probably lower
Population Objective	
Maintain [6, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Lowland Riparian and Spring habitats in Clark and Nye counties
Restoration	Same

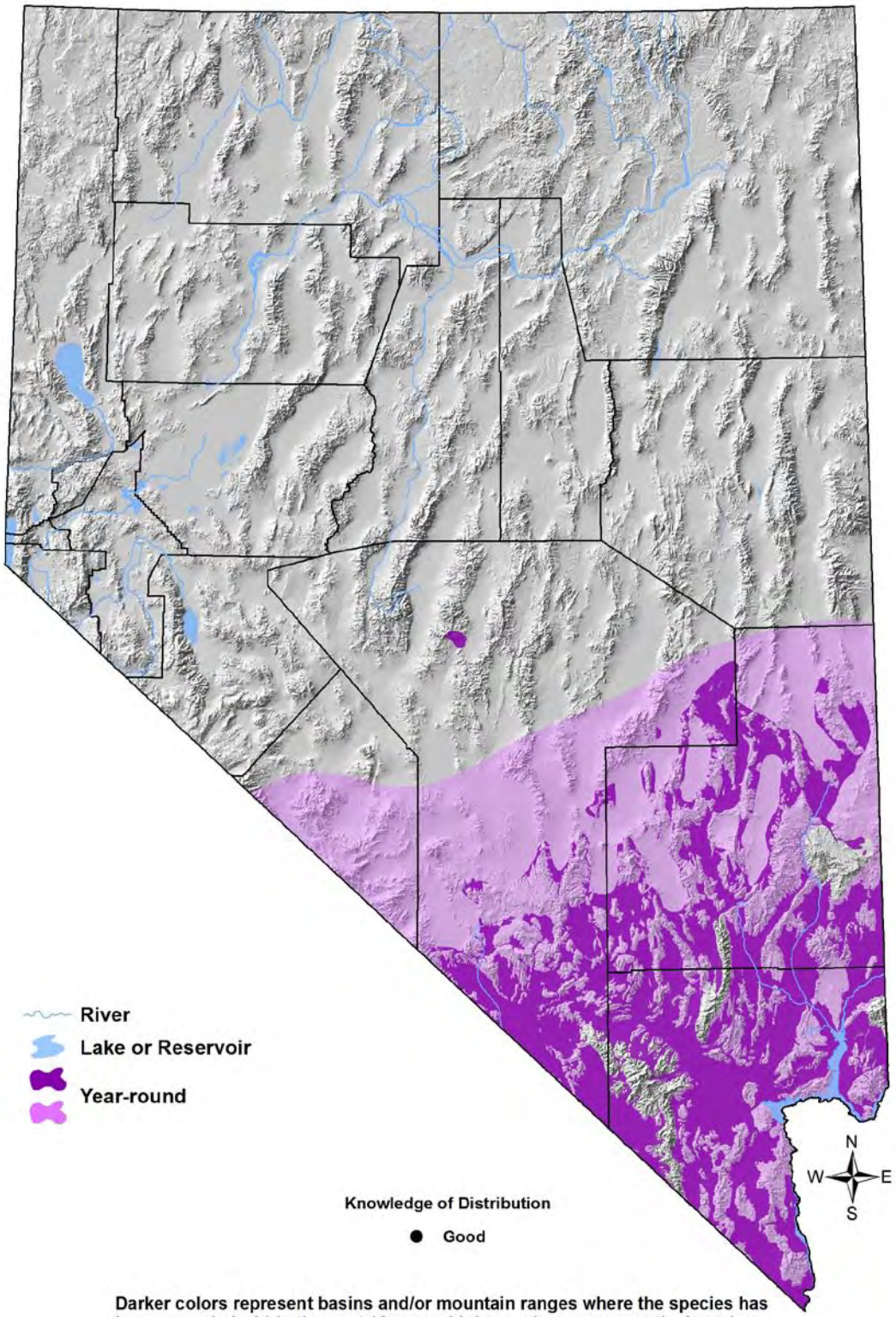
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
March – July[1, 2]	
Nest and Nesting Habits	
Nest Placement	On ground under dense cover[1]
Site Fidelity	Unknown; probably high [EO]
Food Habits	
Basic	Ground forager
Primary Diet	Mesquite seeds, annual plants, cactus fruits[1]
Secondary Diet	Terrestrial insects during breeding[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Gambel's Quail

Callipepla gambelii



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types. Map adapted from NDOW (2008).

Gambel's Quail

Callipepla gambelii

Overview

Gambel's Quail is widely distributed in the brushy lowlands of southern Nevada, but its overall geographical range is limited to a subset of the Sonoran and Mojave Desert regions. Gambel's Quail may be found in a variety of habitat types where cover is sufficiently dense, and where water or succulent vegetation is available. Most spring breeding occurs in honey mesquite woodland, moving to denser screwbean mesquite or riparian habitats in the fall.[7] Annual production and survival is dependent on winter precipitation and the resulting degree of "green-up" the following spring.[1] Annual plants are important in the early spring when mesquite pods are less available.[7] Mortality within populations during dry years may reach 90%, but clutch size and survival may be very high during wet years.[1] Access to surface water improves survival rates, and NDOW has therefore constructed more than 400 artificial water sources in quail habitat in southern Nevada.[3] In our recent analyses, these guzzlers were indeed associated with increased abundances of Gambel's Quail (see below). Even with water improvements, however, Gullion[3] estimated that less than 7% of Nevada's Mojave region would be suitable for this species.

Because of their pronounced annual population fluctuations, it is difficult to determine this managed game bird's true conservation status. Analysis of NDOW's harvest data to shed additional light on long-term trends is therefore an important priority. Currently, invasive plants (particularly red brome) are considered a threat, particularly because they degrade habitat and increase the risk of fire and the consequent loss of woody vegetation.[4] In the longer-term, Gambel's Quail's sensitivity to drought suggests that it could be vulnerable under some climate change scenarios.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Lowland Riparian	86% (31/36)	7.8 (5.3 – 10.3)
Mesquite-Acacia	76% (11/14)	8.8 (4.1 – 13.5)
Agriculture	80% (4/5)	8.9 (3.1 – 14.7)
Joshua Tree	35% (7/30)	4.6 (1.3 – 7.9)
Mojave Scrub	64% (14/22)	5.3 (3.0 – 7.6)

- Densities of 0.15 – 2.40 / ha [0.06 – 0.98 / ac] reported throughout range[1]
- The BBS-derived Nevada population estimate[6] of 14,000 is much smaller than the NBC-derived estimate of 260,000 birds. It is not clear at this time which estimate is more accurate. Based on the table above, NBC data may have overestimated the density of Gambel's Quail in Mojave Scrub habitat, which would have inflated the population size estimate

Gambel's Quail

Callipepla gambelii

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

Statistical analysis (*Appendix 3*) of data from 176 NBC transects within the Mojave region indicated a strong and significant association between Gambel's Quail abundance and Lowland Riparian, Mesquite-Acacia, Agriculture, and to a lesser extent Mojave Scrub habitats. There was also a strong and significant association between Gambel's Quail abundance and proximity to water sources (streams, springs, or guzzlers). This association became non-significant if guzzlers were removed from the analysis, so it appears very likely that guzzlers promote higher quail numbers, at least locally.

Gullion Study

In 1960 Gullion[3] published a peer-reviewed study of the basic ecology of Gambel's Quail in Nevada, which may provide useful baseline information

Main Threats and Challenges

Habitat Threats

- Fire has affected > 3,600 km^2 [900,000 ac] of quail habitat in southern Nevada in recent years; this commonly results in invasion of red brome, which may then promote more frequent fires that prevent or slow re-establishment of native vegetation[5]
- Loss or degradation of habitat due to:
    - Invasive plants (particularly red brome, see above)[4]
    - Wild horse and burro grazing
    - Urban and suburban development
    - Energy development
    - Other Mojave Lowland Riparian habitat threats (p. Hab-11-1)
- Loss or degradation of water sources

Research, Planning, and Monitoring Challenges

- Pronounced annual fluctuations in numbers and survival makes it difficult to detect underlying long-term population trends

Gambel's Quail

Callipepla gambelii

Conservation Strategies

Established Strategies

- NDOW, in conjunction with the Western Quail Management Plan,[8] has developed detailed conservation and management priorities for the Gambel's Quail,[5] with key elements including:
    - Protecting unburned habitat from fire and subsequent red brome invasion
    - Maintaining wild horses and burros in quail habitat at the lower range of defined Appropriate Management Levels
    - Support of post-fire habitat restoration and stabilization efforts
    - Maintaining existing artificial water sources, and establishing new artificial sources where appropriate
    - Protecting or restoring natural water sources
    - Improving weed control efforts
    - Re-establishing populations in previously-occupied areas where appropriate and feasible
    - Creating an improved and detailed map of current Gambel's Quail distribution

Habitat Strategies

- Mesquite-Acacia (p. Hab-10-1), Mojave Lowland Riparian (p. Hab-11-1), Springs (p. Hab-19-1), and Agriculture (p. Hab-1-1) habitat conservation strategies benefit this species
- New developments (residential, industrial, energy) should be sited where possible to avoid impacting high-quality Gambel's Quail habitat
- Feral and free-ranging cat control may be useful where occupied habitat adjoins residential areas

Research, Planning, and Monitoring Strategies

- Analyze NDOW harvest data to better determine long-term population trends
- Additional research should focus on determining seasonal water needs, grazing impacts, and microhabitat characteristics of nest sites[7]

Public Outreach Strategies

- Encourage pet owners near occupied habitat to keep cats indoors

Gambel's Quail

Callipepla gambelii

References: [1]Brown et al. (1998); [2]GBBO unpublished Atlas data; [3]Gullion (1960); [4]Kuvlesky et al. (1992); [5]NDOW (2008); [6]Rich et al. (2004); [7]Rosenberg et al. (1991); [8]Zornes and Bishop (2009); [EO] Expert opinion



Gambel's Quail habitat at Bird Canyon Springs. Photo by Dawn Fletcher

Common Loon

Gavia immer



Photo by Fred Petersen

Habitat Use Profile

Habitats Used in Nevada	
Open Water	
Key Habitat Parameters ◑	
Plant Density	No emergent vegetation
Water Depth	Depth at foraging locations usually 20-27 m [66 - 122 ft];[2] water body must be deep enough to support prey populations[1]
Water Quality	Sufficient to support healthy fish populations; heavy metals detrimental[1]
Area Requirements ○	
Minimum Patch Size	Unknown, but must be large enough to allow loons to become airborne
Recommended Patch Size	Not specifically quantified; at least several km[1,EO]
Home Range / Territory Size	N/A during migration [EO]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats Recent declines (migration)	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S2N
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	Moderate/High Concern
Trends	
Historical ○	Unknown
Recent ●	Declines in number of migrants[4]
Population Size Estimates	
Nevada ◑	~500 migrants, variable among years [EO]
Global ◑	600,000 [1, 3]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW Walker Lake surveys, Aquatic Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Walker, Pyramid, & Topaz Lakes and other Great Basin waterbodies large enough to allow takeoff
Restoration	Walker Lake

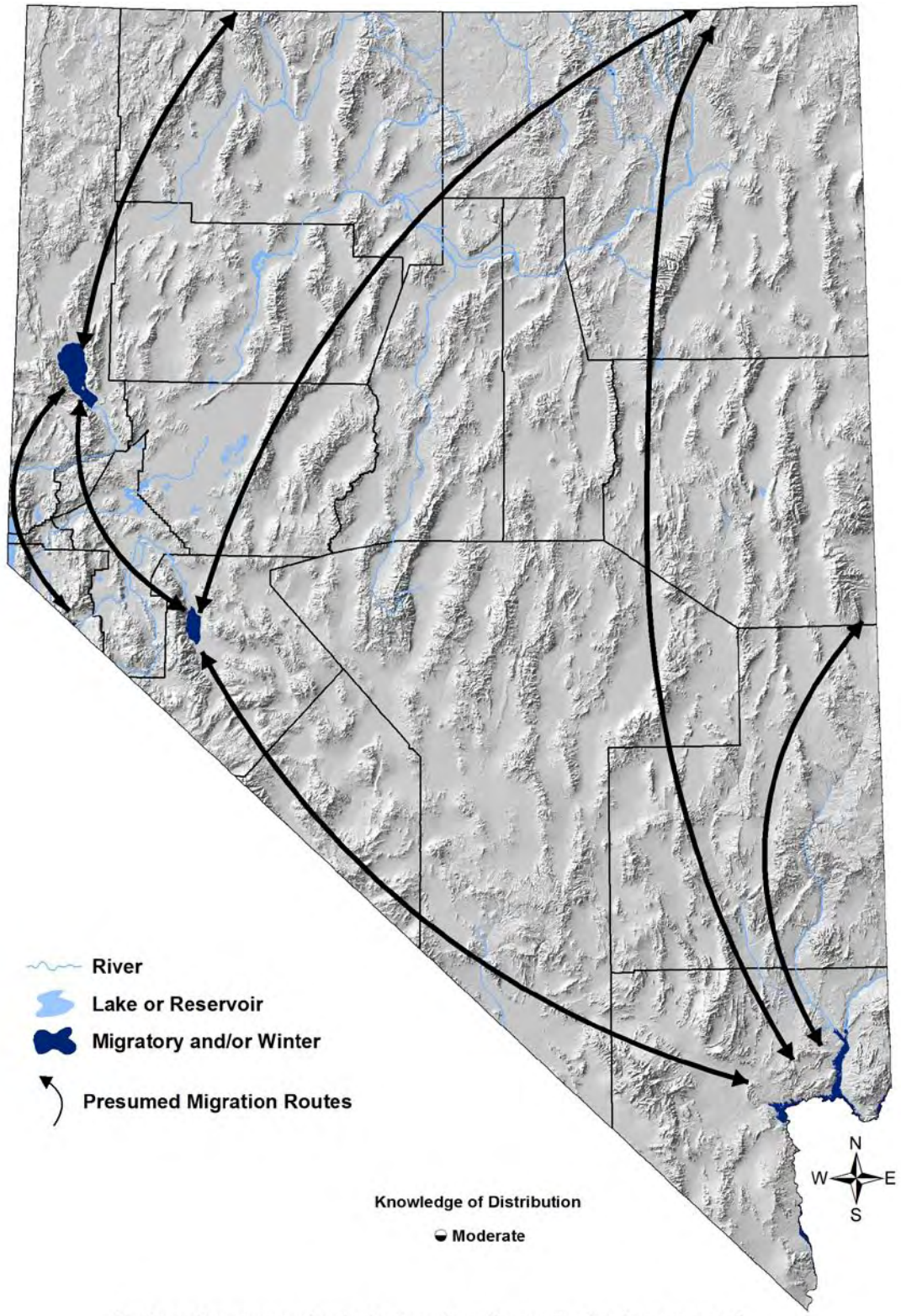
Natural History Profile

Seasonal Presence in Nevada	
Spring (migration peak in April) Fall (migration peak in October) Winter (Mojave)	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Food Habits	
Basic	Diver
Primary Diet	Small fish < 20 cm [8 in] long[1]
Secondary Diet	Aquatic invertebrates[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Common Loon

Gavia immer



Darker colors represent water bodies where the species has been recorded within the past 12 years. Smaller water bodies may be difficult to visualize on the map.

Common Loon

Gavia immer

Overview

In Nevada, the Common Loon has become emblematic of the serious problems facing Walker Lake, where diversion of inflows from the Walker River is threatening the lake's fishery and, in the longer-term, its very existence. Historically, Walker Lake is thought to have hosted more migrating loons than any other inland site. Even as recently as the 1990s, a typical year saw approximately 1,000 migrants at Walker Lake, with reported peaks of about 1,400 birds. More recently however, as the water level continued to decline and water salinity increased, average numbers of migrating loons have fallen below 300, and evidence suggests that similar declines have also occurred on Pyramid Lake.[5] Inflows at Pyramid Lake are now secure, and conservation actions there should focus on maintaining water quality and fishery health. A focus on fishery health is also appropriate for other smaller water bodies (such as Topaz Lake) known to host loons. Walker Lake, however, does not have adequate guaranteed inflows, and securing them is a complex undertaking that lies largely within the political sphere. Without securing adequate inflows, other conservation actions at Walker Lake are secondary.

Although conservation attention is focused primarily on migrating loons in Nevada, some reports suggest that loons may winter on Lake Mead in southern Nevada, at least in some years. This possibility deserves additional study.

Currently, loons at Walker Lake are monitored by means of an annual survey that occurs in mid-October each year. Because the timing of migration peaks can vary among years, and because the timing of migration may be systemically shifting in response to a warming climate, it would be beneficial to expand this monitoring effort across several survey dates each year so that it more effectively captures the migration peak. Additionally, it would be beneficial to broaden this monitoring effort to include other lakes known or suspected of hosting migrant loons.

Abundance and Occupancy by Habitat

In recent years, annual counts at Walker Lake have averaged ~ 285 birds, compared to ~ 1,000 birds in the 1990s. Surveys have not been systematically conducted at other potentially important lakes, but preliminary data[2] suggest that Topaz Lake is also commonly used by migrating loons

Nevada-Specific Studies and Analyses

The Walker Lake survey data set (NDOW) indicates a pronounced decline in number of migrating loons at Walker Lake. Yates[6] conducted some preliminary telemetry study of loons at Walker Lake, but the study is ongoing and results are pending.

Common Loon

Gavia immer

Main Threats and Challenges

Habitat Threats

- Inadequate inflows to Walker Lake, resulting in increased water salinity and decline in fish prey base
- Decline in fisheries in other lakes because of declines in water quality or other issues
- Mercury contamination in fish[4, 6]

Research, Planning, and Monitoring Challenges

- Currently, monitoring occurs only at Walker Lake, and only at one fixed time point each year (see Overview, above)

Conservation Strategies

Habitat Strategies

- The Open Water (p. Hab-15-1) habitat conservation strategy benefits this species
- Secure adequate guaranteed inflows for Walker Lake to stabilize its fishery
- Maintain good water quality and healthy fisheries in other lakes used by loons (Pyramid Lake, Topaz Lake, and Lake Mead)

Research, Planning, and Monitoring Strategies

- Expand current monitoring protocol at Walker Lake to cover a range of survey dates during fall migration, to cover spring migration, and to cover additional lakes known or suspected to be used by loons
- Further investigate the possibility that loons winter on Lake Mead, and if so, determine their conservation status and needs
- Study the possible impact of mercury contamination on loons

Public Outreach Strategies

- Continue efforts coordinated by the Walker Lake Working Group to build public support for saving Walker Lake (http://www.walkerlake.org/about/about_issues.html)

References: [1]Evers et al. (2010); [2]GBBO unpublished data; [3]Kushlan et al. (2002); [4]Nevada Wildlife Action Plan Team (2006); [5]Serdehely (2006); [6]Yates (1999b); [EO] Expert opinion

Eared Grebe

Podiceps nigricollis

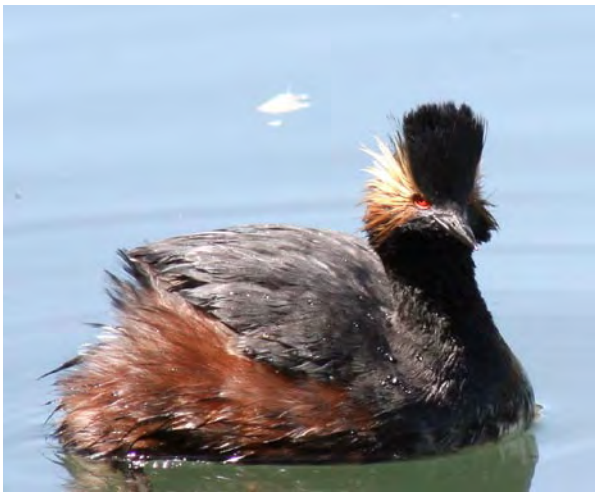


Photo by Jacque Lowery

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size (breeding) Possible habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ○	Unknown
Recent ◑	Stable or increasing[5]
Population Size Estimates	
Nevada ◑	400 (breeding); [5] more migrants [EO]
Global ◑	4,100,000 [6]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good / Fair
Key Conservation Areas	
Protection	Ruby Valley, Lahontan Valley, Walker and Pyramid Lakes
Restoration	Degraded and at-risk marshes

Habitat Use Profile

Habitats Used in Nevada	
Open Water Marsh	
Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges, rushes, submerged aquatic vegetation
Plant Density	Unknown
Mosaic	Unknown
Water Depth	Up to 4 m [13 ft] for foraging[3]
Water Quality	Tolerant of saline conditions[3]
Response to Vegetation Removal	Probably negative for breeding sites [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown; estimated at 20 ha [49 ac] [EO]
Recommended Patch Size	> 50 ha [124 ac] [EO]
Home Range / Territory Size	Unknown

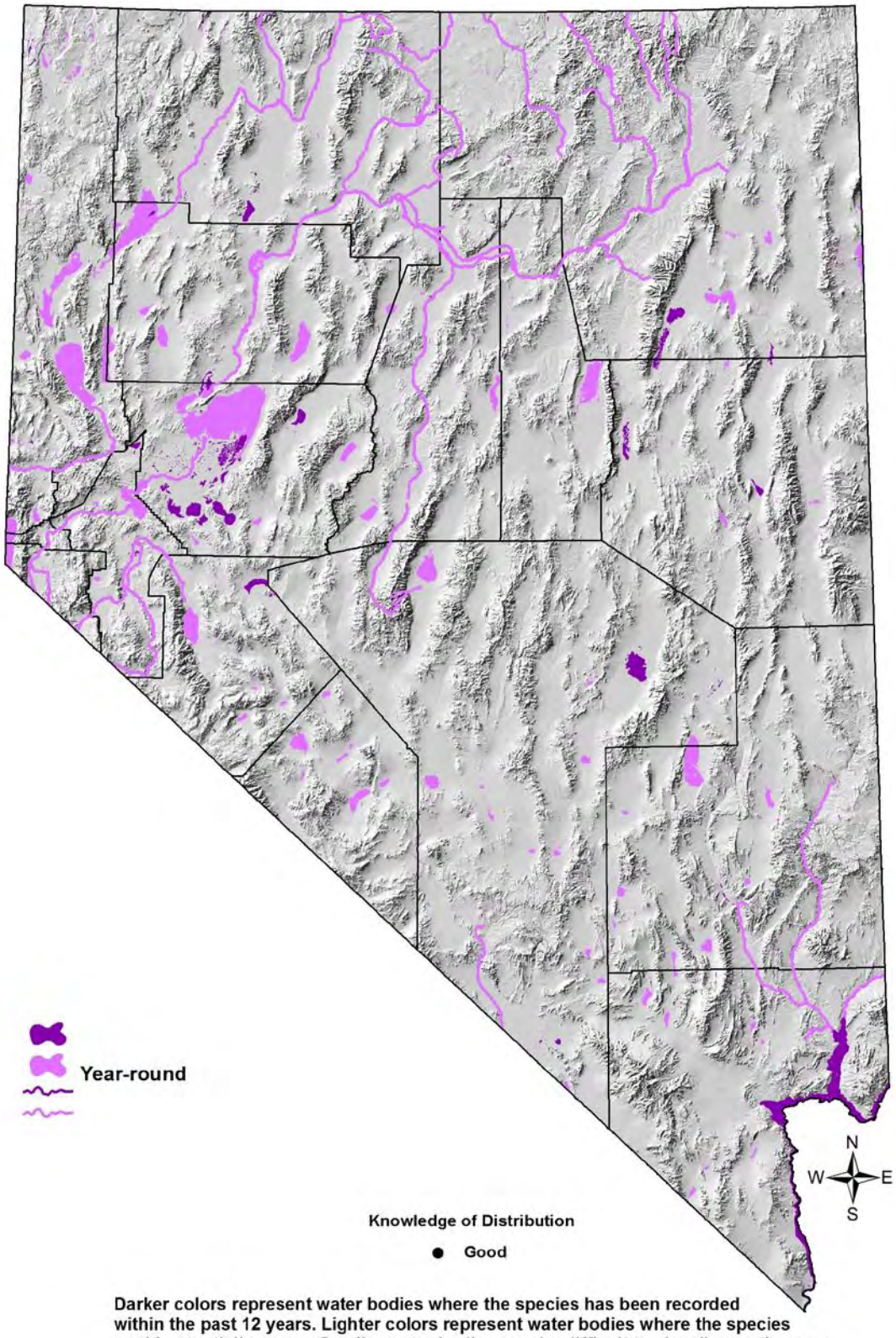
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
May – August[3]	
Nest and Nesting Habits	
Nest Placement	Floating, attached to emergent vegetation[3]
Site Fidelity	Moderate for breeding territory[3]
Other	Nests colonially, but Nevada colonies usually small [3, 4]
Food Habits	
Basic	Diver
Primary Diet	Aquatic invertebrates[3]
Secondary Diet	Small fishes and other vertebrates[3]

Confidence in Available Data: ●High ◑Moderate ○ Low

Eared Grebe

Podiceps nigricollis



Darker colors represent water bodies where the species has been recorded within the past 12 years. Lighter colors represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Eared Grebe

Podiceps nigricollis

Overview

The Eared Grebe is distinctive in at least two ways from Nevada's other Conservation Priority grebes (the Clark's and Western). First, Eared Grebes feed primarily on invertebrates, while Clark's and Western Grebes are primarily fish-eaters. Secondly, unlike the other grebes, Eared Grebes are strongly associated with saline / alkaline wetlands, though primarily so during the non-breeding season.[3] Immediately after breeding, most Eared Grebes from Nevada and surrounding areas wander to either Mono Lake or Great Salt Lake, where they congregate in very large numbers to feed on brine shrimp prior to fall migration.[3] Compared to the Western and Clark's grebes, the Eared Grebe appears to engage in little, if any, significant staging activity within Nevada itself, but they are abundant here throughout the subsequent migration season, and are also present throughout the winter in more modest numbers. Thus while the Eared Grebe has a year-round presence in Nevada, its seasonal cohorts are largely comprised of different birds. The number of migrating Eared Grebes found in Nevada is far larger than the breeding population,[EO] and more attention needs to be devoted to studying the distribution, abundance, habitat use, and conservation needs of these migrants. As a case in point, Lake Mead reportedly hosted 50,000 – 100,000 non-breeders annually as recently as 1972, but shortly thereafter these numbers fell precipitously.[3] Apparently, no definitive explanation for this large decline was ever found.

Abundance and Occupancy by Habitat

- High counts for breeding population are as follows:
  - 600 breeders recorded at Ruby Lake in 1983 [1]
  - Several hundred nests recorded annually at both Carson Lake and Stillwater NWR during wet years in the mid-1990's [2]
- Nevada's migrant population is "much larger" [EO] than the breeding population, but has not been quantified

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss or degradation of marshes (particularly alkaline marshes) due to water diversions, declines in water quality, or development

Eared Grebe

Podiceps nigricollis

Research, Planning, and Monitoring Challenges

- The distribution, abundance, habitat use, and conservation needs of migrating and wintering Eared Grebes have not been well studied

Conservation Strategies

Habitat Strategies

- Open Water (p. Hab-15-1), and Marsh (p. Hab-9-1) habitat conservation strategies benefit this species
- Maintaining healthy populations of aquatic invertebrates is probably important year-round, but especially so in alkaline marshes during the fall migration period

Research, Planning, and Monitoring Strategies

- Conduct additional surveys and monitoring to better document the Eared Grebe's distribution, abundance, habitat use, and conservation needs during the post-breeding, migration, and winter seasons
- Monitor water quality in occupied sites

Public Outreach Strategies

- None identified

References: [1]Alcorn (1988); [2]Chisholm and Neel (2002); [3]Cullen et al. (1999); [4]Floyd et al. (2007); [5]Ivey and Herziger (2006); [6]Kushlan et al. (2002); [EO] Expert opinion

Western Grebe

Aechmophorus occidentalis



Photo by Fred Petersen

Habitat Use Profile

Habitats Used in Nevada	
Open Water (Marsh)	
Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges, pondweeds and submerged aquatic plants
Plant Density	Patches of dense emergent vegetation or pond weed mats for nesting[5]
Mosaic	Mostly open water, with emergent or floating vegetation along shoreline for nesting (no emergent vegetation needed for migration)[5]
Water Depth	Moderate to deep, sufficient to support small fish[5]
Water Quality	Sufficient to support fish[5]
Response to Vegetation Removal	Negative in breeding sites; otherwise neutral [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 200 ha [500 ac] of open water [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
High stewardship responsibility (migration) Small population size (breeding) Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ○	Unknown
Recent ○	Unknown
Population Size Estimates	
Nevada ◑	~ 250 (breeding)[1, 2, 4]
Global ○	110,000 [3]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Nevada Colonial Waterbird Inventory, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Lahontan and Ruby Valleys; Pyramid and Walker Lakes (migration); Lake Mead (year-round)
Restoration	Degraded or at-risk marshes

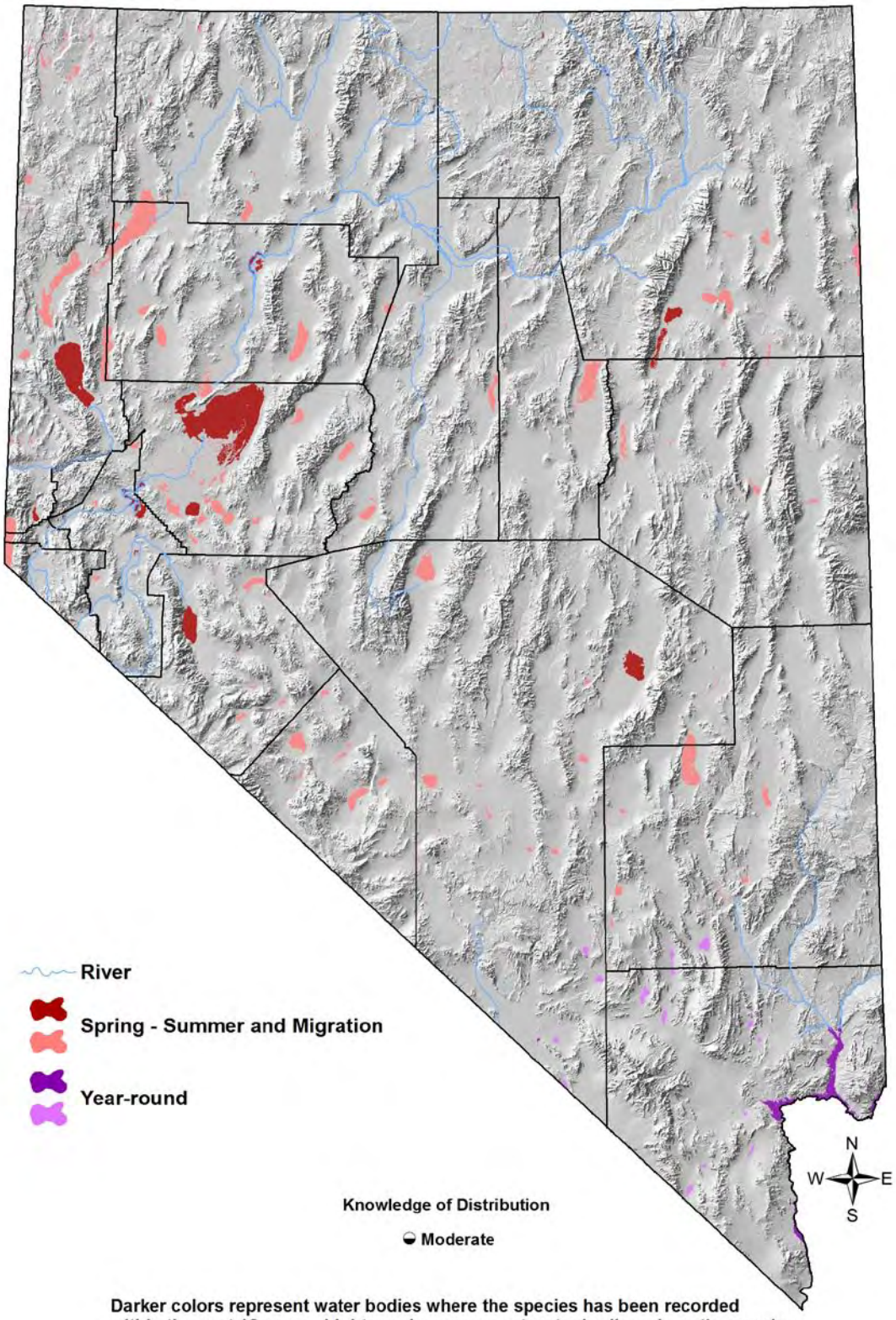
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer, Fall (Great Basin) Year-round (Mojave)	
Known Breeding Dates in Nevada	
April – August [5, EO]	
Nest and Nesting Habits	
Nest Placement	On mound of matted emergent vegetation or floating vegetation[5]
Site Fidelity	Moderate for colony sites[5]
Other	Usually nests in small colonies of < 10 pairs[5, EO]
Food Habits	
Basic	Diver
Primary Diet	Small fish[5]
Secondary Diet	Aquatic invertebrates[5]

Confidence in Available Data: ●High ◑Moderate ○ Low

Western Grebe

Aechmophorus occidentalis



Western Grebe

Aechmophorus occidentalis

Overview

Western Grebes often co-occur with Clark's Grebes in Nevada. The two species are very similar in many respects, and little information exists to distinguish between their respective conservation statuses and needs. Therefore, at this time these two species are probably best managed as a single taxon until differences in their distributions, abundances, habitat use patterns, and conservation needs are better understood. Although Nevada's population of breeding Western Grebes is fairly small and scattered, it appears to be stable. The ongoing Nevada Colonial Waterbird Inventory project being conducted by GBBO and NDOW as part of a regional USFWS colonial waterbird inventory initiative should significantly improve our knowledge of breeding colony locations and lead to a better estimate of the statewide breeding population.

Post-breeding and migratory birds are drawn to Nevada's larger fish-rich waterbodies, such as Pyramid and Walker Lakes, from a wider region, and are much numerous than breeding birds, although data are not sufficient to make precise estimates. Lake Mead is a particularly important resource for Western Grebes in Nevada, as it supports large numbers of Western Grebes year-round.

Abundance and Occupancy by Habitat

- Data from the Nevada Aquatic Bird Count show that during September, Pyramid Lake typically hosts at least several thousand staging and migrating Western and Clark's Grebes
- Data from the Nevada Aquatic Bird Count show that Lake Mead hosts at least 200 Western and Clark's Grebes during every month of the year. This number increase several-fold in spring and fall, and shows a pronounced peak (> 1,000 birds) in April

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

<u>Habitat and Other Threats</u>

- Loss or degradation of marshes or open waterbodies due to water diversions, declines in water quality, or development
- Increasing salinity in Walker Lake, and associated decline of fishery[4]
- Disturbance from close approach of motorized watercraft[4]

Western Grebe

Aechmophorus occidentalis

Research, Planning, and Monitoring Challenges

- Lack of sufficient information about the distribution, abundance, habitat use, and conservation issues for staging, migrating, and wintering populations

Conservation Strategies

Habitat Strategies

- The Open Water (p. Hab-15-1) habitat conservation strategy benefits this species

Research, Planning, and Monitoring Strategies

- Increase inventory and monitoring coverage through the Nevada Colonial Waterbird Inventory or other avenues to collect additional information on the distribution, abundance, habitat use, and conservation status of breeding, post-breeding, staging, migrating, and wintering populations
- Conduct studies to identify any conservation-relevant differences between Clark's and Western Grebes
- Monitor water quality in occupied sites

Public Outreach Strategies

- Educate recreationalists using motorized watercraft to minimize disturbance of nesting areas and staging hotspots
- Support efforts to protect and restore water inflows into Walker Lake

References: [1]Floyd et al. (2007); [2]Ivey and Herziger (2006); [3]Kushlan et al. (2002); [4]Nevada Wildlife Action Plan Team (2006); [5]Storer and Nuechterlein (1992); [EO] Expert opinion

Clark's Grebe

Aechmophorus clarkii



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Open Water (Marsh)	
Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges, pondweed and submerged aquatic plants, willow along shoreline
Plant Density	Patches of dense emergent vegetation or pond weed mats for nesting[5]
Mosaic	Mostly open water, with emergent or floating vegetation along shoreline for nesting (no emergent vegetation needed for migration), variable water depths[5]
Water Depth	Unknown, but dives deeper than Western Grebe[5]
Water Quality	Sufficient to support fish[5]
Response to Vegetation Removal	Negative in breeding sites, otherwise neutral [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 300 ha [740 ac] of open water[5]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
High stewardship responsibility (migration) Small population size (breeding) Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ○	Unknown
Recent ○	Probably stable[2]
Population Size Estimates	
Nevada ◑	~ 300 (breeding)[1, 2, 4]
Global ○	10,000 - 20,000 [3]
Percent of Global	~ 2%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Nevada Colonial Waterbird Inventory, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Lahontan and Ruby Valleys; Pyramid and Walker Lakes (migration); Lake Mead (year-round)
Restoration	Degraded or at-risk marshes

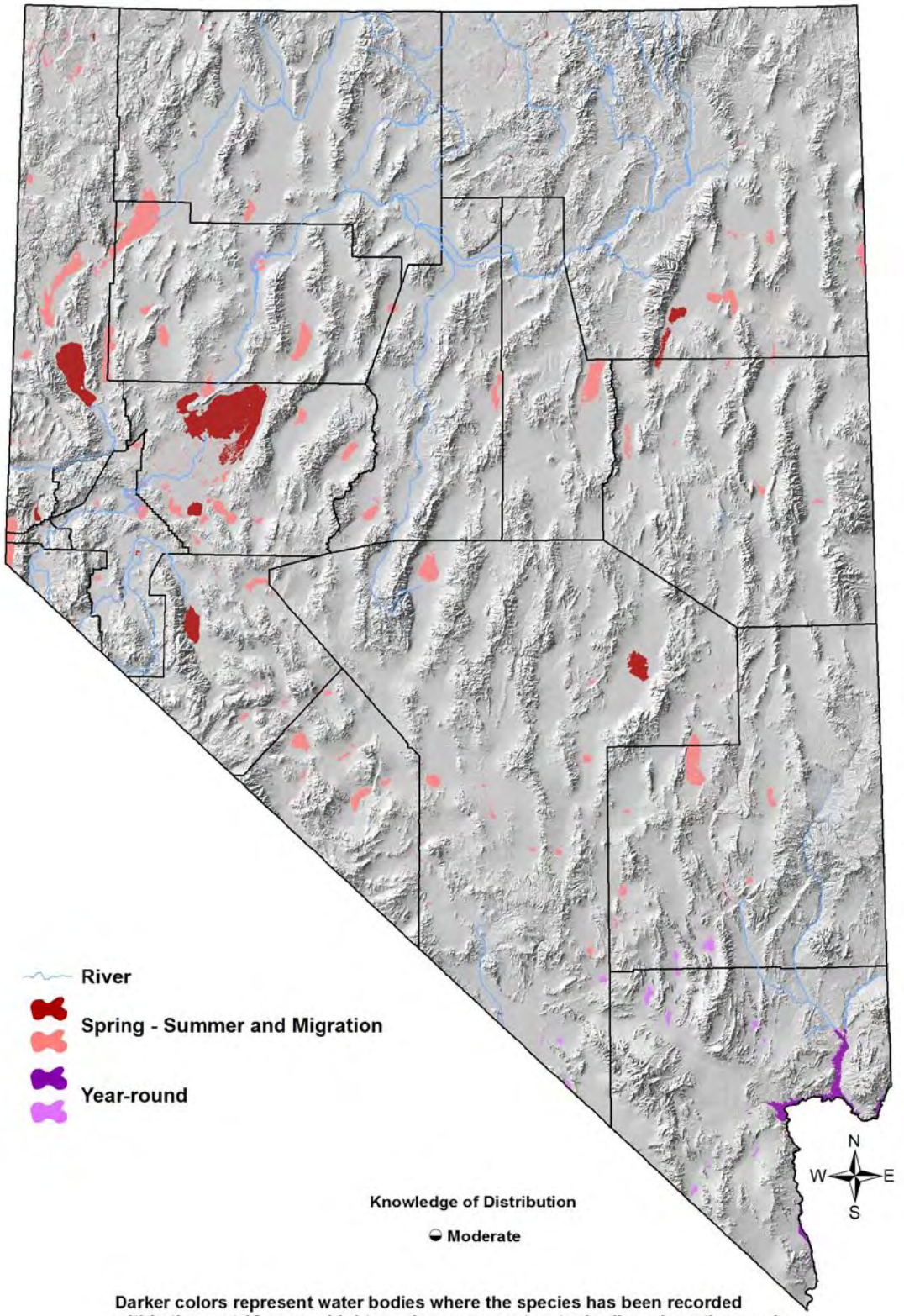
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer, Fall (Great Basin) Year-round (Mojave)	
Known Breeding Dates in Nevada	
April – August [5, EO]	
Nest and Nesting Habits	
Nest Placement	On mount of matted emergent vegetation or floating vegetation[5]
Site Fidelity	Moderate for colony sites[5]
Other	Usually nests in small colonies[45]
Food Habits	
Basic	Diver
Primary Diet	Small fish[5]
Secondary Diet	Aquatic invertebrates[5]

Confidence in Available Data: ●High ◑Moderate ○ Low

Clark's Grebe

Aechmophorus clarkii



Darker colors represent water bodies where the species has been recorded within the past 12 years. Lighter colors represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Clark's Grebe

Aechmophorus clarkii

Overview

Clark's Grebes often co-occur with Western Grebes in Nevada. The two species are very similar in many respects, and little information exists to distinguish between their respective conservation statuses and needs. Therefore, at this time these two species are probably best managed as one taxon until differences in their distributions, abundances, habitat use patterns, and conservation needs are better understood. Although Nevada's population of breeding Clark's Grebes is fairly small and scattered, it appears to be stable. The ongoing Nevada Colonial Waterbird Inventory project being conducted by GBBO and NDOW as part of a regional USFWS colonial waterbird inventory initiative should significantly improve our knowledge of breeding colony locations and lead to a better estimate of the statewide breeding population.

Post-breeding and migratory birds are drawn to Nevada's larger fish-rich water bodies, such as Pyramid and Walker Lakes, from a wider region, and are much numerous than breeding birds, although data are not sufficient to make precise estimates. Lake Mead is a particularly important resource for Western Grebes and large numbers of Clark's Grebes year-round.

Abundance and Occupancy by Habitat

- Data from the Nevada Aquatic Bird Count show that during September, Pyramid Lake typically hosts at least several thousand staging and migrating Clark's and Western Grebes
- Data from the Nevada Aquatic Bird Count show that Lake Mead hosts at least 200 Clark's and Western Grebes during every month of the year. This number increase several-fold in spring and fall, and shows a pronounced peak (> 1,000 birds) in April

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

<u>Habitat and Other Threats</u>

- Loss or degradation of marshes or open waterbodies due to water diversions, declines in water quality, or development
- Increasing salinity in Walker Lake, and associated decline of fishery[4]
- Disturbance from close approach of motorized watercraft[4]

Clark's Grebe

Aechmophorus clarkii

Research, Planning, and Monitoring Challenges

- Lack of sufficient information about the distribution, abundance, habitat use, and conservation issues for staging, migrating, and wintering populations

Conservation Strategies

Habitat Strategies

- The Open Water (p. Hab-15-1) habitat conservation strategy benefits this species
- Lakes and reservoirs with healthy fisheries are particularly important to this species

Research, Planning, and Monitoring Strategies

- Increase inventory and monitoring coverage through the Nevada Colonial Waterbird Inventory or other avenues to collect additional information on the distribution, abundance, habitat use, and conservation status of breeding, post-breeding, staging, migrating, and wintering populations
- Conduct studies to identify any conservation-relevant differences between Clark's and Western Grebes
- Monitor water quality in occupied sites

Public Outreach Strategies

- Educate recreationalists using motorized watercraft to minimize disturbance of nesting areas and staging hotspots
- Support efforts to protect and restore water inflows into Walker Lake

References: [1]Floyd et al. (2007); [2]Ivey and Herziger (2006); [3]Kushlan et al. (2002); [4]Nevada Wildlife Action Plan Team (2006); [5]Storer and Nuechterlein (1992); [EO] Expert opinion

American White Pelican

Pelicanus erythrorhynchos



Photo by Bob Goodman

Habitat Use Profile

Habitats Used in Nevada	
Open Water (Great Basin Lowland Riparian)	
Key Habitat Parameters ●	
Plant Density	No emergent vegetation cover
Colony Site	Large, dry, sparsely-vegetated island in large lake
Mosaic	For foraging, open waterbodies of various sizes, with a diverse depth profile
Water Depth	Deep sections for fisheries, shallow areas < 2 m deep [6.6 ft] for foraging[3]
Water Quality	Sufficient to support healthy fish populations
Area Requirements ●	
Minimum Patch Size	Probably 20 - 40 ha [50 -100 ac] for colony island; smaller for foraging water bodies [EO]
Recommended Patch Size	Unknown
Home Range	1,000s of km^2 (see Overview, below)

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Restricted habitat (breeding colony) Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ●	Decreases until 1960s; then increases[3]
Recent ◑	Probably stable[4]
Population Size Estimates	
Nevada ◑	Average 8,600, highly variable among years[10]
Global ◑	134,000 [4]
Percent of Global	~ 6 %
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Anaho Island NWR annual colony counts and other NWR migration counts[10]
Coverage in NV	Good
Key Conservation Areas	
Protection	Pyramid Lake, Truckee River, Walker Lake, Topaz Lake
Restoration	All Great Basin rivers and open waterbodies with fisheries

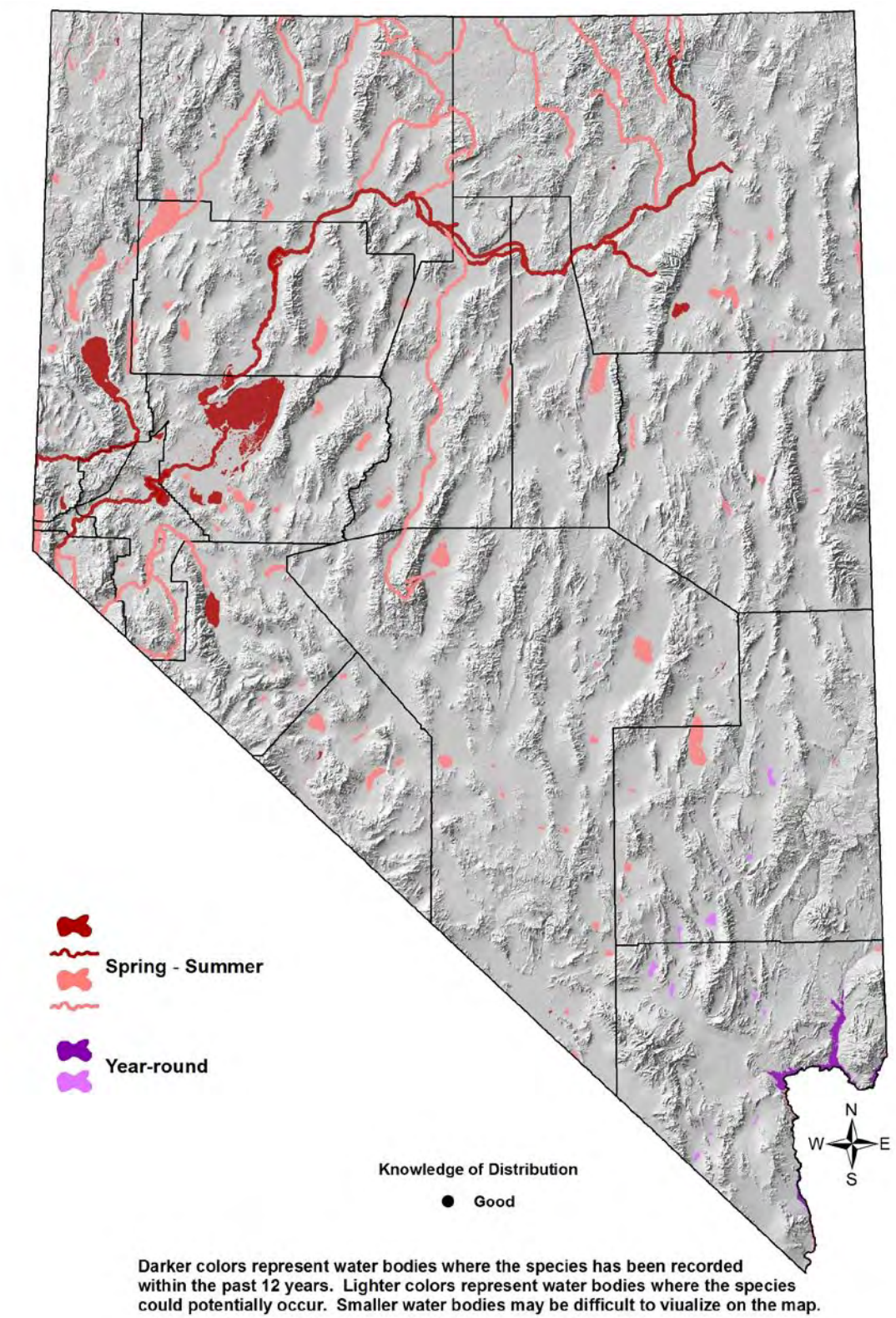
Natural History Profile

Seasonal Presence in Nevada	
Spring-Summer, Fall Year-round (Mojave)	
Known Breeding Dates in Nevada	
Mid March – early September[1]	
Nest and Nesting Habits	
Nest Placement	On ground on large colony island located on large water body[3, 10]
Site Fidelity	High for Anaho Island colony, variable elsewhere[3]
Other	May form new colonies in high water years[3, 10]
Food Habits	
Basic	Fishes by dabbling
Primary Diet	Fish up to 70 cm [27 in] long[3, 9]
Secondary Diet	None

Confidence in Available Data: ●High ◑Moderate ○ Low

American White Pelican

Pelicanus erythrorhynchos



American White Pelican

Pelicanus erythrorhynchos

Overview

The American White Pelican is unique among the Conservation Priority species covered in this plan in that its Nevada breeding population is almost entirely represented by a single large colony located on Pyramid Lake's Anaho Island. This is one of the ten largest colonies in North America.[2] Birds from this colony forage not only in Pyramid Lake, but they frequently commute long distances (regularly exceeding 100 km [62 mi] one-way), to other relatively shallow waterbodies,[12] as reflected in the range map shown above. In these widespread sites, they hunt for fish such as cui-ui (*Chasmistes cujus*), tui chub (*Gila bicolor*), and similar-sized species that are about 21-69 cm in length [8 – 27 in].[9,11] In wet years, pelican numbers may be double of those of dry years,[11] and reproductive success on Anaho Island is positively correlated with Truckee River spring and summer flows.[6] Also during wet years, smaller colonies may form and breed on ephemeral islands in the Carson Sink, at Franklin Lake in Ruby Valley, or elsewhere in the Great Basin,[7] but this is a very intermittent phenomenon. After breeding, birds from Anaho Island wander throughout the state until they eventually migrate along the west coast to their wintering grounds in southern California, Arizona, the Sea of Cortez, and Central America.[12] In the fall, migrating pelicans from the north pass through Nevada and often make foraging stopovers. Some birds also winter along the lower Colorado River system.

The Pyramid Lake colony is monitored annually by Anaho Island NWR, and Anaho Island is well-protected from disturbances. Therefore, the primary threats to American White Pelicans within Nevada probably take the form of threats to their prey populations.

Abundance and Occupancy by Habitat

The Anaho Island colony has persisted annually from the time of the original record of the site. The number of breeders present at Anaho Island over the past 50 years has varied from 2,670 to 21,500 birds, with an annual average of 8,600 and a typical ten-year peak of 13,500.[10] All bodies of open water that contain fish in the preferred size range are potential foraging habitat for pelicans during the breeding, post-breeding, or fall migration season. However, densities of birds at foraging sites have not been systematically determined.

Nevada-Specific Studies and Analyses

The Anaho Island colony has been surveyed annually for about 50 years by Anaho Island NWR,[10] resulting in detailed productivity, survival, and demographic information.

American White Pelican

Pelicanus erythrorhynchos

Main Threats and Challenges

Habitat and Other Threats

- Decline in water quality or water inflow volume, resulting in decline of prey populations within key waterbodies such as Pyramid Lake, Walker Lake, Lahontan Valley wetlands, and Humboldt Sink
- Foraging adults are sensitive to human disturbance
- Pelicans are susceptible to Type C Botulism and West Nile Virua[8,12]

Research, Planning, and Monitoring Challenges

- Systematic monitoring of important foraging and stopover sites and compilation of all existing data would be valuable

Conservation Strategies

Habitat Strategies

- The Open Water (p. Hab-15-1) habitat conservation strategy benefits this species
- Protect or restore water quality and inflow volume for key foraging areas (Pyramid Lake, Walker Lake, Humboldt River, and other large waterbodies and rivers in the Great Basin) in order to maintain healthy populations of prey fish

Research, Planning, and Monitoring Strategies

- Monitor water quality where declines in water quality may be occurring
- Collect and compile monitoring data from important foraging areas and intermittent colony areas outside of Pyramid Lake
- Conduct additional study on the possible population-level impacts of West Nile Virus and Type C Botulism

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]King and Anderson (2005); [3]Knopf and Evans (2004); [4]Kushlan et al. (2002); [5]Murphy (2005); [6]Murphy and Tracy (2005); [7]Nevada Wildlife Action Plan Team (2006); [8]Rocke et al. (2005); [9]Scoppettone et al. (2006); [10]Anaho Island NWR data; [11]Wiemeyer and Saake (2007); [12]Yates (1999a); [EO]Expert opinion

Least Bittern

Ixobrychus exilis



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada
Marsh (Mojave Lowland Riparian)

Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges
Plant Density	Dense emergent vegetation[7]
Mosaic	Shallow marsh with moderate to high stem density of emergent vegetation, interspersed with open water and woody vegetation; approximately equal proportion of open water and emergent vegetation[7]
Water Depth	At nest, 8 – 96 cm [3 – 37 in]; for foraging, < 60 cm [23 in][7]
Hydrology	Minimal daily fluctuation in stage probably preferred [EO]
Response to Vegetation Removal	Negative [EO]

Area Requirements ○	
Minimum Patch Size	2 – 6 ha [5 – 15 ha][10]
Recommended Patch Size	> 10 ha [25 ac][9]
Home Range / Territory Size	Unknown; home range at least 2 ha [5 ac] in other regions[1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats Restricted habitat Possible declines Small population size	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S2b
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	Moderate Concern
Other	Covered by Lower Colorado River MSCP[6]
Trends	
Historical ○	Unknown, but declines probable[7]
Recent ○	Unknown, possible declines[7]
Population Size Estimates	
Nevada ○	Unknown
Global ○	Unknown
Percent of Global	Unknown
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Secretive-marshbird surveys by BOR, SNWA, and others
Coverage in NV	Unknown
Key Conservation Areas	
Protection	Muddy and Virgin Rivers, Ash Meadows NWR, Henderson Bird Viewing Preserve, Las Vegas Wash, Pahranagat NWR, Lahontan Valley
Restoration	Degraded Mojave region marshes

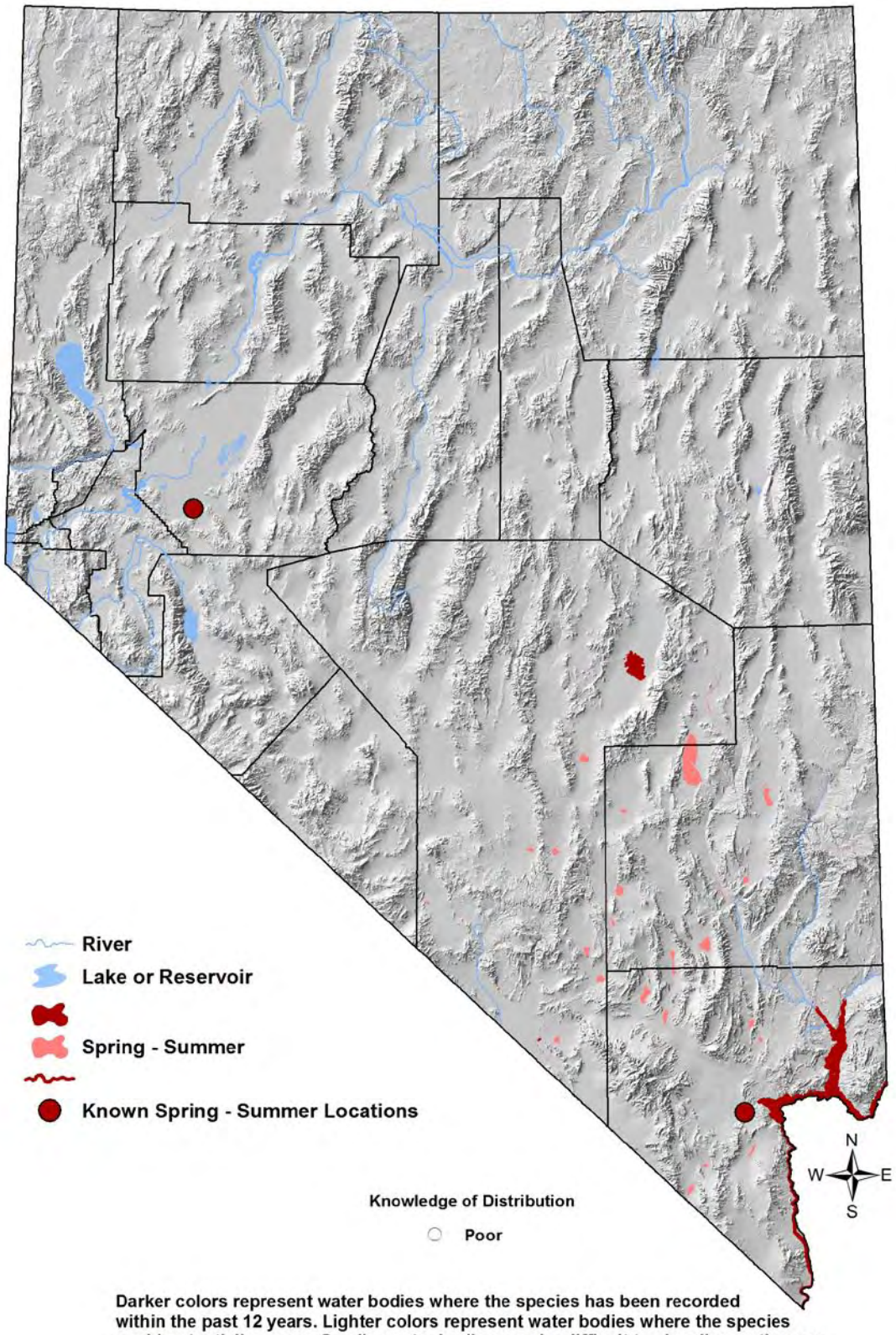
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer Possibly Year-round and Migration	
Known Breeding Dates in Nevada	
May – August, possibly earlier[7]	
Nest and Nesting Habits	
Nest Placement	Platform in emergent or adjacent woody cover 15 – 76 cm [6 – 30 in] above water; less than 10 m [33 ft] from open water[7]
Site Fidelity	Unknown
Food Habits	
Basic	Ambush predator and prober
Primary Diet	Small fish, aquatic invertebrates[7]
Secondary Diet	Crustaceans, small mammals, plant material, eggs[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Least Bittern

Ixobrychus exilis



Least Bittern

Ixobrychus exilis

Overview

Secretive marshbirds like the Least Bittern are generally not detected by multi-species survey and inventory protocols. For this reason, we are only now beginning to understand the distribution of Least Bitterns in Nevada. The Nevada Breeding Bird Atlas project[4] confirmed earlier evidence of breeding in Lahontan Valley (at Carson Lake, with the earlier reports also including Stillwater NWR), and found evidence of likely breeding at Overton WMA and Pahranagat NWR. Other areas with confirmed breeding include wetlands along the Virgin and Muddy Rivers, the Henderson Bird Viewing Preserve, and the Las Vegas Wash restoration area, where Least Bitterns have been regular breeders since at least 2006 [2, 8, 10] (D. VanDooremolen, *pers. comm.*). Although Least Bitterns are likely breeders at Pahranagat NWR (based on atlas observations and old records), no recent breeding confirmation has been obtained (C. Tomlinson, *pers. comm.*). Ruby Valley also has old breeding records, but no recent confirmations. These findings suggest a very spotty breeding distribution, but as with other secretive marshbirds, it is likely that there are breeding locations in the state that are yet to be identified. The Least Bittern is also known or suspected to use Nevada during migration and winter,[5] but there are no data available that pinpoint key locations during the non-breeding seasons.

It has been suggested that Least Bitterns have fairly narrow habitat requirements, and further study is needed to quantify key habitat parameters, so that resource managers can adjust conservation strategies to be maximally effective. Now that a survey protocol has been developed specifically for secretive marshbirds,[3] it is also a high priority to implement this protocol in areas where Least Bitterns could potentially occur. SNWA and BOR are already beginning to perform these surveys, and it would be beneficial if they were implemented in wider areas of the state and into the migration and winter seasons in southern Nevada.

Abundance and Occupancy by Habitat

- ~ 1 bird / ha [0.4 / ac] in suitable marshes along the Lower Colorado River[7]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss or degradation of marshes due to water diversions, declines in water quality, or development

Least Bittern
Ixobrychus exilis

- Water fluctuations during breeding season[7]
- Possible effects of selenium accumulation [EO]

Research, Planning, and Monitoring Challenges

- Least Bitterns require specific survey methods[3] because of their secretive habits
- Distribution and seasonal use patterns in Nevada are incompletely known
- Specific habitat parameters remain to be quantified

Conservation Strategies

Habitat Strategies

- The Marsh (p. Hab-9-1) habitat conservation strategy benefits this species
- Protect water inflows and water quality for known or likely breeding, migration, and wintering marshes
- Maintain consistent water stage in known breeding sites during nesting season (estimated to be 1 May – 15 July)
- Discourage development and disturbances in or near known breeding locations
- Conduct marsh restoration projects where feasible within the Least Bittern's known or likely range

Research, Planning, and Monitoring Strategies

- Inventory known and likely breeding, migration, and wintering sites using the secretive marshbird survey protocol developed by Conway[3]
- Conduct studies to better determine specific preferred habitat parameters
- Investigate possible impacts of accumulated selenium
- Monitor water quality in occupied sites

Public Outreach Strategies

- None identified

References: [1]Bogner and Baldassare (2002); [2]Braden et al. (2009); [3]Conway (2009); [4]Floyd et al. (2007); [5]Ivey and Herziger (2006); [6]LCRMSCP (2004); [7]Poole et al. (2009); [8]Rathbun and Braden (2003); [9]Shuford and Gardali (2008); [10]Southern Nevada Water Authority, unpublished Las Vegas Wash survey data (2010); [EO] Expert opinion

Snowy Egret

Egretta thula



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada
Marsh Great Basin and Mojave Lowland Riparian (Agriculture) (Open Water)

Key Habitat Parameters ●	
Plant Composition	Cottonwoods, willows, Russian olive, cattail, bulrush, sedges
Plant Density & Size	Nesting: Large cottonwoods, large willow patches, or very dense emergent vegetation; Foraging: marsh vegetation of intermediate density[7]
Mosaic	Large groves of riparian trees or willows located near a large marsh and waterway[7, EO]
Water Depth	< 20 cm [8 in] for foraging[7]
Hydrology	No known relationship; more vulnerable to mercury in drought years[2, 3]
Response to Vegetation Removal	Negative [EO]

Area Requirements ◑	
Minimum Patch Size	Unclear; uses marshes of different sizes for foraging, but probably requires large habitat patches for nesting [EO]
Recommended Patch Size	> 150 ha [370 ac] of riparian – marsh complex [EO]
Home Range	~ 500 ha [1,240 ac] [EO]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and possible recent declines Habitat threats Small population size	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ●	Rangewide declines, followed by increases[7]
Recent ○	Declining regionally,[4] but increasing rangewide[5]
Population Size Estimates	
Nevada ◑	~ 600, with high annual variability[6]
Global ◑	143,000 [5]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Nevada Colonial Waterbird Inventory, NDOW aerial surveys, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	All major rivers, Lahontan Valley
Restoration	Degraded riparian – marsh complexes along major rivers

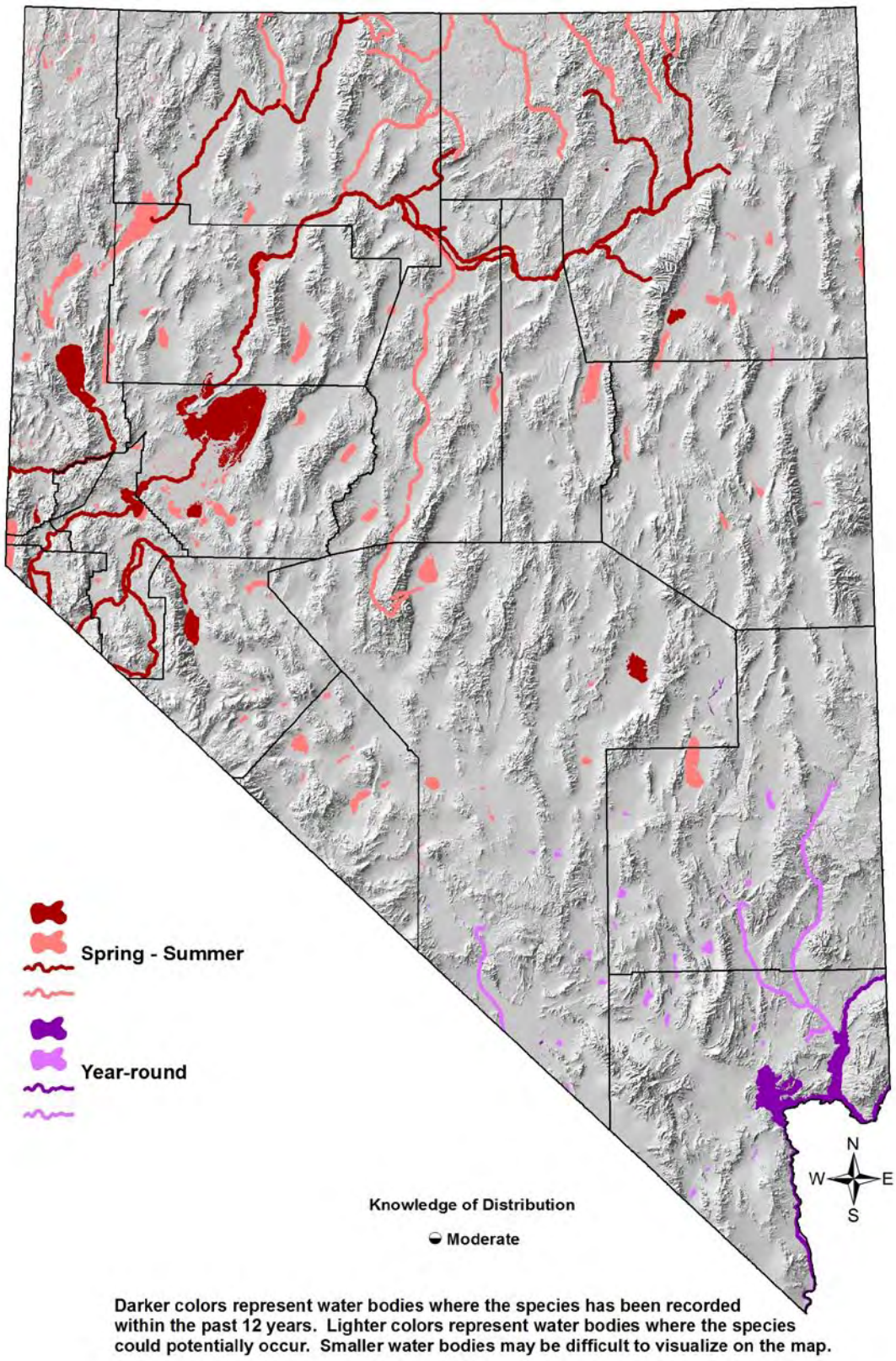
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (Great Basin) Year-round (Mojave)	
Known Breeding Dates in Nevada	
April – early June[1]	
Nest and Nesting Habits	
Nest Placement	Platform nests in trees or thickets[7]
Site Fidelity	High for colony site[7]
Other	Highly colonial nester in mixed or single species colonies, may re-use nests[7]
Food Habits	
Basic	Ambush predator
Primary Diet	Fish, crustaceans, aquatic invertebrates[7]
Secondary Diet	Small amphibian and terrestrial vertebrates[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Snowy Egret

Egretta thula



Snowy Egret

Egretta thula

Overview

Snowy Egrets have a particularly complex regional pattern of population trends, and it is not clear how Nevada fits into these broader patterns. After serious historical declines related to feather harvesting for the millinery trade, the Snowy Egrets resurged in many areas, only to suffer new setbacks beginning in the late 20th century.[7] The most recent trend information is mixed and somewhat contradictory,[8] and it is further complicated by substantial annual population variations related to drought-cycles and precipitation patterns. Ivey and Herziger's[4] report of declines in the Intermountain West is probably reliable, but it is possible that trends within Nevada itself are more stable.[6] The ongoing Nevada Colonial Waterbird Inventory project being conducted by GBBO and NDOW as part of a regional USFWS colonial waterbird inventory initiative should significantly improve our knowledge of breeding colony locations and population size, but further work to determine Nevada trends is merited. In addition, it would be helpful to determine key areas in Nevada for migrating and wintering Snowy Egrets. Limited data from the Nevada Aquatic Bird Count suggest that the Lake Mead area, the Virgin River, and Ash Meadows NWR are important in this respect.

Abundance and Occupancy by Habitat

- Most recent ten-year peak for Lahontan Valley was 1,000 birds in 2004 (L. Neel, *pers. comm*.)

Nevada-Specific Studies and Analyses

Mercury – Drought Studies on the Lower Carson River

The complexity of the factors controlling population stability and reproductive output in Snowy Egrets is well illustrated by studies conducted by Henny et al.[2] and Hill et al.[3] The Carson River carries high levels of mercury as a result of historical upstream mining operations. These coordinated ten-year studies on the lower Carson River and Lahontan Reservoir revealed that mercury exposure had a negative impact on reproductive success in Snowy Egrets, but only during drought years when water levels were low. Impacts were much smaller during high-water years.

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of lowland riparian and marsh habitats due to:
    - Habitat conversion
    - Water diversions
    - Sustained livestock grazing

Snowy Egret
Egretta thula

  - Invasive plants
  - Altered hydrology that prevents effective recruitment of cottonwoods
- Prolonged droughts
- Mercury contamination, particularly along the Carson River system during drought years[2,3]

Research, Planning, and Monitoring Challenges

- Population trend for Nevada populations is unknown
- Winter and migration distribution within Nevada is poorly documented

Conservation Strategies

Habitat Strategies

- Marsh (p. Hab-9-1), Great Basin Lowland Riparian (p. Hab-7-1), and Mojave Lowland Riparian (p. Hab-11-1) habitat conservation strategies benefit this species
- Manage emergent marshes in known or potential breeding locations to ensure sufficient water inflows and sufficient stem densities for platform nests during the nesting period (1 May – 15 July)
- River restoration projects have the potential to create large areas of suitable habitat for Snow Egrets
- Ensure that riverine marshes near egret rookeries support fish populations throughout the breeding season, at least during most years

Research, Planning, and Monitoring Strategies

- Continue the Nevada Colonial Waterbird Inventory, Aquatic Bird Count, or other similar efforts to better document breeding distribution, numbers, and Nevada trends
- Conduct surveys outside of the breeding season to identify key areas for wintering and migrating Snowy Egrets
- Include plans for the creation of suitable colony nesting and foraging habitat as part of river restoration projects

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Henny et al. (2007); [3]Hill et al. (2008); [4]Ivey and Herziger (2006); [5]Kushlan et al. (2002); [6] Nevada Wildlife Action Plan Team (2006); [7]Parsons and Master (2000); [8]Sauer et al. (2008); [EO] Expert opinion

White-faced Ibis

Plegadis chihi



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Marsh Wet Meadow Agriculture	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, pasture grasses, hay crops, willows, salt cedar
Plant Density	Nesting: Dense emergent vegetation or flooded shrub thickets; Foraging: Moderately dense, flooded wet meadow or agricultural vegetation[6]
Mosaic	Shallow marsh with emergent vegetation, < 6 km [3.7 mi] from flooded agricultural fields or wet meadows;[6, EO] population requires both core and peripheral breeding sites distributed over a large area[1]
Water Depth	< 30 cm [12 in] for foraging [EO]
Hydrology	Requires flooded conditions in foraging areas[6]
Response to Vegetation Removal	Negative in nesting site [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 1,200 ha [2,960 ac][6, EO]
Home Range / Territory Size	Unknown

Confidence in Available Data: ●High ◑Moderate ○ Low

Conservation Profile

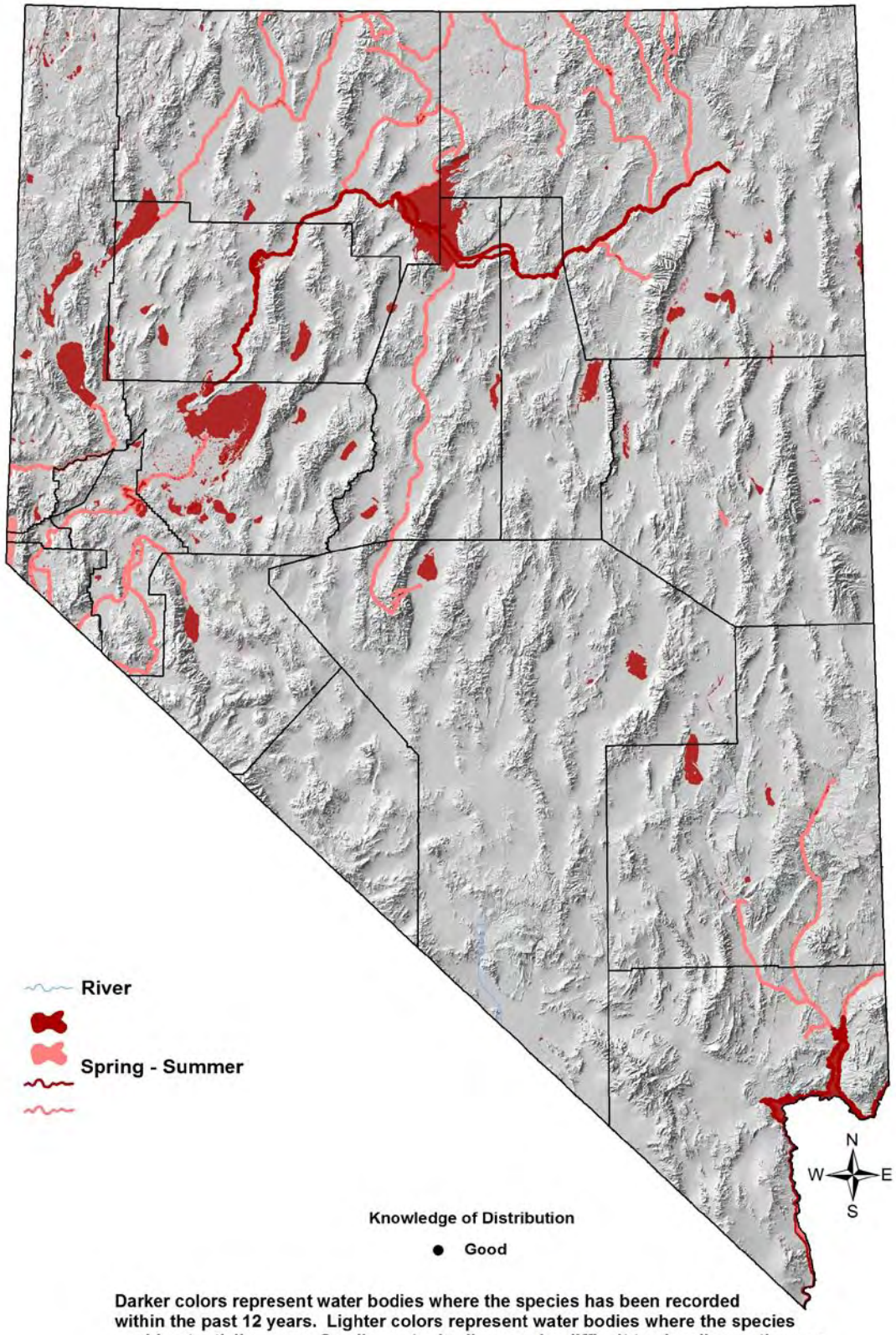
Priority Status	
Conservation Priority Species	
Species Concerns	
Unknown population trend Habitat threats Possible high stewardship responsibility	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	Moderate Concern
Trends	
Historical◑	Significant declines[6]
Recent ○	Unknown, but possibly declining
Population Size Estimates	
Nevada ◑	~ 5,000 – 6,000 with high annual variability[3, 5, EO]
Global ○	> 100,000 [4]
Percent of Global	< 10%
Population Objective	
Increase by 20% [EO]	
Monitoring Coverage	
Source	Nevada Colonial Waterbird Inventory, NDOW aerial surveys and Lahontan Valley counts, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Lahontan and Ruby Valleys, Humboldt River system
Restoration	Degraded marshes and wet meadows

Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
May – July[2]	
Nest and Nesting Habits	
Nest Placement	20 – 50 cm [8 – 20 in] above water in tall emergent vegetation or flooded shrubs[6]
Site Fidelity	High for colony site[6]
Other	Highly colonial nester[6]
Food Habits	
Basic	Prober
Primary Diet	Benthic, aquatic, and soil invertebrates[6]
Secondary Diet	Small vertebrates[6]

White-faced Ibis

Plegadis chihi



White-faced Ibis

Plegadis chihi

Overview

Determining the population trend and conservation status of the White-Faced Ibis in Nevada is surprisingly difficult considering that it is a fairly common and easily detected species. White-faced Ibises have suffered significant historical declines due to habitat loss and pesticides, but staged a strong recovery beginning in the 1980s.[1,3,6] Until recently, it appeared that ibis numbers had stabilized in Nevada (subject to normal precipitation-driven fluctuations),[5] but more recent data suggest the possibility of a renewed declining trend. Evidence comes primarily from Lahontan Valley, the White-faced Ibis's breeding stronghold in the state. The current ten-year average count for Lahontan Valley is 4,200 birds, substantially lower than the three-year average reported in 1999 (12,200),[3] the five-year average reported in 2000 (11,300; L. Neel pers. comm.), and far below the peaks reported in the 1980s and early 1990s.[1,6] If the species is indeed declining in Nevada, this would contrast with the regionally-reported trend towards increases or stability over the past few decades.[6]

Determining whether recent counts indicate a real population decline, or represent an extended, precipitation-driven fluctuation, is a high priority. The ongoing Nevada Colonial Waterbird Inventory project being conducted by GBBO and NDOW as part of a regional USFWS colonial waterbird inventory initiative should help in this regard. However, White-faced Ibises are nomadic during their seasonal tenure in Nevada, and they are known to shift colony sites flexibly based on local conditions[1,3] (L. Neel, *pers. comm*.), which can complicate monitoring efforts and add an additional element of uncertainty to population and trend estimates.

Abundance and Occupancy by Habitat

The current population estimate is based on a 10-year average of Lahontan Valley counts, plus an estimated 800 birds in Ruby Valley and elsewhere in Nevada. Densities of 75 – 150 nests / ha [30 – 60 / ac] have been recorded at Carson Lake and Lahontan Valley.[6]

Nevada-Specific Studies and Analyses

Earnst et al.[1] conducted a detailed analysis of White-faced Ibis monitoring and inventory data from the Great Basin for the 1985 – 1997 time period. Data from different states, including Nevada, were broken out separately in their presentation. During the period analyzed, ibis numbers nearly tripled, a phenomenon that appeared to be partly, though not completely, explained by annual precipitation patterns. The authors discussed the nomadic habits of the White-faced Ibis as an adaptive strategy to cope with shifting resource availability, and introduced the concepts of core and peripheral breeding areas, both of which are needed for long-term population health and persistence.

White-faced Ibis

Plegadis chihi

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of marsh and wet meadow habitat due to water diversions, declines in water quality, or development
- Water level fluctuations during nesting may cause nest failure[6]
- Changes in traditional flood irrigation practices in or near critical nesting areas, which reduces foraging opportunities
- Human disturbance at colony sites can cause nest abandonment[3]
- White-faced Ibises are susceptible to avian botulism[3,5]

Research, Planning, and Monitoring Challenges

- Current population trends in Nevada are not known
- White-faced Ibises are challenging to monitor because of high annual variability and frequent nomadic movements within and among years
- Patch size requirements need further study

Conservation Strategies

Habitat Strategies

- Marsh (p. Hab-9-1), Wet Meadow (p. Hab-20-1), and Agriculture (p. Hab-1-1) habitat conservation strategies benefit this species; also, Ivey et al.[7] provide additional conservation strategies for Great Basin populations
- Protect marshes near wet meadows and flood-irrigated agricultural fields from water diversions and development
- Maintain water levels in breeding sites during the nesting period (1 May – 15 July)
- Protect colony sites from human disturbance

Research, Planning, and Monitoring Strategies

- Explore existing data, collect additional data, and conduct studies to determine population status of White-faced Ibises in Nevada
- Continue the Nevada Colonial Waterbird Inventory, Aquatic Bird Count, or other similar efforts to better document breeding distribution, numbers, and Nevada trends
- Investigate patch size requirements
- Assess whether both core breeding sites and a network of peripheral sites[1] are healthy and adequately protected

Public Outreach Strategies

- Encourage traditional practices in agricultural areas within known range, including flood irrigation

References: [1]Earnst et al. (1998); [2]GBBO unpublished Atlas data; [3]Ivey and Herzinger (2006); [4]Kushlan et al. (2002); [5]Nevada Wildlife Action Plan Team (2006); [6]Ryder and Manry (1994); [7]Ivey et al. (2004); [EO] Expert opinion

Bald Eagle

Haliaeetus leucocephalus

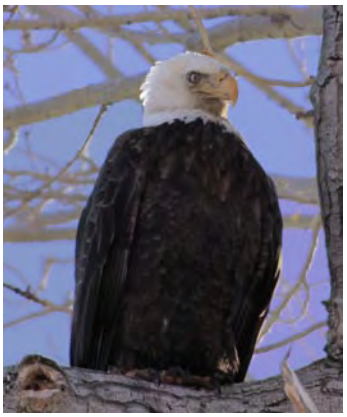


Photo by Wendy Francis

Habitat Use Profile

Habitats Used in Nevada	
Open Water Great Basin (and Mojave) Lowland Riparian (Coniferous Forest) (Agriculture)	
Key Habitat Parameters ●	
Plant Composition	Pines, spruces, fires, cottonwoods. Conifers preferred as winter roost sites[1], but deciduous trees also used
Plant Density, Size	Nests placed in trees ~ 20 – 60 m [60 – 200 ft] high and 50 – 190 cm [20 – 75 in] DBH; usually a tree larger than its neighbors[1]. Winter roost trees usually 30 – 100 cm [12 – 40 in] DBH, 15 – 60 m [50 – 200 ft] high[1]
Mosaic	Nest trees usually in open canopy area and/or near forest edge[1]
Distance to Water	Nests in tree close to lake, river, or other water body, usually < 2 km [1 mile][1]
Other	Summer and winter habitat similar, but in winter, roost sites that provide shelter from weather exposure important[1]
Area Requirements ◑	
Minimum Patch Size	300 km^2 [74,000 ac] in winter[1]
Recommended Patch Size	> 500 km^2 [120,000 ac] in winter[EO]
Home Range / Territory Size	5 – 20 km^2 [1,200 – 4,800 ac] home range in breeding season; ~ 300 km^2 [74,000 ac] in winter. Typical territory size ~ 1 – 2 km^2 [250-500 ac][1]

Conservation Profile

Priority Status	
Special Status Species	
Species Concerns	
Historical declines	
Other Rankings	
Continental PIF	Stewardship Species
Audubon Watchlist	None
NV Natural Heritage	G5, S1B, S3N
USFWS	Eagle Act, Migratory Bird, Bird of Conservation Concern
BLM	None
USFS	Sensitive Species
NDOW	Conservation Priority
Trends	
Historical ◑	Substantial declines regionally and in Nevada[1]
Recent ◑	Stable/increasing regionally and in Nevada[1, 5]
Population Size Estimates	
Nevada ●	~ 10 breeders[3, 4]; > 120 wintering birds[1]
Global ●	330,000 [4]
Percent of Global	< 1 %
Population Objective	
Maintain / Increase[7, EO]	
Monitoring Coverage	
Source	NDOW winter raptor surveys, USFS and USFWS breeding surveys
Coverage in NV	Good for breeding
Key Conservation Areas	
Protection	Lake Tahoe Basin; Carson River; known winter roost sites
Restoration	Potential winter roost sites near all open water

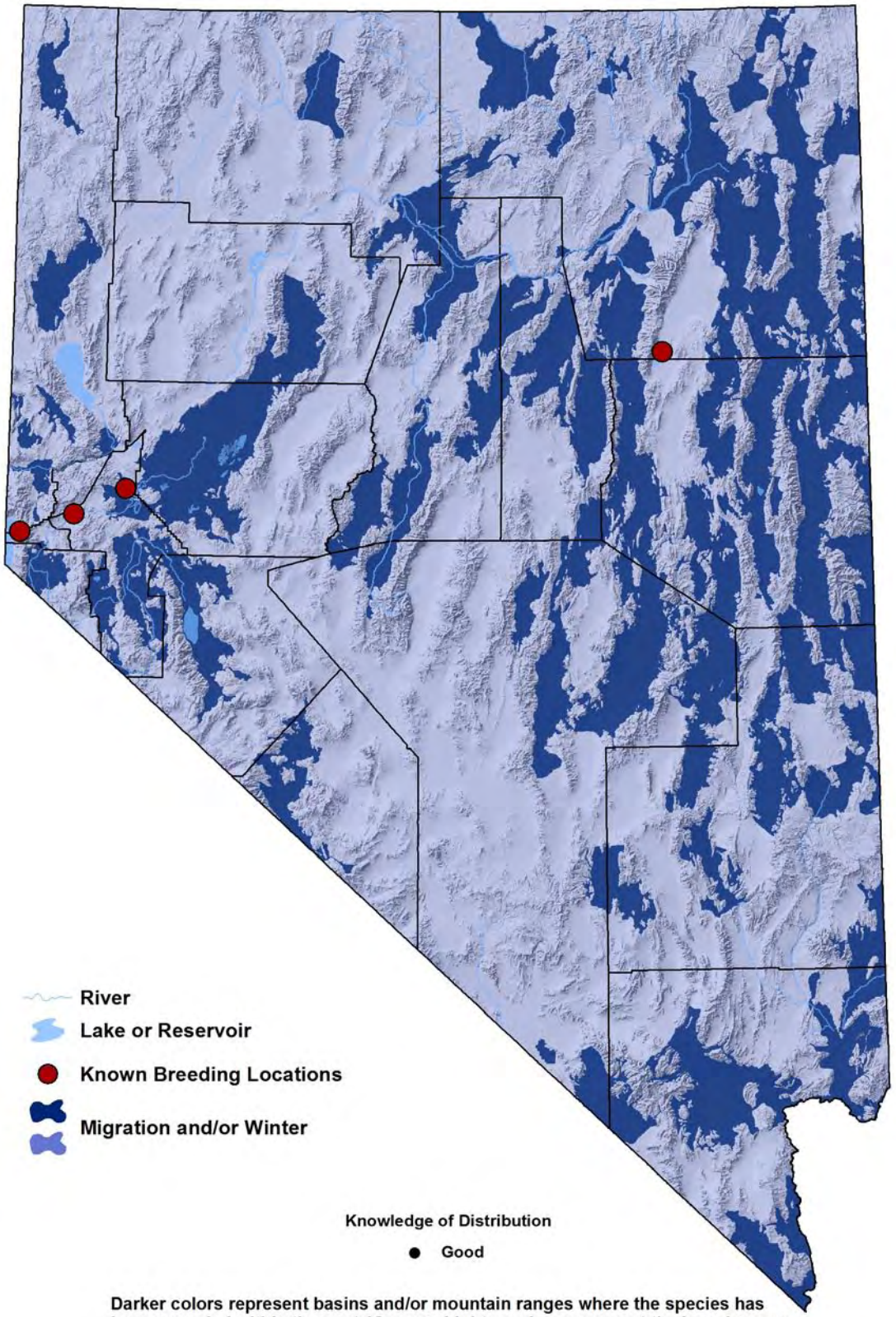
Natural History Profile

Seasonal Presence in Nevada	
Winter; small Spring-Summer breeding population	
Known Breeding Dates in Nevada	
Early May – August[1, 2]	
Nest and Nesting Habits	
Nest Placement	Platform stick nests in large trees (cliffs more rarely) near large water body, usually > 500 m from human development[1]
Site Fidelity	High for breeding sites and winter roosts[1]
Food Habits	
Basic	Predatory; hunts from air, scavenger, food pirate
Primary Diet	Fish (34-38 cm [13-15 in] length preferred during breeding season)[1]
Secondary Diet	Carrion, waterfowl, small mammals[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Bald Eagle

Haliaeetus leucocephalus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Bald Eagle

Haliaeetus leucocephalus

Overview

Bald Eagles inhabit Nevada primarily during the winter. A small breeding population was detected in the state in the mid 1980s and continues to be present, following more than a century in which no Nevada breeding was recorded.[8] However, breeding activity in Nevada is likely still more restricted (and irregular) than it was in the early 19th century -- historical accounts exist of nesting Bald Eagles in several locations (such as Anaho Island in Pyramid Lake) that are no longer used.[8] Given current management practices, it is possible that Nevada's nesting population will slowly increase over the coming years.

In winter, roost sites (each often hosting several eagles) are often located near lakes and reservoirs that are large enough to remain unfrozen. However, eagles sometimes forgo proximity to water in exchange for roost sites offering good protection from weather extremes. An informal review of current information suggests many of Nevada's wintering Bald Eagles are not, in fact, located in immediate proximity to water bodies. For instance, in northeastern Nevada, mixed species roost sites with both Bald and Golden Eagles are found in high-elevation coniferous forests (P. Bradley *pers. comm.*), where they have been reported to prey primarily upon jackrabbits.[8] There are also reports of Bald Eagles wintering in proximity to agricultural areas where they opportunistically feed upon calving afterbirth.[3]

The Bald Eagle is regarded as a Special Status species in this plan based upon its recent de-listing in 2007. Despite modest declines in Nevada's wintering population in the 1990s,[6] current trends appear to be stable or slightly positive. As might be expected given its iconic status, Bald Eagles in Nevada are generally well-monitored and closely managed. One important monitoring objective for the species, however, is to develop a thorough inventory of Bald Eagle winter roost sites.

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss of suitable nest and roost trees or forest patches in proximity to large water bodies

Bald Eagle

Haliaeetus leucocephalus

- Human activity close to nest sites and winter roosts can cause nest or roost abandonment or interfere with required activity patterns; it may also prevent eagles from attempting to breed in otherwise suitable locations[1]
- Bio-accumulated mercury from fish or exposure to other pesticides may interfere with reproduction or cause direct mortality[1, 3]

Conservation Strategies

Established Strategies

- USFS Lake Tahoe Basin Management Unit (http://www.fs.fed.us/r5/ltbmu/) guidelines prohibit logging, human disturbance, and use of chemicals toxic to eagles within a primary zone of ~ 100 m [330 ft] around nest sites, and less stringent restrictions within a secondary zone of at least 200 m [660 ft] around nest sites

Habitat Strategies

- Open Water (p. Hab-15-1) and Great Basin Lowland Riparian (p. Hab-7-1) habitat conservation strategies benefit this species
- In areas near known nest sites, several large trees (especially known nest trees) in proximity to large water bodies with large fish should be left intact
- Tree removal should be restricted or closely supervised in known winter roost areas
- Restrict human disturbances and pesticide use near nest sites per current USFS guidelines
- Manage recreational use of lakes and reservoirs to prevent undue disturbance of nest sites and actively used foraging areas
- Monitor and, if necessary, manage human disturbance in proximity to winter roost sites

Research, Planning, and Monitoring Strategies

- Conduct a thorough inventory of winter roost sites, coordinated with the Midwinter Bald Eagle Survey[7]

Public Outreach Strategies

- Conduct additional outreach to private landowners that have stewardship over winter roost sites or potential breeding sites to encourage appropriate land use practices
- Support ongoing outreach efforts, such as the annual Eagles and Agriculture Festival in Gardnerville

References: [1]Buehler (2000); [2]Nevada Breeding Bird Atlas unpublished data; [3]Nevada Wildlife Action Plan Team (2006); [4]Rich et al. (2006); [5]Sauer et al. (2008); [6]Steenhof et al. (2002); [7]Steenhof et al. (2008); [8]U.S. Fish and Wildlife Service (1986); [EO] Expert opinion

Northern Goshawk

Accipiter gentilis



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Aspen Coniferous Forest (Pinyon-Juniper) (Springs)	
Key Habitat Parameters ●	
Plant Composition	Aspen, mixed coniferous trees, sagebrush, willows, montane shrubs
Plant Density & Size	Nests in mature tree stands (usually aspen) with ≥ 60% canopy closure; nest trees 10 – 15 m [33 – 50 ft] tall[3, 12]
Mosaic	Mature aspen stands surrounded by undisturbed coniferous forest and/or montane shrubland for foraging[7, 12]
Distance to Water	Close to water[3, 12]
Response to Vegetation Removal	Negative[EO]
Area Requirements ●	
Minimum Patch Size	Aspen stand: ≥ 0.8 ha [2 ac], at least 180 m [600 ft] long, 23 m [75 ft] wide[3]
Recommended Patch Size	> 3,500 ha [8,700 ac] including foraging areas [12]
Home Range	570 – 3,500 ha [1,400 – 8,700 ac][12]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Restricted habitat Small population size Possible recent declines Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S2
USFWS	Migratory Bird
BLM	Sensitive Species
USFS	Sensitive Species
NDOW	Conservation Priority
Trends	
Historical ○	Unknown in the West
Recent ◑	In Nevada, information mixed, but recent declines possible[3, 5, 6 ,EO]
Population Size Estimates	
Nevada (NBC) ◑	700 [3]
Global ◑	580,000 [8]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[EO]	
Monitoring Coverage	
Source	USFS, NDOW raptor surveys, Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Carson, Jarbidge, Schell Creek, Snake, Toiyabe, Monitor, Bull Run, Independence, Ruby, and East Humboldt ranges
Restoration	Degraded Great Basin aspen stands

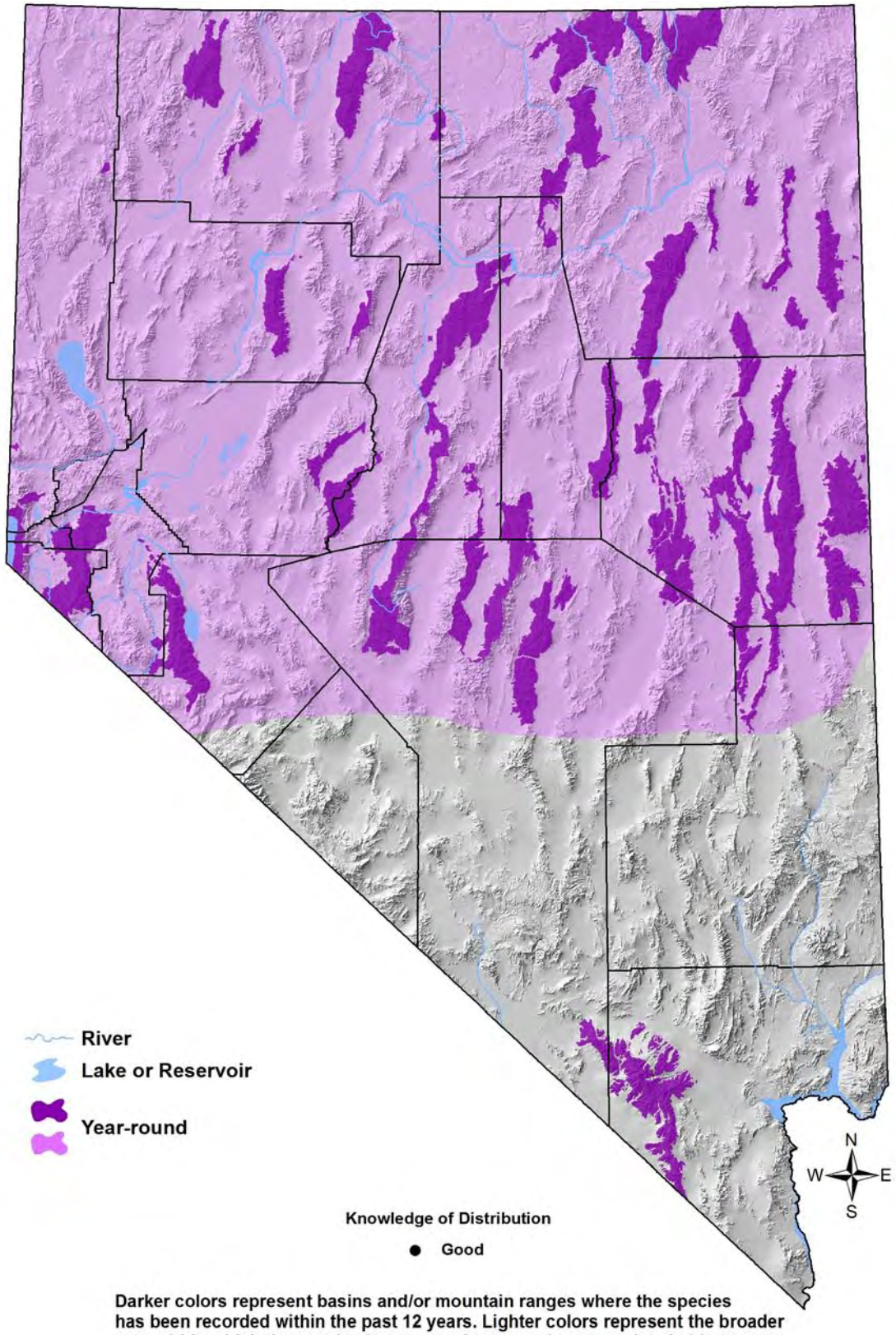
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Early April – August[1, 12]	
Nest and Nesting Habits	
Nest Placement	In large top branches of mature tree [9, 12]
Site Fidelity	High for nesting area[EO]
Other	Multiple alternate nests used within stand[12]
Food Habits	
Basic	Aerial predator
Primary Diet	Small to medium sized mammals and birds[12]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Northern Goshawk

Accipiter gentilis



Northern Goshawk

Accipiter gentilis

Overview

Although the Northern Goshawk is not a priority species in most regional or national conservation plans, they are a definite conservation priority in Nevada, particularly on USFS lands in the Sierra Nevada, where detailed management guidelines have been developed.[7,14] Concern for goshawks in Nevada is related to their strong association with aspen woodlands, which are limited in extent and subject to many threats (p. Hab-3-1), and recent data suggest that the species is declining.[5] There has also been a wider regional conservation concern for goshawks since at least the 1990s, when an unsuccessful attempt was made to list the bird under the ESA.[3]

Unlike some other raptors, goshawks do not appear to select nesting areas based on prey abundance, but rather based on forest structure.[2] Goshawks in Nevada usually nest in mature aspen stands (or less commonly, coniferous stands) with trees large enough to support their substantial stick nest.[16] This association with aspen in Nevada is somewhat unique, for in most other parts of the West, goshawks more typically nest in coniferous forest.[12] It should be noted that there are at least two recent reports of goshawk nests in pinyon-juniper woodlands (Kathleen Johnson and Adam Ryba, *pers. comm.*), and the possibility that this occurs more widely should be further explored. Current information regarding the need for understory cover within aspen nesting habitat is somewhat contradictory and needs to be clarified. Winter habitat use is also poorly understood, but preliminary data on immature birds suggest that they wander within a radius of about 150 km [95 miles] during the post-breeding season.[11]

Nevada's aspen stands are at significant risk of decline and loss, and therefore a conservation strategy to promote the health and persistence of aspen stands is probably the most beneficial strategy for Northern Goshawks in Nevada.

Abundance and Occupancy by Habitat

- The NBC population estimate and the estimate provided by Herron[3] are in close agreement (~ 700 birds)
- In Nevada, there is usually a single pair per aspen patch.[3] There are usually < 5 pairs / 100 km^2 [25,000 ac][12]

Nevada-Specific Studies and Analyses

- NDOW aerial and ground surveys from 2000 – 2010[4] suggest population declines in eastern and southern Nevada, with more than half of historical nesting sites currently unoccupied by goshawks (Pete Bradley *pers. comm.*)
- In the Sierra Nevada region, the USFS conducts annual monitoring of historically occupied goshawk territories as well as surveys of potential habitat, using the *USFS Pacific Southwest Regional Survey Methodology for Goshawks*. [11] Detections and survey efforts are recorded in a national USFS database.

Northern Goshawk
Accipiter gentilis

- Recent research in the Lake Tahoe Basin highlights the effects of anthropogenic disturbance and provides guidance on how to prioritize territory locations for restoration. [4]

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of mature aspen stands, which may be caused by:
  - Livestock or other ungulate grazing and browsing that prevents stand regeneration or removes understory vegetation
  - Tree pathogens or Aspen Decline Syndrome (p. Hab-3-1)
  - Stand-wide fires that destroy suitable nesting trees (although less intense fires may stimulate regeneration)
  - Invasion and eventual replacement of aspen stands by conifers
- Illegal take of eggs or nestlings for falconry
- Human recreational activity in proximity to nest sites may be detrimental

Research, Planning, and Monitoring Challenges

- The importance of aspen understory integrity is not known
- It is possible that nesting occurs outside of aspen stands (i.e., in pinyon-juniper) more often than is currently realized
- It is not known whether or not West Nile Virus might be a significant source of mortality, as suggested by anecdotal reports
- The frequency and impact of illegal take of eggs or nestlings is currently unknown and should be investigated



Small aspen stand in western Nevada. Photo by John Boone.

Northern Goshawk

Accipiter gentilis

Conservation Strategies

Established Strategies

- Northern Goshawk management guidelines and standards for USFS lands in the Sierra Nevada region are specified in the *Sierra Nevada Framework Plan Amendment*. [14] This document recommends a two-year pre-project survey be conducted in suitable habitat to determine if goshawks are present. Occupied areas can be protected by specific strategies including limitations on land disturbance near nesting areas and during other critical time periods (15 April – 15 July)
- Reynolds et al.[7] provide detailed goshawk management guidelines for the southwest region, but these were primarily based on areas where goshawks nest in conifers

Habitat Strategies

- The Aspen (p. Hab-3-1) and Coniferous Forest (p. Hab-5-1) habitat conservation strategies, with emphasis on the following elements, benefit this species
- Protect aspen stands from levels of grazing and motorized recreation that prevent stand regeneration
- Allow regenerating burns to occur in stands where active or traditional nest sites are not at risk
- Remove conifers encroaching aspen stands where appropriate and feasible
- Retain intact, relatively undisturbed mosaics of suitable habitat (aspen stands of the recommended size and adjacent coniferous forest or shrubland) at the recommended patch size (< 3,500 ha [8,700 ac]) wherever possible
- Continue stringent restrictions on egg and nestling take until trends in Nevada are better quantified, and consider increased law enforcement during the nesting season

Research, Planning, and Monitoring Strategies

- Continue and broaden coverage by current monitoring programs to allow better determination of statewide trends
- Increase efforts to quantify nesting outside of aspen stands
- Study habitat requirements during the non-breeding season
- Investigate the scope and impact of illegal takes
- Investigate the susceptibility of Northern Goshawks to West Nile Virus and possible impacts
- Consider statewide implementation of the nationwide monitoring strategy that has been developed by the USFS [15] and applied in the Lake Tahoe Basin. [10]

continued

Northern Goshawk

Accipiter gentilis

Conservation Strategies (continued)

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Greenwald et al. (2005); [3]Herron (1999); [4]Morrison et al. (2010); [5]NDOW unpublished ground and aerial raptor survey data 2000-2010 (Pete Bradley pers. comm.); [6]Nevada Wildlife Action Plan Team (2006); [7]Reynolds et al. (1992); [8]Rich et al. (2004); [9]Shuford and Gardali (2008); [10]Slauson et al. (2008); [11]Smith (2000); [12]Squires and Reynolds (1997); [13]USFS (2000); [14]USFS (2001); [15]Woodbridge and Hargis (2006); [16]Younk and Bechard (1994); [EO] Expert opinion



Aspen patch in western Nevada. Photo by John Boone.

Swainson's Hawk

Buteo swainsoni

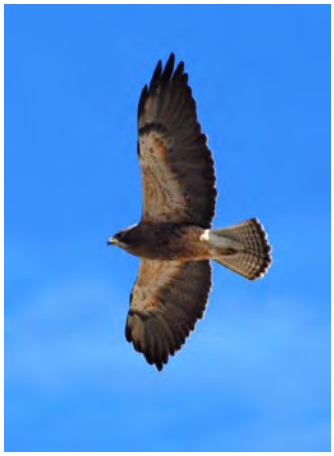


Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada
Great Basin and Mojave Lowland Riparian Agriculture Sagebrush (Wet Meadow)

Key Habitat Parameters ●	
Plant Composition	Fremont cottonwood, agricultural crops (especially alfalfa), perennial grasses, sedges and rushes, sagebrush and sagebrush-associated shrubs[2]
Plant Density	Sparse tree cover, or single old-growth cottonwoods; avoids dense forest stands[2]
Mosaic	Open riparian woodlands with significant expanses of pasture, agricultural fields, wet meadow, or open shrublands with grass cover in immediate vicinity[2]
Distance to Water	In Nevada, usually occurs close to riparian or other wet habitats[EO]
Response to Vegetation Removal	Negative to tree removal, otherwise response depends on prey populations[EO]

Area Requirements ◑	
Minimum Patch Size	Unknown; varies with prey density
Recommended Patch Size	> 10,000 ha [25,500 ac][EO]
Home Range	70 – 8,700 ha [170 – 21,500 ac] [9]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Small population size Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2B
USFWS	Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines and range contractions[2]
Recent ◑	Probable declines[2, 7]
Population Size Estimates	
Nevada ○	~ 300 [7]
Global ◑	460,000 [10]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [7, EO]	
Monitoring Coverage	
Source	NDOW raptor surveys, Nevada Bird Count
Coverage in NV	Good / Fair
Key Conservation Areas	
Protection	Great Basin lowland riparian and agricultural habitats
Restoration	Same

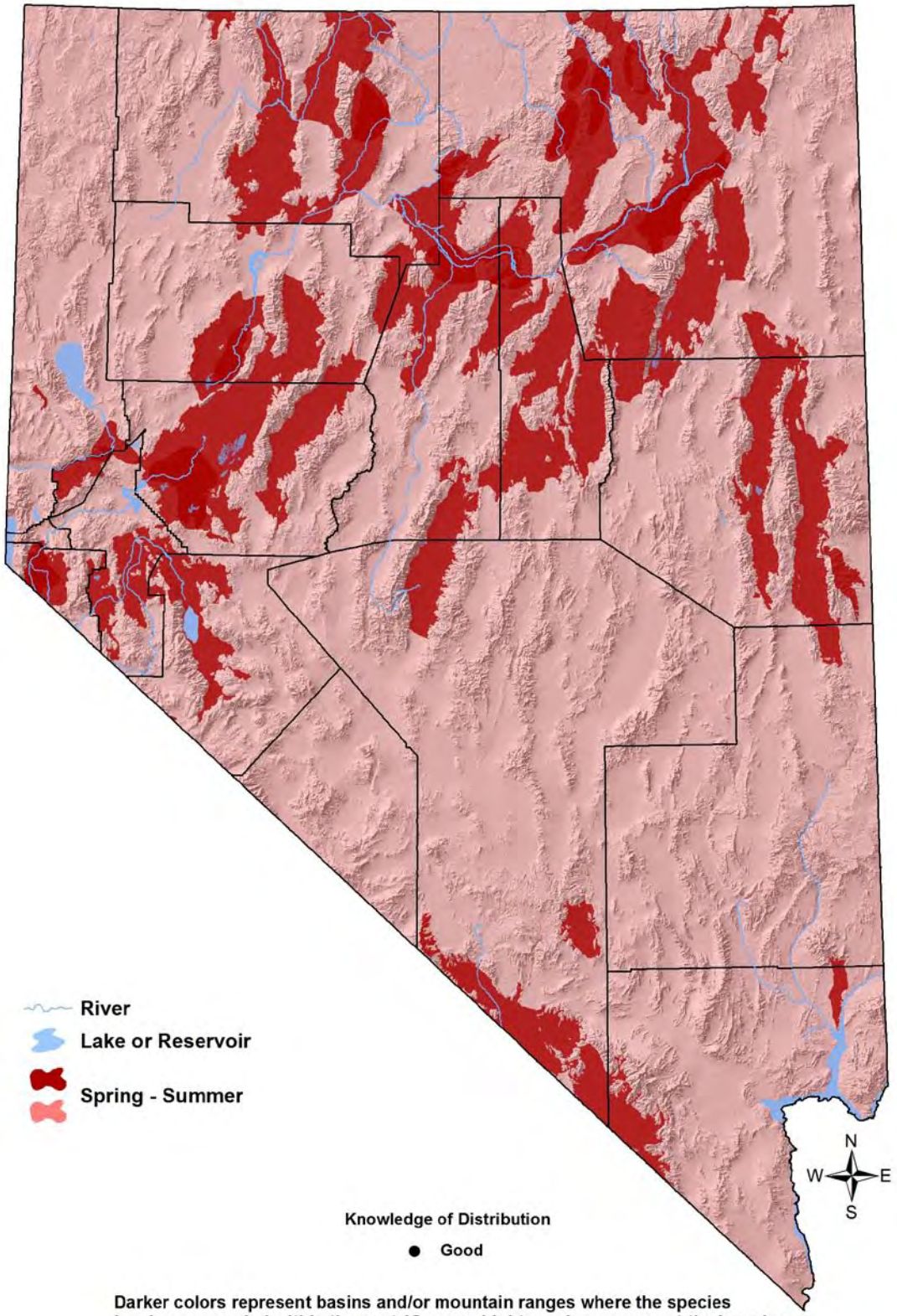
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
April – August[2, 5]	
Nest and Nesting Habits	
Nest Placement	Platform in old large tree with overhead cover, or on cliff ledge, juniper[2, EO]
Site Fidelity	High for breeding territory[2]
Other	Often re-uses old raptor or heron nests[EO]
Food Habits	
Basic	Aerial predator
Primary Diet	Small to medium-sized mammals, especially ground squirrels and rabbits[2]
Secondary Diet	Reptiles, large insects[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Swainson's Hawk

Buteo swainsoni



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Swainson's Hawk

Buteo swainsoni

Overview

Several aspects of the Swainson's Hawk's biology are particularly interesting, including their long-distance migration to wintering grounds in Argentina, and the contrast between their winter diet (primarily insects) and summer diet (ground squirrels and other small mammals).[2] Historical and recent declines have been relatively well documented for this species, and it may encounter threats on the breeding grounds, wintering grounds, and along the migration routes.[2] A decline of 90% from historical levels in the Central Valley of California was thought to be due to loss of riparian woodland, introduction and spread of nonnative annuals and perennials, alteration of fire regime, overgrazing by livestock, and alteration and degradation of habitat.[4]

Swainson's Hawks have adapted to agricultural landscapes in Nevada, and the greatest threats to the species in this state are probably loss of traditional alfalfa fields to other uses, and loss of nesting trees within several kilometers of suitable foraging areas.[3] An ideal landscape for the Swainson's Hawk provides large riparian nesting trees, agricultural fields, and open shrublands within relatively close proximity. Its use of agricultural fields on the wintering grounds (Argentina) unfortunately resulted in a severe die-off (at least 5% of the global population) during the 1990s from pesticides that are not used in the United States.[6]

Our best estimate of population size for Swainson's Hawk is now over 25 years old,[7] and it is important to obtain a current population estimate given ongoing regional population declines. Because of its association with agricultural landscapes, Swainson's Hawk offers an opportunity for landowner outreach that encourages the retention of nest trees and conveys the benefits of traditional agricultural practices.

Abundance and Occupancy by Habitat

- Typical densities in Nevada < 0.4 pairs / 100 ha [0.2 / 100 ac][8]
- Population estimates derive from NBC (21,000) and BBS (7,700)[10] (*Appendix 4*) are not considered reliable because soaring birds are difficult to relate to a defined surface area during surveys

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss of traditional agricultural and riparian landscapes, including large trees and tree groves
- Residential development

Swainson's Hawk

Buteo swainsoni

- Loss of prey populations (small to medium-sized mammals) to crop conversion, development, or shrubland degradation

Research, Planning, and Monitoring Threats

- Population and trend estimates are not current
- Current monitoring efforts (NBC) overestimate the numbers of soaring birds such as Swainson's Hawk
- Effects of agricultural pesticide use are not well understood

Conservation Strategies

Habitat Strategies

- Great Basin Lowland Riparian (p. Hab-7-1), Mojave Lowland Riparian (p. Hab-11-1), Agriculture (p. Hab-1-1), and Sagebrush (p. Hab-17-1) habitat conservation strategies benefit this species
- Encourage conservation of traditional agricultural and riparian landscapes that support large scattered trees or groves and healthy prey populations

Research, Planning, and Monitoring Strategies

- Review NBC data collection techniques to reduce possibility of over-counting
- Using modified monitoring techniques and data, develop updated population size and trend estimates
- A statewide monitoring program in California may provide opportunities for collaboration (http://www.dfg.ca.gov/rap/projects/swainsonhawk/)[1]
- Conduct research on the possible effects of pesticide use on prey populations and Swainson's Hawks

Public Outreach Strategies

- Support outreach to private landowners to encourage retention of nesting trees and promote the value of traditional agricultural practices for wildlife

References: [1]Anderson et al. (2007); [2]Bechard et al. (2010); [3]Brown et al. (2008); [4]Estep (2009); [5]GBBO unpublished Atlas data; [6]Goldstein et al. (1997); [7]Herron et al. (1985); 8[5]Neel (1999); [9]Nevada Wildlife Action Plan Team (2006); [10]Rich et al. (2004); [EO]Expert opinion

Ferruginous Hawk

Buteo regalis



Photo by Teri Slatauski

Habitat Use Profile

Habitats Used in Nevada	
Sagebrush Pinyon-Juniper (Salt Desert Scrub)	
Key Habitat Parameters ◑	
Plant Composition	Sagebrush spp., juniper spp., upland grasses and forbs
Plant Density	Details unknown, but avoids heavily forested areas[1]
Mosaic	Variety of open habitats with widely spaced juniper or pine trees[1]
Distance to Water	Unknown
Prey Populations	Typically associated with high-density prey populations[1]
Response to Vegetation Removal	Negative, if prey populations are reduced[EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 8,000 ha [20,000 ac][EO]
Home Range	590-760 ha [1,450 – 1,900 ac][1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Possible recent declines Small population size Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S2
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ◑	Declines in the 1980s, probably declines more recently in Nevada[1, 5, 6]
Population Size Estimates	
Nevada (NBC) ◑	1,200
Global ○	6,000 – 22,500 [1, 7]
Percent of Global	≥ 5%
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	NDOW raptor surveys, Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Northern and eastern Nevada
Restoration	Same

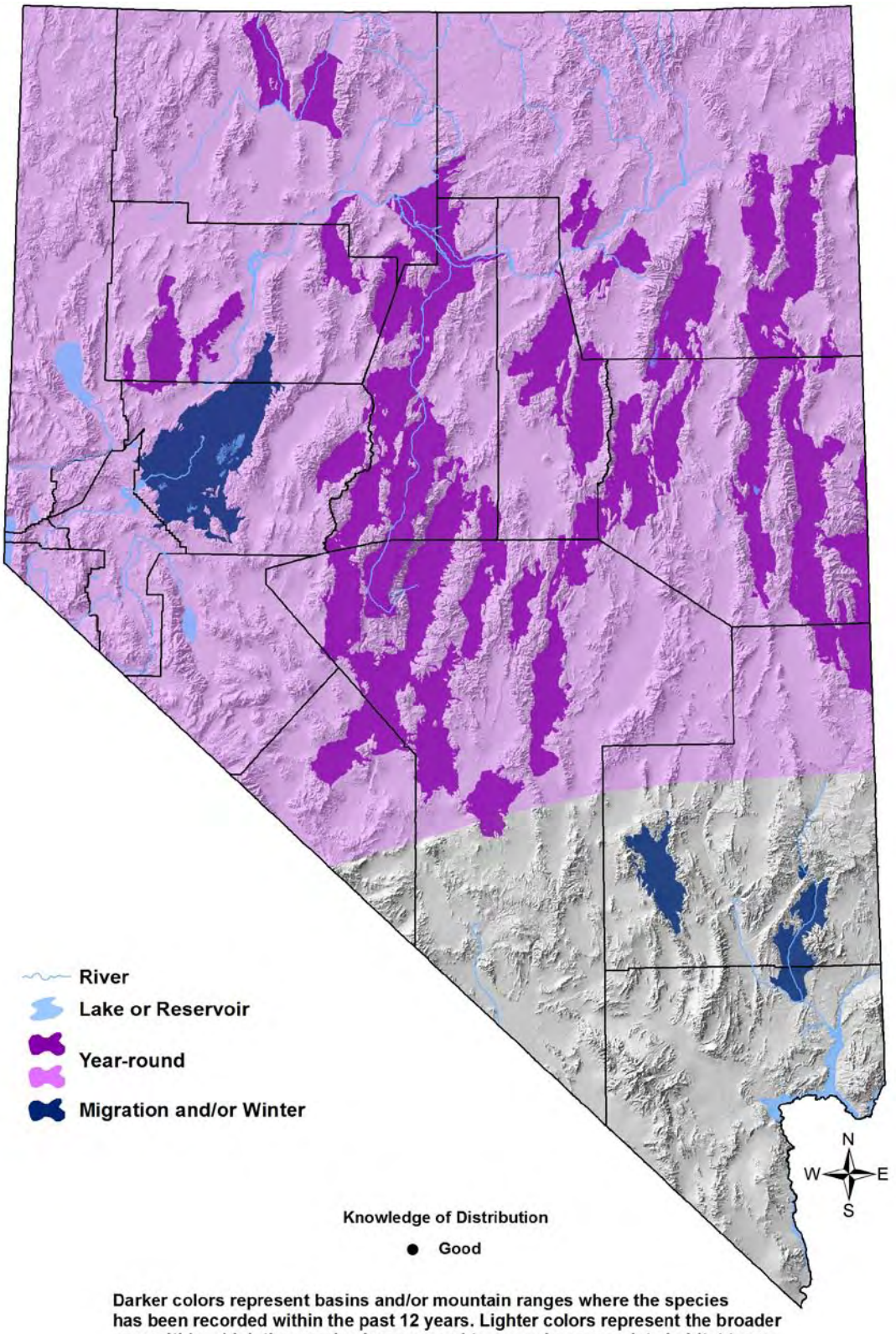
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
March – August[1, 3]	
Nest and Nesting Habits	
Nest Placement	Stick platform on isolated trees, ledges, poles, ground[1]
Site Fidelity	High for breeding territory[2]
Food Habits	
Basic	Aerial predator
Primary Diet	Jackrabbits, cottontails[1]
Secondary Diet	Ground squirrels, birds, reptiles[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Ferruginous Hawk

Buteo regalis



Ferruginous Hawk

Buteo regalis

Overview

Open, rolling sagebrush near the pinyon-juniper interface is the preferred landscape for breeding Ferruginous Hawks in Nevada. Usually a "sit-and-wait" predator, this hawk forages where scattered tree perches are available near open shrubland.[1] Ferruginous Hawks are known for their extensive post-breeding vagrancy, and the birds that winter in Nevada are often different individuals than those that breed here. They may also range into a wider variety of habitats than is the case during the breeding season. Ferruginous Hawks exhibit substantial annual variability in numbers and in nest success as a function of the fluctuating abundance of jackrabbits and cottontails, their preferred prey items. Clear population trends are therefore difficult to obtain. Ferruginous Hawks in Nevada reportedly prefer landscapes where the human presence is minimal,[EO] and they are generally more sensitive to nest disturbances than most other raptors.[1,10] In other states and regions, however, Ferruginous Hawks sometimes exhibit either an aversion[8] or an affinity[4] for the shrubland-agriculture interface.[2] The relationship between agriculture and Ferruginous Hawks in Nevada therefore merits further investigation.

Based on widespread population declines in the 1980s, Ferruginous Hawks were petitioned for listing under the ESA in 1991,[1] but were not subsequently listed. Nonetheless, the Ferruginous Hawk remains a conservation priority among land management agencies in Nevada due to its small numbers and probable declines. Keys to management are providing suitable nest sites, protecting active nest areas from disturbance, and improving habitat for prey.[2]

Abundance and Occupancy by Habitat

- The highest densities of Ferruginous Hawks in Nevada have been reported in relatively remote valleys where native vegetation is mostly intact and where human activities are minimal [EO]
- Densities of Ferruginous Hawks may be as high as 1 pair / 40 km^2 [1 pair / 4,000 ha] under optimal conditions (Pete Bradley, *pers. comm*.)

Nevada-Specific Studies and Analyses

NDOW Telemetry Studies in Northeastern Nevada (Pete Bradley, *pers. comm*.)

Ferruginous Hawks monitored by radio-telemetry spent 97% of their June foraging time in sagebrush and salt desert habitats. Birds nearly always remained within 4 km [2.5 mi] of their breeding territory until early July, when they began to make 1-3 day foraging trips (sometimes accompanied by fledged young) to adjacent valleys up to 46 km [29 mi] from the nest site. Post-fledging migrational movements of 40 – 600 km [25 – 370 mi] per day began in late July. Tagged birds wintered in a variety of areas outside Nevada, to the east, south, and west, suggesting that Nevada's wintering population and breeding population are not comprised of the same individuals.

Ferruginous Hawk

Buteo regalis



Photo by Larry Neel

Main Threats and Challenges

Habitat and Other Threats

- Sensitive to factors negatively affecting prey populations, including invasive plants, habitat fragmentation, fire, and development
- More sensitive to nest site disturbances than other *Buteo*s, especially during early stages of nesting cycle[1, 10]
- Loss of nesting trees (usually isolated junipers) at the shrubland-woodland interface
- Illegal take of eggs or nestlings[EO]

Research, Planning, and Monitoring Challenges

- Relative impacts of specific modes of habitat degradation (invasive plants, livestock grazing, fragmentation) are not clear

Ferruginous Hawk

Buteo regalis

Conservation Strategies

Habitat and Other Strategies

- Sagebrush (p. Hab-17-1) and Pinyon-Juniper (p. Hab-16-1) habitat conservation strategies benefit this species
- Maintain or create a sagebrush / pinyon-juniper interface in which scattered or lone trees are present; fuels reduction and pinyon-juniper management projects should avoid creating an abrupt shrubland-woodland edge
- Manage rangelands to promote healthy prey populations and maintain intact herbaceous understory[6]
- Attempt to control invasive plants, particularly cheatgrass and *Halogeton*
- Trails, access roads, and other developments should be sited to maintain a non-disturbance buffer (minimally 250 m [820 ft], ideally 4 km [2.5 mi]) around nest sites[9, EO]
- Minimize fragmentation in sagebrush habitats by consolidating development and land impacts as much as possible
- From 1 April – 30 June, consider seasonal road closures and increased law enforcement presence in key breeding areas to reduce illegal take of eggs or nestlings

Research, Planning, and Monitoring Strategies

- Continue monitoring to better determine population trends in Nevada, and document important nesting areas and regions
- Develop and implement a fire management plan that prioritizes conservation of productive sagebrush habitat, especially near the pinyon-juniper interface
- Where disturbances do occur in proximity to nesting locations, document nesting outcomes to improve our knowledge of necessary buffer areas
- Conduct research to investigate the relationships between prey density, land use practices, and site occupancy or abundance
- Explore the use of artificial nest platforms by this species[1] as a short-term management tool to mitigate for nest site losses to impacts.

Public Outreach Strategies

- None identified

Ferruginous Hawk

Buteo regalis

References: [1]Bechard and Schmutz (1995); [2]Dechant et al. (1999); [3]GBBO unpublished Atlas data; [4]Leary et al. (1998); [5]Olendorff (1993); [6]Paige and Ritter (1999); [7]Rich et al. (2004); [8]Schmutz (1987); [9]Suter and Joness (1981); [10]White and Thurow (1985); [EO] Expert opinion



Sagebrush-woodland interface with scattered junipers, White Pine Co. Photo by John Boone

Golden Eagle

Aquila chrysaetos



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada
Cliffs Sagebrush (Salt Desert Scrub) (Mojave Scrub) (Joshua Tree) (Mojave Lowland Riparian) (Wet Meadow) (Pinyon-Juniper)

Key Habitat Parameters ●	
Plant Composition	Variety of open / semi-open landscapes with sufficient mammalian prey base; avoids heavily forested areas[10]
Cliff Properties (mean ± 1 SD)	25.5 (± 14.8) m [80 ± 50 ft] in SW Idaho; 21.7 (± 12.8) m [72 ± 42 ft] in N Utah[1]; multiple ledges preferred, with no consistent orientation preference[10]
Mosaic	Require suitable nest sites and sufficient prey base[10]
Distance to Water	No known relationship

Area Requirements ◑	
Minimum Patch Size	~ 250 km² [60,000 ac][EO]
Recommended Patch Size	> 1,000 km² [250,000 ac][EO]
Home Range / Territory Size	Variable by location, prey density, and season, but typical home range of ~ 250 km² / pair [60,000 ac / pair] in breeding season; defend territory of 20–35 km² [5,000 – 8,600 ac] or more[10]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Possible recent declines	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	G5, S4
USFWS	Eagle Act, Migratory Bird, Bird of Conservation Concern
BLM	Sensitive Species
USFS	None
NDOW	None
Trends	
Historical ●	Substantial declines[10]
Recent ◑	Recent data suggest declines regionally and in Nevada[10, 15]
Population Size Estimates	
Nevada (NBC) ◑	3,000
Global ◑	172,000 [14]
Percent of Global	2 %
Population Objective	
Maintain[EO]	
Monitoring Coverage	
Source	NDOW winter raptor surveys, Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Intact shrublands near suitable nesting cliffs
Restoration	Degraded / fragmented shrublands near suitable nesting cliffs

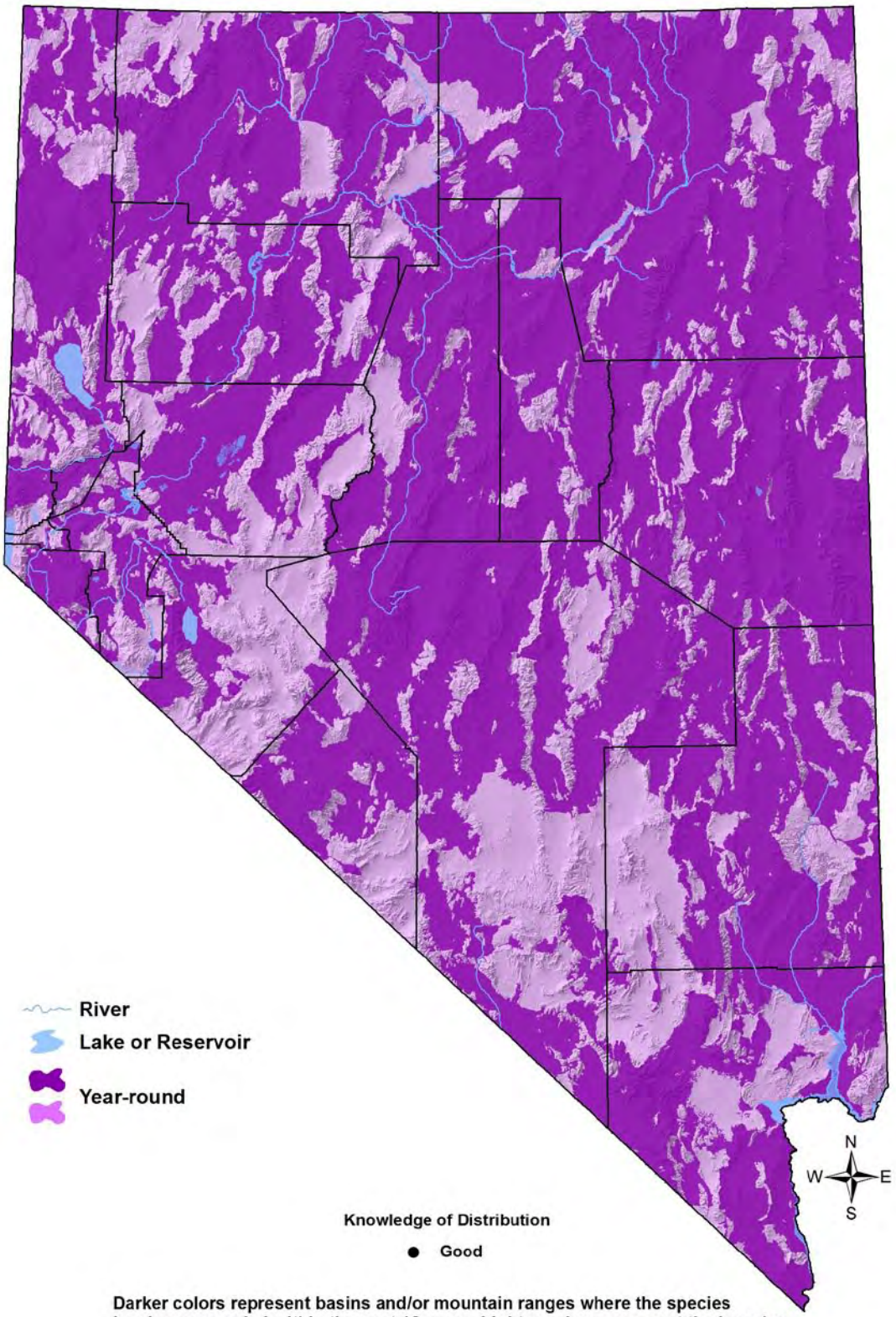
Natural History Profile

Seasonal Presence in Nevada	
Year-round, more abundant in winter	
Known Breeding Dates in Nevada	
Late January –August[5, 10]	
Nest and Nesting Habits	
Nest Placement	Most often on cliffs, but sometimes on ground, in trees, or on steep hillsides[10, 12]
Site Fidelity	High for breeding sites[10]
Food Habits	
Basic	Terrestrial hunter
Primary Diet	Jackrabbits, cottontails, large rodents[10]
Secondary Diet	Medium-sized birds (500 – 2,000 g) [1 – 4.5 lbs][10]

Confidence in Available Data: ●High ◑Moderate ○ Low

Golden Eagle

Aquila chrysaetos



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Golden Eagle

Aquila chrysaetos

Overview

The Golden Eagle's distribution is largely restricted to the west, with some of its highest densities in the shrubsteppe habitats of the Great Basin.[10] In Nevada, the only habitats routinely avoided by the Golden Eagle are forests, large agricultural areas, and urban areas. Although the Golden Eagle is a year-round resident of Nevada, home ranges, densities, and activity patterns likely shift seasonally.

Key limiting factors for Golden Eagle populations are prey densities and availability of nest sites near suitable prey populations.[2,10] For these reasons, habitat management should primarily focus on maintaining populations of jackrabbits, cottontails, and larger rodents such as ground squirrels. Once Golden Eagles reach adulthood, their main source of premature mortality appears to be collisions with structures and electrocutions from power lines or other electrical equipment.[12] Direct disturbance of nests appears to be infrequent, but localized disturbances can cause nest failure or abandonment.[10, EO]

Of particular concern are recent data suggesting that after several decades of relative stability, Golden Eagle numbers may again be declining in the West, particularly in the sagesteppe region.[4,6,8,10,16] This possibility needs to be further investigated in Nevada. Also of concern are possible effects of large-scale energy developments on the Golden Eagle's foraging habitat. Monitoring has been conducted by west-wide aerial surveys from 2003-2009.[11] In 2011, the Great Basin Bird Observatory and NDOW will conduct a statewide inventory of Golden Eagle nesting sites, which will supplement NDOW raptor surveys and the Nevada Bird Count and improve our ability to evaluate population trends.

Abundance and Occupancy by Habitat

- The NBC-based Nevada population estimate of 3,000 is close to Herron's[7] earlier estimate of 2,400
- Nest spacing of 0.8 – 16 km (mean 4.3 km) [0.5 – 10 mi, mean 2.7 mi] is typical in suitable habitat in southwestern Idaho[10]
- In Nevada, the highest Golden Eagle densities have been observed in long stretches of cliff located along river systems[7]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

<u>Habitat and Other Threats</u>

- Reduction in prey populations due to degradation or loss of rangelands
- Large-scale wind/solar energy developments in rangelands could reduce prey densities and hunting opportunities

Golden Eagle

Aquila chrysaetos

- Electrocution may be significant source of mortality in some areas; vehicles on roadways may also cause significant mortality in some areas[10,12,EO]
- Human disturbance or activity may cause nest abandonment, render a nest site less productive, or prevent a suitable nest site from being utilized[10,13]
- Shooting and poisoning are much less common than in the past, but still may occur; the most important current source of poisoning may be mine tailings and heap leach [EO]

Conservation Strategies

Habitat Strategies

- Cliff (p. Hab-4-1) and Sagebrush (p. Hab-17-1) habitat conservation strategies benefit this species
- Manage open habitats for healthy mammalian prey populations, particularly jackrabbits and cottontails
- When siting energy developments, proximity to known or likely Golden Eagle nesting areas should be avoided, ideally with a 10 km or 6 mile buffer
- In areas with actual or potential nest disturbance issues, establish disturbance-free buffer zones of 1 km (0.6 mile) around nest locations where possible[3,17]
- To minimize electrocution deaths, use Eagle Guards on transmission lines with high electrocution risk,[3] and ensure that new lines are built to specifications established by the Avian Power Line Interaction Committee (newly updated)[1]
- Encourage burial of mining drip lines to minimize risk of poisoning[EO]

Research, Planning, and Monitoring Strategies

- Improve monitoring and survey coverage, and conduct additional analysis, to better quantify current population trends, conservation requirements, and habitat needs
- U.S. Fish and Wildlife Service has new inventory and monitoring protocols that should be implemented in Nevada[13]

Public Outreach Strategies

- Pursue road signage and public education to reduce the frequency of vehicular deaths[EO]

References: [1]Avian Power Line Interaction Committee (2006); [2]Beecham and Kochert (1975); [3]DeLong (2004); [4]Farmer et al. (2008); [5]GBBO unpublished Atlas data; [6]Good et al. (2007); [7]Herron (1985); [8]Hoffman and Smith (2005); [9]Kochert and Steenhof (2002); [10]Kochert et al. (2002); [11]Nielson et al. (2010); [12]Page and Seibert (1973); [13]Pagel et al. (2010); [14]Rich et al. (2004); [15]Sauer et al. (2008); [16]Smith et al. (2008); [17]Suter and Joness (1981); [EO] Expert opinion

Peregrine Falcon

Falco peregrinus



Photo by Christy Klinger

Habitat Use Profile

Habitats Used in Nevada	
Cliffs (Mojave Lowland Riparian) (Mojave Scrub) (Marsh)	
Key Habitat Parameters ◑	
Plant Composition and Density	Does not have strong vegetation preferences
Mosaic	Many habitat types flown or foraged over, but always near cliffs or elevated nesting sites and suitable prey populations[11]
Distance to Water	Usually breeds in proximity to a water body[4]
Prey Populations	Presence of suitable avian prey base required
Cliff Properties	Usually 12 – 200 m [40 – 640 ft] tall, mean height 100 m [330 ft] tall, with ledges ~ 1/3 down, usually oriented to north or west [11, EO] ; some overhead cover preferred[11]
Area Requirements ◑	
Minimum Patch Size	~ 400 km^2 [100,000 ac][EO]
Recommended Patch Size	> 1,200 km^2 [300,000 ac][EO]
Home Range	Typically 300 – 1,500 km^2 [75,000 – 375,000 ac], but varies greatly with prey abundance; typically forages ~ 10 km [6 mi] from nest site[11]

Conservation Profile

Priority Status	
Special Status Species	
Species Concerns	
Historical declines	
Other Rankings	
Continental PIF	Stewardship Species
Audubon Watchlist	None
NV Natural Heritage	G4, S2
USFWS	ESA De-listed, Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	Sensitive Species
NDOW	Conservation Priority
Trends	
Historical ●	Historical declines, with very large declines in 1950s - 1970s [11]
Recent ◑	Stable or increasing[11]
Population Size Estimates	
Nevada ◑	140-180 [EO]
Global ◑	340,000 [9]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[10, EO]	
Monitoring Coverage	
Source	NDOW and Lake Mead NRA surveys
Coverage in NV	Good
Key Conservation Areas	
Protection	Lake Mead NRA
Restoration	Areas with depleted prey base near suitable cliffs

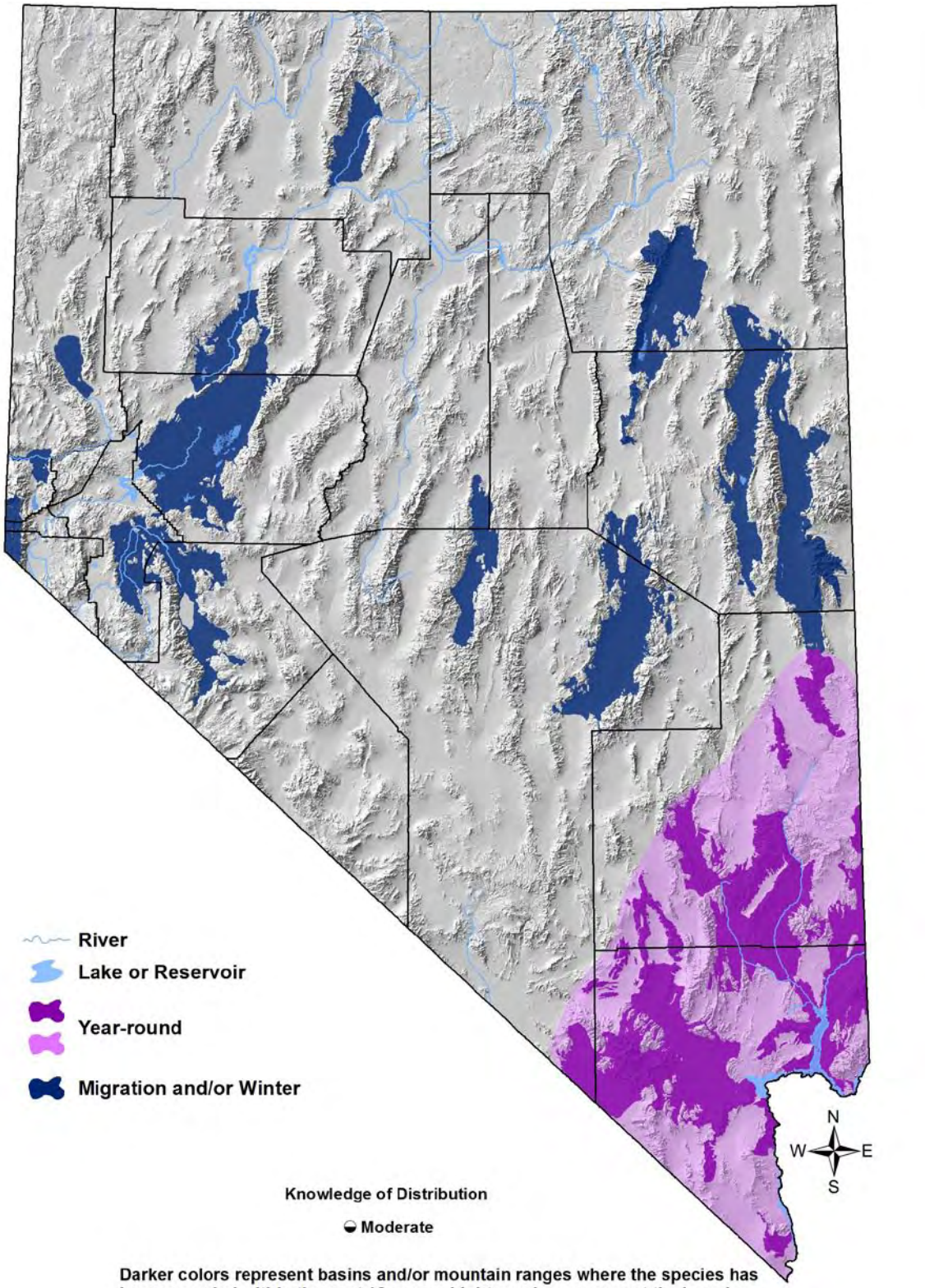
Natural History Profile

Seasonal Presence in Nevada	
Year-round in Lake Mead area; Summer – Spring and/or Migration elsewhere	
Known Breeding Dates in Nevada	
Late Feb – July[EO]	
Nest and Nesting Habits	
Nest Placement	Cliffs or building ledges[11]
Site Fidelity	High [11]
Other	See Cliff Properties in Habitat Use Profile
Food Habits	
Basic	Aerial predator
Primary Diet	Mid- to small-sized birds[11]
Secondary Diet	Occasionally bats or other mammals[11]

Confidence in Available Data: ●High ◑Moderate ○ Low

Peregrine Falcon

Falco peregrinus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropiate habitat types.

Peregrine Falcon

Falco peregrinus

Overview

The Peregrine Falcon is a flagship species of avian conservation, and is among the largest and most successful species recovery effort of the Endangered Species Act.[2] After the near-extinction caused by widespread use of eggshell-thinning DDT and other chlorinated hydrocarbons in the 1950s – 1970s, Peregrine Falcons recovered sufficiently to be removed from the Endangered Species List in 1999.

After a period of absence, the Peregrine Falcon was rediscovered in Nevada when a breeding pair was detected along the cliffs of Lake Mead in 1985. An ongoing natural recolonization was then augmented by NDOW's reintroduction of 48 birds between 1988 and 1993.[7] At present, Peregrine Falcons in Nevada are concentrated around the Lake Mead NRA, where they nest on earthen and rock cliffs surrounding the reservoir. This apparent Mojave Desert orientation of the species, however, is at least partly an artifact of an incomplete recovery that is presumably being driven by colonizers from the south.[11] Historical breeding occurred throughout a greater portion of Nevada, and some of this former breeding range could eventually be reoccupied. Indeed, new territories are discovered in southern Nevada each year, progressively farther away from the core Lake Mead population center. Populations in northern California are doing very well and may be a source for new dispersal into western Nevada.[6] In summer of 2003, a nesting pair was observed in the White Pine Range in eastern Nevada, and in 2009, four young were fledged in Lincoln County.[7, (C. Klinger *pers. comm.*)] Marshes and nearby uplands throughout much of the state are already used as foraging sites by migrating falcons. Migrant population counts have also increased in the Goshute Mountains (1983-2001).[5] Given this pattern of expansion, the range map shown above (which currently indicates no breeding in the Great Basin portion of Nevada) may well require revision in the future.

The species remains closely monitored, and many species protection measures are in place.[10] Key conservation needs are protecting known nesting locations from excessive disturbances and maintaining sufficient avian prey populations. Conserving marshes may also benefit migrating Peregrine Falcons. The Peregrine Falcon is a Covered Species in the Clark County MSHCP[3], and is also covered in the Humboldt-Toiyabe National Forest Plan and the Regional Plan for the Lake Tahoe Basin.

Abundance and Occupancy by Habitat

The population estimate given in the Conservation Profile Table (140 – 180 birds) is based on approximately 100 known breeding birds detected in 2010, plus an estimated 40 – 80 undetected breeders throughout the state (C. Klinger, *pers. comm.*). The *Nevada Wildlife Action Plan*[8] reports a lower breeding population (10 nesting pairs), probably based on earlier information.

Peregrine Falcon

Falco peregrinus

Nevada-Specific Studies and Analyses

NDOW and Lake Mead NRA Monitoring Studies

Ongoing monitoring of known breeding territories suggest stable to increasing rates of nest occupancy, success, and productivity in southern Nevada (C. Klinger, *pers. comm*.).

Main Threats and Challenges

Habitat and Other Threats

- As a well-managed recovering species, there are currently no major threats known
- Energy development (wind and solar) may impact foraging areas
- Nest disturbance (i.e. recreational rock climbing), illegal or legal falconry take, or persecution may be localized threats



Recently fledged Peregrine Falcon. Photo by Joe Barnes.

Peregrine Falcon

Falco peregrinus

Conservation Strategies

Established Strategies

- Monitoring of Peregrine Falcons is prescribed by the USFWS' *Monitoring Plan for the American Peregrine Falcon*[10]

Habitat Strategies

- The Cliff (p. Hab-4-1) habitat conservation strategy benefits this species
- Manage habitat near known or likely nesting locations and consistently-used migratory sites for avian prey productivity
- Protect known nesting cliffs or structures and adjacent foraging habitat from disturbance

Research, Planning, and Monitoring Strategies

- As a delisted species, the Peregrine Falcon is well-monitored in known breeding range[10]; however other monitoring programs should be primed to document breeding range expansions, should they occur
- Conduct exploratory surveys for new breeding activity. A call-playback protocol developed under the Clark County MSHCP specifically for Peregrine Falcons may be ideal for this purpose (J. Barnes *pers. comm*.)
- Conduct research to determine the presence of preferred habitat characteristics in areas distant from current high-quality breeding areas near water

Public Outreach Strategies

- Encourage seasonal closures of recreational climbing routes near known nest locations on managed lands

References: [1]Blancher, unpublished PIF data; [2]Cade et al. (1988); [3]Clark County (2000); [4]Herron et al. (1985); [5]Hoffman and Smith (2003); [6]Kauffman et al. (2004); [7]NDOW (2010); [8]Nevada Wildlife Action Plan Team (2006); [9]Rich et al. (2004); [10]U.S. Fish and Wildlife Service (2003); [11]White et al. (2002), [EO]Expert opinion

Peregrine Falcon

Falco peregrinus



Peregrine Falcon nesting cliffs, Grand Wash, southern Nevada. Photo by Joe Barnes.

Prairie Falcon

Falco mexicanus



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Cliff Sagebrush Mojave Scrub Salt Desert Scrub (Joshua Tree) (Wet Meadow) (Agriculture)	
Key Habitat Parameters ◑	
Plant Composition	Forage over saltbush, sagebrush, creosote bush, greasewood, agricultural crops, winterfat, native perennial grasses
Cliff Properties	Nesting cliff heights range from <25 m [80 ft] to >100 m [325 ft]; 60% of nests located on cliffs <30 m [100 ft] high[3]
Mosaic	Cliffs near suitable prey habitat; avoids dense cheatgrass[4, 8]
Distance to Water	No known relationship
Response to Vegetation Removal	Probably negative to shrub loss, depending on prey population response[4, 9, EO]
Area Requirements ◑	
Minimum Patch Size	~ 7,500 ha [18,500 ac][EO]
Recommended Patch Size	> 20,000 ha [50,000 ac][EO]
Home Range	5,000 – 7,500 ha [12,400 – 18,500 ac] or more[8]

Conservation Profile

Priority Status	
Stewardship Species	
Species Concerns	
High stewardship responsibility Unknown population trend	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Stewardship
Trends	
Historical ○	Unknown
Recent ○	Trends in Nevada unknown, possibly stable[7, EO]
Population Size Estimates	
Nevada (NBC) ◑	11,500
Global ◑	36,000 [6] (other estimates lower[3])
Percent of Global	~ 30%
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	Nevada Bird Count, NDOW raptor counts
Coverage in NV	Good
Key Conservation Areas	
Protection	Shrub and scrub lands near suitable nesting cliffs
Restoration	Same

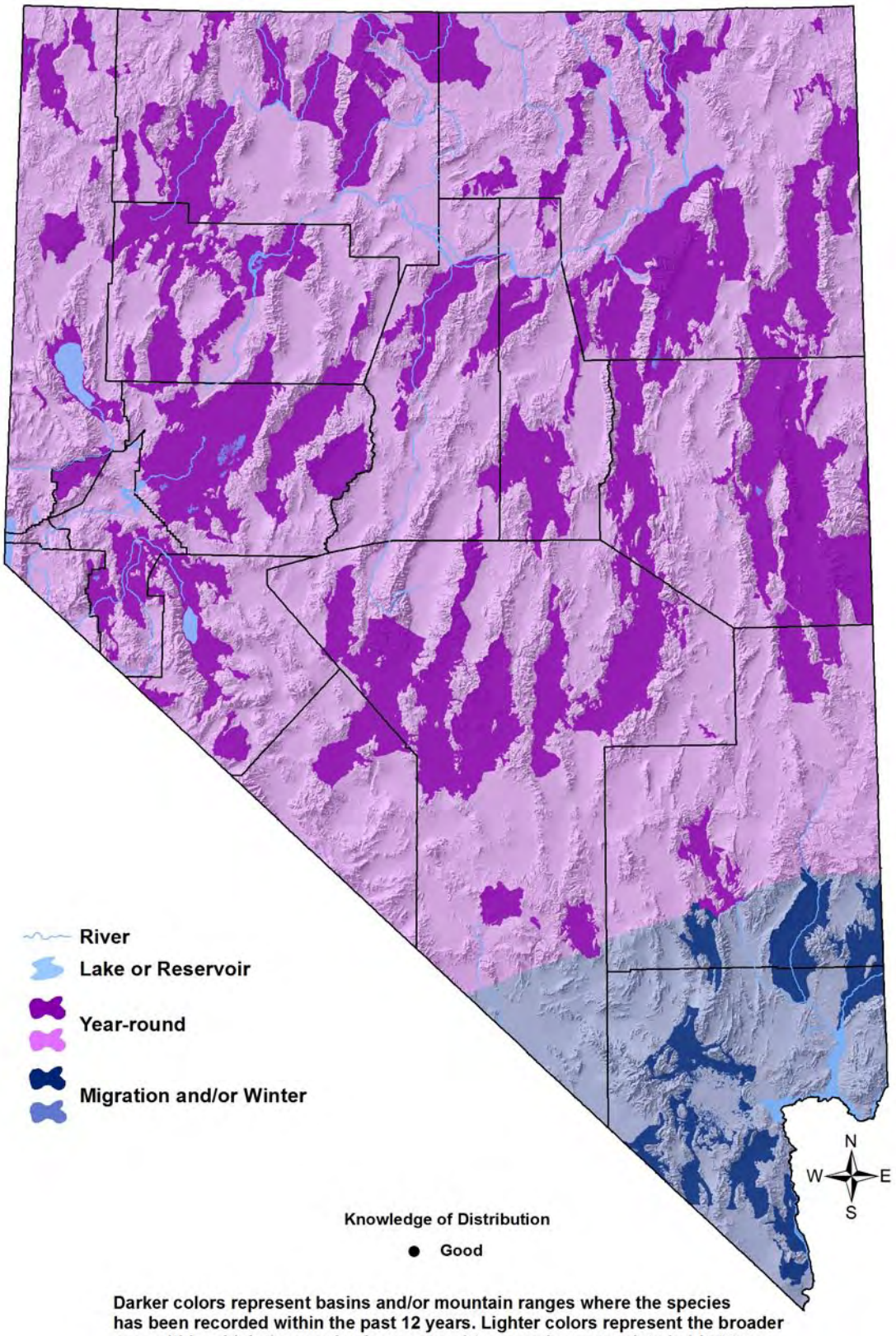
Natural History Profile

Seasonal Presence in Nevada	
Year-round; Winter only in southern Nevada	
Known Breeding Dates in Nevada	
February – July[2]	
Nest and Nesting Habits	
Nest Placement	On cliff ledge, usually on upper half of cliff, most often facing south or east[3, 5]
Site Fidelity	High for breeding sites[5]
Food Habits	
Basic	Aerial predator
Primary Diet	Small mammals, especially Townsend's ground squirrel[1, 4, 5, 8]
Secondary Diet	Small birds (especially in winter), reptiles[8]

Confidence in Available Data: ●High ◑Moderate ○ Low

Prairie Falcon

Falco mexicanus



Prairie Falcon

Falco mexicanus

Overview

A significant proportion of the world's Prairie Falcons inhabit Nevada, where their preferred landscapes (cliffs adjacent to arid valleys with low vegetation) are abundant. Prairie Falcons are most often observed foraging over a variety of sagebrush, salt desert, and Mojave scrub shrublands throughout the year, and they also occur in agricultural lands, especially during the winter months. Although the range map shown above correctly suggests a valley-bottom orientation, Prairie Falcons have also been documented to nest at higher elevations in foothills and lower mountain ranges (Teri Slatuaski, *pers. comm.*). Density and home range sizes vary considerably over time and space, depending on prey abundance patterns and the availability of suitable cliffs for nesting. Apart from localized disturbances to nesting cliffs, no serious threats to the species have been identified. However, given our high stewardship responsibility, it is important to maintain an ongoing monitoring effort in order to better understand population trends, which are currently not clear. Because Prairie Falcons respond strongly to prey availability, management of habitat to maintain or restore healthy populations of ground squirrels and other small mammals is likely to be an effective conservation strategy.

Abundance and Occupancy by Habitat

- Nests may be spaced as closely as ~ 0.5 km [0.3 mi] in good habitat; more typically 1 – 10 km [0.6 – 6.0 mi][8]
- Highest densities in Nevada reported to be "near mouth of narrow canyons, overlooking riparian vegetation and agricultural lands" [3]
- Herron et al.[3] estimated Nevada's population at 2,500 birds in 1985, considerably lower than the NBC-generated estimate of 11,500 birds and the BBS-generated estimate of 8,500 birds[6]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Human disturbances near nest sites may cause nest abandonment, especially when disturbances take place on the cliff top, above the nest[5]
- Small mammal (prey) populations can be negatively impacted if livestock grazing in shrublands significantly reduces forb and grass cover

Prairie Falcon

Falco mexicanus

- Heavy infestations of cheatgrass or other weeds may reduce small mammal (prey) density

Research, Planning, and Monitoring Challenges

- The possible impacts of illegal take for falconry are not known
- The manner in which various rangeland fire scenarios affect prey populations needs further study

Conservation Strategies

Habitat Strategies

- Cliff (p. Hab-4-1), Sagebrush (p. Hab-17-1), Salt Desert Scrub (p. Hab-18-1), and Mojave Scrub (p. Hab-12-1) habitat conservation strategies benefit this species
- If development or significant activity is occurring or planned near potentially suitable cliffs, survey for Prairie Falcon nests
- Where possible, maintain a 1 km [0.6 mi] disturbance-free buffer zone around nesting cliffs[10]
- To benefit prey populations, manage shrublands in the vicinity of cliffs to maintain or restore habitat-appropriate grass and forb cover, and to control invasive weeds

Research, Planning, and Monitoring Strategies

- Continue monitoring to better estimate ongoing population trend and population size
- Attempt to determine whether illegal take of Prairie Falcons negatively impacts population stability
- Further study how rangeland fires of varying size and intensity affect prey populations in the short and long term

Public Outreach Strategies

- None identified

References: [1]Dobkin and Sauder (2004); [2]GBBO unpublished Atlas data; [3]Herron et al. (1985); [4]Marzluff et al. (1997); [5]Paige and Ritter (1999); [6]Rich et al. (2004); [7]Sauer et al. (2008); [8]Steenhof (1998); [9]Steenhof et al. (1999); [10]Suter and Jones (1981); [EO] Expert opinion

Clapper Rail

Rallus longirostris



Photo by Jenny Ross

Habitat Use Profile

Habitats Used in Nevada
Marsh (Mojave Lowland Riparian)
Key Habitat Parameters ●
Plant Composition: Cattail, bulrush, sedges, willows, saltcedar
Plant Density: Low to moderate stem densities (< 80 / m² [7.5 / ft²]) required[9]
Mosaic: Shallow marsh with low to moderate stem densities and little residual vegetation, interspersed with dry spots, mudflats, and open water, and buffered by riparian zones[5, 9]
Water Depth: Some water < 30 cm [12 in] around margins of marsh, with some deeper water acceptable[3, 9]
Hydrology: Minimal fluctuation in stage[9]
Response to Vegetation Removal: Positive to prescribed burns in densely vegetated marshes[4, 9]
Area Requirements ●
Minimum Patch Size: 8 ha [20 ac][9]
Recommended Patch Size: > 150 ha [370 ac][9]
Home Range: < 24 ha [59 ac][9]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
ESA listing: Endangered subspecies (Yuma Clapper Rail) Small population size Habitat threats Restricted Habitat	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S1
USFWS	Endangered subspecies, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Endangered
Other	Covered by Clark County MSHCP amendment,[1] Lower Colorado River MSCP,[8] Virgin River HCRP[11]
Trends	
Historical ◑	Rangewide subspecies declines, but pattern in Nevada unclear[5]
Recent ◑	Stable or increasing[6]
Population Size Estimates	
Nevada ●	20 – 40 [6]
Global ◑	7,000 (Yuma Clapper Rail only)[9]
Percent of Global	0.4%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Secretive marshbird surveys by USFWS, BOR, SNWA, NWR's and others
Coverage in NV	Good
Key Conservation Areas	
Protection	Muddy and Virgin Rivers, Amargosa River, Ash Meadows NWR
Restoration	LV Wash and degraded or overgrown marshes

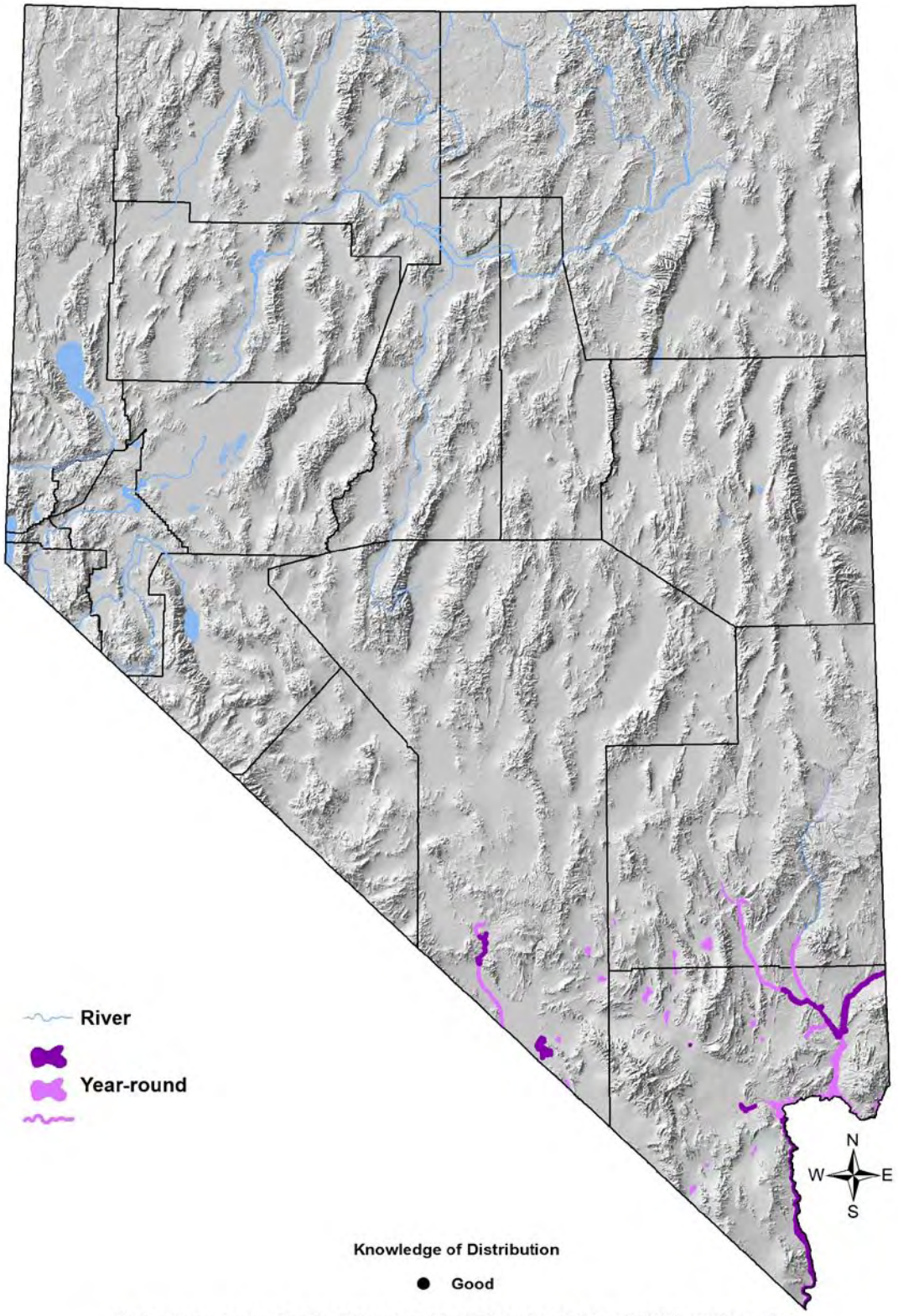
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Late March – August[5]	
Nest and Nesting Habits	
Nest Placement	Near shoreline in emergent vegetation, over ground or water < 2.5 cm [1 in] deep[5, 9]
Site Fidelity	Moderate for breeding territory[45]
Other	Multiple nests, re-nesting, moving of eggs[5, 9]
Food Habits	
Basic	Prober and pecker
Primary Diet	Crustaceans, especially crayfish,[9] clams
Secondary Diet	Small fishes, other vertebrates, seeds, insects, eggs[5]

Confidence in Available Data: ●High ◑Moderate ○ Low

Clapper Rail

Rallus longirostris



Dark colors represent critical Year-round habitat designated by USFWS. Lighter colors represent the areas within which the species could potentially occur.

Clapper Rail

Rallus longirostris

Overview

Clapper Rails inhabiting the inland southwest, including southern Nevada, belong to the "Yuma" subspecies, *R.l. yumanensis*. Unlike their coastal relatives, Yuma Clapper Rails are mostly restricted to a freshwater environment along the lower Colorado River system and its tributaries. Clapper Rails are found in large, shallow marshes with a moderate density of emergent vegetation, avoiding both open water and overgrown emergent stands.[9] Prescribed fire in overgrown marshes has recently been shown to be beneficial for this species without adversely affecting sympatric species, and thus might be a replacement for the historical floods that once provided the necessary disturbances.[4]

Most Clapper Rails in Nevada have been documented along the Virgin and Muddy Rivers,[8] but more recently, they were also confirmed at Ash Meadows NWR (C. Lundblad, *pers. comm.*). In addition to known breeding areas, other sites where breeding could potentially occur include the Las Vegas Wash and Pahranagat NWR. In Nevada, an average of about 14 Clapper Rails are detected during annual inventories,[6] but research indicates that only about 40% of the rails that are actually present are detected using standard survey methods.[3] Therefore, our conservative population estimate for Nevada is 20 - 40 individuals, with the range of values allowing for the annual variations that have been observed since the species was first surveyed in 2000. It is possible that Clapper Rails have become more common in Nevada in recent decades due to water impoundments and resulting marsh development along the lower Colorado River in areas that are farther north than the species' presumed historical range.[6] Clapper Rails may therefore be able to respond to projected warming trends with continue northward movements, if sufficient marsh habitat is available to them. Clapper Rails are thought to be mostly sedentary,[5] but their ability to disperse or move seasonally has not been examined in great depth.

As one of only two federally endangered bird subspecies in Nevada, detailed management recommendations for the Yuma Clapper Rail have been developed,[9] and are currently undergoing revision.[10] Our current understanding of the Yuma Clapper Rail's population trends, threats, and habitat requirements is derived largely from studies of Arizona populations, but with a continuation of current Nevada-based research and monitoring programs, a better understanding of Nevada's population will likely emerge.

Abundance and Occupancy by Habitat

- Nevada population estimate based on average of 14 birds detected annual, with a 40% detectability correction factor[3, 6]
- Density ranges from 0.1 – 0.8 birds / ha [0.04 – 0.32 / ac] in suitable habitat in Arizona[5]

Nevada-Specific Studies and Analyses

Species inventories by USFWS, SNWA, BOR, and others

Clapper Rail

Rallus longirostris

Main Threats and Challenges

Habitat Threats

- Loss or degradation of marshes due to water diversions, decline in water quality, development, or overgrowth
- Large changes in water level during nesting period

Research, Planning, and Monitoring Challenges

- Yuma Clapper Rails are assumed to be sedentary, but seasonal movement patterns have not been studied
- Clapper Rails require special survey techniques[2] because of their secretive habits

Conservation Strategies

Established Strategies

- The Yuma Clapper Rail Recover Plan,[9] currently under revision,[10] specifies conservation strategies for the subspecies. Key elements include:
  - Maintain consistent water levels in marshes in the Virgin and Muddy River Valleys
  - Control invasive plants in marshes
  - Control nest predators where unusual predation levels are documented
  - Continue ongoing monitoring and research to better determine population trends, threats, and habitat requirements

Habitat Strategies

- The Marsh (p. Hab-9-1) habitat conservation strategy benefits this species
- Yuma Clapper Rails probably respond positively to creation of artificial wetlands if habitat parameters are suitable
- Prescribed fire in overgrown marshes has been shown to have beneficial effects for these rails[4,9]

Research, Planning, and Monitoring Strategies

- Implement secretive marshbird survey protocols[2] in potential habitat
- Conduct studies to determine whether seasonal movements occur

Public Outreach Strategies

- None identified

References: [1]Clark County (2000); [2]Conway (2009); [3]Conway et al. (1993); [4]Conway et al. (2010); [5]Eddleman and Conway (1998); [6]Garnett et al. (2004); [7]LCRMSCP (2004); [8]Rathbun and Braden (2003); [9]USFWS (1983); [10]USFWS (2009); [11](Jeri Krueger, *pers. comm.*); [EO] Expert opinion

Sandhill Crane

Grus canadensis



Photo by Steve Ting

Habitat Use Profile

Habitats Used in Nevada	
Wet Meadow Marsh Agriculture Great Basin Lowland Riparian	
Key Habitat Parameters ◑	
Plant Composition	Bulrush, sedges, rushes, willows, grasses, agricultural crops (pasture, wheat, barley crops)
Plant Density	Unknown
Mosaic	Diversity of wetland types and structures, interspersed with agriculture[10]
Distance to Water	Always near water; nest success higher if surrounded by deeper water (> 30 cm [12 in])[8]
Hydrology	Seasonally stable stage preferred[10]
Response to Vegetation Removal	Negative [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown; but larger wet meadow / agricultural complexes probably preferred [EO]
Recommended Patch Size	> 150 ha [370 ac] [EO]
Territory Size	10 – 23 ha [25 - 57 ac][10]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines High stewardship responsibility (Lower Colorado River Valley population) Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3B
USFWS	Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ●	Range contractions and declines [5, 10]
Recent ◑	Stable or increasing[5, 10]
Population Size Estimates	
Nevada ◑	650 – 1,000 [9, EO]
Global ◑	700,000 [10]
Percent of Global	< 1% global; > 32% of Lower Colorado River Valley population [EO]
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	NDOW aerial surveys, NWR and WMA counts, Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Ruby Valley, Humboldt River and tributaries, Owyhee watershed, Boyd Wetland IBA
Restoration	Pahranagat Valley, main stem of Humboldt River system from Elburz to Mote

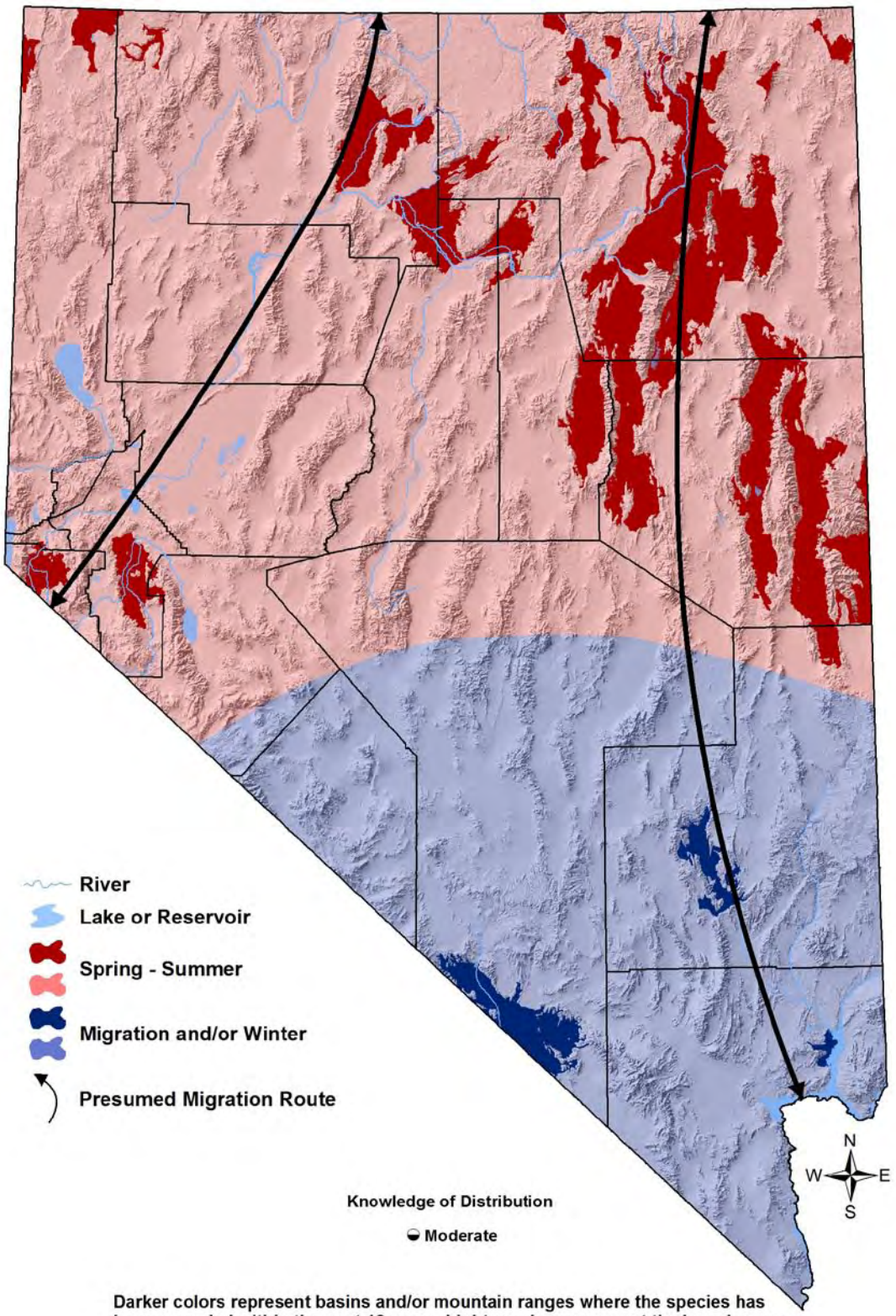
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (Great Basin) Spring and Fall (migration, especially Mojave)	
Known Breeding Dates in Nevada	
Early May – early August[4]	
Nest and Nesting Habits	
Nest Placement	On ground near water's edge or platform over water in marsh or flooded field[10]
Site Fidelity	Moderate to high for breeding sites[10]
Food Habits	
Basic	Prober and gleaner
Primary Diet	Invertebrates, grains, seeds, tubers[10]
Secondary Diet	Roots, small vertebrates[10]

Confidence in Available Data: ●High ◑Moderate ○ Low

Sandhill Crane

Grus canadensis



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Sandhill Crane

Grus canadensis

Overview

Nevada contains some of the Sandhill Crane's southernmost breeding sites, which are disjunct from the species' main breeding range in Canada and Alaska. Nevada breeding cranes belong to the subspecies *G. c. tabida*, the Greater Sandhill Crane. Within this subspecies, two distinct populations, named for their wintering grounds, breed here, the Lower Colorado River Valley population (LCRVP) in northwestern and central Nevada, and the Central Valley population (CVP) in western Nevada.[10] Sandhill Cranes occupy flat river valleys and basins, often where the landscape offers a mix of marsh, riparian, wet meadow, and agricultural habitats. They nest on or near water, preferentially using small islands or peninsulas where available. Foraging takes place in adjacent wet terrestrial habitats. Nevada also provides Sandhill Cranes with important migratory stopover sites, including several in southern Nevada where breeding does not occur.

Sandhill Cranes from both population segments are stable or increasing in Nevada, although low recruitment has occurred in some years and should be monitored.[3,6] The majority of Nevada's cranes depend significantly upon habitat on privately-owned lands, and public outreach is therefore an important component of a comprehensive conservation strategy. Additional work is needed to determine whether or not specific conservation issues exist at key migration stopover areas. Any such efforts should be coordinated closely with the existing Sandhill Crane research group headed by NDOW, which has been conducting radio-telemetry studies and species inventories at five-year intervals for the LCRVP. [1,2,7] Similar research and inventory efforts for the CVP would also be beneficial.

Abundance and Occupancy by Habitat

As part of its obligation under the Pacific Flyway Council LCRV Population Management Plan, NDOW conducts an aerial nesting population survey for Sandhill Cranes at five-year intervals. In 2005, NDOW documented a record high of 641 cranes in northern Nevada, including at least 215 breeding pairs.[7]

Nevada-Specific Studies and Analyses

NDOW is currently conducting radio-telemetry studies of the LCRVP, with full results forthcoming.[1,2,7] No comprehensive studies of the CVP in Nevada have been conducted.

Main Threats and Challenges

<u>Habitat and Other Threats</u>

- Loss or degradation of wet meadow, marsh, and riparian habitat due to:
  - Habitat conversion (agriculture, gravel operations, development, etc.)
  - Water diversions
  - Possible impacts of groundwater pumping in occupied areas

Sandhill Crane

Grus canadensis

  - Heavy livestock grazing during nesting and fledging season, particularly in wet meadows
  - Invasive plants
- Loss of traditional crop agriculture in migration stopover sites [EO]
- Early haying that impacts nests or young
- Effects of predator populations have been noted, but predator control efforts do not always increase crane productivity[7]

Research, Planning, and Monitoring Challenges

- Habitat threats at migration stopover sites need more study
- The CVP in Nevada has received less monitoring and study than the LCRVP

Conservation Strategies

Habitat Strategies

- Wet Meadow (p. Hab-20-1), Marsh (p. Hab-9-1), Agriculture (p. Hab-1-1), and Great Basin Lowland Riparian (p. Hab-7-1) habitat conservation strategies benefit this species
- Manage wet meadows for maximum vegetation cover from 1 April – 15 July
- Protect water inflows in marsh and wet meadow areas used by cranes

Research, Planning, and Monitoring Strategies

- Continue monitoring of the LCRVP at five-year intervals
- Implement a five-year interval monitoring program for the CVP
- In areas potentially impacted by groundwater pumping, monitor for changes in water supplies and for impacts on crane productivity

Public Outreach Strategies

- Work with landowners in areas used by cranes to encourage:
  - Deferring haying until after 15 July
  - Use of flushbars on harvest equipment, especially before 15 July
  - Conservation of wet meadows, marshes, and riparian woodlands on private land
  - Encourage traditional agricultural practices

References: [1]August et al. (2009); [2]Bradley (2005); [3]Drewien et al. (1995); [4]GBBO unpublished Atlas data; [5]Ivey and Dugger (2008); [6]Ivey and Herziger (2006); [7]Laca et al. (2008); [8]McWethy and Austin (2009); [9]Nevada Wildlife Action Plan Team (2006); [10]Tacha et al. (1992); [EO] Expert opinion

Snowy Plover

Charadrius alexandrinus



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Ephemeral Wetland and Playa (Open Water (shorelines))	
Key Habitat Parameters ●	
Plant Density	Very sparse or barren; avoids all moderately to densely vegetated areas[6]
Mosaic	Alkali flat, mudflat, or flat beach adjacent to permanent or seasonal surface water; unvegetated or nearly so; often in highly alkaline soils[6]
Hydrology & Water Quality	Readily accepts ephemeral wetlands and alkaline conditions, but water must be present during breeding season, even if only as a small seep[6, 10]
Response to Vegetation Removal	Neutral or positive [EO]
Area Requirements ○	
Minimum Patch Size	Unquantified, but sometimes present adjacent to very small seeps[10]
Recommended Patch Size	> 10 ha [25 ac] [EO]
Home Range and Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and possible recent declines Habitat threats Small population size	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Critically Important
Trends	
Historical ◑	Rangewide declines[6]
Recent ○	Declining regionally, trends in Great Basin not well quantified
Population Size Estimates	
Nevada ◑	~ 350 – 1,000, with high annual variability[2, 3]
Global ○	18,000 [4] (North American population)
Percent of Global	2% (% of North American population)
Population Objective	
Increase by 100% [EO]	
Monitoring Coverage	
Source	NDOW shorebird surveys, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Fair for established management areas, Poor for many playa lakes
Key Conservation Areas	
Protection	Northwest playa lakes, Lahontan Valley
Restoration	Playa lakes or springs that are dewatered during the breeding season

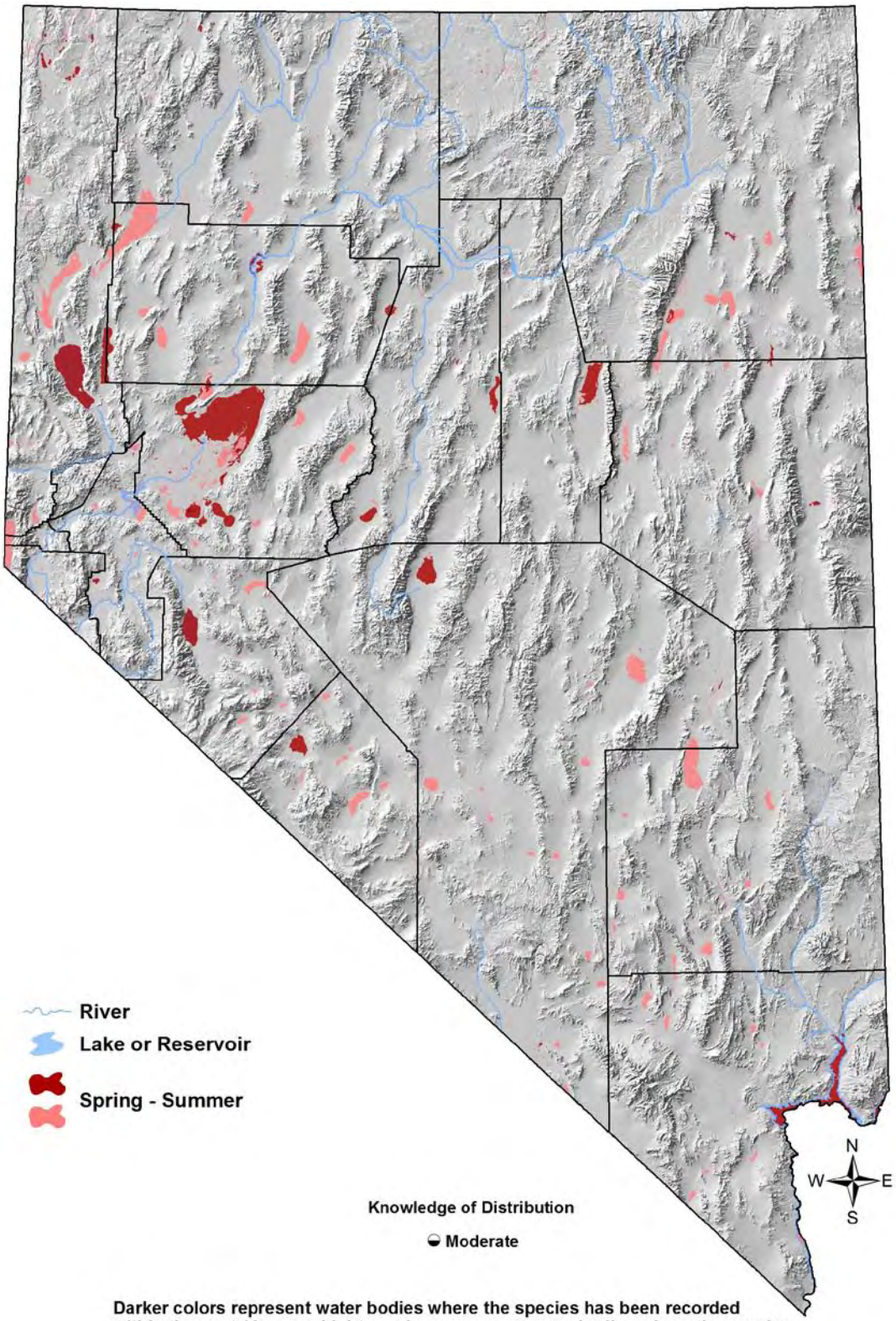
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late March – July[1, 2]	
Nest and Nesting Habits	
Nest Placement	Scrape on bare ground, usually near water edge but can be up to 3 km [1.8 mi] away[6]
Site Fidelity	Moderate for breeding sites with predictable water[6, 10]
Food Habits	
Basic	Prober and ground gleaner
Primary Diet	Benthic, aquatic, and terrestrial invertebrates, such as brine flies and brine shrimp[6]
Secondary Diet	N/A

Confidence in Available Data: ●High ◑Moderate ○ Low

Snowy Plover

Charadrius alexandrinus



Darker colors represent water bodies where the species has been recorded within the past 12 years. Lighter colors represent water bodies where the species could potentially occur. Smaller water bodies may be difficult to visualize on the map.

Snowy Plover

Charadrius alexandrinus

Overview

It is easy to describe the Snowy Plover's habitat preferences in Nevada, namely the barren shorelines of alkaline playa lakes. Nevada breeders are part of the species' interior population, and they are not part of the federally listed Western Snowy Plover population of the Pacific coast. The interior population has its own conservation issues, however, which have been best studied at Great Salt Lake, where at least half of the inland population breeds.[7] In Nevada, at least 85 sites either have confirmed Snowy Plover records, or meet the basic breeding habitat requirements of the species. In the recent USFWS Regional Inventory of Western Snowy Plovers, conducted in Nevada by GBBO and NDOW in 2007-2008, Snowy Plovers were located at 20 sites, 14 of which had confirmed breeding. One of these, Lake Mead, had not previously been known as a Snowy Plover breeding site. In this inventory, 350 adults were recorded, with the greatest numbers of birds at Big Well (Railroad Valley), Gridley Lake, the Muddy River delta of Lake Mead, Massacre Lakes, and Stillwater NWR. In other recent surveys, Carson Lake in Lahontan Valley and Ash Meadows NWR have also been hotspots for the species.

The Snowy Plover has been declining regionally for an extended period, and it seems likely that Nevada's population has been declining as well. Quantifying a long-term trend for Nevada is difficult, however, because it is obscured by the "noise" of shorter-term fluctuations that occur in response to drought cycles or other factors, both regional and local. For instance, counts in western Nevada playas in 1988 totaled only 71% of 1980 population levels,[4,5] probably due to drier conditions and loss of water in many playas. At the same time, however, the number of plovers increased on Walker Lake, probably because recent drops in the lake's water level created new habitat consisting of recently exposed, moist, and barren shoreline.[5] Also during the same time frame, a severe decline in Snowy Plover numbers in Owens Lake, CA, was reversed by the shallow flooding of large areas for dust control.[8] These complex spatial and temporal patterns of plover abundance highlight an important feature of the species' biology, namely that overall population health depends on being able to shift to alternative breeding locations when conditions at the primary locations are unsuitable.

The most obvious threat facing Snowy Plovers in Nevada is the diversion of runoff water away from the terminal playas where it historically collected.[9] Further efforts are needed to catalogue the scope of this problem, and to determine the degree to which it can be reversed or mitigated. Additionally, the possible impacts of other habitat threats have received very little study or attention.

Abundance and Occupancy by Habitat

Known peak population in recent decades was ~ 900 breeding birds in northwestern Nevada in 1980.[3] In the most recent inventory (2007-2008), Nevada populations were estimated at < 400.

Snowy Plover

Charadrius alexandrinus

Nevada-Specific Studies and Analyses

There have been at least two systematic Snowy Plover inventory efforts in Nevada, one by Page et al.[5] in the late 1980s, and more recently by GBBO and NDOW in 2007-2008. There has been no species-specific ecological or conservation research in the state, however.

Main Threats and Challenges

Habitat Threats

- Dewatering of playas or springs during the breeding season due to water diversions or drought

Research, Planning, and Monitoring Challenges

- Nevada-specific population trends need to be better clarified
- Dewatering of playas by water diversion needs to be more systematically catalogued and monitored

Conservation Strategies

Habitat Strategies

- The Ephemeral Wetland and Playa (p. Hab-6-1) habitat conservation strategy benefits this species
- Protect or restore season water inflow for playas through the end of the breeding season (approximately 1 July)
- Manage or restrict playa activities to protect the integrity of the clay soil pan and maximize water retention

Research, Planning, and Monitoring Strategies

- Continue periodic species-specific (or playa-centric) inventory efforts to clarify long-term population trends
- Investigate the extent to which water diversions reduce the amount of suitable breeding habitat for Snowy Plovers, and investigate opportunities to reverse or mitigate dewatering

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]GBBO unpublished Snowy Plover inventory data; [3]Herman et al. (1988); [4]Morrison et al. (2006); [5]Page and Stenzel (1991); [6]Page et al. (2009); [7]Paton (1995); [8]Ruhlen et al. (2006); [9]Shuford et al. (2002); [10]Shuford and Gardali (2008); [EO] Expert opinion

Black-necked Stilt

Himantopus mexicanus



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Ephemeral Wetland and Playa Open Water (shorelines)	
Key Habitat Parameters ●	
Plant Composition	Cattail, sedges, rushes
Plant Density	Sparse or no emergent vegetation[1]
Mosaic	Shallow marsh with sparse emergent vegetation, interspersed with dry spots, mudflats; also playa margins[7]
Water Depth	< 30 cm [12 in] [EO]
Water Quality	Prefers relatively low salinity[7]
Hydrology	Stage can be variable [EO]
Response to Vegetation Removal	Probably neutral [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 130 ha [320 ac][7]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Critically Important
Trends	
Historical ◑	Range contractions, but extent of declines unclear[7]
Recent ◑	Unknown, thought to be declining in Nevada [EO]
Population Size Estimates	
Nevada ◑	~ 3,000, with high annual variability [EO]
Global ◑	175,000 [1, 4]
Percent of Global	~ 2 %
Population Objective	
Increase by 30% [EO]	
Monitoring Coverage	
Source	NDOW Lahontan Valley counts, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in managed areas, Fair / Poor elsewhere, especially playas
Key Conservation Areas	
Protection	Lahontan Valley, Humboldt system, Lake Mead
Restoration	Degraded / dewatered marshes and playa wetlands, mitigation wetlands

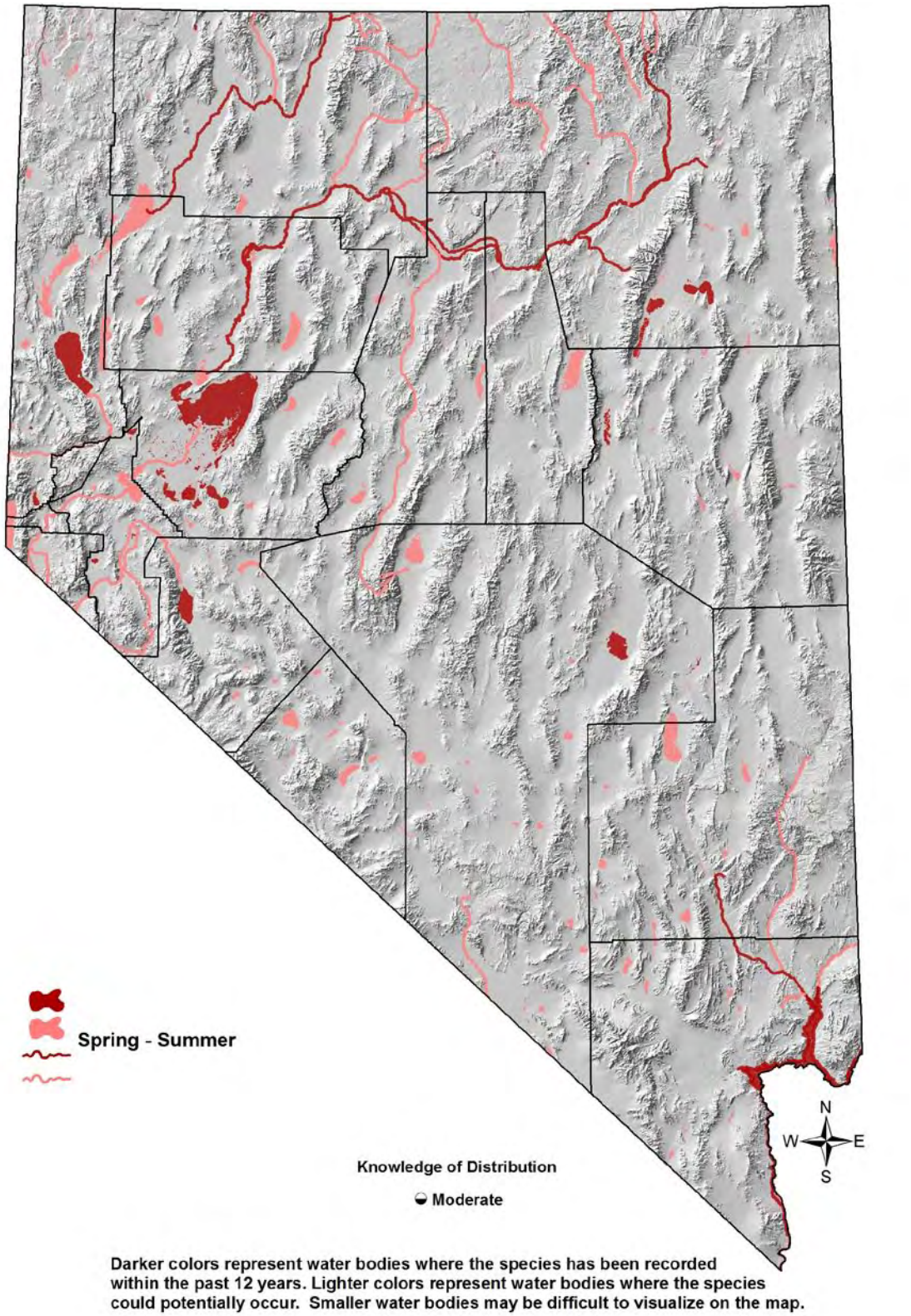
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer Fall and Spring (migration)	
Known Breeding Dates in Nevada	
Early April – July[2]	
Nest and Nesting Habits	
Nest Placement	On ground near shore in sparse vegetation, or slightly elevated over water on mats of vegetation[7, EO]
Site Fidelity	Unknown
Other	Semi-colonial nester[7]
Food Habits	
Basic	Prober
Primary Diet	Invertebrates from sediment or water[7]
Secondary Diet	Small fish, seeds[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Black-necked Stilt

Himantopus mexicanus



Black-necked Stilt

Himantopus mexicanus

Overview

Like the more numerous and equally handsome American Avocet, the Black-necked Stilt is able to exploit ephemeral wetlands and other temporarily favorable wetland conditions. During wet years, when suitable habitat is widely available, their populations can show significant peaks. Compared to avocets, stilts are somewhat less tolerant of saline or alkaline waters, are less colonial, and also are more likely to forage within emergent vegetation.[7] Overall, the American Avocet is slightly better documented in Nevada than the Black-necked Stilt, probably because its population is larger. Stilts breed more commonly in the Great Basin portion of the state, but southern Nevada has breeding strongholds as well in the Lake Mead area and at Ash Meadows NWR. As is the case with many other Conservation Priority shorebirds, Lahontan Valley is Nevada's most consistently important site for Black-necked Stilts. For this reason, it has been designated as a "Site of Hemispheric Importance" by the Western Hemisphere Shorebird Reserve Network (www.whsrn.org).

Black-necked Stilts are also common in Nevada during migration, particularly during the fall.[8] They wander widely across the Great Basin in the post-breeding season, moving among wetlands as the summer progresses and some sites dry out or become otherwise unsuitable, and this ability to shift among seasonally-available ephemeral wetlands is a critical feature of the Black-necked Stilt's adaptive biology.[6] Conservation strategies need to provide for the protection of suitable wetland habitat well beyond the breeding season. This complicates the management challenge, since the sites that are important for breeding may not be the same as the sites that are important for post-breeding wandering and migration. Because of their substantial similarities, Black-necked Stilts and American Avocets can be regarded as having the same management needs in most circumstances.

Abundance and Occupancy by Habitat

- The Nevada population estimate is based on an average count of 2,400 for Lahontan Valley and 600 in other scattered sites across the state (L. Neel, pers. comm.)
- The most recent ten-year peak population estimate is ~ 7,000 birds,[3] and a peak of 8,000 birds in Lahontan Valley alone was recorded in 1987 [5]

Nevada-Specific Studies and Analyses

No information

Black-necked Stilt

Himantopus mexicanus

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of ephemeral and permanent wetlands due to water diversions or development
- Increased salinization of wetlands and accumulation of contaminants[7]
- Because Black-necked Stilts use ephemeral wetlands and wet playas extensively, they may be impacted by changing precipitation patterns associated with climate change

Research, Planning, and Monitoring Challenges

- Populations using ephemeral wetlands are not well monitored
- The impact of water quality is not well-studied

Conservation Strategies

Habitat Strategies

- Ephemeral Wetland and Playa (p. Hab-6-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- Promote seasonal fresh-water runoff into ephemeral wetlands and playas, as well as into sparsely-to-moderately vegetated permanent marshes, sufficient to create mudflats and maintain a shallow-water shoreline for the longest possible period
- Manage or restrict playa activities to protect the integrity of the clay soil pan and maximize water retention
- Wetlands with uneven bottoms and shallow islands are especially important for nesting [EO]
- Artificial mitigation wetlands can provide productive breeding habitat. Ideal configuration is > 130 ha [320 ac] wetland with a 2:1 ratio of shallow water (<15 cm [6 in]) feeding areas to elevated nesting areas[1]

Research, Planning, and Monitoring Strategies

- Improve monitoring coverage of ephemeral wetlands and playas from the breeding season through the post-breeding and fall migration periods[9]
- Conduct additional study to determine tolerance to water quality variations

Public Outreach Strategies

- None identified

References: [1]Brown et al. (2001); [2]GBBO unpublished Atlas data; [3]IWJV (in prep.); [4]Morrison et al. (2006); [5]Neel and Henry (1996); [6]Robinson and Oring (1996); [7]Robinson et al. (1999); [8]Shuford et al. (2002); [9]Warnock et al. (1998); [EO] Expert opinion

American Avocet

Recurvirostra americana



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Ephemeral Wetland and Playa Open Water (shorelines)	
Key Habitat Parameters ●	
Plant Composition	Cattail, bulrush, sedges, rushes, saltgrass
Plant Density	Sparse or no emergent vegetation[9]
Mosaic	Shallow marsh with sparse emergent vegetation, large mudflats, and dry islands; also playa margins[9]
Water Depth	< 20 cm [8 in] preferred[9]
Water Quality	Tolerant of alkaline, saline conditions, but chicks require fresh water inflows[6]
Hydrology	Requires shallow standing water[9]
Response to Vegetation Removal	Probably neutral [EO]
Area Requirements ◑	
Minimum Patch Size	~ 130 ha [320 ac] [EO]
Recommended Patch Size	>150 ha [370 ac] [EO]
Home Range and Movements	Unknown breeding home range, but 200 km [125 mi] movements common post-breeding[7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Critically Important
Trends	
Historical ◑	Range contractions, but extent of declines unclear[9]
Recent ◑	Stable[1]
Population Size Estimates	
Nevada ◑	~ 18,000, with high annual variability [EO]
Global ◑	450,000 [1]
Percent of Global	~ 4%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW Lahontan Valley counts, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in managed areas, Fair / Poor elsewhere, especially playas
Key Conservation Areas	
Protection	Lahontan Valley, Humboldt system, Ash Meadows NWR, Lake Mead
Restoration	Degraded/dewatered marshes and playa wetlands, mitigation wetlands

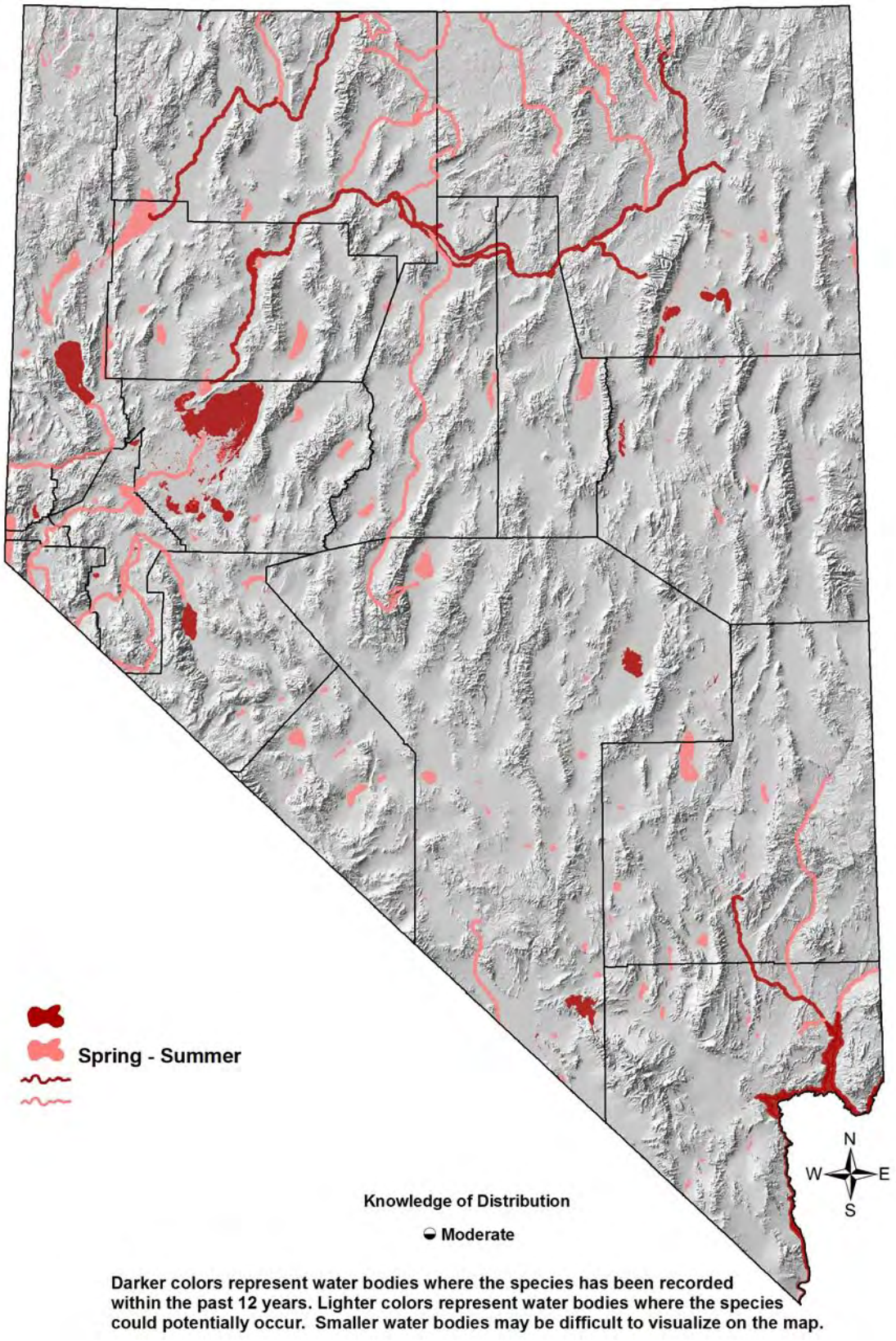
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer Fall and Spring (migration)	
Known Breeding Dates in Nevada	
Early April – July[2]	
Nest and Nesting Habits	
Nest Placement	Ground on sparsely vegetated shoreline or island, or on matted-down vegetation[9, EO]
Site Fidelity	Probably low [EO]
Other	Semi-colonial breeder[9]
Food Habits	
Basic	Prober
Primary Diet	Invertebrates from sediment or water[9]
Secondary Diet	Small fish, seeds[9]

Confidence in Available Data: ●High ◑Moderate ○ Low

American Avocet

Recurvirostra americana



American Avocet

Recurvirostra americana

Overview

The American Avocet is one of Nevada's most visible and characteristic shorebirds, often seen in association with Black-necked Stilts, which it typically outnumbers. Compared to stilts, avocets are more tolerant of alkaline and saline conditions, are more colonial, and are less likely to forage in emergent vegetation. Although the avocet's breeding range extends throughout Nevada, they are more often recorded in the northern half of the state, and more intermittently distributed in the south. American Avocets readily use ephemeral wetlands, including playa lakes, and as such, their numbers can vary substantially from year to year depending on precipitation patterns. They are also found on mudflats along larger waterbodies, particularly on shorelines recently exposed by receding water, or where newly-flooded areas become available.[4] As is the case with many other Conservation Priority shorebirds, Lahontan Valley is Nevada's most consistently important site for American Avocets. For this reason, it has been designated as a Site of Hemispheric Importance by the Western Hemisphere Shorebird Reserve Network (www.whsrn.org).

Avocets in our region wander widely among Great Basin wetlands after breeding to locate alternate wetlands as the summer progresses and some sites dry up or become otherwise unsuitable. Migrants are also very common in Nevada, particularly in the fall,[10] when they are often seen on mudflats exposed by receding waters.[6] In fact, peak fall migration numbers probably exceed peak breeding numbers by a considerable margin.[5] During the post-breeding and migration period, avocets depend on the availability of low-elevation ephemeral and permanent wetlands scattered across very large landscapes (> 10,000 km^2 [2.5 million ac]).[7] This ability to shift among seasonally-available ephemeral wetlands is a critical feature of the avocet's biology.[8] Conservation strategies should therefore address the protection of suitable wetland habitat well beyond the breeding season and across regions. This complicates the management challenge, since the sites that are important for breeding may not be the same as the sites that are important for post-breeding wandering and migration.

Abundance and Occupancy by Habitat

- The Nevada population estimate is based on an average count of 12,500 for Lahontan Valley, plus 5,500 birds from other consistently productive sites (L. Neel, *pers. comm.*)
- The most recent ten-year population peak is ~ 33,000 birds[3]

Nevada-Specific Studies and Analyses

No information

American Avocet

Recurvirostra americana

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of ephemeral and permanent wetlands due to water diversions or development
- Loss of fresh-water inflows needed by chicks during brood-rearing[6]
- Because American Avocets use ephemeral wetlands and wet playas extensively, they are likely to be impacted by changing precipitation patterns associated with climate change

Research, Planning, and Monitoring Challenges

- Populations using ephemeral wetlands are not well monitored
- Although American Avocets are tolerant of alkaline and somewhat saline conditions, the impact of other water quality parameters is not well-studied

Conservation Strategies

Habitat Strategies

- Ephemeral Wetland and Playa (p. Hab-6-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- Promote seasonal fresh-water runoff into ephemeral wetlands and playas, as well as into sparsely-vegetated permanent marshes, sufficient to create mudflats and maintain a shallow-water shoreline for the longest possible period
- Manage or restrict playa activities to protect the integrity of the clay soil pan and maximize water retention
- Wetlands with uneven bottoms and shallow islands are especially important for nesting [EO]
- Artificial mitigation wetlands can provide productive breeding habitat. Ideal configuration is > 130 ha [320 ac] wetland with 2:1 ratio of shallow water (<15 cm [6 in]) feeding areas to elevated nesting areas[9]

Research, Planning, and Monitoring Strategies

- Improve monitoring coverage of ephemeral wetlands and playas from the breeding season through the post-breeding and fall migration periods[11]
- Conduct additional study to determine tolerance to water quality variations

Public Outreach Strategies

- None identified

References: [1]Brown et al. (2001); [2]GBBO unpublished Atlas data; [3]IWJV (in prep.); [4]Manning and Paul (2003); [5]Neel and Henry (1996); [6]Oring and Reed (1996); [7]Plissner et al. (1999, 2000); [8]Robinson and Oring (1997); [9]Robinson et al. (1997); [10]Shuford et al. (2002); [11]Warnock et al. (1998); [EO] Expert opinion

Willet

Tringa semipalmata



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Wet Meadow Marsh (Great Basin Lowland Riparian)	
Key Habitat Parameters ●	
Plant Composition	Sedges, spike rush and other rushes, wet meadow grasses and forbs, some agricultural and pasture crops
Plant Density & Height	Low-growing (< 15 cm [6 in]), dense emergent or wet meadow vegetation[5]
Mosaic	Wet meadow expanses next to marsh, open water, or ephemeral wetlands; adjacent open uplands or agricultural areas for foraging; no trees or dense shrubs [5, 6, 7]
Water Depth	< 8 cm [3.1 in] depth, and/or saturated soils[5]
Response to Vegetation Removal	Unknown
Area Requirements ●	
Minimum Patch Size	100 ha [250 ac] [5, 7]
Recommended Patch Size	> 150 ha [375 ac] [EO]
Home Range	~ 45 ha [110 ac][7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats Historical declines Possible high stewardship responsibility	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Very Important
Trends	
Historical ◑	Rangewide declines[5]
Recent ◑	Stable[1]
Population Size Estimates	
Nevada ◑	2,100 [EO]
Global ◑	250,000;[1] much less for Western Willet
Percent of Global	~1%; much higher but unquantified percent of Western Willet population
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	NWR and WMA counts, Nevada Bird Count, Aquatic Bird Count
Coverage in NV	Fair / Poor in most of the state
Key Conservation Areas	
Protection	Lahontan, Ruby, Carson, Washoe, and Mason Valleys, Humboldt River, Lake Mead
Restoration	Same

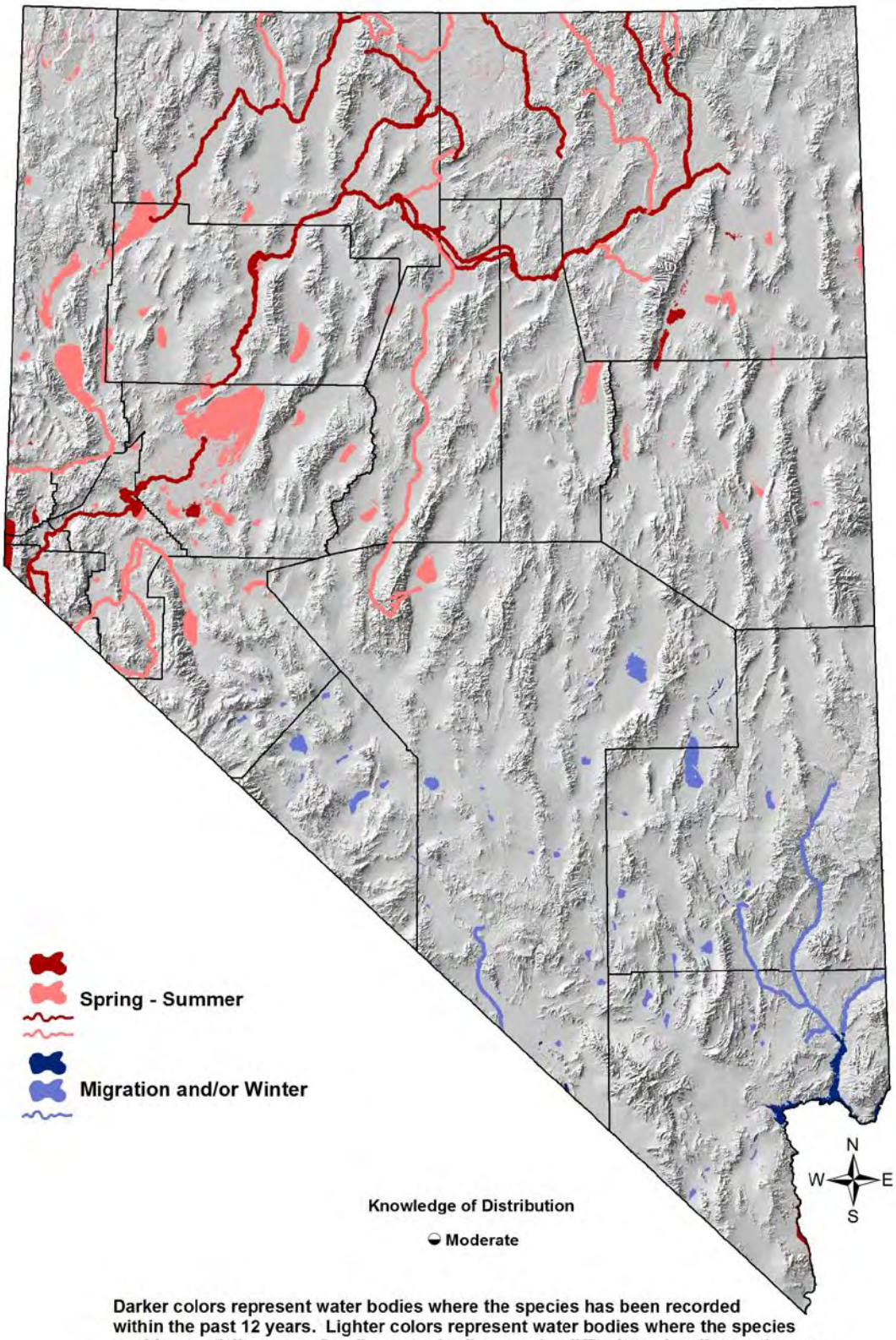
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer Spring and Fall (migration)	
Known Breeding Dates in Nevada	
Early April – July[2]	
Nest and Nesting Habits	
Nest Placement	On dry ground near shoreline or wet meadow[5]
Site Fidelity	Unknown
Food Habits	
Basic	Prober, pecker, fisher
Primary Diet	Terrestrial, benthic and aquatic invertebrates[5]
Secondary Diet	Small fishes[5]

Confidence in Available Data: ●High ◑Moderate ○ Low

Willet

Tringa semipalmata



Willet

Tringa semipalmata

Overview

Nevada's Willets belong to the *inornatus* subspecies, known as the Western Willet. Like the Long-billed Curlew, the Willet's habitat is not limited to shoreline areas, but it does not typically stray as far from water or saturated soils as the curlew often does. Willets use a diverse array of wet habitat types, including irrigated agricultural lands, although not to the same extent as the Long-billed Curlew or Sandhill Crane. Willet territories tend to be large, and they may therefore be more sensitive to fragmentation or wet landscapes than some other shorebirds. Nevada Aquatic Bird Count data and other sources suggest that Nevada probably supports more migrating Willets than breeding Willets, with the largest number of migrants recorded in Ruby Valley and Lake Mead, and smaller numbers at many other sites throughout most of the state.[3, 8] Most of the areas shown in the map above as "Spring – Summer" range may therefore be equally or more important as migratory stopover locations.

Given that Nevada probably hosts a fairly large, if unquantified, proportion of the total Western Willet breeding population, this species is not sufficiently-well studied or monitored in our state, nor have its threats received enough investigation. Specific habitat preferences during migration also need to be better determined.

Abundance and Occupancy by Habitat

The Nevada population estimate was generated by multiplying the amount of suitable habitat in Humboldt, Truckee, Carson, and Walker River systems, Lahontan Valley, and Ruby Valley by a mean density of 2 birds / 100 acres, which is typical of the Humboldt River system.[8] The total statewide population estimate may be conservative in that densities in some of these areas are probably higher than the density within the Humboldt River system.

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss of wet meadows to water diversions, groundwater pumping, or development
- Loss or degradation of marsh habitat due to water diversions, declines in water quality, or development
- Loss of flood irrigated agricultural fields to habitat conversion
- Fragmentation of wet landscapes

Willet

Tringa semipalmata

- Heavy livestock grazing or haying during the nesting period

Research, Planning, and Monitoring Challenges

- Nevada population size and total Western Willet population size need to be better estimated, and presumed stable trend needs better confirmation
- Willets are not sufficiently-well sampled by current monitoring programs, partly because they are not vocal during the incubation period[4]

Conservation Strategies

Habitat Strategies

- Wet Meadow (p. Hab-20-1) and Marsh (p. Hab-9-1) habitat conservation strategies benefit this species
- Prioritize protection of large landscapes with a continuous mosaic of wet meadows, marshes, and irrigated agricultural lands
- Manage wet meadows for maximum density of low vegetation cover during the nesting period (1 April – 15 July) by deferring grazing or haying
- Burning or grazing after the nesting season can help to create desirable low vegetation conditions for the subsequent breeding season

Research, Planning, and Monitoring Strategies

- Improve or supplement current monitoring programs to better sample Willets during the breeding and migration seasons
- Conduct additional studies to better understand population size, trends, distribution, habitat needs, and seasonal movements

Public Outreach Strategies

- Where Willets nest on or use privately owned lands, encourage landowners to defer haying and grazing until after the nesting period (1 April – 15 July)

References: [1]Brown et al. (2001); [2]GBBO unpublished Atlas data; [3]GBBO unpublished Nevada Aquatic Bird Count data; [4]Gratto-Trevor (2006); [5]Lowther et al. (2001); [6]Oring and Reed (1996); [7]Ryan and Renken (1987); [8]Shuford et al. (2002); [EO] Expert opinion

Long-billed Curlew

Numenius americanus



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Agriculture Wet Meadow	
Key Habitat Parameters ●	
Plant Composition	Agricultural crops and pastures, perennial grasses, annual grasses
Plant Density & Height	Naturally short grasslands and short-stubble agriculture; height 4-15 cm [1.5 – 5.9 in] throughout home range,[13] < 10 cm [4 in] at nest sites;[2] seek denser cover for broods[2, 7]
Mosaic	Landscapes with grasslands and irrigated agricultural fields. May benefit from nearby marshes with mudflats or wet soils and shallow shorelines[2]
Water Depth	< 16 cm [6.2 in] for foraging[2]
Distance to Water	Unclear whether foraging opportunities along shorelines are important during breeding season[3]
Response to Vegetation Removal	Positive to shortening (grazing) prior to breeding, but neutral/negative during brood rearing[2]
Area Requirements ●	
Minimum Patch Size	50 ha [125 ac][2]
Recommended Patch Size	> 100 ha [250 ac][2]
Home Range	6 -14 ha [16 - 36 ac][2]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats Historical declines	
Other Rankings	
Continental PIF	None
Audubon Watchlist	Yellow
NV Natural Heritage	S2S3B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Critically Important
Trends	
Historical ●	Rangewide declines[2]
Recent ◑	Stable or increasing[3]
Population Size Estimates	
Nevada ◑	1,150 [3]
Global ◑	160,000; 40,000 in Great Basin [3]
Percent of Global	~ 1%
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	Nevada Bird Count, NWR and WMA counts
Coverage in NV	Good / Fair
Key Conservation Areas	
Protection	Ruby Valley, Humboldt River system
Restoration	Degraded wet meadows

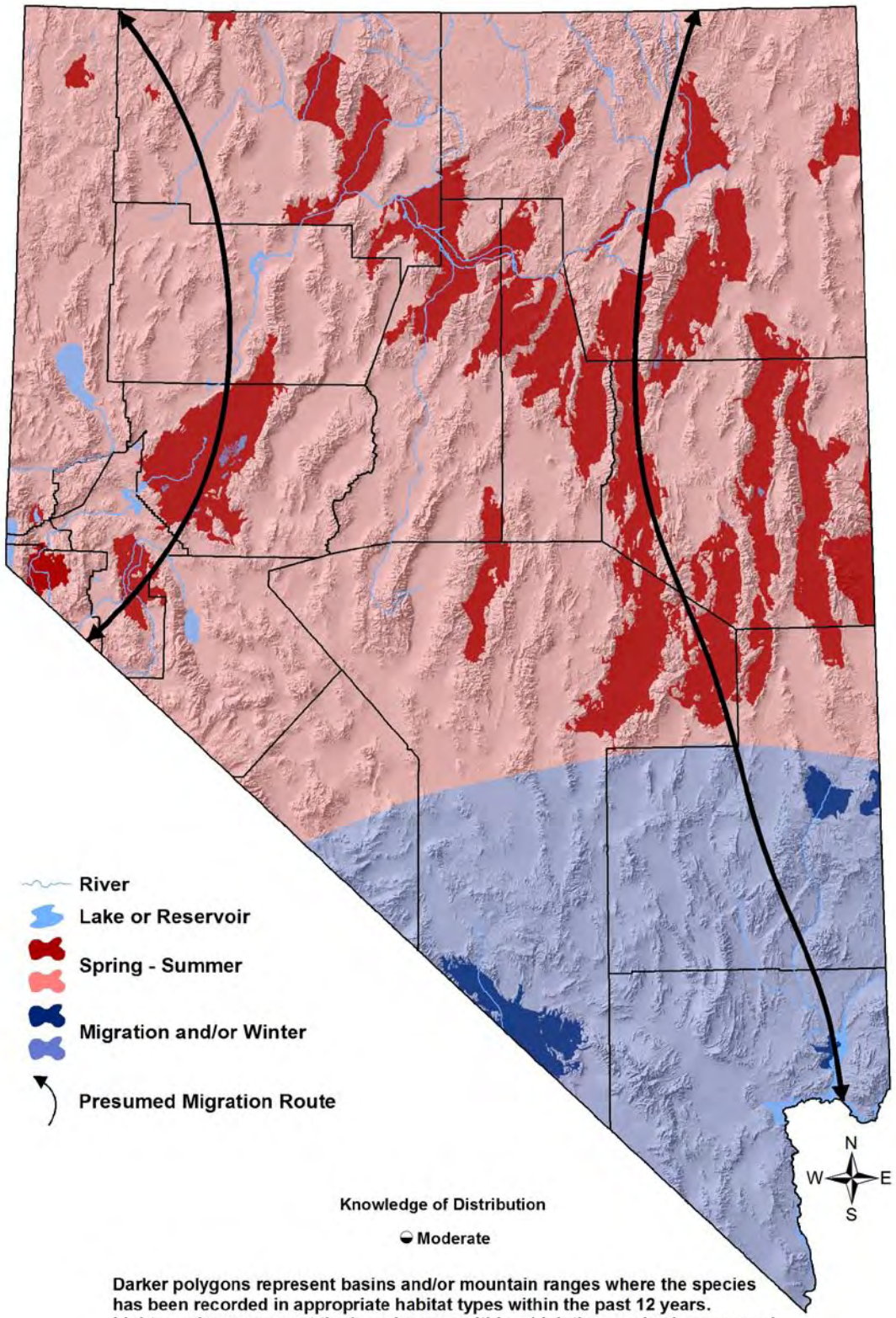
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
April – July[4] (nest initiation in Ruby Valley 17 April - 31 May)[7]	
Nest and Nesting Habits	
Nest Placement	Scrape on ground[2]
Site Fidelity	High[3]
Food Habits	
Basic	Prober
Primary Diet	Medium to large terrestrial and soil invertebrates[2]
Secondary Diet	Small vertebrates[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Long-billed Curlew

Numenius americanus



Long-billed Curlew

Numenius americanus

Overview

Long-billed Curlews breed across northern Nevada, but there is a pronounced concentration in the northeast quadrant of the state, which is regarded as a breeding stronghold.[9] Although the Great Basin contains only a modest portion of the global population of Long-billed Curlews, research conducted here has made a disproportionately large contribution to our knowledge of the species.[1,5,6,7,11,12] Compared to other shorebirds, curlews breed in surprisingly dry areas (the photo above was taken during migration). In Nevada, they are found breeding and foraging in open habitats with moderate grass or other ground cover. Areas with trees, high shrub densities, and tall dense grass are generally avoided.[11,13] The curlew's foraging habitats during the nesting and brood-rearing period contrast markedly with its use of shorelines and shallow water for foraging during other parts of the year.

Historically, breeding Long-billed Curlews were associated with native perennial grasslands, but they have adapted well to the wet meadows and agricultural lands located along major Great Basin waterways.[6, 7] Irrigated pastures and hayfields, along with their reliable invertebrate food sources, appear to be particularly suitable for Nevada breeding populations. Taller row crop production areas are generally avoided, however.[3] In Ruby Valley, where suitable agricultural landscapes are abundant, curlews nest at very high densities that are comparable to their historical densities in the prairie grasslands.[6] Agricultural lands are clearly critical to Long-billed Curlews in Nevada and the Great Basin, a situation that remains somewhat distinct from that seen elsewhere within the species' range. Flooding during the nesting period and predators, such as coyotes and Prairie Falcons, appear to be the main sources of reproductive failure, with livestock impacts also contributing to nest mortality.[7] Because Long-billed Curlews have a large presence on privately-owned lands, outreach and coordination with landowners are important parts of this bird's conservation strategies. Little is known about the curlew's migratory habitats in Nevada, but they are not commonly observed in wet meadows, agricultural areas, and marshes during migration.

Abundance and Occupancy by Habitat

- As many as 450 Long-billed Curlews have been inventoried in North Ruby Valley, with densities recorded of ~ 7 males / km^2 [6 birds / 100 ac],[5] and 5 birds / km^2 [2 birds / 100 ac][3]

Nevada-Specific Studies and Analyses

Oring Group Studies

Seminal studies on the Long-billed Curlew's habitat use, breeding biology, and conservation status within the Great Basin have been conducted by Lew Oring and his colleagues at the University of Nevada, Reno.[5,6,7] These studies are the primary source of our information about the Long-billed Curlew's biology and conservation needs in Nevada.

Long-billed Curlew

Numenius americanus

Main Threats and Challenges

Habitat Threats

- Loss of wet meadows to water diversions, groundwater pumping, or development
- Loss of flood-irrigated agricultural fields to habitat conversion
- Heavy livestock grazing, haying, or dragging that cause inadvertent nest losses[2,9]

Research, Planning, and Monitoring Challenges

- None identified

Conservation Strategies

Habitat Strategies

- Agriculture (p. Hab-1-1) and Wet Meadow (p. Hab-20-1) habitat conservation strategies benefit this species
- Conserve and protect whole landscapes with a mix of different habitats (agriculture, wet meadow, perennial grasses, and marshes)[9]

Research, Planning, and Monitoring Strategies

- Determine whether proximity to marshes benefits curlews during the breeding season
- Bolster NBC and other monitoring programs to better monitor curlew population concentrations following rangewide survey and monitoring guidelines[8]
- Where groundwater pumping occurs, monitor impacts on wet meadows used by curlews

Public Outreach Strategies

- Continue outreach and coordination efforts to private landowners to encourage wildlife-friendly agricultural practices (e.g., installation of flushbars on mowing equipment, retaining native grasses and forbs, and low pesticide use)
- Encourage deferment of haying and other mechanized treatments until after the main nesting period during 15 April – 1 July (but any delays to avoid the first half of the breeding season are also beneficial)
- Rotational grazing occurring prior to (or after) breeding season may be beneficial for curlews
- Encourage stable water levels in irrigated pastures during breeding season, and discourage large irrigation pulses

References: [1]Allen (1980); [2]Dugger and Dugger (2002); [3]Fellows and Jones (2009); [4]GBBO unpublished Atlas data; [5]Hartman (2008); [6]Hartman and Oring (2006); [7]Hartman et al. (2009); [8]Jones et al. (2003); [9]Nevada Wildlife Action Plan Team (2006); [9]Paige and Ritter (1999); [10]Pampush and Anthony (1993); [11]Redmond and Jenni (1986); [12]Saalfeld et al. (2010); [EO]Expert opinion

Marbled Godwit

Limosa fedoa



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada
Marsh Open Water (shorelines) (Ephemeral Wetland and Playa)

Key Habitat Parameters ○	
Plant Composition	Bulrush, sedges, rushes, cattail[1]
Plant Density	Variable[2]
Mosaic	Variety of types and sizes of marshes, lakes, and ephemeral wetlands, with emergent vegetation, open shoreline, and mudflats; availability of aquatic plant tubers especially important during migration[2]
Water Depth	≤ 13 cm [5 in][2]
Hydrology	Unknown
Water Quality	Unknown
Response to Vegetation Removal	Unknown

Area Requirements ○	
Minimum Patch Size	Unknown, but often seen at smaller marshes and water bodies [EO]
Recommended Patch Size	> 10 ha [25 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats Historical and recent declines Insufficient knowledge of habitat requirements	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3M
USFWS	Migratory Bird; Bird of Conservation Concern
BLM	None
USFS	None
NDOW	Stewardship
IW Shorebird Plan	Very Important
Trends	
Historical ◑	Declines[2]
Recent ◑	Probably declining in Nevada[1, EO]
Population Size Estimates	
Nevada ◑	350 [EO]
Global ◑	175,000 [4]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	WMA and NWR counts, Aquatic Bird Count
Coverage in NV	Fair in WMA's and NWR's; Poor elsewhere
Key Conservation Areas	
Protection	Lahontan Valley, Upper Walker River
Restoration	Unknown

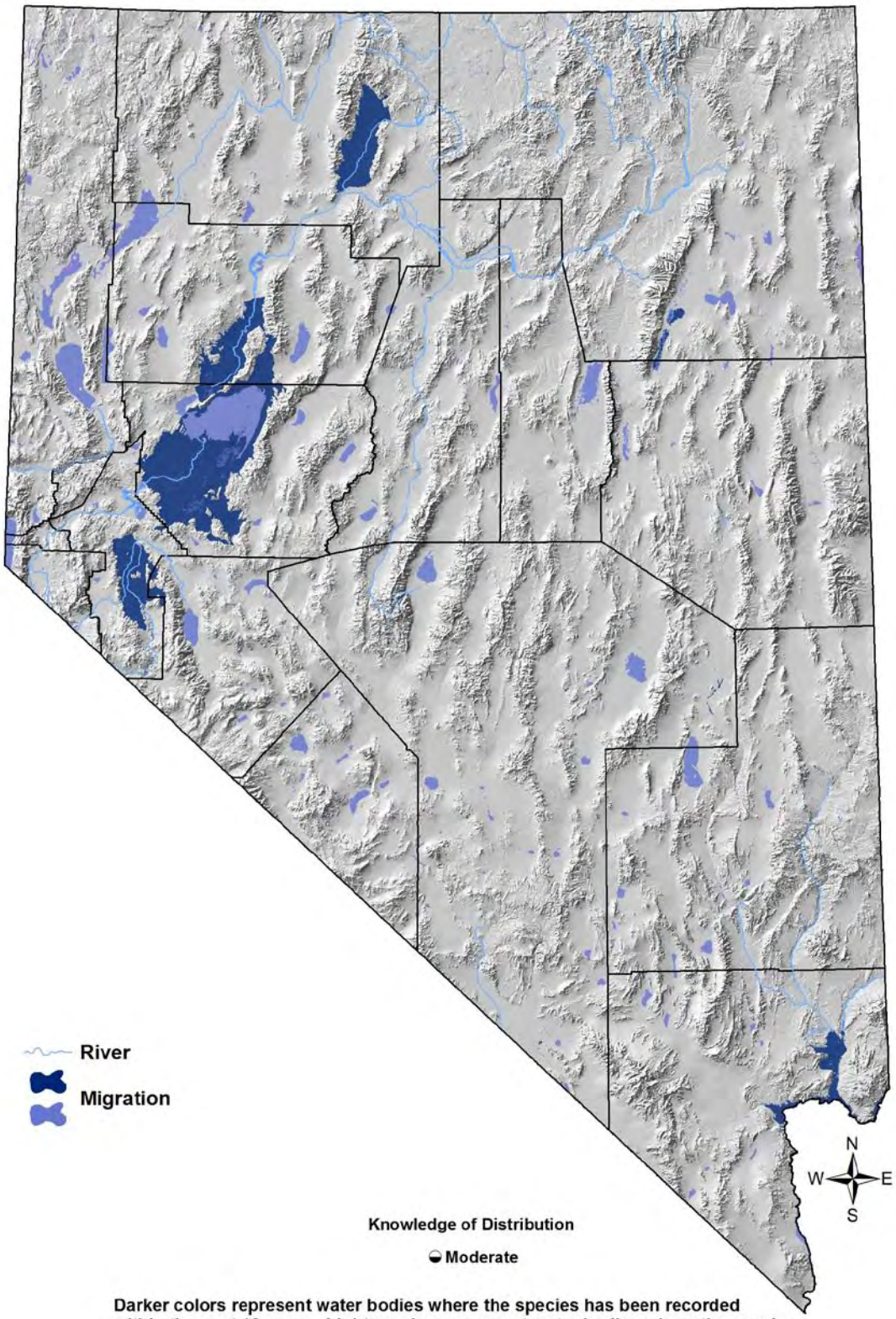
Natural History Profile

Seasonal Presence in Nevada	
Spring (migration, May peak) Fall (migration, late June – August peak)	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Site Fidelity	Unknown
Food Habits	
Basic	Prober
Primary Diet	Invertebrates, usually from sediment[2]
Secondary Diet	Plant tubers, especially during migration[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Marbled Godwit

Limosa fedoa



Marbled Godwit

Limosa fedoa

Overview

These large shorebirds are only present in Nevada during migration stopovers, more commonly in the spring than in the fall, although it is possible that fall migrants are under-reported because godwits begin their southward migration several weeks earlier than other shorebirds. There are nearby wintering areas in California's Sacramento Valley, and there have been reports of wintering birds in western Nevada, although there are no recent records. At migration stopover sites, Marbled Godwits tend to be seen around smaller water features where they forage on mudflats or in shallow water with or without emergent vegetation. Although godwits are fairly conspicuous during migration, there is not much information about their habitat use, their conservation needs, or any threats. For instance, it is not clear whether or not birds migrating through Nevada primarily eat aquatic plant tubers, which has been reported as a general characteristic of migrating populations.[2] In fact, the Marbled Godwits is a poorly studied bird in general,[2] which is particularly unfortunate given that it appears to be declining.

Apart from simply protecting the water supplies of marshes and ephemeral wetlands during the migration periods, the main conservation need for this species is to collect better information on nearly every aspect of its biology, ecology, and conservation status. The Marbled Godwit's early fall migration pattern could pose management challenges in situations where its seasonal needs may not correspond to other shorebirds on a more "normal" migration schedule.

Abundance and Occupancy by Habitat

- High counts recorded in Lahontan Valley were 1,000 birds in 1947, and 465 birds in 1989 [5]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Diversion of water, causing shrinking or drying of marshes, ponds, or lakes before the fall migration peak
- Enhancing water availability will also help diminish the deleterious effects of contaminants[3]

Marbled Godwit

Limosa fedoa

Research, Planning, and Monitoring Challenges

- Very little is known about the Marbled Godwit's biology, ecology, or conservation needs
- We need a better understanding of habitat quality at stopover sites, as indicated by a) length of stay and turnover rates, and b) body condition[3]
- Monitoring coverage is inadequate

Conservation Strategies

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies should benefit this species
- Protect / maintain inflows into key stopover areas that are sufficient to provide water through the migration peaks[3]
- Marshes and lakes with broad muddy shorelines may be preferred by Marbled Godwits and should receive priority management consideration

Research, Planning, and Monitoring Strategies

- Supplement current monitoring programs, especially during the fall migration period (21 June – 31 August) to collect better information on distribution, trends, and habitat use
- A significant program of research is needed to gather information about the Marbled Godwit's biology, ecology, habitat use, threats, and conservation status[3]

Public Outreach Strategies

- None identified

References: [1] Brown et al. (2001); [2]Gratto-Trevor (2000); [3]Melcher et al. (2010); [4]Morrison et al. (2006); [5]Neel and Henry (1996); [EO] Expert opinion

Western Sandpiper

Calidris mauri



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Open Water (shorelines) Ephemeral Wetland and Playa	
Key Habitat Parameters ●	
Plant Density	Very sparse or no vegetation[8]
Mosaic	Shallow-water shorelines and mudflats with saturated soils and little or no vegetation[8]
Water Depth	< 4 cm [1.6 in][8]
Water Quality	Tolerates variety of salinities EO
Response to Vegetation Removal	Neutral EO
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 100 ha [250 ac] EO
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Recent declines High stewardship responsibility (migration) Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S5M
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	None
IW Shorebird Plan	Very Important
Trends	
Historical ○	Unknown
Recent ◑	Probably declining[1]
Population Size Estimates	
Nevada ◑	~ 12,000, with high annual variability[2]
Global ●	3,500,000 [1]
Percent of Global	< 1%
Population Objective	
Increase by 30% EO	
Monitoring Coverage	
Source	NDOW shorebird surveys, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in Lahontan Valley, Fair elsewhere
Key Conservation Areas	
Protection	Lahontan and Ruby Valleys, Humboldt and Key-Pittman WMA's, Pyramid Lake, all open water habitat with muddy shoreline
Restoration	Threatened open water shorelines, dewatered playas

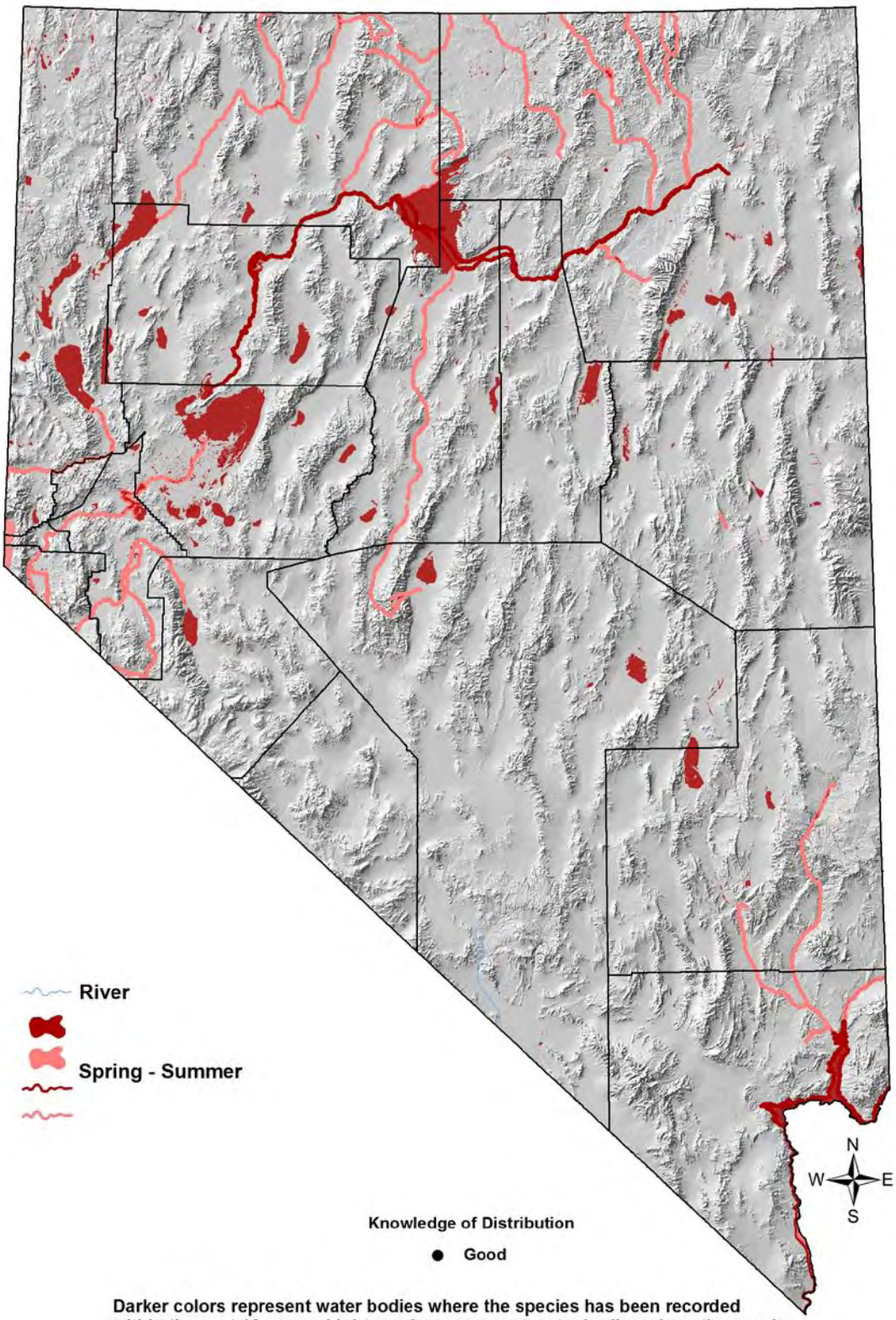
Natural History Profile

Seasonal Presence in Nevada	
Spring (migration, peak April) Fall (migration, peak August - September)	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Site Fidelity	Probably low - moderate for migration stopover sites EO
Food Habits	
Basic	Prober
Primary Diet	Benthic invertebrates[8]
Secondary Diet	Terrestrial invertebrates[8]

Confidence in Available Data: ●High ◑Moderate ○ Low

Western Sandpiper

Calidris mauri



Western Sandpiper

Calidris mauri

Overview

Although most Western Sandpipers migrate between their Arctic breeding grounds and wintering grounds using a route that parallels the Pacific Coast, significant numbers take inland routes through the Great Basin where they are the most commonly observed small sandpiper. Western Sandpipers use shallow ephemeral wetlands, mudflats, and recently exposed or otherwise damp shorelines and beaches of Nevada's open water habitats. Numbers of spring and fall migrants are roughly equivalent, with a modest preponderance of spring migrants in the Great Basin,[7] which contrasts with the preponderance of fall migrants along other migration routes through the continent's interior.[8] As is the case with many other Conservation Priority shorebirds, Lahontan Valley provides Nevada's most critically important habitat for Western Sandpipers.[5] For this reason, it has been designated as a "Site of Hemispheric Importance" by the Western Hemisphere Shorebird Reserve Network (www.whsrn.org). In addition to Lahontan Valley, Western Sandpipers also have a well-establish migratory presence across most of Nevada, including Ruby Lake NWR in the east and Lake Mead in the far south. They commonly use shorelines along ephemeral wetlands and playas, if water is present.

Western Sandpipers appear to be declining across their range, and it has been suggested that threats during migration and on the wintering grounds play a role in this decline. Beyond this general statement, however, the precise causes of declines have not been the subject of any significant study. Gathering more data on migrating populations in Nevada might therefore be especially helpful in determining specific conservation strategies. In particular, further study and attention should be given to determining the relative importance of ephemeral wetlands and playas to Western Sandpipers.

Abundance and Occupancy by Habitat

The ten-year average seasonal count for Lahontan Valley is 7,600 birds, with 4,400 estimated to occur in other locations across Nevada (L. Neel, pers. comm.). Ten-year peaks in Lahontan Valley typically exceed 45,000, with highest recorded peak (which included some Least Sandpipers) of 66,700 in 1987, and another slightly smaller peak of 59,000 in 1990.[4]

Nevada-Specific Studies and Analyses

Shuford et al. (2002)[7] provides the most comprehensive data for migratory shorebirds in the Intermountain West region, including Nevada.

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of flat, muddy open water shorelines due to water diversions, declines in water quality, or development

Western Sandpiper

Calidris mauri

- Because Western Sandpipers may use ephemeral wetlands and wet playas extensively, they may be impacted by changing precipitation patterns associated with climate change
- Mid-summer dewatering of traditional or potential fall migration stopover sites
- Dewatering of ephemeral wetlands and playas due to diversion of seasonal runoff

Research, Planning, and Monitoring Challenges

- Extent and causes of declines are not well understood[3]
- The relative importance of ephemeral wetlands such as flooded playas, particularly during spring migration, has not been well-studied[6]

Conservation Strategies

Habitat Strategies

- Open Water (p. Hab-15-1) and Ephemeral Wetland and Playa (p. Hab-6-1) habitat conservation strategies benefit this species
- Maintain flooded conditions in important stopover habitat during the migration periods (20 April – 10 May; 1 – 30 August); prevent mid-summer dewatering of traditional or potential fall migration stopover sites
- Allow or encourage seasonal runoff into ephemeral wetlands and playas sufficient to create mudflats with water depth < 4 cm [1.6 in] during migration periods

Research, Planning, and Monitoring Strategies

- Devote more inventory and monitoring effort to ephemeral wetlands and playas to determine their relative importance as migration habitat
- Continue and expand current monitoring efforts to confirm and better quantify population trend and identify possible causes

Public Outreach Strategies

- None identified

References: [1]Brown et al. (2001); [2]IWJV (in prep.); [3]Fernández et al. (2010); [4]Neel and Henry (1996); [5]Oring and Reed (1996); [6]Oring et al. (2000); [7]Shuford et al. (2002); [8]Wilson (1994); [EO]Expert opinion

Least Sandpiper

Calidris minutilla



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Open Water (shorelines) Ephemeral Wetland and Playa	
Key Habitat Parameters ◑	
Plant Density	Sparse emergent and shoreline vegetation[4]
Mosaic	Shallow waters near shoreline with sparse vegetation, interspersed with mudflats, wet meadows, and flooded agricultural stubble fields[4]
Water Depth	< 4 cm [1.6 in][4]
Water Quality	Tolerant of a variety of salinities EO
Hydrology	Tolerant of stage fluctuations EO
Response to Vegetation Removal	Probably neutral EO
Area Requirements ○	
Minimum Patch Size	Unknown, but uses smaller waterbodies than some other shorebirds[4]
Recommended Patch Size	> 50 ha [125 ac] EO
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Recent declines Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4N
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Very Important
Trends	
Historical ○	Unknown
Recent ◑	Declining[1]
Population Size Estimates	
Nevada ◑	~ 2,200, with high annual variablility[2]
Global ○	600,000 - 700,000 [1, 3]
Percent of Global	< 1%
Population Objective	
Maintain / Increase EO	
Monitoring Coverage	
Source	NDOW shorebird surveys, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in Lahontan Valley, Fair / Poor elsewhere
Key Conservation Areas	
Protection	Lahontan and Ruby Valleys, Mojave wetlands
Restoration	Threatened open water shorelines

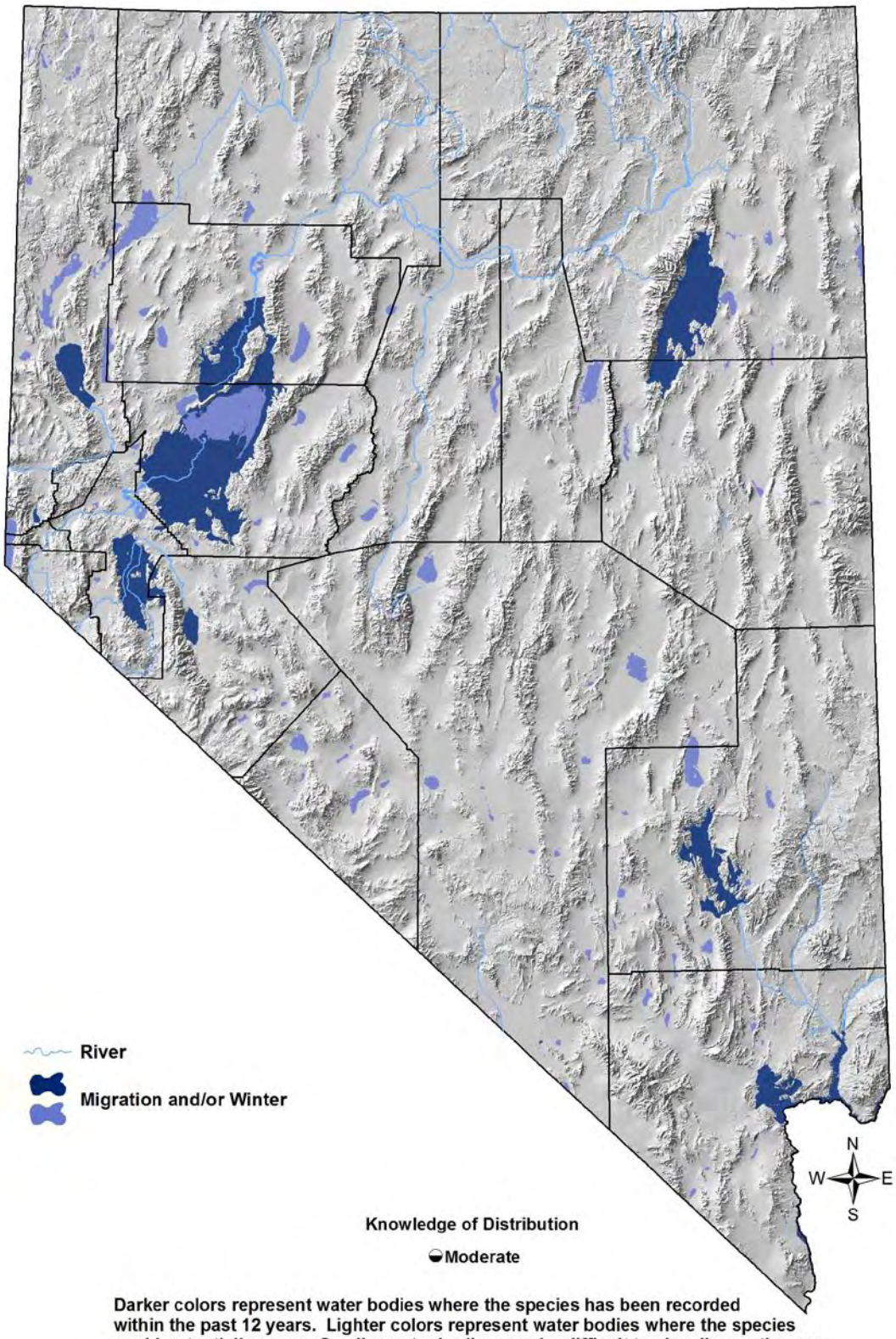
Natural History Profile

Seasonal Presence in Nevada	
Spring (migration, peak April) Fall (migration, peak August) Winter (southern Mojave)	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Site Fidelity	Unknown
Food Habits	
Basic	Prober
Primary Diet	Aquatic invertebrates < 6 mm [0.2 in] long[4]
Secondary Diet	Terrestrial invertebrates[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Least Sandpiper

Calidris minutilla



Least Sandpiper

Calidris minutilla

Overview

The Least Sandpiper is seen most often in Nevada in mixed, migrating flocks, usually with Western Sandpipers, which are generally more numerous. Like the Western Sandpiper, Least Sandpipers use shallow water and mudflats for foraging, but they are more likely to also forage on the drier parts of beaches and shorelines than their flock-mates.[4] Least Sandpipers are also more likely to use small habitat patches,[4] which are typically more vulnerable to habitat conversion than larger water features.[7] Least Sandpipers tend to be more numerous during spring migration than fall migration, with the greatest numbers occurring in Lahontan Valley, followed by Ruby Valley, southern Nevada (primarily Lake Mead and Ash Meadows NWR), and Pyramid Lake.[6] According to data from the Nevada Aquatic Bird Count program, some Least Sandpipers also remain in far southern Nevada throughout the winter, primarily in Lake Mead, but also in smaller numbers at Ash Meadows NWR. As is the case with many other Conservation Priority shorebirds, Lahontan Valley provides Nevada's most critically important habitat for Least Sandpipers. For this reason, it has been designated as a "Site of Hemispheric Importance" by the Western Hemisphere Shorebird Reserve Network (www. whsrn.org).

Because of their affinity for mixed-species flocks, it is difficult to obtain accurate counts of Least Sandpipers, and population estimates for Nevada are somewhat suspect. Least Sandpipers appear to be declining, though perhaps more sharply in the eastern part of North America than in the west. It has been suggested that ongoing declines are related to threats associated with migration or wintering grounds, but specific mechanisms of decline, or possible management responses, have not yet been identified.[7] It is unclear whether Least Sandpipers use ephemeral wetlands and playas (when wet) to the extent postulated for Western Sandpipers. Further investigation into this issue seems warranted.

Abundance and Occupancy by Habitat

The ten-year average seasonal count for Lahontan Valley is 2,000 birds, with 200 birds estimated to occur in other locations around Nevada (L. Neel, pers. comm.). The most recent ten-year peak for Lahontan Valley was 8,300 birds in 2001 (L. Neel, pers. comm.)

Nevada-Specific Studies and Analyses

Shuford et al. (2002)[6] provides the most comprehensive data for migratory shorebirds in the Intermountain West region, including Nevada.

Least Sandpiper

Calidris minutilla

Main Threats and Challenges

Habitat Threats

- Loss or degradation of flat, muddy open water shorelines due to water diversions, declines in water quality, or development
- Mid-summer dewatering of traditional or potential fall migration stopover sites

Research, Planning, and Monitoring Challenges

- Extent and causes of declines are not well understood
- The relative importance of ephemeral wetlands such as flooded playas, particularly during spring migration, has not been well-studied[5]

Conservation Strategies

Habitat Strategies

- Open Water (p. Hab-10-1) and Ephemeral Wetland and Playa (p. Hab-6-1) habitat conservation strategies benefit this species
- Maintain flooded conditions in important stopover habitat during the migration periods (20 April – 10 May; 1 – 30 August); prevent mid-summer dewatering of traditional or potential fall migration stopover sites
- Allow or encourage seasonal runoff into ephemeral wetlands and playas sufficient to create mudflats with water depth < 4 cm [1.6 in] during migration periods

Research, Planning, and Monitoring Strategies

- Devote more inventory and monitoring effort to ephemeral wetlands and playas to determine their relative importance as migration habitat
- Continue and expand current monitoring efforts to confirm and better quantify population trend and identify possible causes

Public Outreach Strategies

- None identified

References: [1]Brown et al. (2001); [2]IWJV (in prep.); [3]Morrison et al. (2006); [4]Nebel and Cooper (2008); [5]Oring et al. (2000); [6]Shuford et al. (2002); [7]Thomas et al. (2006); [EO] Expert opinion

Long-billed Dowitcher

Limnodromus scolopaceus



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water Ephemeral Wetland and Playa	
Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges, rushes, submerged aquatic vegetation
Plant Density	Forages in open (shallow) water or where stem density is low[9]
Mosaic	Shallow marsh with low stem densities, interspersed with mudflats and shallow open water[9]
Water Depth	< 16 cm [6.2 in] for foraging[9]
Water Quality	Tolerates variety of salinities[7, 9]
Response to Vegetation Removal	Probably neutral [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 50 ha [125 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Habitat threats Historical and recent declines High stewardship responsibility (migration)	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4N
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Critically Important
Trends	
Historical ●	Rangewide declines[9]
Recent ○	Probably declining[5, 10]
Population Size Estimates	
Nevada ◑	14,000 – 20,000, with high annual variability[3, 10]
Global ○	500,000 [1]
Percent of Global	~ 3%, but much higher in peak years
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW shorebird counts, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in Lahontan Valley and NWR's; Fair elsewhere
Key Conservation Areas	
Protection	Lahontan and Ruby Valleys
Restoration	Degraded marshes

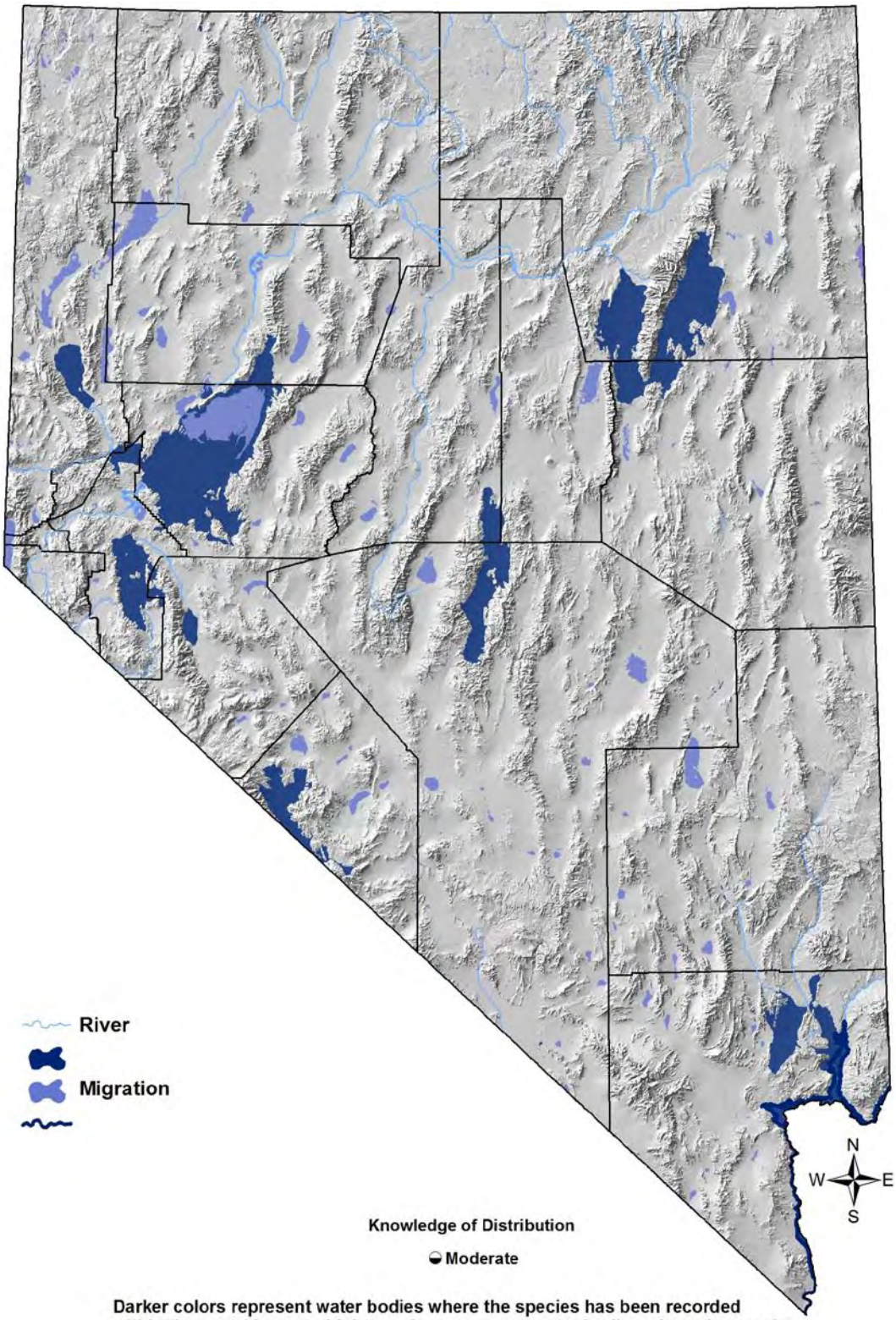
Natural History Profile

Seasonal Presence in Nevada	
Spring (migration, May peak) Fall (migration, September peak)	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Food Habits	
Basic	Prober
Primary Diet	Benthic and soil invertebrates[9]
Secondary Diet	Terrestrial invertebrates, seeds[10]

Confidence in Available Data: ●High ◑Moderate ○ Low

Long-billed Dowitcher

Limnodromus scolopaceus



Long-billed Dowitcher

Limnodromus scolopaceus

Overview

The Great Basin provides critical migration stopover habitat for Long-Billed Dowitchers in both fall and spring.[7, 8] and this species is one of the most numerous migrant shorebirds in the big wetland complexes of western Nevada,[6] where they typically spend their time wading in shallow open water, probing for invertebrates.[9] The Lahontan Valley is particularly important for migrating dowitchers, hosting perhaps 90% of all birds passing through Nevada. As such, it has been designated as a "Site of Hemispheric Importance" by the Western Hemisphere Shorebird Reserve Network (www.whsrn.org). Other locations with significant numbers include Lake Mead, Ash Meadows NWR, and Ruby Valley, along with a number of smaller sites, including some ephemeral wetlands.[2] A few Long-billed Dowitchers are present in mid-winter in western Nevada near Reno (www.ebird.org), but it is not clear if this is a regular or unusual phenomenon, or whether it involves overwintering birds or late / early migrants.

Most Long-billed Dowitchers in Nevada use areas that are actively managed for birds and have some level of protection, but nonetheless the population may be declining. Long-billed Dowitcher numbers in Lahontan Valley have recently been averaging ~ 14,000 – 20,000 birds,[3, 10] down substantially from levels seen in the 1980's.[5] While some of this decline can perhaps be attributed to water diversions and cyclic drought, dowitchers have not rebounded as might be expected during periods when available water increased (L. Neel, pers. comm.). Apart from the obviously critical issue of water supply, factors that might be responsible for lower numbers are not known.

Abundance and Occupancy by Habitat

NDOW and USFWS inventories in Lahontan Valley in the 1980's documented peak annual numbers in excess of 100,000 birds, in two different years.[5] Average numbers for this period were approximately 30,000 birds, with annual differences attributable to precipitation patterns and available water. During the peak years, Nevada may have hosted up to 30% of the global Long-billed Dowitcher population.[5]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Diversion of water, causing shrinking or drying of marshes, ponds, or lakes before the fall migration peak

Long-billed Dowitcher

Limnodromus scolopaceus

Research, Planning, and Monitoring Challenges

- It is not known whether apparent declines are directional or cyclical, and if the former, their causes are unclear
- There is little information on the impacts of water quality

Conservation Strategies

Habitat Strategies

- Marsh (p. Hab-9-1), Open Water (p. Hab-15-1), and Ephemeral Wetland and Playa (p. Hab-6-1) habitat conservation strategies benefit this species
- Protect / maintain inflows into key stopover areas that are sufficient to provide water through the migration peaks
- Where the inflow volume can be controlled, flooding of mudflats to a depth of ≤ 10 cm [4 in] from April 20 – May 10, and from August 1 – 30 creates maximum numbers of benthic prey items for the migration periods [EO]

Research, Planning, and Monitoring Strategies

- Possible declines need to be further investigated to determine if they are "real" or a cyclic fluctuation, and if real, the possible causes should be researched and assessed
- The effects of water quality need further research

Public Outreach Strategies

- None identified

References: [1]Brown et al. (2001); [2]GBBO unpublished Nevada Aquatic Bird Count data; [3]IWJV (in prep.); [4]Morrison et al. (2006); [5]Neel and Henry (1996); [6]Neel et al. (2000); [7]Oring and Reed (1996); [8]Shuford et al. (2002); [9]Takekawa and Warnock (2000); [10]Nevada Wildlife Action Plan Team (2006); [EO] Expert opinion

Wilson's Phalarope

Phalaropus tricolor



Photo by Steve Ting

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water Ephemeral Wetland and Playa (Wet Meadow)	
Key Habitat Parameters ●	
Plant Composition	Breeding: Spikerush, sedges, other short, dense vegetation near shore[3]
Plant Density	Breeding: Variable, but often dense, short vegetation within 100 m [330 ft] of shore[3, EO]
Mosaic	Breeding: Variety of large and small marshes with sufficient shoreline vegetation; Staging / migration: larger saline lakes comprised of mostly open water[3]
Water Depth	Variety of depths, but most often < 2 m [6.6 ft][3, EO]
Water Quality	Breeding: Freshwater; Staging / migration: saline lakes[3]
Response to Vegetation Removal	Neutral [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 10 ha [25 ac] [EO]
Home Range	Breeding: Small territories with nest spacing as close as 5 m [16 ft], but may be more solitary in NV[3, EO]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Habitat threats High stewardship responsibility (staging and migration)	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S2S3B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	None
IW Shorebird Plan	Critically Important
Trends	
Historical ◑	Significant declines[3]
Recent ◑	Probable declines[1 EO]
Population Size Estimates	
Nevada ◑	3,000 (breeding); ~12,000 (staging and migration), with high annual variability[7, EO]
Global ○	1,500,000 [1, 3, 10]
Percent of Global	< 1%
Population Objective	
Maintain / increase [EO]	
Monitoring Coverage	
Source	NODW shorebird counts, WMA and NWR counts, Aquatic Bird Count
Coverage in NV	Good / Fair in Lahontan Valley, NWR's, and WMA's; Fair / Poor elsewhere
Key Conservation Areas	
Protection	See "Overview", below
Restoration	Degraded or at-risk marshes, lakes, and ponds

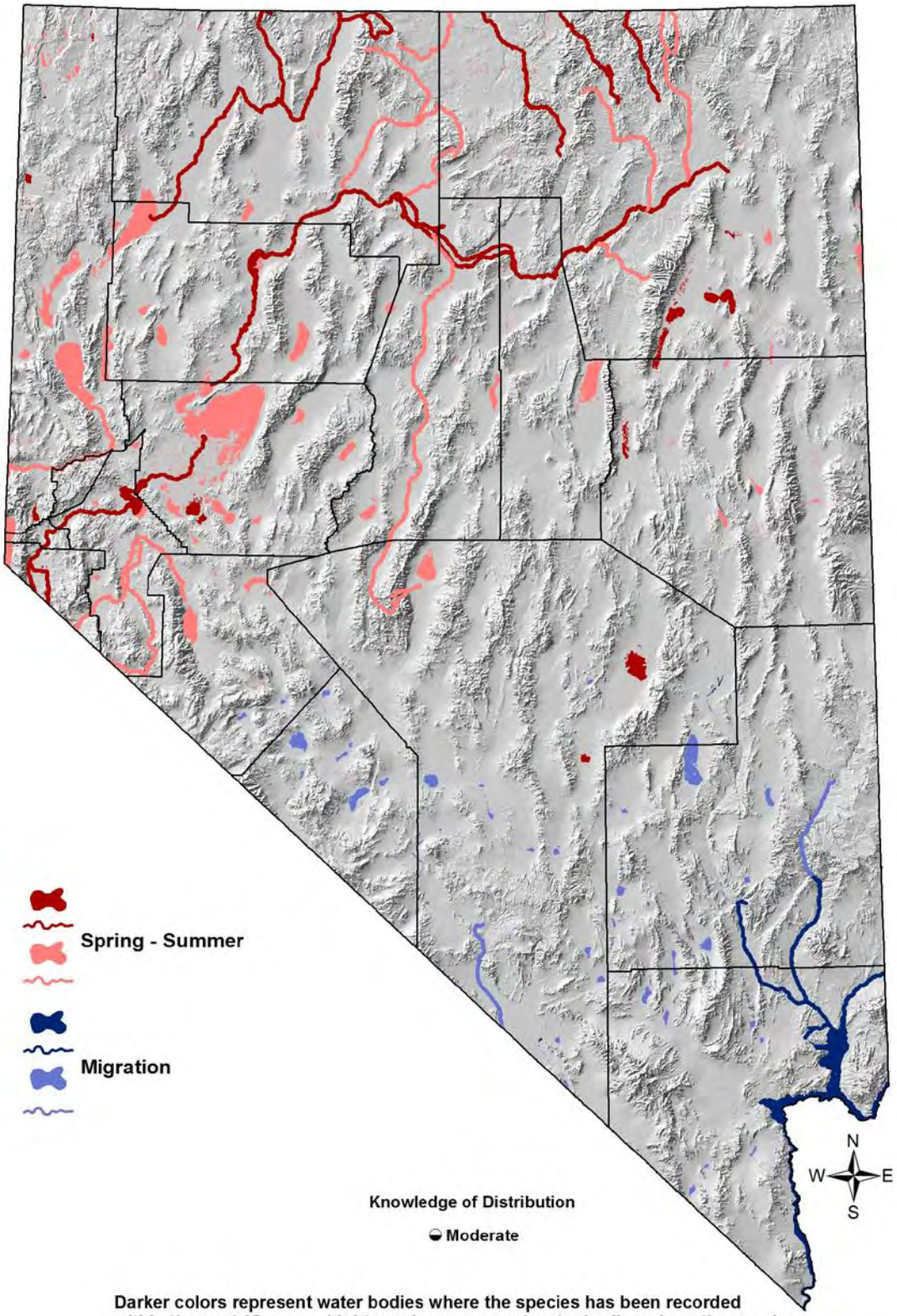
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (breeding) Fall and Spring (migration)	
Known Breeding Dates in Nevada	
May – July[1, 6]	
Nest and Nesting Habits	
Nest Placement	Ground nests in wet areas with vegetation cover, < 100 m [330 ft] from water edge[3]
Site Fidelity	Probably low[4]
Other	Gregarious nester[3]
Food Habits	
Basic	Dabbler and prober
Primary Diet	Invertebrates from water column or sediment[3]
Secondary Diet	Terrestrial invertebrates[3]

Confidence in Available Data: ●High ◑Moderate ○ Low

Wilson's Phalarope

Phalaropus tricolor



Wilson's Phalarope

Phalaropus tricolor

Overview

Wilson's Phalarope is well known for the huge flocks that congregate at saline lakes prior to their long-distance fall migration,[8] especially just outside Nevada's borders at the Great Salt Lake and Mono Lake. Although the Wilson's Phalarope's presence in our state is more modest, Nevada does contain important staging sites, particularly in Lahontan Valley, where a peak staging abundance of 67,000 birds was recorded in 1987.[11] Because of their critical importance to staging Wilson's Phalaropes and other species, the Lahontan Valley Wetlands have been designated as a "Site of Hemispheric Importance" by the Western Hemisphere Shorebird Reserve Network (www. whsrn.org). Ruby Lake NWR, the Henderson Sewage Ponds, Lake Mead, Pyramid Lake, and several WMA's are also known staging locations.[14]

Wilson's Phalaropes also breed fairly widely across the northern part of the Nevada, in permanent or ephemeral freshwater marshes and ponds. Their nesting habitat may extend somewhat beyond the actual marsh edge into dense cover in meadows, grasslands, or irrigated agricultural fields.[3] In addition to Lahontan Valley, important breeding locations include Ruby Lake NWR, wetlands along the Humboldt River, and Washoe Valley.[5, EO] Although Nevada's staging population has been reasonably well characterized, less information has been collected on the breeding population. This is unfortunate, because indications are that Wilson's Phalaropes, though still numerous, have been declining rather steadily within Nevada and the greater region for some time. Better identification of the specific threats to this bird, during both the breeding season and the staging period, is a critical prerequisite to identifying effective conservation strategies.[9]

Abundance and Occupancy by Habitat

Although the fall staging population is typically ~ 12,000 birds (mostly in Lahontan Valley), peak numbers reached 67,000 in Lahontan Valley alone in 1987.[11] Even larger counts were reported in Lahontan Valley in 1970's, but have not recurred since.[2]

Nevada-Specific Studies and Analyses

Shuford et al. (2002)[14] provides the most comprehensive data for migratory shorebirds in the Intermountain West region, including Nevada.

Main Threats and Challenges

Habitat Threats

- Loss or degradation of marshes, ponds, and lakes due to water diversions, declines in water quality, development, or climate change[13]

Wilson's Phalarope

Phalaropus tricolor

- Possible negative impacts of livestock grazing / trampling on wet terrestrial habitats used for nesting[13]

Research, Planning, and Monitoring Challenges

- The relative importance of ephemeral wetlands such as flooded playas, particularly during spring migration, has not been well-studied and deserves further investigation[12]
- The conservation needs of breeding birds have not been well studied

Conservation Strategies

Habitat Strategies

- Open Water (p. Hab-15-1), Ephemeral Wetland and Playa (p. Hab-6-1), and Marsh (p. Hab-9-1) habitat conservation strategies benefit this species
- Maintain conditions that produce healthy populations of aquatic invertebrates (brine shrimp, brine flies, and others) during the spring and fall migration periods
- Manage livestock grazing, recreation, and other land uses to minimize the disturbance of shoreline and wet meadow vegetation that provide nest cover

Research, Planning, and Monitoring Strategies

- Improve current monitoring programs to better count peak migration numbers
- Devote more inventory and monitoring effort to ephemeral wetlands to determine their relative importance as migration habitat
- Conduct studies to better determine breeding habitat requirements and conservation needs
- Monitor water quality in occupied sites, especially key staging areas

Public Outreach Strategies

- None identified

References: [1]Brown et al. (2001); [2]Chishom and Neel (2002); [3]Colwell and Jehl (1994); [4]Colwell and Oring (1988); [5]Floyd et al. (2007); [6]GBBO unpublished Atlas data; [7]IWJV (in prep.); [8]Jehl (1988); [9]Lesterhuis and Clay (2010); [10]Morrison et al. (2006); [11]Neel and Henry (1996); [12]Oring et al. (2000); [13]Powers and Glimp (1996); [14]Shuford et al. (2002); [EO] expert opinion

Red-necked Phalarope

Phalaropus lobatus



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Open Water Ephemeral Wetland and Playa (Marsh)	
Key Habitat Parameters ◑	
Plant Density	Low density of emergent plants[6]
Mosaic	Variety of lakes, ponds, and marshes dominated by open water; no other habitat features known to be important[6]
Water Depth	Not quantified, but occurs on water bodies of varying sizes and depths[6]
Water Quality	Tolerates variety of salinities, but often associated with saline or hypersaline wetlands[6, EO]
Response to Vegetation Removal	Neutral [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown; small wetlands used[6]
Recommended Patch Size	> 50 ha [125 ac] [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
High stewardship responsibility (staging and migration) Historical and possible recent declines Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S4M
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Shorebird Plan	Very Important
Trends	
Historical ◑	Significant declines[6]
Recent ○	Possible declines[2, 6]
Population Size Estimates	
Nevada ◑	~3,000 (staging and migration), with high annual variability[3]
Global ○	2,500,000 [1, 4]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	NDOW shorebird counts, NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in Lahontan Valley, NWR's, and WMA's; Fair / Poor elsewhere
Key Conservation Areas	
Protection	Lahontan Valley (esp. Big Soda Lake), Humboldt Sink, Walker Lake
Restoration	Degraded or at-risk marshes, lakes, and ponds

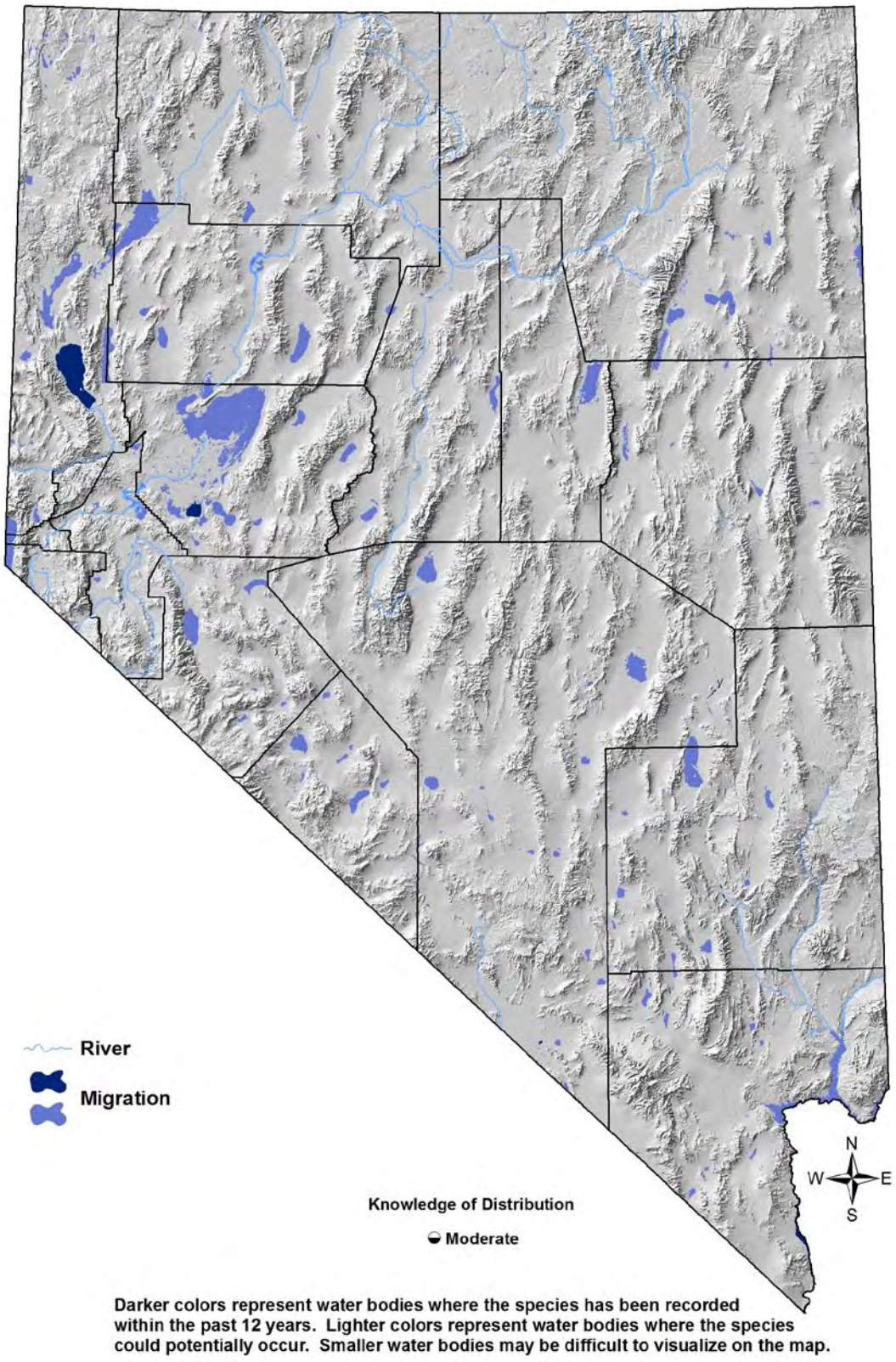
Natural History Profile

Seasonal Presence in Nevada	
Fall (migration, late July - early August peak, variable) Spring (migration, April - May peak, variable)	
Known Breeding Dates in Nevada	
N/A	
Nest and Nesting Habits	
Nest Placement	N/A
Site Fidelity	Unknown
Food Habits	
Basic	Dabbler
Primary Diet	Small aquatic invertebrates[6]
Secondary Diet	Some flying insects[6]

Confidence in Available Data: ●High ◑Moderate ○ Low

Red-necked Phalarope

Phalaropus lobatus



Red-necked Phalarope

Phalaropus lobatus

Overview

Although taxonomically a shorebird, Red-necked Phalaropes spend most of their lives at sea. Significant numbers of these long-distance migrants, however, stage or stop over in Nevada during migration, particularly in Lahontan Valley. Numbers vary greatly from year to year, but when ideal conditions are present, the number of phalaropes may be many times greater than in a typical year. For instance, in the late 1980's, approximately 30,000 birds were estimated to be present in Big Soda Lake (Lahontan Valley Wetlands) alone (L. Neel, *pers. comm.*). Even larger congregations are typical of nearby areas such as Great Salt Lake and Mono Lake.[6]

Fall migrants consistently outnumber spring migrants in Nevada and surrounding areas by wide margin.[7] That said, however, phalarope numbers are difficult to assess accurately during migration, as migration peaks are short, and their timing is variable. Additionally, fall migration generally occurs earlier (late July) than for most other shorebirds (L. Neel, *pers. comm.*), and is therefore not always effectively captured by multi-species migration counts. For these reasons, population size estimates for Nevada need to be confirmed with further research and monitoring.

The Red-necked Phalarope is a Conservation Priority Species in part because Nevada (particularly Lahontan Valley) provides migration stopover habitat for several thousand birds each year. In recognition of their critical importance to Red-Necked Phalaropes and other shorebirds,[4, 7] the Lahontan Valley Wetlands have been designated as a "Site of Hemispheric Importance" by the Western Hemisphere Shorebird Reserve Network (www. whsrn.org).

Abundance and Occupancy by Habitat

Although about 3,000 Red-necked Phalaropes are estimated to stopover in Nevada, on average, numbers vary substantially from "wet" years to "dry" years. Peak counts of 16,200 have been observed in Lahontan Valley as recently as 1987,[1] and 30,000 in the late 1980s (L. Neel, *pers. comm.*).

Nevada-Specific Studies and Analyses

Shuford et al. (2002)[7] provides the most comprehensive data for migratory shorebirds in the Intermountain West region, including Nevada.

Main Threats and Challenges

Habitat Threats

- Loss or degradation of marshes, ponds, and lakes due to water diversions, declines in water quality, or development

Red-necked Phalarope

Phalaropus lobatus

Research, Planning, and Monitoring Challenges

- The relative importance of ephemeral wetlands such as flooded playas, particularly during spring migration, has not been well-studied and deserves further investigation[5]

Conservation Strategies

Habitat Strategies

- Open Water (p. Hab-15-1) and Ephemeral Wetland and Playa (p. Hab-6-1) habitat conservation strategies benefit this species
- Maintain conditions that produce healthy populations of aquatic invertebrates (brine shrimp, brine flies, and others) during the spring and fall migration periods

Research, Planning, and Monitoring Strategies

- Improve current monitoring programs to better count peak migration numbers
- Devote more inventory and monitoring effort to ephemeral wetlands to determine their relative importance as migration habitat
- Monitor water quality in occupied sites

Public Outreach Strategies

- None identified

References: [1]Alcorn (1988); [2]Brown et al. (2001); [3]IWJV (in prep.); [4]Oring and Reed (1996); [5]Oring et al. (2000); [6]Rubega et al. (2000); [7]Shuford et al. (2002); [EO] Expert opinion

Franklin's Gull

Leucophaeus pipixcan



Photo by Fred Petersen

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water (Agricultural)	
Key Habitat Parameters ◑	
Plant Composition	Bulrush, cattail, sedges, rushes, submerged aquatic vegetation
Plant Density	Patches of emergent vegetation with low-intermediate stem densities[2]
Mosaic	Marshes with emergent vegetation patches with low-intermediate stem densities for nesting, open water and nearby agricultural lands for foraging[3]
Water Depth	30 – 60 cm [12-24 in] at nest site, surrounded by deeper water[3]
Hydrology	Minimal fluctuation in stage during incubation [EO]
Response to Vegetation Removal	Probably positive to prescribed burns in upland habitats in overgrown sites [EO]
Area Requirements ○	
Minimum Patch Size	Unknown, but prefers larger wetland complexes for nesting
Recommended Patch Size	200 ha [494 ac] for total marsh size [EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S3B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ◑	Slow increases in Great Basin in past 75 years[3]
Recent ○	Increasing[4]
Population Size Estimates	
Nevada ◑	350 [EO]
Global ○	500,000 – 1,000,000 [3, 4, 5]
Percent of Global	< 1%
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	NWR and WMA counts, Aquatic Bird Count
Coverage in NV	Good in NWR's and WMA's, Fair / Poor elsewhere
Key Conservation Areas	
Protection	Ruby Valley, Lahontan Valley
Restoration	Degraded marshes

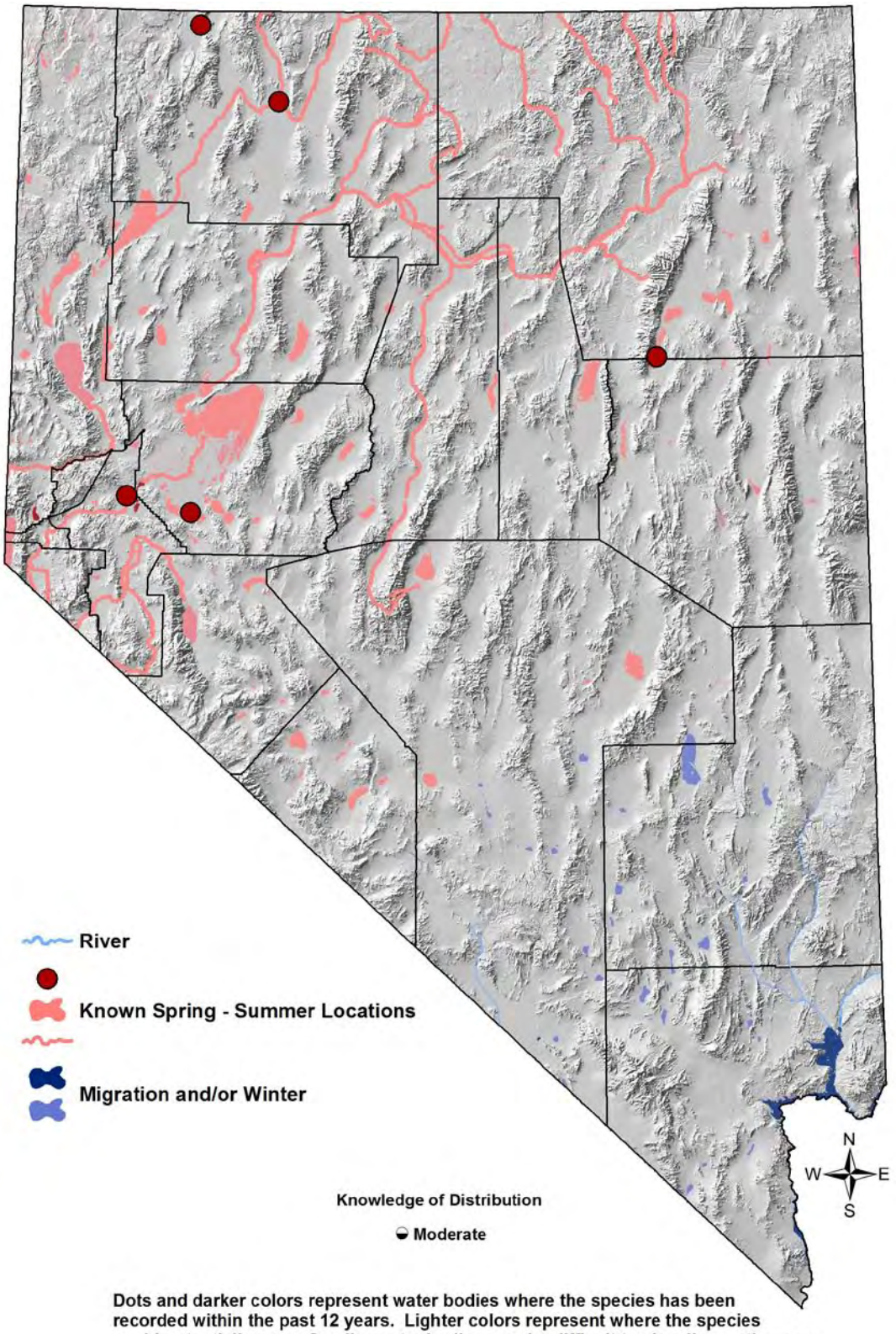
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer Fall (migration)	
Known Breeding Dates in Nevada	
May – July[3]	
Nest and Nesting Habits	
Nest Placement	On mats of floating vegetation[3]
Site Fidelity	Unknown
Other	Nests colonially[3]
Food Habits	
Basic	Dabbles and forages aerially and terrestrially
Primary Diet	Terrestrial and aquatic insects, seeds[3]
Secondary Diet	Plant matter[3]

Confidence in Available Data: ●High ◑Moderate ○ Low

Franklin's Gull

Leucophaeus pipixcan



Franklin's Gull

Leucophaeus pipixcan

Overview

Historical and recent population trends of the Franklin's Gull in the western U. S. are complex and variable across the species' breeding range.[3] In Nevada, however, at the southern margins of their breeding range, Franklin's Gulls have slowly increased. Franklin's Gulls were apparently unknown in the Great Basin until approximately 75 years ago, and the first Nevada breeding records date from only 1970 or 1971.[1, 3, 4] Until recently, Nevada's breeding population was very small (about 20 birds, occasionally peaking at about 50), but beginning in 2006 or 2007, number of breeders began to increase, especially in Ruby Lake NWR, which now hosts most of the state's known breeding pairs. Despite these increases, the Franklin's Gull is still a Conservation Priority species because of its small population size and its sensitivity to human disturbance and changing water levels in the breeding colony sites. Franklin's Gulls engage in significant post-breeding vagrancy prior to southward migration,[3] and birds migrating from farther north use a number of stopover sites in Nevada. Additional work is needed to determine whether conservation issues exist for post-breeding or migratory Franklin's Gulls in Nevada.

Abundance and Occupancy by Habitat

- Nest spacing in colonies may be as close as 1 m (more typically ~ 3 m) [3]
- Although Nevada's numbers have historically been small (< 50 pairs / site), they are increasing, and could potentially become significantly larger, as is the case in Oregon, Idaho, and Utah[3, 4]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat and other Threats

- Loss or degradation of marshes due to water diversions, declines in water quality, or development
- Vulnerable to human disturbance during nesting[3]
- Sensitive to changes in water level during incubation[3]

Franklin's Gull

Leucophaeus pipixcan

Research, Planning, and Monitoring Challenges

- Additional survey and monitoring efforts in areas other than NWR's and WMA's would be useful to better determine Nevada's breeding population size and identify any significant breeding locations
- The degree to which Franklin's Gulls use Nevada marshes during the post-breeding and fall migration periods needs to be better understood

Conservation Strategies

Habitat and Other Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species
- Manage marshes to provide the preferred vegetation composition and density (see Habitat Use Profile table, above). More specifically, alkali bulrush and emergent narrowleaf pondweed are desirable vegetation components as they provide ideal material for nest platforms [EO]
- Maintain water at a consistent stage throughout the breeding season (1 May – 15 July), or at least during the incubation period (1 May – 15 June)[3]
- Limit human disturbance at colony sites

Research, Planning, and Monitoring Strategies

- Conduct additional surveys and monitoring to identify any significant breeding locations outside NWR's and WMA's
- Conduct additional surveys to better determine the extent to which post-breeding birds and fall migrants use Nevada marshes
- Monitor water quality in important breeding sites

Public Outreach Strategies

- None identified

References: [1]Alcorn (1988); [2]Burger (1974); [3]Burger and Gochfield (2009); [4]Ivey and Herziger (2006); [5]Kushlan et al. (2002); [EO] Expert opinion

Black Tern

Chlidonias niger



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Marsh Open Water	
Key Habitat Parameters ◑	
Plant Composition	Pondweed, bulrush, sedges, rushes[2]
Plant Density	25-75% cover within patches of emergent vegetation[2]
Mosaic	Large marsh complexes (avoids small isolated marshes); roughly equal amounts of open water and emergent vegetation; < 50% tilled upland[2, 5]
Water Depth	0.5 – 1.2 m [1.6 – 3.9 ft] at nest site[2]
Water Quality	Presumed to require very low salinity [EO]
Hydrology	Minimal fluctuation in stage during incubation [EO]
Response to Vegetation Removal	Probably negative [EO]
Area Requirements ◑	
Minimum Patch Size	20 ha [49 ac][2]
Recommended Patch Size	> 1,000 ha [2,500 ac] based on requirement of marsh complexes[2, EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Small population size Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S2S3B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
IW Waterbird Plan	High Concern
Trends	
Historical ●	Rangewide declines[6]
Recent ◑	Declining[3]
Population Size Estimates	
Nevada ◑	700 [EO]
Global ◑	300,000 [4]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Ruby Lake NWR surveys, Aquatic Bird Count
Coverage in NV	Good at Ruby Lake NWR, Fair / Poor elsewhere
Key Conservation Areas	
Protection	Ruby Valley
Restoration	Lahontan Valley, Ruby Valley

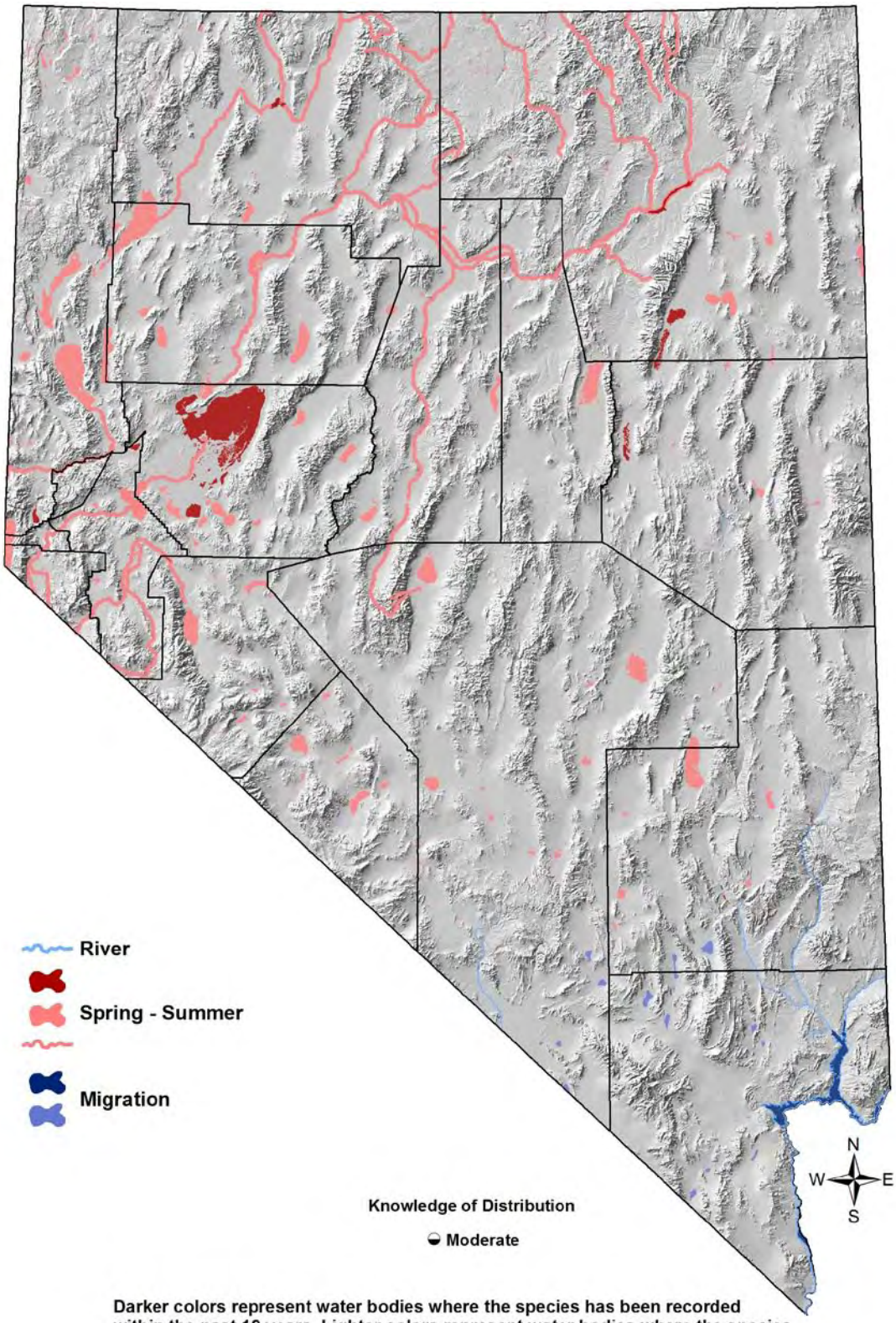
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late June – August[1]	
Nest and Nesting Habits	
Nest Placement	Floating nest in emergent or dense mats of submerged vegetation, near open water[2]
Site Fidelity	Low fidelity to nest area[2]
Other	Semi-colonial, 11-50 pairs, nests spaced 5 - 20 m [2]
Food Habits	
Basic	Aerial forager and dipper
Primary Diet	Insects; fish 2.5-3 cm [1-1.2 in] in length[2]
Secondary Diet	Unknown

Confidence in Available Data: ●High ◑Moderate ○ Low

Black Tern

Chlidonias niger



Black Tern

Chlidonias niger

Overview

The Black Tern is one of several Conservation Priority species covered in this plan that are declining in Nevada for no clearly identified reason. The regional loss and degradation of marshes is undoubtedly an important factor, but this does not explain why Black Terns seem to be declining more rapidly than most other marsh-associated species. Until very recently, the main Black Tern breeding colony in Nevada has been located at Ruby Lake NWR. However, no breeding has been observed in this colony since 2006, which is particularly disturbing because waterbird habitats in this NWR are well-managed and protected from most threats. Biologists have not yet developed concrete hypotheses for the recent loss of this colony, nor is there any information about whether it is the result of regional declines, or simply a displacement of birds to other breeding locations. It should be noted that the Black Tern's declining trends in Nevada are mostly attributable to the decline and recent loss of the Ruby Lake NWR colony. Confirming definitive statewide trends (that may also include migrant populations) will require collecting additional survey and monitoring data from a wider area. Apart from Ruby Lake NWR, other known historical and current breeding sites within Nevada include the Lahontan Valley, Humboldt Sink, Mason Valley WMA, the Boyd Humboldt Valley IBA, Quinn River, and Pahranagat NWR. The numbers of breeders at these sites have always been relatively low and variable, at least over recent decades. Possible breeding locations that deserve further study include Kirch WMA, and Key Pittman WMA, which are currently migration stopover sites for the species. Because several nearby sites in California provide important migration stopover location for Black Terns,[7] it is likely that many of the Nevada sites shown in the map above as Spring–Summer range also provide important migration habitat.

Abundance and Occupancy by Habitat

The Nevada population estimate shown above in the Conservation Profile table is based on recent historic average of 600 breeders at Ruby Lake NWR before 2006, plus an estimate of 100 additional breeders [EO] at scattered locations throughout state.

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of marshes due to water diversions, declines in water quality, or development
- Changes in water level during incubation may destroy nests
- Heavy metal contamination may be a threat

Black Tern
Chlidonias niger

- Human nest disturbance, invasive plants, and pesticides have also been suggested as threats, but not well documented[2]

Research, Planning, and Monitoring Challenges

- Causes of ongoing declines are not well understood and require more detailed research and monitoring in order to determine appropriate conservation actions
- Enhanced monitoring and survey efforts are needed to better determine breeding numbers and distributions at known or potential breeding sites across the state. This could also help to determine whether current declines, which are largely attributable to the decline and recent loss of the Ruby Lake NWR breeding colony, are systemic across Nevada

Conservation Strategies

Habitat Strategies

- Marsh (p. Hab-9-1) and Open Water (p. Hab-15-1) habitat conservation strategies benefit this species; Shuford[8] provides additional Black Tern conservation strategies
- Restored or artificial marshes can provide suitable habitat if the amount of emergent vegetation is appropriate.[5] Additionally, artificial nest platforms may be beneficial in waterbodies where water fluctuations would otherwise threaten nests
- River restoration projects along the Humboldt River system and elsewhere in historic breeding habitat can benefit Black Terns, if river-associated wetlands are created[2]

Research, Planning, and Monitoring Strategies

- Additional research and monitoring is needed to document the ongoing status of the Ruby Lake NWR, and to determine the causes for the cessation of breeding activity in 2006
- Expanded statewide surveys and monitoring efforts are needed to determine:
    - The numbers distribution of breeders at other sites
    - Whether declines are systematic
    - The extent to which Nevada marshes provide important migration stopover habitat
- Monitor water quality in important breeding sites

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Heath et al. (2009); [3]Ivey and Herziger (2006); [4]Kushlan et al. (2002); [5]Naugle et al. (2000); [6]Sauer et al. (2008); [7]Shuford and Gardali (2008); [8]Shuford (1999); [EO] Expert opinion

Band-tailed Pigeon

Columba fasciata



Photo by Steve Ting

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest	
Key Habitat Parameters ●	
Plant Composition	Mixed-conifer, including white fir, ponderosa pine, Jeffrey pine, red fir, lodgepole pine; may also use pinyon, juniper, manzanita, oak[4]
Plant Density & Size	150 - 500 trees / ha [60 – 200 trees / ac][1]; typical dbh 16-32 cm [6-12 in][4]; nests more likely where canopy closure and tree height are greater than average for the area[3]
Shrub Understory	Not required[4]
Distance to Water	Unknown
Response to Vegetation Removal	Probably negative to overstory removal, neutral to understory[EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	Entire mountain range[EO]
Home Range	Typically 11,000 ha [27,000 ac]; range 300 – 180,000 ha [750 – 450,000 ac][4]

Conservation Profile

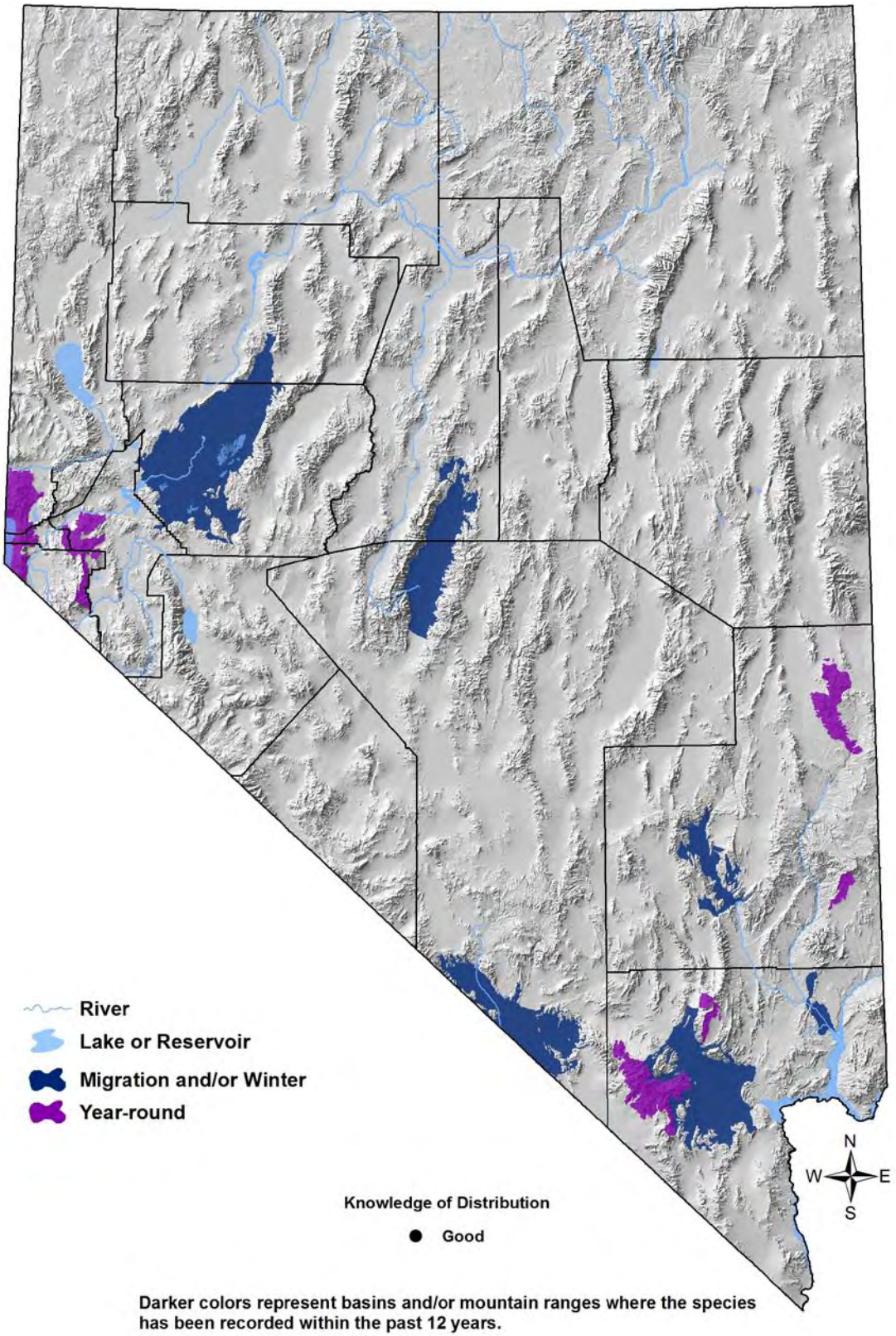
Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Small population size Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	None
NV Natural Heritage	S3
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Upland Gamebird
Trends	
Historical ◑	Rangewide declines[4]
Recent ●	In West, annual decline of 1.4 - 2.1% [8]
Population Size Estimates	
Nevada (NBC) ◑	615
Global ◑	970,000 [7]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Carson Range, Spring Mountains
Restoration	Carson Range

Natural History Profile

Seasonal Presence in Nevada	
Year-round (with seasonal movements)	
Known Breeding Dates in Nevada	
Mid May – October[2]	
Nest and Nesting Habits	
Nest Placement	Tall conifer limb, often facing S/SW, with open flyway to nest[4]
Site Fidelity	Probably moderate[4]
Food Habits	
Basic	Arboreal gleaner[3]
Primary Diet	Fruits, grains, acorns, pine nuts[4]
Secondary Diet	Flowers and buds of trees and shrubs[4]
Other	Grit, mineral salts, and salt licks required; feeders may be visited[4]

Band-tailed Pigeon

Columba fasciata



Band-tailed Pigeon

Columba fasciata

Overview

The Band-tailed Pigeon presents a conservation dilemma that is fortunately unusual; that of a species undergoing a steady decline for which there is no confirmed (or even plausibly hypothesized) explanation. Because of this species' very large home range requirements, however, it seems possible that landscape-level changes in habitat mosaics may play an important role. There are two distinct populations (subspecies) of Band-tailed pigeon that enter Nevada at opposite ends of the state. They are concentrated in the coniferous forests of the Carson Range and the Spring Mountains. They also occur patchily around the margins of the state, but appear to be mostly absent from the central region as breeders. In winter, they engage in downward elevational movements and occur across a somewhat wider geographic area. Given the prospect of continuing declines, and the lack of a specific explanation for these declines, a significant effort at expanded monitoring and research is warranted. Each population has its own management plan, developed by the Pacific and Central Flyways.[6]

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Coniferous Forest	26% (5/19)	1.0 (0.2 – 1.8)
Mojave		
Coniferous Forest	50% (2/4)	0.2 (n/a)

- BBS-derived Nevada population estimate (7,500 birds)[7] is much larger than the NBC estimate (615)

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Causes of observed declines not well understood range-wide or in Nevada, but given the Band-tailed Pigeon's exceptional large home range requirements, landscape-level changes may play a role [EO]

Band-tailed Pigeon

Columba fasciata

Research, Planning, and Conservation Challenges

- Management of these birds is especially challenging. It is difficult to reliably estimate population size because of the difficulty in locating and observing pigeons.[6]
- Lack of information about causes of ongoing population declines

Conservation Strategies

Habitat Strategies

- Until further information is gathered, it is assumed that the Coniferous Forest habitat conservation strategy (p. Hab-5-1) benefits this species
- Maintain a forest mosaic that includes older-aged closed-canopy patches interspersed with open-canopy patches and forest openings
- Providing supplemental salt / mineral blocks may be beneficial

Research, Planning, and Monitoring Strategies

- Improve monitoring coverage to confirm population trends and more accurately determine occupied range and population size; several potential monitoring protocols have been tested in Arizona.[5] Monitoring strategies at mineral sources developed for Pacific populations[1] do not work as well for interior populations, which do not visit mineral deposits as regularly
- Conduct research to better determine habitat needs, area requirements, and causes for declines
- Investigate incidence of disease and disease vulnerability

Public Outreach Strategies

- None identified

References: [1]Cassaza et al. (2005); [2]GBBO unpublished Atlas data; [3]Hughes (2007); [4]Keppie and Braun (2000); [5]Kirkpatrick et al. (2005); [6]Pacific Flyway Study Committee (2001); [7]Rich et al. (2004); [8]Sauer et al. (2009); [EO] Expert opinion

Yellow-billed Cuckoo

Coccyzus americanus



Photo by Murrelet Halterman

Habitat Use Profile

Habitats Used in Nevada	
Mojave Lowland Riparian Great Basin Lowland Riparian (historically) (Springs)	
Key Habitat Parameters ●	
Plant Composition	Fremont cottonwood, willows, saltcedar, mesquite
Plant Density & Height	High-density (≥ 50% cover) riparian woodlands with canopy heights varying from 5-30 m [16 – 100 ft][2, 8]
Mosaic	Large intact patches of riparian gallery forest, or tall riparian shrub thickets; diverse vertical structure important[8]
Distance to Water	< 100 m [330 ft] from water[8]
Response to Vegetation Removal	Negative [EO]
Area Requirements ◑	
Minimum Patch Size	> 20 ha [50 ac][2, 4, EO]
Recommended Patch Size	> 80 ha [200 ac][8, 12]
Home Range	~ 20 ha [50 ac] with core area of ~ 4 ha [10 ac][20]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
ESA listing: Candidate species - Historical declines Small population size - Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S1B
USFWS	Candidate Species; Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	Sensitive Species
NDOW	Conservation Priority
Other	Covered by Clark County MSHCP,[3] Lower Colorado River MSCP,[18] and Virgin River HCRP[19]
Trends	
Historical ●	Steep declines in west[8]
Recent ○	Unknown[16]
Population Size Estimates	
Nevada ◑	10-20 [14]
Global ◑	< 2,000 west of Rocky Mountains[8]
Percent of Global	~ 1% of western population
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Special surveys by USBR, USFWS, NDOW, SNWA and others
Coverage in NV	Good
Key Conservation Areas	
Protection	All currently occupied habitat
Restoration	All lowland riparian areas, and springs in Mojave region

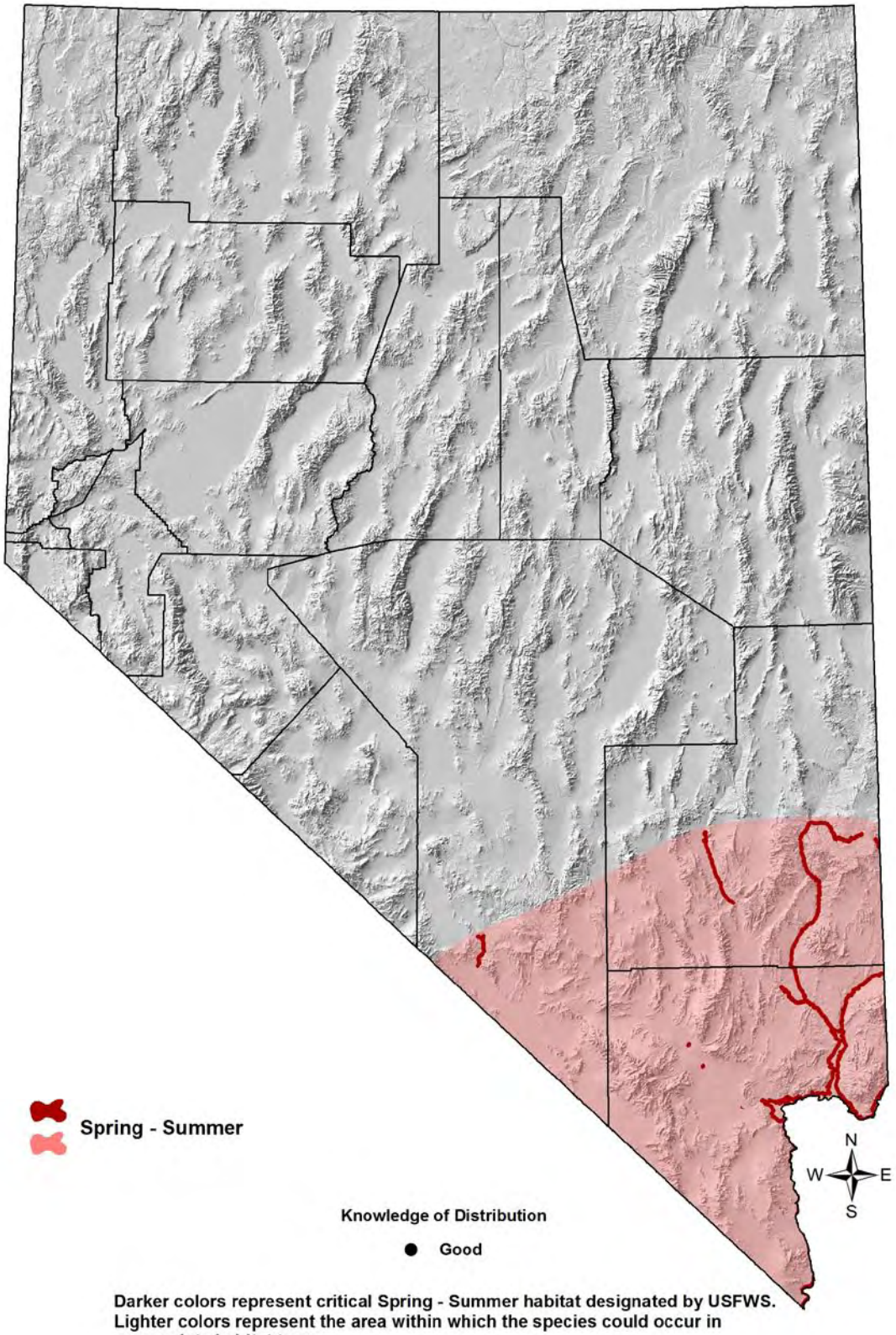
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late June – early September [EO]	
Nest and Nesting Habits	
Nest Placement	Above ground (< 10 m [33 ft] high) in dense riparian thicket[8]
Site Fidelity	Probably moderate for breeding site [EO]
Other	Not territorial[8]
Food Habits	
Basic	Shrub gleaner
Primary Diet	Large terrestrial insects, e.g., cicadas, caterpillars, grasshoppers, crickets[8]
Secondary Diet	Small vertebrates, eggs[8]

Confidence in Available Data: ●High ◑Moderate ○ Low

Yellow-billed Cuckoo

Coccyzus americanus



Yellow-billed Cuckoo

Coccyzus americanus

Overview

Although the Yellow-billed Cuckoo is common and widespread in the Great Plains and eastward, its western populations have suffered drastic declines and range reductions since the settlement period. Once suspected in the 1970s of being extirpated from Nevada,[8] Yellow-billed Cuckoos now breed semi-regularly along the Virgin and Muddy Rivers.[14,15] Surveys by the Nevada Department of Wildlife and others have discovered cuckoos in a few additional locations in southern Nevada,[14] and the Nevada Bird Count and Nevada Breeding Bird Atlas projects have added records in western and northeastern Nevada, although these probably involved nomadic non-breeders.[12]

Yellow-billed Cuckoos require large patches of multi-layered riparian gallery forest, with cottonwoods and willows (ideally both) clearly being preferred.[5,11] Riparian mesquite habitats may be used, but usually only when willow-cottonwood habitat is unavailable.[12] Key habitat features are dense foliage, especially within 10 m [33 ft] of the ground,[4] and moist conditions.[8] Cuckoos may require the relatively cool temperatures and high humidity that only larger patches of dense forest next to open water can provide.[8,9] On the lower Colorado River, cuckoo habitat is characterized by a dense overstory dominated by cottonwoods and willows, a subcanopy with willow and, often, saltcedar components, and a sparse understory. However, sites where the subcanopy is dominated by saltcedar are less likely to be used.[9] Cuckoos will forage in pure saltcedar stands, but they have not been found breeding in them, except in New Mexico.[17] Cuckoos will readily use younger forest stands with canopy heights of 10 m [33 ft] or less,[4] as is the case with restoration sites on the South Fork of the Kern River (CA).[11,13] In this restoration project, sites with less than 40% canopy closure were not used by cuckoos, and those with greater than 65% canopy closure were deemed optimal.

Cuckoos may use patches of forest as small as 10-20 ha [25-50 ac] in area and 100 m [330 ft] wide,[4] but ideally habitat patches should be > 80 ha [200 ac] or > 600 m [2,000 ft] wide and contain open water within 100 m [330 ft] of the bird's activity center.[12] Although cuckoos appear to respond more strongly to local patch features than to the surrounding landscape mosaic,[5] the presence of multiple patches of suitable habitat in close proximity to one another is still thought to be beneficial for the species' population dynamics. Thus fragmentation and isolation of remaining habitat is a concern, as are potentially low colonization rates for newly-restored sites.[12] Fortunately, there has been recent evidence that in some cases, cuckoos can find new restoration sites more rapidly than previously expected.[4,11,20] Beyond some threshold distance from source areas, however, colonization does appear to be slow. As an example, apparently suitable habitat that has been restored within the cuckoo's historical Great Basin breeding range has yet to be colonized.

Yellow-billed Cuckoo

Coccyzus americanus

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

Because of its status as an ESA candidate species, Yellow-billed Cuckoos are heavily monitored and studied in Nevada by NDOW, USBR, USFWS, SNWA, and others.

Relevant Conservation Plans and other legal documents can be found at:
http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B06R

A thorough review of the Yellow-billed Cuckoo's natural history and a survey protocol are available at: [7]
http://www.southernsierraresearch.org/cuckoo_methodology_May2010%5B1%5D.pdf

Main Threats and Challenges

Habitat and Other Threats

- Loss, degradation, and fragmentation of riparian habitat due to:[10]
  - Surface water diversion and flood control projects
  - Saltcedar invasion
  - Fire
  - Livestock grazing, primarily in historically-occupied Great Basin areas
- High-water events of long duration that can kill cottonwoods and willows[9]
- Disturbance of nesting area, which may cause nest abandonment[11]
- The tendency of cuckoo populations to decline after warm years has been suggested as a possible indication of sensitivity to climate change[1]

Research, Planning, and Monitoring Challenges

- Reasons for the continued absence of Yellow-billed Cuckoos from apparently suitable habitat in the Great Basin need further investigation

Yellow-billed Cuckoo

Coccyzus americanus

Conservation Strategies

Habitat Strategies

- Mojave Lowland Riparian (p. Hab-11-1) and Great Basin Lowland Riparian (p. Hab-7-1) habitat conservation strategies benefit this species
- Protect current Yellow-billed Cuckoo habitat from additional loss or degradation
- Promote natural recruitment of cottonwoods and willows by facilitating channel-scouring hydrological processes, where possible
- Restore native riparian habitat, where opportunities exist, to create patches of suitable size in all historical locations, including the corridors of the Colorado River and tributaries in southern Nevada, and the Walker, Truckee, and Carson River corridors in northern Nevada
- In currently grazed river reaches with diminished foliage density, removal of cattle has been shown to increase cuckoo numbers[10, 13]

Research, Planning, and Monitoring Strategies

- Continue current population monitoring efforts
- Identify areas where potential exists to restore native riparian vegetation in patches of 40 ha [100 ac] or larger, and pursue partnerships and strategies to implement restoration projects
- Conduct additional surveys of potential breeding areas in northern and western Nevada
- Where groundwater pumping or channel diversions, or flood control projects occur, monitor effects on potential habitat
- Design and implement a coordinated fire management strategy that protects occupied remnants of cuckoo habitat

Public Outreach Strategies

- None identified

Yellow-billed Cuckoo

Coccyzus americanus

References: [1]Anders and Post (2006); [2]Biosystems Analysis (1989); [3]Clark County (2000); [4]Gaines and Laymon (1984); [5]Girvetz and Greco (2009); [6]Greco (2008); [7]Halterman et al. (2009); [8]Hughes (1999); [9]Johnson et al. (2008); [10]Krueper et al. (2003); [11]Laymon (1998); [12]Laymon and Halterman (1989); [13]Laymon et al. (1997); [14]NDOW (2009); [15]Rathbun and Braden (2003); [16]Sauer et al. (2008); [17]Sogge et al. (2008); [18]LCR MSCP (2004); [19](Jeri Krueger, *pers. comm.*); [20]Sechrist et al. (2009); [EO]Expert opinion



Yellow-billed Cuckoo habitat in the Mojave region. Photo by Jen Ballard.

Flammulated Owl

Otus flammeolus



Photo by Fred Petersen

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest Aspen	
Key Habitat Parameters ●	
Plant Composition	Ponderosa and Jeffrey pines, white fir, mix of other coniferous species, aspen; prefers well-developed shrub understory in forest stands[1, 4, 6]
Plant Density & Size	At nest sites,138-1040 trees/ha [56 – 420 / ac]; canopy closure 35-75%; trees present with dbh > 50 cm [20 in]; shrub density 182-776 shrubs/ha [74–315 / ac][6]
Mosaic	Mature forest with large-diameter (dbh 44-87 cm [17 – 34 in]) snags, forest openings, clumps of saplings and shrubs, multiple canopy layers, aspen groves[6]
Slope	16 – 30% [6]
Response to Vegetation Removal	Negative [EO]
Area Requirements ●	
Minimum Patch Size	Estimated at 50 ha [125 ac][6, EO]
Recommended Patch Size	> 150 ha [370 ac] [EO]
Home Range / Territory Size	3 - 16 ha [7 - 40 ac][6]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Habitat threats Unknown population trend	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S4B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	Sensitive Species
NDOW	Stewardship
Trends	
Historical ○	Unknown
Recent ○	Unknown
Population Size Estimates	
Nevada ○	Uncertain; < 2,500 [EO]
Global ◑	29,000 [9]
Percent of Global	Unknown
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	No systematic monitoring
Coverage in NV	Poor
Key Conservation Areas	
Protection	Spring Mountains, Carson, Schell Creek and Snake Ranges
Restoration	Unknown

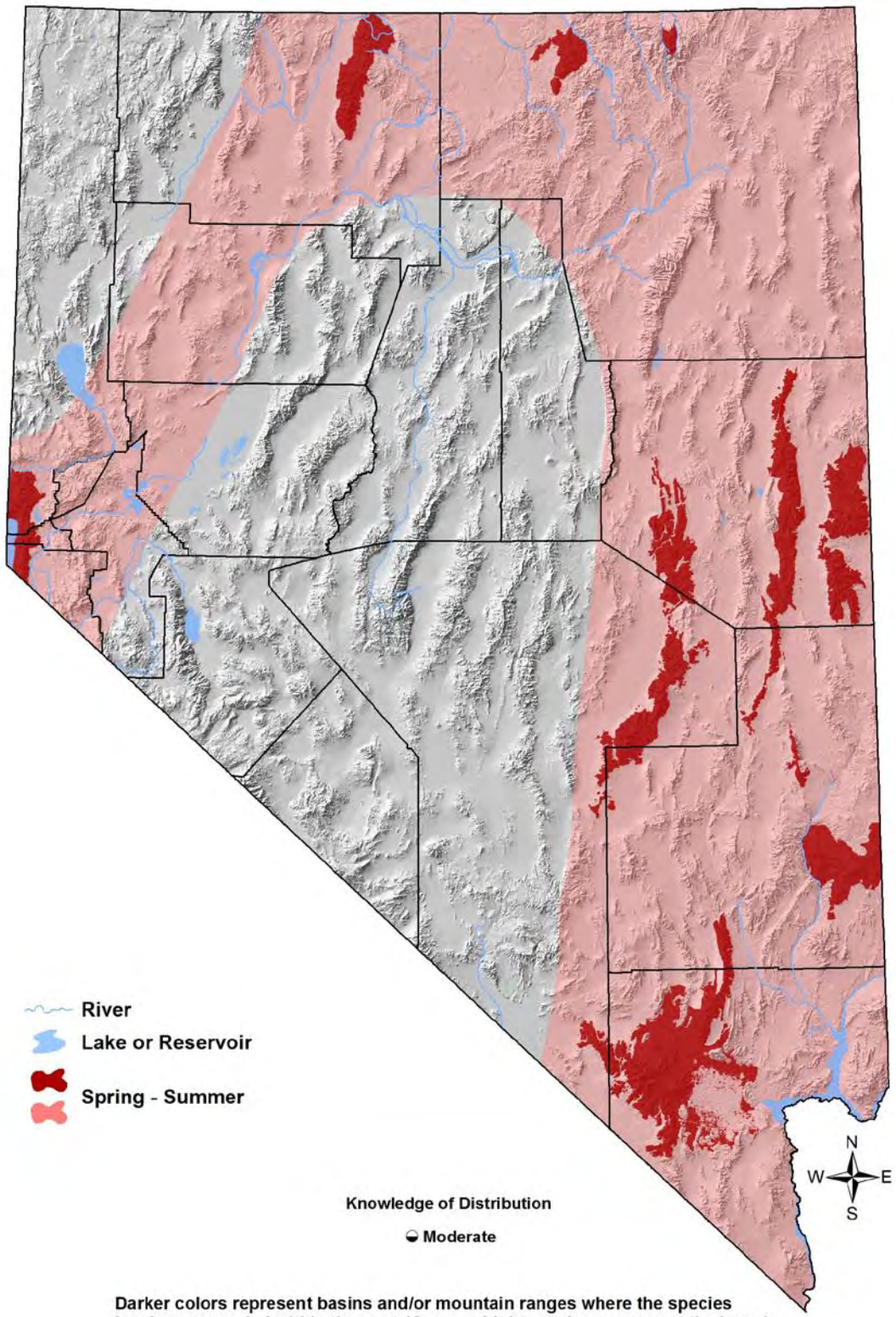
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late May – early August[3, EO]	
Nest and Nesting Habits	
Nest Placement	Large woodpecker cavity in large snag[6]
Site Fidelity	High for breeding territory[6]
Other	Nest within 30-100 m [100 – 330 ft] of forest opening[6]
Food Habits	
Basic	Aerial insectivore
Primary Diet	Nocturnal flying insects, especially moths[6]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Flammulated Owl

Otus flammeolus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Flammulated Owl

Otus flammeolus

Overview

Although its habitat needs are relatively well characterized, much less is known about the Flammulated Owl's numbers, distribution, or conservation status in Nevada. Records have come from the Santa Rosa, Jarbidge, Spring, Schell Creek, Quinn Canyon, White Pine, Sheep, Clover, Snake, Highland, Bull Run, and Carson ranges, but this small owl could potentially occur in other ranges as well.[2] Recent inventories in the central Nevada ranges, however, suggest that it may be absent there, as it may be more generally absent from large landscapes where suitable habitat is sparsely scattered.[10] The Flammulated Owl's preference for a varied forest mosaic would seem to suggest that they occupy only in the larger forested patches that can provide this structural diversity, but in reality they have been found in forest patches of < 50 ha [125 ac].[2] All of these factors suggest that Flammulated Owl distribution may be affected not only by local habitat factors, but by the spatial arrangement of suitable habitat patches across large landscapes.

Flammulated Owls are most often associated with ponderosa pine, but populations in southeastern Idaho and northern Utah are known to nest in large aspen stands with no pine in the area.[5, 8] Several of the species' known locations in Nevada also lack ponderosa pine.[2] Natural openings in the forest (for foraging) are apparently critical, as are clumps of understory vegetation for roosting. Perhaps the key management factor for this bird is managing forests to ensure the presence of large-diameter snags. Flammulated Owls often breed in loose clusters comprised of multiple pairs, making targeted protection of nesting areas easier.[1]

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

Arsenault et al.,[1] Dunham et al.,[2] and Mika[7] have conducted detailed studies of various aspects of Flammulated Owl biology in Nevada.

Main Threats and Challenges

<u>Habitat and Other Threats</u>

- Loss of large snags to fuel gathering, fuels reduction activities, or large, high-severity fires[EO]
- Simplification of the forest mosaic as a result of large, high-severity fires (although smaller, patchy fires may be beneficial by creating forest openings and increasing stand diversity)
- Recent genetic studies suggest that Nevada populations may be smaller, more isolated, and less stable than others in the West[7]

Flammulated Owl

Otus flammeolus

Research, Planning, and Monitoring Challenges

- Current population trends in Nevada are not known
- Factors controlling distribution patterns are poorly understood

Conservation Strategies

Habitat Strategies

- Coniferous Forest (p. Hab-5-1) and Aspen (p. Hab-3-1)habitat conservation strategies benefit this species
- Manage fuels reduction and harvesting activities to conserve large-diameter snags
- In occupied ranges, manage forests to encourage a mosaic of older trees (especially ponderosa and Jeffrey pine), younger-aged trees, and forest openings with a well-developed shrub layer
- Fire management strategies should generally encourage smaller-scale patchy fires that increase diversity of the forest mosaic, and actively discourage large-scale stand-replacing fires

Research, Planning, and Monitoring Strategies

- Conduct additional study and monitoring to determine population trends and conservation status of Flammulated Owls
- A Western network of Flammulated Owl monitoring programs is being considered (http://sites.google.com/site/pifwesternworkinggroup/projects/flammulated-owl-monitoring); Nevada should seek to become involved in such a program if it is implemented
- Additional study of occupancy patterns in Nevada mountain ranges (and their possible controlling factors) would be beneficial

Public Outreach Strategies

- None identified

References: [1]Arsenault et al. (2003); [2]Dunham et al. (1996); [3]GBBO unpublished. Atlas data; [4]Herron et al. (1985); [5]Marti (1997); [6]McCallum (1994); [7]Mika (2010); [8]Powers et al. (1996); [9]Rich et al. (2004); [10]Wright (1996); [EO] Expert opinion

Burrowing Owl

Athene cunicularia



Photo by Derek Hall

Habitat Use Profile

Habitats Used in Nevada	
Sagebrush Salt Desert Scrub (Mojave Scrub) (Joshua Tree)	
Key Habitat Parameters ●	
Plant Composition	Treeless areas with low vegetation; usually sagebrush or salt desert, but also urban / suburban and disturbed sites[10]
Plant Density & Size	Vegetation must be low (< 15 cm [6 in] acceptable, < 5 cm [2 in] preferred),[6, 10, 19] with < 30% ground cover[EO]
Mosaic	Burrows dug by rodents or other small to medium sized mammals must be available, along with sufficient prey base[10, 19]
Distance to Water	Unknown, probably unimportant[10]
Response to Vegetation Removal	Often present where disturbance or grazing has shortened or removed some vegetation[10]
Area Requirements ◑	
Minimum Patch Size	~ 80 ha [200 ac][EO]
Recommended Patch Size	> 300 ha [750 ac][EO]
Home Range	50 – 500 ha [120 – 1,200 ac], but most activity occurs within 600 m [2,000 ft] of burrow[10]

Conservation Profile

Priority Status	
Special Status Species	
Species Concerns	
Unknown population trend	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	G4T4, S3B
USFWS	Migratory Bird, Bird of Conservation Concern
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Other	Proposed Covered Species under Clark County MSHCP amendment,[21] Covered Species under Coyote Springs Investment HCP[21]
Trends	
Historical ●	Large declines (> 50% in Nevada)[4, 10, 14]
Recent ○	Mixed in the West; patterns in Nevada uncertain[4, 10, 18]
Population Size Estimates	
Nevada (NBC) ◑	3,000
Global ◑	2,000,000 [15]
Percent of Global	< 1 %
Population Objective	
Maintain / Increase[EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Known colony sites
Restoration	Former colony sites

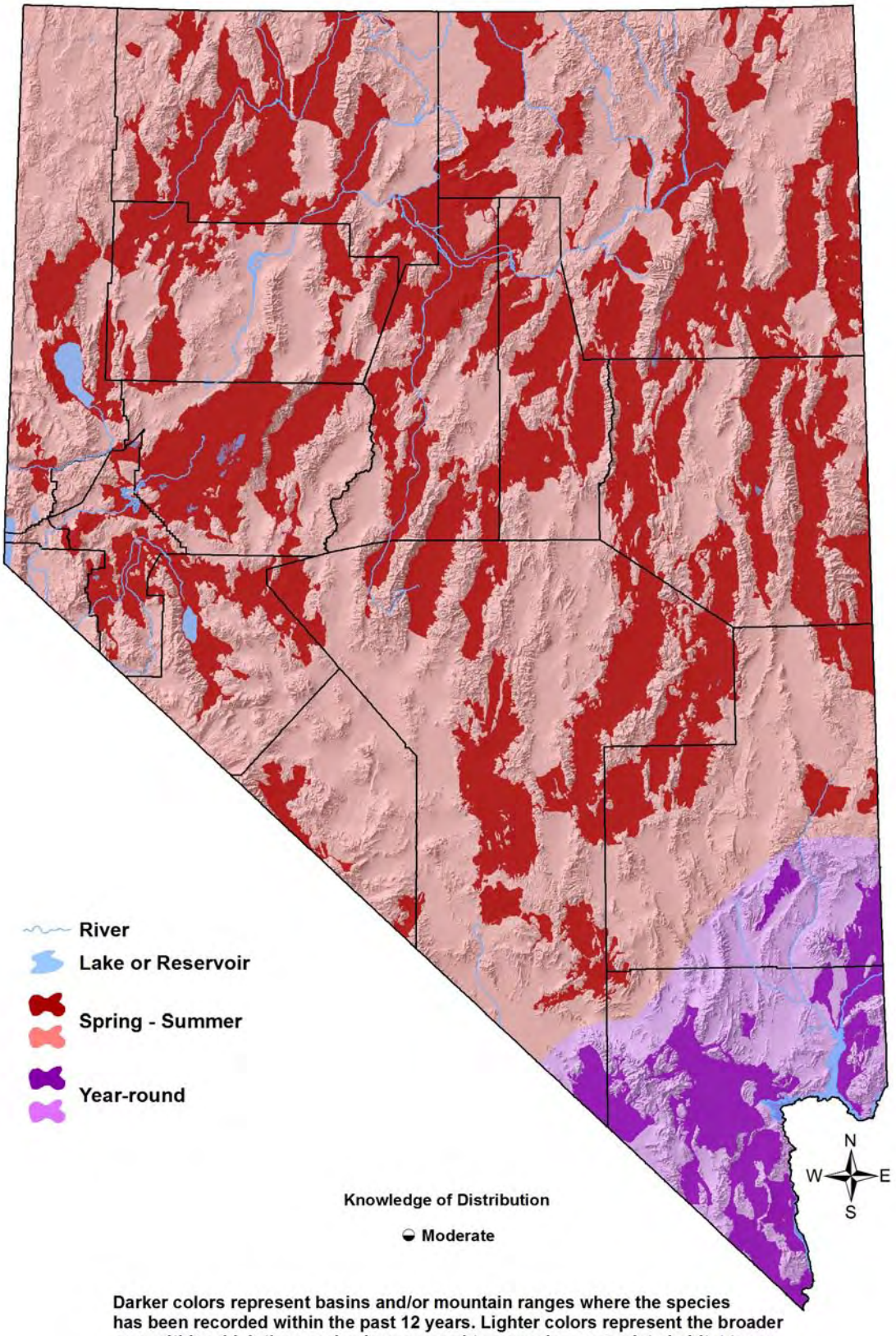
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer; Year-round in Mojave region[7, 11, 12]	
Known Breeding Dates in Nevada	
Mid-April – early August[5]	
Nest and Nesting Habits	
Nest Placement	Nests in burrows dug by burrowing animals, or artificial burrows[8, 10, 19, EO]
Site Fidelity	High for general breeding area; may also re-use burrows[10, 19]
Food Habits	
Basic	Terrestrial predator (nocturnal and diurnal)
Primary Diet	Variety of arthropod, small mammalian and reptilian prey[9, 10, 19, EO]
Secondary Diet	Carrion[10]

Confidence in Available Data: ●High ◑Moderate ○ Low

Burrowing Owl

Athene cunicularia



Burrowing Owl

Athene cunicularia

Overview

Across much of its range, the Burrowing Owl has long been considered to be a declining species. It has also been the subject of many local and regional status assessments and planning documents, including the Western Burrowing Owl Assessment.[12] As a result, the Burrowing Owl is generally prominent on the "conservation radar screen", and in Nevada it is currently an Evaluation Species in the Clark County MSHCP.[1] Certainly Burrowing Owls have undergone substantial historical declines, but these have occurred mainly in the prairie regions to the east of Nevada, where loss of prairie dogs and large-scale agricultural conversion greatly reduced the amount of suitable habitat. In these regions, declines appear to be continuing, but the population status of the Burrowing Owl in Nevada and other parts of the arid west is harder to decipher, with verdicts ranging from "declining" to "increasing", depending on the source consulted.[4,10,12,13,18] The main reason for these contradictory results is that survey data on Burrowing Owls in Nevada are inadequate to determine statewide trends. This uncertainty is the reason for giving the Burrowing Owl a "Special Status Species" designation in this plan. The main need at this time is to determine whether or not the species is declining in Nevada, and if so, to identify the most important threats.

In Nevada, Burrowing Owls occur sporadically in valley bottoms, sometimes in loose colonies.[8,14] Apart from their need for burrows, suitable prey, and low vegetation, the importance of other habitat parameters and landscape features are not well understood.[4] The fact that disturbed areas are used by Burrowing Owls, though, suggests some flexibility in habitat use as long as the basic requirements are met.[12,17]

Abundance and Occupancy by Habitat

- NBC data show that 44% of observations occurred in Sagebrush habitat, 22% in grasslands, 21% in Salt Desert Scrub, and 9% in Agriculture
- The NBC population estimate for Nevada (3,000 birds) corresponds well with the population size range reported by Klute et al.[12] (1,000 – 10,000 birds), but is much lower than the BBS-derived estimate of 22,000 [15]

Nevada-Specific Studies and Analyses

Nevada National Security Site (Formerly Nevada Test Site) Studies

In Nevada, the Burrowing Owl has been most extensively studied at the Nevada National Security Site (NNSS). These studies have produced detailed information about the owl's natural history, ecology, breeding biology, and current status.[8,9] Interestingly, Burrowing Owls at the NNSS appeared to be fairly tolerant of human activities, and were frequently observed using human-created structures (culverts, pipes) as artificial burrows. USGS studies are also ongoing in southern and central Nevada, but results were not yet available at the time of this plan release.

Burrowing Owl

Athene cunicularia

Main Threats and Challenges

Habitat Threats

- Habitat loss to urbanization, agriculture, or other development
- Reduction in populations of burrowing animals
- Disturbance of breeding colonies by humans or dogs in some areas[10]
- Possible pesticide impacts[10]

Research, Planning, and Monitoring Challenges

- Population status and trends in Nevada are not known

Conservation Strategies

Habitat Strategies

- Elements of the Sagebrush (p. Hab-17-1) and Salt Desert Scrub (p, Hab-18-1) habitat conservation strategies benefit this species, insofar as they allow for areas of very low vegetation
- Manage known colony locations to maintain short vegetation, healthy populations of burrowing animals, and healthy owl prey populations (small vertebrates, arthropods)
- If possible, establish a no-disturbance buffer zone of 60 m (200 ft) around active nest burrows[8]
- Providing artificial burrows can be effective in helping to restore populations[10, 20]

Research, Planning, and Monitoring Strategies

- Establish and implement effective monitoring programs[2,3] and determine population status and trend in Nevada

Public Outreach Strategies

- Educate the public and private landowners about the impacts of disturbance
- Where breeding owls are present near agricultural lands, encourage absence of pesticide use within 600 m [2,000 ft] of nest burrows[4,14]

References: [1]Clark County (2000); [2]Conway and Garcia (2008); [3]Conway and Simon (2003); [4]Dobkin and Sauder (2004); [5]GBBO unpublished Atlas data; [6]Green and Anthony (1989); [7]Greger and Hall (2009); [8]Hall et al. (2003); [9]Hall et al. (2009); [10]Haug et al. (1993); [11]Herron et al. (1985); [12]Klute et al. (2003); [13]NatureServe (2010); [14]Paige and Ritter (1999); [15]Rich et al. (2004); [16]Rosenberg (2004); [17]Saab et al. (1995); [18]Sauer et al. (2008); [19]Shuford and Gardali (2008); [20]Trulio (1995); [21](Jeri Krueger, *pers. comm.*); [EO] Expert opinion

Spotted Owl

Strix occidentalis



Photo by Brian Harsha

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest	
Key Habitat Parameters ●	
Plant Composition	White, red, and Douglas firs; white, Jeffrey and ponderosa pines; and other high-elevation conifer species
Plant Density, Age, & Size	Canopy closure ≥ 40%,[5] with > 70% closure in nest vicinity;[1] old-growth or late seral stages with multiple canopy layers; some trees with dbh > 90 cm [35 in]; ample downed woody debris; little or no shrub understory[5]
Mosaic	Multiple seral stages over larger landscape[5]
Distance to Water	No known relationship
Response to Vegetation Removal	Negative, but proscribed fires may be beneficial[2, EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 5,000 ha [12,000 ac] [EO]
Home Range	~ 1,500 ha [3,700 ac][4]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Historical declines Possible recent declines Restricted habitat Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S1B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	Sensitive Species
NDOW	Conservation Priority
Trends	
Historical ◑	Large declines likely in Sierra Nevada[5]
Recent ◑	Continuing declines assumed but not confirmed in Sierra Nevada[5]
Population Size Estimates	
Nevada ◑	12 or less[8]
Global ◑	11,000 [9]
Percent of Global	< 1%
Population Objective	
Increase by 100% [9, EO]	
Monitoring Coverage	
Source	USFS and NDOW surveys
Coverage in NV	Good
Key Conservation Areas	
Protection	Carson Range
Restoration	Carson Range

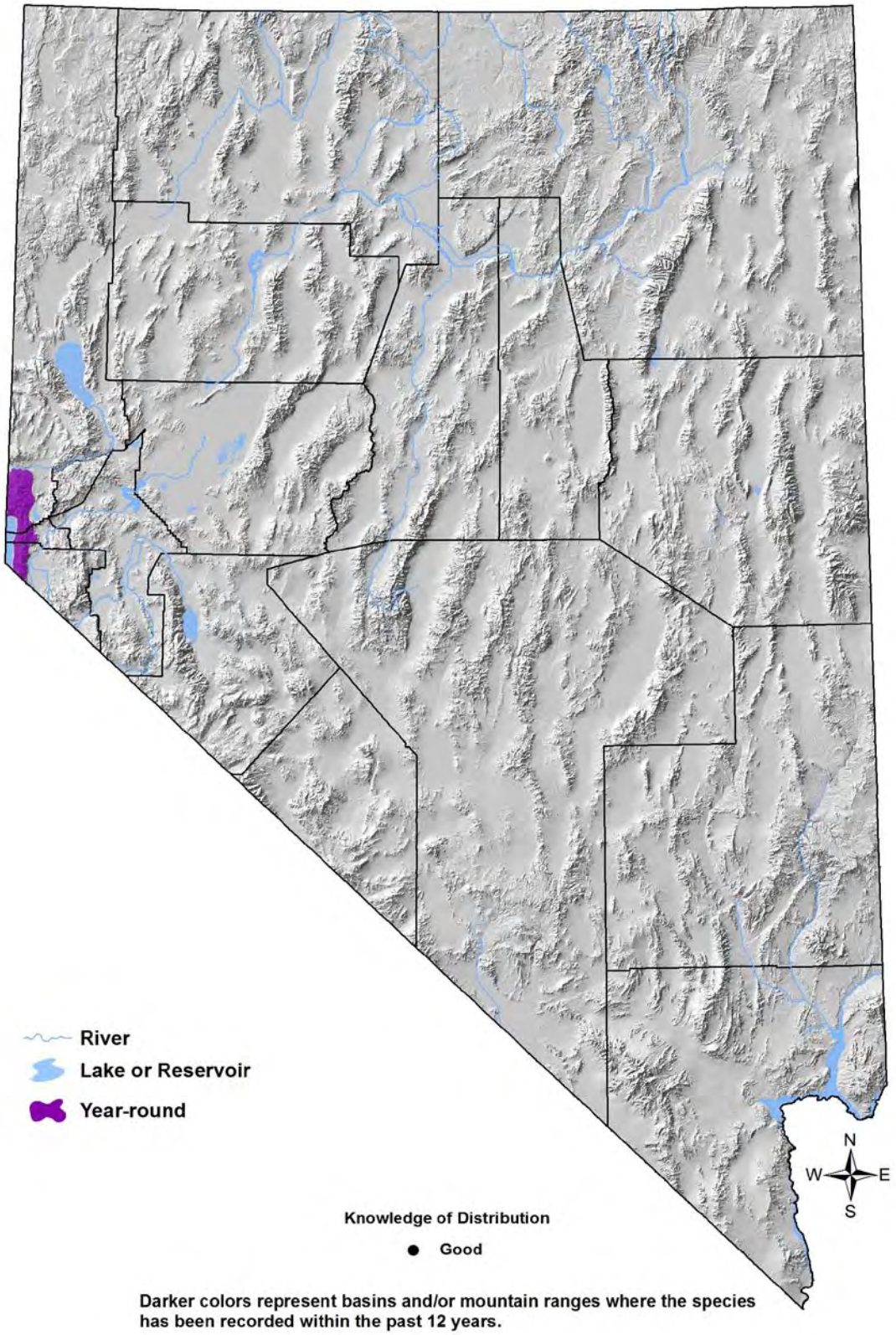
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Mid-May – early August [EO]	
Nest and Nesting Habits	
Nest Placement	In large pre-existing tree cavity[5]
Site Fidelity	High for breeding territory[5]
Food Habits	
Basic	Aerial predator
Primary Diet	Small to medium-sized mammals, especially woodrats and flying squirrels[5]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Spotted Owl

Strix occidentalis



Spotted Owl

Strix occidentalis

Overview

The distribution of the California Spotted Owl (*S. o. occidentalis*) lies primarily west of the Sierra Nevada crest, with only a few documented cases on the east side.[12] This includes Nevada, however, where a small number Spotted Owls occurs within the Carson Range. Although breeding in Nevada had long been suspected, it was not confirmed until 2009 (M. Easton *pers. comm.*). Spotted Owls are associated with large contiguous tracts of old-growth or late-seral coniferous forest in the Pacific Northwest, but pairs in the Carson Range have been noted to occur in smaller, more isolated forest stands. Studies specific to the Sierra Nevada found that occupied territories had more mature conifer forest than non-use sites,[10] with Spotted Owls spending most of their time (78%) in forests having > 40% canopy cover,[4] and nesting in stands with > 70% canopy cover[1] and concentrations of larger trees with DBH > 77 cm [30 in].[2] After nesting is completed, Spotted Owls may migrate downward in elevation,[7] but generally do not leave the confines of coniferous forest habitat.

As is the case with several other birds species associated with coniferous forests, conservation concerns that are common elsewhere in the west, specifically commercial logging, are not a concern in Nevada. Furthermore, because the locations of our nesting pairs are typically well known to managers, inadvertently harmful forest management practices are avoided. Managing fires and fuels to adequately balance wildlife habitat benefits with private property protection is an ongoing challenge. Although not yet a threat, it is possible that Barred Owls (*Strix varia*) may soon expand their range into western Nevada, where they have the potential to displace Spotted Owls as they have done elsewhere.[6] Continuing current monitoring and management practices is, in the meantime, the main conservation need.

Abundance and Occupancy by Habitat

- For California Spotted Owls in the Sierra Nevada, densities range from 0.12 – 0.21 owls / km^2 [0.31 – 0.54 / sq mi]

Nevada-Specific Studies and Analyses

- USFS Carson District and NDOW are actively monitoring and studying Spotted Owls in the Carson Range

Main Threats and Challenges

Habitat Threats

- One or more large fires could destroy a significant portion of suitable habitat

Spotted Owl
Strix occidentalis

- Insect outbreaks, urban encroachment, or other factors that fragment old forest tracts could be detrimental

Research, Planning, and Monitoring Challenges

- None identified

Conservation Strategies

Established Strategies

- The *Sierra Nevada Forest Plan Amendment*[11] provides detailed recommendations and guidance for managing Spotted Owls in the Sierra Nevada Range

Habitat Strategies

- The Coniferous Forest (p. Hab-5-1) habitat conservation strategy benefits this species, with a focus on conserving old-growth and late-seral forest stands with preferred age, size, and density parameters (see Habitat Use Profile)
- Fuels reduction projects that thin smaller trees and reduce fuel ladders can help to protect older stands from catastrophic fires

Research, Planning, and Monitoring Strategies

- Continue current monitoring and research efforts in the Carson Range
- Within the currently occupied region, conduct additional surveys searching for Spotted Owls in atypical habitat (smaller forest patches, mixed-age tracts, etc.)
- Study juvenile dispersal and season movements, perhaps using radio-telemetry, to better determine conservation needs specific to Nevada's Spotted Owl population
- Conduct studies to determine the conservation needs of primary prey species (woodrats and flying squirrel) in the eastern Sierra Nevada

Public Outreach Strategies

- None identified

References: [1]Blakesley et al. (2005); [2]Bond et al. (2002); [3]Bond et al. (2004); [4]Call et al. (1992); [5]Gutiérrez et al. (1995); [6]Kelly et al. (2003); [7]Laymon (1989); [8]Nevada Wildlife Action Plan Team (2006); [9]Rich et al. (2004); [10]Seamans and Gutiérrez (2007); [11]USFS (2001); [12]Verner et al. (1992); [EO] Expert opinion

Short-eared Owl

Asio flammeus



Photo by Larry Neel

Habitat Use Profile

Habitats Used in Nevada	
Wet Meadow (Sagebrush) (Agriculture) (Marsh) (Great Basin Lowland Riparian)	
Key Habitat Parameters ●	
Plant Composition	Perennial grasses and forbs, pasture and hay crops, sagebrush steppe with well-developed grass layer
Plant Density	Very high density grass or other herbaceous cover; sufficiently dense to host vole populations[7]
Mosaic	Wet meadow or grassland bordered by open shrublands or other dry habitat; marsh component beneficial; little or no urban encroachment[7, EO]
Other	Uses undisturbed pinyon-juniper or riparian woodlands for winter roosting[7]
Response to Vegetation Removal	Presumed neutral, if prey populations are unaffected [EO]
Area Requirements ◑	
Minimum Patch Size	100 ha [250 ac][7]
Recommended Patch Size	> 150 ha [395 ac] [EO]
Home Range	Poorly known for western populations, possibly as large as 200 ha [500 ac][3]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S4
USFWS	Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines[7]
Recent ○	Possibly stable,[6] but difficult to determine due to large inter-annual fluctuations
Population Size Estimates	
Nevada (BBS) ◑	5,000 [5]
Global ◑	710,000 [5]
Percent of Global	< 1%
Population Objective	
Increase by 100% [5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	All wet meadows and traditional agricultural lands in Great Basin
Restoration	Same

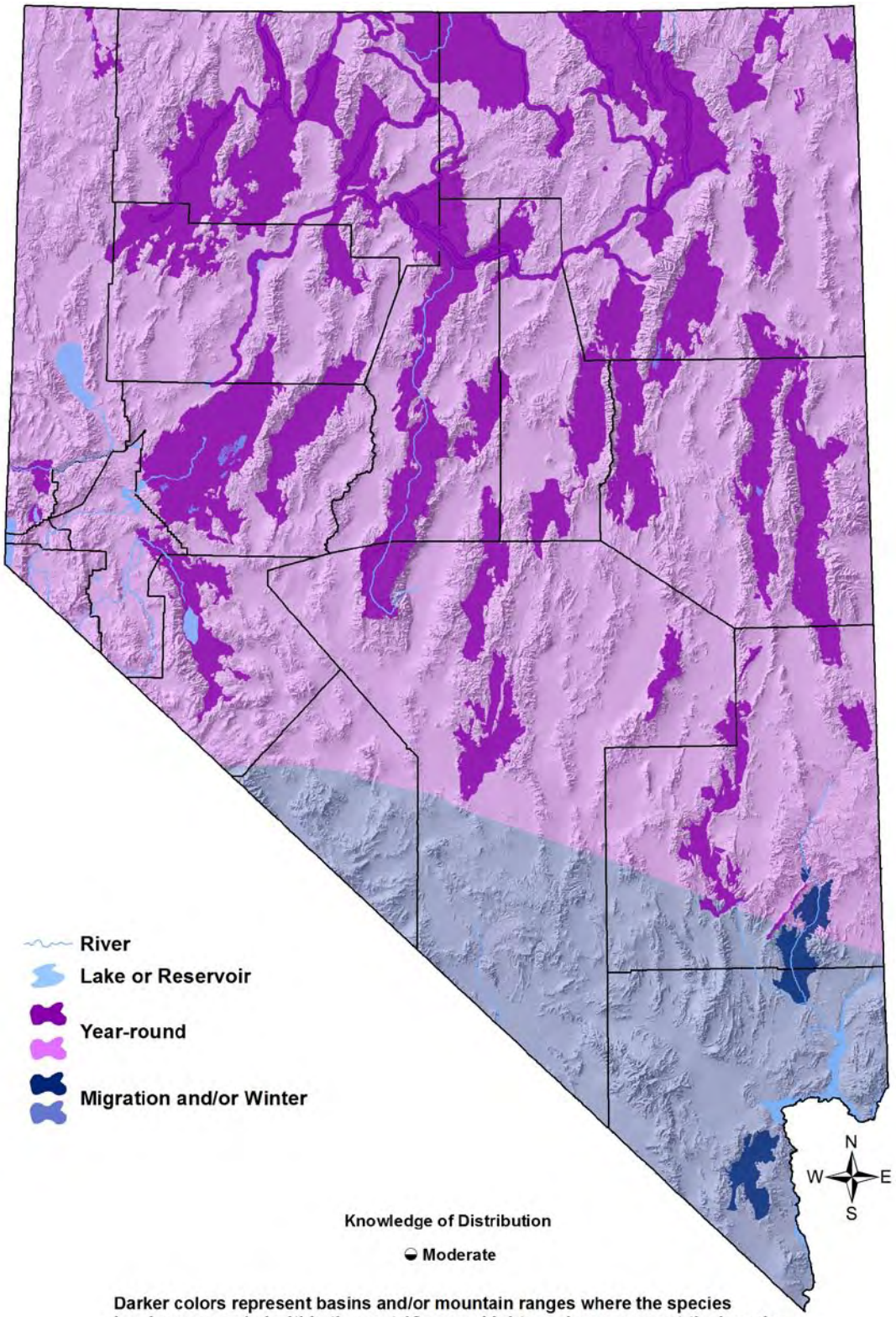
Natural History Profile

Seasonal Presence in Nevada	
Year-round (with seasonal movements)	
Known Breeding Dates in Nevada	
March – early July[2]	
Nest and Nesting Habits	
Nest Placement	On dry ground near grassland / meadow, with vegetation 35 – 55 cm [14 – 21 in] tall[7]
Site Fidelity	Unknown; probably low[7]
Other	Often nest semi-colonially[7]
Food Habits	
Basic	Aerial predator
Primary Diet	Specialist on voles and similar-sized rodents[7]
Secondary Diet	Small birds and large insects[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Short-eared Owl

Asio flammeus



Short-eared Owl

Asio flammeus

Overview

Typically a bird of dense grasslands, the Short-eared Owl is relatively uncommon in Nevada, but it can also be found in diverse types of open country where small mammal populations are sufficiently dense. Voles, their preferred prey, are typically most numerous in wet meadows, grasslands, or crop fields where herbaceous cover is well-developed, and Short-eared Owls often mirror their distribution patterns. Because voles are diurnally active, Short-eared Owls can often be seen hunting during daylight hours. Short-eared Owls populations also tend to follow annual fluctuations in vole abundance, which can be very pronounced. These predator-prey population "booms and busts" make it difficult to distinguish underlying population trends of the Short-eared Owl or to accurately estimate population size. Conservation concern exists because the Short-eared Owl's preferred habitats are threatened by a variety of land-use demands, including intensified agriculture, locally heavy grazing pressure, and water withdrawals. Additionally, Short-eared Owls appear to be particularly sensitive to habitat fragmentation, and it has been suggested that patches of suitable habitat > 100 ha [250 ac] in size are needed.[7] Although Short-eared Owls are present year-round in most of Nevada, the species exhibits pronounced seasonal movements, and is migratory in some parts of its range. These owls often roost communally during the winter, and they may breed semi-colonially in some situations.[1]

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss, degradation, or fragmentation of habitat with well-developed herbaceous cover (wet meadows, grasslands) due to:
  - Habitat conversion
  - Livestock grazing,[1] especially during the early part of the breeding season
  - Intensified / altered agricultural practices, including early haying that disturbs nests
  - Water withdrawals that negatively affect herbaceous cover, especially during the early breeding season
  - Invasive plants

Short-eared Owl

Asio flammeus

Research, Planning, and Monitoring Challenges

- Pronounced fluctuations in abundance make it difficult to determine current population trends
- Short-eared Owls are not well-monitored by current methods; an adaptation of diurnal raptor surveys may do better

Conservation Strategies

Habitat Strategies

- The Wet Meadow (p. Hab-20-1) habitat conservation strategy benefits this species
- Short-eared Owls respond positively to many conservation measures conducted to benefit shorebirds, water birds, and waterfowl[4]
- Manage for good grass / herbaceous cover and productivity from nest initiation (mid-late March) through fledging (June) in areas where voles are present

Research, Planning, and Monitoring Strategies

- Continue monitoring through NBC, and enhance monitoring through other means when possible, to attempt to determine population trend in Nevada
- Conduct additional research on the distributions and habitat requirements of wintering populations

Public Outreach Strategies

- None identified

References: [1]Fondell and Ball (2004); [2]GBBO unpublished Atlas data; [3]NatureServe (2010); [4]Paige and Ritter (1999); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]Wiggins et al. (2006); [EO] Expert opinion

Common Poorwill

Phalaenoptilus nuttallii



Photo by Will Richardson

Habitat Use Profile

Habitats Used in Nevada	
Sagebrush Pinyon-Juniper Montane Shrubland (Salt Desert Scrub) (Mojave Scrub)	
Key Habitat Parameters ○	
Plant Composition	Sagebrushes, mountain mahogany, juniper, pinyon pine and associated shrubs[EO]
Plant Density & Size	Low, sparse vegetation[4]
Mosaic	Interspersion of physiographic elements, including dry washes, sloping uplands, and rocks[4]
Distance to Water	Unknown
Response to Vegetation Removal	Unknown, possibly positive[EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	Unknown
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Stewardship Species	
Species Concerns	
High stewardship responsibility Possible recent declines	
Other Rankings	
Continental PIF	None
Audubon Watchlist	None
NV Natural Heritage	S5B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	None
Trends	
Historical ○	Unknown
Recent ○	Unknown, but possible declines[3]
Population Size Estimates	
Nevada ○	Unknown
Global ○	3,000,000 [2]
Percent of Global	Unknown
Population Objective	
Maintain [EO]	
Monitoring Coverage	
Source	Nevada Bird Count, Breeding Bird Survey
Coverage in NV	Poor
Key Conservation Areas	
Protection	Unknown
Restoration	Unknown

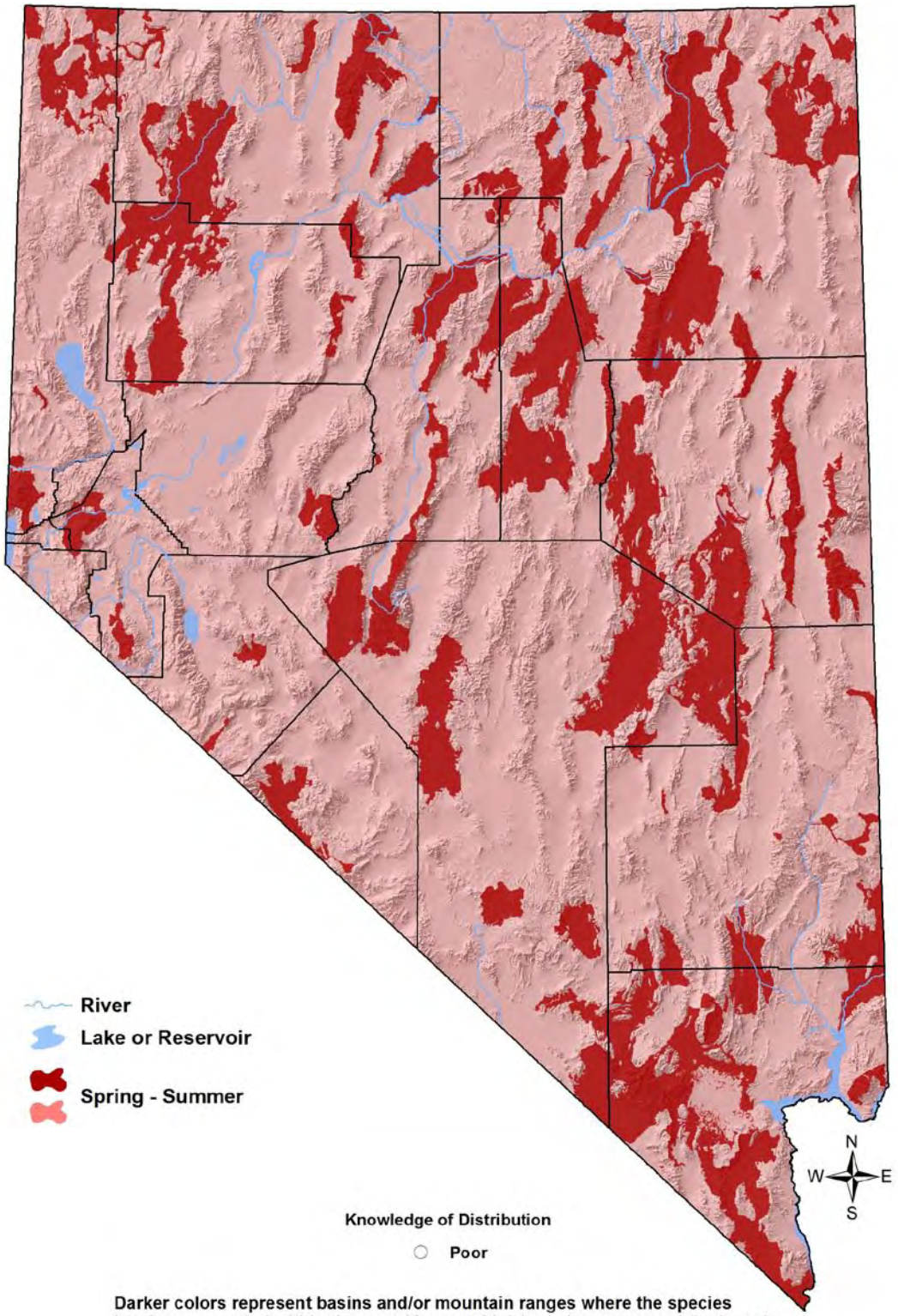
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer, possibly Year-round in Mojave	
Known Breeding Dates in Nevada	
May – August[4] , possibly earlier[EO]	
Nest and Nesting Habits	
Nest Placement	On bare ground, often partially shaded by rock, low shrub, or prickly pear cactus[4]
Site Fidelity	Unknown
Food Habits	
Basic	Aerial forager
Primary Diet	Nocturnal flying insects[4]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Common Poorwill

Phalaenoptilus nuttallii



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Common Poorwill

Phalaenoptilus nuttallii

Overview

Because of its nocturnal habits and extreme inconspicuousness during daylight hours, very little is known, or even conjectured, about the habitat use requirements and conservation status of the Common Poorwill. It is apparent, though, that Nevada has a relatively large proportion of the global population of Common Poorwills, despite representing a much smaller fraction of the bird's geographical range. Common Poorwills are therefore regarded as a Stewardship Species in this plan.

Common Poorwills are most commonly detected in open scrublands, especially those dominated by sagebrush or salt desert shrubs. One recent study in the Sonoran Desert found that poorwill abundance was positively associated with presence of washes, uplands, and rocky substrate, and negatively associated with low grass cover,[1] and similar patterns appear to hold in Nevada.[EO] Improving our understanding of this cryptic bird will require implementation of a species-appropriate nocturnal survey and monitoring program in representative locations throughout the state.

Abundance and Occupancy by Habitat

- A new 32 km [20 mi] night-driving survey route in far northern Nevada documented 34 Common Poorwills, or 1 poorwill / km [1.7 poorwill / mi] (Pete Bradley, pers. comm.)

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Nothing definitive is known about the impacts of typical land uses in Sagebrush, Pinyon-Juniper, or Salt Desert habitats
- Habitat-destroying fire and invasion of exotic plants are likely to be detrimental, but no data exist to confirm this

Common Poorwill

Phalaenoptilus nuttallii

Research, Planning, and Monitoring Challenges

- The dearth of any reliable information about conservation status, threats, or trends make it difficult to manage Common Poorwills effectively

Conservation Strategies

Habitat Strategies

- It is likely that Sagebrush (p. Hab-17-1), Pinyon-Juniper (p. Hab-16-1), and Montane Shrubland (p. Hab-14-1) habitat conservation strategies benefit this species

Research, Planning, and Monitoring Strategies

- Implement night survey / monitoring programs at strategic locations throughout state to better determine distribution, trends, population density, and habitat requirements
- Standard protocols for the United States Nightjar Survey Network are available at: http://ccb-wm.org/nightjars.htm
- Encourage research projects on the species to better understand habitat, mosaic, and area requirements

Public Outreach Strategies

- None identified

References: [1]Hardy et al. (1998); [2]Rich et al. (2004); [3]Sauer et al. (2008); [3]Woods et al. (2005); [EO] Expert opinion

White-throated Swift

Aeronautes saxatalis



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Cliff Great Basin and Mojave Lowland Riparian Montane Riparian (Pinyon-Juniper)	
Key Habitat Parameters ◑	
Plant Composition	n/a
Mosaic	Cliffs adjacent to riparian, open water, marsh, or wet meadow habitats[4]
Cliff Height	Unknown; estimated at ≥ 40 m [130 ft][EO]
Distance to Water	Specifics unknown, but nests close to water[4]
Response to Vegetation Removal	n/a
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 3,000 ha [7,400 ac] around suitable nesting cliff [EO]
Home Range / Territory Size	Specifics unknown; home range at least several ha [ac][4]

Conservation Profile

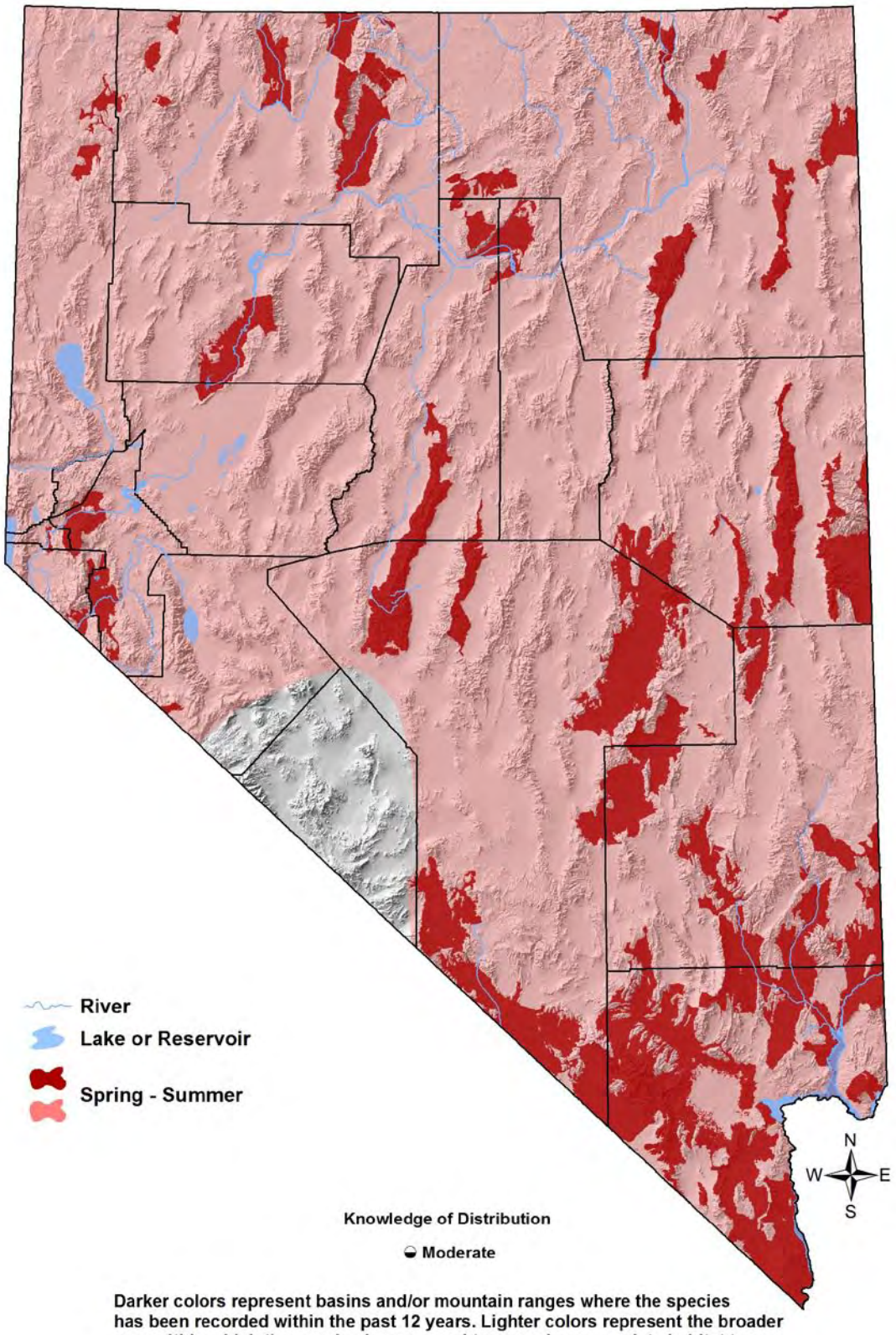
Priority Status	
Conservation Priority Species	
Species Concerns	
Possible recent declines	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ○	Rangewide declines suspected; most recently appears to be stabilizing regionally;[5] Nevada trends unknown
Population Size Estimates	
Nevada (NBC) ◑	14,000
Global ◑	280,000 [2]
Percent of Global	5%
Population Objective	
Increase by 100% [2]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	All suitable cliff habitat near rivers, marshes, lakes, or meadows
Restoration	Rivers, marshes, lake, and meadows near cliffs

Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
April – September[1, 4]	
Nest and Nesting Habits	
Nest Placement	In crevice of cliff or artificial structure[4]
Site Fidelity	Very high for breeding sites[4]
Food Habits	
Basic	Aerial forager
Primary Diet	Exclusively flying insects[4]
Secondary Diet	n/a

White-throated Swift

Aeronautes saxatalis



White-throated Swift

Aeronautes saxatalis

Overview

White-throated Swifts breed throughout Nevada wherever suitable nesting cliffs or artificial structures are present in proximity to water and to sufficient flying insect populations. The species usually breeds communally, with numbers of birds varying greatly among sites. Taller cliffs near rivers seem to be preferred as nest sites,[3, EO] and White-throated Swifts are especially common around Lake Mead and along southern Nevada rivers.[EO] Because of their foraging habits, they can also be seen with some frequency over a broad array of upland habitat types. Current monitoring efforts primarily capture mainly the smaller, and relatively numerous, communal breeding sites that are spread across the state. They do not, however, provide adequate coverage of the most productive communal breeding sites, which are more patchily distributed across the state. For this reason, population size and trend estimates generated from existing data must be viewed with caution. Nevada's most productive White-throated Swift communal breeding sites should be systematically inventoried and monitored to provide a better basis for future population status assessments.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Lowland Riparian	9% (6/66)	3.5 (0.6 – 6.4)
Montane Riparian	5% (4/88)	2.7 (0.3 – 5.1)
Mojave		
Lowland Riparian	19% (7/36)	8.8 (-3.5 – 21.1)

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Loss or degradation of marsh and riparian habitat which negatively affects foraging opportunities
- Disturbance of communal breeding sites
- Possible pesticide bioaccumulation effects, especially near agricultural areas

White-throated Swift

Aeronautes saxatalis

Research, Planning, and Monitoring Challenges

- The most productive breeding sites are few in number and widely scattered. The Nevada Bird Count effectively samples the smaller breeding sites, but misses many of most productive sites
- Basic area requirements, trends, and population size are not well known

Conservation Strategies

Habitat Strategies

- Cliff (p. Hab-4-1), Great Basin Riparian (p. Hab-7-1), Mojave Riparian (p. Hab-11-1), and Montane Riparian (p. Hab-13-1) habitat conservation strategies benefit this species

Research, Planning, and Monitoring Strategies

- Identify, monitor, and protect most productive communal breeding cliffs and structures
- Improve existing monitoring effort with targeted surveys in most productive breeding sites, to generate better estimates of population size and trends
- If White-throated Swifts in Nevada are confirmed to be declining, conduct additional research to determine causes of declines, with possible focus on pesticide impacts

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Rich et al. (2004); [3]Rossi and Knight (2009); [4]Ryan and Collins (2000); [5]Sauer et al. (2008); [EO] Expert opinion

Costa's Hummingbird

Calypte costae



Photo by Scott Page

Habitat Use Profile

Habitats Used in Nevada	
Mojave Scrub Springs Mojave Lowland Riparian Mesquite-Acacia Joshua Tree	
Key Habitat Parameters ◑	
Plant Composition (Woody)	Joshua tree, other *Yucca* spp., acacia, mesquite, desert willow, willow spp., cactuses, pinyon pine, juniper (post-breeding)
Plant Composition (Nectar)	Bladderpod, creosote bush, penstemon spp., squaw cabbage, desert willow, and other flower-bearing forbs and shrubs[1]
Plant Density	3-10 suitable flowering shrubs in territory[1]
Mosaic	Unknown
Distance to Water	Unknown; springs or dry washes important
Response to Vegetation Removal	Probably negative[EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 100 ha [250 ac][1, EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Recent population declines Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ◑	No changes in NV reported[1]
Recent ○	Apparent declines in West, unknown in NV [5]
Population Size Estimates	
Nevada (NBC) ◑	14,000
Global ◑	1,800,000 [3]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[4, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Springs, riparian, ephemeral washes, Joshua tree and transitional habitats in Clark and Nye counties
Restoration	Same

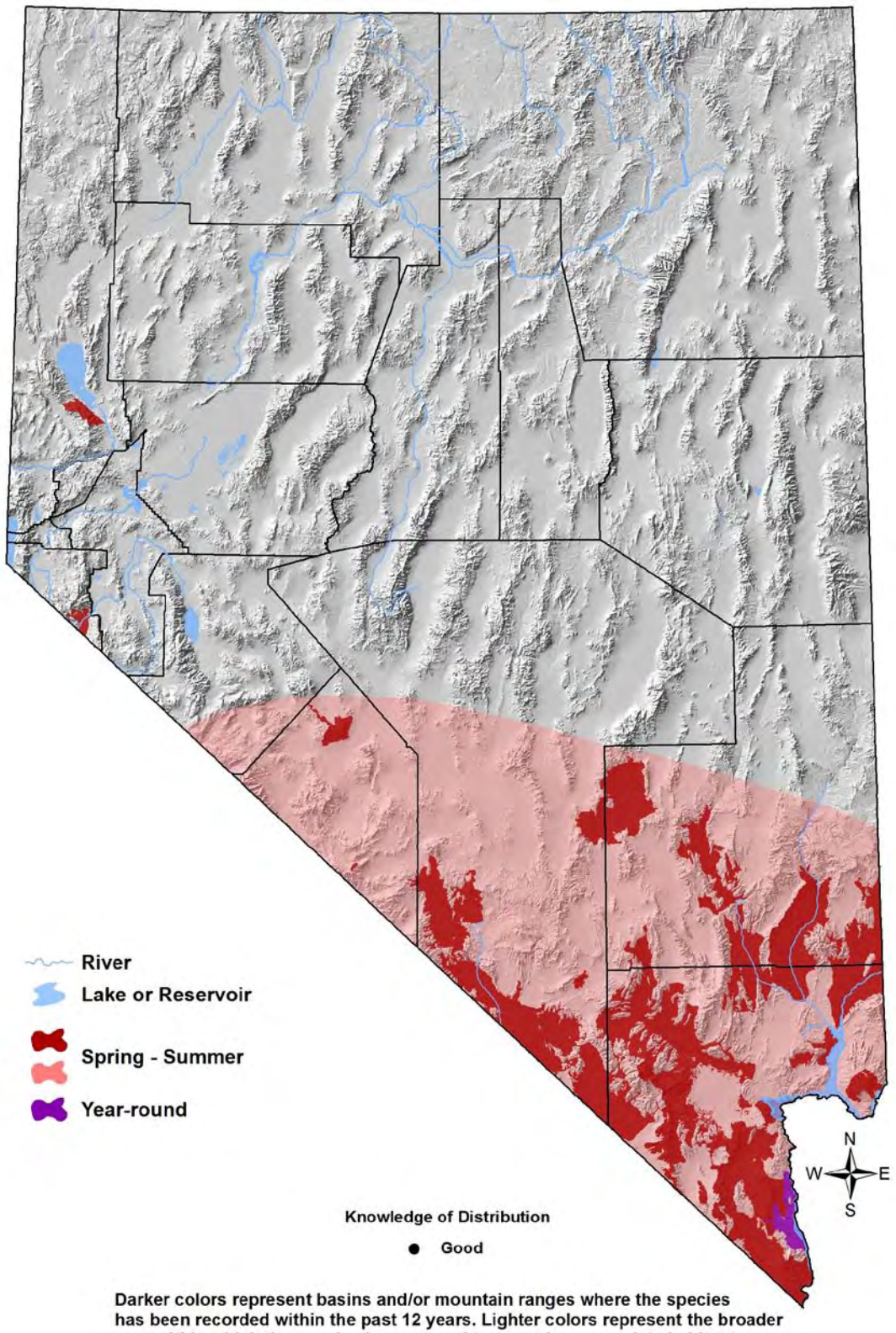
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer; Year-round along lower Colorado River	
Known Breeding Dates in Nevada	
Late March – early July[2, EO]	
Nest and Nesting Habits	
Nest Placement	In woody plant or cactus, < 3 m [10 ft] off ground[1]
Site Fidelity	Low; site occupancy highly variable[1]
Food Habits	
Basic	Forb/shrub layer; also fly-catches
Primary Diet	Nectar and small invertebrates[1]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Costa's Hummingbird

Calypte costae



Costa's Hummingbird

Calypte costae

Overview

Costa's Hummingbird is traditionally regarded as a Mojave Desert bird in Nevada, but the Nevada Bird Count and the Nevada Breeding Bird Atlas project confirmed that it also occurs sporadically as far north as Pyramid Lake. Further study is needed to determine whether this geographical pattern represents an ongoing northward range expansion or simply increased survey efforts, but this species is known for regular vagrancy into Oregon and beyond.[1] Costa's Hummingbird is found in a variety of valley and foothill habitat types, and is less commonly associated with feeders than other hummingbirds (which are dominant).[1] Nonetheless, many records in Nevada are from feeder sightings outside the breeding season. Unfortunately, we have comparatively little information on habitat and foraging requirements during the nesting season. Considered to be a bird of desert scrub, springs and desert washes may also be critical.[1, 4] Because hummingbirds are difficult to monitor effectively, the causes of apparent declines are not well understood. An additional complicating factor is the possible impact of climate change on the blooming phenology and distribution of important food plants. As with the other Conservation Priority hummingbirds, the implementation of a monitoring effort specifically designed to capture more information about hummingbirds would be very useful in assessing conservation status and determining appropriate management actions.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds /40 ha (95% C.I.)
Lowland Riparian	17% (3/36)	1.7 (0.3 – 3.0)
Mojave Scrub	14% (3/22)	1.5 (.05 – 2.0)
Mesquite-Acacia	14% (2/14)	0.8 (n/a)
Joshua Tree	25% (5/20)	0.7 (0.0 – 1.4)
Montane Shrubland	25% (2/8)	0.2 (n/a)
Montane Riparian	22% (2/9)	0.1 (n/a)

Nevada-Specific Studies and Analyses

Landscape Associations (NBC)

Costa's Hummingbirds were detected on 24 of the NBC transects in the Mojave region (several in peripheral habitats not shown on the table above). On a landscape scale, they were most strongly associated with the presence of Mojave Scrub habitat, although most transects with Costa's Hummingbirds also had a significant Lowland Riparian, Springs, or Mesquite-Acacia component. This supports the potential importance of proximity to water or to the flowering plants associated with moist habitats.

Costa's Hummingbird

Calypte costae

Main Threats and Challenges

Habitat Threats

- No clear habitat threats have been identified for this species
- Possible threats include water diversions and groundwater pumping, which may impact blooming plants around riparian and spring areas; invasive plants that compete with preferred food plants, and destruction or degradation of habitat by fire or heavy grazing that significantly reduces abundance of blooming plants during critical times

Research, Planning, and Monitoring Challenges

- Population trends, habitat needs, and threats need further investigation

Conservation Strategies

Habitat Strategies

- Mojave Scrub (p. Hab-12-1), Springs (p. hab-19-1), Mojave Lowland Riparian (p. Hab-11-1), Mesquite-Acacia (p. Hab-10-1), and Joshua Tree (p. Hab-8-1) habitat conservation strategies benefit this species
- Areas with well-developed flowering shrubs and forbs that are located near springs or other water sources should be protected from grazing pressure that would significantly reduce bloom abundance
- Implement weed control programs in these areas as needed

Research, Planning, and Monitoring Strategies

- Develop and implement a monitoring program suited to hummingbirds, and develop better estimates of current trends
- Conduct studies to clarify habitat requirements, use of urban food sources, and threats
- Where groundwater pumping occurs, monitor effects on flowering plant communities
- Develop strategy to attack fires that threaten desert spring vegetation
- Investigate opportunities to integrate research and monitoring efforts with national hummingbird conservation networks; http://www.hummonnet.org

Public Outreach Strategies

- None identified

References: [1]Baltosser and Scott (1996); [2]GBBO unpublished Atlas data; [3]Rich et al. (2004); [4]Rosenberg et al. (1991); [5]Sauer et al. (2008); [EO] Expert opinion

Calliope Hummingbird

Stellula calliope

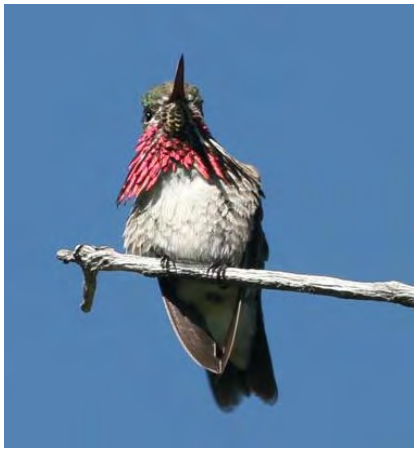


Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Montane Shrubland Montane Riparian Aspen Coniferous Forest Springs	
Key Habitat Parameters ◑	
Plant Composition (Woody)	Aspen, willow, mixed deciduous and coniferous trees[1]
Plant Composition (Nectar)	Requires blooming understory, primarily forbs[1, EO]
Plant Density	Canopy closure < 40% [1]
Mosaic	Mixed-age stand structure, usually early- to mid-successional; typically near forest openings or adjacent to montane shrublands or meadows; also benefits from presence of sap wells made by sapsuckers[1]
Distance to Water	Near water[1]
Other Habitats Used	In migration, lowland riparian, (sub)urban areas with feeders[1]
Response to Vegetation Removal	Negative, especially for understory[EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	Entire stand of deciduous woodland [EO]
Home Range	4 km [2.5 mi] of linear habitat[1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Possible habitat threats Unknown population trend	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	None
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Stewardship
Trends	
Historical ○	Unknown
Recent ○	Poor data, possibly stable[6]
Population Size Estimates	
Nevada (NBC) ○	9,500
Global ◑	1,000,000 [5]
Percent of Global	1%
Population Objective	
Maintain / Increase[5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Carson , Jarbidge, and Toiyabe ranges
Restoration	All Great Basin Montane Riparian and Aspen habitat

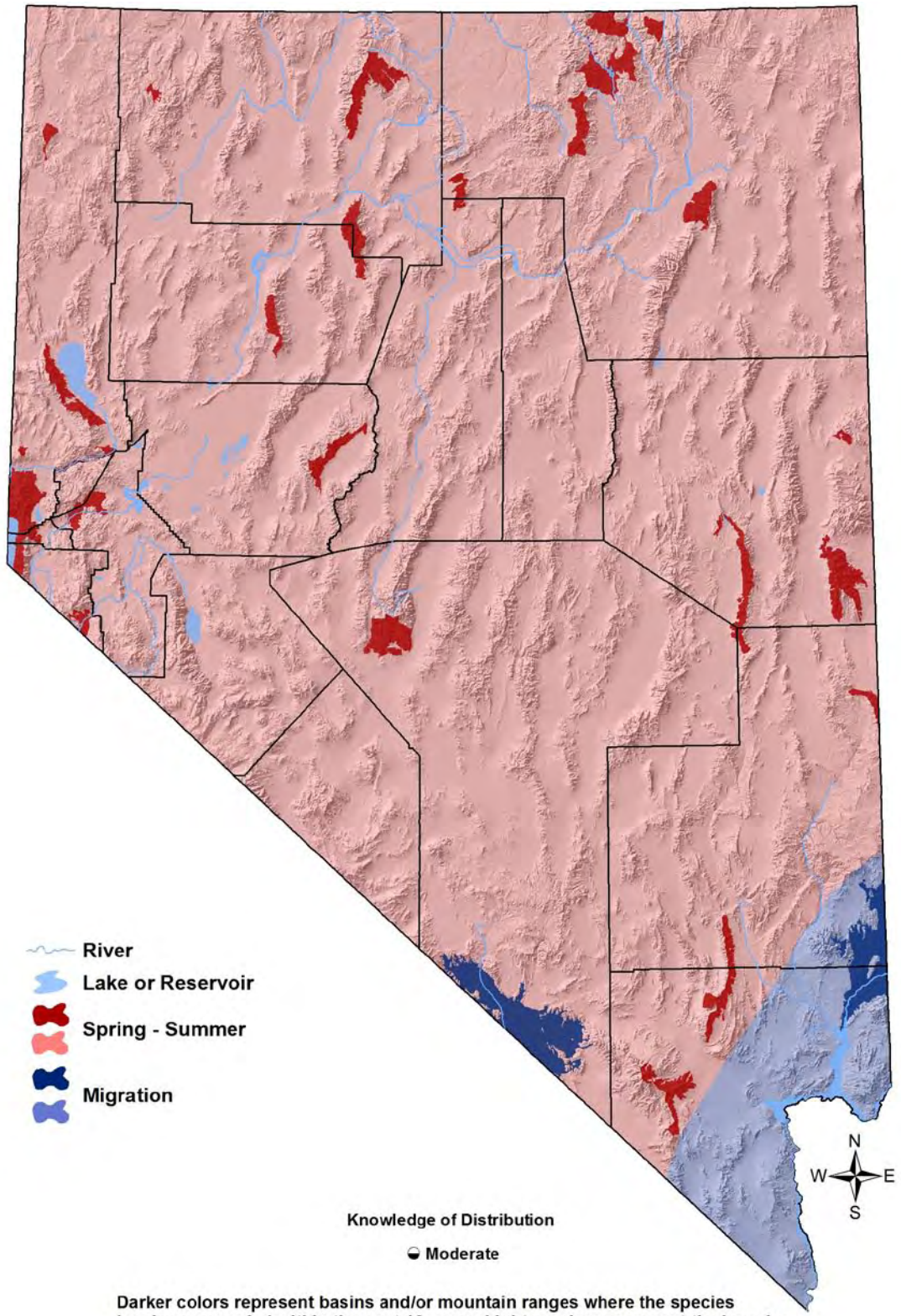
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late April – July[2, 3]	
Nest and Nesting Habits	
Nest Placement	On tree branch 2-12 m [6.5 – 40 ft] off ground, concealed by higher branch[1]
Site Fidelity	Moderate to high for breeding territory[1]
Food Habits	
Basic	Nectarivore and insectivore in forb/shrub layer
Primary Diet	Nectar and small insects from flowers[1]
Secondary Diet	Sap wells made by sapsuckers[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Calliope Hummingbird

Stellula calliope



Calliope Hummingbird

Stellula calliope

Overview

The Calliope Hummingbird is a fairly common breeder in mixed forests of the Carson Range and Jarbidge Mountains. It also occurs in smaller numbers throughout much of the state, for example the Spring Mountains and Sheep Range of southern Nevada. Calliope Hummingbirds are most associated with a montane mosaic of deciduous woodland, blooming understory, and forest edges and openings.

The difficulty of monitoring hummingbird populations accurately is apparent in the widely varying statewide population estimates produced by the Nevada Bird Count (9,500) and Partners in Flight (60,000).[5] For this reason, we encourage development of more targeted monitoring approach than has been available in the past for this and other hummingbird species. Better monitoring protocols and additional research would allow us to better estimate trends, and to more accurately determine habitat requirements and potential threats. At present, conservation concern for the Calliope Hummingbird is somewhat conjectural. It bears noting that hummingbirds that depend upon montane blooms may be impacted in some manner if and when climate change alters blooming phenology in their currently occupied range.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Montane Riparian	2% (2/88)	1.3 (0.1 – 2.5)
Aspen	11% (2/18)	0.7 (0.6 – 0.8)
Coniferous Forest	26% (5/19)	0.6 (0.4 – 0.8)
Mojave		
Montane Riparian	11% (1/9)	0.2 (n/a)
Aspen	14% (1/7)	1.0 (n/a)

- Across wider region, estimated density 0.7 – 2 birds / ha in good breeding habitat[1]
- BBS-based population estimate for Nevada is 60,000 [5]

Nevada-Specific Studies and Analyses

No information

Calliope Hummingbird

Stellula calliope

Main Threats and Challenges

Habitat Threats

- No clear habitat threats have been identified for this species
- Habitat threats to Aspen (p. Hab-3-1), Coniferous Forest (p. Hab-5-1), Montane Riparian (p. Hab-13-1), Montane Shrubland (p.Hab-14-1) and Springs (p. Hab-19-1) habitats apply to this species

Research, Planning, and Conservation Challenges

- Population trends and population size are not known
- Beyond general landscape preferences, specific habitat needs and threats are not well understood

Conservation Strategies

Habitat Strategies

- In the absence of more specific information, Aspen (p. Hab-3-1), Coniferous Forest (p. Hab-5-1), Montane Riparian (p. Hab-13-1), Montane Shrubland (p.Hab-14-1) and Springs (p. Hab-19-1) habitat conservation strategies should benefit this species
- Manage montane areas to maintain a multi-age mosaic of deciduous woodlands (willows and aspen), coniferous forest, montane shrubs, and forest openings and meadows that support flowering forbs
- Seek opportunities to protect productive flowering meadows from grazing pressure if it significantly reduces bloom abundance

Research, Planning, and Monitoring Strategies

- Develop and implement a monitoring program suited to hummingbirds, and develop better estimates of trends and population size
- Conduct studies to clarify habitat requirements and threats
- Investigate opportunities to integrate research and monitoring efforts with national hummingbird conservation networks[4]

Public Outreach Strategies

- None identified

References: [1]Calder and Calder (1994); [2]GBBO unpublished Atlas data; [3]Heath and Ballard (2003); [4]Hummingbird Monitoring Network, www.hummonnet.org; [5]Rich et al. (2004); [6]Sauer et al. (2008); [EO] Expert opinion

Rufous Hummingbird

Selasphorus rufus



\ Photo by Scott Page

Habitat Use Profile

Habitats Used in Nevada
Montane Riparian Great Basin and Mojave Lowland Riparian Aspen Wet Meadow Springs (Mesquite-Acacia)

Key Habitat Parameters ◑	
Plant Composition	Red tubular, nectar-rich flowers: *Castilleja, Aquilega, Epilobium, Delphinium, Penstemon, Monarda, Linaria, Cleome, Lonicera* spp. and similar[1]
Plant Density	Unknown; highly territorial, so high densities most beneficial[EO]
Mosaic	Unknown; flower density appears to be more important than habitat mosaic[EO]
Distance to Water	Unknown, but preferred nectar plants are more common in wetter areas[EO]
Response to Vegetation Removal	Negative to removal of forb layer[EO]

Area Requirements ○	
Minimum Patch Size	Unknown; estimated at 0.1 ha [0.25 ac][EO]
Recommended Patch Size	Whole patch with forb understory[EO]
Home Range	Unknown; depends on flower density[1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Reasons for Priority Status	
Habitat threats High stewardship responsibility (migration)	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	None
NV Natural Heritage	S3M
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ◑	Declines of 2% / year in the West; Nevada unknown[5]
Population Size Estimates	
Nevada ○	Unknown; estimated at > 1,000,000 [EO]
Global ◑	6,500,000 [3]
Percent of Global	≥ 15%
Population Objective	
Increase by 100% [3, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair / Poor
Key Conservation Areas	
Protection	All montane riparian, montane shrubland, aspen, wet meadow, springs, lowland riparian
Restoration	Same

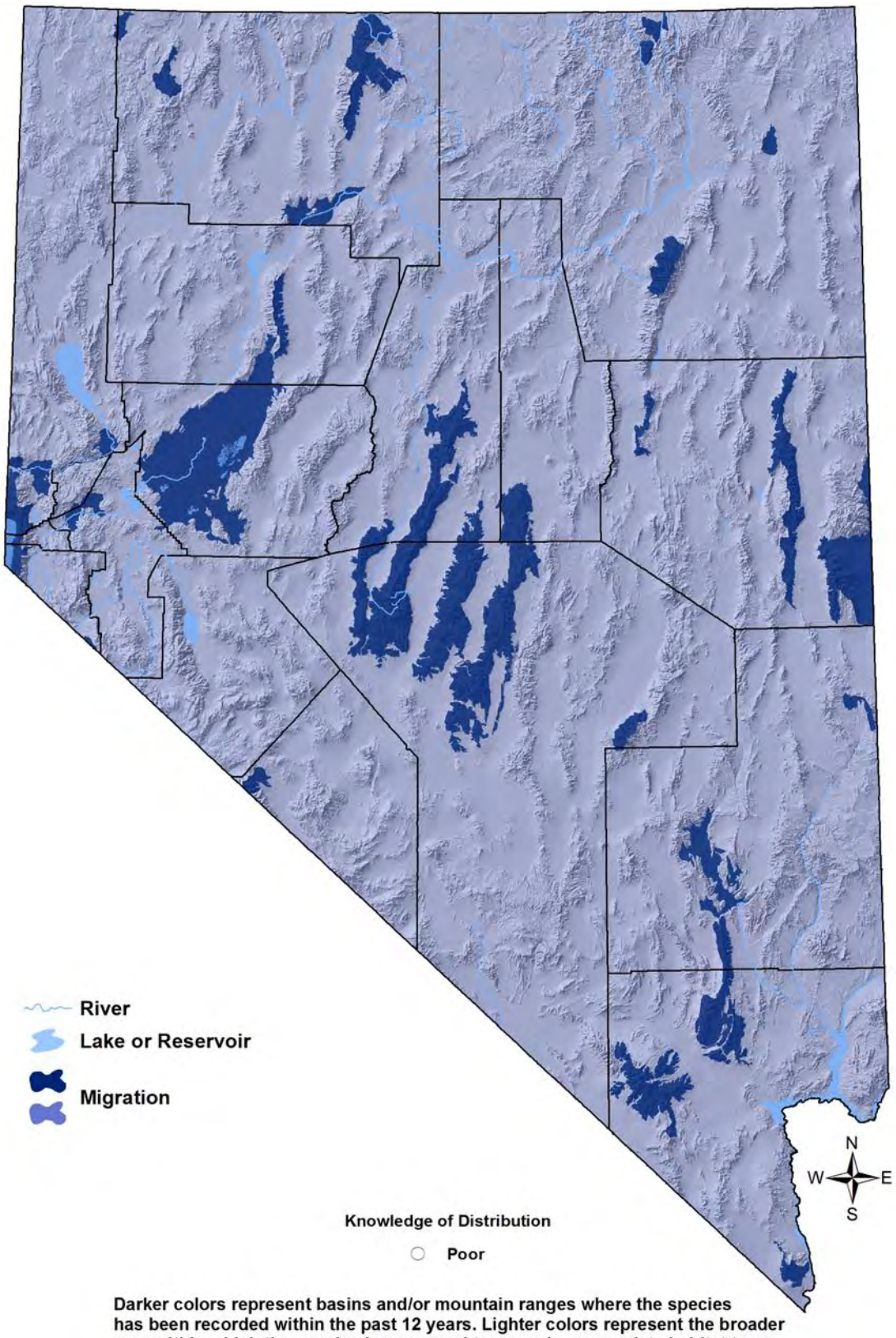
Natural History Profile

Seasonal Presence in Nevada	
Fall migration (July – September)[1, EO]	
Known Breeding Dates in Nevada	
Does not breed in Nevada	
Nest and Nesting Habits	
Nest Placement	n/a
Site Fidelity	Unknown; 1-2 week stopover in suitable patch[1]
Food Habits	
Basic	Nectarivore
Primary Diet	Nectar[1]
Secondary Diet	Sapsucker wells, hummingbird feeders[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Rufous Hummingbird

Selasphorus rufus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Rufous Hummingbird

Selasphorus rufus

Overview

The Rufous Hummingbird is the most abundant and widespread migrant hummingbird in Nevada during fall migration. During this period, it occurs in a wide variety of primarily montane habitats where flowering plants are present in sufficiently dense patches. Interestingly, most published breeding range maps suggest breeding in the northeast corner of Nevada, even though breeding has never been confirmed in the state. Spring migration occurs mostly in the Sierra Nevada and further to the west.

Though still numerous, Rufous Hummingbirds are declining steadily in numbers, with no confirmed cause. Our conservative estimate of migrant population size in Nevada is based on the number of birds estimated to use urban feeders. NBC data (which capture some of the earlier migrants) suggest that Rufous Hummingbirds also heavily use the montane forb-rich habitats that are presumably their traditional migration stopover habitat. Populations of hummingbirds using wet meadows on the eastern base of the Sierra are strongly affected by the yearly variation in flower density, which has implications for climate change.[4] Additional study is needed to determine the cause of ongoing declines, and whether migration stopover habitat plays an important role in the declines. This latter issue is particularly important for Nevada, through which a significant proportion of all fall migrants pass. Targeted monitoring of the Rufous Hummingbird during the peak of fall migration would provide useful data to supplement that collected in the species' breeding range.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions*

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Aspen	6% (1/18)	3.8 (n/a)
Coniferous Forest	11% (2/19)	1.0 (n/a)
Montane Riparian	7% (6/88)	0.7 (0.4 – 1.0)
Mojave		
Aspen	43% (3/7)	0.6 (0.1 – 1.1)

* NBC sampling terminates in late July, prior to fall migration peak

Nevada-Specific Studies and Analyses

No information

Rufous Hummingbird

Selasphorus rufus

Main Threats and Challenges

Habitat Threats

- No clear habitat threats have been identified for this species in Nevada's migratory stopover areas
- Possible threats include destruction or degradation of habitat by fire or heavy grazing that significantly reduces abundance of blooming plants during the fall migration period

Research, Planning, and Monitoring Challenges

- Causes of declines not yet determined[1]
- Rufous Hummingbirds in fall migration are incompletely monitored by the breeding-season NBC program

Conservation Strategies

Habitat Strategies

- Montane Riparian (p. Hab-13-1), Aspen (p. Hab-3-1), Great Basin (p. Hab-7-1) and Mojave (p. Hab-11-1) Lowland Riparian, Wet Meadow (p. Hab-20-1), and Springs (p. hab-19-1) habitat conservation strategies benefit this species
- Montane areas with well-developed flowering shrubs and forbs should be protected from grazing pressure that would significantly reduce bloom abundance during the fall migration period
- Manage primary habits to encourage structural and floristic diversity that results in patches with high forb / flow density

Research, Planning, and Monitoring Strategies

- Investigate possibility of breeding in northeast Nevada
- Pursue a fall migration monitoring effort that would allow determination of migrant population size, trends, and habitat use
- Investigate opportunities to integrate research and monitoring efforts with national hummingbird conservation networks[2]

Public Outreach Strategies

- Promote hummingbird-friendly plantings and feeders
- Rufous Hummingbirds are suitable subjects for citizen science projects through eBird or similar outreach tools[2]

References: [1]Healy and Calder (2006); [2]Hummingbird Monitoring Network, www.hummonnet.org; [2]Rich et al. (2004); [4]Russell et al. (1994); [5]Sauer et al. (2008); [EO]Expert opinion

Lewis's Woodpecker

Melanerpes lewis



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Aspen Montane Riparian (Coniferous Forest)	
Key Habitat Parameters ●	
Plant Composition	Aspen, cottonwoods, ponderosa and Jeffrey pines
Plant Density & Size	Prefers snags of dbh ≥ 31 cm [12 in] at density of 2 / ha [1 / ac]; tree canopy closure 30% for nesting; shrub cover 50% [7]
Mosaic	Intact deciduous tree and shrub layers in riparian / aspen zones; multiple age-classes with older-aged component in adjacent coniferous forest[7]
Distance to Water	Usually in close proximity in Nevada[3]
Response to Vegetation Removal	Negative [EO]
Prey Populations	May benefit from presence of anthills which are used as a food source[7]
Area Requirements ○	
Minimum Patch Size	Unknown, but can occur in small / narrow riparian patch[EO]
Recommended Patch Size	Entire riparian / aspen stand[EO]
Home Range / Territory Size	Territories 1 – 6 ha [2 - 15 ac]; foraging area much larger[7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Possible recent declines Habitat threats Stewardship responsibility	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Red
NV Natural Heritage	S3
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Declines and range contractions[7]
Recent ◑	Probable declines[6]
Population Size Estimates	
Nevada (NBC) ◑	13,000
Global ◑	130,000 [5]
Percent of Global	10 %
Population Objective	
Maintain / Increase[5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Carson, Ruby, Jarbidge, East Humboldt, Independence, Bull Run, and Monitor Ranges
Restoration	Montane Riparian and Aspen habitat in northern 2/3 of Nevada

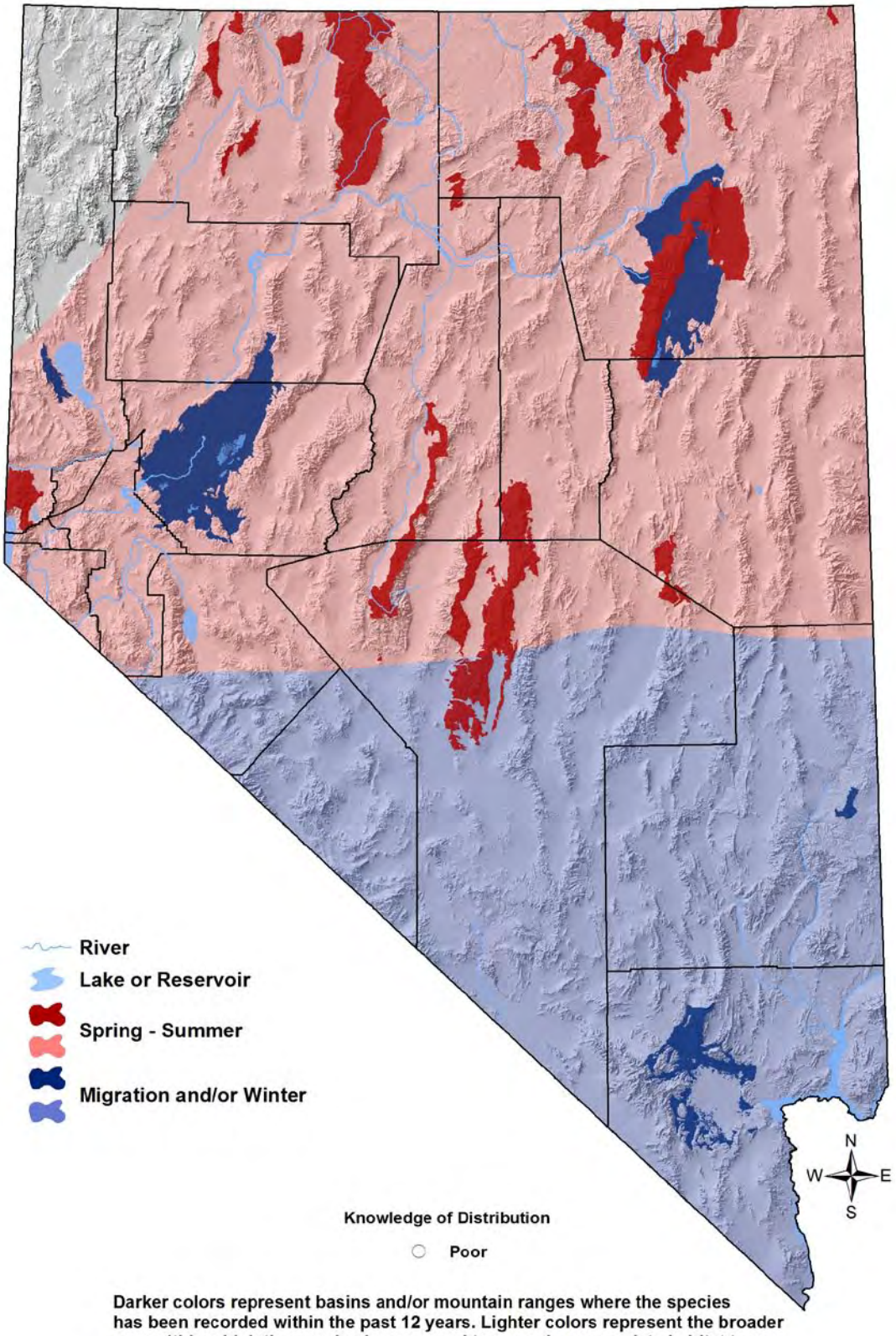
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer; possibly Winter in Mojave region	
Known Breeding Dates in Nevada	
Mid-May – early September[2]	
Nest and Nesting Habits	
Nest Placement	Cavity excavator or re-user; requires large trunk or branch on snag[7]
Site Fidelity	Low[7]
Food Habits	
Basic	Arboreal / terrestrial gleaner and fly-catcher[7]
Primary Diet	Ants, flying insects[7]
Secondary Diet	Nuts and fruits in non-breeding season[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Lewis's Woodpecker

Melanerpes lewis



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Lewis's Woodpecker

Melanerpes lewis

Overview

Throughout most of its geographical range, the Lewis's Woodpecker is regarded as a specialist on open forests of ponderosa pine, burned pine forests, oak woodlands, and cottonwood galleries. In Nevada, however, this species is most strongly associated with deciduous riparian woodlands dominated by aspen or cottonwood.[3] Nomadic movements often extend its activities into other habitat types, mainly Coniferous Forest, and in the far-western Carson Range, this habitat type is also used for breeding. Lewis's Woodpecker is no longer known to breed in the valley-bottom riparian woodlands where they are thought to have historically occurred.

As a weak excavator, the Lewis's Woodpecker is even more dependent on dead trees than other woodpeckers. Key habitat factors include the presence of large, partly-decayed snags, an open forest structure for aerial foraging, and a well-developed shrub or native herbaceous layer that promotes healthy populations of flying insects.[1] Annual variation in Lewis's Woodpecker numbers and their very patchy breeding distribution within the state make it hard to pinpoint current trends in Nevada, but the species is a conservation concern because of historic rangewide declines and Nevada's moderately high global stewardship responsibility.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Aspen	33 % (6/18)	2.7 (0.6 – 4.8)
Montane Riparian	7% (6/88)	1.5 (0.3 – 2.7)
Mojave		
Aspen	14% (1/7)	0.3 (n/a)
Montane Riparian	22% (2/9)	1.0 (n/a)

Nevada-Specific Studies and Analyses

- Analysis of NBC data indicates that Lewis's Woodpecker has a significant (p=0.01) statistical association with the Aspen and Montane Riparian habitat types

Lewis's Woodpecker

Melanerpes lewis

Main Threats and Challenges

Habitat Threats

- Loss or degradation of aspen stands and associated understory due to improper livestock grazing, conifer invasion, and aspen decline (due to pathogens, drought, reductions in stream flows, climate change, and other factors)
- Degradation of deciduous Montane Riparian habitat and associated understory due to grazing pressure from domestic livestock and wild horses and burros

Research, Planning, and Monitoring Challenges

- The most beneficial fire regime (scale, return interval, etc.) is unclear
- Home range, patch size requirements, and preferred landscape structure is not sufficiently well understood

Conservation Strategies

Habitat Strategies

- Aspen (p. Hab-3-1) and Montane Riparian (p. Hab-13-1) habitat conservation strategies benefit this species
- Manage grazing in Aspen and Montane Riparian habitats to protect the integrity of understory vegetation and allow sufficient tree regeneration[4]
- Retain large snags in Aspen and Montane Riparian habitats
- Conduct restoration / exclosure efforts to in Aspen and Montane Riparian habitats to re-establish understory vegetation and tree regeneration
- Pending further information, manage for small-scale stand-rejuvenating fire

Research, Planning, and Monitoring Strategies

- Continue monitoring to better determine current population trends
- Conduct further research to determine area requirements and most beneficial fire regime

Public Outreach Strategies

- None identified

References: [1]Abele et al. (2004); [2]GBBO unpublished Atlas data; [3]GBBO unpublished NBC data; [4]Newlon (2005); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]Tobalske (1997); [EO] Expert opinion

Williamson's Sapsucker

Sphyrapicus thyroideus



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest Aspen	
Key Habitat Parameters ●	
Plant Composition	Ponderosa, Jeffrey, and lodgepole pines, and Douglas-fir for foraging; often aspen for nesting[2]
Plant Density & Size	Little information; probably prefers > 30 snags/ ha [12 / ac] with dbh > 30 cm [12 in][2, 4]
Mosaic	Coniferous Forest juxtaposed with Aspen stands, with standing snags[2]
Distance to Water	No known relationship
Response to Fragmentation	Probably fairly tolerant due to small home ranges[2]
Response to Vegetation Removal	Negative to tree/snag removal; tolerates fires well if some living timber and standing snags remain[2, EO]
Area Requirements ◑	
Minimum Patch Size	~ 15 ha [38 ha][EO]
Recommended Patch Size	> 100 ha [250 ac][EO]
Home Range	~ 4 – 9 ha [10 - 22 ac][2]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Possible declines[2] Restricted habitat	
Other Rankings	
Continental PIF	Stewardship
Audubon Watchlist	Yellow
NV Natural Heritage	S2
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	Management Indicator
NDOW	Stewardship
Trends	
Historical ○	Unknown
Recent ◑	Pronounced declines in 1980's; more recent trends unclear[2, 7]
Population Size Estimates	
Nevada (NBC) ◑	1,500
Global ◑	310,000 [6]
Percent of Global	< 1%
Population Objective	
Maintain[6]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Carson Range, White Pine County, Spring Mountains
Restoration	Same

Natural History Profile

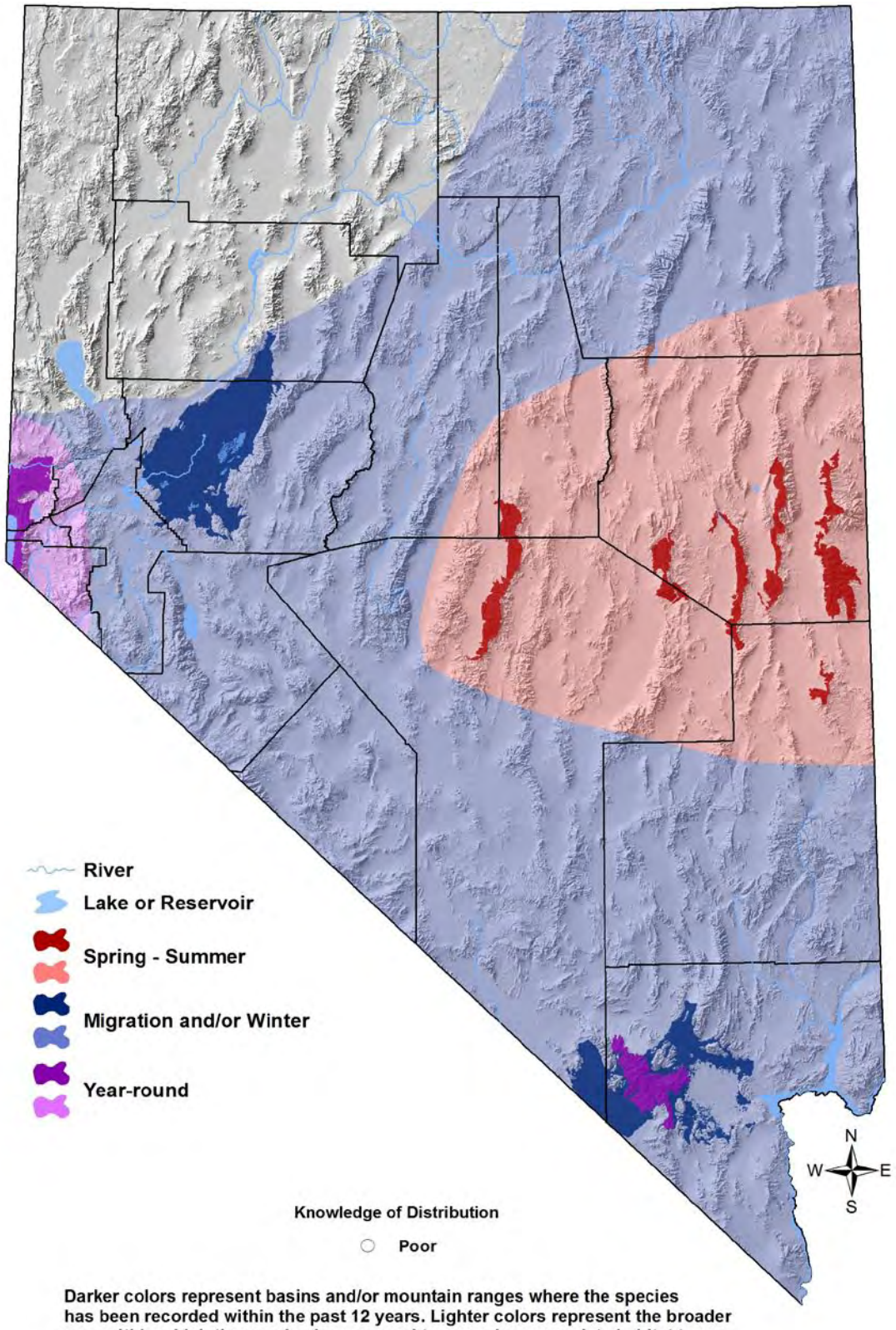
Seasonal Presence in Nevada	
Year-round in Carson Range and Spring Mts; Spring – Summer elsewhere[2, EO]	
Known Breeding Dates in Nevada	
May – mid-August[2, 3]	
Nest and Nesting Habits	
Nest Placement	Excavates cavity most often in aspen snag 25 – 70 cm [10 – 27 in] dbh; also in living aspen or conifer with dead top[2, 3]
Site Fidelity	High for breeding territory[2]
Other	Usually excavates new cavity every year[2]
Food Habits	
Basic	Tree trunk prober, gleaner, and borer[2]
Primary Diet	Conifer sap wells, especially in non-breeding season[2]
Secondary Diet	Ants and other insects in breeding season[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

AR062996

Williamson's Sapsucker

Sphyrapicus thyroideus



Williamson's Sapsucker

Sphyrapicus thyroideus

Overview

Williamson's Sapsucker is somewhat unusual in that it is tightly tied to one forest type (Aspen) for nesting, and another (Coniferous Forest) for foraging. Populations in Nevada are fragmented, and the species apparently does not breed in large portions of central Nevada despite the availability of presumably suitable habitat. In western and southern Nevada, Williamson's Sapsuckers occur year-round, and in eastern Nevada, they are summer breeders that migrate. Their seasonal distribution around the state is very poorly known, and the range map shown above could change significantly with the collection of additional data. During migration, Williamson's Sapsuckers may occur broadly in pinyon-juniper or riparian woodlands.[2]

Because Williamson's Sapsuckers nest primarily in snags or live trees with broken or dead tops, older forest stands with some decadence will usually be most suitable,[5, EO] especially if snags are concentrated in patches and relatively large.[1] Possible threats are poorly characterized, although it can be inferred that loss or degradation of higher-elevation aspen stands or a significant decrease in snag density would be detrimental. Preserving a landscape matrix in which healthy Coniferous Forest and Aspen habitats are both readily available will be beneficial.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin Region
(Mojave data insufficient)

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Coniferous Forest	32% (6/19)	1.8 (0.4 – 3.2)
Aspen	11% (2/18)	0.4 (-0.1 – 0.9)

- Where measured elsewhere within the West, densities range from 2 – 8 birds / 40 ha[2]
- BBS-based population estimate for Nevada (500 birds)[5] is lower than NBC estimate (1,500)

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

- Seven out of eight NBC transects where Williamson's Sapsuckers were present were dominated by montane Coniferous Forest (the eighth had a large Pinyon-Juniper component); six of the transects had a secondary Aspen component (1-7% of land cover according to GIS vegetation map).

Williamson's Sapsucker

Sphyrapicus thyroideus

Main Threats and Challenges

Habitat Threats

- Reported to be relatively resistant to many typical habitat disturbances such as fire, grazing, and logging as long as some forest patches and snags remain[2]
- Loss of snags to fire, salvage logging
- Loss or degradation of aspen woodland

Research, Planning, and Monitoring Challenges

- Habitat use and patch size requirements for Nevada populations is not fully understood
- The seasonal distribution of the species is very poorly understood

Conservation Strategies

Habitat Strategies

- Coniferous Forest (p. Hab-5-1) and Aspen (p. Hab-3-1) habitat conservation strategies benefit this species
- Within known range, give special conservation consideration to aspen stands located within a coniferous forest matrix
- Retain aspen snags of the preferred size range, in clumps wherever possible

Research, Planning, and Monitoring Strategies

- Continue monitoring to better determine current population trends
- Conduct surveys in suitable habitat in areas where Williamson's Sapsucker is currently undocumented
- Conduct research to better determine habitat and patch size requirements, and seasonal distribution patterns

Public Outreach Strategies

- None identified

References: [1]Conway and Martin; [2]Dobbs et al. (1997); [3]GBBO unpublished Atlas data; [4]GBBO (2008a); [5]Gyug et al. (2009); [6]Rich et al. (2004); [7]Sauer et al. (2008); [EO] Expert opinion

White-headed Woodpecker

Picoides albolarvatus



Photo by Steve Ting

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest	
Key Habitat Parameters ●	
Plant Composition	Ponderosa, Jeffrey, sugar, and lodgepole pines, white fir, incense cedar, Douglas-fir[1]
Plant Density, Size, & Age	Prefers multi-storied forest with 50-70% canopy closure; high number of large trees (dbh > 53 cm [21 in]); 45 snags/ 40 ha with dbh > 58 cm [23 in][1]; average tree spacing ~ 8.2 m [27 ft][5]
Mosaic	Older-aged, multi-canopied, multi-species forest with ample wood decay; understory not required[1]
Distance to Water	No known relationship
Response to Fragmentation	Probably sensitive[1]
Response to Vegetation Removal	Negative to tree/snag removal[EO]
Area Requirements ◑	
Minimum Patch Size	~ 500 ha [1,250 ac][EO]
Recommended Patch Size	> 2,000 ha [5,000 ac][EO]
Home Range	100 - 300 ha or more [250 - 750 ac][1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Restricted habitat	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	Sensitive Species
NDOW	Conservation Priority
Trends	
Historical ○	Unknown, declines suspected[1]
Recent ◑	Stable[4]
Population Size Estimates	
Nevada (NBC) ◑	840
Global ◑	72,000 [3]
Percent of Global	1%
Population Objective	
Maintain[3, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Carson Range
Restoration	Carson Range

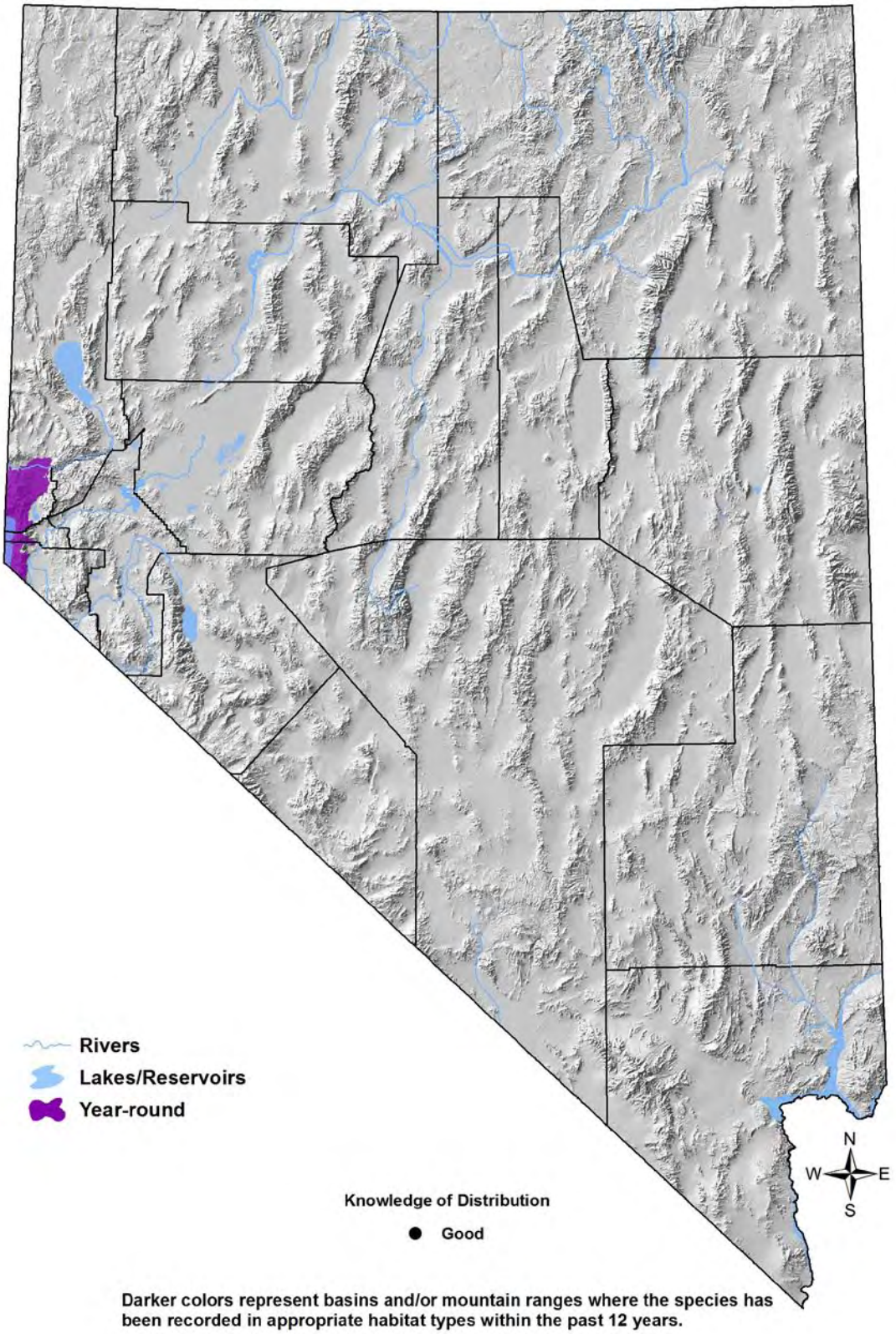
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
May – mid-August[1]	
Nest and Nesting Habits	
Nest Placement	Excavates cavity in large, decayed coniferous snag > 60 cm [24 in] dbh[1, 6, EO]
Site Fidelity	High for breeding territory[1]
Other	Usually excavates new cavity every year[1]
Food Habits	
Basic	Arboreal prober and gleaner
Primary Diet	Large pine seeds; bark insects while breeding[1]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

White-headed Woodpecker

Picoides albolarvatus



White-headed Woodpecker

Picoides albolarvatus

Overview

White-headed Woodpeckers are restricted to the Carson Range of far western Nevada, at the eastern edge of their core geographical range which runs through the Sierra Nevada - Cascade axis. This is strictly a bird of Coniferous Forest habitats, particularly those with large trees, older or mixed-age forest structure, mixed-species tree composition (as long as pines are present), and a high density of standing snags. Though this woodpecker is not typically associated with post-burn landscapes, it may respond positively to low-severity fire,[1] or even tolerate high-severity if snags are not removed.[2] A mosaic of burn severities across the landscape may, in fact, improve white-headed woodpecker habitat by opening forest canopies in the higher severity burn areas, while retaining decayed nags created before wildfire and live, cone-producing trees in unburned or low-severity burn areas.[6]

Traditional forestry practices that result in loss of large-diameter trees and snags may present a threat to this species, but such practices rarely occur in Nevada. The primary conservation strategies are management of forests to maintain patches of old-growth stands with moderate canopy closure, and continued population monitoring to confirm that numbers remain stable.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Carson Range

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Coniferous Forest	32% (6/19)	1.3 (0.7 – 1.9)

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

White-headed Woodpeckers occurred on eight NBC transects. Six were classified as Coniferous Forest habitat, one as Aspen habitat, and one as Montane Riparian habitat, but all eight transects contained > 60% cover of coniferous forest within their boundaries

Main Threats and Challenges

Habitat Threats

- Characteristic threats within other parts of the White-headed Woodpecker's geographical range (clear-cutting, even-age stand management, forest fragmentation) occur infrequently in the Carson Range

White-headed Woodpecker

Picoides albolarvatus

- Possible threats in Nevada include changes in historical fire regimes and fuels reduction projects that result in removal of snags and/or simplification of forest structure and composition

Conservation Strategies

Habitat Strategies

- The Coniferous Forest (p. Hab-5-1) habitat conservation strategy benefits this species
- Design fuels reduction projects to retain older and mixed-age stands with moderate canopy closure at the recommended patch size
- Maintenance of large snags and large-diameter conifers (especially pines) is important for this species

Research, Planning, and Monitoring Strategies

- None identified

Public Outreach Strategies

- None identified

References: [1]Garrett et al. (1996); [2] Hanson and North (2008); [3] Rich et al. (2004); [4] Sauer et al. (2008); [5] Siegel and DeSante (2003); [6]Wightman et al. (2010); [EO] Expert opinion

Gilded Flicker

Colaptes chrysoides



Photo by Harold Stiver

Habitat Use Profile

Habitats Used in Nevada	
Joshua Tree (Mojave Lowland Riparian (conjectural))	
Key Habitat Parameters ○	
Plant Composition	Joshua tree, other tall *Yucca* spp., various cactus species
Plant Density & Size	Requires trees with ≤ 30-50 cm [12 – 20 in] dbh[4]
Mosaic	Unknown
Distance to Water	No known relationship
Response to Vegetation Removal	Negative, but exotic weed control encouraged [EO]
Area Requirements ○	
Minimum Patch Size	~ 100 ha [250 ac][EO]
Recommended Patch Size	> 1000 ha [2,500 ac][EO]
Home Range	50 – 100 ha [120 – 240 ac][4]

Conservation Profile

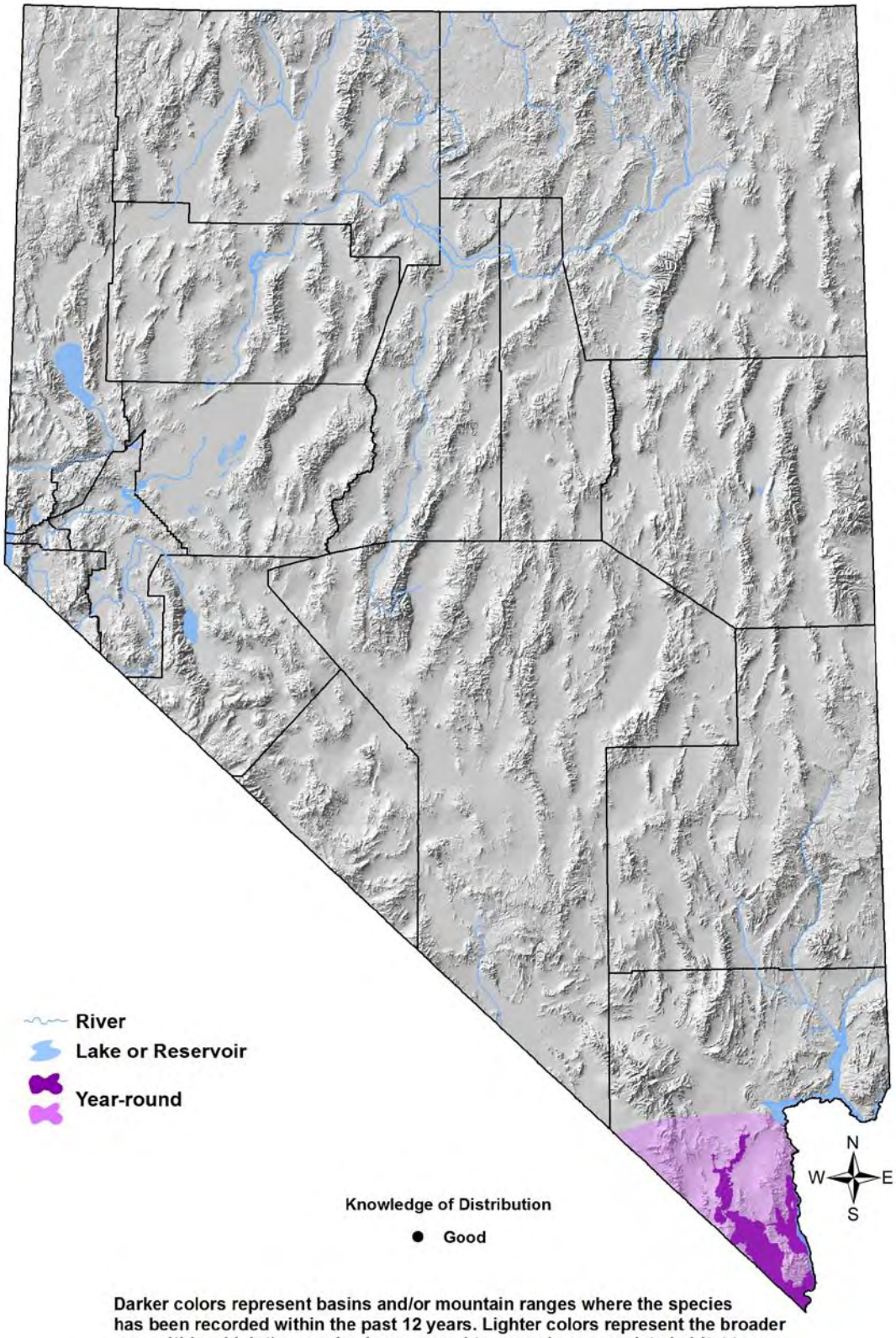
Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Habitat threats	
Other Rankings	
Continental PIF	None
Audubon Watchlist	Red
NV Natural Heritage	S1
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	None
Trends	
Historical ○	Unknown
Recent ○	Appears stable range-wide, but may be declining in Mojave region [7]
Population Size Estimates	
Nevada ◑	< 100 [2]
Global ◑	1,000,000 [5]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair / Poor
Key Conservation Areas	
Protection	Joshua tree habitat in Eldorado Valley, McCullough and Newberry ranges
Restoration	Joshua tree stands throughout Clark and Nye counties

Natural History Profile

Seasonal Presence in Nevada	
Probably Year-Round	
Known Breeding Dates in Nevada	
Early April – July[3, 4]	
Nest and Nesting Habits	
Nest Placement	Excavates cavity in large tree, primarily *Yucca* spp. in Nevada[4]
Site Fidelity	Unknown
Food Habits	
Basic	Omnivorous ground forager
Primary Diet	Terrestrial insects[4]
Secondary Diet	Fruits, seeds[4]

Gilded Flicker

Colaptes chrysoides



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Gilded Flicker

Colaptes chrysoides

Overview

Prior to the Nevada Breeding Bird Atlas project, Gilded Flickers were not known to breed within the state. During atlas surveys, however, a small but persistent breeding population was discovered in southern Nevada not far from Searchlight. It is unknown whether Gilded Flickers have had a long-term presence here, or whether these birds are the result of a recent colonization event.[EO] Gilded Flickers in Nevada are clearly associated with Joshua Trees and other tall *Yucca*s that provide a substrate for nest cavities. In Tucson (AZ), they were more commonly found at sites with more native desert scrub vegetation in the landscape (within 1.7 km [1 mi]).[8] They have also used Mojave Lowland Riparian habitat along the Lower Colorado River (mostly outside of Nevada), but fewer than 300 remain.[6] Continued monitoring and additional research are needed to better understand the status and needs of this bird, but in the meantime, its limited habitat in Nevada should be protected from development or excessive disturbances.

Abundance and Occupancy by Habitat

- No information for Nevada; 20 birds / 40 ha recorded in Arizona[4]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Habitat threats for Gilded Flickers in Nevada are conjectural, but may include loss or degradation of habitat due to:
    - Suburban / urban development
    - Energy development
    - Fire
    - Heavy OHV use
    - Invasive weeds that increase fire frequency
    - Fragmentation of existing habitat through any of the preceding mechanisms

Research, Planning, and Monitoring Challenges

- Lack of detailed knowledge of distribution, status, and ecological requirements

Gilded Flicker

Colaptes chrysoides

Conservation Strategies

Habitat Strategies

- The Joshua Tree habitat conservation strategy (p. Hab-8-1) benefits this species; the Mojave Lowland Riparian (p. Hab-11-1) may benefit this species
- Protect current known habitat from development and heavy recreational use
- Aggressively fight fire that threatens known habitat

Research, Planning, and Monitoring Strategies

- Search for additional breeding locations in areas with suitable habitat, including Wee Thump Joshua Tree Wilderness Area
- Use current monitoring and research programs (NBC, Clark County MSHCP[1], etc.) to look for occurrences of Gilded Flicker in or near Mojave Lowland Riparian Habitat
- Conduct research to determine habitat needs, patch size, and seasonal movements of Gilded Flickers in Nevada
- Continue and enhance monitoring to better estimate population size and determine trends

Public Outreach Strategies

- None identified

References: [1]Clark County (2000); [2]Floyd et al. (2007); [3]GBBO unpublished Atlas data; [4]Moore (1995); [5]Rich et al. (2004); [6]Rosenberg et al. (1991); [7]Sauer et al. (2007); [8]Turner (2006); [EO] Expert opinion

Olive-sided Flycatcher

Contopus cooperi



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest	
Key Habitat Parameters ●	
Plant Composition	Ponderosa and Jeffrey pines, red fir
Plant Density & Age	Canopy closure ≤ 39%, excluding forest openings;[12] late-successional forest[1]
Mosaic	Closely associated with natural or disturbance-created forest openings with dense shrub layer[1]
Distance to Water	Usually close to surface water[1]
Response to Vegetation Removal	Positive to creation of forest openings, but requires shrub layer within openings[1]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 200 ha (500 ac) EO
Home Range	Up to 45 ha [110 ac][1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Significant range contraction[1]
Recent ◑	Declines of 3% / year in West[10]
Population Size Estimates	
Nevada (NBC) ◑	5,600
Global ◑	1,200,000 [8]
Percent of Global	< 1%
Population Objective	
Increase by 100% [8, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Carson, Pine Nut, Toiyabe, Monitor and nearby ranges
Restoration	Same

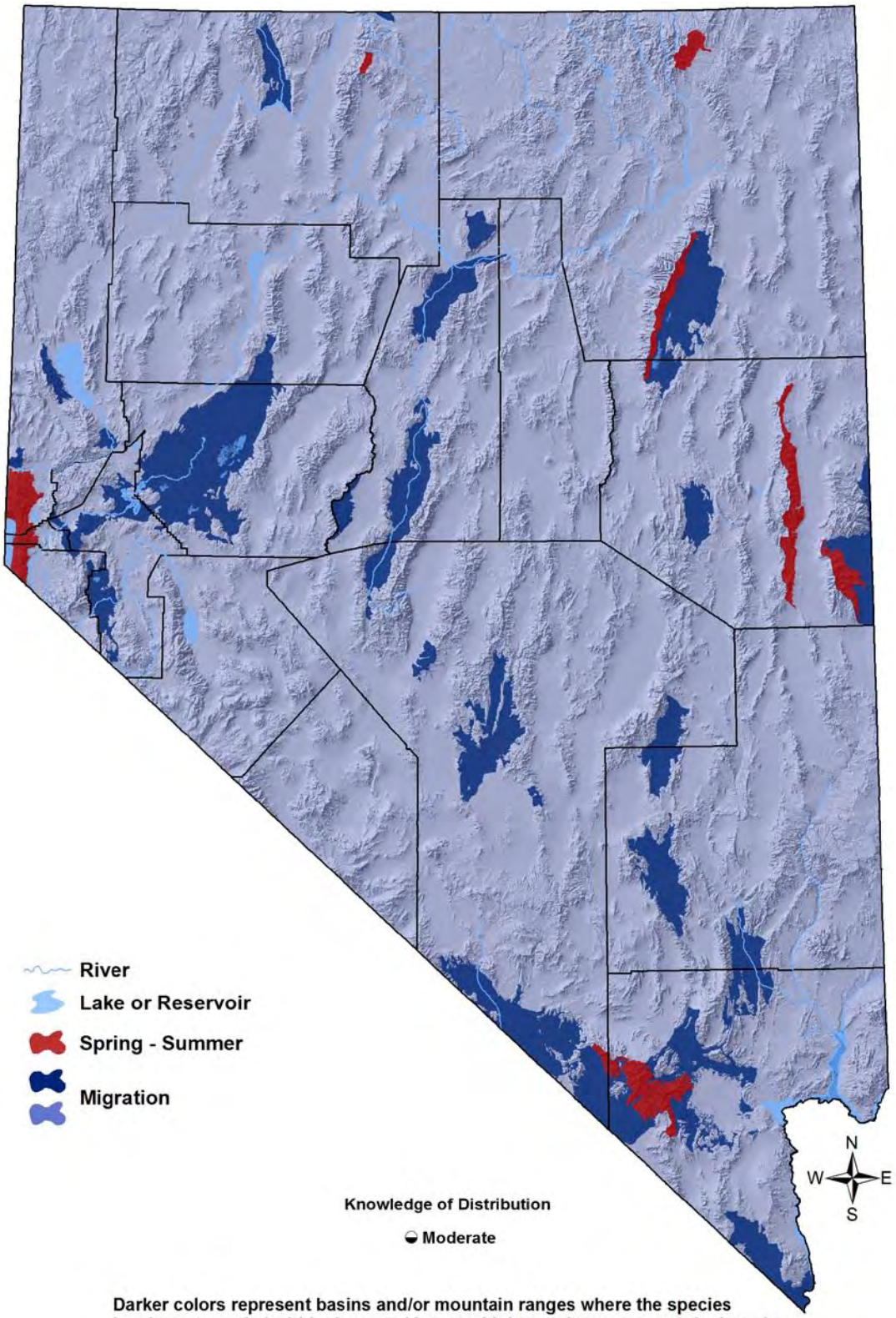
Natural History Profile

Seasonal Presence in Nevada	
Spring - Summer	
Known Breeding Dates in Nevada	
Mid-June – early August[2]	
Nest and Nesting Habits	
Nest Placement	At tip of high horizontal branch in conifer[1, 11]
Site Fidelity	Probably high for breeding area[6]
Food Habits	
Basic	Fly-catcher
Primary Diet	Flying insects, exclusively[1]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Olive-sided Flycatcher

Contopus cooperi



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Olive-sided Flycatcher

Contopus cooperi

Overview

This long-distance migrant breeds in coniferous forests across Nevada, although its distribution is notably patchy within the state. The range map shown above illustrates only confirmed spring-summer range, but it is possible that heretofore undetected breeding occurs in other mountainous areas. Fire is thought to play an important role in creating the Olive-sided Flycatcher's preferred landscape, which consists of mature coniferous forest interspersed with brush-filled openings for foraging.[1] This combination of foraging perches located next to open foraging spaces can occur at forest edges, in patchily burned or partially logged stands, or in open boreal (subalpine) forest. Olive-sided Flycatchers are one of several bird species that make ready use of open patches of snags created by stand-replacement fires.[3] Limited studies of reproductive success in burned vs. logged stands have had conflicting results.[5, 9]

The Olive-sided Flycatcher is declining steadily and the causes for the decline are still not fully understood,[1] although changes in historical fire regimes have been suggested as a likely culprit.[4] Breeding populations in central, eastern, and southern Nevada are smaller and more isolated than is the case within most of the species' breeding range, and this may render the species especially vulnerable to local habitat threats.[7]

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Coniferous Forest	42% (8/19)	3.5 (1.4 – 5.6)
Aspen	17% (3/18)	0.9 (0.5 – 1.3)
Pinyon-Juniper	3% (2/70)	0.6 (n/a)
Mojave		
Coniferous Forest	75% (3/4)	0.4 (0.3 – 0.5)

- The BBS-derived population estimate[8] of 1,000 birds in Nevada is much lower than the NBC-derived estimate of 5,600 birds. It is not clear which estimate is more realistic

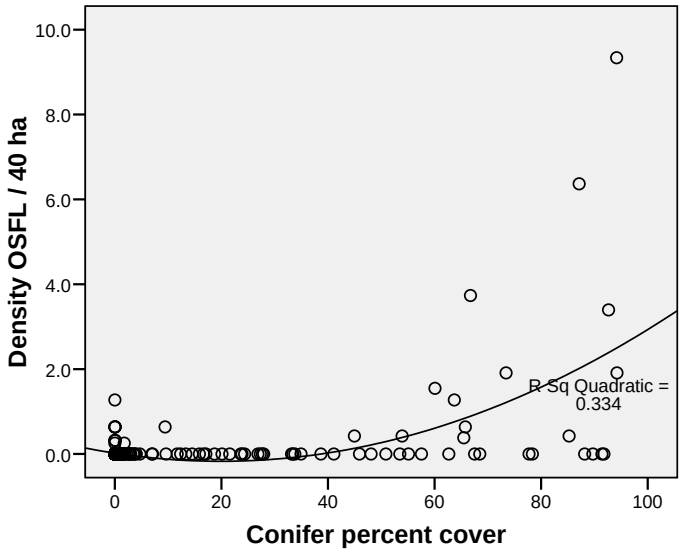
Olive-sided Flycatcher

Contopus cooperi

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

- NBC data indicate that Olive-sided Flycatchers are most often found in areas where > 50% of the landscape is covered by coniferous forest (see graph below; OSFL = Olive-sided Flycatcher)



- NBC data show that except in western Nevada, Olive-sided Flycatchers may occasionally breed in aspen and pinyon-juniper woodlands that are relatively distant from coniferous forest. Densities and frequencies of occurrence in these alternate habitats tend to be lower than in coniferous forest

Main Threats and Challenges

Habitat Threats

- Causes of ongoing declines in Nevada are not known, but in the Sierra Nevada region, it has been suggested that changes in historical fire regimes have contributed to declines.[1] It is likely that fire suppression has reduced the frequency of smaller fires that create the forest openings that this species prefers
- Although not immediately relevant to Nevada resource managers, it has been suggested that habitat loss and degradation on the Olive-sided Flycatcher's wintering grounds in South and Central America may be contributing to the species' declines[1]

Olive-sided Flycatcher

Contopus cooperi

Research, Planning, and Monitoring Challenges

- Causes of ongoing declines are not fully understood
- Uncertainty about the most beneficial fire regime for the species
- Possibility that the species' full breeding range in Nevada has not yet been delineated

Conservation Strategies

Habitat Strategies

- The Coniferous Forest (p. Hab-5-1) habitat conservation strategy benefits this species
- Allow small stand-replacing fires to burn when possible to create and maintain forest openings
- Manage forests to retain standing snags and isolated trees, which provide beneficial sallying stations

Research, Planning, and Monitoring Strategies

- Continue monitoring to determine if trends in Nevada reflect regional trends, and to better estimate population size
- Search for Olive-sided Flycatchers in mountain ranges where there is currently no breeding evidence
- Conduct additional research on populations in central, southern, and eastern Nevada (which have not been as well-studied as those in western Nevada) to determine whether they have unique habitat requirements
- Investigate the role of fire intensity, scale, and frequency in creating suitable habitat for Olive-sided Flycatchers, and develop fire management strategies based upon these findings

Public Outreach Strategies

- None identified

References: [1]Altman and Sallabanks (2000); [2]GBBO unpublished Atlas data; [3]Hutto (1995); [4]Kotliar (2007); [5]Meehan and George (2003); [6]Nevada Wildlife Action Plan Team (2006); [7]Reed (1995); [8]Rich et al. (2004); [9]Robertson and Hutto (2007); [10]Sauer et al. (2008); [11]Shuford and Gardali (2008); [12]Verner (1980); [EO] Expert opinion

Olive-sided Flycatcher

Contopus cooperi



Olive-sided Flycatcher habitat near Lake Tahoe. Photo by Dave Catalano.

Willow Flycatcher

Empidonax traillii



Photo by Martin Meyers

NOTE: Information specific to the Southwestern Willow Flycatcher (*E. t. extimus*) is coded "SWFL"; Information specific to *E. t. adastus* and *brewsteri* in the Great Basin is coded "GB"

Habitat Use Profile

Habitats Used in Nevada	
Mojave and Great Basin Lowland Riparian Montane Riparian, Springs (Marsh)	
Key Habitat Parameters ●	
Plant Composition	Willows, salt cedar, Fremont cottonwood, alder, ash
Plant Density & Height	Dense riparian vegetation ≥ 4 m [13 ft] high (or 2-4 m [6.5.-13 ft] in montane areas[26]); > 50% cover in territory, > 80% cover at nest;[4, 30, 31] tall canopy trees scattered or absent [21, 25]
Mosaic	Extensive thickets of willow or other riparian shrubs with saturated soils and nearby surface water[21]
Distance to Water	< 40 m [130 ft][21]
Response to Vegetation Removal	Negative, including defoliation of saltcedar [EO]
Area Requirements ●	
Minimum Patch Size	0.4 ha [1 ac] for GB;[21] > 1 ha [2.5 ac] in montane areas;[26, 31] 0.8 ha [2 ac] for SWFL[25]
Recommended Patch Size	> 6 ha [15 ac][4, EO]
Territory Size	0.3 -0.6 ha [0.7 -1.5 ac] for GB;[10, 21] 0.1 – 2.3 ha [0.25 – 5.7 ac] for SWFL [25]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
ESA listing: Endangered subspecies (SWFL) Historical and recent declines Habitat threats Small population size	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3B (SWFL: S1B)
USFWS	Endangered subspecies (SWFL), Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	Sensitive Species (SWFL)
NDOW	Conservation Priority, Endangered (SWFL)
Other	Covered by several HCPs, see below[5, 29]
Trends	
Historical ●	Rangewide declines [21]
Recent ◑	Declining at 3% / year for GB;[20] SWFL probably stable[21]
Population Size Estimates	
Nevada (BBS) ◑	1,500; SWFL: 90 [27]
Global ◑	3,300,000; [16] 2,400 for SWFL[15]
Percent of Global	< 1%; 7.5% for SWFL
Population Objective	
Increase by 50% [16, EO]	
Monitoring Coverage	
Source	SWFL surveys by USBR, USFWS, NDOW and others; Nevada Bird Count for GB
Coverage in NV	Good
Key Conservation Areas	
Protection & Restoration	See Overview, below See Overview, below

Natural History Profile

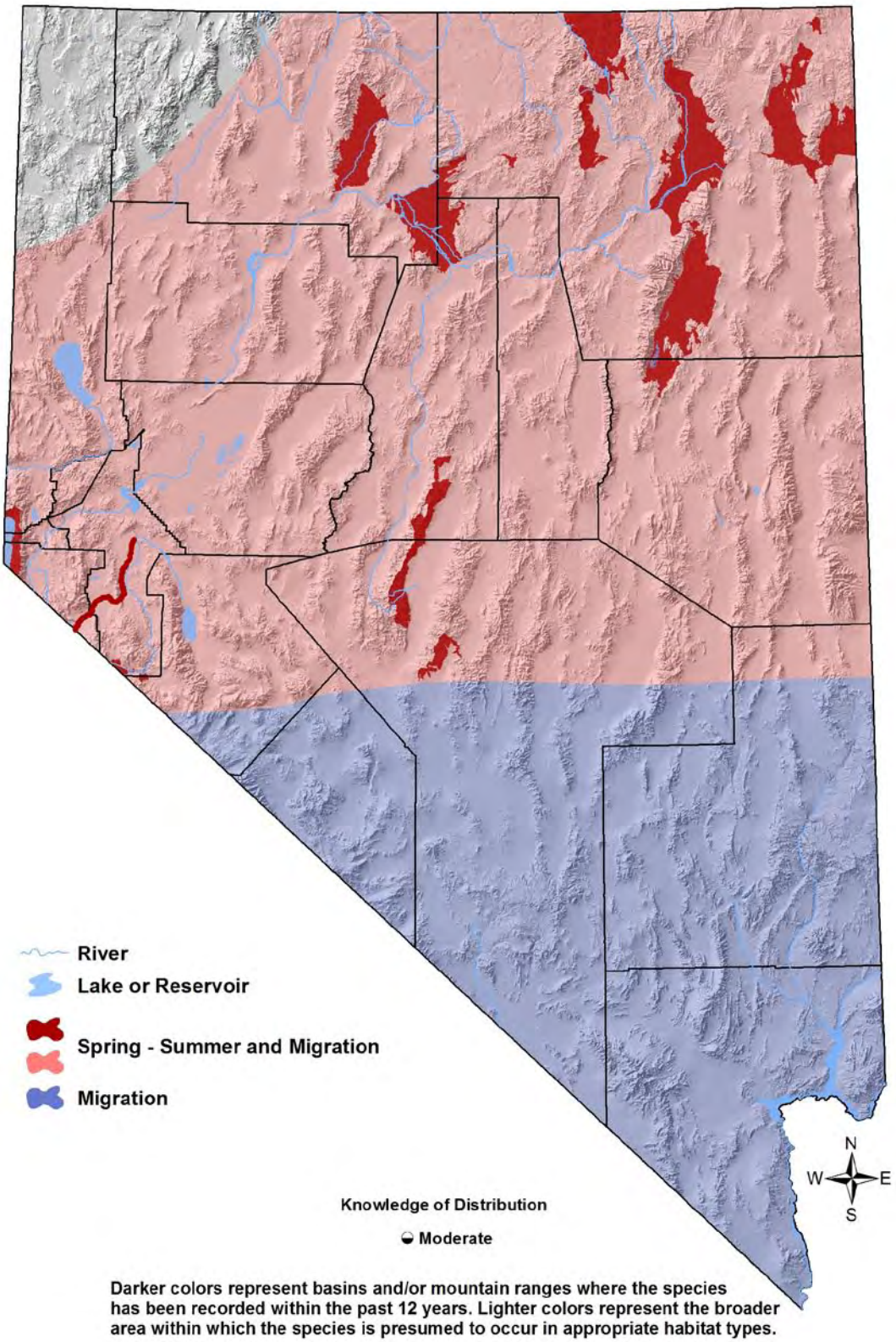
Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late May – August[8, 27]	
Nest and Nesting Habits	
Nest Placement	In crotch of tall (> 4 m, [13 ft]), very dense riparian shrub[21]
Site Fidelity	High for specific drainage
Food Habits	
Basic	Fly-catcher
Primary Diet	Variety of flying insects[21]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Willow Flycatcher

Empidonax traillii

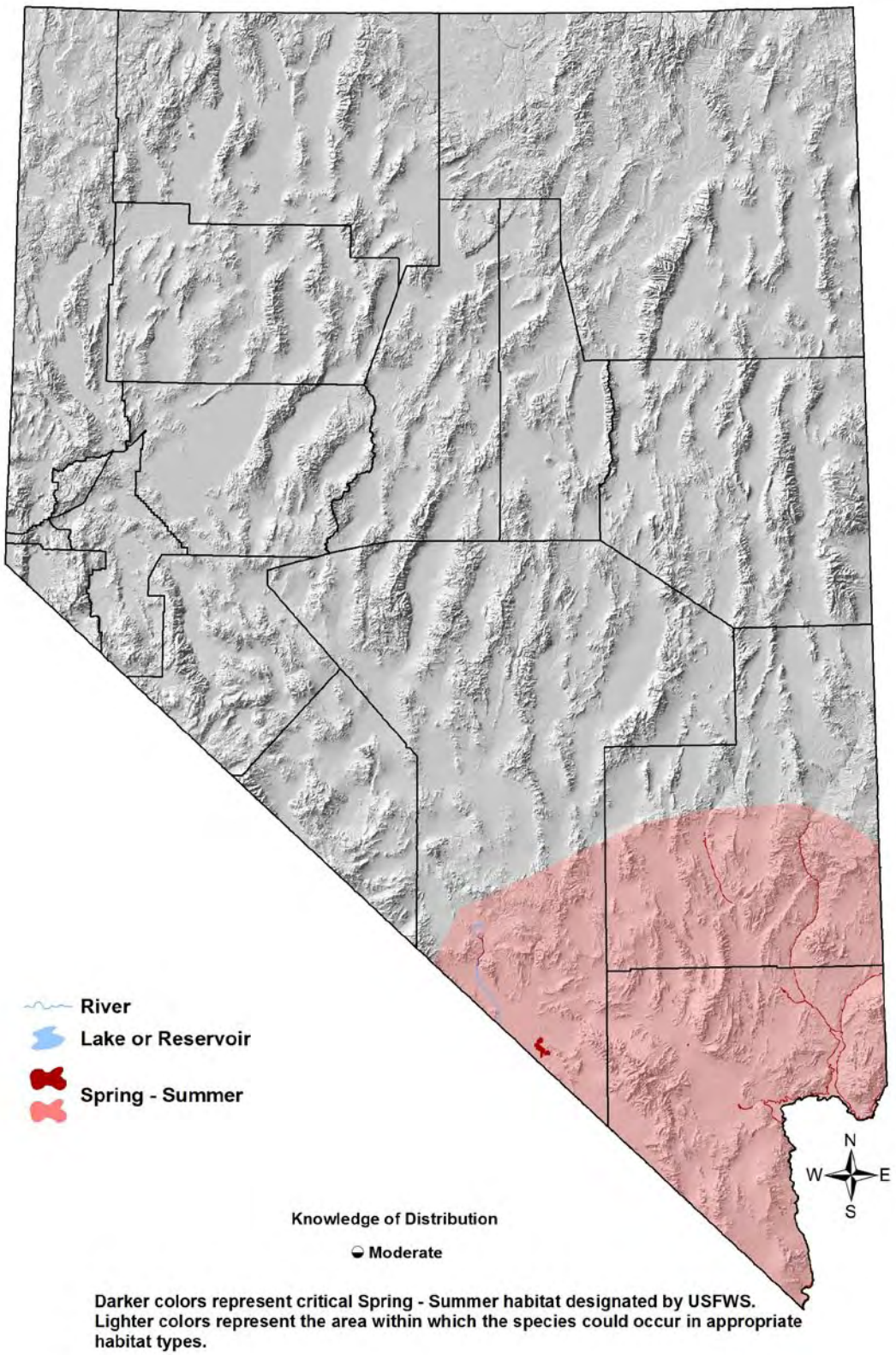
E .t. adastus and *E .t. brewsteri*



Willow Flycatcher

Empidonax traillii

E .t. extimus



Willow Flycatcher

Empidonax traillii

Overview

Although fairly common in states to the north and east of Nevada, the Willow Flycatcher is far less abundant in the arid West, where much of its historical riparian habitat has been lost or degraded.[16] Three subspecies breed in Nevada: the endangered Southwestern Willow Flycatcher, *E. t. extimus* (SWFL) in the Mojave region along the Colorado, Virgin, and Muddy Rivers, and in the Meadow Valley Wash, Pahranagat Valley, and Ash Meadows NWR[14,27]; *E .t. adastus* throughout the Great Basin portion of Nevada in small numbers[2]; and *E. t. adastus* may be replaced in far-western Nevada by *E. t. brewsteri*, from which it is difficult to distinguish.[10] NBC data show that in far-western Nevada, Willow Flycatchers are primarily found in montane riparian habitat, with some spillover into lowland riparian areas. In central, eastern, and northern Nevada, the rare *E. t. adastus* is found in both lowland and montane riparian habitats, and occasionally in other inundated areas such as aspen stands or wet meadows. All three subspecies use the lower Colorado River corridor during migration.[30]

Because of its listing under the ESA, SWFL has been intensively studied, and detailed recovery strategies have been developed.[30] *E. t. brewsteri* in the Sierra Nevada has also been studied in some depth.[4, 10, 26] However, there have been no studies in Nevada of the increasingly rare *E .t. adastus* subspecies, despite the substantial declines it has suffered over recent decades. Consequently, the Great Basin lowland populations of Willow Flycatcher receive little conservation attention.

All three Willow Flycatcher subspecies are riparian-obligates and have undergone large historical declines because of the widespread loss of dense, shrubby riparian habitat with water-saturated soils. Willow Flycatchers were common in the Sierra Nevada until 1910, and at least locally abundant through 1940, with noticeable declines occurring after 1950.[15] In recent surveys, birds were absent from 53 of 135 previously known sites,[10] and there may now be only 300-400 individuals left in the entire Sierra Nevada,[10, 26] with only a small fraction of these in our state. Willow Flycatchers in Nevada's Great Basin have become exceedingly rare in recent decades, and historical data from the lower Truckee River indicate that the species was considered abundant in the late 1800s, but is absent as a breeder today.[1] Similar declines almost certainly occurred along other Great Basin rivers as well, and remaining populations are small and fragmented.[6,10]

Willow Flycatchers breed in tall dense shrubs, and in most studies, occupancy and nesting success is related to shrub cover and volume.[4,15,22] Willows are the traditionally preferred vegetation,[25] but other shrub species are also used, although riparian mesquite bosques are usually avoided (except in Ash Meadows NWR).[30] The SWFL will readily nest in saltcedar stands, as long as they are sufficiently tall and dense. About 25% of all known SWFL breeding territories are now located at sites dominated by salt cedar,[24] and intensive studies in Arizona have found no apparent drop in any measure of foraging or nesting success for birds nesting in saltcedar stands.[15] Cover of overstory trees is variable across occupied sites, but they are generally only scattered and often absent. All

Willow Flycatcher
Empidonax traillii

subspecies are tied to wet areas (standing water or highly saturated soils),[10] and the SWFL is particularly dependent on the presence of permanent surface water.[30] For example, a severe drought in 2002 may have completely eliminated SWFL reproduction in some areas.[15] Heterogeneity of vegetation structure may be an important factor in determining habitat suitability,[15] as large patches of riparian shrubs without interspersed openings are often avoided.[10,31] Willow Flycatchers can breed in very small patches (0.1 ha [0.25 ac]),[10,31] but aggregations of suitable patches promote healthy population dynamics. Individuals will readily move among patches within a drainage, sometimes up to 30-40 km [19-25 mi].[15] The width and continuity of the riparian vegetation can also be important.[19,22] Narrow strips < 10 m [33 ft] wide are generally not occupied.[30]

Most threats to Willow Flycatchers and lowland riparian habitats have been well-documented (see Main Threats and Challenges, below).[30] Threats to montane populations are less well-studied, but probably center upon the dewatering of riparian or meadow patches as a result of water diversions, or lowering of local water tables (and the consequent impacts on riparian shrubs) by gully erosion from heavy livestock use, road building, or natural runoff events.[10] Cowbird parasitism is low in montane populations, but it can be problematic in lowland populations, and has been a major concern for SWFL.[33] Cowbird trapping has been shown to increase the local reproductive output of SWFL in the short-term, but it is not clear that it has benefits to long-term population recovery. Trapping is therefore an expensive and short-term solution recommended only in emergencies.[17]

The SWFL currently makes extensive use of saltcedar stands, and would suffer if large areas of saltcedar were removed without restoring suitable replacement habitat.[24] A new threat has therefore emerged with the release of the tamarisk leaf beetle (*Diorhabda* spp.) as a biocontrol agent.[11] The tamarisk beetle continues to expand across the southwestern landscape, defoliating large expanses of saltcedar fairly rapidly, and consequently increasing the need to accelerate the process of restoring native vegetation in areas of defoliation. Saltcedar is not only common in southern Nevada, but also has significant presence in the Great Basin, where releases of tamarisk beetles have also occurred. Because *E. t. adastus* has received such limited study, impacts of saltcedar defoliation on the Great Basin populations are not known.

Habitat restoration plays a key role in conservation planning for the Willow Flycatcher in Nevada. SWFL in particular seem to prefer relatively young vegetation, and new sites can become suitable just 3-5 years after disturbance,[15] providing an unusually rapid return on habitat restoration efforts. Indeed, restoration projects conducted to benefit SWFL in the Mojave region have been quite successful. In the Great Basin, however, recovery of Willow Flycatcher populations following habitat restoration could be hindered by the relative lack of sufficient regional source populations. In general, given the species' need for both specific microhabitats and a favorable landscape mosaic, it is important that long-term management plans consider the geomorphology, hydrology, and successional dynamics of whole river reaches.[9,30]

Willow Flycatcher

Empidonax traillii

The SWFL is a covered species under the Clark County MSHCP,[5] the Lower Colorado River MSCP,[29] the Southeastern Lincoln County HCP (Jeri Krueger, *pers. comm.*), and the Virgin River Habitat Conservation and Recovery Plan (HCRP) (Jeri Krueger, *pers. comm.*). Key conservation and restoration areas for SWFL include the Muddy and Virgin River corridors and Pahranagat Valley. Key conservation and restoration areas for the Great Basin populations include the Humboldt, Carson, Truckee, and Walker River systems.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Lowland Riparian	12% (8/66)	2.7 (0.0 – 5.4)
Montane Riparian	6% (4/88)	1.6 (0.3 – 2.9)
Mojave		
Lowland Riparian	14% (5/36)	0.5 (0.2 – 0.8)

- Additional information on abundance is available in the sources listed in the following section
- Because Willow Flycatchers are late breeders, standard breeding season surveys such as NBC and BBS detect a large number of spring migrants that ultimately breed outside of Nevada. Population size estimates derived from these surveys are therefore significantly inflated and unreliable

Nevada-Specific Studies and Analyses

Numerous sources document the Willow Flycatcher (particularly SWFL) in great detail, although few are exclusively focused on Nevada. The most important and useful resources include:

- USGS SWFL site
  http://sbsc.wr.usgs.gov/cprs/research/projects/swwf/
- US Fish and Wildlife Service SWFL Home Page
  http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B094
- US Fish and Wildlife Service Arizona Ecological Services SWFL site
  http://www.fws.gov/southwest/es/arizona/Southwes.htm
- Final Recovery Plan for the Southwestern Willow Flycatcher[30]
  http://www.fws.gov/southwest/es/arizona/SWWF_RP.htm

Willow Flycatcher

Empidonax traillii

- A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher (newly updated 2010)[25]
  http://pubs.usgs.gov/tm/tm2a10/
- Status, Ecology, and Conservation of the Southwestern Willow Flycatcher[7]
  http://www.fs.fed.us/rm/pubs/rmrs_gtr060.html
- Southwestern Willow Flycatcher Surveys, Demography, and Ecology Along the Lower Colorado River and Tributaries, 2003 – 2007 [13]
  http://www.lcrmscp.gov/worktasks/systemmonitoring/D2/5year0307.pdf

Main Threats and Challenges

Great Basin

Habitat Threats

- Loss, degradation, and fragmentation of lowland riparian habitat due to
  - Surface water diversions impoundments, and flood control[6, 21]
  - Heavy livestock grazing[26]
- Desiccation of montane riparian and wet meadow habitat from water diversion, drought, or gullying[10]
- Increase in nest predator access due to meadow desiccation and conifer encroachment[10]

Research, Planning, and Monitoring Challenges

- The detailed distribution, population sizes, and current trends of Willow Flycatchers in the Great Basin need to be more thoroughly studied
- Lack of knowledge about the geographical boundaries between *adastus* and *brewsteri* subspecies, and uncertainty as to whether distinctions between these subspecies have conservation implications
- Lack of knowledge about the possible impacts of saltcedar defoliation on Great Basin populations
- Lack of conservation urgency despite significant (and probably continuing) declines

Mojave (SWFL)

Habitat Threats

- Surface water diversion, flood control activities, groundwater pumping that dewater habitat
- High-intensity, habitat-converting fire
- Sudden removal of large amounts of saltcedar as a result of biocontrol agents or restoration efforts, if timely revegetation cannot occur
- Brown-headed Cowbird parasitism

Willow Flycatcher

Empidonax traillii

Research, Planning, and Monitoring Challenges

- None currently identified; because of SWFL's ESA status, managers can draw on a large number of studies, data sets, and planning documents

Conservation Strategies
Great Basin

Habitat Strategies

- Great Basin Lowland Riparian (p. Hab-7-1), Montane Riparian (p. Hab-13-1), and Springs (p. Hab-19-1) habitat conservation strategies benefit these subspecies
- Manage shrub willow habitat to maintain or restore patches > 6 ha [15 ha], preferably multiple patches along a given riparian reach[4,26]
- Manage grazing at sustainable levels that do not significantly fragment or reduce the density of willow patches
- Maintain the presence of wet soils and nearby surface water[10, 26]
- Emphasize restoration of vegetation and hydrology in potential habitat, especially in areas within easy colonization distance from currently-occupied habitat[26]
- Where necessary, limit or manage human activities to allow for the recovery of degraded areas[26, 28]
- Reduce nest predator access by preventing conifer encroachment into montane nesting habitat, and by maintaining or restoring hydrology and vegetation as described above[10, 26]

Research, Planning, and Monitoring Strategies

- Expand current monitoring protocol to cover all known or likely breeding sites of Great Basin subspecies. The following protocol may be appropriate, particularly if it can be adapted to multi-species monitoring protocols: *A Willow Flycatcher Survey Protocol for California*[3] http://dfg.ca.gov/wildlife/nongame/docs/wifl_2003_protocol.pdf
- Conduct research on the distribution, trends, population size, subspecies ranges, and specific ecological needs of Willow Flycatcher in Nevada's Great Basin
- Determine the extent to which Willow Flycatchers in the Great Basin use saltcedar habitat, and, if necessary, develop strategies to compensate for losses of both saltcedar and native riparian shrubs.

Public Outreach Strategies

- None identified

Willow Flycatcher

Empidonax traillii

Conservation Strategies
Mojave (SWFL)

Established Strategies

- Extensive conservation measures outlined in the USFWS's 2002 *Final Recovery Plan for Southwestern Willow Flycatcher*[30] and the 2005 Designation of Critical Habitat[31]

Habitat Strategies

- The Mojave Lowland Riparian (p. Hab-11-1) habitat conservation strategy benefits this subspecies
- Protect all known nesting habitat from disturbances, habitat conversion, and other threats
- Restore lost or degraded riparian habitat to a willow-dominated condition. Phase restoration projects to avoid removing large amounts of saltcedar before creating suitable replacement habitat. Creating even as little as 20% cover by native vegetation in saltcedar stands has significant value for Willow Flycatchers[32]
- Develop strategies to address the potential loss of current saltcedar breeding habitat to biocontrol agents

Research, Planning, and Monitoring Strategies

- Develop comprehensive fire management strategies emphasizing initial attack to protect important breeding habitat
- Continue current monitoring and research efforts, as described in *A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher* (http://pubs.usgs.gov/tm/tm2a10) [25]

Public Outreach Strategies

- None identified

Willow Flycatcher

Empidonax traillii

References: [1]Ammon (2002); [2]Bergstrom (1998); [3]Bombay et al. (2003a); [4]Bombay et al. (2003b); [5]Clark County (2000); [6]Dobkin and Sauder (2004); [7]Finch and Stoleson (2000); [8]GBBO unpublished Atlas data; [9]Graf et al. (2002); [10]Green et al. (2003); [11]Hatten et al. (2010); [12]Hultine et al. (2010); [13]McLeod et al. (2008); [14]NDOW (2009); [15]Paxton et al. (2007); [16]Rich et al. (2004); [17]Rothstein et al. (2003); [18]Rourke et al. (1999); [19]Sanders and Edge (1998); [20]Sauer et al. (2008); [21]Sedgwick (2000); [22]Sedgwick and Knopf (1992); [23]Sogge et al. (2003); [24]Sogge et al. (2008); [25]Sogge et al. (2010); [26]Stefani et al. (2001); [27]Swett (1999); [28]Taylor and Littlefield (1986); [29]LCRMSCP (2004); [30]USFWS (2002); [31]USFWS (2005); [32]Van Riper (2008); [33]Whitfield and Sogge (1999); [34]Yong and Finch (1997); [EO] Expert opinion



Willow Flycatcher habitat in the Mojave region. Photo by Jen Ballard.

Gray Flycatcher

Empidonax wrightii



Photo by Fred Petersen

Habitat Use Profile

Habitats Used in Nevada	
Pinyon-Juniper Sagebrush Montane Shrubland	
Key Habitat Parameters ◑	
Plant Composition	Pinyon pine, juniper, tall sagebrush species, bitterbrush, mountain mahogany
Plant Density & Size	Open tree stands with shrub understory or tall shrubland;[6] requires at least some shrubs or trees > 1 m [1.6 ft] tall[6]
Mosaic	Mixed shrublands and woodlands of varying canopy densities; avoids closed-canopy woodlands[6]
Distance to Water	Probably attracted to areas near riparian or wetland edge [EO]
Response to Vegetation Removal	Negative to tree/shrub removal [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 50 ha [120 ac] [EO]
Territory Size	1 – 5.3 ha [2.5 - 13 ac][6]

Conservation Profile

Priority Status	
Stewardship Species	
Species Concerns	
High stewardship responsibility	
Other Rankings	
Continental PIF	Stewardship
Audubon Watchlist	None
NV Natural Heritage	S4B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Stewardship
Trends	
Historical ○	Unknown
Recent ○	Uncertain, possibly stable[5]
Population Size Estimates	
Nevada (NBC) ◑	650,000
Global ◑	1,200,000 [4]
Percent of Global	> 50%
Population Objective	
Maintain[3, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Great Basin sagebrush / pinyon-juniper transition zones
Restoration	Same

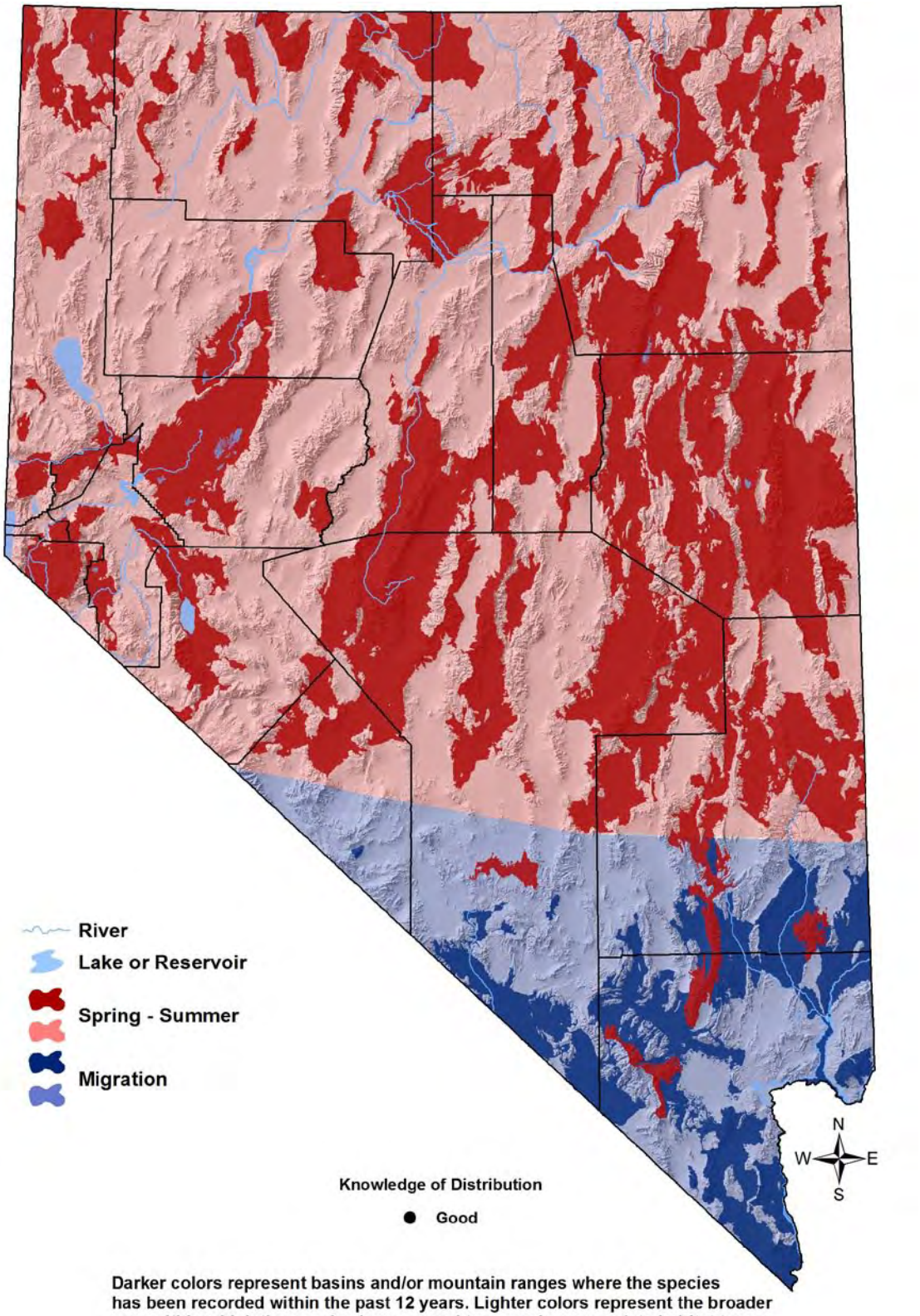
Natural History Profile

Seasonal Presence in Nevada	
Spring - Summer	
Known Breeding Dates in Nevada	
Late May – early August[2, 6]	
Nest and Nesting Habits	
Nest Placement	In densely foliated branch of small pine or juniper; occasionally in tall shrub[6]
Site Fidelity	Probably low for breeding territory[6]
Food Habits	
Basic	Fly-catcher
Primary Diet	Flying insects[6]
Secondary Diet	Terrestrial arthropods on shrubs or ground[6]

Confidence in Available Data: ●High ◑Moderate ○ Low

Gray Flycatcher

Empidonax wrightii



Gray Flycatcher

Empidonax wrightii

Overview

Gray Flycatchers are widespread and common in Nevada, which hosts over half of the species' global breeding population according to the best available population estimates.[4] This species is most often associated with pinyon-juniper / sagebrush transition zones, or with tall stands of mature sagebrush and / or bitterbrush. It also occurs in the lower-elevation bands of montane woodland and shrubland, and in southern Nevada it sometimes uses Joshua tree stands. Although it usually avoids denser patches of trees, one study in pinyon-juniper woodlands of New Mexico found nests in denser than average stands of trees.[3] Beyond these general associations, the specific habitat characteristics that promote presence and abundance are not fully understood.[1] During migration, the Gray Flycatchers are particularly abundant in montane and lowland riparian habitat, but they occur in many other habitat types as well.

Although Gray Flycatchers would appear to be secure in Nevada for the time being, their preferred habitats are the subject of substantial conservation concern. Significant acreages of tall mature sagebrush stands have been lost to fire in recent years (p. Hab-17-1), and optimizing management strategies for the pinyon-juniper / sagebrush transition zone in the face of pinyon-juniper expansion is the subject of ongoing investigation and evaluation (p. Hab-16-1). The main conservation needs for Gray Flycatchers are protection of high-quality habitat, maintenance of favorable pinyon-juniper / sagebrush transition zones, and ongoing monitoring to detect changes in population status.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Pinyon-Juniper	74% (52/70)	7.0 (5.5 – 8.5)
Sagebrush	24% (8/33)	2.2 (0.6 – 3.8)
Montane Shrubland	45% (9/20)	5.3 (1.5 – 9.1)
Montane Riparian	19% (17/88)	3.7 (1.9 – 5.5)
Mojave		
Pinyon-Juniper	67% (8/12)	0.9 (0.5 – 1.3)
Sagebrush	46% (12/26)	3.9 (2.4 – 5.4)
Montane Shrubland	75% (6/8)	1.0 (0.3 – 1.7)
Montane Riparian	44% (4/9)	1.9 (0.7 – 3.1)
Joshua Tree	55% (11/20)	0.5 (0.2 – 0.8)

Gray Flycatcher

Empidonax wrightii

Nevada-Specific Studies and Analyses

Habitat Requirements (NBC data)

An analysis of ground-measured habitat variables on NBC transects (*Appendix 3*) indicated that sites where Gray Flycatchers were present had a greater density of trees (including junipers and pinyon pines), greater litter cover, and lower density of shrub and grass cover than unoccupied sites. These findings are consistent with the Gray Flycatcher's reported use of fairly open pinyon–juniper / sagebrush transitional habitats. It may be consistent with use of mature sagebrush stands characterized by larger, spaced-out shrubs, although this merits more investigation.

Landscape Associations (NBC data)

Transects classified as Pinyon-Juniper had over twice the density of Gray Flycatchers as transects classified as Sagebrush (table above). This would be expected because many Pinyon-Juniper transects contain substantial sagebrush cover, whereas Sagebrush transects contain (by definition) no significant cover of pinyon-juniper. A within-transect analysis found that Gray Flycatchers were strongly associated with both pinyon-juniper and sagebrush cover.

Main Threats and Challenges

Habitat Threats

- Loss of early-mid successional pinyon pine and juniper from the woodland / sagebrush transition zone leads to declines in Gray Flycatchers[6]
- Loss of landscapes dominated by tall mature sagebrush and associated shrubs to fire or other disturbances

Research, Planning, and Monitoring Challenges

- Lack of uniform strategy to maintain favorable pinyon-juniper / sagebrush transition zones while still addressing other habitat management and fuels management needs
- Uncertainty as to current population trends in Nevada

Gray Flycatcher

Empidonax wrightii

Conservation Strategies

Habitat Strategies

- Pinyon-Juniper (p. hab-16-1), Sagebrush (p. Hab-17-1), and Montane Shrubland (p. Hab-14-1) habitat conservation strategies benefit this species
- Protect stands of tall, mature sagebrush and associated shrubs from loss to fire
- Maintain or restore broad, intergraded transition zones between pinyon-juniper woodlands and sagebrush. These zones should be characterized by widely and irregularly spaced trees. Such transition zones are especially important where the shrub understory is tall and mature

Research, Planning, and Monitoring Strategies

- Conduct additional research and planning to identify and implement a set of guidelines for pinyon-juniper treatment projects that balances the need to maintain transition zones with the need to manage pinyon-juniper encroachment and fuels
- Continue monitoring to determine current population trends
- The possible importance of riparian and/or meadow habitats during the post-fledgling stage should be further investigated

Public Outreach Strategies

- None identified

References: [1]Dobkin and Sauder (2004); [2]GBBO unpublished Atlas data; [3]Goguen et al. (2005); [4]Rich et al. (2004); [5]Sauer et al. (2008); [6]Sterling (1999); [EO] Expert opinion

Gray Flycatcher

Empidonax wrightii



Gray Flaycatcher nest in big sagebrush. Photo by Jen Ballard.

Bell's Vireo

Vireo bellii



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Mojave Lowland Riparian (Mesquite-Acacia) (Springs)	
Key Habitat Parameters ●	
Plant Composition	Cottonwoods, willows, saltcedar, mesquite (particularly honey mesquite), arrow-weed, *Baccharis*[11]
Plant Density & Size	Dense shrub understory up to 3 m [10 ft] high;[1] tree overstory either relatively open or absent
Mosaic	Prefers structurally diverse habitat and patches of saturated soils;[11] in areas dominated by saltcedar, interspersion of some native trees increases habitat value
Distance to Water	< 1,000 m [0.6 mi] from water; standing water is an important habitat element [11]
Response to Vegetation Removal	Negative, especially for shrub layer[8, 11]
Area Requirements ◑	
Minimum Patch Size	Probably > 5 ha [12 ac],[EO] preferably with opportunity to place territory > 400 m [1,300 ft] from habitat edge[10]
Recommended Patch Size	> 20 ha [49 ac][11, 12, EO]
Home Range	0.2 - 1.6 ha [0.5 - 4.0 ac][11]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Restricted habitat Small population size Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Red
NV Natural Heritage	S2B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Other	Covered by Clark County MSHCP[4] and Lower Colorado River MSCP[18]
Trends	
Historical ◑	Rangewide declines[11, 16]
Recent ◑	Persistent declines of ~ 2.7% / year, most recently stabilizing[16]
Population Size Estimates	
Nevada (NBC) ◑	1,000
Global ◑	1,100,000 [14]
Percent of Global	< 1%
Population Objective	
Increase by 100% [14, EO]	
Monitoring Coverage	
Source	Nevada Bird Count, LCR MSCP[18]
Coverage in NV	Good
Key Conservation Areas	
Protection	Muddy and Virgin Rivers, Ash Meadows NWR, Meadow Valley Wash
Restoration	Same

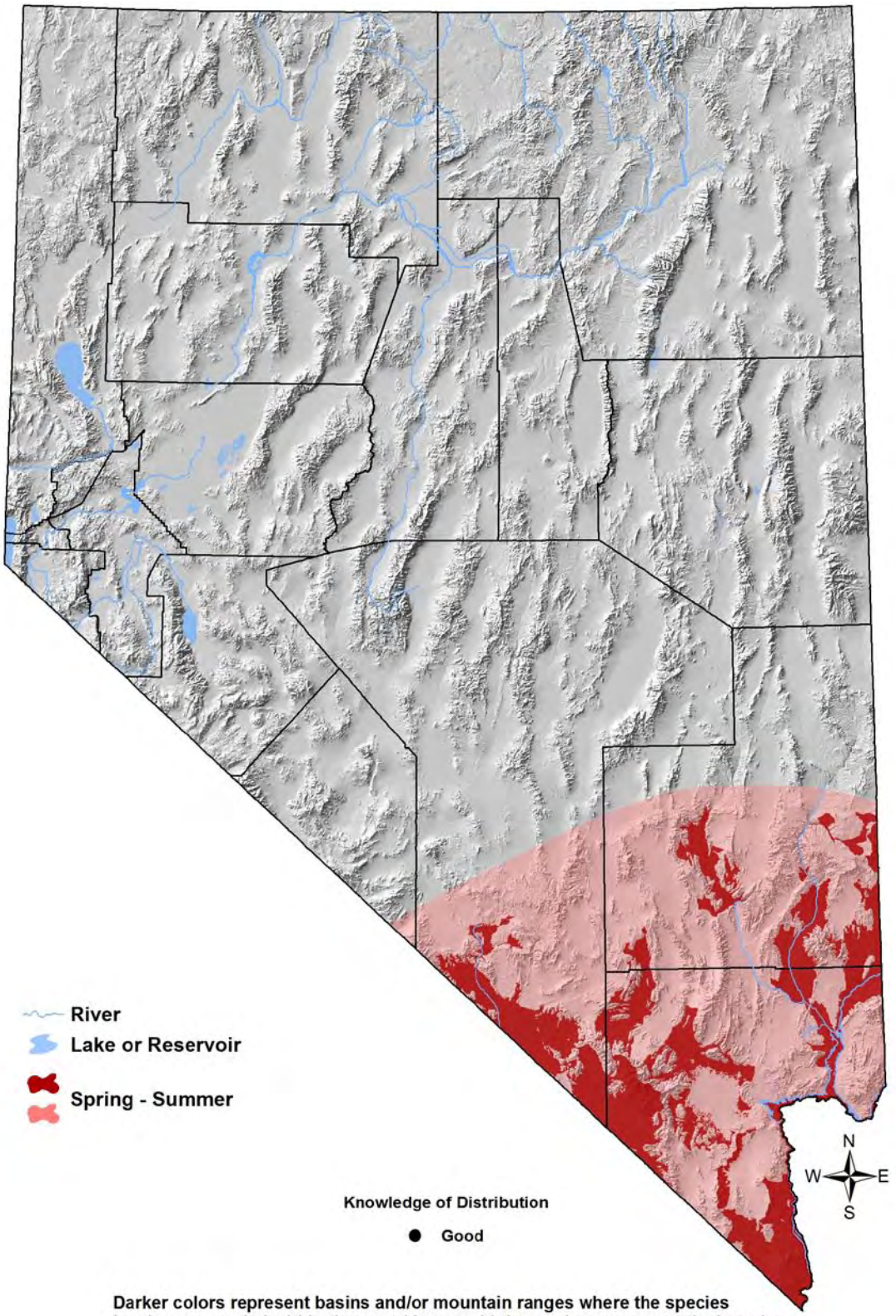
Natural History Profile

Seasonal Presence in Nevada	
Spring - Summer	
Known Breeding Dates in Nevada	
April – July[6]	
Nest and Nesting Habits	
Nest Placement	Suspended from dense riparian branches, 0.5 - 1.5 m [1.6 – 5 ft] above ground[11]
Site Fidelity	High[11]
Food Habits	
Basic	Arboreal and shrub gleaner
Primary Diet	Insects and spiders[11]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Bell's Vireo

Vireo bellii



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Bell's Vireo

Vireo bellii

Overview

The only Bell's Vireo subspecies currently known to be present in southern Nevada is *Vireo bellii arizonae,*the Arizona Bell's Vireo. However, the federally endangered Least Bell's Vireo (*V. b. pusillus*) has recently been documented < 50 km [30 mi] from Nevada in the Tecopa – Shoshone area of California (Carl Lundblad, *pers. comm.*), and until pending genetic tests are completed, the possibly that Least Bell's Vireos are present in Nevada's Ash Meadows NWR or other border areas cannot be dismissed. Regardless, the Arizona Bell's Vireo is a conservation concern in its own right because of long-term population declines and continuing threats to its lowland riparian habitats.

Bell's Vireos breed in riparian areas dominated by willow, cottonwood, riparian mesquite, or salt cedar,[11] but in all cases presence of dense understory is the crucial habitat feature. Research consistently shows that the risk of cowbird parasitism[11] and sometimes nest predation[3] decreases as understory vegetation becomes denser. Most recommendations for habitat management and restoration focus on increasing the density of understory vegetation.[3,17] In one restoration project, vireo abundance more than doubled within four years of cattle removal (and resulting increases in understory density) on the San Pedro River in Arizona.[8] In addition to understory density, patch size is also important. Bell's Vireos were found to be more abundant and successful in larger cottonwood and willow patches (> 160 ha [435 ac]) in the lower Colorado River valley.[11,12] Finally, presence of nearby surface water is also an important component of habitat suitability.[10,11]

The Bell's Vireo has adopted salt cedar as a breeding substrate, and several studies have shown that nesting densities in saltcedar and native riparian vegetation are roughly comparable,[1,11] although this may be less applicable in hotter desert climates.[19] On the San Pedro River in Arizona, Bell's Vireos had similar densities in saltcedar and native vegetation, although nest production was higher in native vegetation.[2] In surveys along the lower Colorado River,[5] Bell's Vireos were generally neutral to the amount of saltcedar present, but they did not use any sites where saltcedar cover exceeded 90%, suggesting that saltcedar stands with a native vegetation component are more suitable than monotypic saltcedar. Restoration projects seeking to replace invasive saltcedar with native vegetation should be geographically and temporally staggered, and appropriately scaled to avoid eliminating large amounts of usable breeding habitat without concurrently generating native habitat. It is possible that, at least in some cases, reintroducing a native component to areas currently dominated by monotypic saltcedar is the most efficient short-term approach to restoration from the standpoint of the Bell's Vireo.

The Bell's Vireo is particularly susceptible to parasitism by Brown-headed Cowbirds (*Molothrus ater*), which can seriously impact populations within certain areas. However, cowbird parasitism is not thought to be a main driver of declines in Bell's Vireo, but rather a local contributing factor.[11] Cowbird trapping has been shown to increase nest success in *V. b. arizonae,*[13] and sometimes population size in *V.b. pusillis,*[9] but it is an expensive and short-term solution recommended only in emergencies.[15]

Bell's Vireo

Vireo bellii

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

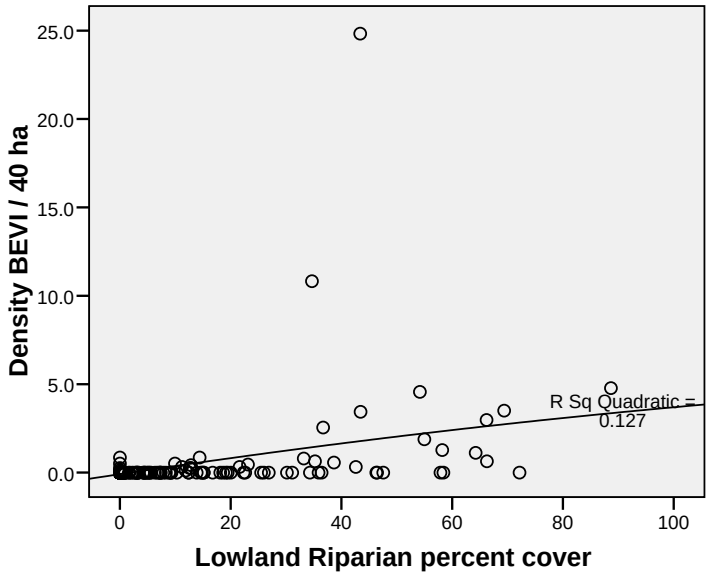
Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Lowland Riparian	64% (23/36)	3.3 (1.1 – 5.5)
Mesquite-Acacia	21% (3/14)	0.4 (0.1 – 0.7)

- Pair densities across geographical range vary from 0.5 – 200 / 40 ha [0.005 – 2.0 / ac][11]
- In southwest, densities in mesquite are highly variable[11]

Nevada-Specific Studies and Analyses

Landscape Associations (NBC)

As expected, transect-level logistic regressions indicated that Bell's Vireos were closely associated with Mojave Lowland Riparian habitat (which includes saltcedar), and were also more likely to be found in close proximity to water. All 30 transects where Bell's Vireos were detected were classified as Lowland Riparian based on either visual examination or the presence of at least 10% riparian cover as indicated within the GIS habitat classification. As shown in the figure below, density of Bell's Vireos appears to be closely related to the percent cover by Lowland Riparian habitat in the transect.



Bell's Vireo

Vireo bellii

Main Threats and Challenges

Habitat and Other Threats

- Loss or degradation of habitat and surface water due to water diversions, flood control, or groundwater pumping
- Loss of habitat to fire
- Removal of large amounts of saltcedar without concurrent creation of suitable replacement habitat
- Human disturbance may reduce nest success[7, 10]
- Cowbird nest parasitism[11]

Research, Planning, and Monitoring Challenges

- Possible presence of Least Bell's Vireo in Nevada has not been conclusively resolved



Bell's Vireo habitat near the Lower Colorado River. Photo by Amy Leist.

Bell's Vireo

Vireo bellii

Conservation Strategies

Habitat Strategies

- The Mojave Lowland Riparian (p. Hab-11-1) habitat conservation strategy benefits this species
- Manage riparian habitat to provide early and intermediate successional stages characterized by dense shrub understory
- Protect existing native riparian woodlands (cottonwood, willow, and riparian mesquite) that exhibit suitable shrub understory density
- Restore degraded areas or those dominated by saltcedar, but plan restorations so that large amounts of saltcedar are not removed without concurrently creating suitable replacement habitat

Research, Planning, and Monitoring Strategies

- Continue monitoring for population trends
- Develop fire management strategies balancing the need short-term habitat protection and long-term habitat regeneration
- Conduct nesting studies in Nevada to better assess the relative habitat quality of native vegetation versus saltcedar
- Investigate possible presence of Least Bell's Vireo within Nevada, especially at Ash Meadows NWR

Public Outreach Strategies

- None identified

References: [1]Averill-Murray et al. (1999); [2]Brand et al. (2010b); [3]Budnik et al. (2002); [4]Clark County (2000); [5]GBBO (2009); [6]GBBO unpublished Atlas data; [7]Greaves (1989); [8]Krueper et al. (2003); [9]Kus and Whitfield (2005); [10]Kus et al. (2008); [11]Kus et al. (2010); [12]Lynn (1996); [13]Morrison and Averill-Murray (2002); [14]Rich et al. (2004); [15]Rothstein and Peer (2005); [16]Sauer et al. (2008); [17]Sharp and Kus (2006); [18]LCRMSCP (2004); [19]Walker (2006); [EO] Expert opinion

Gray Vireo

Vireo vicinior



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Pinyon-Juniper	
Key Habitat Parameters ●	
Plant Composition	Pinyon pine, juniper, variety of understory shrubs, especially sagebrush
Plant Density & Size	Open woodland with well-developed shrub understory;[1, 8] canopy closure ~ 5 – 15%;[8, 10] shrub height typically 0.5 – 2m [1.6 – 6.6 ft]; nest tree height ~ 3 m [10 ft]; vegetation typically dense within the vireo's vertical foraging profile, which ranges from 1 – 4 m [3.3 – 13 ft] above ground[1]
Mosaic	Open woodlands with variable ages and densities of trees and shrubs; shallow drainages at base of slope or escarpment may be preferred [EO]
Distance to Water	No apparent relationship
Response to Vegetation Removal	Negative [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 100 ha [250 ac] [EO]
Territory Size	2 -10 ha [5 - 25 ac][1]

Conservation Profile

Priority Status	
Conservation Priority Species	
Reasons for Priority Status	
Possible recent declines Possible habitat threats High stewardship responsibility	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ○	Conflicting data[3, 7]
Population Size Estimates	
Nevada (NBC) ◑	78,000
Global ◑	360,000 [6]
Percent of Global	22%
Population Objective	
Maintain[6, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Lower- to mid-elevation pinyon-juniper woodlands in Clark and Lincoln counties
Restoration	Same

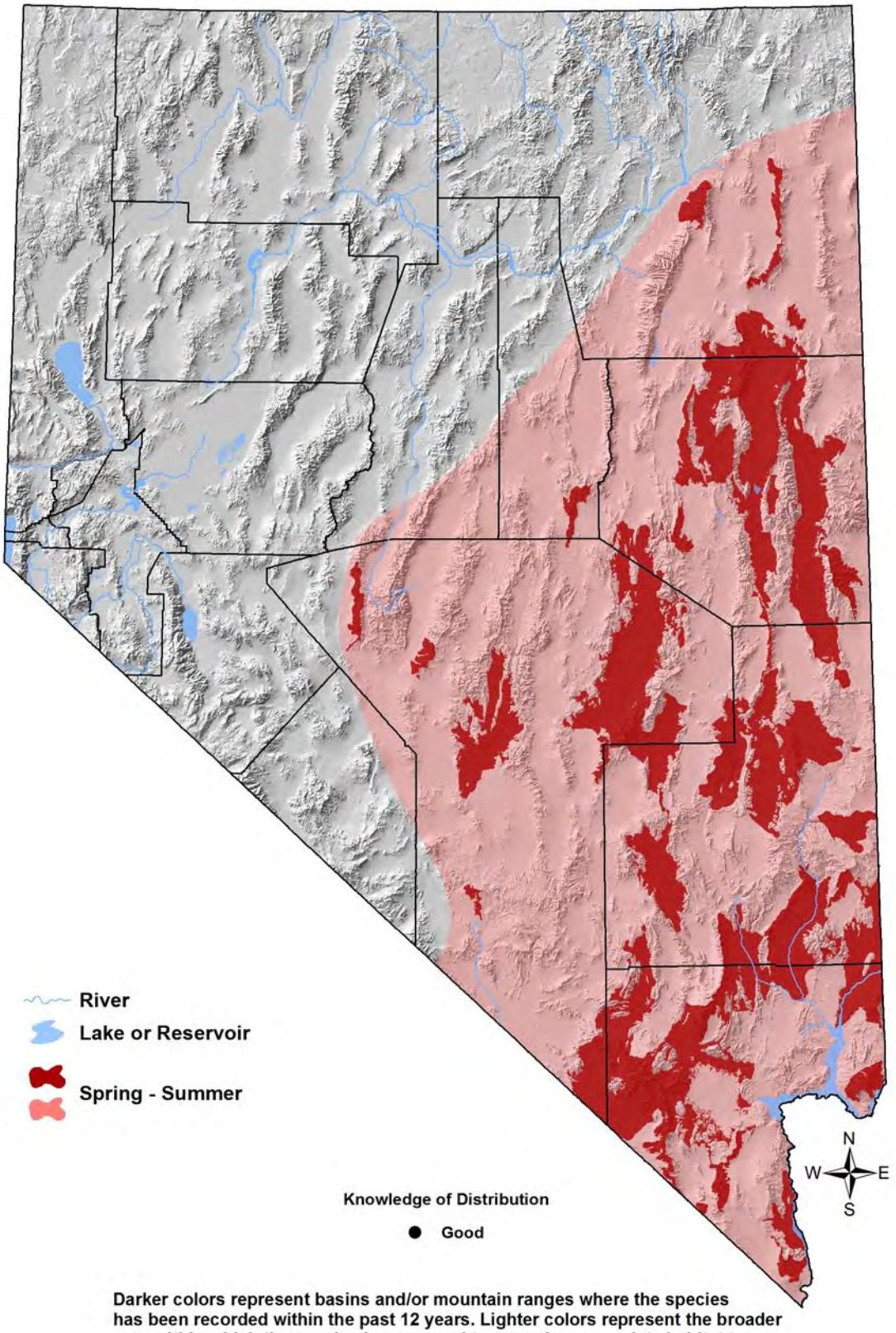
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late March – mid-July[4, EO]	
Nest and Nesting Habits	
Nest Placement	In dense, live branch of tree, usually juniper; often facing west or north[1]
Site Fidelity	Probably high[9]
Food Habits	
Basic	Arboreal and shrub gleaner
Primary Diet	Arthropods[1]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Gray Vireo

Vireo vicinior



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Gray Vireo

Vireo vicinior

Overview

The global breeding range of the Gray Vireo is largely restricted to the American Southwest. Within the last twelve years, the Nevada Breeding Bird Atlas project and the Nevada Bird Count extended the known breeding range of the Gray Vireo northward by a substantial distance into eastern and central Nevada (White Pine County, southern Elko County, northern Nye County, and southern Eureka County). Confirmation of this new breeding range also resulted in a substantial increase in the estimated Nevada population size of Gray Vireos. With this new information, it is now estimated that Nevada hosts over 20% of this species' breeding population.

Gray Vireos use mature or mixed-age pinyon-juniper woodlands with scattered trees and open canopies, preferably where juniper is dominant.[8, 10] They also favor sites with a well-developed and often diverse shrub understory, within which they frequently forage. Gray Vireos typically occur in relatively narrow mid- or lower-elevation bands within the pinyon-juniper zone, often at the warmer bases of rocky slopes.[10] As might be expected, Gray Vireos in the Mojave region usually occupy higher elevations[5] than those further to the north in Nevada (GBBO unpublished NBC data). Average densities of Gray Vireos tend to be lower than other birds characteristic of pinyon-juniper woodlands, and their territories are large for a songbird.[8] These factors, along with the Gray Vireo's somewhat scattered pattern of occurrence, should be considered when evaluating potential threats, and they form part of the basis for inclusion of the Gray Vireo as an Evaluation Species within the Clark County MSHCP.[2] Much remains to be clarified about this bird, including Nevada population trends.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Pinyon-Juniper	26% (18/70)	3.5 (1.9 – 5.1)
Mojave		
Pinyon-Juniper	75% (9/12)	2.8 (1.5 – 4.1)
Montane Riparian	44% (4/9)	3.1 (0.0 – 6.6)
Montane Shrubland	63% (5/8)	1.3 (0.5 – 2.1)
Coniferous Forest	75% (3/4)	1.3 (0.0 – 3.0)

- Estimated density 2.56 birds / 40 ha [0.026 / ac] in northern Arizona and southern Utah[8]

Gray Vireo

Vireo vicinior

Nevada-Specific Studies and Analyses

Habitat Requirements (NBC data)

Analysis of ground-collected habitat data from sites occupied by Gray Vireos and nearby control sites indicated that occupied sites within pinyon-juniper woodland were characterized by having less bare ground, lower tree density, and a higher proportion of juniper trees to pinyon pines than unoccupied sites.

Landscape Associations (NBC)

In addition to the well-known association of Gray Vireos with Pinyon-Juniper habitat, logistic regression using land cover types suggested that Gray Vireos may be directly or indirectly avoiding mountain mahogany stands, although the negative association was not quite statistically significant (*Appendix 3*). They were present on only one of the 50 transects having > 1% cover of Mountain Mahogany habitat. Distance to water does not influence the distribution or density of this species.

Main Threats and Challenges

Habitat Threats

The nature and severity of threats to Gray Vireos are not well studied, and are somewhat conjectural. Possible threats include:

- Increasing canopy closure of pinyon-juniper woodlands as a function of altered fire regimes and successional processes
- Heavy livestock grazing that decreases the density or diversity of shrub understory
- Invasive plants
- Brown-headed Cowbird (*Molothrus ater*) parasitism may have negative impacts on reproductive output, but this has not been confirmed or quantified [EO]

Research, Planning, and Conservation Challenges

- Uncertainty about population trends within Nevada is perhaps the most critical knowledge deficit
- Detailed information about some habitat parameters is incomplete or contradictory
- Possible importance of other habitat types (montane riparian, montane shrubland) within the landscape matrix are unknown

Gray Vireo

Vireo vicinior

Conservation Strategies

Habitat Strategies

- The Pinyon-Juniper (p. Hab-16-1) habitat conservation strategy benefits this species
- Pinyon-juniper thinning / removal projects would be most beneficial to Gray Vireos in areas where
    - Pinyon-juniper canopy closure currently exceeds 35%
    - Potential for further development of a desirable shrub understory is high, and potential for invasive weeks is low or manageable
- Manage livestock grazing and other land uses to maintain or restore well-developed shrub understory communities within open pinyon-juniper woodland

Research, Planning, and Monitoring Strategies

- Continue monitoring to determine population trend within Nevada
- Conduct additional studies to clarify habitat requirements, including canopy closure and preferred shrub density and species composition
- Conduct additional studies to determine the scope and severity of habitat threats to Gray Vireos, and potential impacts from cowbird parasitism

Public Outreach Strategies

- None identified

References: [1]Barlow et al (1999); [2]Clark County (2000); [3]Dobkin and Sauder (2004); [4]GBBO unpublished Atlas data; [5]Johnson (1972); [6]Rich et al. (2004); [7]Sauer et al (2008); [8]Schlossberg (2006); [9]Shuford and Gardali (2008); [10]Walker and Doster (2009); [EO] Expert opinion

Gray Vireo

Vireo vicinior



Gray Vireo habitat in northern Nevada. Photo by Jen Ballard.

Pinyon Jay

Gymnorhinus cyanocephalus



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Pinyon-Juniper (Sagebrush)	
Key Habitat Parameters ●	
Plant Composition	Pinyon pine, juniper, sagebrush; occasionally Ponderosa or Jeffrey pine
Plant Density & Age	Wide range of tree densities and ages, but less common in very dense, closed-canopy settings[1, 3, EO]
Mosaic	Woodlands with stand diversity, large canopy openings, and shrub understory; may prefer proximity to broad woodland / shrubland transition zones over woodland interiors[1, 3, EO]
Elevation, Aspect	Lower elevations within pinyon-juniper zone; appear to prefer sunny aspects[1, 3, EO]
Distance to Water	No information
Response to Vegetation Removal	Positive to creation of openings in closed-canopy stands, otherwise negative [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 3,000 ha [7,400 ac][3]
Home Range	1,400 – 2,000 ha [3,500 – 5,000 ac][3]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Habitat threats High stewardship responsibility	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3S4
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ◑	Probable rangewide declines[1]
Recent ●	Rangewide declines of 4.4 – 6.4% / year[6]
Population Size Estimates	
Nevada (NBC) ◑	428,000
Global ○	4,100,000 [5]
Percent of Global	> 10%
Population Objective	
Increase by 100% [5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Pinyon-juniper woodland where pinyon pine is present, especially woodland / shrubland transition zones
Restoration	Same, plus woodland interiors that could be thinned to create open stands

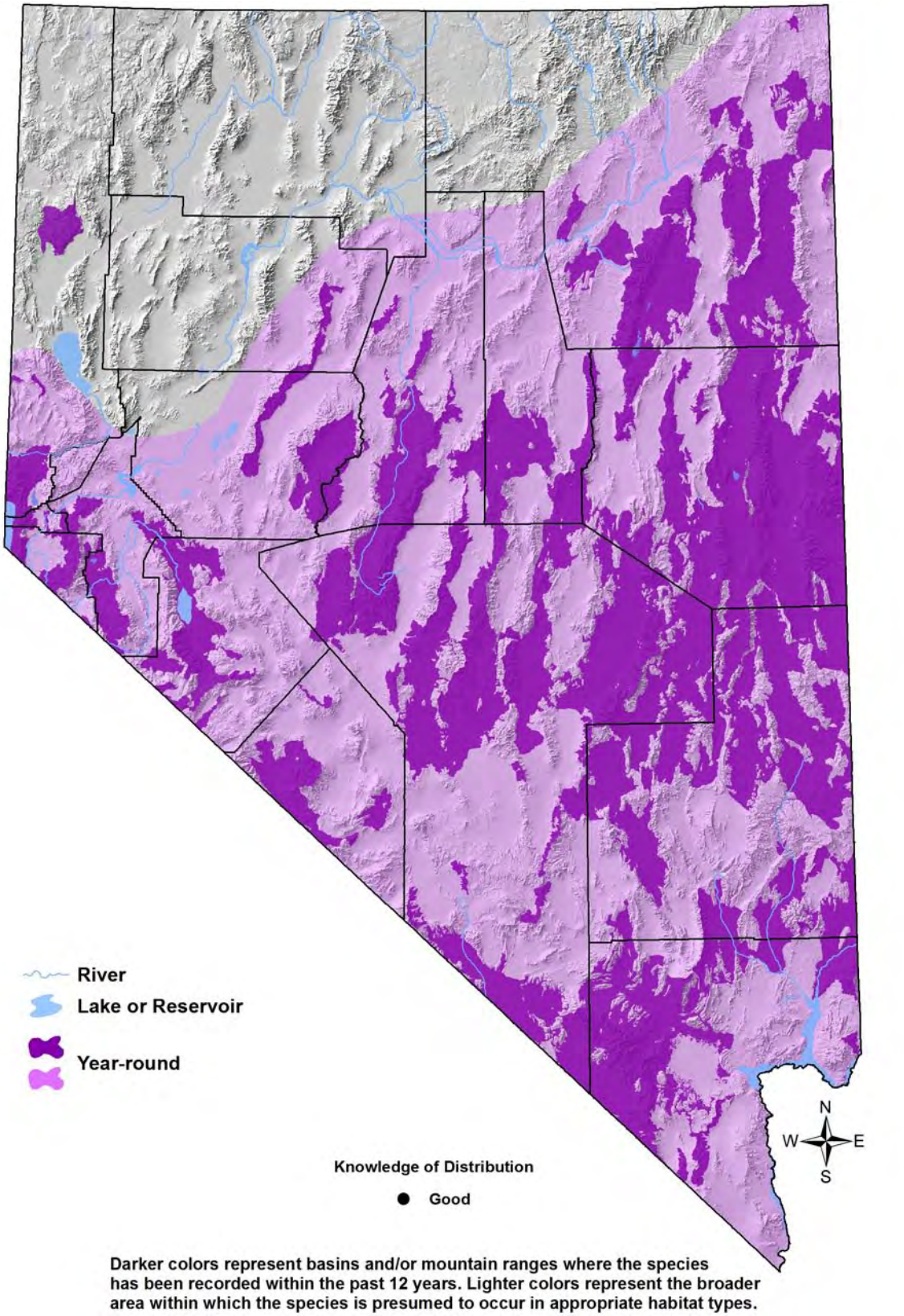
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Late March – August[2]	
Nest and Nesting Habits	
Nest Placement	Interior of mature pine or juniper near trunk, often on south-facing slope[1]
Site Fidelity	Unknown
Other	Highly social year-round, including nesting[1, 3]
Food Habits	
Basic	Mostly granivorous
Primary Diet	Pinyon pine seeds[1]
Secondary Diet	Arthropods during nesting, other seeds, and feeders where available[1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Pinyon Jay

Gymnorhinus cyanocephalus



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Pinyon Jay

Gymnorhinus cyanocephalus

Overview

Pinyon Jays present both a conservation challenge and a paradox. During the same period when the species has been declining at a rapid rate, its preferred habitat, pinyon-juniper woodland, has been expanding. Compounding this management challenge, nearly everything that was known until very recently about Pinyon Jay habitat requirements was based on the long-term study of a single flock in New Mexico, near the southern edge of the species' geographical range.[1]

In 2007 the Great Basin Bird Observatory conducted an initial radio-telemetry study of five Pinyon Jay flocks in White Pine County. The data collected during this study indicated that Pinyon Jays prefer a mixed-age mosaic of woodland transitioning into, or interspersed with, sagebrush shrubland. Although Pinyon Jays were observed to roost and build nests within relatively dense groves of trees, these groves were typically located within 2 km [1.2 mi] of the woodland-sagebrush habitat edge. These findings, if representative of all Great Basin populations, would suggest that the large expanses of closed-canopy pinyon-juniper woodland that have become more common in Nevada over the past century are largely unsuitable for Pinyon Jays. Mixed-age woodland mosaics with shrubby openings and a complex habitat edge, in contrast, appear to have decreased in extent during the same period (see Pinyon-Juniper habitat account, p. Hab-16-1).[4, 7] Thus, one hypothesis for the species' declines involves changes in the age profile and structural features of pinyon-juniper woodlands, not in their overall extent. Another possible factor is the Pinyon Jay's well-known dependence on pinyon pine nut production. Further research on the ecological correlates of pine nut production might generate additional hypotheses for the Pinyon Jay's decline.

Pinyon Jays make heavy use of pine nut crops during their production period (early to late fall), but rely for the rest of the year on seed caches or other food sources. Seed caches are usually located in the woodland-shrubland transition zone, or in pure shrublands within ~ 2 km [1.2 mi] of the woodland edge (GBBO unpublished data). It therefore seems likely that the Pinyon Jay's association with edge habitat is at least partly related to the location of cache sites.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Pinyon-Juniper	41% (29/70)	6.0 (2.4 – 9.6)
Sagebrush	6% (2/33)	6.4 (n/a)
Mojave		
Pinyon-Juniper	67% (8/12)	14.0 (0.0 – 36.0)

- Pinyon Jays are usually detected in the form of flocks that occur sporadically across the landscape. Mean density within areas where flocks are present during

Pinyon Jay

Gymnorhinus cyanocephalus

the survey period are not representative of average density across the landscape. NBC density estimates in the table above should be interpreted accordingly

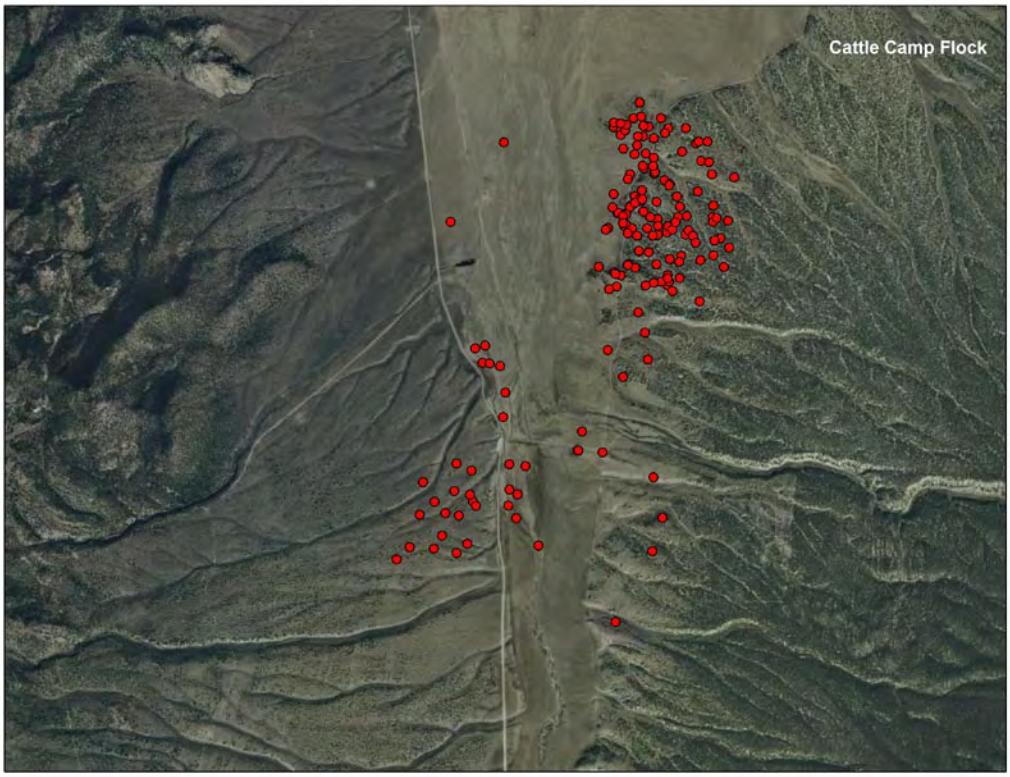
- Transects with any pinyon-juniper present are classified as Pinyon-Juniper in the table above, even if they contained a substantial amount of sagebrush cover
- Pinyon Jays were also detected on at least 10% of NBC transects classified as Montane Shrub (both Great Basin and Mojave), and Montane Riparian (Mojave)
- The BBS-derived population estimate for Pinyon Jays in Nevada is 1,650,000,[5] considerably larger than the NBC-derived estimate of 428,000. The NBC-estimate is extrapolated from more sampling points and is therefore probably more accurate

Nevada-Specific Studies and Analyses

Habitat Requirements (unpublished GBBO radio-telemetry study, White Pine County)

Study of radio-tagged Pinyon Jays in White Pine County in 2007-2009 produced the following findings:

- Foraging Pinyon Jays appeared to favor transitional areas where pinyon-juniper woodland is interspersed with sagebrush
- During daytime, jays were usually found within 800 m [2,600 ft] of the woodland edge, and always within 2 km [1.2 mi] of the edge, as shown in the figure below.



Telemetry locations for a Pinyon Jay flock in South Steptoe Valley, White Pine County, over a one-week period in August 2009. Darker areas on the aerial photo are pinyon-juniper woodland, lighter areas are sagebrush.

Pinyon Jay

Gymnorhinus cyanocephalus

- For roosting and nesting, jays went deeper (but usually no more than 3 km [1.8 mi]) into the woodland interior to denser trees stands
- Jays were nearly always found in areas with diverse woodland canopy closure and age structure; they were not observed in large contiguous areas of mature, dense woodland
- Although very large flocks have been reported elsewhere, we most often observed smaller subflocks (< 30 birds) that periodically joined other subflocks to form flocks of 50-100 birds.
- Sub-flock home ranges were < 20 km^2 [5,000 ac] in all cases
- Findings were similar for all five flocks studied, regardless of whether they had access to urban feeders
- Presumably, Nevada flocks wander more widely when local food supplies are insufficient,[1] though such vagrant movements were not detected during the study

Landscape Associations (NBC)

Logistic regression analysis confirmed the importance of Pinyon-Juniper habitat to this species, but added little additional insight (*Appendix 3*). Given the manner in which landcovers were assigned in the GIS map (i.e. areas with any pinyon-juniper present were classified as "Pinyon-Juniper", regardless of the amount of sagebrush cover they contained) we could not yet quantify the importance of sagebrush microhabitat within the woodland mosaic

Main Threats and Challenges

Habitat Threats

- Preliminary data suggest that Pinyon Jay declines may be at least partly related to substantial increases in the acreage of closed-canopy, mature (or senescent) woodland with a poor shrub understory, coupled with a corresponding loss of mixed-age woodland mosaics with openings and a complex shrubland edge. These landscape scale changes are largely the result of altered fire regimes, although grazing pressure and invasive plants may be contributing factors.

Research, Planning, and Monitoring Challenges

- Monitoring is challenging because flocks are irregularly distributed across the landscape
- The factors controlling pinyon pine nut production, and their short and long-term impacts on jay populations, need further study
- Lack of clear strategies that make pinyon-juniper habitat treatment programs compatible with the habitat requirements of Pinyon Jays

Pinyon Jay

Gymnorhinus cyanocephalus

Conservation Strategies

Habitat Strategies

- The Pinyon-Juniper (p. Hab-16-1) habitat conservation strategy benefits this species
- Maintain or increase the proportion of pinyon-juniper woodland that is characterized by mixed-age structure, woodland openings, interspersion with sagebrush habitat, and well-developed shrub understory. An ideal landscape would contain (within a patch size of ~ 3,000 ha [7,400 ac]) mature cone-bearing trees, some dense closed-canopy stands near the woodland edge, and large numbers of younger trees interspersed with shrubland
- Pinyon-juniper treatment projects should try to avoid creating a sharp, well-defined edge between dense woodland and recovered shrubland

Research, Planning, and Monitoring Strategies

- Continue monitoring for population trends
- Additional studies need to be conducted to confirm, refine, or revise the preliminary findings derived from the radio-telemetry studies described above
- In-depth studies of the landscape-scale successional processes that may impact or control pinyon pine nut production would be valuable. The possible impact of climate change on pinyon nut production also deserves consideration and study

Public Outreach Strategies

- None identified

References: [1]Balda (2002); [2]GBBO unpublished Atlas data; [3]GBBO unpublished telemetry data; [4]Miller et al. (2008); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]Tausch et al. (1981); [EO] Expert opinion

Sage Thrasher

Oreoscoptes montanus



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Sagebrush Montane Shrubland Salt Desert Scrub	
Key Habitat Parameters ●	
Plant Composition	Sagebrush, greasewood, various salt desert or montane shrub species; avoids cheatgrass[8, EO]
Plant Density & Height	Shrub cover 11 – 44%,[9] average height 30 – 90 cm (1 – 3 ft), but can be taller; sparse to moderate ground cover[8, EO]
Mosaic	High-quality shrubland with spatial variability in density and height and structural complexity; patches of bare ground are acceptable [8]
Distance to Water	May prefer nearby water[2]
Response to Vegetation Removal	Negative to reducing shrub cover below 10%; exotic weed control encouraged[8, EO]
Area Requirements ◑	
Minimum Patch Size	Unknown, but thought to avoid small patches
Recommended Patch Size	> 100 ha [250 ac] [EO]
Territory Size	0.64 – 1.9 ha [1.6 – 4.7 ac][8]

Conservation Profile

Priority Status	
Stewardship Species	
Species Concerns	
High stewardship responsibility Habitat threats	
Other Rankings	
Continental PIF	Stewardship Species
Audubon Watchlist	None
NV Natural Heritage	S5B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Stewardship
Trends	
Historical ○	Unknown
Recent ◑	Stable, or slight declines[11]
Population Size Estimates	
Nevada (NBC) ◑	1,500,000
Global ◑	7,900,000 [10]
Percent of Global	~ 20%
Population Objective	
Maintain[10, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	High-quality Great Basin sagebrush and montane shrubland
Restoration	Degraded / burned Great Basin sagebrush and montane shrubland

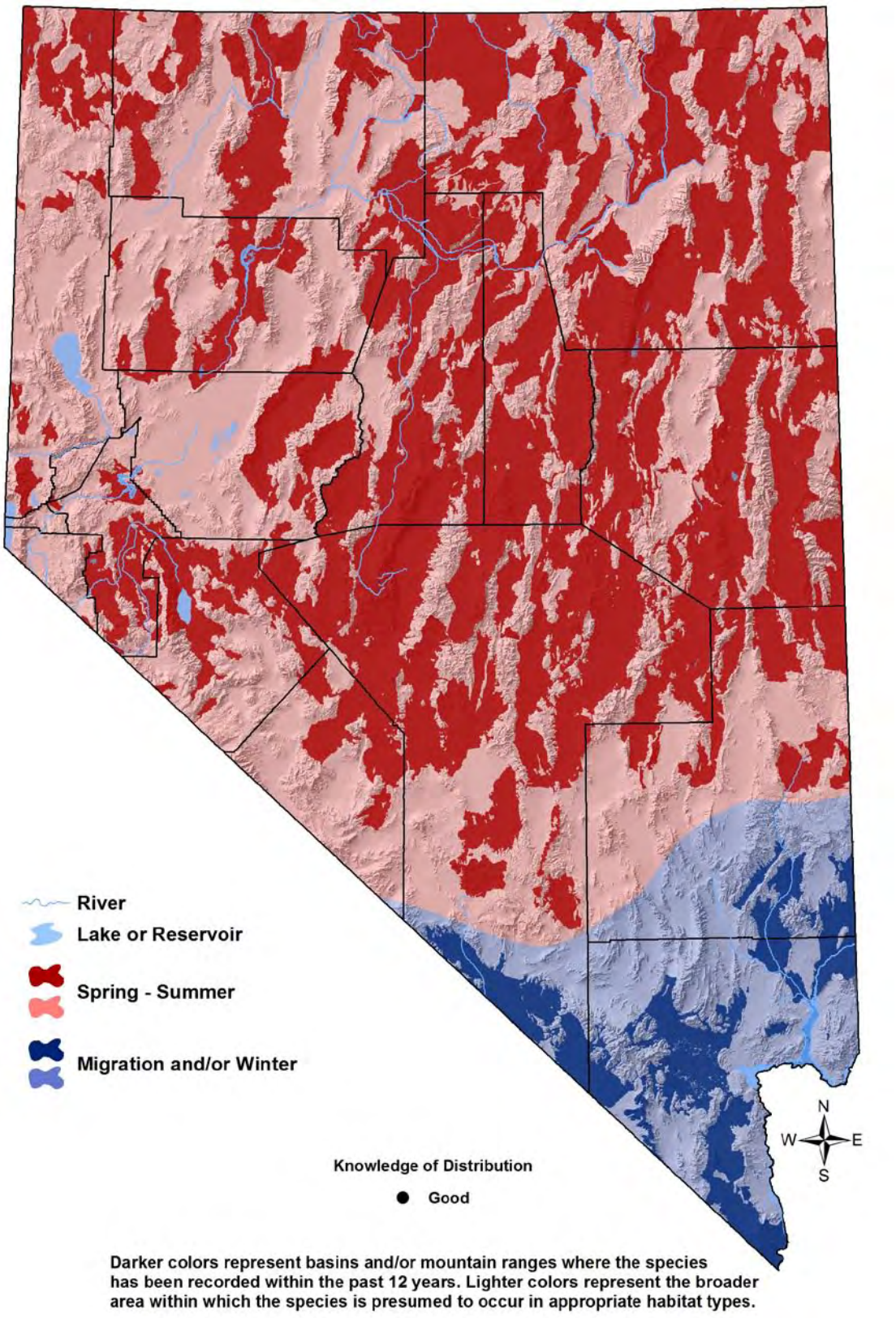
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
April – late August[1]	
Nest and Nesting Habits	
Nest Placement	On ground or low branch of dense shrub > 70 cm [27 in] tall; sometimes with roof[8, 9]
Site Fidelity	Moderate for breeding territory[8]
Food Habits	
Basic	Ground forager
Primary Diet	Medium-sized terrestrial insects, such as crickets[8]
Secondary Diet	Berries and seeds in non-breeding season[8]

Confidence in Available Data: ●High ◑Moderate ○ Low

Sage Thrasher

Oreoscoptes montanus



Sage Thrasher

Oreoscoptes montanus

Overview

Nevada provides a home for about one-fifth of the global population of Sage Thrashers. They primarily inhabitat sagebrush valleys, but can also be found breeding in salt desert (especially where it intergrades with sagebrush or where greasewood predominates) and montane shrubland.[2, 3, 6] For reasons that are unclear, Sage Thrashers are not declining to the same degree as several other sagebrush-associated songbirds, including Brewer's Sparrow (p. Spp-73-1).[8] Still, Breeding Bird Survey results indicate possible declines in Nevada dating from approximately 1980.[11]

Sage Thrashers are consistently more numerous in areas with greater cover of high-quality sagebrush,[5,8] and they are often positively associated with greater shrub height[4] and vertical complexity.[13] They avoid areas with junipers, even if they are present in low densities.[6] On a landscape scale, Sage Thrashers are more likely to occur where uninterrupted sagebrush cover is present over large spatial expanses.[5] Any treatment that decreases or fragments sagebrush cover is likely to be detrimental,[4, 12] and indeed, Sage Thrashers were shown to be negatively affected by fire in two studies involving sagebrush cover in a montane setting.[3, 6] However, at least one study in eastern Washington found Sage Thrashers to be relatively insensitive to patch size, although fragmentation of habitat by agriculture appears to reduce reproductive success.[12] Although primarily associated with the Great Basin region of Nevada, the Sage Thrasher's breeding range extends southward into the northern Mojave region in the areas where sagebrush habitat is present. Effective conservation and management of healthy sagebrush landscapes in Nevada (see p. Hab-17-1) is the key factor for ensuring the stability of the Sage Thrasher.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Sagebrush	76% (25/33)	4.6 (3.1 – 6.1)
Salt Desert	83% (19/23)	3.9 (2.8 – 5.0)
Montane Shrubland	40% (8/20)	5.5 (2.9 – 8.1)
Mojave		
Sagebrush	77% (20/26)	5.8 (4.0 – 7.6)

- Other data for the Great Basin indicate that density rarely exceeds 12 birds / 40 ha [0.12 / ac] even in high-quality local sites[7]

Sage Thrasher

Oreoscoptes montanus

Nevada-Specific Studies and Analyses

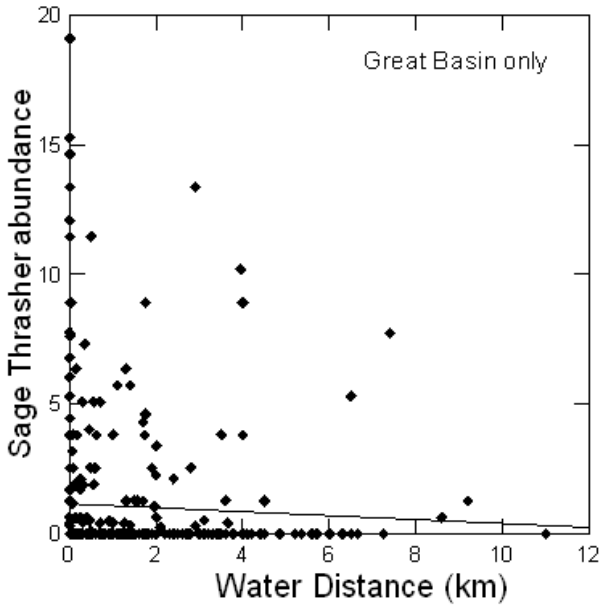
Habitat Requirements (NBC data)

The multivariate analysis (*Appendix 3*) summarized in the table below was based on ground-collected microhabitat measurements taken on NBC transects where Sage Thrashers were present. Sage Thrasher abundance was significantly associated with higher shrub density and lack of trees. There was no significant association with herbaceous cover, and only a weak association with shrub height (variables not shown).

Vegetation parameter	Multivariate p-value and sign
Shrub Cover %	<0.001 (+)
Herbaceous Cover %	0.175 (-)
Tree Density (#/ha)	0.001 (-)
Area under ROC curve	**0.797**

Landscape Associations (NBC data)

Both linear and logistic analyses (*Appendix 3*) confirmed that sagebrush cover was preferred, and that use of Salt Desert and Montane Shrubland habitats was at least partly dependent on the presence of juxtaposed or interspersed sagebrush. Sage Thrashers appeared to be more common closer to water (as shown in the figure below). However, this relationship was not statistically definitive, and could have been a function of some unmeasured covariate, such as elevation.



Sage Thrasher

Oreoscoptes montanus

Main Threats and Challenges

Habitat Threats

Loss, degradation, or fragmentation of high-quality sagebrush shrubland due to:

- Fire
- Invasive plants, especially cheatgrass
- Expansion of pinyon-juniper woodland into sagebrush
- Heavy livestock grazing
- Heavy OHV use

Research, Planning, and Monitoring Challenges

- Further research is needed to determine the best management strategies for the pinyon-juniper / sagebrush interface zone for multi-species benefits
- Although short-term fire management strategies are established, further research and planning is needed to clarify the most beneficial longer-term fire management strategies that protect important habitat while promoting its long-term viability
- Further study is needed to determine the Sage Thrasher's patch size requirements, and to better quantify its sensitivity to patch size



Sage Thrasher habitat in central Nevada. Photo by John Boone.

Sage Thrasher

Oreoscoptes montanus

Conservation Strategies

Habitat Strategies

- Sagebrush (p. Hab-17-1), Montane Shrubland (p. Hab14-1), and Salt Dessert Scrub (p. Hab-18-1) habitat conservation strategies benefit this species
- Protect large expanses of high-quality sagebrush (see below) from fire to the extent possible
- Within large expanses of high-quality sagebrush with few invasive plants, attempt to channel activities that can promote establishment or maintenance of cheatgrass, including heavy livestock grazing and heavy OHV use, to areas that are already degraded
- Where pinyon-juniper encroachment is known to have recently occurred within high-quality sagebrush habitat, conduct pinyon-juniper removal projects. However, we recommend that pinyon-juniper management projects consider the importance of maintaining a natural, interspersed interface zone between sagebrush shrublands and pinyon-juniper woodlands, as discussed in the Pinyon-Juniper (p. Hab-16-1) habitat conservation plan

Research, Planning, and Monitoring Strategies

- Identify and map large patches of intact, mature sagebrush (especially Wyoming big sagebrush) that contain dense shrubs and little cheatgrass
- Develop a fire management strategy that ensures that high-quality sagebrush habitat receives priority fire suppression efforts in the immediate future. Additionally, develop fire management strategies that balance the need for short-term habitat protection with long-term habitat viability
- Conduct additional research to determine how to pinyon-juniper management projects can both benefit Sage Thrashers as well as the suite of birds that use the pinyon-juniper / sagebrush interface zone (see p. Hab-16-1)
- Continue monitoring to better determine population trends and the extent to which breeding activity occurs the Mojave region of Nevada

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]GBBO unpublished NBC data; [3]Holmes (2007); [4]Kerley and Anderson (1995); [5]Knick and Rotenberry (1995); [6]Noson et al. (2006); [7]Paige and Ritter (1999); [8]Reynolds et al. (1999); [9]Rich (1980); [10]Rich et al. (2004); [11]Sauer et al. (2008); [12]Vander Haegan (2007); [13]Wiens and Rotenberry (1981); [EO] Expert opinion

Bendire's Thrasher

Toxostoma bendirei



Photo by Dorothy Crowe

Habitat Use Profile

Habitats Used in Nevada	
Joshua Tree Mesquite-Acacia (Mojave Scrub)	
Key Habitat Parameters ●	
Plant Composition	Joshua tree, *Yucca* spp., cholla (*Cylindropuntia* spp.), mesquite, acacia, squawtea, cheese bush, desertthorn, and similar shrubs[3, 6, EO]
Plant Density	Intermediate[3]
Mosaic	Patches of preferred overstory species, interspersed with Mojave Scrub shrubs (creosote bush, cholla, or transitional areas into blackbrush) and open areas[3]
Distance to Water	Unimportant[EO]
Response to Vegetation Removal	Negative, but exotic weed control encouraged[3]
Area Requirements ◑	
Minimum Patch Size	200 ha [500 ac][3, EO]
Recommended Patch Size	> 1,000 ha [2,500 ac][EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Small population size Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Red
NV Natural Heritage	S1
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines of 5.7% / year since 1966 [7]
Recent ○	Recently stabilizing, but patterns in Nevada unclear[1]
Population Size Estimates	
Nevada ◑	< 50 [EO]
Global ◑	130,000 [5]
Percent of Global	< 1%
Population Objective	
Increase by 100% [5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair / Poor
Key Conservation Areas	
Protection	Valleys and foothills of the McCullough and Newberry Mts., Tule Desert, Delamar Valley, Joshua Tree habitats throughout Clark and Nye counties
Restoration	Joshua Tree habitats throughout Clark and Nye counties

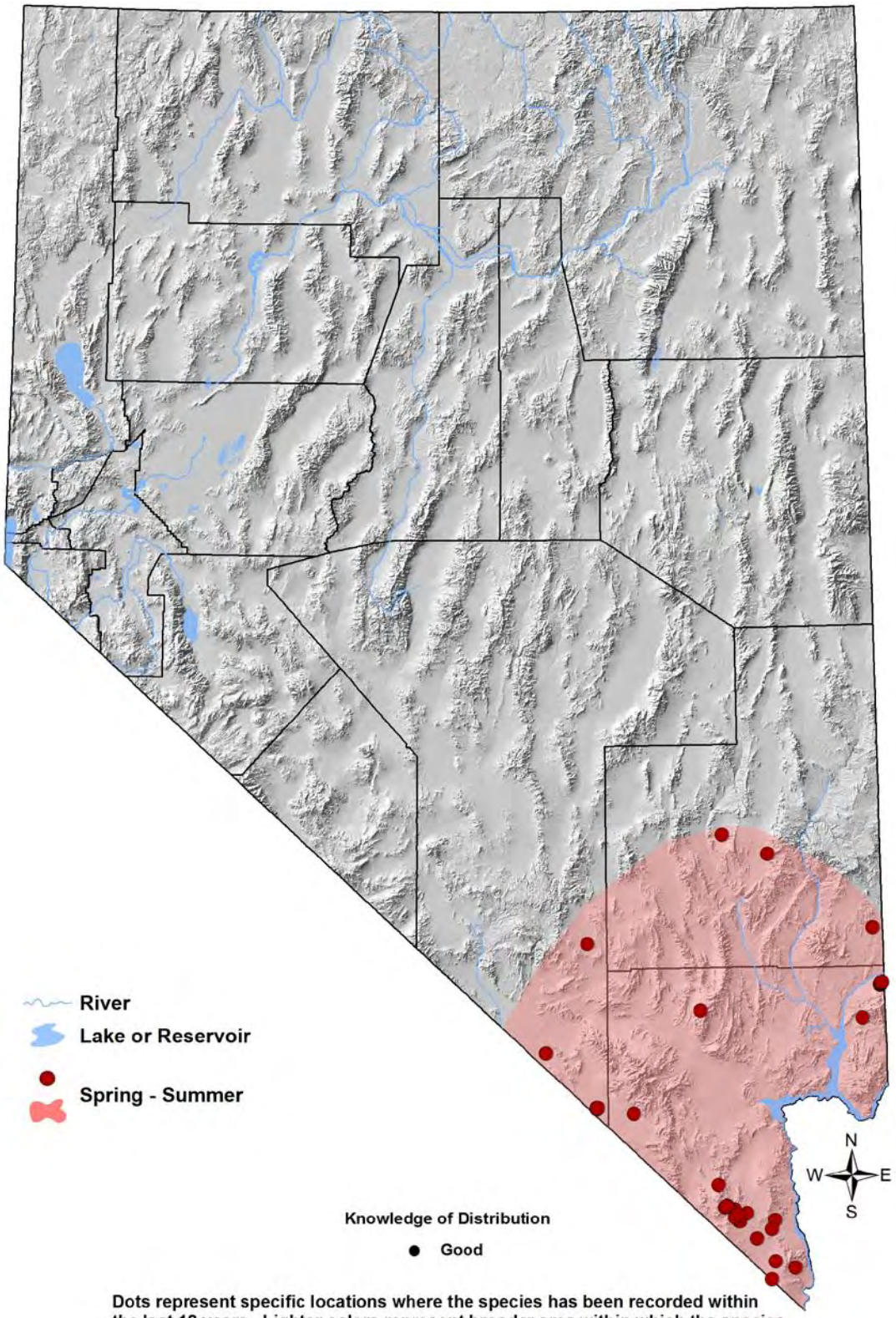
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Mid-March – early July[4, 6]	
Nest and Nesting Habits	
Nest Placement	1 – 1.5 m [3 – 5 ft] above ground in trees or tall shrubs[3]
Site Fidelity	Unknown
Food Habits	
Basic	Ground / litter forager
Primary Diet	Terrestrial invertebrates[3]
Secondary Diet	Seeds, berries[3]

Confidence in Available Data: ●High ◑Moderate ○ Low

Bendire's Thrasher

Toxostoma bendirei



Bendire's Thrasher

Toxostoma bendirei

Overview

Bendire's Thrasher, much like Le Conte's Thrasher, has a restricted geographical range whose northern extent includes a small population in Nevada's Mojave Desert region. However, unlike Le Conte's Thrasher, Bendire's Thrasher partially migrates southward out of Nevada during the winter. Many aspects of the biology, habitat use, and conservation status of Bendire's Thrasher have not been well-studied, but this work has recently been initiated by Dawn Fletcher of the Public Lands Institute at UNLV and NPS, and will need to be continued to gain a better understanding of the species' conservation needs. It appears that Bendire's Thrasher prefers landscapes with a scattered presence of taller vegetation (such as Joshua trees or mesquite) within a broader Mojave shrubland mosaic. Bendire's Thrasher also tends to occur in areas where shrubs are denser and taller than is the case for Le Conte's Thrasher.

Bendire's Thrasher has suffered substantial declines over the last half-century,[7] and is particularly vulnerable to further declines because of its small population size and use of restricted habitat. For these reasons, it is an Evaluation Species under the Clark County MSHCP.[1] Unfortunately, Bendire's Thrasher is difficult to monitor satisfactorily using standard multi-species monitoring programs (BBS and NBC) because of its global rarity and spotty occurrence across the landscape. Development of a more focused and effective monitoring strategy is therefore a priority.

Nevada's population is probably < 50 birds, compared with California's estimated population of < 400 birds,[2] although rigorous estimates are difficult to generate. The greatest known concentration of birds in the Mojave Desert is located just outside the Nevada border in the vicinity of the New York Mountains east of Baker, California.[6] Successful conservation of the Mojave population may therefore best be approached in coordination with California agencies managing these lands.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Joshua Tree	15% (3/20)	0.3 (0.1 – 0.5)
Mesquite-Acacia	14% (2/14)	1.3 (n/a)
Mojave Scrub	4.5% (1/22)	1.0 (n/a)

Bendire's Thrasher

Toxostoma bendirei

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

Bendire's Thrashers have been detected on only six point-count transects, which are insufficient for conducting statistical analysis. However, of these six transects:

- All six contained a substantial amount of the Mojave Scrub habitat type
- All six contained at least some of the denser shrub cover associated with dry washes
- Only one transect had substantial mesquite cover
- Joshua Trees were present on three of the six occupied transects

Main Threats and Challenges

Habitat Threats

The basis for assessing threats is incomplete, but there is cause for concern about the following causes of potential habitat loss or degradation:[EO]

- Urban, suburban, and agricultural development
- Energy (wind and solar) development
- Fire
- Invasive plants
- Heavy OHV use
- As with Le Conte's Thrasher, habitat fragmentation may be a concern, but further information on home range requirements is needed to make this evaluation

Research, Planning, and Monitoring Challenges

- Incomplete understanding of habitat use parameters, particularly regarding the importance of Joshua Trees or other taller vegetation
- Nature, scope, and severity of threats are not well understood
- Tolerance of Bendire's Thrasher to human encroachment and disturbances of intermediate-to-low intensity is unknown in Nevada, and conflicting reports exist for other parts of the species' range[3]

Bendire's Thrasher

Toxostoma bendirei

- Monitoring is difficult due to the species' rarity and its unpredictability in occurrence across the landscape. Bendire's Thrashers may take advantage of ephemeral resources from year to year, and may therefore require large landscapes to support vagrancy

Conservation Strategies

Habitat Strategies

- Joshua Tree (p. Hab-8-1) and Mesquite-Acacia (p. Hab-10-1) habitat conservation strategies benefit this species
- Protect occupied habitat at the recommended patch size from habitat conversion, energy development, and fire as much as possible
- Monitor and (if necessary) limit OHV use in occupied habitat
- Control invasive weeds in and near occupied habitat to reduce fire risk, wherever possible

Research, Planning, and Monitoring Strategies

- Inventory and map important habitat, especially Joshua Tree habitat
- Developed an improved, focused method for monitoring Bendire's Thrashers; this may include use of call playback surveys (Dawn Fletcher, pers. comm.)
- Collect additional monitoring and survey data, including data from areas outside the current known range of the species, to better determine northern extent of breeding range, and to improve estimates of population size and trends in Nevada
- Conduct studies to better estimate minimum patch size, home range, landscape mosaic use, vagrancy, and response to edge effects
- Estimate population losses to solar and wind development scenarios

Public Outreach Strategies

- Promote additional land protections for critical habitat

Bendire's Thrasher

Toxostoma bendirei

References: [1]Clark County (2000); [2]England and Laudenslayer (1989); [3]England and Laudenslayer (1993); [4]GBBO unpublished Atlas data; [5]Rich et al. (2004); [6]Shuford and Gardali (2009); [7]Sauer et al. (2008); [EO] Expert opinion



Bendire's Thrasher habitat in southern Nevada. Photo by Dawn Fletcher.

Le Conte's Thrasher

Toxostoma lecontei



Photo by Dawn Fletcher

Habitat Use Profile

Habitats Used in Nevada	
Salt Desert Scrub (Mojave region) Mojave Scrub Mesquite-Acacia Joshua Tree	
Key Habitat Parameters ◑	
Plant Composition	Saltbush, cholla (*Cylindropuntia* spp.), *Yucca* spp., cactus (*Opuntia* spp.),mesquite, creosote bush (but usually avoids pure stands)[9]
Plant Density & Size	Shrub spacing usually < 15 m [50 ft], shrub height usually < 2.5 m [8 ft][9]
Mosaic	Multiple species of shrub, tree, or cactus preferred; ephemeral washes with high shrub cover favored[9, EO]
Soil, Litter Cover	Undisturbed, sandy soils with ample shrub litter cover[8]
Distance to Water	Unimportant[9]
Response to Vegetation Removal	Negative, but exotic weed control encouraged[EO]
Area Requirements ●	
Minimum Patch Size	160 ha [400 ac][8, EO]
Recommended Patch Size	> 1,000 ha [2,500 ac][5, EO]
Home Range	Year-round 40 - 100 ha [100 – 250 ac][9]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ◑	Rangewide declines, pattern in Nevada unclear[9]
Recent ○	Assumed to be stable[7]
Population Size Estimates	
Nevada ◑	< 100 [EO]
Global ◑	150,000 [6]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[6, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Salt Desert Scrub, Joshua Tree / *Yucca* spp., and ephemeral washes in Clark and Nye Counties; see "Conservation Strategies" for additional detail
Restoration	Same

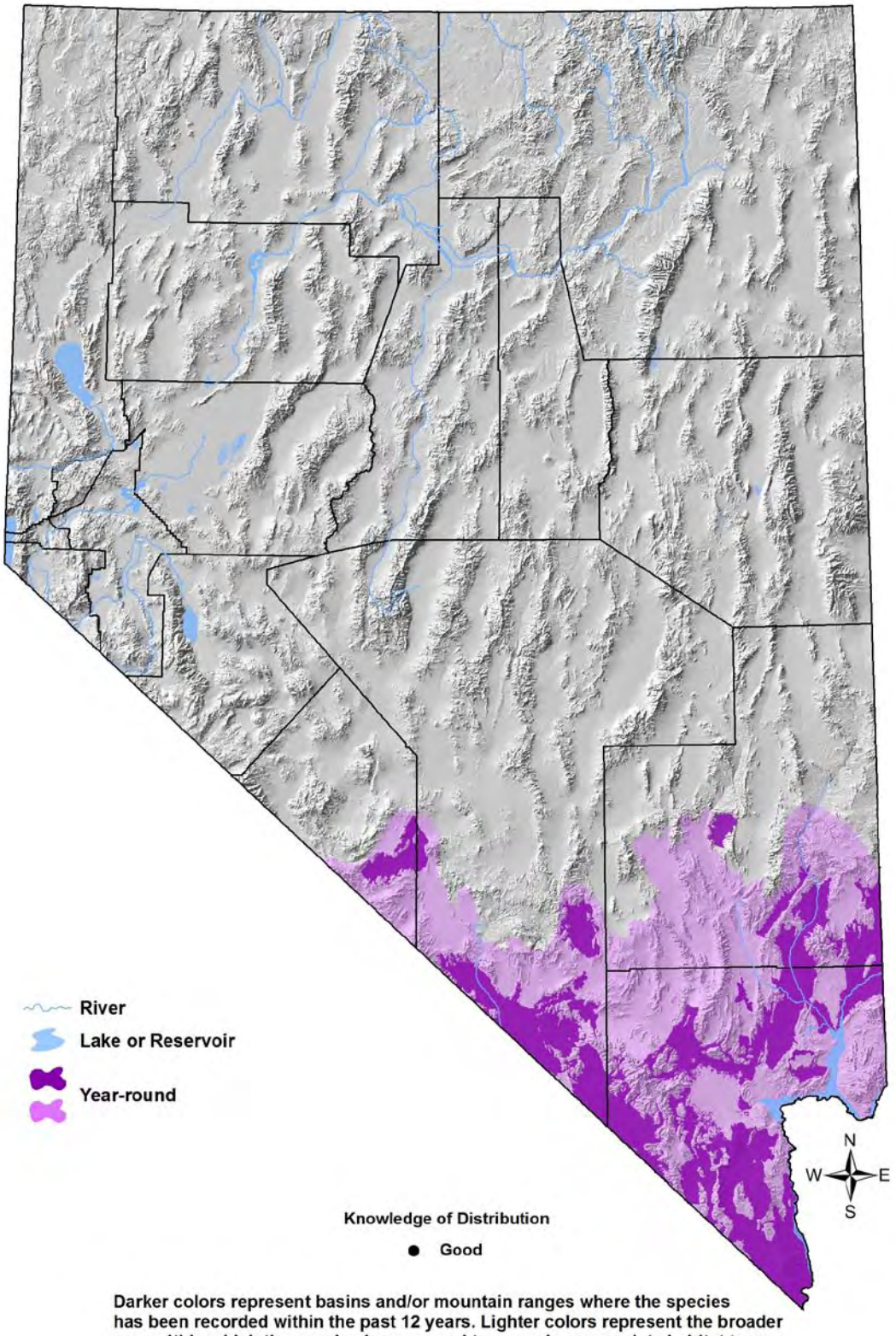
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Late February – July[3]	
Nest and Nesting Habits	
Nest Placement	Above ground in dense, often thorny shrub, such as *Cylindropuntia* spp., saltbush[9]
Site Fidelity	Unknown
Other	Maintain territory year-round[9]
Food Habits	
Basic	Ground / litter forager
Primary Diet	Terrestrial arthropods; seeds[9]
Secondary Diet	Lizards [EO]

Confidence in Available Data: ●High ◑Moderate ○ Low

Le Conte's Thrasher

Toxostoma lecontei



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Le Conte's Thrasher

Toxostoma lecontei

Overview

Le Conte's Thrasher has a small geographical range within which it is patchily distributed at low densities. It occurs in low elevation (-75 – 500 m [-250 – 1600 ft]), sandy desert habitats, where it can survive and nest without any access to water.[8, 9] Home ranges are large and may encompass substantial movements within or across years.[8, 9] This thrasher is generally associated with nearly flat landscapes with short, open stands of scrublands with specific shrub components, such as saltbush, cholla (specifically *Cylindropuntia* spp. [EO]), prickly pear cactus, or yucca.[2, 4] Creosote bush is often present, but not in pure stands.[9] Mesquite-Acacia habitat is frequently inhabited, but only if these key shrub components are present. Based on anecdotal data, Le Conte's Thrasher appears to use mesquite stands that are not occupied by Crissal Thrasher.[8] Similarly, Le Conte's and Bendire's Thrashers also seem to partition habitat, with Le Conte's using areas where shrubs are less dense and lower than those used by Bendire's.[9] Interestingly, Le Conte's Thrasher is part of a nesting guild (including Cactus Wren and Loggerhead Shrike) that may compete for limited nest sites among thorny dense plants.[8] Therefore, areas that contain cholla or similarly desirable nesting substrates may be of particular conservation interest for this species. It has also been suggested (though not yet demonstrated) that Le Conte's Thrashers have substrate preferences for the sediments associated with ancient Pliestocene lakebeds.[EO]

Le Conte's Thrasher is an Evaluation Species under the Clark County MSHCP[1], but it is still insufficiently studied in Nevada. These thrashers are known to be sensitive to habitat disturbances and conversion[9], and they are at risk of declines (which have been substantial in the California desert)[10] because of their small population size and large home range requirements.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Mesquite-Acacia	50% (7/14)	3.3 (-2.0 – 8.6)
Mojave Scrub	32% (7/22)	1.3 (0.4 – 2.3)
Salt Desert	20% (2/10)	1.9 (0.0 – 3.9)
Joshua Tree	10% (2/20)	2.3 (-11.1 – 15.8)

Le Conte's Thrasher

Toxostoma lecontei

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)[4]

Although detected only on a small number of transects, a multivariate association with "Mesquite-Acacia" and "Barren" habitat was apparent (table below; note that as classified, Barren habitat often contained sparse cover of Mojave Scrub and Salt Desert shrubs). Raw NBC data suggest further that Le Conte's Thrashers are not dependent on large amounts of Mesquite vegetation itself, but rather are associated with some combination of Mojave Scrub, Salt Desert, and Barren habitat vegetation. Le Conte's Thrashers were detected farther from water than average, indicating that the bird does not require access to surface water.

Logistic Regression Summary

Habitat Type (Proportion w/in 200 m)	sign	p-value
Mojave Scrub	+	0.283
Mesquite-Acacia	+	**0.003**
Salt Desert Scrub	+	0.325
Barren	+	**0.001**
DISTANCE TO WATER	+	**0.015**

Fletcher Thesis[2]

Models based on 45 detections indicated that Le Conte's Thrashers occur within areas of little topographic relief such as valley bottoms near dry lake beds (playas). They were never observed on slopes greater than 5 degrees. There were strong positive associations with playas and saltbush assemblages (specifically, *Atriplex polycarpa* and *A. canescens*). Positive associations were also determined for three other plant assemblages: wash vegetation, cholla (*Cylindropuntia* spp.), and Mojave mixed scrub (dominated by *Yucca schidigera*). A predictive map was created that identified 4,000 km^2 [990,000 ac] of potentially suitable habitat within Clark County.

Main Threats and Challenges

Habitat Threats

- Due to their requirement for large home ranges, the Le Conte's Thrashers are sensitive to habitat fragmentation, degradation, or conversion stemming from a variety of disturbances, including development (urban, agricultural, or industrial), heavy OHV use, and fire[9]

Le Conte's Thrasher

Toxostoma lecontei

- Extended, late-summer livestock grazing is harmful to habitat[10]
- Of particular concern in southern Nevada are plans for developing large solar energy gathering facilities which could affect significant acreages of occupied habitat[EO]
- Invasive plants may degrade habitat, if they change the open habitat structure and fire frequency of a site
- Feral cats and dogs reduce nest success near human settlements[9]

Research, Planning, and Monitoring Challenges

- Le Conte's Thrashers are challenging for resource managers because they occur at low densities, have a small population size, and may be absent from large areas of seemingly suitable habitat



LeConte's Thrasher habitat in southern Nevada. Photo by Dawn Fletcher.

Le Conte's Thrasher

Toxostoma lecontei

Conservation Strategies

Habitat Strategies

- Salt Desert Scrub (p. Hab-18-1), Mojave Scrub (p. Hab-12-1), Mesquite-Acacia (p. Hab-10-1), and Joshua Tree (p. Hab-8-1) habitat conservation strategies benefit this species
- Specific areas that merit conservation attention [EO] include
    - Saltbush stands in vicinity of Corn Creek field station, Desert NWR (IBA candidate area)
    - Piute Valley between Searchlight and Cal-Nev-Ari
    - Valleys and washes between McCullough Range and Highland Mts., and between McCullough Range and Lucy Gray Mts.
- Protect occupied habitat at the recommended patch size from habitat conversion, energy development, and fire as much as possible
- Maintain corridors of suitable habitat at the recommended patch size between currently occupied areas
- Where development proceeds in or near occupied habitat, encourage contiguous rather than patchy development patterns to minimize habitat fragmentation
- Monitor and (if necessary) limit OHV use in occupied habitat
- Control invasive weeds in and near occupied habitat to reduce fire risk, wherever possible

Research, Planning, and Monitoring Strategies

- Inventory and map critical habitat
- Assess invasive weed, fire, land use, and energy development threats to critical habitat
- Estimate population losses to solar and wind development scenarios
- Improve monitoring efforts (especially during the early breeding season which is currently poorly monitored) and generate improved population size and trend estimates
- Investigate the possible role of substrate type in determining species distribution

Public Outreach Strategies

- Promote additional land protections for critical habitat
- Educate the public about the impacts of free-ranging cats in / near critical habitat

References: [1]Clark County (2000); [2]Fletcher (2009); [3]GBBO unpublished Atlas data; [4]GBBO unpublished NBC data; [5]Nevada Wildlife Action Plan Team (2006); [6]Rich et al. (2004); [7]Sauer et al. (2008); [8]Sheppard (1973); [9]Sheppard (1996); [10]Shuford and Gardali (2008); [EO] Expert opinion

Virginia's Warbler

Oreothlypis virginiae



Photo by Greg Scyphers

Habitat Use Profile

Habitats Used in Nevada	
Pinyon-Juniper Montane Shrubland Montane Riparian	
Key Habitat Parameters ◑	
Plant Composition	Montane shrubs, mountain mahogany, pinyon pine, juniper, willows, possibly aspen
Plant Density	Dense shrub layer, open woodlands; no quantitative information on plant density[4]
Mosaic	Steep brushy areas within or in proximity to open pinyon – juniper, mountain mahogany, or montane riparian woodlands[4]
Distance to Water	Unknown
Response to Vegetation Removal	Unknown
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	100 ha [250 ac] [EO]
Territory Size	0.8 – 2.3 ha [2 - 6 ac][4]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Insufficient knowledge of habitat requirements Unknown population trend Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S4B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ○	Limited information suggests stable trend rangewide, less certain in Nevada[5]
Population Size Estimates	
Nevada (NBC) ◑	8,200
Global ◑	410,000 [5]
Percent of Global	2%
Population Objective	
Maintain / Increase[4, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Brushy mid-elevations of central and eastern mountains
Restoration	Same

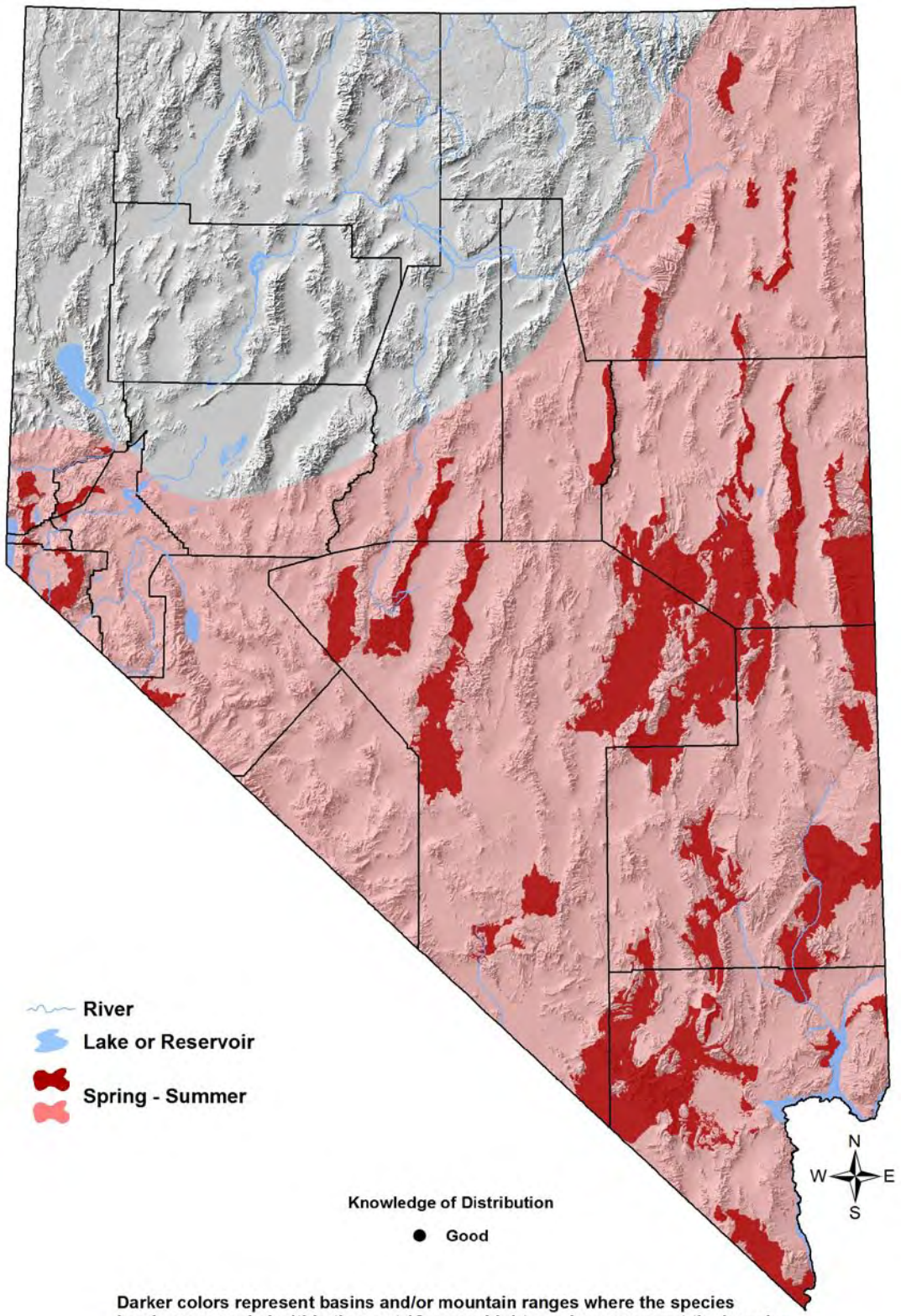
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late May – July[3]	
Nest and Nesting Habits	
Nest Placement	On ground under vegetation cover, often on slope[4]
Site Fidelity	Unknown
Food Habits	
Basic	Arboreal and shrub gleaner
Primary Diet	Terrestrial or flying arthropods[4]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Virginia's Warbler

Oreothlypis virginiae



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Virginia's Warbler

Oreothlypis virginiae

Overview

Virginia's Warbler is most often described as a breeder in pinyon-juniper and oak woodlands.[4] In Nevada, at the northwest periphery of its range, its habitat associations appear to be somewhat more complex. Most often, Virginia's Warbler are found on mid-elevation slopes with a mixture of dense brush and open woodland, but specific habitat parameters are not well quantified, and this warbler's patterns of occurrence and abundance cannot be adequately explained as a function of any single defined habitat type. In Colorado, it was found on steep slopes with large shrubs, lower tree canopy cover, high shrub diversity, and more habitat edge; [7] or, in another study, areas with many small and dense patches of shrubs, often with skunkbush and scattered juniper and pine.[1]

Because the Virginia's Warbler tends to occur at the interface of basins and ranges (i.e. foothills), its local distribution patterns are not well captured in the range map shown above, which misleadingly suggests that it is present in valley bottoms. Of potential importance in Nevada is the Virginia's Warbler's reported affinity for mountain mahogany stands,[EO] which is consistent with NBC data. It is not clear whether or not Virginia's Warblers benefit from proximity to water, or whether occasional reports of breeding in aspen woodlands in southern Nevada are representative or exceptional.

Virginia's Warblers arrive late on the breeding grounds (late April to early May), are patchily distributed throughout most of their range, and are often absent from apparently suitable habitat.[2] This patchy distribution, uncertainty about population trends, and the likelihood that specific habitat requirements exist that are not yet quantified, form the basis for conservation concern about this species.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Montane Riparian	5% (4/88)	1.4 (0.5 – 2.3)
Pinyon-Juniper	7% (5/70)	1.9 (0.9 – 2.9)
Mojave		
Montane Riparian	33% (3/9)	1.9 (0.0 – 3.8)
Montane Shrubland	38% (3/8)	1.2 (0.6 - 1.8)
Pinyon-Juniper	17% (2/12)	0.4 (n/a)

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

The strongest explanatory factors for Virginia's Warbler presence/abundance in logistic regression analysis (*Appendix 3*) were cover of mountain mahogany, pinyon-juniper

Virginia's Warbler

Oreothlypis virginiae

woodland, and coniferous forest. Montane riparian woodland may be important at the microhabitat scale, but was not significant in the analysis at the transect (i.e. landscape) scale. In the raw NBC data, presence of Pinyon-Juniper habitat was the most consistent property of transects on which Virginia's Warblers were present

Main Threats and Challenges

Habitat Threats

- Habitat threats have not been determined, but may include:[EO]
  - Grazing by livestock or wild horses and burros
  - Fire
  - Invasive plants
  - Residential development, especially in southern Nevada

Research, Planning, and Monitoring Challenges

- Lack of detailed knowledge of preferred habitat parameters, population trends, and habitat threats

Conservation Strategies

Habitat Strategies

- Pinyon-Juniper (p. Hab-16-1), Montane Shrubland (p. Hab-14-1), and Montane Riparian (p. Hab-13-1) habitat conservation strategies benefit this species
- Manage mid-elevation slopes in occupied range to favor the persistence of landscapes comprised of interspersed or adjoining patches of dense brush, montane riparian woodlands, pinyon-juniper woodland, and mountain mahogany

Research, Planning, and Monitoring Strategies

- Continue monitoring to better determine trends, occupancy patterns, and habitat associations
- Conduct additional study to better determine habitat preferences, including the possible importance of mountain mahogany and proximity to water, and the possible use of aspen habitat in southern Nevada

Public Outreach Strategies

- None identified

References: [1]Berry and Bock (1998); [2]Dobkin and Sauder (2004); [3]GBBO unpublished Atlas data; [4]Olson and Martin (1999); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]Sedgwick (1987); [EO]Expert opinion

Lucy's Warbler

Oreothlypus luciae



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Mojave Lowland Riparian Mesquite-Acacia (Springs)	
Key Habitat Parameters ◑	
Plant Composition	Riparian mesquite (especially honey mesquite), willow, Fremont cottonwood, saltcedar
Plant Density &Age	Dense mid-story, relatively sparse shrub understory; older stands of mesquite preferred, but unclear whether Lucy's Warblers use mature cottonwood gallery woodland[4, EO]
Mosaic	Prefers intact riparian mesquite, but also uses washes with old mesquite and saltcedar[3, EO]
Distance to Water	Always close to water but distance not quantified
Response to Vegetation Removal	Negative [EO]
Area Requirements ○	
Minimum Patch Size	Unknown, probably ~ 5 ha [12 ac][EO]
Recommended Patch Size	> 20 ha [50 ac] [EO]
Territory Size	Often < 0.5 ha [1.2 ac][3]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2S3B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ◑	Declines[3, 7]
Recent ○	Stable regionally, uncertain in Nevada[6]
Population Size Estimates	
Nevada (NBC) ◑	2,900
Global ◑	920,000 [5]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Muddy, Virgin, and Lower Colorado River corridors, Meadow Valley Wash, Ash Meadows NWR, Pahranagat Valley, Springs
Restoration	Same

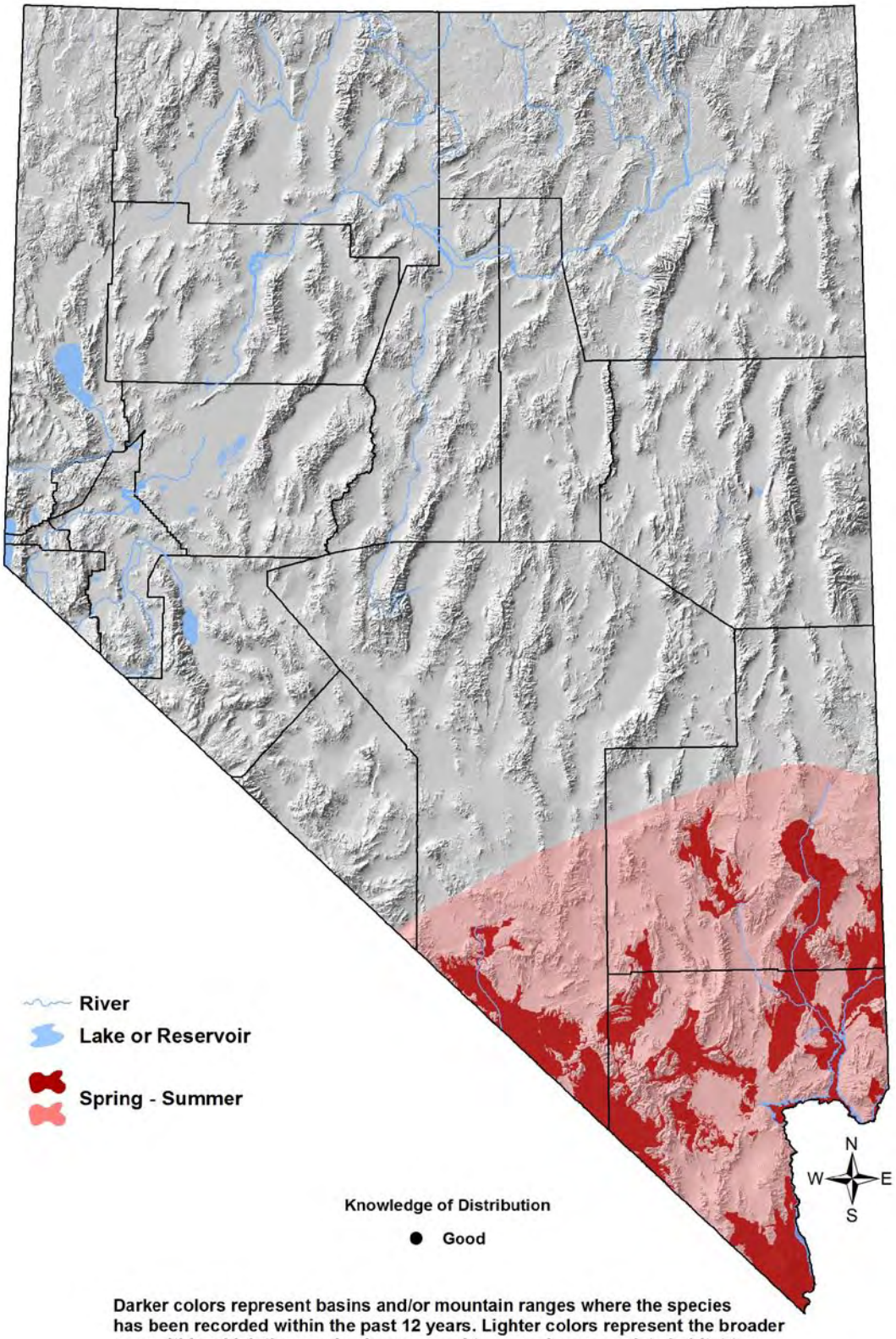
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Early March – early August[2]	
Nest and Nesting Habits	
Nest Placement	Pre-existing cavities and cavity-like crevices (under peeling bark) 1 – 6 m [3 – 20 ft] above ground in large trees[3]
Site Fidelity	Unknown, probably high for breeding territory[EO]
Food Habits	
Basic	Foliage gleaner
Primary Diet	Arthropods[3]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Lucy's Warbler

Oreothlypus luciae



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Lucy's Warbler

Oreothlypus luciae

Overview

Lucy's Warbler is one of several Conservation Priority Species covered in this plan with a restricted southwestern geographical range that includes southern Nevada. Unlike the other representatives of this group, however, Lucy's Warbler can occur in particularly high densities within its preferred habitat. This unusual cavity-nesting warbler prefers dense riparian mesquite woodlands (especially honey mesquite) with older, larger trees for nesting.[3] Nest cavities are either created by woodpeckers or provided by peeling bark or other structural fissures within tree trunks. Cottonwood and willow woodlands with a relatively open understory are also suitable for Lucy's Warblers, as are non-riparian mesquite-acacia stands in seasonal washes.[4] However, breeding densities are generally lower as the distance from permanent water increases.

Many areas formerly occupied by native riparian woodlands are now dominated by saltcedar. As is the case with several other Mojave lowland riparian birds, Lucy's Warblers now make use of saltcedar habitat for nesting, presenting a potential dilemma to resource managers wishing to restore native vegetation. Complete removal of saltcedar without creating suitable native habitats afterwards may leave Lucy's Warbler without suitable habitat within a treatment area. Lucy's Warbler's use of saltcedar and dry washes suggests that they may be relatively resilient to the effects of groundwater depletion, but further loss of its preferred native riparian habitat would still be detrimental.[1]

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Lowland Riparian	86% (31/36)	6.1 (4.3 – 7.9)
Mesquite - Acacia	43% (6/14)	6.3 (-2.2 – 14.8)

Note: Lowland Riparian habitat as defined by the NBC includes mesquite – acacia habitat occurring within the riparian zone. Mesquite-Acacia refers exclusively to non-riparian stands of mesquite-acacia

- Densities up to 25 birds / ha [10 / ac] have been reported in optimal habitat[3]

Nevada-Specific Studies and Analyses

Landscape Associations (NBC Data)

Nearly all NBC transects with significant numbers of Lucy's Warblers had at least some Mojave Lowland Riparian habitat, including mesquite, present. The presence of this habitat type was the strongest explanatory factor for Lucy's Warbler abundance in the logistic regression model (*Appendix 3*). Transects closer to water also had significantly more Lucy's Warblers than those at greater distances from water. Mesquite-Acacia habitat (comprised exclusively of non-riparian mesquite stands) was also an important predictive variable after controlling for Lowland Riparian habitat.

Lucy's Warbler

Oreothlypus luciae

Main Threats and Challenges

Habitat Threats

- Loss or degradation of native riparian habitat (including mesquite) due to
  - Wood-cutting
  - Fire
  - Water diversions
  - Invasive plants
  - Recreational activities
- Loss of saltcedar habitat during restoration efforts, unless suitable restored habitat becomes available shortly after removal

Research, Planning, and Monitoring Challenges

- None identified

Conservation Strategies

Habitat Strategies

- Mojave Lowland Riparian (p. Hab-11-1) and Mesquite–Acacia (p. Hab-10-1) habitat conservation strategies benefit this species
- Protect mature mesquite stands and intact lowland riparian woodlands
- Restore native riparian woodlands (including mesquite), but do not remove large expanses of saltcedar within a short time frame; instead, stagger restoration spatially and temporally so that suitable new habitat can be created as saltcedar is removed

Research, Planning, and Monitoring Strategies

- Continue monitoring to better determine population size and trends
- Collect additional information on microhabitats selected
- Develop fire management and suppression priorities that favor the long-term persistence of mature riparian and mesquite woodlands

Public Outreach Strategies

- None identified

References: [1]Brand et al. (2010a); [2]GBBO unpublished Atlas data; [3]Johnson et al. (1997); [4]Meents et al. (1984); [5]Rich et al. (2004); [7]Sauer et al. (2008); [8]Shuford and Gardali (2008); [EO] Expert opinion

Hermit Warbler

Dendroica occidentalis



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest	
Key Habitat Parameters ◑	
Plant Composition	Douglas fir, Jeffrey, ponderosa, and lodgepole pines, incense cedar, red fir
Plant Density	Closed-canopy stands preferred; understory apparently unimportant; typical foraging height 30 m [100 ft][4]
Mosaic	Largely unknown; prefers mid to late successional forests; avoids clearings and edges[4]
Distance to Water	No known relationship
Response to Vegetation Removal	Negative [EO]
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	> 50 ha [125 ac] [EO]
Home Range	0.35 ha [0.9 ac][4]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Restricted habitat Unknown population trend	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ○	Stable in core of range, uncertain in Nevada[6]
Population Size Estimates	
Nevada (NBC) ◑	140
Global ◑	2,400,000 [5]
Percent of Global	< 1%
Population Objective	
Maintain / Increase[5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Fair
Key Conservation Areas	
Protection	Carson Range
Restoration	Carson Range

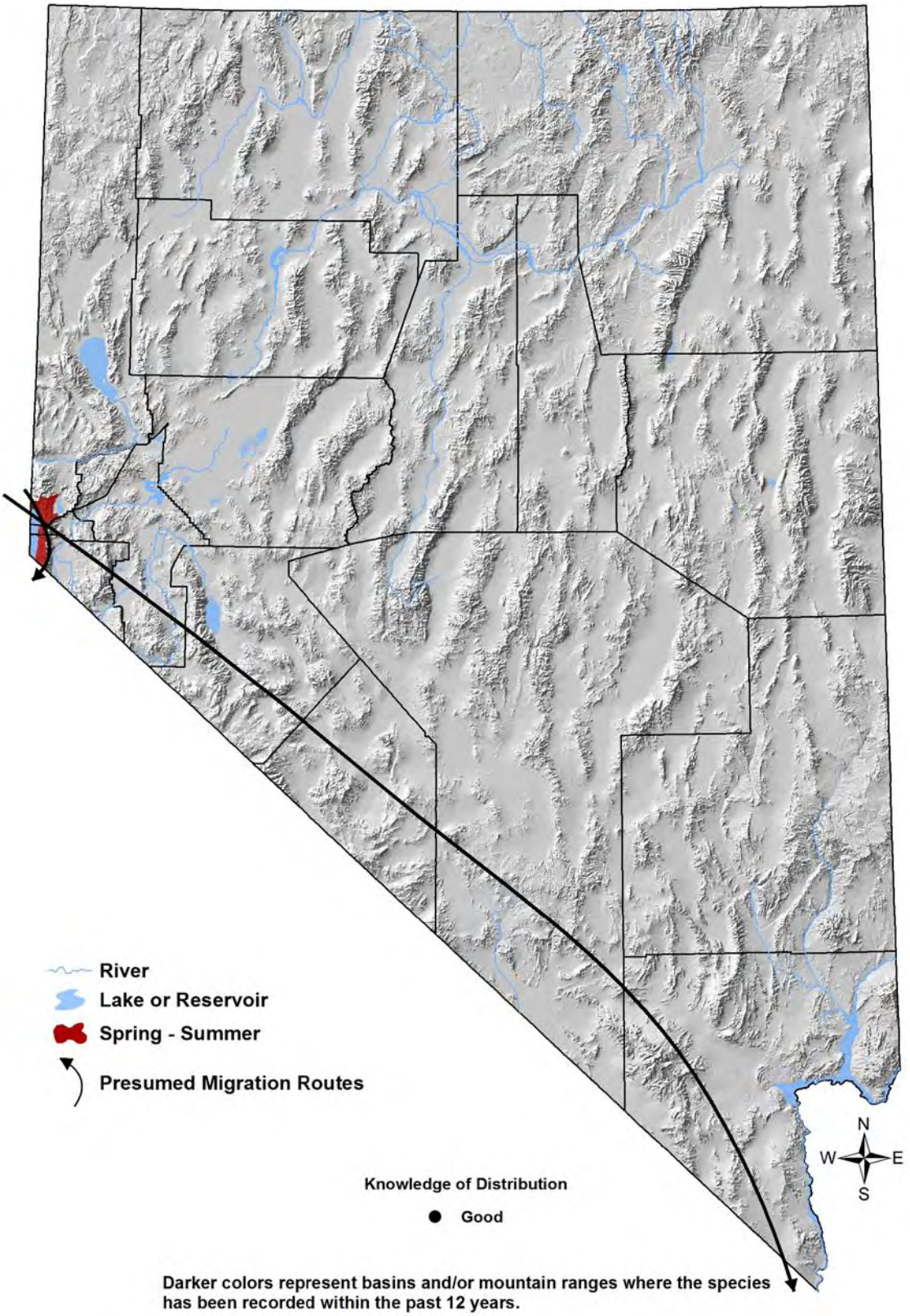
Natural History Profile

Seasonal Presence in Nevada	
Spring - Summer	
Known Breeding Dates in Nevada	
Mid-April – July[4]	
Nest and Nesting Habits	
Nest Placement	In live, dense conifer branch ≤ 7 m [23 ft] high;[4] no nests yet found in Nevada
Site Fidelity	Unknown
Food Habits	
Basic	Arboreal (canopy) gleaner
Primary Diet	Terrestrial arthropods[4]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Hermit Warbler

Dendroica occidentalis



Hermit Warbler

Dendroica occidentalis

Overview

Hermit Warblers breed in montane coniferous forests in the Pacific Northwest and the northern and central Sierra Nevada. Nevada's breeding population in the Carson Range is small and located at the periphery of the species geographical range. The Hermit Warbler is one of our very few presumed breeding birds for which a nest has yet to be located, due to its highly secretive nesting habits.

Hermit Warblers require large tracts of mature coniferous forest. They apparently tolerate moderate forest thinning or removal of trees in small patches,[7] but extensive thinning that creates a large amount of habitat edge is detrimental.[4] Likewise, stand-replacement fires will decrease the habitat suitability for Hermit Warblers.[2] It has also been shown to be negatively affected by development in the Lake Tahoe Basin.[3] Unlike most other warblers, this species rarely uses hardwood stands.[1] In July, after breeding is completed, Hermit Warblers often migrate upwards in elevation in small flocks that persist until the initiation of fall migration.[4]

The greatest needs for this species are to conserve larger tracts of mature coniferous forest in the Carson Range, and to expand monitoring efforts to better determine its population and conservation status.

Abundance and Occupancy by Habitat

- In some areas west of the Sierra crest, Hermit Warblers can be the most abundant bird species detected in some forests, with densities reported from 40 – 70 birds / 40 ha [0.4 – 0.7 / ac][4]

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Habitat threats have not been determined; possible threats include forest fragmentation due to fire, disease, or residential development

Hermit Warbler

Dendroica occidentalis

Research, Planning, and Monitoring Challenges

- Lack of specific knowledge about habitat requirements, area requirements, population trends, or threats in Nevada
- Secretive habits, dense habitat, and small numbers make the species more difficult to monitor than most other songbirds

Conservation Strategies

Habitat Strategies

- The Coniferous Forest (p. Hab-5-1) habitat conservation strategy benefits this species
- Protect and conserve mature coniferous forest in the Carson Range, with focus on closed-canopy stands of > 50 ha [125 ac]

Research, Planning, and Monitoring Strategies

- Increase monitoring coverage in the Carson Range to better determine population status and trends, and attempt to locate nests and quantify nesting microhabitat
- Determine minimum patch size requirements and preferred forest mosaic
- Conduct studies to determine Hermit Warbler response to forest thinning / fuel reduction
- Develop a fire management plan that promotes the long-term conservation of the Hermit Warbler's preferred forest type

Public Outreach Strategies

- None identified

References: [1]Airola and Barrett (1985); [3]Fontaine et al. (2009); [3]Manley et al. (2007); [4]Pearson (1997); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]Siegel and DeSante (2003); [EO]Expert opinion

Grace's Warbler

Dendroica graciae

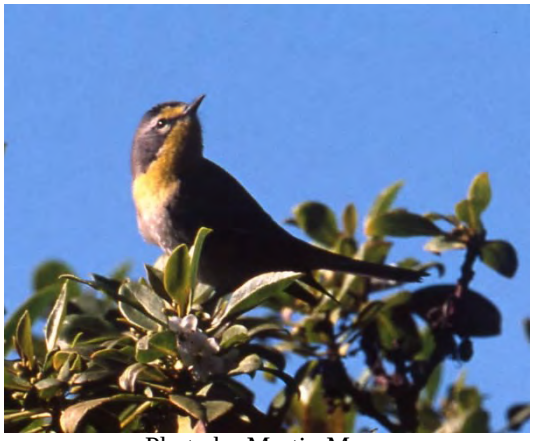


Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Coniferous Forest (Montane Riparian)	
Key Habitat Parameters ●	
Plant Composition	Ponderosa pine, white fir, bristlecone pine, juniper, pinyon pine
Plant Density	Park-like stands with 14 - 46 m [46 – 150 ft] spacing between large trees; average 46% canopy closure, ~ 911 trees / ha [370 / ac], 80 snags / ha [32 / ac][7]
Mosaic	Trees of mixed age and size classes[6]
Slope, Aspect	Average 10%, north or east[7]
Distance to Water	Available information is contradictory[7, EO]
Response to Vegetation Removal	Positive to thinning of overgrown stands, negative to complete removal [EO]
Area Requirements ◑	
Minimum Patch Size	Unknown, but assumed to require large area [EO]
Recommended Patch Size	100 ha [250 ac] [EO]
Territory Size	1 – 6.25 ha [2.5 - 15 ac][7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Restricted habitat Possible habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S2B
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown[6]
Recent ◑	Stable or slowly declining[6, 7]
Population Size Estimates	
Nevada (NBC) ◑	610
Global ◑	1,000,000 [4]
Percent of Global	< 1%
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good / Fair
Key Conservation Areas	
Protection	Spring Mountains, Sheep Range, Clover Mountains
Restoration	Same

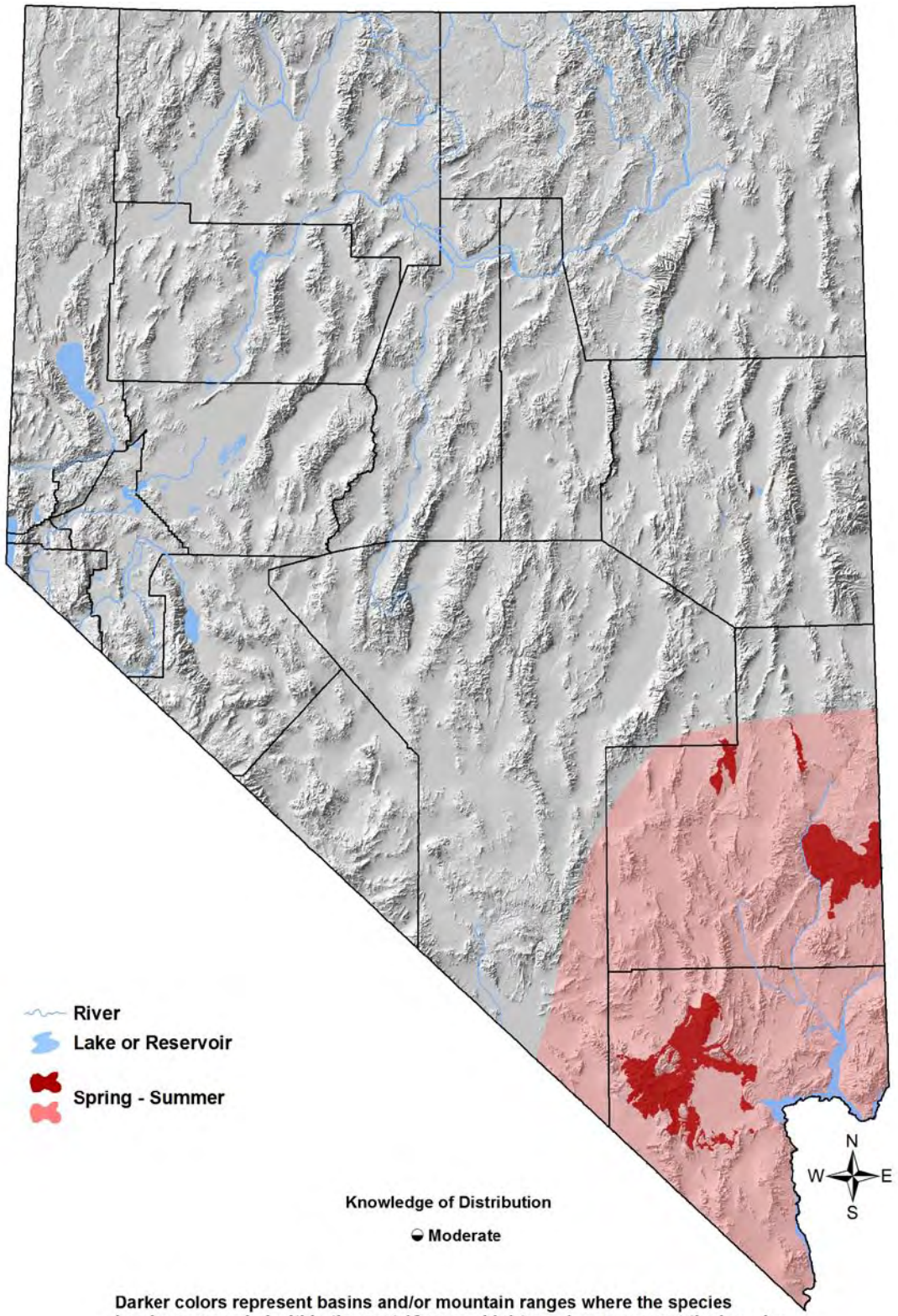
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late April – late July[1, EO]	
Nest and Nesting Habits	
Nest Placement	In live conifer branch, 6 - 18 m [20 – 60 ft] off ground[7]
Site Fidelity	Unknown
Food Habits	
Basic	Arboreal gleaner
Primary Diet	Arboreal arthropods[7]
Secondary Diet	n/a

Confidence in Available Data: ●High ◑Moderate ○ Low

Grace's Warbler

Dendroica graciae



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Grace's Warbler

Dendroica graciae

Overview

Grace's Warblers may have reached southern Nevada only during the last 50 years as the result of a northward range expansion.[2] They are still not very numerous in the state, and exhibit substantial annual variation in numbers.[7] Grace's Warblers are largely restricted to ponderosa pine forests with tall trees, but beyond this, many aspects of their habitat needs and conservation status have not been well characterized, particularly in Nevada.[7] The species has been documented in a relatively small number of mountain ranges, and additional work needs to be done to determine whether Grace's Warblers breed in other southern ranges that provide appropriate habitat.

The response of Grace's Warbler to fire will depend on both severity and spatial scale of the disturbance as well as pre-fire forest structure. In general, low-severity fires that help maintain open pine forest structure should be beneficial, and high-severity fires that threaten the limited ponderosa pine forests in Nevada should be detrimental. However, studies of the effect of moderate to severe fire in Arizona are ambiguous.[3, 5] More study is required to identify the most beneficial fire management practices Although the PIF continental population objective for the species is to increase numbers by 50%,[3] maintaining current numbers in Nevada is a more reasonable goal given the limited opportunities for creating new habitat.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Coniferous Forest	75% (3/4)	1.1 (0.8 – 1.4)
Montane Riparian	22% (2/9)	1.0 (n/a)

Nevada-Specific Studies and Analyses

No information

Main Threats and Challenges

Habitat Threats

- Threats are poorly known.[7] Issues of possible concern include:
  - Loss of park-like ponderosa pine forests to large, intense fires
  - Loss of surface water sources within forests due to diversions or plugging of springheads
  - Urban encroachment in the Spring Mountains
  - Outbreaks of conifer pathogens and insects causing forest degradation

Grace's Warbler

Dendroica graciae

Research, Planning, and Monitoring Challenges

- Uncertainty about distribution, population size, trends, and conservation threats
- Uncertainty about most appropriate fire management strategies
- The possible importance of montane riparian habitat and proximity of water needs clarification

Conservation Strategies

Habitat Strategies

- The Coniferous Forest (p. Hab-5-1) habitat conservation strategies benefit this species
- Maintain ponderosa pine forests in occupied range (especially in the Key Conservation Areas, see above) in healthy condition with multiple age classes, large trees, and adequate regeneration
- Moderate silvicultural thinning to open forest structure can be beneficial if existing forest tree density is high[7]

Research, Planning, and Monitoring Strategies

- Continue current monitoring to better document trends and population size
- Investigate other possible breeding locations within potential breeding range (see map above), including the Virgin, Hiko, and Grant ranges
- Determine fire management rules to benefit the species and promote long term persistence of healthy ponderosa pine forests
- Conduct research to determine whether availability of montane riparian habitat and water sources are important to Grace's Warblers
- Assuming that water sources are beneficial, protect or restore springheads in the Spring Mountains and Sheep Range

Public Outreach Strategies

- None identified

References: [1]GBBO unpublished Atlas data; [2]Johnson (1994); [3]Kirkpatrick et al. (2006); [4]Rich et al. (2004); [5]Saab et al. (2007); [6]Sauer et al. (2008); [7]Stacier and Guzy (2002); [EO] Expert opinion

Green-tailed Towhee

Pipilo chlorurus



Photo by Bob Goodman

Habitat Use Profile

Habitats Used in Nevada	
Montane Shrubland Aspen Pinyon-Juniper Montane Riparian	
Key Habitat Parameters ●	
Plant Composition	Aspen, currants, willows, alder, sagebrush, squawbush, other montane riparian and transitional shrubs; high species richness of shrubs preferred[3]
Plant Density & Height	High density shrub cover, 0.5 – 1.5 m [1.6 – 5 ft] tall[1]
Mosaic	Patches of different montane shrub species[1, 3]
Distance to Water	Water or mesic habitats usually within 1 km [0.6 mi][3]
Response to Vegetation Removal	Positive in coniferous forest canopy, if shrub layer benefits; negative for shrub removal[1]
Area Requirements ◑	
Minimum Patch Size	Unknown
Recommended Patch Size	> 10 ha (22 ac) [EO]
Territory Size	Averages 0.9 ha [2.2 ac][1]

Conservation Profile

Priority Status	
Stewardship Species	
Species Concerns	
High stewardship responsibility Historical declines	
Other Rankings	
Continental PIF	Stewardship
Audubon Watchlist	None
NV Natural Heritage	None
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Stewardship
Trends	
Historical ◑	Probable declines[1]
Recent ○	Stable[1, 8]
Population Size Estimates	
Nevada (NBC) ◑	885,000
Global ◑	4,100,000 [7]
Percent of Global	22%
Population Objective	
Maintain [7, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Great Basin montane riparian, aspen, montane shrubland habitat
Restoration	Great Basin montane riparian and aspen woodlands

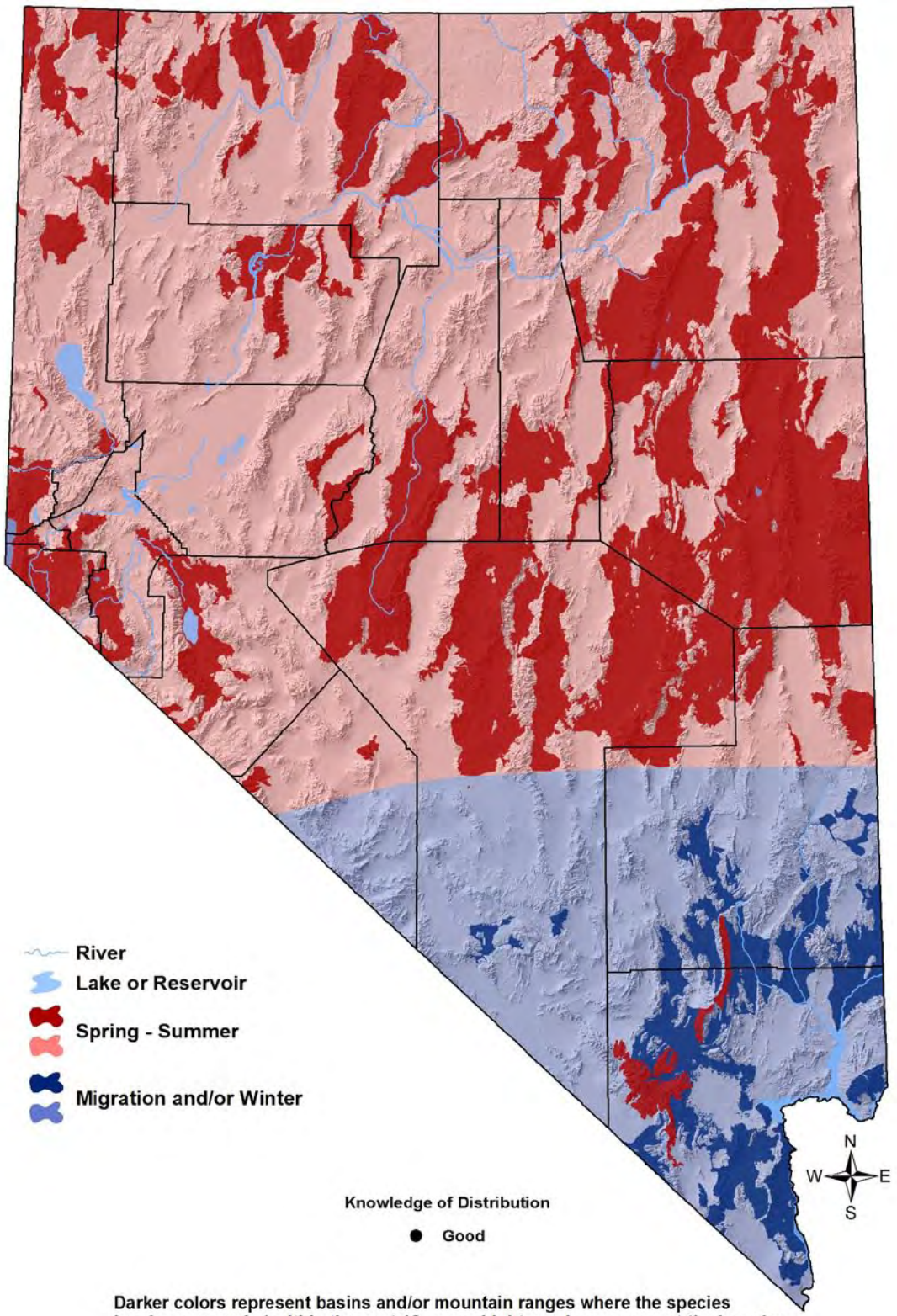
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (Great Basin) Winter (Mojave)	
Known Breeding Dates in Nevada	
Mid-May – early August[2]	
Nest and Nesting Habits	
Nest Placement	On or within 1 m [3 ft] of ground in or under dense shrub[1]
Site Fidelity	Moderate for breeding territory[1]
Food Habits	
Basic	Ground or near-ground forager
Primary Diet	Terrestrial arthropods, seeds[1]
Secondary Diet	Fruit [1]

Confidence in Available Data: ●High ◑Moderate ○ Low

Green-tailed Towhee

Pipilo chlorurus



Green-tailed Towhee

Pipilo chlorurus

Overview

The Green-tailed Towhee is nearly always found within dense shrub cover in montane settings, especially in transitional zones that feature high shrub species diversity, interspersed trees, and a high proportion of edge habitat. As such, this bird's distribution patterns do not neatly align with standard habitat type categories. For instance, favored habitat in northwestern Nevada has been described as ecotones between "sagebrush and other shrub species, especially mountain mahogany",[6] whereas in southeastern Oregon, Green-tailed Towhees were shown to prefer intermediate levels of juniper cover.[6] Green-tailed Towhees were recorded on many different NBC-defined habitat types, as shown in the table below.

Beyond the general preference for dense, diverse cover of montane shrubs, there is surprisingly little detailed information about habitat use of Green-tailed Towhees, especially given that the species is widespread and relatively common. Nevada, as the home of about one-fifth of the global breeding population, therefore has an opportunity to make significant contributions to our knowledge about this bird and to its conservation. Fortunately, current trends appear to be stable, and habitat threats to montane shrublands appear overall less severe than for many other habitat types.

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Montane Shrubland	75% (15/20)	8.6 (4.8 – 12.4)
Montane Riparian	57% (50/88)	4.7 (3.5 – 5.9)
Aspen	83% (15/18)	5.9 (3.8 – 8.0)
Coniferous Forest	47% (9/19)	2.1 (0.0 – 4.4)
Pinyon-Juniper	59% (41/70)	6.6 (4.9 – 8.3)
Mojave		
Montane Shrubland	75% (6/8)	5.1 (0.0 – 13.8)
Montane Riparian	67% (6/9)	0.3 (0.1 – 0.5)
Aspen	86% (6/7)	3.6 (2.0 – 5.2)
Coniferous Forest	75% (3/4)	3.2 (2.6 – 3.8)
Pinyon-Juniper	58% (7/12)	0.9 (0.3 – 1.5)

Green-tailed Towhee

Pipilo chlorurus

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

Green-tailed Towhees had positive associations (*Appendix 3*) with several different habitat types that often contain dense shrub layers, including Montane Shrubland, Pinyon-Juniper, Mountain Mahogany (an NBC-defined habitat type, and subset of Pinyon-Juniper habitat as defined in this plan), Montane Riparian, and Aspen. As in other parts of its range, Green-tailed Towhees appear to use openings in coniferous forests in Nevada, although their density in such settings is usually lower than in other montane habitat types. Green-tailed Towhees were somewhat more common on transects closer to water, and were most numerous on transects characterized by a diversity of available habitat types.

Main Threats and Challenges

Habitat Threats

- Historically, loss of shrublands is thought to have reduced Green-tailed Towhee numbers, but current threats are not well characterized[1]
- Reduction in fire return intervals due to fire suppression may have reduced landscape complexity and diversity in the long-term, but prescribed fire has been shown to have a negative effect on Green-tailed Towhees for at least five years after the initial fire[4]
- Heavy grazing or browsing that reduces shrub cover or diversity may negatively impact this bird

Research, Planning, and Monitoring Challenges

- Substantial additional research is needed to better defined this species' microhabitat preferences, and to quantify its preferred landscape mosaic
- Additional studies are needed to determine the nature and severity of any current habitat threats
- Additional research is needed to determine the most beneficial long-term fire regime for diverse montane shrubland systems, and to develop a fire-management plan that incorporates these findings

Green-tailed Towhee

Pipilo chlorurus

Conservation Strategies

Habitat Strategies

- Montane Shrubland (p. Hab-14-1), Montane Riparian (p. Hab-13-1), Aspen (p. Hab-3-1), and Pinyon-Juniper (p. Hab-16-1) habitat conservation strategies benefit this species
- Conserve and protect montane areas with diverse, dense shrubs and interspersion of habitat types
- Manage livestock grazing to maintain dense shrub layers within Aspen and Montane Riparian habitats

Research, Planning, and Monitoring Strategies

- Continue monitoring to detect any changes from current population stability
- Conduct research to:
    - Better determine microhabitat preferences and quantify preferred landscape mosaic
    - Further investigate possible habitat threats
    - Identify preferred fire regime for montane shrubland systems to maintain long-term shrub and habitat diversity

Public Outreach Strategies

- None identified

References: [1]Dobbs et al. (1998); [2]GBBO unpublished Atlas data; [3]GBBO unpublished NBC data; [4]Jehle et al. (2006); [5]Knopf et al. (1990); [6]Noson et al. (2006); [7]Rich et al. (2004); [2]Sauer et al. (2008); [EO] Expert opinion

Green-tailed Towhee

Pipilo chlorurus



Green-tailed Towhee habitat in western Nevada. Photo by Elisabeth Ammon.

Abert's Towhee

Melozone aberti



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Mojave Lowland Riparian Mesquite-Acacia Springs (Agriculture)	
Key Habitat Parameters ◑	
Plant Composition	Willow, cottonwood, mesquite, acacia, saltcedar, quailbush, and other dense, mesic or semi-mesic shrubs and small trees[7]
Plant Density	Dense shrub and forb/grass cover
Mosaic	No known landscape mosaic requirements
Distance to Water	Most abundant close to water [EO]
Response to Vegetation Removal	Negative to shrub/understory removal[7]
Area Requirements ○	
Minimum Patch Size	Unknown, estimated 3 ha [7 ac] [EO]
Recommended Patch Size	> 20 ha [50 ac] [EO]
Territory Size	1.2 ha [3.0 ac][7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical declines Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S3
USFWS	Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines[7]
Recent ●	Stable[6]
Population Size Estimates	
Nevada (NBC) ◑	2,300
Global ◑	210,000 [5]
Percent of Global	1%
Population Objective	
Maintain / Increase [5, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Muddy and Virgin Rivers, Mesquite-Acacia washes
Restoration	Muddy and Virgin Rivers, Springs

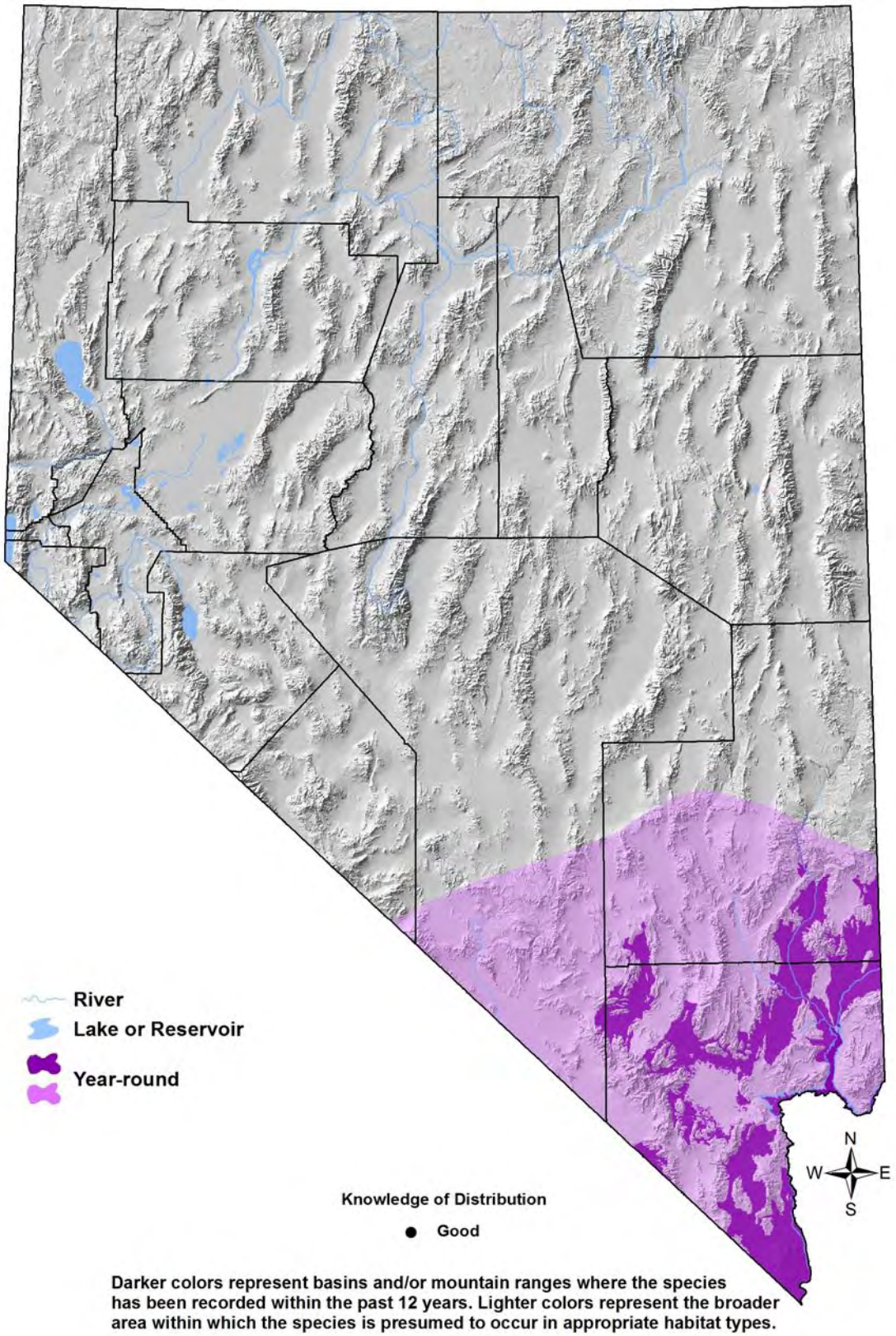
Natural History Profile

Seasonal Presence in Nevada	
Year-round	
Known Breeding Dates in Nevada	
Early April – early August[2]	
Nest and Nesting Habits	
Nest Placement	In dense shrub or tree, 1.5-2.5 m [4.9 – 8.2 ft] above ground[7]
Site Fidelity	High; species is sedentary with year-round residency
Other	Usually nests near water[7]
Food Habits	
Basic	Ground / litter forager
Primary Diet	Invertebrates[7]
Secondary Diet	Seeds, especially outside the breeding season[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Abert's Towhee

Melozone aberti



Abert's Towhee

Melozone aberti

Overview

In southern Nevada, Abert's Towhees occur in dense, shrubby riparian vegetation up to 1,300 m [4,300 ft] in elevation,[7] and are especially numerous in the Colorado, Muddy, and Virgin River Valleys, and in the Las Vegas Wash. They also occur in smaller riparian and spring areas, Mesquite-Acacia washes characterized by dense understory, and in some agricultural lands.

Ideal habitat is characterized by high foliage density at the shrub and ground level, presence of cottonwoods and willows, and nearby water.[4] However, like several other southern Nevada riparian birds, Abert's Towhee has adapted to saltcedar stands in areas where native riparian vegetation has been lost or severely degraded. In such cases, it is important that efforts to restore native vegetation avoid removing large saltcedar stands very rapidly. Restoration should instead occur in a stepwise manner to ensure that a significant amount of usable habitat is always present in the project area. Unintended defoliation of saltcedar by biocontrol agents (see Willow Flycatcher account for details, pp. Spp-59-1) poses similar risks. Fortunately, Abert's Towhee responds very well to most riparian restoration efforts, including those that target Southwestern Willow Flycatcher.[7] For example, densities of Abert's Towhees doubled on the San Pedro River in Arizona only three years after cattle were removed to allow for recovery of riparian shrubs and ground covers.[3]

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Lowland Riparian	50% (18/36)	5.3 (3.3 – 7.3)
Agriculture	80% (4/5)	2.6 (0.6 – 4.6)
Mesquite-Acacia	14% (2/14)	0.5 (n/a)

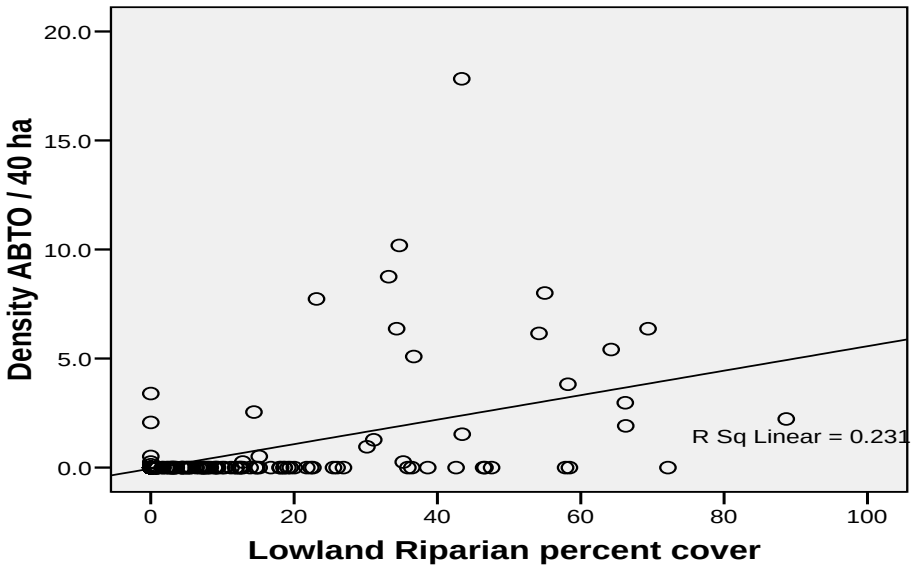
Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

The density of Abert's Towhee was statistically related to the amount of Lowland Riparian habitat present within survey transects (see figure below). Strong correlations were also found with the amount of Agricultural habitat present and the proximity to water (*Appendix 3*).

Abert's Towhee

Melozone aberti



Main Threats and Challenges

Habitat Threats

- Heavy livestock grazing that significantly reduces foliage density in the shrub and ground cover layers [EO]
- Water diversions or groundwater pumping that lower water tables and reduce density of native riparian shrubs, forbs, and grasses.[EO] Saltcedar is more resistant to these impacts[1]
- Flood control and other channel engineering activity that physically damage habitat or alter hydrology [EO]
- Removal of large areas of saltcedar without revegetation efforts of native riparian habitat
- Loss of habitat to fire

Research, Planning, and Monitoring Challenges

- Patch size and landscape mosaic preferences are not well characterized
- Factors promoting the use of agricultural lands and mesquite-acacia washes are not explicitly known, although foliage density of understory and ground cover is important

Abert's Towhee

Melozone aberti

Conservation Strategies

Habitat Strategies

- Mojave Lowland Riparian (p. Hab-11-1), Mesquite-Acacia (p. Hab-10-1), and Springs (p. Hab-19-1) habitat conservation strategies benefit this species
- Manage livestock grazing and other land uses to maintain dense riparian shrub and ground cover
- Pursue restoration of native riparian habitat in suitable areas, such as Las Vegas Wash and other revegetation projects. Where saltcedar is removed, ensure that native habitat is restored in a timely manner

Research, Planning, and Monitoring Strategies

- In situations where water diversions or groundwater pumping may lower water tables or impact riparian shrubs, monitor for impacts on Abert's Towhees
- Develop fire management strategies that emphasize the protection of native riparian habitat
- Conduct additional research on the factors that promote Abert's Towhee use of agricultural lands and mesquite-acacia habitat

Public Outreach Strategies

- None identified

References: [1]Brand et al. (2010); [2]GBBO unpublished Atlas data; [3]Krueper et al. (2003); [4]Meents et al. (1981); [5]Rich et al. (2004); [6]Sauer et al. (2008); [7]Tweit and Finch (1994); [EO]Expert opinion

Abert's Towhee

Melozone aberti



Mojave Lowland Riparian Habitat. Photo by Jen Ballard.

Brewer's Sparrow

Spizella breweri



Photo by Jacque Lowery

Habitat Use Profile

Habitats Used in Nevada	
Montane Shrubland (primarily montane sagebrush) Sagebrush Salt Desert Scrub	
Key Habitat Parameters ●	
Plant Composition	Sagebrush, greasewood, perennial upland grasses
Plant Density & Size	High shrub density preferred, shrub canopy height usually < 1.5 m [5 ft][9]
Mosaic	Bare ground avoided[9]
Distance to Water	More likely to be present < 1 km [0.6 mi] from water[3]
Response to Vegetation Removal	Negative to all reduction in plant cover[9]
Area Requirements ◑	
Minimum Patch Size	Unknown; estimated at 20 ha [50 ac][EO]
Recommended Patch Size	> 150 ha [370 ac][EO]
Territory Size	0.5-2.4 ha [1.2 – 5.9 ac][9]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and recent declines Habitat threats High stewardship responsibility	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Yellow
NV Natural Heritage	S4B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines since 1968 [9, 10]
Recent ●	Declines of 2% / year across West[10]
Population Size Estimates	
Nevada (NBC) ◑	7,400,000
Global ◑	16,000,000 [8]
Percent of Global	> 40%
Population Objective	
Increase by 20% [EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Montane shrubland and high-quality sagebrush in Great Basin
Restoration	Degraded sagebrush, particularly if close to water

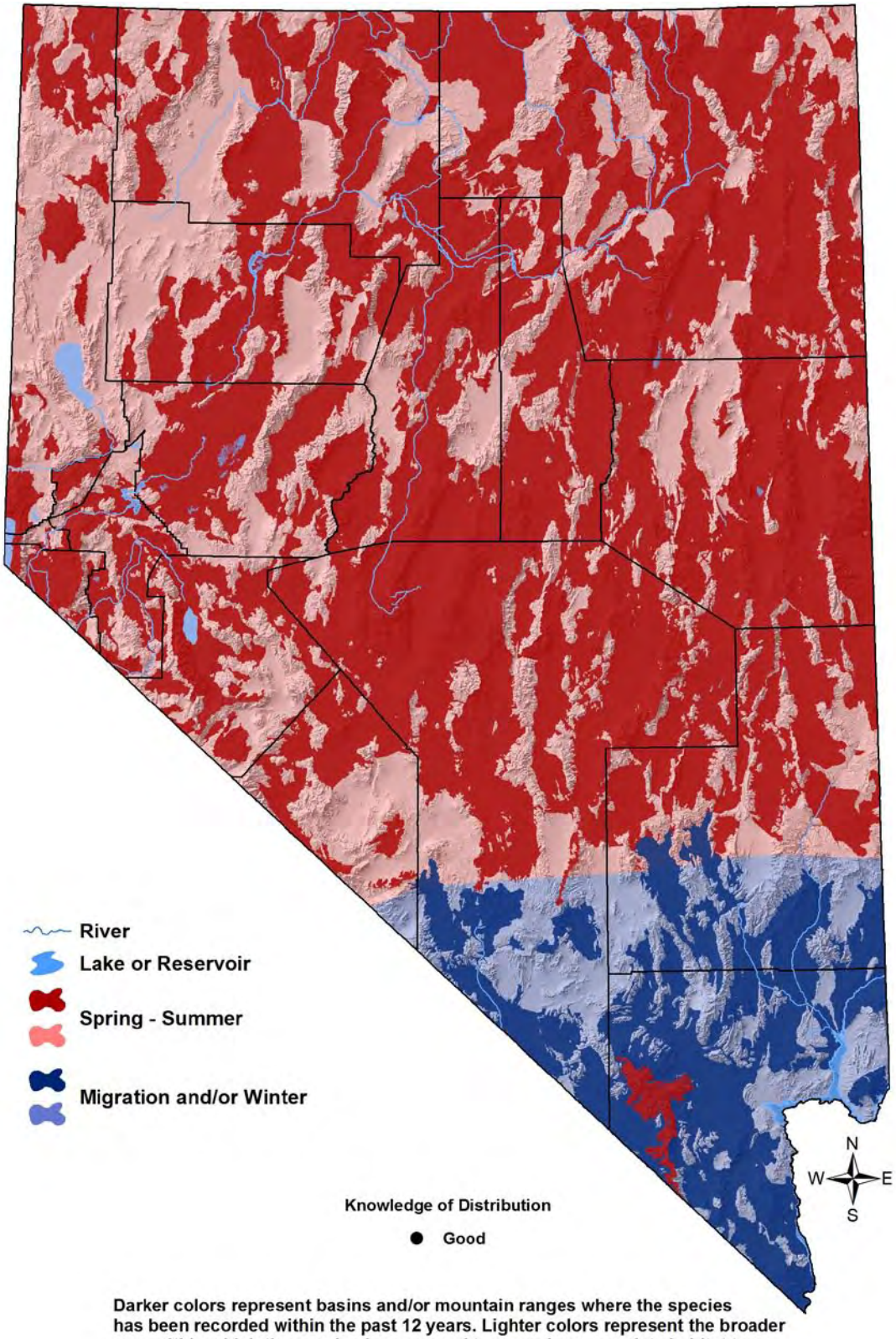
Natural History Profile

Seasonal Presence in Nevada	
Spring-Summer (Great Basin) Winter (Mojave)	
Known Breeding Dates in Nevada	
Mid April – early August[2]	
Nest and Nesting Habits	
Nest Placement	In dense crown of tall shrub, about 0.7 m [2.3 ft] off-ground[9]
Site Fidelity	Moderate for breeding territory[9]
Food Habits	
Basic	Shrub gleaner and forager
Primary Diet	Insects within shrub layer[9]
Secondary Diet	Small seeds[9]

Confidence in Available Data: ●High ◑Moderate ○ Low

Brewer's Sparrow

Spizella breweri



Brewer's Sparrow

Spizella breweri

Overview

One of Nevada's most widely distributed and abundant birds,[1] the Brewer's Sparrow is nonetheless a conservation concern due to ongoing regional and rangewide declines,[10] along with the fact that Nevada hosts approximately 40% of the global breeding population. The Nevada Bird Count and Nevada Breeding Bird Atlas project extended the Brewer's Sparrow's confirmed breeding range to southern Nevada, although it is far more abundant in the Great Basin portion of the state. Brewer's Sparrows are attracted to sagebrush in many different settings, not only within the relatively monotypic "sagebrush sea" of the valley floors.[5] For instance, NBC data indicate that Brewer's Sparrows have especially high breeding densities in montane sagebrush (which occurs within the NBC-defined Montane Shrubland habitat type),[3] and they even occur in sagebrush-dotted meadows that are embedded within conifer forest zones, provided that the meadows are not highly isolated.[12] Proximity to forest edge, however, appears to increase the potential for nest predation, and Brewer's Sparrow densities and nest success rates are consequently highest in treeless areas.[6]

Although the Brewer's Sparrow uses a wider variety of landscapes and is probably less sensitive to fragmentation than the Sage Sparrow,[5] the species is still most abundant in relatively large habitat patches, and it is negatively affected by the widespread loss and degradation of high-quality sagebrush habitat.[7] Several studies provide insight about the Brewer's Sparrow's landscape and patch-size affinities. For instance, one study in eastern Washington showed that reproductive success was lower in landscapes fragmented by agriculture than in continuous shrubsteppe landscapes.[11] Others demonstrated in a somewhat contradictory fashion that while Brewer's Sparrows generally decline after large-scale burns,[4] they may not be seriously affected by patchier burn patterns affecting < 50% of the landscape, as long as the unaffected areas provide the habitat structure required by nesting birds.[6] Nevada Bird Count analyses and other sources[7] indicate that Brewer's Sparrows are most abundant when the landscape mosaic provides varying shrub densities, and furthermore, that they are most likely to occur within 1,000 m [3,300 ft] of surface water.[3]

Threats to Brewer's Sparrow are primarily those that result in the loss or degradation of mature sagebrush cover,[7] which the species uses almost exclusively during the breeding season. Although PIF's "North American Landbird Conservation Plan" [8] suggested a population objective of "Increase by 100%" for the Brewer's Sparrow, we believe that in Nevada, a more realistic goal is a population increase of 20% , which could be achieve through restoration or regeneration of habitat lost to fire over the last decade, coupled with improved livestock management.

Abundance and Occupancy by Habitat

Brewer's Sparrows occurred on fourteen different NBC-defined habitat types, generally as a function of the sagebrush patches that were embedded within or located in

Brewer's Sparrow

Spizella breweri

juxtaposition to the dominant vegetation. Densities in the table below are shown only for habitats with a large sagebrush component.

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Sagebrush	94% (31/33)	16.0 (11.1 – 20.9)
Montane Shrubland	85% (17/20)	24.6 (15.2 – 34.0)
Pinyon-Juniper	54% (38/70)	7.9 (5.3 – 10.5)
Salt Desert	74% (17/23)	10.7 (6.7 – 14.7)
Mojave		
Sagebrush	85% (22/26)	21.2 (14.3 – 28.1)
Montane Shrubland	75% (6/8)	10.0 (0.0 – 21.4)

Nevada-Specific Studies and Analyses

Habitat Requirements (NBC data)

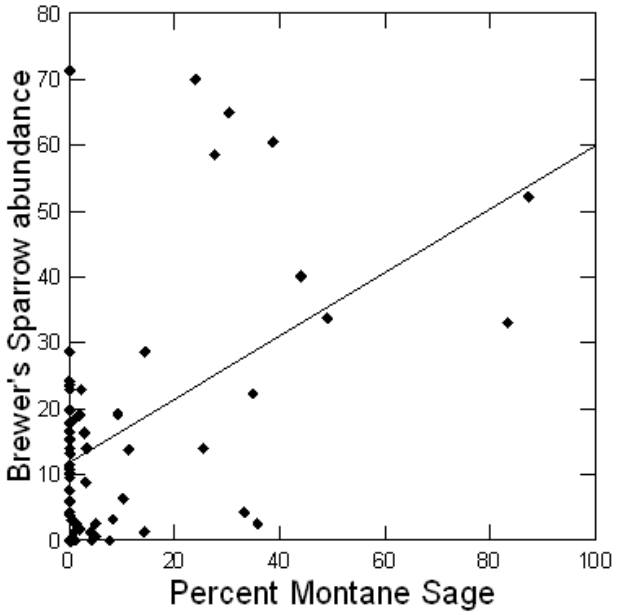
According to logistic regression analysis (*Appendix 3*). Brewer's Sparrows were more likely to be detected on sites with fewer trees ($p < 0.001$), greater sagebrush heights ($p < 0.001$), and the presence of surface water within 1 km [0.6 mi] ($p < 0.001$) as compared to non-detection sites. Litter cover, however was a poorer predictor ($p = 0.09$). The odds of finding Brewer's Sparrows within 1 km of surface water were very high. It is unclear whether the association of Brewer's Sparrow with proximity of water was due to the physical availability of water itself, or an indirect result of better shrub cover in areas that are closer to water.

Landscape Associations (NBC data)

Although ubiquitous in valley-floor Sagebrush habitat ($p < 0.001$), the Brewer's Sparrow had an even stronger positive relationship with montane sagebrush (when separated out from the Montane Shrubland habitat type; see graph below). Thus the Brewer's Sparrow exhibits a much wider use of the full elevational range of sagebrush vegetation than either the Sage Thrasher or Sage Sparrow Associations were still positive, but not as strong, for landscapes with significant pinyon-juniper ($p = 0.07$) or lowland riparian ($p = 0.04$) components after controlling for sagebrush. The Brewer's Sparrow's association with Salt Desert was less pronounced than was the case for Sage Sparrow and Sage Thrasher. At the landscape scale (10 km [6.2 mi]), Brewer's Sparrows were not as strongly associated with proximity to water as they were in the microhabitat analysis described above (*Appendix 3*).

Brewer's Sparrow

Spizella breweri



Main Threats and Challenges

Habitat Threats

Loss, degradation, or possibly fragmentation of high-quality sagebrush and montane sagebrush shrubland due to:

- Fire
- Invasive plants, especially cheatgrass
- Expansion of pinyon-juniper woodland into sagebrush
- Heavy livestock grazing
- Heavy OHV use

It is likely that some of these threats are more pronounced and require more management attention in lowland sagebrush habitat than in montane sagebrush.

Research, Planning, and Monitoring Challenges

- Uncertainty about the Brewer's Sparrows sensitivity to habitat fragmentation, and of minimum acceptable patch sizes
- Further research is needed to determine the best management strategies for the pinyon-juniper / sagebrush interface zone for multi-species benefits
- Although short-term fire management strategies are established, further research and planning is needed to clarify the most beneficial longer-term fire management strategies that protect important habitat while promoting its long-term viability

Brewer's Sparrow

Spizella breweri

Conservation Strategies

Habitat Strategies

- Montane Shrubland (p. Hab-14-1), Sagebrush (p. Hab-17-1), and Salt Desert Scrub (p. Hab-18-1) habitat conservation strategies benefit this species
- Protect large expanses of high-quality sagebrush (see below) from fire to the extent possible
- Within large expanses of high-quality sagebrush with few invasive plants, attempt to channel activities that can promote establishment or maintenance of cheatgrass, including heavy livestock grazing and heavy OHV use, to areas that are already degraded
- Where pinyon-juniper encroachment is known to have recently occurred within high-quality sagebrush habitat, conduct pinyon-juniper removal projects. However, we recommend that pinyon-juniper management projects consider the importance of maintaining a natural, interspersed interface zone between sagebrush shrublands and pinyon-juniper woodlands, as discussed in the Pinyon-Juniper (p. Hab-16-1) habitat account

Research, Planning, and Monitoring Strategies

- Identify and map large patches of intact, mature sagebrush that contain dense shrubs and little cheatgrass
- Develop a fire management strategy that ensures that high-quality sagebrush habitat receives priority fire suppression efforts in the immediate future. Additionally, develop fire management strategies that balance the need for short-term habitat protection with long-term habitat viability
- Conduct additional research to determine how to pinyon-juniper management projects can both benefit Brewer's Sparrows as well as the suite of birds that use the pinyon-juniper / sagebrush interface zone (see p. Hab-16-1)
- Continue monitoring to better determine phenology and extent of breeding in southern Nevada

Public Outreach Strategies

- None identified

References: [1]Floyd et al. (2007); [2]GBBO unpublished Atlas data; [3]GBBO unpublished NBC data; [4]Holmes (2007); [5]Knick and Rotenberry (1995); [6]Knick et al. (2005); [7]Paige and Ritter (1999); [8]Rich et al. (2004); [9]Rotenberry et al. (1999); [10]Sauer et al. (2008); [11]Vander Haegan (2007); [12]Wilson et al. (2009); [EO] Expert opinion

Black-chinned Sparrow

Spizella atrogularis



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Pinyon-Juniper Montane Shrubland Joshua Tree	
Key Habitat Parameters ◑	
Plant Composition	Pinyon pine, juniper, ponderosa pine, manzanita, yucca, sagebrush, and variety of other xeric shrubs;[8] high shrub diversity probably preferred [EO]
Plant Density	Open tree canopy (closed-canopy stands avoided), dense shrub canopy at 1-2 m [3 – 7 ft] height[8]
Mosaic	Mature, open woodland interspersed with open patches containing dense shrubs[2, 8]
Aspect	South-facing slopes probably preferred[8]
Response to Vegetation Removal	Negative [EO]
Area Requirements ○	
Minimum Patch Size	Unknown; estimated at 20 ha [50 ac][EO]
Recommended Patch Size	> 100 ha [250 ac][EO]
Territory Size	1.6 - 4 ha [4 - 10 ac][8]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Probable Recent Declines Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Red
NV Natural Heritage	S3B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ○	Rangewide declines of 5%/year, declines probable but not confirmed in Nevada[7, EO]
Population Size Estimates	
Nevada (NBC) ◑	8,400
Global ◑	3,900,000 [6]
Percent of Global	< 1%
Population Objective	
Increase by 50% [6, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Spring Mountains, Sheep Range, Virgin Mountains
Restoration	Unknown

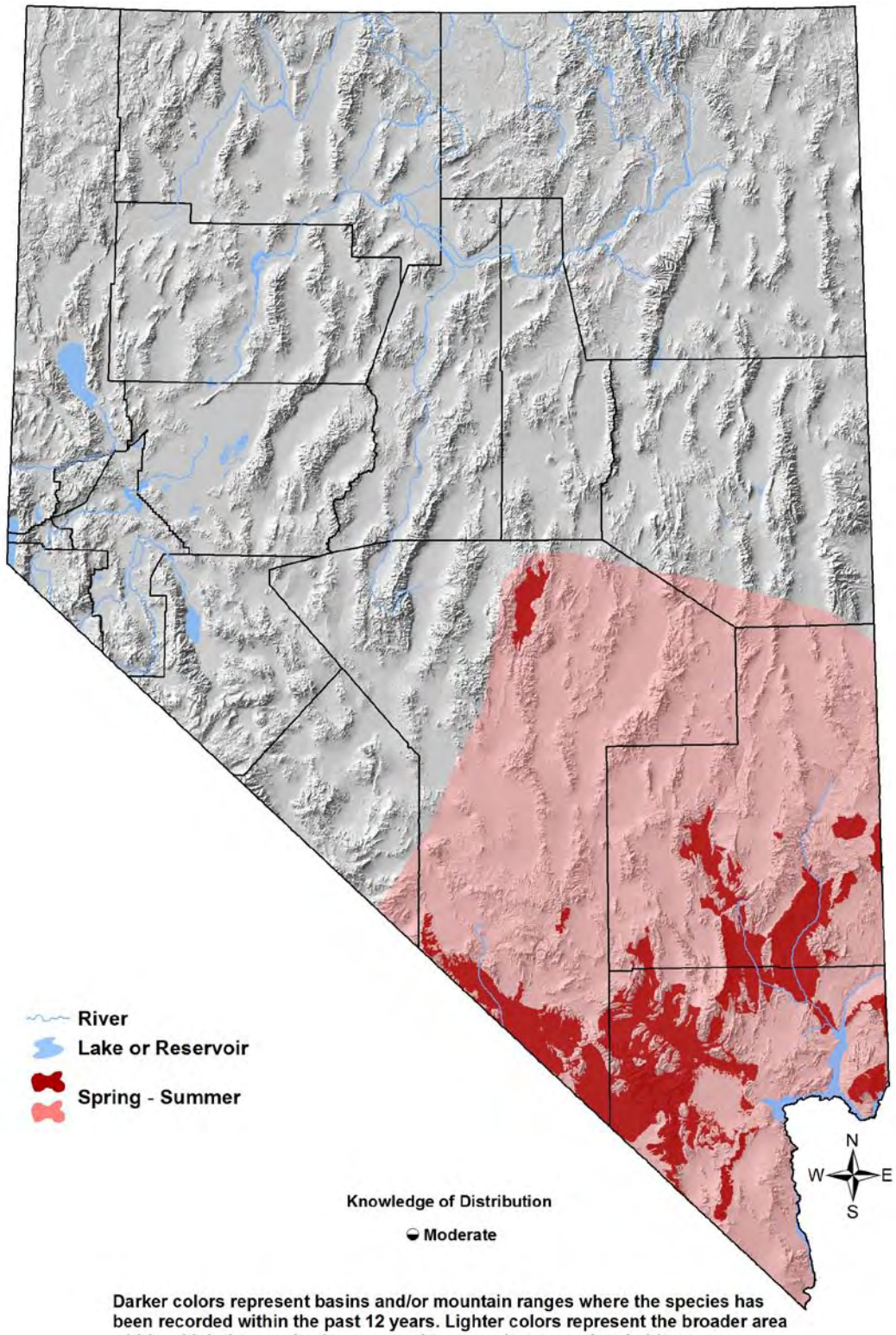
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late March – mid August[3, EO]	
Nest and Nesting Habits	
Nest Placement	Above ground in dense shrub[8]
Site Fidelity	Low[8]
Food Habits	
Basic	Shrub gleaner
Primary Diet	Insects[8]
Secondary Diet	Seeds during non-breeding season[8]

Confidence in Available Data: ●High ◑Moderate ○ Low

Black-chinned Sparrow

Spizella atrogularis



Black-chinned Sparrow

Spizella atrogularis

Overview

Although the Nevada Bird Count and the Nevada Breeding Bird Atlas project significantly expanded the known range and the population size estimate for this species, Nevada's Black-chinned Sparrow population may be somewhat disjunct from the main breeding populations in the Southwest and Mexico. Indeed, Black-chinned Sparrows are patchily distributed throughout much of their occupied range, and are sometimes absent from apparently suitable habitat.[8] This, in part, may be due to a preference for some particular (but not yet quantified) "blend" of juxtaposed habitat types. Data from the Nevada Bird Count have provided some insight into the Black-chinned Sparrow's key habitat requirements in Nevada (see below), but a there is still a large and problematic deficit in our knowledge of the biology and conservation needs of this reclusive species.[5] Some evidence exists that Black-chinned Sparrows tend to avoid close proximity to development,[1] and furthermore, their habitat preferences seem to vary among the different regions within their breeding range.[4]

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Mojave Region

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Pinyon-Juniper	92% (11/12)	2.0 (0.9 – 3.1)
Montane Shrubland	75% (6/8)	0.9 (0.3 – 1.5)
Montane Riparian	44% (4/9)	1.4 (0.1 – 1.5)
Joshua Tree	15% (3/20)	1.1 (0.3 – 1.9)

- In southern California chaparral, densities as high as 37 birds / 40 ha [0.37 / ac] reported[4]

Nevada-Specific Studies and Analyses

Landscape Associations (NBC data)

Black-chinned Sparrows were strongly associated with percent cover of Pinyon-Juniper habitat in both multivariate and univariate regressions (*Appendix 3*). More interestingly, they were especially numerous in NBC transects where Pinyon-Juniper and Mojave Scrub habitats were both present (i.e. "edge" areas between lower-elevation shrubland and higher-elevation woodland), as shown by a strong interaction term between these two cover types in the multivariate logistic regression. There were positive but weaker associations of Black-chinned Sparrow density with Montane Shrubland and Montane Riparian habitats. The species was never detected on transects containing any Mesquite-Acacia habitat, or more than 3% cover of Salt Desert habitat. These findings are consistent with a preference for a specific "blend" of different woodland and grassland patches.

Black-chinned Sparrow

Spizella atrogularis

Main Threats and Challenges

Habitat Threats

Threats are not well documented, but may include:

- Alteration of fire regimes that are increasing the density of pinyon-juniper woodlands
- Heavy grazing by horses, burros, or livestock[8]
- Invasive plants EO
- Heavy OHV use[8]

Research, Planning, and Monitoring Challenges

- Poor understanding of Nevada population trends and habitat / landscape preferences
- Poor understanding of the causes of probable, ongoing declines

Conservation Strategies

Habitat Strategies

- Pinyon-Juniper (p. Hab-16-1), Montane Shrubland (p. Hab-14-1), and Joshua Tree (p. Hab-8-1) habitat conservation strategies benefit this species
- Thinning overgrown pinyon-juniper woodlands near their shrubland interface may be beneficial

Research, Planning, and Monitoring Strategies

- Conduct studies to better pinpoint key habitat and landscape features that are important to Black-chinned Sparrows
- Continue monitoring to determine Nevada population trends
- Conduct further research to identify and quantify conservation threats

Public Outreach Strategies

- None identified

References: [1]Bolger et al (1997); [2]Floyd et al. (2007); [3]GBBO unpublished Atlas data; [4]Hargrove (2010); [5]Nevada Wildlife Action Plan Team (2006); [6]Rich et al. (2004); [7]Sauer et al. (2008); [8]Tenney (1997); [EO] Expert opinion

Sage Sparrow

Amphispiza belli



Photo by Jacque Lowery

Habitat Use Profile

Habitats Used in Nevada	
Sagebrush Salt Desert Scrub	
Key Habitat Parameters ●	
Plant Composition	Sagebrush, saltbushes, greasewood, and other xeric shrubs
Plant Density & Height	Variable shrub density with shrub height up to 1 – 2 m [3.3 – 6.6 ft]; typically low amounts of grass / forb cover[7]
Mosaic	Treeless sagebrush or salt desert shrubland with little or no cheatgrass invasion[7]
Distance to Water	No relationship[3, 7]
Response to Vegetation Removal	Negative; but exotic weed control encouraged[7, EO]
Area Requirements ◑	
Minimum Patch Size	Unknown, but avoids small patches
Recommended Patch Size	> 200 ha [430 ac][8, EO]
Territory Size	0.65 – 5.8 ha [1.6 – 14.3 ac][7]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Historical and possible recent declines Habitat threats High stewardship responsibility	
Other Rankings	
Continental PIF	Stewardship Species
Audubon Watchlist	Yellow
NV Natural Heritage	S4B S4N
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	None
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines[14]
Recent ○	Assessments vary, but probably close to stable[1, 14]
Population Size Estimates	
Nevada (NBC) ◑	2,900,000
Global ○	3,900,000 [11]
Percent of Global	> 50%
Population Objective	
Maintain[11, EO]	
Monitoring Coverage	
Source	Nevada Bird Count
Coverage in NV	Good
Key Conservation Areas	
Protection	Extensive, intact sagebrush landscapes
Restoration	Degraded / burned sagebrush

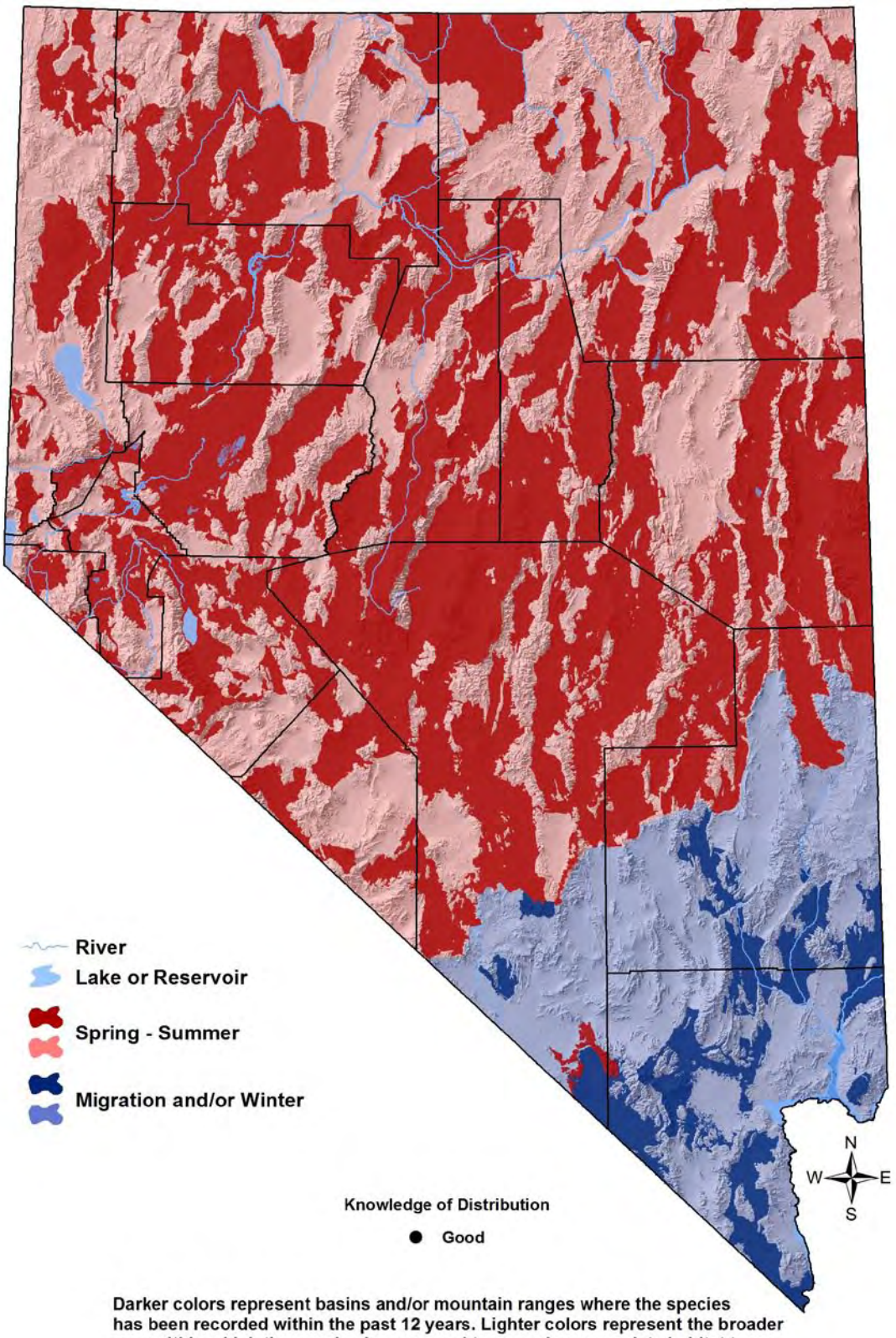
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer (Great Basin) Winter (Mojave)	
Known Breeding Dates in Nevada	
Early April – early August[2]	
Nest and Nesting Habits	
Nest Placement	In dense crown of 50-100 cm [20 – 40 in] tall shrub, [9] or on ground under shrub[EO]
Site Fidelity	High for breeding territory[7]
Food Habits	
Basic	Ground forager
Primary Diet	Arthropods[7]
Secondary Diet	Seeds and other plant matter[7]

Confidence in Available Data: ●High ◑Moderate ○ Low

Sage Sparrow

Amphispiza belli



Darker colors represent basins and/or mountain ranges where the species has been recorded within the past 12 years. Lighter colors represent the broader area within which the species is presumed to occur in appropriate habitat types.

Sage Sparrow

Amphispiza belli

Overview

The Sage Sparrow is abundant in Nevada, but it is nonetheless a significant conservation concern here because of its history of declines, threats to its preferred habitat, and Nevada's stewardship of approximately one-half of the species' global breeding population. Nevada also has among the highest known breeding densities for the Sage Sparrow. Sparrows are most abundant in sagebrush habitat, but they also breed in salt desert scrub more frequently than other sagebrush "obligate" birds.[6] Greasewood may also be used as a breeding substrate with some frequency, although existing evidence is ambiguous.[17] Some Sage Sparrows winter in southern Nevada, usually in sagebrush or Mojave scrub shrublands, but also in honey mesquite stands.[7]

Sage Sparrows avoid highly fragmented landscapes and are most abundant in large expanses of unbroken shrubland.[5, 16] Where present in fragmented landscapes, they are usually found nesting in only the largest shrubland fragments, although the minimum patch size threshold differs among studies,[6, 8] and nest success is typically reduced as fragmentation increases.[15] Landscape level attributes that have been positively correlated with Sage Sparrow abundance include high sagebrush density, large patch size, spatial homogeneity, and low levels of disturbance.[5, 12] At a microhabitat scale, Sage Sparrows are positively associated with density of sagebrush, total shrub cover, and amount of bare ground, and they tend to occur where shrub height is locally greater than is typical of surrounding areas.[4, 8] Sage Sparrows may also prefer a locally heterogeneous shrub-clumping pattern, but the data are not definitive.[7] The Sage Sparrow is thought to be sensitive to cheatgrass invasion because it results in less sagebrush cover for nesting and less bare ground suitable for foraging.[8] Although such information is valuable, managing directly for sagebrush microhabitat structure is difficult, in part because preferred microhabitat may vary among years, across space, and with different landscape contexts.[10, 12, 13] Fortunately, if sagebrush habitat is managed to ensure the presence of healthy intact landscapes, appropriate microhabitat will be present within this mosaic.[12]

Abundance and Occupancy by Habitat

Birds / 40 ha on NBC Transects in the Great Basin and Mojave Regions

Primary Habitat at Transect	Transects Occupied	Birds/40 ha (95% C.I.)
Great Basin		
Sagebrush	76% (25/33)	14.4 (9.8 – 19.0)
Salt Desert Scrub	70% (16/23)	8.0 (5.1 – 10.9)
Montane Shrubland	35% (7/20)	5.5 (1.6 – 9.4)
Mojave		
Sagebrush	46% (12/26)	12.4 (5.6 – 19.2)
Salt Desert Scrub	20% (2/10)	0.4 (0.0 – 0.9)

Sage Sparrow

Amphispiza belli

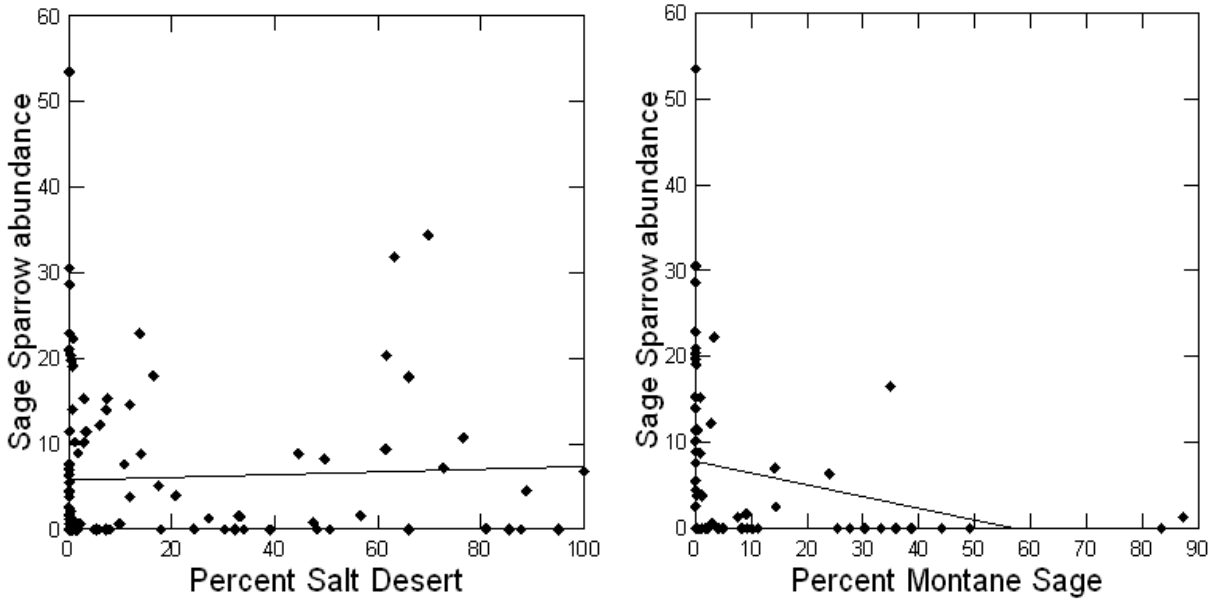
Nevada-Specific Studies and Analyses

Habitat Requirements (NBC data)

Sage Sparrows were strongly associated with greater shrub cover ($p = 0.003$) and the absence of trees ($p = <0.001$). They were negatively associated with greater herbaceous cover ($p = <0.001$), shrub height was not a strong predictor, and there was no relationship to proximity of water (*Appendix 3*).

Landscape Associations (NBC data)

Sage Sparrows were strongly associated with Sagebrush habitat, and secondarily with Salt Desert Scrub habitat ($p < 0.001$ for both), and were negatively associated with most other habitat types (*Appendix 3*). Sage Sparrows were more likely to use Salt Desert Scrub habitat than any of the other sagebrush "obligate" birds (e.g. Brewer's Sparrow, Sage Thrasher). In fact, as demonstrated in the first graph below (where the X-axis shows the proportion of Salt Desert Scrub habitat present within transects containing only Sagebrush and Salt Desert Scrub habitats), they appear to use the two habitats almost interchangeably. Although the table of densities shown above suggests some association with Montane Shrubland habitat (which includes Montane Sagebrush, an NBC-defined habitat type), a more detailed analysis indicates that Sage Sparrows occurred in Montane Shrubland transects only when they contained or adjoined large amounts of (lowland) Sagebrush habitat. This is demonstrated in the second graph, where the X-axis shows the amount of "Montane Sage" habitat present within the transects that contained only Montane Sagebrush (i.e. Montane Shrubland) and (lowland) Sagebrush habitats.



Sage Sparrow
Amphispiza belli

The pattern of results obtained in these analyses suggest that Sage Sparrows tend to be "edge avoiders" that prefer large patches of suitable, unfragmented shrubland.

Main Threats and Challenges

Habitat Threats

Because Sage Sparrows prefer relatively large expanses of intact shrubland,[8] they are negatively affected by many factors that fragment their habitat or alter its basic structure, including:

- Fire
- Cheatgrass invasion
- Heavy livestock use
- Expansion of Pinyon-Juniper woodland into shrubland
- Heavy OHV use

Additionally, Sage Sparrows may attempt to nest unsuccessfully in degraded habitat because of persistent fidelity to breeding territories.[7]

Research, Planning, and Monitoring Challenges

- Minimum patch size needs to be further investigated in different shrubland types
- Although short-term fire management strategies are established, further research and planning is needed to clarify the most beneficial longer-term fire management strategies that protect important habitat while promoting its long-term viability



Sage Sparrow habitat in eastern Nevada. Photo by John Boone.

Sage Sparrow

Amphispiza belli

Conservation Strategies

Habitat Strategies

- Sagebrush (p. Hab-17-1) and Salt Desert Scrub (p. Hab-18-1) habitat conservation strategies benefit this species
- Protect large expanses of high-quality sagebrush (see below) from fire
- Within large expanses of high-quality sagebrush with few invasive plants, attempt to channel activities that can promote establishment or maintenance of cheatgrass, including heavy livestock grazing and heavy OHV use, to areas that are already degraded
- Where pinyon-juniper encroachment is known to have recently occurred within high-quality sagebrush habitat, conduct pinyon-juniper removal projects. However, we recommend that pinyon-juniper management projects consider the importance of maintaining a natural, interspersed interface zone between sagebrush shrublands and pinyon-juniper woodlands, as discussed in the Pinyon-Juniper (p. Hab-16-1) habitat conservation plan
- Development activities should be conducted to minimize the fragmentation of large expanses of high-quality habitat
- Preserve soil integrity in salt desert scrub shrubland

Research, Planning, and Monitoring Strategies

- Identify and map large patches of intact, mature sagebrush that contain dense shrubs and little cheatgrass
- Develop a fire management strategy that ensures that high-quality sagebrush habitat receives priority fire suppression efforts in the immediate future. Additionally, develop fire management strategies that balance the need for short-term habitat protection with long-term habitat viability
- Conduct additional research to determine how pinyon-juniper management projects can both benefit Sage Sparrows as well as the suite of birds that use the pinyon-juniper / sagebrush interface zone (see p. Hab-16-1)

Public Outreach Strategies

- None identified

References: [1]Dobkin and Sauder (2004); [2]GBBO unpublished Atlas data; [3]GBBO unpublished NBC data; [4]Holmes and Johnson (2005); [5]Knick and Rotenberry (1995); [6]Knick et al. (2008); [7]Martin and Carlson (1998); [8]Paige and Ritter (1999); [9]Petersen and Best (1985); [10]Petersen and Best (1987); [11] Rich et al. (2004); [12]Rotenberry and Knick (1999); [13]Rotenberry and Wiens (2009); [14] Sauer et al. (2008); [15]Vander Haegan (2007); [16]Vander Haegan et al. (2000); [17]Wiens and Rotenberry (1981); [EO] Expert opinion

Tricolored Blackbird

Agelaius tricolor



Photo by Martin Meyers

Habitat Use Profile

Habitats Used in Nevada	
Marsh (Agriculture (foraging))	
Key Habitat Parameters ◑	
Plant Composition	Cattail, bulrush, sedges, willows
Plant Density	High-density emergent vegetation[2]
Mosaic	Large patches of emergent vegetation, adjacent to open water and large agricultural areas, pastures, or wet meadow[2, EO]
Water Depth	Unknown, but estimated < 30 cm [12 in] at nest sites [EO]
Hydrology	Permanent wetland or recently flooded wet meadow; requires water through nesting season[1]
Response to Vegetation Removal	Negative [EO]
Area Requirements ◑	
Minimum Patch Size	> 0.8 ha [2 ac] for wetland[1]
Recommended Patch Size	>1,500 ha [3,700 ac] for colony and surround foraging area[2]
Territory Size	< 0.1 ha [0.2 ac] within colony [EO]

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Small population size Historical declines Unknown population trend Restricted habitat Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Red
NV Natural Heritage	S1B
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ●	Rangewide declines[2]
Recent ○	Declines slowing rangewide, uncertain in Nevada[4]
Population Size Estimates	
Nevada ◑	< 100 [1]
Global ◑	250,000 [3]
Percent of Global	< 1%
Population Objective	
Increase by 100% [3, EO]	
Monitoring Coverage	
Source	GBBO special species inventory
Coverage in NV	Good, but future of inventory uncertain
Key Conservation Areas	
Protection	Carson Valley
Restoration	Carson Valley

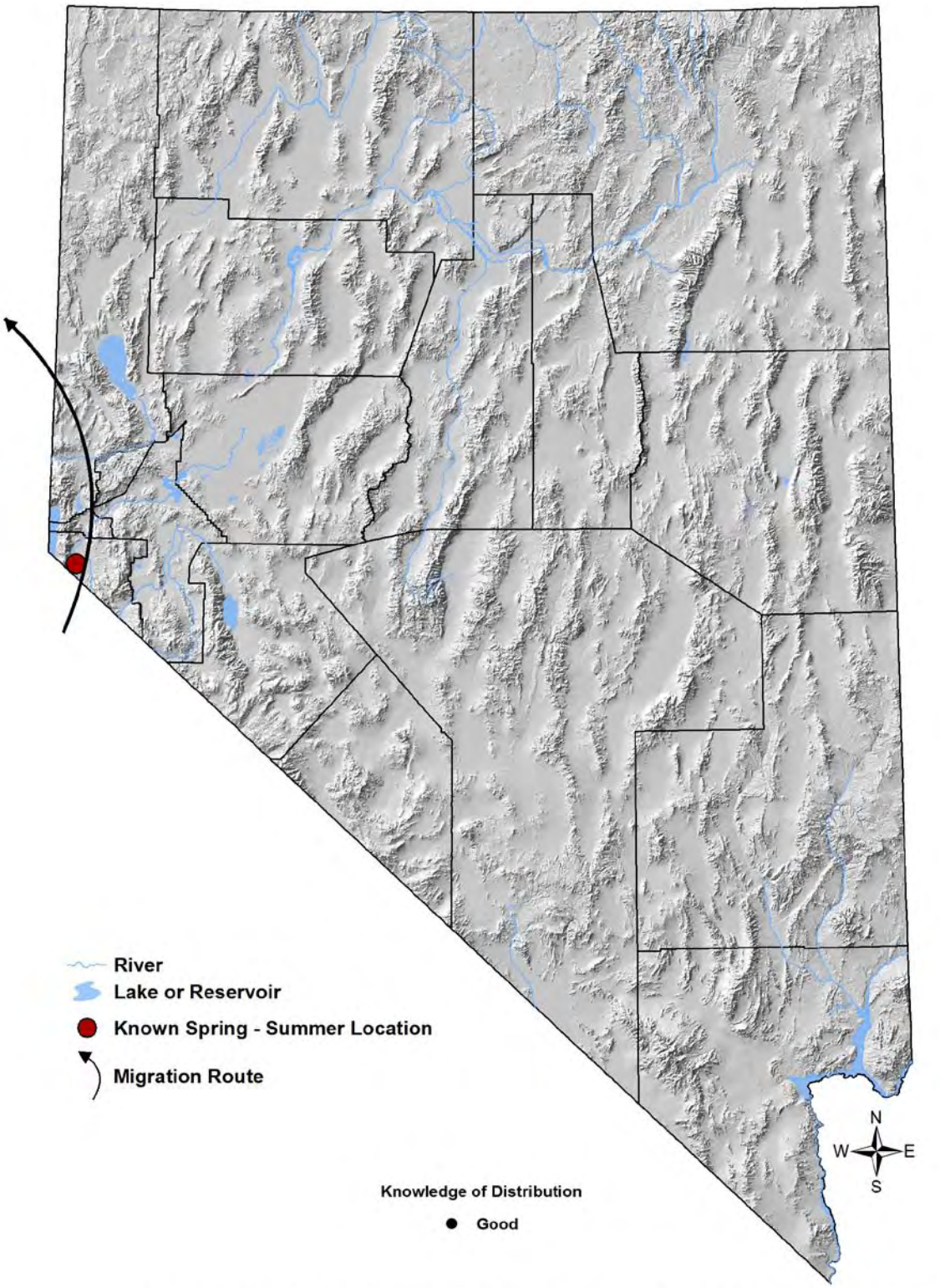
Natural History Profile

Seasonal Presence in Nevada	
Spring – Summer	
Known Breeding Dates in Nevada	
Late March – July[1]	
Nest and Nesting Habits	
Nest Placement	Attached to tall emergent vegetation 0.1 – 1.5 m [0.3 – 4.9 ft] above water or ground[2]
Site Fidelity	High for colony site[1]
Other	Highly colonial[1, 2]
Food Habits	
Basic	Ground forager and shrub gleaner
Primary Diet	Terrestrial invertebrates during breeding[2]
Secondary Diet	Agricultural grains, seeds post-breeding[2]

Confidence in Available Data: ●High ◑Moderate ○ Low

Tricolored Blackbird

Agelaius tricolor



Dots represent specific locations where the species has been recorded within the past 12 years.

Tricolored Blackbird

Agelaius tricolor

Overview

The overwhelming majority of Tricolored Blackbirds reside year-round in central California, where they have suffered from significant loss of wetland habitats. Nevada's single reliable breeding colony is migratory, and is peripheral and disjunct from the main population of Tricolored Blackbirds, which it rejoins in the winter months. This colony usually breeds in a small privately-owned marsh in Douglas County, in close proximity to both Red-winged and Yellow-headed Blackbirds.[1] There have also been periodic reports of additional small breeding colonies in other nearby marshes in Carson Valley, but their locations, sizes, and annual regularity of occurrence have not been systematically recorded. The degree to which nearby dairy farming and cattle ranching activities in Carson Valley provide a valuable foraging resource to the breeding colony has not been explicitly documented, but in the core of their breeding range (Central Valley of California), Tricolored Blackbirds forage in similar agricultural lands. The main conservation need in Nevada is to secure some form of protection for the single reliable breeding location and for other nearby (within a minimum radius of 5 km [3 mi]) marshes that may also host breeding colonies. Additional needs are ensuring that population monitoring is continued, and conducting searches for additional breeding sites in Carson Valley or elsewhere in western Nevada.

Abundance and Occupancy by Habitat

- Colonial breeder, ~ 20 pairs annually on average in Nevada[1]

Nevada-Specific Studies and Analyses

- Ammon and Woods[1] reported on the status of the species in Nevada as of 2008

Main Threats and Challenges

Habitat threats

- Nevada's single persistent breeding colony inhabits a small (0.8 ha [2 ac]) marsh located on private land. This site is not managed specifically for wildlife, and thus could be vulnerable to many of the threats described in the Marsh habitat account (p. Hab-9-1); to date, however, no specific habitat threats have been identified

Research, Planning, and Monitoring Challenges

- The single persistent breeding colony is located on privately-owned land with no management guidelines currently in place
- It is unclear whether additional breeding colonies are present rarely or frequently, and the factors controlling their presence on a year-to-year basis are not known

Tricolored Blackbird

Agelaius tricolor

Conservation Strategies

Habitat Strategies

- The Marsh (p. Hab-9-1) habitat conservation strategy benefits this species

Research, Planning, and Monitoring Strategies

- Continue monitoring of known persistent breeding colony
- Search for other breeding sites in Nevada, and if found, document their breeding colonies and the annual frequency of breeding
- Attempt to secure some form of protection for the known and possible breeding marshes, through the IBA program or other mechanisms
- Conduct studies of Nevada breeding population(s) and compare habitat use and foraging patterns to those of larger California populations

Public Outreach Strategies

- Encourage landowners at and around known persistent colony to continue their stewardship
- Explore incentives and assistance programs to secure landowner stewardship

References: [1]Ammon and Woods (2008); [2]Beedy and Hamilton (1999); [3]Rich et al. (2004); [4]Sauer et al. (2008); [EO] Expert opinion

Black Rosy-Finch

Leucosticte atrata



Photo by Greg Scyphers

Habitat Use Profile

Habitats Used in Nevada	
Alpine (Montane Shrubland (winter)) (Sagebrush (winter))	
Key Habitat Parameters ◑	
Plant Composition	Summer: treeless alpine tundra; Winter: sagebrush and montane shrubs
Plant Density	Unknown
Mosaic	Summer: alpine shrubs and herbaceous cover,interspersed with talus, cliffs and snowpockets; Winter: shrublands within 10 km [6 mi] of suitable roost sites[1, 4]
Other	Requires cave, mine entrances, or large rock fissures in sagebrush/pinyon-juniper zone in winter for roosting [1, 4, EO]
Response to Vegetation Removal	Unknown
Area Requirements ○	
Minimum Patch Size	Unknown
Recommended Patch Size	Summer: entire alpine patch; Winter: area of 10 km [6 mi] radius around roost site[1, EO]
Home Range / Territory Size	Unknown

Conservation Profile

Priority Status	
Conservation Priority Species	
Species Concerns	
Unknown population trend Small population size Restricted habitat (summer and winter) Habitat threats	
Other Rankings	
Continental PIF	Watch List
Audubon Watchlist	Red
NV Natural Heritage	S3
USFWS	Bird of Conservation Concern, Migratory Bird
BLM	Sensitive Species
USFS	None
NDOW	Conservation Priority
Trends	
Historical ○	Unknown
Recent ○	Unknown
Population Size Estimates	
Nevada ○	Unknown
Global ●	20,000 [6]
Percent of Global	Unknown
Population Objective	
Maintain / Increase [EO]	
Monitoring Coverage	
Source	Not systematically monitored
Coverage in NV	Poor
Key Conservation Areas	
Protection	Ruby, E. Humboldt, Schell Creek, Snake, and Jarbidge ranges; eastern Nevada valleys with concentrations of caves or mine shafts
Restoration	Degraded / sealed winter roost sites

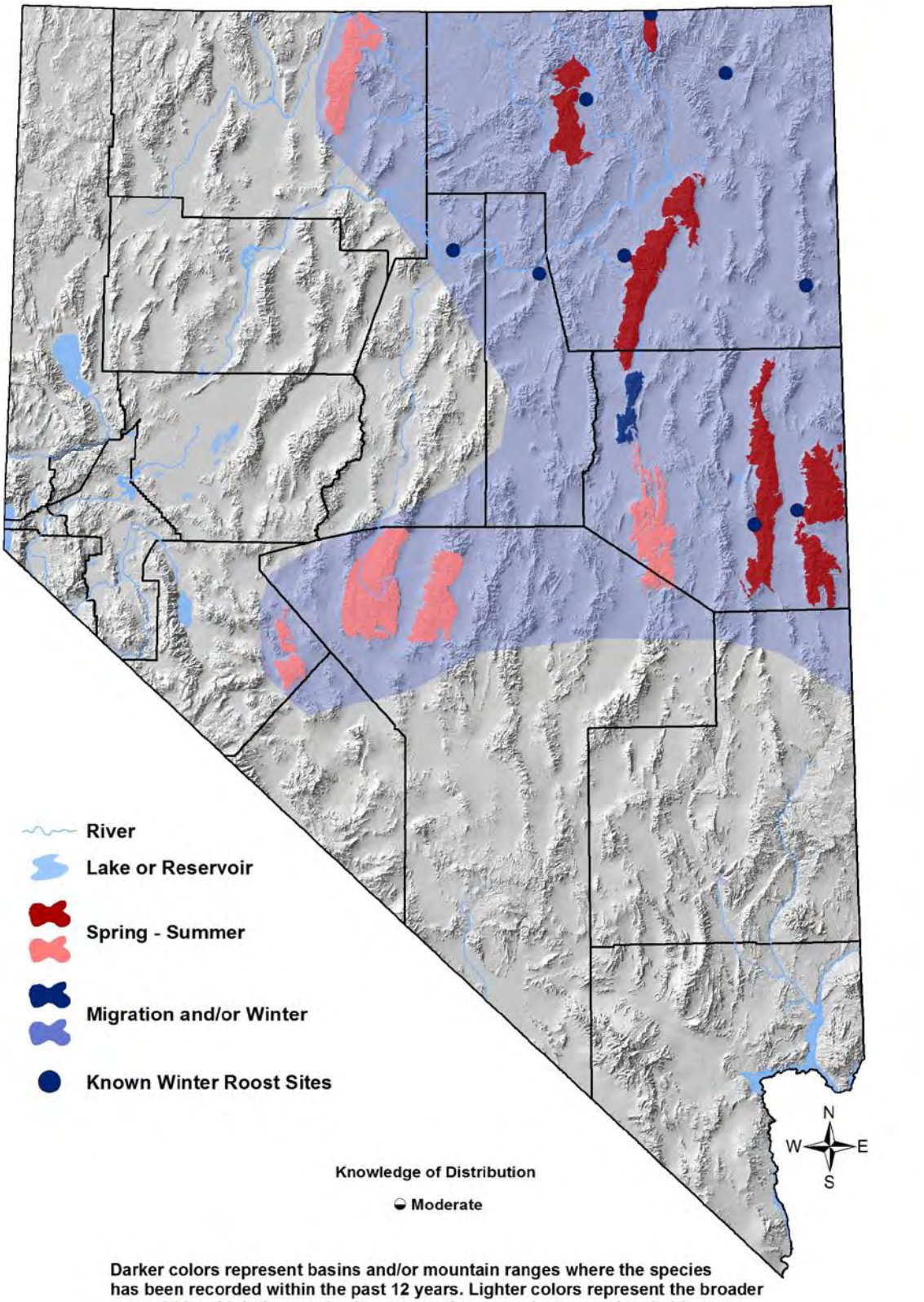
Natural History Profile

Seasonal Presence in Nevada	
Year-round (elevational migrant)	
Known Breeding Dates in Nevada	
Late June – July[3, 4]	
Nest and Nesting Habits	
Nest Placement	On ground in alpine meadow, talus or cracks of cliffs[4]
Site Fidelity	Unknown
Food Habits	
Basic	Ground forager
Primary Diet	Insects and seeds on snowbanks in summer[4]
Secondary Diet	Seeds in winter[4]

Confidence in Available Data: ●High ◑Moderate ○ Low

Black Rosy-Finch

Leucosticte atrata



Black Rosy-Finch

Leucosticte atrata

Overview

Black Rosy-Finches breed in remote alpine habitats, where they are difficult to monitor and study. They are more easily observed after they descend to lower elevations for the winter, where they often join with Gray-crowned Rosy-Finches (*Leucosticte tephrocotis*) in mixed foraging and roosting flocks of 25 – 1,000 individuals.[1] In addition to the confirmed ranges shown in the map above, breeding may also occur in other high ranges (Toiyabe, Toquima, White Pine ranges).[2, 4] Nevada trends and population size are unknown, and breeding populations are small and discontinuous. The Black Rosy-Finch's high-elevation breeding areas are not subject to most of the habitat threats characteristic of more accessible areas, but the potential impact of climate change on Nevada's limited alpine habitat is a concern. Most of the conservation attention for this bird is focused on protecting communal winter roost sites (which are critical for survival) and winter foraging areas.

Abundance and Occupancy by Habitat

No information

Nevada-Specific Studies and Analyses

NDOW Winter Telemetry Studies[1]

Winter telemetry studies in northeastern Nevada revealed that Black Rosy-Finches, which are often present with Gray-crowned Rosy-Finches in mixed flocks of 25 – 1,000 birds, depend heavily upon the shelter offered by below-ground communal roost sites, including abandoned mine shafts, caves, and deep fissures in metamorphic rock outcrops. The flocks return to these roost sites every evening after foraging in sagebrush or montane shrubland habitat up to 10 km [6 mi] away. Flocks may remain in the roosts for extended periods when the weather is inclement. Known roost sites were located at elevations ranging from 1,400 – 2,800 m [4,600 – 9,200 ft] within a matrix of sagebrush, montane shrubland, and pinyon-juniper habitats, and were typically higher in elevation than their associated foraging sites.

Main Threats and Challenges

Habitat Threats

- On the wintering grounds, threats include:
  - Mine entrance sealings (see photo, below), especially within 10 km [6 mi] of known winter foraging sites
  - Disturbance of winter roosting sites
  - Possible wind energy development on foraging sites
- Climate change is the main threat to alpine breeding habitat

Research, Planning, and Monitoring Challenges

- Lack of information about population trends and size, and full breeding range

Black Rosy-Finch

Leucosticte atrata

Conservation Strategies

Habitat Strategies

- The Alpine (p. Hab-2-1) habitat conservation strategies benefit this species
- Encourage gating rather than sealing of mine entrances in wintering range
- Limit disturbances within 9 km [5.5 mi] of known winter roost sites

Research, Planning, and Monitoring Strategies

- Attempt to better document population trends and full breeding range
- Perform full inventory of important winter roost sites (partially completed by NDOW Elko office) and protect from disturbance through cooperative roost conservation strategies[5]
- Conduct further study of wintering biology to determine any additional threats
- Model possible impacts of climate change and develop mitigation strategies if possible

Public Outreach Strategies

- None identified

References: [1]Bradley and Voget (2005); [2]Floyd et al. (2007); [3]GBBO unpublished Atlas data; [4]Johnson (2002); [5]Nevada Wildlife Action Plan Team (2006); [6]Rich et al. (2004); [EO] Expert opinion



Sealing of a mine and former winter roost site, Ellen D. Mountain, Elko Co.
Photo by Pete Bradley.

Conclusions

Overview

In this section, we identify the conservation strategies that frequently recur in our species and habitat accounts. In particular, we highlight the strategies that:

1) Provide the greatest benefits for multiple bird species
2) Generate a high conservation return on investments
3) Are critical for effective bird conservation

This section is intended for all plan users, but is most applicable for those who manage large landscapes that contain multiple habitat types and multiple Priority bird species. Those users with management obligations that center around particular species or habitats may wish to focus on the relevant species and habitat accounts. In contrast with the layout in the species and habitat accounts, we begin here with the more conceptual research, planning, and monitoring strategies, and progress to the more applied habitat strategies.

Research, Planning, and Monitoring Strategies

Improve Habitat Mapping and Classification

Poorly-Mapped Habitats

Some of Nevada's most important bird habitats are also the most poorly mapped. The problem is particularly acute for habitats that occur mainly in small or narrow patches. An effort to **significantly improve existing map products for lowland and montane riparian, springs, wet meadow, and aspen habitat** would greatly facilitate conservation planning and monitoring programs, not just for birds but for wildlife in general. Improving the existing map products for these habitats is also feasible, given the availability of high-quality aerial photography. As an example, a greatly improved map of mesquite-acacia habitat was generated as part of the Clark County MSHCP project (Clark County 2000) using a combination of classification approaches. Mapping of Joshua Tree habitat has also been problematic in the past due to limitations on remote sensing techniques for this habitat type, but efforts are underway in southern Nevada and surrounding regions to generate improved maps (Todd Esque, *pers. comm.*).

High-Quality Habitat Patches

The species accounts for sagebrush-associated birds repeatedly stress the need to identify and protect large remaining patches of "high-quality" habitat. This recommendation applies to other habitat types as well (with "high-quality" characteristics defined within the relevant habitat accounts), but it is particularly relevant to sagebrush habitat because:

1) Decades of livestock grazing and weed invasion have, in some areas, caused significant departures from a desired condition
2) Large areas of high-quality sagebrush shrubland have been lost to fire, particularly over the last decade

Conclusions

3) Restoration of post-burn sagebrush habitat to its desired condition is very problematic because many sagebrush varieties are not well adapted to modern fire regimes, especially given the presence of invasive weeds

Unfortunately, the remaining high quality habitat patches that require protection are often poorly mapped. In many cases, their locations are known to local managers, but that knowledge is not often consolidated across the state in the form of maps that are available to those making statewide management decisions. Therefore **incorporating condition assessments into map products** would streamline the conservation planning process and allow for more efficient protection of valuable patches. Habitat types that would benefit most are sagebrush, aspen, and riparian, where condition maps could be used to pinpoint areas where restoration activities or additional protection are most needed.

Focus on Critical Landscape Mosaics

Conservation thinking and planning is often organized by habitat type, and in many cases this is appropriate. However, some landscape mosaics, where multiple habitat types constitute particularly suitable setting, can have greater conservation value than any of their component habitat types individually. Specific examples are covered below, under "Habitat Strategies: Landscape Mosaics". These **high-value landscape mosaics should be preferentially targeted for conservation and restoration activities**.



Wilson's Phalarope. Photo by Larry Neel

Conclusions

Consolidate Bird Data

A substantial effort was made in the preparation of this plan to consult and synthesize many sources of bird data. Still, some data sources were not fully utilized because they were difficult to access or had problems with formatting. This experience leads us to suspect that many management decisions affecting Nevada's birds are made without the benefit of all relevant bird data, simply because of access problems. Nevada's managers and conservation planners would benefit tremendously from an effort to **consolidate all relevant bird data in an easily accessible, uniform repository that is regularly update.** Readers are encouraged to consult eBird (www.ebird.org) for a demonstration of the power and functionality of consolidated data sets. There are tentative plans to consolidate Nevada's bird data using the Avian Knowledge Network (www.avianknowledge.net) data node model, but this effort will be labor intensive and will require funding support.

Address Gaps in Monitoring Coverage

Rigorous, well-designed monitoring programs are critical for determining the distribution, population status, trends, and habitat requirements of Nevada's birds, and furthermore will be needed to document the shifts in distribution and abundance that may accompany climate change. Although statewide monitoring coverage has improved greatly over the last 15 years, additional resources are needed to **improve long-term collection of monitoring data.** Existing monitoring programs include, but are not limited to:

1) NDOW's winter raptor counts, aerial waterfowl and waterbird counts, colonial waterbird and shorebird counts, WMA counts, lek counts, hunter surveys, regionally-focused counts (such as the Black Rosy-Finch winter roost site inventory and Sandhill Crane counts in northwestern Nevada), and special taxa counts (including Common Loon counts on Walker Lake)
2) GBBO partner-funded Nevada Bird Count, Aquatic Bird Count, special taxa counts (for example, the Snowy Plover inventory and colonial waterbird count), and focal area counts
3) USFWS's NWR counts and special taxa counts

Collectively, these programs provide good monitoring coverage for most diurnal landbirds, upland game birds, and waterfowl statewide, and waterbirds and shorebirds in established management areas (particularly Lahontan and Ruby Valleys, NWR's, and WMA's). Fair monitoring coverage is in place for most raptors and the Burrowing Owl. However, full statewide coverage is not in place for colonial or migrating waterbirds, and shorebirds like the Marbled Godwit, American Avocet, and Snowy Plover that are not well monitored outside the focal areas. Monitoring coverage is poor to non-existent for secretive marshbirds (except in a few focal areas), owls, hummingbirds, and nightjars. Special monitoring protocols have been developed for some of these under-surveyed groups (Conway 2009, Crow and Longshore 2010a, Fylling et al. 2009, Jones et al. 2003, Page et al. 2010, http://ccb-m.org/nightjars.htm), but not for others, especially hummingbirds. Additional planning and support is needed to attempt to fill some of these monitoring gaps. Also, some existing monitoring programs, including the Nevada

Conclusions

Bird Count, could be improved by expanding the network of randomly selected monitoring locations to provide more inferential power.

Investigate Seasonal Distribution, Abundance, and Habitat Use

Most bird research and inventory efforts have focused on the breeding season. As a result, our knowledge of bird distribution, abundance, habitat use, and conservation status during the rest of the year is often inadequate. Yet, some of our year-round Priority birds may face their greatest conservation challenges during the non-breeding season (e.g., Black Rosy-Finches reliant on winter roost sites). Others may engage in poorly-documented seasonal movements (e.g., Pinyon Jay, Golden Eagle). Still others may be present only during migration (e.g., Common Loon, Least Sandpiper). Finally, some Nevada breeders may be far more numerous during the non-breeding season than during breeding (e.g., Bald Eagle, Wilson's Phalarope). Efforts should be made to **collect more information about priority birds during all critical periods of their seasonal cycle**.

Determine Patch Size Requirements

Knowledge of a bird's required habitat patch size is a fundamental component of effective conservation planning and management. Yet, a perusal through the species accounts in this plan demonstrates that this knowledge is lacking for many birds. Additional study is needed to **better determine habitat patch size requirements for all priority species**.



Burrowing Owl. Photo by Martin Meyers

Develop Integrated Short- and Long-Term Fire Management Strategies

Fire plays a fundamental, but complicated, role in bird conservation (see pp. *Conservation Concerns-3 and -5*). Extensive resources are devoted to fire-fighting and to fire prevention in

Conclusions

Nevada, and in terms of conservation, these activities are often warranted to minimize the loss of important habitat, particularly sagebrush. Beyond this, what is needed is the **development of a comprehensive fire-management policy that integrates the immediate need for habitat and property protection with the longer-term needs for habitat maintenance and regeneration, which in some cases may require periodic fires** (see Habitat Strategies, below).

Plan for Climate Change

If climate change proceeds according to consensus projections, it will almost certainly have substantial effects on most, if not all, of Nevada's bird habitats. The potential impacts of climate change on birds are addressed in this plan (see habitat accounts), and they are a focus of the upcoming revision to the *Nevada Wildlife Action Plan* (Nevada Wildlife Action Plan Team 2006), both of which provide some basis for identifying possible mitigation strategies. In addition, we expect that future updates to this plan will address issues of changes in bird breeding and migration phenologies, and shifts in temporal and spatial resource availability, as more data become available on climate change effects.

Promote Agency Coordination and Use Adaptive Management

Although we do not make detailed recommendations in the plan regarding agency administrative issues and organization, we do encourage the establishment of **interagency working groups to address high-priority conservation needs** that can benefit from shared resources and coordinated planning. Additionally, we note that several of the strategies discussed, including improved monitoring coverage and consolidation of bird data, will be most effective if they are incorporated into an adaptive management framework that is endorsed by a wide variety of partners.

Outreach Strategies

Actively Promote, Distribute, and Update Plan; Develop an Implementation Plan

This plan will be most effective if it is widely available and actively promoted to the resource management community, and if it is regularly updated to reflect advances in bird conservation science. This agenda is a high priority for the Nevada Partners in Flight working group. Additionally, this group may explore options for developing an implementation plan to accompany this bird conservation plan to ensure conservation action. As new products (consolidated bird data, improved maps, etc.) become available, we will seek to actively distribute them and promote their use through the mechanism of regular plan updates that will be available online at **www.gbbo.org/bird_conservation_plan.html**.

Partner with Private Landowners and Permittees

Resource managers and NGOs should continue to seek partnerships with private landowners and permittees to implement the conservation strategies outlined in this plan. This approach is particularly critical for maintaining biologically-valuable agricultural, aspen, riparian, and wet meadow habitats, and for guiding the timing of agricultural activities to minimize impacts on

Conclusions

Priority birds. Effective partnerships with private entities can also greatly facilitate the implementation of livestock grazing regimes that allow conservation of aspen, lowland riparian, and sagebrush habitats.

Promote Birding

Bird-watchers form an important constituency for bird conservation. Most NGOs and management agencies have programs in place to promote wildlife appreciation, and maintaining and expanding these programs is an important long-term conservation strategy. Efforts should be made to promote eBird (www.ebird.org) as a simple way for birders to contribute to conservation science. Increased educational efforts within the school system should also be actively pursued.

Publicize Restoration Successes

Habitat restoration is a critical component of bird conservation, and restoration projects are expensive. In a period of tight budgets, it becomes even more important to highlight and publicize successful restoration projects in order to build support for bird conservation and to celebrate successes in wildlife stewardship.

Engage the Public

There are opportunities to involve the public in implementing conservation strategies presented in this plan. Volunteer activities could include weed control, tree planting, bird listing, and others. The **IBA program is a particularly suitable umbrella for organizing such volunteer efforts and public promotion of bird conservation** in a variety of landscapes. In addition, it is beneficial for bird conservation to promote public appreciation of the habitats used for particular recreational activities (fishing, camping, hunting, etc).



Tundra Swans. Photo by Bob Goodman

Conclusions

Habitat Strategies

Detailed habitat strategies are presented in the habitat accounts and, for the most part, these are not repeated here. Rather, this section is intended to present common themes that recur among multiple habitats, to provide landscape context, and to highlight and emphasize the most critical habitat-specific strategies.

Landscape Mosaic

Landscape mosaics consist of multiple habitat types that occur together in a way that they can all be accessed by Priority species that need multiple habitat types throughout their life cycle. **Where these landscape mosaics occur, they have enhanced value for birds and should be preferentially conserved**. Future revisions of this plan will highlight these landscape types in more detail.

Montane Mosaics: Montane landscapes where Montane Shrubland, Montane Riparian, Aspen, and Coniferous Forest habitats are juxtaposed or interspersed appear to be especially bird-rich, for example if the forested areas contain openings and snags, or pockets of aspen stands with trees in multiple age categories and a healthy herbaceous understory. Springs with surface water can be similarly valuable as riparian or aspen habitats in these landscapes.

Forest Burn Mosaic: Over a large area, it is clear that coniferous forests support the greatest abundance and diversity of birds if they are comprised of different-aged tree stands, and interspersed with openings and deadwood resulting from periodic small-scale fires.

Pinyon-Juniper / Sagebrush Edge: There is evidence that this woodland-shrubland ecotone is significantly more important to a suite of bird species than either woodland or shrubland alone. Understanding this habitat association better, and including this knowledge in adaptive management is especially critical given the current urgency for pinyon-juniper management activities.

Springs and Uplands: Although our data are not always definitive, there are many indications that upland areas have greater bird abundance and diversity the closer they are to springs or other sources of surface water and its associated vegetation.

Lowland Riparian / Marsh / Wet Meadow Mosaic: All of these habitat types are valuable on their own, but they are especially valuable when they are interspersed along an extended water course.

Fragmentation of Habitats

It is widely accepted that habitat fragmentation is detrimental to many Priority species, but two challenges occur in preventing fragmentation from reaching levels that are harmful to birds:

1) Current vegetation maps rarely incorporate habitat condition or quality as attributes, and it is therefore difficult to determine the current fragmentation status of a landscape except in its most obvious manifestations

2) We often do not know the threshold patch size requirements for priority birds, and can therefore not determine when fragmentation is reaching critical levels.

The most practical long-term approach to these problems is to incorporate condition assessments into our habitat maps and to better determine bird area requirements. In the short term, it is important to **channel development and disturbances into areas that are already heavily impacted, and away from areas that appear to be more intact** based on our current sources of information. Similarly, fire-fighting efforts should be prioritized toward these larger intact areas, particularly in sagebrush.

Restoration

Restoration is perhaps the most critical habitat strategy for lowland riparian and other mesic habitats, and in general, it can be very effective where the possibility exists to manipulate water. In Nevada, highly effective projects have restored several natural river reaches, marshes, springs, wet meadows, and aspen stands. Artificially created wetlands and riparian areas can also beneficial for many birds.

Restoration in uplands is more complicated because of longer successional processes of vegetation, complex ecosystem processes, the need for above-average moisture levels to facilitate seedling establishment, and native plant seedlings facing competition from invasive weeds. In forests, prescribed fire and manual thinning can be very beneficial, but they are expensive or administratively complex to apply across large areas. Post-fire seeding of burned shrublands may help tip the successional balance to favor native species over invasive plants in the case of sagebrush, but the success of these efforts is likely mixed. Interagency planning efforts that facilitate communication of effective strategies would be enormously beneficial to bird conservation.

Invasive Plants

Invasive plants are a threat in most habitat types that occur at low and intermediate elevations. A coordinated, multi-lateral, and geographically concentrated approach to weed management is likely the most effective and efficient approach, but weed management will remain an ongoing struggle in Nevada.

Key Habitat Strategies

Habitat-specific conservation strategies are fully covered in the habitat accounts. Below, we simply list, for a few selected habitat types, the habitat-specific strategies that we feel are the most critical for conserving priority birds. We refer the reader to the corresponding habitat accounts for details.

Pinyon-Juniper: Pinyon-Juniper management projects should maintain a complex, interspersed, and broad ecotone between pinyon-juniper woodland and sagebrush shrubland. Creating an abrupt edge eliminates a landscape mosaic element that is especially bird-rich.

Conclusions

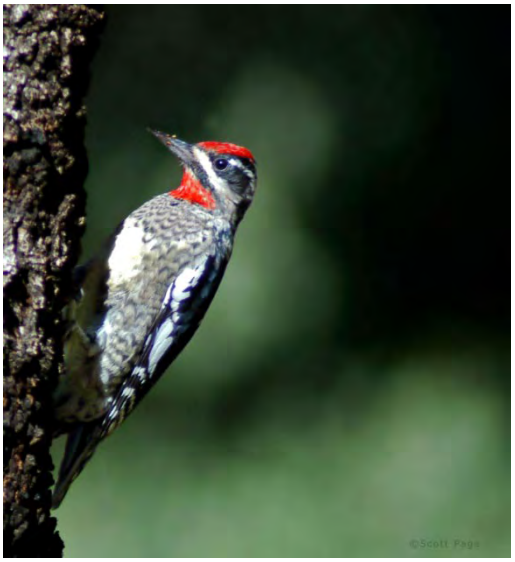
Sagebrush: Livestock and wild horse grazing, invasive plants, fire, and fragmentation form a vicious circle that has significantly degraded Nevada's signature habitat type. The situation can be improved by ensuring that:

1) **Grazing is kept at levels that sustain sagebrush and native understory components**
2) **Large, relatively intact habitat patches are protected from fire**
3) **Weed control is aggressively pursued in high-priority areas**
4) **Development projects are sited to prevent further fragmentation intact habitat patches**

Aspen: Many aspen stands in Nevada are in poor condition and vulnerable to permanent loss. The key strategy is to **allow stands to regenerate**. This may require creating livestock exclosures, reviewing grazing levels, using prescribed fire or manual methods to reduce conifer invasion and encourage aspen regeneration, and managing recreational activities.

Lowland Riparian (Great Basin and Mojave): Although they are degraded from past impacts, lowland riparian habitats can in many cases be fully restored by:

1) **Reinstating natural flow regimes or flows that mimic natural regimes**
2) **Engineering river channels to re-create natural meanders and floodplain processes**
3) **Intervening in the vegetation succession process to favor native plants over weeds**



Red-naped Sapsucker, an Indicator of healthy Aspen habitat. Photo by Scott Page

The case of saltcedar, especially in southern Nevada, deserves special mention. Several Priority birds now make use of saltcedar-dominated riparian areas. Ideally, restored riparian habitats would contain only native vegetation, but care should be exercised to ensure that **as saltcedar is removed or defoliated, revegetation efforts** occur as soon as possible.

Marsh, Ephemeral Wetland and Playa, and Open Water: Minimizing or eliminating loss of functional waterbodies and wetlands is a high conservation priority, and primarily a matter of **securing, maintaining, or in some cases increasing water inflows, and maintaining reasonable water quality standards** for wetlands and lakes. This conceptually simple but functionally challenging prescription is largely in the political and public realm, perhaps nowhere more than in the case of Walker Lake. However, the issue of water availability for natural resources and bird conservation is worth serious exploration of all options.

Coniferous Forest: Nevada has overall few of the forestry-related conservation concerns that are common in other western states. The main conservation strategy in this habitat type to benefit

Conclusions

birds is to **create the most natural possible fire regime**, which will create forest openings, produce snags, and maintain a large-scale multi-aged forest mosaic.

Agriculture: Several priority birds used agricultural landscapes. Key conservation strategies are to:

1) **Maintain traditional agricultural practices such as flood irrigation, stubble fields, and shelterbelts**
2) **Protect isolated large trees or tree groves**
3) **Conduct mechanized agricultural activities to avoid inadvertent impacts on nests and young during the most vulnerable periods** (typically May – early July, but variable by species)



American White Pelican. Photo by Fred Petersen

Literature Cited

Abele, S.C., V.A. Saab, and E.O. Garton. 2004. Lewis's Woodpecker (*Melanerpes lewis*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/lewisswoodpecker.pdf

Abella, S.R. 2008. A systematic review of wild burro grazing effects on Mojave Desert vegetation, USA. Environmental Management 41:809-819.

Ackerly, D.D., S.R. Loarie, and W.K. Cornwall. 2010. The geography of climate change: implications for conservation biogeography. Diversity and Distributions 16:476-487.

Airola, D.A., and R.H. Barrett. 1985. Foraging and habitat relationships of insect-gleaning birds in a Sierra Nevada mixed-conifer forest. Condor 87:205-216.

Alcorn, J.R. 1988. The Birds of Nevada. Fairview West Publishing, Fallon, NV. 418 pp.

Aldridge, C.L., S.E. Nielsen, H.L. Beyer, M.S. Boyce, J.W. Connelly, S.T. Knick, and M.A. Schroeder. 2008. Range-wide patterns of Greater Sage-grouse persistence. Diversity and Distributions 14:983-994.

Allen, J.N. 1980. The ecology and behavior of the Long-billed Curlew in southeastern Washington. Wildlife Monographs 73:1–67.

Altman, B., and R. Sallabanks. 2000. Olive-sided Flycatcher (*Contopus cooperi*). *In* The Birds of North America, No. 502 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Ammon, E.M. 2002. Changes in the bird community of the lower Truckee River, Nevada, 1868-2001. Great Basin Birds 5:13-20. http://www.gbbo.org/gbb_pastissues.html

Ammon, E.M., and P.B. Stacey. 1997. Avian nest success in relation to past grazing regimes in a montane riparian system. Condor 99:7-13.

Ammon, E.M., and J. Woods. 2008. Status of Tricolored Blackbirds in Nevada. Great Basin Birds 10:63-66.

Anders, A.D., and E. Post. 2006. Distribution-wide effects of climate on population densities of a declining migratory landbird. Journal of Animal Ecology 75:221-227.

Anderson, J.E. and R.S. Inouye. 2001. Landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years. Ecological Monographs 71:531-556.

Anderson, R., R. Anderson, M. Bradbury, C. Chun, J. Dinsdale, J. Estep, K. Fien, R. Schlorff. 2007. California Swainson's Hawk Inventory: 2005-2006 DFG Staff Report Final Report Contract P0485902. UC Davis Wildlife Health Center Department of Fish and Game Resource Assessment Program. http://www.dfg.ca.gov/rap/projects/swainsonhawk/

(APLIC) Avian Power Line Interaction Committee. 2006. Suggested practices for raptor protection on power lines: the state of the art in 2006. Edison Electric Institute, APLIC, and California Energy Commission. Sacramento, CA. http://www.aplic.org/SuggestedPractices2006(LR).pdf

Archer, S.R., and K.I. Predick. 2008. Climate change and ecosystems of the Southwestern United States. Rangelands (June 2008):23-28.

Arsenault, D.P., G.E. Wilson, and L. Neel. 2003. Flammulated Owls in the Spring Mountains, Nevada. Great Basin Birds 6:45-51. http://www.gbbo.org/gbb_pastissues.html

Literature Cited

Atamian, M.T., J.S. Sedinger, J.S. Heaton, and E.J. Blomberg. 2010. Landscape-level assessment of brood rearing habitat for Greater Sage-Grouse in Nevada. Journal of Wildlife Management 74:1533-1543.

August, C., C. Mortimore, C. Nicolai, J. Mackey, and P. Bradley. 2009. Greater Sandhill Crane colt survival in northeastern Nevada. Unpublished Research Project Status Report, Nevada Department of Wildlife, Reno, NV.

Austin, J.E., and M.R. Miller. 1995. Northern Pintail (*Anas acuta*). *In* The Birds of North America, No. 163 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Austin, J.E., C.M. Custer, and A.D. Afton. 1998. Lesser Scaup (*Aythya affinis*). *In* The Birds of North America, No. 338 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Austin, J. E., A.D. Afton, M.G. Anderson, R.G. Clark, C.M. Custer, J.S. Lawrence, J.B. Pollard, and J.K. Ringelman. 2000. Declining scaup populations: issues, hypotheses, and research needs. Wildlife Society Bulletin 28:254-263.

Averill-Murray, A., S. Lynn, and M.L. Morrison. 1999. Cowbird parasitism of Arizona Bell's Vireos (*Vireo bellii arizonae*) in a desert riparian landscape: implications for cowbird management and riparian restoration. Studies in Avian Biology 18:109-120.

Baker, W.L. 2006. Fire and restoration of sagebrush ecosystems. Wildlife Society Bulletin 34:177-185.

Baker, W.L., and D.J. Shinneman 2004. Fire and restoration of piñon-juniper woodlands in the western United States: a review. Forest Ecology and Management 189:1-21.

Balda, R.P. 2002. Pinyon Jay (*Gymnorhinus cyanocephalus*). *In* The Birds of North America, No. 605 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Baltosser, W.H., and P.E. Scott. 1996. Costa's Hummingbird (*Calypte costae*). *In* The Birds of North America, No. 251 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Barger, N.N., H.D. Adams, C. Woodhouse, J.C. Neff, and G.P. Asner. 2009. Influence of livestock grazing and climate on pinyon pine (*Pinus edulis*) dynamics. Rangeland Ecology and Management 62:531-539.

Barlow, J.C., S.N. Leckie, and C.T. Baril. 1999. Gray Vireo (*Vireo vicinior*). *In* The Birds of North America, No. 447 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Bart, J. 2005a. Monitoring the abundance of bird populations. Auk 122:15-25.

Bart, J. 2005b. Estimating total population size for songbirds. Pages 777-780 *in* Bird Conservation and Implementation in the Americas: Proceedings of the Third International Partners in Flight Conference, vol.1 (C.J.Ralph and T.D.Rich, eds.). U.S.Department of Agriculture, Forest Service, General Technical Report PSW-GTR-191.

Bart, J., and S. Earnst. 2002. Double sampling to estimate density and population trends in birds. Auk 119:36-45.

Barton, D.C., and A.L. Holmes. 2007. Off-highway vehicle trail impacts on breeding songbirds in northeastern California. Journal of Wildlife Management 71:1617-1620.

Literature Cited

Bauer, J.M., and P.J. Weisberg. 2009. Fire history of a central Nevada pinyon-juniper woodland. Canadian Journal of Forest Research 39:1589-1599.

Beason, J., and S.A. Jentsch. 2001. Breeding birds of the McCullough Mountains. Great Basin Birds 4:25-26. http://www.gbbo.org/gbb_pastissues.html

Bechard, M.J., C.S. Houston, J.H. Sarasola, and A.S. England. 2010. Swainson's Hawk (*Buteo swainsoni*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from: http://bna.birds.cornell.edu/bna/species/265

Bechard, M.J., and J.K. Schmutz. 1995. Ferruginous Hawk (*Buteo regalis*). *In* The Birds of North America, No. 172 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Beecham, J.J., and M.N. Kochert. 1975. Breeding biology of the Golden Eagle in southwestern Idaho. Wilson Bulletin 87:506-513. http://elibrary.unm.edu/sora/Wilson/v087n04/p0506-p0513.pdf

Beedy, E.C., and W.J. Hamilton III. 1999. Tricolored Blackbird (*Agelaius tricolor*). *In* The Birds of North America, No. 423 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Beever, E.A., R. Tausch, and W. Thogmartin. 2008. Multi-scale responses of vegetation to removal of horse grazing from Great Basin (USA) mountain ranges. Plant Ecology 196:163-184.

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54:419-431.

Bergstrom, E. 1998. Willow Flycatchers on the western edge of the Great Basin. Great Basin Birds 1:10-11. http://www.gbbo.org/gbb_pastissues.html

Berry, M.E., and C.E. Bock. 1998. Effects of habitat and landscape characteristics on avian breeding distributions in Colorado foothills shrub. Southwestern Naturalist 43:453-461.

Bevanger, K. 1994. Bird interactions with utility structures: Collision and electrocution, causes and mitigating measures. Ibis 136:412-425.

Biosystems Analysis, Inc. 1989. Endangered Species Alert Program Manual: Species Accounts and Procedures. Southern California Edison Environmental Affairs Division. http://www.sce.com/nrc/bioarc/0812_ESAM.pdf

Blakesley, J.A., B R. Noon, and D.R. Anderson. 2005. Site occupancy, apparent survival, and reproduction of California spotted owls in relation to forest stand characteristics. Journal of Wildlife Management 69:1554-1564.

(BLM) Bureau of Land Management. 2002. Management considerations for sagebrush (*Artemisia*) in the western United States: a selective summary of current information about the ecology and biology of woody North American sagebrush taxa. USDI Bureau of Land Management, Information Bulletin No. 2002-120. Washington, DC. Available at: http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_information.html

Blus, L. J., and C.J. Henny. 1997. Field studies on pesticides and birds: unexpected and unique relations. Ecological Applications 7:1125-1132.

Bogner, H.E., and G.A. Baldassarre. 2002. Home range, movement, and nesting of Least Bitterns in western New York. Wilson Bulletin 114:297-308.

Literature Cited

Bolger, D.T., T.A. Scott, and J.T. Rotenberry. 1997. Breeding bird abundance in an urbanizing landscape in coastal Southern California. Conservation Biology 11:406-421.

Bombay, H.L., T.M. Benson, B.E. Valentine, and R.A. Stefani. [Online]. 2003a. A Willow Flycatcher Survey Protocol for California. California Department of Fish and Game. http://dfg.ca.gov/wildlife/nongame/docs/wifl_2003_protocol.pdf

Bombay, H.L., M.L. Morrison, and L S. Hall. 2003b. Scale perspectives in habitat selection and animal performance for Willow Flycatchers (*Empidonax traillii*) in the central Sierra Nevada, California. Studies in Avian Biology 26:60-72.

Bond, M.L., R.J. Gutiérrez, A.B. Franklin, W.S. LaHaye, C.A. May, and M.E. Seamans. 2002. Short-term effects of wildfires on Spotted Owl survival, site fidelity, mate fidelity, and reproductive success. Wildlife Society Bulletin 30:1022-1028.

Bond, M.L., M.E. Seamans, and R.J. Gutiérrez. 2004. Modeling nesting habitat selection of California Spotted Owls (*Strix occidentalis occidentalis*) in the central Sierra Nevada using standard forest inventory metrics. Forest Science 50:773-780.

Braden, G.T., L. Crew, and A. Miller. 2009. Avian diversity, vegetation composition, and vegetation structure of the Las Vegas Wash: 2005 to 2009. San Bernardino County Museum, Biological Sciences Division, 2024 Orange Tree Lane, Redlands, CA 92374. November 2009. Prepared for: Las Vegas Wash Coordination Committee.

Bradley, B.A. 2009. Regional analysis of the impacts of climate change on cheatgrass invasion shows potential risk and opportunity. Global Change Biology 15:196-208.

Bradley, B.A. 2010. Assessing ecosystem threats from global and regional change: hierarchical modeling of risk to sagebrush ecosystems from climate change, land use and invasive species in Nevada, USA. Ecography 33:198-208.

Bradley, B.A. and J.F. Mustard. 2008. Comparison of phenology trends by land cover class: A case study in the Great Basin, USA. Global Change Biology 14:334-346.

Bradley, P.V. 2005. Nevada Greater Sandhill Crane nesting survey. Unpublished Field Trip Report. Nevada Department of Wildlife. Elko, NV. 6pp.

Bradley, P. V., and K. W. Voget. 2005. Winter night roost selection by Black and Gray-crowned Rosy-Finches in the Great Basin, Nevada, USA. Proceeding of the Annual Joint Meeting - Wilson Ornithological Society and the Association of Field Ornithologists, Beltsville MD.

Brand, L.A., G.C. White, and B.R. Noon. 2008. Factors influencing species richness and community composition of breeding birds in a desert riparian corridor. Condor 110:199-210.

Brand, L.A., J.C. Stromberg, D.C. Goodrich, M.D. Dixon, K. Lansey, D. Kang, D.S. Brookshire, and D.J. Cerasale. [Online]. 2010a. Projecting avian response to linked changes in groundwater and riparian floodplain vegetation along a dryland river: a scenario analysis. Ecohydrology: http://onlinelibrary.wiley.com/doi/10.1002/eco.143/pdf

Brand, L.A., J.C. Stromberg, and B R. Noon. 2010b. Avian density and nest survival on the San Pedro River: importance of vegetation type and hydrologic regime. Journal of Wildlife Management 74:739-754.

Literature Cited

Brennan, L.A., W.M. Block, and R.J. Gutiérrez. 1987. Habitat use by Mountain Quail in northern California. Condor 89:66-74.

Breshears, D.D., N.S. Cobb, P.M. Rich, K P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens, M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyer. 2005. Regional vegetation die-off in response to global-change-type drought. Proceedings of the National Academy of Sciences of the United States of America 102:15144-15148. http://www.pnas.org/content/102/42/15144.full.pdf+html

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J E. Keeley, J.M. Ditomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. BioScience 54:677-688.

Brooks, M.L., and B. Lair. 2005. Ecological effects of vehicular routes in a desert ecosystem. Report to USGS - Recoverability and Vulnerability of Desert Ecosystems: http://geography.wr.usgs.gov/mojave/rvde

Brooks, M.L., and J.R. Matchett. 2006. Spatial and temporal patterns of wildfires in the Mojave Desert, 1980-2004. Journal of Arid Environments 67:148-164.

Brown, D.E., J.C. Hagelin, M. Taylor, and J. Galloway. 1998. Gambel's Quail (*Callipepla gambelii*). *In* The Birds of North America, No. 321 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Brown, J.L. C.W. Briggs, and M.W. Collopy. 2008. Swainson's Hawk nesting habitat and patterns of expected land-use change. Great Basin Birds 10:16-25.

Brown, K, A.J. Hanson, R.E. Keane, and L.J. Graumlich. 2006. Complex interactions shaping aspen dynamics in the Greater Yellowstone Ecosystem. Landscape Ecology 21:933-951.

Brown, M., and J.J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. Journal of Wildlife Management. 50:392-397.

Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. The U.S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, MA. http://www.fws.gov/shorebirdplan/USShorebird/PlanDocuments.htm

Budnik, J.M., F.R. Thompson III, and M.R. Ryan. 2002. Effect of habitat characteristics on the probability of parasitism and predation of Bell's Vireo nests. Journal of Wildlife Management 66:232-239.

Buehler. D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Burger, J. 1974. Breeding adaptations of Franklin's Gull (*Larus pipixcan*) to a marsh habitat. Animal Behaviour 22:521-567.

Burger, J., and M. Gochfeld. 2009. Franklin's Gull (*Larus pipixcan*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/116

Cade, T.J., J.H. Enderson, C.G. Thelander, and C.M. White, eds. 1988. Peregrine Falcon populations: Their management and recovery. The Peregrine Fund, Inc. Boise, ID.

Literature Cited

Calder, W.A., and L.L. Calder. 1994. Calliope Hummingbird (*Stellula calliope*). *In* The Birds of North America, No. 135 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Call, D.R., R.J. Gutiérrez, and J. Verner. 1992. Foraging habitat and home-range characteristics of California Spotted Owls in the Sierra Nevada. Condor 94:880-888.

Camp, R.J., and R.L. Knight. 1998. Rock climbing and cliff bird communities at Joshua Tree National Park, California. Wildlife Society Bulletin 26:892-898.

Carey, C. 2009. The impacts of climate change on the annual cycles of birds. Philosophical Transactions of the Royal Society B: Biological Sciences 364:3321-3330.

Cassaza, M.L., J.L. Yee, M.R. Miller, D L. Orthmeyer, D.R. Yparraguirre, R.L. Jarvis, C.T. Overton. 2005. Evaluation of current population indices for Band-tailed Pigeons. Wildlife Society Bulletin 33:606-615.

Chambers, J.C., A. Evenden, and N. Devoe. 2008. Collaborative management and research in the Great Basin–Examining the issues and developing a framework for moving forward. USDA Forest Service General Technical Report RMRS-204. http://www.fs.fed.us/rm/pubs/rmrs_gtr204.html

Chambers, J.C., E. Leger, and E. Gergen. 2009. Cold desert fire and invasive species management: resources, strategies, tactics, and response. Rangelands 31:14-20.

Chambers, J.C., B.A. Roundy, R.R. Blank, S.E. Meyer, and A. Whittaker. 2007. What makes Great Basin sagebrush ecosystems invasible by *Bromus tectorum*? Ecological Monographs 77:117-145

Chambers, J.C., N. Devoe, and A. Evenden, eds. 2008. Collaborative management and research in the Great Basin — examining the issues and developing a framework for action. USDA Forest Service General Technical Report RMRS-204. http://www.fs.fed.us/rm/pubs/rmrs_gtr204.html

Chambers, J.C., and M.J. Wisdom. 2009. Priority research and management issues for the imperiled Great Basin of the western United States. Restoration Ecology 17:707-714.

Charlet, D.A. 1996. Atlas of Nevada Conifers: a phytogeographic reference. University of Nevada Press. Reno, NV.

Chase, M.K., and G.R. Geupel. 2005. The use of avian focal species for conservation planning in California. Page 130-142 *in* Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. March 20-24, 2002. Asilomar, California. USDA Forest Service General Technical Report PSW-191. http://gis.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/130-142.pdf

Chesser, R.T., R.C. Banks, F.K. Barker, C.Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, P C. Rasmussen, J.V. Remsen, J.D. Rising, D.F. Stotz, and K. Winker. 2010. Fifty-first supplement to the American Ornithologists' Union Check-List of North American Birds. Auk 127:726-744

Chisholm, G., and L. A. Neel. 2002. Birds of the Lahontan Valley: A Guide to Nevada's Wetland Oasis. University of Nevada Press, Reno, NV. 237 pp.

Clark, L. 1998. Great Basin Christmas Bird Counts. Great Basin Birds 1:49-58.

Clark County (CC MSHCP). [Online]. 2000. Clark County Multi-Species Habitat Conservation Plan http://www.accessclarkcounty.com/depts/daqem/epd/dcp/Pages/dcp_mshcp.aspx

Literature Cited

Coates, P.S. 2001. Movement, survivorship, and reproductive behavior of Columbian Sharp-tailed Grouse translocated to Nevada. Master's Thesis. University of Nevada, Reno.

Coates, P.S., S.J. Stiver, and D.J. Delehanty. 2006. Using Sharp-tailed Grouse movement patterns to guide release-site selection. Wildlife Society Bulletin 34:1376-1382.

Coates, P.S., and D.J. Delehanty. 2010. Nest predation of Greater Sage-Grouse in relation to microhabitat factors and predators. Journal of Wildlife Management 74:240-248.

Colwell, M.A., and J.R. Jehl, Jr. 1994. Wilson's Phalarope (*Phalaropus tricolor*). *In* The Birds of North America, No. 83 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Colwell, M.A., and L.W. Oring. 1988. Return rates of prairie shorebirds: sex and species differences. Wader Study Group Bulletin 55:21-24.

Connelly, J.W., M.W. Gratson, and K.P. Reese. 1998. Sharp-tailed Grouse (*Tympanuchus phasianellus*). *In* The Birds of North America, No. 354 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines for management of Sage Grouse populations and habitats. Wildlife Society Bulletin 28:967–985.

Connelly, J.W., S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. Conservation assessment of Greater Sage-grouse and sagebrush habitats, Unpublished report, Western Association of Fish and Wildlife Agencies, Cheyenne, Wyoming, 610 pages. Available at: http://sagemap.wr.usgs.gov/.

Connelly, J.W., E.T. Rinkes, and C.E. Braun. 2011(*in press*). Characteristics of Greater Sage-Grouse habitats: a landscape species at micro and macro scales. *In* Greater Sage-Grouse: Ecology and conservation of a landscape species and its habitats. (S.T. Knick, and J.W. Connelly, eds). Studies in Avian Biology 38. http://sagemap.wr.usgs.gov/monograph.aspx

Conway, C.J. 2009. Standardized North American Marsh Bird Monitoring Protocols, version 2009-2. Wildlife Research Report #2009-02. U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ. Available at: http://www.mibci.org/fileadmin/user_upload/ResearchMonitoring/NA_Marsh_Bird_Protocol_2009.pdf

Conway, C.J., W.R. Eddleman, S.H. Anderson and L.R. Hanebury. 1993. Seasonal changes in Yuma Clapper Rail vocalization rate and habitat use. Journal of Wildlife Management 57:282-290.

Conway, C.J., V. Garcia, M.D. Smith, and K. Hughes. 2008. Factors affecting detection of Burrowing Owl nests during standardized surveys. Journal of Wildlife Management 72:688-696.

Conway, C.J., and T.E. Martin 1993. Habitat suitability for Williamson's Sapsuckers in mixed-conifer forests. Journal of Wildlife Management 57:322-328.

Conway, C.J., C.P. Nadeau, and L. Piest. 2010. Fire helps restore natural disturbance regime to benefit rare and endangered marsh birds endemic to the Colorado River. Ecological Applications 20:2024-2035.

Covington, W.W., R.L. Everett, R. Steele, L.L. Irwin, T.A. Daer, and A.N.D. Auclair. 1994. Historical and anticipated changes in forest ecosystems of the Inland West of the United States. Journal of Sustainable Forestry 2:13-63.

Literature Cited

Crawford, J.A., R.A. Olson, N.E. West, J.C. Moseley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg, and C.S. Boyd. 2004. Ecology and management of Sage-Grouse and Sage-Grouse habitat. Journal of Range Management 57:2–19. http://etmd.nal.usda.gov/bitstream/10113/10979/1/IND43647350.pdf

Crowe, D.E., and K.M. Longshore. 2010a. Estimates of density, detection probability, and factors influencing detection of Burrowing Owls in the Mojave Desert. Journal Raptor Research 44:1-11.

Crowe, D.E., and K.M. Longshore. 2010b. Population status and reproductive ecology of the Western Burrowing Owl (*Athene cunicularia hypugaea*) in Clark County, Nevada. United States Geological Survey. Final Report 2005-USGS-582-P. Henderson, NV.

Cullen, S.A., J.R. Jehl Jr., and G.L. Nuechterlein. 1999. Eared Grebe (*Podiceps nigricollis*). *In* The Birds of North America, No. 433 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Custer, C., T. Custer, and E. Hill. 2007. Mercury exposure and effects on cavity-nesting birds from the Carson River, Nevada. Archives of Environmental Contamination and Toxicology 52:129-136.

Davies, K.W., and J. Bates. 2010. Native perennial forb variation between mountain big sagebrush and Wyoming big sagebrush plant communities. Environmental Management 46:452-458.

Davies, K.W., J.D. Bates, and R.F. Miller. 2006. Vegetation characteristics across part of the Wyoming big sagebrush alliance. Rangeland Ecology and Management 59:567-575.

Deacon, J.E., A.E. Williams, C.D. Williams, and J.E. Williams. 2007. Fueling population growth in Las Vegas: How large-scale groundwater withdrawal could burn regional biodiversity. BioScience 57:688-698.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, A.L. Zimmerman, and B.R. Euliss. 1999 (revised 2003). Effects of management practices on grassland birds: Ferruginous Hawk. Northern Prairie Wildlife Research Center, Jamestown, ND. (Version 12DEC2003). http://www.npwrc.usgs.gov/resource/literatr/grasbird/feha/feha.htm

DeFalco, L.A., T.C. Esque, S.J. Scoles-Sciulla, and J. Rodgers. 2010. Desert wildfire and severe drought diminish survivorship of the long-lived Joshua tree (*Yucca brevifolia*; Agavaceae). American Journal of Botany 97:243-250.

Delehanty, D.J., S.S. Eaton, and T.G. Campbell. 2004. From the field: Mountain Quail fidelity to guzzlers in the Mojave Desert. Wildlife Society Bulletin 32:588-593.

DeLong, J.P. 2004. Effects of management practices on grassland birds: Golden Eagle. Northern Prairie Wildlife Research Center, Jamestown, ND. Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/literatr/grasbird/goea/goea.htm (Version 28MAY2004).

Devoe, N. 2008. Energy development in the Great Basin. Pages 24-28 *in* Collaborative management and research in the Great Basin — examining the issues and developing a framework for action. (J.C. Chambers, N. Devoe, and A. Evenden, eds.). USDA Forest Service General Technical Report RMRS-204. http://www.fs.fed.us/rm/pubs/rmrs_gtr204.html

Dickson, B.G., E. Fleishman, D.S. Dobkin, and S.R. Hurteau. 2009. Relationship between avifaunal occupancy and riparian vegetation in the central Great Basin (Nevada, U.S.A.) Restoration Ecology 17:722-730.

Literature Cited

Dobbs, R.C., T.E. Martin and C.J. Conway. 1997. Williamson's Sapsucker (*Sphyrapicus thyroideus*). *In* The Birds of North America, No. 285 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Dobbs, R.C., P.R. Martin, and T.E. Martin. 1998. Green-tailed Towhee (*Pipilo chlorurus*). *In* The Birds of North America, No. 368 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Dobkin, D.S., A.C. Rich, J.A. Pretare, and W.H. Pyle. 1995. Nest-site relationships among cavity-nesting birds of riparian and snowpocket aspen woodlands in the northwestern Great Basin. Condor 97:694-707. http://elibrary.unm.edu/sora/Condor/files/issues/v097n03/p0694-p0707.pdf

Dobkin, D.S., and J.D. Sauder. 2004. Shrubsteppe landscapes in jeopardy. Distributions, abundances, and the uncertain future of birds and small mammals in the Intermountain West. High Desert Ecological Research Institute, Bend, OR. Available at: http://sagemap.wr.usgs.gov/Docs/shrubsteppe_landscapes.pdf

Dobkin, D.S., and B.A. Wilcox. 1986. Analysis of natural forest fragments: riparian birds in the Toiyabe Mountains, Nevada. Pages 293–299 *in* Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. (J. Verner, M.L. Morrison, and C.J. Ralph, eds.). University of Wisconsin Press. Madison, WI.

Doherty, K.E., D.E. Naugle, and B.L. Walker. 2010. Greater Sage-Grouse nesting habitat: the importance of managing at multiple scales. Journal of Wildlife Management 74:1544-1553.

Donovan, T.M., C.J. Beardmore, T.M. Donovan, C.J. Beardmore, D.N. Bonter, J.D. Brawn, R.J. Cooper, J.A. Fitzgerald, R. Ford, S.A. Gauthreaux, Jr., T.L. George, W.C. Hunter, T.E. Martin, J. Price, K.V. Rosenberg, P.D. Vickery, and T.B. Wigley. 2002. Priority research needs for the conservation of Neotropical migrant landbirds. Journal of Field Ornithology 73:329-339.

Drever, C.R., G.D. Peterson, C. Messier, Y. Bergeron, and M.D. Flannigan. 2006. Can forest management based on natural disturbances maintain ecological resilience? Canadian Journal of Forest Research 36:2285-2299.

Drever, M.C., and K. Martin. 2010. Response of woodpeckers to changes in forest health and harvest: Implications for conservation of avian biodiversity. Forest Ecology and Management 259:958-966.

Drew, J., and S.P. Espinosa. 2008. Potential impacts of energy development on Greater Sage-grouse (C*entrocercus urophasianus*) and their habitat in Nevada. Nevada Department of Wildlife. http://www.ndow.org/wild/conservation/sg/resources/report/2008_energy_impacts_to_sg.pdf

Drewien, R.C., W.M. Brown, and W.L. Kendall. 1995. Recruitment in Rocky Mountain Greater Sandhill Cranes and comparisons with other crane populations. Journal of Wildlife Management 59:339-356.

Dugger, B.D., and K.M. Dugger. 2002. Long-billed Curlew (*Numenius americanus*). *In* The Birds of North America, No. 628 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Dukes, J.S., and H.A. Mooney. 2004. Disruption of ecosystem processes in western North America by invasive species. Revista Chilena de Historia Natural 77:411–437.

Literature Cited

Dunham S., L. Butcher, D.A. Charlet, and J.M. Reed. 1996. Breeding range and conservation of Flammulated Owls (*Otus flammeolus*) in Nevada. J. Raptor Research 30:189-193.

Earnst, S.L., L. Neel, G.L. Ivey, and T. Zimmerman. 1998. Status of the White-faced Ibis: Breeding colony dynamics of the Great Basin population, 1985-1997. Colonial Waterbirds 21:301-313.

Eddleman, W.R., and C.J. Conway. 1998. Clapper Rail (*Rallus longirostris*). *In* The Birds of North America, No. 340 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Elliot, W J., I.S. Miller, and L. Audin, eds. 2010. Cumulative watershed effects of fuel management in the western United States. USDA Forest Service General Technical Report RMRS-231. http://www.fs.fed.us/rm/pubs/rmrs_gtr231.html

England, A.S., and W.F. Laudenslayer Jr. 1989. Distribution and seasonal movements of Bendire's Thrasher in California. Western Birds 20:97-123. http://elibrary.unm.edu/sora/wb/v20n03/p0097-p0124.pdf

England, A.S., and W.F. Laudenslayer Jr. 1993. Bendire's Thrasher (*Toxostoma bendirei*). *In* The Birds of North America, No. 71 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Espinosa, S., and R. Phenix. 2008. Effects of wildfire (1999–2007) on Greater Sage-Grouse (*Centrocercus urophasianus*) and key ecological sagebrush systems that they depend on in Nevada. Unpublished Report. Nevada Department of Wildlife. http://www.ndow.org/wild/conservation/sg/resources/Effects%20of%20Fire%20on%20GSG%20and%20Sagebrush%20in%20NV.pdf

Estep, J.A. 2009. The influence of vegetation structure on Swainson's Hawk foraging habitat suitability in Yolo County. Prepared by Estep Environmental Consulting for the Yolo Natural Heritage Program, Woodland, CA. http://www.yoloconservationplan.org/yolo_pdfs/reports/veg-struc-swains-hawk-feb2009.pdf

Evers, D.C., J.D. Paruk, J.W. Mcintyre and J F. Barr. 2010. Common Loon (*Gavia immer*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/313

Farmer, C.J., L.J. Goodrich, E. Ruelas Inzunza, and J.P. Smith. 2008. Conservation status of North America's birds of prey. Pages 303-420 *in* State of North America's birds of prey. (K.L. Bildstein, J.P. Smith, E.R. Inzunza and R.R. Veit, eds). Series in Ornithology #3, Nuttall Ornithological Club and The American Ornithologists' Union.

Fellows, S.D., and S.L. Jones. 2009. Status assessment and conservation action plan for the Long-billed Curlew (Numenius americanus). U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication, FWS/BTP-R6012-2009, Washington, D.C. http://library.fws.gov/BTP/long-billedcurlew.pdf

Fernández, G., N. Warnock, D.B. Lank, and J.B. Buchanan. 2010. Conservation Plan for the Western Sandpiper (*Calidris mauri*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, Massachusetts. http://www.whsrn.org/conservation-plans

Finch, D.M., and S.H. Stoleson (eds). 2000. Status, Ecology, and Conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report RMRS-60. http://www.fs.fed.us/rm/pubs/rmrs_gtr060.html

Literature Cited

Flack, J.A.D. 1976. Bird populations of aspen forests in western North America. Ornithological Monographs, No. 19. http://elibrary.unm.edu/sora/om/om019.pdf

Fleishman, E., and D.S. Dobkin. 2009. Current and potential future elevational distributions of birds associated with pinyon-juniper woodlands in the central Great Basin, U.S.A. Restoration Ecology 17:731-739.

Fleishman, E., G.T. Austin, and DD. Murphy. 2001. Biogeography of Great Basin butterflies: Revisiting patterns, paradigms, and climate change scenarios. Biological Journal of the Linnean Society 74:501-515.

Fleskes, J.P., R.L. Jarvis, and D.S. Gilmer. 2003. Selection of flooded agricultural fields and other landscapes by female Northern Pintails wintering in Tulare Basin, California. Wildlife Society Bulletin 31:793-803.

Fletcher, D.M. 2009. Distribution and site selection of Le Conte's and Crissal Thrashers in the Mojave Desert: A multi-model approach. M.S. Thesis. University of Nevada, Las Vegas.

Floyd, T. 2001. Summary of significant bird sightings in the Great Basin in 2000. Great Basin Birds 4:33-39. http://www.gbbo.org/gbb_pastissues.html

Floyd, T., C.S. Elphick, G.Chisholm, K. Mack, R.G. Elston, E.M. Ammon, and J.D. Boone. 2007. Atlas of the Breeding Birds of Nevada. University of Nevada Press, Reno, NV. 581 pp.

Fondell, T.F., and I.J. Ball. 2004. Density and success of bird nests relative to grazing on western Montana grasslands. Biological Conservation 117:203-213.

Fontaine, J.B., D.C. Donato, W.D. Robinson, B.E. Law, and J.B. Kauffman. 2009. Bird communities following high-severity fire: Response to single and repeat fires in a mixed-evergreen forest, Oregon, USA. Forest Ecology and Management 257:1496-1504.

Forbis, T., L. Provencher, L. Frid, and G. Medlyn. 2006. Great Basin land management planning using ecological modeling. Environmental Management 38:62-83.

Freese, M.T. 2009. Linking Greater Sage-Grouse habitat use and suitability across spatiotemporal scales in central Oregon. M.S. thesis. Oregon State University. Corvallis, OR.

Friend, M., R.G. McLean, and F.J. Dien. 2001. Disease emergence in birds: challenges for the twenty-first century. Auk 118:290-303. http://elibrary.unm.edu/sora/Auk/v118n02/p00290-p00303.pdf

Gaines, D., and S.A. Laymon. 1984. Decline, status, and preservation of the Yellow-billed Cuckoo in California. Western Birds 15:49-80.

Gammonley, J.H. 1996. Cinnamon Teal (*Anas cyanoptera*). *In* The Birds of North America, No. 209 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Garnett, M.C., J. Kahl, Jr., J. Swett, and E.M. Ammon. 2004. Status of the Yuma Clapper Rail (*Rallus longirostris yumanensis*) in the northern Mojave Desert compared with other parts of their range. Great Basin Birds 7:6-15. http://www.gbbo.org/gbb_pastissues.html

Garrett, K.L., M.G. Raphael, and R.D. Dixon. 1996. White-headed Woodpecker (*Picoides albolarvatus*). *In* The Birds of North America, No. 252 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Literature Cited

(GBBO) Great Basin Bird Observatory. 2008b. Habitat models for bird conservation in Nevada. Final report to the National Fish and Wildlife Foundation. Great Basin Bird Observatory, Reno, NV.

(GBBO) Great Basin Bird Observatory. 2009. Annual report on the Lower Colorado River riparian bird surveys. 2009. System Monitoring for Riparian Obligate Avian Species (Work Task D6) and Avian Use of Restoration Sites (Work Task F2) – Lower Colorado River Multi-Species Conservation Program. Document # 07SF300004. U. S. Bureau of Reclamation, Lower Colorado River Region, Boulder City, NV.

Giesen, K.M., and J.W. Connelly. 1993. Guidelines for the management of Columbian Sharp-tailed Grouse habitats. Wildlife Society Bulletin 21:325-333.

Gillihan, S.W. 2006. Sharing the Land with Pinyon-Juniper Birds. Partners in Flight Western Working Group. Salt Lake City, Utah. http://www.rmbo.org/v2/web/Publications/manuals.aspx

Girvetz, E.H., and S.E. Greco. 2009. Multi-scale predictive habitat suitability modeling based on hierarchically delineated patches: an example for Yellow-billed Cuckoos nesting in riparian forests, California, USA. Landscape Ecology 24:1315-1329.

Goguen, C.B., D.R. Curson, and M.E. Mathews. 2005. Breeding ecology of the Gray Flycatcher in pinyon-juniper woodlands in New Mexico. Western Birds 36:286-295. http://elibrary.unm.edu/sora/wb/v36n04/p0286-p0295.pdf

Goldstein, M.I., B. Woodbridge, M.E. Zaccagnini, and S.B. Canavelli. 1997. An assessment of mortality of Swainson's Hawks on wintering grounds in Argentina. Journal of Raptor Research 30:106-107

Good, R.E., R.M. Nielson, H. Sawyer and L.L. McDonald. 2007. A population estimate for Golden Eagles in the western United States. Journal of Wildlife Management 71:395-402.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and Willow Flycatchers: A summary of their science and policy connections. Geomorphology 47:169–188. http://www.seo.state.nm.us/PDF/ISC/BasinsPrograms/GilaSanFrancisco/Graf-2002-et-al.pdf

Graham, R.T., S. McCaffrey, and T.B. Jain. 2004. Science basis for changing forest structure to modify wildfire behavior and severity. USDA Forest Service General Technical Report RMRS-GTR-120. http://www.fs.fed.us/rm/pubs/rmrs_gtr120.html

Gratto-Trevor, C.L. 2000. Marbled Godwit (*Limosa fedoa*). *In* The Birds of North America, No. 492 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA.

Gratto-Trevor, C.L. 2006. Upland nesting prairie shorebirds: use of managed wetland basins and accuracy of breeding surveys. Avian Conservation and Ecology - Écologie et conservation des oiseaux 1(2): 2. [online] URL: http://www.ace-eco.org/vol1/iss2/art2/

Greaves, J.M. 1989. Maintaining site integrity for breeding Least Bell's Vireos. Pages 293-298 *in* Proceedings of the California Riparian Systems Conference: protection, management, and restoration for the 1990s. (D.L. Abell, ed.). USDA Forest Service General Technical Report PSW-110. Davis, CA. http://gis.fs.fed.us/psw/publications/documents/psw_gtr110/

Grebence, B.L., and C.M. White. 1989. Physiographic characteristics of Peregrine Falcon nesting habitat along the Colorado River system in Utah (USA). Great Basin Naturalist 49:408-418.

Greco, S.E. 2008. Long-term conservation of the Yellow-billed Cuckoo on the Sacramento River will require process-based restoration. Ecesis 18:4-7.

Literature Cited

Green, G.A., and R.G. Anthony. 1989. Nesting success and habitat relationships of Burrowing Owls in the Columbia Basin, Oregon. Condor 91:347-354.

Green, G.A., H .L. Bombay, and M .L. Morrison. 2003. Conservation Assessment of the Willow Flycatcher in the Sierra Nevada. USDA Forest Service, Region 5, Vallejo, CA. http://www.sierraforestlegacy.org/Resources/Conservation/SierraNevadaWildlife/WillowFlycatcher/WF-Green03.pdf

Greenwald, D.N., D.C. Crocker-Bedford, L. Broberg, K.F. Suckling, and T. Tibbitts. 2005. A review of Northern Goshawk habitat selection in the home range and implications for forest management in the western United States. Wildlife Society Bulletin 33:120-129.

Greger, P.D., and D.B. Hall. 2009. Burrow occupancy patterns of the Western Burrowing Owl in southern Nevada. Western North American Naturalist 69:285-294.

Griffis-Kyle, K.L., and P. Beier. 2003. Small isolated aspen stands enrich bird communities in southwestern ponderosa pine forests. Biological Conservation 110:375-385.

Gullion, G.W. 1960. The ecology of Gambel's Quail in Nevada and the arid Southwest. Ecology 41:518-536.

Gutiérrez, R.J., A.B. Franklin, and W.S. Lahaye. 1995. Spotted Owl (*Strix occidentalis*). *In* The Birds of North America, No. 179 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Gutiérrez, R.J., and D.J. Delehanty. 1999. Mountain Quail (*Oreortyx pictus*). *In* The Birds of North America, No. 457 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Gyug, L.W., C. Steeger, and I. Ohanjanian. 2009. Characteristics and densities of Williamson's Sapsucker nest trees in British Columbia. Canadian Journal of Forest Research 39:2319- 2331.

Hall, D.B, P.D. Greger, A.V. Cushman, and C.A. Wills. 2003. Ecology of the Western Burrowing Owl on the Nevada Test Site. Prepared by Bechtel Nevada Ecological Services for the U. S. Department of Energy, publication no. DOE/NV/11718-701, Las Vegas, NV.

Hall, D.B, P.D. Greger, and J.R. Rosier. 2009. Regional and seasonal diet of the Western Burrowing Owl in south central Nevada. Western North American Naturalist 69:1-8.

Halterman, M.D., M.J. Johnson and J A. Holmes. 2009. Western Yellow-billed Cuckoo natural history summary and survey methodology. Unpublished draft report, Southern Sierra Research Station, P.O. Box 1316, Weldon, CA 93283. Latest updates at: http://www.southernsierraresearch.org/cuckoo_methodology_May2010%5B1%5D.pdf

Hansen, A. J., R.L. Knight, J.M. Marzluff, S. Powell, K. Brown, P.H. Gude, and K. Jones. 2005. Effects of exurban development on biodiversity: Patterns, mechanisms, and research needs. Ecological Applications 15:1893-1905.

Hanson, C.T., and M.P. North. 2008. Postfire woodpecker foraging in salvage-logged and unlogged forests of the Sierra Nevada. Condor 110:777-782.

Hardy, P.C., T.N. Abeloe, R.X. Barry, and M.L. Morrison. 1998. Abundance and habitat associations of Common Poorwills in the Sonoran Desert. Southwestern Naturalist 43:234-241

Literature Cited

Hargrove, L. 2010. Black-chinned Sparrow: Notes on breeding behavior and nesting ecology in San Diego County, California. Western Birds 41:62-67.

Harms, R.S., and R.D. Hiebert. 2006. Vegetation response following invasive tamarisk (*Tamarix* spp.) removal and implications for riparian restoration. Restoration Ecology 14:461-472.

Hart, J.H., and D.L. Hart. 2001. Heartrot fungi's role in creating picid nesting sites in living aspen. p. 207–213 *in* Sustaining aspen in Western landscapes: symposium proceedings. (W.D. Shepperd, D. Binkley, D.L. Bartos, T.J. Stohlgren, and L.G. Eskew, eds.). USDA Forest Service Proceedings RMRS-P-18. http://www.fs.fed.us/rm/pubs/rmrs_p018.html

Hartman, C.A. 2008. Behavioral ecology and population biology of Long-billed Curlews in northeastern Nevada. PhD. Dissertation. University of Nevada, Reno.

Hartman, C.A., and L.W. Oring. 2006. Hayfields in Nevada: critical habitat for the highly imperiled Long-billed Curlew. Great Basin Birds 8:11-15.

Hartman, C.A., L.W. Oring, and C.M. Handel. 2009. Reproductive Success of Long-Billed Curlews (*Numenius americanus*) in Northeastern Nevada Hay Fields. Auk 126:420-430.

Hatten, J.R., E.H. Paxton, and M.K. Sogge. 2010. Modeling the dynamic habitat and breeding population of Southwestern Willow Flycatcher. Ecological Modelling 221:1674-1686.

Haug, E.A., B.A. Millsap, and M.S. Martell. 1993. Burrowing Owl (*Athen cunicularia*). *In* The Birds of North America, No. 61 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Healy, S., and W.A. Calder. 2006. Rufous Hummingbird (*Selasphorus rufus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/053

Heath, S.K., and G. Ballard. 2003. Bird species composition, phenology, nesting substrate, and productivity for the Owens Valley alluvial fan, eastern Sierra Nevada, California 1998-2002. Great Basin Birds 6:18-35. http://www.gbbo.org/gbb_pastissues.html

Heath, S.R., E.H. Dunn and D.J. Agro. 2009. Black Tern (*Chlidonias niger*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/147

Heckmann, K.E., P.N. Manley, and M.D. Schlesinger. 2008. Ecological integrity of remnant montane forests along an urban gradient in the Sierra Nevada. Forest Ecology and Management 255:2453-2466.

Heekin, P. E., and K. P. Reese. 1995. Validation of a Mountain Quail survey technique. Technical Report Appendix E.3.2-4. Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID. http://www.idahopower.com/pdfs/Relicensing/hellscanyon/hellspdfs/techappendices/Wildlife/e32_04.pdf

Heller, N E., and E.S. Zavaleta 2009. Biodiversity management in the face of climate change: A review of 22 years of recommendations. Biological Conservation 142:14-32.

Henny, C.J., R.J. Hallock, amd E.F. Hill. 1994. Cyanide and migratory birds at gold mines in Nevada, USA. Ecotoxicology 3:45-58.

Literature Cited

Henny, C.J., E.F. Hill, R.A. Grove, and J.L. Kaiser. 2007. Mercury and drought along the lower Carson River, Nevada: I. Snowy Egret and Black-crowned Night-Heron annual exposure to mercury, 1997 – 2006. Archives of Environmental Contamination and Toxicology 53:269-280.

Herman, S.G., J.B. Bulger, and J.B. Buchanan. 1988. The Snowy Plover in southeastern Oregon and western Nevada. Journal of Field Ornithology 59:13-21.

Herron, G. 1999. Status of the Northern Goshawk in the Great Basin. Great Basin Birds 2:9-12. http://www.gbbo.org/gbb_pastissues.html

Herron, G.B., C.A. Mortimore, and M.S. Rawlings. 1985. Nevada raptors: their biology and management. Nevada Department of Wildlife. Biological Bulletin No. 8. Reno. 121pp.

Hill, E.F., C.J. Henny, and R.A. Grove. 2008. Mercury and drought along the lower Carson River, Nevada: II. Snowy Egret and Black-crowned Night-Heron reproduction on Lahontan Reservoir, 1997 – 2006. Ecotoxicology 17:117-131.

Hilty, J.A., C. Brooks, H. Heaton, and A.M. Merenlender. 2006. Forecasting the effect of land-use change on native and non-native mammalian predator distributions. Biodiversity and Conservation 15:2853-2871.

Hoffman, S.W., and J.P. Smith. 2003. Population trends of migratory raptors in western North America, 1977-2001. Condor 105:397-419.

Hoffman, S.W., and J.P. Smith. 2005. Do Golden Eagles warrant special concern based on migration counts in the western United States? Reply to McCaffery and McIntyre. Condor 107:473-475.

Hollenbeck, J.P. 2006. Multi-scale relationships between aspen and birds in the Northern Yellowstone Ecosystem. Ph.D. Dissertation, Oregon State University.

Holmes, A.L. 2007. Short-term effects of a prescribed burn on songbirds and vegetation in mountain big sagebrush. Western North American Naturalist 67:292-298.

Holmes, J.A., and M.J. Johnson. 2005. Sage Sparrow (*Amphispiza belli*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/sagesparrow.pdf

Homer, C. 1998. Intermountain Region Land Cover Caracterization. CD-ROM, Remote Sensing/GIS Laboratories, Utah State University. ftp://ftp.gap.uidaho.edu/products/nevada/

Hughes, J.M. 1999. Yellow-billed Cuckoo (*Coccyzus americanus*). *In* The Birds of North America, No. 418 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA.

Hughes, K.M. 2007. Habitat selection of Band-tailed Pigeons. School of natural resources. Tucson, University of Arizona. M. S. thesis. 84 pp.

Hultine, K.R., J. Belnap, C. van Riper III, J.R. Ehleringer, P.E. Dennison, M.E. Lee, P.L. Nagler, K.A. Snyder, S.M. Uselman, and J.B. West. 2010. Tamarisk biocontrol in the western United States: ecological and societal implications. Frontiers in Ecology and the Environment 8:467-474.

Hunt, D., and S. Stiver. 2000. The effects of the 1999 wildfires on Nevada birds. Great Basin Birds 3:4-6. http://www.gbbo.org/gbb_pastissues.html

Literature Cited

Hutto, R.L. 1995. Composition of bird communities following stand-replacement fires in northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1041-1058.

Ivey, G.L. 1990. Population status of Trumpeter Swans in southeastern Oregon. Pages 118-122 *in* Proceedings and Papers of the 11th Trumpeter Swan Society Conference (D. Compton, ed.) The Trumpeter Swan Society, Maple Plain, MN.

Ivey, G.L., and B.D. Dugger. 2008. Factors influencing nest success of Greater Sandhill Cranes at Malheur National Wildlife Refuge, Oregon. Waterbirds 31:52-61.

Ivey, G.L., S.L. Earnst, E.P. Kelchlin, L. Neel, and D.S. Paul. 2004. White-faced Ibis status update and management guidelines: Great Basin population. U.S. Fish and Wildlife Service, Department of the Interior. Portland, OR.

Ivey, G.L., and C.P. Herziger. 2006. Intermountain West Waterbird Conservation Plan, Version 1.2. A plan associated with the Waterbird Conservation for the Americas Initiative. U.S. Fish and Wildlife Service Pacific Region, Portland, Oregon. http://www.fws.gov/pacific/migratorybirds/IWWCP-FINALversion%20with%20cover.pdf

IWJV (Intermountain West Joint Venture). *In preparation*. Figures compiled by Brad Andres for Revised Implementation Plan – Shorebirds.

Jehl, Jr., J.R. 1988. Biology of the Eared Grebe and Wilson's Phalarope in the nonbreeding season: A study of adaptations to saline lakes. Studies in Avian Biology 12:1–74. http://elibrary.unm.edu/sora/Condor/cooper/sab_012.pdf

Jehle, G., J.A. Savidge, and N.B. Kotliar. 2006. Green-tailed Towhee response to prescribed fire in montane shrubland. Condor 108:634-646.

Johnson, M.J., S.L. Durst, C.M. Calvo, L. Stewart, M.K. Sogge, G. Bland, and T. Arundel. 2008, Yellow-billed Cuckoo distribution, abundance, and habitat use along the lower Colorado River and its tributaries, 2007 Annual Report. U.S. Geological Survey Open-File Report 2008-1177. 274 pp. http://pubs.usgs.gov/of/2008/1177/

Johnson, N.K. 1972. Breeding distribution and habitat preference of the Gray Vireo in Nevada. California Birds 3:73-78. http://elibrary.unm.edu/sora/wb/v03n04/p0073-p0078.pdf

Johnson, N.K. 1994. Pioneering and natural expansion of breeding distributions in western North American birds. Studies in Avian Biology 15:27-44.

Johnson, R.E. 2002. Black Rosy-Finch (*Leucosticte atrata*). *In* The Birds of North America, No. 678 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA.

Johnson, R.R., H.K. Yard, and B.T. Brown. 1997. Lucy's Warbler (*Vermivora luciae*). *In* The Birds of North America, No. 318 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Jones, S.L., T.R. Stanley, S.K. Skagen, R.L. Redmond. 2003. Long-billed Curlew (*Numenius americanus*) Rangewide Survey and Monitoring Guidelines. http://library.fws.gov/Bird_Publications/long-billed_curlew_survey03.pdf

Kadlec, J.A., and L.M. Smith. 1989. The Great Basin marshes. Pages 451-475 *in* Habitat Management for Migrating and Wintering Waterfowl in North America (L. M. Smith, R. L Pederson, and R. M. Kaminski, eds.). Texas Tech University Press.

Literature Cited

Kauffman, M.J., J.F. Pollock, and B. Walton. 2004. Spatial structure, dispersal, and management of a recovering raptor population. American Naturalist 164:582-597

Kay, C.E. 2003. The condition and trend of aspen communities on BLM administered lands in central Nevada – with recommendations for management. Year Three. Providence, UT, Wildlife Management Services.

Kaye, M.W., D. Binkley, and T.J. Stohlgren. 2005. Effects of conifers and elk browsing on quaking aspen forests in the central Rocky Mountains, USA. Ecological Applications 15:1284-1295.

Keane, R.E., K.C. Ryan, T.T. Veblen, C.D. Allen, J. Logan, and B. Hawkes. 2002. Cascading effects of fire exclusion in the Rocky Mountain ecosystems: a literature review. USDA Forest Service General Technical Report RMRS-91:1-24. http://www.fs.fed.us/rm/pubs/rmrs_gtr091.html

Kelly, E.G., E.D. Forsman, and R.G. Anthony. 2003. Are Barred Owls displacing Spotted Owls? Condor 105:45-53.

Keppie, D.M., and C.E. Braun. 2000. Band-tailed Pigeon (*Columba fasciata*). *In* The Birds of North America, No. 530 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Kerley, L.L., and S.H. Anderson. 1995. Songbird responses to sagebrush removal in a high elevation sagebrush steppe ecosystem. Prairie Naturalist 27:129-146.

Ketner, K.B., and D.C. Ketner. 2002. Comparisons of avian populations at six localities in northern Nevada and Utah: 1867-1869 and 1994-2000. Great Basin Birds 5:6-12. http://www.gbbo.org/gbb_pastissues.html

King, D.T., and D.W. Anderson. 2005.Recent population status of the American White Pelican: a continental perspective. Waterbirds 28(Special Publication 1):48-54.

Kirkpatrick, C., C.J. Conway, K. Hughes, and J. deVos. 2005. An evaluation of survey methods for monitoring interior populations of Band-tailed Pigeons. Final Report. Wildlife Research Report #2005-03, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit. http://ag.arizona.edu/research/azfwru/cjc/research/Distribution,%20abundance....Band-tailed%20Pigeons/Publications/Webless%20Final%20Report%20February%202005.pdf

Kirkpatrick, C., C.J. Conway, and P.B. Jones. 2006. Distribution and relative abundance of forest birds in relation to burn severity in southeastern Arizona. Journal of Wildlife Management 70:1005-1012.

Kliejunas, J.T., B.W. Giles, J.M. Glaeser, E.M. Goheen, P. Hennon, M-S. Kim, H. Kope, J. Stone, R. Sturrock, S.J. Frankel. 2009. Review of literature on climate change and forest diseases of western North America. USDA Forest Service General Technical Report PSW-225. http://gis.fs.fed.us/psw/publications/documents/psw_gtr225/

Klute D.S., L.W. Ayers, M.T. Green, W.H. Howe, S.L. Jones, J.A. Shaffer, S.R. Sheffield, and T.S. Zimmerman. 2003 Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States. U. S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R6001-2003. Washington, D.C. http://library.fws.gov/BTP/westernburrowingowl03.pdf

Knapp, P. A. 1996. Cheatgrass (*Bromus tectorum* L) dominance in the Great Basin Desert : history, persistence, and influences to human activities. Global Environmental Change 6:37-52.

Literature Cited

Knick, S.T., and J.W. Connelly (editors). 2011(*in press*). Greater Sage-Grouse: Ecology and conservation of a landscape species and its habitats. Studies in Avian Biology Series (vol. 38), University of California Press, Berkeley, CA. http://sagemap.wr.usgs.gov/monograph.aspx

Knick, S T., and J.T. Rotenberry. 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. Conservation Biology 9:1059-1071.

Knick, S.T., and J.T. Rotenberry. 2002. Effects of habitat fragmentation on passerine birds breeding in Intermountain shrubsteppe. Studies in Avian Biology 25:130-140.

Knick, S.T., D.S. Dobkin, J.T. Rotenberry, M. A. Schroeder, W.M. Vander Haegen, and C. Van Riper III. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 105:611-634.

Knick, S.T., A.L. Holmes, and R.F. Miller. 2005. The role of fire in structuring sagebrush habitats and bird communities. Studies in Avian Biology 30:63-75.

Knick, S.T., J.T. Rotenberry, and M. Leu. 2008. Habitat, topographical, and geographical components structuring shrubsteppe bird communities. Ecography 31:389-400.

Knopf, F.L., and R.M. Evans. 2004. American White Pelican (*Pelecanus erythrorhynchos*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/057

Knopf, F.L., R.R. Johnson, T.D. Rich, F.B. Samson, and R.C. Szaro. 1988. Conservation of riparian ecosystems in the United States. Wilson Bulletin 100:272-284.

Knopf, F.L., J.A. Sedgwick, and D.B. Inkley. 1990. Regional correspondence among shrubsteppe bird habitats. Condor 92:45-53.

Kochert, M.N., and K. Steenhof. 2002. Golden Eagles in the U.S. and Canada: status, trends, conservation challenges. Journal of Raptor Research 36(supp.):33-41.

Kochert, M.N., K. Steenhof, C.L. McIntyre, and E.H. Craig. 2002. Golden Eagle (*Aqila chrysaetos*). *In* The Birds of North America, No. 684 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Kolada, E.J., M.L. Casazza, and J.S. Sedinger. 2009. Ecological factors influencing nest survival of Greater Sage-Grouse in Mono County, California. Journal of Wildlife Management 73:1341-1347.

Kotliar, N.B. 2007. Olive-sided Flycatcher (*Contopus cooperi*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/olivesidedflycatcher.pdf [accessed Feb 2010].

Krausman, P.R., D.E. Naugle, M.R. Frisina, R. Northrup, V.C. Bleich, W.M. Block, M.C. Wallace, and J.D. Wright. 2009. Livestock grazing, wildlife habitat, and rangeland values. Rangelands (Oct. 2009):15-19.

Kristan, W.B. III, and W.I. Boarman. 2007. Effects of anthropogenic developments on Common Raven nesting biology in the west Mojave Desert. Ecological Applications 17:1703-1713.

Krueger, J.K. 2000. Phainopepla (*Phainopepla nitens*) use of southern Nevada mesquite woodlands and management implications. Great Basin Birds 3:10-12.

Literature Cited

Krueper, D., J. Bart, and T.D. Rich. 2003. Response of vegetation and breeding birds to the removal of cattle on the San Pedro River, Arizona (U.S.A.). Conservation Biology 17:607-615.

Kruse K.L., J.R. Lovvorn, J.Y. Takekawa, and J. Mackay. 2003a. Long-term productivity of Canvasbacks (*Aythya valisineria*) in a snowpack-driven desert marsh. Auk 120:107-119.

Kruse K.L., J.R. Lovvorn, J.Y. Takekawa, and J. Mackay. 2003b. Winter distribution and survival of a high-desert breeding population of Canvasbacks. Condor 105:791-804.

Kus, B.E., and M.J. Whitfield. 2005. Parasitism, productivity, and population growth: response of Least Bell's Vireos (*Vireo bellii pusillus*) and Southwestern Willow Flycatchers (*Empidonax traillii extimus*) to Cowbird (*Molothrus* spp.) Control. Ornithological Monographs 57:16-27.

Kus, B.E., B.L. Peterson, and D.H. Deutschman. 2008. A multiscale analysis of nest predation on Least Bell's Vireo (*Vireo bellii pusillus*). Auk 125:277-284.

Kus, B.E., S.L. Hopp, R.R. Johnson and B.T. Brown. 2010. Bell's Vireo (*Vireo bellii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/035

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas. Washington, DC, U.S.A. http://www.pwrc.usgs.gov/nacwcp/nawcp.html

Kuvlesky, W.P., Jr., T.E. Fulbright, and R. Engel-Wilson. 2002. The impact of invasive exotic grasses on quail in the southwestern United States. Pages 118–128 *in* Quail V: The Fifth National Quail Symposium. (S.J. DeMaso, W.P. Kuvlesky, Jr., F. Hernandez, and M.E. Berger, eds.). Texas Parks and Wildlife Department, Austin, TX. ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/pdf/quail/ttrs_2001_21.118_128.pdf

Kuvlesky, W.P., Jr., L.A. Brennan, M.L. Morrison, K.K. Boydston, B.M. Ballard, and F.C. Bryant. 2007. Wind energy development and wildlife conservation: challenges and opportunities. Journal of Wildlife Management 71:2487-2498.

Laca, M., C. Mortimore, C. Nicolai, J. Mackay, and P. Bradley. 2008. Greater Sandhill Crane colt survival in northeastern Nevada. Unpublished Research Project Status Report, Nevada Department of Wildlife, Reno, NV.

Lammers, W.M., M.W. Collopy, and B. Comstock. 2007. Interactions between avian predators and Greater Sage-Grouse before and after construction of an overhead electric transmission line in northern Nevada. Great Basin Birds 9:43-51.

Laymon, S.A. 1989. Altitudinal migration movements of Spotted Owls in the Sierra Nevada, California. Condor 91:837-841.

Laymon, S.A. 1998. Yellow-billed Cuckoo (*Coccyzus americanus*). *In* The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight.http://www.prbo.org/calpif/htmldocs/species/riparian/yellow-billed_cuckoo.htm

Literature Cited

Laymon, S.A., and M.D. Halterman. 1989. A proposed habitat management plan for Yellow-billed Cuckoos in California. Pages 272-277 *in* Proceedings of the California Riparian Systems Conference: protection, management, and restoration for the 1990s. (D.L. Abell, ed.). USDA Forest Service General Technical Report PSW-110. Davis, CA. http://gis.fs.fed.us/psw/publications/documents/psw_gtr110/

Laymon, S.A., P.L. Williams, and M.D. Halterman. 1997. Breeding status of the Yellow-billed Cuckoo in the South Fork Kern River Valley, Kern County, California: Summary report 1985 - 1996. Administrative Rep. U.S.D.A Forest Service, Sequoia National Forest, Cannell Meadow Ranger District, Challenge Cost-Share Grant #92-5-13.

Laymon, S.A., and M.D. Halterman. 1998. The effects of Brown-headed Cowbirds on neotropical migrants in the Great Basin National Park and Lake Mead National Recreation Area: an overview report for 1995-96. Great Basin Birds 1:42-45. http://www.gbbo.org/gbb_pastissues.html

(LCR MSCP) Lower Colorado River Multi-species Conservation Program. 2004. Habitat Conservation Plan. Volume II in Lower Colorado River Multi-species Conservation Program. Prepared by Jones and Stokes, Sacramento, California. Prepared for the LCR MSCP, U.S. Bureau of Reclamation, Boulder City, Nevada. http://www.lcrmscp.gov/

Leary, A.W., R. Mazaika, and M.J. Bechard. 1998. Factors affecting the size of Ferruginous Hawk home ranges. Wilson Bulletin 110:198-205.

Lehman, R.N. 2001. Raptor electrocution on power lines: Current issues and outlook. Wildlife Society Bulletin 29:804-813.

Lehmkuhl, J.F., M. Kennedy, E.D. Ford, P.H. Singleton, W.L. Gaines, and R.L. Lind. 2007. Seeing the forest for the fuel: Integrating ecological values and fuels management. Forest Ecology and Management 246:73-80.

Lemly, A.D. 1994. Irrigated agriculture and freshwater wetlands: A struggle for coexistence in the western United States. Wetlands Ecology and Management 3:3-15.

Lesterhuis, A.J., and R.P. Clay. 2010. Conservation Plan for Wilson's Phalarope (*Phalaropus tricolor*). Version 1.1. Manomet Center for Conservation Sciences, Manomet, MA. http://www.whsrn.org/conservation-plans

Leu, M., S.E. Hanser, and S.T. Knick. 2008. The human footprint in the West: a large-scale analysis of anthropogenic impacts. Ecological Applications 18:1119-1139.

Limpert, R.J., and S.L. Earnst. 1994. Tundra Swan (*Cygnus columbianus*). *In* The Birds of North America, No. 89 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Lowther, P.E., H.D. Douglas III, and C.L. Gratto-Trevor. 2001. Willet (*Catoptrophorus semipalmatus*). *In* The Birds of North America, No. 579 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Lynn, S. 1996. Bird use of cottonwood-willow patches in the lower Colorado River Valley. M.S. thesis. University of Arizona.

Mack, R.N., and J.N. Thompson. 1982. Evolution in steppe with few large, hoofed animals. American Naturalist 119:757-773.

Literature Cited

Maguire, T.J. and K.S. Hadley. 2010. A multi-scale assessment of avian diversity following stream rewatering, Owens River Gorge, California. Natural Areas Journal 30:124-137.

Manley, P.N., D.D. Murphy, M.D. Schlesinger, L.A. Campbell, S. Merideth, M. Sanford, K. Heckmann, and S. Parks. 2007. The role of urban forests in conserving and restoring biological diversity in the Lake Tahoe Basin. Final report. USFS Lake Tahoe Basin Management Unit. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5150403.pdf

Manning A.E., and D S. Paul. 2003. Migratory waterbird use of the Great Salt Lake ecosystem. Great Basin Birds 6:5-17. http://www.gbbo.org/gbb_pastissues.html

Manzer, D.L., and S.J. Hannon. 2005. Relating grouse nest success and corvid density to habitat: a multi-scale approach. Journal of Wildlife Management 69:110-123.

Marks, J.S., and V.A.S. Marks, 1988. Habitat selection of Columbian Sharp-tailed Grouse in west-central Idaho. Journal of Wildlife Management 51:468-471.

Marti, C. D. 1997. Flammulated Owls (*Otus flammeolus*) breeding in deciduous forests. Pages 262-266 *in* Proceedings of the Second International Symposium on the Biology and Conservation of Owls of the Northern Hemisphere. (J. Duncan, ed.). 5-9 February 1997. Winnipeg, Manitoba, Canada. USDA Forest Service, Northeast Experiment Station.

Martin, J.W., and B.A. Carlson. 1998. Sage Sparrow (*Amphispiza belli*). *In* The Birds of North America, No. 326 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Marzluff, J.M., B.A. Kimsey, L.S. Schueck, M.E. McFadzen, M.S. Vekasy, and J.C. Bednarz. 1997. The influence of habitat, prey abundance, sex, and breeding success on the ranging behavior of Prairie Falcons. Condor 99:567-584.

McCallum, D.A. 1994. Flammulated Owl (*Otus flammeolus*). *In* The Birds of North America, No. 93 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

McIvor, D.E. 2005. Important bird areas of Nevada. Lahontan Audubon Society, Reno, Nevada. 150 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 206 pp. http://www.lcrmscp.gov/worktasks/systemmonitoring/D2/5year0307.pdf

McWethy, D.B., and J.E. Austin. 2009. Nesting ecology of Greater Sandhill Cranes (*Grus canadensis tabida*) in riparian and palustrine wetlands of eastern Idaho. Waterbirds 32:106-115.

Medin, D.E., B.L. Welch, and W.P. Clary. 2000. Bird habitat relationships along a Great Basin elevational gradient. USDA Forest Service Research Paper RMRS-RP-23. Fort Collins, CO. http://www.fs.fed.us/rm/pubs/rmrs_rp023.pdf

Meehan. T.D., and T.L. George. 2003. Short-term effects of moderate- to high-severity wildlife on a disturbance-dependent flycatcher in northwest California. Auk 120:1102-1113.

Meents, J.K., B.W. Anderson, and R.D. Ohmart. 1981. Vegetation characteristics associated with Abert's Towhee numbers in riparian habitats. Auk 98:818-827. http://elibrary.unm.edu/sora/Auk/v098n04/p0818-p0827.pdf

Literature Cited

Meents, J.K., B.W. Anderson, and R.D.Ohmart. 1984. Sensitivity of riparian birds to habitat loss. Pages 612-619 *in* California riparian systems: Ecology, conservation and productive management. (R.E. Warner, and K.E. Hendrix, eds.). Univ. of California Press, Berkeley.

Melcher, C.P., A. Farmer, and G. Fernández. 2010. Version 1.2. Conservation Plan for the Marbled Godwit (*Limosa fedoa*). Manomet Center for Conservation Science, Manomet, Massachusetts. http://www.whsrn.org/conservation-plans

Merritt, D.M., and N.L. Poff. 2010. Shifting dominance of riparian *Populus* and *Tamarix* along gradients of flow alteration in western North American rivers. Ecological Applications 20:135-152.

Meyers, M., R. Saval, and G. Chisholm. 1998. Seasons in the Basin. Great Basin Birds 1:12-25.

Mika, M. 2010. Population genetics and recent evolutionary history of the Flammulated Owl *(Otus flammeolus).* Ph.D. dissertation. University of Nevada, Las Vegas.

Miller, J.D., H.D. Safford, M. Crimmins, and A.E. Thode. 2009. Quantitative evidence for increasing forest fire severity in the Sierra Nevada and Southern Cascade Mountains, California and Nevada, USA. Ecosystems 12:16-32.

Miller, R.F. and J.A. Rose. 1999. Fire history and western juniper encroachment in sagebrush steppe. Journal of Range Management 52:550-559.

Miller, R.F., J. Rose, T. Svejcar, J. Bates, and K. Palntner. 1995. Western Juniper Woodlands: 100 Years of Plant Succession. Pages 16-23 *in* Desired future conditions for piñon-juniper ecosystems. (D.W. Shaw, E.F. Aldon, and C. LoSapio, eds). August 8-12, 1994. USDA Forest Service General Technical Report RM-258. http://www.fs.fed.us/rm/pubs_rm/rm_gtr258.html

Miller, R.F., R.J. Tausch, E.D. McArthur, D.D. Johnson, and S.C. Sanderson. 2008. Age structure and expansion of piñon-juniper woodlands: a regional perspective in the Intermountain West. USDA Forest Service Research Paper RMRS-RP-69. http://www.fs.fed.us/rm/pubs/rmrs_rp069.html

Miller, R.F., S. T. Knick, D.A. Pyke, C.W.Meinke, S.E. Hanser, M.J.Wisdom, and A.L. Hild. 2011(*in press*). Characteristics of sagebrush habitats and limitations to long-term conservation. *In* Greater Sage-Grouse: Ecology and conservation of a landscape species and its habitats. (S.T. Knick, and J.W. Connelly, eds). Studies in Avian Biology 38. http://sagemap.wr.usgs.gov/monograph.aspx

Mitchell, C.D., and M.W. Eichholz. 2010. Trumpeter Swan (*Cygnus buccinator*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/105

Mitchell, J.E., and Roberts, T.C., Jr. 1999. Distribution of pinyon-juniper in the western United States. Pages 146-154 *in* Proceedings: ecology and management of pinyon-juniper communities within the Interior West. (S.B. Monsen, and R. Stevens, eds.). 1997 September 15-18. USDA Forest Service RMRS-P-9. http://www.fs.fed.us/rm/pubs/rmrs_p009.html

Moore, W.S. 1995. Northern Flicker (*Colaptes auratus*). *In* The Birds of North America, No. 166 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Morrison, M.L., and A. Averill-Murray, 2002. Evaluating the efficacy of manipulating cowbird parasitism on host nesting success. Southwestern Naturalist 47:236-243.

Literature Cited

Morrison, M.L., R.J. Young, J.S. Romsos, and R. Golightly. 2010 (online preview). Restoring forest raptors: influence of human disturbance and forest condition on Northern Goshawks. Restoration Ecology. http://onlinelibrary.wiley.com/doi/10.1111/j.1526-100X.2009.00596.x/abstract

Morrison, R.I.G, B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor, and B.A. Andres. 2006. Population estimates of North American shorebirds, 2006. Wader Study Group Bulletin 111:67–85.

Mowbray, T.B. 2002. Canvasback (*Aythya valisineria*). *In* The Birds of North America, No. 659 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Mueggler, W.F. 1985. Vegetation associations. Pages 45-55 *in* Aspen: Ecology and management in the western United States. (N.V. DeByle, and R.P. Winokur, eds.). USDA Forest Service General Technical Report RM-119. http://www.fs.fed.us/rm/pubs_rm/rm_gtr119.html

Murphy, E.C. 2005. Biology and conservation of the American White Pelican: current status and future challenges. Waterbirds 28:107-112.

Murphy, E.C., and J.C. Tracy. 2005. Century-long impacts of increasing human water use on numbers and production of the American White Pelican at Pyramid Lake, Nevada. Waterbirds (Special Publ.) 28:61-72.

Nagel, T.A., and A.H. Taylor. 2005. Fire and persistence of montane chaparral in mixed conifer forest landscapes in the northern Sierra Nevada, Lake Tahoe Basin, California, USA. Journal of the Torrey Botanical Society 132:442-457.

NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life (web application). Version 7.0. NatureServe, Arlington Virginia. http://www.natureserve.org/explorer.

Naugle, D.E., C.L. Aldridge, B.L. Walker, K.E. Doherty, M.R. Matchett, J. McIntosh, T.E. Cornish, and M.S. Boyce. 2005. West Nile virus and Sage-grouse: What more have we learned? Wildlife Society Bulletin 33:616-623.

Naugle, D.E., K.F. Higgins, M.E. Estey, R.R. Johnson, and S.M. Nusser. 2000. Local and landscape-level factors influencing Black Tern habitat suitability. Journal of Wildlife Management 64:253-260.

Nebel, S., and J. M. Cooper. 2008. Least Sandpiper (*Calidris minutilla*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/115

NDOW (Nevada Department of Wildlife). 2008. Nevada Upland Game Species Management Plan. Game Division Internal Document. Nevada Department of Wildlife, 1100 Valley Road, Reno, NV.

NDOW (Nevada Department of Wildlife). 2009. Southwestern Willow Flycatcher and Yellow-billed Cuckoo survey and monitoring at select sites in southern Nevada. 2008 Annual Report. Reno.

NDOW (Nevada Department of Wildlife). 2010. Peregrine Falcon Fact Sheet. Available at: http://www.ndow.org/wild/animals/facts/birds_falcon_peregrine.shtm

Neel, L. 1999. In the regions – the NDOW year: summary of the Nevada Division of Wildlife 1998 non-game activities, NDOW Region I. Great Basin Birds 2:30-38.

Neel, L.A. 1999. Nevada Bird Conservation Plan. Nevada Partners in Flight Working Group. Reno, NV. http://www.partnersinflight.org/bcps/plan/pl-nv-10.pdf

Literature Cited

Neel, L.A., and W.G. Henry. 1996. Shorebirds of the Lahontan Valley, Nevada, USA: a case history of western Great Basin shorebirds. International Wader Studies 9:15–19.

Neel, L.A., P.V. Bradley, and C. Tomlinson. 2000. Nevada Division of Wildlife: 1999 bird report. Great Basin Birds 3:62-67.

Neilson, R.P., J.M Lenihan, D. Bachelet, and R.J. Drapek. 2005. Climate change implications for sagebrush ecosystems. Transactions of the North American Wildlife and Natural Resources Conference 70:145-159.

Nelle, P.J., K.P. Reese, and J.W. Connelly. 2000. Long-term effects of fire on Sage Grouse habitat. Journal of Range Management 53:586–591.

Nevada Governor's Sage-Grouse Conservation Team. 2004. Greater Sage-Grouse Conservation Plan for Nevada and Eastern California – First Edition. Nevada Department of Wildlife, Reno, NV. http://www.ndow.org/wild/conservation/sg/plan/index.shtm

Nevada Governor's Sage-Grouse Conservation Team. 2010. Nevada energy and infrastructure standards to conserve Greater Sage-Grouse and their habitats. http://www.ndow.org/wild/conservation/sg/resources/nevada_energy_standards_for_sage-grouse_2010.pdf

Nevada Wildlife Action Plan Team. 2006. Nevada Wildlife Action Plan. Nevada Department of Wildlife, Reno. 547 pp. http://www.ndow.org/wild/conservation/cwcs/

Newlon, K.R. 2005. Demography of Lewis's Woodpecker, breeding bird densities, and riparian aspen integrity in a grazed landscape. M.S. Thesis, Montana State University. http://www.rmrs.nau.edu/publications/Newlonthesis_final/Newlonthesis_final.pdf

Nicolai, C.H., P.L. Flint, and M.L. Wege. 2005. Annual survival, recovery rates, and site fidelity of Northern Pintails banded on the Yukon-Kuskokwim Delta, Alaska. Journal of Wildlife Management 69:1202-1210.

Nielson, R.M., T. Rintz, M.B. Stahl, R.E. Good, L.L. McDonald and T.L. McDonald. 2010. Results of the 2009 survey of Golden Eagle (*Aquila chrysaetos*) in the western United States. Western Ecosystems Tech. Inc. Contract # 201818C027 for the USFWS. http://www.west-inc.com/reports/2009GoldenEagleSurvey.pdf

Noson, A.C., R.A. Schmitz, and R.F. Miller. 2006. Influence of fire and juniper encroachment on birds in high-elevation sagebrush steppe. Western North American Naturalist 66:343-353.

Noyes, J.H. 1986. Consumption of largemouth bass eggs by Redhead ducks at Ruby Lake, Nevada. Auk 103:219-221. http://elibrary.unm.edu/sora/Auk/v103n01/p0219-p0221.pdf

Ohmart, R.D. 1994. The effects of human-induced changes on the avifauna of western riparian habitats. Pages 273-285 *in* A century of avifaunal change in western North America. (J.R. Jehl Jr., and N.K. Johnson, eds.). Studies in Avian Biology No. 15.

Olendorff, R.R. 1993. Status, biology, and management of Ferruginous Hawks: a review. Raptor Research and Technical Assistance Center, Special Report. U.S. Department of the Interior, Bureau of Land Management, Boise, Idaho. 84 pages.

Olson, C.R., and T.E. Martin. 1999. Virginia's Warbler (*Vermivora virginiae*). *In* The Birds of North America, No. 477 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Literature Cited

Oring, L.W., and J.M. Reed. 1996. Shorebirds of the western Great Basin of North America: overview and importance to continental populations. International Wader Studies 9:6-14.

Oring, L.W., L. Neel, and K.E. Oring. 2000. Intermountain west regional shorebird plan. U.S. Shorebird Conservation Plan. Version 1.0. U.S. Fish and Wildlife Service. Arlington, Virginia. http://www.fws.gov/shorebirdplan/RegionalShorebird/downloads/IMWEST4.pdf

Ouren, D.S., C. Haas, C.P. Melcher, S.C. Stewart, P.D. Ponds, N.R. Sexton, L. Burris, T. Fancher, and Z.H. Bowen. 2007. Environmental effects of off-highway vehicles on Bureau of Land Management lands: A literature synthesis, annotated bibliographies, extensive bibliographies, and internet resources: U.S. Geological Survey, Open-File Report 2007-1353, 225 p. http://www.mesc.usgs.gov/products/publications/22021/22021.pdf

Pacific Flyway Study Committee and Central Flyway Webless Migratory Game Bird Technical Committee. 2001. Pacific and Central Flyways management plan for the Four Corners population of Band-tailed Pigeons. Pacific Flyway Council, U.S. Fish and Wildlife Service, Portland, Oregon. 43pp. http://www.pacificflyway.gov/Documents/ibp_plan.pdf

Pacific Flyway Council. 2001. Pacific Flyway management plan for the western population of Tundra Swans. Pacific Flyway Study Comm., Subcomm. on Tundra Swans. Unpubl. Rept. [c/o USFWS], Portland, OR. 28 pp.+ appendices. http://www.pacificflyway.gov/Documents/Wts_plan.pdf

Page, G.W., and L.E. Stenzel. 1991. Distribution and abundance of the Snowy Plover on its western North American breeding grounds. Journal of Field Ornithology 62:245-255.

Page, G.W., L.E. Stenzel, G.W. Page, J.S. Warriner, J.C. Warriner and P.W. Paton. 2009. Snowy Plover (*Charadrius alexandrinus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from: http://bna.birds.cornell.edu/bna/species/154

Page, J.L., and D.J. Siebert. 1973. Inventory of Golden Eagle nests in Elko County, Nevada. Cal-Neva Wildlife: 1-8. http://www.tws-west.org/transactions/Page%20Seibert.pdf

Page, J.L., N.L. Dodd, T.O. Osborne, and J.A. Carson. 1978. The influence of livestock grazing on non-game wildlife. Cal-Neva Wildlife 1978:159-173.

Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. Interim Golden Eagle technical guidance: inventory and monitoring protocols; and other recommendations in support of eagle management and permit issuance. Division of Migratory Bird Management, U.S. Fish and Wildlife Service. http://www.fws.gov/southwest/es/oklahoma/Documents/Wind%20Power/Documents/USFWS_Interim_GOEA_Monitoring_Protocol_10March2010.pdf

Paige, C., and S.A. Ritter. 1999. Birds in a Sagebrush Sea: managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, ID. 47 pp. http://www.partnersinflight.org/wwg/sagebrush.pdf

Pampush, G.F., and R.G. Anthony. 1993. Nest success, habitat utilization, and nest-site selection of Long-billed Curlews in the Columbia Basin, Oregon. Condor 95:957-967.

Parsons, K.C., and T.L. Master. 2000. Snowy Egret (*Egretta thula*). *In* The Birds of North America, No. 489 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Paton, P.W.C. 1995. Breeding biology of Snowy Plovers at Great Salt Lake, Utah. Wilson Bulletin 107:275-288. http://elibrary.unm.edu/sora/Wilson/v107n02/p0275-p0288.pdf

Literature Cited

Pavlacky, D.C., Jr., and S.H. Anderson. 2001. Habitat preferences of pinyon-juniper specialists near the limit of their geographic range. Condor 103:322-331.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J.R. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in central Arizona—a 10-year synthesis report. U.S. Geological Survey Open-File Report 2007-1381. 143 p.

Pearson, S.F. 1997. Hermit Warbler (*Dendroica occidentalis*). *In* The Birds of North America, No. 303 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Pellant, M. 1994. History and applications of the Intermountain greenstripping program. Pages 63–68 *in* (S.B. Monsen and S.G. Kitchen, eds.). Proceedings—ecology and management of annual rangelands. General Technical Report INT-GTR-313, U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. http://www.sagestep.org/educational_resources/bibliographies/articles/Pellant1994.pdf

Petersen, K.L., and L.B. Best. 1985. Nest-site selection by Sage Sparrows. Condor 87:217-221.

Petersen, K.L., and L.B. Best. 1987. Territory dynamics in a Sage Sparrow population: are shifts in site use adaptive? Behavioral Ecology and Sociobiology 21:351-358.

Peterson, E.B. 2008. A Synthesis of Vegetation Maps for Nevada (Initiating a 'Living' Vegetation Map). Documentation and geospatial data, Nevada Natural Heritage Program, Carson City, Nevada. http://heritage.nv.gov/reports/synthmap.pdf

Picman, J., M.L. Milks, and M. Leptich. 1993. Patterns of predation on passerine nests in marshes: Effects of water depth and distance from edge. Auk 110:89-94.

Plissner, J.H., S.M. Haig, and L.W. Oring. 1999. Within- and between-year dispersal of American Avocets among multiple western Great Basin wetlands. Wilson Bulletin 111:314-320. http://elibrary.unm.edu/sora/Wilson/v111n03/p0314-p0320.pdf

Plissner, J.H., S.M. Haig, and L.W. Oring. 2000. Postbreeding movements of American Avocets and implications for wetland conservation in the western Great Basin. Auk 117:290-298. http://elibrary.unm.edu/sora/Auk/v117n02/p00290-p00298.pdf

Poole, A.F., and F. Gill, eds. 1992-2010. Birds of North America (BNA) Species Accounts (see individually cited accounts). http://bna.birds.cornell.edu/bna/

Poole, A.F., P. Lowther, J.P. Gibbs, F.A. Reid, and S.M. Melvin. 2009. Least Bittern (*Ixobrychus exilis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/017

Powers, L.C., and H.A. Glimp. 1996. Impacts of livestock on shorebirds: a review and application to shorebirds of the western Great Basin. International Wader Studies 9:55-63.

Powers, L.R., A. Dale, P.A. Gaede, C. Rodes, L. Nelson, J.J. Dean, and J.D. May. 1996. Nesting and food habits of the Flammulated Owl (*Otus flammeolus*) in southcentral Idaho. Journal of Raptor Research 30:15-20.

Prior-Magee, J.S., K.G. Boykin, D.F. Bradford, W.G. Kepner, J.H. Lowry, D.L. Schrupp, K.A. Thomas, and B.C. Thompson, editors. 2007. Southwest Regional Gap Analysis Project Final Report. U.S. Geological Survey, Gap Analysis Program. Moscow, ID. 422 pp. http://fws-nmcfwru.nmsu.edu/swregap/pubs.htm

Literature Cited

Provencher, L., T.A. Forbis, L. Frid, and G. Medlyn. 2007. Comparing alternative management strategies of fire, grazing, and weed control using spatial modeling. Ecological Modelling 209:249-263.

Rathbun, M.R., and G.T. Braden. 2003. The status of Yuma Clapper Rail and Yellow-billed Cuckoo along portions of the Virgin River and Muddy River in Southern Nevada for 2002. Unpublished Report to the Southern Nevada Water Authority, Las Vegas, NV.

Raumann, C.G., and M.E. Cablk. 2008. Change in the forested and developed landscape of the Lake Tahoe basin, California and Nevada, USA, 1940-2002. Forest Ecology and Management 255:3424-3439.

Rebholz, J.L. 2007. Influence of habitat characteristics on Greater Sage-Grouse reproductive success in the Montana Mountains, Nevada. M.S. thesis. Oregon State University, Corvallis, OR.

Redmond, R.L., D.A. Jenni. 1986. Population ecology of the Long-billed Curlew (*Numenius americanus*) in western Idaho. Auk 103:755–767. http://elibrary.unm.edu/sora/Auk/v103n04/p0755-p0767.pdf

Reed, J.M. 1995. Relative vulnerability of extirpation of montane breeding birds in the Great Basin. Great Basin Naturalist 55:342-351.

Reese, K.P., J.L. Beck, P. Zager, and P.E. Heekin. 2005. Nest and brood site characteristics of Mountain Quail in west-central Idaho. Northwest Science 79:254-264.

Reese, K.P., and R.T. Bowyer. 2007. Monitoring Populations of Sage-Grouse. Proceedings of a symposium at Idaho State University. College of Natural Resources Experiment Station. Station Bulletin 88. Moscow, Idaho. http://sgrp.usu.edu/files/uploads/grouseProcdngs4.pdf

Reinhardt, E.D., R.E. Keane, D.E. Calkin, and J.D. Cohen. 2008. Objectives and considerations for wildland fuel treatment in forested ecosystems of the interior western United States. Forest Ecology and Management 256:1997-2006.

Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce, Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the Northern Goshawk in the southwestern United States. USDA Forest Service General Technical Report RM-217. http://www.fs.fed.us/rm/pubs_rm/rm_gtr217.html

Reynolds, T.D., T.D. Rich, and D.A. Stephens. 1999. Sage Thrasher (*Oreoscoptes montanus*). *In* The Birds of North America, No. 463 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Rice, M.B., D.A. Haukos, J.A. Dubovsky, and M.C. Runge. 2010. Continental survival and recovery rates of Northern Pintails using band recovery data. Journal of Wildlife Management 74:778-787.

Rich, T. 1980. Nest placement in Sage Thrashers, Sage Sparrows and Brewers Sparrows. Wilson Bulletin 92:362-368. http://elibrary.unm.edu/sora/Wilson/v092n03/p0362-p0368.pdf

Rich, T.D. 2002. Using breeding land birds in the assessment of western riparian systems. Wildlife Society Bulletin 30:1128-1139.

Rich, T.D., M.J. Wisdom, and V.A. Saab. 2005. Conservation of priority birds in sagebrush ecosystems. Page 589-606 *in* Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference. March 20-24, 2002. Asilomar, California. USDA Forest Service General Technical Report PSW-191. http://gis.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/589-606.pdf

Literature Cited

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S.W. Bradstreet, G.S. Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A. Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, T.C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY. Partners in Flight website. http://www.partnersinflight.org/cont_plan/ (VERSION: March 2005).

Richardson, T.W., L.H. Crampton, and D.D. Murphy. 2007. Springs and sky islands: influence of springs and elevation on breeding bird communities in the Spring Mountains of southern Nevada. Great Basin Birds 9:21-34.

Robertson, B.A., and R.L. Hutto. 2007. Is selectively harvested forest an ecological trap for Olive-sided Flycatchers? Condor 109:109-121.

Robertson, G.J., and F. Cooke. 1999. Winter philopatry in migratory waterfowl. Auk 116:20-34. http://elibrary.unm.edu/sora/Auk/v116n01/p0020-p0034.pdf

Robinson, J.A., and L.W. Oring. 1996. Long-distance movements by American Avocets and Black-necked Stilts. Journal of Field Ornithology 67:307-320.

Robinson, J.A., and L.W. Oring. 1997. Natal and breeding dispersal in American Avocets. Auk:416-430. http://elibrary.unm.edu/sora/Auk/v114n03/p0416-p0430.pdf

Robinson, J.A., L.W. Oring, J.P. Skorupa, and R. Boettcher. 1997. American Avocet (*Recurvirostra americana*). *In* The Birds of North America, No. 275 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Robinson, J.A., J.M. Reed, J.P. Skorupa, and L.W. Oring. 1999. Black-necked Stilt (*Himantopus mexicanus*). *In* The Birds of North America, No. 449 (A. Poole and F. Gill, eds.). Academy of Natural Sciences, Philadelphia.

Rocke, T., K. Converse, C. Meteyer, and B. McLean. 2005. The impact of disease in the American White Pelican in North America. Waterbirds 28(Special Publication 1):87-94.

Rogers, P.C., W.D. Shepperd, and D.L. Bartos. 2007. Aspen in the Sierra Nevada: Regional conservation of a continental species. Natural Areas Journal 27:183-193.

Romme, W.H., L. Floyd-Hanna, D.D. Hanna, and E. Bartlett. 2001. Aspen's ecological role in the West. Pages. 243–259 *in* Sustaining Aspen in Western Landscapes: Symposium Proceedings, 13–15 June 2000, Grand Junction, CO. USDA Forest Service Proceedings RMRS-P-18.

Romme, W.H., C.D. Allen, J.D. Bailey, W.L. Baker, B.T. Bestelmeyer, P.M. Brown, K.S. Eisenhart, M.L. Floyd, D.W. Huffman, B.F. Jacobs, R.F. Miller, E.H. Muldavin, T.W. Swetnam, R.J. Tausch, and P.J. Weisberg. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in piñon–juniper vegetation of the western United States. Rangeland Ecology and Management 62:203-222.

Rosenberg K.V. 2004. Partners in Flight continental priorities and objectives defined at the state and bird conservation region levels: Nevada. Cornell Laboratory of Ornithology. Ithaca, NY.

Rosenberg, K.V., and P.J.Blancher. 2005. Setting numerical population objectives for priority landbird species. Pages 57–67 *in* Bird Conservation and Implementation in the Americas: Proceedings of the Third International Partners in Flight Conference, vol.1 (C.J.Ralph and T.D.Rich, eds.). U.S.Department of Agriculture, Forest Service, General Technical Report PSW-GTR-191.

Literature Cited

Rosenberg, K.V., R.D. Ohmart, W.C. Hunter, and B.W. Anderson. 1991. Birds of the Lower Colorado River Valley. University of Arizona Press, Tucson. 416 pp.

Rossi, L.G., and R.L. Knight. 2009. Cliff attributes and bird communities in Jefferson County, Colorado. Natural Areas Journal 26:331-338.

Rotenberry, J.T., and S.T. Knick. 1999. Multiscale habitat associations of the Sage Sparrow: implications for conservation biology. Studies in Avian Biology 19:95-103.

Rotenberry, J.T., M.A. Patten, and K.L. Preston. 1999. Brewer's Sparrow (*Spizella breweri*). *In* The Birds of North America, No. 390 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Rotenberry, J.T., and J.A. Wiens. 2009. Habitat relations of shrubsteppe birds: a 20-year retrospective. Condor 111:401-413.

Rothstein, S.I. 1994. The cowbird's invasion of the far west: history, causes and consequences experienced by host species. Studies in Avian Biology 15:301-315.

Rothstein, S.I., and B.D. Peer. 2005. Conservation solutions for threatened and endangered cowbird (*Molothrus* spp.) hosts: separating fact from fiction. Ornithological Monographs 57:98-114.

Rothstein, S.I., B.E. Kus, M.J. Whitfield, and S .J. Sferra. 2003, Recommendations for cowbird management in recovery efforts for the Southwestern Willow Flycatcher. Studies in Avian Biology 26:157–167.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report 144. Arizona Game and Fish Department, Phoenix, Arizona. http://sbsc.wr.usgs.gov/cprs/research/projects/swwf/Reports/WIFL_Nest_Monitoring_Protocol.pdf

Rubega, M.A., D. Schamel, and D.M. Tracy. 2000. Red-necked Phalarope (*Phalaropus lobatus*). *In* The Birds of North America, No. 538 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Ruhlen, T. D., G. W. Page, and L.E. Stenzel. 2006. Effects of a changing environment on nesting Snowy Plovers at Owens Lake, California. Western Birds 37:126-138. http://elibrary.unm.edu/sora/wb/v37n03/p0126-p0138.pdf

Russell, R.W., F.L. Carpenter, M.A. Hixon, and D.C. Paton. 1994. The impact of variation in stopover habitat quality on migrant Rufous Hummingbirds. Conservation Biology 8:483-490.

Ryan, M.R., and R.B. Renken. 1987. Habitat use by breeding Willets in the northern Great Plains USA. Wilson Bulletin 99:175-189. http://elibrary.unm.edu/sora/Wilson/v099n02/p0175-p0189.pdf

Ryan, T.P., and C.T. Collins. 2000. White-throated Swift (*Aeronautes saxatalis*). *In* The Birds of North America, No. 526 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Ryder, R.R., and D.E. Manry. 1994. White-faced Ibis (*Plegadis chihi*). *In* The Birds of North America, No. 130 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Saab, V.A., and J.S. Marks. 1992. Summer habitat use by Columbian Sharp-tailed Grouse in western Idaho. Great Basin Naturalist 52:166-173.

Literature Cited

Saab V.A., C.E. Bock, T.D. Rich, and D.S. Dobkin. 1995. Livestock grazing effects in western North America. Pages 311-353 *in* Ecology and Management of Neotropical Migratory Birds. (T.E. Martin, and D.M. Finch, eds.). Oxford University Press, New York.

Saab, V.A., W.M. Block, R. Russell, J.F. Lehmkuhl, L. Bate, and R. White. 2007. Birds and burns of the interior West: descriptions, habitats, and management in western forests. USDA Forest Service General Technical Report. PNW-GTR-712. http://www.fs.fed.us/pnw/pubs/pnw_gtr712.pdf

Saalfeld, S.T., W.C. Conway, D.A. Haukos, M. Rice, S.L. Jones, and S.D. Fellows. 2010. Multiscale habitat selection by Long-Billed Curlews (*Numenius americanus*) breeding in the United States. Waterbirds 33:148-161. http://www.fws.gov/mountain-prairie/species/birds/longbilled_curlew/Saalfeld-et-al-2010-Waterbirds.pdf

Safford, H.D., D.A. Schmidt, and C.H. Carlson. 2009. Effects of fuel treatments on fire severity in an area of wildland-urban interface, Angora Fire, Lake Tahoe Basin, California. Forest Ecology and Management 258:773-787.

Sanders, T.A., and W.D. Edge 1998. Breeding bird community composition in relation to riparian vegetation structure in the western United States. Journal of Wildlife Management 62:461-473.

Sauer, J.R., J.E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD; http://www.mbr-pwrc.usgs.gov/bbs/bbs.html; Accessed on 4/16/2010.

Schenk, M., and L. Goldblatt. 2005. Riparian Areas of the Great Basin: A Management Guide for Landowners. Wildlife Habitat Council. Silver Spring, Maryland. http://www.wildlifehc.org/migratorybirds/projects.cfm

Schier, G.A., J.R. Jones, and R.P. Winokur. 1985. Vegetative regeneration. Pp. 29-33 *in* Aspen: Ecology and management in the western United States. (N.V. DeByle, and R.P. Winokur, eds.). USDA Forest Service General Technical Report RM-119.

Schlesinger, M.D., P.N. Manley, M. Holyoak. 2008. Distinguishing stressors acting on land bird communities in an urbanizing environment. Ecology 89:2302-2314.

Schlossberg, S. 2006. Abundance and habitat preferences of Gray Vireos (*Vireo vicinior*) on the Colorado Plateau. Auk 123:33-44.

Schmutz, J.K. 1987. The effect of agriculture on Ferruginous and Swainson's Hawks. Journal of Range Management 40:438-440.

Schoennagel, T., T.T. Veblen, and W.H. Romme. 2004. The interaction of fire, fuels, and climate across Rocky Mountain forests. BioScience 54:661-676.

Schroeder, M.A., J.R. Young, and C.E. Braun. 1999. Sage Grouse (*Centrocercus urophasianus*). *In* The Birds of North America, No. 425 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Scoppettone, G.G., P.H. Rissler, D. Withers, and M.C. Fabes. 2006. Fish tag recovery from the American White Pelican colony on Anaho Island, Pyramid Lake, Nevada. Great Basin Birds 8:6-10.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H.-P. Huang, N. Harnik, A. Leetmaa, N.-C. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. Science 316:1181-1184.

Literature Cited

Seamans, M.E., and R.J. Gutiérrez. 2007. Habitat selection in a changing environment: the relationship between habitat alteration and spotted owl territory occupancy and breeding dispersal. Condor 109:566-576.

Seavy, N.E., T. Gardali, G.H. Golet, F.T. Griggs, C.A. Howell, R. Kelsey, S.L. Small, J.H. Viers, and J.F. Weigand. 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. Ecological Restoration 27:330-338.

Sedgwick, J.A. 1987. Avian habitat relationships in pinyon-juniper woodland. Wilson Bulletin 99:413-431. http://elibrary.unm.edu/sora/Wilson/v099n03/p0413-p0431.pdf

Sedgwick, J.A. 2000. Willow Flycatcher (*Empidonax traillii*). *In* The Birds of North America, No. 533 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Sedgwick, J.A., and F.L. Knopf. 1992. Describing Willow Flycatcher habitats: Scale perspectives and gender differences. Condor 94:720-733.

Serdehely, D. 2006. 2004 Pyramid Lake waterbird census, Washoe County, Nevada, including tabulation of census data from 1999 to 2004. Great Basin Birds 8:51-54.

Sharp, B.L., and B. E. Kus, 2006. Factors influencing the incidence of cowbird parasitism of Least Bell's Vireos. Journal of Wildlife Management 70:682-690.

Shaw, N.L., M. Pellant, and S.B.Monsen (compilers). 2005. Sage-grouse habitat restoration symposium proceedings. 2001 June 4-7, Boise, ID. USDA Forest Service Proceedings RMRS-P-38. http://www.fs.fed.us/rm/pubs/rmrs_p038.html

Shea, R.E., H.K. Nelson, L.N. Gillette, J.G. King, and D.K. Weaver. 2002. Restoration of Trumpeter Swans in North America: A century of progress and challenges. Waterbirds 25 (Special Publication 1): 296-300.

Sheppard, J.M. 1973. An initial study of Le Conte's Thrasher (*Toxostoma lecontei*). M.S. thesis, California State University, Long Beach.

Sheppard, J.M. 1996. Le Conte's Thrasher (*Toxostoma lecontei*). *In* The Birds of North America, No. 230 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Shuford, W.D. 1999. Status assessment and conservation plan for the Black Tern (*Chlidonias niger surinamensis*) in North America. U.S. Department of the Interior, Fish and Wildlife Service, Denver Federal Center, Denver CO.

Shuford, W.D., and T. Gardali (eds.). 2008. California Bird Species of Special Concern: A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California. Studies of Western Birds No.1, Western Field Ornithologists, and Calif. Department of Fish and Game, Sacramento. http://dfg.ca.gov/wildlife/nongame/ssc/birds.html

Shuford, W.D., G.W. Page, and L.E. Stenzel. 2002. Patterns of distribution and abundance of migratory shorebirds in the Intermountain West of the United States. Western Birds 33:134-174. http://elibrary.unm.edu/sora/wb/v33n03/p0134-p0174.pdf

Siegel, R.B., and D.F. DeSante. 2003. Bird communities in thinned versus unthinned Sierran mixed conifer stands. Wilson Bulletin 115:155-165.

Literature Cited

Slauson, K.M., W. J. Zielinski, and J. Baldwin. 2008. Northern Goshawk population monitoring in the Lake Tahoe Basin: Monitoring plan development and protocol. Final Report. USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, CA. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5150417.pdf

Smith, J.P. 2000. Fall 1999 raptor migration in the Goshute Mountains, Nevada. Great Basin Birds 3:28-31.

Smith, J.P., J.T. Hoffman, K.F. Sullivan, E.P. Van Arsdel, and D. Vogler. 2000. First report of white pine blister rust in Nevada. Plant Disease 84:594-594

Smith, J.P. C.J. Farmer, S.W. Hoffman, G.S. Kaltenecker, K.Z. Woodruff, and P.F. Sherrington. 2008. Trends in autumn counts of migratory raptors in western North America. Pages 217-254 *in* State of North America's birds of prey. (K.L. Bildstein, J.P. Smith, E. Ruelas Inzunza, and R.R. Veit, eds). Series in Ornith. #3, Nuttall Ornith. Club and the Am. Ornith. Union. http://www.idahobirdobservatory.org/publications/smith-raptor.pdf

Smith, S.D., K.J. Murray, F.H. Landau, and A.M. Sala. 1995. Structure of woody riparian vegetation in Great Basin National Park. Pages 246-251 *in* Proceedings: wildland shrub and arid land restoration symposium. (B.A. Roundy, E.D. McArthur, J.S. Haley, and D.K. Mann, eds.). 1993 October 19-21; Las Vegas, NV. USDA Forest Service General Technical Report INT-GTR-315. http://www.fs.fed.us/rm/pubs_int/int_gtr315/int_gtr315_246_251.pdf

Smith, T.F., D.M. Rizzo, and M. North. 2005. Patterns of mortality in an old-growth mixed-conifer forest of the southern Sierra Nevada, California. Forest Science 51:266-275.

Sogge, M.K., B.E. Kus, S.J. Sferra, M.J. Whitfield. 2003. Ecology and conservation of the Willow Flycatcher. Studies in Avian Biology 26: Cooper Ornithological Society, Camarillo, CA, 210 p.

Sogge, M.K., S.J. Sferra, and E.H. Paxten. 2008. *Tamarix* as habitat for birds: implications for riparian restoration in the southwestern United States. Restoration Ecology 16:146-154.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A natural history summary and survey protocol for the Southwestern Willow Flycatcher: U.S. Geological Survey Techniques and Methods 2A-10, 38 p. http://pubs.usgs.gov/tm/tm2a10/

Southern Nevada Water Authority. 2010. Marsh Bird Monitoring, including Yuma Clapper Rail, along Las Vegas Wash, Clark County, Nevada, 2007-2009. Las Vegas Wash Project Coordination Team. http://www.lvwash.org/assets/pdf/resources_ecoresearch_marshmonitoring.pdf

Squires, J.R., and R.T. Reynolds. 1997. Northern Goshawk (*Accipiter gentilis*). *In* The Birds of North America, No. 298 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Stacier, C.A., and M.J. Guzy. 2002. Grace's Warbler (*Dendroica graciae*). *In* The Birds of North America, No. 677 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Steenhof, K. 1998. Prairie Falcon (*Falco mexicanus*). *In* The Birds of North America, No. 346 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Steenhof, K., L. Bond, K.K. Bates, and L.L. Leppert. 2002. Trends in midwinter counts of Bald Eagles in the contiguous United States, 1986-2000. Bird Populations 6:21-32.

Steenhof, K., L. Bond, and L. L. Dunn. 2008. The midwinter Bald Eagle survey results and analysis 1986-2005. U.S.Geological Survey, National Biological Information Infrastructure, and

Literature Cited

Northwest Alliance for Computational Science and Engineering. Available on-line at http://www.nacse.org/nbii/eagles. (Accessed October 2010)

Steenhof, K., M.N. Kochert, L.B. Carpenter, and R.N. Lehman. 1999. Long-term Prairie Falcon population changes in relation to prey abundance, weather, land uses and habitat conditions. Condor 101:28-41.

Stefani, R.A., H. L.Bombay, and T.M. Benson. 2001. Willow Flycatcher. Pp. 143-195 *in* USDA Forest Service, Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement, Volume 3, Chapter 3, Part 4.4. USDA Forest Service, Pacific Southwest and Intermountain Regions.

Sterling, J.C. 1999. Gray Flycatcher (*Empidonax wrightii*). *In* The Birds of North America, No. 458 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA.

Stiver, S.J., A.D. Apa, J.R. Bohne, S.D. Bunnell, P.A. Deibert, S.C. Gardner, M.A. Hilliard, C.W. Mccarthy, and M.A. Schroeder. 2006. Greater Sage-Grouse Comprehensive Conservation Strategy. Western Association of Fish and Wildlife Agencies. Unpublished Report. Cheyenne, WY. http://www.wafwa.org/ documents/pdf/GreaterSage-grouseConservationStrategy2006.pdf

Stoleson, S.H., R.S. Shook, and D.M. Finch. 2000. Breeding biology of Lucy's Warbler in southwestern New Mexico. Western Birds 31:235-242. http://elibrary.unm.edu/sora/wb/v31n04/p0235-p0242.pdf

Storer, R.W., and G.L. Nuechterlein. 1992. Western Grebe (*Aechmophorus occidentalis*), Clark's Grebe (*Aechmophorus clarkii*). *In* The Birds of North America, No. 26 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Stromberg, J.C. 1993. Riparian mesquite forests: a review of their ecology, threats, and recovery potential. Journal of the Arizona-Nevada Academy of Science 27:111-124.

Stromberg, J.C. 2001. Restoration of riparian vegetation in the south-western United States: importance of flow regimes and fluvial dynamism. Journal of Arid Environments 49:17-34.

Stromberg, J.C., M.K. Chew, P.L. Nagler, and E.P. Glenn. 2009. Changing perceptions of change: The role of scientists in *Tamarix* and river management. Restoration Ecology 17:177-186.

Suring, L.H., M.J. Wisdom, R.J. Tausch, R.F Miller, M.M. Rowland, L. Schueck, and C.W. Meinke. 2005. Chapter 4: Modeling threats to sagebrush and other shrubland communities. Pages 114-149 *in* Habitat Threats in the Sagebrush Ecosystem. (M.J. Wisdom, M.M. Rowland, and L.H. Suring, eds.). Alliance Communications Group. Lawrence, Kansas.

Suter, G.W., and J.L. Joness. 1981. Criteria for Golden Eagle, Ferruginous Hawk, and Prairie Falcon nest site protection. Raptor Research 15:12-18.

Swett, J. 1999. The Southwestern Willow Flycatcher: an update. Great Basin Birds 2:12-15. http://www.gbbo.org/gbb_pastissues.html

Szaro, R.C. 1991. Wildlife communities of southwestern riparian ecosystems. Pages 175–201 *in* Wildlife and habitats in managed landscapes: an overview. (J.E. Rodiek and E.G. Bolen, eds). Island Press, Washington, DC.

Tacha, T.C., S.A. Nesbitt, and P.A. Vohs. 1992. Sandhill Crane (*Grus canadensis*). *In* The Birds of North America, No. 31 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Literature Cited

Takekawa, J.Y., and N. Warnock. 2000. Long-billed Dowitcher (*Limnodromus scolopaceus*). *In* The Birds of North America, No. 493 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Tausch, R.J., N.E. West, and A.A. Nabi. 1981. Tree age and dominance patterns in Great Basin pinyon-juniper woodlands. Journal of Range Management 34:259-264.

Taylor, D.M., and C.D. Littlefield. 1986. Willow Flycatcher and Yellow Warbler response to cattle grazing. American Birds 40:1169-1173.

Tenney, C.R. 1997. Black-chinned Sparrow (*Spizella atrogularis*). *In* The Birds of North America, No. 270 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Thogmartin, W.E., F.P. Howe, F.C. James, D.H. Johnson, E.T. Reed, J.R. Sauer, and F.R. Thompson III. 2006. A review of the population estimation approach of the North American Landbird Conservation Plan. Auk 123:892-904.

Thogmartin, W.E. 2010. Sensitivity analysis of North American bird population estimates. Ecological Modelling 221:173-177.

Thomas, G.H., R.B. Lanctot, and T. Székely. 2006. Can intrinsic factors explain population declines in North American breeding shorebirds? A comparative analysis. Animal Conservation 9:252-258.

(TNC) The Nature Conservancy. 2007. Conservation Action Planning Handbook: Developing strategies, taking action and measuring success at any scale. The Nature Conservancy, Arlington, VA. http://conserveonline.org/workspaces/cbdgateway/cap/index_html

Tobalske, B.W. 1997. Lewis' Woodpecker (*Melanerpes lewis*). *In* The Birds of North America, No. 284 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Torregrosa, A., and N. Devoe. 2008. Urbanization and changing land use in the Great Basin. Pages 9-13 *in* Collaborative management and research in the Great Basin — examining the issues and developing a framework for action. (J.C. Chambers, N. Devoe, and A. Evenden, eds.). USDA Forest Service General Technical Report RMRS-204. http://www.fs.fed.us/rm/pubs/rmrs_gtr204.html

Trammell, E.J., K. Berry, S. Bassett, and D.W. Sada. 2009. Distribution and recovery of vegetational assemblages in Ash Meadows National Wildlife Refuge, Nevada. The Southwestern Naturalist 53:326-334.

Trulio, L.A. 1995. Passive relocation: a method to preserve Burrowing Owls on disturbed sites. Journal of Field Ornithology 66:99-106.

Turner, W.R. 2006. Interactions among spatial scales constrain species distributions in fragmented urban landscapes. Ecology and Society 11:6.[online] http://www.ecologyandsociety.org/vol11/iss2/art6/

Tweit, R.C., D.M. Finch. 1994. Abert's Towhee (*Pipilo aberti*). *In* The Birds of North America, No. 111 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

(USFS) U.S. Forest Service. 2000. Survey methodology for Northern Goshawks in the Pacific Southwest Region. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region. Vallejo, CA.

(USFS) U.S. Forest Service. 2001. Sierra Nevada Forest Plan Amendment, Final Environmental Impact Statement U.S. Forest Service, Regional Office. Vallejo, CA. Available on-line at http://www.fs.fed.us/r5/snfpa/library/archives/rod/rod.pdf

Literature Cited

(USFWS) U.S. Fish and Wildlife Service. 1983. Yuma Clapper Rail (*Rallus longirostris yumanensis*) Recovery Plan. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM. http://www.fws.gov/southwest/es/arizona/Documents/RecoveryPlans/YumaClapperRail.pdf

(USFWS) U.S. Fish and Wildlife Service. 1986a. North American Waterfowl Management Plan. U.S. Department Interior, Washington, D.C. http://www.fws.gov/birdhabitat/nawmp/index.shtm

(USFWS) U.S. Fish and Wildlife Service. 1986b. Pacific Bald Eagle Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. http://www.fws.gov/ecos/ajax/docs/recovery_plan/0604193.pdf

(USFWS) U.S. Fish and Wildlife Service. 1998. North American Waterfowl Management Plan. 1998 update, Expanding the vision. U.S. Department of the Interior. Washington, D.C. http://www.fws.gov/birdhabitat/nawmp/index.shtm

(USFWS) U.S. Fish and Wildlife Service. 2001. Ruby Lake National Wildlife Refuge annual narrative report. Pages 18-26 *in* Unpublished Report, Ruby Lake NWR, Nevada.

(USFWS) U.S. Fish and Wildlife Service. Southwestern Willow Flycatcher Recovery Plan. Albuquerque, New Mexico. i-ix + 210 pp . http://www.fws.gov/southwest/es/arizona/SWWF_RP.htm

(USFWS) U.S. Fish and Wildlife Service. 2003. Monitoring Plan for the American Peregrine Falcon, a species recovered under the Endangered Species Act. U.S. Fish and Wildlife Service, Divisions of Endangered Species and Migratory Birds and State Programs, Pacific Region, Portland, OR. http://ecos.fws.gov/docs/species/doc1164.pdf

(USFWS) U.S. Fish and Wildlife Service. 2005. Designation of critical habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), Final Rule: Federal Register 70:60886–61009 (October 19, 2005).

(USFWS) U.S. Fish and Wildlife Service. 2009. Yuma Clapper Rail (*Rallus longirostris yumanensis*) Recovery Plan. Draft First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, NM. 64 pp. http://www.fws.gov/southwest/es/arizona Accessed on March 1, 2010.

Vamstad, M.S., and J.T. Rotenberry. 2010. Effects of fire on vegetation and small mammal communities in a Mojave Desert Joshua tree woodland. Journal of Arid Environments 74:1309-1318.

van Buskirk, J., R.S. Mulvihill, and R.C. Leberman. 2009. Variable shifts in spring and autumn migration phenology in North American songbirds associated with climate change. Global Change Biology 15:760-771.

van Kooten, G.C., A.J. Eagle, and M.E. Eiswerth. 2007. Determinants of threatened Sage Grouse in northeastern Nevada. Human Dimensions of Wildlife 12:53-70.

van Riper, C., K. L. Paxton, C. O'Brien, P.B. Shafroth, and L.J. McGrath. 2008. Rethinking avian response to *Tamarix* on the Lower Colorado River: a threshold hypothesis. Restoration Ecology 16:155-167.

Vander Haegen, W.M. 2007. Fragmentation by agriculture influences reproductive success of birds in a shrubsteppe landscape. Ecological Applications 17:934-947.

Vander Haegen, W.M., F.C. Dobler, and D.J. Pierce. 2000. Shrubsteppe bird response to habitat and landscape variables in eastern Washington, USA. Conservation Biology 14:1145–1160.

Literature Cited

Verner, J. 1980. Bird communities of mixed-conifer forests of the Sierra Nevada. Pages 198-223 *in* Management of western forests and grasslands for nongame birds. (R.M. DeGraff and N.G. Tilghman, eds.). USDA Forest Service General Technical Report INT-86. http://www.fs.fed.us/rm/pubs_int/int_gtr086.html

Verner, J., K.S. McKelvey, B.R. Noon, R.J. Gutiérrez, G.I. Gould Jr., and T.W. Beck. 1992. The California Spotted Owl: a technical assessment of its current status. USDA Forest Service General Technical Report PSW-GTR-133. http://gis.fs.fed.us/psw/publications/documents/psw_gtr133/

(WAFWA) Western Association of Fish and Wildlife Agencies. 2009. Prescribed fire as a management tool in xeric sagebrush ecosystems: is it worth the risk to sage-grouse? Available at: http://www.ndow.org/wild/conservation/sg/resources/report/prescribed_fire_white_paper.pdf

Walker, H.A. 2006. Southwestern avian community organization in exotic *Tamarix*: Current patterns and future needs. Pp. 274-286 *in* Monitoring Science and Technology Symposium: Unifying Knowledge for Sustainability in the Western Hemisphere. (C. Aguirre-Bravo, P.J. Pellicane, D.P. Burns, and S. Draggan, eds.). September 20-24, 2004; Denver, CO. USDA Forest Service Proceedings RMRS-P-42CD. http://www.fs.fed.us/rm/pubs/rmrs_p042.html

Walker, H.A., and R.H. Doster, eds. 2009. Proceedings of the Gray Vireo Symposium Co-Sponsored by the New Mexico Department of Game and Fish and the New Mexico Ornithological Society. 12–13 April 2008; Albuquerque, New Mexico. The New Mexico Department of Game and Fish, Santa Fe, New Mexico. http://www.wildlife.state.nm.us/conservation/threatened_endangered_species/documents/Proceedings-Gray-Vireo-Symposium_12-13-April-2008.pdf

Walston L.J., B.L. Cantwell and J.R. Krummel. 2009. Quantifying spatiotemporal changes in a sagebrush ecosystem in relation to energy development. Ecography 32:943-952.

Ward, J.P., Jr., and S.H. Anderson. 1988. Influences of cliffs on wildlife communities in southcentral Wyoming. Journal of Wildlife Management 52:673-678.

Waring, K., D. Reboletti, L. Mork, C.-H. Huang, R. Hofstetter, A. Garcia, P. Fulé, and T. Davis. 2009. Modeling the impacts of two bark beetle species under a warming climate in the southwestern USA: ecological and economic consequences. Environmental Management 44:824-835.

Warnock, N., S.M. Haig, L.W. Oring. 1998. Monitoring species richness and abundance of shorebirds in the western Great Basin. Condor 100:589-600.

Welch, B.L., and C. Criddle. 2003. Countering Misinformation Concerning Big Sagebrush. USDA Forest Service Research Paper RMRS-RP-40. http://www.fs.fed.us/rm/pubs/rmrs_rp040.html

West, J.M., S.H. Julius, P. Kareiva, C. Enquist, J.J. Lawler, B. Petersen, A.E. Johnson, and M.R. Shaw. 2009. U.S. natural resources and climate change: concepts and approaches for management adaptation. Environmental Management 44:1001–1021.

Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and earlier spring increases in western U.S. forest wildfire activity. Science 313:940-943.

Whisenant, S.G. 1990. Changing fire frequencies of Idaho's Snake River Plains: ecological and management implications. Pages 4–10 *in* Proceedings of the symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management. (E.D. MacArthur, E.M.

Literature Cited

Romney, D. Stanley, and P.T. Tueller, eds.). USDA Forest Service General Technical Report INT-276.

White, C.M., and T.L. Thurow. 1985. Reproduction of Ferruginous Hawks exposed to controlled disturbance. Condor 87:14-22.

White, C.M., N.J. Clum, T.J. Cade, and W.G. Hunt. 2002. Peregrine Falcon (*Falco peregrinus*). *In* The Birds of North America, No. 660 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Studies in Avian Biology 18:182-190.

Wiemeyer, S.N., and N. Saake. 2007. Feeding areas of American White Pelicans nesting at Pyramid Lake, Nevada. Great Basin Birds 9:35-42.

Wiens, J.A., and J.T. Rotenberry. 1981. Habitat associations and community structure of birds in shrubsteppe environments. Ecological Monographs 51:21-42.

Wiggins, D.A., D.W. Holt and S.M. Leasure. 2006. Short-eared Owl (*Asio flammeus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/062

Wightman, C.S., V.A. Saab, C. Forristal, K. Mellen-McLean, and A. Markus. 2010. White-headed Woodpecker nesting ecology after wildfire. Journal of Wildlife Management 74:1098-1106.

Wilson, T., E. Johnson, and J. Bissonette. 2009. Relative importance of habitat area and isolation for bird occurrence patterns in a naturally patchy landscape. Landscape Ecology 24:351-360.

Wilson, W.H. 1994. Western Sandpiper (*Calidris mauri*). *In* The Birds of North America, No. 90 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA.

Wisdom, M.J., and J.C. Chambers. 2009. A landscape approach for ecologically based management of Great Basin shrublands. Restoration Ecology 17:740-749.

Wisdom, M.J., B.C. Wales, M.M. Rowland, M.G. Raphael, R.S. Holthausen, T.D. Rich, and V.A. Saab. 2002. Performance of Greater Sage-Grouse models for conservation assessment in the interior Columbia Basin, U.S.A. Conservation Biology 16:1232–1242.

Woodbridge, B., and C.D. Hargis. 2006. Northern Goshawk Inventory and Monitoring Technical Guide. USDA Forest Service General Technical Report WO-71. http://gis.fs.fed.us/biology/wildecology/docs/GoshawkTechGuideJuly06.pdf

Woodin, M.C., and T.C. Michot. 2002. Redhead (*Aythya americana*). *In* The Birds of North America, No. 695 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA.

Woods, C.P., R.D. Csada, and R.M. Brigham. 2005. Common Poorwill (*Phalaenoptilus nuttallii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/032

Worrall, J.J., L. Egeland, T. Eager, R.A. Mask, E.W. Johnson, P.A. Kemp, and W.D. Shepperd. 2008. Rapid mortality of *Populus tremuloides* in southwestern Colorado, USA. Forest Ecology and Management 255:686-696.

Literature Cited

Wright, V. 1996. Multi-scale analysis of Flammulated Owl habitat use: owl distribution, habitat management, and conservation. M.S. Thesis. University of Montana. Missoula, MT. 91 pp.

Yates, M. 1999a. Satellite and conventional telemetry study of American White Pelicans in northern Nevada. Great Basin Birds 2:4-12. http://www.gbbo.org/gbb_pastissues.html

Yates, M. 1999b. Walker Lake telemetry loon study. Great Basin Birds 2:9-11.

Yates, M., M. Fuller, C. Henny, W. Seegar, and J. Garcia. 2010. Wintering area DDE source to migratory White-faced Ibis revealed by satellite telemetry and prey sampling. Ecotoxicology 19:153-162.

Yerkes, T. 2000. Nest-site characteristics and brood-habitat selection of Redheads: An association between wetland characteristics and success. Wetlands 20:575-580.

Yong, W., and D.M. Finch. 1997. Migration of the Willow Flycatcher along the middle Rio Grande. Wilson Bulletin 109:253–268. http://elibrary.unm.edu/sora/Wilson/v109n02/p0253-p0268.pdf

Younk, J.V., and M.J. Bechard. 1994. Breeding ecology of the Northern Goshawk in the high-elevation aspen forests of northern Nevada. Studies in Avian Biology 16:83-87. http://elibrary.unm.edu/sora/Condor/cooper/sab_016.pdf

Young, J.A. 1994. Changes in plant communities in the Great Basin induced by domestic livestock grazing. Pages 113-123 *in* Natural history of the Colorado Plateau and Great Basin. (K.T. Harper, L.L. St. Clair, K.H. Thorne, and W.M. Hess, eds.). University Press of Colorado, Niwot.

Zornes, M, and R.A. Bishop. 2009. Western Quail Conservation Plan. Edited by Scot J. Williamson. Wildlife Management Institute. Cabot, VT. 92 pp. http://westernquail.org/

Zwickel, F.C., and J.F. Bendell. 2005. Blue Grouse (*Dendragapus obscurus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/015

Glossary

Glossary of Terms Frequently Used in the Nevada Comprehensive Bird Conservation Plan

Aerial	In this plan, refers to the foraging habit of catching prey items on the wing (e.g., Common Poorwill catching moths in the air)
Aquatic	In this plan, usually refers to plants or prey items that are fully submerged under water (or birds dependent on open water)
Area Requirements	These include all known data on minimum patch size, recommended patch size, and territory or home range sizes to provide a scale for effective conservation action
Arthropod	Invertebrate with hard exoskeleton, including insects, spiders, centipedes, millipedes, crabs, and others, and includes their soft immature stages
Benthic	In this plan, refers to prey items that are buried in the soil substrates of wetlands or wet meadows
Clonal; Clone	Refers to plants that spread vegetatively, usually through the root system (e.g., aspen)
Colonial	Refers to birds (or other biota) that occur in clusters during all or part of their life stage; e.g., colonial waterbirds that nest in close proximity to one another
Conservation Priority	In this plan, all bird species defined as either Conservation Species or Stewardship Species
Conservation Species	In this plan, all species that are targeted by conservation efforts because of regional concerns, such as population declines, habitat threats, or restricted population sizes
Crepuscular	Describes animals that are primarily active during the twilight hours of dawn and dusk (e.g., Common Poorwills)
Dabbler	Refers to waterbirds that feed on aquatic prey or plant material while floating at the water surface, without diving; these species are often associated with shallow waterbodies
Diurnal	Describes animals that are primarily active during the daylight hours (e.g., Lewis's Woodpecker)
Diver	Refers to waterbirds that acquire aquatic prey and plant material by diving under water; these species are often associated with intermediate or deep water depths
Emergent	Refers to vegetation that is rooted under water but has significant growth above the water surface

Glossary

Forb	Broadleaved herbaceous plant species, including typical wildflower species and other, less showy cousins
Gleaning	Refers to foraging habit of picking prey items from the surface of a substrate (usually foliage)
Graminoid	Non-broadleaved herbaceous species, including grasses, sedges, and rushes
Granivorous	Feeds primarily or exclusively on seeds
Habitat	Term describing environmental requirements or suitable environments of one or more species of birds (including, but not restricted to, vegetation parameters); in this plan, often used interchangeably with “habitat type”
Habitat type	Bird habitat type, loosely defined as a major land cover type or local setting providing the basis for a unique bird assemblage; in this plan, often used interchangeably with “habitat”
Hemi-marsh	A marsh with 30 - 60% cover of emergent vegetation, large open water areas, and areas where small patches of emergent vegetation and open water are interspersed; ideal for many Priority bird species
Herbivory	Feeds primarily or exclusively on plant material
Herbaceous	All non-woody plants, including graminoids, forbs, and emergent aquatic plants such as cattail and bulrushes
Home Range	Area of activity by one breeding pair or vagrant during their stay in Nevada; home ranges are not actively defended against intruders
Important Bird Area	Nationally recognized hotspot for bird conservation, featuring a variety and abundance of conservation priority species; program administered by Audubon Society
Indicator species	Bird species that are not themselves conservation priorities, but only occur in intact habitat conditions that are presumed to be suitable for a majority of the native bird community; species selected based on expert opinion
Insectivorous	Feeds primarily on invertebrates, including insects, spiders, other arthropods and worms
Invasive plants	All plant species that have a tendency to colonize and dominate native plant communities in disturbed states, including noxious weeds, exotics, and some native species
Invertebrate	All animals that are not vertebrates, including insects, spiders, worms, clams, and crustaceans

AR063167

Glossary

Key Conservation Area	Regions or sites that are known to be particularly important to the species and in which conservation action is likely most effective; areas for protection are important for preserving existing populations, and areas for restoration are those regions where populations may be recovered through conservation and restoration
Landscape	The wider area beyond the habitat patch an organism occurs in; the mixture of cover types and other elements in this area, the ways an organism uses them, or the ways in which they affect the organism
Mesic	A relative term referring to plants or plant communities with greater access to water; although usually referring to conditions between xeric deserts and hydric wetlands, in this plan it is often used to refer to the entire wetter part of the continuum, including riparian and wetland habitats
Mosaic	In this plan, refers to habitat patchiness within a major land cover type; for instance, a grebe may use dense marsh vegetation for breeding, but it is important that open water is available for foraging within the same waterbody; the term can also refer to the arrangement of land cover types in the wider landscape
Nevada Bird Count	Statewide landbird monitoring program administered by GBBO since 2002; addresses long-term trend monitoring for all birds, but is most effective for diurnal landbirds
Nocturnal	Describes animals that are primarily active at night (e.g., Flammulated Owl)
Patch Size	Area of land in appropriate habitat required by a breeding pair or migrant; minimum patch size refers to the area required to attract at least one individual or pair; recommended patch size refers to the area estimated to be minimally necessary for achieving conservation effectiveness
Phenology	Particular pattern of a sequence of events; for instance, nesting phenology can be described with seasonal timing of onset, timing of peaks, and duration of breeding activities
Phreatophyte	A deep-rooted plant that obtains its water from the water table or the layer of sil immediately above it
Piscivorous	Feeds primarily or exclusively on fish
Predatory	In this plan, refers to birds that hunt primarily for terrestrial vertebrates
Probing	Refers to retrieving prey or other food items by inserting the bill into substrate (usually soil or bark)
Riparian	Associated with streams and rivers; usually short for “riparian habitat”, which refers to plant and insect communities and physical conditions associated with streamsides or river floodplains with direct access to water

Glossary

Seral stage	Refers to successional stage of particular plant or plant assemblage
Special Status Species	These include species that are not included as conservation species, but for which at least a moderate conservation concern, major research needs, or written agency policies exist
Species Concerns	Refers to reasons why the species was ranked as a Conservation Priority or Special Status species
Site Fidelity	Estimated degree of dependence on historically occupied sites; if ranked high, birds are unlikely to use alternate sites if their historic location is destroyed; if ranked low, birds are not particularly tied to any location on the landscape and readily colonize new sites if appropriate habitat becomes available
Stewardship Species	In this plan, Priority species that are not ranked as Conservation Species, but for which Nevada has a significant responsibility for maintaining populations because ≥ 20% of their global population occurs in the state
Stressor	Process or activity that can have negative effects on bird populations or bird habitats
Territory Size	Area used and defended by a breeding pair, or by a migrant during its stopover in Nevada; differs from home range in that territory only refers to the actively defended area, usually around the nest or an important food resource
Uplands	Refers in this plan to non-mesic habitat types, such as salt desert, Mojave scrub, Joshua tree, coniferous forest, pinyon-juniper, etc.; the distinction is made to distinguish from wetland, riparian, open water, or aspen, which display vegetation that either directly or indirectly accesses water most of the time

AR063169

Acronyms

Acronyms Frequently Used in the Nevada Comprehensive Bird Conservation Plan

ABC	American Bird Conservancy
ACEC	Area of Critical Environmental Concern (BLM designation)
AKN	Avian Knowledge Network (data sharing program administered by Cornell Lab of Ornithology)
BBS	Breeding Bird Survey (national bird monitoring program administered by USGS)
BLM	Bureau of Land Management (U.S. Department of Interior)
CAP	Conservation Action Planning (TNC process)
CC MSHCP	Clark County Multiple Species Habitat Conservation Plan (administered by Clark County Desert Conservation Program)
CSI MSHCP	Coyote Springs Investments LLC Multiple Species Habitat Conservation Plan
DBH	Diameter at Breast Height (4.5 feet)
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
ESA	Endangered Species Act (USFWS)
GBBO	Great Basin Bird Observatory
GAP	Gap Analysis Program (USGS)
GIS	Geographic Information Systems (spatial analysis software)
IBA	Important Bird Area (administered by Audubon Society)
IWJV	Intermountain West Joint Venture
LCR MSCP	Lower Colorado River Multi-Species Conservation Program (administered by USBR)
NBC	Nevada Bird Count Program (administered by GBBO)
NDOW	Nevada Department of Wildlife (State of Nevada)
NGO	Non-governmental organizations (such as ABC, GBBO, or TNC)
NNHP	Nevada Natural Heritage Program
NPS	National Park Service (U.S. Department of Interior)

Acronyms

NRA	National Recreation Area (managed by NPS or USFS)
NVPIF	Nevada chapter of Partners-in-Flight (PIF)
NWAP	Nevada Wildlife Action Plan (NDOW)
NWI	National Wetlands Inventory (USFWS)
NWR	National Wildlife Refuge (managed by USFWS)
OHV	Off-highway-vehicle (popular tool for recreation in Nevada)
PIF	Partners in Flight (multi-organizational, national bird conservation initiative)
SLC HCP	Southeastern Lincoln County Habitat Conservation Plan
SNC MSHCP	Southern Nye County Multiple Species Habitat Conservation Plan
SNWA	Southern Nevada Water Authority
SW ReGAP	Southwest Regional Gap Analysis Project
TNC	The Nature Conservancy
UNR	University of Nevada, Reno
USBR	U.S. Bureau of Reclamation (U.S. Department of Interior)
USFS	U.S. Forest Service (U.S. Department of Agriculture)
USFWS	U.S. Fish and Wildlife Service (U.S. Department of Interior)
USGS	U.S. Geological Survey (U.S. Department of Interior)
VR HCRP	Virgin River Habitat Conservation and Recovery Program
WAFWA	Western Association of Fish and Wildlife Agencies
WMA	Wildlife Management Area (managed by NDOW)

Appendices

Appendix 1: Methods

Selection of Priority Species

General Selection Criteria

Priority bird species for this plan were selected based on a set of systematic qualifying criteria. By default, a species was given priority status if it: 1) regularly occurs in Nevada (*Appendix 2*), and 2) meets one or more of the following criteria as determined by agencies, bird conservation initiatives, legal mandate, or Nevada stewardship responsibility:

a) *Audubon Watchlist*: Red or Yellow List rankings
b) *Partners in Flight North American Landbird Conservation Plan* (Rich et al. 2004): Watch List ranking
c) *Intermountain West Waterbird Conservation Plan* (Ivey and Herziger 2006): High or Moderate Concern rankings
d) *Intermountain West Regional Shorebird Plan* (Oring et al. 2000): Critically Important or Very Important rankings
e) Pacific Flyway portions of the *North American Waterfowl Management Plan* (USFWS 1986, 1998): High-ranking species with significant presence in Nevada
f) *Nevada Department of Wildlife Upland Game Species Management Plan* (NDOW 2008): High Concern ranking
g) Listed by USFWS under the Endangered Species Act (ESA), including candidate species
h) Protected under the Bald and Golden Eagle Protection Act
i) Significant species stewardship responsibility: ≥ 20% of the estimated global population occurs in Nevada.

Priority species were divided into three different categories, following the usage of Chase and Geupel (2005). All Priority species, regardless of category, are treated in an individual species account. Each category is described below.

Conservation Priority Species

Conservation Priority species require active conservation efforts, such as habitat protection, habitat restoration, special or enhanced monitoring efforts, further research, or additional public education. Generally, there are tangible reasons for concern about a Conservation Priority species, which may include:

a) Known or probable population declines
b) Dependence on restricted habitats
c) Small population size
d) Habitat threats

Although the habitat-based conservation strategies presented in this plan were designed to benefit entire bird communities, they were initially motivated by the needs of Conservation Priority species.

Stewardship Species

There were four species that qualified for Priority status based only upon the fact that Nevada is estimated to support ≥ 20% of global population. These were designated as Stewardship species. We believe these Stewardship species deserve priority consideration in Nevada because significant threats in the state can have significant impacts on the entire species. In some cases, Conservation Priority species also had high Nevada stewardship percentages; this is noted in the "Conservation Profile" tables within the species accounts.

Special Status Species

The Special Status designation was used for three species that did not qualify as Conservation Priority or Stewardship Species, but that still merited attention in this plan. Two of these species, Bald Eagle and Peregrine Falcon, have recently been de-listed under the ESA and require ongoing population monitoring. The third species, Burrowing Owl, was included in this category because its conservation status is currently difficult to assess. On the one hand, there are conservation concerns about Burrowing Owls in many western states, but on the other, we could find no evidence of population declines or serious threats in Nevada. We anticipate being able to determine whether or not Burrowing Owl should be assigned Conservation Priority status in some future revision of this plan.

Exceptions

Northern Goshawk and Ferruginous Hawk were included as Conservation Priority species despite not formally qualifying under the guidelines listed above. Both are considered priority species by management agencies in Nevada (USFS, BLM, NDOW), and the Nevada PIF working group felt that their omission from the regional planning documents listed above was an oversight that should be corrected in this plan.

Sources of Information

In preparing this plan, we reviewed and synthesized many sources of information about the status, ecology, and management of Priority species and their habitats in Nevada. We relied most heavily on the following set of sources that were particularly well-suited to the needs of the plan:

Published Sources

Birds of North America (BNA) Species Accounts (Poole and Gill 1992-2002; cited individually in the *Literature Cited* section): This catalog of species accounts generally features an exhaustive literature review and synthesis of knowledge about every North American bird. As such, it is often the best source of information about a given species' ecology, distribution, habitat use,

breeding and foraging habits, migration patterns and phenology, population trends, threats, and conservation needs. In practice, not all species accounts cover these topics with equal thoroughness, and Nevada-specific information was available for some species but not for others.

Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004): The continental Partners in Flight (PIF) plan provided global population estimates for landbirds, which were needed for estimating percent of global population size present in Nevada. Global population estimates were based on an analysis of Breeding Bird Survey (BBS) data for the North American portion of a species' distribution. These global estimates were stepped down to the state level by Peter Blancher and colleagues, which provided us with one source of statewide landbird population estimates for Nevada, which we referred to as the "PIF estimate." [These estimates can be found online at the Partners in Flight Landbird Population Estimates Database: http://rmbo.org/pif_db/laped/] Because Nevada has only a few historically-active BBS routes from which to extrapolate, the stepped-down statewide population estimates may be unreliable for some species.

Intermountain West Regional Shorebird Plan (Oring et al. 2000): This regional plan was created under the umbrella of the U.S. Fish and Wildlife Service's *U.S. Shorebird Conservation Plan* (Brown et al. 2001). It provides an excellent source of information about the status, trends, population sizes, hotspots, and conservation issues regarding Nevada's shorebirds.

Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006): This regional plan was created under the umbrella of the "Waterbird Conservation for the Americas Initiative," which produced the *North American Waterbird Conservation Plan* (Kushlan et al. 2002). It provides an excellent source of information about the status, trends, population sizes, distributions, and conservation issues of Nevada's nongame waterbirds.

Nevada Upland Game Species Management Plan (NDOW 2008): This plan was consulted as the best single source of information about the status, trends, population sizes, distributions, and management concerns of Nevada's upland game birds.

Other published sources

We expended considerable effort to glean as much information as possible from scientific journals and agency reports. We gave the greatest weight to quantitative, species-specific conservation or habitat related data from Nevada or immediately adjacent regions. Next in priority were sources relevant to wider regions (such as the Intermountain West) that had some applicability to Nevada. These are cited throughout the plan with full references collected in the *Literature Cited* section.

Data Sources

Nevada Bird Count

The Nevada Bird Count (NBC) was the most heavily used source of data for this plan. Due to its length, a full description of this program is presented at the end of this section (p. App-1-5).

Appendices

Breeding Bird Survey (BBS) Trends and Analyses

The latest trends analyses of BBS data (Sauer et al. 2008; http://www.mbr-pwrc.usgs.gov/bbs/) were consulted to determine regional and continental population trends for the period 1966 – 2007. For most species, reliable Nevada-specific trends were not available, but trend estimates were often available for wider geographic regions that included Nevada.

Nevada Breeding Bird Atlas Project

The Nevada Breeding Bird Atlas project, conducted by the Great Basin Bird Observatory (GBBO), involved systematic statewide data collection to document all confirmed and probable breeding bird species during the period 1997 – 2000 (see Floyd et al. 2007 for details). The database that was generated by the atlas contains over 30,000 bird observation records, and it provides one of the major sources of data on bird distribution, breeding status, and breeding phenology in Nevada. The atlas database is available upon request to GBBO. Atlas methods were well-suited for surveying most diurnal landbirds and some secretive species, such as owls, but they were less effective for birds that tend to congregate in large numbers in widely scattered sites (e.g., many shorebirds, waterbirds, and waterfowl), for upland game birds with sporadic, disconnected distributions, and for a handful of other bird taxa that are difficult to survey with a standard multi-species protocol (e.g., nightjars, hummingbirds). Many of the species that were under-surveyed by atlas methods were better covered by data sets residing at the federal and state wildlife agencies, which were also consulted for this plan.

Nevada Department of Wildlife Diversity Database

The Nevada Department of Wildlife maintains a database of wildlife occurrence records that are collected during the course of the agency's work across the state. This database, combined with databases from the Nevada Bird Count and the Nevada Breeding Bird Atlas project, was used for determining distribution patterns and creating range maps (see "Range Maps" section, below).

Site-Specific Waterbird and Shorebird Surveys

Site-specific monitoring of waterbirds and shorebirds is routinely performed on National Wildlife Refuges by USFWS refuge staff and on Nevada's State Wildlife Management Areas by NDOW staff. Additionally, NDOW conducts annual aerial surveys of colonial waterbirds and waterfowl, and seasonal migration surveys of shorebirds in the Lahontan Valley area (Larry Neel, *pers. comm.*). Collectively, these data sources allow us to estimate waterbird and shorebird numbers, abundance peaks, distributions, and, in some cases, trends. These data sources were compiled by Larry Neel (NDOW) for use in this plan.

Aquatic Bird Count

The Aquatic Bird Count is a GBBO program for aquatic bird monitoring throughout Nevada. Although this program's survey activities vary in scope from year to year, it has generated a database that is useful in helping to determine the distributions and seasonal presence of

waterfowl, waterbirds, and shorebirds in many areas of the state. The Aquatic Bird Count database is available upon request to GBBO.

eBird

eBird (www.ebird.org), an offering of the Cornell Laboratory of Ornithology and partners, is a web-based repository of observations and sightings uploaded by birders and ornithologists from across the globe. Its visualization tools are especially useful for determining seasonal presence, phenology, and distribution of birds across any area of interest.

Other

Other data sources consulted for particular species included:

a) Raptor nest surveys conducted by NDOW, USFS, BLM, and their partners (including the "Great Basin Raptor Nest Survey" program coordinated by HawkWatch International; see www.hawkwatch.org/conservation-science/raptor-nest-survey)
b) Winter raptor surveys conducted by NDOW and partners (Southern Nevada Water Authority, GBBO)
c) Special surveys conducted for species of interest (including Yellow-billed Cuckoo, Southwestern Willow Flycatcher, Peregrine Falcon, Yuma Clapper Rail, Snowy Plover, Bendire's Thrasher, and Flammulated Owl) by a variety of agencies, organizations, consultants, or academic scientists

Nevada Bird Count (detailed program description)

Overview: The Nevada Bird Count (NBC) is a standardized statewide landbird monitoring program that was initiated by the Great Basin Bird Observatory in 2002. Like the atlas project, it is focused on the breeding season, but NBC uses a more quantitative approach to sampling in order to more effectively detect long-term population trends (e.g. Bart 2005a). NBC monitoring has been conducted every year since program inception, and its dataset at the time this plan was prepared included eight years (2002-2009) of monitoring results from 546 transects. As such, it provides the most useful single source of information about the distributions, habitat relationships, population sizes, and densities for Nevada's landbirds.

The NBC uses a standard point-count protocol combined with area search/spot-mapping surveys in a double-sampling effort, in order to obtain detectability estimates for as many species as possible. It is an "all-bird" protocol, meaning that all species detected during a survey are recorded, but detection rates are best for small diurnal landbirds, such as songbirds, woodpeckers and their allies, and similar species that are readily visible or detectable by sound.

The NBC dataset was heavily used in the preparation of this plan, especially for generating:

a) Nevada population size estimates
b) Density estimates by habitat type
c) Statistical analyses of habitat associations

d) Range maps, in combination with atlas data and NDOW data, as described above

NBC Study Design: The NBC sampling plan is habitat-stratified (see "Habitat Types" section below for a complete description of the habitat designations used). To the extent possible, transects were randomly selected within each habitat type with the help of GIS land cover maps, although adjustments were sometimes required due to access issues or poorly mapped habitat types. All transects were located off-road, except in sites where roads could not be avoided (e.g., riparian areas in canyons), or where roads are part of the habitat type being surveyed (e.g., agricultural areas). Allocation of survey effort among habitat types was determined by conservation priorities, agency needs, and a statistical power analysis conducted during the first two years of the NBC program.

Several partner organizations and agencies were willing to integrate their ongoing monitoring efforts by adhering to NBC protocols and contributing their data to the NBC database. These partners included the Clark County Desert Conservation Program, Great Basin National Park, the USFS Humboldt-Toiyabe National Forest, NDOW, BLM, Lake Mead National Recreation Area, Southern Nevada Water Authority, the USFWS National Wildlife Refuge system, and the U.S. Bureau of Reclamation. This coordination has greatly improved the scope and statistical power of the NBC database.

NBC Survey Protocol: Full descriptions of NBC survey protocols can be obtained at http://www.gbbo.org/data.html. Briefly, NBC surveys are conducted between April 25 and June 30 in the Mojave Desert region, and between May 25 and July 10 in the Great Basin region. Each transect (location) is covered using an array of ten point-count stations. A 10-minute survey is conducted at each point, in fair weather conditions, and with all ten points of one transect completed within four hours after daybreak. All birds detected by sight and sound are recorded in three time intervals (0-3 min, 3-5 min, 5-10 min) and at three distance intervals (0-50 m, 50-100 m, > 100 m).

Detectability: Point-count data are affected by species-specific detectability, and thus the NBC protocol includes a double-sampling effort that combines areas searches with point-counts to estimate species-specific detectability (Bart and Earnst 2002). Results to date show that for moderately vocal or visible species, the 10-minute survey protocol for point counts results in a detection ratio of close to 1.0 within a 100 m distance (all birds present are detected). Therefore, all NBC-based analyses (in particular, densities and population size estimates) presented in this plan assume a detection ratio of 1.0. All cryptic species, or species groups known to be poorly sampled by NBC, are assumed to have a detection ratio of significantly < 1.0, and these species are excluded from NBC-based analyses in this plan.

Vegetation Assessments: Vegetation and habitat assessments are part of the NBC protocol, as more fully described at http://www.gbbo.org/data.html. We used NBC-derived habitat measurements for statistical analyses of habitat relationships for a small number of relatively common Priority species in this plan.

Transect Habitat Assignments: Many NBC transects were located entirely within a single relatively uniform habitat type. In order to survey habitat types that occur in small or narrow

patches, however, many transects had to cross habitat type boundaries. Rules were therefore established to ensure that a minimum amount of the target habitat type was present, and to generate an acceptable level of consistency in habitat-based analyses.

Habitat Types

Habitat types are defined, for the purpose of this plan, as distinct land cover categories that support relatively distinct bird communities. While the term "habitat" technically describes only the environmental needs of one particular species, here we embrace the less formal use of the word, where "habitat" means a major land cover type or local setting providing environmental requirements or suitable environments for a unique bird assemblage. This definition allows us to group bird species under the umbrella of shared habitat conservation strategies.

The process of selecting habitat types for this plan paralleled the processes used in the original *Nevada PIF Bird Conservation Plan* (Neel 1999) and the Nevada Bird Count (NBC) habitat stratification. For both the 1999 plan and NBC, habitat types were created by lumping together land cover types identified in the GAP vegetation map (Homer et al. 1998). For instance, several land cover types that were dominated by coniferous trees were combined into a "Coniferous Forest" habitat type (we capitalize formal habitat type designations to distinguish them from more casual references to dominant vegetation). Other coniferous land cover types were combined to form "Pinyon-Juniper" habitat. In the more recent *Nevada Wildlife Action Plan* (Nevada Wildlife Action Plan Team 2006), the same general approach was used, but it was based primarily on land cover types identified by the Southwest Regional Gap Analysis Project (SW ReGAP) mapping effort (Prior-Magee et al. 2007). We also used the same approach in this plan, but chose to consider land cover types as defined in several different mapping efforts. A more detailed description of this process is given below in the "Spatial Habitat Data" section.

The habit types designated in the four efforts described above were very similar, but there were some variations resulting from the use of different fundamental land cover types, different approaches to grouping land cover types, and different terminology. The relationships between habitat types designated in these four efforts are summarized in Table App-1-1, below.

Table App-1-1: Cross-walk of habitat types defined by four different programs / plans. 1999 Plan = original PIF bird plan (Neel 1999); NWAP = Nevada Wildlife Action Plan

This Plan	1999 Plan[1]	NBC	NWAP [2]	Short Description for This Plan
Agriculture	Ag Lands	Agriculture	Agricultural Lands	All irrigated agricultural fields and associated infrastructure
Alpine	(not included)	(not included)	Alpine and tundra	Above treeline (tundra)
Aspen	Aspen	Aspen	Aspen woodland	All aspen-dominated woodlands

Appendices

This Plan	1999 Plan[1]	NBC	NWAP [2]	Short Description for This Plan
Cliff	Cliffs and Talus	(not included)	Cliffs and Canyon	Prominent cliffs and talus
Coniferous Forest	Coniferous Forest	Coniferous Forest	Intermountain (and Sierra) conifer forests and woodlands	All mixed and pure coniferous woodlands except pinyon-juniper
Springs	(included under Wetlands/ Lakes)	(not included)	Springs and springbrooks	All spring systems that are too small to form major riparian or wetland patches
Ephemeral Wetland and Playa	(included under Wetlands/ Lakes)	(not included)	Desert playas and ephemeral pools	All wetlands without perennial, or mostly perennial, water
Great Basin Lowland Riparian	Lowland Riparian	Lowland Riparian	Intermountain Rivers and streams	Streamside vegetation and river-fed wetlands that are mostly restricted to valley floors in the Great Basin (generally < 5,500 ft or 1,800 m)
Joshua Tree	(included under Mojave Shrub)	Joshua Tree	Mojave mid-elevation mixed Desert Scrub	Mid-elevation Mojave uplands that have a significant component of Joshua tree or other *Yucca* spp.
Marsh	(included under Wetlands/ Lakes)	(included under Wetland)	Marshes	Permanent wetlands dominated by emergent vegetation, interspersed with open water
Mesquite-Acacia	Mesquite-Catclaw	Mesquite-Catclaw	Mesquite bosques and Desert washes	Mesquite and/or *Acacia*-dominated washes and bosques in the Mojave Desert

Appendices

This Plan	1999 Plan[1]	NBC	NWAP [2]	Short Description for This Plan
Mojave Lowland Riparian	Lowland Riparian	Lowland Riparian	Mojave rivers and streams	Streamside vegetation and river-fed wetlands that are mostly restricted to valley floors in the Mojave Desert and White River Valley (generally < 4,000 ft or 1,300 m)
Mojave Scrub	Mojave Shrub	Mojave Scrub	Mojave/ Sonoran Warm Desert Scrub	Low-mid elevation scrub communities of the Mojave Desert, usually dominated by creosote
Montane Riparian	Montane Riparian	Montane Riparian	Intermountain rivers and streams	Streamside vegetation that is mostly restricted to montane areas (generally > 5,000 ft or 1,600 m)
Montane Shrubland	Montane Shrub and Sagebrush	Montane Shrub and Montane Sagebrush	(shared among several habitat types)	Deciduous and non-deciduous shrubs generally at or above the pinyon-juniper zone, but not including the alpine zone, including Montane Sagebrush
Open Water	Wetlands/ Lakes	(not included)	Lakes and Reservoirs	Water bodies that are usually large and have only a minor component of emergent vegetation, such as lakes and reservoirs
Pinyon-Juniper	Pinyon-Juniper and Mountain Mahogany	Pinyon-Juniper and Mountain Mahogany	Lower Montane woodlands	Pinyon-juniper dominated landscapes, including mountain

Appendices

This Plan	1999 Plan[1]	NBC	NWAP [2]	Short Description for This Plan
				mahogany components and open woodlands with shrub understory
Sagebrush	Sagebrush (including Montane Sagebrush)	Sagebrush (excluding Montane Sagebrush)	Sagebrush (including Montane Sagebrush)	Sagebrush-dominated shrublands below the pinyon-juniper zone (not including Montane Sagebrush – see Montane Shrubland)
Salt Desert Scrub	Salt Desert	Salt Desert Scrub	Intermountain cold desert scrub	Desert scrub below the sagebrush or Mojave Scrub zone, often dominated by saltbush, greasewood, and other salt-tolerant species
Wet Meadow	Wetlands/ Lakes and Montane Parkland	Wetland	Wet Meadows	Mesic graminoid-dominated meadows (sedges, rushes, grasses) that have ample access to water, but little emergent vegetation

[1] Neel (1999); [2] Nevada Wildlife Action Plan Team (2006)

The 20 habitat types listed above provide the basis for the habitat accounts presented in this plan, where we describe the physical and floristic characteristics of each habitat type, relate these characteristics to bird habitat suitability, list major threats, and recommend conservation strategies. These habitat types account for most of the surface area in Nevada. The remaining portions of the state consist mostly of developed areas (urban, suburban, rural, industrial, roads), barren areas, and exotic vegetation, none of which were considered conservation priority habitats. There are also very limited upland areas of native grassland, but they are difficult to distinguish accurately from irrigated fields or wet meadows in GIS maps, so they were not included in our habitat classification.

Appendices

Spatial Habitat Data

Overview

In order to analyze NBC data as a function of habitat, we needed to define habitat types listed above in terms of underlying land cover categories (we refer to this process as a "roll-up" hereafter), and then map the spatial distributions of each habitat type. We felt that all of the individual mapping efforts upon which the roll-ups could be based had inadequacies, and further that these inadequacies could be partly rectified by combining their more reliable features. Therefore, we used land cover categories derived from several different sources as the basis for rolling-up habitat types.

Habitat classification and mapping

We relied primarily on the multi-partner LandFire Existing Vegetation Type (EVT) map (www.landfire.gov) as a source of land cover categories. The LandFire Existing Vegetation Type (EVT) map, in particular, is thought to capture small-scale riparian features more effectively than the Southwest ReGAP map (Peterson 2008), which was a major basis for our decision. Table App-1-2 shows the sources of the land cover categories that were used for habitat type roll-ups in this plan. A detailed accounting and rationale of exactly which land cover categories were used to define each habitat type is available from GBBO upon request. Below, we describe the exceptions to the general pattern of rolling up either LandFire land cover categories.

1) Cliff and talus distribution was best mapped by the Southwest ReGAP product (Prior-Magee et al. 2007), which was used as a basis for our Cliff habitat type
2) Ephemeral Wetland and Playa habitat was mapped based on the National Wetlands Inventory (NWI) dataset (http://www.fws.gov/wetlands/) and the Nevada Natural Heritage Program's water-playa shapefile (http://heritage.nv.gov/gis/gis.htm)
3) The boundary between the Great Basin Lowland Riparian and Mojave Lowland Riparian habitat types was based on the accepted eco-regional boundary between these two regions, although this boundary may vary slightly in different products. Our ecoregional shapefile is available upon request to GBBO
4) Joshua Tree was poorly classified by LandFire and ReGAP land cover types. Instead, we used a first-generation Joshua Tree habitat map created by USGS (Todd Esque, *pers. comm.*)
5) Marshes and wetlands were captured best by the Southwest ReGAP product, which was used as a basis for the Marsh habitat type
6) Mesquite-Acacia was poorly classified by LandFire and ReGAP land cover categories. Instead, we used a map of Mesquite-Acacia habitat that was created by the University of Nevada Reno (UNR) as part of the Clark County MSHCP project (Clark County 2000)
7) The LandFire land cover categories contributing to the Mojave Lowland Riparian habitat type roll-up severely overestimated the extent of actual riparian vegetation, as determined by systematic overlays of these land covers with aerial photography. We conducted an in-depth effort to reclassify this habitat type based primarily on a stream-order determination using Arc GIS tools. Details are available upon request to GBBO

8) Montane Riparian habitat could often be separated from the two lowland riparian habitat types based on the definition of underlying land cover categories. In other cases, however, a land cover category spanned what we felt to be the reasonable boundary between the montane and lowland riparian zones. In these cases, we defined Montane Riparian habitat to occur above 1,600 m in elevation, and Lowland Riparian (either Great Basin or Mojave, depending on location) below 1,600 m (5,280 feet)
9) Springs habitat could not be distinguished from vegetation-based land covers in the ReGAP or LandFire products. Instead, we used a springs shapefile provided by BLM as the basis for our Springs map
10) Wet Meadow was best captured by examining both LandFire and ReGAP land cover categories in tandem, as both resulted in misclassifications considered individually

Table App-1-2: Source of land cover categories used in defining habitat types.

Habitat Type	Land Cover Source
Agriculture	LandFire
Alpine	LandFire
Aspen	LandFire
Cliff	ReGAP
Coniferous Forest	LandFire
Ephemeral Wetland and Playa	National Wetlands Inventory, Nevada Natural Heritage program shapefile
Great Basin Lowland Riparian	LandFire, < 1,600 m elevation threshold, and Great Basin / Mojave ecoregional boundary
Joshua Tree	USGS shapefile
Marsh	ReGAP
Mesquite-Acacia	UNR / Clark County MSHCP shapefile
Mojave Lowland Riparian	LandFire, < 1,600 m elevation threshold, Great Basin / Mojave ecoregional boundary, and manual reclassification based on stream order
Mojave Scrub	LandFire
Montane Riparian	LandFire, > 1,600 m elevation threshold
Montane Shrubland	LandFire
Open Water	LandFire
Pinyon-Juniper	LandFire
Sagebrush	LandFire
Salt Desert Scrub	LandFire
Springs	BLM springs shapefile
Wet Meadow	LandFire and ReGAP

In general, we believe that our final habitat type map was as accurate as possible, given the limitations of its underlying spatial datasets. Map accuracy is poorest for habitats that occur in small or narrow patches, including all Riparian habitat types, Wet Meadow, and Aspen. Improved mapping efforts would significantly improve our ability to analyze bird – habitat relationships.

Analytical and Statistical Methods

Bird – Habitat Analyses

For the priority songbirds in this plan that were sufficiently well sampled by the NBC, we conducted analyses of NBC data using GIS-derived transect attributes as explanatory variables. In general, we referred to this as "landscape-level" analysis, which was distinct from the microhabitat analysis described in the next section.

The first step required was to define the area effectively sampled by an NBC transect. To do this, we applied a 200 m radius buffer around each survey point, and then merged the buffered points within a given transect into a single polygon in GIS. The 200 m radius buffers were selected because they capture nearly all of the effectively surveyed area around each survey point. Significantly smaller buffers would have resulted in discontinuous transect polygons and may have under-represented the habitats that were actually used by the detected birds. Once the transect polygons were defined, they were intersected with the habitat map described in the previous section, as well as a landownership map. Attributes were then created for each transect polygon, as follows:

1) Surface area of each transect polygon occupied by each habitat type that was present
2) Shortest distance from any portion of the transect polygon to the nearest year-round water source
3) Landownership breakdown of the transect polygon

We also investigated the possibility of extracting transect attributes from maps of recent burn activity, but found that too few NBC transects were located in areas of recent burn activity to permit meaningful analysis.

We used logistic regression to analyze the model the relationships between bird presence (detection or non-detection) and habitat type or distance to water. For most of the species analyzed, data were sufficient to support up to three variables in a multivariate model. For a few of the most common species, we were able to conduct additional analyses by using abundance data in a linear regression analysis. We note these in the species accounts only if they changed the resulting conclusion. Data from the Great Basin and Mojave Desert were analyzed separately.

Microhabitat Analyses

For a few priority songbirds, we also conducted statistical analyses of bird abundance and presence as a function of detailed vegetation measurements that were collected "on the ground" as part of the NBC protocol (see www.gbbo.org/data.html). These analyses were originally presented in a GBBO technical report (GBBO 2008b), where details of these analyses are presented.

Appendices

Bird Density and Occupancy Rates by Habitat Type

For the Priority species with sufficient NBC data, we calculated average density within each habitat type. Habitat-specific densities were calculated separately for the Great Basin and Mojave Desert regions of Nevada. Density estimates were based on the actual number of birds detected within 100 m of each NBC survey point (assuming a detection probability of 1.0 within this radius), divided by the area of a 100 m radius circle. Results were then standardized to birds per 40 ha. Many transects were surveyed in multiple years, and some were surveyed multiple times within a year, and in these cases we avoided bias by using a single average density for a given transect. Averages for each transect were then averaged again to create the overall density estimate, which is presented in the species accounts along with an estimate of error. For a given species, we averaged densities only from the transects where the bird was present (i.e., zero-density transects were not used). This step was necessary to avoid skewing results for birds whose geographical range in Nevada is smaller than the spatial extent of the habitats they use. The best way to interpret our density estimates, therefore, is that they provide an indication of the average habitat-specific density of a given bird within the parts of the state where they occur.

In calculating density estimates, we considered only the single habitat type designator associated with each NBC transect. We did not create subgroups of points within transects that overlaid multiple habitat types. This created situations where a bird has a non-zero density for a habitat type that it rarely, if ever, uses. For instance, a bird that always occurs within Coniferous Forest habitat may have been counted on some Montane Shrubland transects that contained a small amount of Coniferous Forest habitat. This bird will therefore show a non-zero density within the Montane Shrubland habitat type. To allow us to better detect and interpret these anomalies, we also present "occupancy rate" in the species accounts, which are defined as the proportion of all transects of a given habit type on which the bird was detected during NBC surveys. If a bird's occupancy rate for a given habitat is very low, then its associated density estimate for that habitat type is not very meaningful.

Population Size Estimates

Increasingly, bird conservation initiatives have desired to have estimates of the total population sizes of bird species of concern; within a project area, within a state, or within the entire range of the species (i.e. "global"). This is an attempt to explicitly quantify current population status in relation to future conservation targets (Rosenberg and Blancher 2005). Inspired by the success of the North American Waterfowl Management Plan (USFWS 1986, 1998) in following this strategy, the major bird conservation initiatives produced in the last decade have all produced global population size estimates for their focal species (Brown et al. 2001, Kushlan et al. 2002, Rich et al. 2004), which we use as source material in this plan. Below, we discuss the sources of Nevada population size estimates used in this plan.

Partners in Flight's BBS-based Population Size Estimates

Partners in Flight generated global or continental estimates for landbird population sizes based on Breeding Bird Survey (BBS) data, as part of their development of a continental plan (Rich et al. 2004). The next step was to calculate the proportion of this population estimated to occur in

Nevada. We have taken these estimates from an unpublished spreadsheet produced by Peter Blancher (*pers. comm.*). However, BBS coverage in Nevada has been poor in past decades, and in order to produce these estimates, it was sometimes necessary to extrapolate from adjoining regions outside of the state (especially for the Sierra Nevada ecoregion). Because of this limitation, we decided to use NBC data to produce a new set of Nevada population size estimates for landbirds.

NBC-Based Population Size Estimates

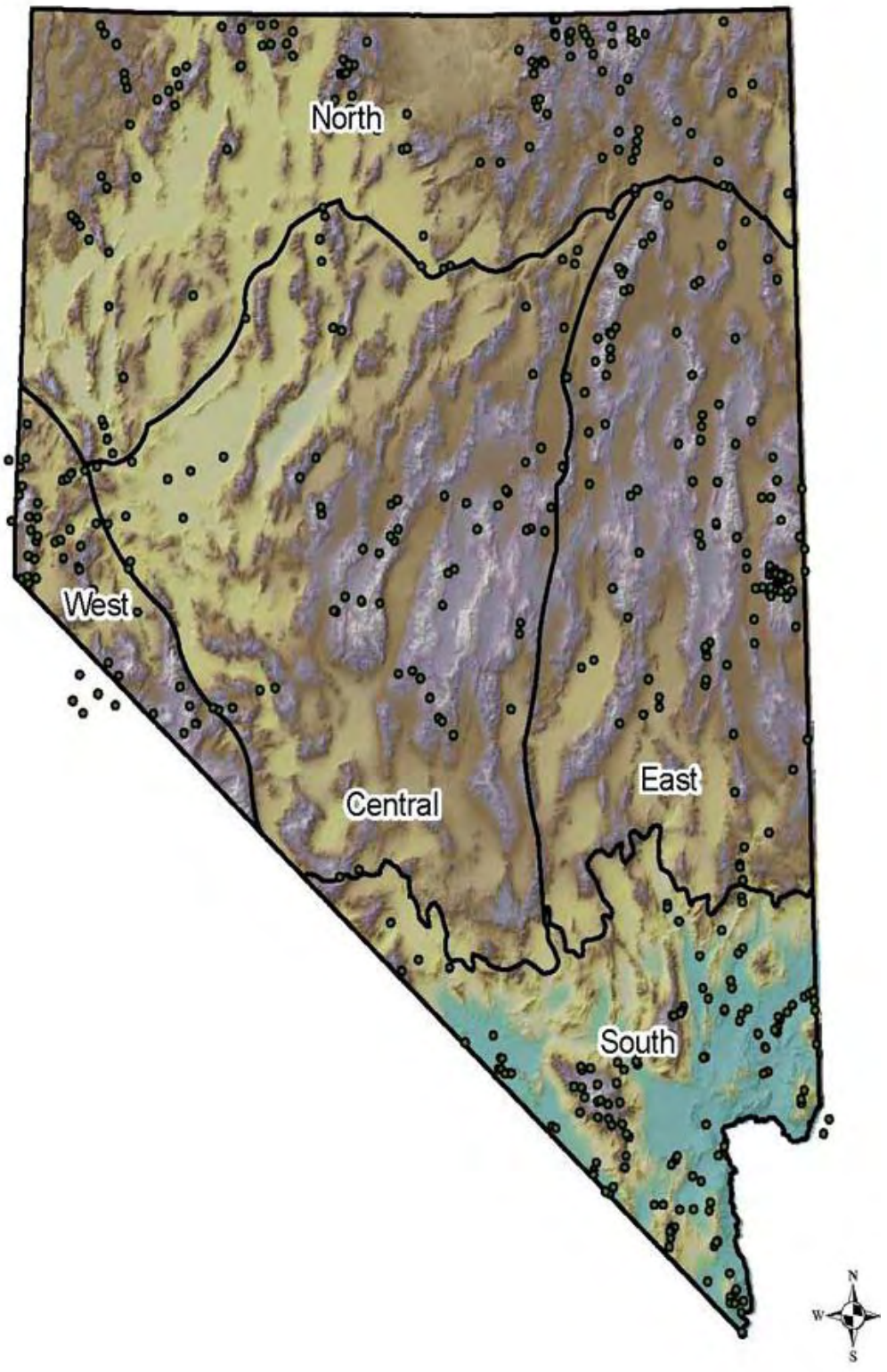
The large Nevada Bird Count database provided us with an opportunity to generate new population size estimates for the state that were improvements on previously available estimates. For species that were well-sampled by the NBC, data-based population estimates were obtained by extrapolating observed bird densities across the entire landscape, while accounting for habitat-based and regional differences in these densities. As with density estimation, we considered only the single habitat type designator associated with each transect; but in contrast, we remained entirely within the framework of the original GAP-based habitat type designators used to stratify the NBC sampling plan throughout this exercise (Table App-1-1). Also in contrast to the density estimation exercise, we used all transects (including those on which a given bird species did not occur). Otherwise, we would have created inflated population size estimates by extrapolating densities that were uncharacteristic of Nevada as a whole.

Data for population size estimates were obtained from 546 NBC transects that were surveyed at variable frequencies between 2002 and 2009. These transects received an average of 2.5 surveys each during this period, generating 1376 transect-visits. Data from multiple surveys for a given transect were averaged to produce a single density estimate for each species. In order to account for the fact that many species are not distributed equally throughout the entire extent of their habitats, we divided Nevada into five geographical regions (north, west, central, east, and south) based on natural ecoregional boundaries that correspond well with most breeding ranges (Figure M1; see also Floyd et al. 2007). For example, the Gray Vireo is concentrated in Pinyon-Juniper habitat in the south region, is also present in smaller but still significant densities in the east region, and is almost totally absent from Pinyon-Juniper habitat in the remaining regions. The Pinyon Jay, in contrast, uses Pinyon-Juniper habitat statewide, except in the north region where it is mostly absent. Therefore, density estimates were generated for each unique combination of species, habitat type, and region, and those estimates were extrapolated based on the area occupied by that same habitat-region combination to arrive at a population estimate for that habitat-region. Statewide population estimates were then generated by adding all of the unique habitat-region population estimates. Systematic intra-regional variation in density within a habitat type, which no doubt occurs, was not addressed by this method, although it is reasonable to assume that it averaged out in most cases, and did not result in significantly skewed estimates.

Table App-1-3 shows the number of transects that were surveyed, by habitat type, in each of the five regions (see also Figure App-1-1). In many (though not all) cases where there appears to be poor NBC survey coverage for a given habitat-region combination, this was a result of few or no such habitat-region combinations existing. For instance, Mesquite-Catclaw habitat occurs only in southern Nevada, and is simply not present in the other four regions of the state.

Appendices

Figure App-1-1: Division of Nevada into regions for population estimates, and locations of NBC transects.



Appendices

Table App-1-3: Number of NBC transects surveyed by habitat and region, 2002-2009. Habitat types are those identified in the original GAP-based NBC stratification process.

Habitat Type	Region					
	Central	East	North	West	South	Total
Agricultural	2	0	0	1	5	8
Aspen	2	7	5	4	7	25
Coniferous Forest	0	2	3	14	4	23
Joshua Tree	1	0	0	0	20	21
Lowland Riparian	15	9	26	16	36	102
Mesquite-Catclaw	0	0	0	0	14	14
Mojave Scrub	0	0	0	0	22	22
Montane Riparian	6	35	34	13	9	97
Montane Sagebrush	3	2	4	2	3	14
Montane Shrub	3	4	2	0	5	14
Mountain Mahogany	1	4	4	0	0	9
Pinyon-Juniper	13	35	5	8	12	73
Sagebrush	20	6	4	3	26	59
Salt Desert	5	17	0	1	10	33
Wetland	6	22	1	1	2	32

The following formal sequence of steps was used to derive NBC-generated population estimates:

a) We determined the total number of hectares for each habitat type within each of the five regions based on the GAP map (Table App-1-4). Using this approach, 93% of the state's total land area could be classified as one of the NBC focal habitat types. The remainder consisted of cover types such as urban, barren, cliffs, alpine, etc. Thus this 7% of the state's total land area was excluded from the analysis
b) We calculated species-specific average density estimates (birds per 40 ha) for every NBC transect
c) We averaged the density estimates for all transects within a given habitat-region combination, and repeated this step for all other habitat-region combinations
d) We multiplied the overall density estimate for each habitat-region combination by the number of hectares of that habitat-region combination to produce a series of population size estimates for each habitat- region combination.
e) We summed all resulting population size estimates for a given species to produce a statewide population estimate

Appendices

Table App-1-4: Total area of land, in hectares, covered by each habitat type in each region of Nevada.

Habitat Type	Region				
	North	South	West	Central	East
Agriculture	191,253	18,060	59,157	149,950	97,400
Aspen	56,131	0	114	5,352	37,345
Coniferous Forest	8,840	29,393	59,990	1,760	126,442
Lowland Riparian	16,030	12,376	6,238	9,077	8,041
Mesquite-Catclaw	0	7,539	0	0	0
Mojave Scrub (combined with Joshua Tree)	0	2,878,464	0	65,941	123,822
Montane Riparian	1,186	0	556	4,242	2,389
Montane Shrubland	62,664	60,496	14,099	48,771	185,060
Mountain Mahogany	2,939	0	1,327	57,504	89,819
Montane Sagebrush	574,378	2	65,434	322,470	161,712
Pinyon-Juniper	59,300	115,978	228,094	984,092	1,484,705
Sagebrush	4,623,741	202,593	579,070	3,661,461	2,792,070
Salt Desert	1,730,663	473,072	107,785	3,211,603	1,244,730
Other (not used)	527,605	168,466	75,891	490,738	133,697
Wetland	1,768	318	2,826	69,884	31,396
TOTAL	7,856,496	3,966,756	1,200,584	9,082,845	6,518,627

Population size estimates were created for all priority passerine birds, hummingbirds, woodpeckers, doves, and easily-detected upland game birds and raptors. Although NBC methods were not designed specifically for raptors, NBC-derived population estimates for this species group corresponded fairly well with previous estimates, with some exceptions. Population size estimates for all species analyzed were rounded to the nearest round number within 5%. This was done to emphasize the imprecise nature of population size estimation, which differs from a total population count in that it includes error from extrapolation and sampling. We decided on a species by species basis whether or not the NBC population estimate was the best available estimate, as presented in the species accounts (see *Appendix 4* for a summary).

Other Population Size Estimates

Population estimates for many of this plan's Priority species could not reasonably be derived from either NBC or BBS data, particularly for waterfowl, waterbirds, shorebirds, and owls. Additionally, NBC-derived population estimates for some upland game birds and raptors were unreliable enough to merit consideration of other population size estimates. For these species groups, we relied on the key sources described previously to obtain population size estimates.

Because we chose only one population estimate to report on the front page of the species accounts, readers may wish to examine *Appendix 4*, where the comparison of all available estimates is summarized in tabular form. In the species accounts, we discuss the factors that might weigh in favor of one estimate or the other where appropriate.

Error Estimation for Population Size Estimates

It is generally understood that population estimates derived from any currently available data source are necessary very approximate. Methods of calculating population size estimates are continuing to be critically reviewed and recommendations being made (Thogmartin et al. 2006). The most important recommendation, of course, would be the collection of more and better monitoring data.

There are many sources of potential error in the process of generating a population size estimate, and integrating them meaningfully into a single error index is a very complex undertaking that deserves careful attention (e.g. Bart 2005b, Thogmartin 2010). Rather than reporting oversimplified (and possibly misleading) estimate errors, we chose to defer this exercise until a future revision of this plan.

Range Maps

For species range maps, we used actual detections of a species as the basis for creating known and presumed distributions within Nevada. This was a conservative, data-driven approach that contrasted, to some extent, with more typical approaches to range map creation. Detection records were obtained primarily from NBC data, the Nevada Breeding Bird Atlas project, the GBBO Aquatic Bird Count, and the NDOW diversity database (see "Sources of Information" section, above). For all of these sources, only records collected since the beginning of the Nevada Breeding bird atlas project (i.e. 1997) were used in order to avoid inadvertently plotting distributions that no longer apply. Other data sources, notably the *Nevada Upland Game Species Management Plan* (NDOW 2008) and personal observations from reliable experts, were occasionally used to supplement these sources, as noted in the species accounts. Once detections were mapped, the range maps were created using the following approaches.

For landbirds, we used the USGS basin and range shapefile to divide the state into a contiguous array of basins and mountain ranges. A bird sighting that occurred within a given basin or mountain range resulted in the extrapolation of "known distribution" to that entire basin or mountain range. For species present at intermediate elevations, detections often occurred in both basins and mountain ranges. Presumed ranges were then superimposed on known range by a subjective, iterative process involving opinion from several experts, outside map review, and biological context.

For waterbirds, waterfowl, shorebirds, and marshbirds, we used a similar approach employing the shapefiles that defined Open Water and Ephemeral Wetland and Playa habitats (see above), rather than basins and mountain ranges. A detection that occurred within or adjacent a water bodies was extrapolated throughout that water feature. Presumed range was then extrapolated to other water bodies, using a process similar to that described above for landbirds.

Despite our efforts to systematize the distribution mapping process, judgment calls were still required in many cases. It is important to note that the absence of a mapped "known" distribution for a species within a given part of the state is NOT intended to imply that the species is known to be absent from that area. Rather, it has not yet been observed, and definitive determination of presence or absence will require focused local survey efforts. We show both known and presumed range on most species maps to avoid this possible misinterpretation.

Threats Determination and Conservation Strategies

Assessment of conservation concerns and threats is primarily discussed in the *Conservation Concerns* chapter of this plan. Determinations as to whether or not conservation concerns represented threats to a given habitat or bird species were the result of integrating the Conservation Action Planning (CAP) outputs (TNC 2007), literature review, analysis, and substantial discussion among the Nevada PIF planning group. In presenting what we determined to be significant threats, we tended to focus on threats that may lead to significant negative changes in habitats or in the abundance / distribution of Priority species over the next ten years. We did not attempt to formally rank threats to a given bird or habitat; rather we presented only the threats that we regarded to be credible.

Likewise, conservation strategies were formed as the result of literature review, analysis, and feedback from the Nevada PIF planning group. Two PIF meetings were devoted entirely to developing group consensus on conservation strategies.

Appendices

Appendix 2: Nevada Bird List and Statuses.

Table App-2-1: Bird species that occur with some regularity in Nevada. Priority species under this plan are shown in **bold type**, with suffixes defined as follows: (C) = Conservation Priority species; (S) = Stewardship species; (SS) = Special Status species. Seasonal Status (in Nevada) is defined as follows:

Breeder = primarily present during the breeding season

Breeder/Migrant = both breeding populations and significant migrant populations that breed elsewhere occur in the state, and migrants are of conservation importance in areas where the species does not breed

Breeder/Winter = occurs in the state during all seasons, but not necessarily in the same areas

Migrant/Winter = non-breeding populations are most abundant and of greatest conservation interest (breeders are rare or absent relative to other seasons)

Extirpated = species historically nested in Nevada, but was extirpated in recent decades

Reintroduced = species historically nested in Nevada and was reintroduced after extirpation

Names and taxonomic order are in accordance with the AOU checklist through the 51st supplement (Chesser et al. 2010)

Common Name	Genus	Species	Seasonal Status
Greater White-fronted Goose	*Anser*	*albifrons*	Migrant
Snow Goose	*Chen*	*caerulescens*	Migrant/Winter
Ross's Goose	*Chen*	*rossii*	Migrant
Cackling Goose	*Branta*	*hutchinsii*	Migrant
Canada Goose	*Branta*	*canadensis*	Breeder/Winter
Trumpeter Swan (C)	***Cygnus***	***buccinator***	**Reintroduced**
Tundra Swan (C)	***Cygnus***	***columbianus***	**Migrant/Winter**
Wood Duck	*Aix*	*sponsa*	Breeder/Winter
Gadwall	*Anas*	*strepera*	Breeder/Winter
American Wigeon	*Anas*	*americana*	Breeder/Winter
Mallard	*Anas*	*platyrhynchos*	Breeder/Winter
Blue-winged Teal	*Anas*	*discors*	Breeder/Migrant
Cinnamon Teal (C)	***Anas***	***cyanoptera***	**Breeder/Migrant**
Northern Shoveler	*Anas*	*clypeata*	Breeder/Winter
Northern Pintail (C)	***Anas***	***acuta***	**Breeder/Migrant**
Green-winged Teal	*Anas*	*crecca*	Breeder/Winter
Canvasback (C)	***Aythya***	***valisineria***	**Breeder/Migrant**
Redhead (C)	***Aythya***	***americana***	**Breeder/Winter**
Ring-necked Duck	*Aythya*	*collaris*	Breeder/Winter
Greater Scaup	*Aythya*	*marila*	Migrant
Lesser Scaup (C)	***Aythya***	***affinis***	**Migrant/Winter**
Bufflehead	*Bucephala*	*albeola*	Migrant/Winter
Common Goldeneye	*Bucephala*	*clangula*	Migrant/Winter
Hooded Merganser	*Lophodytes*	*cucullatus*	Migrant/Winter
Common Merganser	*Mergus*	*merganser*	Breeder/Winter
Red-breasted Merganser	*Mergus*	*serrator*	Migrant
Ruddy Duck	*Oxyura*	*jamaicensis*	Breeder/Winter

Appendices

Common Name	Genus	Species	Seasonal Status
Chukar	*Alectoris*	*chukar*	Breeder
Himalayan Snowcock	*Tetraogallus*	*himalayus*	Breeder
Gray Partridge	*Perdix*	*perdix*	Breeder
Ring-necked Pheasant	*Phasianus*	*colchicus*	Breeder
Ruffed Grouse	*Bonasa*	*umbellus*	Breeder
Greater Sage-Grouse (C)	*Centrocercus*	*urophasianus*	Breeder
Dusky Grouse (C)	*Dendragapus*	*obscurus*	Breeder
Sooty Grouse (C)	*Dendragapus*	*fuliginosus*	Breeder
Sharp-tailed Grouse (C)	*Tympanuchus*	*phasianellus*	Reintroduced
Wild Turkey	*Meleagris*	*gallopavo*	Breeder
Mountain Quail (C)	***Oreortyx***	***pictus***	**Breeder**
California Quail	*Callipepla*	*californica*	Breeder
Gambel's Quail (C)	***Callipepla***	***gambelii***	**Breeder**
Common Loon (C)	***Gavia***	***immer***	**Migrant**
Pied-billed Grebe	*Podilymbus*	*podiceps*	Breeder/Winter
Horned Grebe	*Podiceps*	*auritus*	Migrant
Eared Grebe (C)	***Podiceps***	***nigricollis***	**Breeder/Migrant**
Western Grebe (C)	***Aechmophorus***	***occidentalis***	**Breeder/Migrant**
Clark's Grebe (C)	***Aechmophorus***	***clarkii***	**Breeder/Migrant**
American White Pelican (C)	***Pelecanus***	***erythrorhynchos***	**Breeder/Migrant**
Double-crested Cormorant	*Phalacrocorax*	*auritus*	Breeder/Winter
American Bittern	*Botaurus*	*lentiginosus*	Breeder/Migrant
Least Bittern (C)	***Ixobrychus***	***exilis***	**Breeder**
Great Blue Heron	*Ardea*	*herodias*	Breeder/Winter
Great Egret	*Ardea*	*alba*	Breeder/Winter
Snowy Egret (C)	***Egretta***	***thula***	**Breeder/Migrant**
Cattle Egret	*Bubulcus*	*ibis*	Breeder
Green Heron	*Butorides*	*virescens*	Breeder
Black-crowned Night-Heron	*Nycticorax*	*nycticorax*	Breeder/Migrant
White-faced Ibis (C)	***Plegadis***	***chihi***	**Breeder/Migrant**
Turkey Vulture	*Cathartes*	*aura*	Breeder/Migrant
Osprey	*Pandion*	*haliaetus*	Breeder/Migrant
White-tailed Kite	*Elanus*	*leucurus*	Breeder
Bald Eagle (SS)	***Haliaeetus***	***leucocephalus***	**Migrant/Winter**
Northern Harrier	*Circus*	*cyaneus*	Breeder/Migrant
Sharp-shinned Hawk	*Accipiter*	*striatus*	Breeder/Winter
Cooper's Hawk	*Accipiter*	*cooperii*	Breeder/Winter
Northern Goshawk (C)	***Accipiter***	***gentilis***	**Breeder/Winter**
Red-shouldered Hawk	*Buteo*	*lineatus*	Breeder
Swainson's Hawk (C)	***Buteo***	***swainsoni***	**Breeder/Migrant**
Red-tailed Hawk	*Buteo*	*jamaicensis*	Breeder/Winter
Ferruginous Hawk (C)	***Buteo***	***regalis***	**Breeder/Winter**
Rough-legged Hawk	*Buteo*	*lagopus*	Migrant/Winter
Golden Eagle (C)	***Aquila***	***chrysaetos***	**Breeder/Winter**
American Kestrel	*Falco*	*sparverius*	Breeder/Migrant
Merlin	*Falco*	*columbarius*	Migrant
Peregrine Falcon (SS)	***Falco***	***peregrinus***	**Breeder/Migrant**

Appendices

Common Name	Genus	Species	Seasonal Status
Prairie Falcon (S)	***Falco***	***mexicanus***	**Breeder/Winter**
Clapper Rail (C)	***Rallus***	***longirostris***	**Breeder**
Virginia Rail	*Rallus*	*limicola*	Breeder/Winter
Sora	*Porzana*	*carolina*	Breeder/Winter
Common Moorhen	*Gallinula*	*chloropus*	Breeder/Winter
American Coot	*Fulica*	*americana*	Breeder/Winter
Sandhill Crane (C)	***Grus***	***canadensis***	**Breeder/Migrant**
Black-bellied Plover	*Pluvialis*	*squatarola*	Migrant
Snowy Plover (C)	***Charadrius***	***alexandrinus***	**Breeder**
Semipalmated Plover	*Charadrius*	*semipalmatus*	Migrant
Killdeer	*Charadrius*	*vociferus*	Breeder/Winter
Black-necked Stilt (C)	***Himantopus***	***mexicanus***	**Breeder/Migrant**
American Avocet (C)	***Recurvirostra***	***americana***	**Breeder/Migrant**
Spotted Sandpiper	*Actitis*	*macularius*	Breeder/Migrant
Solitary Sandpiper	*Tringa*	*solitaria*	Migrant
Greater Yellowlegs	*Tringa*	*melanoleuca*	Migrant
Willet (C)	***Catoptrophorus***	***semipalmatus***	**Breeder/Migrant**
Lesser Yellowlegs	*Tringa*	*flavipes*	Migrant/
Whimbrel	*Numenius*	*phaeopus*	Migrant
Long-billed Curlew (C)	***Numenius***	***americanus***	**Breeder/Migrant**
Marbled Godwit (C)	***Limosa***	***fedoa***	**Migrant**
Sanderling	*Calidris*	*alba*	Migrant
Semipalmated Sandpiper	*Calidris*	*pusilla*	Migrant
Western Sandpiper (C)	***Calidris***	***mauri***	**Migrant**
Least Sandpiper (C)	***Calidris***	***minutilla***	**Migrant**
Baird's Sandpiper	*Calidris*	*bairdii*	Migrant
Pectoral Sandpiper	*Calidris*	*melanotos*	Migrant
Dunlin	*Calidris*	*alpina*	Migrant
Short-billed Dowitcher	*Limnodromus*	*griseus*	Migrant
Long-billed Dowitcher (C)	***Limnodromus***	***scolopaceus***	**Migrant**
Wilson's Snipe	*Gallinago*	*delicata*	Breeder/Winter
Wilson's Phalarope (C)	***Phalaropus***	***tricolor***	**Breeder/Migrant**
Red-necked Phalarope (C)	***Phalaropus***	***lobatus***	**Migrant**
Franklin's Gull (C)	***Leucophaeus***	***pipixcan***	**Breeder/Migrant**
Bonaparte's Gull	*Chroicocephalus*	*philadelphia*	Migrant
Ring-billed Gull	*Larus*	*delawarensis*	Breeder/Winter
California Gull	*Larus*	*californicus*	Breeder/Migrant
Herring Gull	*Larus*	*argentatus*	Migrant/Winter
Caspian Tern	*Sterna*	*caspia*	Breeder
Black Tern (C)	***Childonias***	***niger***	**Breeder/Migrant**
Common Tern	*Sterna*	*hirundo*	Migrant
Forster's Tern	*Sterna*	*forsteri*	Breeder/Migrant
Rock Pigeon	*Columba*	*livia*	Breeder/Winter
Band-tailed Pigeon (C)	***Columba***	***fasciata***	**Breeder/Winter**
Eurasian Collared-Dove	*Streptopelia*	*decaocto*	Breeder/Winter
White-winged Dove	*Zenaida*	*asiatica*	Breeder
Mourning Dove	*Zenaida*	*macroura*	Breeder/Winter

Appendices

Common Name	Genus	Species	Seasonal Status
Inca Dove	*Columbina*	*inca*	Breeder
Yellow-billed Cuckoo (C)	***Coccyzus***	***americanus***	**Breeder**
Greater Roadrunner	*Geococcyx*	*californianus*	Breeder/Winter
Barn Owl	*Tyto*	*alba*	Breeder/Winter
Flammulated Owl (C)	***Otus***	***flammeolus***	**Breeder**
Western Screech-Owl	*Otus*	*kennicottii*	Breeder/Winter
Great Horned Owl	*Bubo*	*virginianus*	Breeder/Winter
Northern Pygmy-Owl	*Glaucidium*	*gnoma*	Breeder/Winter
Elf Owl	*Micrathene*	*whitneyi*	Extirpated
Burrowing Owl (SS)	***Athene***	***cunicularia***	**Breeder**
Spotted Owl (C)	***Strix***	***occidentalis***	**Breeder/Winter**
Long-eared Owl	*Asio*	*otus*	Breeder/Migrant
Short-eared Owl (C)	***Asio***	***flammeus***	**Breeder/Winter**
Northern Saw-whet Owl	*Aegolius*	*acadicus*	Breeder/Winter
Lesser Nighthawk	*Chordeiles*	*acutipennis*	Breeder
Common Nighthawk	*Chordeiles*	*minor*	Breeder/Migrant
Common Poorwill (S)	***Phalaenoptilus***	***nuttallii***	**Breeder/Migrant**
Mexican Whip-poor-will	*Caprimulgus*	*arizonae*	Breeder
Vaux's Swift	*Chaetura*	*vauxi*	Migrant
White-throated Swift (C)	***Aeronautes***	***saxatalis***	**Breeder/Migrant**
Black-chinned Hummingbird	*Archilochus*	*alexandri*	Breeder/Migrant
Anna's Hummingbird	*Calypte*	*anna*	Breeder/Migrant
Costa's Hummingbird (C)	***Calypte***	***costae***	**Breeder**
Calliope Hummingbird (C)	***Stellula***	***calliope***	**Breeder/Migrant**
Broad-tailed Hummingbird	*Selasphorus*	*platycercus*	Breeder/Migrant
Rufous Hummingbird (C)	***Selasphorus***	***rufus***	**Migrant**
Belted Kingfisher	*Megaceryle*	*alcyon*	Breeder/Winter
Lewis's Woodpecker (C)	***Melanerpes***	***lewis***	**Breeder/Winter**
Williamson's Sapsucker (C)	***Sphyrapicus***	***thyroideus***	**Breeder/Winter**
Red-naped Sapsucker	*Sphyrapicus*	*nuchalis*	Breeder
Red-breasted Sapsucker	*Sphyrapicus*	*ruber*	Breeder
Ladder-backed Woodpecker	*Picoides*	*scalaris*	Breeder/Winter
Downy Woodpecker	*Picoides*	*pubescens*	Breeder/Winter
Hairy Woodpecker	*Picoides*	*villosus*	Breeder/Winter
White-headed Woodpecker(C)	***Picoides***	***albolarvatus***	**Breeder/Winter**
American Three-toed Woodpecker	*Picoides*	*dorsalis*	Breeder/Winter
Black-backed Woodpecker	*Picoides*	*arcticus*	Breeder/Winter
Northern Flicker	*Colaptes*	*auratus*	Breeder/Winter
Gilded Flicker (C)	***Colaptes***	***chrysoides***	**Breeder**
Pileated Woodpecker	*Dryocopus*	*pileatus*	Breeder/Winter
Olive-sided Flycatcher (C)	***Contopus***	***cooperi***	**Breeder**
Western Wood-Pewee	*Contopus*	*sordidulus*	Breeder/Migrant
Willow Flycatcher (C)	***Empidonax***	***traillii***	**Breeder/Migrant**
Hammond's Flycatcher	*Empidonax*	*hammondii*	Breeder/Migrant
Gray Flycatcher (S)	***Empidonax***	***wrightii***	**Breeder/Migrant**
Dusky Flycatcher	*Empidonax*	*oberholseri*	Breeder/Migrant

Appendices

Common Name	Genus	Species	Seasonal Status
Pacific-slope Flycatcher	*Empidonax*	*difficilis*	Probable Migrant
Cordilleran Flycatcher	*Empidonax*	*occidentalis*	Breeder/Migrant
Black Phoebe	*Sayornis*	*nigricans*	Breeder/Migrant
Say's Phoebe	*Sayornis*	*saya*	Breeder/Migrant
Vermilion Flycatcher	*Pyrocephalus*	*rubinus*	Breeder
Ash-throated Flycatcher	*Myiarchus*	*cinerascens*	Breeder
Brown-crested Flycatcher	*Myiarchus*	*tyrannulus*	Breeder
Cassin's Kingbird	*Tyrannus*	*vociferans*	Breeder
Western Kingbird	*Tyrannus*	*verticalis*	Breeder
Eastern Kingbird	*Tyrannus*	*tyrannus*	Breeder
Loggerhead Shrike	*Lanius*	*ludovicianus*	Breeder/Migrant
Northern Shrike	*Lanius*	*excubitor*	Migrant/Winter
Bell's Vireo (C)	***Vireo***	***bellii***	**Breeder**
Gray Vireo (C)	***Vireo***	***vicinior***	**Breeder**
Plumbeous Vireo	*Vireo*	*plumbeus*	Breeder/Migrant
Cassin's Vireo	*Viireo*	*cassinii*	Breeder/Migrant
Warbling Vireo	*Vireo*	*gilvus*	Breeder/Migrant
Steller's Jay	*Cyanocitta*	*stelleri*	Breeder
Western Scrub-jay	*Aphelocoma*	*californica*	Breeder
Pinyon Jay (C)	***Gymnorhinus***	***cyanocephalus***	**Breeder**
Clark's Nutcracker	*Nucifraga*	*columbiana*	Breeder
Black-billed Magpie	*Pica*	*hudsonia*	Breeder
American Crow	*Corvus*	*brachyrhynchos*	Breeder
Common Raven	*Corvus*	*corax*	Breeder
Horned Lark	*Eremophela*	*alpestris*	Breeder/Migrant
Tree Swallow	*Tachycineta*	*bicolor*	Breeder/Migrant
Violet-green Swallow	*Tachycineta*	*thalassina*	Breeder/Migrant
Northern Rough-winged Swallow	*Stelgidopteryx*	*serripennis*	Breeder/Migrant
Bank Swallow	*Riparia*	*riparia*	Breeder/Migrant
Cliff Swallow	*Petrochelidon*	*pyrrhonota*	Breeder/Migrant
Barn Swallow	*Hirundo*	*rustica*	Breeder/Migrant
Black-capped Chickadee	*Poecile*	*atricapilla*	Breeder
Mountain Chickadee	*Poecile*	*gambeli*	Breeder
Juniper Titmouse	*Baelophus*	*ridgwayi*	Breeder
Verdin	*Auriparus*	*flaviceps*	Breeder
Bushtit	*Psaltriparus*	*minimus*	Breeder
Red-breasted Nuthatch	*Sitta*	*canadensis*	Breeder
White-breasted Nuthatch	*Sitta*	*carolinensis*	Breeder
Pygmy Nuthatch	*Sitta*	*pygmaea*	Breeder
Brown Creeper	*Certhia*	*americana*	Breeder
Cactus Wren	*Campylorhynchus*	*brunneicapillus*	Breeder
Rock Wren	*Salpinctes*	*obsoletus*	Breeder
Canyon Wren	*Catherpes*	*mexicanus*	Breeder
Bewick's Wren	*Thryomanes*	*bewickii*	Breeder
House Wren	*Troglodytes*	*aedon*	Breeder
Pacific Wren	*Troglodytes*	*pacificus*	Breeder
Marsh Wren	*Cistothorus*	*palustris*	Breeder/Migrant

Appendices

Common Name	Genus	Species	Seasonal Status
American Dipper	*Cinculus*	*mexicanus*	Breeder
Golden-crowned Kinglet	*Regulus*	*satrapa*	Breeder/Migrant
Ruby-crowned Kinglet	*Regulus*	*calendula*	Breeder/Migrant
Blue-gray Gnatcatcher	*Polioptila*	*caerulea*	Breeder
Black-tailed Gnatcatcher	*Polioptila*	*melanura*	Breeder
Western Bluebird	*Sialia*	*mexicana*	Breeder
Mountain Bluebird	*Sialia*	*currucoides*	Breeder/Migrant
Townsend's Solitaire	*Myadestes*	*townsendi*	Breeder/Migrant
Swainson's Thrush	*Catharus*	*ustulatus*	Breeder/Migrant
Hermit Thrush	*Catharus*	*guttatus*	Breeder/Migrant
American Robin	*Turdus*	*migratorius*	Breeder/Migrant
Gray Catbird	*Dumetella*	*carolinensis*	Breeder
Northern Mockingbird	*Mimus*	*polyglottos*	Breeder/Migrant
Sage Thrasher (S)	***Oreoscoptes***	***montanus***	**Breeder/Migrant**
Bendire's Thrasher (C)	***Toxostoma***	***bedirei***	**Breeder**
Crissal Thrasher	*Toxostoma*	*crissale*	Breeder
Le Conte's Thrasher (C)	***Toxostoma***	***lecontei***	**Breeder**
European Starling	*Sturnus*	*vulgaris*	Breeder/Migrant
American Pipit	*Anthus*	*rubescens*	Breeder/Migrant
Bohemian Waxwing	*Bombycilla*	*garrulus*	Migrant/Winter
Cedar Waxwing	*Bombycilla*	*cedrorum*	Breeder/Migrant
Phainopepla	*Phainopepla*	*nitens*	Breeder
Orange-crowned Warbler	*Oreothlypis*	*celata*	Breeder/Migrant
Nashville Warbler	*Oreothlypis*	*ruficapilla*	Breeder/Migrant
Virginia's Warbler (C)	***Oreothlypis***	***virginiae***	**Breeder/Migrant**
Lucy's Warbler (C)	***Oreothlypis***	***luciae***	**Breeder**
Yellow Warbler	*Dendroica*	*petechia*	Breeder/Migrant
Yellow-rumped Warbler	*Dendroica*	*coronata*	Breeder/Winter
Black-throated Gray Warbler	*Dendroica*	*nigrescens*	Breeder/Migrant
Townsend's Warbler	*Dendroica*	*townsendi*	Migrant
Hermit Warbler (C)	***Dendroica***	***occidentalis***	**Breeder**
Grace's Warbler (C)	***Dendroica***	***graciae***	**Breeder**
MacGillivray's Warbler	*Oporornis*	*tolmiei*	Breeder/Migrant
Common Yellowthroat	*Geothlypis*	*trichas*	Breeder/Migrant
Wilson's Warbler	*Wilsonia*	*pusilla*	Breeder/Migrant
Yellow-breasted Chat	*Icteria*	*virens*	Breeder/Migrant
Summer Tanager	*Piranga*	*rubra*	Breeder
Western Tanager	*Piranga*	*ludoviciana*	Breeder/Migrant
Green-tailed Towhee (S)	***Pipilo***	***chlorurus***	**Breeder/Migrant**
Spotted Towhee	*Pipilo*	*maculatus*	Breeder/Winter
Abert's Towhee (C)	***Melozone***	***aberti***	**Breeder/Winter**
Rufous-crowned Sparrow	*Aimophila*	*ruficeps*	Breeder
American Tree Sparrow	*Spizella*	*arborea*	Winter
Chipping Sparrow	*Spizella*	*passerina*	Breeder/Migrant
Brewer's Sparrow (C)	***Spizella***	***breweri***	**Breeder/Migrant**
Black-chinned Sparrow (C)	***Spizella***	***atrogularis***	**Breeder**
Vesper Sparrow	*Pooecetes*	*gramineus*	Breeder/Migrant

Appendices

Common Name	Genus	Species	Seasonal Status
Lark Sparrow	*Chondestes*	*grammacus*	Breeder/Migrant
Black-throated Sparrow	*Amphispiza*	*bilineata*	Breeder/Migrant
Sage Sparrow (C)	***Amphispiza***	***belli***	**Breeder/Winter**
Savannah Sparrow	*Passerculus*	*sandwichensis*	Breeder/Winter
Fox Sparrow	*Passerella*	*iliaca*	Breeder/Migrant
Song Sparrow	*Melospiza*	*melodia*	Breeder/Winter
Lincoln's Sparrow	*Melospiza*	*lincolnii*	Breeder/Migrant
White-crowned Sparrow	*Zonotrichia*	*leucophrys*	Breeder/Winter
Golden-crowned Sparrow	*Zonotrichia*	*atricapilla*	Migrant/Winter
Dark-eyed Junco	*Junco*	*hyemalis*	Breeder/Winter
Lapland Longspur	*Calcarius*	*lapponicus*	Winter
Chestnut-collared Longspur	*Calcarius*	*ornatus*	Migrant
Black-headed Grosbeak	*Pheucticus*	*melanocephalus*	Breeder/Migrant
Blue Grosbeak	*Passerina*	*caerulea*	Breeder
Lazuli Bunting	*Passerina*	*amoena*	Breeder/Migrant
Indigo Bunting	*Passerina*	*cyanea*	Probable Breeder
Bobolink	*Dolichonyx*	*oryzivorus*	Breeder/Migrant
Red-winged Blackbird	*Agelaius*	*phoeniceus*	Breeder/Winter
Tricolored Blackbird (C)	***Agelaius***	***tricolor***	**Breeder/Migrant**
Western Meadowlark	*Sturnella*	*neglecta*	Breeder/Winter
Yellow-headed Blackbird	*Xanthocephalus*	*xanthocephalus*	Breeder/Migrant
Brewer's Blackbird	*Euphagus*	*cyanocephalus*	Breeder/Winter
Great-tailed Grackle	*Quiscalus*	*mexicanus*	Breeder/Winter
Brown-headed Cowbird	*Molothrus*	*ater*	Breeder/Migrant
Hooded Oriole	*Icterus*	*cucullatus*	Breeder
Bullock's Oriole	*Icterus*	*bullockii*	Breeder/Migrant
Scott's Oriole	*Icterus*	*parisorum*	Breeder
Gray-crowned Rosy-Finch	*Leucosticte*	*tephrocotis*	Migrant/Winter
Black Rosy-Finch (C)	***Leucosticte***	***atrata***	**Breeder/Winter**
Pine Grosbeak	*Pinicola*	*enucleator*	Breeder/Winter
Cassin's Finch	*Carpodacus*	*cassini*	Breeder/Winter
House Finch	*Carpodacus*	*mexicanus*	Breeder/Winter
Red Crossbill	*Loxia*	*curvirostra*	Breeder/Winter
Pine Siskin	*Spinus*	*pinus*	Breeder/Winter
Lesser Goldfinch	*Spinus*	*psaltria*	Breeder/Winter
American Goldfinch	*Spinus*	*tristis*	Breeder/Winter
Evening Grosbeak	*Coccothraustes*	*vespertinus*	Breeder/Winter
House Sparrow	*Passer*	*domesticus*	Breeder/Winter

Appendices

This Page Intentionally Left Blank

Appendices

Appendix 3: Statistical Results

We gather here the statistical results for the NBC-based analyses summarized in the species accounts under the "Nevada-Specific Studies and Analyses" heading. For the priority songbirds in this plan that were sufficiently well sampled by the NBC, we conducted analyses of NBC data using GIS-derived transect attributes as explanatory variables. In general, we referred to this as "landscape-level" analysis. The statistical analyses are described in detail in *Appendix 1,* apart from the results which are reported below. In brief, the dependent variable was presence/absence of a given priority species. Most of the explanatory variables examined were proportional surface areas of each habitat type within each transect's effective sampling area (defined as the region lying within 200 m of at least one of the transect's ten point-count stations). Habitat types were those identified in the original GAP-based NBC stratification process, which varied slightly from the habitat types otherwise defined in this plan (see *Appendix 1*). One additional explanatory variable was:

> DISTANCE TO WATER: Shortest distance from any portion of the transect sampling area to the nearest year-round water source (with a maximum value of 10 km). Note that a positive relationship with distance would mean that the bird was more likely to occur farther from water.

We used logistic regression to analyze the relationships between bird presence (detection or non-detection) and habitat types or distance to water. The p-values of the univariate relationships are reported in the following tables:

Table App-3-1: Univariate p-values for habitat models of six Priority species in the **Great Basin** region. Significant positive relationships are in **Bold.** Positive relationships are denoted by "(+)" and negative relationships by "(-)".

Habitat Type (Proportion)	Brewer's Sparrow	Gray Fly-catcher	Green-tailed Towhee	Pinyon Jay	Sage Sparrow	Sage Thrasher
Mojave Scrub						
Salt Desert Scrub	0.241(+)	0.007(-)	<.001(-)	0.098(-)	**<.001(+)**	**<.001(+)**
Lowland Sagebrush	**<.001(+)**	**0.013(+)**	0.276	0.213(-)	**<.001(+)**	**<.001(+)**
Montane Sagebrush	**<.001(+)**	0.475	**0.001(+)**	0.038(-)	0.139(-)	0.550
Montane Shrub	0.495	0.038(-)	0.798	0.515	0.197(-)	0.290
Montane Riparian	0.579	0.047(-)	0.133(+)	0.277	0.002(-)	0.009(-)
Aspen	0.562	0.038(-)	**<.001(+)**	0.034(-)	0.004(-)	0.003(-)
Mt. Mahogany	0.063(-)	0.084(-)	**0.001(+)**	0.652	0.014(-)	0.004(-)
Pinyon-Juniper	<.001(-)	**<.001(+)**	**0.001(+)**	**<.001(+)**	<.001(-)	<.001(-)
Coniferous Forest	<.001(-)	0.012(-)	0.194(+)	0.149(-)	0.030(-)	0.011(-)
Mesquite-Catclaw						
Lowland Riparian	0.238(-)	0.190(-)	0.069(-)	0.561	0.118(-)	0.090(-)
Wet Meadow	0.055(-)	0.032(-)	0.006(-)	0.151(-)	0.158(-)	0.060(-)
Wetland	0.081(-)	0.109(-)	0.045(-)	0.226(-)	0.300(-)	0.300
Agricultural	0.089(-)	0.009(-)	0.003(-)	0.110(-)	0.084(-)	0.390
Developed	0.057(-)	0.023(-)	0.324	0.719	0.524	0.060(-)
DISTANCE TO WATER	0.110(-)	0.588	0.274	0.027(+)	0.017(+)	0.590

AR063200

Appendices

Table App-3-2: Univariate p-values for habitat models of five Priority species in the Mojave Desert region. Significant positive relationships are in **Bold.** Positive relationships are denoted by "(+)" and negative relationships by "(-)".

Habitat Type (Proportion)	Abert's Towhee	Bell's Vireo	Lucy's Warbler	Gambel's Quail	Black-chinned Sparrow
Mojave Scrub	0.233(-)	0.091(-)	0.131(-)	**0.002(+)**	0.140(+)
Salt Desert Scrub	0.456	0.441	0.410	0.320	0.234(-)
Lowland Sagebrush	0.178(-)	0.208(-)	0.119(-)	0.017(-)	0.064(-)
Montane Sagebrush	0.276	0.370	0.204(-)	0.099(-)	0.230(-)
Montane Shrub	0.251	0.759	0.117(+)	0.399	**0.011(+)**
Montane Riparian	0.151(-)	0.865	0.188(-)	0.012(-)	**<.001(+)**
Aspen					
Mt. Mahogany		0.577	0.639	0.084(-)	0.841
Pinyon-Juniper	0.217(-)	0.725	0.384	0.239(-)	**<.001(+)**
Coniferous Forest	0.468	0.619	0.492	0.325	0.486
Mesquite-Catclaw	0.902	**0.064(+)**	**0.012(+)**	**0.015(+)**	
Lowland Riparian	**<.001(+)**	**<.001(+)**	**<.001(+)**	**<.001(+)**	0.021(-)
Wet Meadow		0.425	0.524	0.281	0.633
Wetland	0.525	0.676	**0.022(+)**		0.446
Agricultural	**<.001(+)**	**0.012(+)**	**0.003(+)**	**0.029(+)**	0.535
Developed	**0.035(+)**	0.439	**0.003(+)**	0.587	0.527
DISTANCE TO WATER	**0.008(-)**	**0.013(-)**	**0.003(-)**	0.119(-)	0.731

Table App-3-3: Univariate p-values for habitat models of two Priority species whose range encompassed both southern and east-central Nevada. Significant positive relationships are in **Bold.** Positive relationships are denoted by "(+)" and negative relationships by "(-)". Only data from the south and east NBC regions were analyzed (*see Appendix 1*).

Habitat Type (Proportion)	Gray Vireo	Virginia's Warbler
Mojave Scrub	0.065(+)	0.075(-)
Salt Desert Scrub	0.122(-)	0.318
Lowland Sagebrush	0.022(-)	0.068(-)
Montane Sagebrush	0.095(-)	0.727
Montane Shrub	0.410	0.711
Montane Riparian	0.753	0.168(+)
Aspen	0.253	0.560
Mt. Mahogany	0.144(-)	**0.002(+)**
Pinyon-Juniper	**0.001(+)**	**0.001(+)**
Coniferous Forest	0.310	**<.001(+)**
Mesquite-Catclaw	0.270	
Lowland Riparian	0.229(-)	0.347
Wet Meadow	0.203(-)	0.384
Wetland	0.432	0.552
Agricultural	0.182(-)	0.345
Developed	0.233(-)	0.158(+)
DISTANCE TO WATER	0.790	0.524

Appendices

Appendix 4: Comparison of Population Size Estimates for Priority Species in Nevada.

Because we report only one population size estimate on the front pages of the species accounts, here we gather all sources of estimates for comparison. One methodological issue should be noted. BBS-based estimates (Rich et al. 2004, and unpublished Blancher spreadsheet; see *Appendix 1: Methods*) are adjusted by several "correction factors" based on bird detectability. The most important is that raw count numbers are automatically doubled, under the assumption that only males are being detected. NBC estimates, in contrast, do not use correction factors, based on our indications that most of the more visible or local landbirds are being detected within the defined sample area of each survey point (see *Appendix 1: Methods*). Refinement of correction factors and determining when their use is appropriate are priority considerations for improving the population estimation process (Thogmartin et al. 2006).

Table App-4-1: Population size estimates for Priority species. NBC = Nevada Bird Count; BBS = Breeding Bird Survey, with analysis by Blancher (i.e. "Blancher spreadsheet"). Numbers in **bold** are the ones reported in the species accounts. "Source for reported estimate" gives citations or other source information about the estimate shown in bold. WAP = Wildlife Action Plan.

SPECIES	NBC	BBS	Other	Source for reported estimate
Trumpeter Swan			**≤ 30 breeding**	Census
Tundra Swan			**1–10,000 winter**	Expert Opinion
Cinnamon Teal			**> 10,000**	Nevada WAP Team 2006
Northern Pintail			**5,000 breeders**	Nevada WAP Team 2006
Canvasback			**4,600 breeders**	Nevada WAP Team 2006
Redhead			**4,500 breeders**	Nevada WAP Team 2006
Lesser Scaup			**~650 breeders**	USFWS (2001)
Greater Sage-Grouse			**68-88,000**	Nevada WAP Team 2006
Blue Grouse		174	**Unknown**	
Sharp-tailed Grouse			**226**	NDOW reintroductions
Mountain Quail		**840**		Blancher spreadsheet
Gambel's Quail	**260,000**	14,000		Nevada Bird Count
Common Loon			**500 migrants**	Expert Opinion
Eared Grebe			**400 breeders**	Ivey and Herziger 2006
Western Grebe			**250**	Nevada WAP Team 2006
Clark's Grebe			**300**	Nevada WAP Team 2006
American White Pelican			**8,600**	Anaho Island NWR data
Least Bittern			**Unknown**	
Snowy Egret			**600**	Nevada WAP Team 2006
White-faced Ibis	16,000		**5–6,000**	Ivey and Herziger 2006
Bald Eagle			**~ 10; >120**	Buehler 2000; WAP 2006
Northern Goshawk	700	17	**700**	Herron 1999
Swainson's Hawk	21,000	7,700	**300**	Herron et al. 1985
Ferruginous Hawk	**1,200**	900		Nevada Bird Count
Golden Eagle	**3,000**	6,200	2,400	Nevada Bird Count

Appendices

SPECIES	NBC	BBS	Other	Source for reported estimate
Peregrine Falcon			**140-180**	Klinger,NDOW,*pers.comm.*
Prairie Falcon	**11,500**	8,600	2,500	Nevada Bird Count
Clapper Rail			**20-40**	Garnett et al. 2004
Sandhill Crane	3,300		**650 – 1,000**	Bradley 2005
Snowy Plover			**350 – 1,000**	GBBO unpublished data
Black-necked Stilt			**3,000**	Expert Opinion
American Avocet			**18,000**	Expert Opinion
Willet	6,800		**2,100**	Expert Opinion
Long-billed Curlew	15,000		**1,150**	Fellows and Jones 2009
Marbled Godwit			**350**	Expert Opinion
Western Sandpiper			**12,000 migrants**	IWJV (in prep.)
Least Sandpiper			**2,200**	IWJV (in prep.)
Long-billed Dowitcher	174		**14–20,000**	IWJV (in prep.);WAP 2006
Wilson's Phalarope			**3,000 breeders** **12,000 migrants**	IWJV (in prep.) Expert Opinion
Red-necked Phalarope			**3,000**	IWJV (in prep.)
Franklin's Gull			**350**	Expert Opinion
Black Tern			**700**	Expert Opinion
Band-tailed Pigeon	**615**	7,500		Nevada Bird Count
Yellow-billed Cuckoo			**10-20**	NDOW 2009
Flammulated Owl			**< 2,500**	Expert Opinion
Burrowing Owl	**3,000**	22,000		Nevada Bird Count
Spotted Owl			**<12**	Nevada WAP Team 2006
Short-eared Owl		**5,000**		Blancher spreadsheet
Common Poorwill			**Unknown**	
White-throated Swift	**14,000**	4,300		Nevada Bird Count
Costa's Hummingbird	**14,000**			Nevada Bird Count
Calliope Hummingbird	**9,500**	60,000		Nevada Bird Count
Rufous Hummingbird	218		**>1,000,000 migrants**	Expert Opinion
Lewis's Woodpecker	**13,000**	10,000		Nevada Bird Count
Williamson's Sapsucker	**1,500**	480		Nevada Bird Count
White-headed Woodpecker	**840**	660		Nevada Bird Count
Gilded Flicker			**<100**	Floyd et al 2007
Olive-sided Flycatcher	**5,600**	1,000		Nevada Bird Count
Willow Flycatcher	7,300	**1,500**		Blancher spreadsheet
SW Willow Flycatcher			**90**	Swett 1999
Gray Flycatcher	**650,000**	601,000		Nevada Bird Count
Bell's Vireo	**1,000**			Nevada Bird Count
Gray Vireo	**78,000**	300		Nevada Bird Count
Pinyon Jay	**428,000**	1,353,000		Nevada Bird Count
Sage Thrasher	**1,500,000**	3,820,000		Nevada Bird Count

Appendices

SPECIES	NBC	BBS	Other	Source for reported estimate
Bendire's Thrasher	3,100	1,000	**<50**	Expert Opinion
Le Conte's Thrasher	20,000	9,700	**<100**	Expert Opinion
Virginia's Warbler	**8,200**	101,857		Nevada Bird Count
Lucy's Warbler	**2,900**	29,000		Nevada Bird Count
Hermit Warbler	**140**	7,300		Nevada Bird Count
Grace's Warbler	**610**	170		Nevada Bird Count
Green-tailed Towhee	**885,000**	686,000		Nevada Bird Count
Abert's Towhee	**2,300**			Nevada Bird Count
Brewer's Sparrow	**7,400,000**	7,000,000		Nevada Bird Count
Black-chinned Sparrow	**8,400**			Nevada Bird Count
Sage Sparrow	**2,900,000**	1,824,000		Nevada Bird Count
Tricolored Blackbird			**<100**	Ammon and Woods 2008
Black Rosy-finch			**Unknown**	

Appendices

This Page Intentionally Left Blank

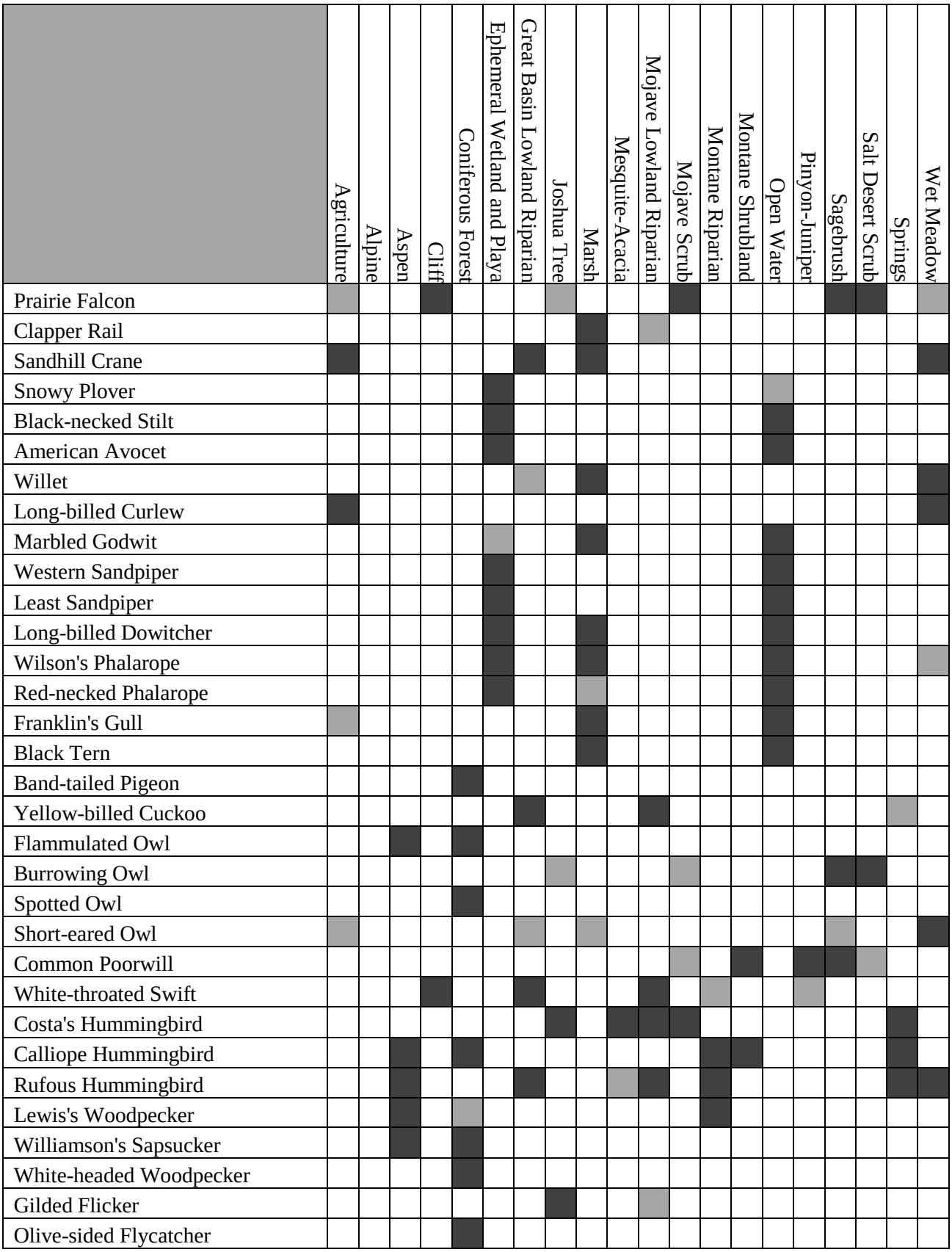
Appendices

Appendix 5: Habitat Use of Conservation Priority, Stewardship, and Special Status Species.

Table App-5-1: The habitats used by Priority species, as listed in the individual species and habitat accounts. Habitat types are defined in *Appendix 1:Methods*. Dark grid cells indicate the habitat type(s) most commonly associated with a given species. Lighter gray grid cells indicate the habitat type(s) that are used less commonly, or seasonally. Species are listed in AOU taxonomic order.

	Agriculture	Alpine	Aspen	Cliff	Coniferous Forest	Ephemeral Wetland and Playa	Great Basin Lowland Riparian	Joshua Tree	Marsh	Mesquite-Acacia	Mojave Lowland Riparian	Mojave Scrub	Montane Riparian	Montane Shrubland	Open Water	Pinyon-Juniper	Sagebrush	Salt Desert Scrub	Springs	Wet Meadow
Trumpeter Swan									■						■					
Tundra Swan									■						■					
Cinnamon Teal	▒					▒	▒		■						■					
Northern Pintail							▒		■						■					
Canvasback									■						■					
Redhead									■						■					
Lesser Scaup									■						■					▒
Greater Sage-Grouse	▒		▒				▒						▒	■			■		▒	■
Sooty / Dusky ("Blue") Grouse			■		■									■						
Sharp-tailed Grouse			■										■	■			▒			
Mountain Quail			■		■								■	■					▒	
Gambel's Quail	■									■	■								■	
Common Loon															■					
Eared Grebe									■						■					
Western Grebe									▒						■					
Clark's Grebe									▒						■					
American White Pelican							▒								■					
Least Bittern									■		▒									
Snowy Egret	▒						■		■		■				▒					
White-faced Ibis	■								■											■
Bald Eagle	▒				▒		■				▒				■					
Northern Goshawk			■		■											▒			▒	
Swainson's Hawk	■						■				■						■			▒
Ferruginous Hawk																■	■	▒		
Golden Eagle				■				▒			▒	▒				▒	■	▒		▒
Peregrine Falcon				■					▒		▒	▒								

Appendices


Agriculture
Alpine
Aspen
Cliff
Coniferous Forest
Ephemeral Wetland and Playa
Great Basin Lowland Riparian
Joshua Tree
Marsh
Mesquite-Acacia
Mojave Lowland Riparian
Mojave Scrub
Montane Riparian
Montane Shrubland
Open Water
Pinyon-Juniper
Sagebrush
Salt Desert Scrub
Springs
Wet Meadow
Prairie Falcon
Clapper Rail
Sandhill Crane
Snowy Plover
Black-necked Stilt
American Avocet
Willet
Long-billed Curlew
Marbled Godwit
Western Sandpiper
Least Sandpiper
Long-billed Dowitcher
Wilson's Phalarope
Red-necked Phalarope
Franklin's Gull
Black Tern
Band-tailed Pigeon
Yellow-billed Cuckoo
Flammulated Owl
Burrowing Owl
Spotted Owl
Short-eared Owl
Common Poorwill
White-throated Swift
Costa's Hummingbird
Calliope Hummingbird
Rufous Hummingbird
Lewis's Woodpecker
Williamson's Sapsucker
White-headed Woodpecker
Gilded Flicker
Olive-sided Flycatcher

Appendices

	Agriculture	Alpine	Aspen	Cliff	Coniferous Forest	Ephemeral Wetland and Playa	Great Basin Lowland Riparian	Joshua Tree	Marsh	Mesquite-Acacia	Mojave Lowland Riparian	Mojave Scrub	Montane Riparian	Montane Shrubland	Open Water	Pinyon-Juniper	Sagebrush	Salt Desert Scrub	Springs	Wet Meadow
Willow Flycatcher							■		▒		■		■						■	
Gray Flycatcher														■		■	■			
Bell's Vireo										▒	■								▒	
Gray Vireo																■				
Pinyon Jay																■	▒			
Sage Thrasher														■			■	■		
Bendire's Thrasher								■		■		▒								
Le Conte's Thrasher								■		■		■						■		
Virginia's Warbler													■	■		■				
Lucy's Warbler										■	■								▒	
Hermit Warbler					■															
Grace's Warbler					■								▒							
Green-tailed Towhee			■										■	■		■				
Abert's Towhee	▒									■	■								■	
Brewer's Sparrow														■			■	■		
Black-chinned Sparrow								■						■		■				
Sage Sparrow																	■	■		
Tricolored Blackbird	▒								■											
Black Rosy-Finch		■												▒			▒			

Appendices

This Page Intentionally Left Blank

AR063209

Appendices

Appendix 6: Priority Species Occurrence in Nevada Important Bird Areas

Many of the "Key Conservation Areas" listed in the species accounts are designated as Important Bird Areas under the Lahontan Audubon Society's Important Bird Area in Nevada Program (http://www.nevadaaudubon.org/iba.html). This program provides an excellent framework within which to organize bird conservation efforts, restoration projects, and activities involving public participation. The tables below summarize the seasonal occurrence of Priority species in all of Nevada's Important Bird Areas.

Table App-6-1: Confirmed and presumed occurrences of Priority species in Nevada's Important Bird Areas, **northwestern region**, with all historical records included. Species are listed in AOU taxonomic order. B = confirmed breeding; b = presumed breeding; M = confirmed migration (including winter); m = presumed migration (including winter); W = confirmed winter; w = presumed winter; N = confirmed non-breeding (excluding migration and winter); n = presumed non-breeding (excluding migration and winter).

Region	Northwest													
County	Washoe / Carson City						Humboldt		Lyon	Douglas		Churchill	Mineral	
Species	Carson Range	High Rock Resource Area	Pyramid Lake	Sheldon NWR	Swan Lake	Washoe Valley	Bilk Creek - Montana Ranges	Gridley Lake	Carson River Delta	Carson Valley	Wellington- Pine Grove Hills	Lahontan Valley Wetlands	Mount Grant	Walker Lake
Trumpeter Swan														
Tundra Swan			W	M	W	W			W			W		M
Cinnamon Teal			M	B	B	B	B	M	B	B		B		M
Northern Pintail			M	B	b	B			b	B		B		M
Canvasback			W	B	B	W				b		B		W
Redhead			M	B	B	B		M	b	B		B		W
Lesser Scaup			M	B	M	B			m	m		M		M
Greater Sage-Grouse		B		B			B				B		B	
Dusky Grouse														
Sooty Grouse	B												B	
Sharp-tailed Grouse														
Mountain Quail	B										B			
Gambel's Quail														
Common Loon			M			M								M
Eared Grebe			M	B	B	b				b		B		M
Western Grebe			M	B	b	B			b	B		B		B?
Clark's Grebe			M	B	b	B			b	B		B		B?
American White Pelican			B			n			n			B		N
Least Bittern												B		
Snowy Egret			B	M	m	B				B		B		
White-faced Ibis				M	b	B			M	b		B		M

AR063210

Appendices

Region	Northwest													
County	Washoe / Carson City						Humboldt		Lyon	Douglas		Churchill	Mineral	
Species	Carson Range	High Rock Resource Area	Pyramid Lake	Sheldon NWR	Swan Lake	Washoe Valley	Bilk Creek - Montana Ranges	Gridley Lake	Carson River Delta	Carson Valley	Wellington- Pine Grove Hills	Lahontan Valley Wetlands	Mount Grant	Walker Lake
Bald Eagle	B		W	W		W			B	B	W	W		W
Northern Goshawk	B									w				
Swainson's Hawk				B		b	B		b	B		B		
Ferruginous Hawk				B		w	B			w		B		
Golden Eagle	B	B	B	B	N	N	B	N	N	B	B	B	B	b
Peregrine Falcon												M		
Prairie Falcon		B	B	B		b	B	b	b	W	B	B	b	b
Clapper Rail														
Sandhill Crane				B	M	M				B				
Snowy Plover			M	B		M		B				B		B
Black-necked Stilt			M	B	B	B		B		B		B		b
American Avocet			M	B	B	B		B	N	B		B		b
Willet				B	M	B		b	b	B		B		
Long-billed Curlew			M	B	M	B		B		B		B		
Marbled Godwit			M		M	M		M		M		M		M
Western Sandpiper			M	M	M	M		M	M	M		M		M
Least Sandpiper			M	M	M	M		M	M	M		M		M
Long-billed Dowitcher			M	M	M	M		M	M	M		M		M
Wilson's Phalarope			M	B	M	B		b	M	b		B		M
Red-necked Phalarope			M		M	N		n	n			N		N
Franklin's Gull			N		N	n						B		n
Black Tern			M		M	M		m	m	M		B		M
Band-tailed Pigeon	B													
Yellow-billed Cuckoo									(b)					
Flammulated Owl	B													
Burrowing Owl				B	B		B			b		B		b
Spotted Owl	B													
Short-eared Owl				B	W		B	b		w		B	b	
Common Poorwill	B	b	b	b			b	b	b		b	b	b	b
White-throated Swift		B					B		b					b
Costa's Hummingbird														
Calliope Hummingbird	B	b		b			b					B	b	
Rufous Hummingbird	m	m		M		m	m		m	M	m	M	m	
Lewis's Woodpecker	B			M								M		
Williamson's Sapsucker	B													
White-headed Woodpecker	B													

Appendices

Region	Northwest													
County	Washoe / Carson City						Humboldt		Lyon	Douglas		Churchill	Mineral	
Species	Carson Range	High Rock Resource Area	Pyramid Lake	Sheldon NWR	Swan Lake	Washoe Valley	Bilk Creek - Montana Ranges	Gridley Lake	Carson River Delta	Carson Valley	Wellington- Pine Grove Hills	Lahontan Valley Wetlands	Mount Grant	Walker Lake
Gilded Flicker														
Olive-sided Flycatcher	B			M		m						M		
Willow Flycatcher	B			M		n			b	n				
Gray Flycatcher	b	B		B		b	B			b	b	M	b	
Bell's Vireo														
Gray Vireo														
Pinyon Jay	B									N	B		b	
Sage Thrasher		B		B			B	b			B		B	b
Bendire's Thrasher														
Le Conte's Thrasher														
Virginia's Warbler											b		b	
Lucy's Warbler														
Hermit Warbler	b													
Grace's Warbler														
Green-tailed Towhee	B	B		B		b	b			b	B	M	B	
Abert's Towhee														
Brewer's Sparrow	B	B		B	b	b	B	b		b	b	b	B	
Black-chinned Sparrow														
Sage Sparrow		B	b	B	b	b	B	b	b	b	B	B	B	b
Tricolored Blackbird										B				
Black Rosy-Finch														

Appendices

Table App-6-2: Confirmed and presumed occurrences of Priority species in Nevada's Important Bird Areas, **eastern and northern regions**, all historical records included. Species are listed in AOU taxonomic order. B = confirmed breeding; b = presumed breeding; M = confirmed migration (including winter); m = presumed migration (including winter); W = confirmed winter; w = presumed winter; N = confirmed non-breeding (excluding migration and winter); n = presumed non-breeding (excluding migration and winter).

Region	East/North										
County	Elko								White Pine		
Species	Boyd Humboldt Valley Wetlands	Franklin Lake	Goshute Mountains	Jarbidge Mountains	Mary's River	North Ruby Valley	Ruby Lake	Ruby Mountains	David E Moore Bird Sanctuary	Great Basin National Park	Northern Snake Range
Trumpeter Swan							B				
Tundra Swan							W				
Cinnamon Teal	B	B			B	B	B				
Northern Pintail	b	B			b	B	B				
Canvasback	b	B					B				
Redhead	b	B			N		B				
Lesser Scaup	m	m				m	B				
Greater Sage-Grouse		B		B	B	B	B	B		B	B
Dusky Grouse			B	B				B	b	B	B
Sooty Grouse											
Sharp-tailed Grouse				B							
Mountain Quail											
Gambel's Quail											
Common Loon							M				
Eared Grebe		B					B				
Western Grebe		B					B				
Clark's Grebe		B					B				
American White Pelican							B				
Least Bittern											
Snowy Egret	B				M		B				
White-faced Ibis	B	B			N	b	B				
Bald Eagle	w	w	M	w	w	B	n	w		w	w
Northern Goshawk			M	B	B			B		B	B
Swainson's Hawk	B		M	B	b	B	B	B			
Ferruginous Hawk	w	B	B			B	B	B			
Golden Eagle		n	B	b	n	b	N	B			B
Peregrine Falcon		M	M				M			b	
Prairie Falcon			b	B	b	b	B	B		b	b
Clapper Rail											
Sandhill Crane	M	b		b	B	b	B		n		
Snowy Plover		b									
Black-necked Stilt		B					B				
American Avocet		B				b	B				

Appendices

Region	East/North										
County	Elko								White Pine		
Species	Boyd Humboldt Valley Wetlands	Franklin Lake	Goshute Mountains	Jarbidge Mountains	Mary's River	North Ruby Valley	Ruby Lake	Ruby Mountains	David E Moore Bird Sanctuary	Great Basin National Park	Northern Snake Range
Willet	B	B				B	B				
Long-billed Curlew	B	B			b	B	B		B		
Marbled Godwit	M	M					M				
Western Sandpiper		M					M				
Least Sandpiper		M					M				
Long-billed Dowitcher		M					M				
Wilson's Phalarope	B	B			B	B	B				
Red-necked Phalarope		B					M				
Franklin's Gull		N					B				
Black Tern	B	b			m		B				
Band-tailed Pigeon											
Yellow-billed Cuckoo											
Flammulated Owl			N	B	B			b		B	B
Burrowing Owl	B	b				b	B		b	b	
Spotted Owl											
Short-eared Owl	B	b			N	b	B				
Common Poorwill		b		B	b	b	B	b	b	B	b
White-throated Swift				B	b			B		B	B
Costa's Hummingbird											
Calliope Hummingbird				B	N	b	B	B		B	
Rufous Hummingbird	m	M	m	m	m	m	M	m	m	m	m
Lewis's Woodpecker				B	B			B		M	m
Williamson's Sapsucker				b						B	b
White-headed Woodpecker											
Gilded Flicker											
Olive-sided Flycatcher				B				b		B	
Willow Flycatcher					B	b	B	b		b	b
Gray Flycatcher				b	B	b	B	B		b	b
Bell's Vireo											
Gray Vireo											
Pinyon Jay								B	B	B	B
Sage Thrasher	b	b	b	b	B	b	B	B	b	B	B
Bendire's Thrasher											
Le Conte's Thrasher											
Virginia's Warbler				b				B	b	B	b
Lucy's Warbler											
Hermit Warbler											
Grace's Warbler											
Green-tailed Towhee				B	B			B	b	B	b

Appendices

Region	East/North										
County	Elko								White Pine		
Species	Boyd Humboldt Valley Wetlands	Franklin Lake	Goshute Mountains	Jarbidge Mountains	Mary's River	North Ruby Valley	Ruby Lake	Ruby Mountains	David E Moore Bird Sanctuary	Great Basin National Park	Northern Snake Range
Abert's Towhee											
Brewer's Sparrow		b	b	B	B	B	B	B	b	B	B
Black-chinned Sparrow											
Sage Sparrow	b	b	b	b	b	b	B	b	b	B	B
Tricolored Blackbird											
Black Rosy-Finch								B	n	B	

Table App-6-3: Confirmed and presumed occurrences of Priority species in Nevada's Important Bird Areas, **central and southern regions**, all historical records included. Species are listed in AOU taxonomic order. B = confirmed breeding; b = presumed breeding; M = confirmed migration (including winter); m = presumed migration (including winter); W = confirmed winter; w = presumed winter; N = confirmed non-breeding (excluding migration and winter); n = presumed non-breeding (excluding migration and winter).

Region	Central/South													
County	Nye				Lincoln		Clark							
Species	Toiyabe Range	Monitor Valley	Oasis Valley	Ash Meadows NWR	Meadow Valley Wash	Pahranagat Valley Complex	Catclaw Washes	Lake Mead	Moapa Valley	Spring Mountains	Sheep Range	Virgin River	Lower Muddy River	Wee Thump Joshua Tree Forest
Trumpeter Swan														
Tundra Swan														
Cinnamon Teal				B		B		w				m	B	
Northern Pintail				B		B		w				n	B	
Canvasback		M				W		W						
Redhead		b		B		B		W	b				b	
Lesser Scaup		m		M		M		M						
Greater Sage-Grouse	B	B												
Dusky Grouse	B													
Sooty Grouse														
Sharp-tailed Grouse														
Mountain Quail														
Gambel's Quail			b	B	B	B	B	B	B	B	B	B	B	B

Appendices

Region	Central/South													
County	Nye				Lincoln		Clark							
Species	Toiyabe Range	Monitor Valley	Oasis Valley	Ash Meadows NWR	Meadow Valley Wash	Pahranagat Valley Complex	Catclaw Washes	Lake Mead	Moapa Valley	Spring Mountains	Sheep Range	Virgin River	Lower Muddy River	Wee Thump Joshua Tree Forest
Common Loon								W						
Eared Grebe				b		B		W					W	
Western Grebe				M		B		b					b	
Clark's Grebe				M		B		b?					b	
American White Pelican						M		W?					M	
Least Bittern								b	b			b	b	
Snowy Egret				M		b		B	b			b	M	
White-faced Ibis			n	M		B		M	b			M	M	
Bald Eagle	w	w		W		W		W				w	W	
Northern Goshawk	B	B								B				
Swainson's Hawk	B		b	B	m	m			m			m	m	
Ferruginous Hawk	B	B	w	w	w	w			w			w	w	w
Golden Eagle	B	b	b	b	N	N	b		N	b	b	N	N	b
Peregrine Falcon				M	M	M		B		B		B	N	
Prairie Falcon	B	b	b	b	b	B	b	B	b	b	b	b	b	b
Clapper Rail				n					b			B	b	
Sandhill Crane						M								
Snowy Plover				B				B						
Black-necked Stilt		B		B		B		b	b			b	b	
American Avocet		B		b		n		b				b	b	
Willet		b		M		M							M	
Long-billed Curlew		b		M		M							M	
Marbled Godwit		M				M			m				M	
Western Sandpiper		M		M		M		M	m				M	
Least Sandpiper		M		M		M		M	m				M	
Long-billed Dowitcher		M		M		M		M	M				M	
Wilson's Phalarope		M		M		M		M	M				M	
Red-necked Phalarope		M		M		M		M	M				M	
Franklin's Gull				M		M		M	m				m	
Black Tern		m		M		M		M	M				M	
Band-tailed Pigeon										B	b			
Yellow-billed Cuckoo			b	n	b	B			B			B		
Flammulated Owl										B	B			
Burrowing Owl			b	B		N	b	B	b					b
Spotted Owl														
Short-eared Owl						B								
Common Poorwill	b	b	b	b	b	B	b	b	b	B	b			b
White-throated Swift	B			B				B	B	b	b	b		b

Appendices

Region	Central/South													
County	Nye				Lincoln		Clark							
Species	Toiyabe Range	Monitor Valley	Oasis Valley	Ash Meadows NWR	Meadow Valley Wash	Pahranagat Valley Complex	Catclaw Washes	Lake Mead	Moapa Valley	Spring Mountains	Sheep Range	Virgin River	Lower Muddy River	Wee Thump Joshua Tree Forest
Costa's Hummingbird			b	b	b	N	b	B	B	B	b	b	b	b
Calliope Hummingbird	B					M					b			
Rufous Hummingbird	m	m	m	M	m	M	m	m	m	m	m	m		m
Lewis's Woodpecker	B					M							M	
Williamson's Sapsucker										B	b			
White-headed Woodpecker														
Gilded Flicker														B
Olive-sided Flycatcher				M		M				B	b			
Willow Flycatcher	B		b	B	B	B		B	B	B		B	b	
Gray Flycatcher	B	B	n	n		N				B	B	n		(B)
Bell's Vireo			b	B	b	B	b	B	B	B		B		
Gray Vireo	B				n				n	B	B			B
Pinyon Jay	B	B								B	B			n
Sage Thrasher	B	B		W		W								
Bendire's Thrasher														B
Le Conte's Thrasher				B		B	b					b	b	B
Virginia's Warbler	B			M		M				B	B			
Lucy's Warbler			b	B	b	B	b	B	B			B		
Hermit Warbler														
Grace's Warbler										B	B			
Green-tailed Towhee	B	b		M		M			M	B	B			
Abert's Towhee			b	b?	b	b?	b	B	B			B	b	b
Brewer's Sparrow	B	B	n	B		B	w		w	b				w
Black-chinned Sparrow					n					B	B			b
Sage Sparrow	B	B	n	B		B	w		W	b				w
Tricolored Blackbird														
Black Rosy-Finch														

ISB 0100
15CPA 0109

SAN BERNARDINO COUNTY
LAND USE SERVICES
PLANNING PROJECT NOTICE
15900 Smoke Tree Street, Hesperia, CA 92345

Referral Date:
February 17, 2015

ATTENTION REVIEWING AGENCIES

The development proposal listed below has been filed with County Planning. Please comment in the space below. You may attach additional pages as necessary.

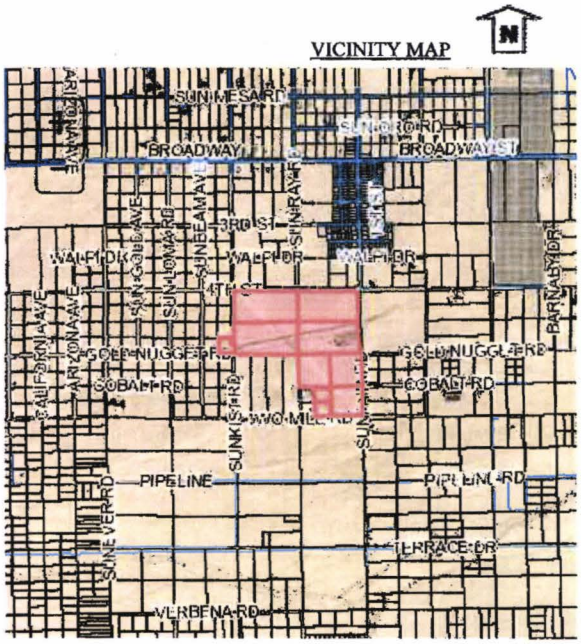
Your comments must be received by Planning **no later than March 03, 2015 to be sure that they are included in the final project action.** Please refer to this project by the Applicant's name and the Assessor Parcel Number indicated below. If you have no comment, a reply is not necessary. If you have any questions regarding this proposal, please contact **Planner, TRACY CREASON** at **(760) 995-8143**, by email at **Tracy.Creason@lus.sbcounty.gov**, or mail your comments to the address above. If you wish, you may also FAX your comments to (760) 995-8167.

ASSESSOR PARCEL NUMBER:	**0607-231-11**	**(See map below for more information)**
PROJECT NUMBER:	**P201400482/CUP**	*** Multiple Parcel Associations ***
APPLICANT:	**MELIN, JESS/ NEXTERA ENERGY RESOURCES**	
LAND USE DISTRICT (ZONING):	**JT/IN**	
IN THE COMMUNITY OF:	**JOSHUA TREE/3RD/ SUPERVISORIAL DISTRICT**	
LOCATED AT:	**5500 SUNFAIR RD., JOSHUA TREE 92252**	
PROPOSAL:	**Conditional Use Permit to establish a 20 megawatt photovoltaic solar energy generating facility on 10 parcels totaling approximately 115 acres at the former Hi Desert (Roy Williams) Airport**	

If you want to be notified of the project decision, please print your name clearly and legibly on this form and mail it to the address above along with a self-addressed, stamped envelope. All decisions are subject to an appeal period of ten (10) calendar days after an action is taken.
Comments (If you need additional space, please attach additional pages):

Recd
VFO
2/19/15

VICINITY MAP



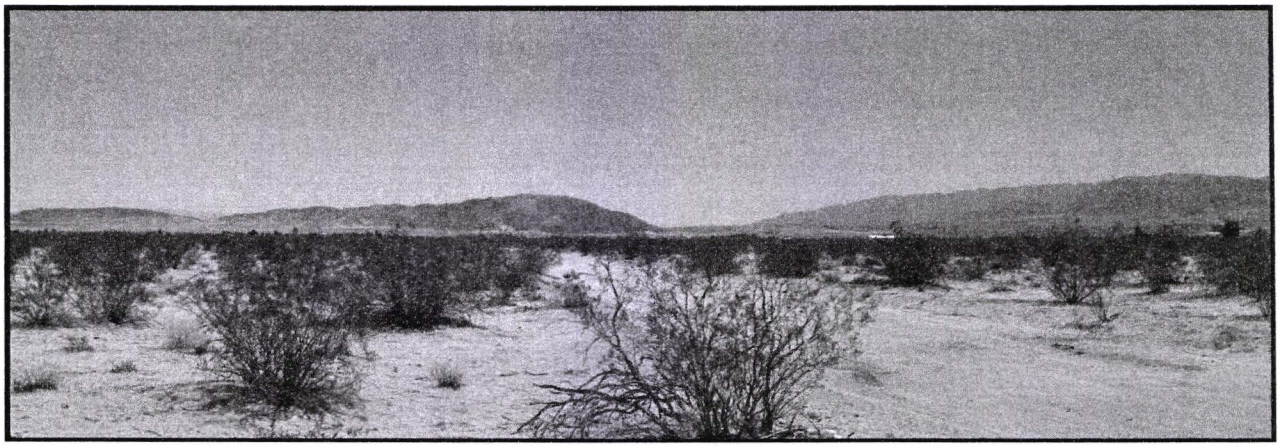
SIGNATURE **DATE** **AGENCY**

IF THIS DECISION IS CHALLENGED IN COURT, SUCH CHALLENGE MAY BE LIMITED TO ONLY THOSE ISSUES RAISED IN WRITING AND DELIVERED TO LAND USE SERVICES BEFORE THE PROJECT DECISION IS MADE.

IF A PUBLIC HEARING IS HELD ON THE PROPOSAL, YOU OR SOMEONE ELSE MUST HAVE RAISED THOSE ISSUES AT THE PUBLIC HEARING OR IN WRITTEN CORRESPONDENCE DELIVERED TO THE HEARING BODY AT, OR PRIOR TO, THE HEARING. DUE TO TIME CONSTRAINTS AND THE NUMBER OF PERSONS WISHING TO GIVE ORAL TESTIMONY, TIME RESTRICTIONS MAY BE PLACED ON ORAL TESTIMONY AT ANY PUBLIC HEARING ABOUT THIS PROPOSAL. YOU MAY WISH TO MAKE YOUR COMMENTS IN WRITING TO ASSURE THAT YOU ARE ABLE TO EXPRESS YOURSELF ADEQUATELY.

Joshua Tree Solar Farm

Conditional Use Permit



Prepared for:

San Bernardino County
Land Use Services Department
Planning Division
385 N. Arrowhead Avenue
San Bernardino, CA 92415-0182

Project Applicant:

Joshua Tree Solar Farm, LLC
700 Universe Boulevard, FBD/JB
Juno Beach, Florida 33408

November 2014

Joshua Tree Solar Farm
Contents

Conditional Use Permit Application

Section A – Fees/Deposit

Tab 1 – San Bernardino County Land Use Services Division Review Fee

Tab 2 – Environmental Health Services Division Review Fee

Tab 3 – San Bernardino County Fire Department Review Fee

Tab 4 – Public Works/Land Development Division Fee

Section B – County Documents

Tab 5 – Land Use Application Questionnaire

Tab 6 – Hazardous Waste Site Certification Form

Tab 7 – Adequate Service Certification

Section C – Other Documents

Tab 8– Plot Plan

Tab 9 – Reduced Plot Plan

Tab 10– Letter of Intent

Tab 11 – Preliminary Title Report

Tab 12 – Articles of Incorporation

Tab 13 – Trust Agreement

Tab 14 – Assessor's Map

Tab 15 – United States Geological Survey Map

Tab 16 – County/Agency Correspondence

Tab 17 – Site Photos/Vicinity Map

Tab 18 – Water Quality Management Plan

Section D – Special Studies

Tab 19 – Geologic Feasibility Study

Tab 20 – Slope Analysis

Tab 21 – Other Studies

Tab 21a Air Quality Emissions Model

Tab 21b Visual Impact Assessment

Tab 21c Cultural Resources Assessment

Tab 21d Hydrology/Drainage Report

Tab 21e Phase I ESA Report

Tab 21f Jurisdictional Delineation

Tab 22 – Traffic Study

Tab 23 – Biological Resources Report

Tab 24 – Fiscal Impact Report

Tab 25– Water Supply Assessment

Section E – Public Notice Materials/Surrounding Property Owners Certification

Tab 26 – Mailing Labels

Tab 27 – Certification Sheet

Tab 28– Radius Map

Section F – Additional Materials

Section G – Redevelopment Area

Section H – Plot Plan

Conditional Use Permit Application

San Bernardino County

Land Use Services Department, Planning Division
San Bernardino County Government Center
385 N. Arrowhead Ave., San Bernardino, CA 92415-0182
15900 Smoke Tree Street, Hesperia, CA 92345
San Bernardino Office – (909) 387-8311 High Desert Office – (760) 995-8140
Fax (909) 387-3249 Fax (760) 995-8167

CONDITIONAL USE PERMIT
INFORMATION SHEET AND APPLICATION

Fees/Deposit:

LUSD Processing Fees			
Area Being Developed	0 to 0.99 acres	1 to 4.99 acres	5 acres and over
Actual Cost Initial Deposit (J631)	**$6,705.00**	**$7,450.00**	**$8,940.00**

Please Note: This is a deposit only. The basic review fees for this application are charged on an "actual cost" basis. Your project will be charged at the hourly and mileage rate(s) as provided in County Code Section 16.0228B(b) ($65 to $250/hr) as well as any other costs incurred by the County in processing your project. These costs include, but are not limited to, any required advertising, mailings, and notices. Other divisions and departments will be charging to the deposit listed above. You are responsible for all charges made to the project account. If account funds are depleted an additional deposit will be required. If an additional deposit is required it must be paid to allow staff to continue processing. Any failure to pay the required deposit will result in suspension and possible termination of the project review process as well as sending your account to collections. After the review is completed, a minimum deposit balance will be required for condition compliance processing. For more information on fees, please contact County Planning.

In addition to the deposit listed above other fees may be required for reviews by County Fire, Environmental Health Services, Code Enforcement, Surveyor, Public Works and special report reviews by Building and Safety. State Fish and Game fees as noted on the attached pages may be required before your project can be approved.

A Conditional Use Permit (CUP) is required by the County Development Code to evaluate the location, design and operation for certain new or expanded land uses as specified in each Land Use District. These uses, although generally deemed to be consistent with the purpose and intent of the Land Use District, typically have characteristics which require special consideration in order to avoid conflicts with surrounding land uses. **Note: Wireless telecommunication facilities are required to be submitted on a specialized application.**

The Conditional Use Permit application and process provides the County the opportunity to completely review the proposed project before its implementation. Conditions of Approval will be required of the project prior to its final approval or implementation.

Conditional Use Permits will be reviewed by Planning Staff and will be considered by the Planning Commission at a public hearing. Actions of the Planning Commission may be appealed to the Board of Supervisors within ten days following the date of the action. Appeals must be made by means of a separate application and may require an additional fee.

Please use this information sheet as a checklist to assemble the materials required for the submittal of your Conditional Use Permit and bring it with you when you submit your application. An appointment is not required to submit your application; however, appointments are available upon request. If you wish to schedule an appointment, please call one of the numbers listed above.

GENERAL PROCEDURES

1. Submit application and fees – County staff will use the checklist to determine whether your application may be accepted. The County's standard Land Use Application shall be used and is contained in this packet.
2. Determination of Application Completeness – County staff will determine whether the materials you have submitted are adequate or if additional materials or reports are required. You will be notified in writing if any additional materials are required.
3. Environmental Action Determination – County staff will prepare an Environmental Initial Study in compliance with the California Environmental Quality Act (CEQA). It is through the Initial Study that the determination is made as to what type of environmental determination will be required. If an Environmental Impact Report (EIR) is required, staff will contact you to explain the process and the costs.
4. Application processing – The project planner will have the project and materials reviewed by all appropriate County Departments and Agencies. Any required corrections, questions or revisions to the plans or other materials will be reviewed by the project planner and then provided to you.
5. Recommendations, conditions of approval and final report – The project planner will prepare these materials for consideration by the Planning Commission.

CHECKLIST OF SUBMITTAL MATERIALS

Please use this checklist as you assemble the materials for the submittal of your application. County staff will use the checklist to determine whether your application is acceptable for submission. **If your submittal package does not contain all of the information listed below, your application will not be taken in and receipted for processing.** If you have any questions about the items requested or if you wish to obtain information on processing schedules, please call the Customer Service Unit at (909) 387-8311 or (760) 995-8140.

Section A – Fees/Deposit

1. X Check or money order made payable to "San Bernardino County" in the correct amount.

LUSD Processing Fees			
Area Being Developed	0 to 0.99 acres	1 to 4.99 acres	5 acres and over
Actual Cost Initial Deposit (J631)	**$6,705.00**	**$7,450.00**	**$8,940.00**

Provide **one copy** of the following receipts or a letter stating such fees are not applicable:

2. X **Receipt** from the Environmental Health Services Division (DEHS) of payment of required review fees. Contact DEHS at (909) 387-4666 for fee amount, applicability and payment prior to application submittal
3. X **Receipt** from the appropriate fire jurisdiction of payment of required review fees.
4. X **Receipt** from the Department of Public Works/Land Development Division of payment of required review fees.

Note: If your project is within a Geologic Hazard Overlay District, you will be required to pay the Building and Safety Division the review fees for any required geologic reports. You will be notified when you will need to complete this part of the process. The fee amount will be as established by the County Fee Ordinance.

The fees listed above (2 - 4) for DEHS, County Fire, Public Works and Building and Safety are in addition to the "actual cost" deposit. Additional fees will be required if the application is the subject of a Code Enforcement action.

"Actual Cost Initial Deposit" – ***This is a deposit only. The basic review fees for this application are charged on an "actual cost" basis. Your project will be charged at the hourly and mileage rate(s) as provided in County Code Section 16.0228B(b) ($65 to $250/hr) as well as any other costs incurred by the County in processing your project. These costs include, but are not limited to, any required advertising, mailings, and notices. Other divisions and departments will be charging to the deposit listed above. You are responsible for all charges made to the project account. If account funds are depleted an additional deposit will be required. If an additional deposit is required it must be paid to allow staff to continue processing. Any failure to pay the***

required deposit will result in suspension and possible termination of the project review process as well as sending your account to collections. After the review is completed, a minimum deposit balance will be required for condition compliance processing. For more information on fees, please contact County Planning.

In addition to the deposit listed above other fees may be required for reviews by County Fire, Environmental Health Services, Code Enforcement, Surveyor, Public Works and special report reviews by Building and Safety. State Fish and Game fees as noted on the attached pages may be required before your project can be approved.

Section B - County Documents

5. X — **Two copies** of a completed Land Use Application Questionnaire.
Only two copies of the application are required for the initial filing of this application. *Revisions may or may not be required. When Customer Service Unit staff determines that the application is complete, you will be required to submit additional copies of the application. The specific number of copies to be submitted will be determined at that time.*
6. X — **One copy** of the completed Hazardous Waste Site Certification form contained in this packet.
7. X — **Two copies** of the Adequate Service Certification for water and sewer service. Please use the forms (A, W1, W2, S1 and S2) at the end of this packet.

Section C – Other Documents

8. X — **Two copies** of a plot plan drawn at a scale to accurately delineate the proposed project as it is to be constructed. A conceptual plan is not acceptable. (Folded accordion style - 8" x 10 1/2" size.) (Refer to the Plot Plan Checklist for specific requirements.) *Only two copies of the plot plan are required for the initial filing of this application. Revisions may or may not be required. When Customer Service Unit staff determines that the plan is complete, you will be required to submit additional copies of the plot plan. The specific number of copies to be submitted will be determined at that time.*
9. X — **One copy** of the plot plan reduced to 11" X 17".
10. X — **One copy** of a "Letter of Intent" which specifically details the proposed business or operation. Include hours of operation, number of employees, truck trips, and any other details that will accurately describe the business.
11. X — **One copy** of a) the recorded Grant Deed or b) the Quit Claim Deed with the previous Grant Deed for each lot or parcel or c) a copy of a current Preliminary Title Report (issued within 60 days of filing).
12. X — **One certified copy** each, if applicable, of the Articles of Incorporation including the latest statement of officers; the Partnership Papers (limited or general); or the recorded Fictitious Business Name Statement naming the owner(s) of the firm, if either the Grantor or Grantee are Corporations, Partnerships, or Fictitious Firms
13. X — **One copy** of the trust agreement if a trustee is listed as the property owner.
14. X — **One copy** of the appropriate Assessor's map. This may be obtained from the Assessor's Office.
15. X — **One copy** of the United States Geological Survey (USGS) Map of the project area clearly showing project boundaries and labeled with the quadrangle map name and applicant's name. A legible photocopy is acceptable. The USGS map may be purchased at a local blueprint company.
16. N/A — **One copy** of any letter or document received from the County or other agency regarding this project.
17. X — **One copy** of original color photos of the project site from various angles (digital photos on a disk/CD are preferred). Include a vicinity map indicating the location and direction of view.
18. X — **Two copies** of a Water Quality Management Plan (WQMP) with a cover page that contains contact information for the project applicant and engineer. Detention basins shall be designed to closely conform to the natural topography. Native, drought-tolerant landscaping shall be required to maintain the natural aesthetic.

Section D - Special Studies (if applicable)

19. N/A — **Three copies** of a Geologic Feasibility Study for any property in a Geologic Hazard (GH) Overlay District.
20. N/A — **Four copies** of a Slope Analysis for any project in a Fire Safety Review Area (FS) Overlay District where grading is proposed.
21. X — **Three copies** of any other studies prepared for this project.
22. X — **Four copies** of any required traffic study. A **traffic study** can be required. A final determination will be made after submittal of the project.

23. X **Five copies** of any required Endangered Species Report and/or general Biological Study (Desert Tortoise, Mojave Ground Squirrel, Southern Rubber Boa, Delhi Sand Loving Fly, etc.).
24. N/A **Two copies** of the Fiscal Impact Report for any mobilehome or multi-family project of 50 units or more.
25. N/A **Four copies** of a Water Supply Assessment in accordance with SB 221 and SB 610 for a residential project of 500 units or more; shopping centers or business establishments employing more than 1,000 people or 250,000 SF of floor space; hotels more than 500 rooms; industrial uses on 40 acres and greater, or 650,000 SF or more.

Section E – Public Notice Materials/Surrounding Property Owners Certification
Please refer to the sheet titled "Surrounding Property Owners Certification" for details regarding requirements and label format. This sheet also includes the required signature block for the person who prepared the information and labels. ***The Mailing Labels should include the applicants' and representatives' mailing addresses.***

26. X **Two** adhesive sets *and* one reproducible copy of **mailing labels** for all property owners that own property within the following specified areas. The following are based on the project area being:
    ____ 20.0 acres or less: All parcels within 300 feet of the external boundaries of the project parcel.
    X 20.1 acres to 160 acres: All parcels within 700 feet of external boundaries of the project parcel.
    ____ 160.1 acres or greater: All parcels within 1,300 feet of the external boundaries of the project parcel.
27. X **One copy** of the certification sheet signed by the person who prepared the list and labels.
28. X **One copy** of a radius map showing all the Assessor's Parcels at the same scale and including the radius notification specified above based on parcel size.

Section F – Additional Materials*
Technical studies for traffic, drainage, noise, air quality, biotic resources, archeological resources, groundwater resources, hazardous materials, visual impact or other issues may be required to process your application. You will be notified if any additional materials will be required for the application.

Section G – Redevelopment Area: If a project is in a Redevelopment Area, building colors, signage, and landscape plans should be provided.

Section H – Plot Plan and Building Elevations: Use the following checklist to be sure that your plans include all of the required elements. The plot plan is a drawing, to scale, on one sheet of paper (minimum size of 18" x 24") of the entire land parcel showing buildings, improvements, other physical features and all dimensions. Building elevations must be fully dimensioned and illustrate proposed structure(s) from all sides; the building drawings should also show each story of any multi-story building. Remember that the staff and Planning Commission are not familiar with the property and will need this information to evaluate your project. **If the plans are not legible or do not contain the information listed below, your application will be returned.**

1. X Official Stamp Area: A 4 inch by 14 inch area in the upper right hand side of the plot plan shall be left blank and labeled "Official Use Only".

2. X Plan Identification: The lower right hand corner of the plan shall contain the following information in this order: a) Assessor's Parcel Number(s) (APN:); b) application type *and proposed land use/building size "CUP for ____" c) the names, addresses and telephone numbers of the applicant, representative, recorded Property Owner(s) (if different from applicant), and plan preparer and d) plot plan preparation date and any revision date(s).*

3. X Utilities: Indicate names, address and telephone numbers of water company, sewage disposal, electric, gas, telephone, cable television. If no utility company, indicate method of supply.

4. X Legal Description: Complete legal description of the property including number of acres. Include APN. If a portion of a large parcel is being developed, include a detailed description of that portion.

5. X North Arrow: Indicate north (pointing to top or left hand side of the plan), date of drawing and the scale. Use an Engineer's Scale (1" to 10', 1" to 20', etc.)

6. X Dimensions: Show all property lines and dimensions. Also, show boundary lines of project with dimensions if only a portion of the property is being developed. *Property lines shall be shown as a solid, distinctive line. Entire property must be shown.*

7. X Roads/Easements: Indicate location, names, centerline, existing and proposed widths of boundary streets, and recorded road, utility, and drainage easements on the property. If none exist, indicate by a note that no easements exist. If property is not on a road or easement, show legal and physical access to property.

8. X Paving: Delineate edge of paving (if any) and indicate any existing curbs, driveways, and sidewalks. If no paving exists, indicate type of road (dirt, or gravel) and a note that curb and gutter and/or sidewalks do not exist. If paving does not exist, provide in a notation the distance to nearest paved road and name of road.

9. X Drainage: Indicate any drainage or hilly terrain by flow-line arrows and contour lines. Show proposed drainage of site by flow-line arrows and swales.

10. X Grading/Topographic Information:
_____ Show existing contours and proposed finish contours.
_____ Show finish elevations at lot corners and graded areas.
_____ Show finish grades for all structures, pads and parking surfaces.
_____ If no grading is proposed, state " No grading proposed."
_____ Show location, size and height of any existing or proposed walls.

11. X Land Use District: Indicate existing and proposed General Plan Land Use District (zoning) for project and all adjacent property including across any streets. If adjacent property is within a City, list the City and City Zoning.

12. X Structures/Land Use (Adjacent Areas): Indicate the existing land use, including "Vacant" or "citrus grove," of structures on all adjacent property including areas across any adjacent streets. Indicate distance to any structure that is within 20 feet of the project property line.

13. X Structures (Project Area): Indicate with dimensions all existing and proposed structures, including but not limited to power poles, towers, fences, trash enclosures, signs, septic systems. Indicate type of construction and approximate age of any existing/proposed structures.
_____ Locate by distance in relation to other structures and property lines.
_____ Indicate existing structures that are to remain or to be removed.
_____ Indicate the specific use of all existing and proposed structures.
_____ Indicate height, building footprint dimensions, including eave overhang projections, square footage of each story and number of stories including basements.
_____ Show location and height of any wall.

14. X Vicinity Map: Indicate project location within a general vicinity map with a north arrow. Indicate nearest cross streets, major access roads and community name.

15. X Signage: Provide a dimensioned side elevation of any proposed free-standing or monument identification sign including the proposed "copy" (wording). Include distance from both top and bottom of sign to grade. Refer to Development Code for information on allowable type and size of signs. If no sign is proposed state "No signs proposed". If a sign is proposed at a later date, additional review and costs may be incurred.

16. X Parking: [Refer to the County Development Code for details.] Show all parking areas with dimensions, number/type of spaces, and surfacing materials. Show the formula per the San Bernardino County Development Code by which you computed the number of spaces required for each use/tenant/unit. Indicate the number of spaces required for each use and indicate the number of spaces proposed as well as the minimum number of spaces required. Use the following chart as an example:

PARKING SPACE ANALYSIS:

Land Use/Requirement	Parking Rate	Bldg. Size/rate	Required	Provided
Warehouse	1/1000 sq. ft.	10,000 sq.ft. ÷ 1000 sq.ft.	= 10 minimum	12
Office/retail	1/250 sq. ft. (minimum 4)	600 sq.ft. ÷ 250 sq.ft/min. 4	= 4 minimum	4
restaurant	1/3seats (minimum 10)	1000 sq. ft. w/20 seats/min 10	= 10 minimum	12
Loading Zone	1/5000 per use	11,600 sq. ft.	= 3 minimum	3
TOTAL		**11, 600 sq.ft.**	**27**	**31**
Van accessible spaces for the disabled			1	2
Disabled person spaces			1	0

17. N/A Path of Travel: Show a marked path of travel from handicap space(s) and from the street to the main building(s).

18. X Lot Coverage: Show percentages of parcel covered by impervious surface, landscaping, and open space.

19. X Plant and Tree Protection: If no protected or endangered trees exist on the site state "No Protected Plants", otherwise show the location, size, and type of all native trees, including unbranched cacti, yuccas, palms and joshuas, and indicate whether any of the following trees are to be removed:

    Valley or Mountain Areas – Six inches or greater in diameter or 19 inches in circumference measured at 4.5 feet above average ground level of the base.
    Desert Areas – All Joshua trees and all species of century plants, nolinas and yuccas. Creosote rings that are 10 feet or greater in diameter. For smoketrees and mesquites, two (2) inches or greater in diameter or six (6) feet or greater in height. All plants protected by the State Desert Native Plants Act shall be protected in accordance with that ordinance.

20. X Landscaping: Show areas to be landscaped. If in a ReDevelopment Area (RDA), a project specific landscaping plan is required at time of submittal.

21. X Lighting: Show location of outdoor lighting. In a note, indicate the type of lighting and planned shielding design.

22. N/A Commercial, Industrial, or Institutional Projects: Show uses of all buildings and structures with number of occupants, hours of operation, etc. If proposed use is storage, indicate type of material to be stored.

23. X Truck traffic: If truck activity is involved in the project, show the turn maneuvers for the driveways relative to the street.

Section A

Fees / Deposit

Tab 1. San Bernardino County Land Use Services Division Review Fee

Tab 1- San Bernardino County Land Use Services Division Review Fee

A hard copy check in the amount of **$8,940** has been sent to San Bernardino County as evidenced by the UPS tracking shown below.



At the request of Rita Ellman, this notice alerts you of the status of the shipment listed below.

Tracking Detail
Your package is on time with a scheduled delivery date of 11/12/2014

Tracking Number:	1ZF5W8320193534719
Type:	Package
Status:	**In Transit - On Time**
Scheduled Delivery:	11/12/2014 SAN BERNARDINO COUNTY LAND USE SERVICES DIVISION
Shipped To:	385 NORTH ARROWHEAD AV. 2ND FLOOR SAN BERNARDINO,CA,US,924150103
Shipped/Billed On:	11/11/2014
Reference Number(s):	019, 200080
Service:	NEXT DAY AIR

Shipment Progress

Location	Date	Local Time
SAN BERNARDINO, CA, US	11/12/2014	7:12 A.M. Out For Delivery
ONTARIO, CA, US	11/12/2014	6:49 A.M. Departure Scan
	11/12/2014	5:02 A.M. Arrival Scan
LOUISVILLE, KY, US	11/12/2014	3:33 A.M. Departure Scan
LOUISVILLE, KY, US	11/11/2014	11:54 P.M. Arrival Scan
WEST PALM BEACH, FL, US	11/11/2014	9:41 P.M. Departure Scan
	11/11/2014	8:57 P.M. Arrival Scan

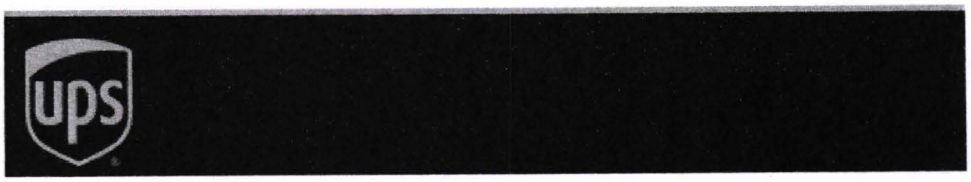
RIVIERA BEACH, FL, US	11/11/2014	8:37 P.M. Departure Scan
	11/11/2014	7:12 P.M. Origin Scan
	11/11/2014	4:03 P.M. Pickup Scan
US	11/11/2014	8:47 A.M. Order Processed: Ready for UPS

Tracking results provided by UPS: 11/12/2014 11:50 A.M. Eastern Time

Tab 2. Environmental Health Services Division Review Fee

Tab 2- Environmental Health Services Division Review Fee

A hard copy check in the amount of **$502** has been sent to San Bernardino County Environmental Health Services Division as evidenced by the UPS tracking shown below.



At the request of Rita Ellman, this notice alerts you of the status of the shipment listed below.

Tracking Detail
Your package is on time with a scheduled delivery date of 11/12/2014

Tracking Number:	1ZF5W8320193534719
Type:	Package
Status:	**In Transit - On Time**
Scheduled Delivery:	11/12/2014
	SAN BERNARDINO COUNTY
	LAND USE SERVICES DIVISION
Shipped To:	385 NORTH ARROWHEAD AV.
	2ND FLOOR
	SAN BERNARDINO,CA,US,924150103
Shipped/Billed On:	11/11/2014
Reference Number(s):	019, 200080
Service:	NEXT DAY AIR

Shipment Progress

Location	Date	Local Time
SAN BERNARDINO, CA, US	11/12/2014	7:12 A.M. Out For Delivery
ONTARIO, CA, US	11/12/2014	6:49 A.M. Departure Scan
	11/12/2014	5:02 A.M. Arrival Scan
LOUISVILLE, KY, US	11/12/2014	3:33 A.M. Departure Scan
LOUISVILLE, KY, US	11/11/2014	11:54 P.M. Arrival Scan
WEST PALM BEACH, FL, US	11/11/2014	9:41 P.M. Departure Scan
	11/11/2014	8:57 P.M. Arrival Scan

RIVIERA BEACH, FL, US	11/11/2014	8:37 P.M. Departure Scan
	11/11/2014	7:12 P.M. Origin Scan
	11/11/2014	4:03 P.M. Pickup Scan
US	11/11/2014	8:47 A.M. Order Processed: Ready for UPS

Tracking results provided by UPS: 11/12/2014 11:50 A.M. Eastern Time

Tab 3. San Bernardino County Fire Department Review Fee

Tab 3- San Bernardino County Fire Department Review Fee

A hard copy check in the amount of **$1,576** has been sent to the Fire Department. A UPS tracking showing proof that the check has been sent is attached below.



At the request of Rita Ellman, this notice alerts you of the status of the shipment listed below.

Tracking Detail
Your package is on time with a scheduled delivery date of 11/12/2014

Tracking Number:	1ZF5W8320192567329
Type:	Package
Status:	**In Transit - On Time**
Scheduled Delivery:	11/12/2014
Shipped To:	SAN BERNARDINO COUNTY FIRE DEPT. 15900 SMOKETREE HESPERIA,CA,US,923453222
Shipped/Billed On:	11/11/2014
Reference Number(s):	019, 200080
Service:	NEXT DAY AIR

Shipment Progress

Location	Date	Local Time
VICTORVILLE, CA, US	11/12/2014	7:24 A.M. Out For Delivery
ONTARIO, CA, US	11/12/2014	6:29 A.M. Departure Scan
	11/12/2014	5:02 A.M. Arrival Scan
LOUISVILLE, KY, US	11/12/2014	3:33 A.M. Departure Scan
LOUISVILLE, KY, US	11/11/2014	11:54 P.M. Arrival Scan
WEST PALM BEACH, FL, US	11/11/2014	9:41 P.M. Departure Scan
	11/11/2014	8:57 P.M. Arrival Scan

RIVIERA BEACH, FL, US	11/11/2014	8:37 P.M. Departure Scan
	11/11/2014	7:12 P.M. Origin Scan
	11/11/2014	4:03 P.M. Pickup Scan
US	11/11/2014	8:49 A.M. Order Processed: Ready for UPS

Tracking results provided by UPS: 11/12/2014 11:49 A.M. Eastern Time

Tab 4. Public Works/Land Development Division Fee

Tab 4- Public Works/Land Development Division Fee

A hard copy check in the amount of **$520** has been sent to San Bernardino County Public Works/Land Development Division as evidenced by the UPS tracking shown below.



At the request of Rita Ellman, this notice alerts you of the status of the shipment listed below.

Tracking Detail
Your package is on time with a scheduled delivery date of 11/12/2014

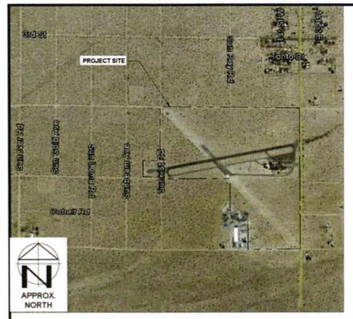
Tracking Number:	1ZF5W8320193534719
Type:	Package
Status:	**In Transit - On Time**
Scheduled Delivery:	11/12/2014
	SAN BERNARDINO COUNTY
	LAND USE SERVICES DIVISION
Shipped To:	385 NORTH ARROWHEAD AV.
	2ND FLOOR
	SAN BERNARDINO,CA,US,924150103
Shipped/Billed On:	11/11/2014
Reference Number(s):	019, 200080
Service:	NEXT DAY AIR

Shipment Progress

Location	Date	Local Time
SAN BERNARDINO, CA, US	11/12/2014	7:12 A.M. Out For Delivery
ONTARIO, CA, US	11/12/2014	6:49 A.M. Departure Scan
	11/12/2014	5:02 A.M. Arrival Scan
LOUISVILLE, KY, US	11/12/2014	3:33 A.M. Departure Scan
LOUISVILLE, KY, US	11/11/2014	11:54 P.M. Arrival Scan
WEST PALM BEACH, FL, US	11/11/2014	9:41 P.M. Departure Scan
	11/11/2014	8:57 P.M. Arrival Scan

RIVIERA BEACH, FL, US	11/11/2014	8:37 P.M. Departure Scan
	11/11/2014	7:12 P.M. Origin Scan
	11/11/2014	4:03 P.M. Pickup Scan
US	11/11/2014	8:47 A.M. Order Processed: Ready for UPS

Tracking results provided by UPS: 11/12/2014 11:50 A.M. Eastern Time



VICINITY MAP
NOT TO SCALE

SURFACE COVERAGE CALCULATIONS	
MODULE WIDTH (FT)	3.25
MODULE HEIGHT (FT)	6.42
MODULE AREA (SQ FT)	20.87
MODULE QUANTITY	84,096
TOTAL MODULE SURFACE AREA (SQ FT)	1,754,663.04
INVERTER PAD AREA (SQ FT)	570.12
INVERTER PAD QUANTITY	14
TOTAL INVERTER PAD SURFACE AREA (SQ FT)	7,981.68
TOTAL PROJECT AREA (SQ FT)	5,114,330.86
PERCENT COVERAGE	34%

WHILE THE SOLAR PANELS ARE IMPERVIOUS, THE PANELS ARE SEPARATED AND ELEVATED FROM THE GROUND SURFACE. ANY PRECIPITATION THAT FALLS ONTO A SOLAR PANEL WILL RUN OFF ON THE SOIL AND EITHER INFILTRATE OR RUN OFF THE SITE AS IT HAS DONE HISTORICALLY

EASEMENTS ITEMS PER P.T.R. 997-23052913-ML3

1. WATER RIGHTS. CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS - AFFECTS ALL PROPERTIES
2. RIGHTS OF PUBLIC IN ANY PORTION LYING WITHIN ROAD,STREET, OR HIGHWAY
3. RESERVATIONS IN PATENT H/PATENTS/236
4. OPERATION & MAINTENANCE OF RR; RIGHT OF WAY FOR COUNTY ROADS; RIGHT TO USE WATER RISING UPON LAND. PER 498/Do/299 (RESERVED ON PAGE 357 THEREOF)
5. 17' INGRESS/EGRESS & ROAD EASEMENT PER 6462/OR/732
6. 25' GENERAL TELEPHONE EASEMENT PER 7663/OR/411
7. 40' PUBLIC ROAD EASEMENT PER 92-251092 O.R. (OFFERED PER 82-029702 O.R.)
8. PUBLIC ROAD EASEMENT PER 92-113701 O.R (OFFERED PER 72/PM/40-41)
9. AIRPORT RUNWAY EXPANSION EASEMENT PER 93-094639 O.R
10. RIGHTS OF THE PUBLIC OVER ANY PORTION LYING WITHIN A ROAD/HIGHWAY
11. CENTERLINE CALIFORNIA ELECTRIC POWER EASEMENT PER 2389/OR/268 (NO WIDTH GIVEN)
12. APPRX. CENTERLINE 6' WIDE SO. CA. EDISON EASEMENT PER 8026/OR/962 (DOC. HAS HAND WRITTEN NOTES)
13. 50' PUBLIC ROAD EASEMENT PER 806/OR/921
14. 40' PUBLIC ROAD EASEMENT PER 2003-0555328
15. PUE PER 78/MB/71-72
16. CC&R'S PER 5236/OR/439. BUILDING RESTRICTIONS (DOCUMENT STATES THAT THE PLANNING COMMISSION CAN RE-ZONE)
17. ELECTRIC POWER EASEMENT PER 6271/OR/415
18. PUBLIC ROAD EASEMENT PER 1966-0283419

OTHER ITEMS LISTED WHICH AFFECT ALL PARCELS: ANY EASEMENTS NOT DISCLOSED BY PUBLIC RECORDS; MATTERS WHICH MAY BE DISCLOSED BY AN ALTA/ACSM SURVEY; RIGHTS OF PARTIES IN POSSESSION. REFER TO P.T.R.

THE DESIGN ASSUMES THAT ANY EASEMENTS EFFECTING THE SOLAR FIELD WILL BE VACATED PRIOR TO THE START OF CONSTRUCTION.

KEYED NOTES:

1. PERIMETER ACCESS: 26' WIDE CLEAR ACCESS WAY TO BE CONSTRUCTED USING APPROVED NATIVE MATERIAL OR GRAVEL, COMPACTED TO 85% COMPACTION.
2. INTERIOR ACCESS: 20' WIDE CLEAR ACCESS WAY TO BE CONSTRUCTED USING APPROVED NATIVE MATERIAL OR GRAVEL, COMPACTED TO 85% COMPACTION.

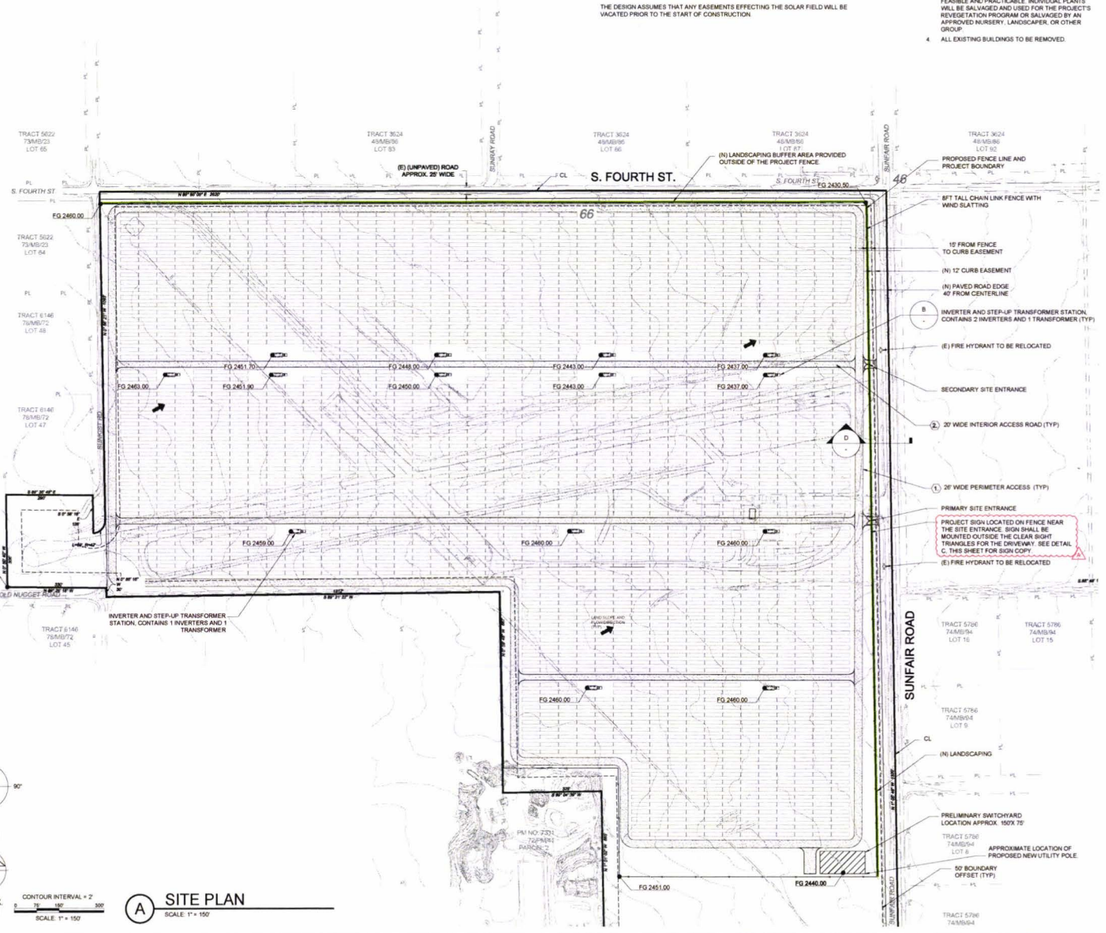
NOTES:

1. SAFETY LIGHTING WILL BE INSTALLED AT THE ENTRY GATES AND THE SWITCHGEAR LOCATION. A LIMITED AMOUNT OF LIGHTING WILL BE INSTALLED AND WILL BE DESIGNED TO PREVENT SPILLOVER INTO NEIGHBORING PROPERTIES. THERE WILL BE OPERABLE LIGHTING AT EACH CONVERSION STATION, BUT THESE UNITS WILL BE USED AS NEEDED AND WILL NOT TYPICALLY OPERATE AT NIGHT. THE ENTRY WILL HAVE FIXTURES TO PROVIDE MINIMAL LIGHTING AND WILL HAVE ADDITIONAL ON-DEMAND (E.G. TIMER) LIGHTING AS NEEDED OR REQUIRED.
2. GRUBBING AND GRADING ACTIVITIES WILL BE LIMITED DUE TO THE PREVIOUS DEVELOPMENT ACTIVITIES AND INHERENTLY SPARSE VEGETATION. SITE GRADING WILL BE SOLELY FOR STORM WATER CONTROL. THE PREVIOUS DEVELOPMENT SIGNIFICANTLY REDUCES THE NEED FOR SITE LEVELING, CUT AND FILL, AND OTHER INVASIVE SITE MODIFICATIONS. FOR THE VAST MAJORITY OF THE ARRAY AREA, NO SITE GRADING WILL BE EMPLOYED.
3. PLANT AND TREE PROTECTION: SPECIES IN THE JOSHUA TREE SOLAR PROJECT VICINITY THAT ARE SUBJECT TO PERMITTING INCLUDE JOSHUA TREE (*YUCCA BREVIFOLIA*) AND SEVERAL SPECIES OF CACTI (SILVER CHOLLA, BUCKHORN CHOLLA [*CYLINDROPUNTIA ACANTHOCARPA*] PENCIL CHOLLA [*C. RAMOSISSIMA*] AND BEAVERTAIL CACTUS [*OPUNTIA BASILARIS*]). PLEASE SEE *DESERT TORTOISE SURVEY AND GENERAL BIOLOGICAL RESOURCES ASSESSMENT FOR THE JOSHUA TREE SOLAR FARM (AIRPORT SITE) SAN BERNARDINO COUNTY, CA, 2012. TETRA TECH* FOR THE LOCATIONS OF THESE PLANTS. WHERE FEASIBLE AND PRACTICABLE, INDIVIDUAL PLANTS WILL BE SALVAGED AND USED FOR THE PROJECT'S REVEGETATION PROGRAM OR SALVAGED BY AN APPROVED NURSERY, LANDSCAPER, OR OTHER GROUP.
4. ALL EXISTING BUILDINGS TO BE REMOVED.

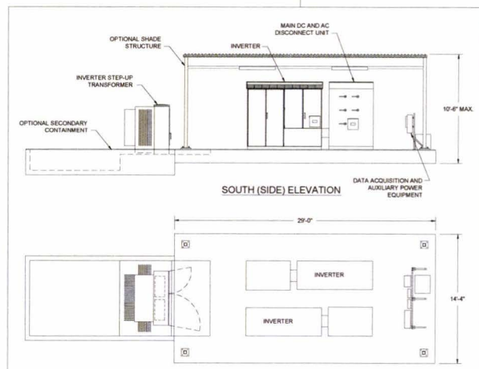
LEGEND

- PERIMETER FENCE
- PROPERTY BOUNDARY
- EXISTING CONTOUR 2450

FOR OFFICIAL USE ONLY:

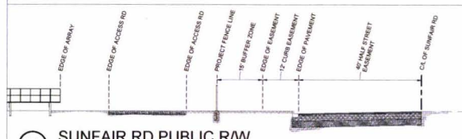


A SITE PLAN
SCALE: 1" = 150'

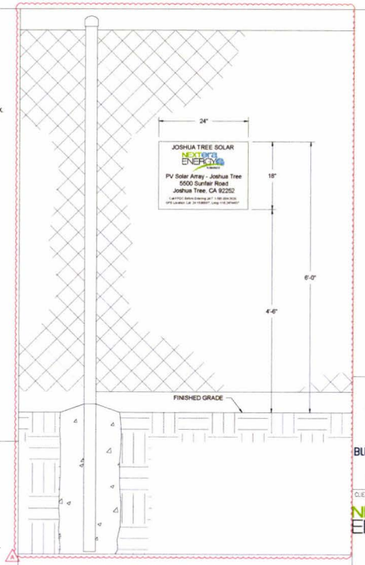


B INVERTER AND STEP-UP TRANSFORMER STATION
SCALE: NTS

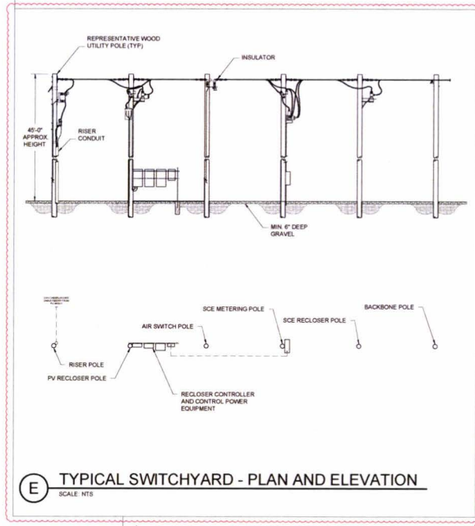
PLAN (TOP) VIEW



D SUNFAIR RD PUBLIC R/W
SCALE: NTS



C SITE ENTRANCE SIGN
SCALE: NTS



E TYPICAL SWITCHYARD - PLAN AND ELEVATION
SCALE: NTS

GENERAL DESCRIPTION

A PORTION OF THE SE 1/4 OF SECTION 21 OF TOWNSHIP 1 NORTH, RANGE 7 EAST, S.B.M. AND LOT 46 TRACT 6146 TOGETHER WITH A PORTION OF SUN KIST AVENUE, COUNTY OF SAN BERNARDINO COUNTY, STATE OF CALIFORNIA.

SURVEY NOTES

1. EASEMENTS AFFECTING THE PROPERTY SHOWN HEREON AND HAVE BEEN PLOTTED BASED UPON A PRELIMINARY TITLE REPORT (P.T.R. #)BY FIDELITY NATIONAL TITLE COMPANY, ORDER NO: 997-23052913-ML3, DATED SEPTEMBER 10, 2014.
2. ITEMS WITHOUT PLOTTED LINEWORK ARE UNPLOTTABLE, BLANKET IN NATURE, OR BOTH. GENERALLY THESE ITEMS ARE LISTED UNDER THE APN #

PLOT PLAN NOTES

1. THIS "PLOT PLAN" DRAWING IS A COMPILATION OF RECORD DATA AND/OR CALCULATIONS MADE FROM RECORD INFORMATION AND IS FOR INFORMATION AND/OR CONCEPT PLANNING PURPOSES ONLY. AN ACTUAL SURVEY WILL RESULT IN DIFFERENCES FROM THE BOUNDARY INFORMATION SHOWN HEREON. THE INFORMATION SHOWN ON THIS DRAWING DOES NOT REPRESENT A BOUNDARY SURVEY AND THE ACCURACY IS UNKNOWN. PRIOR TO CRITICAL DESIGN OR DECISIONS, AN ACTUAL SURVEY SHOULD BE PERFORMED TO BE USED AS THE BASIS FOR SUCH DESIGN OR DECISIONS

PLAN IDENTIFICATION:

2. APPLICATION TYPE: CUP FOR NEW PHOTOVOLTAIC ARRAY.

UTILITIES:

1. ELECTRIC UTILITY:
   SOUTHERN CALIFORNIA EDISON CO.
   6999 OLD WOMAN SPRINGS RD
   YUCCA VALLEY, CA 92284
   (760) 369-5400
2. TELEPHONE AND INTERNET UTILITY:
   AT&T
   59080 29 PALMS HWY.
   YUCCA VALLEY, CA 92284
   (760) 365-1505

PARCELS ADJACENT TO PROJECT SITE

APN#:	ZONING:	EXISTING LAND USE:
0607-364-05	RURAL LIVING	VACANT
0607-364-04	RURAL LIVING	VACANT
0607-328-02	RURAL LIVING	VACANT
0607-324-08	RURAL LIVING	VACANT
0607-312-06	RURAL LIVING	VACANT
0607-312-05	RURAL LIVING	VACANT
0607-312-03	RURAL LIVING	VACANT
0607-312-02	SINGLE RESIDENTIAL 10,000SF MIN.	VACANT
0607-312-06	SINGLE RESIDENTIAL 10,000SF MIN.	VACANT
0607-312-07	SINGLE RESIDENTIAL 10,000SF MIN.	VACANT
0607-251-17	SINGLE RESIDENTIAL 10,000SF MIN.	SINGLE FAMILY RESIDENTIAL USE
0607-341-01	RURAL LIVING	VACANT
0607-341-08	RURAL LIVING	VACANT
0607-341-11	RURAL LIVING	VACANT
0607-343-10	RURAL LIVING	SINGLE FAMILY RESIDENTIAL USE
0607-201-02	RURAL LIVING	VACANT
0607-221-04	RURAL LIVING	VACANT
0607-231-17	COMMUNITY INDUSTRIAL	CEMENT PLANT INDUSTRIAL USE
0607-231-16	COMMUNITY INDUSTRIAL	CEMENT PLANT INDUSTRIAL USE
0607-231-03	RURAL LIVING	VACANT
0607-231-04	RURAL LIVING	VACANT
0607-231-05	RURAL LIVING	VACANT
0607-231-06	RURAL LIVING	VACANT
0607-353-05	RURAL LIVING	VACANT
0607-241-01	RURAL LIVING	VACANT

CONTACT INFORMATION:

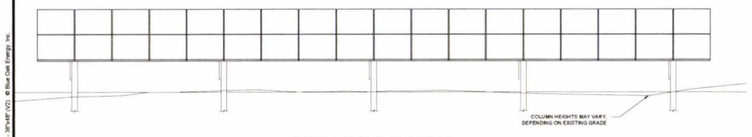
APPLICANT
JOSHUA TREE SOLAR FARM, LLC
700 UNIVERSE BLVD.
JUNO BEACH, FL 33408
CONTACT: JESS MELIN
TEL: (415) 319- 5901

PROPERTY OWNER
MAUREEN RICHARDSON
P.O. BOX 657
DEL MAR, CA 92014

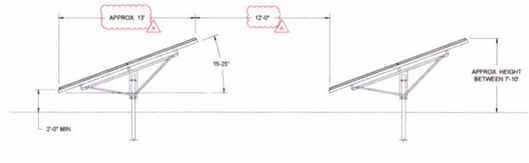
PLAN PREPARER
BLUE OAK ENERGY
1560 DREW AVE.
DAVIS, CA 95618
CONTACT: AARON SANDERS, PE
TEL: (530) 8747-2026 X207

PARCELS WITHIN PROJECT SITE

APN#:	ZONING:
0607-231-07	COMMUNITY INDUSTRIAL
0607-231-09	COMMUNITY INDUSTRIAL
0607-231-10	COMMUNITY INDUSTRIAL
0607-231-11	INSTITUTIONAL
0607-231-12	INSTITUTIONAL
0607-231-13	INSTITUTIONAL
0607-231-14	INSTITUTIONAL
0607-231-15	COMMUNITY INDUSTRIAL
0607-231-18	COMMUNITY INDUSTRIAL
0607-364-06	RURAL LIVING



F TYPICAL ARRAY DETAILS
SCALE: NTS



EAST (SIDE) ELEVATION

BLUE OAK ENERGY
1560 Drew Avenue
Davis, CA 95618
www.blueoakenergy.com
530.747.2026

CLIENT:
NEXTera ENERGY RESOURCES
700 UNIVERSE BLVD.
JUNO BEACH, FL 33408

PRELIMINARY
NOT FOR CONSTRUCTION

INTERNAL USE ONLY:		
DRAWN:	MJN	
CHKD:	AAS	
TM:		
PROJECT #:	14373	
FILE NAME:		
PLOT_LOC.dwg		
03/09/15		
PRINTED:		
DATE:		
BY:		

NO.	DESCRIPTION	DATE	BY
A	CUP PLAN CHECK COMMENTS	8.22.15	TEM
	CUP SUBMITTAL	3.9.15	MJN

JOSHUA TREE SOLAR FARM
5500 SUNFAIR ROAD
JOSHUA TREE, CA 92252

PLOT PLAN AND BUILDING ELEVATIONS

DRAWING NO.
W-111

AR063242

BOE - ARCH E SIZE - 36"x48" (VC) - © Blue Oak Energy, Inc.

Tab 10. Letter of Intent

Letter Of Intent

Joshua Tree Solar Farm

1.0 INTRODUCTION

Joshua Tree Solar Farm, LLC (JTSF or applicant) is pleased to submit this Conditional Use Permit (CUP) application package for the Joshua Tree Solar Farm project (the "project"). JTSF proposes to construct, own, and operate a 20 megawatt (MW) alternating current (AC) solar photovoltaic (PV) generating facility located on approximately 115 acres of disturbed land, 3.5 miles east of the city of Joshua Tree and 1.3 miles north of Twentynine Palms Highway in unincorporated San Bernardino County. The generated power will be delivered to the electrical grid via a 33 kilovolt (kV) interconnection to the Southern California Edison (SCE) distribution system.

The project location has been deliberately chosen to repurpose a previously developed site, the deactivated, privately owned Hi Desert (or Roy Williams) Airport (airport). JTSF understands and respects the principles of avoiding, minimizing and mitigating when proposing or building a renewable energy project. The siting of this project was done with thought and careful planning.

Initially, a larger parcel of vacant land (approximately 160 acres) to the south of the airport was being considered for the project. Concerns about surface hydrology and undisturbed desert vegetation led JTSF to evaluate a project site to the north, when it became known that the deactivated airport was available for sale. Land option agreements were made with the owner of the airport and environmental studies of the airport site commenced. It was soon determined that the 115 acres constituting the airport site were not sufficient in quantity to produce 20 MW_{AC} of power using a tracking PV system.

JTSF then began negotiations to purchase an additional 40 acres adjacent to the airport to the east. Again, environmental studies including cultural resources, biology, and waters of the State were conducted to assess the environmental and existing condition of the 40 acres. After hearing community concerns about the use of undisturbed desert land for solar project, JTSF decided to revert back to only using the 115 acres on the disturbed airport site. By doing so, and in order to still meet the objective of producing 20 MW_{AC} of power, the configuration was changed from tracking to fixed tilt. A fixed tilt layout is able to accommodate more PV panels in a smaller space.

The following factors contributed to the decisions in the site selection:

- The project site is a deactivated airport which has already been disturbed. Development of this site would lower the environmental impact to vegetation and wildlife habitat as compared to developing on undisturbed land.
- The land is fairly level, reducing the need for grading.
- There is existing access to the site off of Twentynine Palms Highway and Sunfair Road., eliminating the need for new roads or new right of way.
- The project site is in an area with an excellent solar energy resource with high irradiance and is of sufficient size to produce up to 20 MW_{AC} of electricity from PV solar panels.

AR063244

- The project site is adjacent to an existing SCE electrical distribution line which will take energy produced by the project into the grid. Only minimal upgrades to the existing line will be required.

Therefore, in siting this project, JTSF has **avoided** impacting undisturbed desert habitat, **minimized** the footprint and other environmental concerns, and is prepared to **mitigate** any residual minor impacts of the project.

1.1 PROJECT OBJECTIVES

The primary objective of the project is to assist in achieving or exceeding the State's Renewable Portfolio Standards and greenhouse gas emissions reduction objectives by developing and constructing California Renewable Portfolio Standards-qualified solar generation, approved under Senate Bill X12, which established renewable energy targets of 20 percent total electricity sold to retail customers by the end of 2013, 25 percent by the end of 2016, and 33 percent of total electricity sold to retail customers by 2020.

The project specific objectives are as follows:

1. Develop approximately 20 MW_{AC} of renewable solar energy that that can operate during on-peak power periods, indirectly reduce the need to emit greenhouse gases caused by the generation of similar quantities of electricity from either existing or future non-renewable sources to meet existing and future electricity demands.
2. Develop approximately 20 MW_{AC} of renewable solar energy that satisfies the terms of the Project's Interconnection Agreement, while minimizing environmental impacts by using previously disturbed land.
3. Develop a renewable project that is consistent with the principles contained in the draft Desert Renewable Energy Conservation Plan (DRECP 2014), the County of San Bernardino General Plan (San Bernardino 2014a), and the draft Solar Ordinance developed by San Bernardino County (San Bernardino 2014b). See Attachment A of this Letter of Intent.
4. Invest approximately 50 million dollars in total expenditures, which will help to support the economy in San Bernardino County through the creation of jobs and capital expenditures.
5. Maximize the potential for creation of local construction jobs for a variety of trades, thereby supporting unemployment reduction goals in the area for the duration of construction.

2.0 PROJECT DESCRIPTION

The following sections provide further detail on the design, construction, operation, maintenance, and decommissioning of the project. Preliminary design is underway, with project size, typical equipment, and array configurations determined. A final selection of solar modules, inverters, mounting system, and precise dimensions will be decided during detailed design and equipment procurement. A project overview is provided in Table 1 below. Specifics of the project are detailed in the following subsections.

AR063245

Table 1: Project Summary Information

Site Capacity	20.0 MW_{AC}
Collection and Intertie	33 kV line (SCE)
Array Configuration	Fixed tilt 15-25 degrees

The following project plans will satisfy County guidelines on project development, design, construction, and operation of the project:

- The effective service life of the project is approximately 30 years (before major overhaul of equipment) with the potential to repower
- Site grading will be minimal due to previous development and flat terrain
- Grading and cut/fill operations are expected to be limited to storm water management
- Recycling goals of 50 percent will be implemented where possible of all building materials and packaging
- Existing reusable structures will be disassembled and materials recycled as possible (hangars, shelters, etc.)
- Where practical, site asphalt pavement will remain; concrete pads will be demolished and removed
- Site debris that cannot be reused or recycled will be taken to an off-site disposal facility approved for disposal of the target debris

2.1 LOCATION AND EXISTING CONDITIONS

The 115-acre Joshua Tree project site is within Section 21, Township 1 North, Range 7 East, as mapped on the United States Geological Survey 7.5-minute series Joshua Tree North, California, and Sunfair, California quadrangles (Figure 1).

AR063246

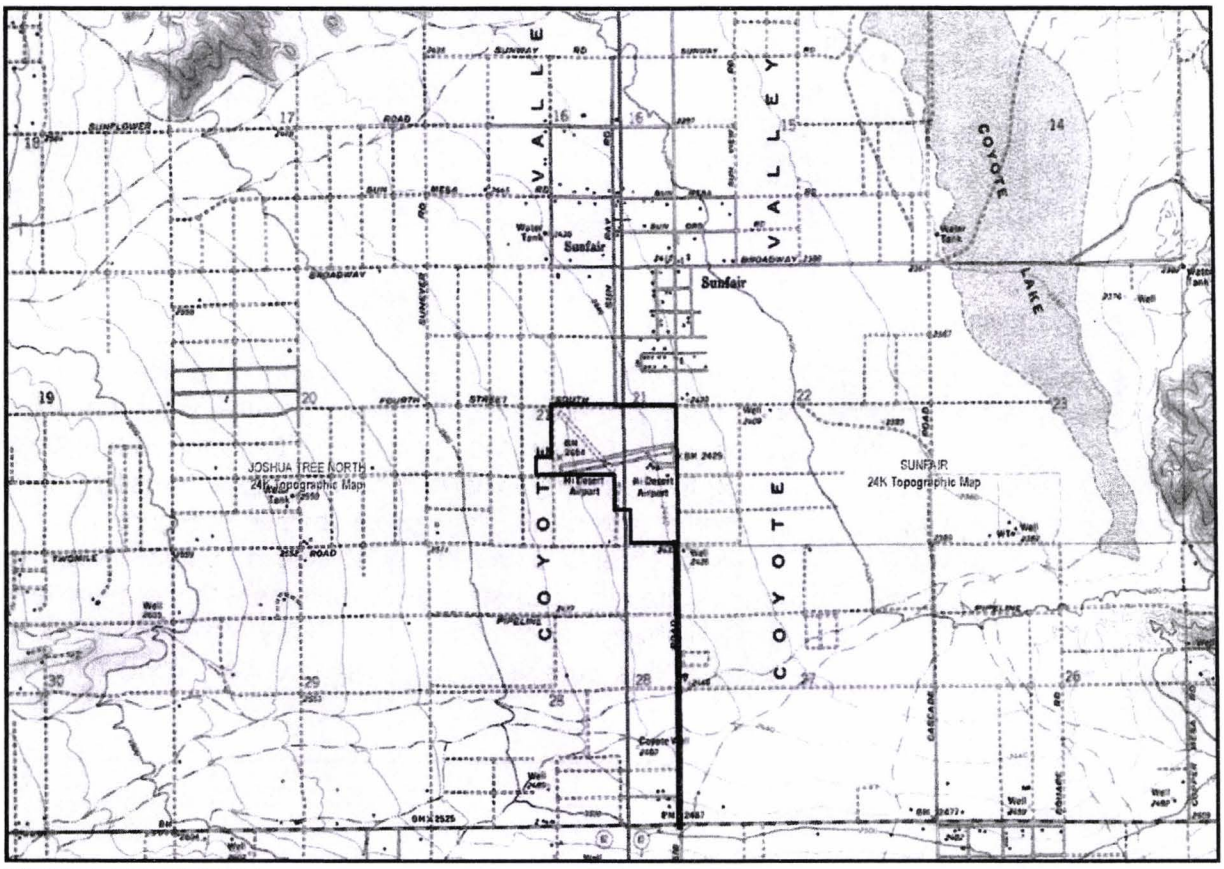


FIGURE 1: PROJECT SITE

The topography of the project site is relatively flat and ranges in elevation from approximately 2,470 feet above mean sea level on the western boundary of the site to 2,430 feet above mean sea level on the northeast corner of the site. The project site is previously developed and is accessed through Sunfair Road, a paved County road that runs along the eastern border of the site. The project site is bordered by Two Mile Road to the south, unpaved Fourth Street to the north, and unmaintained vacant land to the south and west. Hi-Grade Materials Company occupies the parcel adjacent to the southwest border of the project site. The current composition of the existing land is best described as vacant land of dirt and sand with a sparse vegetative community consisting of native grasses and shrubs. A summary of the Assessor's Parcel Number designations for the site are summarized in Table 2.

Table 2: Assessor's Parcel Number Index and Parcel Areas

Parcel Number	Acres
0607-231-12-0-000	20.00
0607-231-13-0-000	19.24
0607-231-14-0-000	20.00
0607-231-11-0-000	19.24
0607-231-09-0-000	10.00
0607-231-07-0-000	10.00
0607-231-15-0-000	2.50
0607-231-18-0-000	2.50

AR063247

Table 2: Assessor's Parcel Number Index and Parcel Areas

Parcel Number	Acres
0607-231-10-0-000	9.39
0607-364-06-0-000	2.14
Total	**115.01**

2.2 PROJECT LIMITS

The project footprint is defined by the property boundaries of the airport. The site-produced electrical energy will be collected and routed to the switchgear adjacent to the entry gate. The combined output of the plant will be routed from the switchgear through underground conductors to the southeast corner of the property where the conductors transition from underground to overhead and interconnect with SCE (grey circle, below in Figure 2). The distribution line, provided by SCE, runs due south along the west side of Sunfair Road on existing or to-be-replaced distribution structures in an existing utility easement to the main tie-in on the south side of Twentynine Palms Highway (also referred to as Hwy 62). The upgraded distribution line will be on SCE property and is outside the property boundary containing the solar arrays.

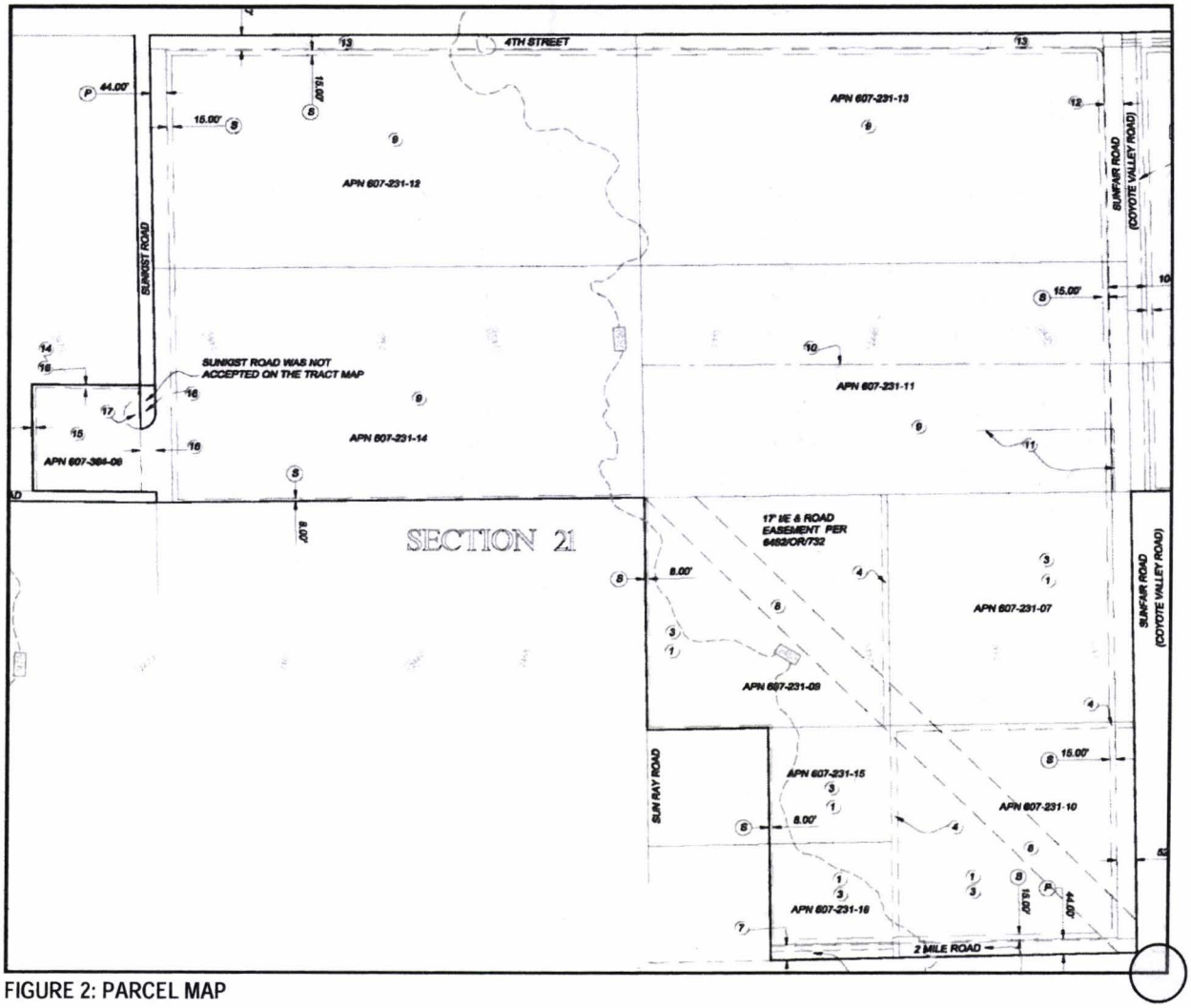


FIGURE 2: PARCEL MAP

AR063248

2.3 FACILITIES OVERVIEW

The overall project will have a maximum capacity of 20 MW_{AC} using fixed tilt configuration. The preliminary Site Plan is shown below as Figure 3.

The project employs solar PV modules for energy generation, power conversion stations, and typical electrical equipment to collect the produced energy and deliver it to the point of interconnection with SCE's distribution system. The PV modules produce low-voltage Direct Current (DC) electrical power which is collected and delivered to the utility-scale inverter stations distributed throughout the site. The power conversion stations convert DC electricity to AC electricity and step it up to medium voltage of 33 kV. The power is collected at medium voltage, fed through the appropriate protective equipment, and delivered to the utility at the point of interconnection.

2.4 MODULES

The PV modules convert incoming sunlight to DC electrical energy. Modules are arranged in series to effectively increase output voltage. These series chains of modules are called "strings" in industry terms. The "string" is the basic building block of power conversion in the solar array. The chosen PV technology type will either be crystalline silicon or thin film (copper indium gallium selenide or cadmium telluride).

2.5 ARRAY MOUNTING SYSTEM

The modules will be mounted on a steel and aluminum structural system ("racking" system) which will be supported, when practical, by driven piers (piles) directly embedded in the ground. The front (south, lower) side of the arrays with fixed tilt racking will maintain a 24-inch clearance from ground level. The array height will generally be approximately 7 feet from ground level. The highest maximum height of an array (from the ground to the north, upper side) will be approximately 10 feet, or less than the height of the inverters.

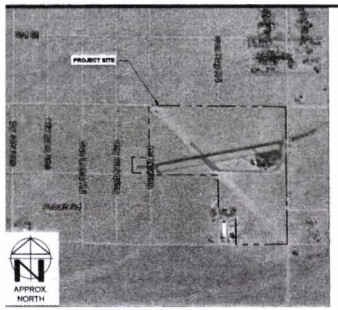
2.6 POWER INVERTER STATIONS

The Inverter Stations convert the DC electrical energy from the PV arrays into AC. These stations perform three critical functions for the plant: (1) collect DC power in a central location, (2) convert the DC power into AC power, and, (3) convert low-voltage AC power to medium-voltage AC power at the appropriate grid potential.

Each inverter station consists of DC collection equipment (junction boxes and overcurrent protective devices, etc.), utility-scale inverters, and a low-to-medium-voltage transformer. The output power from the inverter stations is then fed to the AC collection system, an underground network of medium-voltage conductors and collection switchgear, discussed next. While the preliminary design is based on 750 kW_{AC} utility-scale inverters and 1.6 MVA (megavolt amps) transformers (Figure 4), the final rating will be determined during detailed design and equipment procurement. The typical height of an inverter station is approximately 9 feet, with a maximum possible height of approximately 10.5 feet.

AR063249

FOR OFFICIAL USE ONLY:



VICINITY MAP
NOT TO SCALE

SURFACE COVERAGE CALCULATIONS	
MODULE WIDTH (FT)	3.35
MODULE HEIGHT (FT)	6.42
MODULE AREA (SQ FT)	20.67
MODULE QUANTITY	84,096
TOTAL MODULE SURFACE AREA (SQ FT)	1,764,663.04
INVERTER PAD AREA (SQ FT)	576.13
INVERTER PAD QUANTITY	14
TOTAL INVERTER PAD SURFACE AREA (SQ FT)	7,961.68
TOTAL PROJECT AREA (SQ FT)	6,114,330.86
PERCENT COVERAGE	34%

WHILE THE SOLAR PANELS ARE IMPERVIOUS, THE PANELS ARE SEPARATED AND ELEVATED FROM THE GROUND SURFACE. ANY PRECIPITATION THAT FALLS ONTO A SOLAR PANEL WILL RUN OFF ON THE SOIL AND EITHER INFILTRATE OR RUN OFF THE SITE AS IT HAS DONE HISTORICALLY.

EASEMENTS ITEMS PER P.T.R. 997-23052913-ML3

1. WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS - AFFECTS ALL PROPERTIES
2. RIGHTS OF PUBLIC IN ANY PORTION LYING WITHIN ROAD STREET, OR HIGHWAY
3. RESERVATIONS IN PATENT H/PATENTS/336
4. OPERATION & MAINTENANCE OF RR, RIGHT OF WAY FOR COUNTY ROADS, RIGHT TO USE WATER RISING UPON LAND, PER 4960/0295 (RESERVED ON PAGE 357 THEREOF)
5. 17' INGRESS/EGRESS & ROAD EASEMENT PER 6455/OR/32
6. 25' GENERAL TELEPHONE EASEMENT PER 7663/OR/411
7. 40' PUBLIC ROAD EASEMENT PER 93-251080 O.R. (OFFERED PER 93-029782 O.R.)
8. PUBLIC ROAD EASEMENT PER 93-113781 O.R (OFFERED PER 73PM49-41)
9. AIRPORT RUNWAY EXPANSION EASEMENT PER 93-094839 O.R.
10. RIGHTS OF THE PUBLIC OVER ANY PORTION LYING WITHIN A ROAD/HIGHWAY
11. CENTERLINE CALIFORNIA ELECTRIC POWER EASEMENT PER 2385/OR/268 (NO WIDTH GIVEN)
12. APPROX. CENTERLINE 8' WIDE SO. CA. EDISON EASEMENT PER 8035/OR/962 (DOC. HAS HAND WRITTEN NOTES)
13. 50' PUBLIC ROAD EASEMENT PER 806 \OR\521
14. 40' PUBLIC ROAD EASEMENT PER 2003-0555326
15. PUE PER 78/MB/71-72
16. CC&R's PER 5236/OR/435 BUILDING RESTRICTIONS (DOCUMENT STATES THAT THE PLANNING COMMISSION CAN RE-ZONE)
17. ELECTRIC POWER EASEMENT PER 5271/OR/15
18. PUBLIC ROAD EASEMENT PER 1998-0283415

OTHER ITEMS LISTED WHICH AFFECT ALL PARCELS. ANY EASEMENTS NOT DISCLOSED BY PUBLIC RECORDS, MATTERS WHICH MAY BE DISCLOSED BY AN ALTA/ACSM SURVEY. RIGHTS OF PARTIES IN POSSESSION... REFER TO P.T.R.

THE DESIGN ASSUMES THAT ANY EASEMENTS EFFECTING THE SOLAR FIELD WILL BE VACATED PRIOR TO THE START OF CONSTRUCTION.

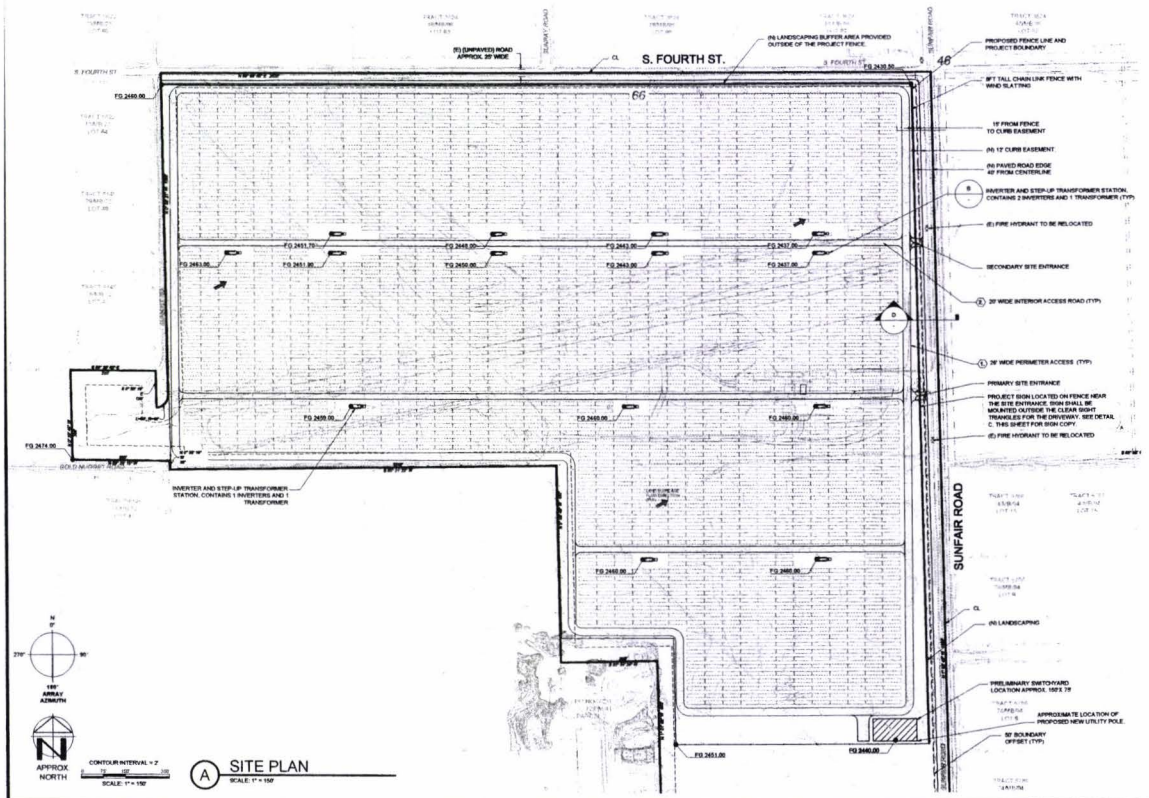
KEYED NOTES:

1. PERIMETER ACCESS: 26' WIDE CLEAR ACCESS WAY TO BE CONSTRUCTED USING APPROVED NATIVE MATERIAL OR GRAVEL, COMPACTED TO 85% COMPACTION.
2. INTERIOR ACCESS: 20' WIDE CLEAR ACCESS WAY TO BE CONSTRUCTED USING APPROVED NATIVE MATERIAL OR GRAVEL, COMPACTED TO 85% COMPACTION.

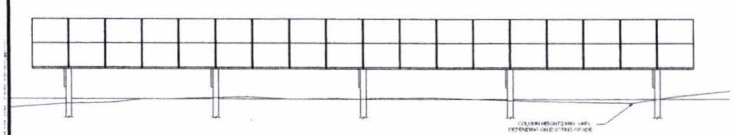
NOTES:

1. SAFETY LIGHTING WILL BE INSTALLED AT THE ENTRY GATES AND THE SWITCHGEAR LOCATION. A LIMITED AMOUNT OF LIGHTING WILL BE INSTALLED AND WILL BE DESIGNED TO PREVENT SPILLOVER INTO NEIGHBORING PROPERTIES. THERE WILL BE OPERABLE LIGHTING AT EACH CONVERSION STATION, BUT THESE UNITS WILL BE USED AS NEEDED AND WILL NOT TYPICALLY OPERATE AT NIGHT. THE ENTRY WILL HAVE FIXTURES TO PROVIDE MINIMAL LIGHTING AND WILL HAVE ADDITIONAL ON-DEMAND (E.G. TIMER) LIGHTING AS NEEDED OR REQUIRED.
2. GRUBBING AND GRADING ACTIVITIES WILL BE LIMITED DUE TO THE PREVIOUS DEVELOPMENT ACTIVITIES AND INHERENTLY SPARSE VEGETATION. SITE GRADING WILL BE SOLELY FOR STORM WATER CONTROL. THE PREVIOUS DEVELOPMENT SIGNIFICANTLY REDUCES THE NEED FOR SITE LEVELING, CUT AND FILL, AND OTHER INVASIVE SITE MODIFICATIONS. FOR THE VAST MAJORITY OF THE ARRAY AREA, NO SITE GRADING WILL BE EMPLOYED.
3. PLANT AND TREE PROTECTION: SPECIES IN THE JOSHUA TREE SOLAR PROJECT VICINITY THAT ARE SUBJECT TO PERMITTING INCLUDE JOSHUA TREE (YUCCA BREVIFOLIA) AND SEVERAL SPECIES OF CACTI (SILVER CHOLLA, BUCKHORN CHOLLA [CYLINDROPUNTIA ACANTHOCARPA], PENCIL CHOLLA [C. RAMOSISSIMA], AND BEAVERTAIL CACTUS [OPUNTIA BASILARIS]). PLEASE SEE *DESERT TORTOISE SURVEY AND GENERAL BIOLOGICAL RESOURCES ASSESSMENT FOR THE JOSHUA TREE SOLAR FARM (AIRPORT SITE) SAN BERNARDINO COUNTY, CA, 2012, TETRA TECH* FOR THE LOCATIONS OF THESE PLANTS. WHERE FEASIBLE AND PRACTICABLE, INDIVIDUAL PLANTS WILL BE SALVAGED AND USED FOR THE PROJECT'S REVEGETATION PROGRAM OR SALVAGED BY AN APPROVED NURSERY, LANDSCAPER, OR OTHER GROUP.
4. ALL EXISTING BUILDINGS TO BE REMOVED.

LEGEND	
PERIMETER FENCE	
PROPERTY BOUNDARY	
EXISTING CONTOUR	

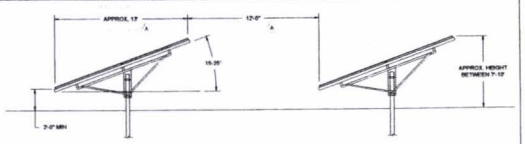


A SITE PLAN
SCALE: 1" = 150'

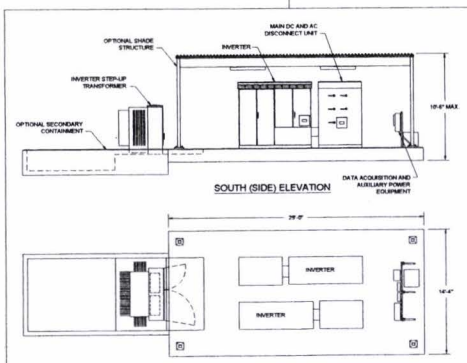


F TYPICAL ARRAY DETAILS
SCALE: NTS

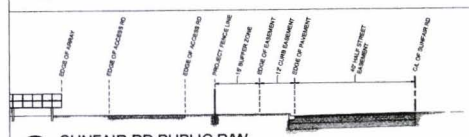
SOUTH (FRONT) ELEVATION



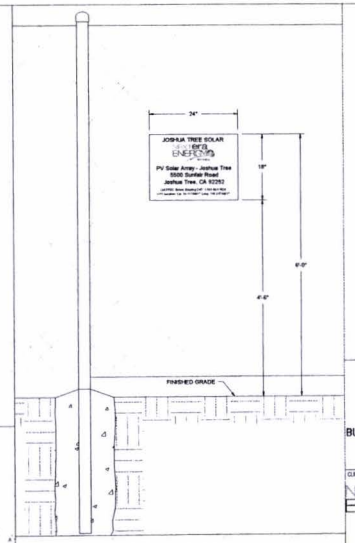
EAST (SIDE) ELEVATION



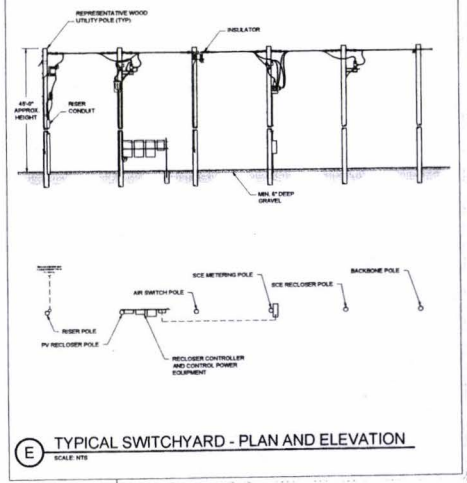
B INVERTER AND STEP-UP TRANSFORMER STATION
SCALE: NTS



D SUNFAIR RD PUBLIC R/W
SCALE: NTS



C SITE ENTRANCE SIGN
SCALE: NTS



E TYPICAL SWITCHYARD - PLAN AND ELEVATION
SCALE: NTS

GENERAL DESCRIPTION

A PORTION OF THE SE 1/4 OF SECTION 21 OF TOWNSHIP 1 NORTH, RANGE 7 EAST, S.B.M. AND LOT 46 TRACT 6148 TOGETHER WITH A PORTION OF SUN KIST AVENUE, COUNTY OF SAN BERNARDINO COUNTY, STATE OF CALIFORNIA.

SURVEY NOTES

1. EASEMENTS AFFECTING THE PROPERTY SHOWN HEREON AND HAVE BEEN PLOTTED BASED UPON A PRELIMINARY TITLE REPORT OF T.B. BY: FIDELITY NATIONAL TITLE COMPANY, ORDER NO. 997-23052913-ML3, DATED: SEPTEMBER 10, 2014
2. ITEMS WITHOUT PLOTTED LINEWORK ARE UNPLOTTABLE, BLANKET IN NATURE, OR BOTH. GENERALLY THESE ITEMS ARE LISTED UNDER THE ARTS #

PLOT PLAN NOTES

1. THIS PLOT PLAN DRAWING IS A COMPILATION OF RECORD DATA AND/OR CALCULATIONS MADE FROM RECORD INFORMATION AND/OR INFORMATION AND/OR CONCEPT PLANNING PURPOSES ONLY. AN ACTUAL SURVEY WILL RESULT IN DIFFERENCES IN THE PROPERTY BOUNDARY INFORMATION SHOWN HEREON. THE INFORMATION SHOWN ON THIS DRAWING DOES NOT REPRESENT A BOUNDARY SURVEY, AND THE ACCURACY IS UNKNOWN. PRIOR TO FINAL DESIGN OR DECISIONS, AN ACTUAL SURVEY SHOULD BE PERFORMED TO BE USED AT THE BASIS FOR FINAL DESIGN OR DECISIONS.

PLAN IDENTIFICATION:

2. APPLICATION TYPE: CUP FOR NEW PHOTOVOLTAIC ARRAY.

UTILITIES:

1. ELECTRIC UTILITY:
SOUTHERN CALIFORNIA EDISON CO.
6999 OLD WOMAN SPRINGS RD
YUCCA VALLEY, CA 92284
(760) 369-5490
2. TELEPHONE AND INTERNET UTILITY:
AT&T
56980 29 PALMS HWY.
YUCCA VALLEY, CA 92284
(760) 365-1605

CONTACT INFORMATION:

APPLICANT
JOSHUA TREE SOLAR FARM, LLC
700 UNIVERSE BLVD.
JUNO BEACH, FL 33408
CONTACT: JESSI MELIN
TEL: (415) 319- 5901

PROPERTY OWNER
MAUREEN RICHARDSON
P.O. BOX 857
DEL MAR, CA 92014

PLAN PREPARER
BLUE OAK ENERGY
1660 DREW AVE.
DAVIS, CA 95616
CONTACT: AARON SANDERS, PE
TEL: (530) 574-7026 X307

PARCELS WITHIN PROJECT SITE

APN#	ZONING:
0607-231-07	COMMUNITY INDUSTRIAL
0607-231-09	COMMUNITY INDUSTRIAL
0607-231-10	COMMUNITY INDUSTRIAL
0607-231-11	INSTITUTIONAL
0607-231-12	INSTITUTIONAL
0607-231-13	INSTITUTIONAL
0607-231-14	INSTITUTIONAL
0607-231-15	COMMUNITY INDUSTRIAL
0607-231-18	COMMUNITY INDUSTRIAL
0607-364-06	RURAL LIVING

PARCELS ADJACENT TO PROJECT SITE

APN#	ZONING:	EXISTING LAND USE:
0607-364-05	RURAL LIVING	VACANT
0607-364-04	RURAL LIVING	VACANT
0607-328-02	RURAL LIVING	VACANT
0607-324-08	RURAL LIVING	VACANT
0607-312-06	RURAL LIVING	VACANT
0607-312-05	RURAL LIVING	VACANT
0607-312-03	RURAL LIVING	VACANT
0607-312-02	SINGLE RESIDENTIAL 10,000SF MIN.	VACANT
0607-312-06	SINGLE RESIDENTIAL 10,000SF MIN.	VACANT
0607-312-07	SINGLE RESIDENTIAL 10,000SF MIN.	VACANT
0607-251-17	SINGLE RESIDENTIAL 10,000SF MIN.	SINGLE FAMILY RESIDENTIAL USE
0607-341-01	RURAL LIVING	VACANT
0607-341-08	RURAL LIVING	VACANT
0607-341-11	RURAL LIVING	VACANT
0607-343-10	RURAL LIVING	SINGLE FAMILY RESIDENTIAL USE
0607-261-02	RURAL LIVING	VACANT
0607-221-04	RURAL LIVING	VACANT
0607-231-17	COMMUNITY INDUSTRIAL	CEMENT PLANT INDUSTRIAL USE
0607-231-16	COMMUNITY INDUSTRIAL	CEMENT PLANT INDUSTRIAL USE
0607-231-03	RURAL LIVING	VACANT
0607-231-04	RURAL LIVING	VACANT
0607-231-05	RURAL LIVING	VACANT
0607-231-06	RURAL LIVING	VACANT
0607-353-05	RURAL LIVING	VACANT
0607-241-0	RURAL LIVING	VACANT

BLUE OAK ENERGY
1660 Drew Avenue
Davis, CA 95618
www.blueoakenergy.com
530.747.2026

CLIENT:
NEXTera ENERGY RESOURCES
700 UNIVERSE BLVD.
JUNO BEACH, FL 33408

PRELIMINARY
NOT FOR CONSTRUCTION

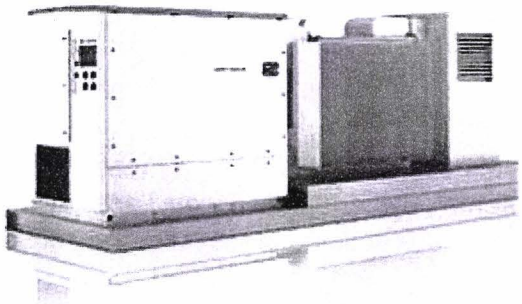


FIGURE 4: EXAMPLE MEDIUM-VOLTAGE INVERTER STATION

2.7 AC COLLECTION SYSTEM

The AC collection system is 33 kV, and all related equipment will be 35 kV class. The collection system is a network of either buried or aboveground cables appropriately sized to minimize energy loss. The system will effectively collect energy from the solar panels and transfer energy to the main collection switchgear, which will allow the energy to be transmitted to the electric grid. The project's current design is an underground collection system which will terminate at the switchgear, which will be separately enclosed with a security fence and lockable access gates.

2.8 DISTRIBUTION LINE IMPROVEMENTS

The distribution line improvements will be constructed, owned, and operated by SCE. The existing power poles on the west side of Sunfair Road will be reconductored to accommodate the new project. The utility line will be retrofitted by augmenting existing poles or by replacing poles. It may be necessary to replace the existing poles and that decision will be made by the SCE team.

The system will be designed and built by SCE, so all final design and engineering decisions will be made by SCE and fully supported by the project. A photograph of a typical upgraded pole structure is shown in Figure 5.

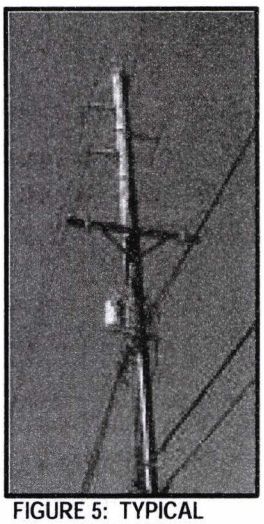


FIGURE 5: TYPICAL POLE STRUCTURE

2.9 ACCESS PATHS AND FENCING

Fencing will be installed around the perimeter of the site. The fencing is currently planned to be 8 feet tall and will be built in accordance with the County standards. Access roads will be constructed along the interior perimeter of the site and between the MW block solar arrays. Primary access to the project will be via a gate on Sunfair Road.

2.10 SAFETY LIGHTING

Safety lighting will be installed at the entry gates and the switchgear location. A limited amount of lighting will be installed and will be designed to prevent spillover into neighboring properties. There will be operable lighting at each conversion station, but these units will be used as

AR063251

needed and will not typically operate at night. The entry will have fixtures to provide minimal lighting and will have additional on-demand (e.g. timer) lighting as needed or required.

3.0 PROJECT CONSTRUCTION

Project construction work is expected to last for approximately six months and will consist of site preparation, site improvements, system installation, and system acceptance. The various phases of the construction cycle are outlined in the following sections.

3.1 SITE PREPARATION

Site preparation will involve the erection of a perimeter security fence, deconstruction or demolition of existing buildings, remediation of a few specific site conditions if applicable, and establishment of temporary utilities. The utility connections are already established to the site, making power and water connections readily available. Demolition of existing buildings will be the majority of site preparation. Where possible and feasible, materials from existing structures will be reused or recycled. All concrete structures (hangar aprons, foundations, and slabs) are expected to be demolished and removed. All other paved areas, including the existing runways, are expected to be left in place.

Grubbing and grading activities will be limited due to the previous development activities and inherently sparse vegetation. Prior to or concurrently with installing the security fencing, the site may include a desert tortoise exclusionary fence, or similar measures that may be recommended by the U.S. Fish and Wildlife Service or California Department of Fish and Wildlife.

3.2 CONSTRUCTION ACCESS

Construction vehicles will access the site via Sunfair Road on the eastern boundary of the site. The staging area and the laydown area will most likely be located just inside of the gate on the previously paved airport parking and taxi area. The main temporary logistics area of the site includes construction trailers, a first aid station, worker parking, truck loading and unloading areas, and areas for site assembly tasks. Portable toilet facilities will be installed for use by construction workers during the construction phase and will be serviced by a private company on a regular basis.

3.3 STORM WATER AND EROSION CONTROL

If required, a Storm Water Pollution Prevention Plan incorporating best management practices for erosion control will be prepared prior to the start of construction. During site preparation the Storm Water Pollution Prevention Plan will be implemented and initial erosion and sedimentation controls will be installed. In addition, water truck reloading stations will be established for dust control. No retention basins or ponds are currently planned for the project. The project will also comply with applicable water quality requirements adopted by the Regional Water Quality Control Board and the State Water Resources Control Board.

AR063252

3.4 SITE GRADING

The previous airport development significantly reduces the need for site leveling, cut and fill, and other site modifications. No site grading is planned for the majority of the array area; however, limited grading may be required for erosion or stormwater control to comply with permit conditions.

3.5 FACILITY INSTALLATION

The bulk of the project activities involve installation of major equipment, including array foundations (driven piers when practical), power stations, cable installation, and switchgear placement. Rack piers are usually driven into the ground at depths of 6 to 12 feet as dictated by the soils and the array structural design. The module racking assembly is connected to the piers. The modules are fastened to the racking assembly and electrically connected together in series strings. The strings will be routed to DC combiners at the ends of each array row and subsequently routed to the power conversion stations where the electricity is converted from DC to AC.

The AC collection system will be a series of cables, sized to minimize energy losses and to effectively collect and transfer energy to the project switchgear. The switchgear will be separately enclosed with a security fence and lockable access gates.

3.6 DISTRIBUTION LINE IMPROVEMENT CONSTRUCTION

SCE will be responsible for any distribution line necessary to serve the project. The distribution line improvement construction may include enhancement or replacement of the utility poles along Sunfair Road along with stringing of new overhead electrical cable and a tap to the distribution line on the south side of Twentynine Palms Highway. It is anticipated that the work areas needed for replacement of this line and the stringing of the new overhead electrical cable will be entirely included within the existing SCE easement.

3.7 CONSTRUCTION WASTE

Most construction waste is expected to be non-hazardous and to consist primarily of cardboard, wood pallets, copper and aluminum wire cut-offs, scrap steel, common trash, and wooden wire spools. Construction waste will be recycled wherever possible. Non-recyclable construction waste will be disposed of by a licensed contractor at an approved facility.

3.8 POTENTIALLY HAZARDOUS MATERIALS USED DURING PROJECT CONSTRUCTION

Construction equipment will utilize various hazardous materials such as hydraulic oil, diesel fuel, grease, lubricants, solvents, adhesives, paints, and other petroleum-based products contained in construction vehicles. All potentially hazardous materials will be contained, stored, and used in accordance with the manufacturers' instructions and handled in compliance with the applicable standards and regulations, such as those administered by the San Bernardino County Fire Department, Occupational Safety and Health Administration, and the California Occupational Safety and Health Administration.

AR063253

3.9 FUGITIVE DUST CONTROL

Short-Term Dust Generation

Construction activities including clearing, grading, excavating, and moving of heavy equipment will create fugitive dust at the site at various rates throughout the construction cycle. Any substantial fugitive dust is expected to be short-term and limited to the time period of early construction during the limited clearing and grading activities. The contractors will be required to comply with applicable Mojave Desert Air Quality Management District rules and policies. Dust may be controlled by covering stockpiles with tarps and water application which consists of trucks canvassing the site to apply water for dust suppression and soil conditioning. Water truck reloading stations may be established. After construction and during the operations period there is expected to be a minimal amount of fugitive dust.

Long-Term Dust Generation. The long-term operations associated with the project are not anticipated to generate a significant amount of dust.

3.10 CONSTRUCTION WATER REQUIREMENTS

Potable water for drinking and domestic needs will be either brought to the project site or provided by existing facilities serving the airport. Construction water needs will be limited to soil conditioning and dust suppression. Approximately 30 acre-feet of water will be required during construction and is expected to be obtained from Joshua Basin Water District via a nearby existing waterline co-located within the western bounds of Sunfair Road. Water truck reloading stations will be established on site and will be fed by this existing waterline.

3.11 CONSTRUCTION WORKERS, HOURS, AND EQUIPMENT

The construction workers will consist of laborers, electricians, supervisory personnel, support personnel, and construction management personnel. It is expected that most workers will commute to the site from nearby communities including Joshua Tree, Yucca Valley, Twentynine Palms, and Palm Springs. It is anticipated that there will be an average of 125 workers on site during the construction period with approximately 150 workers during certain phases.

Construction work will generally be done during daylight hours. Non-daylight work hours may be necessary to make up schedule deficiencies, or to complete critical construction activities. Construction activities will be conducted consistent with San Bernardino County Ordinance Section 83.01.080 and 83.01.090 regarding acceptable decibel levels.

Construction activities, duration, equipment, and workers are estimated below in Table 3.

Table 3: Estimated Construction Duration, Equipment and Workers by Activity

Activity	Duration	Equipment	Pieces	Workers
Demolition – existing structures and related infrastructure	1 Month	Backhoe	2	
		Bulldozer	1	
		5 cubic yard dump truck	2	

AR063254

Table 3: Estimated Construction Duration, Equipment and Workers by Activity

Activity	Duration	Equipment	Pieces	Workers
Site Preparation and Clearing/Grading	1 Month	Water Truck – 3 axles	3	Maximum – 150 Average – 125
		Grader	2	
		Bulldozer	1	
		25-Cubic Yard Paddle Scraper	1 (optional)	
		10-Ton Roller	2	
Desert Tortoise Fencing	2 Months	Bobcat	1	
		Trencher	1	
		Pick Up Truck	1	
Utility Upgrades	Intermittent, up to 6 Months	Line truck (with spool trailer)	1	
		Boom truck (with bucket)	2	
Underground Work	2 Months	Small Backhoe	2	
		Small Sheepsfoot Roller	2	
		Trencher	2	
		5-Cubic Yard Dump Truck	2	
		5kW Generator	2	
System Installation	3 Months	4x4 Forklift	4	
		Small Crane	1	
		ATV Vehicle	4	
		Pick-Up Truck	5	
		Pile Driver	2	
		5-kW Generator	4	
Testing/Commissioning	1 Month	Pick-Up Truck	2	
Clean Up/Restoration	1 Months	Grader	2	

The construction activities shown above in Table 3 will be overlapping in certain phases with a total construction time of approximately six months.

Truck activity will be regularly required only during the project's construction. The types of truck, number of trucks estimated to be on site daily, and their approximate gross weight are presented below.

Truck Type	Average on Site	Gross Weight
8,000 Gallon Water Truck	3	25 tons empty/50 tons full
5 CY Dump Truck	3	15,000 lbs
Pick-up Trucks	5	5,000 lbs
Pile Driver	2	7,500 lbs
Grader	2	40,000 lbs
Boom truck with bucket	2	16,000 lbs
Utility line service truck	1	35,000 lbs

AR063255

Periodic truck activity will be needed for routine maintenance and panel washing activities once the project is in operation.

3.12 TESTING, COMMISSIONING, AND ACCEPTANCE

Testing will happen throughout the PV facility installation at all stages. As each MW block is completed, the electrical components of the system will be tested as a subsystem at the functional level. Once all blocks are completed, the system will be interconnected to the SCE distribution system and each block will be commissioned again to test performance. This commissioning and testing period is expected to last approximately one month after interconnection to the SCE system.

3.13 SITE CLEANUP

There will be ongoing cleanup and recycling of materials during the construction phase. Industrial trash receptacles will be established in the temporary laydown area and will be emptied or interchanged throughout the construction of the project. Once the project is completed the site will be cleared of any remaining debris or materials and each will be recycled or disposed of appropriately.

4.0 PROJECT OPERATIONS, MAINTENANCE, AND DECOMMISSIONING

Once placed into service, the project will be operated on an unstaffed basis and monitored remotely with scheduled personnel visitations for security, maintenance, services, and system monitoring.

Brief weekly inspections are planned. Ongoing maintenance is expected to occur on a monthly basis and will be scheduled to avoid peak power demand periods, and unplanned maintenance will typically be responded to as needed depending on the event. Preventative maintenance kits and certain critical spares will be stored on-site, while all other components will be readily available from a remote warehouse facility.

4.1 MODULE CLEANING

Periodic array module washings will be scheduled and completed depending on the soiling conditions that will exist at the site, which could be up to 4 times per year. It is expected that less than 1 acre foot of water will be used per washing; this water may be supplied by the Joshua Basin Water District. Due to evaporation and onsite ground percolation, it is expected that no water from the washings will run offsite. Module cleaning will use conditioned water obtained from the closest source of adequate quality water.

4.2 POTENTIALLY HAZARDOUS MATERIALS USED DURING PROJECT OPERATIONS

The only potentially hazardous material within the fully operation site would be the mineral insulating oil in the step-up transformers. The transformer oil has low toxicity and is a fully bio-neutral, biodegradable fluid. In the case of a major transformer breach, oil would be captured in a built-in oil containment system suitably sized to accommodate the maximum possible spillage. Upon leakage failure, the seeped fluid would be removed by a certified vehicle and recapture system and the entire transformer would be replaced.

AR063256

4.3 PROJECT DECOMMISSIONING

A PV solar plant has a typical life of about 30 years. Once the useful life of the plant is exhausted, the plant could be refurbished to continue operating as a power plant or decommissioned and removed. If the system is to be removed, most of the materials (steel, aluminum, copper, and glass) would be recycled at nearby facilities. The materials that cannot be recycled, and those materials which contain any oil or lubricants, would be disposed of according to San Bernardino County Development Code Section 84.29.060 or other applicable development standards at the time of decommissioning. The amount of water used during decommissioning will be similar to the amount used during construction, primarily for dust control. The site could then be converted to other uses in accordance with applicable land use regulations.

AR063257

5.0 REFERENCES

Desert Renewable Energy Conservation Plan (DRECP), draft. 2014. Desert Renewable Energy Conservation Plan Preliminary Conservation Strategy. Available at http://www.drecp.org.

San Bernardino County. 2014a. County of San Bernardino General Plan. Amended 2014. Available at http://cms.sbcounty.gov/lus/Planning/GeneralPlan.aspx including all amendment pages.

San Bernardino County, 2014b. Draft "Solar Ordinance" amending Chapter 84.29, Renewable Energy Generation Facilities.

AR063258

Attachment A

Compliance with SB County Draft Solar Ordinance

AR063259

Compliance with San Bernardino Solar Ordinance- Findings of Fact		
1	The proposed commercial solar energy generation facility is either: (A) sufficiently separated from existing communities and existing/developing rural residential areas so as to avoid adverse effects, or (B) of a sufficiently small size, provided with adequate setbacks designed to be lower profile than otherwise permitted, and sufficiently screened from public view so as to not adversely affect the desirability and future development of communities, neighborhoods, and rural residential use	The Project site is 3.5 miles east of the city of Joshua Tree and 1.3 miles north of Twentynine Palms Highway in unincorporated San Bernardino County. The facility will be located on 115 acres, and will be screened with an 8 foot fence with landscaping along Sunfair Road.
2	Proposed fencing, walls, landscaping, and other perimeter features of the proposed commercial solar energy generation facility will minimize the visual impact of the project so as to blend with and be subordinate to the environment and character of the area where the facility is to be located.	The facility will be located on 115 acres, and will be screened with an 8 foot fence with landscaping as required by the County along Sunfair Road.
3	The siting and design of the proposed commercial solar energy generation facility will be either: (A) unobtrusive and not detract from the natural features, open space and visual qualities of the area as viewed from communities, rural residential uses, and major roadways and highways, or (B) located in such proximity to already disturbed lands, such as electrical substations, surface mining operations, landfills, wastewater treatment facilities, etc., that it will not further detract from the natural features, open space and visual qualities of the area as viewed from communities, rural residential uses, and major roadways and highways.	The siting of the project has been deliberately located on a deactivated airport, an already disturbed location. The project will have limited disturbance to native biological resources, including wildlife, vegetation, and soils.
4	The siting and design of project site access and maintenance roads have been incorporated in the visual analysis for the project and shall minimize visibility from public view points while providing needed access to the development site	Access will be along the existing Sunfair Road; no new transportation routes will need to be included in visual assessments.
5	The proposed commercial solar energy generation facility will not adversely affect the feasibility of financing infrastructure development in areas planned for infrastructure development or will be located within an area not planned for future infrastructure development (e.g., areas outside of water agency jurisdiction).	The project is not expected to adversely affect the feasibility of financing infrastructure development. The project is within the Joshua Basin Water District.
6	The proposed commercial solar energy generation facility will not adversely affect to a significant degree the availability of groundwater supplies for existing communities and existing and developing rural residential areas	Very little water will be used for the construction or operation of the project. Water for panel washing will occur up to 4 times per year and the water will be most likely be provided by the Joshua Basin Water District.

AR063260

Compliance with San Bernardino Solar Ordinance- Findings of Fact		
7	The proposed commercial solar energy generation facility will minimize site grading, excavating, and filling activities by being located on land where the existing grade does not exceed an average of five (5) percent across the developed portion of the project site, and by utilizing construction methods that minimize ground disturbance.	The topography of the project site is relatively flat, with slopes less than 1 %. Grading will be minimized because the site is a deactivated airport. Where possible, existing pavement and asphalt will be retained.
8	The proposed commercial solar energy generation facility will be located in proximity to existing electrical infrastructure, such as transmission lines, utility corridors, and roads, so that: (A) minimal ground disturbance and above ground infrastructure will be required to connect to the existing transmission grid, considering the location of the project site and the location and capacity of the transmission grid, (B) new electrical generation tie lines will be co-located on existing power poles whenever possible, and (C) existing rights-of-way and designated utility corridors will be utilized to the extent practicable.	The project will interconnect at the project boundary into the existing transmission system along Sunfair Road. No new ROW is needed for transmission.
9	The proposed commercial solar energy generation facility will be sited so as to avoid or minimize impacts to the habitat of special status species, including threatened, endangered, or rare species, Critical Habitat Areas as designated by the U.S. Fish and Wildlife Service, important habitat/wildlife linkages or areas of connectivity designated by County, state or federal agencies, and areas of Habitat Conservation Plans or Natural Community Conservation Plans that discourage or preclude development.	The siting of the project has been deliberately located on a deactivated airport, an already disturbed location. Very little vegetation or wildlife habitat exists at the project location.
10	Adequate provision has been made to maintain and promote native vegetation and avoid the proliferation of invasive weeds during and following construction.	Weeds will be managed during construction and operations.
11	The proposed commercial solar energy generation facility will be located so as to avoid or mitigate impacts to significant cultural and historic resources, as well as sacred landscapes.	A cultural resources survey has been conducted and there are no resources of significance.
12	The proposed commercial solar energy generation facility will be designed in a manner that does not impede flood flows, avoids substantial modification of natural water courses, and will not result in erosion or substantially affect area water quality.	The project is not sited in a floodplain; nor will it modify natural water course. The project site does not contain any washes or waters of the State.
13	The proposed commercial solar energy generation facility will not be located within a floodway designated by the Federal Emergency Management Agency (FEMA), has been evaluated for flood hazard impacts pursuant to Chapter 82.14 of the Development Code, and will not result in increased flood hazards to upstream or downstream properties	The project is not sited in a FEMA designated floodplain.

AR063261

Compliance with San Bernardino Solar Ordinance- Findings of Fact		
14	All on-site solar panels, switches, inverters, transformers, and substations shall be located at least one foot above the base flood elevation as shown on the Flood Insurance Rate Maps	Project features will be designed to be at least one foot above base flood elevation.
15	For development sites proposed on or adjacent to undeveloped alluvial fans, the commercial solar energy generation facility has been designed to avoid potential channel migration zones as demonstrated by a geomorphic assessment of the risk of existing channels migrating into the proposed development footprint, resulting in erosion impacts.	The project site does not contain any washes or waters of the State, and is not located on an alluvial fan.
16	For proposed facilities located on prime agricultural soils or land designated by the California Farmland Mapping and Monitoring Program as Prime Farmland, Unique Farmland, or Farmland of Statewide Importance, where use of the land for agricultural purposes is feasible, the proposed commercial solar energy generation facility will not substantially affect the agricultural viability of surrounding lands.	The project is not located on prime agricultural farmland. The project was deliberately sited on a deactivated airport to reduce environmental impacts.
17	If the proposed site is subject to a Williamson Act contract, the proposed commercial solar energy generation facility is consistent with the principals of compatibility set forth in California Government Code Section 51238.1.	The project is not subject to a Williamson Act contract.
18	The proposed commercial solar energy generation facility will not preclude access to significant mineral resources.	There are no known mineral resource conflicts with the project site.
19	The proposed commercial solar energy generation facility will avoid modification of scenic natural formations.	No scenic natural formations exist on the project site.
20	The proposed commercial solar energy generation facility will be designed, constructed, and operated so as to minimize dust generation, including provision of sufficient watering of excavated or graded soil during construction to prevent excessive dust. Watering will occur at a minimum of three (3) times daily on disturbed soil areas with active operations, unless dust is otherwise controlled by rainfall or use of a dust palliative, or other approved dust control measure.	Best management practices will ensure that dust is minimized during construction.
21	All clearing, grading, earth moving, and excavation activities will cease during period of winds greater than 20 miles per hour (averaged over one hour), or when dust plumes of 20 percent or greater opacity impact public roads, occupied structures, or neighboring property, and in conformance with Air Quality Management District (AQMD) regulations.	Construction activities and dust control will be performed in accordance with County and AQMD regulations.
22	For sites where the boundary of a new commercial solar energy generation facility will be located within one-quarter mile of a primary residential structure, an adequate wind barrier will be provided to reduce potentially blowing dust in the direction of the residence during construction and ongoing operation of the commercial solar energy generation facility	There are residences within ¼ mile to the north boundary of the project. An appropriate wind barrier will be included in the project design.

AR063262

Compliance with San Bernardino Solar Ordinance- Findings of Fact		
23	Any unpaved roads and access ways will be treated and maintained with a dust palliative or graveled or treated by another approved dust control method to prevent excessive dust, and paving requirements will be applied pursuant to Chapter 83.09 of the Development Code	Best management practices will be used on unpaved roads to control dust.
24	On-site vehicle speed will be limited to 15 miles per hour	Vehicle speeds will be limited to 15 miles per hour for unimproved roads on the project site.
25	For proposed commercial solar energy generation facilities within two (2) miles of the Joshua Tree National Park boundaries, the location, design, and operation of the proposed commercial solar energy generation facility will not be a predominant visual feature along the main access roads to the park (Park Boulevard and Utah Trail), nor will it substantially impair views from hiking/nature trails, campgrounds, and backcountry camping areas within the National Park	The project will not be seen from main roads within Joshua Tree National Park. There are no known designated hiking trails or camping areas within the Park where the project could be seen.
26	For proposed facilities within two (2) miles of the Mojave National Preserve boundaries, the location, design, and operation of the proposed commercial solar energy facility will not be a predominant visual feature of, nor substantially impair views from, hiking and backcountry camping areas within the National Preserve	The project is not within 2 miles of the Mojave National Preserve boundaries.
27	For proposed facilities within two (2) miles of Death Valley National Park boundaries, the location, design, and operation of the proposed commercial solar energy facility will not be a predominant visual feature of, nor substantially impair views from, hiking and backcountry camping areas within the National Park	The project is not within 2 miles of the Death Valley National Park.
28	For proposed facilities within two (2) miles of the boundaries of a County, state or federal agency designated wilderness area, the location, design, and operation of the proposed commercial solar energy facility will not be a predominant visual feature of, nor substantially impair views from, the designated wilderness area	The project is not within 2 miles of any known wilderness area.
29	For proposed facilities within two (2) miles of the boundaries of any active military base, the location, design, and operation of the proposed commercial solar energy facility will not substantially impair the mission of the facility	The project is not within 2 miles of a military base.
30	When located within a city's sphere of influence, in addition to other County requirements, the proposed commercial solar energy facility will also be consistent with relevant city zoning requirements that would be applied to similar facilities within the city.	The project is not known to be within Joshua Tree's sphere of influence.

Compliance with San Bernardino Solar Ordinance- Findings of Fact		
31	On terms and in an amount acceptable to the Director, adequate surety is provided for reclamation of commercial solar energy generation facility sites should energy production cease for a continuous period of 180 days and/or if the site is abandoned.	Adequate reclamation surety's will be discussed with the County and provided.

AR063264

Arizona Cooperative Fish and Wildlife Research Unit **July 2006**

Relative Abundance of Yuma Clapper Rails, California Black Rails, and Burrowing Owls Within a Proposed Geothermal Power Plant Site in Imperial Valley California







Record Id 7302

County Imperial

Year 2004

Spp YCR (+) B.O. (+)

Srv. Rpt.
D.B. DC 7/25/07

GIS

L+R
File

Courtney J. Conway
Christopher P. Nadeau

Wildlife Research Report #2006-03

* Additional info attached in back. CDs w/ coordinates in permit file.

Relative abundance of Yuma clapper rails, California black rails, and burrowing owls within a proposed geothermal power plant site in Imperial Valley California

7 July 2006

Submitted to:
CE Obsidian Energy LLC
BioEnvironmental Associates
CH2M HILL

by

Courtney J. Conway
and
Christopher P. Nadeau

Arizona Cooperative Fish & Wildlife Research Unit
104 Biological Sciences East
University of Arizona
Tucson, AZ 85721
ph: 520-626-8535
FAX: 520-621-8801
email: cconway@ag.arizona.edu

Suggested Citation: Conway, C. J., and C. P. Nadeau. 2006. Relative abundance of Yuma clapper rails, California black rails, and burrowing owls within a proposed geothermal power plant site in Imperial Valley California. Wildlife Research Report No. 2006-03. Arizona Cooperative Fish and Wildlife Research Unit, Tucson, Arizona.

Table of Contents

List of Figures **3**
List of Tables **3**
Introduction **4**
Study Area **4**
Union Pond 5
Rock Hill Marsh 5
McKendry Marsh 5
Irrigation Drainage Ditch 5
Survey Methods **5**
Yuma clapper rail surveys 5
California black rail surveys 6
Burrowing owl surveys 7
California Brown Pelicans 7
Mountain Plovers 7
Survey Results **7**
Yuma clapper rail surveys 8
California black rail surveys 8
Burrowing owl surveys 9
California Brown Pelicans 9
Mountain Plovers 9
Literature Cited **10**

List of Figures

Figure 1. Study area.....12
Figure 2. 2004 burrowing owl survey results (OB1-5).....13
Figure 3. 2004 burrowing owl survey results (OBI1-3).....14
Figure 4. 2005 burrowing owl survey results (OB1-5).....15
Figure 5. 2005 burrowing owl survey results (OBI1-3).....16
Figure 6. 2006 burrowing owl survey results (OB1-5).....17
Figure 7. 2006 burrowing owl survey results (OBI1-3).....18

List of Tables

Table 1. Summary of clapper rail and black rail surveys at Union Pond.....19
Table 2. Summary of clapper rail and black rail surveys at Rock Hill Marsh.....19
Table 3. Summary of clapper rail and black rail surveys at McKendry Marsh.....20
Table 2. Summary of clapper rail and black rail surveys at the Irrigation Ditch.....20
Table 3. Summary of burrowing owls detected on walking surveys.....21
Table 4. Summary of burrowing owls detected on roadside surveys.....23

Introduction

The Yuma clapper rail (*Rallus longirostris yumanensis*) is federally endangered (U.S. Fish and Wildlife Service 1989), and the California black rail (*Laterallus jamaicensis coturniculus*) is listed as state endangered or state threatened throughout its range (Arizona Game and Fish Department 1988, California Department of Fish and Game 1994). The burrowing owl (*Athene cunicularia*) is listed as a Bird of National Conservation Concern by the U.S. Fish and Wildlife Service (2002) and is a species of special concern in California (California Department of Fish and Game 1994). Burrowing owls are declining in large portions of their North American breeding range, but populations have increased in the Imperial Valley of California between 1966-1996 (Sauer et al. 2002). Habitat loss and degradation have been identified as a primary threat to all three species (Evens et al. 1991, Eddleman and Conway 1998, Klute et al. 2003).

The California brown pelican (*Pelecanus occidentalis californicus*) is federally endangered (U.S. Fish and Wildlife Service 1983), but records of brown pelican have increased in California since the ban on DDT in 1972. Brown pelicans were first observed breeding in Salton Sea in June of 1996, but numbers at Salton Sea were set back by the botulism outbreak in the fall of 1996. Since then, nesting activity has been observed on a small rocky islet offshore of Obsidian Butte.

Mountain plovers (*Charadrius motanus*) are a species of special concern in California (California Department of Fish and Game 1994) and have been proposed for listing as federally threatened by the U.S. Fish and Wildlife Service. The Imperial Valley has one of the largest wintering populations of mountain plovers, but they do not breed in the Salton Sea area.

The following report summarizes the results of surveys conducted by the Arizona Cooperative Fish and Wildlife Research Unit in 2004, 2005, and 2006. Surveys were conducted to quantify relative abundance of Yuma clapper rails, California black rails, and burrowing owls in the project area for a proposed geothermal plant by CE Obsidian Energy LLC. We also looked for mountain plovers and brown pelicans during all surveys.

Study Area

The study area was located southeast of the Salton Sea in California's Imperial Valley and included a 305 meter (1000 foot) radius surrounding each of the 8 proposed well sites (OB1, OB2, OB3, OB4, OB5, OBI1, OBI2, OBI3; see Fig 1). With exception of the area surrounding OB3, the study area was dominated by irrigated agriculture. The area surrounding OB3, located on Obsidian Butte, consisted of sparse vegetation on an otherwise rocky landscape. The survey locations were identified in 2004 by examining the area within 305 meters of the 8 proposed well sites and the project site for potential rail or owl habitat. Areas were searched on foot or by vehicle. Areas were searched again in 2005 and 2006 so that any new habitat could be included in the 2005 and 2006 surveys. Burrowing owl habitat was located mainly adjacent to roadsides and irrigation canals. Four marshes were located and surveyed for both species of rails. All four

marshes were surveyed in 2004. The irrigation ditch was excluded from surveys in 2005 and 2006 because it does not contain suitable rail habitat. Descriptions of each marsh are provided below.

Union Pond

Union Pond is located on the southern end of the Salton Sea (Fig. 1). It was created by the Sonny Bono Salton Sea National Wildlife Refuge (SSNWR) and is managed for Yuma clapper rails. The pond is dominated by southern cattail (*Typha domingensis*). The only other vegetation present is sparse salt cedar (*Tamarix ramosissima*) on the edges of the pond. This area provides excellent habitat for Yuma clapper rails which prefer areas dominated by emergent plants such as southern cattail (Todd 1986, Conway et al. 1993). Union Pond is not currently optimal habitat for California black rails, which prefer shallow marshes dominated by common threesquare (*Schoenoplectus pungens*) and other emergent plants (Repking and Ohmart 1977, Conway et al. 2002).

Rock Hill Marsh

Rock Hill Marsh is a triangular-shaped wetland located on the eastern shore of the Salton Sea, north of Union Pond (Fig. 1). The marsh is separated from the Salton Sea by a levee and is supplied with agricultural runoff by a culvert on the southeastern corner of the marsh. The marsh was dominated by open water in 2004 but filled in with southern cattail in 2005 and 2006. The marsh was not optimal habitat for Yuma clapper rails and California black rails in 2004, but became much better habitat in 2005 and 2006 due to the growth of southern cattail.

McKendry Marsh

McKendry Marsh is located on the eastern shore of the Salton Sea, east of Obsidian Butte, and is separated from the Salton Sea by a levee (Fig. 1). The marsh is dominated by open water but contains small patches of southern cattail. The marsh is currently not optimal habitat for Yuma clapper rails or California black rails due to the amount and depth of the open water.

Irrigation Drainage Ditch

The irrigation ditch is located south of McKendry Marsh (Fig. 1) and is used to drain irrigation water from the surrounding agricultural fields. The ditch is approximately 5 meters wide and has steep sides vegetated by dense stands of common reed (*Phragmites occidentalis*). Cattail and bulrush are not present in the ditch. This ditch is not suitable habitat for Yuma clapper rails or California black rails due to the depth of the water, the steep sides, and the lack of suitable emergent vegetation.

Survey Methods

Yuma clapper rail surveys

We conducted at least 3 replicate call-broadcast surveys for Yuma clapper rails in McKendry Marsh, Union Pond, Rock Hill Marsh, and the irrigation drainage ditch in 2004 (Fig. 1). All replicate surveys were repeated in 2005 and 2006, except for the surveys along the irrigation drainage ditch (we concluded that the ditch lacked suitable habitat for rails in 2004). Survey points were distributed along the upland peripheries of the marshes at 150-m intervals. Surveyors got as close to the marsh vegetation as

possible at each survey point, and recorded the location of each survey point using a Global Positioning System (GPS) receiver. Each point was also marked with flagging tape and a wooden stake to assure replicate surveys were performed at exactly the same location. We used a portable CD player attached to a pair of amplified speakers. We taped the speakers together, placed them on the ground at the marsh edge, and faced them toward the marsh. We used standard USFWS survey protocols for Yuma clapper rails as per the January 2000 approved protocols. All surveys were replicated at least three times at each marsh from 13 April to 15 May in all three years. Each survey at each point included: an initial 1-min settling period, 2 min of call-broadcast, 2 min of passive listening, 2 min of call-broadcast, and 1 min of passive listening. The call-broadcast period consisted of pre-recorded calls of Yuma clapper rails being broadcast into the wetland at 80-90 decibels (measured 1m in front of the speaker) to elicit vocalizations. We used digital CD recordings of the 3 most-common breeding calls of Yuma clapper rails for the call-broadcast (*kek*, *clatter*, *kek-hurrah*). Surveyors recorded all rails heard and/or seen during the survey period at each point, and each rail was recorded on a separate line on the data sheet. We recorded whether each vocalization was part of a paired duet or was an isolated call, and whether each bird was detected at a previous survey point. We recorded the vegetative community where each bird was detected and drew the location of each bird on a map of the area. All replicate surveys were conducted in the morning (30 min before sunrise until 2 hours after sunrise) or evening (2 hours before sunset until 30 min after sunset). Surveys were conducted on days without rain and when wind speeds did not exceed 10 mph. We recorded percent cloud cover, wind speed, and ambient temperature at the beginning and end of each survey. We also recorded any events or disturbances that may have affected detection probability on each survey.

California black rail surveys

We conducted 5 replicate call-broadcast surveys for California black rails in McKendry Marsh, Union Pond, Rock Hill Marsh , and the irrigation drainage ditch in 2004 (Fig. 1). All replicate surveys were repeated in 2005 and 2006, except for surveys along the irrigation drainage ditch. Survey points were distributed along the upland peripheries of all emergent marshes at 50-m intervals. Surveyors got as close to the marsh vegetation as possible at each survey point, and recorded the location of each survey point using a GPS receiver. Each point was also marked with flagging tape and a wooden stake to assure replicate surveys were performed at exactly the same location on replicate surveys. We used a portable CD player attached to a pair of amplified speakers to broadcast black rail calls during each survey. We taped the speakers together, placed them on the ground at the marsh edge, and faced them toward the marsh. We used standard survey protocols for California black rails (Conway et al. 2002, Conway et al. 2004). All surveys were conducted between 10 April and 17 May in all three years. Each survey at each point included: an initial 3-min passive segment followed by a 3-min period of call-broadcast. The 3-min broadcast sequence consisted of three 1-min segments of 30 sec of black rail calls (15 sec of "*kic-kic-kerr*" calls and 15 sec of "*grr*" calls) followed by 30 sec of silence. The 30-sec call-broadcast period consisted of pre-recorded calls of California black rails being broadcast into the wetland at 80-90 decibels (measured 1m in front of the speaker) to elicit vocalizations. Surveyors recorded all rails heard and/or seen during the survey period at each point, and each rail was recorded on a separate line on the data sheet. We recorded whether each rail was detected at a previous survey point and the

vegetative community where each bird was detected. We marked the location of each bird on a map of the area. We also recorded whether each vocalization was part of a paired duet or was an isolated call. All replicate surveys were conducted in the morning (30 min before sunrise until 2 hours after sunrise) or evening (2 hours before sunset until 30 min after sunset). Surveys were conducted on days without rain and when wind speeds did not exceed 10 mph. We recorded percent cloud cover, wind speed, and ambient temperature at the beginning and end of each survey. We also recorded any events or disturbances that may have affected detection probability during each survey.

Burrowing owl surveys

We conducted standardized call-broadcast surveys for burrowing owls (Conway and Simon 2003, California Burrowing Owl Consortium 1997) along all passable roads within 1000 feet of the project site and well pads. Survey points were established along all roads and adjacent survey points were located 0.8 km apart unless local conditions warranted a closer distance (i.e., barriers or topography prevented observers from seeing all available habitat within 0.4 km). The permanent location of each survey point was recorded using a GPS receiver so that the exact survey location could be re-surveyed in future years. We conducted 4 replicate surveys in 2004 and 3 replicate surveys in both 2005 and 2006 at each survey point. Standardized burrowing owl surveys included an initial 3-min passive segment followed by a 3-min call-broadcast segment. The 3-min call-broadcast segment included a series of 30 sec call-broadcasts (*coo-coo* call and alarm call broadcast at 80-90 dB measured 1 m in front of the speaker) interspersed with 30 sec of silence. Surveys were restricted to the early morning (30 min before sunrise until 0800 hr) and evening hours (1800 until 30 min after sunset). Surveys were not conducted during rain or when wind speed was >20mph. At each point, observers recorded (1) the number of adult owls, (2) the number of juvenile owls, and (3) the number of presumed nest sites. We also conducted 4 replicate walking line-transect surveys in 2004 and 2 replicate walking line-transect surveys in both 2005 and 2006 in all areas that represented potential burrowing owl nesting habitat. Distance between adjacent transects was 30m unless local conditions warranted a closer distance. All burrows and burrowing owls located were marked onto maps of the area. The UTM coordinates of each burrow were recorded using a GPS receiver. In 2005 and 2006, we also placed a small identification tag at the entrance of the burrow, and revisited all previously detected burrows on each replicate survey. All surveys were conducted between 20 April and 17 May in all three years.

California Brown Pelicans

During all Yuma clapper rail and California black rail surveys, we also looked for California brown pelicans.

Mountain Plovers

During all burrowing owl surveys, we also looked for mountain plovers.

Survey Results

Yuma clapper rail surveys

In 2004, we conducted a total of 65 point-count surveys using the Yuma clapper rail protocol. Yuma clapper rails were detected in both Rock Hill Marsh and Union Pond with a mean number of 0.75 and 11.4 birds per survey, respectively (Table 1-3). Of the clapper rails detected, 67% were paired in Rock Hill Marsh and 46% were paired in Union Pond. We did not detect Yuma clapper rails in McKendry Marsh or the irrigation drainage ditch in 2004. California black rails were not detected during any of the Yuma clapper rail surveys.

In 2005, we conducted 47 point-count surveys using the Yuma clapper rail protocol. Yuma clapper rails were detected in Rock Hill Marsh, Union Pond, and McKendry Marsh with a mean number of 0.75, 10.2, and 0.33 birds per survey, respectively (Table 1-3). Of the clapper rails detected in Union Pond, 23% were paired. Pairs were not detected in Rock Hill Marsh or McKendry Marsh. California black rails were not detected during any of the Yuma clapper rail surveys.

In 2006, we conducted 33 point-count surveys using the Yuma clapper rail protocol. Yuma clapper rails were detected in Rock Hill Marsh, Union Pond, and McKendry Marsh with a mean number of 2.6, 20.3, and 1.3 birds per survey, respectively (Table 1-3). Of the clapper rails detected, 14%, 30%, and 17% were paired in Union Pond, Rock Hill Marsh, and McKendry Marsh respectively. California black rails were not detected during any of the Yuma clapper rail surveys.

California black rail surveys

In 2004, we conducted 225 point-count surveys using the California black rail protocol. California black rails were not detected at any of the survey points. Yuma clapper rails were detected in both Rock Hill Marsh and Union Pond with a mean number of 0.8 and 12.6 birds per survey, respectively (Table 1-3). Of the clapper rails detected, 50% were paired in Rock Hill Marsh and 44% were paired in Union Pond.

In 2005, we conducted 140 point-count surveys using the California black rail protocol. A single California black rail was detected in McKendry Marsh during 1 of the replicate surveys. We did not detect black rails at Union Pond or Rock Hill Marsh. Yuma clapper rails were detected in Rock Hill Marsh, Union Pond, and McKendry Marsh during our black rail surveys with a mean number of 1.6, 13.6, and 1.4 birds per survey, respectively (Table 1-3). Of the clapper rails detected, 29% were paired in McKendry Marsh, and 25% were paired in both Rock Hill Marsh and Union Pond.

In 2006, we conducted the same 140 point-count surveys using the California black rail protocol. California black rails were not detected at any of the survey points. Yuma clapper rails were detected in Rock Hill Marsh, Union Pond, and McKendry Marsh during our black rail surveys with a mean number of 2.8, 19.6, and 1.0 birds per survey, respectively (Table 1-3). Of the clapper rails detected, 0 were paired in McKendry Marsh, 21% were paired in Rock Hill Marsh, and 15% were paired in Union Pond.

Burrowing owl surveys

In 2004, we detected a total of 27 active burrowing owl burrows (Fig. 2-3, Table 4-5). Four of these burrows were found outside the 305 meter radius surrounding the well sites. Of the 27 detected burrows 54% were occupied by pairs, 39% were occupied by one adult, and 7% had signs of occupancy (i.e., feces or lining at the burrow entrance) but we didn't detect owls. We believe 40% (4 of 10) of the burrows where we observed only 1 adult, were actually occupied by a pair of owls, due to the presence of lining at the entrance of the burrow. The female was likely incubating at these burrows and was therefore not detected outside the burrow.

In 2005, we detected a total of 29 active burrowing owl burrows (Fig. 4-5, Table 4-5). Eight of these burrows were found outside the 305 meter radius surrounding the well sites. Of the 29 active burrows detected 48% were occupied by pairs, 20% were occupied by one adult, 13% had signs of occupancy (i.e., feces or lining at the burrow entrance) but we didn't detect owls, and we were unable to locate a burrow for 17% of the owls we detected during surveys. We believe 83% (5 of 6) of the burrows where we observed only 1 adult were actually occupied by a pair of owls. Of the active burrows detected in 2004, 48% were occupied or showed signs of occupancy during 2005, 23% were not occupied by owls, and 29% could not be relocated and were assumed to be destroyed or collapsed.

In 2006, we detected a total of 29 active burrowing owl burrows (Fig. 6-7, Table 4-5). Six of these burrows were found outside the 305 meter radius surrounding the well sites. Of the 29 active burrows detected 45% were occupied by pairs, 38% were occupied by one adult, and 17% had signs of occupancy (i.e., feces or lining at the burrow entrance). We believe 64% (7 or 11) of the burrows where we observed only 1 adult were actually occupied by a pair of owls. Of the active burrows detected in 2005, 48% were occupied or showed signs of occupancy during 2006, 14% were not occupied by owls, and 38% could not be relocated and were assumed to be destroyed or collapsed.

California Brown Pelicans

We did not detect any brown pelicans, or any obvious pelican roost trees, during any of our rail surveys in 2004, 2005, or 2006.

Mountain Plovers

We did not detect any mountain plovers during any of our burrowing owl surveys in 2004, 2005, or 2006.

Literature Cited

Arizona Game and Fish Department, 1988. Threatened native wildlife in Arizona. Arizona Game and Fish Department Publication, Phoenix.

California Burrowing Owl Consortium. 1997. Burrowing Owl Survey Protocol and Mitigation Guidelines. *Journal of Raptor Research Report* 9:171-177.

California Department of Fish and Game. 1994. State and Federal Endangered and Threatened Animals of California, California Department of Fish and Game, Sacramento.

Conway, C. J., W. R. Eddleman, S. H. Anderson, L. R. Hanebury. 1993. Seasonal Changes in Yuma Clapper Rail Vocalization Rate and Habitat Use. *Journal of Wildlife Management* 57:282-290.

Conway, C. J., and J. Simon. 2003. Comparison of detection probability associated with burrowing owl survey methods. *Journal of Wildlife Management* 67:501-511.

Conway, C. J., C. Sulzman, and B. A. Raulston. 2002. Population trends, distribution, and monitoring protocols for the California black rail. Final Report. California Department of Fish and Game, Sacramento, California.

Conway, C. J., C. Sulzman, and B. A. Raulston. 2004. Factors affecting detection probability of California black rails. *Journal of Wildlife Management* 68:360-370.

Eddleman W. R. and C. J. Conway. 1998. Clapper rail (*Rallus longirostris*). No. 340 in The Birds of North America, A. Poole and F. Gill (eds.). The Birds of North America.

Evens, J.G., G.W. Page, S.A. Laymon, and R.W. Stallcup. 1991. Distribution, relative abundance, and status of the California black rail in western North America. *Condor* 93: 952-966.

Klute, S.D., W.H. Howe, S.R. Sheffield, L.W. Ayers, S.L. Jones, T.S. Zimmerman, M.T. Green, and J.A. Shaffer. 2003. Status Assessment and Conservation Plan for the Western burrowing owl in the United States. Biological Technical Publication, BTP-R6001-2003.

Repking, C. F., and R. D. Ohmart. 1977. Distribution and density of black rail populations along the lower Colorado River. *Condor* 79: 186-189.

Sauer, J.R., J.E. Hines, and J. Fallon. 2002. The North American Breeding Bird Survey Results and Analysis 1966-2000. Version 2001.2. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, Maryland. http://www.mbr-pwrc.usgs.gov/bbs/bbs2001.html.

Todd, R. L. 1986. A salt water marsh hen in Arizona: A history of the Yuma clapper rail (*Rallus longirostoris yumanensis*). Completion Report, Arizona Game and Fish Dept., Fed. Aid Proj. W-95-R, Phoenix.

U.S. Fish and Wildlife Service. 1983. The California brown pelican recovery plan. Portland, OR.

U.S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants. 50 CFR 17.11 and 17.12. U.S. Government Printing Office, Washington, D.C.

U.S. Fish and Wildlife Service. 2002. Birds of Conservation Concern 2002. Division of Migratory Bird Management, Arlington, VA.

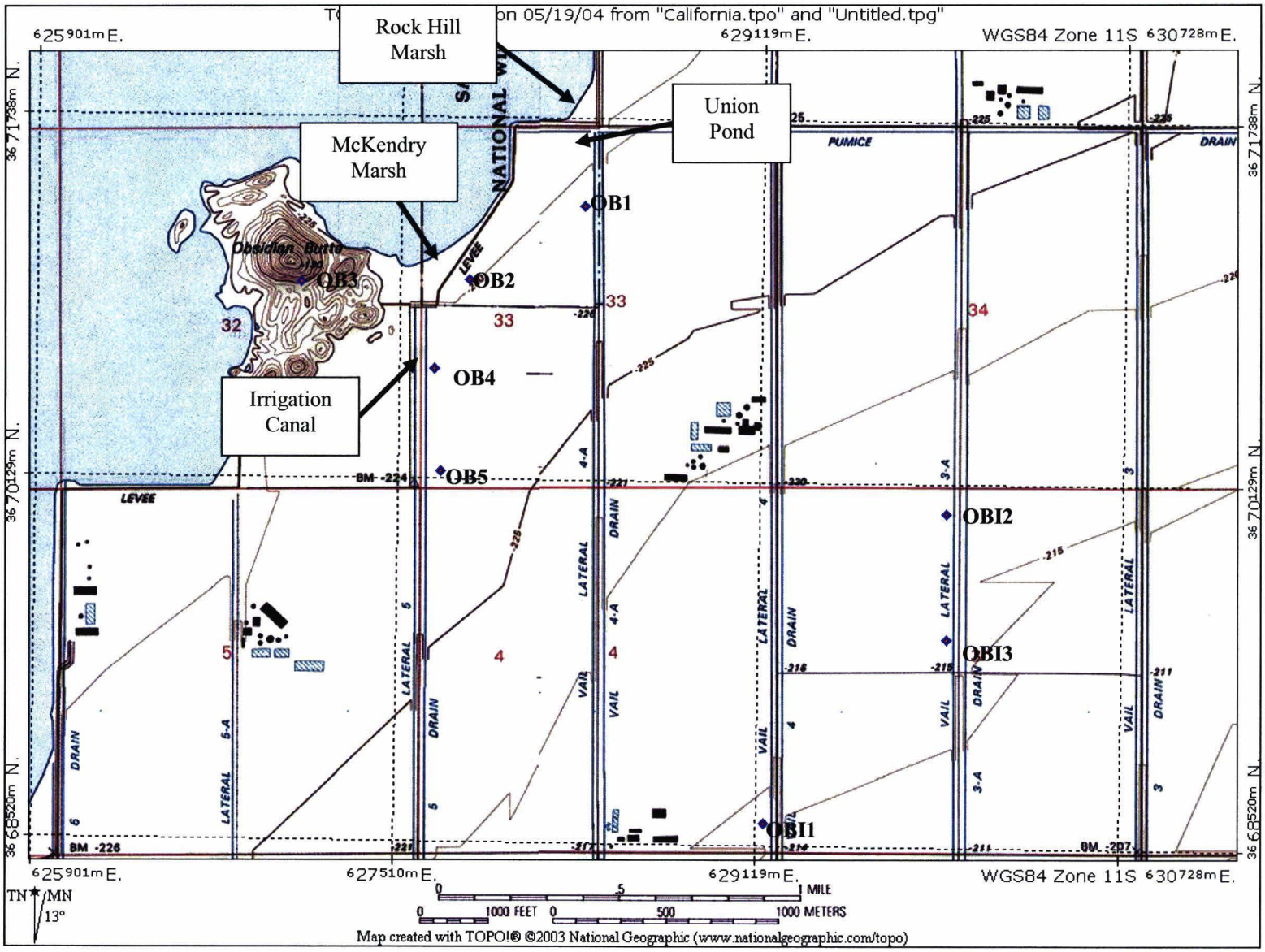
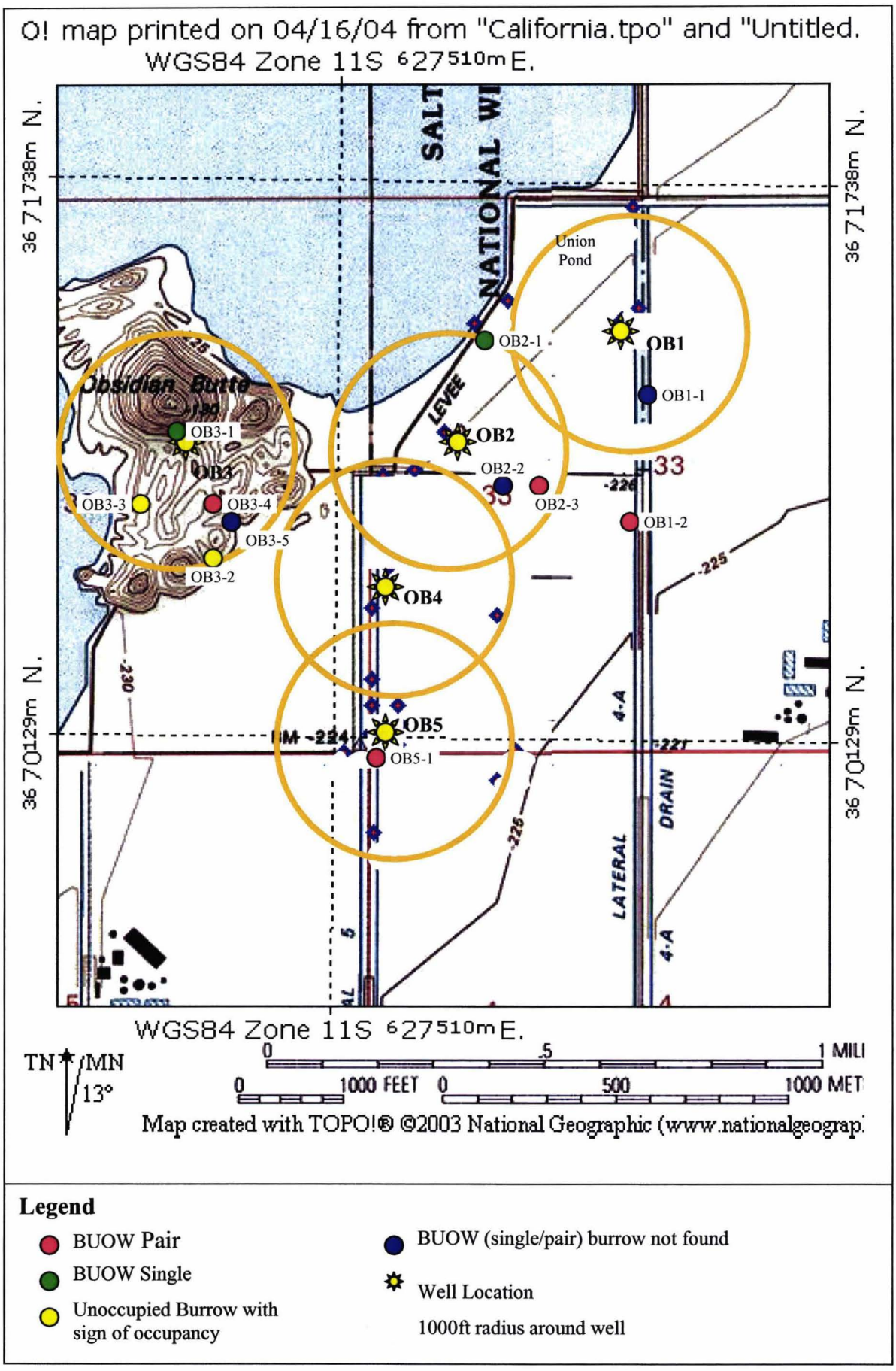


Figure 1. Study Area.



Legend

- BUOW Pair
- BUOW Single
- Unoccupied Burrow with sign of occupancy
- BUOW (single/pair) burrow not found
- Well Location
- 1000ft radius around well

Figure 2. 2004 burrowing owl survey results (OB1-5).

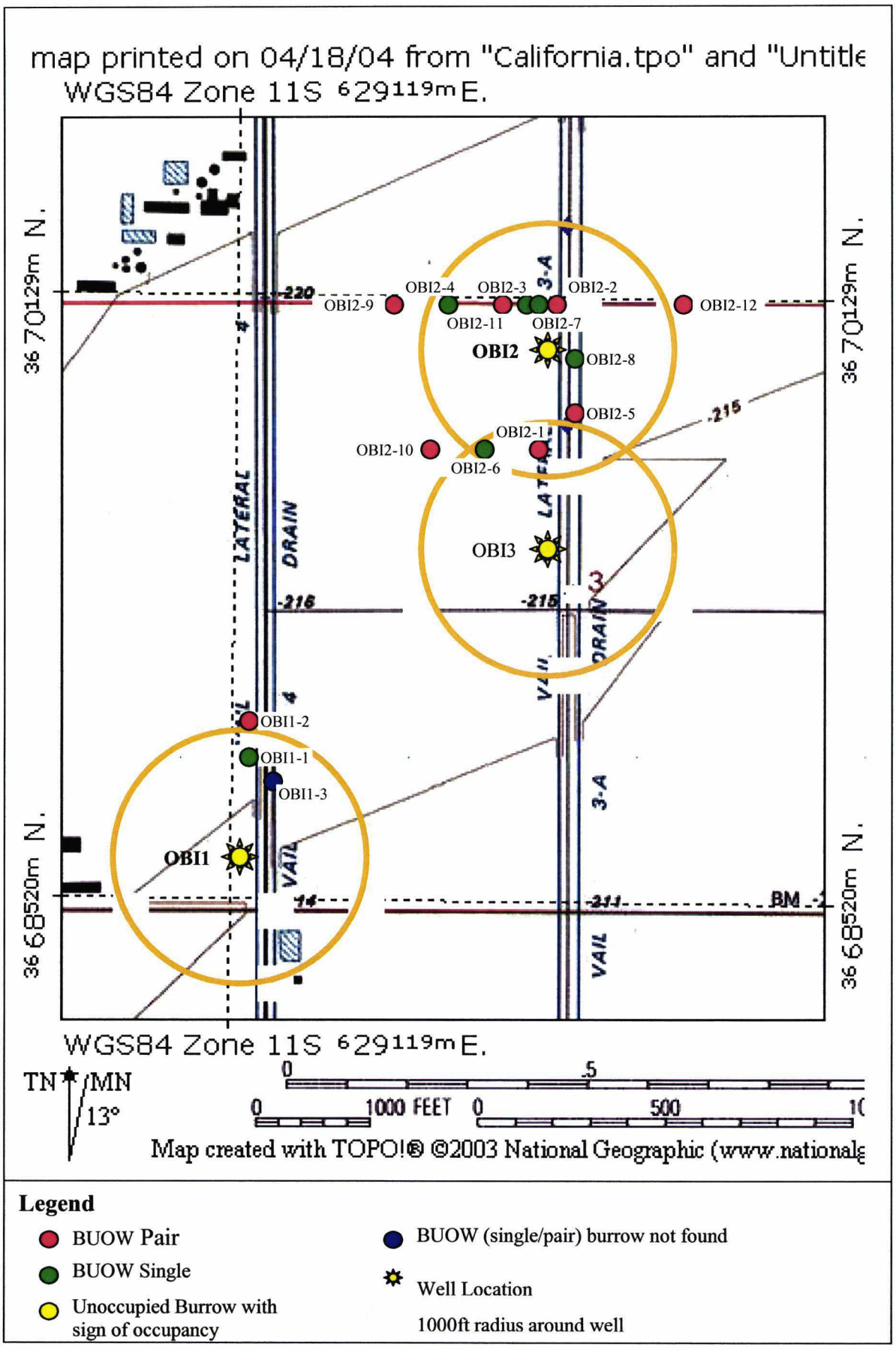


Figure 3. 2004 burrowing owl survey results (OBI 1-3).

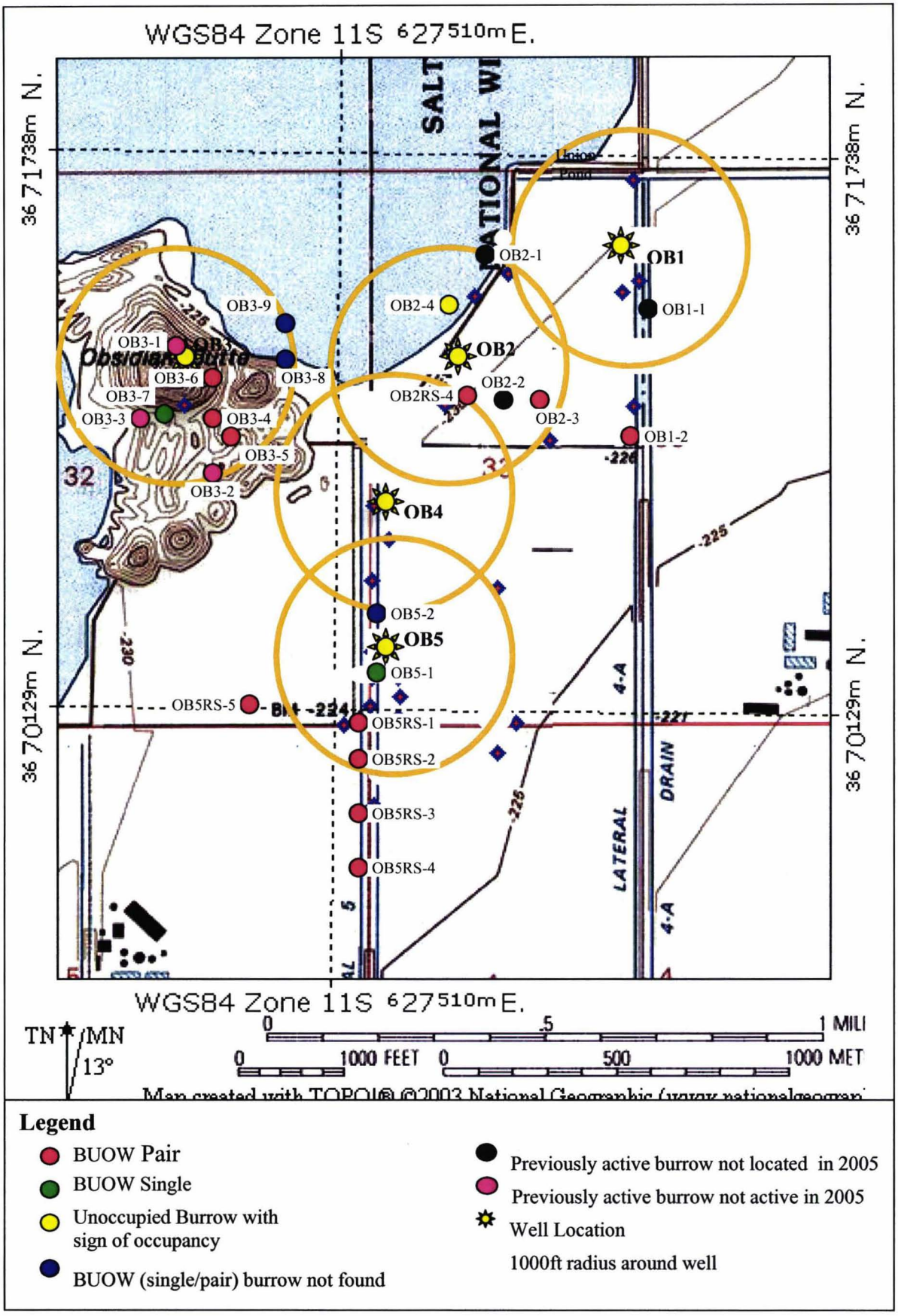


Figure 4. 2005 burrowing owl survey results (OBI 1-3).

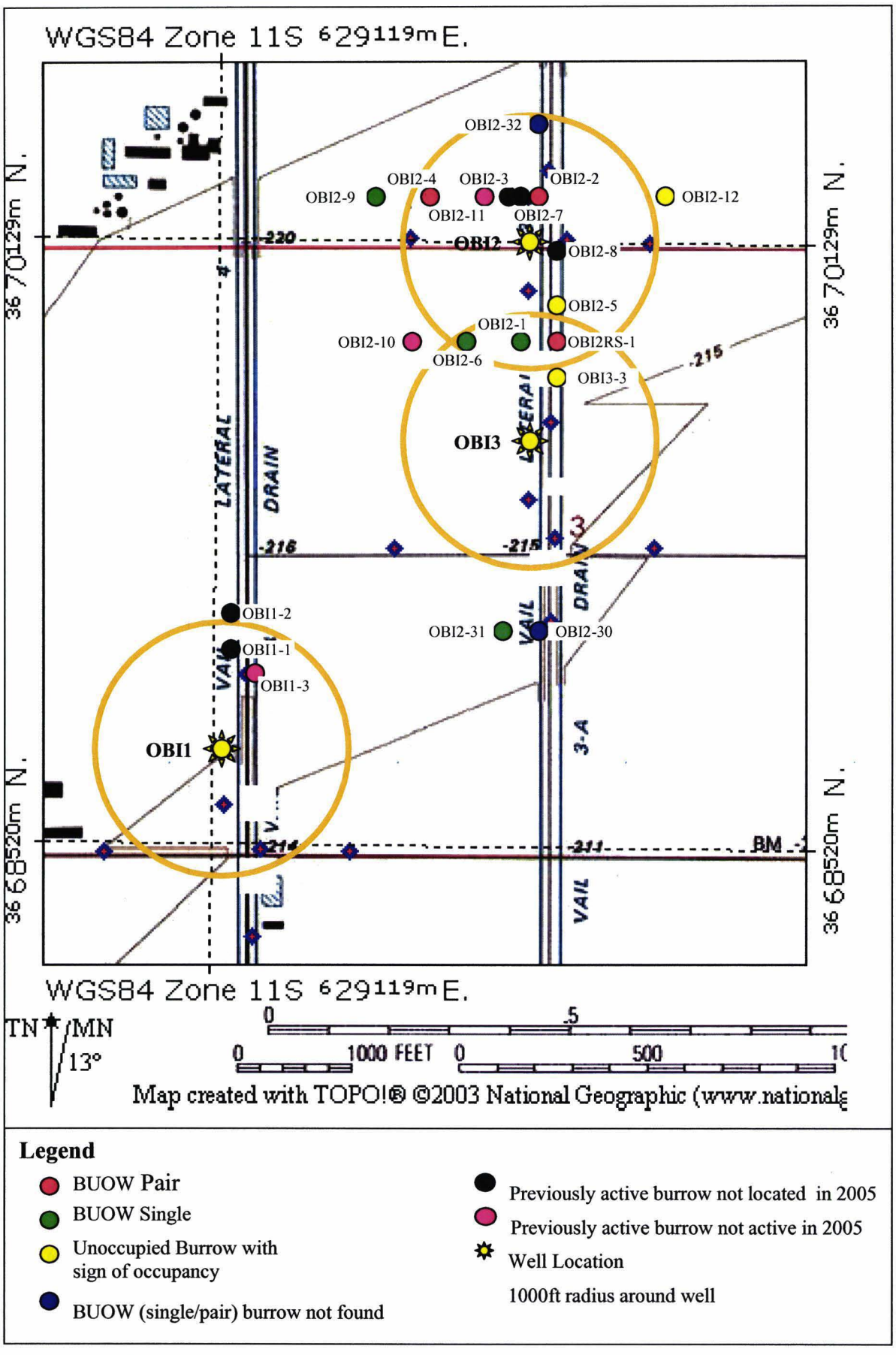


Figure 5. 2005 burrowing owl survey results (OB1-5).

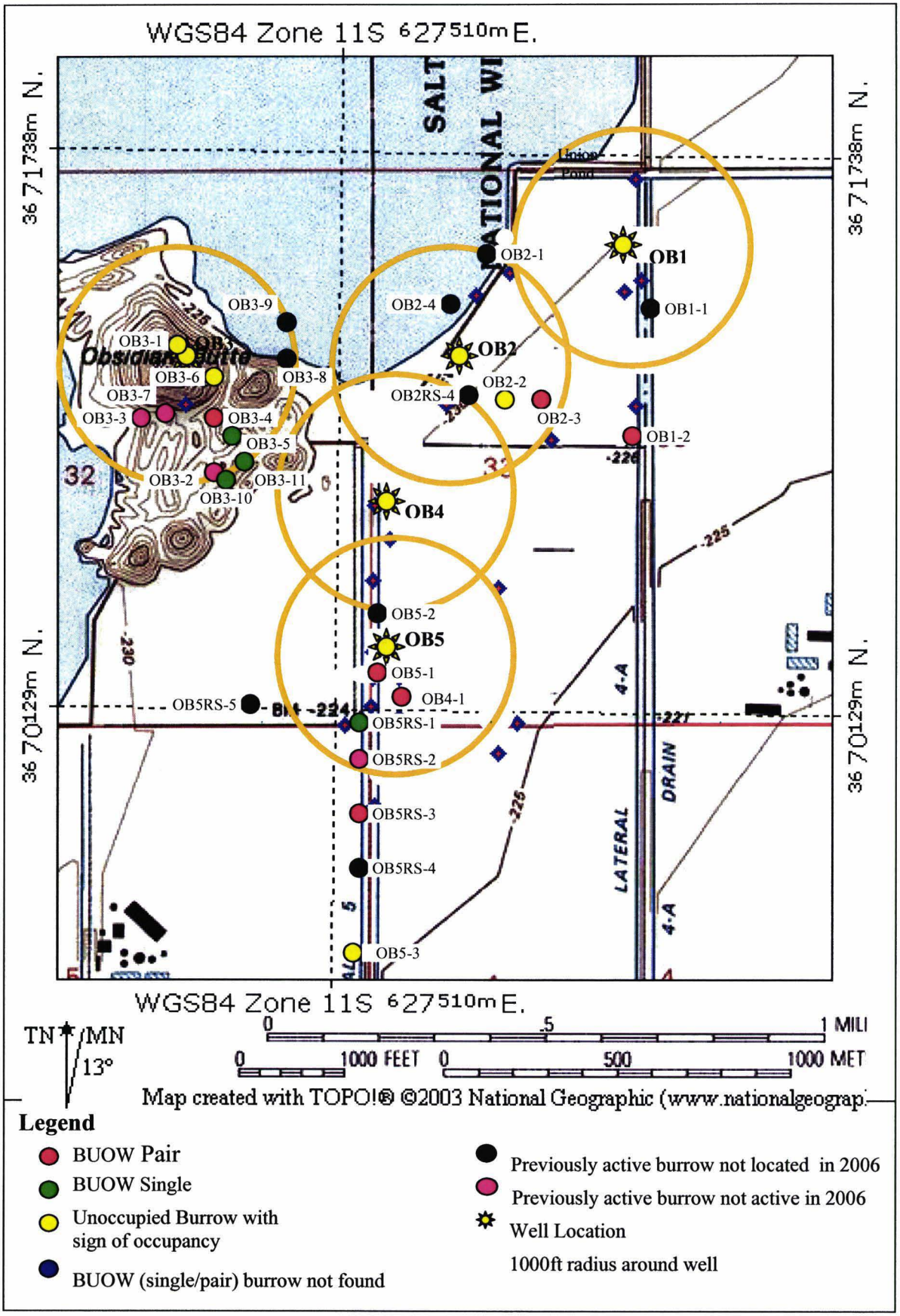
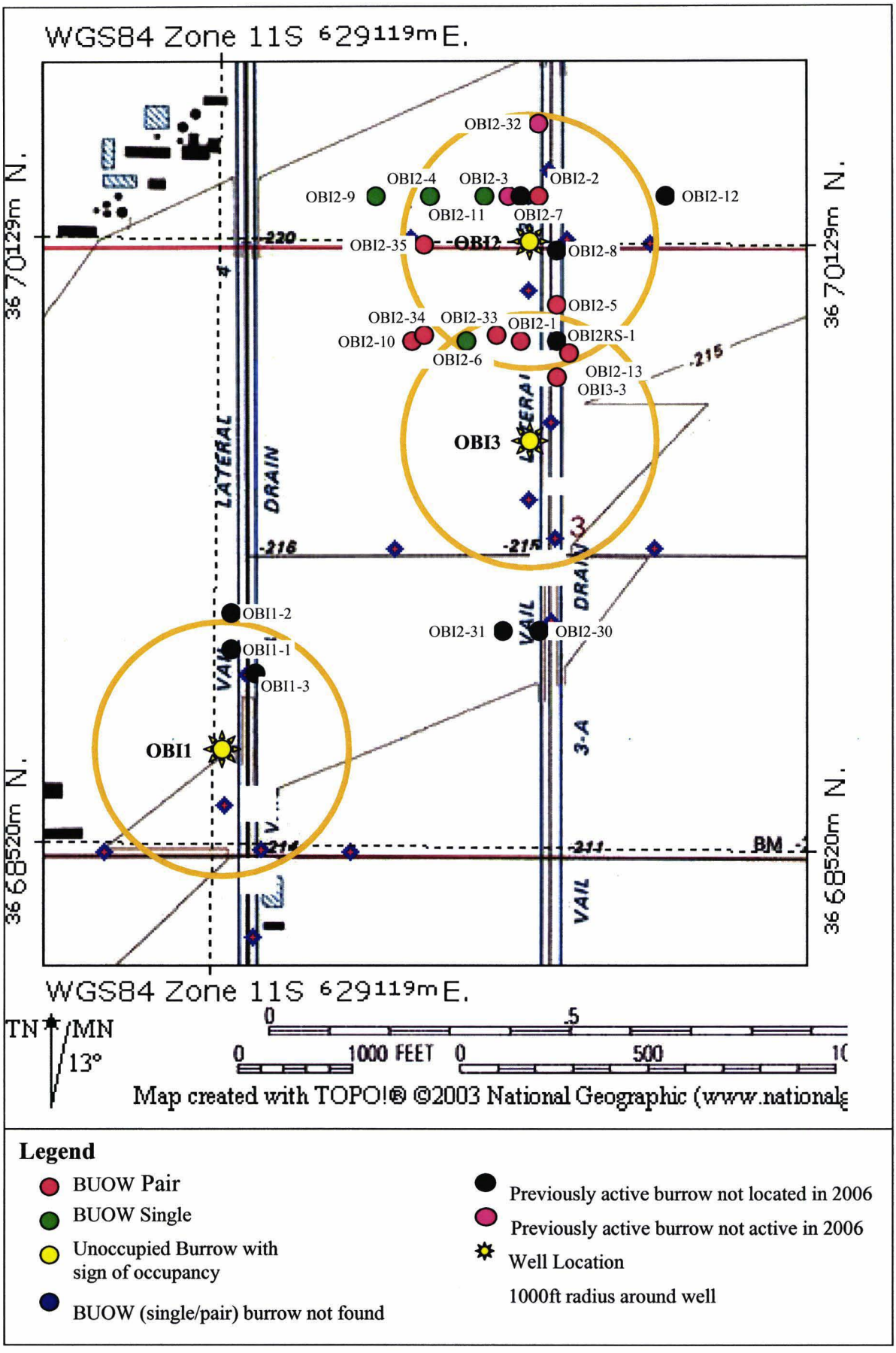


Figure 6. 2006 burrowing owl survey results (OBI 1-3).



Legend

- BUOW Pair
- BUOW Single
- Unoccupied Burrow with sign of occupancy
- BUOW (single/pair) burrow not found
- Previously active burrow not located in 2006
- Previously active burrow not active in 2006
- Well Location
- 1000ft radius around well

Figure 7. 2006 burrowing owl survey results (OB1-5).

Table 1. Summary of clapper rail and black rail surveys at Union Pond.

Type of Survey	2004				2005				2006			
	Date	# BLRA	Total # CLRA	# CLRA Pairs	Date	# BLRA	Total # CLRA	# CLRA Pairs	Date	# BLRA	Total # CLRA	# CLRA Pairs
Black Rail	15-Apr	0	8	2	13-Apr	0	19	4	14-Apr	0	18	3
	20-Apr	0	16	3	22-Apr	0	22	6	25-Apr	0	20	6
	29-Apr	0	14	3	30-Apr	0	14	3	3-May	0	17	5
	5-May	0	11	4	8-May	0	6	2	10-May	0	23	5
	14-May	0	14	2	15-May	0	7	2	17-May	0	20	3
Mean # detected		0	12.6	2.8		0	13.6	3.4		0	19.6	4.4
Clapper Rail	14-Apr	0	11	3	12-Apr	0	12	2	13-Apr	0	25	3
	23-Apr	0	8	2	21-Apr	0	12	5				
	27-Apr	0	13	5	25-Apr	0	11	3	29-Apr	0	18	2
	4-May	0	10	2	5-May	0	10	2				
	14-May	0	15	1	14-May	0	6	0	13-May	0	21	4
Mean # detected		0	11.4	2.6		0	10.2	2.4		0	21.3	3
Mean # detected with both survey types		0	12	2.7		0	11.9	2.9		0	20.3	3.9

Table 2. Summary of clapper rail and black rail surveys at Rock Hill Marsh.

Type of Survey	2004				2005				2006			
	Date	# BLRA	Total # CLRA	# CLRA Pairs	Date	# BLRA	Total # CLRA	# CLRA Pairs	Date	# BLRA	Total # CLRA	# CLRA Pairs
Black Rail	15-Apr	0	1	0	13-Apr	0	0	0	14-Apr	0	2	1
	20-Apr	0	0	0	22-Apr	0	2	1	25-Apr	0	3	1
	29-Apr	0	0	0	30-Apr	0	1	0	3-May	0	2	0
	5-May	0	2	1	8-May	0	2	0	10-May	0	3	1
	14-May	0	1	0	15-May	0	3	1	17-May	0	4	0
Mean # detected		0	0.8	0.2		0	1.6	0.4		0	2.8	0.6
Clapper Rail	23-Apr	0	0	0	12-Apr	0	1	0	13-Apr	0	2	1
					21-Apr	0	0	0				
	27-Apr	0	1	0	25-Apr	0	0	0	29-Apr	0	2	0
	4-May	0	0	0								
	14-May	0	2	1	14-May	0	2	0	13-May	0	3	1
Mean # detected		0	0.8	0.3		0	0.8	0		0	2.3	0.7
Mean # detected with both survey types		0	0.8	0.2		0	1.2	0.2		0	2.6	0.6

Table 3. Summary of clapper rail and black rail surveys at McKendry Marsh.

	2004				2005				2006			
Type of Survey	Date	# BLRA	Total # CLRA	# CLRA Pairs	Date	# BLRA	Total # CLRA	# CLRA Pairs	Date	# BLRA	Total # CLRA	# CLRA Pairs
Black Rail	16-Apr	0	0	0	13-Apr	1	3	0	14-Apr	0	3	0
	20-Apr	0	0	0	22-Apr	0	2	1	21-Apr	0	0	0
	28-Apr	0	0	0	29-Apr	0	0	0	28-Apr	0	0	0
	4-May	0	0	0	8-May	0	2	1	4-May	0	1	0
	13-May	0	0	0	15-May	0	0	0	11-May	0	1	0
Mean # detected		0	0	0		0.2	1.4	0.4		0	1	0
Clapper Rail	15-Apr	0	0	0	12-Apr	0	1	0	13-Apr	0	2	0
	27-Apr	0	0	0	25-Apr	0	0	0	29-Apr	0	1	0
	14-May	0	0	0	14-May	0	0	0	13-May	0	2	1
Mean # detected		0	0	0		0	0.3	0		0	1.7	0.3
Mean # detected with both survey types		0	0	0		0.1	1.0	0.3		0	1.3	0.1

Table 4. Summary of clapper rail and black rail surveys at the Irrigation Ditch.

	2004			
Type of Survey	Date	# BLRA	Total # CLRA	# CLRA Pairs
Black Rail	16-Apr	0	0	0
	20-Apr	0	0	0
	28-Apr	0	0	0
	4-May	0	0	0
	13-May	0	0	0
Mean # detected		0	0	0
Clapper Rail	15-Apr	0	0	0
	27-Apr	0	0	0
	14-May	0	0	0
Mean # detected		0	0	0
Mean # detected with both survey types		0	0	0

Conway and Nadeau 2006

Table 5. Summary of burrowing owls detected on walking surveys.

Burrow Name	UTMs		2004 Occupancy	2004 Date Detected				2005 Date Detected			2006 Date Detected		
	Easting	Northing		round 1	round 2	round 3	round 4	2005 Occupancy	round 1	round 2	2006 Occupancy	round 1	round 2
OB1-1	628412	3671176	pair	-	-	-	13-May	not re-located	22-Apr	11-May	not re-located	18-Apr	9-May
OB1-2	628336	3670816	pair	-	-	-	13-May	pair	22-Apr	11-May	pair	18-Apr	9-May
OB2-1	627909	3671329	single	-	28-Apr	4-May	13-May	not re-located	22-Apr	11-May	not re-located	18-Apr	9-May
OB2-2	627996	3670920	pair	-	28-Apr	4-May	-	not re-located	22-Apr	11-May	active, no owls	18-Apr	9-May
OB2-3	628144	3670906	pair	-	-	-	13-May	pair	22-Apr	11-May	single	18-Apr	9-May
OB2-4	628304	3670868	-	-	-	-	-	active, no owls	-	11-May	not re-located	18-Apr	9-May
OB2RS-4	627969	3670930	-	-	-	-	-	pair	22-Apr	11-May	not re-located	18-Apr	9-May
OB3-1	627054	3671043	single	-	28-Apr	-	14-May	not active	20-Apr	10-May	active, no owls	21-Apr	17-May
OB3-2	627127	3670704	active, no owls	-	-	-	14-May	not active	20-Apr	10-May	not active	21-Apr	17-May
OB3-3	626947	3670852	active, no owls	-	-	-	14-May	not active	20-Apr	10-May	not active	21-Apr	17-May
OB3-4	627134	3670867	pair	-	-	4-May	14-May	pair	20-Apr	10-May	pair	21-Apr	17-May
OB3-5	627220	3670785	single	-	27-Apr	-	15-May	pair	20-Apr	10-May	single	21-Apr	17-May
OB3-6	627131	3670932	-	-	-	-	-	pair	20-Apr	10-May	active, no owls	21-Apr	17-May
OB3-7	626999	3670845	-	-	-	-	-	single	20-Apr	10-May	not active	21-Apr	17-May
OB3-8	627363	3671028	-	-	-	-	-	single	-	10-May	not re-located	21-Apr	17-May
OB3-9	627356	3671113	-	-	-	-	-	single	-	10-May	not re-located	21-Apr	17-May
OB3-10	627166	3670765	-	-	-	-	-	-	-	-	single	21-Apr	17-May
OB3-11	627227	3670878	-	-	-	-	-	-	-	-	single	21-Apr	17-May
OB4-1	627696	3670170	-	-	-	-	-	-	-	-	pair	21-Apr	17-May
OB5-1	627627	3670116	pair	21-Apr	28-Apr	4-May	13-May	single	22-Apr	12-May	pair	18-Apr	9-May
OB5-2	627685	3670113	-	-	-	-	-	single	22-Apr	12-May	not re-located	18-Apr	9-May
OB5-3	627577	3669355	-	-	-	-	-	-	-	-	active, no owls	18-Apr	9-May
OB5RS-1	627568	3669937	-	-	-	-	-	-	-	-	not active	18-Apr	9-May
OB5RS-2	627573	3669837	-	-	-	-	-	-	-	-	not active	18-Apr	9-May
OB5RS-3	627575	3669491	-	-	-	-	-	pair	22-Apr	12-May	pair	18-Apr	9-May
OB5RS-4	627582	3669288	-	-	-	-	-	pair	22-Apr	12-May	not re-located	18-Apr	9-May
OB5RS-5	627191	3669994	-	-	-	-	-	-	-	-	not re-located	18-Apr	9-May

Burrow Name	UTMs		2004 Occupancy	2004 Date Detected				2005 Date Detected			2006 Date Detected		
	Easting	Northing		round 1	round 2	round 3	round 4	2005 Occupancy	round 1	round 2	2006 Occupancy	round 1	round 2
OBI1-1	629196	3668892	single	22-Apr	-	4-May	13-May	not re-located	21-Apr	12-May	not re-located	19-Apr	3-May
OBI1-2	629195	3669008	pair	22-Apr	-	-	-	not re-located	21-Apr	12-May	not re-located	19-Apr	3-May
OBI1-3	629240	3668843	single	-	28-Apr	4-May	13-May	not active	21-Apr	12-May	not re-located	19-Apr	3-May
OBI2-1	629921	3669719	pair	22-Apr	28-Apr	4-May	13-May	single	21-Apr	12-May	pair	19-Apr	3-May
OBI2-10	629569	3669707	pair	-	-	4-May	-	not active	21-Apr	12-May	pair	19-Apr	3-May
OBI2-11	629836	3670135	pair	-	-	4-May	-	not active	21-Apr	12-May	single	19-Apr	3-May
OBI2-12	630335	3670135	pair	-	-	-	13-May	active, no owls	21-Apr	12-May	not re-located	19-Apr	3-May
OBI2-13	630040	3669766	-	-	-	-	-	-	-	-	single	19-Apr	3-May
OBI2-2	629934	3670140	pair	22-Apr	-	-	13-May	pair	21-Apr	12-May	active, no owls	19-Apr	3-May
OBI2-3	629839	3670139	single	22-Apr	-	-	-	not re-located	21-Apr	12-May	not active	19-Apr	3-May
OBI2-30	629916	3668908	-	-	-	-	-	single	21-Apr	12-May	not re-located	19-Apr	3-May
OBI2-31	629844	3668908	-	-	-	-	-	single	21-Apr	12-May	not re-located	19-Apr	3-May
OBI2-32	629993	3670327	-	-	-	-	-	single	21-Apr	12-May	not active	19-Apr	3-May
OBI2-33	629846	3669719	-	-	-	-	-	-	-	-	single	19-Apr	3-May
OBI2-34	629636	3669720	-	-	-	-	-	-	-	-	pair	19-Apr	-
OBI2-35	629655	3670136	-	-	-	-	-	-	-	-	pair	19-Apr	-
OBI2-36			-	-	-	-	-	-	-	-	single	-	3-May
OBI2-4	629714	3670134	single	22-Apr	-	4-May	-	pair	21-Apr	12-May	single	19-Apr	3-May
OBI2-5	630050	3669873	pair	22-Apr	28-Apr	4-May	13-May	active, no owls	21-Apr	12-May	pair	19-Apr	3-May
OBI2-6	629742	3669722	single	-	28-Apr	4-May	13-May	single	21-Apr	12-May	single	19-Apr	3-May
OBI2-7	629889	3670138	single	-	28-Apr	-	13-May	not re-located	21-Apr	12-May	not re-located	19-Apr	3-May
OBI2-8	630038	3670076	-	-	-	-	-	not re-located	21-Apr	12-May	not re-located	19-Apr	3-May
OBI2-9	629568	3670133	-	-	-	-	-	single	21-Apr	12-May	single	19-Apr	3-May
OBI2RS-1	630038	3669812	-	-	-	-	-	pair	21-Apr	12-May	not re-located	19-Apr	3-May
OBI3-3	630031	3669625	-	-	-	-	-	active, no owls	-	12-May	pair	19-Apr	3-May
OBI3-4			-	-	-	-	-	-	-	-	pair	19-Apr	3-May
OBI3-5	630049	3669542	-	-	-	-	-	-	-	-	pair	19-Apr	3-May

Table 6. Summary of burrowing owls detected on roadside surveys.

Burrow Name	UTMs		2004 Occupancy	2004 Date Detected				2005 Occupancy	2005 Date Detected			2006 Occupancy	2005 Date Detected		
	Easting	Northing		Round 1	Round 2	Round 3	Round 4		Round 1	Round 2	Round 3		Round 1	Round 2	Round 3
OB5-1	627627	3670116	pair	22-Apr	28-Apr	4-May	14-May	single	-	4-May	17-May	single	19-Apr	-	-
OBI1-2	629195	3669008	pair	-	-	-	14-May	-	-	-	-	-	-	-	-
OBI2-1	629930	3669692	pair	-	-	-	14-May	single	-	-	17-May	-	-	-	-
OBI2-2	630335	3670135	pair	21-Apr	-	-	14-May	pair	-	-	17-May	pair	19-Apr	-	16-May
OBI2-5	630042	3669870	single	-	-	-	14-May	-	-	-	-	pair	19-Apr	-	
OBI2-6	630042	3669870	single	-	-	-	14-May	-	-	-	-	-	-	-	-
OBI2-7	630042	3669870	single	-	-	-	14-May	-	-	-	-	-	-	-	-
OBI2-8	630038	3670076	single	-	-	4-May	-	-	-	-	-	-	-	-	-
OBI2-9	629568	3670133	pair	-	-	-	14-May	-	-	-	-	-	-	-	-
OBI2RS-1	630038	3669812	-	-	-	-	-	pair	20-Apr	4-May	17-May	-	-	-	-
OB5RS-1	627568	3669937	-	-	-	-	-	pair	20-Apr	4-May	17-May	single	19-Apr	-	-
OB5RS-3	627575	3669491	-	-	-	-	-	pair	20-Apr	4-May	17-May	-	-	-	-
OB5RS-2	627573	3669837	-	-	-	-	-	pair	20-Apr	4-May	17-May	-	-	-	-
OB2-3	628144	3670906	-	-	-	-	-	pair	20-Apr	4-May	17-May	-	-	-	-
OB5RS-5	627191	3669994	-	-	-	-	-	pair	-	4-May	17-May	-	-	-	-
OB2RS-4	627969	3670930	-	-	-	-	-	pair	-	4-May	17-May	-	-	-	-
OB1-2	628336	3670816	-	-	-	-	-	pair	-	4-May	17-May	-	-	-	-
OBI2-4	629714	3670134	-	-	-	-	-	pair	-	-	17-May	-	-	-	-
OBI3-3	630031	3669625	-	-	-	-	-	-	-	-	-	pair	19-Apr	-	-
OB4-1	627696	3670170	-	-	-	-	-	-	-	-	-	single	19-Apr	-	-
BUOW10			-	-	-	-	-	-	-	-	-	single	19-Apr	-	16-May
OBI3-4			-	-	-	-	-	-	-	-	-	single	-	3-May	-
OBI2-11	629836	3670135	-	-	-	-	-	-	-	-	-	single	-	-	16-May

U.S. Fish and Wildlife Service
Regional Office
Division of Endangered Species – Permits
P.O. Box 1306
Albuquerque, New Mexico 87103

Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road
Carlsbad, California 92009

Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix Arizona, 85021-4951

11 December 2006

Dear Cooperator,

The following report is being submitted to fulfill the requirements of Federal Fish and Wildlife Permit number TE039466-1. This permit was issued to the Arizona Cooperative Fish and Wildlife Research Unit to conduct call-broadcast surveys for Yuma clapper rail and California black rail along the Lower Colorado River and All American Canal in Arizona and California and on the Salton Sea NWR in California. In 2006 we conducted surveys at 800 points. Each point received 3-10 replicate point-count surveys between March 6 and July 13. Point count surveys ranged from 6-10 minutes in length and included both a 3-5 minute silent period and 3-5 minute call-broadcast period. All detections of primary marsh bird species were recorded, including detections of California black rail and Yuma clapper rail.

In total we recorded 788 detections of California black rails and 1802 detections of Yuma clapper rails. These numbers include multiple detections of the same individuals (because we surveyed each marsh multiple times). The results of our survey efforts are summarized in the enclosed Excel spread sheet. Also enclosed is a digital copy of the report produced for Cal Obsidian Energy LLC, evaluating the potential effects of development on California black rail and Yuma clapper rail habitat in the Imperial Valley of California.

Although it is suggested in the permit, copies of field datasheets were not included with this report due to the volume of data collected. Copies of the approximately 1500 datasheets may be obtained upon request.

Sincerely,

Christopher Nadeau
Wildlife Biologist
Arizona Cooperative Fish and Wildlife Research Unit
University of Arizona
104 Biological Sciences East
Tucson, Arizona 85721
(520) 626-8912

CD stored with annual report in permittee's file.

4/26/07



"Christopher P. Nadeau" <cnadeau@email.arizona.edu>

07/09/2007 02:07 PM

To Stacey_Love@fws.gov
cc cconway@ag.arizona.edu
bcc
Subject USFWS Permit Report

History: This message has been replied to.

Stacey,

I summarized our data in a few different ways in hopes that it will give you what you need. Please let me know if you need further information. I also attached maps created from 1:24000 USGS Topos.

Chris

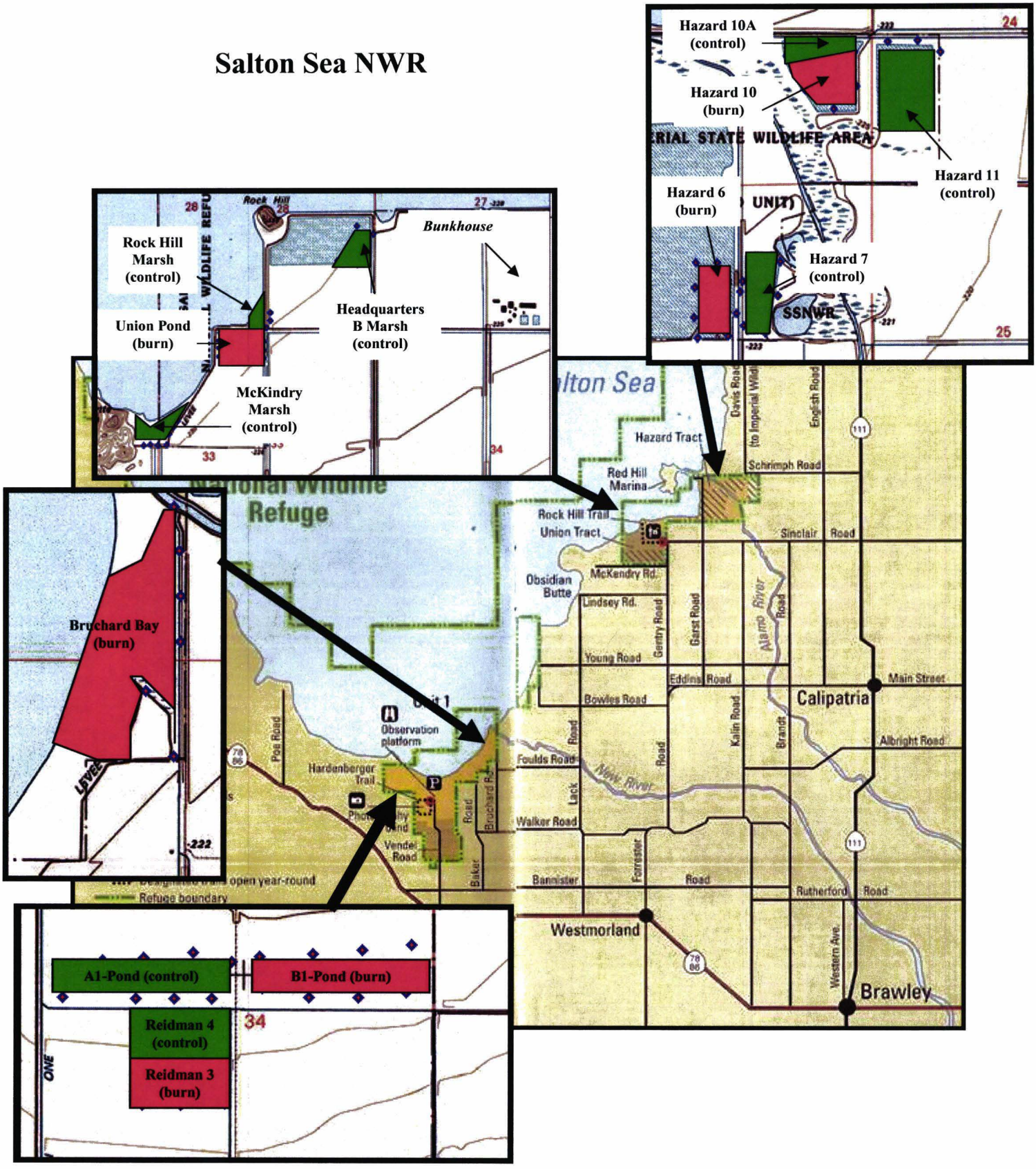
--

Christopher Nadeau
Wildlife Biologist
University of Arizona
104 Biological Sciences East
Tucson, Arizona 85721
ph:(520)626-8912


2004-2005CLRASummary.xls


AllSurveyLocations.doc

Salton Sea NWR



PowerPlantSurveys

Site	Year	First Date Surveyed	Last Date Surveyed	Observers	Average # of Birds Detected Per Survey		Total # of Birds Detected Per Survey (repeat detections included)	
					BLRA	CLRA	BLRA	CLRA
mckindry marsh	2004	15-Apr-04	14-May-04	Erik Meyer, Nick Bartok	0.0	0.0	0.0	0.0
mckindry marsh	2005	12-Apr-05	14-May-05	Chris Nadeau, Crissa Cooey	0.0	1.0	0.0	1.0
mckindry marsh	2006	13-Apr-06	13-May-06	Jake Molhmann, Nick Bartok	0.0	1.7	0.0	5.0
mckindry marsh fr	2004	16-Apr-04	13-May-04	Chris Nadeau, Erik Meyer, Mike Vamstad, Nick Bartok, Roberta Montano	0.0	0.0	0.0	0.0
mckindry marsh fr	2005	13-Apr-05	15-May-05	Amy Schwarzer, Crissa Cooey, Nick Bartok	1.0	2.3	1.0	7.0
mckindry marsh fr	2006	14-Apr-06	11-May-06	Jake Molhmann, Meaghan Conway, Nick Bartok	0.0	1.7	0.0	5.0
rock hill marsh	2004	15-Apr-04	14-May-04	Chris Nadeau, Erik Meyer, Nick Bartok, Roberta Montano	0.0	2.1	0.0	15.0
rock hill marsh	2005	12-Apr-05	15-May-05	Amy Schwarzer, Chris Nadeau, Crissa Cooey, Nick Bartok	0.0	3.7	0.0	22.0
rock hill marsh	2006	13-Apr-06	17-May-06	Archer Larned, Chris Nadeau, Jake Molhmann, Meaghan Conway, Nick Bartok	0.0	6.9	0.0	62.0
salton sea canal	2004	15-Apr-04	14-May-04	Erik Meyer, Nick Bartok	0.0	0.0	0.0	0.0
salton sea canal fr	2004	16-Apr-04	13-May-04	Chris Nadeau, Erik Meyer, Mike Vamstad, Nick Bartok, Roberta Montano	0.0	0.0	0.0	0.0
union pond	2004	13-Apr-04	14-May-04	Erik Meyer, Mike Vamstad, Nick Bartok, Roberta Montano	0.0	9.5	0.0	105.0
union pond	2005	12-Apr-05	19-May-05	Amy Schwarzer, Chris Nadeau, Crissa Cooey, Nick Bartok	0.0	9.4	0.0	94.0
union pond	2006	11-Apr-06	13-May-06	Chris Nadeau, Jake Molhmann, Meaghan Conway, Nick Bartok	0.0	20.0	0.0	160.0
union pond fr	2004	15-Apr-04	14-May-04	Chris Nadeau, Erik Meyer, Mike Vamstad, Roberta Montano	0.0	12.6	0.0	63.0
union pond fr	2005	13-Apr-05	15-May-05	Amy Schwarzer, Chris Nadeau, Crissa Cooey, Nick Bartok	0.0	11.8	0.0	59.0
union pond fr	2006	14-Apr-06	17-May-06	Archer Larned, Chris Nadeau, Meaghan Conway, Nick Bartok	0.0	16.8	0.0	101.0



"Christopher P . Nadeau" <cnadeau@email.arizona.edu>
07/26/2007 12:04 PM

To Stacey_Love@fws.gov
cc
bcc
Subject Re: USFWS Permit Report

History: This message has been replied to.

Stacey,

This was a glaring error on my part. We have been going around on this for so long I got confused as to which report we were discussing. I forgot I had sent
you the most up to date report. The attached table should replace the one I sent yesterday. Hopefully this table makes more sense.

Again, I apologize for the confusion,
Chris

Quoting Stacey_Love@fws.gov:

> Chris,
>
> Thank you for the tables. However, I don't understand the
> "2006AndDataNotInReports" table. What data aren't in reports? Why aren't
> they in reports? Also, it is my understanding that the Power Plant and
> Fire Effects reports include 2006 work. Is that in the
> "2006AndDataNotInReports" table? If so, why isn't the 2006 work in the
> "EffectsOfFireReport" and the "PowerPlantReport" tables as requested?
> Please let me know as soon as you can.
>
> Thanks,
> Stacey
>
>
>
>
>
> "Christopher P. Nadeau" <cnadeau@email.arizona.edu>
> 07/25/2007 03:24 PM
>
> To Stacey_Love@fws.gov
> cc cconway@ag.arizona.edu
> Subject Re: USFWS Permit Report
>
>
>
>
>
>
>
>
>
>
>
> Hi Stacey,
>

> A table summarizing our data (formatted to match your example) is attached.
>
> -Chris
>
>
> Quoting Stacey_Love@fws.gov:
>
>> Hi Chris,
>>
>> Well, I quickly made up a table--hopefully it makes sense. Please let me
>> know if it doesn't.
>>
>> Thanks,
>> Stacey
>>
>> (See attached file: TableExample.xls)
>>
>>
>>
>>
>> "Christopher P.
>> Nadeau"
>> <cnadeau@email.ar
> To
>> izona.edu> Stacey_Love@fws.gov
>>
> cc
>> 07/17/2007 03:14
>> PM
> Subject
>> Re: USFWS Permit Report
>>
>>
>>
>>
>>
>>
>>
>>
>>
>>
>>
>> Stacey,
>>
>>
>> I guess I'm still confused. What do you mean by "results"?
>>
>>
>> Can you please send me an example table showing the data you would like
> and
>> the format you would like the data in? That way I can try to reproduce
>> exactly what you want.
>>
>>
>> -Chris
>>
>>
>>
>> Quoting Stacey_Love@fws.gov:
>>
>>> Hello Chris,
>>>

>>> Thanks for the additional maps--they look good.
>>>
>>> I'm sorry if I wasn't clear with my request; the table doesn't quite
> have
>>> everything we're looking for. For each report (lower Colorado River and
>>> Geothermal power plant site), please send a separate table showing range
>> of
>>> dates at each site (sites within the study area, such as Rock Hill marsh
>>> and Deer Island) with personnel and with results. Also, please include
>> the
>>> information for 2006.
>>>
>>> Per our conversation, we will not make any changes to your list of
>>> authorized individuals on your permit at this time. As we discussed, all
>>> individuals conducting/assisting with your activities in CA must be on
>> your
>>> permit, unless they are authorized for those activities under their own
>>> permit. When you have a list of individuals compiled for next season,
>>> please contact Sandy Marquez (sandy_marquez@fws.gov) to make a request
> to
>>> change the List of Authorized Individuals. For each individual, please
>>> specify whether they are independent or supervised. For each independent
>>> individual, please include a summary of each individuals' experience
> with
>>> YCR (including approximate hours of direct observation) and two
>> references
>>> and/or letters of recommendation. For each supervised individual, please
>>> send a current resume. Also, please allow us ample time to review your
>>> request before the season starts. If that's difficult, please be in
>>> communication with Sandy so we can work with you to get it done.
>>>
>>> Please let me know if you have any questions.
>>>
>>> Thanks,
>>> Stacey
>>>
>>> Stacey Love
>>> U.S. Fish and Wildlife Service
>>> Carlsbad Fish and Wildlife Office
>>> 6010 Hidden Valley Road
>>> Carlsbad, CA 92011
>>> (760) 431-9440 x263
>>> stacey_love@fws.gov
>>>
>>>
>>>
>>> "Christopher P.
>>> Nadeau"
>>> <cnadeau@email.ar To
>>> izona.edu> Stacey_Love@fws.gov
>>> cc
>>> 07/09/2007 02:07 cconway@ag.arizona.edu
>>> PM Subject
>>> USFWS Permit Report
>>>
>>>
>>>
>>>
>>>
>>>
>>>

>>>
>>>
>>>
>>> Stacey,
>>>
>>> I summarized our data in a few different ways in hopes that it will give
>>> you
>>> what you need. Please let me know if you need further information. I
> also
>>> attached maps created from 1:24000 USGS Topos.
>>>
>>> Chris
>>>
>>> --
>>>
>>> Christopher Nadeau
>>> Wildlife Biologist
>>> University of Arizona
>>> 104 Biological Sciences East
>>> Tucson, Arizona 85721
>>> ph:(520)626-8912
>>> [attachment "2004-2005CLRASummary.xls" deleted by Stacey
>>> Love/CFWO/R1/FWS/DOI] [attachment "AllSurveyLocations.doc" deleted by
>>> Stacey Love/CFWO/R1/FWS/DOI]
>>
>>
>>
>> --
>>
>> Christopher Nadeau
>> Wildlife Biologist
>> University of Arizona
>> 104 Biological Sciences East
>> Tucson, Arizona 85721
>> ph:(520)626-8912
>
>
>
> --
>
> Christopher Nadeau
> Wildlife Biologist
> University of Arizona
> 104 Biological Sciences East
> Tucson, Arizona 85721
> ph:(520)626-8912
>
> [attachment "2004-2006SurveySummary(observersAndRangeOfDates).xls" deleted
> by Stacey Love/CFWO/R1/FWS/DOI]

--

Christopher Nadeau
Wildlife Biologist
University of Arizona
104 Biological Sciences East
Tucson, Arizona 85721
ph:(520)626-8912



2004-2006SurveySummary.xls

amec

Record Id 9816
County Riverside
Year 2007
Spp YCR(+)
Surv. Rpt.
D.B. dlc 10/22/08
RN 6-14-13
GIS [redacted]
L+R
File

2007
DOS PALMAS CORE MARSH SURVEYS FOR YUMA CLAPPER RAIL AND CALIFORNIA BLACK RAIL

Prepared for:

Coachella Valley Water District
P.O. Box 1058
Coachella, California 92236

Prepared by:

AMEC Earth & Environmental, Inc.
3120 Chicago Avenue, Suite 110
Riverside, CA 92507
(951) 369-8060
FAX (951) 369-8035

Contact: Chet McGaugh
chet.mcgaugh@amec.com

5 September 2007

RECEIVED
OCT 15 2008
US FWS
CARLSBAD FIELD OFFICE CA

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION 1
1.1 Background 1
1.1.1 Yuma Clapper Rail 1
1.1.2 California Black Rail 2

2.0 SURVEY METHODOLOGY 2

3.0 RESULTS 4

4.0 LITERATURE CITED 6

LIST OF TABLES

Table 1. Rail Surveys in the Dos Palmas Core Marsh in 2007. 2
Table 2. Results of Surveys for Yuma Clapper Rail and California Black Rail in the Dos Palmas Core Marsh in 2007. 4
Table 3. Results of Surveys for Yuma Clapper Rail and California Black Rail in the Dos Palmas Core Marsh in 2006. 5

APPENDICES

Appendix I
Map 1. Dos Palmas Core Marsh: Vicinity
Map 2. Dos Palmas Core Marsh Rail Survey Stations 2007

Appendix II
Yuma Clapper Rail Survey Cover Sheets

Appendix III
Yuma Clapper Rail Survey Data Sheets

Appendix IV
California Black Rail Survey Data Sheets

Appendix V
Dos Palmas Core Marsh Rail Surveys: Bird Species List

Appendix VI
Photographic Exhibits: Rail Survey Stations

DOS PALMAS CORE MARSH SURVEYS FOR YUMA CLAPPER RAIL AND CALIFORNIA BLACK RAIL

1.0 INTRODUCTION

AMEC Earth and Environmental, Inc. (AMEC) ornithologists conducted surveys for Yuma Clapper Rail (*Rallus longirostris yumanensis*) and California Black Rail (*Laterallus jamaicensis coturniculus*) in the 105 acre Dos Palmas Core Marsh in the spring of 2007. These 2007 surveys comprise the second year of on-going rail monitoring. Survey stations were established prior to the 2006 surveys. Photographs of these survey stations are in included in Appendix VI of this report.

The Core Marsh is part of the Bureau of Land Management's (BLM's) Dos Palmas Area of Critical Environmental Concern (ACEC), and is managed by the Center for Natural Lands Management (CNLM) (see Appendix I, Map 1).

The purpose of these surveys is the collection of baseline data regarding the current status and annual variations in the numbers of each species in the Dos Palmas Core Marsh, and, if practical, to provide information regarding habitat quantity, suitability, and use by the two rail species. The results of these surveys will be used as the baseline for monitoring change over time and will provide information for adaptive management strategies for the aquatic habitats in the Core Marsh. Marsh birds may be "indicator" species for assessing wetland ecosystem quality and restoration efforts.

1.1 Background

1.1.1 Yuma Clapper Rail

The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is one of up to 21 subspecies of the widespread Clapper Rail (*Rallus longirostris*). The Yuma Clapper Rail is found in a "variety of marshy situations, from pure cattails and rushes to (marginally) stands of cane and flooded salt cedar" (Garrett and Dunn 1981). In the Imperial Valley and Salton Sea area the Yuma Clapper Rail is most common in freshwater marshes near the sea, but occurs locally "some distance from the sea at Dos Palmas Spring" (Garrett and Dunn 1981; see also AMEC 2006).

The Yuma Clapper Rail is a federally-listed Endangered species, and a California-listed Threatened species. Populations of Yuma Clapper Rails have undergone decline in the United States due to the destruction and degradation of freshwater marsh habitat.

The Yuma Clapper Rail is a slender, tawny-breasted bird with grayish edges on brown centered back feathers, olive wing coverts, vertical white bars on the flanks, a white stripe over the eye, and a long, partially orange bill.

1.1.2 California Black Rail

The Black Rail (*Laterallus jamaicensis*) is the smallest rail in North America. The California Black Rail (subspecies *coturniculus*) is a California-listed Threatened species, and, like the Yuma Clapper Rail, is found in marsh habitats and has been impacted by the loss and degradation of these habitats. Bulrush (*Scirpus* spp.) marshes seem to be favored in the Imperial Dam area (Garrett and Dunn 1981). The population of Black Rails in the Colorado River Valley between Needles, California and Yuma, Arizona was estimated to be 75-100 individuals in 1991 (Evens *et al.* 1991).

The California Black Rail is a rare to uncommon bird in the Salton Sea area, with most detections occurring in spring and summer, and its status considered "irregular and unpredictable" (Garrett and Dunn 1981). The uncertain status of the species makes it difficult to determine population dynamics, but there is evidence that canal lining projects have decreased habitat for the California Black Rail east of the Salton Sea (Evens et al. 1991).

The California Black Rail is blackish above with white speckling, has a chestnut nape, grayish-black underparts, narrow white barring on the flanks, and a short black bill.

2.0 SURVEY METHODOLOGY

AMEC ornithologists John F. Green, Chet McGaugh, and Stephen J. Myers made survey visits on six days in the spring of 2007 (see Table 1).

Table 1. Rail Surveys in the Dos Palmas Core Marsh in 2007.

Date	Route	Stations	Time	Surveyors
18 April	North	1-5	0556-0847	Green/McGaugh
27 April	West	16-21	0724-0908	Green/McGaugh
30 April	East	6-15	0557-0949	Green/McGaugh
18 May	North	1-5	0549-0707	McGaugh/Myers
25 May	West	16-21	0612-0750	Green/McGaugh
30 May	East	6-15	0548-0850	Green/McGaugh

McGaugh is permitted to take (harass by survey) Yuma Clapper Rails under Federal Fish and Wildlife Permit TE836517-5.

Yuma Clapper Rail and California Black Rail are included in the Memorandum of Understanding by and between AMEC Earth and Environmental, Inc. and the California Department of Fish and Game (expiration date: 31 October 2009).

Survey stations were established in 2006 based on accessibility, position relative to marsh habitat and position relative to other stations. Table 1 shows which stations were on each route (North, East, or West). The routes consisted of the stations surveyed on a particular day. Map 2 (Appendix I) shows the location of each of the stations. Each station was photographed (Appendix VI) and flagged, and a GPS waypoint was marked.

As Map 2 (Appendix I) indicates, the survey stations were almost completely on the perimeter of the marsh. It was decided that establishing points in the interior of the marsh would be very difficult, budget-consuming, hard to replicate, and potentially harmful to birds and their nests. In 2006, survey station 22, though clearly not deep into the Core Marsh, took 43 minutes to reach after completing the survey at station 21. Access required a level of "bushwhacking" not acceptable in habitat known to harbor sensitive species. This station was not surveyed in 2007. A route through the center of the Core Marsh may be desirable for future surveys, but considerable work, done prior to the survey/nesting season, would be necessary to establish interior marsh stations.

Two other survey stations, 6 and 7, were moved from their 2006 positions (Map 2) to minimize potential impacts to nesting birds. In 2006, station 7 provided the closest encounter with a clearly agitated Yuma Clapper Rail.

Yuma Clapper Rail

The "Yuma Clapper Rail Survey Protocol" (U.S. Fish and Wildlife Service 2000) establishes requirements for official surveys for the Yuma Clapper Rail. The protocol requires two surveys at each location to be conducted between 15 March and 31 May, with at least one week between surveys. Surveys are to be conducted between 30 minutes before sunrise until 3.5 hours after sunrise. Survey points should be 150-200 meters apart, depending on local conditions. Surveys should not be conducted if winds exceed 10 miles per hour.

The official Yuma Clapper Rail survey cassette tape was played at each station, with broadcast duration and sequence of listening periods as described in the protocol: two minutes broadcast, two minutes listen, two minutes broadcast, one minute listen, for a total survey time of seven minutes, not including a one minute period of listening prior to the first tape broadcast.

California Black Rail

Gibbs and Melvin (1993) posit that three surveys are necessary to confirm seasonal presence/absence for California Black Rails; Conway *et al.* (2002) recommend that the survey periods be 21-30 March, 21-30 April, and 21-30 May in the Lower Colorado River region. In 2007, AMEC conducted surveys in April and May; authorization for the surveys came too late for the March surveys.

Recorded California Black Rail vocalizations were played following each of the Yuma Clapper Rail survey periods. The standard California Black Rail protocol (Conway *et al.* 2002) provides a broadcast/listen regime of six minutes duration that begins with three minutes of silence, then alternates thirty second broadcast periods with thirty second periods of silence.

Equipment used included a cassette tape player, an iPod with external speaker, official Yuma Clapper Rail survey cassette tape, California Black Rail vocalization recordings, binoculars, two Global Positioning System (GPS) units, a digital SLR camera, and maps.

3.0 RESULTS

The results of the 2007 Dos Palmas Core Marsh surveys for Yuma Clapper Rail and California Black Rail are presented in Table 2. Table 3 presents the results from the 2006 surveys. Both data sets are presented here to allow for easy comparison between the two years of monitoring.

Table 2. Results of Surveys for Yuma Clapper Rail and California Black Rail in the Dos Palmas Core Marsh in 2007.

Station	Yuma Clapper Rail(s) detected?	California Black Rail(s) detected?	Coordinates: Decimal Degrees; Datum: NAD27 CONUS	
			Latitude	Longitude
1	Yes, 18 April & 18 May	No	33.50216	-115.82731
2	Yes, 18 April & 18 May	No	33.50104	-115.82811
3	Yes, 18 May	No	33.50158	-115.82653
4	Yes, 18 May	No	33.49960	-115.82487
5	Yes, 18 April & 18 May	Yes, 18 April	33.49958	-115.82282
6	No	No	33.49999	-115.82060
7	No	No	33.49954	-115.81923
8	No	No	33.49907	-115.81778
9	Yes, 30 April & 30 May	No	33.49761	-115.81722
10	Yes, 30 April	No	33.49639	-115.81869
11	Yes, 30 May	No	33.49495	-115.81881
12	No	No	33.49377	-115.81981
13	No	No	33.49201	-115.82063
14	Yes, 30 April	No	33.49048	-115.82114
15	Yes, 30 April & 30 May	No	33.48913	-115.82129
16	No	No	33.49985	-115.82662
17	No	No	33.49855	-115.82574
18	No	No	33.49738	-115.82467
19	Yes, 25 May	No	33.49589	-115.82440
20	No	No	33.49455	-115.82337
21	Yes, 27 April	No	33.49299	-115.82235

Table 3. Results of Surveys for Yuma Clapper Rail and California Black Rail in the Dos Palmas Core Marsh in 2006.

Station	Yuma Clapper Rail(s) detected?	California Black Rail(s) detected?	Coordinates: Decimal Degrees; Datum: NAD27 CONUS	
			Latitude	Longitude
1	No	No	33.50216	-115.82731
2	No	No	33.50104	-115.82811
3	No	No	33.50158	-115.82653
4	No	No	33.49960	-115.82487
5	No	No	33.49958	-115.82282
6	Yes, 6 April	No	33.49958	-115.82125
7	Yes, 19 April	No	33.49995	-115.81848
8	Yes, 19 April	No	33.49907	-115.81778
9	No	No	33.49761	-115.81722
10	Yes, 19 April	No	33.49639	-115.81869
11	Yes, 13 June	No	33.49495	-115.81881
12	No	No	33.49377	-115.81981
13	Yes, 19 April	No	33.49201	-115.82063
14	No	No	33.49048	-115.82114
15	No	No	33.48913	-115.82129
16	No	No	33.49985	-115.82662
17	Yes, 11 May	No	33.49855	-115.82574
18	No	No	33.49738	-115.82467
19	Yes, 11 May	No	33.49589	-115.82440
20	No	No	33.49455	-115.82337
21	No	No	33.49299	-115.82235
22	No	No	33.49696	-115.82328

Yuma Clapper Rail

Yuma Clapper Rails were detected at 10 of 21 stations surveyed in 2007 (Table 2). In 2006 (Table 3) Yuma Clapper Rails were detected at 8 of 22 stations surveyed. Station 22 was not surveyed in 2007; access to the station is difficult and potentially harmful to marsh-nesting birds.

Each station was surveyed twice in 2007, in compliance with U.S. Fish and Wildlife Service protocol. Yuma Clapper Rail detections in the first round (April) were 8 at 21 stations, in May there were 9 detections at the 21 stations. These results compare very favorably to the 8 detections at 22 stations in 2006, when each station was surveyed only once.

No Yuma Clapper Rails were seen during the surveys. Both "clatter" calls and "kek" calls were heard. (See Appendix II, "Yuma Clapper Rail Survey Cover Sheets" and Appendix III, "Yuma Clapper Rail Survey Data Sheets").

Most of the Yuma Clapper Rails heard were 50m+ distance from the station, and the dense, tall vegetation made assessment of the vegetative and hydrological characteristics of the location the rail was calling from impossible.

California Black Rail

On 18 April, the first rail survey day of 2007, Green and McGaugh heard a California Black Rail call three times near survey station 5 (see survey data sheet, Appendix IV). The vocalizations were agitated "grrr" calls, and were initiated on the last silence segment of the broadcast regime. The bird was estimated to be approximately 35 meters from the survey station. After the survey period, a few extra vocalizations were broadcast for the purpose of 1) eliciting a response that might include the more familiar and frequently heard "kicky-doo" call, and 2) allow the observers to compare the bird's call with the recorded vocalizations. The California Black Rail did not respond.

The North route was repeated on 18 May, but no California Black Rails were detected.

As shown in Table 3, California Black Rails were not detected during the 2006 surveys.

We now know that California Black Rails use the Dos Palmas Core Marsh. Whether there is breeding or it is a migratory stopover has yet to be determined, and much of what is known about the status and distribution of this species in the region continues to be an "artifact of detectability" (Patten *et al.* 2003).

It is possible, and perhaps even likely, that the Dos Palmas Core Marsh has not yet been surveyed during the period when California Black Rails are most vocal. If three surveys provide 90% certainty of presence/absence, per Gibbs and Melvin (1993), missing the first survey period, possibly the "most vocal" period, could lower the accuracy of our results to an unacceptable level.

Other wetland bird species detected during the surveys include Virginia Rail, Sora, and Least Bittern. A complete list of bird species detected at Dos Palmas during the course of AMEC's rail surveys in 2007 is included as Appendix V.

4.0 LITERATURE CITED

AMEC. 2006. Dos Palmas Core Marsh Surveys for Yuma Clapper Rail and California Black Rail.

Anderson, S.H. 1 983. Yuma Clapper Rail Recovery Plan. Wyoming Cooperative Research Unit.

California Department of Fish and Game. 2000. State and Federally Listed Endangered and Threatened Animals of California. State of California. The Resources Agency. Department of Fish and Game. Natural Heritage Division. Natural Diversity Data Base. 14pp.

Conway, C.J. 2005. Standardized North American Marsh Bird Monitoring Protocols. Wildlife Research Report #2005-04. U.S. Geological Survey, Arizona Fish and Wildlife Research Unit, Tucson, AZ.

Conway, C.J., C. Sulzman, and B.E. Raulston. 2002. Population trends, distribution, and monitoring protocols for the California Black Rail. Final Report. AGFD Heritage.

Gibbs, J.P. and S.M. Melvin. 1993. Call-response surveys for monitoring breeding waterbirds. J. Wildl. Manage. 57:27-34.

Patten, M.A., G McCaskie, P. Unitt. 2003. Birds of the Salton Sea: Status, Biogeography, and Ecology. Univ. of Calif. Press. Berkeley and Los Angeles.

Program IIPAM Grant #199010. Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson. 42 pp. plus appendices.

Eddleman E. R. 1989. Biology of the Yuma Clapper Rail in the Southwestern U.S. and northwestern Mexico. Final report submitted to the Bureau of Reclamation, Yuma Projects Office, and U.S. Fish and Wildlife Service Region 2. Intra-Agency agreement No. 4-AA-30-02060. 177pp

Eddleman, W.R., and C.J. Conway. 1988. Clapper Rail (*Rallus longirostris*). *In* The Birds of North America, No. 340. (A. Poole and F. Gill, eds.) The Birds of North America, Inc., Philadelphia, PA.

Evens, J.G., G.W. Page, S.A. Laymon and R.W. Stallcup. 1991. Distribution, Relative Abundance and Status of the California Black Rail in Western North America. *Condor* 93:952-966.

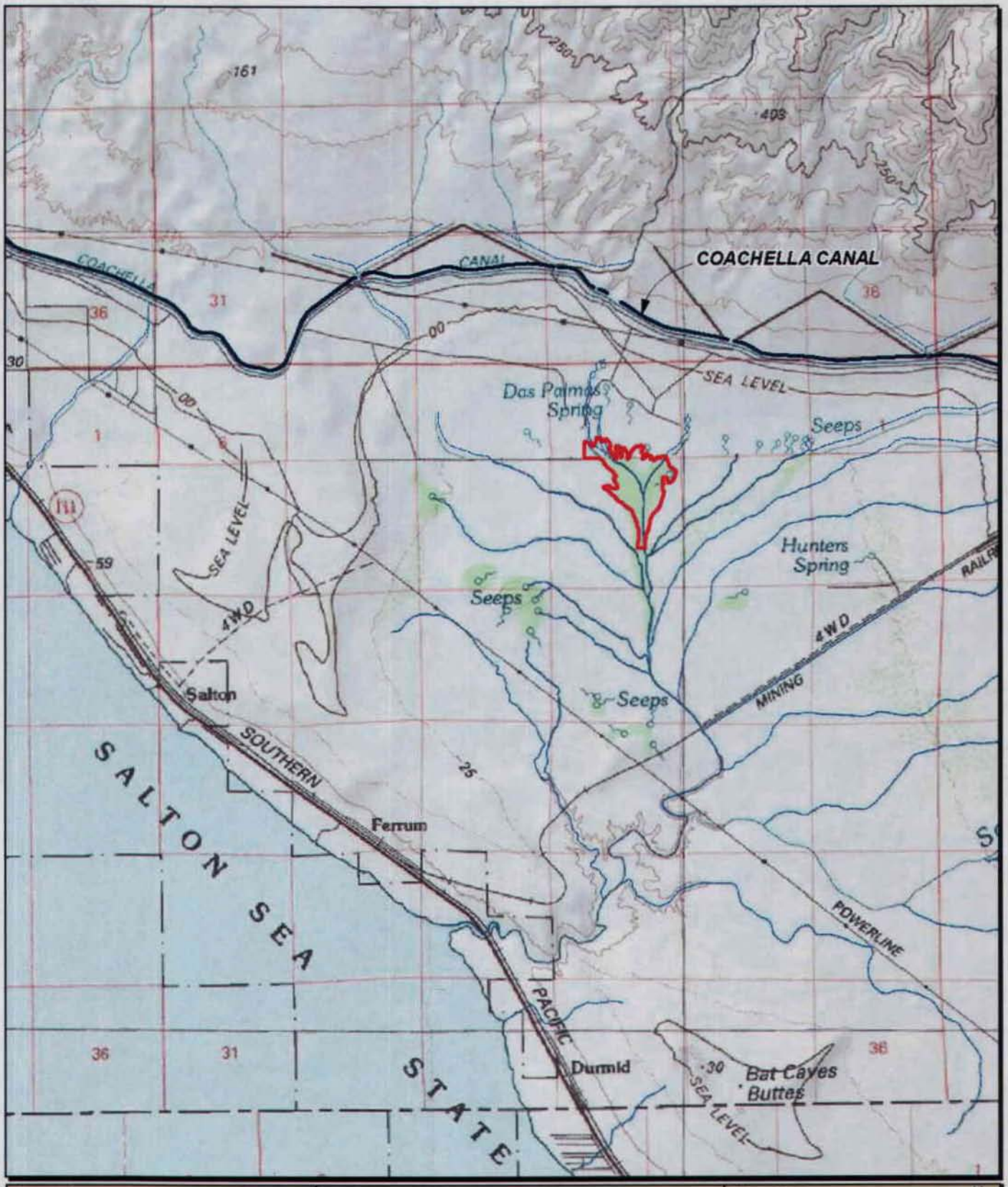
Flores, R.D. and W.R. Eddleman. 1995. California Black Rail Use of Habitat in Southwestern Arizona. J. Wildl. Manage. 59(2): 357-363.

Garrett, K. and J.Dunn. 1981. Birds of Southern California, Status and Distribution. Los Angeles Audubon Society.

U.S. Fish and Wildlife Service. 2000. Memorandum: Yuma Clapper Rail Revised Survey Protocol. Field Supervisor, Phoenix, Arizona.

Wilbur, S.R. and R.E. Tomlinson. 1976. The Literature of Western Clapper Rails. U.S. Fish and Wildlife Service Special Scientific Report – Wildlife No. 194. Washington, D.C.

Appendix I
Maps



Legend

- Core Marsh Assessment Area
- Coachella Canal
- Streams

Map 1

Rail Survey Vicinity Map
Dos Palmas Core Marsh

Mecca, CA, Unincorporated Riverside County

0 0.25 0.5 1 1.5 2 Miles

1 inch equals 1 miles

Map Notes

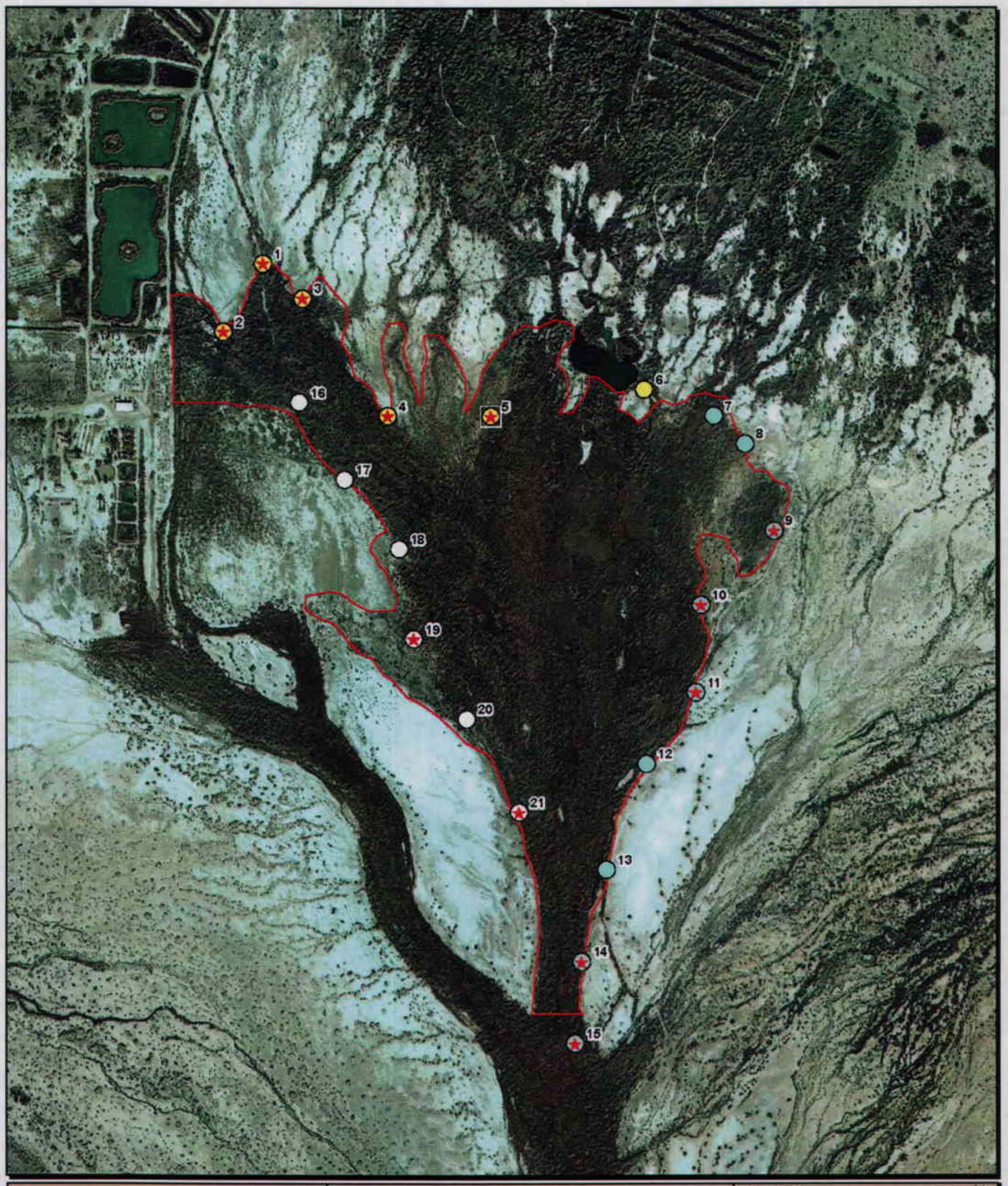
Data Source:
AMEC - Core Marsh Assessment Area - 2006

Projection: UTM Zone 11, NAD 83, Meter
Path: z:\sd04\eal\coachella\mxd\
CCLP_3554001019_0003_
CM_rail_survey_map1.mxd
Draft By: YYL
Date: 09/19/2007

amec

Coachella Canal Lining Project

AR063309



Legend

- California Black Rail Detected 2007
- Yuma Clapper Rail Detected 2007
- Survey Station on East Route
- Survey Station on North Route
- Survey Station on West Route
- Core Marsh Assessment Area

Map 2

Rail Survey Stations 2007
Dos Palmas Core Marsh

Mecca, CA, Unincorporated Riverside County

0 220 440 880 1,320 1,760 Feet

1 inch equals 800 feet

Map Notes

Data Source:
AMEC - Rail Survey - 2006, 2007
AMEC - Core Marsh Assessment Area - 2006

Projection: UTM Zone 11, NAD 83, Meter
Path: z:\sd04\eal\coachella\mxd\CCLP_3554001019_0003_CM_rail_survey.mxd
Draft By: YYL
Date: 09/18/2007

amec

Coachella Canal Lining Project

Appendix II
Yuma Clapper Rail Survey Cover Sheets

YUMA CLAPPER RAIL SURVEY
COVER SHEET
(JANUARY 2000)

Date: APRIL 18, 2007

Location Information:
Location Name DOS PALMAS CORE MARSH Route NORTH, STATIONS 1-5

Map Name OROCOPIA CANYON, DURMID Township/Range/Section T8S, R11E, S3,10

Observer(s) CHET MCGAUGH, JOHN GREEN

Weather:
Start %Cloud Cover 0 Temp 52°F Wind Speed 0
End % Cloud Cover 0 Temp 65°F Wind Speed 0

Data Summary:

1) Total individual rails seen or heard while surveying 3
2) Number of other rails seen or heard (incidentals) 6

Total rails per route or location equals #1+#2 9
For rails/hour, each stop is 7 minutes

Observations:

Events during survey that may have affected results:

Other Observations/Comments:

YUMA CLAPPER RAIL SURVEY
COVER SHEET
(JANUARY 2000)

Date: APRIL 27, 2007

Location Information:
Location Name DOS PALMAS CORE MARSH Route WEST, STATIONS 16-21

Map Name OROCOPIA CANYON, DURAND Township/Range/Section T8S, R11E, S3,10

Observer(s) CHET McGAUGH, JOHN GREEN

Weather:
Start %Cloud Cover 0 Temp _____ Wind Speed 0
End % Cloud Cover 0 Temp _____ Wind Speed 0

Data Summary:

1) Total individual rails seen or heard while surveying 1
2) Number of other rails seen or heard (incidentals) 0

Total rails per route or location equals #1+#2 1
For rails/hour, each stop is 7 minutes

Observations:

Events during survey that may have affected results:

Other Observations/Comments:

YUMA CLAPPER RAIL SURVEY
COVER SHEET
(JANUARY 2000)

Date: APRIL 30, 2007

Location Information:
Location Name LOS PALMAS CORE MARSH Route EAST, STATIONS 6-15

Map Name OROCOPIA CANYON, DURAND Township/Range/Section T8S, R11E, S3, 10

Observer(s) CHET MCGAUGH, JOHN GREEN

Weather:
Start %Cloud Cover 0 Temp 66°F Wind Speed 0
End % Cloud Cover 0 Temp 77°F Wind Speed 0

Data Summary:

1) Total individual rails seen or heard while surveying 4
2) Number of other rails seen or heard (incidentals) 4

Total rails per route or location equals #1+#2 8
For rails/hour, each stop is 7 minutes

Observations:

Events during survey that may have affected results:

Other Observations/Comments:

YUMA CLAPPER RAIL SURVEY
COVER SHEET
(JANUARY 2000)

Date: MAY 18, 2007

Location Information:
Location Name DOS PALMAS CORE MARSH Route NORTH, STATIONS 1-5

Map Name CROCOPIA CANYON, DURMID Township/Range/Section T8S, R11E, S3, 10

Observer(s) CHET McGAUGH, STEVE MYERS

Weather:
Start %Cloud Cover 0 Temp 64° F Wind Speed 0
End % Cloud Cover 0 Temp 78° F Wind Speed 2-5 mph

Data Summary:

1) Total individual rails seen or heard while surveying 5
2) Number of other rails seen or heard (incidentals) 1

Total rails per route or location equals #1+#2 6
For rails/hour, each stop is 7 minutes

Observations:

Events during survey that may have affected results:

Other Observations/Comments:

YUMA CLAPPER RAIL SURVEY
COVER SHEET
(JANUARY 2000)

Date: MAY 25, 2007

Location Information:
Location Name DOS PALMAS CORE MARSH Route WEST, STATIONS 16-21

Map Name OROCOPIA CANYON, DURMID Township/Range/Section T8S, R11E S3, 10

Observer(s) CHET McGAUGH, JOHN GREEN

Weather:
Start %Cloud Cover 0 Temp 63° F Wind Speed _____
End % Cloud Cover 0 Temp 79° F Wind Speed _____

Data Summary:

1) Total individual rails seen or heard while surveying 1
2) Number of other rails seen or heard (incidentals) 0

Total rails per route or location equals #1+#2 1
For rails/hour, each stop is 7 minutes

Observations:

Events during survey that may have affected results:

Other Observations/Comments:

YUMA CLAPPER RAIL SURVEY
COVER SHEET
(JANUARY 2000)

Date: MAY 30, 2007

Location Information:
Location Name DOS PALMAS CORE MARSH Route EAST, STATIONS 6-15

Map Name OROCOPIA CANYON, DURMID Township/Range/Section T8S, R11E, S3, 10

Observer(s) CHET McGAUGH, JOHN GREEN

Weather:
Start %Cloud Cover 0 Temp 61° F Wind Speed 0
End % Cloud Cover 0 Temp 80° F Wind Speed 0

Data Summary:

1) Total individual rails seen or heard while surveying 3
2) Number of other rails seen or heard (incidentals) 0

Total rails per route or location equals #1+#2 3
For rails/hour, each stop is 7 minutes

Observations:

Events during survey that may have affected results:

Other Observations/Comments:

Appendix III
Yuma Clapper Rail Survey Data Sheets

Yuma Clapper Rail Survey Data Sheet — January 2000

Location DOS PALMAS Route NORTH Date APRIL 18, 2007

Weather-start 52°F CLEAR end 69°F CLEAR Observer C MCGAUGH, J. GREEN

Stop #	Time Start	Time Stop	Clatter Call	Kek Call	Other Call	Was Rail Seen?	Was Rail Heard?	Was Rail Paired?	Other Species?	Habitat Type Where Rail Was Detected
3	5:56	6:03							SORA	
4	6:23	6:30							VIRA SORA	
5	6:49	6:56		✓*		NO	yes		SORA BLRA	
1	8:21	8:28		✓		NO	yes			
2	8:40	8:47		✓		NO	yes		SORA	

Page total:

Total rails recorded on survey 3

Incidental observations of rails in survey area 6

* AFTER SURVEY PERIOD

Yuma Clapper Rail Survey Data Sheet — January 2000

Location DOS PALMAS Route WEST Date APRIL 27, 2007

Weather-start ~~60°F~~, CLEAR end ~~72°F~~, CLEAR Observer C MCGAUGH, J. GREEN

Stop #	Time Start	Time Stop	Clatter Call	Kek Call	Other Call	Was Rail Seen?	Was Rail Heard?	Was Rail Paired?	Other Species?	Habitat Type Where Rail Was Detected
16	7:24	7:31								NOTE: YCR HEARD NEAR 16 BEFORE SURVEY
17	7:47	7:54								
18	8:06	8:13								
19	8:24	8:31								
20	8:50	8:57								
21	9:04	9:08		✓		NO	YES			

Page total:

Total rails recorded on survey 1

Incidental observations of rails in survey area 1

Yuma Clapper Rail Survey Data Sheet — January 2000

Location DOS PALMAS Route EAST Date APRIL 30, 2007

Weather-start 60°F, CLEAR end 77°F CLEAR Observer C McGAUGH, J. GREEN

Stop #	Time Start	Time Stop	Clatter Call	Kek Call	Other Call	Was Rail Seen?	Was Rail Heard?	Was Rail Paired?	Other Species?	Habitat Type Where Rail Was Detected
9	5:57	6:04	✓							
10	6:16	6:23		✓						
11	6:34	6:41							VIRA YCRA*	
12	6:57	7:04							VIRA	
13	7:18	7:25								
14	7:34	7:41		✓						
15	7:50	7:57		✓						
8	8:29	8:36							VIRA	
7a	8:48	8:55								
6a	9:42	9:49								

Page total:

Total rails recorded on survey 4

Incidental observations of rails in survey area 4 (INCL. YCRA)

* AFTER COUNT PERIOD

Yuma Clapper Rail Survey Data Sheet

January 2000

Location DOS PALMAS Route NORTH Date MAY 18, 2007

Weather-start 64° clear end 76° clear Observer MCGAUGH, MYERS

Stop #	Time Start	Time Stop	Clatter Call	Kek Call	Other Call	Was Rail Seen?	Was Rail Heard?	Was Rail Paired?	Other Species?	Habitat Type Where Rail Was Detected
1	0549	0556		✓						
2	0606	0613		✓					COMO	
3	0628	0635		✓						
4	0643	0650		✓					LEBI	
5	0700	0707		✓						

Page total:

Total rails recorded on survey 5

Incidental observations of rails in survey area 1

Yuma Clapper Rail Survey Data Sheet

January 2000

Location DOS PALMAS Route WEST Date MAY 25, 2007

Weather-start 63°F CLEAR end 72° CLEAR Observer GREEN, McGAUGH

Stop #	Time Start	Time Stop	Clatter Call	Kek Call	Other Call	Was Rail Seen?	Was Rail Heard?	Was Rail Paired?	Other Species?	Habitat Type Where Rail Was Detected
16	0612	0619								
17	0630	0637								
18	0647	0654								
19	0711	0714		/		NO	YES			
20	0726	0733								
21	0743	0750								

Page total:

Total rails recorded on survey 1

Incidental observations of rails in survey area 0

Yuma Clapper Rail Survey Data Sheet — January 2000

Location DOS PALMAS Route EAST Date MAY 30, 2007

Weather-start 61°F CLEAR end 80°F CLEAR Observer GREEN MCGAUGH

Stop #	Time Start	Time Stop	Clatter Call	Kek Call	Other Call	Was Rail Seen?	Was Rail Heard?	Was Rail Paired?	Other Species?	Habitat Type Where Rail Was Detected
7	0555	0602								
8	0611	0618								
9	0628	0635	✓			NO	Yes			
10	0651	0658								
11	0706	0713	✓			NO	Yes			
12	0722	0729								
13	0738	0747								
14	0753	0800								
15	0806	0813		✓		NO	Yes			
6	0849	0856								

Page total:

Total rails recorded on survey 3

Incidental observations of rails in survey area 0

Appendix IV
Dos Palmas Core Marsh California Black Rail

Date: APRIL 18, 2007
Marsh: DOS PALMAS CORE MARSH - NORTH
Observer: GREEN, MCGAUGH

survey station #	time start	Species	Responded During:									<50 m	repeat	noise	comments
			passive segment			call broadcast segment									
			1st min	2nd min	3rd min	30 sec calls	30 sec silence	30 sec calls	30 sec silence	30 sec calls	30 sec silence				
3	6:06														
4	6:30	VIRA				1		1							
		VIRA						1							
		VIRA						1							
		SORA						1							
5	6:57	YCRA							1						
		SORA				1									
		CBRA									1				
1	8:28	YCRA	1	1	1	1	1	1	1	1	1				SAME BIRD
2	8:48	YCRA	1	1	1	1	1	1	1	1	1				

Date: APRIL 27, 2007
Marsh: DOS PALMAS CORE MARSH - ~~EAST~~ WEST
Observer: GREEN, McGAUGH

survey station #	time start	Species	Responded During:									<50 m	repeat	noise	comments
			passive segment			call broadcast segment									
			1st min	2nd min	3rd min	30 sec calls	30 sec silence	30 sec calls	30 sec silence	30 sec calls	30 sec silence				
16	7:31														
17	7:53														
18	8:13														
19	8:31														
20	8:44														
21	9:07	YCRA	1	1	1							NO			

Date: APRIL 30, 2007
Marsh: DOS PALMAS CORE MARSH - EAST
Observer: GREEN, MCGAUGH

survey station #	time start	Species	Responded During:									<50 m	repeat	noise	comments
			passive segment			call broadcast segment									
			1st min	2nd min	3rd min	30 sec calls	30 sec silence	30 sec calls	30 sec silence	30 sec calls	30 sec silence				
9	6:03	YCRA				✓									
10	6:20	YCRA	✓												
		YCRA				✓						✓			
		VIRA				✓									
11	6:40	VIRA	✓			✓	✓				✓				
		YCRA	✓												
12	7:03														
13	7:24														
14	7:37	YCRA	✓												
15	7:55														
8	8:35														
7	8:54														
6	9:48														

Date: MAY 18, 2007
Marsh: DOS PALMAS CORE MARSH- NORTH
Observer: MCGAUGH, MYERS

survey station #	time start	Species	Responded During:									<50 m	repeat	noise	comments
			passive segment			call broadcast segment									
			1st min	2nd min	3rd min	30 sec calls	30 sec silence	30 sec calls	30 sec silence	30 sec calls	30 sec silence				
1	0556	YCR			✓	✓	✓	✓	✓	✓	✓				
		COMO			✓					✓					
2	0613	YCR		✓	✓										
3	0631	YCR	✓	✓											
4	0646	YCR	✓	✓	✓	✓	✓	✓	✓	✓	✓				
		LEBI	✓	✓	✓	✓	✓		✓						
5	700	YCR	✓	✓	✓	✓	✓	✓	✓	✓					

Date: MAY 25, 2007
Marsh: DOS PALMAS CAIC MARSH - WEST
Observer: GREEN, MCGAUGH

survey station #	time start	Species	Responded During:									<50 m	repeat	noise	comments
			passive segment			call broadcast segment									
			1st min	2nd min	3rd min	30 sec calls	30 sec silence	30 sec calls	30 sec silence	30 sec calls	30 sec silence				
16	0618														
17	0637														
18	0653	AMCO							AMCO						
19	0713														
20	0732														
21	0749														

Date: MAY 30, 2007
Marsh: DOS PALMAS CORE MARSH - EAST
Observer: GREGG MCGRUDER

survey station #	time start	Species	Responded During:									<50 m	repeat	noise	comments
			passive segment			call broadcast segment									
			1st min	2nd min	3rd min	30 sec calls	30 sec silence	30 sec calls	30 sec silence	30 sec calls	30 sec silence				
7	5:48														
8	6:05														
9	6:22														
10	6:45														
11	7:00														
12	7:16														
13	7:32														
14	7:48														
15	8:02	YCRA				✓						NO			
6	8:43	〃													

Appendix V
Dos Palmas Core Marsh Rail Surveys: Bird Species List

amec

DOS PALMAS CORE MARSH RAIL SURVEYS: BIRD SPECIES LIST

This list reports only birds observed in the Dos Palmas area during the rail surveys conducted by AMEC in 2007, including travel (by foot) to rail survey stations, and related activities. Nomenclature and taxonomy generally follows the American Ornithologists' Union Checklist and its supplements.

SYMBOLS AND ABBREVIATIONS:

* Non-native species

** Sensitive species (State or Federally Listed as Threatened or Endangered, or a CDFG Species of Special Concern, or a USFWS Bird of Conservation Concern)

BIRDS	CLASS AVES
Ducks, Geese, and Swans	**Family Anatidae**
Mallard	*Anas platyrhynchos*
Cinnamon Teal	*Anas cyanoptera*
Ring-necked Duck	*Aythya collaris*
Ruddy Duck	*Oxyura jamaicensis*
Cormorants	**Family Phalacrocoracidae**
Double-crested Cormorant	*Phalacrocorax auritus*
New World Quail	**Family Odontophoridae**
Gambel's Quail	*Callipepla gambelii*
Grebes	**Family Podicipedidae**
Pied-billed Grebe	*Podilymbus podiceps*
Herons, Bitterns, and Allies	**Family Ardeidae**
**Least Bittern	*Ixobrychus exilis*
Great Blue Heron	*Ardea herodias*
Ibises and Spoonbills	**Family Threskiornithidae**
White-faced Ibis	*Plegadis chihi*
New World Vultures	**Family Cathartidae**
Turkey Vulture	*Cathartes aura*
Hawks, Kites, Eagles, and Allies	**Family Accipitridae**
**Sharp-shinned Hawk	*Accipiter striatus*
Rails, Gallinules, and Coots	**Family Rallidae**
**Yuma Clapper Rail	*Rallus longirostris yumanensis*
Virginia Rail	*Rallus limicola*
**California Black Rail	*Laterallus jamaicensis coturniculus*
Sora	*Porzana carolina*
Common Moorhen	*Gallinula chloropus*
American Coot	*Fulica americana*

Lapwings and Plovers	**Family Charadriidae**
Killdeer	*Charadrius vociferus*
Sandpipers, Phalaropes, and Allies	**Family Scolopacidae**
Greater Yellowlegs	*Tringa melanoleuca*
Pigeons and Doves	**Family Columbidae**
White-winged Dove	*Zenaida asiatica*
Mourning Dove	*Zenaida macroura*
Goatsuckers	**Family Caprimulgidae**
Lesser Nighthawk	*Chordeiles acutipennis*
Swifts	**Family Apodidae**
White-throated Swift	*Aeronautes saxatalis*
Rollers, Motmots, Kingfishers and Allies	**Family Coraciiformes**
Belted Kingfisher	*Ceryle halcyonl*
Woodpeckers and Allies	**Family Picidae**
Ladder-backed Woodpecker	*Picoides scalaris*
Tyrant Flycatchers	**Family Tyrannidae**
**Olive-sided Flycatcher	*Contopus cooperi*
Western Wood-Pewee	*Contopus sordidulus*
**Willow Flycatcher	*Empidonax traillii*
Hammond's Flycatcher	*Empidonax hammondii*
Gray Flycatcher	*Empidonax wrightii*
Dusky Flycatcher	*Empidonax olberholseri*
"Western" Flycatcher	*Empidonax* sp.
Black Phoebe	*Sayornis nigricans*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Western Kingbird	*Tyrannus verticalis*
Shrikes	**Family Laniidae**
**Loggerhead Shrike	*Lanius ludovicianus*
Vireos	**Family Vireonidae**
Cassin's Vireo	*Vireo cassini*
Warbling Vireo	*Vireo gilvus*
Crows and Jays	**Family Corvidae**
Common Raven	*Corvus corax*
Swallows	**Family Hirundinidae**
Tree Swallow	*Tachycineta bicolor*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Penduline Tits and Verdins	**Family Remizidae**
Verdin	*Auriparus flaviceps*

Wrens	**Family Troglodytidae**
Cactus Wren	*Campylorhynchus brunneicapillus*
Marsh Wren	*Cistothorus palustris*
Old World Warblers and Gnatcatchers	**Family Sylviidae**
Black-tailed Gnatcatcher	*Polioptila melanura*
Mockingbirds and Thashers	**Family Mimidae**
Crissal Thrasher	*Toxostoma crissale*
Starlings	**Family Sturnidae**
*European Starling	*Sturnus vulgaris*
Silky-flycatchers	**Family Ptilogonatidae**
Phainopepla	*Phainopepla nitens*
Wood-Warblers	**Family Parulidae**
Orange-crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
**Yellow-breasted Chat	*Icteria virens*
Tanagers	**Family Thraupidae**
Western Tanager	*Piranga ludoviciana*
Emberizids	**Family Emberizidae**
Abert's Towhee	*Pipilo aberti*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
White-crowned Sparrow	*Zonotrichia leucophrys*
Cardinals, Saltators, and Allies	**Family Cardinalidae**
Black-headed Grosbeak	*Pheucticus melanocephalus*
Lazuli Bunting	*Passerina amoena*
Blackbirds	**Family Icteridae**
Red-winged Blackbird	*Agelaius phoeniceus*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Great-tailed Grackle	*Quiscalus mexicanus*
Brown-headed Cowbird	*Molothrus ater*
Bullock's Oriole	*Icterus bullockii*
Fringilline & Cardueline Finches & Allies	**Family Fringillidae**
House Finch	*Carpodacus mexicanus*

Appendix VI
Photographic Exhibits: Rail Survey Stations

APPENDIX VI. PHOTOGRAPHIC EXHIBITS: RAIL SURVEY STATIONS



Photo 1. Rail Survey Station #1. Yuma Clapper Rail detected 18 April & 18 May.

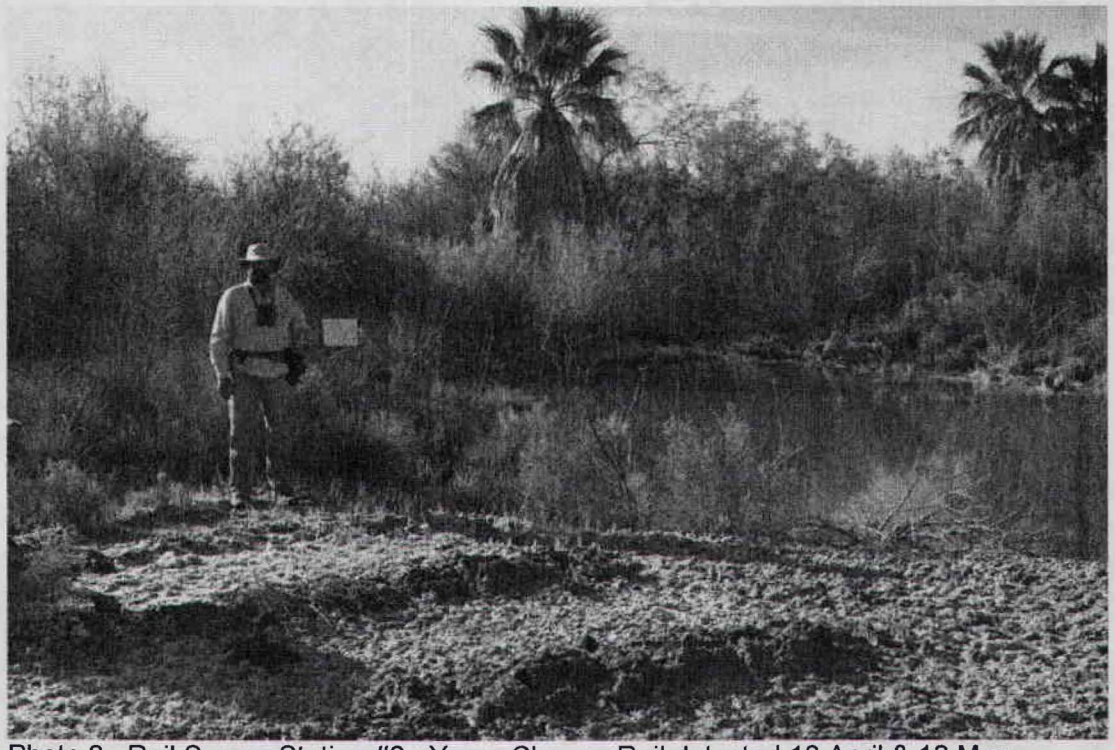


Photo 2. Rail Survey Station #2. Yuma Clapper Rail detected 18 April & 18 May.



Photo 3. Rail Survey Station #3. Yuma Clapper Rail detected 18 May.

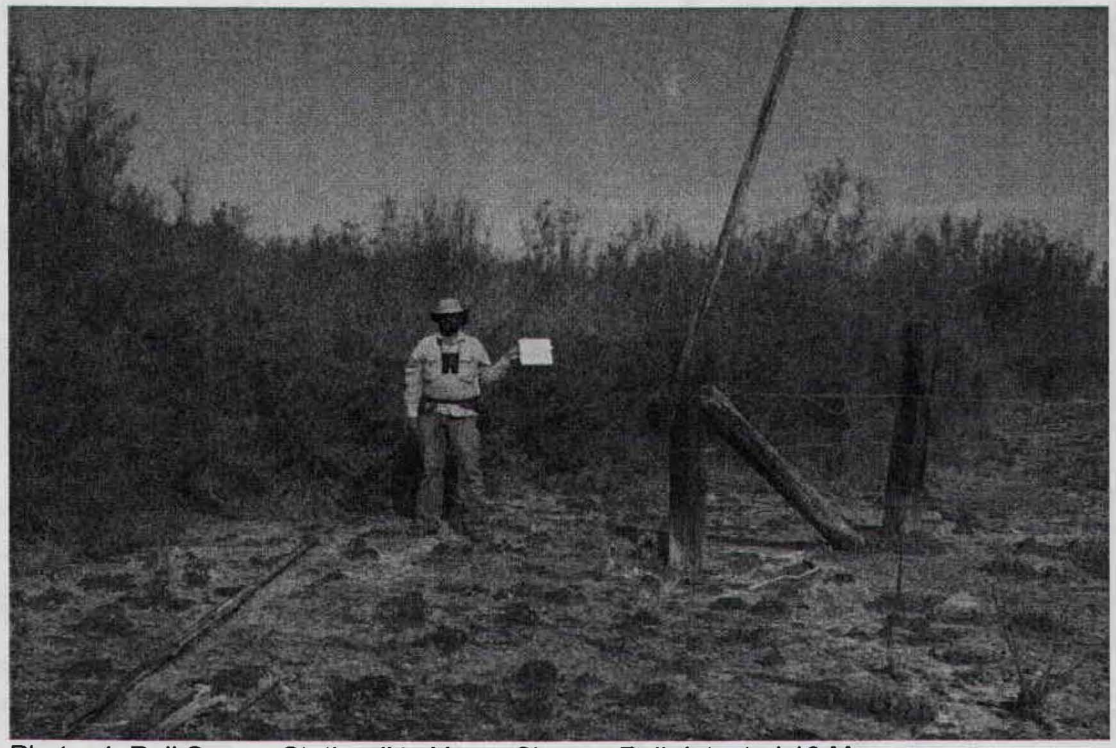


Photo 4. Rail Survey Station #4. Yuma Clapper Rail detected 18 May.



Photo 5. Rail Survey Station #5. California Black Rail detected 18 April; Yuma Clapper Rail detected 18 April & 18 May.

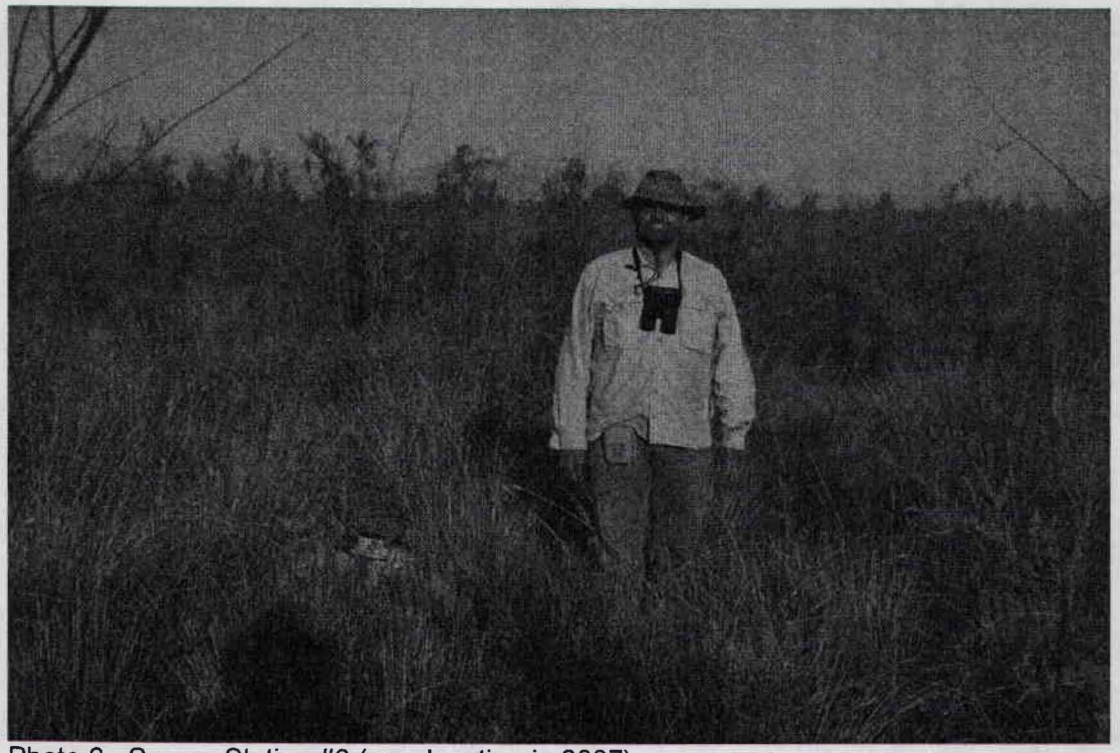


Photo 6. Survey Station #6 (new location in 2007).



Photo 7. Rail Survey Station #7. Station moved in 2007.

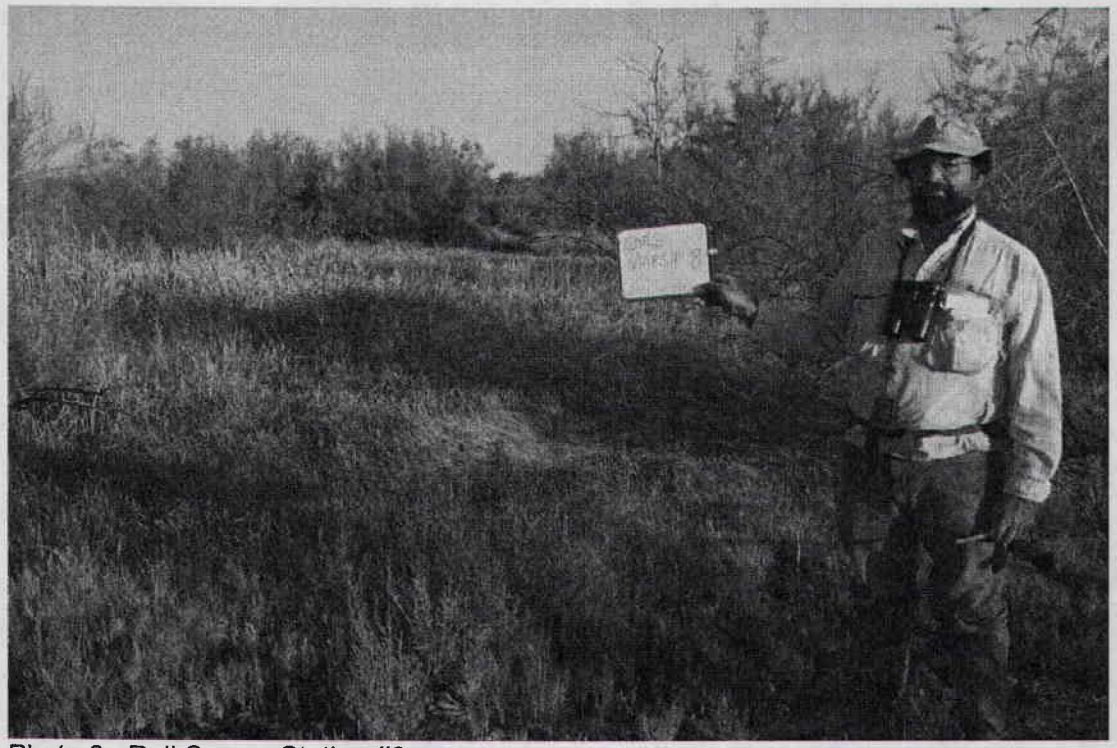


Photo 8. Rail Survey Station #8. .



Photo 9. Rail Survey Station #9. Yuma Clapper Rail detected 30 April & 30 May.

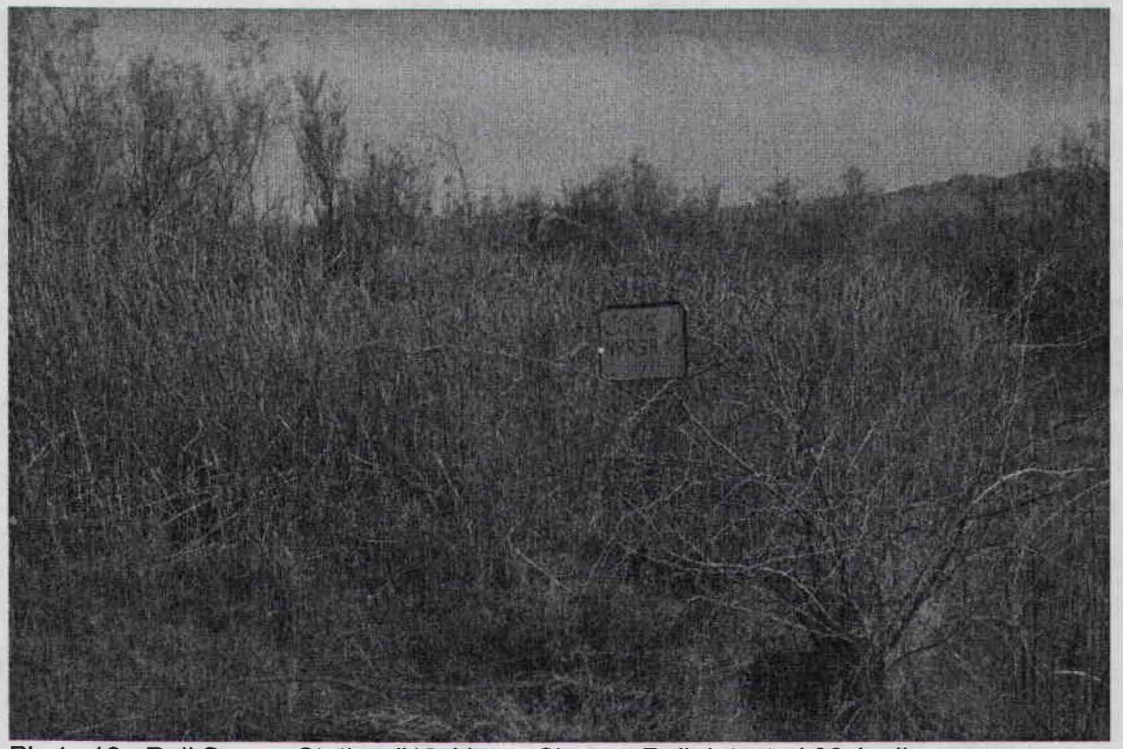


Photo 10. Rail Survey Station #10. Yuma Clapper Rail detected 30 April.

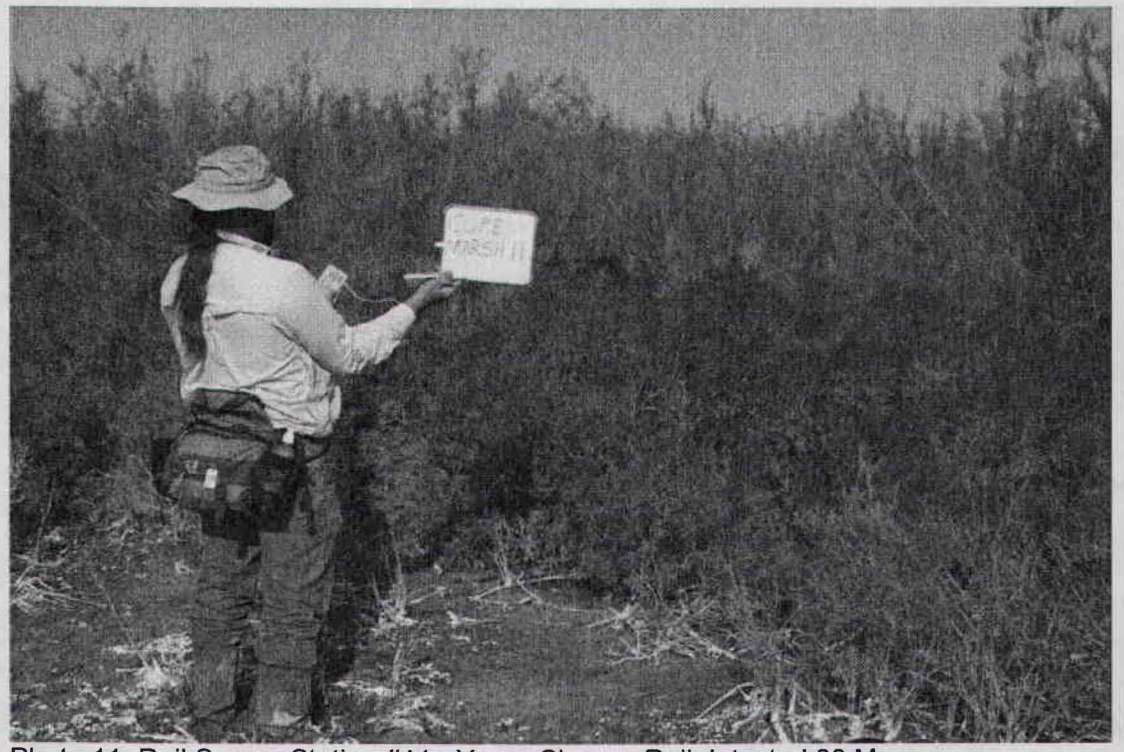


Photo 11. Rail Survey Station #11. Yuma Clapper Rail detected 30 May.

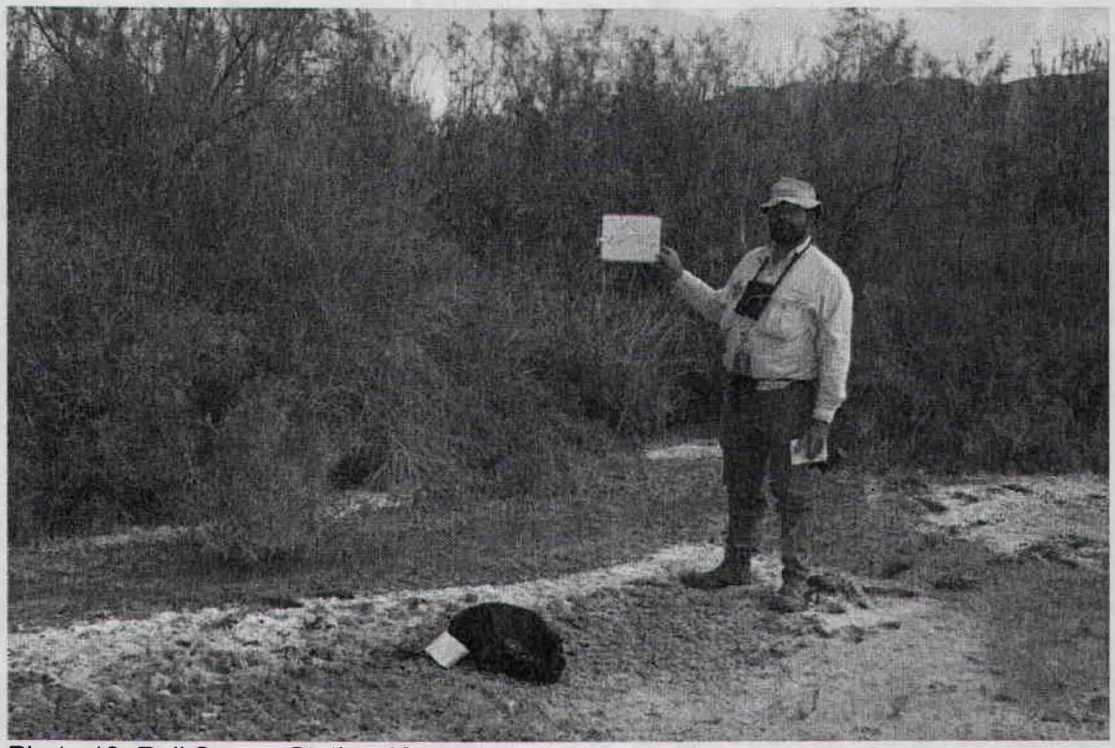


Photo 12. Rail Survey Station 12.



Photo 13. Rail Survey Station #13.

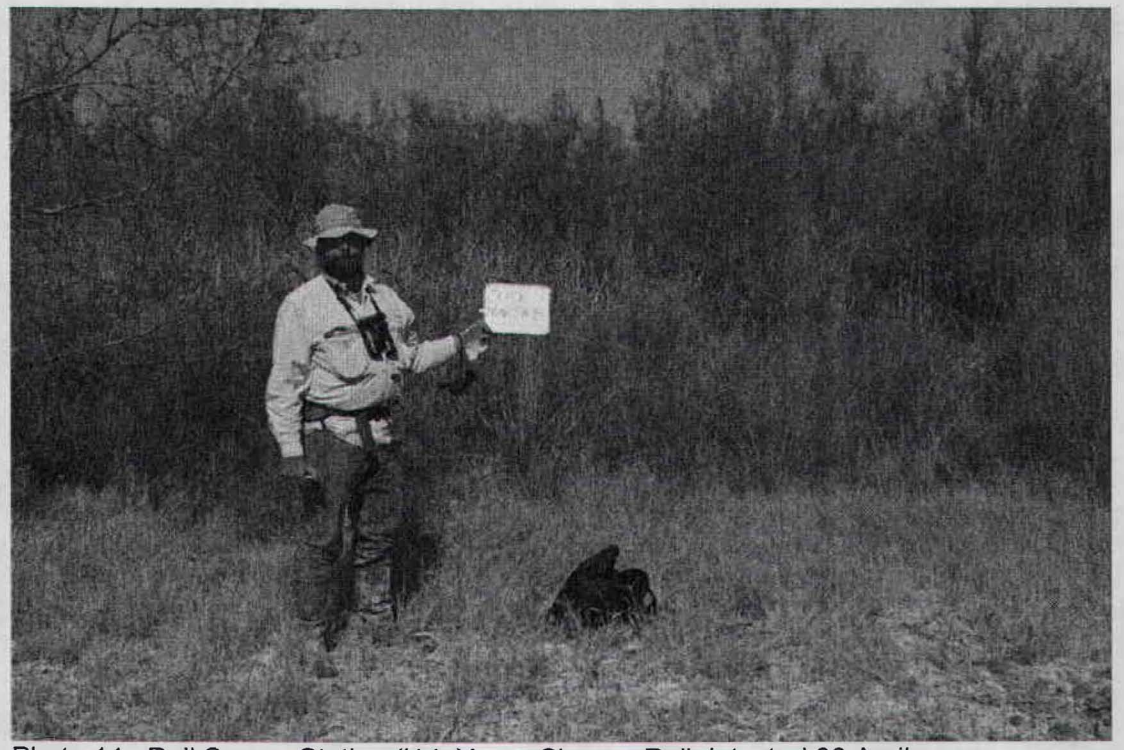


Photo 14. Rail Survey Station #14. Yuma Clapper Rail detected 30 April.

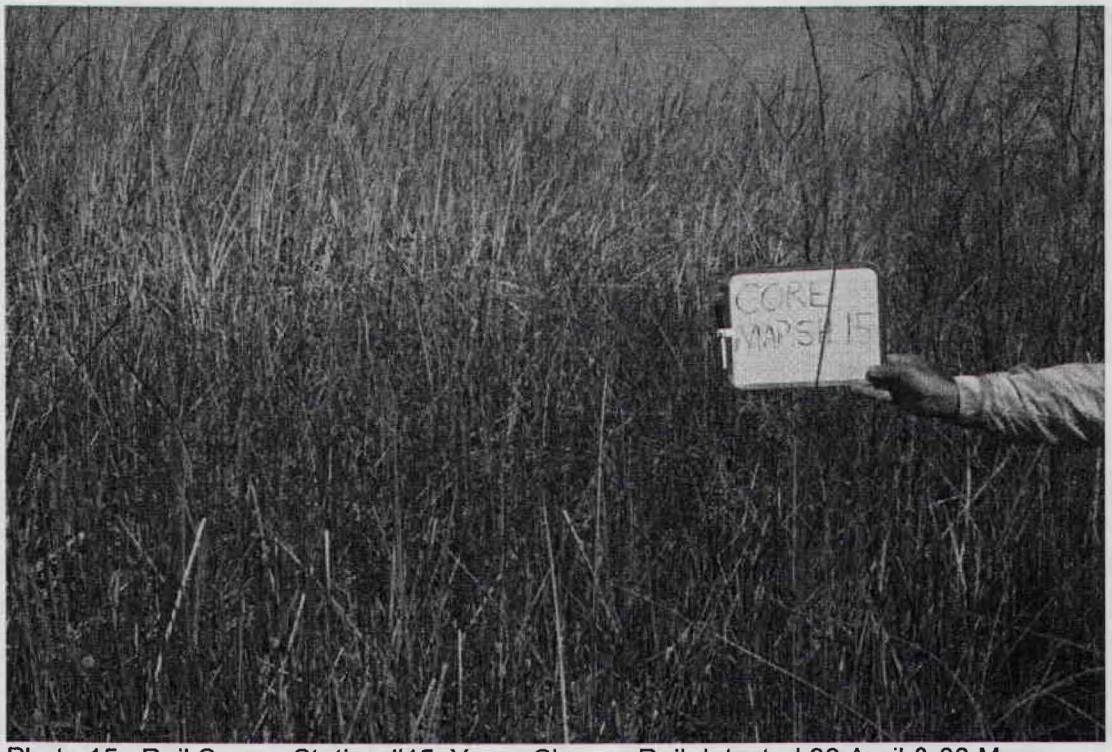


Photo 15. Rail Survey Station #15. Yuma Clapper Rail detected 30 April & 30 May.

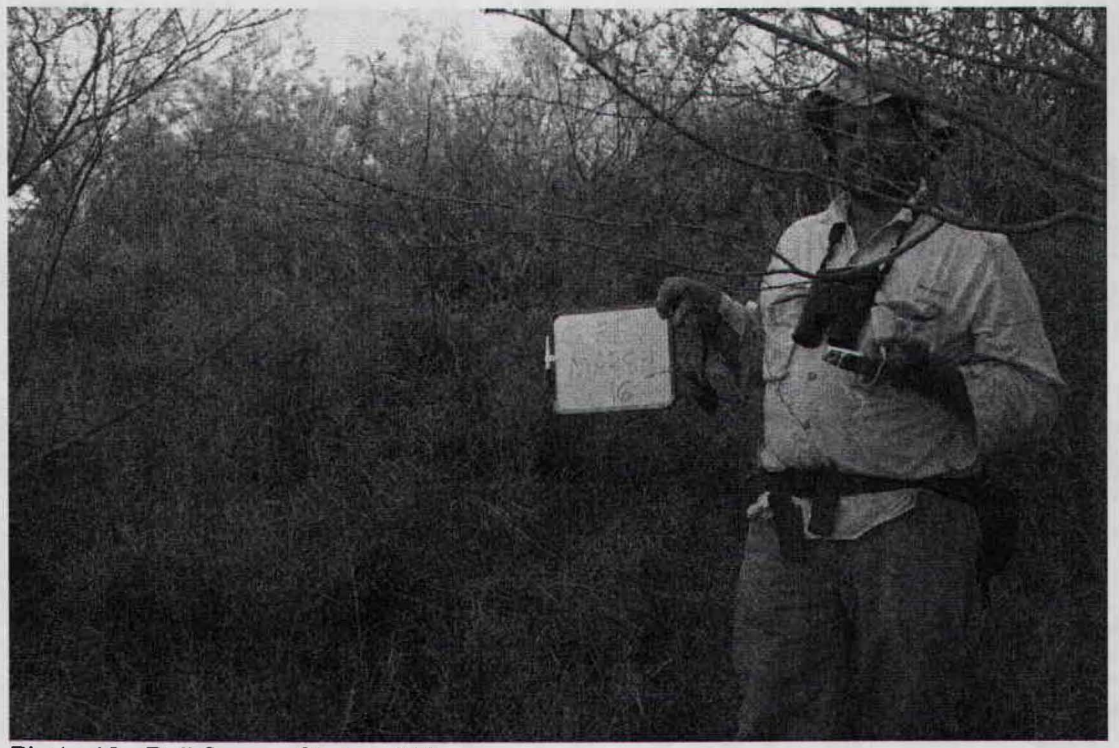


Photo 16. Rail Survey Station #16.

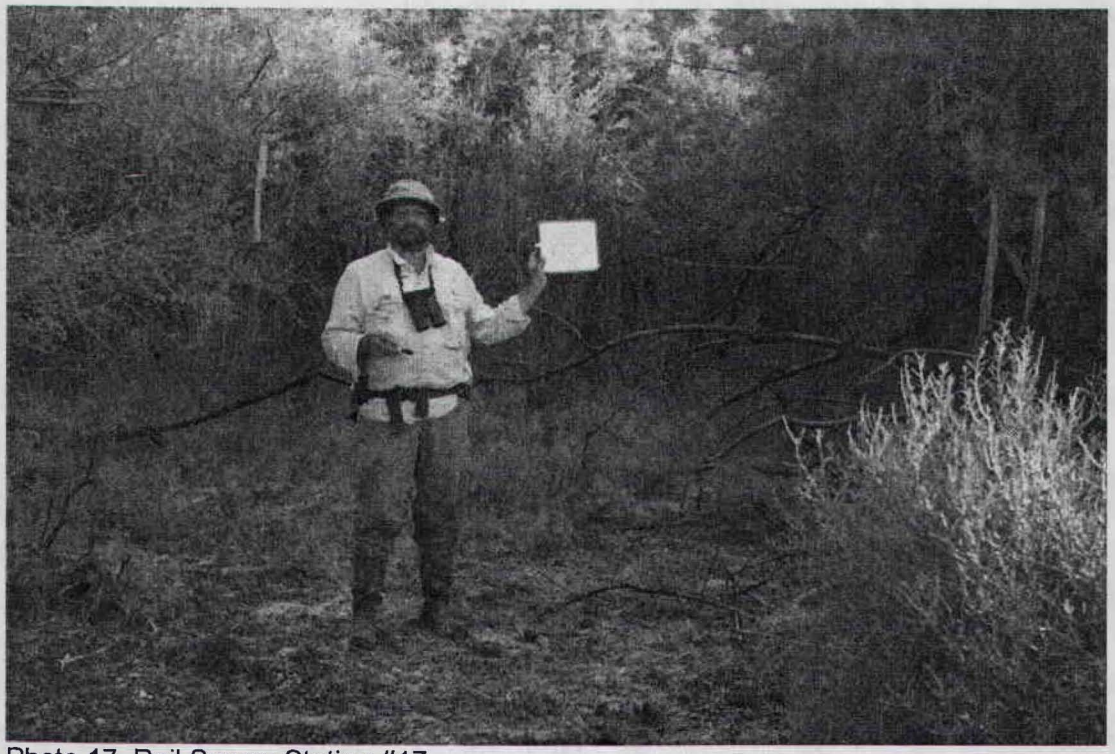


Photo 17. Rail Survey Station #17.

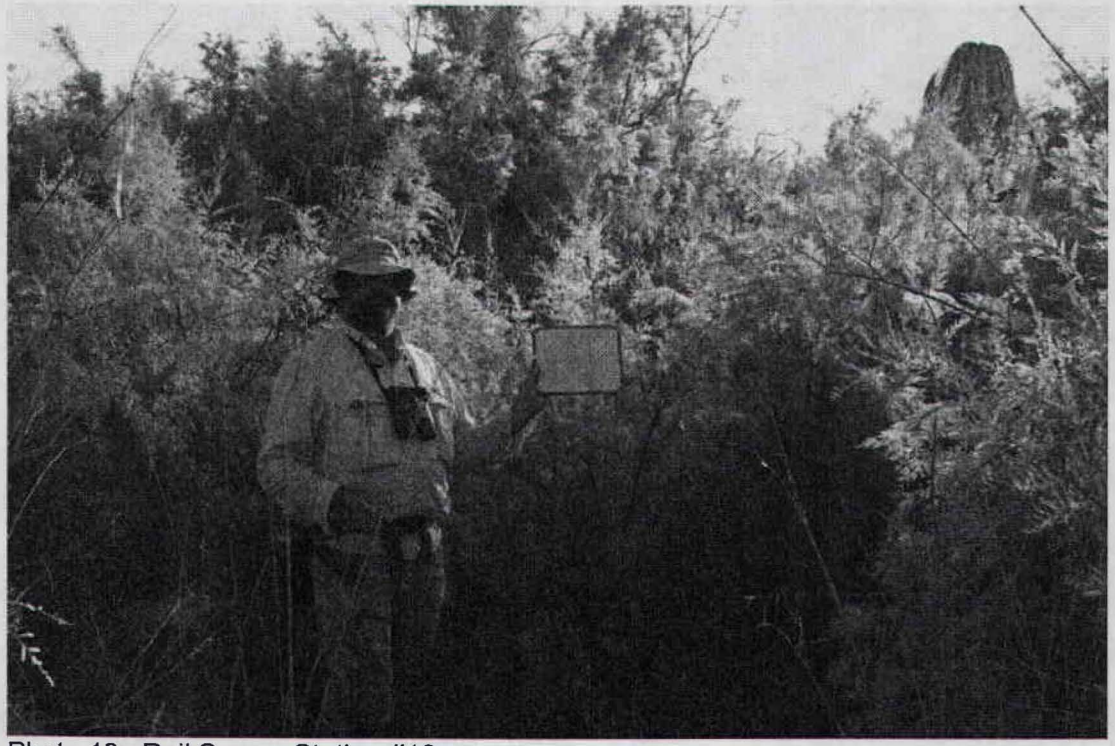


Photo 18. Rail Survey Station #18.



Photo 19. Rail Survey Station #19. Yuma Clapper Rail detected 25 May.

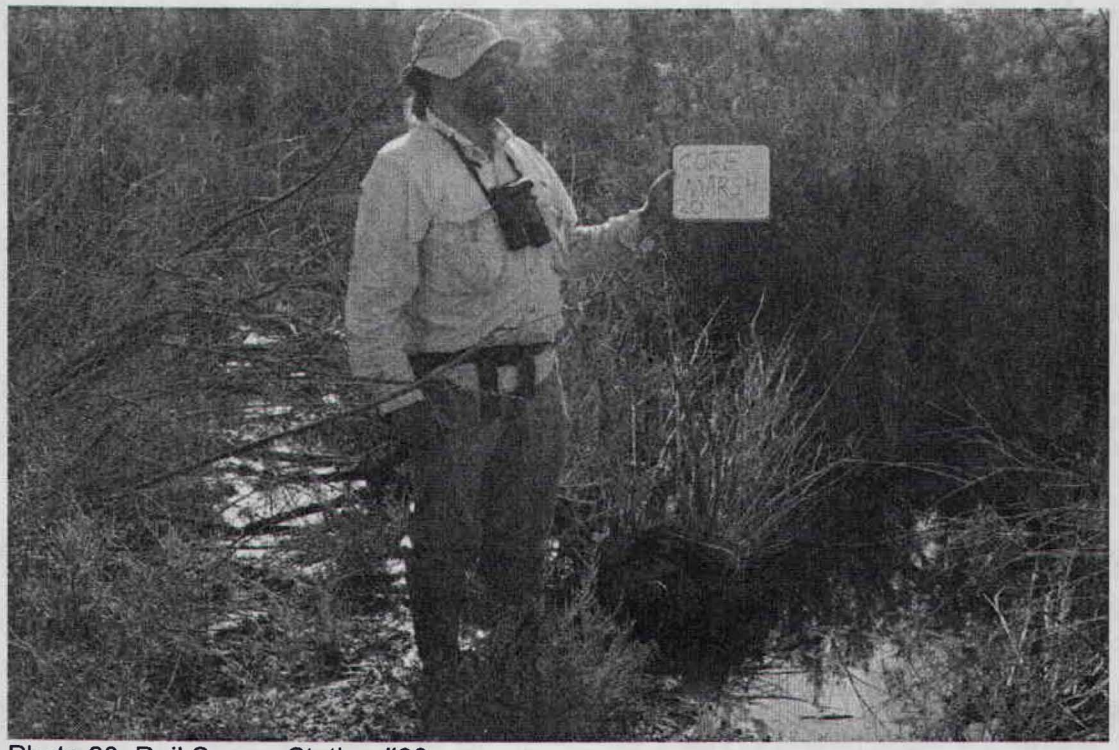


Photo 20. Rail Survey Station #20.

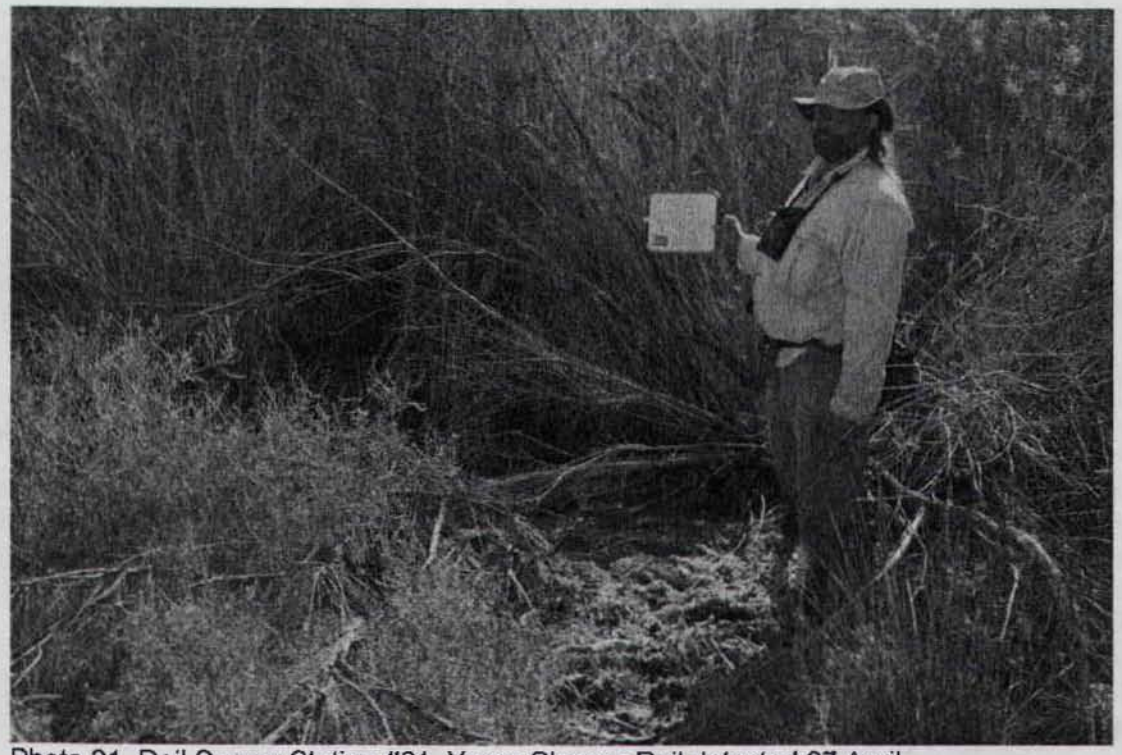


Photo 21. Rail Survey Station #21. Yuma Clapper Rail detected 27 April.

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

Record Id 6137
County Imperial
Year 2010
SWWF (+) Transient willow flycatcher(s) detected, subspecies uncertain.
Spp incidental
LBV (—) incidental BAEA (+) YCR (+)
Srv. Rpt. 6575-3D
D.B. 12/10/10
GIS
L+R
File

December 3, 2010

U.S. Fish and Wildlife Service
Attn: Recovery Permit Coordinator
6010 Hidden Valley Road, Suite 100
Carlsbad, California 92011

Subject: ***Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat Project, Imperial County, California***

Dear Recovery Permit Coordinator:

This report documents the results of eight protocol-level presence/absence surveys for the state- and federally listed endangered least Bell's vireo (*Vireo bellii pusillus*), and the state- and federally listed endangered southwestern willow flycatcher (*Empidonax traillii extimus*). These focused surveys included approximately 248 acres of suitable habitat within the Salton Sea Species Conservation Habitat project site and adjacent upstream and downstream areas. The surveys were conducted in all areas of suitable least Bell's vireo and southwestern willow flycatcher habitat.

The southwestern willow flycatcher and least Bell's vireo are closely associated with riparian habitats, especially densely vegetated willow scrub and riparian forest vegetation. These species are threatened primarily by loss, degradation, and fragmentation of riparian habitats. They also are impacted by brown-headed cowbird (*Molothrus ater*) nest parasitism.

LOCATION AND EXISTING CONDITIONS

The approximately 248-acre survey area is situated within Imperial County, California (Figure 1) and lies within the U.S. Geological Survey (USGS) 7.5-minute map, Niland and Westmorland West Quadrangles: Section 5, Township 12 South, Range 13 East; Principal Meridian: San Bernardino; latitude 33°9'14.8" N; and longitude 115°38'24.0" W (Figure 2). The project site is slightly sloped with gradients from the southeast to the northwest. For the Alamo River portion of the survey, the elevation ranges from a high of -221 feet above mean sea level (AMSL) near the southeast portion to approximately -231 feet AMSL near the northwest portion. For the New River portion of the survey, the elevation ranges from a high of -216 feet AMSL near the southeast portion to approximately -228 feet AMSL near the northwest portion

RECEIVED
USFWS
CFWO-CARLSBAD, CA
2007 DEC -6 AM 8:21

VEGETATION COMMUNITIES

Tamarisk riparian habitat was the only vegetation community identified in the study area that was considered potentially suitable habitat for least Bell's vireo and southwestern willow flycatcher. This vegetation community is described below and shown as the survey area on Figure 3.

Tamarisk Riparian Habitat (248 acres)

According to Holland (1986), tamarisk habitat is a weedy, monoculture of any of several Tamarix species, usually supplanting native vegetation following a major disturbance. This habitat is usually found in sandy or gravelly braided washes or intermittent streams. Common species include narrowleaf willow (*Salix exigua*), big salt bush (*Atriplex lentiformis*), salt grass (*Distichilis spicata*), tamarisk (*Tamarix* sp.), and arrowweed (*Pluchea sericea*). Tamarisk often occupies jurisdictional wetlands.

Tamarisk habitat occurs throughout the survey area. Within the survey area, this community is characterized by monotypic stands of tamarisk interspersed with patches of fresh and brackish water marsh and stands of common reed (*Phragmites* sp.). The tamarisk habitat occurs in association with the two main rivers that empty into the Salton Sea: New River and Alamo River. The habitat occurs along the edges of the rivers often as a very narrow band of vegetation. In some areas the tamarisk scrub widens out and forms more of a patch of habitat versus a linear strip of vegetation. The narrow linear strips of tamarisk average 30 to 50 feet wide and patches of habitat range from 2 to 4 acres with an approximately 50-acre patch south of the New River.

METHODS

Focused surveys for the least Bell's vireo and southwestern willow flycatcher were conducted for the project on May 20, 21, 27, June 2, 3, 4, 10, 11, 18, 28, 29, and July 8, 9, 19, 20, 28, 29, and 30, 2010, by Paul M. Lemons, Brock A. Ortega, Jeffrey D. Priest, Stuart F. Fraser, Patricia Schuyler, Kamarul J. Muri, and Anita M. Hayworth, Ph.D (Table 1).

Dr. Hayworth, Mr. Ortega, Mr. Priest, and Mr. Lemons hold federal permits to conduct surveys for the southwestern willow flycatcher under TE-781084, TE-813545, TE-840619, and TE-051248, respectively. A federal recovery permit is not required to conduct surveys for the least Bell's vireo. All surveys conducted by Mr. Fraser, Mr. Muri, and Ms. Schuyler, as well as any surveys conducted after the survey period for southwestern willow flycatcher, were focused on the detection of least Bell's vireo; For the surveys when both species could be present, the

permitted biologist simultaneously focused survey efforts on the southwestern willow flycatcher and least Bell's vireo.

For the least Bell's vireo, eight site visits were conducted with at least 10-day intervals between visits except for two of the visits as described below, following the currently accepted U.S. Fish and Wildlife Service (USFWS) protocol (USFWS 2001). For the second and third visits, due to time delays with the authorization from California Department of Fish and Game to conduct the surveys, the interval was seven or eight days; the interval for the balance of the surveys was 10 days per the protocol. The site visits are generally conducted 10 days apart to maximize the detection of early and late arrivals, females, non-vocal birds, and nesting pairs. Surveys were conducted between dawn and approximately noon and were not conducted during periods of excessive or abnormal cold, heat, wind, rain, or other inclement weather. Typically, per the protocol, the survey should be ended at 11 a.m.; however, if birds continued to vocalize and winds remained mild, the survey was continued to its completion. Surveys were conducted between April 10 and July 31, as dictated in the protocol.

For the southwestern willow flycatcher, five surveys are required per *A Natural History Summary and survey protocol for the Southwestern Willow Flycatcher* issued by the USGS and U.S. Department of the Interior and approved by the USFWS (Sogge et al. 2010). For the 2010 protocol, five survey visits are required with one visit between May 15 and May 31, two visits between June 1 and June 24, and two visits between June 25 and July 17 (Sogge et al. 2010). Each survey visit was separated by at least five days. Because the habitat requirements for the two species overlap, surveys conducted between May 15 and July 17 include surveys for both species. A tape of recorded southwestern willow flycatcher vocalizations was used as described in the protocol. The biologist paused quietly for one to two minutes listening for flycatcher calls and songs. The tape of the vocalizations was then played for 10 to 15 seconds followed by a one to two minute listening period. This was repeated approximately every 50 to 100 feet within suitable habitat to induce southwestern willow flycatcher responses. When a southwestern willow flycatcher was detected, playing of the tape ceased to avoid harassment and the biologist did not start playing the tape again until approximately 120 feet away from the detected flycatcher. Various subspecies of this species are not easily differentiated visually or by call or song in the field, and any resident willow flycatchers observed in the final survey period would be assumed to be the "southwestern" subspecies. Non-resident willow flycatchers (those not observed during the third survey period) were assumed to be migrant willow flycatchers. Surveys for the southwestern flycatcher were conducted under Section 10(a), Permit Numbers TE-781084, TE-813545, TE-840619, and TE-051248.

The survey method consisted of slowly walking a systematic, meandering transect within and adjacent to all suitable habitat (i.e., tamarisk scrub) in the study area. This route was arranged to cover all suitable habitat on site. The vegetation along the New and Alamo rivers is composed of a combination of a narrow stringer of trees to larger patches or polygons of trees with a relatively dense understory. Where the vegetation was composed of the narrow open line of tamarisk, the observer moved through relatively quickly since the vegetation was generally composed of the open channel of the river with no overstory or shading, a strip of emergent vegetation, a narrow strip of medium height tamarisk and then the levee or berm. Hence the vegetation is less suitable for either of the riparian bird species. Where the habitat widened out or became dense, the observed spent time listening and searching for vocalizations or activity of least Bell's vireo or willow flycatcher. The survey area was split into three regions and eight full visits were made to each region. The three regions were determined based on the acreage covered with the survey and the access needed to cover the survey area in the time needed. Thus the acreage covered was approximately 77 acres for the Alamo River "A", 92 acres for the New River "A", and 79 acres for the New River "B"/Alamo River "B" survey areas. The total length cover for each area was as follows: 3.2 km for the Alamo River "A", 3.4 km for the New River "A" and 3.2 km for the New River "B"/Alamo River "B" with some areas of narrow or unsuitable habitat interspersed with areas of suitable habitat as described above. A vegetation map (scale 1 inch=200 feet) of the survey area was available to record any detected southwestern willow flycatcher or least Bell's vireo. Binoculars (10×40, 8×42) were used to aid in detecting and identifying wildlife species.

Weather conditions, time of day and season were appropriate for the detection of southwestern willow flycatcher and least Bell's vireo (Table 1).

Table 1
Schedule of Surveys

Date	Location*	Hours	Focus	Personnel	Conditions
5/20/10	Alamo River A	0530–1100	WIFL/LBVI	AMH	clear skies; 3–5 mph winds; 68°F–88°F
5/21/10	New River A	0515–1100	WIFL/LBVI	BAO	Clear skies; 5mph wind; 67°F–95°F
5/27/10	New River B/Alamo River B	0550–1100	WIFL/LBVI	PML	10%–10% cc; 0–2 to 5–8 mph winds; 10+ mph gusts; 63°F–93°F
6/2/10	Alamo River A	0500–1105	WIFL/LBVI	AMH	Clear skies; 0–3 mph winds; 61°F–92°F
6/3/10	New River A	0530–1030	LBVI	PCS	Clear skies; 0–5 mph winds; 65°F–85°F
6/4/10	New River B/Alamo River B	0545–1100	WIFL/LBVI	PML	15%–10% cc; 0–4 mph winds; 71°F–101°F
6/10/10	Alamo River A	0505–1115	WIFL/LBVI	AMH	70% cc–clear skies; 8–10 to 5–8 mph winds; 70°F–86°F
6/10/10	New River A	0500–1115	WIFL/LBVI	BAO	40%–10% cc; 1–5 mph winds; 73°F–100°F

Table 1 (Continued)

Date	Location*	Hours	Focus	Personnel	Conditions
6/11/10	New River B/Alamo River B	0600–1100	WIFL/LBVI	PML	70% cc–clear skies; 1–4 to 1–5 mph winds, 6–10 mph gusts; 75°F–92°F
6/18/10	New River A	0430–1100	WIFL/LBVI	BAO	20% cc–clear skies; 5 to 5 mph winds; 100°F–73°F
6/18/10	Alamo River A	0535–1015	LBVI	SFF	Clear skies; 0 to 3–5 mph winds; 62°F–86°F
6/18/10	New River B/Alamo River B	0545–1100	LBVI	KJM	Clear skies; 0–2 to 2–5 mph winds; 64°F–87°F
6/28/10	Alamo River A	0515–1105	WIFL/LBVI	AMH	Clear skies; 3–5 mph winds; 65°F–92°F
6/28/10	New River B/Alamo River B	0445–1100	WIFL/LBVI	JDP	Clear skies; <1 mph to 1–8 mph winds; 72°F–101°F
6/29/10	New River A	0450–1100	WIFL/LBVI	BAO	Clear skies; 0–1 mph winds; 60°F–99°F
7/8/10	Alamo River A	0500–1100	WIFL/LBVI	JDP	Clear skies; <1 mph to 3 mph winds; 62°F–100°F
7/9/10	New River A	0515–1105	WIFL/LBVI	AMH	30% cc–clear skies; 1–3 mph winds; 68°F–98°F
7/9/10	New River B/Alamo River B	0600–1100	WIFL/LBVI	PML	80%–20% cc; 0–2 to 2–6 mph winds; 83°F–101°F
7/19/10	New River A	0635–1100	LBVI	PML	10%–5% cc; 0–1 mph winds; 85°F–107°F
7/19/10	Alamo River A	0530–1100	LBVI	JDP	10% cc–clear skies; 1 to 2 mph winds; 76°F–103°F
7/20/10	New River B/Alamo River B	0530–1050	LBVI	AMH	30%–10% cc; 0–1 to 3–5 mph winds; 75°F–93°F
7/28/10	Alamo River A	0530–1100	LBVI	SFF	10% cc; 0–2 to 5–8 mph winds ; 80°F–107°F
7/29/10	New River A	0610–1100	LBVI	PML	30%–10% cc; 0–3 to 0–4 mph winds; 85°F–105°F
7/30/10	New River B/Alamo River B	0600–1100	LBVI	KJM	10%–60% cc; 0–2 to 5–10 mph winds; 84°F–98°F

Survey Designations: LBVI: Least Bell's vireo; WIFL: willow flycatcher
Personnel Key: AMH: Anita Hayworth; BAO: Brock Ortega; JDP: Jeffrey Priest; KJM: Kamarul Muri; PCS: Patricia Schuyler; PML: Paul Lemons; SFF: Stuart Fraser
*In the field notes recorded by Dudek biologists, the New River B/Alamo River B survey area is listed as "New River B". The biologist covered the required survey area for New River B/Alamo River B during each survey regardless of how it was listed in the field notes.

RESULTS

The surveys for the state- and federally listed endangered least Bell's vireo were negative. Based on the migratory route of the species and the breeding locations, it is unlikely that the species occurs in this region; however there is some habitat that is suitable for them for both breeding and migratory stopover.

The state-listed endangered willow flycatcher was identified in riparian vegetation in the survey area during the 2010 focused surveys. A total of 27 observations were made of willow flycatcher within the survey areas adjacent to the Salton Sea (Figures 3–5; Table 2).

Table 2
Survey Results

Survey Pass	Date	Survey Area	Number of willow flycatcher individuals observed
1	5/20/2010	Alamo A	1
	5/21/2010	New River A	4
	5/27/2010	New River B/Alamo River B	1
2	6/2/2010	Alamo A	4
	6/4/10	New River B/Alamo River B	0
	6/10/2010	New River A	9
3	6/10/2010	Alamo A	5
	6/11/2010	New River B/Alamo River B	3
	6/18/10	New River A	0
4	6/28/10	Alamo River A	0
	6/28/10	New River B/Alamo River B	0
	6/29/10	New River A	0
5	7/8/10	Alamo River A	0
	7/9/10	New River A	0
	7/9/10	New River B/Alamo River B	0
		Total	**27**

They were generally observed within patches of tamarisk where it was more than just a linear string of trees. They were observed along the New and Alamo rivers within the survey area of each river as well as in a patch of habitat located south of the New River. No southwestern willow flycatchers were observed during the third survey period. Thus it was concluded that southwestern willow flycatcher is not breeding within the study area. The willow flycatcher that was observed during this focused survey could be either one of the other subspecies of willow flycatcher that breed elsewhere or it could be a southwestern willow flycatcher that was migrating through the region and did not remain on site to breed. Based on the discussion of the occurrence of the various subspecies of willow flycatcher in *Birds of Salton Sea* and the dark plumage of the individuals that were detected, the subspecies occurring in this region is likely the little willow flycatcher (*E. t. brewsteri*) (Patten et al. 2002).

A total of 115 wildlife species were detected in the study area during general and focused surveys of the site (Appendix A). Common bird species observed include song sparrow (*Melospiza melodia*), Abert's towhee (*Melozone aberti*), verdin (*Auriparus flaviceps*), house finch

(*Carpodacus mexicanus*), seabirds/shorebirds including a variety of gulls and terns, aquatic birds including pelicans and cormorants, and wading birds including herons and egrets, the names of which are provided in a list in Appendix A.

The Willow Flycatcher Survey and Detection Form (Sogge et al. 2010) was filled out for each visit and is included in Appendix B. Site photographs are included in Appendix C.

Please feel free to contact me at 760.479.4239 with questions or if you require additional information.

I certify that the information in this survey report and attached exhibits fully and accurately represents my work.

Sincerely,

Anita Hayworth, PhD
Senior Biologist

Paul M. Lemons
Biologist

Brock Ortega
Senior Wildlife Biologist

Jeff Priest
Wildlife Biologist

Att: Figures 1–5
Appendices A–C

cc: Sarah Lozano, Dudek
Cliff Feldheim, Department of Water Resources
Kim Nichols, California Department of Fish and Game
Anita Hayworth, PhD, Dudek
Brock Ortega, Dudek
Jeffrey Priest, Dudek
Paul Lemons, Dudek

REFERENCE LIST

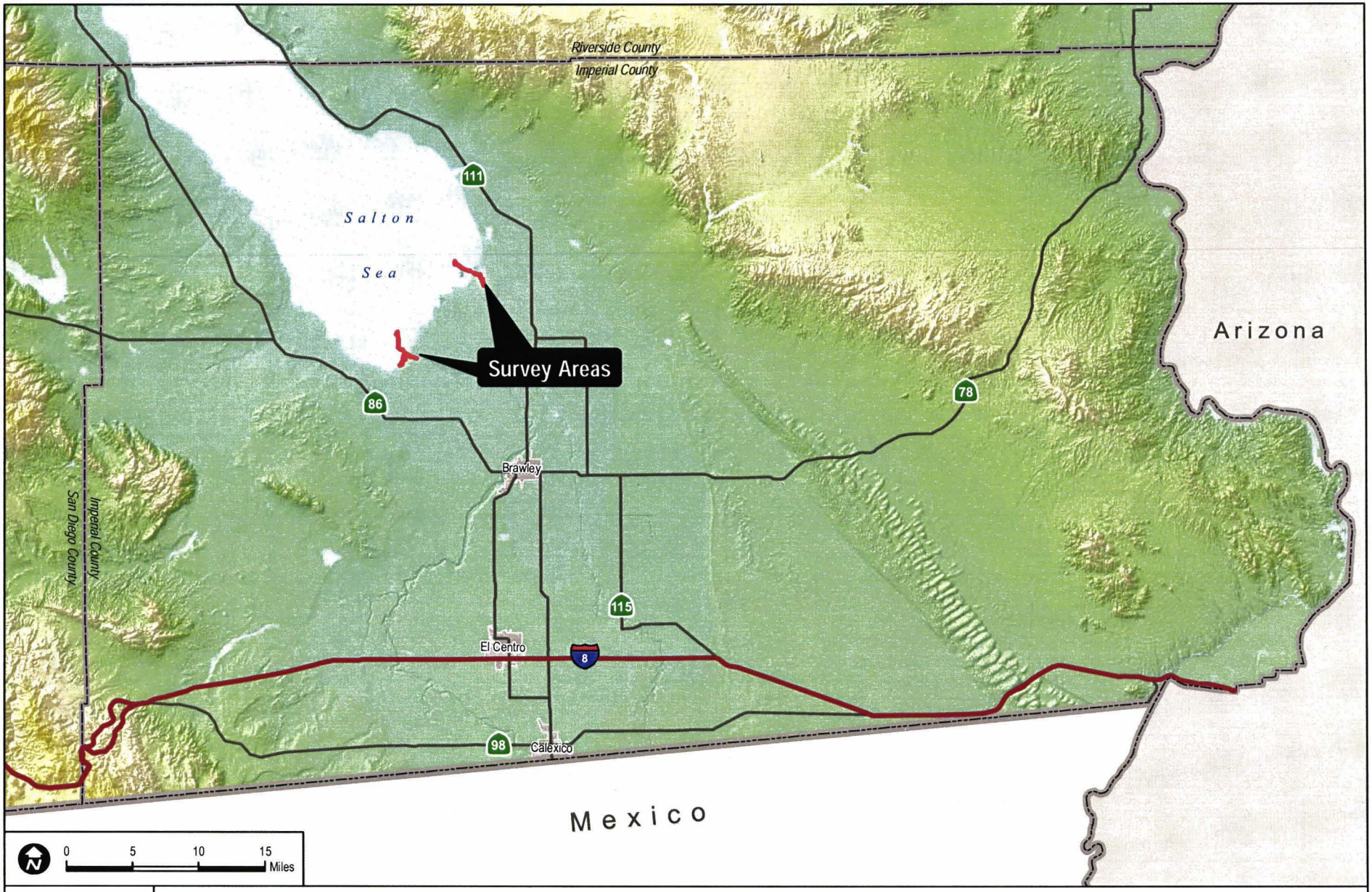
Holland, R.F. 1986. *Preliminary descriptions of the terrestrial natural communities of California. Nongame-Heritage Program, California Department of Fish and Game*. 156 pp.

Patten, M. A., G. McCaskie, and P. Unitt. 2002. *Birds of Salton Sea.* Status, Biogeography, and Ecology. University of California Press, Berkeley, California.

Recovery Permit Coordinator
Subject: Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat Project, Imperial County, California

Sogge, M.K., Ahlers, Darrell, and S.J. Sferra. 2010. *A natural history summary and survey protocol for the southwestern willow flycatcher.* U.S. Geological Survey Techniques and Methods 2A-10. 38 p.

USFWS. 2001. *Least Bell's Vireo Survey Guidelines.* January 19.

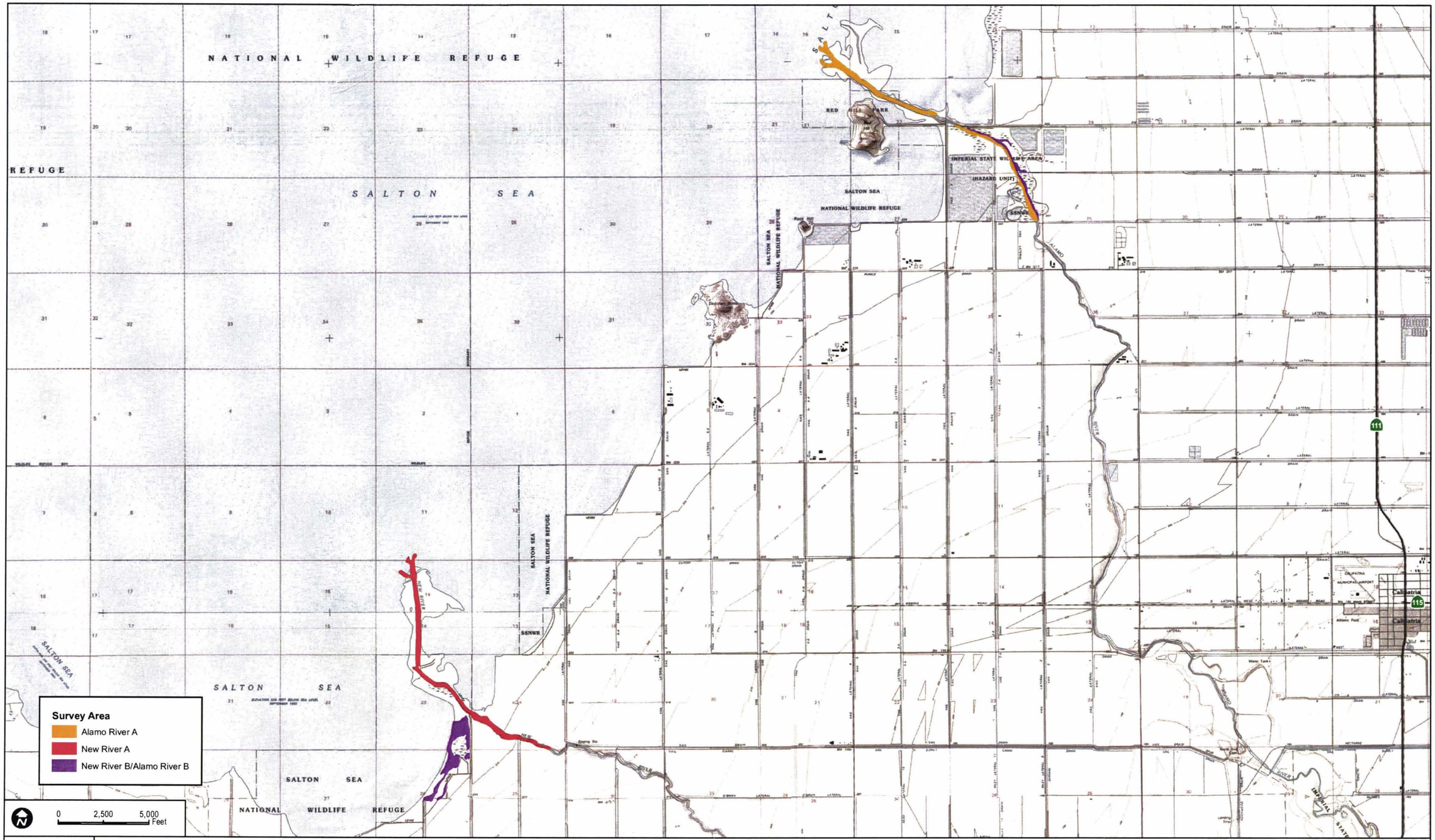


DUDEK

6575-01
OCTOBER 2010

FIGURE 1
Regional Map

Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat project, Imperial and Riverside counties, California



DUDEK

6575-01

OCTOBER 2010

SOURCE: USGS 7.5-Minute Series Obsidian Butte, Calipatria SW, and Niland Quadrangles.

FIGURE 2

Vicinity Map

Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat project, Imperial and Riverside counties, California



DUDEK

6575-01

OCTOBER 2010

SOURCE: CDFG Imagery Service, Imperial County 2009

FIGURE 3

Vegetation/Land Covers and WIFL points

Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat project, Imperial and Riverside counties, California



DUDEK

6575-01
OCTOBER 2010

SOURCE: CDFG Imagery Service, Imperial County 2009

FIGURE 4
WIFL Locations - New River

Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat project, Imperial and Riverside counties, California



DUDEK

6575-01

OCTOBER 2010

SOURCE: CDFG Imagery Service, Imperial County 2009

FIGURE 5

WIFL Locations - Alamo River

Focused Least Bell's Vireo and Southwestern Willow Flycatcher Survey Report for the Salton Sea Species Conservation Habitat project, Imperial and Riverside counties, California

APPENDIX A

Wildlife Species Observed on the Project Site

APPENDIX A
Wildlife Species Observed on the Project Site

WILDLIFE SPECIES – VERTEBRATES

BIRDS

ACCIPITRIDAE **– HAWKS, KITES, EAGLES, AND ALLIES**

Buteo jamaicensis – red-tailed hawk
Circus cyaneus – northern harrier
Haliaeetus leucocephalus – bald eagle
Parabuteo unicinctus – Harris's hawk

AEGITHALIDAE **– LONG-TAILED TITS AND BUSHTITS**

Psaltriparus minimus – bushtit

ANATIDAE **– DUCKS, GEESE, AND SWANS**

Anas acuta – northern pintail
Anas clypeata – northern shoveler
Anas cyanoptera – cinnamon teal
Anas platyrhynchos – mallard
Aythya affinis – lesser scaup
Aythya americana – redhead
Oxyura jamaicensis – ruddy duck

ARDEIDAE **– HERONS, BITTERNS, AND ALLIES**

Ardea alba – great egret
Ardea herodias – great blue heron
Botaurus lentiginosus – American bittern
Bubulcus ibis – cattle egret
Butorides virescens – green heron
Egretta thula – snowy egret
Ixobrychus exilis – least bittern
Nycticorax nycticorax – black-crowned night-heron

CAPRIMULGIDAE **– GOATSUCKERS**

Chordeiles acutipennis – lesser nighthawk

CARDINALIDAE **– CARDINALS AND ALLIES**

Passerina caerulea – blue grosbeak

CATHARTIDAE **– NEW WORLD VULTURES**

Cathartes aura – turkey vulture

APPENDIX A (Continued)

CHARADRIIDAE **– LAPWINGS AND PLOVERS**

Charadrius alexandrinus – snowy plover
Charadrius semipalmatus – semipalmated plover
Charadrius vociferus – killdeer

CICONIIDAE **– STORKS**

Mycteria Americana – wood stork

COLUMBIDAE **– PIGEONS AND DOVES**

Columba livia – rock pigeon
Columbina passerina – common ground-dove
Streptopelia risoria – ringed turtle dove
Zenaida asiatica – white-winged dove
Streptopelia decaocto – Eurasian collared-dove
Zenaida macroura – mourning dove

CORVIDAE **– CROWS AND JAYS**

Corvus brachyrhynchos – American crow
Corvus corax – common raven

CUCULIDAE **– CUCKOOS, ROADRUNNERS, AND ANIS**

Geococcyx californianus – greater roadrunner

EMBERIZIDAE **– EMBERIZIDS**

Passerculus sandwichensis – savannah sparrow
Melospiza lincolnii – Lincoln's sparrow
Melospiza melodia – song sparrow
Melozone aberti – Abert's towhee

FALCONIDAE **– CARACARAS AND FALCONS**

Falco peregrinus – peregrine falcon
Falco sparverius – American kestrel

FRINGILLIDAE **– FRINGILLINE AND CARDUELINE FINCHES AND ALLIES**

Carpodacus mexicanus – house finch
Spinus psaltria – lesser goldfinch

HIRUNDINIDAE **– SWALLOWS**

Petrochelidon pyrrhonota – cliff swallow
Stelgidopteryx serripennis – northern rough-winged swallow

APPENDIX A (Continued)

Tachycineta bicolor – tree swallow
Tachycineta thalassina – violet-green swallow

***ICTERIDAE* – BLACKBIRDS**

Agelaius phoeniceus – red-winged blackbird
Euphagus cyanocephalus – Brewer's blackbird
Icterus bullockii – Bullock's oriole
Molothrus ater – brown-headed cowbird
Quiscalus mexicanus – great-tailed grackle
Sturnella neglecta – western meadowlark
Xanthocephalus xanthocephalus – yellow-headed blackbird

***LANIIDAE* – SHRIKES**

Lanius ludovicianus – loggerhead shrike

***LARIDAE* – GULLS, TERNS, AND SKIMMERS**

Chlidonias niger – black tern
Chroicocephalus philadelphia – Bonaparte's gull
Gelochelidon nilotica – gull-billed tern
Hydroprogne caspia – Caspian tern
Larus californicus – California gull
Larus delawarensis – ring-billed gull
Larus livens – yellow-footed gull
Leucophaeus atricilla – Laughing Gull
Rynchops niger – black skimmer
Sterna forsteri – Forster's tern
Thalasseus elegans – elegant tern

***MIMIDAE* – MOCKINGBIRDS AND THRASHERS**

Mimus polyglottos – northern mockingbird

***ODONTOPHORIDAE* – NEW WORLD QUAIL**

Callipepla gambelii – Gambel's quail

***PARULIDAE* – WOOD-WARBLERS**

Dendroica petechia – yellow warbler
Geothlypis trichas – common yellowthroat
Icteria virens – yellow-breasted chat
Oreothlypis celata – orange-crowned warbler

APPENDIX A (Continued)

PELECANIDAE **– PELICANS**

Pelecanus erythrorhynchos – American white pelican
Pelecanus occidentalis – brown pelican

PHALACROCORACIDAE **– CORMORANTS**

Phalacrocorax auritus – double-crested cormorant

PHASIANIDAE **– PARTRIGES, GROUSE, TURKEYS, AND OLD WORLD QUAIL**

Phasianus colchicus – ring-necked pheasant

PICIDAE **– WOODPECKERS AND ALLIES**

Picoides scalaris – ladder-backed woodpecker

PODICIPEDIDAE **– GREBES**

Aechmophorus clarkii – Clark's grebe
Aechmophorus occidentalis – western grebe
Podilymbus podiceps – pied-billed grebe

POLIOPTILIDAE **– GNATCATCHERS AND GNATWRENS**

Polioptila melanura – black-tailed gnatcatcher

RALLIDAE **– RAILS, GALLINULES, AND COOTS**

Fulica americana – American coot
Gallinula chloropus – common moorhen
Porzana carolina – sora
Rallus longirostris yumanensis – Yuma clapper rail

RECURVIROSTRIDAE **– STILTS & AVOCETS**

Himantopus mexicanus – black-necked stilt
Recurvirostra americana – American avocet

REMIZIDAE **– PENDULINE TITS AND VERDINS**

Auriparus flaviceps – verdin

SCOLOPACIDAE **– SANDPIPERS, PHALAROPES, AND ALLIES**

Arenaria interpres – ruddy turnstone
Calidris mauri – western sandpiper
Limosa fedoa – marbled godwit
Limnodromus griseus – short-billed dowitcher
Limnodromus scolopaceus – long-billed dowitcher
Numenius americanus – long-billed curlew

APPENDIX A (Continued)

Numenius phaeopus – whimbrel
Phalaropus lobatus – red-necked phalarope
Tringa melanoleuca – greater yellowlegs
Tringa semipalmata – willet

***STRIGIDAE* – TYPICAL OWLS**
Athene cunicularia – burrowing owl
Bubo virginianus – great horned owl

***STURNIDAE* – STARLINGS**
Sturnus vulgaris – European starling

***THRESKIORNITHIDAE* – IBISES AND SPOONBILLS**
Plegadis chihi – white-faced ibis

***TROCHILIDAE* – HUMMINGBIRDS**
Archilochus alexandri – black-chinned hummingbird
Calypte anna – Anna's hummingbird
Calypte costae – Costa's hummingbird

***TROGLODYTIDAE* – WRENS**
Cistothorus palustris – marsh wren
Troglodytes aedon – house wren

***TYRANNIDAE* – TYRANT FLYCATCHERS**
Contopus sordidulus – western wood-pewee
Empidonax difficilis – Pacific-slope flycatcher
Empidonax traillii – willow flycatcher
Sayornis nigricans – black phoebe
Tyrannus verticalis – western kingbird
Tyrannus vociferans – Cassin's kingbird

***TYTONIDAE* – BARN OWLS**
Tyto alba – barn owl

APPENDIX B

Willow Flycatcher Survey and Detection Form

Willow Flycatcher (WIFL) Survey and Detection Form (revised April, 2010)

Site Name: Salton Sea SCH - Alamo River A State: CA County: Imperial
USGS Quad Name: Niland Elevation: ~68~ (meters)
Creek, River, or Lake Name: Alamo River
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? *Yes* X *No* ____
Survey Coordinates: Start: E 115°37'12.96" N 33°12'37.023" ~~UTM~~ Datum: NAD83 (See instructions)
Stop: E 115°34'51.23" N 33°11'3.2524" ~~UTM~~ Zone: 11
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.
Fill in additional site information on back of this page*

Survey # Observer(s) (Full Name)	Date (m/d/y) Survey Time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding;-potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary			
Survey # 1 Observer(s): Anita Haywarth	Date: 5/20/10 Start: 0530 Stop: 1100 Total hrs: 5.5	1	Ø	6	N		# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s): Anita Haywarth	Date: 6/2/10 Start: 0600 Stop: 1105 Total hrs: 6	4	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s): Anita Haywarth	Date: 6/10/10 Start: 0505 Stop: 1115 Total hrs: 6	5	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s): Anita Haywarth	Date: 6/25/10 Start: 0515 Stop: 1105 Total hrs: 6	Ø	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s): Jeff Priest	Date: 7/8/10 Start: 0500 Stop: 1100 Total hrs: 6	Ø	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Overall Site Summary. Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total survey hrs: 29.5		Total Adult Residents: Ø	Total Pairs: 4	Total Territories: Ø	Total Nests: Ø	Were any WIFLs color-banded? Yes ____ No X. If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual: Anita Haywarth Date Report Completed: ____
US Fish & Wildlife Service Permit #: TE - 781084 State Wildlife Agency Permit #: SC - 10810

Submit form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual Anita Haywerth Phone # (760) 479-4239
Affiliation Dudek E-mail ahaywerth@dudek.com
Site Name Salton Sea SCH - Alamo Date Report Completed _____
Was this site surveyed in a previous year? Yes___ No X Unknown ____
Did you verify that this site name is consistent with that used in previous years? Yes ____ No _____ Not Applicable ____
If site name is different, what name(s) was used in the past?_____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes X No ____ If no, summarize below.

Management Authority for Survey Area: Federal X Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) USFWS

Length of area surveyed: ___ ___ 3.2 (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

_____ Native broadleaf plants (entirely or almost entirely, > 90% native)

_____ Mixed native and exotic plants (mostly native, 50 - 90% native)

_____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

X Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific names.
Tamarix sp.

Average height of canopy (Do not include a range): 4 (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections; 2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests; 3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

Willow Flycatcher (WIFL) Survey and Detection Form (revised April, 2010)

Site Name: Salton Sea SCH - New River A State: CA County: Imperial
USGS Quad Name: Westmorland West Elevation: -68 (meters)
Creek, River, or Lake Name: New River
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? *Yes* X *No* ____
Survey Coordinates: Start: E 115°41'41.177" N 33°8'0.609" UTM Datum: NAD83 (See instructions)
Stop: E 115°40'8.457" N 33°6'14.57" UTM Zone: 11
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.
Fill in additional site information on back of this page*

Survey # Observer(s) (Full Name)	Date (m/d/y) Survey Time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N If Yes, number of nests	Comments (e.g., bird behavior, evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator.	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s): Brock Ortega	Date: 5/21/10 Start: 0515 Stop: 1100 Total hrs: 5.75	4	ϕ	ϕ	N		# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s): Brock Ortega	Date: 6/10/10 Start: 0500 Stop: 1115 Total hrs: 6.25	9	ϕ	ϕ	N		# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s): Brock Ortega	Date: 6/18/10 Start: 0430 Stop: 1100 Total hrs: 6.5	ϕ	ϕ	ϕ	N		# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s): Brock Ortega	Date: 6/29/10 Start: 0450 Stop: 1100 Total hrs: 6	ϕ	ϕ	ϕ	N		# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s): Anita Haywarth	Date: 7/9/10 Start: 0515 Stop: 1105 Total hrs: 5.75	ϕ	ϕ	ϕ	N		# Birds	Sex	UTM E	UTM N
Overall Site Summary Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total survey hrs: 30.75	Total Adult Residents: ϕ	Total Pairs: ϕ	Total Territories: ϕ	Total Nests: ϕ	Were any WIFLs color-banded? Yes ____ No X If yes, report color combination(s) in the comments section on back of form and report to USFWS.					

Reporting Individual: Anita Haywarth Date Report Completed: ____
US Fish & Wildlife Service Permit #: TE-781084 State Wildlife Agency Permit #: SC-10810

***Submit** form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.*

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual Anita Haywerth Phone # (760)479-4239
Affiliation Dudek E-mail Ahaywerth@dudek.com
Site Name Salton Sea SCH - New River A Date Report Completed _____

Did you verify that this site name is consistent with that used in previous years? Yes ____ No ____ Not Applicable X
If site name is different, what name(s) was used in the past? _____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes X No ____ If no, summarize below.

Management Authority for Survey Area : Federal X Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) USFWS

Length of area surveyed: 3,400 (meters)

Vegetation Characteristics: Mark the category that best describes the predominant tree/shrub foliar layer at this site (check one):

____ Native broadleaf plants (entirely or almost entirely, > 90% native, includes high-elevation willow)

____ Mixed native and exotic plants (mostly native, 50 - 90% native)

____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

X Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific name.
Tamarix sp.

Average height of canopy (Do not include a range): 4 (meters)

Attach copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections.
Attach sketch or aerial photo showing site location, patch shape, survey route, location of any WIFLs or WIFL nests detected.
Attach photos of the interior of the patch, exterior of the patch, and overall site; describe any unique habitat features.

Comments (attach additional sheets if necessary)

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM N	UTM E	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

Willow Flycatcher (WIFL) Survey and Detection Form (revised April, 2010)

Site Name: Salton Sea SCH - New River B/Alamo River S State: CA County: Imperial
USGS Quad Name: Westmorland West + N. land Elevation: -68 (meters)
Creek, River, or Lake Name: New River + Alamo River
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? Yes X No
Survey Coordinates: * Start: E 115°41'7.33" N 33°6'31.415" ~~UTM~~ Datum: WGS83 (See instructions)
Stop: E 115°4'28.695" N 33°5'46.105" ~~UTM~~ Zone: 11
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.
Fill in additional site information on back of this page*

Survey # Observer(s) (Full Name)	Date (m/d/y) Survey Time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s): Paul Lemons	Date: 5/27/10 Start: 0550 Stop: 1100 Total hrs: 5.25	1	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s): Paul Lemons	Date: 6/4/10 Start: 0545 Stop: 1100 Total hrs: 5.25	Ø	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s): Paul Lemons	Date: 6/11/10 Start: 0600 Stop: 1100 Total hrs: 5	3	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s): Jeff Priest	Date: 6/28/10 Start: 0445 Stop: 1100 Total hrs: 6.25	Ø	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s): Paul Lemons	Date: 7/9/10 Start: 0600 Stop: 1100 Total hrs: 5	Ø	Ø	Ø	N		# Birds	Sex	UTM E	UTM N
Overall Site Summary. Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total survey hrs: 26.75		Total Adult Residents: Ø	Total Pairs: Ø	Total Territories: Ø	Total Nests: Ø	Were any WIFLs color-banded? Yes ____ No X. If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual: Anita Haywarth Date Report Completed:
US Fish & Wildlife Service Permit #: TE-781034 State Wildlife Agency Permit #: SC-10810

***Submit** form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.*

* Survey area is split into two areas. The area along Alamo River is: start: 115°35'891"W 33°11'52.415"N
end: 115°34'196"W 33°11'2.273"N

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual Anita Haywerth Phone # (760)479-4239
Affiliation Dudek E-mail Ahayworth@dudek.com
Site Name Salton Sea SCH - New River A/Alamo River B Date Report Completed _____

Did you verify that this site name is consistent with that used in previous years? Yes ____ No ____ Not Applicable X
If site name is different, what name(s) was used in the past? _____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes X No ____ If no, summarize below.

Management Authority for Survey Area : Federal X Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) USFWS

Length of area surveyed: 3,400 (meters)

Vegetation Characteristics: Mark the category that best describes the predominant tree/shrub foliar layer at this site (check one):

____ Native broadleaf plants (entirely or almost entirely, > 90% native, includes high-elevation willow)

____ Mixed native and exotic plants (mostly native, 50 - 90% native)

____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

X Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific name.
Tamarix sp.

Average height of canopy (Do not include a range): 4 (meters)

Attach copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections.
Attach sketch or aerial photo showing site location, patch shape, survey route, location of any WIFLs or WIFL nests detected.
Attach photos of the interior of the patch, exterior of the patch, and overall site; describe any unique habitat features.

Comments (attach additional sheets if necessary)

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM N	UTM E	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

APPENDIX C

Site Photos

APPENDIX C
Site Photos

Alamo–Overall Site



Alamo–Exterior of Patch



APPENDIX C (Continued)

Alamo–Interior of Patch



New River A–Overall Site



APPENDIX C (Continued)

New River A–Exterior of Patch



New River A–Interior of Patch



APPENDIX C (Continued)

New River B–Overall Site



New River B–Exterior of Patch



APPENDIX C (Continued)

New River B–Interior of Patch



SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Flagstaff Office
114 North San Francisco Street, Suite 100
Flagstaff, AZ 86001
Tel 928.774.5500 Fax 928.779.2709
www.swca.com

Record Id 11249
County Imperial
Year 2009
Spp SWFL (+) YCR (+)
Srv. Rpt.
D.B. JC 2/25/11
GIS monitoring
L+R
File

December 14, 2009

Sandra Marquez, Permit Coordinator
Carlsbad U.S. Fish and Wildlife Service
6010 Hidden Valley Road
Carlsbad, CA 92011

Re: SW Willow Flycatcher Studies 2009
T&E Species Permit TE028605-2, Final Permit Report Deliverable

Ms. Marquez:

In fulfillment of SWCA Environmental Consultant's Federal Fish and Wildlife permit (TE028605-2) deliverable requirement with your department, please find enclosed on CD an annual report titled *Southwestern Willow Flycatcher Surveys, Color-banding and Nest Monitoring along the Lower Colorado River and Tributaries in Nevada, California, and Arizona,* 2009. This report details all of our Southwestern Willow Flycatcher studies conducted in California in 2009, and is presented in a site-by-site format to facilitate locating information of interest.

If you or your department requires any additional information, please do not hesitate contacting me directly: (928) 774-5500 ext. 201; tkoronkiewicz@swca.com.

Many thanks for your continuing support, sincerely,

Tom Koronkiewicz
Avian Ecologist

TJK
Enclosure

CFW1 CARLSBAD, CA
2[illegible] DEC 31 PM 12: 06

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Flagstaff Office
114 North San Francisco Street, Suite 100
Flagstaff, AZ 86001
Tel 928.774.5500 Fax 928.779.2709
www.swca.com

2136

25 March, 2010

Sandra Marquez, Permit Coordinator
Carlsbad U.S. Fish and Wildlife Service
6010 Hidden Valley Road
Carlsbad, CA 92011

Re: SW Willow Flycatcher Studies 2009
T&E Species Permit TE028605-2, Final Report Deliverables

Ms. Marquez:

In fulfillment of SWCA Environmental Consultant's Federal Fish and Wildlife permit deliverable requirement with your department, please find enclosed on CDs annual reports titled *Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2009;* and, *Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations along the Virgin and Lower Colorado River Regions, 2009.* These reports detail all of our Southwestern Willow Flycatcher studies conducted in southern Nevada and California in 2009. All reports are presented in a site-by-site format to facilitate locating information of interest.

If you or your department requires any additional information, please do not hesitate contacting me directly: (928) 774-5500 ext. 201; tkoronkiewicz@swca.com.

Many thanks for your continuing support, sincerely,

Tom Koronkiewicz
Avian Ecologist

TJK
Enclosures

CA
APR -1 AM 10: 37

Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2009. Annual Report







U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2010

AR063412

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

Lower Colorado River Multi-Species Conservation Program

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2009. Annual Report

Prepared by Mary Anne McLeod and Thomas J. Koronkiewicz,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA® ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2010

RECOMMENDED CITATION:

McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV, by SWCA Environmental Consultants, Flagstaff, AZ. 165 pp.

CONTENTS

Executive Summary xi

1. INTRODUCTION 1
PROJECT HISTORY 1
SPECIES INTRODUCTION 2
PURPOSE AND DESCRIPTION OF STUDY 3

2. PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS 7
INTRODUCTION 7
Special Concern Species 7
METHODS 9
Site Selection 9
Additional Site Evaluation 12
Broadcast Surveys 12
Site Description 13
RESULTS 13
Pahranagat National Wildlife Refuge, Nevada 19
Pahranagat North 20
Pahranagat West 20
Pahranagat MAPS 20
Pahranagat South 21
Littlefield, Arizona 21
Littlefield Poles 21
Mesquite, Nevada 22
Mesquite East 22
Mesquite West 22
Bunker Marsh North 23
Mormon Mesa, Nevada 23
Mormon Mesa North 23
Hedgerow 24
Mormon Mesa South 24
Virgin River #1 24
Virgin River #2 25
Muddy River, Nevada 26
Overton WMA Pond 26
Overton WMA 26
Ground Reconnaissance Results 27
Topock Marsh, Arizona 27
Pipes #1 27
Pipes #3 28
The Wallows 28
PC6-1 28
Pig Hole 29
In Between 29
800M 29
Pierced Egg 29

Swine Paradise 30
Barbed Wire 30
Platform 30
250M 31
Hell Bird and Glory Hole 31
Beal Lake 31
Lost Slough 32
Lost Pond 32
Lost Lake 32
Ground Reconnaissance Results 33
Topock Gorge, Arizona and California 34
Pulpit Rock 34
Picture Rock 35
Blankenship Bend North 35
Blankenship Bend South 35
Bill Williams River National Wildlife Refuge, Arizona 36
Burn Edge 36
Bill Williams Site #4 and Site #3 36
Last Gasp 37
Bill Williams Site #5 37
Upstream from Site #8 37
Planet Ranch Road 38
Ground Reconnaissance Results 38
Ahakhav Tribal Preserve, Arizona 38
Deer Island 38
Palo Verde Ecological Reserve, California 39
PVER Phase 2 39
Big Hole Slough, California 39
Big Hole Slough 39
Cibola National Wildlife Refuge, Arizona and California 39
CVCA Phase 1 39
CVCA Phase 3 40
Cibola Nature Trail 40
Cibola Island 40
Cibola Site #2 and Cibola Site #1 41
Hart Mine Marsh 41
Cibola Lake East 41
Walker Lake 41
Imperial National Wildlife Refuge, Arizona and California 42
Paradise 42
Hoge Ranch 42
Rattlesnake 42
Milemarker 65 43
Nursery NW 43
Ferguson Lake 43
Great Blue Heron 43
Powerline 44
Martinez Lake 44
Ground Reconnaissance Results 44

Mittry Lake, California 45
Mittry West 45
Ground Reconnaissance Results 45
Yuma, Arizona 45
Gila River Site #2 45
Fortuna Site #1 46
Fortuna North 46
DISCUSSION 46

3. COLOR-BANDING AND RESIGHTING 49
INTRODUCTION 49
METHODS 49
Color-banding 49
Resighting 50
RESULTS 50
All Monitoring Sites 50
Site-by-Site Color-Banding and Resighting 51
Monitoring Sites 51
Non-Monitoring Sites 64
Adult Between-Year Return and Dispersal 65
Juvenile Between-Year Return and Dispersal 66
Within-Year, Between-Study Area Movements 67
DISCUSSION 67
Color-Banding Effort 67
Adult and Juvenile Between-Year Dispersal 68
Adult and Juvenile Survivorship 69

4. NEST MONITORING 71
INTRODUCTION 71
METHODS 71
RESULTS 72
Nest Monitoring 72
Nest Failure 74
Brood Parasitism 75
Mayfield Nest Success and Nest Productivity 76
DISCUSSION 77
Nest Success 78
Nest Failure 78
Brood Parasitism 79

5. VEGETATION AND HABITAT CHARACTERISTICS 81
INTRODUCTION 81
METHODS 81
Currently Occupied Territories 81
Nests in Formerly Occupied Areas 82
Data Analyses 83

RESULTS 83
Currently Occupied Territories 83
Nests in Formerly Occupied Areas 84
DISCUSSION 91
Currently Occupied Territories 91
Nests in Formerly Occupied Areas 92

6. MICROCLIMATE 95
INTRODUCTION 95
METHODS 95
Currently Occupied Territories 95
Temperature and Relative Humidity (T/RH) Measurements 95
Soil Moisture (SM) Measurements 96
Statistical Analyses 97
Nests in Formerly Occupied Areas 98
Statistical Analyses 98
RESULTS 99
Currently Occupied Territories 99
Nests in Formerly Occupied Areas 113
DISCUSSION 115
Currently Occupied Territories 115
Nests in Formerly Occupied Territories 115

7. HABITAT MONITORING: PARKER TO IMPERIAL DAMS 117
INTRODUCTION 117
METHODS 118
Temperature/Humidity (T/RH) Loggers 118
Soil Moisture (SM) Measurements 119
Vegetation Measurements 119
Groundwater Measurements 119
Piezometer Replacement 119
Data Collection 119
Data Validation 120
Statistical Analyses 120
Microclimate 120
Vegetation 121
Groundwater Levels 121
RESULTS 124
Temperature/Humidity Logger Maintenance 124
Piezometer Installation and Maintenance 124
Data Validation 124
Microclimate 125
2009 Microclimate Descriptive Statistics 125
Between-year Comparisons of Microclimate Characteristics 126
Comparison of Parker/Imperial to Topock Marsh: Microclimate 128
Vegetation Measurements 128
Between-year Comparisons of Vegetation Characteristics 128

Groundwater Monitoring 132
Overview of Piezometer Groundwater Levels 132
Evapotranspiration Signature 134
DISCUSSION 138
Microclimate 138
Comparison of Parker/Imperial to Topock Marsh 138
Between-year Comparisons of Microclimate Characteristics 138
Vegetation 139
Groundwater Levels 140
Piezometer Groundwater Levels 140
Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements 141
Evapotranspiration Signature 141

8. SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 143
INTRODUCTION 143
METHODS 143
Surface Water Mapping 143
Microclimate 144
Vegetation 144
Data Analyses 144
Microclimate 144
Vegetation 144
RESULTS 145
Surface Water Mapping 145
Microclimate 145
Vegetation 148
DISCUSSION 150

9. MICROCLIMATE AND VEGETATION MONITORING: PAHRANAGAT 151
INTRODUCTION 151
METHODS 151
Microclimate 151
Vegetation 152
Data Analyses 152
Microclimate 152
Vegetation 152
RESULTS 152
Microclimate 152
Vegetation 153
DISCUSSION 153

10. MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS 155
BROADCAST SURVEYS 155
COWBIRD CONTROL 155
VEGETATION 156
HABITAT MONITORING: PARKER TO IMPERIAL DAMS 156

11. LITERATURE CITED 159

Appendices

A. Field Data Forms
B. Orthophotos Showing Study Sites
C. Detections of Special Concern Species, 2009
D. All Willow Flycatchers Color-Banded and/or Resighted, 2003–2009
E. Hydrographs for Piezometers at Habitat Monitoring Sites
F. Contributing Personnel

Figures

1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*) 2

2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2009 8

5.1. Vertical foliage density at occupied willow flycatcher territories in coyote willow habitat type, 2009 86
5.2. Vertical foliage density at occupied willow flycatcher territories in tamarisk/coyote willow habitat type, 2009 86
5.3. Vertical foliage density at occupied willow flycatcher territories in Goodding willow habitat type, 2009 87
5.4. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2009 87
5.5. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Mormon Mesa, 2009 88
5.6. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Topock Marsh, 2009 88
5.7. Vertical foliage density at occupied willow flycatcher territories in tamarisk habitat type, 2009 89
5.8. Vertical foliage density at occupied willow flycatcher territories in cottonwood/mesquite habitat type, 2009 89

6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009 104
6.2. Mean distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009 105
6.3. Mean percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2009..... 106
6.4. Mean percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2009..... 107
6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009..... 108
6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009..... 109
6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009..... 110
6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009..... 111
6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009..... 112

7.1. Typical daily fluctuation in groundwater levels as the result of evapotranspiration and recharge ... 122
7.2. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2009..... 130
7.3. Daily evapotranspiration (ET) signature (ft) and mean daily water level [WL; feet below ground surface (bgs)] at Topock Marsh, May–August, 2007 135
7.4. Daily evapotranspiration (ET) signature (ft) and mean daily water level [WL; feet below ground surface (bgs)] at Topock Marsh, May–August, 2009 136
7.5. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily temperature (°C) at Topock Marsh, May–August, 2007..... 136
7.6. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily temperature (°C) at Topock Marsh, May–August, 2009..... 137
7.7. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily depth to groundwater (feet below ground surface) at Topock Marsh, May–August, 2007 137
7.8. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily depth to groundwater (feet below ground surface) at Topock Marsh, May–August, 2009 138

8.1. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–August 2009..... 145
8.2. Extent of surface water within In Between, 800M, and Pierced Egg at approximately monthly intervals, March–July 2009..... 146
8.3. Vertical foliage density in areas occupied by flycatchers in at least one year between 2003 and 2009 within the habitat enhancement project area, Topock Marsh, 2009..... 149
8.4. Vertical foliage density in areas not occupied by flycatchers between 2003 and 2009 within the habitat enhancement project area, Topock Marsh, 2009..... 149

Tables

2.1. Proposed Survey Schedule for Selected Sites 9
2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009 13
2.3. Detections of Willow Flycatchers Recorded after 15 June 2009 at Sites Where Breeding or Residency Was Not Confirmed 16
2.4. Yellow-Billed Cuckoo Detections along the Virgin, Bill Williams, and Lower Colorado Rivers, 2009 16
2.5. Yuma Clapper Rail Detections along the Virgin, Bill Williams, and Lower Colorado Rivers, 2009 17
2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2009 17

3.1. Summary of Willow Flycatchers Detected at Monitored Sites during the 2009 Breeding Season 53
3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 54
3.3. Banded Willow Flycatchers, Non-Monitoring Sites, 2009 64
3.4. Resident Adult Willow Flycatcher Annual Return from 2008 to 2009 66
3.5. Summary of Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2009 66
3.6. Summary of Juvenile Flycatchers Banded as Hatch Year Birds in 2001, 2007, or 2008 and Identified for the First Time in 2009 67

4.1. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009 73
4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers and Tributaries from 1996 to 2009 73
4.3. Summary of Causes of Willow Flycatcher Nest Failure at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009 74
4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-Headed Cowbirds, 2009 75
4.5. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009 76
4.6. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009 77

5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2009 85
5.2. Proportion of Stems Omitted from Stem Counts 85
5.3. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mormon Mesa and Topock 90
5.4. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined 91

6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Coyote Willow (n = 8), 2009 100
6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Coyote Willow (n = 4), 2009 100
6.3. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow (n = 5), 2009 101
6.4. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory (n = 7), 2009 101
6.5. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Mormon Mesa (n = 11), 2009 102
6.6. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Topock Marsh (n = 10), 2009 102
6.7. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk (n = 8), 2009 103
6.8. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Mesquite (n = 1), 2009 103
6.9. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mormon Mesa, NV 113
6.10. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Topock Marsh, AZ 114
6.11. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined 114

7.1. Summary of Piezometer Construction and Data Collection at Habitat Monitoring Sites, Lower Colorado River, 2005–2009 125
7.2. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, May–July 2009 127
7.3. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2009 127
7.4. Comparison of Microclimatic Variables at Habitat Monitoring Sites to Territories at Topock Marsh, 2009 128
7.5. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2009 129
7.6. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2009 131
7.7. High and Low Average Monthly Water Depths Recorded at Piezometers at Habitat Monitoring Sites, 2005–2009 133
7.8. Average Monthly Flows (cfs) Below Parker Dam, 2000–2009 133
7.9. Median Daily Evapotranspiration Signature by Month, May–Sep, 2005–2009 135

8.1. Microclimate Measures at Topock Hydrology Monitoring Sites – Use Area (n = 14), 2009 147
8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-use Area (n = 14), 2009 ... 147
8.3. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2009 148

9.1. Descriptive Statistics and Single Effects for Comparison of Microclimate Characteristics, 2005–2007 versus 2009, Pahranagat North 153
9.2. Descriptive Statistics and Single Effects for Comparison of Habitat Characteristics between 2005–2007 and 2009, Pahranagat North 154

EXECUTIVE SUMMARY

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*), listed as federally endangered in 1995, breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico. Historical breeding records and museum collections indicate a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region. Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Willow flycatcher studies have been conducted along the Virgin and lower Colorado Rivers and tributaries annually since 1996, in compliance with requirements set forth by the U.S. Fish and Wildlife Service (USFWS) regarding U.S. Bureau of Reclamation (Reclamation) routine operations and maintenance along the lower Colorado River. Biological Assessments and the resulting Biological Opinions on operations and maintenance were prepared as steps to developing a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). The LCR MSCP was signed in April 2005, and implementation of the program began in October 2005. The LCR MSCP calls for continued surveys and monitoring of willow flycatchers along the lower Colorado River. SWCA was contracted by Reclamation to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the Virgin and lower Colorado River regions in 2009.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet of California apportionment water for 75 years. The point of diversion, previously located below Parker Dam, would change to a point above Parker Dam. These changes in water regulation could cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less and have the potential to modify riparian habitats below Parker Dam. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams. In 2004, Reclamation biologists initiated studies of the microclimate within potentially affected areas. In 2005, these studies were continued and expanded by SWCA Environmental Consultants (SWCA) to address how the hydrological changes might affect riparian habitats along the Parker to Imperial reach.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. Water delivery is anticipated to commence in 2010. Monitoring of vegetation, microclimate, and hydrologic condition in the target area was initiated in 2009 to obtain baseline conditions in the target area.

Breeding flycatchers have been documented annually in 1997–2008 at Pahranagat National Wildlife Refuge in southern Nevada. The primary breeding site at this study area was flooded by Upper Pahranagat Lake during each breeding season until 2008, when structural problems with a levee required draining the lake. USFWS retained SWCA to collect microclimate and vegetation data at Pahranagat in

2009 to compare conditions during inundated periods to the conditions in 2009 when the site was not inundated. Results of this study are presented in a separate chapter in this report.

Approximately 100 sites are included in the study of flycatchers along the Virgin and lower Colorado Rivers, but a portion of the sites are surveyed on a biennial basis rather than annually. In 2009, we completed presence/absence surveys and site descriptions at 69 sites in 15 study areas from the Pahranagat National Wildlife Refuge (NWR), Nevada, south to Yuma, Arizona. We also conducted more intensive studies at the seven study areas where territorial flycatchers were detected in 2009: Pahranagat NWR, Mesquite, Mormon Mesa, and Muddy River Nevada; and Littlefield, Topock Marsh, and Bill Williams River NWR, Arizona. At these study areas, we searched for nests in all areas occupied by territorial flycatchers, monitored willow flycatcher nests to document nest fate, brood parasitism, and causes of nest failure; color-banded and resighted as many willow flycatchers as possible to determine the breeding status of territorial flycatchers and document movement and recruitment; and measured characteristics of vegetation and microclimate in occupied territories and at old flycatcher nests in abandoned areas where we had collected similar data when the nest was active.

We used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 69 sites, ranging in size from <1 to 47 ha, along the Virgin and lower Colorado Rivers and tributaries between 15 May and 26 July 2009, following a 5-survey protocol. We detected willow flycatchers on at least one occasion at 41 of these sites. Breeding or resident flycatchers were detected at 19 sites within the Pahranagat NWR, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams study areas. South of Bill Williams, 44 willow flycatcher detections were recorded between 15 May and 16 June; no flycatcher detections were recorded at any of these sites after 16 June. Monitoring results suggest these flycatchers were not resident, breeding individuals and were most likely spring migrants.

We used targeted mist-net and passive netting techniques to capture and uniquely color-band adult and fledgling willow flycatchers at all survey sites where resident willow flycatchers were detected. Nestlings were banded between 8 and 10 days of age. We banded each willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and one pin-striped, aluminum band on the other. We used binoculars to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combinations on their legs.

We color-banded 17 new adult flycatchers and recaptured 8 individuals previously banded as adults. An additional 55 adults were identified to individual via resighting, while 10 individuals were resighted but did not have their color combinations confirmed. One individual had federal band on one leg and an injury on the other leg, and one adult had a duplicate color-band combination. We detected eight individuals identified as returning nestlings by the presence of a single federal band, with three (38%) identified to individual via recapture. Thirty-one adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 19 adults. We banded 44 nestlings from 21 nests. We banded flycatchers opportunistically at Key Pittman Wildlife Management Area and St. George, capturing and color-banding six new adults and recapturing one returning nestling. Twelve nestlings from five nests were banded.

We recorded 76 territories at all monitored sites. Of these, 50 (66%) consisted of paired flycatchers and 22 (29%) consisted of unpaired individuals. In the remaining four territories (5%), a singing male was confirmed as resident and a second flycatcher, suspected to be a female, was detected for only a few days. Nine breeding males were polygynous, each pairing with two females. Three females mated consecutively with two different males.

Of the 75 resident, adult willow flycatchers identified to individual in 2008, 41 (55%) were identified in 2009; 1 (2%) was detected at a different study area from where it was last detected in 2008. We detected no within-year, between-study area movements in 2009.

Of the 73 juveniles banded at the monitored study areas in 2008, 12 (16%) were identified in 2009. Two additional flycatchers banded as nestlings in St. George in 2008 were identified in 2009. Four individuals originally banded as nestlings in previous years were identified for the first time in 2009. Of the 18 returning nestlings identified in 2009, 10 (56%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2009 was 13.7 km.

We documented 72 willow flycatcher nesting attempts, 65 of which contained eggs and were used in calculating nest success and productivity. Twenty-three (35%) nests were successful and fledged young; 40 (62%) failed, and fate was unknown for 2 (3%). Mayfield survival probability ranged from 0.053 to 0.519 and was 0.368 for all sites combined. Depredation was the major cause of nest failure, accounting for 40% of all failed nests and 48% of nests that failed after flycatcher eggs were laid.

Sixteen of 56 nests (17%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds. Brood parasitism at all study areas ranged from 0 to 100% and was highest at Littlefield. We observed the seventh consecutive year of no brood parasitism at Pahranagat. Nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized.

At Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams, we gathered data on vegetation and microclimate characteristics at one location for each of 56 territorial male flycatchers we identified, regardless of the length of time the male was resident and whether or not he obtained a mate. We delineated the following habitat types: 1) coyote willow, 2) tamarisk with coyote willow, 3) Goodding willow, 4) Goodding willow with tamarisk understory, 5) tamarisk with scattered Goodding willow, 6) tamarisk, and 7) cottonwood with mesquite. Coyote willow and Goodding willow are the only habitat types likely to be created at restoration areas, but we summarize vegetation and microclimate characteristics for all habitat types. Sample sizes in 2009 are likely too small to provide an accurate representation of the range and variance in vegetation and microclimate characteristics in each habitat type.

Territories within most vegetation types exhibited moist or inundated soil conditions throughout the breeding season. Several habitat types showed a general drying trend in soil conditions as the breeding season progressed. Daily maximum temperatures spanned a range of <10°C among habitat types, while daily minimum temperatures spanned <5°C. Vapor pressure increased through the end of July for all habitat types.

In addition to collecting vegetation and microclimate data at occupied territories, we investigated whether changes in vegetation and microclimate might have contributed to the abandonment of some areas by flycatchers. We identified areas at Mormon Mesa and Topock Marsh that had been occupied by nesting flycatchers in at least one previous year from 2003 to 2007 but were unoccupied in 2009, and we relocated old nests at which we had collected vegetation and microclimate information in the year the nest was active. We resampled microclimate and vegetation at these nests in 2009.

We had not noted dramatic, qualitative changes in vegetation in abandoned areas at Mormon Mesa or Topock Marsh. Vegetation data showed a decrease in the proportion of live stems 2.5–8 cm dbh at both study areas, which could reduce the suitability of the vegetation for flycatchers. The proportion of live stems >8 cm dbh increased at Topock, but this variable did not differ between the occupied year and 2009 at Mormon Mesa or when both study areas were combined. Canopy height increased at both Mormon Mesa and Topock between occupied and unoccupied periods, but this increase in canopy height is likely

the result of vegetation maturing over the years and probably did not contribute to abandonment of the area. Canopy closure increased at Mormon Mesa between occupied and unoccupied periods but showed a decreasing trend at Topock. Given that flycatchers typically nest in areas with very high canopy closure, it is unlikely that an increase in canopy closure would contribute to site abandonment. The apparent changes in canopy closure at both Mormon Mesa and Topock were small (<6%) and may be the result of observer variation.

Microclimate at old nests sites differed between occupied and unoccupied periods in at least one variable at both Mormon Mesa and Topock Marsh. At Mormon Mesa, nest sites had higher diurnal and nocturnal vapor pressure when they were occupied versus when they were abandoned. At Topock Marsh, nest sites had higher nocturnal vapor pressure when the nest was occupied. The differences in microclimate we observed between 2009 and the year the nest was occupied at both Topock and Mormon Mesa are likely the result of interannual climatic differences, as recorded at regional weather stations, and not the result of localized changes at the nest sites.

In 2005, we selected 11 sites between Parker and Imperial Dams for inclusion in the habitat monitoring study addressing how changes in water transfer actions might affect riparian habitat. We also selected two control sites above Parker Dam and two below Imperial Dam. At each site we installed 3–5 temperature/humidity data loggers and one groundwater observation well (piezometer). All logger and piezometer locations selected in 2005 were retained in 2006. In August 2006, we installed a piezometer and two temperature/humidity data loggers within occupied flycatcher habitat at Topock Marsh. Two loggers and one piezometer were damaged or destroyed in a fire in December 2006 and were replaced in 2007, and one piezometer that was destroyed by a bulldozer in 2007 was replaced in 2008. At sites that were surveyed for flycatchers in 2009, soil moisture measurements were collected at each data logger location during each of five flycatcher surveys between 15 May and 25 July. At sites that were not surveyed in 2009, soil moisture measurements were collected at the beginning and end of the survey season. Vegetation measurements were also collected at each data logger location after surveys were completed. We used data from piezometers that were located within the woody, riparian vegetation to evaluate whether the evapotranspiration signature in June–August changed over time from 2005 to present. We also compared microclimate characteristics at the habitat monitoring sites to those found within flycatcher territories at Topock Marsh.

Several microclimatic variables at the combined habitat monitoring sites differed significantly from those at Topock Marsh in 2009, with Topock being cooler and more humid than the habitat monitoring sites. Comparison of microclimate variables at the habitat monitoring sites to those at within flycatcher territories at Topock Marsh in each year from 2005 to 2009 have shown that the habitat monitoring sites consistently have warmer temperatures, greater daily temperature range, and lower humidity than occupied territories.

Comparisons of microclimate characteristics among years in 2005–2009 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 than in the other years and cooler conditions in 2009. These interannual changes were similar between test and control sites, suggesting that these changes were regional, rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006 and 2007–2008 were not similar between test and control sites, with soil moisture declining more sharply at the control sites. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. Mean daily temperature range and mean maximum diurnal temperature were higher at test sites but lower at control sites in 2008 versus 2007. These metrics decreased sharply in 2009 at both test and control sites, presumably in response to the unusually cool climate conditions during portions of summer 2009. Thus, there have not been any consistent patterns in the changes in microclimate characteristics at test versus control sites that could be attributed to changes in river flows.

We noted between-year differences at the habitat monitoring sites for several vegetation variables. The only variables that exhibited a consistent change across time were percentage of live stems <2.5 cm dbh, which declined steadily from 2005 to 2009, and percentage of live stems 2.5–8 cm dbh, which was lower in 2008 and 2009 than in the three preceding years. Woody ground cover was the only variable for which there was a significant interaction with location, meaning the changes in all the other variables between years among test sites was not significantly different from the change at control sites. Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years.

There was a between-year difference in live vegetation in the fourth meter interval above the ground and between-year differences for the first, second, third, and fourth meter intervals above the ground for dead vegetation. In all four intervals, density of dead vegetation was higher in 2008 than in 2007. There was a significant interaction between live vertical foliage density and location (test vs. control sites) for the fourth meter interval, but there was no clear pattern, with density generally increasing at control plots in years it decreased at test plots, and vice versa. There was also a significant interaction between dead vertical foliage density and location for the first meter interval, with the density of dead vegetation increasing more in 2007 and 2008 at control plots relative to test plots. The percentage of live vegetation in each meter interval differed between years only in the fourth meter interval; in this case, the live percentage was lower in 2008 than in 2007.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts. The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred.

Daily, weekly, and seasonal cycles in groundwater levels were apparent. Groundwater levels drop during afternoon hours when evapotranspiration is high and on the weekends when water releases from Parker Dam decline. The seasonal cycle in groundwater levels mirrors the seasonal fluctuation in river flow.

Of the 10 piezometers that were within the woody, riparian vegetation, only 6 yielded usable evapotranspiration signature data over multiple years. Inspection of the hydrographs revealed that intraday changes in groundwater level were influenced strongly by the cyclic changes in river water levels associated with dam releases. These sharp rises and declines in the river level overwhelmed the evapotranspiration signature, and data from the piezometers along the river could not be used to assess changes in evapotranspiration signature over time. Further analysis of evapotranspiration data was restricted to the piezometer at Topock Marsh.

The evapotranspiration signature was strongly, directly correlated with depth to groundwater and weakly, directly correlated to temperature during May–August, 2007 and 2009. However, temperature was also correlated with depth to groundwater, because both increased over the May–August period each year. The evapotranspiration signature at Topock Marsh was directly related to depth to groundwater, rather than showing the inverse relationship demonstrated in the literature. The magnitude of the

evapotranspiration signature at Topock appears to be driven by local groundwater hydraulics, and changes in the evapotranspiration signature over time cannot by used as a proxy for vegetation change.

We measured baseline vegetation, microclimate, and surface hydrology conditions in an area of Topock Marsh that is scheduled for delivery of supplemental surface water in 2010. We stratified the site into use (occupied by flycatchers) and non-use (unoccupied by flycatchers) areas, as observed in 2003–2008. We deployed temperature/humidity data loggers within both the use and non-use areas, collected soil moisture measurement biweekly at each logger location, mapped surface water throughout the area on a weekly basis, and collected vegetation data at each logger location at the end of flycatcher breeding season. The percentage of the area that was inundated rose rapidly in late March and early April to a high of almost 45% and then declined just as rapidly in May. By early June, <5% of the site had surface water. Vegetation was primarily tamarisk and had high canopy closure. The densest live foliage occurred above average nest height, and the densest dead vegetation occurred within 3 m of the ground. Soil conditions became progressively drier throughout the season for both the use and non-use areas, while vapor pressure values showed the typical rise seen in July with the onset of summer monsoons. Conditions documented in 2009 will be compared to those documented in 2010 when additional surface water is delivered to the site.

The main flycatcher breeding area at Pahranagat National Wildlife Refuge was inundated annually during the flycatcher breeding seasons of 1997–2007, with up to 1 m of water recorded under the vegetation in mid-May. Major structural problems with the levee that impounds Upper Pahranagat Lake resulted in the site being dry during the breeding seasons of 2008 and 2009. We collected microclimate and vegetation data within the site during 2009 and compared these measurements to vegetation and microclimate data collected within flycatcher territories at the site from 2005 to 2007. The only vegetation variable that differed between the inundated and non-inundated periods was the percentage of the foliage that consisted of native species. This difference is entirely attributable to the development in 2009 of herbaceous ground cover consisting partially of a non-native *Chenopodium* species and does not reflect any change in the woody vegetation.

Microclimate conditions differed between the inundated and non-inundated periods by soil moisture and diurnal and nocturnal vapor pressure being higher during the inundated period. Without humidity data from a nearby weather station, it is impossible to determine if the difference in humidity is attributable to changes in water levels or simply lower regional humidity in 2009. We had expected that inundated conditions might serve to moderate daily temperatures, but the data showed a higher maximum temperature and lower minimum temperature during the inundated period. These differences could not be accounted for by between-year differences in regional climate, with the Caliente weather station showing no between-year differences for either maximum or minimum temperature.

Chapter 2

PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS

INTRODUCTION

Broadcasts of recorded conspecific vocalizations are useful in eliciting responses from nearby willow flycatchers, and multiple broadcast surveys conducted throughout the breeding season are the standard technique for determining the presence or absence of ***E. t. extimus*** (Sogge et al. 1997). According to Sogge et al. (1997) and USFWS (2002), willow flycatchers detected between approximately 15 June and 20 July in the breeding range of ***E. t. extimus*** probably belong to the southwestern subspecies. However, because northbound individuals of all western subspecies of the willow flycatcher migrate through areas where ***E. t. extimus*** are actively nesting, and southbound migrants occur where ***E. t. extimus*** are still breeding (Sogge et al. 1997, USFWS 2002), field confirmation of the southwestern subspecies is problematic.[1] For example, the northwestern ***E. t. brewsteri***, far more numerous than ***E. t. extimus***, has been documented migrating north in southern California as late as 20 June (Garrett and Dunn 1981 as cited in Unitt 1987), and Phillips et al. (1964 as cited in Unitt 1987) documented ***E. t. brewsteri*** collected in southern Arizona on 23 June. An understanding of willow flycatcher migration ecology in combination with multiple broadcast surveys conducted throughout the breeding season is therefore needed to assess the presence and residency of Southwestern Willow Flycatchers.

Migration routes used by ***E. t. extimus*** are not well documented, though more is known of northbound migration in spring than the southbound migration in fall because flycatchers are more vocal in spring and can therefore be distinguished from other ***Empidonax*** species. During northbound migration, all subspecies of willow flycatchers use riparian habitats similar to breeding habitat along major river drainages in the Southwest such as the Rio Grande (Finch and Kelly 1999), Colorado River (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson unpubl. data). Although migrating willow flycatchers may favor young, native willow habitats (Yong and Finch 1997), migrants are also found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, even though not used for breeding, are likely important for both reproduction and survival. For most long-distance Neotropical migrant passerines, migration stopover habitats are needed to replenish energy reserves to continue northbound or southbound migration.

In 2009, we completed multiple broadcast surveys at sites in 15 study areas[2] along the LCR and its tributaries to detect both migrant and resident willow flycatchers (Figure 2.1).

Special Concern Species

The Yuma Clapper Rail (***Rallus longirostris yumanensis***) is listed as federally endangered by the USFWS, and the Yellow-billed Cuckoo (***Coccyzus americanus occidentalis***) is a candidate for federal listing. Both species occur along the LCR and its tributaries and are of concern to managing agencies. Nine additional avian species [California Black Rail (***Laterallus jamaicensis coturniculus***), Western Least Bittern (***Ixobrychus exilis***), Elf Owl (***Micrathene whitneyi***), Gila Woodpecker (***Melanerpes uropygialis***), Gilded Northern Flicker (***Colaptes auratus chrysoides***), Vermilion Flycatcher (***Pyrocephalus rubinus***),

[1] Throughout this document, the terms "flycatcher" and "willow flycatcher" refer to ***E. t. extimus*** when individuals are confirmed as residents. For individuals for which residency is undetermined, subspecies is unknown.

[2] Study areas consist of 1–18 survey sites that are grouped geographically (see Table 2.2).

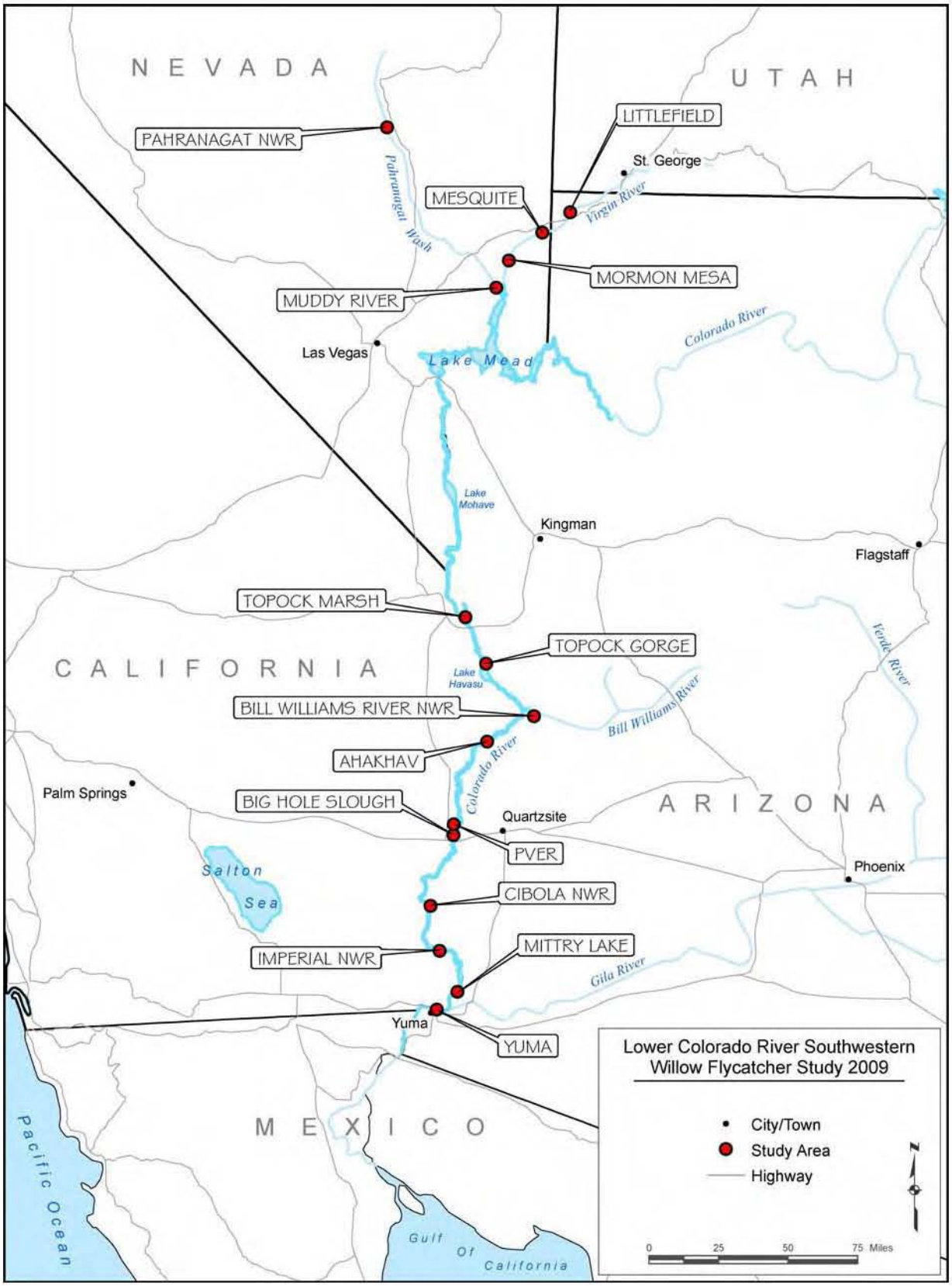


Figure 2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2009. (Note, study area labels represent the approximate center of multiple sites within that region; see Table 2.2)

Arizona Bell's Vireo (*Vireo bellii arizonae*), Yellow Warbler (*Dendroica petechia*), and Summer Tanager (*Piranga rubra*)] are considered to be special-concern species under the LCR MSCP. The Yellow-breasted Chat (*Icteria virens*) is also considered a special concern species in California. We did not survey specifically for these species but recorded all incidental detections.

METHODS

Site Selection

Survey sites were selected based on locations surveyed during previous years of willow flycatcher studies on the LCR (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; McLeod et al. 2008, McLeod and Koronkiewicz 2009) and reconnaissance by helicopter and on foot prior to the start of the 2009 survey period. Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (>50%) and standing water or saturated soil under or adjacent to the vegetation were considered the most suitable habitats for flycatchers. Early successional stands of young riparian vegetation >3 m in height in proximity to surface water or saturated soil were also considered potentially suitable flycatcher habitat. Riparian vegetation contiguous with suitable habitat was often included as part of survey areas. Reclamation biologist Theresa Olson guided and approved site selection. For sites surveyed in previous years, we retained original site names.

In 2008 we implemented a biennial survey schedule at selected sites in study areas where resident flycatchers had not been documented in the previous 10 years of surveys. Sites were selected for biennial surveys based on the absence of damp or wet soils within the site and/or the relative absence of dense vegetation that might provide suitable nesting habitat for flycatchers. After the 2008 survey season, we revised the survey schedule based on conditions observed in the field and added several sites at Bill Williams to the biennial schedule. These sites were ones at which no resident flycatchers had been detected since 2003. The proposed schedule at the beginning of the 2009 survey season is given in Table 2.1 and may be further revised based on conditions observed during 2009.

Table 2.1. Proposed Survey Schedule for Selected Sites

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
TOGO	Pulpit Rock	Tiny. Wet soil adjacent to river; upland edge dry.			X
	Picture Rock	Wet soil adjacent to river, interior dry.			X
	Blankenship Bend North	Stand of willow adjacent to marsh.	X		
	Blankenship Bend South	Mosaic of cattail, bulrush, willow. Areas with water under vegetation.	X		
	Havasu NE	Mature vegetation; interior of site is completely dry, no water beneath the vegetation.		X	
BIWI	Site #2	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Site #11	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
BIWI	Mineral Wash	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Beaver Pond	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Site #8	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within the river channel.		X	
PVER	PVER Phase 2	Restoration area.	X		
BIHO	Big Hole Slough	Marshy, new willows coming in.	X		
EHRE	Ehrenberg	Emergent cottonwood and Goodding willow; understory primarily arrowweed and ***Baccharis*** sp.; formerly contained a dense stand of coyote willow but these willows have all died.		X	
CIBO	CVCA Phase 1	Restoration area.	X		
	CVCA Phase 3	Restoration area.	X		
	Cibola Nature Trail	Generally dry and sparse, restoration area. Habitat improvements taking place, may improve.	X		
	Cibola Island	Narrow, linear site; patches of dense Goodding willow adjacent to marsh.	X		
	Cibola Site 2	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Cibola Site 1	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Hart Mine Marsh	Mostly tamarisk, with linear stretches of marsh vegetation. Dry soil under the tamarisk.			X
	Three Fingers Lake	Very dry and hot in interior, vegetation short.		X	
	Cibola Lake #1 (North)	Patchy vegetation, hot and dry in interior.		X	
	Cibola Lake #2 (East)	Patchy vegetation, hot and dry in interior.			X
	Cibola Lake #3 (West)	Patchy vegetation, hot and dry in interior.		X	
	Walker Lake	Tamarisk with emergent willows; water under vegetation along lake edge.	X		
IMPE	Paradise	Some big willows with tamarisk understory, sometimes has water in marshes.	X		
	Hoge Ranch	Mosaic of tamarisk, willow, and marshes. Sometimes wet.	X		

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
IMPE	Adobe Lake	Perched above river, very dry, dense tamarisk with many dead branches in understory.		X	
	Rattlesnake	Dense willows, wet soils.	X		
	Milemarker 65	Very narrow strip (<50m) of tamarisk adjacent to bulrush marsh. Understory of ***Phragmites*** creates extremely dense vegetation within 3 m of ground.			X
	Clear Lake/The Alley	Mature tamarisk, very dense understory. Very dry except immediately next to backwater channel.		X	
	Nursery NW	Dense tamarisk interspersed with marsh areas.	X		
	Imperial Nursery	Plantation. No understory.		X	
	Ferguson Lake	Mix of willow and tamarisk with water under vegetation on west side of site. East side is dry and scrubby.	X		
	Ferguson Wash	Mature tamarisk with emergent willow. Very dry in interior of site. Borders backwater channel and Ferguson Lake. Moist soils only along channel edge.		X	
	Great Blue Heron	Goodding willow overstory, tamarisk understory; moist soils in parts of the site.	X		
	Powerline	Very small, stringer of trees around cattail marsh that sometimes contains water. Sparse canopy.			X
	Martinez Lake	Scattered willows, tamarisk and arrowweed understory, sparse canopy closure.			X
MITT	Mittry West	Willow overstory, tamarisk understory, 80% canopy closure, sometimes wet.	X		
	Mittry South	Monotypic tamarisk, lots of deadfall. Interior is dry. Adjacent to lake.		X	
YUMA	Gila Confluence North	Patchy. A few small stands of mature willows around cattail marshes. Marshes sometimes contain water. Half of site burned in 2006. Overall canopy closure 50%.		X	
	Gila River Site #2	Cottonwood/willow overstory, tamarisk and arrowweed understory, dry soils in interior, canopy closure 50%.			X
	Fortuna Site #1	Narrow (30m) strip of cottonwood/willow. Patchy understory of tamarisk and arrowweed on periphery, no understory within cottonwood/willow. Interior is dry.			X
	Fortuna North	Mature tamarisk, 80% canopy closure. Interior very dry. Adjacent to Gila River.			X
	Morelos Dam	Recovering from fire, canopy closure less than 50%, widely spaced willow and cottonwood, dense patch of tamarisk on northern end of site.			X

[1] TOGO = Topock Gorge, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, BIHO = Big Hole Slough, EHRE = Ehrenberg, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

We provided field personnel with high-resolution aerial photographs of all selected survey sites. The photographs were overlain with a UTM grid (NAD 83) and an outline of the proposed survey area. The boundaries of all survey sites were refined to include potential flycatcher habitat actually present. New boundaries were delineated on the aerial photographs based on UTM coordinates obtained in the field. All UTM coordinates were obtained using a Garmin Rino 110 GPS unit and were in NAD 83 to comply with Federal Geographic Data Committee standards.

Additional Site Evaluation

During the survey season, we conducted on-the-ground habitat reconnaissance and evaluation to locate additional potentially suitable willow flycatcher habitat and to reevaluate areas we had visited in previous years and had noted as having the potential to become suitable habitat. Field personnel were provided high-resolution aerial photographs overlain with a UTM grid to aide with navigation and the identification of potentially suitable flycatcher habitat. We focused habitat reconnaissance and evaluation in areas that contained or were adjacent to standing water or saturated soils, and that had vegetation characteristics similar to that of flycatcher breeding sites (i.e., dense vegetation within 2–4 m of the ground and high canopy closure). Broadcast surveys were conducted opportunistically during ground reconnaissance. Field personnel formulated qualitative site descriptions of all evaluated areas.

Broadcast Surveys

To elicit responses from nearby willow flycatchers, we broadcast conspecific vocalizations previously recorded throughout the Southwest from 1996 to 1998. All flycatcher surveys were conducted according to methods described in Sogge et al. (1997), and we followed a 5-survey protocol, as recommended by the U.S. Fish and Wildlife Service (USFWS 2000). We completed at least one survey between 15 and 31 May, at least one survey between 1 and 15 June, and three additional surveys between 16 June and 25 July. Surveys were separated by a minimum of five days whenever logistically possible. Field personnel surveyed within the habitat wherever possible, using a portable CD or MP3 player (various models were used) coupled to a Radio Shack 277-1008C mini amplified speaker. Surveyors stopped every 30–40 m and broadcast willow flycatcher primary song (***fitz-bew***) and calls (***breets***). Field personnel watched for flycatchers and listened for vocal responses for approximately one to two minutes before proceeding to the next survey station. Wherever territorial flycatchers were detected, broadcast surveys were discontinued within a radius of 50 m of territories, and territory and nest monitoring commenced (see Chapter 4). If an unidentified ***Empidonax*** flycatcher was observed but did not respond with song to the initial broadcast, we broadcast other conspecific vocalizations including ***creets/breets***, ***wee-oos***, ***whitts***, ***churr/kitters***, and a set of interaction calls given by a mated pair of flycatchers (per Lynn et al. 2003). These calls are frequently effective in eliciting a ***fitz-bew*** song, thereby enabling surveyors to positively identify willow flycatchers. To produce a spatial representation of all survey areas, field personnel recorded survey start and stop UTM coordinates as well as the UTM coordinates of intermediate survey points. Observers recorded start and stop times and the location(s) and behavior of all willow flycatchers detected (see survey form, Appendix A). Field personnel also recorded the presence of Brown-headed Cowbirds (hereafter cowbirds) and livestock, as requested by the Arizona Game and Fish Department. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity (see Chapter 4), while livestock may substantially alter the vegetation in an area (USFWS 2002).

Site Description

Because vegetation structure and hydrology within riparian habitats are seasonally dynamic, field personnel completed site description forms (Appendix A) for each survey site at least three times throughout the survey season: early season (mid-May), mid-season (mid-June), and late season (mid-July). Vegetation composition (native vs. exotic) at survey sites followed the definitions of Sogge et al. (1997) and the Southwestern Willow Flycatcher Range-wide Database. Vegetation composition was defined as (1) native: >90% of the vegetation at a site was native; (2) exotic: >90% of the vegetation at a site was exotic/introduced; (3) mixed-native: 50 to 90% of the vegetation at a site was native; or (4) mixed-exotic: 50 to 90% of the vegetation at a site was exotic/introduced. Information from site description forms was used in conjunction with habitat photographs and comments in field notebooks and on survey forms to formulate qualitative site descriptions.

RESULTS

Field personnel spent 661.2 observer-hours conducting willow flycatcher broadcast surveys at 69 sites along the Virgin and lower Colorado Rivers and tributaries.[3] Willow flycatcher survey results are summarized in Table 2.2 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2009 are shown on orthophotos in Appendix B, along with historically occupied habitat.[4] Each site that was not occupied by territorial flycatchers was formally surveyed five times. Field personnel spent an additional 45.5 observer-hours completing habitat reconnaissance and evaluation and opportunistic surveys. The results of reconnaissance for each study area are presented below following the results for the regularly surveyed sites. Because subspecies identification of willow flycatchers detected between approximately 15 June and 20 July in the breeding range of ***E. t. extimus*** is problematic (Sogge et al. 1997, USFWS 2002), flycatcher detections after 15 June at sites where breeding or residency was not confirmed are summarized in Table 2.3. Yellow-billed Cuckoo and Yuma Clapper Rail detections are listed in Tables 2.4 and 2.5, respectively, and overall numbers of detections of all special concern species are listed in Appendix C. Hydrologic characteristics of each site are summarized in Table 2.6.

Table 2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009*

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
PAHR	North	4.6	23 (6 May–13 Aug)
	West	1.5	ND
	MAPS	2.7	ND
	South	2.5	1 (22 Jun)
LIFI	Poles	4.7	5 (1 Jun–26 Jul)
MESQ	East	4.4	ND
	West	11.5	21 (10 May–13 Aug)

[3] We started the survey season with 70 sites scheduled for surveys in 2009. One site had been bulldozed prior to the start of the survey season and was not surveyed. We discontinued surveys at two additional sites, one because of poor habitat quality and another because a fire destroyed vegetation in most of the site.

[4] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June.

Table 2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009* (Continued)

Study Area1	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)2,3
	Bunker Marsh North	13.6	7 (16 Jun–16 Jul)
MOME	Mormon Mesa North	8.2	ND
	Hedgerow	1.1	ND
	Mormon Mesa South	12.3	ND
	Virgin River #1	46.7	32 (12 May–8 Aug)
	Virgin River #2	36.9	1 (19 May)
MUDD	Overton WMA Pond	0.7	ND
	Overton WMA	14.9	17 (11 May–29 Jul)
TOPO	Pipes #1	5.2	1 (15 May)
	Pipes #3	5.7	2 (8 May–4 Jul)
	The Wallows	0.4	3 (15 May–8 Aug)
	PC6-1	4.8	1 (2–16 Jun)
	Pig Hole	2.4	ND
	In Between	7.7	ND
	800M	6.1	1 (26 May–13 Jul)
	Pierced Egg	6.7	5 (8 May–10 Jul)
	Swine Paradise	1.0	ND
	Barbed Wire	2.4	ND
	Platform	1.3	ND
	250M	1.9	1 (21 May) 1 (3–7 Jun), 1 (25 Jun)
	Hell Bird	3.3	2 (5 Jun–11 Jul)
	Glory Hole	5.0	7 (12 May–6 Aug)
	Beal Lake	13.9	1 (15–23 May), 1 (3 Jun)
	Lost Slough	1.5	ND
	Lost Pond	1.2	ND
	Lost Lake	3.3	1 (29 May)
TOGO	Pulpit Rock	2.1	ND
	Picture Rock	4.6	ND
	Blankenship Bend North	26.7	ND
	Blankenship Bend South	25.9	ND
BIWI	Burn Edge	3.7	ND
	Site #4	9.9	4 (4 Jun–5 Jul)
	Site #3	9.5	8 (10 May–19 Jul)
	Last Gasp	2.1	ND
	Site #5	6.8	1 (5–16 Jun)
	Upstream from Site #8	1.5	2 (12 Jun–14 Jul)
	Planet Ranch Road	2.1	ND
AHAK	Deer Island[4]	15.2	ND

Table 2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
PVER	PVER Phase 2	28.7	1 (27 May), 1 (3 Jun)
BIHO	Big Hole Slough	29.0	1 (17 Jun)
CIBO	CVCA Phase 1[5]	26.2	1 (27 May)
	CVCA Phase 3	41.2	1 (16 May), 1 (27 May), 2 (10 Jun)
	Cibola Nature Trail	13.7	1 (16 May), 2 (27 May), 1 (10 Jun)
	Cibola Island	4.2	4 (26 May), 3 (4 Jun)
	Cibola Site #2	16.4	ND
	Cibola Site #1	7.7	1 (9 Jun)
	Hart Mine Marsh[6]	31.6	ND
	Cibola Lake #2 (East)	4.5	1 (4 Jun)
	Walker Lake	11.4	ND
IMPE	Paradise	7.8	1 (20 May)
	Hoge Ranch	20.7	3 (20 May), 1 (15 Jun)
	Rattlesnake	7.6	1 (19 May)
	Milemarker 65	10.0	ND
	Nursery NW	7.0	1 (16 Jun)
	Ferguson Lake	21.1	3 (21 May), 2 (16 Jun)
	Great Blue Heron	7.1	1 (28 May), 1 (12 Jun)
	Powerline	2.0	1 (28 May)
	Martinez Lake	4.6	ND
MITT	Mittry West	4.4	2 (11 Jun)
YUMA	Gila River Site #2	5.1	3 (30 May), 1 (14 Jun)
	Fortuna Site #1	2.5	2 (31 May)
	Fortuna North	3.4	ND
	Morelos Dam[7]	11.4	ND

* This table includes only sites where regular surveys were scheduled and does not include sites where habitat reconnaissance and opportunistic surveys were conducted.

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River , TOPO = Topock Marsh, TOGO = Topock Gorge, BIWI = Bill Williams River NWR, AHAK = Ahakhav Tribal Preserve, PVER = Palo Verde Ecological Reserve, BIHO = Big Hole Slough, EHRE = Ehrenberg, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Majority of site burned between 2 and 8 July; surveys discontinued.

[5] Named CVCA in previous reports.

[6] Surveys discontinued after fourth survey because of poor quality habitat.

[7] Site completely bulldozed prior to the start of survey season; no surveys completed.

Table 2.3. Detections of Willow Flycatchers Recorded after 15 June 2009 at Sites Where Breeding or Residency Was Not Confirmed

Study Area[1]	Site	Date	Comments
BIHO	Big Hole Slough	17 Jun	Responded briefly to broadcast with primary song (***fitz-bew***)
IMPE	Nursery NW	16 Jun	Responded briefly to broadcast with primary song (***fitz-bew***)
	Ferguson Lake	16 Jun	Two individuals responded briefly to broadcast with primary song (***fitz-bew***)

[1] BIHO = Big Hole Slough, IMPE = Imperial NWR.

Table 2.4. Yellow-Billed Cuckoo Detections along the Virgin, Bill Williams, and Lower Colorado Rivers, 2009

Study Area[1]	Site	Date	Behavioral Observations
MOME	Virgin River #1 South	13 Jul	One individual heard calling continuously for 10 minutes
TOPO	PC6-1	2 Jul	One individual seen flying across the road
	Glory Hole	29 Jun	One individual seen
BIWI	Site #4	20 Jul	One individual heard
	Site #3	30 Jun	One individual heard calling throughout the morning
		7 Jul	One individual heard calling in same location as on 30 Jun
		9 Jul	Two individuals heard calling in same location as on 30 Jun
		12 Jul	One individual heard calling in same location as on 30 Jun
		13 Jul	One individual heard calling in same location as on 30 Jun
		24 Jul	One individual heard calling in same location as on 30 Jun
	Site #5	24 Jun	One individual detected; no notes taken
		9 Jul	Two individuals seen
	Upstream from Site #8	18 Jun	One individual heard
		4 Jul	At least two individuals heard
		14 Jul	One individual heard
		18 Jul	One individual detected; no notes taken
		27 Jul	One individual heard in same location as on 18 Jun
	Planet Ranch Road	12 Jun	One individual heard calling
		8 Jul	At least two individuals heard
		18 Jul	One individual detected; no notes taken
		22 Jul	One adult and one fledgling seen

[1] MOME = Mormon Mesa, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

Table 2.5. Yuma Clapper Rail Detections along the Virgin, Bill Williams, and Lower Colorado Rivers, 2009

Study Area[1]	Site	Date(s)	Behavioral Observations
MESQ	Bunker Marsh North	27 May	One individual heard calling
TOPO	800M	13 Jul	One individual heard kekking
	250M	21 Jul	Keks heard from marsh
	Hell Bird	5 Jun	Two individuals heard calling
	NW Beal Lake	30 May	One individual heard kekking
	Beal Lake	3 Jun	One individual heard calling in marsh to north of site
	NE Lost Lake	25 May	Three individuals heard calling
		10 Jun	Four individuals heard calling; two were interacting
	Lost Lake	29 May	Two individuals heard calling from cattail marsh
	Lost Lake Slough #4	27 May	One individual recorded; no notes taken
TOGO	Picture Rock	9 Jul	One individual recorded; no notes taken
	Blankenship Bend North	29 May	Three individuals recorded; single bird kekking and pair clatter
	Blankenship Bend South	10 Jun	One individual heard kekking
		24 Jun	One individual recorded; no notes taken
		21 Jul	Two individuals recorded; pair clatter
BIWI	Site #3	14 May	One individual seen
CIBO	Hart Mine Marsh	9 Jun	3 individuals heard calling
	Cibola Lake East	26 May	One individual heard kekking
IMPE	Ferguson Lake	22 Jul	One individual recorded; no notes taken
	Powerline	28 May	One individual heard kekking
YUMA	Fortuna Site #1	28 Jun	One individual heard kekking
	Fortuna North	24 Jul	One individual recorded; no notes taken

[1] MESQ = Mesquite, TOPO = Topock Marsh, TOGO = Topock Gorge, BIWI = Bill Williams River NWR, CIBO = Cibola NWR, IMPE = Imperial NWR, YUMA = Yuma.

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2009*

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PAHR	North[4]	3/1/0	10/10/0	1/0/0	0/0/30
	West[4]	0/0/0	0/0/0	0/0/0	2/4/15
	MAPS	0/0/0	0/0/0	0/0/0	130/20/200
	South	3/5/0	40/30/0	0/0/0	0/0/--
LIFI	Poles[4]	10/10/10	20/20/20	5/5/5	0/0/0
MESQ	East[4]	0/0/0	0/0/0	0/0/0	5/5/5
	West	0/0/0	0/0/0	0/0/0	25/25/25
	Bunker Marsh North[4]	20/10/0	30/15/0	10/5/0	0/0/10

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2009* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
MOME	Mormon Mesa North[4]	0/0/0	0/0/0	0/0/0	0/5/125
	Hedgerow	0/0/0	0/0/0	0/0/0	100/100/100
	Mormon Mesa South	0/0/0	0/0/0	0/0/0	200/200/200
	Virgin River #1	10/10/10	30/20/20	5/5/5	0/0/0
	Virgin River #2[4]	0/0/0	0/0/0	0/0/0	0/0/0
MUDD	Overton WMA Pond	1/1/1	20/20/10	1/1/1	0/0//0
	Overton WMA	25/25/5	30/30/10	2/10/3	0/0/0
TOPO	Pipes #1	0/0/0	0/0/0	0/0/0	50/50/50
	Pipes #3	30/1[5]/1[5]	30/30/10	10/10/0	0/0/0
	The Wallows	50/1/1[5]	25/10/10	10/30/--	0/0/0
	PC6-1	60/1/0	--/3/0	10/10/1	0/0/0
	Pig Hole	15/0/0	10/0/0	15/10/0	0/0/130
	In Between	20/0/0	10/0/0	15/0/0	0/50/50
	800M	40/1/0	10/3/0	25/50/0	0/0/55
	Pierced Egg	40/1[5]/1[5]	10/10/10	15/5/0	0/0/0
	Swine Paradise[6]	0/0/0	0/0/0	0/0/0	0/0/10
	Barbed Wire	1[5]/1[5]/0	10/5/0	0/0/0	0/0/120
	Platform[6]	0/0/0	0/0/0	2/2/0	0/0/10
	250M[6]	15/15/0	10/--/0	5/5/5	0/0/0
	Hell Bird	70/10/00	50/30/0	20/30/40	0/0/0
	Glory Hole	--/35/0	--/50/0	--/10/0	0/0/150
	Beal Lake[9]	0/0/0	0/0/0	0/0/0	30/30/30
	Lost Slough	--/15/5	--/30/10	--/0/3	--/0/0
	Lost Pond[4]	75/0/0	30/0/0	10/5/0	0/0/15
	Lost Lake[6]	0/0/0	0/0/0	10/2/0	2/0/--
TOGO	Pulpit Rock[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Picture Rock[4]	0/0/0	0/0/0	5/10/--	0/0/0
	Blankenship Bend North[4]	15/15/15	50/50/50	5/5/5	0/0/0
	Blankenship Bend South[4]	80/10/40	50/10/10	5/10/--	0/0/0
BIWI	Burn Edge	30/15/1	30/10/30	20/5/0	0/0/0
	Site #4[4]	2/2/1	10/10/30	1/1/1	0/0/0
	Site #3	5/3/0	10/3/0	1/5/0	0/0/300
	Last Gasp	5/1/0	30/30/0	0/2/0	0/0/500
	Site #5	2/2/1	>100/>100/--	5/5/1	0/0/0
	Upstream from Site #8	60/40/50	15/20/10	20/10/1	0/0/0
	Planet Ranch Road	50/30/10	70/505/50	30/5/0	0/0/0

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2009* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
AHAK	Deer Island[4]	50/50/50	>100/>100/>100	1/1/1	0/0/0
PVER	PVER Phase 2[7]	0/0/0	0/0/0	0/0/0	0/0/0
BIHO	Big Hole Slough	5/15/25	5/100/50	5/5/5	0/0/0
CIBO	CVCA Phase 1[7]	0/0/0	0/0/0	0/0/0	0/0/0
	CVCA Phase 3[7]	0/0/0	0/0/0	0/0/0	0/0/0
	Cibola Nature Trail[7]	0/80/0	0/10/0	0/10/0	--/0/75
	Cibola Island	20/10/1	30/10/3	10/7/5	0/0/0
	Cibola Site #2	0/0/0	0/0/0	0/5/0	15/0/15
	Cibola Site #1	0/0/0	0/0/0	0/0/0	10/10/10
	Hart Mine Marsh	15/25/30	--/--/--	--/--/--	0/0/0
	Cibola Lake #2 (East)[4]	0/0/0	0/0/0	0/0/0	10/80/50
	Walker Lake[4]	0/0/0	0/0/0	2/0/0	0/10/5
IMPE	Paradise[4]	3/--/0	2/--/0	2/--/0	0/--/0
	Hoge Ranch[4]	0/0/1	0/0/3	0/0/2	0/0/0
	Rattlesnake[6]	0/0/0	0/0/0	0/0/0	200/200/200
	Milemarker 65[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Nursery NW[6]	3/3/--	10/10/--	5/3/--	0/0/--
	Ferguson Lake[4]	0/10/5	0/3/3	3/5/10	0/0/0
	Great Blue Heron[6]	0/0/5	0/0/10	0/0/5	60/150/0
	Powerline[6]	1/0/1	3/0/3	5/0/5	0/50/0
	Martinez Lake[6]	0/0/0	0/0/0	0/0/0	50/50/50
MITT	Mittry West	3/0/0	10/0/0	7/0/0	0/180/180
YUMA	Gila River Site #2[4]	0/0/0	0/0/0	0/0/0	15/0/5
	Fortuna Site #1[4]	6/0/0	10/0/0	10/0/2	0/5/0
	Fortuna North[4]	0/0/0	0/0/0	5/0/0	0/10/10

* Values are given for each site as recorded in mid-May, mid-June, and mid-July.

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite West, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, TOGO = Topock Gorge, AHAK = Ahakhav Tribal Preserve, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, BIHO = Big Hole Slough, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

[2] -- = Hydrologic information not recorded.

[3] Percent of site with saturated soil does not include inundated areas.

[4] Site bordered by a river, lake, or pond.

[5] Saturated soil or water was present only in pig wallows.

[6] Site borders marsh.

[7] Site is irrigated as part of restoration efforts; amount of standing water highly variable throughout survey season.

Pahranagat National Wildlife Refuge, Nevada

Pahranagat National Wildlife Refuge consists of a series of lakes and marshes in Pahranagat Valley approximately 150 km north of Las Vegas, Nevada. Patches of primarily native vegetation exist at the inflow and outflow of Upper Pahranagat Lake. Prior to the 2008 survey season, the majority of the riparian vegetation along the north side of the upper lake (Pahranagat North) was inundated annually with

up to 1 m of water, with the highest water levels occurring in May. Major structural problems with the levee that impounds the upper lake resulted in the upper lake being drained in early 2008, and the riparian vegetation at the north end of the lake was not flooded during the 2008 or 2009 breeding seasons.

Pahranagat North

Area: 4.6 ha Elevation: 1,026 m

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*; hereafter cottonwood) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lakebed. Canopy height within the patch is 15–18 m, and canopy closure is approximately 70%, similar to that recorded in 2008. Canopy closure from 2003 to 2007 was >90%. Reduced canopy closure in 2008–2009 occurred mostly in the northeastern section of the site, where many of the large trees are now dead or dying. During the survey season, standing water and saturated soils were present only in an inflow channel that runs along the northern side of the site and drains into the lakebed at the southeastern corner of the site. The water channel is vegetated with bulrush (*Schoenoplectus* sp.) where it enters the lakebed. Saturated soils were also present within patches of bulrush that border the southern edges of the site.

We detected 20 breeding willow flycatchers, as well as 1 resident, unpaired male. In addition to resident adults, we detected two individuals for which residency and breeding status could not be confirmed. Areas of Pahranagat North not known to be occupied by willow flycatchers were surveyed five times, totaling 6.1 observer-hours. The site lies immediately adjacent to a cattle pasture, but livestock have access only to the cottonwood stringer on the northwestern corner of the lake, which is separated from the survey site by a fence. Cowbirds were detected during one survey and were detected regularly during nest monitoring activities.

Pahranagat West

Area: 1.5 ha Elevation: 1,026 m

This native site consists of a stringer of cottonwood, one to three trees wide and 20 m in height, on the western edge of Upper Pahranagat Lake. The site has no significant understory vegetation, and canopy closure varies from <50 to 80%. The eastern edge of the site is vegetated with bulrush, which extends into the lakebed to the east. During the survey season, the interior of the site was dry, but surface water was present nearby in the lakebed.

We detected no willow flycatchers. We surveyed the site five times, totaling 3.2 observer-hours. No cowbirds were detected, and there was no sign of livestock use.

Pahranagat MAPS

Area: 2.7 ha Elevation: 1,026 m

Pahranagat MAPS is a stringer of cottonwood on the western edge of the bed of Upper Pahranagat Lake. Canopy height is 15–20 m, and canopy closure is approximately 60%. There is very little woody vegetation in the understory. Cattail (*Typha* sp.) and bulrush line the eastern edge of the tree line and extend into the lakebed; much of this vegetation is dead. The site was dry throughout the survey season, with the nearest water or saturated soil being at least 20 and up to 200 m away in the lakebed.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.5 observer-hours. Cowbird were detected on two surveys, and there was no evidence of livestock use.

Pahranagat South

Area: 2.5 ha Elevation: 1,023 m

Pahranagat South consists of a relatively small stringer of Goodding willow, coyote willow (***Salix exigua***), and cottonwood lining a human-made channel that carries the outflow from Upper Pahranagat Lake. The cottonwoods reach approximately 20 m in height, while the willows are generally less than 10 m. In 2005, we noted that dense coyote willow was increasing on the western side of the site; this area of willow had very sparse canopy in 2006 and 2007, and the coyote willow was almost completely dead by 2008. The site is bordered to the west by an open marsh and to the east by upland scrub. Tamarisk (***Tamarix*** spp.) and Russian olive (***Elaeagnus angustifolia***) form a sparse understory. Overall canopy closure at this site is approximately 50%. The channel held water during site visits in May and June but was dry in mid-July.

We detected one willow flycatcher, for which residency and breeding status could not be confirmed, on 22 June after receiving a report from field personnel from an unrelated project that a flycatcher had been detected at the site. The flycatcher was not detected on any of three subsequent territory monitoring visits or on any of the surveys. We surveyed the site five times, totaling 2.8 observer-hours. Cowbirds were detected during two surveys, and no sign of livestock was observed.

Littlefield, Arizona

In 2007, our survey and monitoring activities focused on an area along Beaver Dam Wash immediately upstream of the Highway 91 Bridge. We expanded the survey area in 2008 to include young Goodding and coyote willow stringers downstream of the bridge and expanded the survey area even farther downstream in 2009.

Littlefield Poles

Area: 4.7 ha Elevation: 565 m

Littlefield Poles consists of primarily native vegetation located on Beaver Dam Wash, immediately upstream and downstream of the Highway 91 Bridge. Vegetation upstream of the bridge consists of a scattered overstory of cottonwood averaging 25 m in height. Cottonwood and Goodding willow averaging 10 m in height are present below the overstory but do not form a continuous canopy. Lower strata vegetation approximately 6 m in height consists of coyote willow, tamarisk, and some Russian olive. Dense stands of coyote willow border the southern edge of the patch, along the stream. Downstream of the bridge, young stringers of Goodding and coyote willow reach 5 m in height and form linear patches 10–15 m wide on the edges of multiple stream channels. Larger Goodding willow is present along the southwestern edge of the site on the edge of a golf course, and a dense patch of Goodding willow is present on the northern edge of the downstream end of the site. The downstream end of the site borders a cattail marsh. Canopy closure in the densest areas of Goodding and coyote willow is >90%, though overall canopy closure ranges from 50 to 70%. Surface water was present in stream channels and in the cattail marsh throughout the survey season.

We detected three breeding willow flycatchers; one resident, unpaired male; and one willow flycatcher for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers

were surveyed five times, totaling 14.5 observer-hours. Cowbirds were detected on all surveys, and cattle scat and trails were observed in the site.

Mesquite, Nevada

The Mesquite study area is in the floodplain of the Virgin River near Mesquite and Bunkerville, Nevada. The entire area experience flooding, and some areas were scoured, during the 2004–2005 winter floods.

Mesquite East

Area: 4.4 ha Elevation: 468 m

This mixed-native site lies on several terraces within the floodplain of the Virgin River in Mesquite, Nevada. Vegetation on the lowest terrace, on the northern edge of the site adjacent to the river, consists of cottonwood and Goodding willow generally less than 10 m in height. The central portion of the site lies on a slightly higher terrace and is vegetated entirely by dense tamarisk 7–8 m in height with canopy closure around 80%. The uppermost terrace is vegetated with Goodding willow and a few cottonwood 18–25 m in height and an understory of dense clumps of coyote willow about 8 m in height. Canopy closure on this terrace varies from 50% in the cottonwood/Goodding willow areas to over 90% in the coyote willow clumps. The western half of the upper terrace burned over the 2004–2005 winter and grew back with thick stands of coyote willow and cottonwood. The site was completely dry throughout the survey season, and the coyote willow was dead or dying.

We detected no willow flycatchers. We surveyed the site five times throughout the flycatcher breeding season, totaling 8.6 observer-hours. Cowbirds were detected on all surveys. Cattle trails and scat were observed on all surveys, and domestic pigs were seen in the site on one occasion.

Mesquite West

Area: 11.5 ha Elevation: 470 m

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Golf courses and housing developments border the site to the north, and the Virgin River borders the site to the south. This large site is primarily a mosaic of cattail and bulrush marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The coyote willows are generally 5–6 m in height, and canopy closure varies from 50 to >90%. Hydrology at the site is influenced by irrigation runoff from adjacent golf courses and agriculture. In previous years, the majority of the site was regularly or continuously inundated. At the beginning of the 2009 breeding season, the site was completely dry, and the pond at the western end of the site, which had previously been too deep to wade, had completely dry soil with deep cracks. Water had previously entered the northeastern corner of the site from a deep trench, but in 2009, what little water was flowing had been diverted down the eastern edge of the site in a trench that had been dug the previous year. During the first site visit in early May, we noted premature leaf abscission in the coyote willows. In the last week of June, we noted surface water within the site for the first time during the season, and it was confined to the eastern portion of the site. This portion of the site received surface water for one day at approximately weekly intervals for the remainder of the breeding season, and the willows appeared to respond with new growth. The rest of the site remained dry, though the cracks in the soil at the western end of the site became shallower, suggesting subsurface water.

We detected 16 breeding willow flycatchers, 1 pair for which no nest was located, and 2 resident, unpaired males. In addition to resident adults, we detected one individual for which residency and

breeding status could not be determined. Areas of Mesquite West not known to be occupied by flycatchers were surveyed once at the beginning of the flycatcher breeding season, totaling 2.0 observer-hours. After the initial survey, all areas of the site were covered by territory monitoring, and surveys were discontinued. Cowbirds were detected on the survey and were detected regularly during territory monitoring. Fresh cattle scat was also observed within the site.

Bunker Marsh North

Area: 13.6 ha Elevation: 456 m

This mixed-exotic site lies within the floodplain of the Virgin River near Bunkerville, Nevada, approximately 4 km downstream of Mesquite West. The site is between agricultural fields to the southeast and the Virgin River to the northwest. We explored and surveyed the riparian vegetation along an approximately 1-km reach of the river. The southern end of the site consists of tamarisk 6 m in height with 50–70% canopy closure. This portion of the site is bordered to the north by a small cattail marsh and a strip of 4–5-m-tall Goodding and coyote willow. The tamarisk area was very dry throughout the season and does not represent suitable flycatcher habitat. The willows surrounding the cattail marsh may provide habitat in future years if the area expands and matures. The remainder of the site is a mosaic of 4–6-m-tall tamarisk, scattered Goodding willow, patches of coyote willow 4–5 m in height, and stream channels and marshy areas. Canopy closure ranges from 25 to 90%. One small patch of coyote willow near the center of the site had surface water beneath the woody vegetation; otherwise, the only portions of the site that contained surface water were the marshes, and soils were dry beneath the woody vegetation. The streams and marshes contained surface water through mid-June but were dry in July.

We detected five breeding willow flycatchers and two flycatchers for which residency and breeding status could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 17.0 observer-hours. Cowbirds were detected on four surveys, and cows were observed in the site on multiple occasions.

Mormon Mesa, Nevada

For approximately 15 km upstream of its outflow to Lake Mead, the Virgin River flows through a 1-km-wide floodplain with a mosaic of habitats, including cattail marshes and tamarisk and willow forest. Much of the area is typically seasonally inundated from snowmelt in the spring and monsoon rains in mid and late summer, and the entire study area experienced severe flooding over the 2004–2005 winter. All the areas surveyed at Mormon Mesa are at least 10 km upstream of Lake Mead. The Virgin River did not go completely dry at Mormon Mesa at any point during the survey season of 2009, unlike in some previous years. Much of the tamarisk throughout Mormon Mesa started yellowing in the middle of June as the result of leaf hopper damage. Cattle were encountered at all sites throughout the survey season.

Mormon Mesa North

Area: 8.2 ha Elevation: 390 m

This mixed-exotic site consists primarily of tamarisk 3–5 m in height with areas of emergent Goodding willow up to 12 m in height and patches of coyote willow. Overall canopy closure is around 50%. The western edge of the site has a 100 x 50 m patch of Goodding willow, 8 m in height, with up to 75% canopy closure and dead cattails in the understory. No standing water or saturated soils were present within the site during the survey season, but surface water was adjacent to the site in May and June in the river channel to the south. The site is perched up to 2 m above the water level. Mormon Mesa North has been completely dry throughout the breeding seasons of 2004 to present, and no flycatchers have been

detected at the site in 2006–2009. Portions of the site, particularly the Goodding willows on the western edge of the site, might provide suitable flycatcher habitat with wetter soil conditions but in recent years have been dry. We recommend visiting this site at the beginning of the survey season to assess hydrologic conditions and discontinuing surveys for the season if the site is completely dry.

We did not detect any flycatchers. We surveyed the site five times, totaling 16.4 observer-hours. Cowbirds were detected on all surveys as was evidence of livestock use.

Hedgerow

Area: 1.1 ha Elevation: 390 m

This mixed-exotic site is east of Mormon Mesa North, on the eastern side of the Virgin River. The site consists of a continuous understory of tamarisk 4–5 m in height with scattered emergent Goodding willow up to 12 m in height. Many of the willows have dead branches. The site is surrounded by tamarisk and arrowweed (*Pluchea sericea*) 2–3 m in height. Canopy closure at the site varies from about 50% on the edges of the site up to 80% in the denser areas. Soils within the site were dry throughout the survey season. No flycatchers have been detected in Hedgerow since we began surveys in 2005, and the site has been completely dry in each year. We recommend visiting this site at the beginning of the survey season to assess hydrologic conditions and discontinuing surveys for the season if the site is completely dry.

We did not detect any flycatchers. We surveyed the site five times, totaling 2.3 observer-hours. Cowbirds were detected on three visits.

Mormon Mesa South

North half: Area: 8.9 ha Elevation: 385 m
South half: Area: 3.4 ha Elevation: 385 m

This mixed-exotic site was split into two contiguous areas to facilitate tracking of survey activity. Habitat evaluation at the beginning of the survey season revealed that the Goodding willow in the western third of the area that had been surveyed in previous years was entirely dead, and we discontinued surveys in this portion of the site. The remainder of the site has scattered Goodding willow up to 20 m in height and a patchy understory of tamarisk 4–7 m in height. Clumps of coyote willow are present on the eastern edge of the site, and dead cattail is present in the understory in this area. Canopy closure is widely variable, ranging from >90% in tamarisk thickets to <50% in openings. There was no surface water within the site, but damp soils were noted on the eastern edge of the site in May and June. The presence of dead cattails and deadfall suggest that this site was formerly considerably wetter, and portions of the site still have the structure to provide potential flycatcher habitat with wetter soil conditions.

No willow flycatchers were detected. We surveyed the northern and southern halves of the site five times each, totaling 12.3 and 7.5 observer-hours, respectively. Cowbirds were detected on all but one survey.

Virgin River #1

North half: Area: 12.0 ha Elevation: 380 m
South half: Area: 34.7 ha Elevation: 380 m

Virgin River #1 was also divided into two areas, Virgin River #1 North and Virgin River #1 South, to facilitate streamlining of field logistics. Habitat assessment in Virgin River #1 North at the beginning of the survey season revealed most of the Goodding willow in the northwestern finger of the area that had

been surveyed in 2008 were dead, and surveys in this area were discontinued. The southeastern corner of the formerly surveyed Virgin River #1 North consists of clumps of tamarisk 4–6 m in height, dry soil, and 60% canopy closure; surveys were discontinued in this area as well. The remainder of Virgin River #1 North is primarily tamarisk 4–6 m in height, with areas of emergent Goodding willow and patches of coyote willow in the central and southwestern portions of the site. Canopy closure throughout the site is 50–70%. Surface water and mud were present in May in channels running north to south through the center of the site, and the southwestern corner of the site also contained surface water in May and June.

We detected three breeding flycatchers and one individual for which residency and breeding status could not be confirmed in the southwestern corner of Virgin River #1 North. Areas of this site not known to be occupied by flycatchers were surveyed five times, totaling 23.5 observer-hours. Cowbirds were detected on all but one survey.

We expanded Virgin River #1 South approximately 600 m to the south and east to explore areas where stream channels were noted on the aerial photograph and during aerial reconnaissance. This new area consists of monotypic tamarisk up to 5 m in height with 70–90% canopy closure. Some of the stream channels contained surface water in May and June and damp soil in July. The channels are incised 1–2 m, and soils beneath the tamarisk were entirely dry throughout the survey season. We do not recommend continuing surveys in this area in future years because of the dry soil conditions. The northwestern portion of the site has coyote and Goodding willows interspersed with tamarisk 4–5 m in height. Goodding and coyote willows average 8 and 5 m in height, respectively. This portion of the site contained surface water throughout the survey season and has open, marshy areas. Canopy closure varies from >90% in areas of dense willow and tamarisk to 25% in marshy openings. The middle portion of the site consists of sparser tamarisk 4 m in height with dry, open areas, and the southwestern part of the site consists primarily of tamarisk 3–5 m in height and canopy closure from 60 to 80%. The southwestern part of the site also contains one cluster of emergent Goodding willow 10 m in height with dead coyote willow in the understory, and tamarisk in this area is up to 8 m in height. Soils in this area were damp, but no surface water was noted. For future years we recommend surveying only the northern third of the site and the area immediately around the Goodding willow cluster in the southwestern portion of the site because of the short canopy height and dry soil conditions in the remainder of the site.

We detected 20 breeding willow flycatchers and 4 unpaired, resident males in the northwestern portion of Virgin River #1 South. We detected four additional willow flycatchers for which residency and breeding status could not be confirmed. Areas of the site not known to be occupied by willow flycatchers were surveyed five times, totaling 29.5 observer-hours. Cowbirds were observed on all surveys.

Virgin River #2

Area: 36.9 ha Elevation: 380 m

This site is primarily a monotypic stand of tamarisk 6 m in height with 70–90% canopy closure. Widely scattered emergent Goodding willow up to 10 m in height are present in the northern half of the site. A clump of Goodding willow occurs halfway down the eastern edge of the site, and scattered willows extend to the southern end of the site. The tamarisk in the willow area are dry and brittle, and a greater proportion of mid-sized tamarisk stems are dead compared to previous years (see Chapter 5). The site contained no surface water during the breeding season, though portions of the site contained damp soils. The Virgin River, on the eastern edge of the site, had surface water throughout the season. No flycatchers have been detected in the northern half of the site from 2003 to present, and we recommend discontinuing surveys in this area.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 51.5 observer-hours. Cowbirds were observed on all surveys.

Muddy River, Nevada

The Muddy River study area is along the Muddy River in the Overton Wildlife Management Area (WMA) near Overton, NV.

Overton WMA Pond

Area: 0.7 ha Elevation: 378 m

This site consists of a patch of mixed-native vegetation approximately 150 m long and 150 m wide at the north end of Overton WMA just south of Honeybee Reservoir. The dominant vegetation consists of 10-m-tall Goodding willow with a sparse 5-m-tall tamarisk understory. Cattail and sedges (*Carex* sp.) are also present on the edges of the site. Canopy closure is variable, ranging up to 90%. A small stream channel runs through the site, and it held surface water throughout the season.

We detected no willow flycatchers. We surveyed the site five times for a total of 3.4 observer-hours. Cowbirds were detected two visits, and no sign of livestock use was observed.

Overton WMA

Area: 14.9 ha Elevation: 378 m

This site consists of a 150-m-wide strip of riparian vegetation spanning both sides of the Muddy River. The site is bordered to the southwest by open agricultural fields and to the northeast by sparser areas of riparian vegetation. The site flooded heavily during the 2004–2005 winter, but vegetation at the site was relatively unchanged. The northern portion of the site is dominated by very dense tamarisk up to 7 m in height with canopy closure of 70–90%. The southern portion of the site consists primarily of a stand of Goodding willow 10–12 m in height with an understory of tamarisk and cattail and canopy closure up to 90%. Flowing water was present in the channel of the Muddy River throughout the survey season. Extensive beaver activity resulted in the southern portion of the site being flooded with approximately 30 cm of water through mid-July, at which time water was restricted to channels and the area that had previously been flooded was only muddy. Beavers have felled swaths of Goodding willow in the southern portion of the site, resulting in gaps in the canopy. Approximately 0.3 ha of the southern portion of the site was bulldozed in 2005 as part of Overton WMA efforts to repair flood damage to their water control system. Two stretches of the channel of the Muddy River within the site were dredged with heavy equipment over the 2007–2008 winter, resulting in a cleared swath 10–15 m wide on the western bank of the river.

We located 11 breeding willow flycatchers and 2 unpaired, resident males. We also detected four flycatchers for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 21.9 observer-hours. We observed no signs of livestock but detected cowbirds on all surveys.

Ground Reconnaissance Results

THE NARROWS

The Narrows site is along the Muddy River, immediately upstream of the point where the river enters the Moapa Valley, approximately 1.5 km west of Bowman Reservoir. Aerial photographs show a stretch of dense riparian vegetation along the river in The Narrows. This site consists of an approximately 125-m-wide swath of tamarisk straddling a reach of the Muddy River approximately 900 m in length. The site is bordered to the north and south by upland desert. The site is dominated by very dense tamarisk up to 6 m in height with canopy closure of 70–90%, and areas of saltbush (*Atriplex* sp.) border the tamarisk along the southern uplands. Three small, sparse patches of coyote willow and seep willow (*Baccharis* sp.) are found along the river in the central portion of the site. At points along the river where access was possible, flowing water and saturated soil were present only in the river channel. The widest part of the river channel observed was 2.5 m wide and incised up to 2 m. We recommend visiting this site at the beginning of the survey season to assess hydrologic conditions and discontinuing surveys for the season if water is restricted only to the channel.

We surveyed the site three times for a total of 6.5 observer-hours. Cowbirds were detected on two visits, and no sign of livestock use was observed.

MUDDY RIVER RECON

During aerial reconnaissance in March 2009, we noted a flooded area along the riparian corridor of the Muddy River starting approximately 1 km downstream of the southern end of Overton WMA and continuing downstream for approximately 1 km. Ground reconnaissance in May revealed that the area consists primarily of cattail marsh with scattered tamarisk 3 m in height. A few scattered Goodding willow 8 m in height are also present, and overall canopy closure is <25%. The area was flooded with up to 10 cm of water during the site visit. The sparse woody vegetation and open canopy make this area unsuitable for breeding flycatchers.

We visited the site once for a total of 6.0 observer-hours.

Topock Marsh, Arizona

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow. Seasonally wet, low-lying areas are interspersed throughout the riparian area. Feral pigs are present throughout the Topock study area, and evidence of pigs was observed in all survey sites.

Pipes #1

Area: 5.2 ha Elevation: 140 m

This exotic site is bordered to the east by the refuge road and consists primarily of monotypic tamarisk 5–7 m in height. Arrowweed occurs in dense patches within 50 m of the refuge road. The tamarisk is densest within 100 m of the refuge road and becomes more open toward the western edge of the site. The northern edge of the site has the tallest canopy, and there is relatively little deadfall in this area compared to the rest of the site. The central and southern portions of the site have many dead stems

and clusters of fallen trees. Canopy closure is 70–90%. The site contained no standing water during the survey season but did contain damp soils along the southern edge of the site throughout the season.

We detected one willow flycatcher, for which residency was not confirmed, on 15 May. Three subsequent territory monitoring visits and four subsequent surveys failed to detect the flycatcher again. We surveyed the site five times, totaling 9.0 observer-hours. Cowbirds were detected on all surveys.

Pipes #3

Area: 5.7 ha Elevation: 140 m

This site is bordered to the east by the refuge road. Arrowweed occurs in dense patches within 50 m of the road. Most of the site is vegetated by tamarisk 4–6 m in height. The southeastern portion of the site has a few emergent Goodding willow up to 15 m in height and open, marshy areas. Canopy closure generally exceeds 70%. In May, the portion of the site with Goodding willow and marshes was inundated with up to 10 cm of water, and the central portion of the site had water up to 30 cm in depth beneath the tamarisk. The site progressively dried out through the season but still contained damp soils and standing water in pig wallows in July.

We detected one territorial male flycatcher in Pipes #3. We also detected a second flycatcher at the site on 9 and 13 June. The second flycatcher was interacting with the territorial male and was possibly a female. The second flycatcher was not detected on any of nine territory monitoring visits after 13 June, however. Portions of Pipes #3 not known to be occupied by flycatchers were surveyed five times, totaling 5.3 observer-hours. Cowbirds were detected on three surveys.

The Wallows

Area: 0.4 ha Elevation: 140 m

The Wallows is primarily vegetated by tamarisk 5–6 m in height with emergent Goodding willow on the western side of the site. The northwestern edge of the site borders an open cattail marsh. Overall canopy closure ranges from 50% in the marshy area to 90% in the tamarisk. Half the site was inundated in May, but by mid-June water was present only in intermittent puddles in the marsh, and by mid-July the only remaining surface water was in pig wallows.

We detected two breeding flycatchers and detected another individual on a single occasion on 15 May. Portions of the site not known to be occupied were surveyed 5 times, totaling 5.0 hours. Cowbirds were detected on four surveys.

PC6-1

Area: 4.8 ha Elevation: 140 m

PC6-1 is a mixed-exotic site consisting primarily of tamarisk 6–7 m in height, with a few patches of arrowweed and cattails present in the understory. A scattered overstory of Goodding willow approximately 10–15 m in height is present in the southwestern corner of the site. Arrowweed 1–2 m in height is present under the willow. A portion of the site within approximately 50 m of the refuge road contains thick stands of arrowweed. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the refuge road is approximately 50%. Approximately 60% of PC6-1 contained standing water and saturated soils in May. By mid-June only small puddles remained, and <1% of the site had saturated soil in July.

We detected one willow flycatcher between 2 and 6 June. The site was surveyed five times, totaling 11.0 observer-hours. Cowbirds were detected on three surveys.

Pig Hole

Area: 2.4 ha Elevation: 140 m

Pig Hole consists of monotypic tamarisk 6–7 m in height, with canopy closure ranging from 70 to 90%. The northern edge of the site has smaller-diameter tamarisk, with many wispy branches, than the remainder of the site. Approximately 5% of the site consists of dense patches of arrowweed. Approximately 15% of the site had standing water in May, and another 15% of the site had saturated soils. The standing water had disappeared and only 10% of the site contained saturated soils by mid-June, and by mid-July there was no saturated soil in Pig Hole.

No willow flycatchers were detected. The site was surveyed five times, totaling 5.3 observer-hours. Cowbirds were detected on two surveys.

In Between

Area: 7.7 ha Elevation: 140 m

In Between consists of monotypic tamarisk 6–8 m in height. The lowest 3 m of the stand generally lacks foliage, resulting in a relatively open understory. Canopy closure is 70–90%, and the western edge of the site borders a marsh. Approximately 25% of the site was inundated in May, but no standing water remained by mid-July.

We detected no flycatchers in In Between. We surveyed the site five times, totaling 9.8 observer-hours. Cowbirds were observed on all surveys.

800M

Area: 6.1 ha Elevation: 140 m

800M adjoins the western edge of In Between, and the eastern half of the site consists of a cattail and bulrush marsh with clumps of tamarisk 5–7 m in height and scattered, emergent Goodding willow. The remainder of the site is vegetated by tamarisk 4–7 m in height. Canopy closure in the tamarisk is generally >90%, while canopy closure in the marsh is around 50%. The far southern end of the site, within 50 m of the refuge road, consists of very dry tamarisk 3-5 m in height and is not suitable flycatcher habitat. Approximately 40% of the site was inundated in May, but surface water was restricted to a few puddles within the marsh by mid-June.

We detected one resident male flycatcher. Portions of the site not known to be occupied were surveyed five times, totaling 6.5 observer-hours. Cowbirds were observed on all surveys.

Pierced Egg

Area: 6.7 ha Elevation: 140 m

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height, with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to have a more open understory and contain patches of cattail and bulrush. Overall canopy closure is approximately

80%. Approximately 40% of the site was inundated in May, but by mid-June, the only remaining water was in deep pig wallows.

We located two resident male flycatchers and three additional flycatchers for which residency could not be confirmed. Two of the additional flycatchers were detected on 16 and 19 June, one in each of the occupied territories, and were suspected to be females. They were not detected on any of eight territory monitoring visits after 19 June. The third flycatcher for which occupancy could not be determined was detected along the refuge road on 8 June. We surveyed portions of the site not known to be occupied by flycatchers five times for a total of 8.5 observer-hours. Cowbirds were observed on all surveys.

Swine Paradise

Area: 1.0 ha Elevation: 140 m

This mixed-exotic site borders the open water of Topock Marsh. Vegetation at the site consists of tamarisk 6–8 m in height and scattered, emergent Goodding willow up to 15 m in height, with patches of coyote willow. Overall canopy closure is approximately 80%. The interior of the site was dry throughout the survey season, but standing water and saturated soils persisted throughout the season in the marsh on the eastern edge of the site.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.0 observer-hours. We detected cowbirds on four visits.

Barbed Wire

Area: 2.4 ha Elevation: 140 m

One large, emergent Goodding willow occurs at the site; otherwise, the site is vegetated by tamarisk 6–10 m in height and of varying density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy openings than the southwestern portion of the site. Canopy closure is approximately 90%. Standing water was present in pig wallows in May and June.

We detected no willow flycatchers. We surveyed the site five times, totaling 7.3 observer-hours. Cowbirds were detected on three visits.

Platform

Area: 1.3 ha Elevation: 140 m

This site forms a narrow strip of vegetation between the main refuge road and the open marsh. Vegetation at the site consists of tamarisk 7 m in height with a few isolated, emergent Goodding willow. Overall canopy closure is approximately 90%. Bulrush and cattail line the eastern edge of the site adjacent to the marsh. The interior of the site was dry in June and July.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.5 observer-hours. Cowbirds were detected on three visits.

250M

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is dominated by mesquite trees (*Prosopis* sp.) with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and one emergent Goodding willow approximately 12 m in height. Canopy closure within the site ranges from 70 to 90%. The patch of coyote willow on the northern border of the site was inundated in May and June but dry in July. The remainder of the site was dry throughout the survey season.

We detected three willow flycatchers; one on 21 May, one on 3–7 June, and one on 25 June. Residency could not be confirmed for any of these individuals. The site was surveyed five times, totaling 5.3 observer-hours. Cowbirds were detected on all surveys.

Hell Bird and Glory Hole

Hell Bird: Area: 3.3 ha Elevation: 140 m
Glory Hole: Area: 5.0 ha Elevation: 140 m

These contiguous mixed-exotic sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure are highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6–8 m in height and Goodding willow 15 m in height. Canopy closure ranges from 50 to 90%. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush. Large swampy areas vegetated by cattail and bulrush are interspersed throughout the survey areas. The proportion of Hell Bird covered by surface water declined from 70% in May to 10% in mid-June and 0% in mid-July. Water levels in Glory Hole declined similarly throughout the season, with 30% of the site being inundated with up to 70 cm of water in early June and only damp soils remaining by mid-July.

We detected two unpaired, resident male flycatchers in Hell Bird and four unpaired, resident males in Glory Hole. In Glory Hole, we detected three additional flycatchers for which residency was not confirmed. Hell Bird was surveyed five times, totaling 10.0 observer-hours. Portions of Glory Hole not known to be occupied by flycatchers were surveyed five times, totaling 1.9 observer-hours. Cowbirds were detected on all surveys in Hell Bird and two surveys in Glory Hole.

Beal Lake

Area: 13.9 ha Elevation: 140 m

This mixed-native restoration site consists of a mosaic of cottonwood, Goodding willow, coyote willow, and arrowweed, with some tamarisk and mesquite scattered throughout the site. Canopy height is highly variable and averages approximately 5 m; canopy closure is sparse, averaging 35%. The amount of standing water and saturated soil is highly variable because it is flood irrigated. Sandy soil at the site allows the water to drain rapidly after irrigation, and the site was dry on all survey visits.

We detected one willow flycatcher on 15–23 May and another on 3 June. A third flycatcher was caught in a mist net at Reclamation's MAPS station on 15 May; this flycatcher was later confirmed to be the breeding male in The Wallows. We surveyed this site five times, totaling 9.3 observer-hours. Cowbirds were detected on four surveys.

Lost Slough

Area: 1.5 ha Elevation: 140 m

Lost Slough is located approximately 4 km south of Glory Hole and Hell Bird. This mixed-exotic site runs northeast to southwest for approximately 250 m, and measures 100 m wide at the broadest point. There is a marshy area in the center of the site; a small area of bulrush is present in the marsh, along with stands of coyote willow 6 m in height. Vegetation around the marsh is composed mainly of 6- to 8-m-tall tamarisk with a few emergent Goodding willow and scattered screwbean mesquite (*Prosopis pubescens*). Arrowweed up to 2 m in height makes up the understory vegetation. Canopy closure at the site is variable, with open areas toward the edges of the site and over 70% closure in areas with thick vegetation. Hydrologic conditions at the site were not assessed in May. In mid-June, the marshy area was inundated, and by mid-July small pools remained in the marsh.

We did not detect any willow flycatchers. We surveyed Lost Slough five times, totaling 5.0 observer-hours. Cowbirds were detected during one survey.

Lost Pond

Area: 1.2 ha Elevation: 140 m

This mixed-exotic site is located approximately 700 m southeast of Lost Slough. The site is approximately 200 m long and 125 m wide, with a small pond at the southern edge of the site and a marshy area at the northern end of the site. The edges of the pond are vegetated with a 30-m-wide border of cattail, bulrush, and sedges. Vegetation within the site consists primarily of tamarisk 4 to 7 m in height with canopy closure approximately 90%. The area surrounding the site consists of arrowweed, 3-m-tall tamarisk, and screwbean mesquite. In May, 75% of the site was inundated, but by mid-June water remained only in the pond and marshy areas adjacent to the site.

No willow flycatchers were detected. We surveyed the site five times, totaling 6.3 observer-hours. Cowbirds were detected during one survey.

Lost Lake

Area: 3.3 ha Elevation: 140 m

This site lies approximately 850 m southeast of Lost Pond. It is a narrow (<100-m-wide) strip of riparian vegetation separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. The northern edge of the site consists of an overstory of planted cottonwoods 10–15 m in height, with an understory of tamarisk 5 m in height, on the edge of a cattail marsh. South of the cottonwoods, the site is primarily tamarisk, 5–8 m in height, with small openings vegetated by arrowweed. In previous years, the southeastern end of the site was dominated by dense stands of coyote willow. These willows are now all dead, dramatically reducing the suitability of the site for breeding flycatchers. Overall canopy closure is approximately 80%. The only surface water or saturated soil at Lost Lake was immediately adjacent to the marsh on the northern edge of the site; the interior of the site was dry throughout the survey season.

We detected one willow flycatcher on 29 May. The flycatcher responded to broadcasts but did not vocalize spontaneously. The flycatcher was not detected on three subsequent territory monitoring visits or any of the four subsequent surveys. We surveyed the site five times, totaling 4.5 observer-hours. Cowbirds were detected on four visits.

Ground Reconnaissance Results

NW BEAL LAKE

We explored this area, approximately 600 m northwest of the Beal Lake site, in 2006 after noting a large area of inundated vegetation during aerial reconnaissance. In 2006, vegetation in the area consisted primarily of tamarisk 2–3 m in height with some areas reaching 4 m in height. We returned to this area in 2009 to assess whether vegetation had matured. In 2009, the area was vegetated by tamarisk 3–5 m in height, scattered screwbean mesquite 5–7 m in height, and an understory of arrowweed. Canopy closure was continuous only in low-lying swales; elsewhere, the canopy was broken by open, dry areas in the northwestern portion of the reconnaissance site and by marshes to the southeast. The tamarisk had not grown to a size typical of flycatcher breeding habitat along the LCR. We visited the site once in 2009 for a total of 2.0 observer-hours.

NE LOST LAKE

We explored and surveyed the northern and eastern borders of Lost Lake. Woody vegetation consists entirely of a strip of tamarisk 4 m in height with >90% canopy closure. This strip of tamarisk is 600 m long and generally <50 m wide and is bordered to the west by the cattail marsh on the edge of Lost Lake and to the east by dry uplands vegetated by arrowweed and scattered mesquite. Water from Lost Lake extended into the tamarisk during the site visit in May, but by mid-June surface water was restricted to the cattails and did not extend under the woody vegetation. This site does not have the canopy height typical of occupied flycatcher habitat along the LCR. We surveyed the site four times, for a total of 9.0 observer-hours. No flycatchers were detected. Cowbirds were detected on all visits.

LOST LAKE SOUTH

We explored the area between the southern end of NE Lost Lake and the western tip of the Lost Lake polygon. We had noted this area as being inundated during aerial reconnaissance in March 2009. Vegetation consists of a mosaic of cattail marshes in low-lying areas and a mix of screwbean mesquite, arrowweed, and bulrush in higher areas. Overall canopy closure is <25%, and the vegetation does not resemble that found in occupied flycatcher habitat.

LOST LAKE SLOUGH #1

During aerial reconnaissance in March 2009, we noted several patches of vegetation between the South Dike and New South Dike roads. Lost Lake Slough #1 consists of a 25- x 50-m patch of tamarisk, 4 m in height, 100 m south of the bridge on South Dike Road. The site is surrounded by marsh, but hydrologic conditions within the site were not assessed. Vegetation at the site is too short to resemble typical occupied flycatcher habitat along the LCR. We surveyed the site twice, for a total of 0.5 observer-hour. No flycatchers were detected.

LOST LAKE SLOUGH #2

This native site is approximately 200 m south-southeast of Lost Lake Slough #1. It consists of a 100- x 50-m patch of coyote willow 4 m in height. Canopy closure within the site is around 80%, and the site is surrounded by open marsh. The site was completely inundated in May and had saturated soil in mid-June. Vegetation at the site is currently shorter than that typically found in occupied flycatcher habitat along the LCR, but the site should be monitored in future years to determine if the willows continue to grow or expand to a greater area. We surveyed the site twice, for a total of 1.5 observer-hours. We did not detect any flycatchers and did not detect any other terrestrial birds.

LOST LAKE SLOUGH #3

This mixed-native site is between Lost Lake Slough #2 and New South Dike Road. The site is bordered to the north by marsh and to the south by dry uplands adjacent to the road. Vegetation within the site is a mix of coyote willow and tamarisk, both around 4 m in height. Canopy closure is around 65% at the eastern edge of the site and decreases toward the west. Approximately half the site was inundated in May, but only the edge adjacent to the marsh had standing water in mid-June. This site does not currently have the canopy height or canopy closure typical of occupied flycatcher habitat along the LCR but should be monitored for changes in vegetation in future years. We surveyed the site twice, for a total of 1.0 observer-hour.

LOST LAKE SLOUGH #4

This mixed-native site is approximately 100 m west of Lost Lake Slough #3 and lies between marsh to the north and dry uplands to the south. Vegetation at the site grades from a mix of coyote willow and bulrush on the northern border to coyote willow in the middle of the site and tamarisk on the upland edge of the site. Canopy height in the willows is 3 m while the tamarisk reaches 4 m. Canopy closure is around 90%. This site does not currently have the canopy height typical of occupied flycatcher habitat along the LCR but should be monitored for changes in vegetation in future years. We surveyed the site twice, for a total of 2.0 observer-hours.

MARINA

This site is immediately north of the Topock Gorge Marina and extends for approximately 500 m north, between marsh to the east and dry uplands to the west. The site is less than 50 m wide and grades from a mix of coyote willow and arrowweed along the eastern border to a mix of tamarisk, arrowweed, and screwbean mesquite on the western edge. Canopy height ranges from 3 m in the willows to 4–6 m in the tamarisk, and canopy closure is highly variable, averaging around 60%. Surface water was present only along the eastern edge of the site and did not extend more than a few meters under the woody vegetation. This site does not have the canopy closure typical of occupied flycatcher habitat along the LCR. We surveyed the site three times, totaling 7.3 observer-hours.

Topock Gorge, Arizona and California

Between Topock Marsh and Lake Havasu, the Colorado River winds through Topock Gorge. Throughout the Gorge, the river is confined between steep cliffs and high bluffs, and little vegetation grows along the river. We surveyed backwater areas that support marsh and riparian vegetation.

Pulpit Rock

Area: 2.1 ha Elevation: 140 m

This mixed-exotic site lies where an unnamed wash enters the Colorado River from the Mohave Mountains. The northwestern edge of the site is vegetated by cattails and borders a backwater, and the upland edge is vegetated by arrowweed, honey mesquite (*Prosopis glandulosa*), and ironwood (*Olneya tesota*). Vegetation within the site consists primarily of tamarisk up to 5 m in height, with small patches of coyote willow near the marsh edge. Canopy closure is around 80% near the marsh but only 30% at the upland edges of the site. Hydrologic conditions at the marsh interface were not assessed, but the majority of site appeared to by dry.

No willow flycatchers were detected. We surveyed the site five times, for a total of 2.5 observer-hours. Cowbirds were detected on one survey, and we observed burro tracks and trails around the site. One migrant willow flycatcher has been detected at this site since we began surveying it in 2003. The small size of the site, its isolation from other riparian habitat, and its predominantly dry soils make this site unlikely to support resident flycatchers. We recommend discontinuing surveys at this site.

Picture Rock

Area: 4.6 ha Elevation: 138 m

This mixed-exotic site consists of two patches of riparian vegetation where an unnamed wash enters the Colorado River from the west. Vegetation within the site consists primarily of tamarisk 5–6 m in height, scattered Goodding willow 12 m in height, and one small patch of coyote willow. Bulrush and cattail are present on the edge of the site along the river, and the upland edges of the site contain arrowweed, mesquite, and paloverde (*Parkinsonia* sp.). Canopy closure within the tamarisk is 70–90%. During surveys, surface water was confined to the edge of the site adjacent to the marsh and did not extend under the woody vegetation.

No willow flycatchers were detected. We surveyed the site five times, for a total of 7.3 observer-hours. Cowbirds were detected on two surveys, and burro tracks and trails were observed around the site.

Blankenship Bend North

Area: 26.7 ha Elevation: 138 m

Blankenship Bend contains riparian and marsh vegetation along the eastern bank of the Colorado River adjacent to the Blankenship Valley. The eastern edge of Blankenship Bend North consists of a 100-m-wide strip of vegetation that grades from mesquite 7 m in height at the upland edge to tamarisk and then to a narrow strip of coyote willow 5 m in height. The coyote willow borders a bulrush marsh, and the western edge of the marsh is also vegetated by a narrow (5–10-m-wide) strip of coyote willow as well as several emergent Goodding willow 12 m in height. The remainder of Blankenship Bend North extends for another 400 m to the west until it reaches the open water of the Colorado River. This portion of the site consists of a mosaic of marshes, tamarisk, coyote willow, arrowweed, and mesquite. Vegetation height generally does not exceed 5 m, and canopy closure within the woody vegetation varies between 60 and 80%.

We detected no flycatchers at Blankenship Bend North. We surveyed the site five times, totaling 18.3 observer-hours. We detected cowbirds on all surveys, and evidence of feral pigs and burros was observed.

Blankenship Bend South

Area: 25.9 ha Elevation: 138 m

The eastern edge of Blankenship Bend South consists of a 100-m-wide strip of tamarisk up to 6 m in height with clumps of emergent Goodding willow up to 12 m in height. This strip of vegetation is bordered to the east by dry, upland vegetation and to the west by bulrush marsh and open water. Between this strip of vegetation and the river, approximately 600 m to the west, the site consists primarily of bulrush marsh with widely scattered clumps of tamarisk up to 5 m in height. Canopy closure is approximately 80% in the eastern portion of the site and less than 50% in the remainder of the site. Because woody vegetation in the western portion of the site is widely scattered, we recommend

discontinuing surveys in this portion of the site in future years. The site contained standing water throughout the survey season, with up to 80% of the site inundated.

We detected no flycatchers at Blankenship Bend South. We surveyed the site five times, totaling 14.3 observer-hours. We detected cowbirds on all surveys but did not observe signs of livestock.

Bill Williams River National Wildlife Refuge, Arizona

The Bill Williams River NWR contains the last expanse of native cottonwood-willow forest in the LCR region. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream. We did not observe evidence of livestock use at any of the Bill Williams sites.

In addition to the regularly scheduled surveys, we revisited one site located in previous years that was determined to be potentially suitable flycatcher habitat. Results of this habitat evaluation are presented following the survey results.

Burn Edge

Area: 3.7 ha Elevation: 140 m

Burn Edge is near the northern edge of the Bill Williams riparian corridor, on the eastern edge of an area that burned in 2006. A cattail marsh with Goodding willow and cottonwood 15 m in height runs east-west through the center of the site. This portion of the site also has clumps of tamarisk up to 6 m in height. Canopy closure in the marshy area varies from around 60% at the eastern end to 25% at the western end. The area on either side of the marsh consists of tamarisk 6 m in height with up to 90% canopy closure. The entire marshy area was inundated in May to a depth up to 40 cm. Intermittent pools were present in mid-June, and by late July only two puddles remained.

No willow flycatchers were detected at Burn Edge. We surveyed the site five times, totaling 5.8 observer-hours. Cowbirds were detected on four visits.

Bill Williams Site #4 and Site #3

Site #4: Area: 9.9 ha Elevation: 140 m
Site #3: Area: 9.5 ha Elevation: 140 m

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow 15–20 m in height and patches of monotypic tamarisk up to 8 m in height. Patches of coyote willow are also present. Canopy closure is variable and overall is approximately 50%. Stands of cattails and marshy areas occupy approximately 10% of Site #3. The understory in some areas is very open, and the ground in these areas is covered with herbaceous vegetation. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Mosquito Flats had a network of small, flowing streams in May, but these had dried to damp soil by July. The marshes in Site #3 were dry by July, and the only surface water remaining in Mosquito Flats was in the northwestern corner of Site #4 in a deep backwater channel.

We detected two resident, male flycatchers in Site #4 and detected two additional flycatchers for which residency was not confirmed. One of these was observed on 16–18 June in one of the occupied territories

and was suspected to be a female, though it was not observed on any of five subsequent territory monitoring visits. Eight breeding flycatchers were detected in Site #3. Portions of the sites not known to be occupied by flycatchers were visited five times, totaling 14.3 observer-hours at Site #4 and 7.3 observer-hours at Site #3. Cowbirds were detected on all surveys of Mosquito Flats.

Last Gasp

Area: 2.1 ha Elevation: 140 m

Last Gasp is a narrow, mixed-native site along a channel on the northern edge of the Bill Williams riparian area, approximately 250 m east of Burn Edge. Vegetation within the site consists of a broken overstory of cottonwood and Goodding willow 15–20 m in height and a tamarisk understory 5–7 m in height. The bottom of the channel is 1–2 m below the surrounding ground surface. Canopy closure varies from 50% in the channel to 80–90% in the surrounding tamarisk. The channel contained intermittent pools in May. One pool remained in mid-June, and by mid-July no surface water was present.

No willow flycatchers were detected at Last Gasp. We surveyed the site five times, totaling 7.0 observer-hours. Cowbirds were detected on all visits.

Bill Williams Site #5

Area: 6.8 ha Elevation: 143 m

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the northeast by steep cliffs and to the west by a dry river channel. The survey site was expanded in 2008 approximately 350 m upstream, and in 2009 we ceased surveying the most downstream 250 m of the site. The discontinued area consists of deep pools surrounded by completely dry, patchy tamarisk 4 m in height and does not resemble occupied flycatcher habitat. Vegetation in the site is mixed-native, with Goodding willow and cottonwood 15–20 m in height in the overstory. The understory consists of tamarisk 7 m in height as well as some young Goodding willow and cottonwood. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure in the site is variable, ranging from 25% in open areas to 70–90% in the denser vegetation. Soils in the majority of the site were dry, although a couple of small ponds and marshy areas along the cliff on the northeastern edge of the site contained water through July.

We detected one unpaired, male flycatcher in Site #5. Portions of the site not known to be occupied were surveyed five times, totaling 10.0 observer-hours. Cowbirds were detected on four surveys.

Upstream from Site #8

Area: 1.5 ha Elevation: 170 m

Vegetation in the majority of the site consists of an overstory of cottonwood and Goodding willow up to 15 m in height and an understory of tamarisk. The western third and southern edge of the site are vegetated by Goodding willow and cottonwood up to 10 m in height. The northern edge of the site borders a cattail marsh. Canopy cover is variable and ranges from 50 to 80%. The central portion of the site was inundated throughout the breeding season.

We detected two breeding flycatchers. Portions of the site not known to be occupied were surveyed five times, totaling 4.0 observer-hours. Cowbirds were detected on three visits.

Planet Ranch Road

Area: 2.1 ha Elevation: 170 m

This mixed-native site follows the Bill Williams River at the southern edge of the riparian area. The northern bank of the river is steep and is vegetated by tamarisk and arrowweed perched well above the level of the river. The southern bank is more gradual, and beaver activity along the river has resulted in flooding on this bank. Vegetation on this side of the river consists of an overstory of Goodding willow and cottonwood up to 15 m in height and an understory of tamarisk 5 m in height. Overall canopy closure in this portion of the site is 70–90%. The river and the willow stand on the southern bank had surface water throughout the survey season.

No flycatchers were detected. We surveyed the site five times, totaling 5.8 observer-hours. We detected cowbirds on all surveys.

Ground Reconnaissance Results

PLANET RANCH

This site starts 200 m east of Upstream from Site #8, and extends 400 m east of the starting point. We visited this site in 2007 and 2008 and noted that the central portion of it had vegetation structure resembling that of occupied flycatcher habitat but that surface water was generally lacking. We revisited the site in late May and early July 2009 to determine whether hydrologic conditions had changed. Surface water was present in small pools along approximately 25 m of a stream channel near the north edge of the site, which borders a cattail marsh. Overall, <1% of the site contained surface water. We surveyed the site twice, totaling 2.8 observer-hours.

Ahakhav Tribal Preserve, Arizona

The Ahakhav Tribal Preserve encompasses backwater areas along the Colorado River near Parker, Arizona, and includes restoration sites. We surveyed a portion of Deer Island.

Deer Island

Area: 15.2 ha Elevation: 104 m

This site consists of a narrow strip of mixed-native vegetation on the edge of a long backwater slough. The only dense, woody vegetation occurs in a strip approximately 5 m wide on the edge of the slough and consists of tamarisk and screwbean mesquite up to 6 m in height and an understory of arrowweed. More than 5 m from the water, vegetation is primarily arrowweed with widely scattered tamarisk and mesquite. Canopy closure is <50%. The southern side of the slough has a steep, high bank, and woody vegetation is perched several meters above the water level. The north bank is not as high, with woody vegetation approximately 1 m above the water level. Although extensive areas of inundated soils existed in the slough and the adjacent cattails, water did not extend into the woody vegetation at any time during the survey season. The majority of the site burned between 2 and 8 July, and surveys were discontinued.

We detected no willow flycatchers. We surveyed the site four times, totaling 4.0 observer-hours. Cowbirds were detected on all visits. No evidence of livestock use was observed.

Palo Verde Ecological Reserve, California

PVER Phase 2

Area: 28.7 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of cottonwood, Goodding willow, and coyote willow, which reach heights of 8, 7, and 4 m, respectively. Height and density of the vegetation varies within as well as between cells of the site. Canopy closure is highly variable, ranging from <25 to 80%. The entire site has a ground covering of alfalfa (*Medicado sativa*). The site is flood irrigated but did not contain surface water during any of our site description visits. The irrigation canal adjacent to the site contained water throughout the season.

We detected one willow flycatcher on 27 May and one on 3 June. We surveyed the site five times, totaling 15.0 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was recorded.

Big Hole Slough, California

Big Hole Slough

Area: 29.0 ha Elevation: 82 m

This mixed-native site consists of cattail marshes edged with narrow bands of coyote willow 5 m in height. In upland areas away from the marshes, the site contains tamarisk and honey and screwbean mesquite up to 8 m in height with an understory of arrowweed. A few tall Goodding willow and cottonwood are present at the site. Overall canopy closure is approximately 50%. The site is surrounded by agricultural fields. The marsh contained standing water throughout the survey season.

We detected one willow flycatcher on 17 June. The site was surveyed five times, totaling 17.0 observer-hours. Cowbirds were detected on all visits, often in large flocks. No livestock use was observed.

Cibola National Wildlife Refuge, Arizona and California

CVCA Phase 1

Area: 26.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. Each cell generally contains a single species and age class. The tallest cottonwoods and willows are around 9 m in height, and canopy closure in the densest areas is 80–90%. Coyote willow reaches 3–5 m in height. The site is flood irrigated but did not contain standing water during any of our site description visits. The Colorado River is about 100 m from the northern edge of the site, and the remaining three sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected one willow flycatcher on 27 May. The site was surveyed five times, totaling 17.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA Phase 3

Area: 41.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods reach 7–8 m, Goodding willow reach 6 m, and coyote willow reach 3 m. Canopy closure varies from 20 to 80%. The site is flood irrigated but did not contain standing water during any of our site description visits. The site is surrounded by agricultural fields. The irrigation canal adjacent to the site held water throughout the season.

We detected one willow flycatcher on 16 May, one on 27 May, and two on 10 June. The site was surveyed five times, totaling 15.8 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

Cibola Nature Trail

Area: 13.7 ha Elevation: 70 m

This habitat creation site consists of a mosaic of cottonwood, Goodding willow, and mesquite. Approximately half the site consists of scattered screwbean and honey mesquite up to 5 m in height with a thick understory of seep willow. The northern half of the site contains an extensive stand of Goodding willow 8 m in height. The northern edge of the willow stand has canopy closure <25% and many of the willow are dead. The southern half of the willow stand has canopy closure around 70%. The southwestern corner of the site has a small stand of cottonwoods, and stringers of cottonwoods up to 18 m in height occur throughout the site. The site is flood irrigated and contained varying amounts of surface water through the season.

We detected one willow flycatcher on 16 May, two on 27 May, and one on 10 June. The site was surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Cibola Island

Area: 4.2 ha Elevation: 70 m

This mixed-native site is approximately 9.5 km southwest of Cibola Nature Trail. The site runs north to south, extending approximately 500 m lengthwise, with a width of 100 m. Dirt roads border the site to the north, east, and west. Open farm fields lie across the eastern road, with irrigation channels alongside the road. An irrigation canal empties into the northern end of the site, creating an open, marshy area down the center of the site. Between this marshy area and the western road, vegetation consists of an overstory of Goodding willow 10–12 m in height with an understory of tamarisk 5–7 m in height. Canopy closure within the willows is 80%. The eastern edge of the marsh is lined with a narrow strip of tamarisk 5–6 m in height with a few emergent Goodding willows on the marsh edge. Between the tamarisk strip and the eastern road, vegetation consists of honey mesquite and bushy arrowweed. The marsh was inundated with up to 50 cm of water in May, but in June and July the marsh contained only small pools.

We detected four willow flycatchers on 26 May and three on 4 June. The site was surveyed five times, totaling 5.1 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Cibola Site #2 and Cibola Site #1

Cibola Site #2: Area: 16.4 ha Elevation: 65 m
Cibola Site #1: Area 7.7 ha Elevation: 65 m

These adjacent, mixed-exotic sites consist of a 200-m-wide strip of riparian vegetation between the channelized Colorado River to the west and a levee road to the east. Woody vegetation consists of a mix of tamarisk and arrowweed, 3–4 m in height, which is dry and scrubby on the eastern edge of the sites and becomes denser toward cattail marshes on the western edge of the sites. Emergent Goodding willow and cottonwood are scattered along the eastern edge of the marshes. Overall canopy closure is less than 50%. No surface water was present within the sites during the survey season.

We detected one willow flycatcher on 9 June at Cibola Site #1. We surveyed each site five times, totaling 7.1 hours at Cibola Site #2 and 5.3 hours at Cibola Site #1. Numerous cowbirds were detected on all surveys, and burros were observed using the periphery of the sites.

Hart Mine Marsh

Area: 31.6 ha Elevation: 65 m

This mixed-exotic site parallels the channelized Colorado River immediately south of Cibola Site #1. The site consists of a mix of tamarisk and linear stretches of marsh, which make up about 30% of the site. Height of the tamarisk does not exceed approximately 5 m, and reaches this height only within 20 m of the marshes. Away from the marshes, the tamarisk is 3 m in height and partially dead. Canopy closure within the densest tamarisk is 80–90%. An open channel had been dredged down the middle of the northern third of the site. The marshes contained standing water throughout the survey season, but water did not extend under the woody vegetation. The site lacks the height and extent of woody vegetation typical of occupied flycatcher habitat along the LCR, and surveys were discontinued in July.

No willow flycatchers were detected. We surveyed the site four times, for total of 7.8 observer-hours. Cowbirds were detected on all surveys, and burros were observed on the periphery of the site.

Cibola Lake East

Area: 4.5 ha Elevation: 64 m

This site borders the marsh on the eastern edge of Cibola Lake. Vegetation within the site consists primarily of tamarisk. Within 30 m of the marsh edge, tamarisk reaches 6–7 m in height and 90% canopy closure. As distance from the marsh increases, the height and density of the tamarisk decreases, and the tamarisk becomes mixed with arrowweed. Soil within the site was dry throughout the survey season.

We detected one willow flycatcher on 4 June. We surveyed the site five times, totaling 6.3 observer-hours. Cowbirds were detected on all visits, and burro sign was observed on the periphery of the site.

Walker Lake

Area: 11.4 ha Elevation: 64 m

This mixed-exotic site is located along the northeastern edge of Walker Lake. The majority of the site consists of very dense tamarisk approximately 5 m in height with 90% canopy closure. The southeastern end of the site contains scattered emergent Goodding willow up to 20 m in height, as well as a couple of

emergent cottonwoods. This portion of the site also contains a small opening with dead cattails and a small patch of half-dead coyote willow. Walker Lake contained standing water and saturated soil throughout the survey season. Areas of the site adjacent to Walker Lake had saturated soils in May, though these soils were only damp in June and July. Soils in the interior of the site were dry throughout the survey season.

We detected no willow flycatchers. The site was visited five times, totaling 11.4 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Imperial National Wildlife Refuge, Arizona and California

Paradise

Area: 7.8 ha Elevation: 62 m

The center of this mixed-native site consists of stringers of cottonwood and Goodding willow 15–20 m in height. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. The cottonwoods and willows are separated from the Colorado River by a narrow (50-m-wide) strip of dense tamarisk. A marsh borders the western side of the southern third of the site. This marsh had been vegetated by cattails in previous years but now consists primarily of common reed (*Phragmites australis*). Canopy closure within the site is variable. Standing water was present within the marsh in May.

We detected one willow flycatcher on 20 May. The site was surveyed five times, totaling 6.8 observer-hours. Cowbirds were detected on every visit, and burros were noted near the site.

Hoge Ranch

Area: 20.7 ha Elevation: 61 m

This mixed-exotic site is dominated by tamarisk 4–6 m in height, with a few emergent cottonwood and Goodding willow (15 to 18 m in height) at the southern end of the site near the old ranch. Linear marshes with cattail, bulrush, and common reed occupy less than 20% of the interior of the site, and there are a few patches of coyote willow. Canopy closure is variable and reaches 70–90% in areas of dense, woody vegetation. The marshes in the interior of the site contained small pools of water in July. The site also borders the Colorado River.

We detected three willow flycatchers on 20 May and one on 15 June. The site was surveyed five times, totaling 9.7 observer-hours. Cowbirds were detected on four surveys, and there was evidence of burros using the site.

Rattlesnake

Area: 7.6 ha Elevation: 60 m

This mixed-exotic site is a patchwork of tamarisk 7 m in height with emergent Goodding willow up to 15 m in height and strips of dense coyote willow 6–8 m in height. Canopy closure is 70–90%. Extensive cattail marshes separate this site from the Colorado River. The interior of the site contained no standing water during the survey season.

We detected one willow flycatcher on 19 May. The site was surveyed five times, totaling 6.1 observer-hours. Cowbirds were detected on all surveys, and there was no evidence of livestock use.

Milemarker 65

Area: 10.0 ha Elevation: 58 m

The site is a narrow strip of mixed-exotic vegetation between the Colorado River and a backwater marsh. Vegetation at the site consists primarily of dense tamarisk 6 m in height. Dense common reed, approximately 3 m in height, also occurs throughout the site and together with the tamarisk creates almost complete canopy closure. Because of the impenetrable vegetation at the site, we surveyed it from the river, and hydrologic conditions in the interior of the site during the surveys are unknown.

No willow flycatchers were detected. We surveyed the site five times for a total of 2.9 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Nursery NW

Area: 7.0 ha Elevation: 58 m

This mixed-exotic site lies between the Colorado River and a cattail marsh. The dominant vegetation is tamarisk approximately 5 m in height with an understory of common reed. Mesquite trees are scattered along the western edge of the site. The eastern edge of the site, adjacent to the cattail marsh, has a stand of Goodding willow 9 m in height. Overall canopy closure is around 70%, and the densest portions of the site have canopy closure >90%. Surface water was present in the adjacent marsh in May and June.

We detected one willow flycatcher on 16 June. The site was surveyed five times, totaling 4.4 observer-hours. Cowbirds were detected on all visits, and there was no evidence of livestock use.

Ferguson Lake

Area: 21.1 ha Elevation: 57 m

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with scattered, emergent Goodding willow 10 m in height along the western edge of the site bordering Ferguson Lake. Tamarisk 5–6 m in height is the dominant understory species, and it forms a continuous canopy in portions of the site. The site also contains patches of arrowweed with scattered screwbean mesquite and little canopy cover. The northwestern corner of the site up to 50 m from the lakeshore had damp soils in May and standing water in June and July.

We detected three willow flycatchers on 21 May and two on 16 June. The site was surveyed five times, totaling 16.8 observer-hours. Cowbirds were detected on all visits, and no signs of livestock use were observed.

Great Blue Heron

Area: 7.1 ha Elevation: 58 m

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willow forms an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. Portions of the site contain thickets of willow deadfall. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. The site and the adjacent marsh were dry in

May and June. Pools of water within the woody vegetation were noted in July after thunderstorms the previous night.

We detected one willow flycatcher on 28 May and one on 12 June. The site was surveyed five times, totaling 19.4 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Powerline

Area: 2.0 ha Elevation: 58 m

This mixed-native site consists of a strip of Goodding willow and cottonwood along the border of a cattail marsh. Overstory height is approximately 12 m and canopy closure is <50%. Tamarisk and arrowweed are present in the understory, and honey mesquite is mixed with the tamarisk on the upland edge of the site. Small pools of water were present within the marsh in May and July, but the marsh was dry in June.

We detected one willow flycatcher on 28 May. We surveyed the site five times, totaling 6.3 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were noted within the site.

Martinez Lake

Area: 4.6 ha Elevation: 58 m

This mixed-native site borders the eastern shore of Martinez Lake. The eastern edge of the site, adjacent to the upland, is dominated by arrowweed with scattered Goodding willow, cottonwood, and tamarisk. Goodding willow <10 m in height and cottonwood up to 15 m in height are more prevalent on the western edge of the site, adjacent to cattails and common reed along the lakeshore. Canopy closure is highly variable. No surface water was recording within the site at any time during the survey season, and the marsh edge adjacent to the site was also dry.

No willow flycatchers were detected. We surveyed the site five times, totaling 6.0 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were observed at the site.

Ground Reconnaissance Results

IMPERIAL BURN

This area is between Nursery NW and the uplands to the northeast. A prescribed burn is being considered for this area, and Reclamation requested that we evaluate it. We visited the area on 30 May. It consists of a mosaic of tamarisk and marshy openings. Scattered mesquite trees emerge 1–3 m above the tamarisk, and the area also contains a few widely scattered Goodding willow, which also emerge a few meters above the tamarisk. Surface water did not appear to extend beyond the borders of the marshes. Canopy height and density were not recorded during the site visit, and it is difficult to determine the suitability of the site for willow flycatchers from the limited data available.

Mittry Lake, California

Mittry West

Area: 4.4 ha Elevation: 48 m

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Canopy closure is approximately 80%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. Surface water was present in the site during May, but the site was dry in June and July and a small patch of cattails within the site was noted in June as being primarily dead.

We detected two willow flycatchers on 11 June. The site was visited five times, totaling 7.9 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

Ground Reconnaissance Results

LAGUNA DAM NORTH

We investigated this area, northwest of Mittry West between Imperial Road and the All American Canal, after receiving reports of willow flycatcher detections from personnel from an unrelated project. Vegetation in the area consists of a mix of honey mesquite up to 8 m in height and tamarisk 4 m in height. Scattered Goodding willow up to 6 m in height is also present. Canopy closure is 50–70%. Soils within the site were completely dry at the end of May. The site does not have the vegetation density or mesic conditions typical of occupied flycatcher habitat, and we discontinued surveys after three visits. We detected one willow flycatcher on 29 May and one on 11 June. No flycatchers were detected on 26 June.

Yuma, Arizona

Gila River Site #2

Area: 5.1 ha Elevation: 45 m

The center of this mixed-native site consists of an overstory of cottonwood up to 15 m in height and Goodding willow approximately 8 m in height, with an understory of arrowweed. Canopy closure in the center of the site is 70–90%. The remainder of the site is vegetated by tamarisk 4 m in height and arrowweed, with canopy closure <50%. The site is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. There was no standing water within the vegetation during the survey season, but the northwestern edge of the site borders a marsh, which held water throughout the season.

We detected three willow flycatchers on 30 May and one on 14 June. The site was surveyed five times, totaling 8.2 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Fortuna Site #1

Area: 5.1 ha Elevation: 45 m

This mixed-native site consists of a narrow strip of cottonwood and Goodding willow up to 15 m in height with 50–70% canopy closure. Tamarisk and arrowweed form a patchy understory on the periphery of the site. Within the densest cottonwood/willow areas, there is little understory but many downed branches. The site is bordered to the north by agricultural fields and to the south by a cattail marsh and the Gila River. Surface water was recorded in the lowest portion of the site in May, but the entire site was dry in June and July.

We detected two willow flycatchers on 31 May. We surveyed the site five times, totaling 5.3 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was observed.

Fortuna North

Area: 3.4 ha Elevation: 46 m

This site is vegetated primarily by mature tamarisk approximately 7 m in height. Goodding willow and mesquite, also 7 m in height, are scattered throughout the site but make up less than 10% of the vegetation. Canopy closure is approximately 80%. The western edge of the site borders the Gila River. No surface water was noted within the site during the survey season.

We detected no willow flycatchers at this site. We surveyed the site five times, totaling 6.3 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was observed.

DISCUSSION

Six areas occupied in 2009 by breeding flycatchers (Pahranagat NWR, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams River NWR) consistently held resident and breeding flycatchers in previous years (McKernan and Braden 2002, McLeod et al. 2008, McLeod and Koronkiewicz 2009; details of residency and breeding in 2009 are presented in Chapters 3 and 4 of this document). In 2009, breeding flycatchers were recorded along Beaver Dam Wash at Littlefield (Littlefield Poles) for the first time since 2004. We detected breeding flycatchers for the first time at Bunker Marsh North on the Virgin River. SWCA personnel from an unrelated flycatcher survey project detected no flycatchers at Bunker Marsh North in 2004, and we did not detect flycatchers at the site during habitat reconnaissance and opportunistic surveys in 2006. Bunker Marsh North was surveyed in 2009 based on findings of aerial reconnaissance prior to the survey season when we noted areas of inundated vegetation. Along the Bill Williams River, breeding flycatchers were detected at a new breeding site, Upstream from Site #8. We did not detect flycatchers at Upstream from Site #8 during habitat reconnaissance and opportunistic surveys in 2007 and 2008.

Factors in addition to the presence of standing water during the breeding season appear to be influencing the presence and numbers of breeding flycatchers at Topock Marsh. The amount of standing water throughout the entire Topock study area was markedly reduced in 2005 compared to 2003–2004 and 2006–2008. In 2009, water levels at Topock were as high during flycatcher settlement in May and early June as they had been in previous wet years, but sites dried out earlier in the season than in previous years. The number of flycatchers recorded at Topock since 2003 does not appear to be related solely to

the amount of standing water present during the breeding season, with 25, 67, 41, 37, 31, 30, and 28 adults recorded in 2003–2009, respectively. Factors such as reproductive rates, survival, changes in breeding habitat (see Chapter 5), or other abiotic conditions may be influencing the demographics of this local population. Hydrologic conditions within the sites at Topock prior to mid-May of each year are largely unknown and may influence habitat conditions and flycatcher occupancy. Marsh elevation data obtained for 2006 to 2009 suggest no interannual changes in the amount of water present in the vegetation prior to flycatcher arrival in those years. Marsh elevation data for years prior to 2006 are not available.

In an effort to locate all potentially suitable willow flycatcher habitat at Topock Marsh, we conducted habitat reconnaissance and opportunistic surveys at eight sites. Of the eight sites, one was visited in 2006 and seven were noted as containing areas of inundated vegetation during aerial reconnaissance in 2009. Three of the eight sites currently do not have the vegetation structure typical of occupied flycatcher habitat along the LCR but should be monitored for changes in vegetation in future years. Five of the areas we visited are unlikely to support flycatchers in future years, as it is unlikely that habitat conditions will improve.

Although 40 flycatchers were recorded at sites surveyed south of the Bill Williams on or before 15 June, and four detections were recorded post 15 June, monitoring results and behavioral observations (lack of territorial, aggressive behaviors exhibited toward conspecific broadcasts) at these sites suggest these flycatchers were not resident or breeding individuals but migrants. These results are consistent with those recorded in 2003–2008 (McLeod et al. 2008, McLeod and Koronkiewicz 2009).

In 2008, we implemented a biennial survey schedule at selected sites. At this time, we are not recommending the addition of any sites to the biennial schedule for 2010.

Chapter 3

COLOR-BANDING AND RESIGHTING

INTRODUCTION

Long-term monitoring of willow flycatchers of known identity, sex, and age is the only effective way to determine demographic life history parameters such as annual survivorship of adults and young, site fidelity, seasonal and between-year movements, and population structure. Thus, as an integral part of our studies, we captured and uniquely color-banded as many willow flycatchers as possible, allowing field personnel to resight individuals throughout the breeding season, as well as in subsequent years. Resighting consisted of using binoculars to determine the identity of a color-banded flycatcher by observing, from a distance, the unique color combination on its legs. This allowed field personnel to detect and monitor individuals without recapturing each bird. This was our seventh consecutive year of color-banding studies and builds upon color-banding initiated at these sites in 1997 (McKernan and Braden 1998).

METHODS

Color-banding

From early May through mid-August, we captured, uniquely color-banded, and subsequently monitored adult and nestling willow flycatchers at all study areas where resident willow flycatchers were detected. The color-banding effort also included opportunistic banding at Key Pittman Wildlife Management Area in Nevada (in cooperation with Nevada Division of Wildlife) and in St. George, Utah (in cooperation with Utah Division of Wildlife Resources).

Adult flycatchers were captured with mist-nets, which provide the most effective technique for live-capture of adult songbirds (Ralph et al. 1993). We used a targeted capture technique (per Sogge et al. 2001), whereby a variety of conspecific vocalizations were broadcast from a CD player and remote speakers to lure territorial flycatchers into the nets. In addition, we used "passive netting," whereby several mist-nets were erected and periodically checked, with no broadcast of conspecific vocalizations. We banded each adult willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and a colored metal band on the other. We coordinated all color combinations with the Federal Bird Banding Laboratory and all other Southwestern Willow Flycatcher banding projects to minimize replication of color combinations. For each color-banded bird recaptured, we visually inspected the legs and noted any evidence of irritation or injury that may be related to the presence of leg bands.

Nestlings were banded at 8 to 10 days of age, when they were large enough to retain the leg bands, yet young enough that they would not prematurely fledge from the nest (Whitfield 1990, Paxton et al. 1997). Nestlings were banded only when the location of the nest was such that nest access and removal/replacement of the nestlings would not endanger the nest, nest plant, or nestlings. Nestlings were also banded with a single, numbered federal band on one leg and a metal color-band on the other leg. Prior to 2008, we banded each nestling only with a single federal band, identifying it as a returning nestling in the event it returned in a subsequent year.

For each captured adult willow flycatcher, we recorded morphological measurements including culmen, tail, wing, fat level, and molt onto standardized data forms (Appendix A). Sex was determined based on

the presence of a cloacal protuberance in males or brood patch and/or egg(s) in the oviduct for females. Captured flycatchers lacking breeding characteristics and not observed engaging in male advertising song (see below) were sexed as unknown. Flycatchers with retained primary, secondary, and/or primary covert feathers (multiple aged remiges) were aged as second year adults, and those without (uniformly aged remiges) were aged as after second year (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). Individuals in juvenile plumage (unworn flight feathers and body plumage with broad, buff colored wing bars and fleshy gape) were aged as hatch year.

Resighting

We determined the identity of a color-banded flycatcher by observing with binoculars, from a distance, the unique color combination on its legs. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed. Field personnel typically spent the early part of each morning color-banding, and directed their efforts to resighting as daylight increased and flycatchers became more difficult to capture. All banding, monitoring, and survey field personnel coordinated resighting efforts and recorded observations of color-banded and unbanded flycatchers onto standardized data forms (Appendix A). For resighted flycatchers (i.e., one for which at least one leg was seen clearly enough to determine the presence or absence of a band), we recorded color-band combinations, territory number, site, standardized confidence levels of the resight, and behavioral observations. Willow flycatchers for which detections spanned one week or longer were considered resident at a site, regardless of the portion of the breeding season in which the bird was observed or whether a possible mate was observed. Flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male, and flycatchers observed carrying nest material or constructing or incubating a nest were sexed as female. Flycatchers not observed engaging in one of these diagnostic activities were sexed as unknown.

Inactive territories were visited at least three times (each visit four days apart) before territory visits stopped. All territories were assigned a unique alphanumeric code and were plotted onto high-resolution aerial photographs, thus producing a spatial representation of the flycatcher population at each study location. Flycatchers were determined to be unpaired if none of the following breeding behaviors were observed: presence of another unchallenged flycatcher in the immediate vicinity, counter calling (***whitts***) with a nearby flycatcher, interaction twitter calls (***churr/kitters***) with a nearby flycatcher, a flycatcher in the immediate vicinity carrying nesting material, a flycatcher in the immediate vicinity carrying food or fecal sac, or adult flycatchers feeding young (per Sogge et al. 1997).

Unbanded flycatchers could not be identified to individual, but an unbanded flycatcher detected in a given location on multiple, consecutive visits was assumed to be the same individual. If an unbanded flycatcher was detected at a given location on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered to be different individuals in the absence of behavioral observations indicating the flycatcher was actively defending a territory or was a member of a breeding pair.

RESULTS

All Monitoring Sites

Color-Banding and Resighting – Field personnel color-banded 17 new adult flycatchers and recaptured 8 individuals previously captured as adults. An additional 55 adults were identified to individual via resighting, while 10 individuals were resighted but did not have their color combinations confirmed.

One adult had federal band on one leg and an injury on the other leg, and one adult had a duplicate color-band combination. We detected eight individuals identified as returning nestlings by the presence of a single federal band, with three (38%) identified to individual via recapture. Thirty-one adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 19 adults. Overall, 67% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.1). We banded 44 nestlings from 21 nests. Of the 44 nestlings banded, 5 were known or suspected to have died before fledging. For details on all banded flycatchers detected at the study areas from 2003 to 2009, see Appendix D.

Site-by-Site Color-Banding and Resighting

Monitoring Sites

Pahranagat – We detected 21 resident, adult willow flycatchers from 12 territories at Pahranagat. In addition to resident adults, we detected three individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Of the 12 territories recorded at Pahranagat, 10 consisted of breeding pairs and 2 consisted of unpaired males. Of the breeding individuals, one male was polygynous with two females, and one female mated consecutively with two males.

Field personnel captured and color-banded five new adults and recaptured six flycatchers previously captured as an adult. We resighted and confirmed band combinations for an additional 11 adults. Of the resighted adults, one was originally banded as a nestling in 2008 (see Table 3.6 for juvenile dispersal data). The presence of bands could not be determined for two adults. We banded 11 nestlings from five nests, and 2 of these nestlings were recaptured as fledglings. We resighted 13 unbanded fledglings from four additional nests.

Littlefield – We detected four resident, adult willow flycatchers from three territories at Littlefield. In addition to resident adults, we detected one individual for which residency and/or breeding status could not be confirmed (Table 3.2). Of the three territories, two consisted of breeding pairs and one consisted of an unpaired male. Of the breeding individuals, one male was polygynous with two females.

Field personnel captured and color-banded one new adult. We resighted and confirmed band combinations for an additional adult, which was originally banded as a nestling in 2008 (see Table 3.6). One resident adult remained unbanded, and band status could not be determined for another. Band status also could not be determined for the individual for which residency and/or breeding status could not be confirmed.

Mesquite – We detected 25 resident, adult willow flycatchers from 15 territories at Mesquite. In addition to resident adults, we detected three individuals for which residency and/or breeding status could not be determined. Of the 15 territories recorded at Mesquite, 12 consisted of paired individuals and 3 consisted of unpaired males (Table 3.2). Of the breeding individuals, two males were polygynous with two females and one female mated consecutively with two males.

Field personnel recaptured two flycatchers previously captured as adults. We confirmed the identities of an additional 14 adults via resighting. One additional adult had a federal band on one leg and an injury on the opposite leg, and another adult had a duplicate color combination. Of the resighted adults, three were originally banded as nestlings in 2008 (see Table 3.6). Eight adults remained unbanded, and three adults were banded but band combinations could not be confirmed. We banded four nestlings from four nests.

Mormon Mesa – We detected 27 resident, adult willow flycatchers from 17 territories at Mormon Mesa. In addition to resident adults, we detected six individuals for which residency could not be confirmed (Table 3.2). Of the 17 territories recorded at Mormon Mesa, 13 consisted of breeding individuals and 4 consisted of unpaired males. Of the breeding individuals, three males were each polygynous with two females.

Field personnel captured and color-banded two new adults. We resighted and identified 21 additional returning adults; of these, five were banded as nestlings in 2008 (see Table 3.6). We captured one returning nestling originally banded as a juvenile in 2007 and resighted one additional returning nestling with a single federal band that we were unable to recapture. Four adults remained unbanded, and band combinations could not be confirmed for four adults. We banded 22 nestlings from nine nests. Three of these nestlings were known to have died before fledging. We resighted three unbanded fledglings from three nests.

Muddy River – We detected 13 resident, adult willow flycatchers from eight territories at Muddy River. In addition to resident adults, we detected four individuals for which residency could not be confirmed. Of the eight territories recorded, six consisted of breeding individuals and two consisted of unpaired males (Table 3.2). Of the resident individuals, one female mated consecutively with two males, both of which were consecutively mated with two females.

Field personnel captured and color-banded two new adults. We resighted and identified four other adults, three of which were banded as nestlings in 2008 (see Table 3.6). We resighted one adult for which the band combination could not be confirmed. We resighted two returning nestlings with single federal bands but could not capture these individuals to determine year and study area of origin. Seven adults remained unbanded, and band status could not be determined for one individual. We banded one nestling, which died before fledging.

Topock – We detected 14 resident, adult willow flycatchers from 13 territories at Topock. In addition to resident adults, we detected 14 individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Of the 13 territories recorded at Topock, 1 consisted of paired individuals, 8 consisted of unpaired males, and 1 contained an individual for which gender could not be determined. In each of the remaining three territories, a singing male was detected throughout the breeding season and an unchallenged flycatcher, suspected to be a female, was detected for only a few days in June.

Field personnel captured and color-banded one new adult and resighted and identified two other banded adults. We captured two returning nestlings originally banded in 2007 (see Table 3.6) and resighted but were unable to recapture two additional returning nestlings with single federal bands. Seven adults remained unbanded, and the band status of 12 individuals could not be determined. The color combinations of two banded adults could not be confirmed. We banded three nestlings from one nest.

Table 3.1. Summary of Willow Flycatchers Detected at Monitored Sites during the 2009 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Previously Captured as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Pahranagat	North	23	5	6	0	11	0	0	1	0	11(5)	2[1]	**96**
	South	1	0	0	0	0	0	0	1	0	0	0	**0**
	Study Area Total	**24**	**5**	**6**	**0**	**11**	**0**	**0**	**2**	**0**	**11(5)**	**2**	**92**
Littlefield	Poles	5	1	0	0	1	0	1	2	0	0	0	40
	Study Area Total	**5**	**1**	**0**	**0**	**1**	**0**	**1**	**2**	**0**	**0**	**0**	**40**
Mesquite	West	21	0	2	0	10	2[2]	5	0	2	4(4)	0	73
	Bunker Marsh North	7	0	0	0	3	0	3	0	1	0	0	57
	Study Area Total	**28**	**0**	**2**	**0**	**13**	**2**	**8**	**0**	**3**	**4(4)**	**0**	**71**
Mormon Mesa	Virgin River #1 (North)	4	1	0	0	1	0	1	0	1	0	0	75
	Virgin River #1 (South)	28	1	0	1	20	1[3]	3	0	2	22(9)	0	89
	Virgin River #2	1	0	0	0	0	0	0	0	1	0	0	0
	Study Area Total	**33**	**2**	**0**	**1**	**21**	**1**	**4**	**0**	**4**	**22(9)**	**0**	**89**
Muddy River	Overton WMA	17	2	0	0	4	2[3]	7	1	1	1(1)	0	53
	Study Area Total	**17**	**2**	**0**	**0**	**4**	**2**	**7**	**1**	**1**	**1(1)**	**0**	**53**
Topock	Pipes #1	1	0	0	0	0	0	0	1	0	0	0	0
	Pipes #3	2	0	0	0	0	1[3]	0	1	0	0	0	0
	The Wallows	3	0	0	1	0	0	1	1	0	3(1)	0	33
	PC6-1	1	0	0	0	0	0	1	0	0	0	0	0
	800M	1	0	0	0	0	0	1	0	0	0	0	0
	Pierced Egg	5	0	0	0	1	1[3]	0	2	1	0	0	60
	250M	3	0	0	0	0	0	0	3	0	0	0	0
	Hell Bird	2	0	0	0	0	0	1	1	0	0	0	0
	Glory Hole	7	1	0	1	1	0	2	1	1	0	0	57
	Beal Lake	2	0	0	0	0	0	0	2	0	0	0	0
	Lost Lake	1	0	0	0	0	0	1	0	0	0	0	0
	Study Area Total	**28**	**1**	**0**	**2**	**2**	**2**	**7**	**12**	**2**	**3(1)**	**0**	**32**
Bill Williams	Site #4	4	1	0	0	0	0	1	2	0	0	0	25
	Site #3	8	2	0	0	3	0	3	0	0	3(1)	0	63
	Site #5	1	1	0	0	0	0	0	0	0	0	0	100
	Upstream from Site #8	2	2	0	0	0	0	0	0	0	0	0	100
	Study Area Total	**15**	**6**	**0**	**0**	**3**	**0**	**4**	**2**	**0**	**3(1)**	**0**	**60**
Total		**150**	**17**	**8**	**3**	**55**	**7**	**31**	**19**	**10**	**44(21)**	**2**	**67**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.2.

[1] Both individuals banded as nestlings and recaptured as fledglings.

[2] One individual had silver federal band only and had a visible injury on the unbanded left leg; a male with silver federal band number 2390-92434 and a visible injury on the unbanded left leg was captured at Mesquite in 2005, and this is likely the same individual. Other individual had a duplicate color combination.

[3] Returning nestling(s).

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	1-Jul-06	2370-40047	PU:DD(M)	N/A	A5Y	F	1	RS
	North	6-Jul-05	236059711	KB(M):EE	N/A	5Y	M	1	RS
	North	3-Aug-09	2430-61271	XX:WD(M)	N/A	L	U	1	N
	North	30-Jun-05	2320-31698	RB(M):EE	N/A	5Y	F	3	RS
	North	19-Jul-08	2430-61080	YY(M):XX	N/A	3Y	M	3, 17	RS
	North	14-Jul-09	2370-40074	PU:KB(M)	N/A	L	U	3	N, R 8 Aug
	North	14-Jul-09	2430-61279	XX:DW(M)	N/A	L	U	3	N
	North	26-Jul-07	2370-40168	PU:KOK(M)	N/A	4Y	F	4	RS
	North	24-Jul-08	2430-61083	XX:YR(M)	XX:RW(M)	3Y	M	4	R 28 Jul
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	26-Jun-09	2430-61087	OB(M):XX	N/A	AHY	F	6	N
	North	25-Jul-05	2370-39915	PU:RZ(M)	N/A	A6Y	M	6	R 26 Jun
	North	N/A	N/A	UB:UB	N/A	HY	U	6	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	6	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	6	RS
	North	19-Jun-07	2370-40195	YWY(M):PU	N/A	4Y	F	9	R 13 Aug
	North	3-Aug-08	2430-61127	XX:WG(M)[9]	N/A	A3Y	M	9	R 20 Jul
	North	20-Jul-09	2370-40076	BR(M):PU	N/A	L	U	9	N
	North	20-Jul-09	2430-61277	XX:DB(M)	N/A	L	U	9	N
	North	20-Jul-09	2540-58188	TQ:VY(M)	N/A	L	U	9	N, R 13 Aug
	North	20-Jul-09	2540-58187	TQ:RB(M)	N/A	SY	F	12	N

AR063483

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	6-Aug-01	2320-31592	GO(M):EE	N/A	9Y	M	12	RS
	North	30-Jun-09	2370-40073	PU:KO(M)	N/A	AHY	F	13	N
	North	18-May-04	2320-31595	WKW(M):EE	N/A	A7Y	M	13	R 30 Jun
	North	6-Jul-09	2370-40026	PU:RK(M)	N/A	L	U	13	N
	North	6-Jul-09	2370-40027	YY(M):PU	N/A	L	U	13	N
	North	1-Jul-08	2430-61120	XX:KO(M)	N/A	SY	F	15	RS
	North	29-Jul-07	2370-40157	DWD(M):PU	N/A	A4Y	M	15	RS
	North	14-Jul-09	2370-40075	OW(M):PU	N/A	L	U	15	N[10]
	North	14-Jul-09	2430-61278	XX:GO(M)	N/A	L	U	15	N
	North	14-Jul-09	2540-58185	TQ:RG(M)	N/A	L	U	15	N
	North	17-Jun-07	2370-40194[11]	BR(M):UB	PU:BR(M)	4Y	F	17	R 8 Aug
	North	N/A	N/A	UB:UB	N/A	HY	U	17	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	17	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	17	RS
	North	20-Jun-04	2320-31657	WO(M):EE	N/A	A7Y	F	97[12]	RS
	North	INA	INA	undetermined	N/A	AHY	M	97	
	North	21-Jun-06	2370-40060	YG(M):PU	N/A	A5Y	M	T5, 97	RS; unpaired at T5, then displaced male at 97
	North	N/A	N/A	UB:UB	N/A	HY	U	97	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	97	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	97	RS
	North	25-Jul-08	2430-61179	XX:KB(M)	N/A	A3Y	M	T11	RS; detected 20 May–26 Jul
	South	INA	INA	undetermined	N/A	AHY	U	F19	Detected 22 Jun
	North	13-Aug-09	2370-40140	PU:YO(M)	N/A	AHY	F	F20	N; not detected before or after capture; underside of bill dark, possibly not ***extimus***

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	9-Aug-09	2540-58189	DR(M):TQ	N/A	AHY	U	F21	N; not detected before or after capture
LIFI	Poles	N/A	N/A	UB:UB	N/A	AHY	F	20	RS
	Poles	28-Jun-08	2430-61187	KV(M):XX	N/A	SY	M	20, 105	RS
	Poles	INA	INA	undetermined	N/A	AHY	F	105	
	Poles	8-Jun-09	2370-40155	PU:VB(M)	N/A	AHY	M	T66	N; detected 1–29 Jun
	Poles	INA	INA	undetermined	N/A	AHY	M	F80	Detected 25 Jun
MESQ	West	23-Jun-04	2320-31498	KW(M):EE	N/A	6Y	F	2	RS
	West	4-Jul-01	2390-92434[13]	UB:XX	N/A	9Y	M	2	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	7	RS
	West	3-Jun-07	2370-40197	OG(M):PU	N/A	A4Y	M	7	RS
	West	1-Aug-03	2320-31445	EE:WK(M)	N/A	A8Y	F	24	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	24	RS
	West	27-Jun-09	2430-61155	BB(M):XX	N/A	L	U	24	N
	West	6-Aug-09	2540-58219	TQ:RW(M)	N/A	L	U	24	N
	Bunker Marsh North	INA	INA	banded	N/A	AHY	F	39	RS
	Bunker Marsh North	1-Jul-08	2430-61165	XX:RY(M)	N/A	SY	M	39, 101	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	42	RS
	West	23-Jun-04	2320-31490[11]	UB:WG(M)	EE:OO(M)	A7Y	M	42, 45	R 28 Jun
	West	28-Jun-08	2430-61154	RO(M):XX	N/A	L	U	42	N
	West	20-Jul-06	2370-40066	YO(M):PU	N/A	5Y	F	43	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	43	RS
	West	26-Jul-07	2370-40087	PU:BZ(M)	N/A	A4Y	F	44	RS
	West	6-Jul-06	2360-59751	OG(M):EE	N/A	4Y	M	44	RS
	West	7-Jul-09	2370-40143	PU:RY(M)	N/A	L	U	44	N

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	INA	INA	banded	N/A	AHY	F	45	RS
	West	5-Jul-07	2370-40193	GY(M):PU	N/A	A4Y	F	51[12]	RS
	West	INA	INA	GW(M):PU[14]	N/A	AHY	M	51	RS
	West	23-Jun-06	2370-39940	WV(M):PU	GY(M):PU	A5Y	M	T23, 51	R 26 Jun; unpaired at T23 14–26 May, then displaced male at 51
	West	N/A	N/A	UB:UB	N/A	AHY	F	64	RS
	West	7-Jul-06	2370-39967	KO(M):PU	N/A	A5Y	M	64	RS
	Bunker Marsh North	N/A	N/A	UB:UB	N/A	AHY	F	101	RS
	Bunker Marsh North	N/A	N/A	UB:UB	N/A	AHY	U	102	RS
	Bunker Marsh North	6-Jul-08	2430-61198	XX:KR(M)	N/A	SY	U	102	RS
	West	7-Jul-06	2360-59754	OR(M):EE	N/A	4Y	M	T11	RS; detected 20 May–13 Jul
	West	15-Jul-05	2320-31688	EE:BG(M)	N/A	5Y	M	T41	RS; detected 11 May–21 Jul
	Bunker Marsh North	2-Jul-08	2430-61194	VB(M):XX	N/A	SY	U	F40	RS; detected 16 Jun
	Bunker Marsh North	N/A	N/A	UB:UB	N/A	AHY	M	F68	RS; detected 16–21 Jun
	West	INA	INA	banded	N/A	AHY	U	F80	RS; detected 9 Jul
MOME	Virgin River #1 South	2-Jun-06	2370-40037	PU:DR(M)	N/A	A5Y	F	11	RS
	Virgin River #1 South	14-Jun-06	2370-40046	PU:DK(M)	N/A	5Y	M	11	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	L	U	11	RS
	Virgin River #1 South	19-Jun-09	2370-40175	PU:UB[15]	N/A	L	U	11	N
	Virgin River #1 South	19-Jun-09	2370-40174	XX:KG(M)	N/A	L	U	11	N
	Virgin River #1 South	21-Jun-07	2370-40191	PU:RYR(M)	N/A	A4Y	F	12	RS
	Virgin River #1 South	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A9Y	M	12, 13	RS
	Virgin River #1 South	18-Jun-09	2370-40145	PU:YW(M)	N/A	L	U	12	N[16]
	Virgin River #1 South	18-Jun-09	2540-58216	TQ:GB(M)	N/A	L	U	12	N

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	18-Jun-09	2430-61086	BO(M):XX	N/A	L	U	12	N
	Virgin River #1 South	18-Jun-09	2370-40144	OKO(M):PU	N/A	L	U	12	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	L	U	12	RS
	Virgin River #1 South	6-Aug-05	2360-59788	BO(M):EE	N/A	5Y	F	13	RS
	Virgin River #1 South	15-Jul-09	2370-40029	KOK(M):PU	N/A	L	U	13	RS
	Virgin River #1 South	15-Jul-09	2370-40030	PU:RO(M)	N/A	L	U	13	RS
	Virgin River #1 South	29-Jun-09	2430-61153	WO(M):XX	N/A	AHY	F	14	N
	Virgin River #1 South	21-Jun-06	2370-39988	DW(M):PU	N/A	5Y	M	14, 99	RS
	Virgin River #1 South	23-Jun-09	2370-40151	RR(M):PU	N/A	L	U	14	N
	Virgin River #1 South	23-Jun-09	2430-61159	OK(M):XX	N/A	L	U	14	N
	Virgin River #1 South	23-Jun-09	2370-40152	PU:BW(M)	N/A	L	U	14	N
	Virgin River #1 South	INA	INA	banded	N/A	AHY	F	21	RS
	Virgin River #1 South	15-May-07	2370-40161	PU:DY(M)	N/A	A4Y	M	21	RS
	Virgin River #1 South	23-Jun-09	2370-40023	PU:BO(M)	N/A	L	U	21	N
	Virgin River #1 South	23-Jun-09	2370-40150	WG(M):PU	N/A	L	U	21	N
	Virgin River #1 South	2-Jul-08	2430-61116	VV(M):XX	N/A	A3Y	F	32	RS
	Virgin River #1 South	8-Jun-06	2370-39938	KG(M):PU	N/A	5Y	M	32	RS
	Virgin River #1 South	27-Jun-09	2540-58141	TQ:DD(M)	N/A	L	U	32	N[17]
	Virgin River #1 South	27-Jun-09	2540-58142	BV(M):TQ	N/A	L	U	32	N[17]
	Virgin River #1 South	31-Jul-09	2430-61160	KD(M):XX	N/A	L	U	32	N
	Virgin River #1 South	31-Jul-09	2540-58154	DO(M):TQ	N/A	L	U	32	N
	Virgin River #1 South	31-Jul-09	2540-58155	GG(M):TQ	N/A	L	U	32	N
	Virgin River #1 South	31-Jul-03	2320-31444	RW(M):EE	N/A	A8Y	F	36	RS
	Virgin River #1 South	06/29/03	2320-31471	EE:OW(M)	N/A	7Y	M	36	RS

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	19-Jun-09	2370-40072	OO(M):PU	N/A	L	U	36	N
	Virgin River #1 South	19-Jun-09	2430-61285	XX:GK(M)	N/A	L	U	36	N
	Virgin River #1 South	19-Jun-09	2370-39930	PU:GO(M)	N/A	L	U	36	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	L	U	36	RS
	Virgin River #1 North	23-Jun-08	2430-61172	XX:GR(M)	N/A	SY	F	37	RS
	Virgin River #1 North	7-Jun-09	2370-40176	PU:GK(M)	N/A	AHY	M	37, 51	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	45	RS
	Virgin River #1 South	29-Jun-07	2370-40124	PU:BB(M)	PU:UB	3Y	M	45	R 27 Jun
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	F	51	RS
	Virgin River #1 South	INA	INA	UB:EE	N/A	AHY	F	52	RS
	Virgin River #1 South	12-Jun-07	none[18]	RK(M):UB	N/A	A3Y	M	52	RS
	Virgin River #1 South	28-Jun-08	2430-61185	DB(M):XX	N/A	SY	F	67	RS
	Virgin River #1 South		2360-59752	DRD(M):EE	N/A	4Y	M	67	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	99	RS
	Virgin River #1 South	13-Jul-09	2370-40142	PU:VV(M)	N/A	L	U	99	N
	Virgin River #1 South	1-Jul-08	2430-61118	XX:KK(M)	N/A	SY	M	T1	RS; detected 17 Jun–25 Jul
	Virgin River #1 South	23-Jun-08	2430-61174	XX:KG(M)	N/A	SY	M	T2	RS; detected 27 Jun–13 Jul
	Virgin River #1 South	15-Jul-04	2320-31517	EE:OR(M)	N/A	7Y	M	T5	RS; detected 24 May–16 Jun
	Virgin River #1 South	19-Jun-08	2430-61167	XX:KW(M)	N/A	A3Y	M	T7	RS; detected 17 May–4 Aug
	Virgin River #1 South	23-Jun-08	2430-61173	XX:GY(M)	N/A	SY	U	F3	RS; detected 19 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	M	F4	RS; detected 21–24 May
	Virgin River #1 South	INA	INA	banded	N/A	AHY	M	F6	RS; detected 17–21 Jul
	Virgin River #1 South	26-Jul-07	2370-40086	WRW(M):PU	N/A	3Y	U	F8	RS; detected 21 Jul
	Virgin River #1 North	INA	INA	banded	N/A	AHY	U	F9	RS; detected 6 Jun

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #2	INA	INA	banded	N/A	AHY	U	F46	RS; detected 19 May
MUDD	Overton WMA	INA	INA	PU:UB	N/A	AHY	F	10	RS
	Overton WMA	21-May-09	2430-61085	BV(M):XX	N/A	SY	M	10	N
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	16	RS
	Overton WMA	28-Jun-09	2540-58143	RO(M):TQ	N/A	SY	M	16, 51	N
	Overton WMA	27-Jul-08	2370-40147	OR(M):PU	N/A	SY	F	18	RS
	Overton WMA	1-Jul-08	2430-61191	XX:BD(M)	N/A	SY	M	18	RS
	Overton WMA	17-Jul-09	2430-61161	WB(M):XX	N/A	L	U	18	N[17]
	Overton WMA	INA	INA	EE:UB	N/A	AHY	F	31	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	31, 51	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	38	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	38	RS
	Overton WMA	23-Jun-08	2430-61207	GO(M):XX	N/A	SY	F	51[12]	RS
	Overton WMA	25-Jun-09	2430-61209	GY(M):XX	N/A	A3Y	M	T1	RS; detected 22–29 Jul
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	T48	RS, detected 4–16 Jul
	Overton WMA	INA	INA	undetermined	N/A	AHY	U	F8	Detected 15 May
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	U	F34	RS; detected 19 May
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	F35	RS; detected 19 May
	Overton WMA	INA	INA	banded	N/A	AHY	U	F36	RS; detected 19 May
TOPO	The Wallows	N/A	N/A	UB:UB	N/A	AHY	F	41	RS
	The Wallows	13-Jul-07	2370-40114	VY(M):PU	UB:PU	3Y	M	41	R 15 May and 11 Jun[19]
	The Wallows	29-Jul-09	2370-40048	BG(M):PU	N/A	L	U	41	N
	The Wallows	29-Jul-09	2370-40049	YDY(M):PU	N/A	L	U	41	N
	The Wallows	29-Jul-09	2370-40050	PU:RKR(M)	N/A	L	U	41	N

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pierced Egg	INA	INA	UB:EE	N/A	AHY	M	T1	RS; detected 8 May–6 Jul
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	M	T3	RS; detected 20 May–7 Jul
	Pierced Egg	22-May-08	2430-61135	XX:OY(M)	N/A	3Y	M	T4	RS; detected 27 May–10 Jul
	PC6-1	N/A	N/A	UB:UB	N/A	AHY	M	T7	RS; detected 2–16 Jun
	Glory Hole	18-Jul-07	2370-40158	WK(M):PU	UB:PU	3Y	M	T22	R 1 Jun; detected 12 May–11 Jul
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	M	T24	RS; detected 5 Jun–11 Jul
	Hell Bird	INA	INA	undetermined	N/A	AHY	M	T25	Detected 17–25 Jun
	Glory Hole	22-Jul-04	2320-31562	KY(M):EE	N/A	6Y	M	T42	RS; detected 16 May–27 Jul
	Glory Hole	28-May-09	2370-40181	PU:GV(M)	N/A	AHY	M	T43	N; detected 16 May–7 Jul
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	T63	Detected 15–23 May
	800M	N/A	N/A	UB:UB	N/A	AHY	M	T66	RS; detected 26 May–13 July
	Pipes #3	INA	INA	UB:PU	N/A	AHY	M	T93	RS; detected 8 May–4 Jul
	Pipes #1	INA	INA	undetermined	N/A	AHY	U	F2	Detected 15 May
	Lost Lake	N/A	N/A	UB:UB	N/A	AHY	U	F5	Detected 29 May
	250M	INA	INA	undetermined	N/A	AHY	U	F6	Detected 21 May
	Pierced Egg	INA	INA	banded	N/A	AHY	U	F8	RS; detected 16–19 Jun, possibly female for T1
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F9	Detected 16–19 Jun; possibly female for T4
	Pipes #3	INA	INA	undetermined	N/A	AHY	U	F10	Detected 9–13 Jun; possibly female for T93
	Glory Hole	INA	INA	banded	N/A	AHY	M	F21	Detected 12–16 May
	Glory Hole	INA	INA	undetermined	N/A	AHY	M	F44	Detected 28 May–1 Jun
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	U	F45	Detected 6 Aug
	The Wallows	INA	INA	undetermined	N/A	AHY	M	F46	Detected 15 May
	Beal Lake	INA	INA	undetermined	N/A	AHY	M	F65	Detected 3 Jun

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	250M	INA	INA	undetermined	N/A	AHY	U	F67	Detected 3–7 Jun
	250M	INA	INA	undetermined	N/A	AHY	U	F68	Detected 25 Jun
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F70	Detected 8 Jun
BIWI	Site #3	N/A	N/A	UB:UB	N/A	AHY	F	46	RS
	Site #3	11-Jun-09	2370-40180	PU:KG(M)	N/A	AHY	M	46	N
	Site #3	7-Jul-09	2370-40162	PU:DB(M)	N/A	L	U	46	N
	Site #3	7-Jul-09	2370-40163	OK(M):PU	N/A	L	U	46	N
	Site #3	7-Jul-09	2370-40182	GV(M):PU	N/A	L	U	46	N
	Upstream from Site #8	16-Jun-09	2370-40165	DB(M):PU	N/A	AHY	F	47	N
	Upstream from Site #8	4-Jul-09	2370-39969	PU:KYK(M)	N/A	AHY	M	47	N
	Site #3	6-Jun-08	2430-61137	XX:BR(M)	N/A	3Y	F	61	RS
	Site #3	6-Jun-08	2430-61136	XX:BG(M)	N/A	3Y	M	61	RS
	Site #3	4-Jun-09	2370-40130	PU:GWG(M)	N/A	AHY	F	65	N
	Site #3	N/A	N/A	UB:UB	N/A	AHY	M	65	RS
	Site #3	N/A	N/A	UB:UB	N/A	L	U	65	RS
	Site #3	N/A	N/A	UB:UB	N/A	L	U	65	RS
	Site #3	N/A	N/A	UB:UB	N/A	L	U	65	RS
	Site #3	2-Jul-06	2370-40004	PU:RW(M)	N/A	A5Y	F	69	RS
	Site #3	N/A	N/A	UB:UB	N/A	AHY	M	69	RS
	Site #4	5-Jul-09	2540-58146	YR(M):TQ	N/A	SY	M	T26	N; detected 18 Jun–5 Jul
	Site #5	10-Jun-09	2370-40156	PU:OB(M)	N/A	SY	M	T45	N; detected 5–16 Jun
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	T68	RS; detected 6–24 Jun
	Site #4	INA	INA	undetermined	N/A	AHY	U	F1	Detected 16–18 Jun; possibly female for T68
	Site #4	INA	INA	undetermined	N/A	AHY	U	F27	Detected 20 Jun

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2009.

[5] **Age in 2009**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Right leg injured, but color-band could not be removed.

[10] Nestling suspected to have died before fledging.

[11] This federal band removed.

[12] Female mated consecutively with two different males.

[13] Band number likely 2390-92434 but cannot be confirmed because bird was not captured in 2009. Bird had visible injury on left leg.

[14] Color combination is a duplicate; federal band number and identity of flycatcher unknown.

[15] Right leg not banded because of pre-existing injury.

[16] Fledgling found dead near nest.

[17] Nestling died before fledging.

[18] Original federal band 2370-40173.

[19] Recapture on 15 May was in a passive net at the Beal Lake MAPS station.

Bill Williams – We detected 13 resident willow flycatchers from eight territories at Bill Williams. In addition to resident adults, we detected two individuals for which residency and/or breeding status could not be determined (Table 3.2). Of the eight territories recorded at Bill Williams, five consisted of paired individuals and two consisted of unpaired males. In the remaining territory a singing male was detected through most of June, and an unchallenged flycatcher, suspected to be a female, was detected for only a few days in June.

Field personnel captured and color-banded six new adults. We resighted and identified three returning banded adults. Four adults remained unbanded, and band status could not be determined for two adults. We banded three nestlings from one nest and resighted three unbanded fledglings from another nest.

Non-Monitoring Sites

These study areas were monitored by other agencies, and here we report only banded flycatchers that were captured or resighted. Unbanded individuals or those with unknown band status are not included.

Key Pittman Wildlife Management Area – Field personnel captured and color-banded two new adults (Table 3.3). We resighted and identified four returning banded adults. We banded seven nestlings from three nests.

St. George – Field personnel captured and color-banded four new adults. We resighted and identified two adult flycatchers, one of which was banded as a nestling in 2008. We recaptured another adult that was banded as a nestling in 2001 and had not been identified since. Another adult was identified as a returning nestling, but we were unable to capture this individual to determine year and study area of origin. We banded five nestlings from two nests; four of these died before fledging (Table 3.3).

Table 3.3. Banded Willow Flycatchers, Non-Monitoring Sites, 2009

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Old Color Combination[2,3]	Age[4]	Sex[5]	Observation Status[6]
KEPI	Patch 1	29-Jul-09	2370-40141	PU:YK(M)	N/A	SY	U	N
	Patch 2	30-Jun-05	2370-39980	WO(M):PU	N/A	5Y	M	RS
	Patch 7	27-Jun-06	2320-31674	BW(M):EE	N/A	4Y	M	RS
	Patch 7	23-Jun-04	2320-31484	YB(M):EE	N/A	6Y	M	RS
	Patch 7	27-Jun-09	2540-58145	TQ:DO(M)	N/A	L	U	N
	Patch 7	27-Jun-09	2540-58144	TQ:OG(M)	N/A	L	U	N
	Patch 8	2-Jul-09	2370-40024	PU:BV(M)	N/A	L	U	N
	Patch 8	2-Jul-09	2370-40025	YW(M):PU	N/A	L	U	N
	Patch 9	16-Jul-09	2370-40031	OGO(M):PU	N/A	L	U	N
	Patch 9	16-Jul-09	2430-61156	GK(M):XX	N/A	L	U	N
	Patch 9	16-Jul-09	2430-61157	YB(M):XX	N/A	L	U	N
	Patch 10	16-Jul-09	2430-61158	RB(M):XX	N/A	AHY	M	N
	Patch 10	26-Jun-08	2430-61181	XX:RD(M)	N/A	A3Y	F	RS
STGE	Seegmiller Marsh	2-Aug-01	2540-58131[7]	TQ:KY(M)	Rs:W(HP)/B(HP)	AHY	F	R 22 Jun
	Seegmiller Marsh	22-Jun-09	2540-58132	TQ:OD(M)	N/A	AHY	M	N
	Seegmiller Marsh	21-Jun-04	2320-31660	BZ(M):EE	N/A	6Y	F	RS

Table 3.3. Banded Willow Flycatchers, Non-Monitoring Sites, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Old Color Combination[2,3]	Age[4]	Sex[5]	Observation Status[6]
	Seegmiller Marsh	INA	INA	UB:PU	N/A	AHY	M	RS
	Seegmiller Marsh	22-Jun-09	2370-40099	PU:VW(M)	N/A	L	U	N[8]
	Seegmiller Marsh	22-Jun-09	2370-40146	PU:WV(M)	N/A	L	U	N[8]
	Seegmiller Marsh	22-Jun-09	2370-40154	PU:YV(M)	N/A	L	U	N[8]
	Seegmiller Marsh	22-Jun-09	2370-40153	PU:YY(M)	N/A	L	U	N[8]
	Riverside East	27-Jul-08	2370-40148	PU:KR(M)	N/A	SY	F	RS
	Riverside East	14-Jul-09	2540-58217	TQ:BR(M)	N/A	SY	M	N
	Riverside East	14-Jul-09	2540-58218	KG(M):TQ	N/A	L	U	N
	River Road Bridge	4-Aug-09	2430-61162	BW(M):XX	N/A	AHY	M	N
	Riverside	15-Jul-09	2540-58186	TQ:YB(M)	N/A	AHY	M	N

[1] KEPI = Key Pittman Wildlife Management Area, STGE = St. George.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, TQ = turquoise federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] Old combination included only if rebanded in 2009.

[4] **Age in 2009:** L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[5] **Sex codes**: M = male, F = female, U = unknown.

[6] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[7] Original federal band number 2140-66690.

[8] Nestling died before fledging.

Adult Between-Year Return and Dispersal

In 2008 we individually identified 75 adult, resident willow flycatchers at our monitored study areas, of which 41 (55%) were detected in 2009 (Table 3.4). Of the returning resident adults, one (2%) was detected at a different study area than where it was last detected in 2008 (Table 3.5). One adult flycatcher that was detected in 2008 but not confirmed to be a resident was detected at a different study area in 2009. Two flycatchers that were banded in 2008 at study areas monitored by other agencies were detected at our monitored study areas in 2009. One additional adult, which was last detected in 2006, exhibited between-year movement in 2009. The median dispersal distance for all returning adult flycatchers exhibiting between-year movements in 2009 was 29.1 km (min = 26.9 km, max = 70.2 km).

Table 3.4. Resident Adult Willow Flycatcher Annual Return from 2008 to 2009

Study Area	# Identified in 2008	# of 2008 Birds Detected in 2009	% Return	% Return to Same Study Area
Pahranagat	21[1]	14	67	100
Mesquite	18	12	67	100
Mormon Mesa	18	11	61	91
Muddy River	4	0	0	--
Grand Canyon	1	0	0[2]	--
Topock	7	2	30	100
Bill Williams	5	2	40	100
Total	**75**	**41**	**55**	**98**

[1] One individual that moved from Pahranagat to Key Pittman during the 2008 breeding season is not included.

[2] Grand Canyon study area was not monitored in 2009.

Table 3.5. Summary of Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2009

Study Area/Site/Year Detected[1]	Study Area/Site Detected 2009[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
KEPI/Patch 10/2008[4]	PAHR/North	30.1	2370-39915	PU:RZ(M)	M
MESQ/West/2008	MOME/VR #1S	26.9	2360-59752	DRD(M):EE	M
LVWA/UPSLP/2008	MUDD/Overton WMA	70.2	2430-61209	GY(M):XX	M
KEPI/Patch 4/2008	PAHR/North	29.6	2430-61179	XX:KB(M)	M
MOME/VR #2/2008	MESQ/West	28.6	2370-39940	WV(M):PU	M
MESQ/West/2006	MOME/VR #1S	27.2	2320-31444	RW(M):EE	F

[1] PAHR = Pahranagat NWR, KEPI = Key Pittman WMA, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, LVWA = Las Vegas Wash.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, XX = standard silver federal band, (M) = metal pin striped band, R = red, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold. . Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male.

[4] This individual was at Pahranagat North through 11 Jul but was detected at Key Pittman on 26 Jul 2008.

Juvenile Between-Year Return and Dispersal

In 2008, we banded 74 nestlings at the monitored study areas. One of these nestlings was known to have died before fledging. Of the 73 remaining juveniles, 12 (16%) were identified in 2009. Two additional flycatchers banded as nestlings in St. George in 2008 were identified in 2009. Three individuals originally banded as nestlings in 2007 were identified for the first time in 2009, and one individual banded as a nestling in 2001 was identified breeding in St. George (Table 3.6). Of the 18 returning nestlings identified in 2009, 10 (56%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2009 was 13.7 km (min = 0.03 km, max = 202.8 km).

Table 3.6. Summary of Juvenile Flycatchers Banded as Hatch Year Birds in 2001, 2007, or 2008 and Identified for the First Time in 2009

Study Area/ Site Banded	Year Hatched	Study Area/Site Detected 2009	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/North	2001	STGE/Seegmiller Marsh	143.5	2540-58131	TQ:KY(M)	F
TOPO/Glory Hole	2007	MOME/Virgin River #1 South	202.8	2370-40124	PU:BB(M)	M
TOPO/Glory Hole	2007	TOPO/The Wallows	3.6	2370-40114	VY(M):PU	M
BIWI/Site #3	2007	TOPO/Glory Hole	71.1	2370-40158	WK(M):PU	M
STGE/Seegmiller Marsh	2008	MUDD/Overton WMA	100.6	2370-40147	OR(M):PU	F
STGE/Seegmiller Marsh	2008	STGE/Riverside East	2.6	2370-40148	PU:KR(M)	F
PAHR/North	2008	MOME/Virgin River #1 South	104.8	2430-61118	XX:KK(M)	M
PAHR/North	2008	MESQ/Bunker Marsh North	105.7	2430-61198	XX:KR(M)	U
PAHR/North	2008	PAHR/North	0.3	2430-61120	XX:KO(M)	F
MESQ/West	2008	MESQ/ Bunker Marsh North	4.7	2430-61165	XX:RY(M)	M
MESQ/West	2008	MOME/Virgin River #1 South	27.1	2430-61185	DB(M):XX	F
MESQ/West	2008	LIFI/Poles	19.8	2430-61187	KV(M):XX	M
MESQ/West	2008	MESQ/ Bunker Marsh North	4.3	2430-61194	VB(M):XX	U
MOME/Virgin River #1 South	2008	MOME/Virgin River #1 North	0.1	2430-61172	XX:GR(M)	F
MOME/Virgin River #1 South	2008	MOME/Virgin River #1 South	0.03	2430-61173	XX:GY(M)	U
MOME/Virgin River #1 South	2008	MOME/Virgin River #1 South	0.03	2430-61174	XX:KG(M)	M
MOME/Virgin River #1 North	2008	MUDD/Overton WMA	13.8	2430-61191	XX:BD(M)	M
MOME/Virgin River #1 South	2008	MUDD/Overton WMA	13.6	2430-60207	GO(M):XX	F

[1] PAHR = Pahranagat NWR, STGE = St. George, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, (M) = metal pin striped band, R = red, O = orange, G = green, B = light blue, D = dark blue, V = violet, W = white, Y = yellow, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

Five additional returning nestlings from 2003–2007 were resighted in 2009 (one at Mormon Mesa, two at Muddy River, and two at Topock), but the identity of these individuals was undetermined because we were unable to recapture them.

Within-Year, Between-Study Area Movements

We detected no within-year, between-study area movements in 2009.

DISCUSSION

Color-Banding Effort

Overall, 67% of the adult flycatchers detected at the monitoring sites during 2009 were banded by the end of the breeding season. This compares to 55, 57, 75, 70, 73, and 69% in 2003–2008, respectively.

Unbanded migrant willow flycatchers are included in calculating these percentages; therefore, in most cases, these numbers under-represent the actual proportion of resident banded flycatchers at a given site. We have maintained high overall percentages of banded birds annually over the seven years, which has enabled us to detect movements, generate dispersal data, and determine survival and detection probabilities across study areas (McLeod et al. 2008). Differences between study areas in the percentage of banded individuals are directly related to vegetation density and overall structure, which affect our ability to erect mist-nets in the habitat. Topock Marsh typically has the lowest percentage of color-banded flycatchers because dense vegetation limits the number and size of possible net locations.

Prior to 2008, we banded all nestlings with a single anodized federal band, identifying the bird as a returning nestling in the event it was sighted in a subsequent year. The individual would then have to be recaptured to determine its individual identity and to apply a unique color combination so the bird could be individually identified via resighting. Returning nestlings are particularly difficult to recapture at Topock. The rationale for banding nestlings with a single anodized band was that the majority of nestlings do not return in subsequent years, resulting in the loss of a large number of unique color combinations. To eliminate the need to recapture returning nestlings, in 2008–2009 we applied unique color combinations to all nestlings. The use of full color combinations on nestlings in 2008 resulted in approximately half as many adults with single federal bands being detected in 2009 than in previous years. Additionally, we recorded juvenile dispersal movements that might otherwise have gone undetected. Although a large number (118) of unique color combinations were used on nestlings in 2008–2009, the benefits in terms of high resolution demographic data outweigh the loss of unique color combinations.

Adult and Juvenile Between-Year Dispersal

Adult and juvenile dispersal data for the 2009 field season show high site fidelity exhibited by adult flycatchers and lower natal site fidelity exhibited by juveniles, with juveniles dispersing among study areas annually. These dispersal data are consistent with the patterns observed in the LCR region from 1998 to 2009, over which period 92% of adult returns were to the same study area while only 55% of all juvenile returns were to the natal study area (McKernan and Braden unpubl. data, McLeod et al. 2008, McLeod and Koronkiewicz 2009). These dispersal data are also consistent with range-wide data (Paxton et al. 2007), with adult flycatchers exhibiting high site fidelity to breeding areas. Juvenile dispersal within the Virgin/lower Colorado River population(s) is largely limited to this region, and while reciprocal juvenile movements among geographically isolated flycatcher populations of the greater Southwest do occur, they are rare. Only three instances of willow flycatcher immigration from sites outside the Virgin/lower Colorado River region have been recorded since 1997 (McKernan and Braden unpubl. data, McLeod et al. 2008), with two males originally banded as nestlings in 2003 at Roosevelt Lake recaptured in 2005 at Muddy River and Topock, and one male banded as a nestling in 1999 at Roosevelt Lake recaptured in 2002 in Grand Canyon. Although movements of this magnitude are infrequent, other instances of dispersal distances greater than 140 km have been reported for the Southwestern Willow Flycatcher (Paxton et al. 2007).

The observed dispersal patterns fit well with the tenets of contemporary metapopulation theory (Hanski and Simberloff 1997), suggesting the Virgin/lower Colorado River population may be a panmictic sub-population of a greater metapopulation. Occasional juvenile dispersal between sub-populations is likely an important population variable in terms of both gene flow and possibly the establishment of new flycatcher populations. These juvenile movements contribute to an understanding of the observed patterns of high genetic diversity within and low genetic isolation among Southwestern Willow Flycatcher populations (Busch et al. 2000). Physical connectivity of riparian habitats within the greater landscape is crucial in enabling these long-distance movements. Without adequate stop-over habitats and

foraging areas, flycatchers attempting long-distance movements are more likely to be exposed to adverse environmental conditions.

Adult and Juvenile Survivorship

Annual survivorship is defined as the number of individuals that survive from one year to the next, and accurate estimates depend on year-to-year detection of uniquely marked birds. Fifty-five percent of the adult, resident willow flycatchers identified in 2008 were detected again in 2009, while of the 73 juveniles banded in 2008, only 12 (16%) were identified in 2009. Thus, minimum estimated adult and juvenile survival from 2008 to 2009 was 55 and 16%, respectively. These simple annual percent survivorship calculations assume that all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. To provide more robust estimates of annual survival, demographic data acquired from 2003 to 2012 will be combined with data collected during 1997–2002. Survival and detection probabilities will be estimated using program MARK (White and Burnham 1999) and presented in a summary report in 2012.

Chapter 4

NEST MONITORING

INTRODUCTION

Documentation of nest success and productivity is critical to understanding local population status and demographic patterns of the Southwestern Willow Flycatcher. In 2009, at all sites where willow flycatcher breeding activity was suspected, we conducted intensive nest searches and nest monitoring. Specific objectives of nest monitoring included identifying breeding individuals (see Chapter 3, Color-banding and Resighting), calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Nest monitoring results from 2009 were compared with those at the study areas from 1996 to 2008 (Braden and McKernan unpubl. data, McLeod et al. 2008, McLeod and Koronkiewicz 2009). Although aspects of willow flycatcher breeding ecology can vary widely across its broad geographical and elevational ranges throughout the Southwest (Whitfield et al. 2003), we compared monitoring results with range-wide data to identify specific variables that may contribute to the characterization of flycatcher breeding ecology throughout the lower Colorado and Virgin River riparian systems.

METHODS

Upon locating territorial willow flycatchers, regardless of whether a possible mate was observed, we conducted intensive nest searches following the methods of Rourke et al. (1999). Nest monitoring followed a modification of the methods described by Rourke et al. (1999) and the Breeding Biology Research and Monitoring Database (BBIRD) protocol by Martin et al. (1997).

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites. Nests were monitored every two to four days after nest building was complete and incubation was confirmed. During incubation and after hatching, nest contents were observed directly using a telescoping mirror pole to determine nest contents and transition dates. Nest monitoring during nest building and egg laying stages was limited to reduce the chance of abandonment during these periods. To reduce the risk of depredation (Martin et al. 1997), brood parasitism by the Brown-headed Cowbird, and premature fledging of young (Rourke et al. 1999), we observed nests from a distance with binoculars once the number and age of nestlings were confirmed. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

Per instructions from Reclamation biologists, we considered a willow flycatcher nest successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted based on the number of fledglings actually observed. This method of determining success differs from that recommended by some nest monitoring protocols (e.g., Martin et al. 1997, Rourke et al. 1999), which consider a nest as successful if chicks are observed in the nest within two days of the estimated fledge date. The method we follow produces a conservative estimate of both nest success rate and number of fledges.

We considered a nest to have failed if (1) the nest was abandoned prior to egg laying (abandoned); (2) the nest was deserted with flycatcher eggs or young remaining (deserted); (3) the nest was found empty or

destroyed more than two days prior to the estimated fledge date (depredated); (4) the nest was destroyed due to weather (weather); or (5) the entire clutch was incubated for an excess of 20 days (infertile/addled). For nests containing flycatcher eggs, parasitism was considered the cause of nest failure if (1) cowbird young outlived any flycatcher eggs or young, or (2) the nest was parasitized during egg laying and the disappearance of flycatcher eggs coincided with the appearance of cowbird eggs.

During each nest check, we recorded date and time of the visit, observer initials, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and number and behavior of adults and/or fledges present onto standardized data forms (Appendix A) that included the nest or territory number and UTM coordinates. We calculated flycatcher nest success using both apparent nesting success (number of successful nests/total number of nests containing at least one flycatcher egg) and the Mayfield method (Mayfield 1961, 1975), which calculates daily nest survival to account for nests that failed before they were found. We assumed one egg was laid per day, and incubation was considered to start the day the last egg was laid (per Martin et al. 1997). The nestling period was considered to start the day the first egg hatched and end the day the first nestling fledged. If exact transition dates or dates of depredation events were unknown, we estimated the transition date as halfway between observations. For nests where fate was unknown, we used the last known date of activity to determine the number of observation days. To calculate Mayfield survival probabilities (MSP), we used the average length of each nest stage (2.12, 12.86, and 13.75 days for laying, incubation, and nestling stages, respectively) as observed in this study in 2003–2009 for nests where transition dates were known. Nest productivity was calculated as the number of young fledged per nesting attempt that produced at least one flycatcher egg. Fecundity was calculated as number of young produced per female over the breeding season. Parasitism rates were calculated as the percentage of nests with known contents that included at least one flycatcher egg and one cowbird egg.

RESULTS

Nest Monitoring

We documented 72 willow flycatcher nesting attempts at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams; 65 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Twenty-three (35%) nests were successful and fledged young, 40 (62%) failed, and fate was unknown for 2 (3%). Nest success ranged from 0% at Littlefield and Muddy River to 53% at Mormon Mesa (Table 4.1). For a comparison of apparent nest success at all monitoring sites from 1997 to 2009, see Table 4.2.

Forty-eight nesting females, of which all but three were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was detected for which no nesting attempt could be confirmed. Of the 48 nesting females, 26 had one nesting attempt, 21 had two nesting attempts, and 1 had four nesting attempts. Of the 22 females with multiple nesting attempts, 19 renested after failed nests and 3 renested after successful nests.

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
PAHR	North	10	18	17	8 (47)	8 (47)	1 (6)	0
	Total	*10*	*18*	*17*	*8 (47)*	*8 (47)*	*1 (6)*	*0*
LIFI	Poles	2	2	1	0	1 (100)	0	1 (100)
	Total	*2*	*2*	*1*	*0*	*1 (100)*	*0*	*1 (100)*
MESQ	West	9	13	11	3 (27)	7 (64)	1 (9)	6 (55)
	Bunker Marsh North	3	3	3	0	3 (100)	0	1 (33)
	Total	*12*	*16*	*14*	*3 (21)*	*10 (72)*	*1 (7)*	*7 (50)*
MOME	Virgin River #1 North	2	2	2	0	2 (100)	0	0
	Virgin River #1 South	11	16	15	9 (60)	6 (40)	0	0
	Total	*13*	*18*	*17*	*9 (53)*	*8 (47)*	*0*	*0*
MUDD	Overton WMA	6	9	8	0	8 (100)	0	6 (75)
	Total	*6*	*9*	*8*	*0*	*8 (100)*	*0*	*6 (75)*
TOPO	The Wallows	1	2	2	1 (50)	1 (50)	0	0
	Total	*1*	*2*	*2*	*1 (50)*	*1 (50)*	*0*	*0*
BIWI	Site 3	4	5	5	2 (40)	3 (60)	0	2 (40)
	Upstream from Site #8	1	2	1	0	1 (100)	0	0
	Total	*6*	*7*	*6*	*2 (33)*	*4 (67)*	*0*	*2 (33)*
Overall Total		**49**	**72**	**65**	**23 (35)**	**40 (62)**	**2 (3)**	**16 (29)**

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Table 4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers and Tributaries from 1996 to 2009*

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
1996	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nc[7]	Nc[6]	Nm[3]
1997	Nm[3]	Nd[4]	67 (3)	42 (12)	Bc[9]	Nc[7]	Nc[6]	Nd[4]
1998	47 (19)	Nd[4]	0 (7)	70 (10)	Nm[3]	Nd[4]	53 (15)	Nd[4]
1999	60 (15)	Nm[3]	Nm[3]	45 (11)	Nm[3]	Nc[5]	38 (16)	100 (1)
2000	63 (16)	Nd[4]	50 (8)	38 (13)	100 (1)	Nc[5]	36 (11)	100 (1)
2001	50 (18)	Nd[4]	53 (17)	54 (13)	Nc[6]	Nc[6]	36 (14)	50 (4)
2002	33 (12)	Nd[4]	59 (17)	0 (9)	Nd[4]	Nd[4]	50 (6)	78 (9)
2003	91 (11)	Nd[4]	44 (18)	0 (10)	Nd[4]	Nd[4]	78 (9)	100 (2)
2004	76 (17)	50 (2)	24 (17)	50 (6)	Nd[4]	Bc[7]	45 (38)	Nd[4]
2005	58 (19)	Nd[4]	42 (12)	17 (6)	38 (8)	Nd[4]	24 (34)	100 (2)
2006	60 (15)	Nd[4]	55 (20)	50 (8)	44 (9)	0 (3)	23 (17)[8]	20 (5)
2007	67 (12)	Nd[4]	57 (14)	27 (11)	0 (6)	0 (1)	75 (8)	25 (8)

Table 4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers and Tributaries from 1996 to 2009* (Continued)

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
2008	80 (10)	Nd[4]	82 (11)	62 (13)	25 (8)	Nd[4]	13 (8)[9]	40 (5)[9]
2009	47 (17)[9]	0 (1)	21 (14)[9]	53 (17)	0 (8)	Nm[3]	50 (2)	33 (6)

* Data from 1997 to 2002 are from Braden and McKernan (unpubl. data); these numbers have been verified with the raw data and may differ from those presented in earlier annual reports. Data from 2003 to 2007 are from McLeod et al. 2008, data from 2008 are in McLeod and Koronkiewicz 2009, and data from 2009 are in this document. Data are presented as percent apparent nest success with total number of nests containing at least one flycatcher egg indicated in parentheses.

[1] Study area includes the Mesquite East, Mesquite West, and Bunker Farm sites.

[2] Study area includes the Virgin River Delta at Lake Mead.

[3] Study area not monitored.

[4] Study area surveyed, no breeding documented.

[5] Breeding suspected, nest success not calculated.

[6] Breeding confirmed, nest success not calculated.

[7] Breeding confirmed, undetermined if nestlings from a single nest fledged.

[8] An additional three nests (18%) were suspected to have fledged but fledglings were not visually confirmed.

[9] Fate of one nest was unknown.

Nest Failure

Depredation was the major cause of nest failure, accounting for 40% (19 of 47) of all failed nests (Table 4.3) and 48% (19 of 40) of nests that failed after flycatcher eggs were laid. Seven nesting attempts (15% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, and 10 nests (21%) were deserted. Six nests (13%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism).

Table 4.3. Summary of Causes of Willow Flycatcher Nest Failure at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled	Unknown
PAHR	18	9	1 (11)	0	5 (56)	0	0	3 (33)[2]
LIFI	2	2	1 (50)	0	0	1 (50)	0	0
MESQ	16	12	2 (17)	4 (33)[3]	4 (33)	1 (8)	1 (8)	0
MOME	18	9	1 (11)	3 (33)[4]	5 (56)	0	0	0
MUDD	9	9	1 (11)	2 (22)[5]	2 (22)	3 (33)	1 (11)	0
TOPO	2	1	0	0	1 (50)	0	0	0
BIWI	7	5	1 (20)	1 (20)[6]	2 (40)	1 (20)	0	0
Total	**72**	**47**	**7 (15)**	**10 (21)**	**19 (40)**	**6 (13)**	**2 (4)**	**3 (6)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] Nests were too high to use a mirror pole; depredation likely.

[3] One nest deserted after 14 days incubation, one deserted after 16 days incubation, one nest already deserted when found with one flycatcher egg and one cowbird egg, one nest deserted after partial depredation.

[4] One nest deserted with nestlings, one deserted after 16 days incubation, one deserted after partial depredation.

[5] One nest deserted after being parasitized, one deserted after partial depredation.

[6] Nest deserted after 17 days incubation.

Brood Parasitism

Sixteen of 56[1] nests (17%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.4). For nests containing flycatcher eggs, parasitism caused nest failure at six nests. In four of these cases, the parasitism event coincided with the disappearance of all flycatcher eggs. One nest fledged a cowbird, and another likely fledged a cowbird although the fledgling could not be located. In both of these cases, the one flycatcher egg remaining after the parasitism event did not hatch. Two parasitized nests (13%) successfully fledged at least one flycatcher. Of the remaining six parasitized nests that contained flycatcher eggs, three were deserted, three were depredated, one contained addled eggs, and one had unknown fate. Brood parasitism ranged from 0 to 100% and was highest at Littlefield (see Table 4.1). In 2009, nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized (Chi-square = 3.93, $P = 0.047$).

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-Headed Cowbirds, 2009*

Study Area[1]	Nest ID Code	Outcome[2]
LIFI	20A	Probably fledged a cowbird, but fledging not confirmed. WE did not hatch
	105A	Abandoned with one CE
MESQ	7A	Depredated with two WE and one cowbird nestling
	7B	Abandoned with three CE
	24B	Fledged one flycatcher and one cowbird
	39A	Found deserted with one WE and one CE
	43A	Deserted after partial depredation reduced nest contents from three WE and one CE to one WE and one CE
	43B	Depredated during incubation
	44A	Parasitized during incubation; all three WE disappeared, one CE appeared
	44B	Nest fate unknown; possibly fledged one flycatcher
MUDD	10A	All eggs addled; deserted after 21 days incubation with two CE and one WE
	16A	Parasitized during incubation; both WE disappeared and two CE appeared
	18A	Depredated during nestling period; possibly fledged a cowbird prior to flycatcher nestling being depredated, but no fledgling seen
	38A	Deserted during incubation after parasitism changed clutch from three WE to one WE and two CE
	38B	Parasitized during incubation; all three WE disappeared and one CE appeared
	51B	Parasitized during incubation; all three WE disappeared and one CE appeared
BIWI	46A	Fledged three flycatchers; CE did not hatch
	61B	Fledged one cowbird; WE did not hatch

* All nesting attempts are included.

[1] LIFI = Littlefield, MESQ = Mesquite, MUDD = Muddy River, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg, CE = cowbird egg.

[1] Table 4.1 shows a total of 65 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, nine nests whose contents could not be determined were excluded from calculations (i.e., nests that were too high to check contents to determine presence/absence of cowbird eggs).

Mayfield Nest Success and Nest Productivity

Mayfield survival probability (MSP) ranged from 0.053 at Muddy River to 0.519 at Topock and was 0.368 for all sites combined (Table 4.5). At all sites, 56 nestlings were confirmed to have fledged from 63 nests of known outcome (mean number of fledglings/nest = 0.89, SE = 0.16). Fecundity across study areas ranged from 0 to 3.00 young per female and averaged 1.14 (SE = 0.21) (Table 4.6).

Table 4.5. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Pahranagat	1	0/23	1.000	1.000
	2	7/134	0.948	0.502
	3	1/120.5	0.992	0.892
	MSP all stages = 0.447			
Littlefield	1	0/0	--	--
	2	1/11.5	0.913	0.310
	3	0/0	--	--
	MSP all stages = --			
Mesquite	1	0/19	1.000	1.000
	2	9/140	0.936	0.426
	3	1/72	0.986	0.825
	MSP all stages = 0.351			
Mormon Mesa	1	0/27	1.000	1.000
	2	3/169	0.982	0.794
	3	5/138	0.964	0.602
	MSP all stages = 0.478			
Muddy River	1	1/13	0.923	0.844
	2	6/58.5	0.897	0.249
	3	1/10.5	0.905	0.252
	MSP all stages = 0.053			
Topock	1	0/4	1.000	1.000
	2	0/23	1.000	1.000
	3	1/21.5	0.953	0.519
	MSP all stages = 0.519			
Bill Williams	1	0/13	1.000	1.000
	2	3/78.5	0.962	0.606
	3	1/28.5	0.965	0.612
	MSP all stages = 0.371			
Total	**1**	**1/99**	**0.990**	**0.979**
	2	**29/614.5**	**0.953**	**0.537**
	3	**10/391**	**0.974**	**0.700**
	MSP all stages = 0.368			

* Mayfield survival probability was calculated using 2.12-day egg laying, 12.86-day incubation, and 13.75-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

Table 4.6. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Pahranagat	22	16	1.38 (0.38)	10	2.20 (0.42)
Littlefield	0	1	0	2	0 (0)
Mesquite	3	13	0.23 (0.12)	12	0.25 (0.18)
Mormon Mesa	22	17	1.45 (0.35)	13	1.69 (0.44)
Muddy River	0	8	0 (0)	6	0 (0)
Topock	3	2	1.50 (0.38)	1	3.00
Bill Williams	6	6	1.00 (0.63)	5	1.20 (0.73)
Total	**56**	**63**	**0.89 (0.16)**	**49**	**1.14 (0.21)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females, and nests with unknown outcome are assumed not to have fledged, thus producing a conservative fecundity estimate.

DISCUSSION

In 2009, willow flycatcher nesting was documented at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams. The number of flycatcher pairs recorded at Pahranagat, Mesquite, and Mormon Mesa was nearly identical to that recorded in 2008. Bill Williams and Muddy River both had six pairs in 2009 versus four in 2008. Breeding was recorded at Littlefield for the first time since 2004. Given that southwestern riparian ecosystems experience dynamic change and are not ecologically static (Periman and Kelly 2000), willow flycatcher occupancy and nesting are likely to be affected by changes in habitat suitability, with breeding flycatchers detected at a given site in one year and not in another.

Topock Marsh had 14 resident flycatchers, which consisted of 12 unpaired individuals and only one breeding pair, the lowest number of breeding pairs recorded since monitoring began in 1997. In three other territories at Topock, we detected a second flycatcher in addition to the territorial male. In each case, the additional flycatcher was detected for less than one week and suspected to be female, based on interactions with the male and lack of defensive behavior on the part of the male. Gender was not confirmed, however, and no breeding activity was detected. The three suspected females are not included in calculations of fecundity.

Female willow flycatchers are more discriminating in habitat selection than males, with females having to choose habitat conducive to the complexities of nesting (e.g., concealment, microclimate requirements) versus choosing habitat favorable to male advertising and territory defense (Sedgwick and Knopf 1992). Willow flycatcher nest sites at study areas in the LCR region differed from within-territory locations in several vegetation and microclimate variables, suggesting that females are discriminating among potential nest sites on a very local scale (McLeod et al. 2008). Thus, the male skew in the sex ratio of residents at Topock and presence of suspected non-breeding, floater females may be indicative of poor breeding habitat quality. A similar pattern was observed at Roosevelt Lake, Arizona, during the severe drought of 2002, when declines in vegetation vigor and prey availability dramatically decreased female nesting behavior, resulting in almost complete reproductive failure (Paxton et al. 2007). Males arrived in May and set up territories, but the majority of females detected were floaters, did not nest, or abandoned nests before they were complete (E.H. Paxton pers. comm.). Whether other factors such as annual reproductive rates, survival, population recruitment, or other abiotic conditions contributed to reduced breeding at Topock remains unclear.

Nest Success

As in previous years, Mayfield nest success differed little (4% or less) from apparent nest success at most study areas. At Mesquite, apparent nest success (21%) was lower than Mayfield nest success (35%). The high Mayfield estimate was influenced by several nests having long incubation periods before being deserted and by one nest having an uncertain nest fate. Nests with uncertain fates are not counted as a success in apparent nest success but are not counted as a nest loss in the Mayfield estimate. The close agreement between apparent and Mayfield nest success at most study areas suggests that most nests are found early in the nesting cycle and thus relatively few nests fail before they are found.

Nest success at Pahranagat (apparent nest success = 47%, MSP = 45%), while still higher than the average for all study areas, was the lowest recorded since 2003. Nest success alone, however, is an incomplete measure of the production of young. Successful nests produce from one to four young, and variations in nest productivity are not reflected in nest success rates. In addition, although every failed nest attempt lowers percent nest success and MSP, success of a subsequent nesting attempt may result in the same number of young produced as if the initial nesting attempt had been successful. Thus, nest productivity (young produced per nesting attempt) and fecundity (young produced per female) in conjunction with nest success, provide additional information on the success of a given breeding season. Productivity at Pahranagat in 2009 (1.38 young per nest) was the lowest recorded since 2003 but did not differ significantly from that recorded in any other year (ANOVA $F_{6,93} = 0.570$, $P = 0.7530$). Fecundity (2.20 young per female) was in the middle of the range of fecundity values (1.6–3.0) recorded at the site in 2003–2009. Thus, although nest success in 2009 at Pahranagat was lower than in past years, females renested after unsuccessful first nest attempts, and fecundity did not appear to be affected.

Nest success and fecundity at Mormon Mesa were high for the second consecutive year, while productivity and fecundity at Mesquite dropped from the highest ever recorded in 2008 to the lowest recorded since 1999. Flycatchers at Muddy River experienced complete reproductive failure, as they did in 2007, and this study area has the lowest overall productivity and fecundity for any study area where breeding has been documented regularly. Nest success at Bill Williams continued to exhibit the yearly fluctuations observed since nest monitoring began in 1999. Sample sizes at Topock and Littlefield are too low to attribute much significance to the reproductive rates observed in 2009. Nest success results again illustrate that the demographic patterns of passerine populations often vary year to year, and sometimes to a very large degree (Wiens 1989a). The variable patterns of nest success observed at the study areas over many years demonstrate the need for long-term data.

Nest Failure

As in 2003–2008, depredation was the major cause of willow flycatcher nest failure, accounting for 40% of all failed nests in 2009. These results are consistent with those reported at the monitored study areas from 1998 to 2002 (Braden and McKernan unpubl. data) and at sites across Arizona from 1996 to 2008 (Graber et al. 2007, Ellis et al. 2008, Graber and Koronkiewicz 2009a), which indicate depredation as accounting for the majority of all willow flycatcher nest failures. Factors influencing the increases and decreases in nest depredation at the monitored study areas are inherently complex and at this time remain undetermined. For open-cup nesting passerines, nest depredation rates can vary year to year, and sometimes substantially, with depredation of eggs and young ultimately linked to landscape characteristics and fluctuations in predator densities, abundance, and richness (Wiens 1989b, Robinson 1992, Howlett and Stutchbury 1996).

In 2008, Northern Arizona University (NAU) initiated a nest camera study in cooperation with SWCA on open-cup nesting passerines at selected study areas (Mesquite, Pahranagat, Topock, Bill Williams) along

the lower Colorado River and tributaries. The study used video and still cameras on real and artificial nests to identify depredation rates and nest predators. Problems with both video and still cameras in 2008 affected the detection of depredation events and the identification of nest predators, but both Brown-headed Cowbirds and Yellow-breasted Chats were identified by still cameras as depredating artificial nests, and marks on clay eggs in depredated nests were consistent with these avian predators. This study was continued in 2009, with still cameras deployed at artificial nests and video cameras deployed at real nests at two flycatcher breeding areas (Pahranagat and Mesquite). Marks on clay eggs at these two study areas indicated that most depredation events at Mesquite were from birds, while at Pahranagat both birds and rodents depredated artificial nests (NAU unpubl. data). Video cameras were deployed at five flycatcher nests at Pahranagat and three at Mesquite. Of the five nests at Pahranagat, three successfully fledged flycatcher young, one was depredated during incubation by a Bewick's Wren (*Thyromanes bewickii*), and one was depredated during the nestling period by a red-shouldered hawk (*Buteo lineatus*). At Mesquite, one nest fledged one flycatcher and one cowbird, one nest was depredated during incubation by a cowbird, and the third nest was partially depredated by a cowbird during the nestling period. The cowbird removed two of three nestlings; the remaining nestling fledged successfully (NAU unpubl. data). Results of this study suggest that avian species may be important predators on flycatcher nests. Ellis et al. (2008) also identified Cooper's Hawks (*Accipiter cooperii*) and Yellow-breasted Chats depredating flycatcher nests at sites in Arizona.

Brood Parasitism

Brood parasitism by Brown-headed Cowbirds across all study areas ranged from 0 to 100% and averaged 29% (see Table 4.1). These results are consistent with those reported at the study areas from 1998 to 2007 (Braden and McKernan unpubl. data, McLeod et al. 2008, McLeod and Koronkiewicz 2009), but these parasitism rates are higher than those reported at other monitored sites across Arizona in 1996–2006, which were less than 10% at most sites in most years (Graber et al. 2007, Ellis et al. 2008).

We observed multiple occasions in which the disappearance of flycatcher eggs coincided with the parasitism event. In this case, cowbirds were suspected of ejecting the eggs. Female Brown-headed Cowbirds are known to physically attack willow flycatcher nestlings (Woodward and Stoleson 2002), remove single eggs, and occasionally destroy entire broods after laying is complete or after hatching (Lowther 1993 as cited in Woodward and Stoleson 2002). In addition, cowbirds were photographed removing eggs from artificial nests during the 2008–2009 camera study, and cowbirds were documented on video depredating flycatcher nests during both the incubation and nestling phases. Therefore, it is likely that other depredation events on eggs and nestlings are attributable to cowbirds.

Parasitism does not invariably cause nest failure, but the success rate (21%) for parasitized nests in 2003–2009 was less than half that of unparasitized nests (51%). Similar results were recorded for willow flycatchers in Oregon, with parasitism resulting in a 50% decrease in success rates compared to unparasitized nests (Sedgwick and Iko 1999) and at other sites in Arizona, where in 1996–2005, 20% of parasitized nests fledged flycatcher young vs. 57% of unparasitized nests (Ellis et al. 2008). Parasitized nests that did succeed in fledging flycatcher young at all study areas in 2003–2009 produced on average fewer young (1.3 young/nest) than did unparasitized nests (2.2 young/nest; $F_{1,183} = 18.55$, $P < 0.001$). Cowbirds may eject flycatcher eggs during the parasitism event, thus reducing clutch size, and cowbird young also cause interspecific nestling competition, as evidenced by the presence of severely underdeveloped nestlings in some parasitized nests. For all nests monitored from 2003 to 2009, 42% of nests that fledged a cowbird also fledged flycatcher young. This is a higher rate of success than that observed in Southwestern Willow Flycatchers at Kern River, California (9%; Whitfield and Sogge 1999), but comparable to that observed at other Arizona sites (40%; Ellis et al. 2008).

The inverse relationship of parasitism rates and nest success was particularly apparent at Mesquite in 2008 and 2009. In 2008, Mesquite experienced the lowest parasitism rate and highest nest success recorded at the site since 1999, and then in 2009 experienced the highest parasitism rate and lowest success rate recorded since 1999. High parasitism rates at Mesquite in 2009 may be related to changes in the habitat at Mesquite West, with dry soil conditions causing premature leaf abscission in coyote willows (see Chapter 2).

Female flycatchers may desert their nests after parasitism events and thus expend energy renesting and laying additional eggs. Given that adult flycatchers exhibit high site fidelity to breeding areas (Braden and McKernan unpubl. data, McLeod et al. 2008, McLeod and Koronkiewicz 2009, this document) and renest most often after failed nests (Sedgwick 2000), females returning to sites with high brood parasitism are likely to reduce lifetime fecundity because they are expending energy on multiple failed nesting attempts over many years. An analysis of lifetime fecundity of females will be included in the summary report in 2012. In addition, willow flycatchers that fledge late in the season have been shown to have a lower survival rate than those that fledge early in the season (Paxton et al. 2007, McLeod et al. 2008), suggesting additional hidden effects of parasitism and subsequent renesting on flycatcher demography.

Cowbird trapping and removal studies were initiated at Pahranagat, Mesquite, and Topock Marsh in 2003 and continued through 2007. Results of these studies showed that cowbird trapping appeared to lower parasitism rates in comparison to the pre-trapping period of 1998–2002 only at Pahranagat, with no parasitism detected during trapping years (McLeod et al. 2008). No cowbird trapping was completed in 2008 or 2009, but even in the absence of cowbird trapping, no parasitism events were detected at Pahranagat in either year. We did, however, regularly detect cowbirds within Pahranagat North in 2009, avoided mirror-poling nests on multiple occasions because of the presence of cowbirds, and observed other bird species feeding juvenile cowbirds. These observations suggest that although cowbird trapping may have lingering effects beyond the years in which trapping is completed, cowbirds seemed to be more numerous at Pahranagat in 2009 than in previous years.

We speculated that trapping might have affected the parasitism rate at Pahranagat but not the other study areas because Pahranagat consists of relatively small, isolated patches of riparian habitat rather than existing in a large, contiguous riparian corridor. The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in four of the five years when flycatchers have been monitored at the study area, and overall nest success was 23%, well below the average of 45% across all study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

In addition to cowbird trapping at Muddy River, addling cowbird eggs and/or removing cowbird eggs and young from easily accessible flycatcher nests would likely increase flycatcher nest success and productivity. We do not advise these activities at Pahranagat, which is still part of the five-year post-cowbird-trapping experiment. However, at study areas that were not part of the cowbird trapping experiment (Littlefield, Mormon Mesa, Muddy River, Bill Williams), addling eggs or removing eggs and young would not interfere with ongoing experiments and would likely benefit the flycatcher. At Mesquite and Topock, cowbird trapping was shown not to have any effect on parasitism rates and flycatcher nest success, and thus the post-trapping period will not reveal any lingering effects of trapping. Addling and/or removal of cowbird eggs and nestlings could thus be implemented at these study areas as well.

Chapter 5

VEGETATION AND HABITAT CHARACTERISTICS

INTRODUCTION

Our objective for vegetation sampling is to provide a quantitative summary of the floristic and structural conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if they resemble occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the vegetation consists primarily of very large and widely spaces trees, and these characteristics are unique to the site and not likely to be replicated in restoration areas.

In addition, we investigated whether changes in vegetation characteristics might have contributed to the abandonment of some areas by flycatchers. We identified several areas that had been occupied by nesting flycatchers in at least one previous year from 2003 to 2007 but were unoccupied in 2009, and we relocated old nest sites at which we had collected vegetation information in the year the nest was active. We resampled the vegetation at these nests and compared the vegetation data collected in 2009 to that collected when the nest site was active to elucidate how changes in vegetation through time may influence flycatcher occupancy. These results will provide additional quantitative information on the characteristics of vegetation within flycatcher nesting territories.

METHODS

Currently Occupied Territories

We described and measured vegetation and habitat features following a modification of the methods of James and Shugart (1970). Vegetation characteristics were measured within a 5-m-radius circle. To avoid disrupting flycatcher breeding activities, we measured vegetation late in the summer when the nest, territory, and adjacent flycatcher territories were inactive.

In 2008, we measured vegetation and habitat characteristics at one plot for each resident (i.e., detected for at least one week) male flycatcher we identified, regardless of whether or not he obtained a mate. Plot center locations were determined as soon as territories were identified. We estimated the center of the male's activity by observing his use of singing perches and selecting a location that was approximately equidistant from the perches at the perimeter of his use area. We then proceeded in a randomly selected compass direction for a randomly selected distance between 0 and 20 m. We used additional random numbers to select the exact location in which to hang a temperature/humidity data logger (see Chapter 6) and used that location as plot center. This process resulted in the random selection of a point that was still within the male's territory. These points were marked in the field with flagging, which remained in place over the 2008–2009 winter.

In 2009, we identified the territory center for each resident male as described above. If an existing sampling point was within 20 m of the territory center identified in 2009, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. Sampling points that were identified in 2008 but were not within 20 m of a territory center in 2009 were resampled in 2009. Data from these points are not included in the

2009 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment.

At each plot, we laid out four 5-m-long ropes from plot center, one in each of the four cardinal directions. Each rope was marked at 1 m and 5 m from the center of the plot. At plot center and at 1 m and 5 m from the center of the plot in each cardinal direction, we measured vertical foliage density using a 7.5-m-tall survey rod. Working our way up the rod, we recorded the presence of vegetation, by species, within a 10-cm radius of the rod in 0.1-m intervals (presence of the species within the 0.1-m interval equaled one "hit" on the rod), and summed all hits in 1-m intervals. Presence of dead vegetation (snags) was recorded in the same manner, but not identified to species. If canopy vegetation continued above 8.0 m, we estimated the number of hits as zero, greater than five, or less than five hits per 1-m interval until the canopy vegetation stopped (modified from Rotenberry 1985).

We measured total canopy closure using a Model-A spherical densiometer at 1 m north and south of the center of each plot and averaged these measurements to obtain a single canopy closure value for each plot. We measured average canopy height within each plot by selecting a representative tree and using a survey rod or a clinometer and measuring tape to measure the height of the selected tree. We estimated percent woody ground cover, alive and dead, within 0.5 m of the ground using a Daubenmire-type frame with the lower edge of the frame centered at 1 m north, south, east, and west of plot center. These percentages were averaged to obtain a single measure of percent woody ground cover for each plot.

We tallied the number of live stems for each species within 5 m of the center of the plot. Stems were tallied if they were at least 1.4-m tall and >2.5 cm in diameter at 10 cm above the ground. Stems were tallied by the following diameter at breast height (dbh) categories: <1 cm, 1–2.5 cm, 2.6–5.5 cm, 5.6–8 cm, 8.1–10.5 cm, and 10.5–15 cm. Any stems >15 cm dbh were measured and the exact dbh was recorded. Dead stems were also tallied in these categories, but not identified to species. In 2009, we marked each stem with a piece of chalk after it was tallied to facilitate accurate stem counts.

During vegetation sampling in 2003–2007, if a stem branched above 10 cm but below 1.4 m above the ground, only the largest stem was tallied. In habitats (e.g., tamarisk) where stems frequently branch in this height interval, this method of counting stems may underestimate the density of stems that form an important part of the habitat structure. Therefore, in 2008 and 2009 we tallied stems as we had in previous years and then for each stem that branched between 10 cm and 1.4 m from the ground, we tallied the number of additional stems that were at least 2.5 cm in diameter at 10 cm above the point where it branched from the main stem.

Additional information recorded at each plot included the date when the measurements were taken, observer initials, and UTM coordinates for each plot center.

Nests in Formerly Occupied Areas

The same measurements that were completed at occupied territories were also taken at old nest sites. We used the UTM coordinates of the nest, nest tree species, nest height, and nest flags that remained in the field to locate the old nests. Vegetation plots were centered on the nest location. Each old nest was at least 50 m from any nest or territory center that was active in 2009.

Data Analyses

We used high-resolution aerial photography and field knowledge of each study area to delineate clusters of territories that occur within habitat patches of similar floristics and canopy height. Vegetation characteristics were then summarized for each habitat type. The habitat types delineated in this report do not follow the classification system used by Anderson and Ohmart (1984) and will be related to Anderson and Ohmart (1984) classifications in a future report. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

Stem counts were grouped into the following size categories for analysis: <2.5 cm dbh, 2.5–8 cm dbh, and >8 cm dbh. For each size category, stem counts are reported separately for live and dead stems; the sum of these is the equivalent of the stem counts per size category that were reported in the 2003–2007 summary report (McLeod et al. 2008). Vertical foliage density measurements above 8.0 m that were recorded as < or >5 hits per meter were converted to 2.5 and 7.5 hits, respectively, to allow analyses of these data as continuous rather than categorical. Vertical foliage density was calculated for each meter interval as the mean of the number of hits recorded within the interval at the nine locations in the plot. In 2003–2007, we had measured vertical foliage density only at plot center and 1 m from plot center in each cardinal direction, and foliage density measures per meter interval were presented as the sum of the hits recorded at the five locations in the plot. Thus, vertical foliage data presented in reports from 2003 to 2007 should be divided by 5 to be comparable to data presented here. In the five-year summary report (McLeod et al. 2008), vertical foliage data were grouped into three categories of above, at, and below the nest. We used average nest height as measured in 2003–2009 in each vegetation type to demarcate vertical foliage categories in 2009. As with stem counts, vertical foliage data are reported separately for live and dead vegetation.

Percent native vegetation was calculated as the average of the percent basal area that was native and the percent native vertical foliage hits. For data collected in 2003–2007 (reported in McLeod et al. 2008), we did not use vertical foliage data to calculate percent native because all vertical foliage data were collected within 1 m of plot center and represented only a small portion of the plot. We included vertical foliage data in the percent native calculations in 2009 to account for the influence of stems that were too small to be tallied or were rooted outside the 5-m-radius circle but overhung the plot.

We used non-parametric Wilcoxon signed rank tests for related samples to compare vegetation measurements collected at old nests to the measurements collected during the year the nest was active. We chose non-parametric tests because several parameters had non-normal distributions. Vertical foliage data used in these comparisons were restricted to data collected within 1 m of plot center so as to be directly comparable to data collected prior to 2008. A statistical significance level of $P \leq 0.05$ was chosen to reject null hypotheses.

RESULTS

Currently Occupied Territories

We measured vegetation at 56 occupied territories and 15 territories that were occupied in 2008 but not in 2009 at Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams. We delineated the following habitat types: 1) coyote willow, 2) tamarisk/coyote willow mix, 3) Goodding willow, 4) Goodding willow with tamarisk understory, 5) tamarisk with scattered Goodding willow, 6) tamarisk, and 7) cottonwood/mesquite mix. Coyote willow and tamarisk/coyote willow mix occurred at Mesquite, with coyote willow dominating the eastern half of the site while tamarisk and

coyote willow were mixed in the western half of the site. One location at Topock also consisted of a mix of tamarisk and coyote willow, but exceedingly dense vegetation at this location prevented us from collecting stem count data. Goodding willow occurred in the southern portion of Muddy River, in a small stand readily discernible on high-resolution aerial photographs, and at Littlefield. Goodding willow with tamarisk understory occurred at Bill Williams. Tamarisk with scattered, emergent Goodding willow occurred both at Mormon Mesa and Topock; these two study areas were summarized separately because several variables, including canopy height and canopy closure, differed between the two areas. Tamarisk habitats lacking emergent willows occurred at Mesquite, Muddy River, and Topock, while cottonwood with mesquite occurred at the Beal Lake restoration site at Topock. Average nest height recorded in 2003–2009 and used to assign vertical foliage strata for each vegetation category were 2.1, 2.4, 2.8, 4.2, 2.5, 3.5, and 3.7 m for coyote willow, tamarisk/coyote willow mix, Goodding willow, Goodding willow with tamarisk understory, tamarisk with scattered Goodding willow at Mormon Mesa, tamarisk with scattered Goodding willow at Topock, and tamarisk, respectively. No nests were known from cottonwood/mesquite habitat, so the overall mean nest height of 2.9 m was used to assign vertical foliage categories for that vegetation type.

Vegetation characteristics of each habitat type are summarized in Table 5.1. Habitat types varied widely in many characteristics, and plots within each habitat type also showed a wide range in most habitat variables.

The proportion of stems omitted from stem counts by counting only the largest stem of a cluster that branched between 10 cm and 1.4 m above the ground varied both by size and species of the main stem (Table 5.2). Tamarisk had the highest proportion of omitted stems, and larger stems had more branches that were omitted.

Vertical foliage profiles for each habitat type are shown in Figures 5.1–5.8. Average nest height in each habitat type, as recorded in 2003–2009, is also shown on each graph. No nests were recorded in cottonwood/mesquite habitat, so average nest height across all habitat types is shown on this graph. In all habitat types, the proportion of dead vegetation in the vertical profile was highest immediately above the ground and declined with increasing height. In most habitat types, the densest live foliage occurred between 2 and 4 m above the ground and was near average nest height.

Nests in Formerly Occupied Areas

We gathered vegetation data at 26 old nests at Mormon Mesa and Topock. We were able to locate the exact nest fork in 17 cases and located the nest tree but were unsure of the correct fork in 5 additional cases. In four cases we located the nest vicinity (within 5 m of the nest location) but were unable to verify that we had located the exact nest tree.

Vegetation at nest sites differed between occupied and unoccupied periods in more than one variable at each study area; however, the characteristics that differed were not consistent among sites (Table 5.3). At Mormon Mesa, nest sites had shorter canopy, less canopy closure, more woody ground cover, fewer dead stems 2.5–8 cm dbh, more dead stems >8 cm dbh, and less dead foliage above nest height when they were active compared to when the area was abandoned. At Topock, nest sites had shorter canopy, less woody ground cover, fewer live stems >8 cm dbh, and fewer dead stems 2.5–8 cm dbh when they were occupied. When both study areas were combined (Table 5.4), nest sites had shorter canopy height, fewer live stems <2.5 cm dbh, more live stems >8 cm dbh, and fewer dead stems 2.5–8 cm dbh when they were active versus when the territory was abandoned. The only variables that differed consistently across the two study areas were canopy height and number of dead stems 2.5–8 cm dbh, both of which were greater in 2009 than in the year the nest was active.

Table 5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2009*

Parameter	SAEX (n=8)	TASP and SAEX (n=4)	SAGO (n=5)	SAGO with TASP understory (n=8)	TASP with scattered SAGO (MOME) (n=12)	TASP with scattered SAGO (TOPO) (n=11)	TASP (n=7)	POFR and PRSP (n=1)
Average canopy height (m)	4.9 (0.3)	5.1 (0.5)	10.0 (2.2)	9.4 (2.1)	4.8 (0.4)	6.1 (0.2)	5.0 (0.3)	4.7
	3.5–5.8	4.0–65.5	3.8–14.2	5.1–21.0	2.8–7.5	4.7–7.0	4.1–6.5	
% total canopy closure	89.0 (5.9)	89.6 (5.5)	86.6 (8.2)	84.6 (5.0)	89.4 (3.6)	86.4 (6.1)	93.6 (1.2)	63.5
	57.3–99.0	74.5–98.4	54.7–100.0	53.1–97.4	50.5–98.4	34.9–99.0	89.6–97.9	
% woody ground cover	13.3 (2.4)	12.1 (3.5)	9.7 (2.5)	27.2 (6.8)	15.7 (6.0)	22.9 (4.0)	15.5 (5.8)	6.5
	3.5–24.2	5.8–18.8	2.5–15.0	1.5–48.8	1.5–76.2	7.0–46.2	1.0–38.8	
# live stems <2.5 cm dbh per ha	3247 (784)	4923 (744)	3132 (1855)	589 (412)	2504 (594)	1181 (311)	2383 (340)	382
	509–7639	3438–5730	0–10313	0–3437	0–7894	127–3565	764–3310	
# live stems 2.5–8 cm dbh per ha	8419 (1484)	7682 (1014)	3998 (1490)	1257 (551)	4988 (692)	2917 (765)	4875 (555)	637
	1146–13242	6366–9677	764–8403	0–3820	1655–8912	0–8785	2928–6748	
# live stems >8 cm dbh per ha	143 (126)	0 (0)	942 (275)	398 (515)	340 (118)	718 (178)	291 (126)	0
	0–1018	0–0	127–1783	0–1528	0–1273	0–1528	0–891	
# dead stems <2.5 cm dbh per ha	6398 (1651)	3565 (989)	1986 (881)	127 (110)	3682 (784)	1366 (607)	4456 (1282)	0
	1401–15534	1655–4966	0–4456	0–891	637–10695	0–6112	255–10441	
# dead stems 2.5–8 cm dbh per ha	8563 (2004)	2249 (552)	4533 (1848)	302 (250)	3363 (912)	1157 (357)	4766 (1774)	0
	637–16170	1273–3183	127–9040	0–2037	0–9167	0–3820	127–10950	
# dead stems >8 cm dbh per ha	32 (32)	42 (42)	229 (102)	48 (48)	53 (33)	23 (16)	36.4 (23.5)	0
	0–255	0–127	0–509	0–382	0–382	0–127	0–127	
Percent native	79.9 (5.36)	38.6 (7.1)	91.8 (4.7)	55.3 (15.7)	39.8 (9.9)	14.4 (5.7)	16.6 (10.7)	100.0
	49.9–95.6	28.2–51.7	74.8–100.0	0–98.7	0–91.9	0–50.0	0–62.0	
Live vertical foliage (hits) below nest	4.3 (0.6)	5.3 (1.0)	3.4 (1.2)	13.3 (3.0)	3.5 (0.8)	6.1 (1.0)	4.9 (1.1)	9.2
	2.2–6.6	3.1–7.9	0.8–6.9	2.7–26.8	0–9.2	1.8–12.6	0.7–9.6	
Live vertical foliage (hits) at nest	3.3 (0.7)	3.0 (0.9)	2.4 (0.7)	2.8 (0.8)	2.8 (0.5)	3.2 (0.4)	2.9 (0.5)	4.1
	0.4–6.6	0.9–4.8	1.1–4.6)	1.3–7.6	0.9–6.3	1.0–5.0	1.1–5.1	
Live vertical foliage (hits) above nest	5.1 (1.0)	8.0 (2.5)	14.9 (1.8)	14.0 (6.1)	8.0 (2.2)	8.0 (1.6)	4.9 (0.9)	5.4
	0–8.8	3.6–15.1	8.2–18.8	0.9–50.5	1.8–29.8	0.3–20.8	1.6–7.4	
Dead vertical foliage (hits) below nest	6.3 (0.6)	6.6 (1.0)	5.3 (1.6)	4.4 (1.5)	6.3 (1.0)	8.8 (0.9)	9.5 (0.8)	0.2
	3.7–8.3	3.9–8.4	0.9–5.0	0.4–13.6	2.0–14.7	4.6–13.0	5.8–12.4	
Dead vertical foliage (hits) at nest	2.5 (0.3)	3.0 (0.5)	2.8 (1.2)	0.2 (0.2)	3.2 (0.4)	0.9 (0.4)	1.4 (0.3)	0.1
	1.4–3.9	2.1–4.0	0–6.4	0–1.7	1.4–5.8	0–4.0	0.6–2.3	
Dead vertical foliage (hits) above nest	2.1 (0.8)	1.7 (0.3)	1.4 (0.8)	0.8 (0.4)	1.1 (0.3)	0.5 (0.2)	0.7 (0.3)	0
	0.3–6.7	1.3–2.7	0–3.3	0–2.9	0–2.9	0–2.1	0–2.3	

* Data are presented as mean, standard error, and range. Stem counts include only the largest stem of any cluster that branched above 10 cm above the ground. SAEX = coyote willow, SAGO = Goodding willow, TASP = tamarisk, PRSP = mesquite, POFR = cottonwood.

Table 5.2. Proportion of Stems Omitted from Stem Counts

Size category[1]	Species			
	Tamarisk	Coyote willow	Goodding willow	Dead stems
<2.5 cm dbh	0.19	0.03	0.10	0.20
2.5–8 cm dbh	0.65	0.29	0.00	0.32
>8 cm dbh	2.0	0.44	0.54	0.99

[1] Size category indicates the size of the main stem that was tallied. All stems that were omitted from the stem count are equal to or smaller than the size of the main stem.

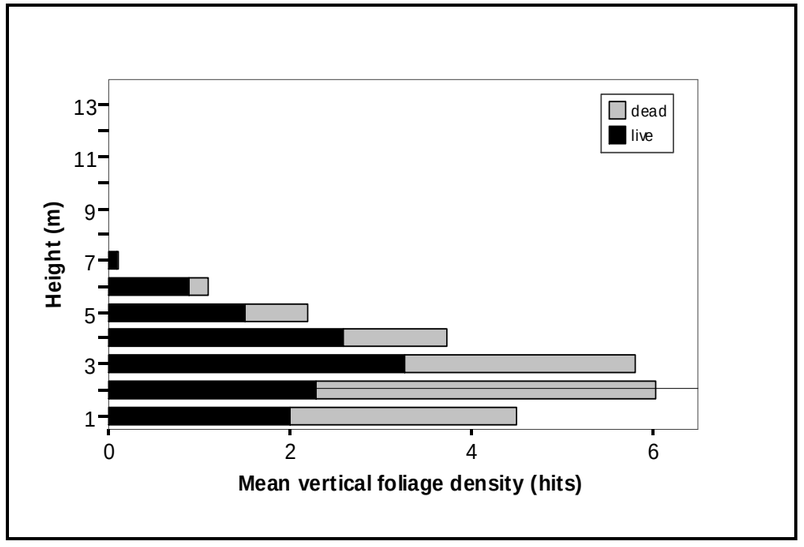


Figure 5.1. Vertical foliage density at occupied willow flycatcher territories in coyote willow habitat type, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

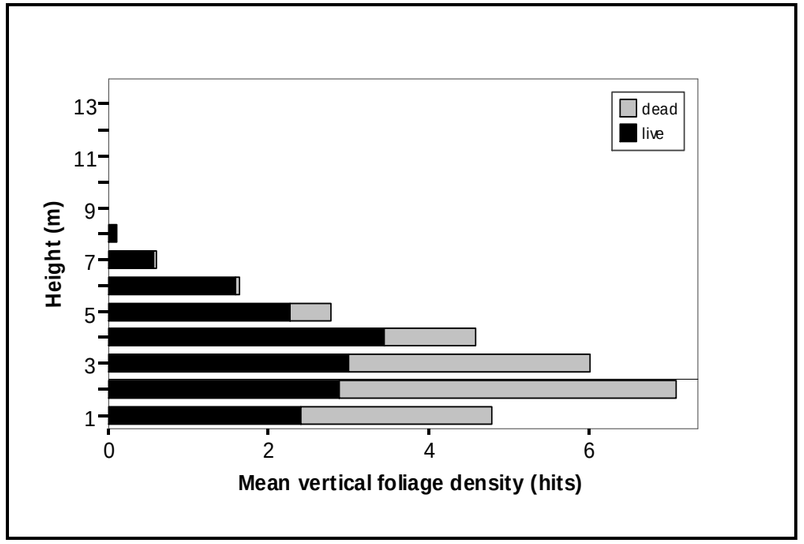


Figure 5.2. Vertical foliage density at occupied willow flycatcher territories in tamarisk/coyote willow habitat type, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

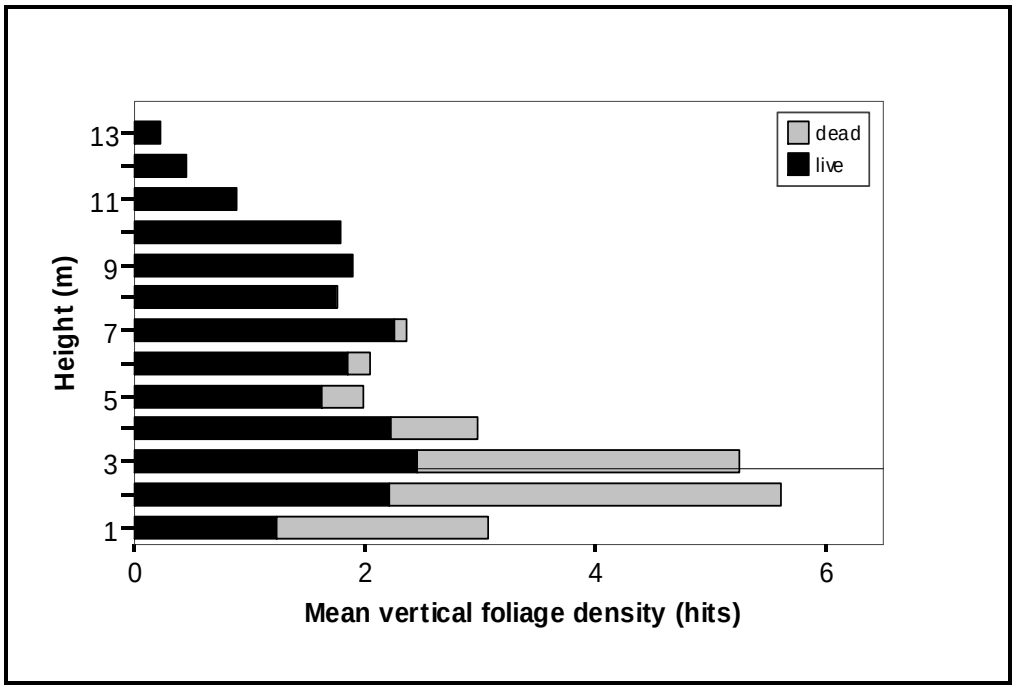


Figure 5.3. Vertical foliage density at occupied willow flycatcher territories in Goodding willow habitat type, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

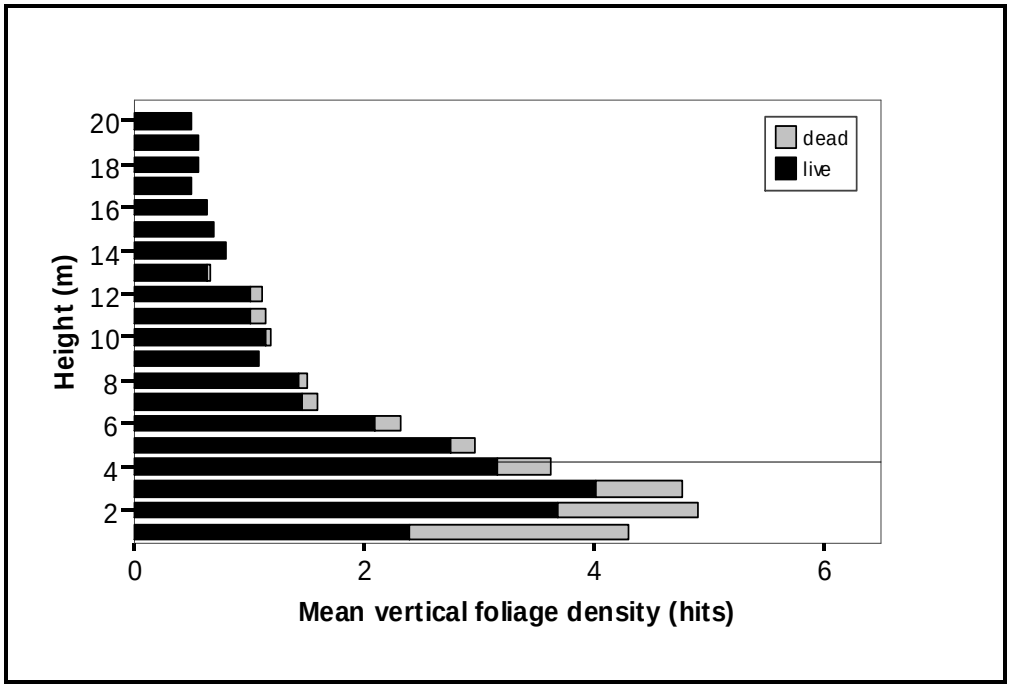


Figure 5.4. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

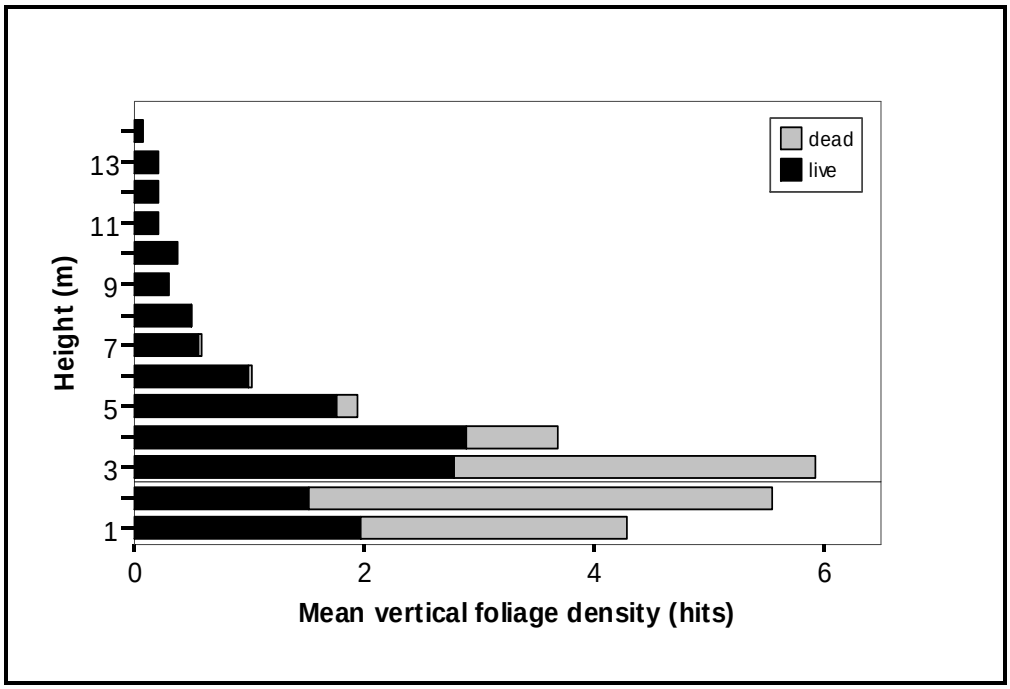


Figure 5.5. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Mormon Mesa, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

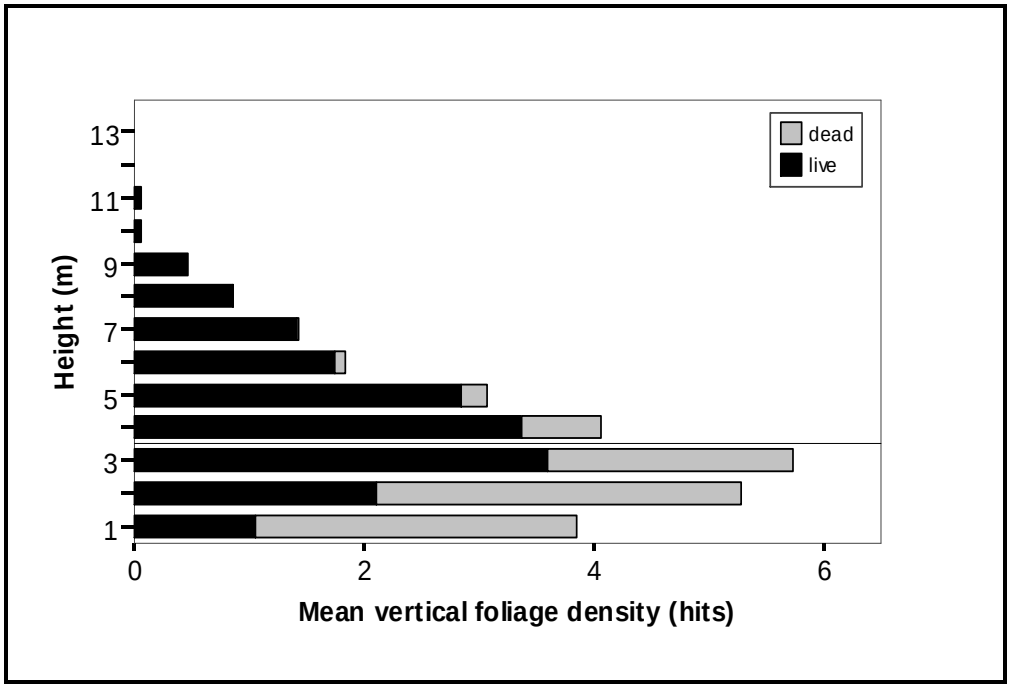


Figure 5.6. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Topock Marsh, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

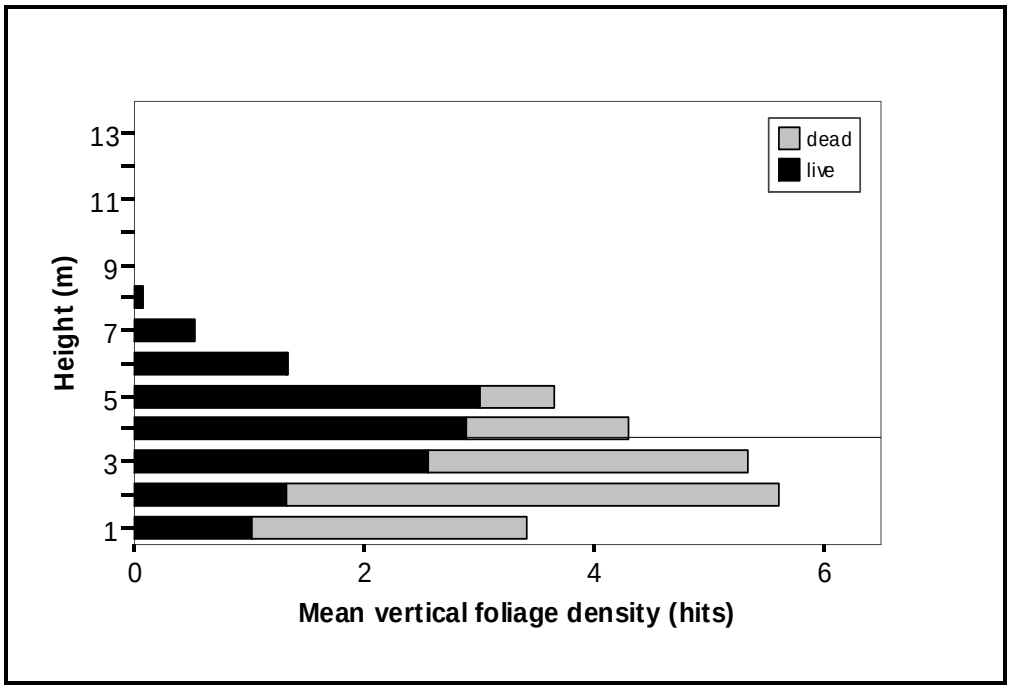


Figure 5.7. Vertical foliage density at occupied willow flycatcher territories in tamarisk habitat type, 2009. Horizontal line shows average nest height in this habitat type in 2003–2009.

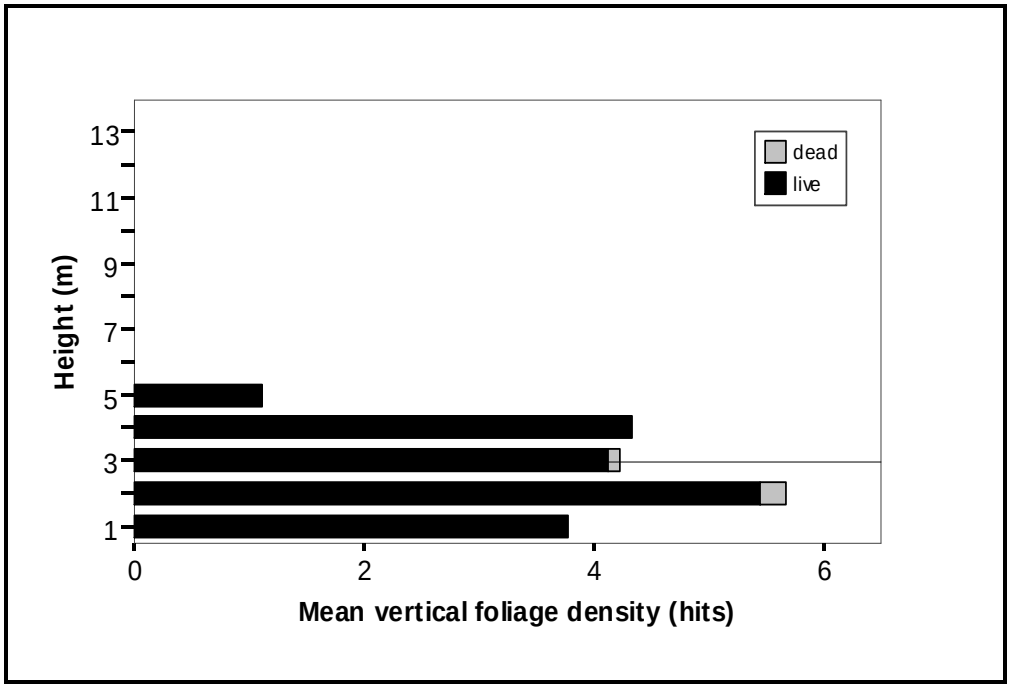


Figure 5.8. Vertical foliage density at occupied willow flycatcher territories in cottonwood/mesquite habitat type, 2009. Horizontal line shows average nest height across all habitat types in 2003–2009.

Table 5.3. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mormon Mesa and Topock*

Variable	Mormon Mesa (n = 13)				Topock (n = 13)			
	Occupied	Unoccupied	Difference	*P*	Occupied	Unoccupied	Difference	*P*
Canopy height (m)	6.0 (0.3)	6.7 (0.4)	0.7 (0.2)	0.023	6.8 (0.2)	7.8 (0.7)	1.0 (0.5)	0.004
% canopy closure	89.7 (1.5)	95.1 (1.0)	5.5 (1.2)	0.002	95.5 (0.8)	93.3 (0.9)	-2.2 (1.3)	0.064
% woody ground cover	16.9 (2.9)	8.1 (2.4)	-8.8 (3.4)	0.036	10.3 (4.8)	22.9 (5.6)	12.6 (2.3)	0.001
# live stems <2.5 cm dbh per ha	803 (250)	451 (206)	-353 (221)	0.305	1244 (300)	784 (212)	-460 (318)	0.132
# live stems 2.5–8 cm dbh per ha	3790 (608)	3536 (536)	-255 (287)	0.574	5670 (519)	5670 (436)	0 (718)	0.780
# live stems >8 cm dbh per ha	823 (160)	960 (120)	137 (200)	0.397	1832 (254)	2409 (154)	578 (227)	0.045
# dead stems <2.5 cm dbh per ha	4290 (337)	4084 (358)	-206 (597)	0.906	5710 (1101)	3320 (560)	-2390 (1351)	0.208
# dead stems 2.5–8 cm dbh per ha	3154 (445)	4153 (343)	989 (382)	0.023	2801 (817)	5906 (582)	3105 (623)	0.002
# dead stems > 8cm dbh per ha	118 (34)	39 (22)	-78 (27)	0.023	39 (30)	88 (33)	49 (45)	0.301
Live vertical foliage density (hits) below nest	0.6 (0.3)	0.5 (0.2)	-0.1 (0.3)	0.759	2.2 (0.4)	2.9 (0.7)	0.8 (0.8)	0.576
Live vertical foliage density (hits) at nest	1.1 (0.3)	1.1 (0.3)	-0.0 (0.2)	0.722	2.5 (0.5)	2.4 (0.4)	-0.2 (0.6)	0.806
Live vertical foliage density (hits) above nest	11.3 (1.5)	13.3 (1.4)	1.9 (2.0)	0.600	13.8 (1.9)	12.3 (1.5)	-1.5 (1.1)	0.249
Dead vertical foliage density (hits) below nest	6.3 (1.0)	6.4 (1.0)	0.1 (0.8)	0.969	8.2 (1.4)	9.9 (1.4)	1.7 (1.4)	0.311
Dead vertical foliage density (hits) at nest	3.4 (0.6)	4.0 (0.4)	0.6 (0.5)	0.239	2.7 (0.6)	2.1 (0.4)	-0.5 (0.7)	0.423
Dead vertical foliage density (hits) above nest	3.4 (0.7)	5.1 (0.9)	1.6 (0.6)	0.009	2.1 (0.7)	2.0 (0.5)	-0.1 (0.7)	0.861
Percent native	17.5 (9.7)	21.7 (10.4)	4.2 (8.2)	0.465	1.2 (1.2)	0.0 (0.0)	-1.2 (1.2)	0.317

* Data are presented as means (standard error).

Table 5.4. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined*

Variable	All Sites (n = 26)				Direction and Magnitude of Change[1]	
	Occupied	Unoccupied	Difference	P	MOME	TOPO
Canopy height (m)	6.4 (0.2)	7.2 (0.4)	0.8 (0.3)	<0.001	↑	↑
% canopy closure	92.6 (1.0)	94.3 (0.7)	-1.6 (1.1)	0.200	↑	↓
% woody ground cover	13.6 (2.8)	15.5 (3.3)	-1.9 (2.9)	0.409	↓	↑
# live stems <2.5 cm dbh per ha	1023 (196)	617 (149)	-406 (190)	0.042	↓	↓
# live stems 2.5–8 cm dbh per ha	4730 (434)	4603 (400)	-127 (380)	0.951	↓	↑
# live stems >8 cm dbh per ha	1327 (178)	1684 (174)	357 (154)	0.034	↑	↑
# dead stems <2.5 cm dbh per ha	5000 (582)	3702 (335)	-1298 (756)	0.346	↓	↓
# dead stems 2.5–8 cm dbh per ha	2977 (457)	5024 (375)	2047 (416)	<0.001	↑	↑
# dead stems >8 cm dbh per ha	78 (24)	64 (20)	-15 (29)	0.541	↓	↑
Live vertical foliage density (hits) below nest	1.4 (0.3)	1.7 (0.4)	0.3 (0.4)	0.891	↓	↑
Live vertical foliage density (hits) at nest	1.8 (0.3)	1.7 (0.3)	-0.1 (0.8)	0.978	↓	↓
Live vertical foliage density (hits) above nest	12.5 (1.2)	12.8 (1.0)	0.2 (1.2)	0.770	↑	↓
Dead vertical foliage density (hits) below nest	7.3 (0.9)	8.1 (0.9)	0.9 (0.8)	0.443	↑	↑
Dead vertical foliage density (hits) at nest	3.0 (0.3)	3.1 (0.5)	0.0 (0.5)	0.819	↑	↓
Dead vertical foliage density (hits) above nest	2.8 (0.5)	3.5 (0.6)	0.8 (0.5)	0.079	↑	↓
Percent native	9.3 (5.0)	10.8 (5.5)	1.5 (4.1)	0.686	↑	↓

* Data are presented as means (standard error).

[1] Arrows indicate the direction of change of the variable between occupied and unoccupied periods for each study area (MOME = Mormon Mesa, TOPO = Topock Marsh, while color indicates the statistical significance of the change as follows: red is P <0.05, green is 0.05< P <0.10, black is P >0.10.

DISCUSSION

Currently Occupied Territories

The purpose of vegetation measurements of occupied habitat is to provide quantitative guidelines for restoration efforts. Coyote willow and Goodding willow are the two habitat types that are known to support breeding flycatchers and are most likely to be replicated in restoration areas. Mesquite West contains the only extensive stand of coyote willow known to be occupied by territorial willow flycatchers along the lower Colorado River and tributaries in any year since 2003. Occupied coyote willow habitat at Mesquite encompasses approximately 3 ha in the eastern and central portions of Mesquite West and is surrounded by cattail marsh and mixed coyote willow and tamarisk. Occupied even-age Goodding

willow habitat occurred in 2009 on less than 1 ha on the southern end of the Overton WMA site at Muddy River and at Littlefield on Beaver Dam Wash.

Sample sizes for the coyote willow and Goodding willow habitat types in 2009 are small (eight and five, respectively) and likely do not provide an accurate representation of the range and variance in vegetation characteristics in each habitat type. In future reports, data from 2009 will be combined with data collected within active territories between 2003 and 2008 to provide a more comprehensive description of each habitat type.

The cottonwood-mesquite habitat type occurred at the Beal Lake restoration area at Topock. Although flycatchers were detected on multiple occasions at Beal Lake, they responded to broadcast but did not engage in the lengthy, unsolicited song typical of territorial male flycatchers. The flycatchers detected at Beal Lake could not be resighted to determine band combinations, and it is unknown whether a given individual remained at Beal Lake or whether different individuals were detected on different occasions. Beal Lake is a mosaic of vegetation types and densities (see description in Chapter 2). The vegetation plot measured at Beal Lake had less canopy closure and far fewer stems than was typical for flycatcher territories in other habitat types, but more extensive sampling would be required to ascertain whether the plot is representative of the site. Because of the uncertainty of whether the site was truly occupied by resident flycatchers and the dissimilarities between the vegetation characteristics measured at Beal Lake and at other flycatcher territories, the vegetation characteristics reported here for cottonwood-mesquite habitat should not be used as a model for flycatcher habitat.

Although other vegetation types occupied by willow flycatchers are not likely to be created in restoration areas, descriptive data are provided for these habitats to assist in the evaluation of areas to determine their suitability as flycatcher breeding habitat. Data from these other vegetation types may also be useful in illustrating structural similarities between occupied areas in different habitat types. Small sample sizes preclude meaningful comparisons of the 2009 data across habitat types.

Nests in Formerly Occupied Areas

Old nests at Mormon Mesa occurred in Virgin River #2, where we first documented nesting flycatchers in 2005. We had not surveyed the area in 2003–2004, but old flagging suggested that the area could have been occupied by flycatchers in years prior to 2003. The site was occupied by breeding flycatchers in each year from 2005 to 2008. The breeding area contained surface water and saturated soil in 2005 and 2006 but was dry in 2007–2009. No dramatic changes in vegetation were apparent from the site descriptions between 2005 and 2009, but one observer thought a much larger proportion of the tamarisk understory appeared dead in 2009 than in 2006, when she had last visited the site (M.A. McLeod pers. obs.). This observation was supported by there being more dead stems 2.5–8 cm dbh and more dead vegetation above nest height in 2009 than in the year the nest was active. However, the vegetation data also showed there were fewer dead stems >8 cm dbh and greater canopy closure in 2009, which appears to contradict there being more dead foliage.

The majority of old nests at Topock occurred in the adjacent sites of 800M and In Between, with one additional nest in Pipes #3. Paired flycatchers were present at 800M and In Between in 2003–2007, though the number of pairs at the two sites declined from 10 in 2004 to 2 in 2007, with no pairs detected in 2008 or 2009. Pipes #3 was occupied by resident flycatchers in 2004–2006 and again in 2009, though breeding was detected only in 2004. As at Mormon Mesa, no changes in vegetation were apparent over the years from the site descriptions, but one observer thought the tamarisk at In Between and 800M had a higher proportion of dead stems and less canopy closure in 2009 than in years when there were active nests in the area (T.J. Koronkiewicz pers. obs.). This observation was supported by there being more dead stems 2.5–8 cm dbh and a trend toward decreased canopy closure in 2009 than in the year the nest

was active. However, vegetation data also showed an increase in the number of live stems <2.5 cm and >8 cm dbh.

Although the methods for collecting the vegetation data used in these analyses were unchanged among years, observer variation could influence between-year differences in stem counts, vertical foliage counts, and canopy closure. To address observer variation in stem and vertical foliage counts, we calculated the proportion of live stems and live hits in each category and then compared the proportions between the occupied and unoccupied periods. As long as each observer counts live vs. dead stems and, similarly, live vs. dead hits in a consistent manner, this technique accounts for any observer differences in the absolute counts. Results of this analysis showed that the proportion of live stems 2.5–8 cm dbh decreased at both Mormon Mesa (0.57 to 0.44, P = 0.039) and Topock (0.72 to 0.50, P = 0.007) and when both study areas were combined (0.64 to 0.47, P = 0.001) between the occupied year and 2009. A decrease in the proportion of live, medium-sized stems could reduce the suitability of the area for flycatchers. The proportion of live stems >8 cm dbh increased at Topock (0.84 to 0.96, P = 0.025), but this variable did not differ between the occupied year and 2009 at Mormon Mesa or when both study areas were combined. Spatial rather than temporal comparisons of occupied and unoccupied areas in 2003–2007 showed that the number of stems 2.5–8 cm dbh was an important factor distinguishing occupied from unoccupied areas, but live and dead stems were not analyzed separately (McLeod et al. 2008). Reanalysis of the 2003–2007 data incorporating the proportion of live vs. dead vegetation may yield further insight into the vegetation characteristics that contribute to flycatcher occupancy.

Canopy height increased at both Mormon Mesa and Topock between occupied and unoccupied periods, likely as the result of vegetation maturing over the years. This increase in canopy height probably did not contribute to abandonment of the area; McLeod et al. (2008) reported that flycatchers typically occupied areas that had greater canopy height than unoccupied areas. Canopy closure increased at Mormon Mesa between occupied and unoccupied periods but showed a decreasing trend at Topock. Given that flycatchers typically nest in areas with very high canopy closure (McLeod et al. 2008) it is unlikely that an increase in canopy closure would contribute to site abandonment. The apparent changes in canopy closure at both Mormon Mesa and Topock were small (<6%) and may be the result of observer variation.

Chapter 6

MICROCLIMATE

INTRODUCTION

Our objective for microclimate sampling is to provide a quantitative summary of microclimate conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if the microclimate resembles that in occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the study area is approximately 650 m higher in elevation and experiences a cooler climate than the LCR MSCP study area.

In addition, we investigated whether changes in microclimate characteristics might have contributed to the abandonment of some areas by flycatchers. We identified several areas that had been occupied by nesting flycatchers in at least one previous year from 2003 to 2007 but were unoccupied in 2009, and we relocated old nest sites at which we had collected microclimate information in the year the nest was active. We resampled the microclimate at these nests to see whether microclimate characteristics had changed. Comparison of microclimate data collected when a nest site was active versus when the area was abandoned may elucidate how changes in microclimate through time may influence flycatcher occupancy. These results will provide additional quantitative information on the characteristics of microclimate within flycatcher nesting territories.

METHODS

Currently Occupied Territories

Temperature and Relative Humidity (T/RH) Measurements

Measurements of temperature and relative humidity (T/RH) were recorded automatically every 15 minutes using a HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) that combines a thermometer (degrees Celsius), relative humidity monitor, and digital data logger. We camouflaged all HOBO units by placing them in an inverted small, plastic container coated with spray adhesive and local vegetation. The opening at the bottom was covered with shadecloth, allowing free air circulation around the unit.

In 2008, we collected microclimate measurements at one location for each resident male flycatcher we identified, regardless of the length of time the male was resident and whether or not he obtained a mate. One HOBO unit was placed within each active flycatcher territory. We estimated the center of the male's territory (see Chapter 5) and then determined the location of the HOBO unit by means of the following instructions and the use of random number sequences:

(1) The compass direction to walk from the territory center, given in degrees from north, was determined from a random number sequence.

(2) The distance (between 0 and 20 m) to walk in the designated direction was determined from a random number sequence. Once that distance was traveled, the closest woody tree or shrub was selected for data logger placement.

(3) The HOBO unit was placed at a randomly selected height within the range of flycatcher nest heights documented at that study area in 2003–2007 (McLeod et al. 2008). The distribution of random numbers followed the distribution of nest heights. If the chosen tree or shrub was of insufficient height to accept the height from the random number sequence, then field personnel placed the HOBO unit at the first height in the sequence that was less than the height of the tree or shrub. If no nests had been previously recorded at that study area, field personnel used the height sequences from the nearest study area with known nests.

(4) The distance (0–2 m) at which the HOBO was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If the tree or shrub was of insufficient radius to accept the distance from the random number sequence, then field personnel placed the unit at the first number in the sequence that was less than the radius of the tree or shrub.

(5) The compass direction, given in degrees from north, at which the unit was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If there was no branch in this compass direction that would support the data logger at the height and distance specified in (3) and (4), field personnel proceeded clockwise around the tree or shrub until a suitable branch was located.

If, as presented in (3) and (4), a number from a subsequent random number sequence (sequence meaning a row in the random number table) was used because the number in the initial sequence was too high, then both sequences were considered used and no longer available for future use. If these directions took field personnel outside of the riparian zone or to a site without trees or shrubs, they returned to the territory center and used the next sequence of random numbers.

HOBO loggers remained in the field over the 2008–2009 winter at these locations and were downloaded and redeployed in the same location in early May 2009. During the breeding season of 2009, we identified the territory center for each resident male. If an existing sampling point was within 20 m of the territory center identified in 2009, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. Sampling points that were identified in 2008 but were not within 20 m of a territory center in 2009 were resampled in 2009. Data from these points are not included in the 2009 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. All HOBO units were removed from the field at the end of the breeding season because of the large number of data logger losses experienced over the 2008–2009 winter.

Soil Moisture (SM) Measurements

A ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively) was used to gather soil moisture (SM) data. The SM readings (nine per site) were recorded directly beneath the HOBO logger (plot center) and at 1.0 and 2.0 m from plot center in each cardinal direction. Soil moisture readings were collected when the HOBO logger was downloaded (for loggers in place since 2008) or deployed (for locations new in 2009) and at two-week intervals throughout the breeding season until the HOBO logger was removed at the end of the season. Soil moisture was recorded both as voltage (mV) and as volumetric water content (%).[1] Soil type on the HH2 was set to mineral soil. For any SM measurement point that was underwater, we recorded the depth of standing water and assigned a value of 994 mV, which is equivalent to 50% volumetric water content, or fully saturated soil. All mV values greater than

[1] The soil moisture logger measures the dielectric constant of moist soil via a direct current voltage, which is converted to volumetric soil moisture with conversion tables. For very high (above ~1000 mV) or low (below ~90 mV) voltage readings, the HH2 reports volumetric soil moisture as "above" or "below" the table, respectively. To eliminate these qualitative readings, we recorded both mV and volumetric soil moisture.

994 were also reassigned as 994 mV, because this reading represents fully saturated soil and because the mV to percent relationship becomes excessively nonlinear for mV readings above this point. Each time we collected soil moisture data, we also recorded the distance to the nearest standing water or saturated soil and recorded the approximate percentage, as estimated in the field, of the site within 20 and 50 m of the data logger that contained inundated or saturated soil.

A soil sample was collected from beneath each HOBO location that was new in 2009. Samples were approximately the size of a medium apple, collected from the surface down to and including a depth of 5 cm, and placed in a heavy zip-lock plastic bag labeled with the site designation. These samples will contribute to an ongoing analysis of soil texture, which strongly influences capillary action and therefore overall SM (Sumner 2000). Results of the soil texture analysis will be presented in the 2012 summary report.

Statistical Analyses

Soil moisture data were entered into a database as they were collected during the field season. We downloaded data from the HOBO data loggers into databases at the end of the field season. We merged all data to create one dataset for further analysis. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Distance to nearest standing water or saturated soil
- % of the site within 20 m that was inundated or saturated
- % of the site within 50 m that was inundated or saturated
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[2]
- Mean nocturnal vapor pressure

Soil moisture variables were summarized per visit, and temperature/humidity variables were summarized on a daily basis. We determined diurnal and nocturnal periods by using the actual daily sunrise and sunset times reported for the region by the National Weather Service (2009). We selected the above measures of temperature and humidity for analysis because they were the most highly correlated with other variables or were the most useful in distinguishing use areas from non-use locations (McLeod et al. 2008). Territories were grouped according to vegetation type (see Chapter 5), and microclimate variables were averaged for each vegetation type over the following two-week periods to show how microclimate conditions changed throughout the breeding season: 16–31 May, 1–15 June, 15–30 June, 1–15 July, 16–31 July, and 1–15 August.

Analyses were conducted using SAS® v.9.1.3 (SAS Institute 2003) and Stata® v.9.2 (StataCorp 2006). Data are presented as mean (standard error) unless otherwise noted.

[2] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

Nests in Formerly Occupied Areas

We used the UTM coordinates of the nest, nest tree species, nest height, and nest flags that remained in the field to locate old nests. During the year when each nest was active, microclimate data were collected for a two-week period immediately following the nest being vacated. In 2009, we hung a HOBO logger at the old nest location on or before the date on which the HOBO was deployed in the year the nest was active and removed the logger on or after the date the logger was removed in the year the nest was active. Soil moisture measurements were taken at the beginning and the end of the two-week period during which the HOBO was deployed in the year the nest was active.

Statistical Analyses

We truncated the temperature and humidity data collected in 2009 to match the two-week period during which data were collected in the year the nest was active. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[3]
- Mean nocturnal vapor pressure

We used paired t-tests to compare measures of microclimate at old nests to the measurements collected during the year the nest was active. P-values were similar to those obtained when a non-parametric test (Wilcoxon signed rank sum) was used to compare matched sites. Analyses were conducted using SAS® v.9.1.3 (SAS Institute 2003) and Stata® v.9.2 (StataCorp 2006). Missing data were excluded test-wise. Data are presented as mean (standard error) unless otherwise noted.

To address whether any observed changes in microclimate between occupied and unoccupied periods could be the result of overall changes in regional climate, we obtained weather station data from the National Climate Data Center (www.ncdc.noaa.gov/oa/ncdc.html) for Overton, Nevada (Station ID #265846) and Needles, California (Station ID #46118) for 2003–2009. Maximum and minimum daily temperature data were available for both weather stations, and dew point data were available for Needles. We used one-way ANOVA to test whether temperature and dew point variables differed between years for the June–August period. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

[3] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

RESULTS

Currently Occupied Territories

We collected microclimate data at 56 active territories and 15 territories that were occupied in 2008 but not in 2009. HOBO loggers failed to collect data at four active territories and one location that was occupied in 2008 but not 2009. Four additional loggers at active territories and one logger at an unoccupied location had bad humidity sensors. Microclimate variables are summarized by two-week periods for each vegetation type in Tables 6.1–6.8. These same variables are plotted in Figures 6.1–6.9 to facilitate comparisons between vegetation types.

All vegetation types except cottonwood/mesquite exhibited moist soil conditions at some point during the breeding season. Goodding willow and tamarisk with scattered willow at Mormon Mesa maintained the overall wettest conditions through the season, with high soil moisture readings and a high percentage of the surrounding area being inundated. Goodding willow with tamarisk understory also had high soil moisture content throughout the season, but distance to surface water increased dramatically as the summer progressed. Soil conditions showed a general drying trend in several habitat types, with the inundated percentage of the surrounding area declining through the season in Goodding willow, Goodding willow with tamarisk understory, tamarisk, and tamarisk with scattered Goodding willow at Topock. Coyote willow and tamarisk with coyote willow both had relatively dry soils, particularly at the beginning of the breeding season.

Mean daily maximum temperatures spanned a range of <10°C among habitat types. Daily minimum temperatures showed a smaller range of <5°C. Cottonwood/mesquite, coyote willow, and tamarisk with coyote willow showed the largest daily temperature ranges throughout the season, while Goodding willow with tamarisk understory and tamarisk with scattered willow at Topock had the most moderate temperature ranges.

Vapor pressure increased through the end of July for all habitat types. Vapor pressure was highest in Goodding willow with tamarisk understory and in tamarisk with scattered willow at Topock. Vapor pressure at the beginning of the season was lowest in coyote willow and tamarisk with coyote willow. In July, these two habitat types along with Goodding willow and tamarisk with scattered willow at Mormon Mesa had lower vapor pressure than the other habitat types.

Table 6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Coyote Willow (n = 8), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–-31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	409.5 (54.5)	342.7 (38.8)	607.4 (106.7)	629.8 (104.3)	726.2 (61.8)	737.0 (105.7)
Mean distance to nearest standing water	186.1 (26.2)	183.1 (25.2)	156.8 (35.3)	110.0 (36.4)	165.0 (32.0)	62.2 (18.8)
% of the site within 20 m that was inundated	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	19.4 (7.9)	3.8 (3.8)	8.6 (5.9)
% of the site within 50 m that was inundated	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	21.3 (8.5)	3.8 (3.8)	10.1 (7.2)
Temperature						
Mean maximum diurnal temperature (°C)	43.5 (0.4)	40.2 (0.4)	44.6 (0.5)	46.4 (0.4)	45.7 (0.5)	39.8 (1.3)
Mean minimum nocturnal temperature (°C)	15.0 (0.3)	14.1 (0.3)	16.6 (0.4)	18.2 (0.3)	21.3 (0.1)	17.0 (0.3)
Mean daily temperature range (°C)	28.5 (0.5)	26.1 (0.4)	28.0 (0.7)	28.3 (0.5)	24.4 (0.5)	22.8 (1.3)
Humidity						
Mean diurnal vapor pressure (Pa)	1037.8 (23.2)	867.2 (16.7)	1188.9 (31.1)	1408.3 (39.5)	2026.5 (35.0)	1686.6 (54.1)
Mean nocturnal vapor pressure (Pa)	1047.7 (18.9)	849.2 (10.4)	1214.0 (26.3)	1324.6 (34.8)	1818.3 (27.0)	1569.6 (37.2)

* Data are presented as mean (standard error).

Table 6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Coyote Willow (n = 4), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	799.5 (63.7)	815.7 (64.2)	592.6 (137.6)	485.6 (98.1)	510.9 (112.8)	751.1 (112.5)
Mean distance to nearest standing water	168.8 (12.0)	147.2 (38.3)	137.5 (38.9)	158.3 (56.7)	167.5 (42.7)	96.7 (64.9)
% of the site within 20 m that was inundated	0.0 (0.0)	10.0 (10.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	13.3 (13.3)
% of the site within 50 m that was inundated	0.0 (0.0)	6.0 (6.0)	8.8 (8.8)	1.0 (1.0)	5.0 (5.0)	16.7 (16.7)
Temperature						
Mean maximum diurnal temperature (°C)	42.5 (0.8)	38.7 (0.6)	45.1 (0.8)	47.1 (0.5)	46.8 (0.8)	41.9 (2.2)
Mean minimum nocturnal temperature (°C)	15.1 (0.4)	15.1 (0.4)	17.6 (0.5)	19.5 (0.4)	22.7 (0.3)	16.4 (0.7)
Mean daily temperature range (°C)	27.4 (1.0)	23.6 (0.6)	27.5 (1.1)	27.6 (0.7)	24.0 (0.9)	25.5 (2.0)
Humidity						
Mean diurnal vapor pressure (Pa)	1190.6 (31.4)	1137.2 (27.2)	1551.7 (84.4)	1745.1 (102.1)	2315.0 (88.6)	1772.4 (114.8)
Mean nocturnal vapor pressure (Pa)	1136.2 (45.0)	1015.2 (28.6)	1343.8 (46.2)	1446.1 (67.4)	1939.4 (53.2)	1461.6 (54.4)

* Data are presented as mean (standard error).

AR063529

Table 6.3. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow (n = 5), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	994.0 (0.0)	994.0 (0.0)	796.6 (190.2)	981.1 (6.3)	741.5 (173.1)	827.0 (141.7)
Mean distance to nearest standing water	0.0 (0.0)	0.0 (0.0)	0.9 (0.8)	0.3 (0.2)	3.6 (2.5)	3.4 (1.8)
% of the site within 20 m that was inundated	95.0 (5.0)	87.5 (12.5)	41.7 (24.2)	53.8 (16.0)	38.8 (17.7)	33.0 (16.8)
% of the site within 50 m that was inundated	85.0 (15.0)	90.0 (10.0)	34.7 (22.7)	41.3 (13.3)	45.0 (11.9)	42.0 (14.6)
Temperature						
Mean maximum diurnal temperature (°C)	44.7 (1.7)	41.7 (1.8)	43.3 (1.4)	43.8 (1.0)	41.4 (0.8)	38.4 (1.5)
Mean minimum nocturnal temperature (°C)	17.8 (0.4)	16.1 (0.4)	18.3 (0.4)	19.8 (0.3)	22.6 (0.2)	18.3 (0.4)
Mean daily temperature range (°C)	26.9 (1.8)	25.6 (1.7)	25.0 (1.5)	24.0 (1.0)	18.9 (0.7)	20.0 (1.4)
Humidity						
Mean diurnal vapor pressure (Pa)	1345.2 (49.3)	1226.3 (41.4)	1443.4 (51.6)	1475.8 (52.6)	2104.8 (34.8)	1432.6 (48.2)
Mean nocturnal vapor pressure (Pa)	1383.1 (48.7)	1315.5 (28.4)	1506.4 (43.4)	1600.8 (42.0)	1902.0 (36.1)	1510.5 (45.6)

* Data are presented as mean (standard error).

Table 6.4. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory (n = 7), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	931.7 (62.3)	909.2 (39.6)	847.1 (84.9)	813.3 (85.9)	823.7 (72.8)	724.7 (69.7)
Mean distance to nearest standing water	9.5 (9.5)	9.9 (5.7)	12.3 (5.7)	138.3 (113.0)	272.4 (91.9)	372.8 (113.5)
% of the site within 20 m that was inundated	28.0 (27.0)	25.5 (24.5)	26.6 (13.1)	10.9 (9.9)	17.1 (11.0)	0.4 (0.4)
% of the site within 50 m that was inundated	32.0 (13.7)	19.0 (6.2)	21.8 (9.8)	9.3 (8.5)	14.7 (9.8)	0.2 (0.2)
Temperature						
Mean maximum diurnal temperature (°C)	39.1 (0.9)	35.8 (0.7)	38.5 (0.7)	40.3 (0.5)	40.7 (0.6)	48.0 (4.5)
Mean minimum nocturnal temperature (°C)	16.4 (0.5)	15.8 (0.3)	17.0 (0.3)	20.1 (0.3)	22.7 (0.2)	17.7 (0.5)
Mean daily temperature range (°C)	22.7 (1.0)	20.1 (0.9)	21.5 (0.7)	20.2 (0.6)	18.0 (0.6)	12.2 (4.5)
Humidity						
Mean diurnal vapor pressure (Pa)	1918.7 (49.9)	1666.9 (29.6)	2277.4 (54.6)	2593.7 (53.4)	3138.0 (48.3)	2210.2 (119.9)
Mean nocturnal vapor pressure (Pa)	1558.5 (32.6)	1346.9 (26.3)	1766.1 (32.1)	2048.1 (39.0)	2488.4 (33.1)	2067.1 (26.8)

* Data are presented as mean (standard error).

AR063530

Table 6.5. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Mormon Mesa (n = 11), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	954.8 (9.4)	932.8 (13.6)	943.3 (11.3)	928.2 (11.8)	927.7 (10.5)	918.3 (9.5)
Mean distance to nearest standing water	8.4 (7.9)	14.7 (8.4)	12.7 (5.0)	16.1 (11.0)	12.9 (3.8)	8.6 (3.0)
% of the site within 20 m that was inundated	47.0 (18.1)	25.4 (11.9)	31.5 (11.3)	42.0 (10.9)	26.4 (9.6)	39.4 (11.2)
% of the site within 50 m that was inundated	40.0 (13.5)	27.9 (11.3)	51.6 (10.5)	38.5 (8.4)	26.7 (6.7)	56.3 (6.5)
Temperature						
Mean maximum diurnal temperature (°C)	38.2 (0.5)	35.9 (0.5)	41.8 (0.5)	44.3 (0.4)	43.0 (0.5)	38.0 (1.2)
Mean minimum nocturnal temperature (°C)	15.1 (0.2)	13.2 (0.2)	16.3 (0.3)	17.5 (0.2)	21.4 (0.1)	16.0 (0.3)
Mean daily temperature range (°C)	23.1 (0.6)	22.7 (0.5)	25.5 (0.6)	26.8 (0.5)	21.5 (0.5)	22.0 (1.1)
Humidity						
Mean diurnal vapor pressure (Pa)	1288.5 (25.4)	1162.7 (16.2)	1302.5 (25.0)	1355.4 (35.9)	2101.8 (26.6)	1551.9 (48.3)
Mean nocturnal vapor pressure (Pa)	1368.1 (21.5)	1259.2 (12.2)	1405.7 (18.8)	1475.6 (24.2)	1876.4 (24.4)	1529.3 (37.6)

* Data are presented as mean (standard error).

Table 6.6. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Topock Marsh (n = 10), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	857.5 (80.8)	848.0 (97.7)	822.5 (70.7)	645.8 (72.8)	518.2 (76.6)	564.4 (98.9)
Mean distance to nearest standing water	10.6 (4.4)	11.1 (4.4)	17.0 (6.5)	40.4 (9.8)	158.9 (25.3)	95.0 (20.9)
% of the site within 20 m that was inundated	30.5 (10.4)	31.2 (11.7)	11.4 (3.1)	2.4 (1.8)	0.4 (0.4)	0.0 (0.0)
% of the site within 50 m that was inundated	36.8 (7.3)	37.2 (9.4)	14.0 (4.4)	8.8 (4.7)	0.2 (0.2)	0.3 (0.1)
Temperature						
Mean maximum diurnal temperature (°C)	38.7 (0.3)	35.1 (0.4)	38.2 (0.5)	41.1 (0.5)	41.3 (0.5)	37.7 (0.8)
Mean minimum nocturnal temperature (°C)	17.0 (0.3)	16.0 (0.2)	18.1 (0.3)	19.8 (0.2)	23.5 (0.2)	18.1 (0.4)
Mean daily temperature range (°C)	21.6 (0.5)	19.1 (0.4)	20.1 (0.6)	21.3 (0.6)	17.8 (0.5)	19.6 (1.8)
Humidity						
Mean diurnal vapor pressure (Pa)	1677.4 (36.0)	1535.8 (26.6)	2156.5 (41.5)	2469.4 (39.2)	2825.8 (35.0)	2140.7 (83.0)
Mean nocturnal vapor pressure (Pa)	1465.1 (18.8)	1345.2 (18.8)	1742.8 (25.7)	1989.9 (27.1)	2382.5 (21.7)	1771.3 (36.9)

* Data are presented as mean (standard error).

AR063531

Table 6.7. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk (n = 8), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	988.3 (5.7)	968.8 (18.7)	846.8 (44.2)	669.2 (131.8)	596.3 (148.2)	835.8 (96.1)
Mean distance to nearest standing water	0.2 (0.2)	5.1 (5.0)	105.2 (40.3)	100.1 (34.5)	128.5 (42.2)	85.2 (50.5)
% of the site within 20 m that was inundated	83.3 (12.0)	55.0 (20.5)	16.2 (16.0)	24.2 (16.4)	27.7 (13.7)	20.0 (13.7)
% of the site within 50 m that was inundated	80.0 (10.0)	58.8 (14.2)	16.1 (16.0)	25.0 (15.9)	30.0 (19.1)	36.3 (21.2)
Temperature						
Mean maximum diurnal temperature (°C)	42.2 (1.1)	37.3 (0.6)	41.3 (0.8)	45.6 (0.6)	46.1 (0.8)	37.8 (1.6)
Mean minimum nocturnal temperature (°C)	17.5 (0.4)	15.1 (0.3)	17.2 (0.4)	19.2 (0.3)	22.6 (0.2)	17.2 (0.4)
Mean daily temperature range (°C)	24.7 (1.2)	22.2 (0.7)	24.2 (0.9)	26.5 (0.7)	23.5 (0.8)	20.6 (1.5)
Humidity						
Mean diurnal vapor pressure (Pa)	1331.9 (45.5)	1371.9 (46.8)	1824.3 (77.5)	1850.9 (98.3)	2367.2 (84.6)	1836.1 (117.6)
Mean nocturnal vapor pressure (Pa)	1365.2 (43.5)	1351.3 (24.9)	1665.3 (42.1)	1697.3 (59.9)	2120.6 (56.9)	1681.3 (57.3)

* Data are presented as mean (standard error).

Table 6.8. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Mesquite (n = 1), 2009*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	119.9 (0.0)	129.2 (0.0)	193.1 (33.3)	122.8 (0.0)	148.9 (0.0)	N/A
Mean distance to nearest standing water	150.0 (0.0)	20.0 (0.0)	30.0 (0.0)	55.0 (0.0)	55.0 (0.0)	N/A
% of the site within 20 m that was inundated	0.0 (0.0)	10.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	N/A
% of the site within 50 m that was inundated	0.0 (0.0)	3.0 (0.0)	14.0 (4.0)	0.0 (0.0)	0.0 (0.0)	N/A
Temperature						
Mean maximum diurnal temperature (°C)	44.0 (0.7)	40.9 (0.7)	44.8 (1.1)	48.6 (0.7)	N/A	N/A
Mean minimum nocturnal temperature (°C)	17.7 (1.0)	16.3 (0.6)	18.6 (0.9)	20.8 (0.7)	N/A	N/A
Mean daily temperature range (°C)	26.3 (1.4)	24.6 (1.0)	26.1 (1.3)	27.8 (1.2)	N/A	N/A
Humidity						
Mean diurnal vapor pressure (Pa)	N/A	N/A	N/A	N/A	N/A	N/A
Mean nocturnal vapor pressure (Pa)	N/A	N/A	N/A	N/A	N/A	N/A

* Data are presented as mean (standard error). N/A = not available.

AR063532

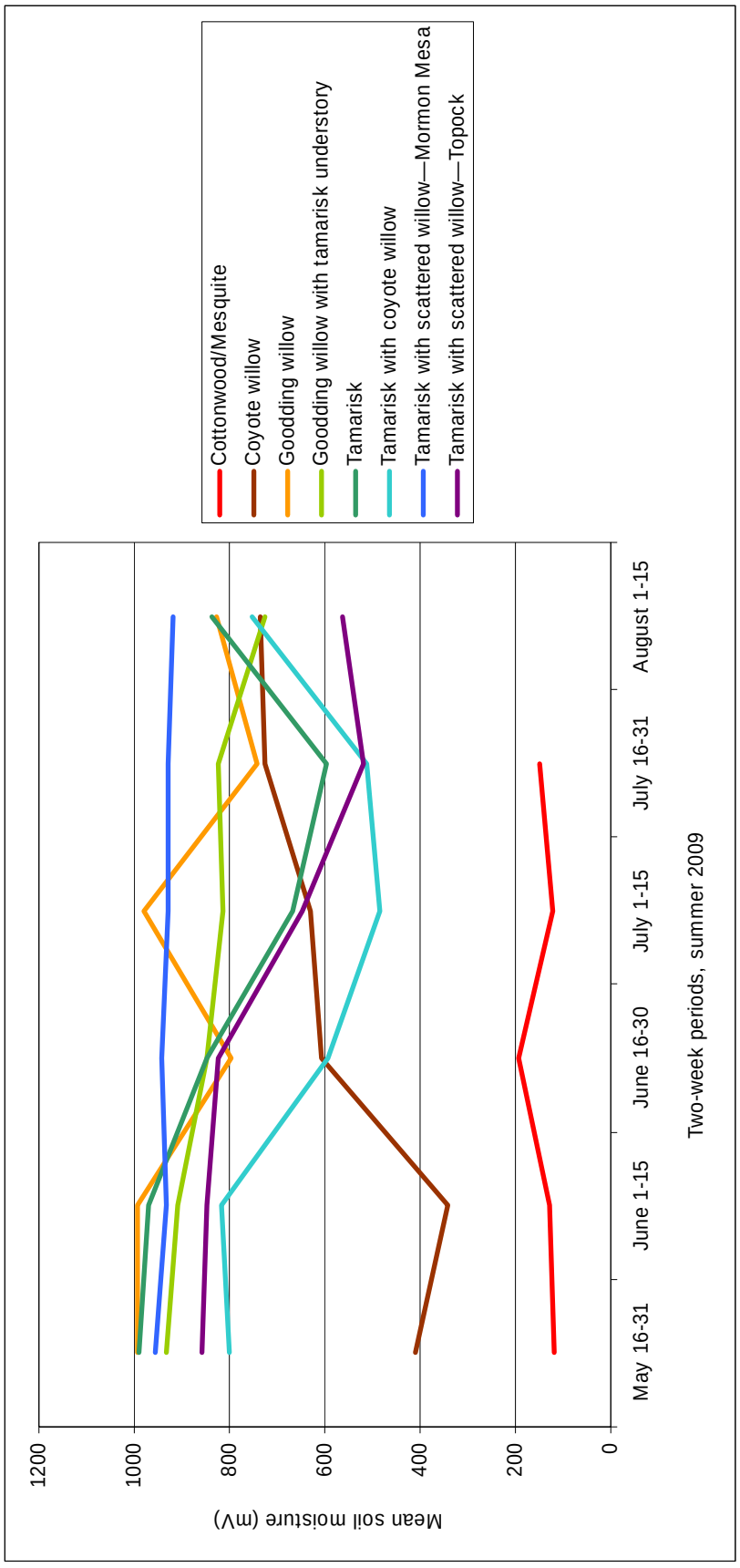


Figure 6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

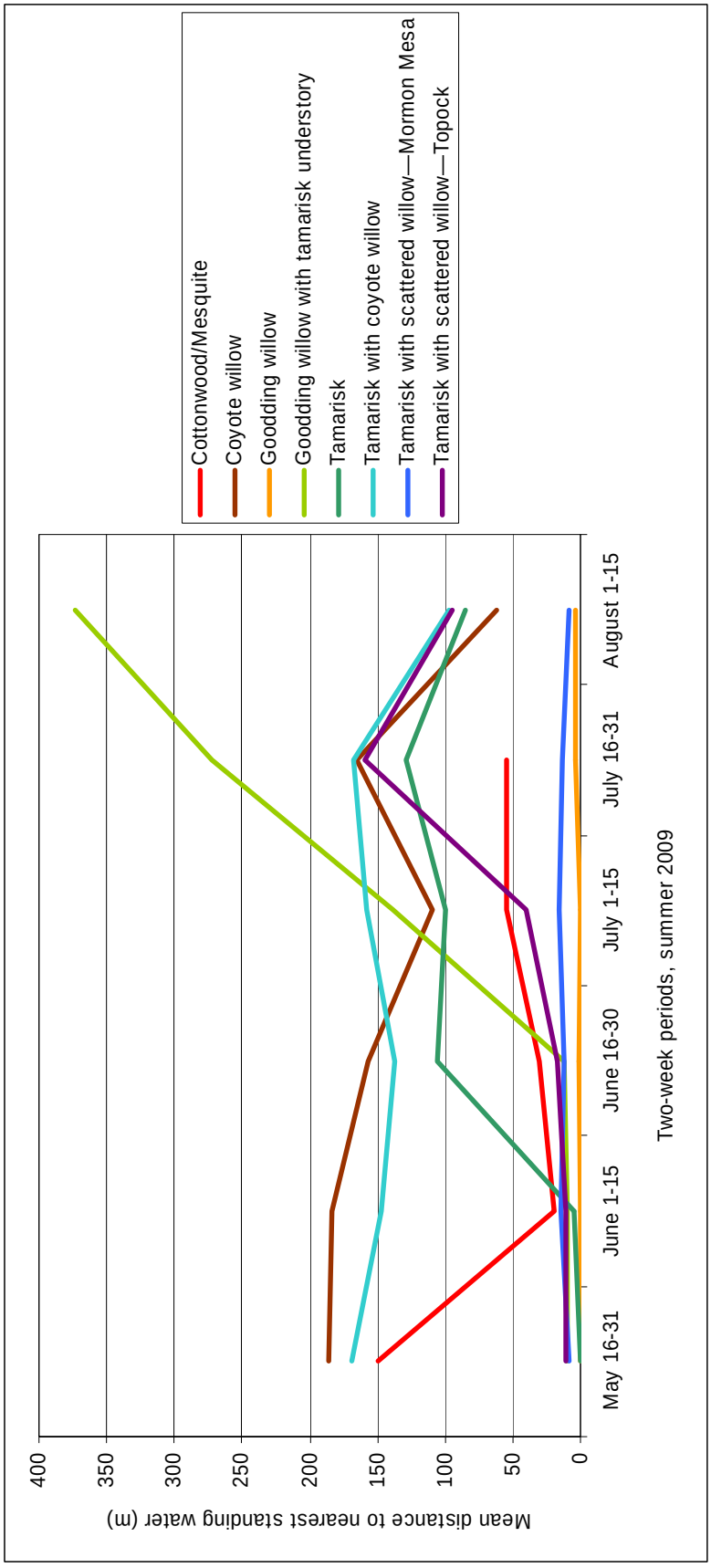


Figure 6.2. Mean distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

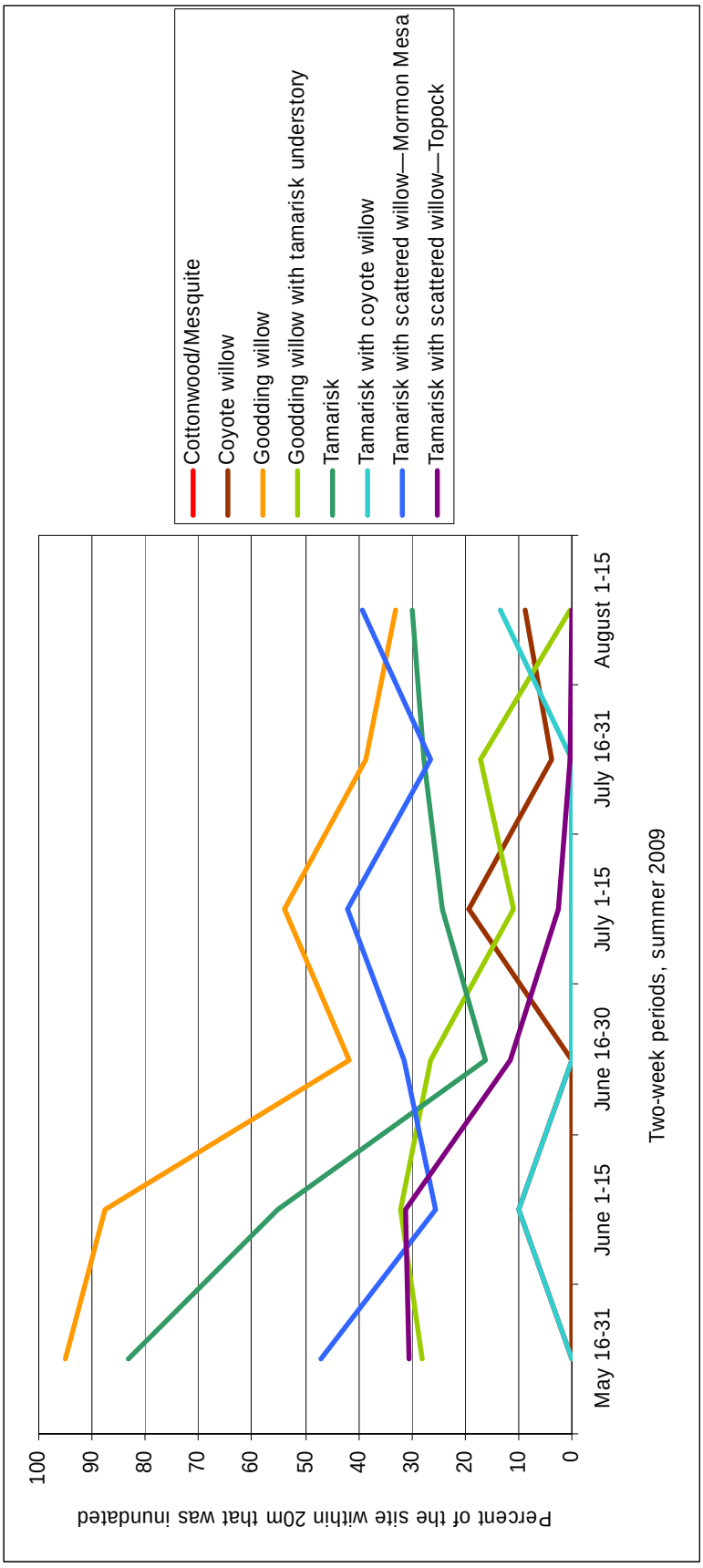


Figure 6.3. Mean percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods. Cottonwood/mesquite does not appear on the graph because it is exactly overlain by tamarisk/coyote willow through the end of July.

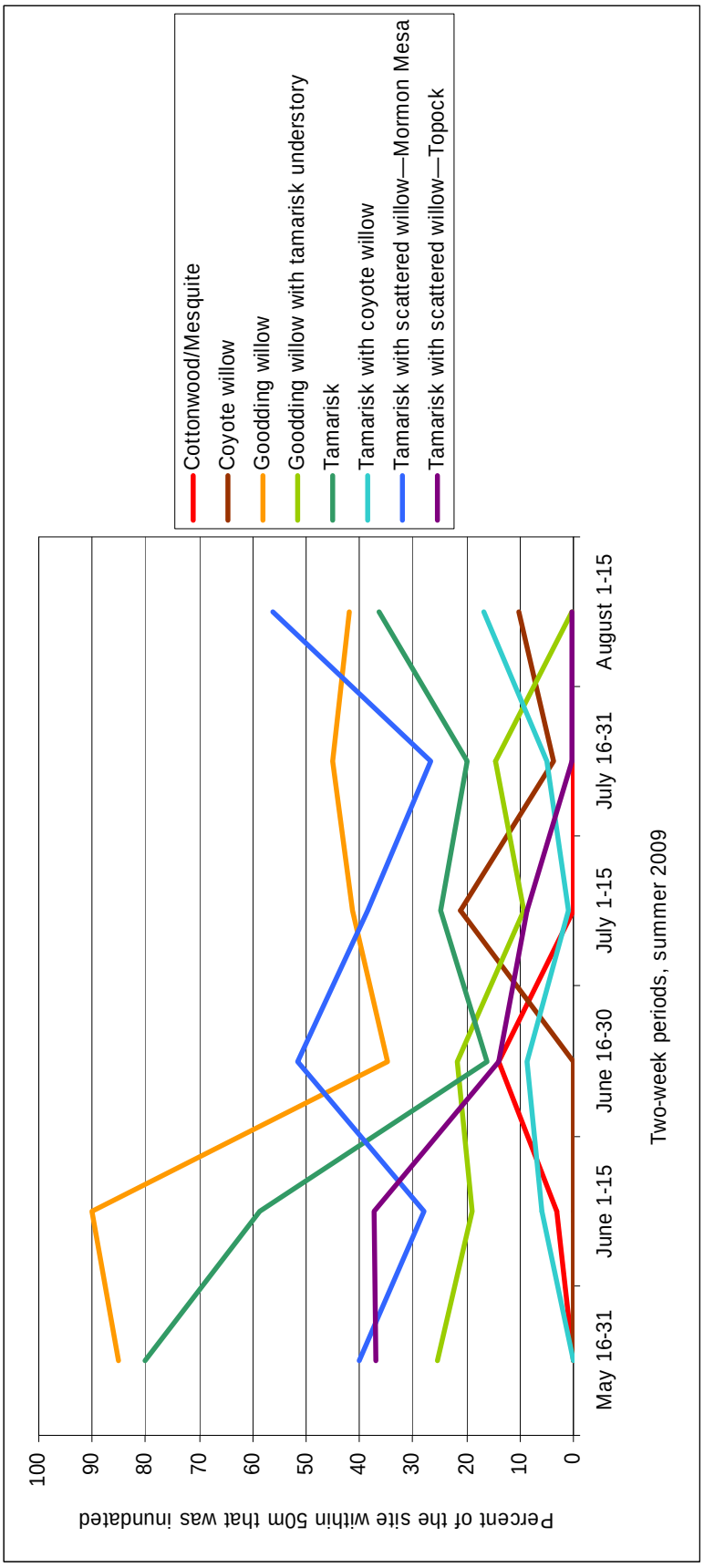


Figure 6.4. Mean percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

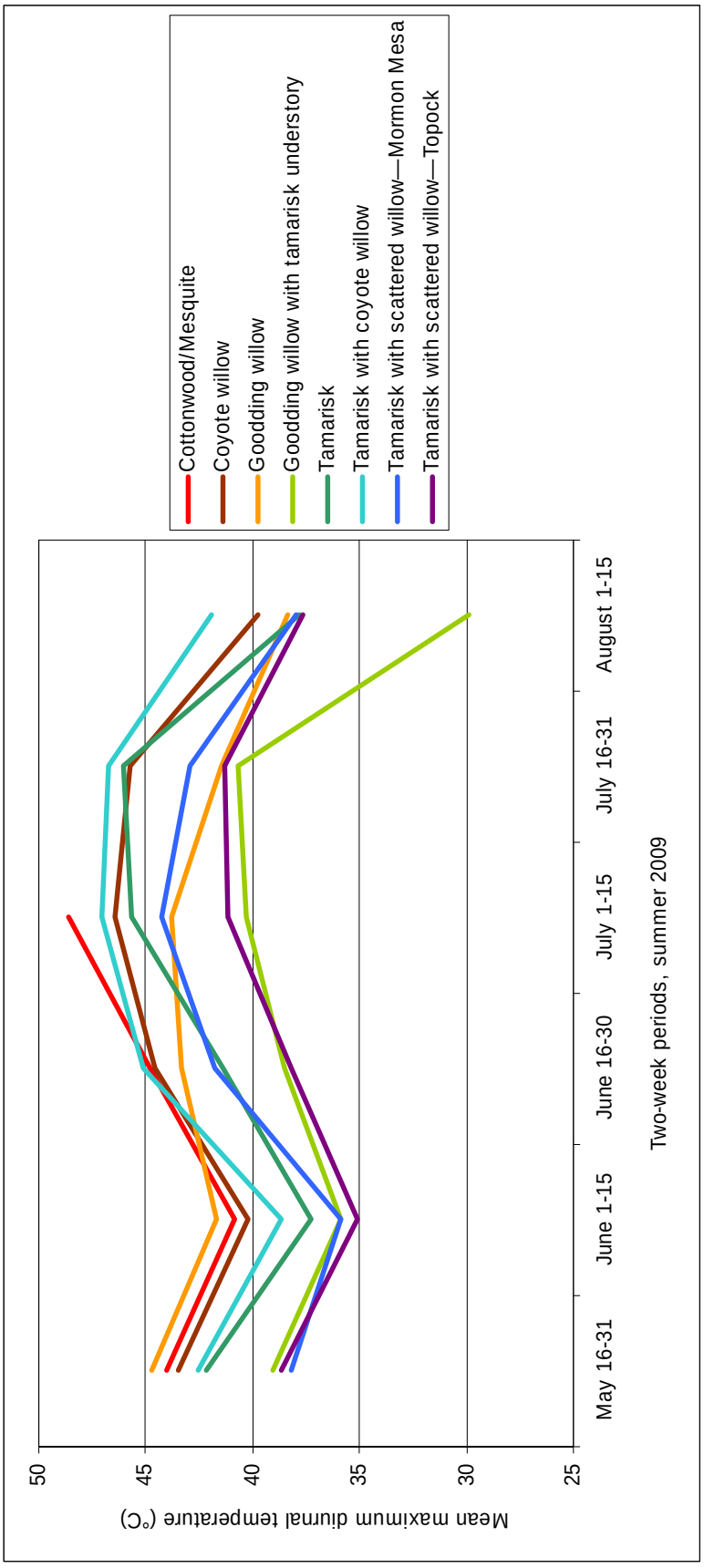


Figure 6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

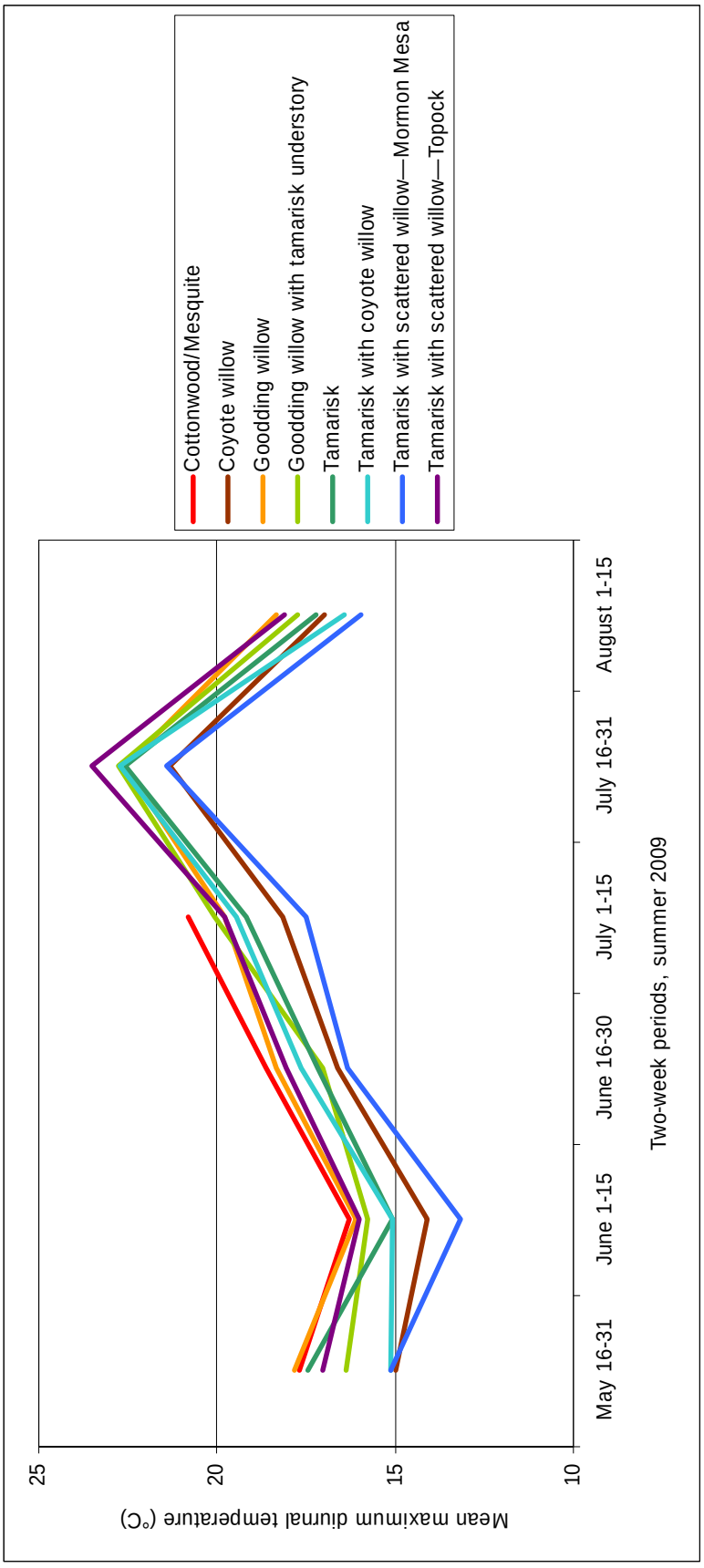


Figure 6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

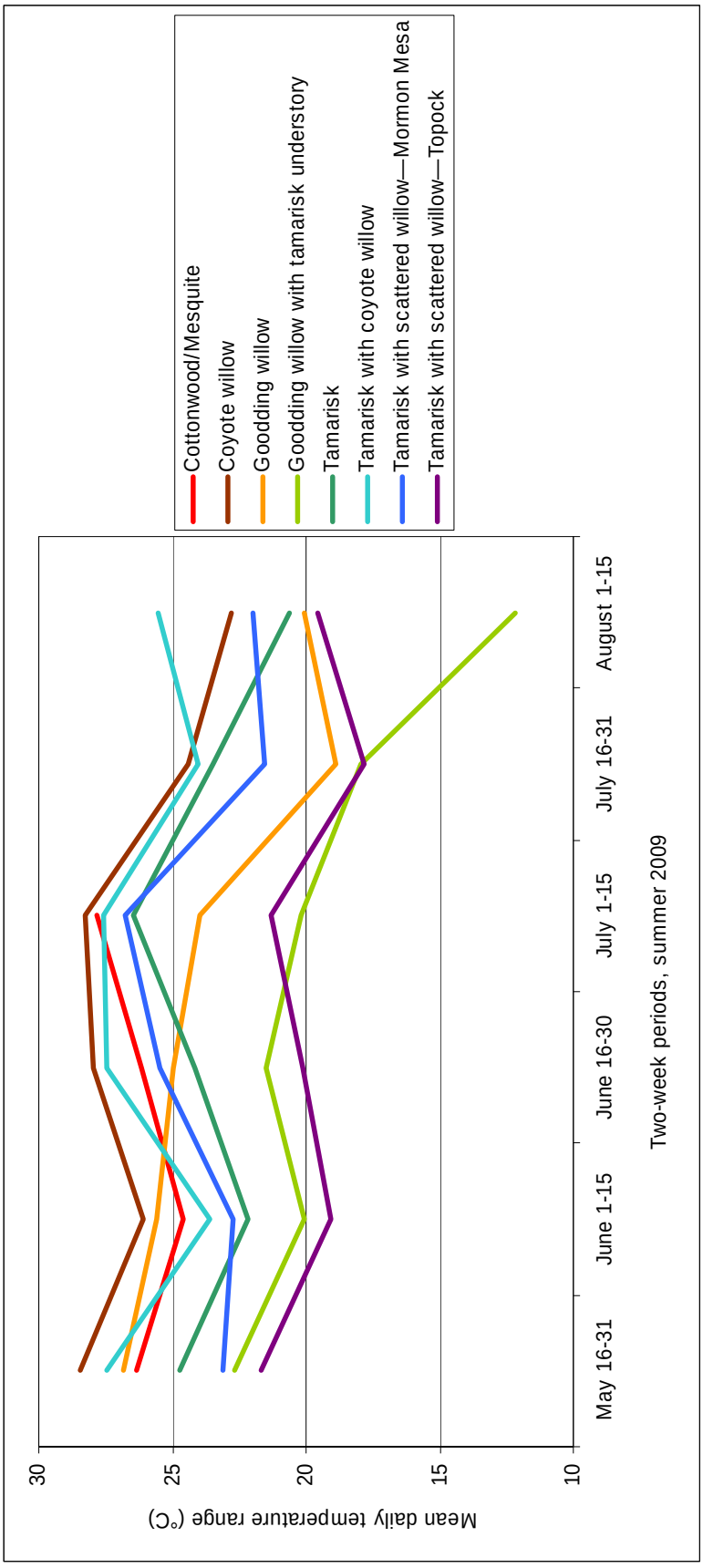


Figure 6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

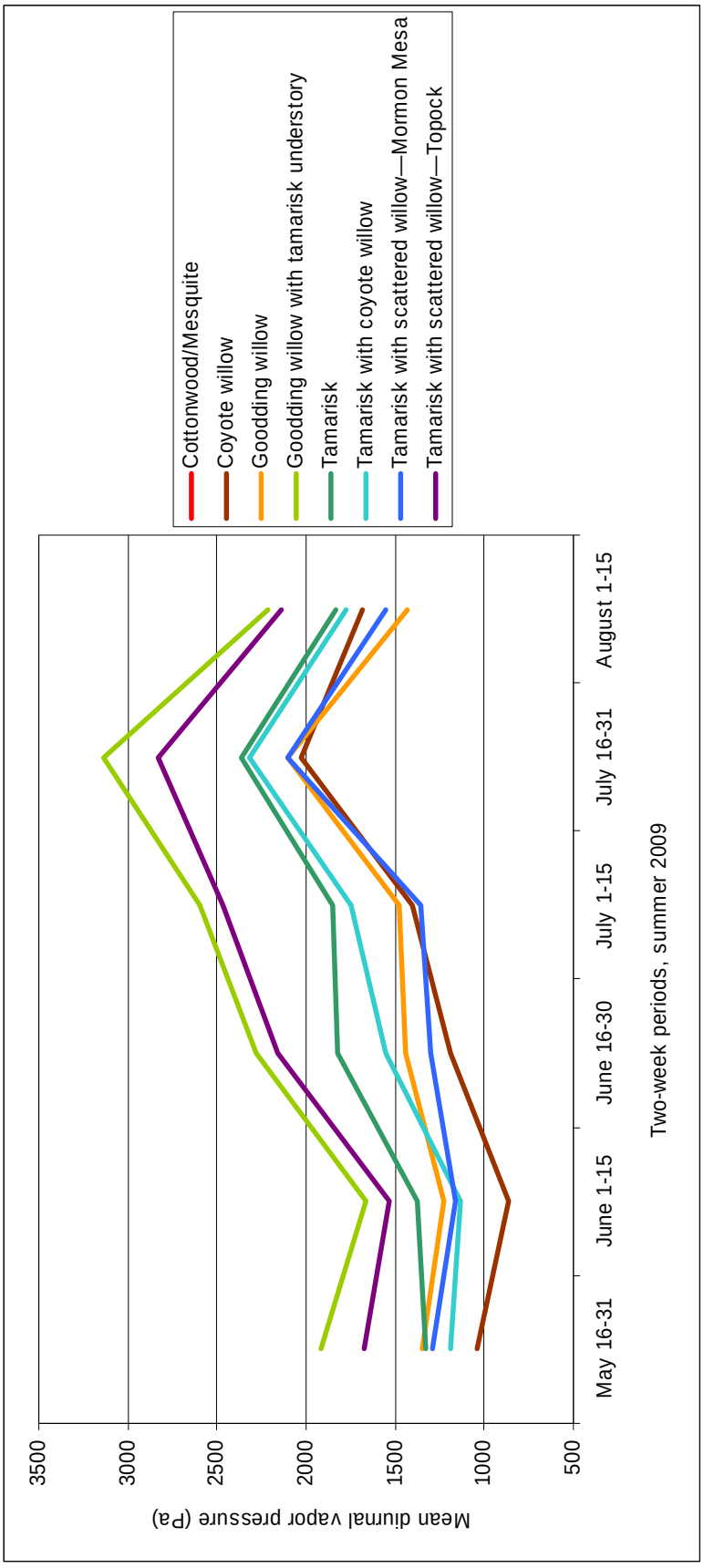


Figure 6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

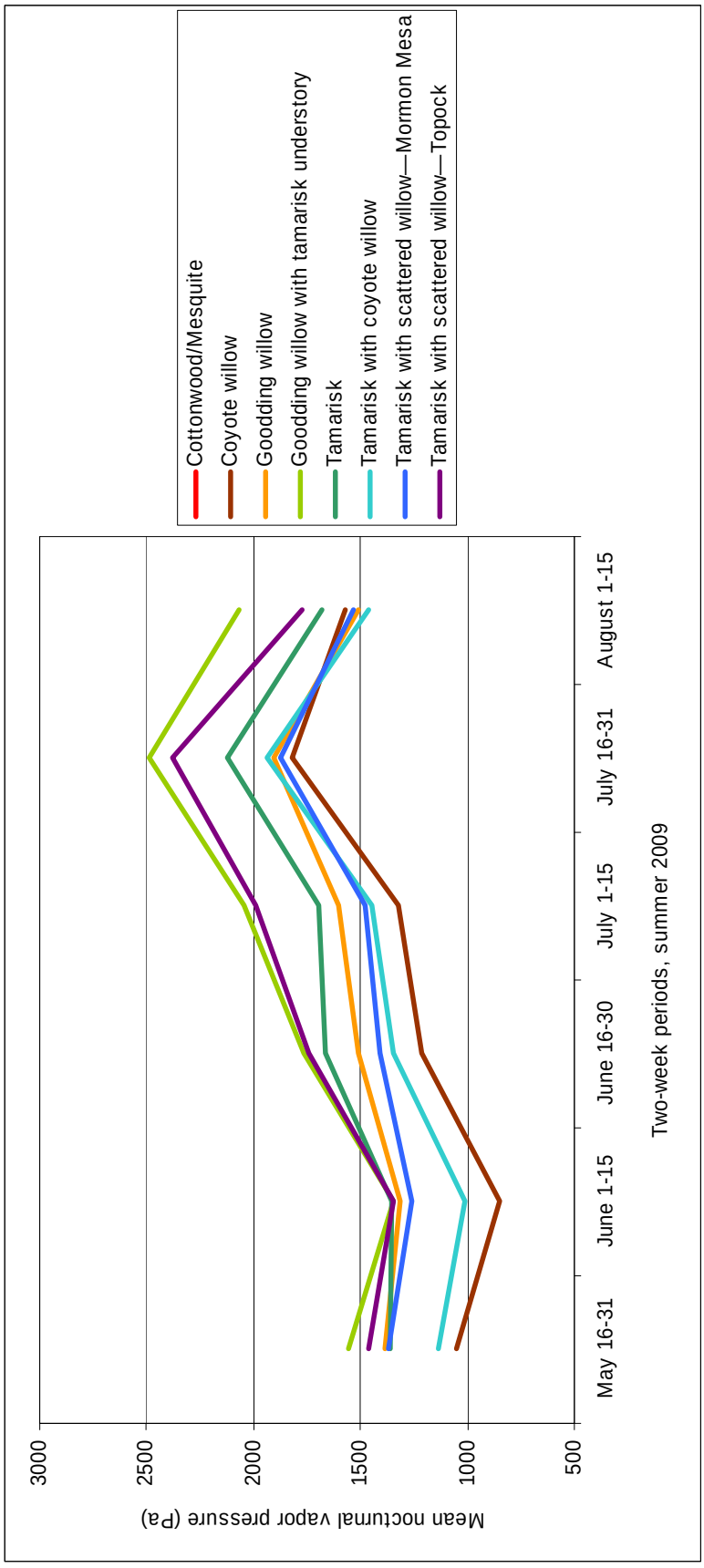


Figure 6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2009. Data are summarized by two-week periods.

Nests in Formerly Occupied Areas

We located 26 old nests at Mormon Mesa and Topock Marsh. We were able to locate the exact nest fork in 17 cases and located the nest tree but were unsure of the correct fork in 5 additional cases. In four cases we located the nest vicinity (within 5 m of the nest location) but were unable to verify that we had located the exact nest tree. Three of the 26 HOBO data loggers failed to collect data, while two loggers collected temperature but no humidity data. Soil moisture data from the occupied period were unavailable for the two nests that were active in 2003.

Microclimate at old nests sites differed between occupied and unoccupied periods in at least one variable at both Mormon Mesa (Table 6.9) and Topock Marsh (Table 6.10). At Mormon Mesa, nest sites had higher diurnal and nocturnal vapor pressure when they were occupied versus when they were abandoned. At Topock Marsh, nest sites had higher nocturnal vapor pressure when the nest was occupied. When data from both sites were pooled, mean diurnal and nocturnal vapor pressure were lower in 2009 versus when the nest was occupied (Table 6.11). The only variables that showed a unidirectional change across study areas were soil moisture and nocturnal vapor pressure, both of which were lower in 2009 versus when the nest was occupied.

Mean daily maximum temperature recorded at the Overton weather station in June–August 2009 (105.3 °F) was lower ($F_{6,630} = 2.7$, $P = 0.014$) than in the same period in 2003 or 2007 (both 108.5 °F). Mean daily minimum temperature at Overton was higher ($F_{6,630} = 8.9$, $P < 0.001$) in 2009 (72.5 °F) than in 2005 (69.3 °F) or 2007 (68.8 °F). At the Needles weather station, mean maximum daily temperature was lower ($F_{6,637} = 6.3$, $P < 0.001$) in June–August 2009 (106.9 °F) than during the same period in 2006 (111.0 °F). Mean minimum daily temperature in 2009 (81.4 °F) was also lower than in 2006 (85.5 °F) ($F_{6,637} = 5.9$, $P < 0.001$). Average dew point at Needles was lower ($F_{6,637} = 13.9$, $P < 0.001$) in 2009 (38.8 °F) than in 2003 (55.7 °F), 2004 (48.3 °F), or 2006 (45.6 °F).

Table 6.9. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mormon Mesa, NV

Microclimate Measure	Occupied	Unoccupied	Difference	*P*
Soil Moisture (n = 8)				
Mean soil moisture (mV)	761.6 (72.4)	722.0 (51.5)	-39.5	0.72
Temperature (n = 13)				
Mean maximum diurnal temperature (°C)	42.6 (0.4)	43.9 (0.4)	1.4	0.22
Mean minimum nocturnal temperature (°C)	22.5 (0.3)	20.9 (0.2)	-1.1	0.16
Mean daily temperature range (°C)	20.0 (0.5)	23.0 (0.4)	2.4	0.10
Humidity (n = 13)				
Mean diurnal vapor pressure (Pa)	1859.5 (46.4)	1303.6 (33.5)	-502.1	0.004
Mean nocturnal vapor pressure (Pa)	1825.7 (38.4)	1312.5 (25.0)	-468.4	0.003

Table 6.10. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Topock Marsh, AZ*

Microclimate Measure	Occupied	Unoccupied	Difference	*P*
Soil Moisture (n = 9)				
Mean soil moisture (mV)	873.5 (28.8)	852.0 (35.9)	-38.0	0.16
Temperature (n = 10)				
Mean maximum diurnal temperature (°C)	39.9 (0.4)	38.7 (0.3)	-1.2	0.39
Mean minimum nocturnal temperature (°C)	21.0 (0.3)	21.2 (0.3)	0.2	0.78
Mean daily temperature range (°C)	18.9 (0.5)	17.5 (0.4)	-1.3	0.34
Humidity (n = 8)				
Mean diurnal vapor pressure (Pa)	2368.6 (43.5)	2433.6 (47.7)	9.9	0.92
Mean nocturnal vapor pressure (Pa)	2128.3 (36.8)	2083.5 (37.4)	-115.6	0.03

* Data are presented as mean (standard error).

Table 6.11. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined*

Microclimate Measure	Occupied	Unoccupied	Difference	*P*	Direction and Magnitude of Change[1]	
					MOME	TOPO
Soil Moisture (n = 17)						
Mean soil moisture (mV)	820.8 (38.7)	802.9 (25.8)	-38.7	0.45	↓	↓
Temperature (n = 23)						
Mean maximum diurnal temperature (°C)	41.3 (0.3)	41.7 (0.3)	0.3	0.77	↑	↓
Mean minimum nocturnal temperature (°C)	21.8 (0.2)	21.1 (0.2)	-0.5	0.28	↓	↑
Mean daily temperature range (°C)	19.5 (0.4)	20.6 (0.3)	0.8	0.45	↑	↓
Humidity (n = 21)						
Mean diurnal vapor pressure (Pa)	2093.2 (35.2)	1964.6 (28.1)	-314.6	0.008	↓	↑
Mean nocturnal vapor pressure (Pa)	1739.2 (40.9)	1609.7 (29.4)	-334.0	0.001	↓	↓

* Data are presented as mean (standard error).

[1] Arrows indicate the direction of change of the variable between occupied and unoccupied periods for each study area (MOME = Mormon Mesa and TOPO = Topock Marsh), while color indicated the statistical significance of the change as follows: red is P <0.05, green is 0.05<P<0.10, black is P >0.10.

DISCUSSION

Currently Occupied Territories

The hydrological conditions recorded in occupied territories in 2009 show that Goodding willow, tamarisk, tamarisk with scattered willow at Topock, and Goodding willow with tamarisk understory habitat types contained the wettest soils at the beginning of the breeding season, with the distance to surface water being less than 30 m and up to 70% of the surrounding area within 50 m containing saturated or inundated soil. Soils became progressively drier throughout the season in all these habitat types, though the speed and extent to which the soils dried out varied among habitat types.

The coyote willow and tamarisk with coyote willow habitat types, both of which are present at Mesquite West, showed a notable departure from the wet conditions observed there in previous years. The Mesquite West site did not receive any surface water until June (see Chapter 2), and the hydrological data show the low soil moisture, low percentage of the area inundated, and high distance to surface water observed at the site in 2009. Despite the dry soil conditions, both habitat types were occupied by breeding flycatchers, though occupancy likely reflects the high site fidelity of adult flycatchers (see Chapter 3) rather than the suitability of the hydrologic conditions for creating and maintaining flycatcher habitat.

The lowest soil moisture values were recorded in the cottonwood/mesquite habitat type at the Beal Lake restoration area. This area is flood irrigated but contains very sandy soil and thus dries quickly. Although flycatchers were detected on multiple occasions at Beal Lake, they responded to broadcast but did not engage in the lengthy, unsolicited song typical of territorial male flycatchers. No flycatcher breeding activity has been detected in this habitat type along the LCR, and this habitat type should not be used as a model for flycatcher habitat

Tamarisk with scattered Goodding willow at Mormon Mesa was the only vegetation type that was influenced by an undammed river. Unlike in most previous years, the Virgin River at Mormon Mesa did not go completely subsurface at any time during the breeding season, and occupied flycatcher habitat at Mormon Mesa did not lose its saturated and inundated soils in 2009 as it had in previous years.

Temperature and humidity varied across habitat types. As in 2008, Goodding willow with tamarisk understory was the most humid, followed by tamarisk with scattered willow at Topock. These two habitat types were also the most thermally stable. In previous years, tamarisk with scattered willow at Mormon Mesa had the highest temperature, largest daily temperature range, and lowest humidity (McLeod et al. 2008, McLeod and Koronkiewicz 2009), but in 2009, coyote willow and tamarisk with coyote willow had daily temperature ranges higher than and humidity comparable to territories at Mormon Mesa. The less humid and less thermally moderate conditions in coyote willow and tamarisk with coyote willow habitat types may be related to the lack of surface water in Mesquite West.

Nests in Formerly Occupied Territories

Willow flycatchers along the lower Colorado River and tributaries selected nest sites that were cooler, wetter, and more thermally moderate than unused sites in the adjacent landscape (McLeod et al. 2008), and we anticipated seeing similar differences when we examined temporal, rather than spatial, variation in habitat use. The only statistically significant differences we observed (lower mean diurnal and nocturnal vapor pressure at Mormon Mesa and lower nocturnal vapor pressure at Topock Marsh in 2009 versus when the nest was active) were consistent with these expectations. However, the mean dew point at the Needles weather station in June–August 2009 was lower than in the corresponding months in 2003, 2004,

or 2006, suggesting that regional climate could have accounted for the observed differences in vapor pressure at nest sites in Topock Marsh. Humidity data were not available for the Overton weather station, but a qualitative comparison of vapor pressure observed at occupied territories at Mormon Mesa in 2009 versus that observed in 2003–2007 (McLeod et al. 2008) suggests that overall humidity was lower in 2009. Thus, the differences in microclimate we observed between 2009 and the year the nest was occupied at both Topock and Mormon Mesa are likely the result of interannual climatic differences and not the result of localized changes at the nest sites. We found some evidence of an increase in the proportion of dead stems at old nests at both Topock and Mormon Mesa (see Chapter 5), but otherwise found no evidence of dramatic changes in vegetation at formerly occupied territories that might result in changes in temperature or humidity. It is possible that subtle changes in vegetation (see Chapter 5) were sufficient to reduce suitability of the sites for flycatchers. It is also possible that changes in occupancy patterns at Topock Marsh may be influenced by an overall decrease, since 2004, in the number of nesting pairs (see Chapter 4).

Soil moisture values did not differ significantly between unoccupied and occupied periods at either study area, and a post-hoc analysis comparing the distance to surface water during occupied vs. unoccupied periods showed no statistical difference at Mormon Mesa (data on distance to water at Topock were too sparse to allow analysis). Surface water conditions at the Virgin River #2 site, where the formerly occupied territories at Mormon Mesa were located, nonetheless differed notably over time, with the occupied territories containing surface water throughout the season in 2005 and at the beginning of the season in 2006 but not in subsequent years. The affinity of willow flycatchers with surface water is well documented in the literature, and the presence of surface water likely affects flycatcher settlement at the beginning of the breeding season. Adult flycatchers also demonstrate high site fidelity, and will return to previously used breeding areas even if conditions are no longer optimal. Thus, it is possible that Virgin River #2 has not represented optimal flycatcher habitat for multiple years, but site fidelity maintained the presence of breeding flycatchers through 2008.

Chapter 7

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

INTRODUCTION

Southwestern Willow Flycatcher nests and breeding territories are typically located near rivers, streams, and open water (Sogge and Marshall 2000) or over wet soil (Flett and Sanders 1987, Harris et al. 1987, Harris 1991). Nest substrate plants are often rooted in or overhang standing water. Although the association between breeding flycatchers and open water or wet soil is widely recognized by managers and scientists alike, the exact nature of the association is poorly quantified. Water may be a direct environmental cue for flycatcher nesting behavior or it may be the ultimate cause of proximate factors such as vegetation composition and structure, prey base, and microclimate.

Anthropogenic or natural modifications to surface water resources (i.e., fluvial hydrology and geomorphology) can modify existing and potential flycatcher breeding habitat and therefore have the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). For example, nine flycatcher territories at San Marcial on the middle Rio Grande in New Mexico exhibited a near absence of nesting attempts in 1996 when a combination of drought, upstream dam operations, and upstream withdrawals for irrigation removed all surface water (Johnson et al. 1999). This was in contrast to previous (1994, 1995) and subsequent (1997) years when active nests were documented at the site, with the river flowing in those years. A nearby control site that contained water exhibited multiple nesting attempts during all four years, leading Johnson et al. (1999) to suggest that the presence of water was a fundamental requirement for nesting. A similar pattern was observed along the Gila River in Arizona when decreased streamflow from 2002 to 2004 coincided with the number of flycatcher territories declining by nearly half each year (Munzer et al. 2005). Since 2004, flows within the Gila River have been greater and more consistent, and correspond with a continuing increase in flycatcher territories (14 to 97) from 2004 to 2009 (Graber and Koronkiewicz 2009b).

Flow characteristics of the lower Colorado River have been modified by numerous dams and irrigation withdrawals (Rosenberg et al. 1991). The river reach between Parker Dam and Imperial Dam is regulated by releases from Parker Dam, which has been in operation since 1939. Existing riparian habitat in the Parker to Imperial reach has likely adjusted to historical water release patterns from Parker Dam and appears to be in a stable or declining condition (LCR MSCP 2004). Implementation of the Secretarial Implementation Agreements/California 4.4 Plan (hereafter SIAs) by Reclamation would change the point of diversion for up to 400,000 acre-feet of California apportionment water for up to 75 years (USFWS 2001). The point of diversion, previously located below Parker Dam at Imperial Dam, would change to a point above Parker Dam, resulting in lower water levels in the river between Parker and Imperial. The change in point of diversion was scheduled to begin in 2002.

River flow changes related to the change in point of diversion have the potential to further modify riparian habitats below Parker Dam, habitats that are presently considered potentially suitable for willow flycatcher (USFWS 2001:47). Reclamation (2000) estimated that implementation of the SIAs will cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less. As a result, 372 acres (151 ha) of occupied[1] Southwestern Willow Flycatcher habitat could lose their moist soils. This loss could influence plant species composition (loss of cottonwood and willow) and structure (loss of vegetation volume) over an undetermined length of time. In addition, Reclamation estimated that 5,404 acres (2,187 ha) of

[1] As per the USFWS, occupied Southwestern Willow Flycatcher habitat is defined as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year since surveys began in 1996.

potential flycatcher habitat could be influenced by the drop in groundwater level. These changes may affect the distribution, abundance, occupancy, and prey base of Southwestern Willow Flycatchers in the Parker to Imperial reach.

In 2004, Reclamation completed a pilot year of habitat monitoring by deploying temperature/ humidity data loggers at several sites in the Parker to Imperial reach. Reclamation then initiated a more comprehensive, long-term study in 2005 for the purpose of addressing how the above hydrological changes might affect riparian habitats along the Parker to Imperial reach. The objective is to monitor 372 acres (151 ha) of occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams for 10–15 years to determine how microclimate, vegetation, and groundwater conditions might be affected by the SIAs water transfer actions. Monitoring did not commence until after diversions started; therefore, antecedent conditions are unknown and monitoring analyses focus on detecting change through time rather than comparing current conditions to a baseline. An additional objective was to compare microclimate characteristics of sites in the Parker to Imperial reach with those at flycatcher breeding areas. This chapter reports the results of this study to date.

METHODS

In 2005, we selected a subset of sites that are currently surveyed for the presence of willow flycatchers for inclusion in the habitat monitoring study. We chose 11 sites distributed along the Parker to Imperial reach that are reasonably accessible, and where we believed groundwater levels were influenced primarily by river levels and not by outside sources such as irrigation return flows. Chosen sites equated to at least 75.3 ha (186 acres) on the California side of the lower Colorado River and at least 75.3 ha (186 acres) on the Arizona side. We also chose four control sites, two above Parker Dam and two below Imperial Dam, to distinguish any changes in microclimate, groundwater, or vegetation caused by water transfer actions from those caused by fluctuations in climate or rainfall. We monitored these same 15 sites from 2005 to 2009. In August of 2006, we initiated habitat monitoring within a consistently occupied breeding site at Topock Marsh to obtain groundwater levels and patterns with which we can compare results obtained at the habitat monitoring sites.

Temperature/Humidity (T/RH) Loggers

In 2005, we deployed HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) temperature/humidity data loggers at several locations within each site selected for habitat monitoring. All loggers collected data at 15-minute intervals and were placed in inverted plastic containers and camouflaged as described in Chapter 6. All 60 logger locations selected in 2005 were retained in 2006. Two additional data loggers were installed in the Topock Marsh monitoring site in August 2006. A portion of Gila Confluence North, one of the control sites below Imperial Dam, burned in December 2006. As a result of the fire, all vegetation at one HOBO location at the site was killed, and vegetation at another HOBO location was dramatically reduced. These two HOBOs were replaced in May 2007 with HOBOs at new locations within unburned portions of the site.

HOBO loggers have been downloaded two or three times per year since installation. At each download, we examine the data to determine if there are any problems with data logger function. Data loggers are replaced whenever a potential problem with the sensors is detected. Battery level is also checked at each download, and the battery is replaced if needed.

Soil Moisture (SM) Measurements

Soil moisture beneath each HOBO logger was measured and recorded using a hand-held ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively). Soil moisture measurements were collected during each presence/absence survey between 15 May and 25 July and when HOBO data were downloaded. For sites that were part of the biennial survey schedule and were not surveyed in 2009 (see Chapter 2), soil moisture measurements were collected only when HOBO data were downloaded at the beginning and end of the survey season. Soil moisture measurements, percent of the area containing inundated or saturated soil, and distance to water were recorded as described in Chapter 6.

Vegetation Measurements

We completed vegetation measurements, following the methods described in Chapter 5, at each HOBO location after flycatcher surveys were completed in late July. All HOBO loggers were also downloaded at this time. Vegetation measurements were completed at the same locations as in 2005–2008, with the exception of Gila Confluence North, where vegetation measurements were collected at the two new HOBO locations established in 2007.

Groundwater Measurements

A small-diameter shallow well, or piezometer, equipped with a pressure transducer/data logger was installed in May–August 2005 near each of the 15 sites selected for habitat monitoring to monitor groundwater levels. These 15 piezometers are described in Koronkiewicz et al. (2006a) and have been downloaded approximately three times per year since installation. One additional piezometer was installed at Topock Marsh within occupied flycatcher habitat in 2006 and has been downloaded on the same schedule as the other piezometers. At each download we check the battery level and function of the data logger. Batteries are replaced as necessary and data are examined to ascertain potential equipment malfunction.

Piezometer Replacement

The piezometer at the Gila Confluence North monitoring site was moved to a new location within the same site in July 2007 because the original station was damaged in a local brush fire. In March 2008, a new piezometer was installed at the Cibola Lake monitoring site to replace the original station, which was bulldozed sometime during the summer of 2007. Several piezometers developed consistent battery failure or other equipment malfunction during 2008. Between the summers of 2008 and 2009, we replaced the original pressure transducers (In-Situ MiniTroll Standard-P) with the newest generation of pressure transducer (In-Situ LevelTroll 500) at sites that appeared to have the worst equipment failure problems.

Data Collection

A pressure transducer/data logger equipped with a vented cable collected data hourly at each piezometer. These devices measure and record pressure of the water column present in the well, and these pressure measurements are then converted into water levels (in distance below top of casing). With vented cables and data transfer ports there is no need to correct measurements for atmospheric pressure changes, and the data can be downloaded at the wellhead without disturbing the pressure transducer in the well.

During the initial installation of the pressure transducers, as well as at each data download thereafter, water levels were manually measured in the piezometers using an electric water level sounder (Solinst-brand). These known water levels were then used to program the pressure transducer with a baseline measurement from which all other automatically recorded water levels were calculated.

We obtained additional hydrologic data from the U.S. Geological Survey (USGS) regarding streamflow and stage height in the Colorado River below Parker Dam (09427520).

Data Validation

We have identified several sources of error in the water levels recorded by the piezometers. We developed a rigorous protocol to validate each data download, determine if any errors exist with the data, and correct the raw data if possible. For consistency, we applied this data validation protocol retroactively to all data obtained since installation of the piezometers.

At each download, we compared the water level recorded by the piezometer with the manual measurement. We also checked the data logger parameters to determine whether the data logger was initialized properly. If a discrepancy >0.3 feet existed between the data logger and the manual measurement, and this discrepancy could not be accounted for and corrected by examining the setup parameters and applying an appropriate correction factor, the data were not used for analysis. Specific sources of error are identified below.

Install Drift. Because piezometers are constructed such that the pressure transducer is almost the same diameter as the inside of the piezometer, removing and inserting the pressure transducers to change batteries can change the water levels in the piezometer temporarily but drastically. This type of error was first recognized in the data following initial piezometer installation and has occurred with increasing frequency due to removing the data logger from the piezometer to change batteries at each download.

Operational Drift. In rare cases, the accuracy of the data loggers can change in the time period between downloads.

Improper Setup. After downloading data, the data loggers are reset for the next round of measurements. Conducting the startup procedure improperly can lead to errors; fortunately, most of these setup errors can be corrected. Common errors include mistakenly setting the type of reference used (i.e., recording water level elevation instead of depth), not resetting the starting water level reference value to the water level value measured manually in the field, and not restarting the data logger but continuing with the previous setup.

The errors described above did not typically prevent data from being analyzed for evapotranspiration signature (see below). The evapotranspiration analysis relies on relative changes in water level over the course of a single day, and these signatures are not affected by improper setup or correction factors.

Statistical Analyses

Microclimate

The following values were calculated for all 15 habitat monitoring sites:

- Mean soil moisture from plot center to 2.0 m from plot center
- Mean maximum diurnal temperature

- Mean minimum nocturnal temperature
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure
- Mean nocturnal vapor pressure

The diurnal and nocturnal periods were determined from the daily sunrise and sunset times reported for the region by the National Weather Service (2009).

These values were then calculated for all 15 sites combined and compared to the same values for territory locations at Topock Marsh. These analyses were restricted to 6 May–31 July 2008, the dates during which microclimate data were collected both within territories at Topock and at the habitat monitoring locations. One-way ANOVA tests were used to test the difference in means for the T/RH and SM values.

We assigned all plots as a control site (above Parker Dam or below Imperial Dam) or as a test site (between Parker and Imperial), then analyzed between-year differences in T/RH and SM values within these two groups using paired t-tests. We then analyzed the between-year differences among the test sites compared to the control sites using one-way repeated measures ANOVA. These analyses were restricted to 1 June–1 August. Analyses were conducted using SAS® Version 9.1 (SAS Institute 2003).

Vegetation

We analyzed the between-year differences among the test sites compared to the control sites using one-way repeated measures ANOVA for canopy height, canopy closure, percent woody ground cover, three categories of stem sizes for both live and dead stems, the percentage of each stem size category that consisted of live stems, and the percentage of the basal area within the plot that consisted of native vegetation. We also used repeated measures ANOVA to examine foliage density for live and dead vegetation at each meter interval above the ground. These analyses and all descriptive statistics were produced using SPSS® Version 16.0 (SPSS Inc.) software. We excluded vertical foliage density measurements at 5 m from plot center from the analysis so as to have comparable data across years.

Groundwater Levels

We calculated monthly high and low water levels for all piezometers. We examined monthly river flow data from below Parker Dam from 2000 to 2009 to determine whether there has been a decrease in water levels since the scheduled implementation of the change in point of diversion from Imperial Dam to above Parker Dam, which began in early 2001.

Evapotranspiration Signature. A distinct daily change in water levels occurs due to removal of water from the shallow aquifer by vegetation. Typically, water levels are lowest in the afternoon, during and following times of peak water use by plants, and water levels are highest in the morning after the shallow aquifer has been able to recharge. For the purposes of this report, we refer to this daily fluctuation as the "evapotranspiration signature." Since the 1930s, various researchers have sought to use this daily fluctuation in groundwater levels to estimate the amount of water lost from the aquifer due to evapotranspiration. Various approaches have been tried, most under highly controlled field conditions (e.g., White 1932, Gatewood et al. 1950, Bowie and Kam 1968, Hays 2003). Several studies refer to this as the "transpiration-well" method.

The transpiration-well method is based on the premise that during the day, water is lost to evapotranspiration at a faster rate than it can be replenished by the hydrostatic pressure of the aquifer. This leads to a decline in the water table between the hours of approximately 6:00 a.m. and 5:00 p.m.

Overnight, the water table rises as evapotranspiration decreases and recharge is greater than losses to vegetation. White (1932) reasoned that if water levels had no net rise or fall over the course of a day, then the net loss of water from the aquifer from evapotranspiration must equal the recharge rate. White assumed that the recharge rate was best estimated between the hours of midnight and 4:00 a.m., when very little, if any, evapotranspiration was occurring. If water levels were falling day to day, then evapotranspiration must exceed recharge, and the evapotranspiration rate would equal the daily recharge rate, plus the amount of decline in day-to-day water levels. White used the following formula (see Figure 7.1):

$$q = y(24r \pm s)$$

Where:

q = the daily evaporation rate (in inches)

y = the specific yield of the soil (unitless)

r = the hourly recharge rate between midnight and 4:00 a.m. (in inches/hour)

s = H2 - H1 = the difference in water levels on consecutive days (in inches). The value s is subtracted when water levels are rising and added when water levels are falling.

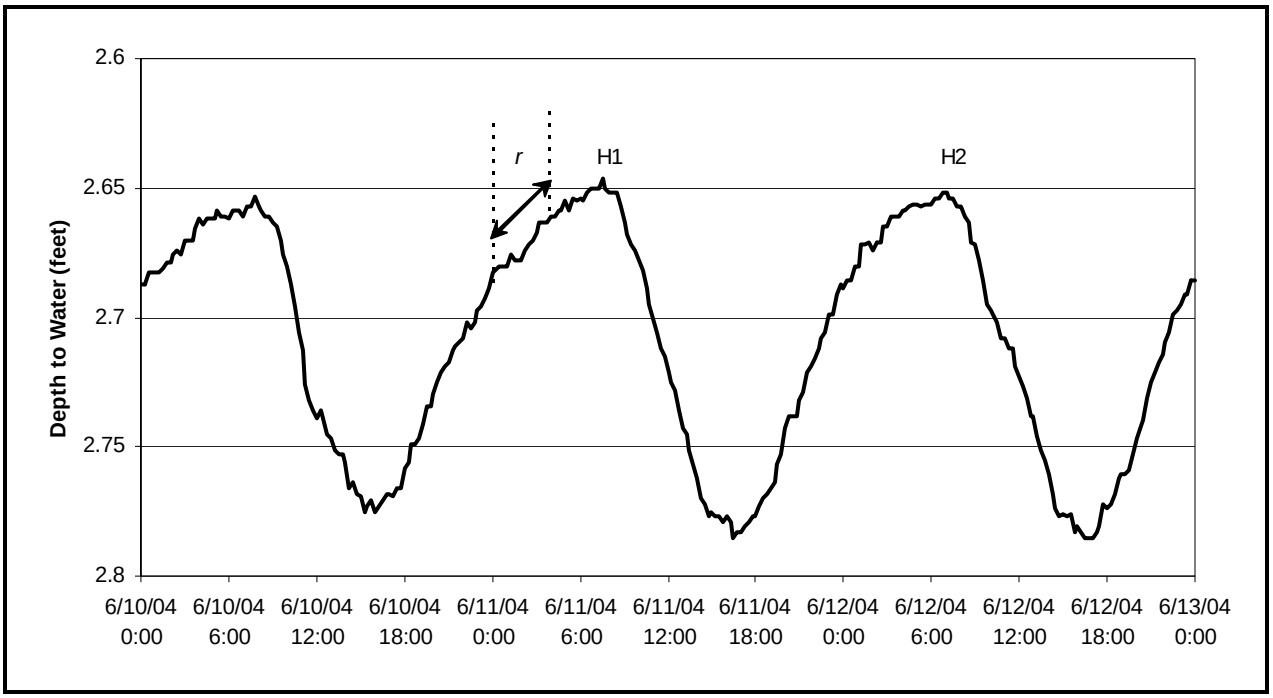


Figure 7.1. Typical daily fluctuation in groundwater levels as the result of evapotranspiration and recharge. H1 and H2 are the maximum water levels on consecutive days, while r is the recharge rate as calculated between midnight and 4 a.m.

The White formula is based on two fundamental assumptions about the shallow aquifer:

- The aquifer has a source of recharge. This source of recharge could be any surface water, either a river or a lake, or it could simply be the surrounding aquifer beyond the influence of the transpiring plants. Without some source of recharge, water levels would only decline and not rebound during the night.

- However, this source of recharge is not close or immediate enough to cause any changes in groundwater levels other than those due to evapotranspiration. Changes in overall water levels from day to day are considered to be indicative of evapotranspiration losses. If water levels rise or fall due to an outside influence (such as changes in river water levels), the calculation of evapotranspiration is rendered invalid.

We used the White formula to calculate evapotranspiration signature, with the following modifications:

- The White formula includes a term for specific yield of the soil. This term allows conversion from water level changes as observed in a piezometer to water level changes as occurring in the actual soil pore space of the aquifer. Because we are only interested in relative changes between years as a method of estimating vegetation health, we dropped the specific yield term from the White formula. Because of this, our calculations of the "evapotranspiration signature" are not directly equivalent to volumetric water loss.

- White did not specify a method for calculating daily water level changes. We have chosen to use the maximum daily water level for each day, in contrast to using the water level at any set hour. This is advantageous because the time of highest water level changes somewhat throughout the season with the changing of day length.

Because evapotranspiration is strongest during the summer months and diminishes over the winter, only the months of May–September were used for this analysis. The evapotranspiration signature reflects changes on an hourly basis, and as such is highly localized, reflecting water use by plants only in the immediate vicinity of the piezometer. The evapotranspiration signature attenuates in the aquifer the further it is from vegetation. Therefore, we limited the evapotranspiration analysis to sites where piezometers are located within the riparian vegetation that is surveyed for flycatchers (Topock Marsh, Blankenship Bend, Havasu NE, Ehrenburg, Cibola Lake, Paradise, Hoge Ranch, Clear Lake, Ferguson Lake, and Ferguson Wash).

The intent of the evapotranspiration analysis was to assess whether changes in the evapotranspiration signature over time could be used as a proxy to detect changes in vegetation density or vegetation cover resulting from changes in river level. Evapotranspiration is affected by other parameters besides vegetation density, including temperature, humidity, groundwater level, solar radiation, and wind. To be effective as a proxy for vegetation density, concurrent changes in these other parameters must be taken into account. As such, we first examined the correlation between the evapotranspiration signature as calculated from the modified White formula and mean diurnal temperature and mean daily water level in the piezometers.

In previous reports we correlated groundwater levels as measured by the piezometers with reservoir releases and soil moisture levels. We do not repeat these analyses here.

RESULTS

Temperature/Humidity Logger Maintenance

All HOBO loggers were downloaded at the beginning and end of the 2009 field season. Eight loggers had fallen to the ground over the winter because of sun damage to the logger housing. Two additional loggers that were in place over the winter had bad humidity sensors but useable temperature data, and one logger would not download. Of the HOBO loggers in place May–August 2009, three had faulty humidity data and one fell to the ground. Data from fallen loggers were not used in the analysis.

Piezometer Installation and Maintenance

The original data loggers (miniTroll models) were replaced with LevelTroll models at Topock Marsh Paradise, Hoge Ranch, Ferguson Wash, and Gila Confluence North in March 2009. Table 7.1 lists details on installation parameters for all piezometers.

All of the data loggers except for Ehrenberg have experienced multiple data breaks over their lifetime due either to battery failure or equipment malfunction. The incidences of battery failure are chronic with all of the originally installed equipment and continuously disrupt data collection. As a result, we have started replacing batteries in the original equipment at each download session regardless of the battery level reading. The LevelTroll models have internal batteries with a manufacturer-reported minimum lifespan of 5 years.

Data Validation

A total of 151 download periods were assessed using the data validation protocol. Of these, 109 download periods (72%) required no correction. An additional 27 download periods (18%) had identifiable errors and a correction factor was applied to the data. Data from 15 download periods (10%) were unable to be validated, and the data were deemed unusable for analysis. Of the 27 download periods with correctable errors, 7 experienced install drift and 3 experienced operational drift. Seventeen download periods required corrections due to improper setup, primarily of reference points. Improper setup errors also caused all 15 of the download periods determined to be unusable; most of these instances resulted from the combination of setup errors and equipment malfunction.

The data validation procedure allows most of the recorded data to be corrected and deemed usable and reliable for analysis; the larger challenge has been equipment loss (Cibola Lake and Gila Confluence North) or outright failure. The new model data logger installed at Hoge Ranch proved to be defective and collected no data in 2009. In addition, hardware communication, software compatibility, and user error issues rendered 2009 data from the new model data loggers unusable at Paradise, Ferguson Wash, and Gila Confluence North. In the September 2009 download, data loggers from Blankenship Bend, Havasu NE, Three Fingers Lake, and Mittry West had to be removed and shipped to the manufacturer for data retrieval. All four data loggers have been deemed by the manufacture to be defective and unrepairable.

Table 7.1. Summary of Piezometer Construction and Data Collection at Habitat Monitoring Sites, Lower Colorado River, 2005–2009*

Site	Depth (ft)	Stickup height (ft)	Date installed	Data breaks	Distance (ft) from habitat
Topock Marsh	INA	2.5	13-Aug-06[1]	Aug 2007–Feb 2008[2] Jun 2008–Mar 2009	Within
Blankenship Bend	7.2	3.4	28-Aug-05	After 12 Aug 2007	Within
Havasu NE	6.1	2.2	09-May-05	Dec 2007–Feb 2008 Jan 2009–March 2009 After April 2009	Within
Ehrenberg	7.4	2.6	29-Aug-05	None[2]	Within
Three Fingers Lake	7.7	4.1	31-May-05	After Mar 2009	540
Cibola Lake	7.2	3.6	30-May-05[3]	Sep–Dec 2005 Feb 2007–Mar 2009	Within
Walker Lake	7.4	2.9	30-May-05	Jul 2008–Mar 2009 After Jun 2009	230
Paradise	11.7	0.6	11-May-05[1]	May–Jun 2006 Aug 2007 Sep 2007–Feb 2008 After 5 Mar 2008	Within
Hoge Ranch	8.7	2.8	11-May-05[1]	Jun–Sep 2006[2] After Sep 2007	Within
Rattlesnake	7.0	2.8	10-May-05	After Apr 2008	1,080
Clear Lake	8.7	2.4	10-May-05	After Apr 2008	Within
Ferguson Lake	7.6	2.7	10-May-05	After Apr 2008	Within
Ferguson Wash	INA	2.2	10-May-05[1]	After Jan 2008[2]	Within
Great Blue Heron	7.3	1.7	31-May-05	Aug–Dec 2005 After Aug 2008[2]	60
Mittry West	5.0	3.0	29-Aug-05	Feb 2008 Dec 2008–May 2009	270
Gila Confluence North	7.9	4.7	29-Aug-05[1,4]	After Jul 2007[2]	50

* INA = information not available, N/A = not applicable.

[1] Original piezometer replaced with new model LevelTroll.

[2] Dates differ from those presented in previous reports due to data validation.

[3] Piezometer destroyed by clearing activity between February and July 2007; replaced 27 March 2008; stick-up height applies to new piezometer.

[4] Location of original piezometer burned in December 2006; piezometer replaced on 5 July 2007; stick-up height applies to new piezometer.

Microclimate

2009 Microclimate Descriptive Statistics

Soil moisture, temperature, and vapor pressure parameters from the 15 study sites monitored in 2009 exhibited substantial variation among sites (Table 7.2). Soil moisture varied by a factor of four among the 2008 study sites, from a low of 227.4 mV at Havasu NE to a high of 917.6 at Great Blue Heron.

Mean maximum diurnal temperatures ranged from a low of 37.4°C at Clear Lake and a high of 50.8°C at Three Fingers Lake. Mean minimum nocturnal temperatures ranged from a low of 18.4°C at Three Fingers Lake to a high of 22.4°C at Ferguson Lake. Mean number of 15-minute intervals above 41°C

each day varied from 1.8 at Rattlesnake to 24.7 at Cibola Lake. Mean daily temperature range varied from 16.0°C at Clear Lake to 32.3°C at Three Fingers Lake.

Mean diurnal vapor pressure was lowest at Three Fingers Lake (1,098.2 Pa) and highest at Rattlesnake (2208.5 Pa). Mean nocturnal vapor pressure was lowest at Three Fingers Lake (1161.2 Pa) and highest at Rattlesnake (1923.6 Pa).

Between-year Comparisons of Microclimate Characteristics

All microclimate characteristics varied significantly over time at test sites (Ehrenberg, Three Fingers Lake, Cibola Lake, Clear Lake, Walker Lake, Ferguson Lake, Ferguson Wash, Great Blue Heron, Hoge Ranch, Paradise, and Rattlesnake; Table 7.3). At control sites (Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North), only mean minimum nocturnal temperature varied significantly over time. Neither test nor control sites showed a unidirectional change in any of the microclimate measures over time. The changes over time differed between test and control sites for soil moisture, mean maximum diurnal temperature, and daily temperature range (right-most column of Table 7.3). Between 2005 and 2006, soil moisture decreased more dramatically at control sites than at test sites, while between 2007 and 2008, soil moisture decreased at control sites but rose at test sites. Between 2007 and 2008, both mean maximum diurnal temperature and mean daily temperature range increased at test sites but decreased at control sites.

Table 7.2. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, May–July 2009*

Descriptive Statistics	Blankenship Bend	Havasu NE	Ehrenberg	Three Fingers Lake	Cibola Lake	Walker Lake	Paradise	Hoge Ranch	Rattlesnake	Clear Lake	Ferguson Lake	Ferguson Wash	Great Blue Heron	Mittry West	Gila Confluence North
Soil Moisture															
Mean soil moisture (mV)	842.4 (51.8)	227.4 (70.8)	699.5 (55.0)	634.4 (55.9)	459.8 (56.6)	869.5 (27.3)	761.5 (41.2)	841.1 (11.9)	786.6 (23.3)	457.0 (146.8)	911.9 (9.4)	356.2 (56.3)	917.3 (4.9)	897.3 (8.2)	335.6 (44.4)
Temperature															
Mean maximum diurnal temperature (°C)	44.7 (0.4)	45.0 (0.4)	46.1 (0.4)	50.8 (0.4)	49.4 (0.3)	41.3 (0.3)	44.7 (0.4)	46.5 (0.3)	38.2 (0.3)	37.4 (0.3)	41.5 (0.3)	41.8 (0.4)	40.9 (0.3)	43.0 (0.4)	43.7 (0.4)
Mean minimum nocturnal temperature (°C)	20.7 (0.2)	22.1 (0.2)	22.0 (0.3)	18.4 (0.3)	21.2 (0.3)	19.7 (0.3)	20.4 (0.3)	19.7 (0.2)	18.8 (0.2)	21.3 (0.2)	22.4 (0.2)	22.1 (0.2)	20.1 (0.2)	20.5 (0.2)	20.2 (0.3)
Mean daily temperature range (°C)	24.0 (0.4)	22.9 (0.5)	24.1 (0.4)	32.3 (0.5)	28.2 (0.4)	21.6 (0.4)	24.3 (0.6)	26.9 (0.4)	19.4 (0.3)	16.0 (0.3)	19.1 (0.3)	19.7 (0.4)	20.8 (0.3)	22.6 (0.5)	23.6 (0.4)
Humidity															
Mean diurnal vapor pressure (Pa)	1425.7 (28.1)	1462.0 (28.7)	1250.8 (31.6)	1098.2 (30.5)	1164.7 (28.0)	1711.5 (34.5)	1585.4 (31.5)	1651.1 (31.5)	2208.5 (43.7)	2205.1 (48.2)	1866.6 (33.3)	1734.1 (32.9)	2088.4 (39.7)	1974.7 (42.6)	1854.7 (36.9)
Mean nocturnal vapor pressure (Pa)	1421.1 (27.5)	1295.0 (25.1)	1305.9 (30.3)	1161.2 (24.3)	1302.2 (23.7)	1515.1 (27.6)	1483.0 (27.1)	1506.4 (26.7)	1923.6 (35.7)	1783.3 (39.6)	1714.2 (28.7)	1436.2 (28.8)	1868.1 (31.9)	1730.9 (35.8)	1792.1 (35.2)

* Soil moisture and temperature/humidity values are means (standard error in parentheses).

Table 7.3. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2009*

Parameter	Test (n=45)										Control (n=15)										P-value for difference between years among test sites compared to control sites
	2005	2006	2007	2008	2009	Change 2005 to 2006	Change 2006 to 2007	Change 2007 to 2008	Change 2008 to 2009	P-value for the difference between years	2005	2006	2007	2008	2009	Change 2005 to 2006	Change 2006 to 2007	Change 2007 to 2008	Change 2008 to 2009	P-value for the difference between years	
Soil Moisture																					
Mean soil moisture (mV)	645.7	634.4	662.9	705.8	699.2	-11.3	28.5	42.9	-6.6	<0.001	694.4	582.9	635.3	607.5	591.7	-111.5	52.4	-27.8	-15.8	0.590	0.003
Temperature																					
Mean maximum diurnal temperature (°C)	44.9	46.1	45.2	46.5	43.8	1.2	-0.9	1.3	-2.7	<0.001	45.6	48.0	46.4	45.7	44.2	2.4	-1.6	-0.7	-1.5	0.053	0.047
Mean minimum nocturnal temperature (°C)	20.7	22.7	20.4	20.7	21.2	2.0	-2.3	0.3	0.5	<0.001	20.2	22.1	20.3	20.8	21.2	1.9	-1.8	0.5	0.4	<0.001	0.185
Mean daily temperature range (°C)	24.2	23.5	24.8	25.8	22.6	-0.7	1.3	1.0	-3.2	<0.001	25.4	26.0	26.1	24.9	23.0	0.6	0.1	-1.2	-1.9	0.079	0.046
Humidity																					
Mean diurnal vapor pressure (Pa)	1,797.2	2,028.4	1,737.9	1770.4	1758.9	231.2	-290.5	32.5	-11.5	<0.001	1,726.3	1,863.9	1,696.9	1,692.3	1,701.1	137.6	-167.0	-4.6	8.8	0.142	0.283
Mean nocturnal vapor pressure (Pa)	1,686.3	1,860.4	1,852.7	1679.8	1618.0	174.1	-7.7	-172.9	-61.8	<0.001	1,638.2	1,703.4	1,559.9	1,582.9	1583.2	65.2	-143.5	23.0	0.3	0.094	0.139

* *The analysis was restricted to 1 June–1 August each year. Some data differ from those presented in previous reports because of additional data proofing.

Comparison of Parker/Imperial to Topock Marsh: Microclimate

Topock Marsh was cooler and more humid than habitat monitoring sites but did not differ from habitat monitoring sites in average soil moisture (Table 7.4).

Table 7.4. Comparison of Microclimatic Variables at Habitat Monitoring Sites to Territories at Topock Marsh, 2009*

Response variable	Habitat Monitoring Sites	Topock Marsh	*P*
N (Temp./Humidity Sensor Arrays)	57	14	N/A
Soil Moisture			
Mean soil moisture (mV)	674.5 (35.6)	657.3 (73.4)	0.832
Temperature			
Mean maximum diurnal temperature (°C)	44.1 (0.8)	41.0 (1.5)	0.077
Mean minimum nocturnal temperature (°C)	20.6 (0.2)	19.2 (0.4)	0.002
Mean daily temperature range (°C)	23.5 (0.9)	21.8 (1.3)	0.358
Humidity			
Mean diurnal vapor pressure (Pa)	1660.5 (56.1)	2278.0 (87.8)	<0.001
Mean nocturnal vapor pressure (Pa)	1535.0 (37.1)	1891.0 (62.2)	<0.001

* Soil moisture and temperature/humidity values are means (standard error in parentheses). N/A = data not available or not applicable. The analysis was restricted to 6 May–31 July 2009.

Vegetation Measurements

Vegetation characteristics varied widely both between and within the selected habitat monitoring sites (Table 7.5). Average canopy height ranged from 3.3 m (Three Fingers Lake) to 11.8 m (Ehrenberg), and average canopy closure ranged from 63.7% (Cibola Lake) to 96.2% (Walker Lake). Measures of other habitat characteristics were similarly variable. Vertical foliage profiles for each site are shown in Figure 7.2. Sites typically exhibited the densest foliage within 3–5 m of the ground, and the majority of vegetation within 2–3 m of the ground typically consisted of dead branches.

Between-year Comparisons of Vegetation Characteristics

Repeated measures ANOVA showed an overall between-year difference in canopy closure ($P < 0.001$), woody ground cover ($P < 0.001$), number of live stems < 2.5 cm and 2.5–8 cm dbh ($P = 0.020$ and $P = 0.041$, respectively), number of dead stems <2.5 cm and 2.5–8 cm dbh ($P = 0.022$ and $P = 0.002$, respectively), percentage of live stems <2.5 and 2.5–8 cm dbh ($P < 0.001$ and $P = 0.002$, respectively), and percent native basal area ($P = 0.013$) for all plots combined (Table 7.6). The only variables that exhibited a consistent change across time were percentage of live stems <2.5 cm dbh, which declined steadily from 2005 to 2009, and percentage of live stems 2.5–8 cm dbh, which was lower in 2008 and 2009 than in the three preceding years. Woody ground cover was the only variable for which there was a significant interaction ($P = 0.019$) with location (test vs. control sites), meaning the changes in all the other variables between years among test sites was not significantly different from the change at control sites. Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years.

Table 7.5. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2009*

Parameter	Blankenship Bend (n=4)	Havasu NE (n=4)	Ehrenberg (n=4)	Three Fingers Lake (n=5)	Cibola Lake (n=5)	Walker Lake (n=3)	Paradise (n=4)	Hoge Ranch (n=4)	Rattlesnake (n=4)	Clear Lake (n=3)	Ferguson Lake (n=5)	Ferguson Wash (n=4)	Great Blue Heron (n=4)	Mittry West (n=4)	Gila Confluence North (n=3)
Average canopy height (m)	5.6 (0.4)	5.1 (0.5)	11.8 (4.6)	3.3 (0.3)	4.8 (0.9)	8.9 (4.2)	8.4 (3.8)	6.7 (1.9)	10.2 (2.5)	7.7 (0.72)	5.5 (0.2)	5.6 (0.8)	7.9 (1.3)	8.2 (1.3)	9.7 (0.2)
	5.0–6.5	4.0–6.0	3.0–21.8	2.8–4.5	2.7–8.4	4.7–17.3	3.4–19.9	3.8–12.2	6.0–16.9	6.4–8.5	5.0–5.9	4.2–7.5	5.5–10.5	4.8–11.0	9.3–9.9
% total canopy closure	88.6 (2.5)	66.7 (8.7)	69.4 (5.6)	85.5 (4.0)	63.7 (12.4)	96.2 (1.4)	83.2 (5.2)	89.7 (3.6)	94.9 (0.7)	94.3 (1.8)	96.0 (1.1)	93.0 (0.9)	90.9 (1.9)	88.8 (3.1)	87.2 (7.1)
	83.3–93.8	54.7–92.2	59.4–82.3	75.5–97.4	18.2–85.9	94.8–99.0	68.8–93.8	83.3–100.0	92.7–95.8	90.6–96.4	93.2–100.0	90.6–94.8	86.5–94.8	82.3–94.8	72.9–94.8
% woody ground cover	61.2 (19.4)	22.0 (4.4)	16.5 (3.2)	7.5 (3.0)	15.2 (4.6)	16.9 (8.18)	44.5 (18.8)	32.1 (9.0)	44.1 (1.0)	25.5 (17.9)	9.8 (4.0)	28.6 (6.2)	26.3 (7.1)	24.4 (12.8)	13.4 (4.0)
	13.0–100.0	11.8–30.0	8.5–23.8	3.0–19.3	5.0–31.0	2.5–30.5	10.0–80.0	14.3–54.0	41.3–45.3	7.0–61.3	1.8–24.8	13.0–41.3	17.0 (47.5)	2.3–59.3	9.0–21.5
# live stems <2.5 cm dbh per ha	1019 (653)	159 (159)	2069 (513)	8964 (1978)	2241 (576)	1231 (667)	2833 (796)	2419 (512)	1910 (1011)	424 (424)	2063 (605)	541 (159)	859 (305)	1783 (868)	2037 (555)
	127–2292	0–637	637–3056	2928–15152	255–3310	0–2292	764–4587	1273–3692	0–4584	0–1273	764–3820	127–891	382–1655	255–3947	1019–2928
# live stems 2.5–8 cm dbh per ha	1783 (320)	255 (138)	95 (61)	4074 (752)	1961 (582)	1401 (628)	2387 (1412)	2769 (715)	2515 (1093)	1867 (1103)	2979 (526)	1273 (349)	3279 (775)	1560 (556)	2334 (858)
	1401–2419	0–637	0–255	1783–6366	127–3310	382–2546	891–6621	637–3692	127–4838	764–4074	1146–4074	509–2165	1273–4966	255–2547	1019–3947
# live stems >8 cm dbh per ha	424 (258)	477 (167)	191 (82)	127 (70)	331 (103)	170 (112)	223 (141)	318 (152)	1337 (377)	1910 (555)	611 (110)	1146 (116)	605 (109)	573 (331)	722 (278)
	0–891	0–764	0–382	0–382	0–637	0–382	0–637	0–637	509–2037	1019–2928	255–891	891–1401	382–891	0–1528	382–1273
# dead stems <2.5 cm dbh per ha	212 (85)	446 (191)	1337 (638)	4905 (615)	2012 (393)	594 (331)	1082 (417)	3820 (1349)	700 (404)	1655 (1210)	2521 (724)	923 (380)	573 (247)	2706 (1044)	2377 (1030)
	127–382	255–1019	255–3183	3056–6494	637–3056	0–1146	382–2292	1401–6748	0–1401	382–4074	1146–5220	382–2037	127–1273	255–5348	382–3820
# dead stems 2.5–8 cm dbh per ha	509 (509)	350 (150)	796 (603)	1146 (217)	1299 (527)	764 (441)	477 (109)	1337 (443)	95 (61)	1570 (185)	1935 (340)	1082 (377)	1146 (249)	573 (82)	1103 (557)
	0–1523	127–764	0–2546	382–1655	0–2801	0–1528	255–764	127–2165	0–255	1273–1910	1146–3056	509–2165	637–1782	382–764	0–1783
# dead stems >8 cm dbh per ha	42 (42)	223 (183)	0 (0)	0 (0)	0 (0)	42 (42)	0 (0)	32 (32)	0 (0)	467 (236)	50.93 (31.2)	223 (109)	318 (37)	159 (121)	0 (0)
	0–127	0–764	0–0	0–0	0–0	0–127	0–0	0–127	0–0	0–764	0–127	0–509	255–382	0–509	0–0
Percent basal area native	28.8 (28.8)	0.0 (0.0)	74.1 (24.7)	0.2 (0.2)	0.0 (0.0)	33.1 (33.1)	0.8 (0.6)	50.5 (24.7)	29.8 (23.0)	0.0 (0.0)	4.6 (3.9)	29.6 (19.3)	42.3 (19.9)	69.0 (23.4)	100.0 (0)
	0–86.5	0–0	0–100.0	0–1.1	0–0	0–99.1	0–2.5	2.5–97.0	0.4–97.4	0–0	0–20.2	0–81.0	0–94.0	0–99.9	100.0–100.0

* Data presented are means, (standard error), and range.

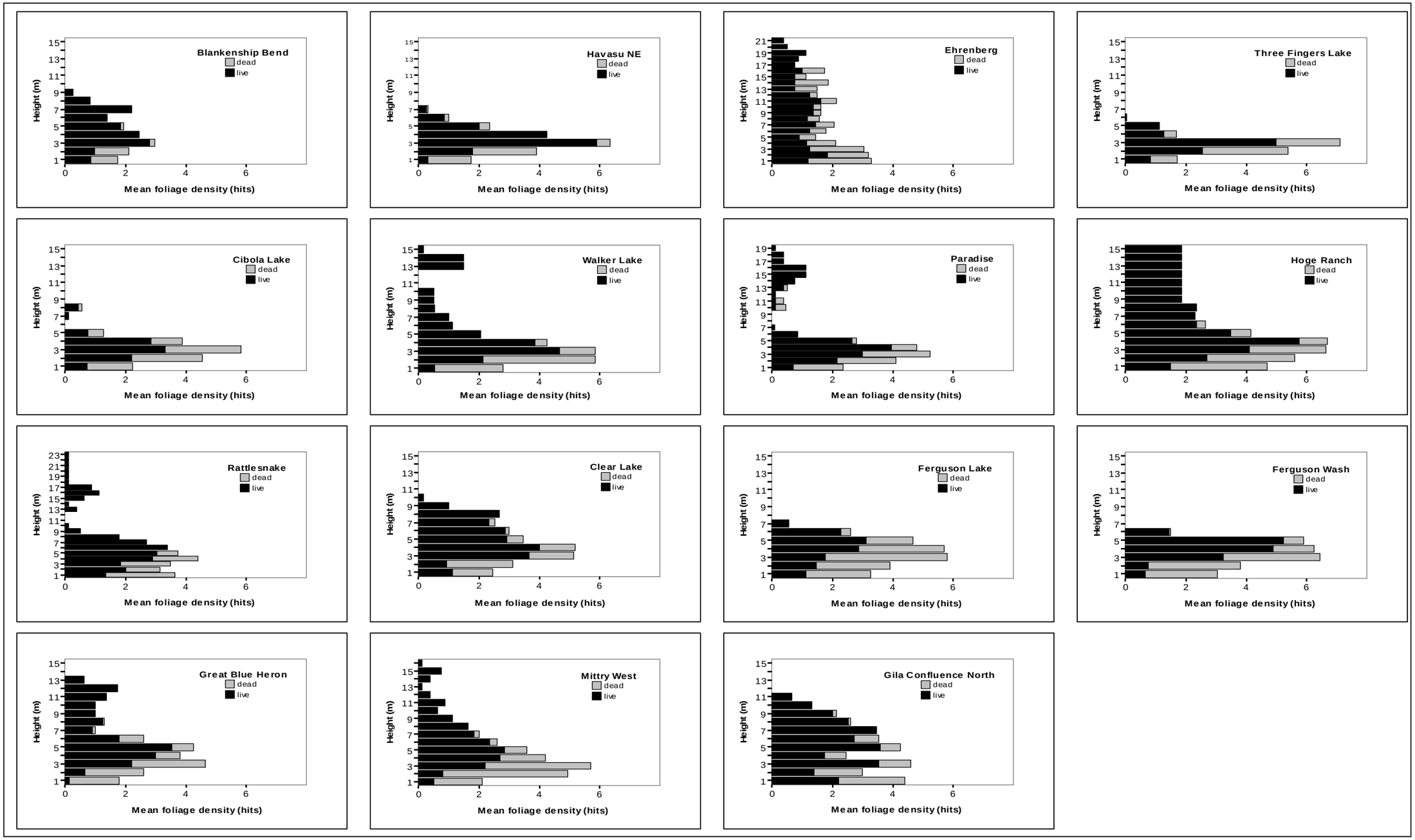


Figure 7.2. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2009.

Table 7.6. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2009

Parameter	Test					Control					P-value for overall difference in means between years	P-value for difference in means between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009		
Average canopy height (m)	6.4	6.8	5.7	6.6	6.7	6.3	6.6	6.9	7.1	6.6	0.7436	0.601
% total canopy closure	84.7	78.3	87.9	88.1	86.7	81.1	76.1	87.1	84.3	80.7	<0.001	0.793
% woody ground cover	31.1	27.2	29.8	41.6	23.0	27.3	48.8	39.3	56.8	34.8	<0.001	0.019
# live stems <2.5 cm dbh per ha	1933	2272	2515	1358	2530	955	2186	1655	743	987	0.020	0.395
# live stems 2.5–8 cm dbh per ha	3107	2722	3143	3899	2314	1613	1984	1910	1963	1220	0.041	0.473
# live stems >8 cm dbh per ha	481	430	654	673	597	668	594	690	753	562	0.195	0.714
# dead stems <2.5 cm dbh per ha	340	1282	1259	1084	1949	803	1305	1294	1422	1348	0.022	0.429
# dead stems 2.5–8 cm dbh per ha	1234	821	925	1879	1081	1284	456	711	1528	562	0.002	0.775
# dead stems >8 cm dbh per ha	48	59	96	108	91	64	95	148	74	138	0.222	0.579
% live stems <2.5 cm dbh	84.1	69.2	67.4	59.3	53.6	65.2	60.9	57.2	43.6	45.7	<0.001	0.808
% live stems 2.5–8 cm dbh	73.6	75.8	77.2	69.2	65.3	66.3	76.4	72.3	53.6	61.3	0.002	0.399
% live stems >8 cm dbh	93.6	86.9	91.2	89.5	89.4	91.0	86.7	85.4	97.1	87.0	0.411	0.520
Percent basal area native	27.2	20.3	28.9	25.9	22.9	36.7	39.5	58.1	45.2	38.5	0.013	0.219

Repeated measures ANOVAs for vertical foliage in each meter interval showed a between-year difference in live vegetation in the fourth meter interval above the ground ($P = 0.048$) and between-year differences for the first, second, third, and fourth meter intervals above the ground for dead vegetation ($P < 0.001$ for each interval). In all four intervals, density of dead vegetation was higher in 2008 than in 2007. There was a significant interaction ($P = 0.039$) between live vertical foliage density and location (test vs. control sites) for the fourth meter interval, but there was no clear pattern, with density generally increasing at control plots in years it decreased at test plots, and vice versa. There was also a significant interaction ($P = 0.001$) between dead vertical foliage density and location for the first meter interval, with the density of dead vegetation increasing more in 2007 and 2008 at control plots relative to test plots. The percentage of live vegetation in each meter interval differed between years only in the fourth meter interval ($P = 0.005$); in this case, the live percentage was lower in 2008 than in 2007.

Groundwater Monitoring

Overview of Piezometer Groundwater Levels

Data collected from fall 2005 to spring 2007 are relatively complete with sporadic recording errors. Many data from 2008 and 2009 are unreliable and eight sites have no data for 2009 (see Table 7.1). The sites that have remained functional (Havasu NE, Ehrenberg, Three Fingers Lake, Walker Lake, Great Blue Heron, and Mittry West) throughout most of the study period show similar patterns across years.

Daily and weekly cycles are still apparent in the piezometer hydrographs. General daily trends include low water levels during the afternoon hours when vegetation water demands and evapotranspiration are greatest and high water levels in early morning hours. General weekly trends follow the changes in river water levels due to power generation and water delivery demands, with low levels on weekends and higher levels in the middle of the week.

In addition to daily and weekly cycles, a seasonal trend is observed in hydrographs in a majority of the sites. The data trend remains similar to that of previous years, although some sites had slightly higher and lower maximum and minimum water levels. For most of the sites between Parker and Imperial Dams, the lowest water levels occurred in December through February, and highest water levels occurred in April (Table 7.7). Topock Marsh, Havasu NE, Walker Lake, and Gila Confluence North did not display this seasonal trend. The shallowest average monthly water level occurred at Mittry West in April and the deepest occurred at Paradise in December. Seasonal changes in water levels range from 0.94 feet at Walker Lake to almost 3.5 feet at Ehrenberg. Hydrographs for all piezometers are included in Appendix E.

Planned Declines in Parker Releases –Average monthly river flow data below Parker Dam from 2000 to 2009 (Table 7.8) show declines in reservoir releases for most months. While there is variation, average monthly flow throughout the year decreased from 2001 (the year prior to the scheduled change in point of diversion) to 2009 except for January and March, the only months that experienced an increase of average flow for 2009. The percent decrease from 2001 to 2009 was lowest in April (6.4%), greatest in December (35.9%), and ranged from 21.5 to 32.2% in June–August. During the period when groundwater levels were recorded (2005–2009), overall annual river flows did not decrease.

Table 7.7. High and Low Average Monthly Water Depths Recorded at Piezometers at Habitat Monitoring Sites, 2005–2009

Location	Shallowest water level (ft bgs)	Month occurred	Deepest water level (ft bgs)	Month occurred
Topock	1.19	April	2.65	October
Blankenship Bend	1.99	June	3.70	December
Havasu NE	1.66	December	2.84	February
Ehrenberg	0.67	April	4.07	December
Three Fingers Lake	2.10	April	4.83	December
Cibola Lake[1]	1.71	April	4.60	December
Walker Lake	4.74	February	5.62	July
Paradise	4.61	April	6.66	December
Hoge Ranch	1.99	April	4.68	December
Rattlesnake	0.71	April	3.73	December
Clear Lake	1.47	April	3.81	January
Ferguson Lake	0.97	April	3.15	December
Ferguson Wash	0.77	April	2.86	December
Great Blue Heron	0.28	April	2.43	December
Mittry West	-0.22	April	2.13	January
Gila Confluence North	3.17	October	4.93	July

[1] Data from two locations.

Table 7.8. Average Monthly Flows (cfs) Below Parker Dam, 2000–2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Difference (2001–present)	% Change (2001–present)
January	6,820	5,599	6,478	6,327	5,536	4,166	5,842	5,945	4,850	6,177	578	10.30%
February	9,123	8,505	8,978	6,881	7,129	4,888	7,798	8,491	8,232	7,137	-1,368	-16.10%
March	11,594	10,524	11,334	12,360	11,523	9,699	9,752	11,122	12,180	11,973	1,449	13.80%
April	14,613	14,090	13,610	13,803	12,824	11,356	11,985	12,618	14,293	13,184	-906	-6.40%
May	14,174	14,068	12,826	11,990	12,252	11,428	11,998	11,718	11,339	10,533	-3,535	-25.10%
June	13,803	14,733	13,713	12,778	12,741	12,444	12,383	12,116	11,957	9,992	-4,741	-32.20%
July	14,210	14,974	14,439	13,100	12,331	13,842	11,688	12,180	12,226	10,645	-4,329	-28.90%
August	11,441	12,047	12,118	10,803	11,420	10,316	10,141	10,317	10,720	9,459	-2,588	-21.50%
September	11,233	10,837	10,429	11,159	9,566	9,048	7,334	9,195	9,072	8,492	-2,345	-21.60%
October	9,362	8,852	8,765	9,761	7,405	6,967	7,424	7,204	7,568	7,241	-1,611	-18.20%
November	7,437	7,357	7,049	6,153	5,163	6,335	6,094	5,420	6,369		-988	-13.40%
December	6,706	5,970	5,615	5,737	4,129	4,841	5,507	4,079	3,829		-2,141	-35.90%

Evapotranspiration Signature

Of the10 sites within the riparian vegetation that is surveyed for flycatchers, 6 (Topock Marsh, Blankenship Bend, Havasu NE, Cibola Lake, Paradise, and Hoge Ranch) yielded usable evapotranspiration signature data over multiple years (Table 7.9). The evapotranspiration signature was calculated for these six piezometers; however, several anomalous patterns became apparent in the piezometers along the river (Blankenship Bend, Havasu NE, Cibola Lake, Paradise, and Hoge Ranch). Notably, sharp reductions in the evapotranspiration signature were occurring with regularity every seven days, suggesting some control other than a seasonal change. Upon close inspection of the hydrographs, we realized that the intraday groundwater level changes in the piezometers were influenced much more strongly by river water levels than anticipated. As reported above, the river experiences a strong weekly pattern in water levels, with low levels on the weekend and higher levels during the week. The sharp rise and fall of the river level during the transitions between week and weekend overwhelmed any water level changes due to the evapotranspiration of water by riparian vegetation. The White formula requires that the source of recharge be distant and consistent; the recharge provided by the river is too strong and immediate to allow use of the White method at these piezometers.

The piezometer within Topock Marsh was deemed the sole location at which the recharge source appeared to be consistent enough to meet the assumptions for the White formula, and we limited further analysis of the evapotranspiration signature to this location. Complete piezometer and temperature data were available at Topock Marsh only for May–August in 2007 and 2009.

Over the course of each season, the White evapotranspiration signature increased steadily while the groundwater level in the aquifer steadily declined (Figures 7.3 and 7.4). The linear regression for mean diurnal temperature versus evapotranspiration signature showed a weak, direct correlation, with coefficients of determination of 0.41 and 0.30 for 2007 and 2009, respectively (Figures 7.5 and 7.6). The linear regression for mean daily water level versus evapotranspiration signature showed a strong, direct correlation, with a coefficient of determination of 0.67 and 0.95 for 2007 and 2009, respectively (Figures 7.7 and 7.8). The direct relationship between depth to water and evapotranspiration (i.e.; the deeper the water dropped over the season, the greater the evapotranspiration from the vegetation) is the opposite of the relationship indicated in the literature, which shows decreasing evapotranspiration with increasing depth to groundwater (e.g., Blaney 1954).

The remaining four piezometers within flycatcher habitat (Ehrenberg, Clear Lake, Ferguson Lake, and Ferguson Wash) yielded water levels that did not consistently reflect daily changes in evapotranspiration. This lack of signature is likely the result of imperfect or delayed communication with the aquifer, caused by tight sediments surrounding the well screen, or possibly plugged well screens. Negative values shown in Table 7.9 are indicative of those piezometers that do not follow the typical daily signature caused by evapotranspiration losses from the aquifer. In these cases, either changes in water levels are significantly delayed (resulting in a reversal of the evapotranspiration signature) or show no daily pattern at all (resulting in a random evapotranspiration signature).

Table 7.9. Median Daily Evapotranspiration Signature by Month, May–Sep, 2005–2009

Site	Median Daily Fluctuation of Groundwater Level (feet)																								
	2005					2006					2007					2008					2009				
	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep	May	Jun	Jul	Aug	Sep
Topock Marsh	-	-	-	-	-	-	-	-	0.499	2.466	0.948	0.266	0.358	0.45	-	2.757	-	-	-	-	-1.317	0.218	0.479	0.563	1.056
Blankenship Bend	-	-	-	-	0.772	0.793	0.715	0.787	0.76	0.683	0.706	0.607	0.678	0.67*	-	-	-	-	-	-	-	-	-	-	-
Havasu NE	1.096*	0.077	0.088	0.13	2.83	2.308	0.182	0.171	0.156	2.168	1.313	0.215	0.236	0.214	1.862	2.03	0.04	0.046	0.071	0.802	0.58	0.036	0.078	0.08	1.252
Ehrenberg	-	-	-	-	-0.503	-0.409	-0.571	-0.482	-0.598	-0.503	-0.286	-0.318	-0.162	-0.558	-0.434	0.103	0.017	0.068	0.053*	-0.324	-0.28	-0.353	-0.445	-0.447	-0.323
Cibola Lake	-	0.043	0.02	0.309	0.388	0.355	0.436	0.37	0.483	0.481	-	-	-	-	-	-	-	-	-	-	0.002	0.018	0.021	0.03	0.033
Paradise	0.314*	0.311	0.202	0.451	0.487	0.611*	0.70*	0.625	0.521	0.457	0.621	0.617	0.546	0.73*	0.518*	-	-	-	-	-	-	0.391	0.489	0.476	-
Hoge Ranch	0.634*	0.483	0.383	0.513	0.521	0.78	0.814	0.727	0.627	0.056*	0.936	0.903	0.802	0.943	0.586*	-	-	-	-	-	-	-	-	-	-
Clear Lake	0.046*	0.013	0.017	0.019	-0.046	-0.02	-0.047	-0.035	-0.071	-0.069	0.003	-0.022	0.026	-0.041	-0.012	-	-	-	-	-	-	0.002	0.003	0.01*	-
Ferguson Lake	-0.035*	-0.067	-0.03	-0.082	-0.055	-0.104	-0.107	-0.098	-0.125	-0.065	-0.113	-0.166	-0.076	-0.127	-0.07	-	-	-	-	0.033*	-	-	-	-	-
Ferguson Wash	0.02*	0.002	0.011	-0.112	-0.059	-0.092	-0.098	-0.107	-0.133	-0.093	-0.098	-0.15	-0.069	-	-0.013	-	-0.053	-0.034	0.04*	-	-	-0.054	-0.059	-0.088	-

* Data for the month not complete.

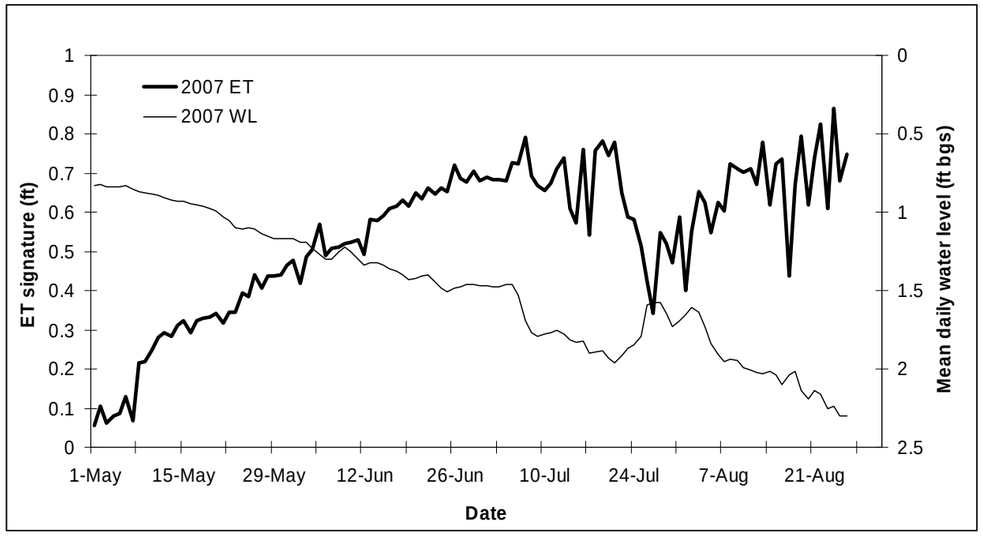


Figure 7.3. Daily evapotranspiration (ET) signature (ft) and mean daily water level [WL; feet below ground surface (bgs)] at Topock Marsh, May–August, 2007.

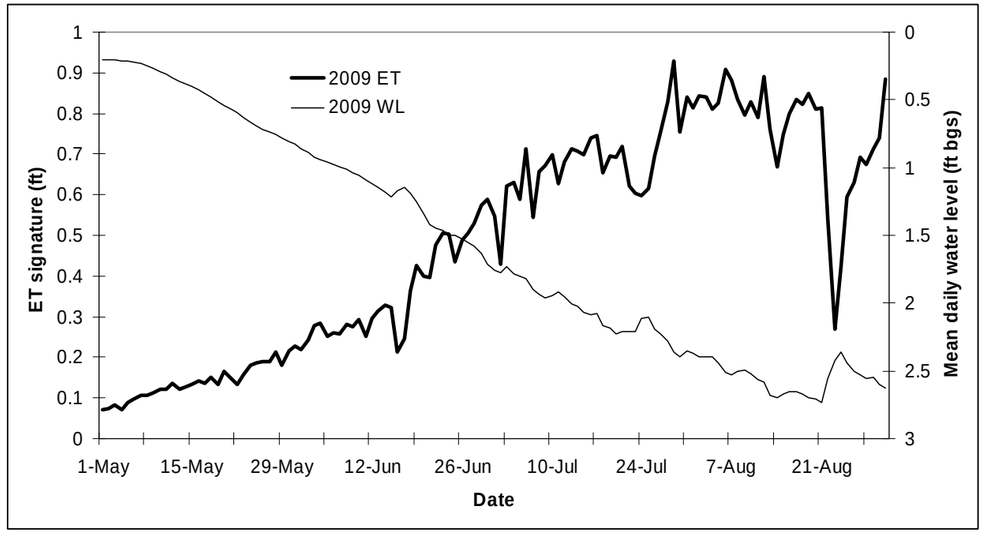


Figure 7.4. Daily evapotranspiration (ET) signature (ft) and mean daily water level [WL; feet below ground surface (bgs)] at Topock Marsh, May–August, 2009.

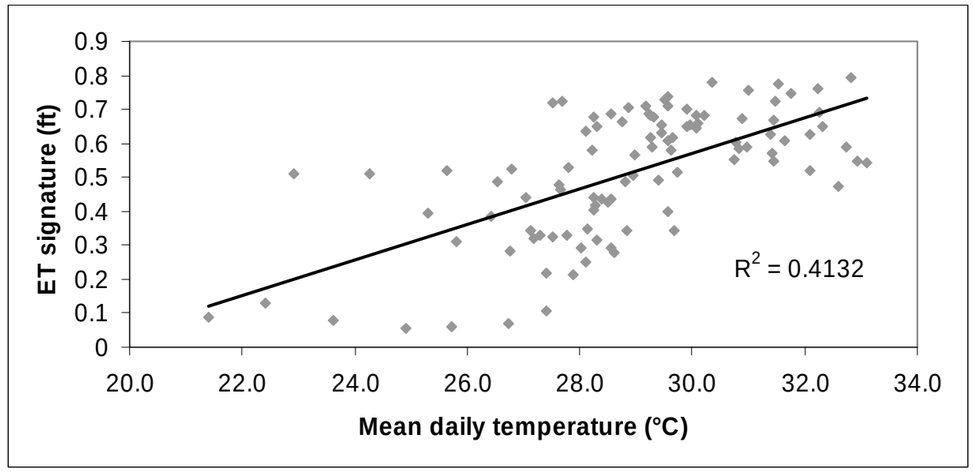


Figure 7.5. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily temperature (°C) at Topock Marsh, May–August, 2007.

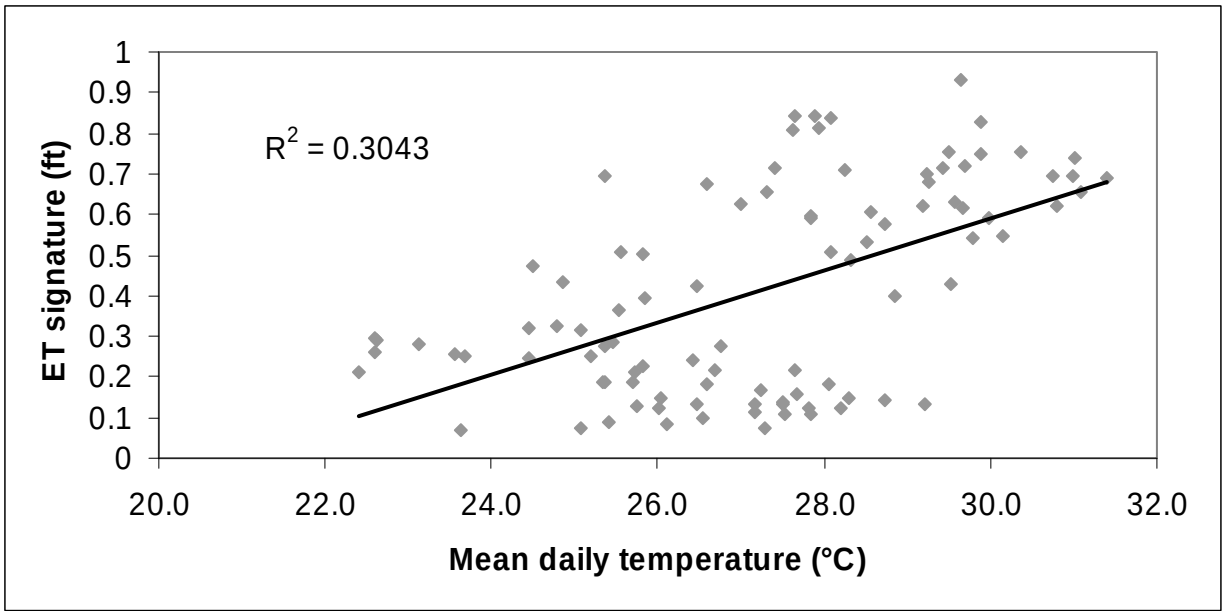


Figure 7.6. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily temperature (°C) at Topock Marsh, May–August, 2009.

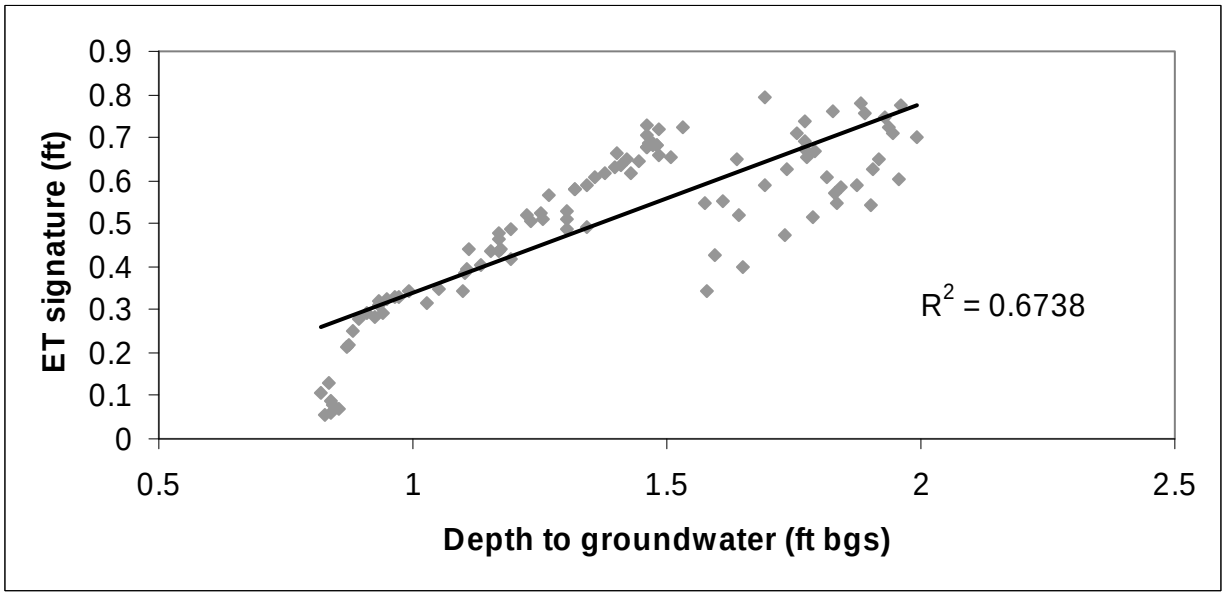


Figure 7.7. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily depth to groundwater (feet below ground surface) at Topock Marsh, May–August, 2007.

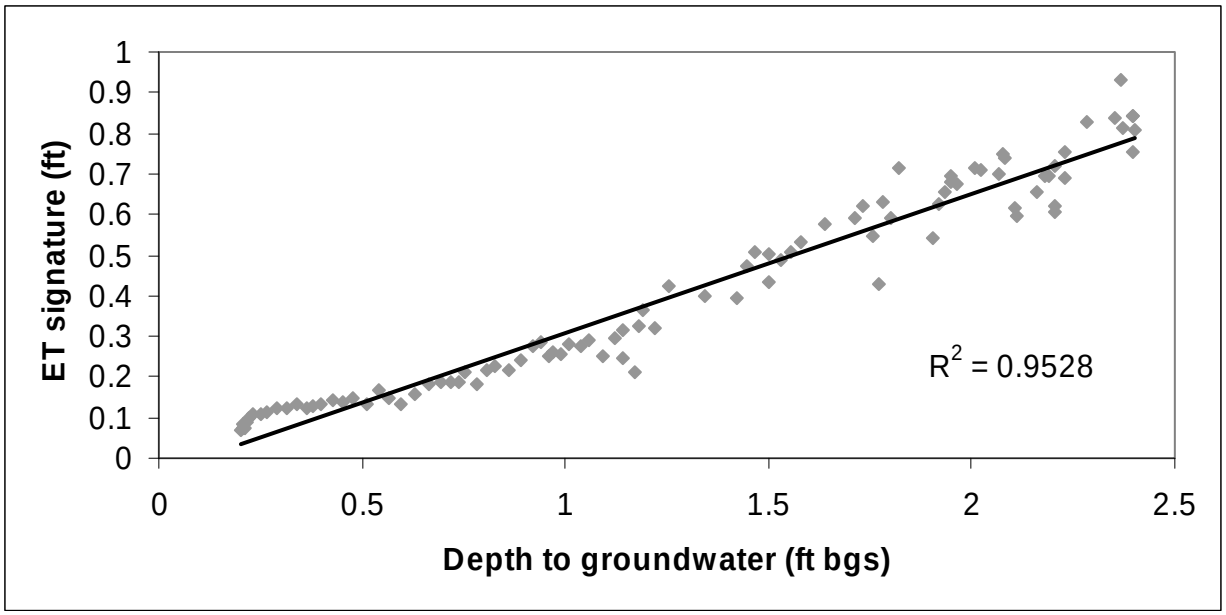


Figure 7.8. Linear regression between daily evapotranspiration (ET) signature (ft) and mean daily depth to groundwater (feet below ground surface) at Topock Marsh, May–August, 2009.

DISCUSSION

Microclimate

Comparison of Parker/Imperial to Topock Marsh

In each year from 2005 to 2009, the 15 habitat monitoring sites consistently had warmer temperatures, greater daily temperature range, and lower humidity than occupied territories at Topock Marsh. In addition, soil moisture within the habitat monitoring sites was consistently lower than that recorded within occupied territories at Topock in 2005–2007. Soil moisture at the habitat monitoring sites did not differ from that measured within occupied territories at Topock in 2008 and 2009. This may be the result of a change in site selection methods at Topock, with soil moisture readings collected in 2008 and 2009 at a point within 20 m of each territory center, regardless of whether the territory remained occupied throughout the season or had a breeding pair, thus resulting in measurements being taken in a wider range of habitat conditions. The hot, dry conditions at the habitat monitoring sites may contribute to these areas not being occupied by resident flycatchers. Because the relationship of microclimate conditions between the habitat monitoring sites and Topock Marsh is well established, we recommend discontinuing this analysis in future years.

Between-year Comparisons of Microclimate Characteristics

Comparisons of microclimate characteristics among years in 2005–2009 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 than in the other years and cooler conditions in 2009. These interannual changes were similar between test and control sites, suggesting that these changes were regional rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006 and 2007–2008 were not similar between test and control sites, with soil moisture declining

more sharply at the control sites. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. However, the role of river flows in influencing soil moisture is unclear, given that no strong relationship was found between piezometer levels and soil moisture (McLeod and Koronkiewicz 2009) and the lack of consistent piezometer data at many sites in 2008 and 2009. Mean daily temperature range and mean maximum diurnal temperature were higher at test sites but lower at control sites in 2008 versus 2007. These metrics decreased sharply in 2009 at both test and control sites, presumably in response to the unusually cool climate conditions during portions of summer 2009. Thus, we have not seen any consistent patterns in the changes in microclimate characteristics at test versus control sites that could be attributed to changes in river flows.

Vegetation

Between-year differences across all sites were noted for many variables, but the only ones that showed unidirectional trends were the percentage of live stems <2.5 cm dbh and the percentage of live stems 2.5–8 cm dbh, both of which declined over time. The percentage of live stems should be less susceptible to observer variation than the absolute stem counts, and it is likely these data represent a true decline in the percentage of live stems. The decline occurred in both test and control sites and could be the result of regional drought.

Few variables showed changes that were specific to control or test sites. Ground cover did not differ between 2005 and 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts did not show any consistent differences between control and test locations.

The pooling of all sites into a test vs. control analysis may obscure changes in vegetation at specific sites. For example, one vegetation plot at Ehrenberg contained a significant coyote willow component (98% of the total basal area) in 2005. The willow gradually died over the next several years until no live willow remained in 2009. Most of the vegetation along the LCR, including at the sites selected for habitat monitoring, consists primarily of tamarisk, which is less sensitive than willow to changes in water availability. Measurable changes in overall vegetation as a response to reduced groundwater levels may take several years to develop in tamarisk, or the tamarisk may change very little if at all.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Repeatability of stem counts depends on having a plot of fixed size. Each plot is divided into quadrants, with a rope having the 5-m distance (the edge of the plot) clearly marked extended in each cardinal direction from plot center. It can be nearly impossible to extend the rope flat or straight, introducing variability into the size of the plot. Even more problematic than this, however, it the inability of the observers, in very dense vegetation, to see the cardinal ropes from the center of the quadrant or to see the center of the plot from the edge to be able to envision an arc connecting the ends of two adjacent cardinal ropes and delineating the edge of the circular plot. Observers vary widely in their ability to estimate distance, and when reference points are not visible, it is very difficult to determine whether a stem near the edge of the plot falls within the plot or not. In 2009, we explicitly instructed observers to use a measuring tape to determine the distance from plot center for any stem for which inclusion in or exclusion from the plot seemed questionable. This method should help reduce difficulties in producing repeatable stem counts but still depends on observers being able to tell when they are near the edge of the plot. Another factor that inhibits accurate stem counts in dense vegetation is the difficulty in keeping track of which stems have been counted already and which have not. In 2009, we began using chalk to mark stems that had already been counted to try to minimize omission or double-counting of stems.

Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred. Other methods, such as analysis of satellite imagery, would have to be used to detect any changes in vegetation that might have occurred prior to 2005.

Groundwater Levels

Piezometer Groundwater Levels

In previous years we examined correlations between piezometer levels and reservoir operations. Groundwater levels in the piezometers between Parker and Imperial Dams, with the exception of Walker Lake, showed strong linear relationships with Parker Dam releases, which are in turn related in a nearly linear fashion to river stage (McLeod and Koronkiewicz 2009). Reclamation (2000) estimated the expected change in river stage between Parker and Imperial Dams that would result from a 400,000 acre-foot reduction in releases from Parker Dam. In a previous report (McLeod et al. 2007), we used this expected reduction in river stage in combination with regression equations developed from the piezometer measurements to predict the corresponding change in groundwater level below each habitat polygon. Thus, releases from Parker Dam can be used to predict the groundwater level beneath the habitat polygons, and the piezometers are no longer needed for measuring groundwater levels as related to river operations.

In general, the daily, weekly, and seasonal cycles observed in previous years' data are still visible in 2009 data. The early morning rise and afternoon drop in water level is attributed to daily evapotranspiration; the mid-week rise and weekend drop of water levels is attributed to river operations. River operation is the primary contributing factor for the seasonal fluctuation in groundwater levels observed in the hydrographs for sites between Parker and Imperial Dams. Seasonal trends can even be detected in the manual measurements at those sites lacking in recent data logger data (Blankenship Bend, Paradise, Clear Lake, and Ferguson Lake).

Several anomalous hydrograph features deserve discussion:

Blankenship Bend, Cibola Lake, and Gila Confluence North – The hydrograph for three piezometers clearly show where equipment has malfunctioned. The Blankenship Bend data logger began to act erratically in the summer of 2007 and has not collected reliable data since. The pressure transducer finally failed entirely and has been removed. The hydrograph for Gila Confluence North has not been normal since the piezometer was moved to the new location after the fire. Even though the equipment has been replaced at this site, the hydrograph indicate the piezometer may not be communicating with the aquifer and most likely needs to be reinstalled. Cibola Lake displayed seasonal fluctuations similar to those observed at other piezometers between Parker and Imperial Dams until the well was destroyed by ground clearing activities. Water levels have remained

essentially flat for the monitoring period since installation of the replacement piezometer. This well may need a re-install or warrant a change in location closer to the selected habitat area.

Walker Lake – Since two apparent inundations in the summer of 2005, the water level at Walker Lake has steadily decreased through the period of record. The seasonal signature continues to be strong and appears to match the pattern at most of the piezometer locations between Parker and Imperial Dams. Though there are breaks in the 2008 and 2009 data, the downward trend and the seasonal highs and lows can be seen. The hydrograph displays periods of spiked water levels on several occasions, including the winter and fall of 2006, fall of 2007, and summer of 2008, indicating Walker Lake may be prone to flashy response time.

Mittry West – While the hydrograph for the Mittry West piezometer was almost flat from installation through December 2005, the data show a seasonal trend in 2006–2008, with peak water levels occurring in the spring of each year. Weekly fluctuations and daily fluctuations are not as apparent on the rising leg of the seasonal curves, but reappear on the declining leg of the curves. A second peak in water levels occurred during the summer of 2007. Apparent inundations have occurred at Mittry West in the spring of 2006, 2007, and 2008 and in winter 2008. Water levels in Mittry West may be influenced by the All American Canal, which is adjacent to the site.

Only 1 of the original 16 piezometers is still functioning, and it has become apparent that the original piezometer data loggers have exceeded their lifespan. The relationship between groundwater levels and river operations has been established, and the strong influence of daily changes in river discharge on groundwater levels renders the piezometer data unsuitable for tracking changes in evapotranspiration over time. Thus, we recommend removing all the piezometers except the one at Topock Marsh, which may be useful in tracking changes in water levels at part of planned water deliveries to a portion of the flycatcher habitat (see Chapter 8).

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

In previous years we correlated piezometer ground water levels and soil moisture measurements and found no strong linear relationship. The strongest relationships were found at sites that had the highest soil moisture values. This suggests that at sites were soil moisture is low, surface soil moisture content is not influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

Evapotranspiration Signature

The evapotranspiration signature at Topock Marsh was weakly correlated with temperature; i.e., increasing temperature was associated with an increased evapotranspiration signature. However, temperature was also correlated with depth to groundwater, because both increased over the May–August period each year. Data from the fall months—when plants are still active, depth to groundwater is high, but temperatures are dropping—may be helpful in distinguishing the effects of temperature from those of depth to groundwater. Fall data are lacking from 2007 but may be available from 2009 after the temperature/humidity loggers are downloaded in spring of 2010.

The evapotranspiration signature at Topock Marsh was directly related to depth to groundwater, rather than showing the inverse relationship demonstrated in the literature. We therefore suspected that the relationship was coincidental, rather than causal. To determine why evapotranspiration might be

increasing in the face of a lowered water table, we deconstructed the White formula. We determined that two fundamental assumptions of the formula likely had been glossed over in previous applications reported in the literature:

- The recharge of the aquifer as measured at the piezometer is driven by basic groundwater hydraulics, and is a function of the aquifer material and the hydraulic gradient between the source of recharge (surface water) and the piezometer. The aquifer material does not change over the season, but the hydraulic gradient does. We realized that as water levels dropped through the season at the piezometer, that lowering of the water table likely affected the overall hydraulic gradient, increasing recharge to the aquifer. The effect of this increasing recharge cannot be controlled for or easily extracted from the evapotranspiration signature.

- Similarly, we realized that the source of recharge to the aquifer, specifically the standing water within Topock Marsh, might also change in location or amount through the season. This would cause a change in hydraulic gradient as well.

These hydraulic effects had not been considered in previous literature on the technique of using the evapotranspiration signature; those studies focused largely on monthly snapshots of evapotranspiration with an eye towards estimating gross volumes of water used by riparian vegetation, without being concerned with stability of the formula through the season. While these findings do not invalidate the White technique, we found that being unable to correct for the changing hydraulic effects likely rendered ineffective the use of the evapotranspiration technique to track vegetation changes over time.

Chapter 8

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

INTRODUCTION

Monitoring of Southwester Willow Flycatcher populations at Topock Marsh began in 1997, and data on number of flycatcher pairs and nest success are available for 1998–2008. The breeding population at Topock declined from a high of 29 pairs in 2004 to fewer than 10 pairs in 2007 and 2008. This decline prompted concern from USFWS about the flycatcher population at Topock, which was presumed to be the likely source population for any flycatchers that would colonize restoration areas on the lower Colorado River. USFWS and Reclamation initiated discussions after the breeding season of 2008 to identify habitat enhancement measures that could be implemented at Topock Marsh in an attempt to raise the number and productivity of flycatchers.

The affinity of breeding Southwestern Willow Flycatchers with standing water and saturated soil is noted consistently in the literature (e.g., Johnson et al. 1999, Munzer et al. 2005, McLeod et al. 2008, Graber and Koronkiewicz 2009b), and flycatcher nests along the Middle Rio Grande that were above inundated or saturated soil all season produced more young per successful nest than nests that were above dry soil all season (Moore and Ahlers 2008). Because of the influence of surface water on flycatcher occupancy and productivity, USFWS and Reclamation developed a plan to pump water into a portion of the flycatcher habitat at Topock.

Two adjacent areas, known as In Between and 800M, have had declining numbers of flycatchers in recent years, with the number of breeding pairs declining steadily from 10 in 2004 to 0 in 2008. These adjacent areas were selected as the location for habitat enhancement via supplemental water delivery because these areas have supported breeding willow flycatchers within the last several years and the vegetation in the area has not changed markedly since the sites were occupied (see Chapter 5 for analysis of vegetation data from formerly occupied nest sites). The addition of surface water and saturated soil to this area may make it more attractive to flycatchers and may increase nest success and productivity of any flycatchers that nest in the area. In addition, widespread inundation of the area may make portions of In Between, 800M, and the surrounding area that typically have been dry during surveys since 2003 and not occupied by flycatchers more suitable for flycatcher occupancy.

Supplemental water delivery is not expected to commence until early 2010. We monitored hydrological, microclimate, and vegetation conditions at In Between, 800M, and the adjacent area of Pierced Egg in 2009 to assess baseline habitat conditions. Similar monitoring will be completed in 2010, and data will be compared to those collected in 2009 to assess the effects of supplemental water delivery on hydrology, microclimate, and vegetation in the target area.

METHODS

Surface Water Mapping

Beginning in early March 2009 and continuing through early August, we visited In Between, 800 M, and Pierced Egg at approximately weekly intervals. During each visit, we traversed trails throughout each site

and used GPS and aerial photographs to map the extent and depth of surface water within the sites. At the conclusion of each weekly visit, we compiled our GPS points and field notes to prepare a hardcopy map of the sites, with areas of surface water and saturated soils delineated on the map and indexed to a key detailing the nature (e.g., pig wallow, open marsh, flooded forest) and depth of each wet area. All hardcopy maps were digitized after the field season using ArcGIS. From the digitized shapefiles, we calculated the percentage of the target area that contained surface water at each visit.

Microclimate

The In Between, 800M, and Pierced Egg polygons were stratified into use (occupied by flycatchers) and non-use (unoccupied by flycatchers) areas, as observed in 2003–2008. Use areas tend to be wetter than non-use areas and thus are presumably low-lying and more likely to be affected by water delivery into the habitat. We excluded the cattail marsh in the center of the 800M polygon from either the use or non-use areas. We superimposed a 25 x 25-m grid on a GIS software shapefile of the use and non-use areas, numbered the grid blocks, and selected blocks using a random number generator. We used the centroid of the selected block as the sample point and located each point in the field by navigating to the given coordinates using a Rino 110 GPS unit. We used HOBO H8 Pro data loggers (see Chapter 6) to record temperature and humidity at each sample point at 15-minute intervals. We determined the exact location of each HOBO unit by means of random number sequences as described in Chapter 6. Each logger remained in place until the end of the flycatcher breeding season. We had originally intended to leave the loggers in place over the winter but decided to remove them at the end of the season after experiencing a large number of losses among the HOBO units that were left in place at occupied territories over the 2008–2009 winter. We collected soil moisture readings, as described in Chapter 6, below each data logger at bi-weekly intervals.

Vegetation

In August 2009, at the end of the flycatcher breeding season, we collected vegetation measurements at each HOBO logger location. Vegetation plots were centered on the logger, and we collected the vegetation measurements described in Chapter 5, with the exception of stem counts. Given the relatively short time span between planned implementation of water delivery (March 2010) and the subsequent vegetation measurements (August 2010), any responses in vegetation are more likely to be apparent in canopy closure and vertical foliage density than in stem counts.

Data Analyses

Microclimate

Microclimate data were summarized as described in Chapter 6. All data were summarized separately for occupied and unoccupied areas.

Vegetation

Vertical foliage data were summarized as described in Chapter 5. Percent native vegetation was calculated as the percent of the foliage hits that consisted of native vegetation. We used the average nest height (3.78 m) recorded at In Between, 800M, and Pierced Egg from 2003 to 2008 to delineate the below, at, and above nest height categories. All data were summarized separately for occupied and unoccupied areas.

RESULTS

Surface Water Mapping

We mapped surface water at weekly intervals from 10 March to 8 August. The percentage of the site that was inundated rose rapidly in late March and early April to a high of almost 45% and then declined just as rapidly in May (Figures 8.1 and 8.2). By early June, <5% of the site had surface water.

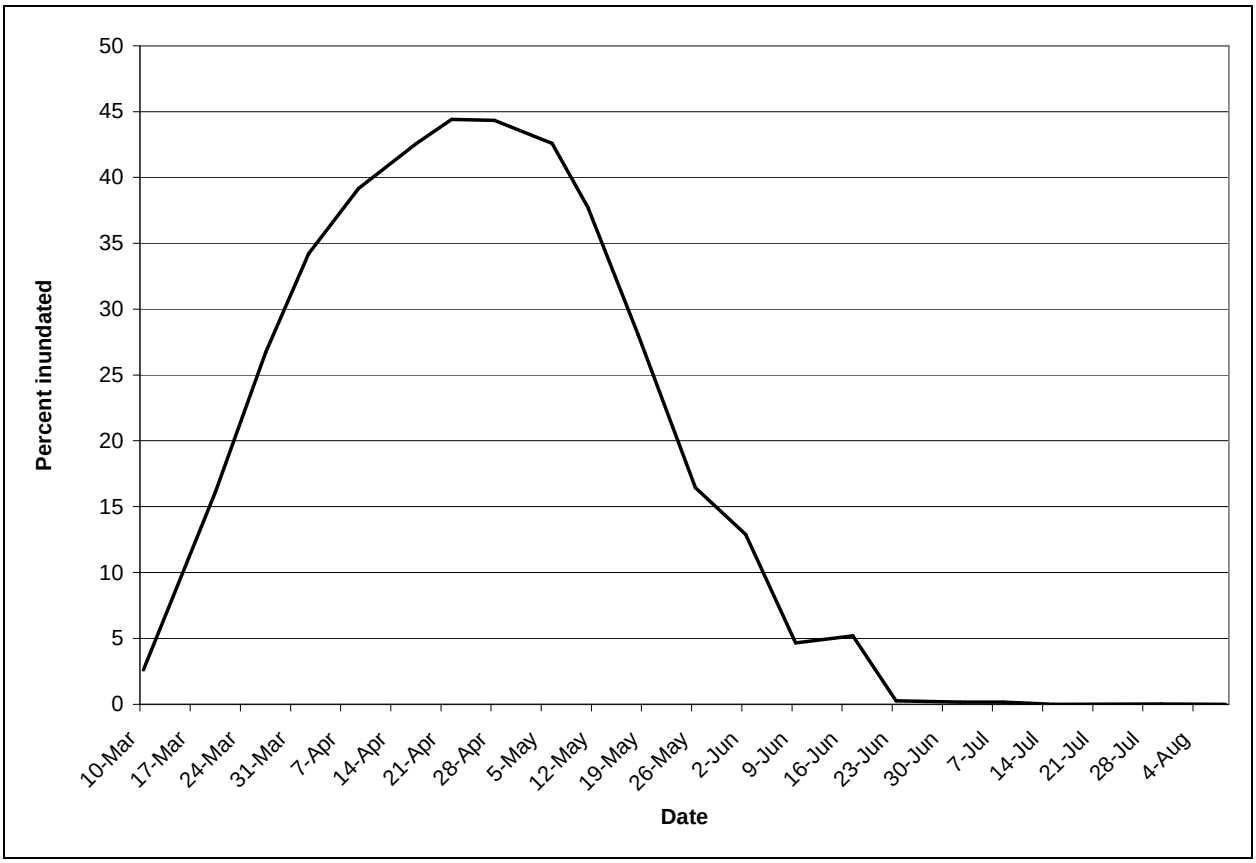


Figure 8.1. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–August 2009.

Microclimate

We deployed 15 HOBO loggers in use areas and 17 loggers in non-use areas between 10 March and 9 April. One use logger and three non-use loggers failed to collect data. Soil conditions became progressively drier throughout the season for both the use and non-use areas, while vapor pressure values showed the typical rise seen in July with the onset of summer monsoons (Tables 8.1 and 8.2). Qualitative comparison of the use and non-use areas shows that the use area had greater soil moisture, lower and more moderate temperatures, and higher humidity consistently through the season, as would be expected (see McLeod et al. 2008).

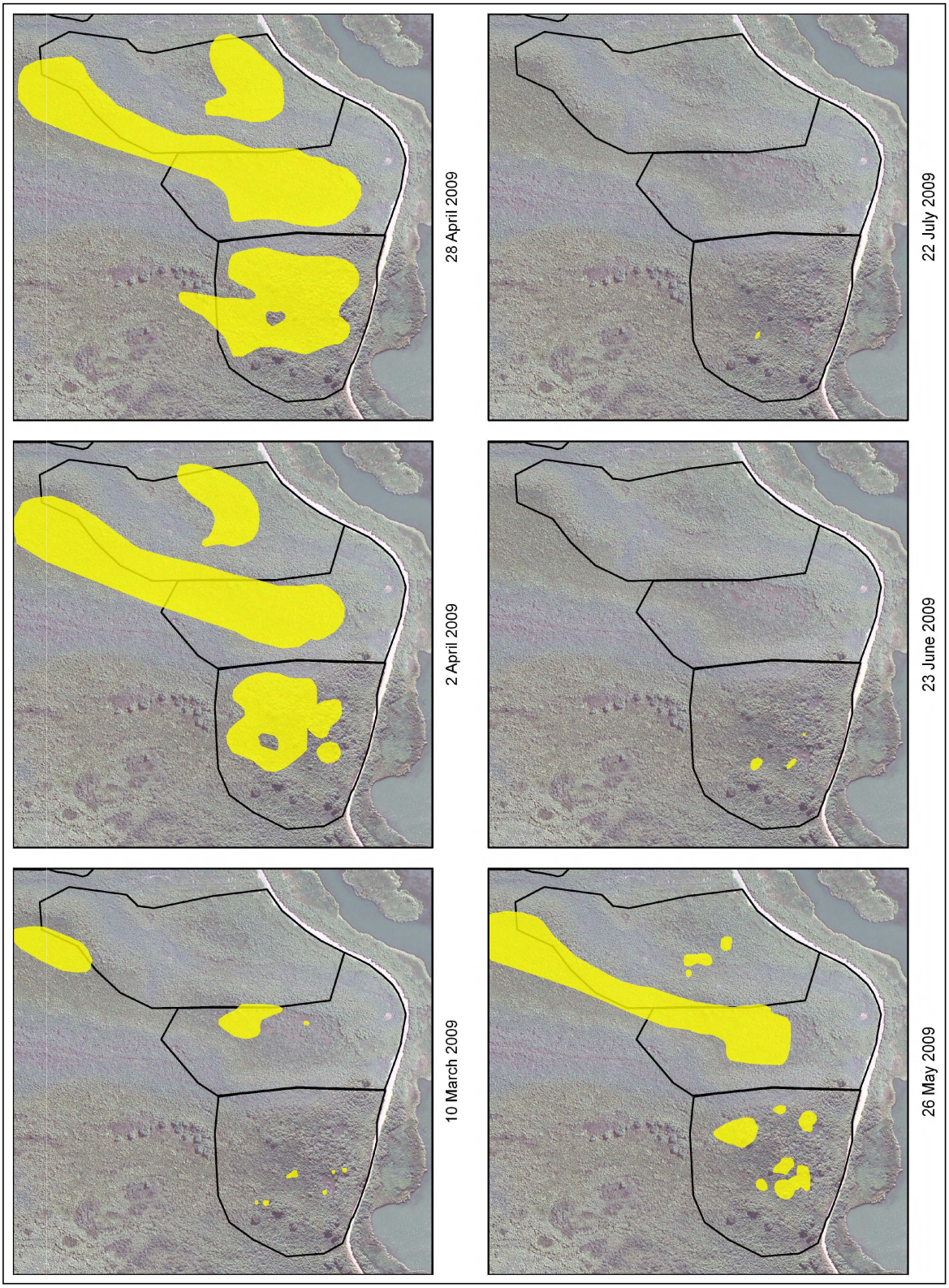


Figure 8.2. Extent of surface water within In Between, 800M, and Pierced Egg at approximately monthly intervals, March–July 2009.

Table 8.1. Microclimate Measures at Topock Hydrology Monitoring Sites – Use Area (n = 14), 2009*

Microclimate Measure	May 12–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	954.1 (8.9)	935.0 (8.5)	920.2 (7.7)	877.7 (15.5)	805.7 (22.1)	842.8 (30.8)
Mean distance to nearest standing water	20.1 (5.3)	48.8 (11.4)	134.9 (24.0)	138.5 (14.2)	154.5 (16.1)	164.0 (10.6)
% of the site within 20 m that was inundated	13.1 (4.6)	1.6 (1.1)	0.4 (0.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of the site within 50 m that was inundated	27.9 (5.9)	8.0 (3.7)	1.9 (1.0)	0.3 (0.3)	0.1 (0.1)	0.0 (0.0)
Temperature						
Mean maximum diurnal temperature (°C)	39.6 (0.4)	35.1 (0.4)	37.3 (0.4)	39.9 (0.4)	40.4 (0.4)	38.6 (0.6)
Mean minimum nocturnal temperature (°C)	16.9 (0.2)	16.5 (0.1)	17.9 (0.2)	20.0(0.2)	23.8 (0.1)	17.3 (0.2)
Mean daily temperature range (°C)	22.8 (0.5)	18.6 (0.4)	19.4 (0.5)	19.9 (0.4)	16.6 (0.4)	21.3 (0.6)
Humidity						
Mean diurnal vapor pressure (Pa)	1668.2 (17.4)	1520.1 (14.8)	2133.6 (28.4)	2471.9 (25.7)	2889.4 (22.9)	2264.1 (36.3)
Mean nocturnal vapor pressure (Pa)	1541.7 (9.9)	1412.6 (11.3)	1796.1 (19.1)	2068.8 (18.3)	2465.4 (16.0)	1825.8 (24.5)

* Data are presented as mean (standard error).

Table 8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-use Area (n = 14), 2009*

Microclimate Measure	May 12–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture						
Mean soil moisture (mV)	901.3 (29.2)	901.3 (13.0)	837.8 (22.7)	792.6 (27.1)	767.9 (44.4)	747.9 (54.0)
Mean distance to nearest standing water	34.7 (10.1)	136.9 (40.9)	150.8 (34.5)	170.2 (23.9)	190.0 (33.4)	230.7 (27.4)
% of the site within 20 m that was inundated	19.5 (9.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of the site within 50 m that was inundated	14.9 (4.6)	4.1 (2.2)	1.3 (1.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Temperature						
Mean maximum diurnal temperature (°C)	42.0 (0.3)	37.2 (0.4)	40.1 (0.5)	42.4 (0.4)	42.2 (0.4)	40.0 (0.6)
Mean minimum nocturnal temperature (°C)	15.5 (0.2)	15.1 (0.2)	16.8 (0.3)	18.7 (0.2)	22.9 (0.2)	15.8 (0.3)
Mean daily temperature range (°C)	26.5 (0.5)	22.1 (0.4)	23.3 (0.5)	23.7 (0.5)	19.3 (0.4)	24.2 (0.7)
Humidity						
Mean diurnal vapor pressure (Pa)	1623.2 (21.2)	1483.6 (18.8)	2088.5 (34.1)	2431.8 (33.0)	2874.9 (30.2)	2235.1 (41.1)
Mean nocturnal vapor pressure (Pa)	1509.5 (13.2)	1363.1 (13.4)	1766.6 (21.3)	2042.4 (20.3)	2480.0 (18.4)	1806.2 (25.3)

* Data are presented as mean (standard error)

AR063576

Vegetation

We collected vegetation data at all 15 use and 17 non-use locations. Vegetation characteristics are summarized in Table 8.3, and vertical foliage profiles for use and non-use locations are shown in Figures 8.3 and 8.4, respectively. Vegetation characteristics are typical of those documented in dense, tamarisk stands at Topock Marsh in previous years (McLeod et al. 2008), with dense canopy closure and a small percentage of native vegetation. As would be expected (McLeod et al. 2008), canopy height was greater in the use area than in the non-use area.

Table 8.3. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2009*

Parameter	Use (n=15)	Non-use (n=17)
Average canopy height (m)	6.7 (0.3)	5.6 (0.3)
	4.7 –8.5	3.3 –8.0
% total canopy closure	96.6 (0.6)	94.0 (0.9)
	91.1 –100.0	82.3 –99.0
% woody ground cover	22.1 (5.5)	26.9 (4.3)
	3.8 –75.0	5.3 –65.0
Live vertical foliage (hits) below nest	2.2 (0.5)	5.3 (0.9)
	0 –6.9	1.6 –14.3
Live vertical foliage (hits) at nest	2.3 (0.3)	4.1 (0.4)
	0.3 –4.4	0.9 –6.6
Live vertical foliage (hits) above nest	11.8 (0.9)	6.4 (1.0)
	4.4 –17.1	0.4 –15.4
Dead vertical foliage (hits) below nest	11.0 (0.7)	11.2 (0.4)
	5.7 –16.7	8.1 –13.7
Dead vertical foliage (hits) at nest	3.0 (0.3)	1.3 (0.2)
	1.7 –5.9	0.0 –2.6
Dead vertical foliage (hits) above nest	2.3 (0.4)	0.4 (0.1)
	0.3 –6.1	0.0 –1.8
Percent native	0.0 (0.0)	8.2 (5.0)
	0 –0.6	0.0 –64.6

* The selected area was stratified into areas occupied and unoccupied by flycatchers in 2003–2008. Data are presented as mean, standard error, and range.

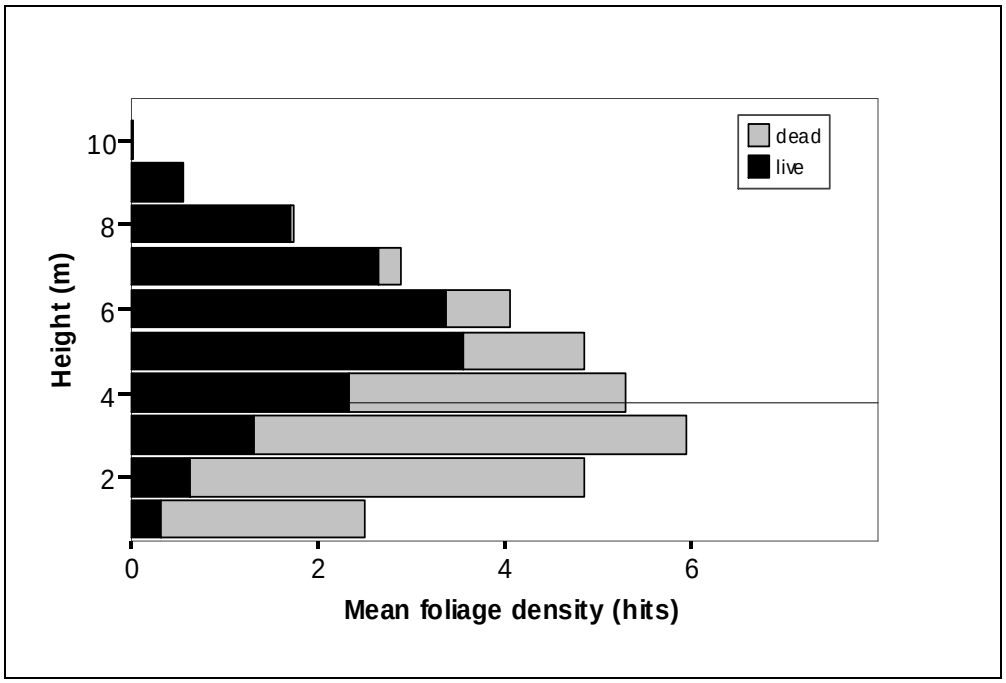


Figure 8.3. Vertical foliage density in areas occupied by flycatchers in at least one year between 2003 and 2009 within the habitat enhancement project area, Topock Marsh, 2009. Horizontal line shows average nest height in the project area, 2003–2008.

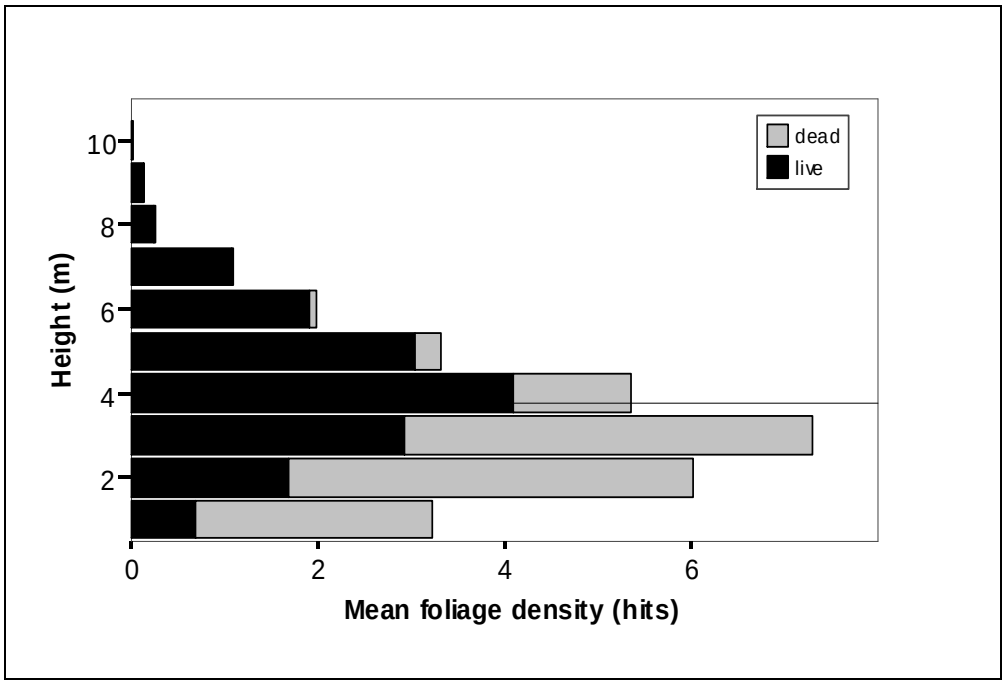


Figure 8.4. Vertical foliage density in areas not occupied by flycatchers between 2003 and 2009 within the habitat enhancement project area, Topock Marsh, 2009. Horizontal line shows average nest height in the project area, 2003–2008.

DISCUSSION

The hydrology, vegetation, and microclimate data collected in 2009 show the pretreatment conditions within the portion of Topock Marsh selected for habitat enhancement via water delivery. Identical methods will be used in 2010 to collect data during the water delivery period, and data from 2010 will be compared to those collected in 2009 to identify any changes in surface hydrology, microclimate, and vegetation.

Chapter 9

MICROCLIMATE AND VEGETATION MONITORING: PAHRANAGAT

INTRODUCTION

From the start of flycatcher monitoring at Pahranagat NWR in 1997 through 2007, occupied flycatcher habitat at Pahranagat North, near the inflow to Upper Pahranagat Lake, has been inundated annually with up to 1 m of water recorded under the vegetation in mid-May. From 2003 to 2007, as much as 100% of the site contained standing water in mid-May, and as much as 95% of the site contained standing water and saturated soil until mid-July. Major structural problems with the levee that impounds the upper lake resulted in the upper lake being drained in early 2008, and the riparian vegetation at the north end of the lake was not flooded during the 2008 and 2009 flycatcher breeding seasons as it had been in previous years.

We collected vegetation and microclimate data within 5–10 m from flycatcher nests (within flycatcher territories) at Pahranagat North in 2005–2007. In 2008, the focus of microclimate and vegetation data collection shifted from comparing conditions in occupied vs. unoccupied habitat to characterizing conditions within flycatcher territories for the purpose of providing data that would inform habitat creation and restoration efforts along the LCR. Data collection at Pahranagat was discontinued in 2008 because the study area is approximately 650 m higher in elevation and experiences a cooler climate than the highest elevation portion of the LCR MSCP study area. In addition, the vegetation at Pahranagat consists primarily of very large and widely spaces trees, and these characteristics are unique to the site and not likely to be replicated in restoration areas. Thus, microclimate and vegetation data were not collected in 2008, the first year Pahranagat North was not inundated, and data collection was not planned for the breeding season of 2009.

In 2009, USFWS retained SWCA to complete microclimate and vegetation measurements at Pahranagat North during the 2009 breeding season and to compare conditions during the inundated period (2005–2007) to those documented in 2009.

METHODS

Microclimate

We deployed HOBO Pro v2 temp/RH data loggers (Onset Computer Corporation, Pocasset, MA) within the area of Pahranagat North that has consistently been occupied by breeding flycatchers. Plot center locations were selected by superimposing a 25 × 25–m grid on an ArcGIS 9.1 software shapefile of the flycatcher breeding area boundary, numbering the grid blocks, selecting blocks by using a random number generator, and using the centroid of each selected block. Plot centers were located in the field by navigating to the given coordinates using a Rino 110 GPS unit. For each HOBO unit we determined the exact height and distance from the tree bole by means of random number sequences as described in Chapter 6. Each logger recorded temperature and humidity at 15-minute intervals and remained in place until the end of the flycatcher breeding season in early August. Soil moisture readings were collected beneath each HOBO logger every two weeks, as described in Chapter 6, from HOBO deployment through HOBO removal.

Vegetation

We completed vegetation measurements in August, after the end of flycatcher nesting activity at Pahranagat North. We used each HOBO as the center for a vegetation plot and collected the same measurements as at the monitoring plots at Topock Marsh (see Chapter 8).

Data Analyses

Microclimate

Soil moisture data were entered into a database as they were collected during the field season. We downloaded data from the HOBO data loggers into databases at the end of the field season and summarized microclimate variables for each HOBO location following the methods presented in Chapter 6. We used one-way ANOVA to compare microclimate measures at within-territory locations from 2005 to 2007 when the site inundated versus 2009 when it was not. Analyses were conducted using SAS® v.9.1.3 (SAS Institute 2003). Data are presented as mean (standard error).

To address whether any observed changes in microclimate could be the result of overall changes in regional climate, we obtained weather station data from the National Climate Data Center (www.ncdc.noaa.gov/oa/ncdc.html) for Caliente, Nevada (Station ID #261358) for 2005–2009. Maximum and minimum daily temperature data were available. We used one-way ANOVA to test whether temperature variables differed between years for the 1 July–15 August period. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

Vegetation

Vertical foliage data were restricted to data collected within 1 m of plot center so as to be directly comparable to data collected prior to 2008 and were summarized as described in Chapter 5. Percent native vegetation was calculated as the percent of the foliage hits that consisted of native vegetation. We used the average nest height (3.9 m) recorded at Pahranagat from 2003 to 2009 to delineate below, at, and above nest categories. We used one-way ANOVA to compare vegetation characteristics in 2005–2007 versus 2009. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

RESULTS

Microclimate

Twenty-eight HOBO loggers were deployed within flycatcher territories at Pahranagat North in early July. They remained in place until 9 August. Six humidity sensors failed to collect data. These data were compared to data collected at 20 within-territory locations in 2005–2007. We included only those within-territory locations where at least half of the 14 day recording period fell between 2 July and 9 August. Soil moisture was higher during the inundated vs. non-inundated period, as was nocturnal and diurnal vapor pressure (Table 9.1). Temperatures differed between the two periods by mean maximum daily temperature being higher and mean minimum nocturnal temperature being lower during the inundated period. Mean daily maximum and minimum temperatures between 1 July and 15 August at the Caliente weather station did not differ between 2009 and any year from 2005 to 2007.

Table 9.1. Descriptive Statistics and Single Effects for Comparison of Microclimate Characteristics, 2005–2007 versus 2009, Pahranagat North*

Response Variable	2005–2007 (n=20)	2009 (n=28)	Difference	*P*
Soil Moisture				
Mean soil moisture (mV)	826.5 (27.9)	741.7 (24.2)	-84.8	0.03
Temperature				
Mean maximum diurnal temperature (°C)	38.4 (1.0)	33.9 (0.1)	-4.5	<0.01
Mean minimum nocturnal temperature (°C)	15.1 (0.5)	17.1 (0.1)	2.0	<0.01
Mean daily temperature range (°C)	16.3 (0.9)	16.8 (0.1)	0.5	0.54
Humidity				
Mean diurnal vapor pressure (Pa)	1648.0 (60.3)	1385.2 (14.6)	-262.8	<0.01
Mean nocturnal vapor pressure (Pa)	1465.0 (53.0)	1149.3 (13.8)	-315.7	<0.01

* Data are presented as mean (standard error).

Vegetation

We collected vegetation data at 28 locations in 2009. These data were compared to vegetation data collected at 26 within-territory locations in 2005–2007. The only variable that differed between the inundated and non-inundated periods was the percentage of the foliage that consisted of native species (Table 9.2).

DISCUSSION

We anticipated that soil moisture and humidity would be lower in 2009 than when the site was inundated, and these expectations are confirmed by the data. However, without humidity data from a nearby weather station, it is impossible to determine whether lower humidity in 2009 was caused by there being less water under the vegetation or if regional humidity was simply lower in 2009. We had expected that inundated conditions might serve to moderate daily temperatures, but the data showed a higher maximum temperature and lower minimum temperature during the inundated period. These differences could not be accounted for by between-year differences in regional climate, with the Caliente weather station showing no between-year differences for either maximum or minimum temperature.

The difference in percent native foliage between the inundated and non-inundated periods is entirely attributable to the development in 2009 of herbaceous ground cover consisting partially of a non-native *Chenopodium* species and does not reflect any change in the woody vegetation. Vertical foliage density below nest height was greater in 2009 than in 2005–2007; however, the increase was not statistically significant. In each year in 2005–2007, vegetation measurements were collected at the end of the flycatcher breeding season, by which time a dense herbaceous layer consisting primarily of Indian hemp (*Apocynum cannabinum*) had developed throughout the drier parts of the site. Thus, although the herbaceous vegetation in 2009 was present throughout the season rather than developing in mid-summer, these between-year changes are not reflected by vegetation measurements collected in August of each year.

Many of the large trees in the northeastern corner of Pahranagat North have died since 2007 (see Chapter 2), but the area of dead trees comprises a small percentage of the site, and only four of the points sampled

in 2009 were near this area. Thus, any changes in vegetation and corresponding changes in microclimate in the northeastern corner of the site did not appear in the data when points across the site were combined.

Although a comparison of vegetation characteristics from when the site was inundated versus was it was not showed no major changes in woody vegetation, two years may be too short of a time for the vegetation to respond to non-inundated conditions. The trees at Pahranagat North are large and presumably have extensive root systems, and although only a small portion of the site contained surface water during 2008 and 2009, the water table beneath the vegetation throughout the site is presumably high. It may take a longer period of time, or a larger drop in the water table, for any changes in the woody vegetation to be detectable.

Table 9.2. Descriptive Statistics and Single Effects for Comparison of Habitat Characteristics between 2005–2007 and 2009, Pahranagat North *

Parameter	**2005–2007** (n=26)	**2009** (n=28)	**P**
Average canopy height (m)	17.6 (1.1)	18.8 (0.8)	0.388
	5.0–30.0	12.3–30.8	
% total canopy closure	91.3 (1.1)	93.0 (1.0)	0.251
	76.0–99.0	78.1–100.0	
% woody ground cover	43.2 (5.8)	30.0 (3.7)	0.059
	2.0–98.0	1.1–80.3	
Live vertical foliage (hits) below nest	2.6 (0.4)	3.4 (0.5)	0.230
	0–8.2	0–9.8	
Live vertical foliage (hits) at nest	1.6 (0.3)	1.3 (0.2)	0.545
	0–5.2	0–4.2	
Live vertical foliage (hits) above nest	21.6 (3.3)	24.7 (2.2)	0.425
	3.8–69.9	6.8–53.6	
Dead vertical foliage (hits) below nest	3.9 (0.6)	3.0 (0.4)	0.190
	0–10.8	0.2–7.6	
Dead vertical foliage (hits) at nest	0.9 (0.2)	1.2 (0.2)	0.318
	0–3.2	0–4.0	
Dead vertical foliage (hits) above nest	2.0 (0.6)	2.8 (0.5)	0.307
	0–15.1	0–12.3	
% live foliage (hits) below nest	42.5 (6.0)	52.7 (4.9)	0.188
	0–100.0	0–94.6	
% live foliage (hits) at nest	63.0 (6.1)	51.1 (6.9)	0.216
	0–100.0	0–100.0	
% live foliage (hits) above nest	90.2 (3.3)	91.1 (1.3)	0.800
	29.8–100.0	74.1–100.0	
Percent native	100.0 (0.0)	97.0 (1.0)	0.005
	100.0–100.0	81.2–100.0	

* Data are presented as mean, standard error, and range.

Chapter 10

MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS

For ease of reference this chapter summarizes all study design and management recommendations discussed in previous chapters.

BROADCAST SURVEYS

Mormon Mesa North and Hedgerow at Mormon Mesa have been completely dry for the last several years, and neither of these sites has supported breeding flycatchers since 2005. We recommend visiting each site at the beginning of the breeding season, when sites are typically wettest, and discontinuing surveys if no surface water or saturated soils are present.

We expanded Virgin River #1 South at Mormon Mesa to explore areas where stream channels were noted on the aerial photograph and during aerial reconnaissance. The channels are incised 1–2 m, and the soils beneath the tamarisk were entirely dry throughout the survey season. We do not recommend continuing surveys in this area in future years because of the dry soil conditions. We recommend surveying only the northern third of the site and the area immediately around the Goodding willow cluster in the southwestern portion of the site because of the short canopy height and dry soil conditions in the remainder of the site.

We completed habitat reconnaissance at several new sites at Muddy River and Topock Marsh. We recommend visiting The Narrows site along the Muddy River at the beginning of the season to assess hydrologic conditions and discontinuing surveys for the season if water is restricted to the active river channel. At Topock Marsh, three sites (Lost Lake Slough #2, Lost Lake Slough #3, and Lost Lake Slough #4) had potential to develop into suitable flycatcher habitat if the vegetation matures. We recommend revisiting these sites in 2010 to assess any changes in the vegetation. The remaining reconnaissance sites (Muddy River Recon, NW Beal Lake, NE Lost Lake, Lost Lake South, and Marina) lacked either the vegetation or hydrologic conditions typical of occupied flycatcher habitat, and we do not recommend revisiting these sites.

We recommend discontinuing surveys at Pulpit Rock in Topock Gorge. The small size of the site, its isolation from other riparian habitat, and its predominantly dry soils make this site unlikely to support resident flycatchers. We also recommend discontinuing surveys in the western portion of Blankenship Bend South because woody vegetation in this portion of the site is widely scattered.

COWBIRD CONTROL

The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in four of the five years when flycatchers have been monitored at the study area, and overall nest success was 23%, well below the average of 45% across all study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

In addition to cowbird trapping at Muddy River, addling cowbird eggs and removing cowbird young from easily accessible flycatcher nests would likely increase flycatcher nest success and productivity. We do not advise these activities at Pahranagat, which is still part of the five-year post-cowbird-trapping experiment. However, at study areas that were not part of the cowbird trapping experiment (Littlefield, Mormon Mesa, Muddy River, Bill Williams), addling eggs and removing young would not interfere with ongoing experiments and would likely benefit the flycatcher. At Mesquite and Topock, cowbird trapping was shown not to have any effect on parasitism rates and flycatcher nest success, and thus the post-trapping period will not reveal any lingering effects of trapping. Addling cowbird eggs and removing nestlings could thus be implemented at these study areas as well, and we recommend addling cowbird eggs and removing cowbird nestlings from easily accessible flycatcher nests at all sites but Pahranagat.

VEGETATION

The vegetation plot measured at Beal Lake had less canopy closure and far fewer stems than was typical for flycatcher territories in other habitat types, but more extensive sampling would be required to ascertain whether the plot is representative of the site. Because of the uncertainty of whether the site was truly occupied by resident flycatchers and the dissimilarities between the vegetation characteristics measured at Beal Lake and at other flycatcher territories, the vegetation characteristics reported here for cottonwood-mesquite habitat should not be used as a model for flycatcher habitat.

Although the methods for collecting the vegetation data were unchanged among years, observer variation could influence between-year differences in stem counts, vertical foliage counts, and canopy closure. To address observer variation in stem and vertical foliage counts, we calculated the proportion of live stems and live hits in each category and then compared the proportions between the occupied and unoccupied periods. As long as each observer counts live vs. dead stems and, similarly, live vs. dead hits in a consistent manner, this technique accounts for any observer differences in the absolute counts. Reanalysis of the 2003–2007 data incorporating the proportion of live vs. dead vegetation may yield further insight into the vegetation characteristics that contribute to flycatcher occupancy.

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

The relationship of microclimate conditions between the habitat monitoring sites and Topock is well established, and we recommend discontinuing this analysis in future years.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it was possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred. Other methods, such as analysis of satellite imagery, should be considered to detect any changes in vegetation that might have occurred prior to 2005.

The relationship between groundwater levels and river operations has been established, and the strong influence of daily changes in river discharge on groundwater levels renders the piezometer data unsuitable for tracking changes in evapotranspiration over time. Thus, we recommend removing all the piezometers except the one at Topock Marsh, which may be useful in tracking changes in water levels as part of planned water deliveries to a portion of the flycatcher habitat.

In previous years we correlated piezometer ground water levels and soil moisture measurements and found no strong linear relationship. The strongest relationships were found at sites that had the highest

soil moisture values. This suggests that at sites were soil moisture is low, surface soil moisture content is not influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Cibola Lake, Havasu NE, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

LITERATURE CITED

Anderson, B.W., and R.D. Ohmart. 1984. Lower Colorado River riparian methods of quantifying vegetation communities to prepare type maps. Final report. U.S. Bureau of Reclamation, Lower Colorado Region, Boulder City, Nevada.

Blaney, H.F. 1954. Consumptive use of ground water by phreatophytes and hydrophytes. Pages 53–62 *in* Publication 37 de l'Association Internationale d'Hydrologie.

Bowie, J.E., and Kam, W., 1968. Use of water by riparian vegetation, Cottonwood Wash, Arizona, USGS Water-Supply Paper 1858.

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. The University of Arizona Press, Tucson, Arizona. 302 pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241–257.

Busch, J.D., M.P. Miller, E.H. Paxton, M.K. Sogge, and P. Keim. 2000. Genetic variation in the endangered Southwestern Willow Flycatcher. Auk 117:586–595.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher breeding site and territory summary – 2005. USGS Southwest Biological Science Center report to the U.S. Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern willow flycatcher final survey and monitoring report. Arizona Game and Fish Department, Research Technical Guidance Bulletin #10, Phoenix, Arizona.

Finch, D.M., and J.F. Kelly. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197–203 *in* Finch, D.M., J.C. Whitney, J.F. Kelly and S.R. Loftin (eds.). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings, RMRS-P-7.

Flett, M.A., and S.D. Sanders. 1987. Ecology of a Sierra Nevada population of Willow Flycatchers. Western Birds 18:37–42.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

Gatewood, J.S., Robinson, T.W., Colby, B.R., Hem, J.D., and Halpenny, L.C. 1950. Use of water by bottom-land vegetation in Lower Safford Valley, Arizona. USGS Water-Supply Paper 1103.

Graber, A.E., and T.J. Koronkiewicz. 2009a. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2008. Final 2008 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona by SWCA Environmental Consultants, Flagstaff, AZ. 66 pp.

Graber, A.E., and T.J. Koronkiewicz. 2009b. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2009. Final 2009 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona by SWCA Environmental Consultants, Flagstaff, AZ. 25 pp.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern willow flycatcher 2006 survey and nest monitoring report. Nongame and Endangered Wildlife Program. Technical report 249. Arizona Game and Fish Department, Phoenix, Arizona.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and willow flycatchers: a summary of their science and policy connections. Geomorphology 47:169–188.

Hanski, I.A., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pages 5–26 *in* Hanski, I.A. and Gilpin, M.E. (eds.). Metapopulation biology: Ecology, genetics, and evolution. Academic Press, San Diego, California.

Harris, J.H. 1991. Effects of Brown-headed Cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13–26.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds 18:27–36.

Hays, K.B., 2003. Water use by saltcedar and associated vegetation on the Canadian, Colorado, and Pecos Rivers in Texas. Thesis, Texas A&M University, May 2003.

Howell, N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Howlett, J.S., and B.J. Stutchbury. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover.

James, F.C., and H.H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

Johnson, K., P. Mahlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered Southwestern Willow Flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44:226–231.

Johnson, M.J., and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Kenwood, K.E., and E.H. Paxton. 2001. Survivorship and movements of Southwestern Willow Flycatchers in Arizona – 2001. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 44 pp.

Koronkiewicz, T.J., S.N. Cardinal, M.K. Sogge, and E.H. Paxton. 2002. Survivorship and movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2002. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. USGS Southwest Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. 43 pp.

Koronkiewicz, T.J., M.A. McLeod, B.T. Brown, and S.W. Carothers. 2006a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff,Arizona. 176 pp.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper III, and E.H. Paxton. 2006b. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. Condor 108:558–570.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, California.

Lowther, P.E. 1993. Brown-headed Cowbird (*Molothrus ater*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 47. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* Sogge, M.K., B.E. Kus, S.J. Sferra and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M., and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, ecology, and conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bulletin 73(3):255–261.

Mayfield, H. 1975. Suggestions for calculating nest success. Wilson Bulletin 87(4):456–466.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 1 – 1996. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada,, [and] the U.S. Fish and Wildlife Service, Carlsbad, California by the San Bernardino County Museum, Redlands, California. 42 pp.

McKernan, R.L., and G. Braden. 1998. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 2 – 1997. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, [and] the U.S. Fish and Wildlife Service, Carlsbad, California, by the San Bernardino County Museum, Redlands, California. 64 pp.

McKernan, R.L., and G. Braden. 1999. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 3 – 1998. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 pp.

McKernan, R.L., and G. Braden. 2001a. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the Lower Colorado River: Year 4 – 1999. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 83 pp.

McKernan, R.L., and G. Braden. 2001b. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 5 – 2000. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 86 pp.

McKernan, R.L., and G. Braden. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 6 – 2001. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada by San Bernardino County Museum, Redlands, California. 58 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada by SWCA Environmental Consultants, Flagstaff, AZ. 153 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada by SWCA Environmental Consultants, Flagstaff, Arizona. 194 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada by SWCA Environmental Consultants, Flagstaff, Arizona. 206 pp.

Moore, D., and D. Ahlers. 2008. 2007 Southwestern Willow Flycatcher study results: selected sites along the Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. Report prepared by Bureau of Reclamation, Technical Service Center, Denver, Colorado. 64 pp.

Munzer, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. Arizona Game and Fish Department, Phoenix, Arizona.

National Weather Service. 2009. Online: http://aa.usno.navy.mil/data/docs/RS_OneYear.html.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 Summary Report. USGS Colorado Plateau Research Station / Northern Arizona University report. 63 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in Central Arizona – a 10-year synthesis report. USGS Open-File Report 2007-1381.

Periman, R.D., and J.F. Kelly. 2000. The dynamic environmental history of Southwest Willow Flycatcher habitat: A survey of changing riparian conditions through time. Pages 25–42 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, Arizona. 212 pp.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. General Technical Report PSW-GTR-144. U.S. Forest Service Pacific Southwest Research Station, Albany, California. 41 pp.

Ridgely, R.S., and G. Tudor. 1994. The birds of South America; Volume II: the Suboscine passerines. University of Texas Press, Austin, Texas.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in Illinois. Pages 408–418. *In* J.M. Hagan III and D.W. Johnston (eds.). Ecology and Conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Rosenberg, K. V., R. C. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson, Arizona.

Rotenberry, J.T. 1985. The role of habitat in avian community composition: Physiognomy or floristics? Oecologia 67:213–217.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix, Arizona.

SAS Institute Inc. 2003. SAS OnlineDoc®, Version 9.1. Cary, North Carolina.

Sedgwick, J.A. 2000. Willow flycatcher (*Empidonax traillii*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 533. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Sedgwick, J.A. and F.L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. The Condor 94:720–733.

Sedgwick, J.A., and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to willow flycatchers. Pages 167–181 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.).Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. Western Birds 32:167–172.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbits. 1997. A Southwestern Willow Flycatcher natural history summary and survey protocol. National Park Service Technical Report USGS/NAUCPRS/NRTR-97/12.

StataCorp LP. 2006. Stata for Windows®, Version 9.2. College Station, Texas.

Stiles, F.G., and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, New York.

Sumner, M.E. 2000. Handbook of soil science. CRC Press, Boca Raton, Florida.

U.S. Bureau of Reclamation (Reclamation). 2000. Biological Assessment for proposed Interim Surplus Criteria, Secretarial Implementation Agreements for California Water Plan components and conservation measures on the Lower Colorado River (Lake Mead to the Southerly International Boundary). Prepared by U.S. Bureau of Reclamation, Lower Colorado Region. 80 pp.

U.S. Bureau of Reclamation (Reclamation). 1999. Long-term restoration program for the historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat along the lower Colorado River. Report submitted by USBR Lower Colorado Region to Lower Colorado Multi-Species Conservation Program. USBR: Boulder City, Nevada. 70 pp.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. Federal Register 60:10694–10715.

U.S. Fish and Wildlife Service (USFWS). 2000. Southwestern willow flycatcher protocol revision 2000. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2001. Biological opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures on the Lower Colorado River, Lake Mead to the Southerly International Boundary, Arizona, California, and Nevada. Final Biological Opinion, U.S. Fish and Wildlife Service, Phoenix, Arizona. 90 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax trailli extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup, August 2002.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. San Diego Natural History Museum report to U.S. Bureau of Reclamation, Phoenix, Arizona.

White, G.S., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 (supplement):S120–139.

White, W.N. 1932. A method of estimating ground-water supplies based on discharge by plants and evaporation from soil, results of investigations in Escalante Valley, Utah. USGS Water-Supply Paper 659-A.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to Brown-headed Cowbird parasitism. M.S. Thesis, California State University, Chico, California. 25 pp.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Pages 182–190 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.). Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Whitfield, M.J., M.K. Sogge, S.J. Sferra, and B.E. Kus. 2003. Ecology and behavior —Introduction. Pages 53–55 *in* Sogge, M.K., B.E. Kus, S.J. Sferra, and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Wiens, J.A. 1989a. The ecology of bird communities. Volume 1: Foundations and patterns. Cambridge University Press, New York.

Wiens, J.A. 1989b. The ecology of bird communities. Volume 2: Processes and variations. Cambridge University Press, New York.

Woodward, H.D., and S.H. Stoleson. 2002. Brown-headed Cowbird attacks on Southwestern Willow Flycatcher nestlings. The Southwestern Naturalist 47(4):626–628.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

Acknowledgements

This project was made possible by the support of many persons, agencies, private landowners, and our dedicated staff and field crew. Work was conducted under the auspices of Federal Fish and Wildlife Threatened and Endangered Species Permit TE028605-1 and Master Banding Permit #23258. Funding was provided by the U.S. Bureau of Reclamation, Boulder City, Nevada (Contract No. GS-10F-0209L). Theresa Olson and Chris Dodge from Reclamation provided background information and guidance, and Mark Santee piloted the helicopter for site tours.

Many thanks to the following national wildlife refuges and personnel for all their assistance and for providing housing: Kevin DesRoberts, Chivia Horton, and Jim Doctor at Pahranagat NWR; John Earl, Jack Allen, and Ty Bennali at Havasu NWR; Dr. Kathleen Blair, Dick Gilbert, and Stan Culling at Bill Williams River NWR; Mike Oldham and Bill Seese at Cibola NWR; and Brenda Zaun and Elaine Johnson at Imperial NWR. Thanks to Keith Day and Pam Wheeler with the Utah Division of Wildlife Resources for their support at Seegmiller Marsh. Also, we would like to thank Cris Tomlinson, Christy Klinger, Ben Conrad, and Keith Brose with Nevada Division of Wildlife for their support at Key Pittman and Overton Wildlife Management Areas.

Thanks to the following agencies and personnel for assistance with obtaining permits: Greg Beatty, Sandy Marquez, Daniel Marquez, Amy Lavoie, Vanessa Martinez, Leilani Takano, Jodi Fraser, and Corey Kallstrom with the U.S. Fish and Wildlife Service; Florence L. Soehnlein and Danny Bystrak with the Federal Bird Banding Laboratory; Melissa Swain with the Arizona Game and Fish Department; Gloria Shaw with Lake Mead National Recreation Area; Luela Roberts, Randi Logsdon, and Esther Burkett with the California Department of Fish and Game; Cris Tomlinson and Julie Meadows with the Nevada Division of Wildlife; Suzanne McMullin with the Utah Division of Wildlife Resources; Stephanie Heinz with the Colorado River Indian Tribe; Tom Denniston with the Bureau of Land Management, St. George; Bill Werner with the Arizona Department of Water Resources; and Bill Dowdle with the Arizona State Lands Department. Robert Bunker, Bill Evans, and Gary Hafen granted access to their properties.

A very special thanks to Eben H. Paxton with the U.S. Geological Survey, Southwest Biological Science Center and Mark K. Sogge with the U.S. Geological Survey, Western Region for support and assistance in all phases of the project. Thanks to Johnny, Mike, and Kathy at Monte Vista Marine, and Brian Dierker and Dr. Steve Carothers for assisting with boating logistics. Jim Christian assisted with ATV logistics.

This project would not be a success without our dedicated staff and field personnel. Many, many thanks to Jessica Maggio and Kimberly MacMillan who went beyond their administrative duties and coordinated housing, permitting, payroll, vehicles, computers, safety and telecommunications and handled all manner of crises with cheerful aplomb. A very special thanks to Glenn Dunno for his GIS talents. Thanks also to Shara Monik, Lisa Jackson, and Kim Wells for administrative and accounting support. And sincere thanks to the 2009 field personnel for hard work, dedication, and sweat.

Appendix A

FIELD DATA FORMS

Willow Flycatcher Survey and Detection Form (revised April, 2004)

Site Name_____ State_____ County _____
USGS Quad Name _____ Elevation _____ feet / meters (circle one)

Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? ☐ *Yes* ☐ *No*

Site Coordinates: Start: N_____ E_____ UTM Datum_____ (NAD27 preferred)
Stop: N_____ E_____ UTM Zone _____

***** Fill in additional site information on back of this page *****

Survey # / Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N	Cowbirds Detected? Y or N	Presence of Livestock, Recent sign, If Yes, Describe Y or N	Comments about this survey (e.g., bird behavior, evidence of pairs or breeding, number of nests, nest contents or number of fledges seen; potential threats)
1_____	Date Start Stop Total hrs_____							
2_____	Date Start Stop Total hrs_____							
3_____	Date Start Stop Total hrs_____							
4_____	Date Start Stop Total hrs_____							
5_____	Date Start Stop Total hrs_____							
Overall Site Summary (Total **resident** WIFLs only) Total survey hrs_____		Adults	Pairs	Territories	Nests	Were any WIFLs color-banded? Yes No If yes, report color combination(s) in the comments section on back of form		

Reporting Individual _____ Date Report Completed _____
US Fish and Wildlife Service Permit #_____ AZ Game and Fish Department (or other state) Permit # _____

Submit original form by August 1st. Retain a copy for your records.

Fill in the following information completely. Submit original form by August 1st. Retain a copy for your records.

Reporting Individual _____ Phone # _____
Affiliation _____ E-mail _____
Site Name_____ Date Report Completed _____

Did you verify that this site name is consistent with that used in previous years? Yes / No (circle one)
If name is different, what name(s) was used in the past? _____
If site was surveyed last year, did you survey the same general area this year? Yes / No If no, summarize in comments below.
Did you survey the same general area during each visit to this site this year? Yes / No If no, summarize in comments below.

Management Authority for Survey Area (circle one): Federal Municipal/County State Tribal Private
Name of Management Entity or Owner (e.g., Tonto National Forest) _____

Length of area surveyed: _____ (specify units, e.g., miles = mi, kilometers = km, meters = m)

Vegetation Characteristics: Overall, are the species in tree/shrub layer at this site comprised predominantly of (check one):

☐ Native broadleaf plants (entirely or almost entirely, includes high-elevation willow)

☐ Mixed native and exotic plants (mostly native)

☐ Mixed native and exotic plants (mostly exotic)

☐ Exotic/introduced plants (entirely or almost entirely)

Identify the 2-3 predominant tree/shrub species: _____

Average height of canopy (Do not put a range): _____ (specify units)

Was surface water or saturated soil present at or adjacent to site? Yes / No (circle one)
Distance from the site to surface water or saturated soil: _____ (specify units)

Did hydrological conditions change significantly among visits (did the site flood or dry out)? Yes / No (circle one)
If yes, describe in comments section below.

Remember to attach a copy of a USGS quad/topographical map (REQUIRED) of the survey area, outlining the survey site and location of WIFL detections. Also include a sketch or aerial photograph showing details of site location, patch shape, survey route in relation to patch, and location of any willow flycatchers or willow flycatcher nests detected. Such sketches or photographs are welcomed, but DO NOT substitute for the required USGS quad map. Please include photos of the interior of the patch, exterior of the patch, and overall site and describe any unique habitat features.

Comments (attach additional sheets if necessary)

_____
_____
_____
_____
_____
_____
_____

WIFL Detection Locations:

Date Detected	N UTM	E UTM	Date Detected	N UTM	E UTM

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (10–25 July)]

General Info

Study Area: _____ **Survey Site:** _____ **Date:** _____

Observer(s): _____ **early**____ **mid**____ **late**____ **other**____

Vegetation

Vegetation at site: >90% native 50–90% native 50–90% exotic >90% exotic

Canopy closure: <25% 25–50% 50–70% 70–90% >90%

Overstory height (m): _____ **Dominant overstory species:** TASP SAGO SAEX POFR Other _____

Understory height (m): _____ **Dominant understory species:** TASP SAGO SAEX PLSE Other _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

Hydrology

% of site inundated: _____

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc):
_____

Average depth of surface water:
toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils (do not include inundated areas in percentage!): _____

% of site with damp soils (do not include inundated or saturated areas): _____

If not inundated or saturated, distance (m) to standing water or saturated soil:_____

How was distance determined? Visually estimated in field Measured in field using GPS
Measured from aerial photograph Other _____

Describe type of nearest surface water: _____

Narrative and Pictorial Description

Does this description cover the entire site? Y N **If not, which portion is described?**_____
_____

On the reverse, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats:
_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____

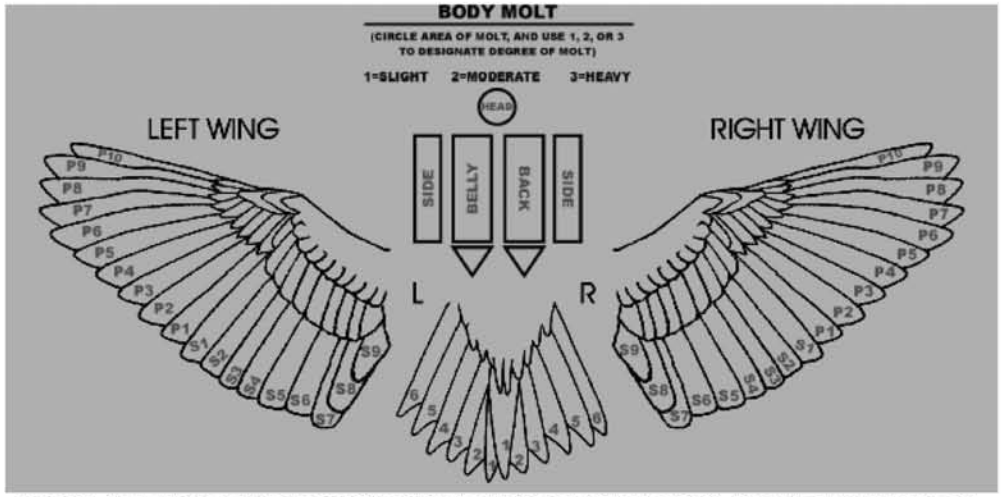
STUDY AREA: _____ **SITE**: _____ **BANDER**: _____ **DATE**: _____ **TIME**: _____ **TERR/NEST #**: _____
UTM: NAD_____ **Zone**_____ _____**E** _____**N** **NBN:** ____ of ____ WN banded **WN developmental age**:_____
NOTES:_____

FEDERAL BAND #	COLOR COMBO L	COLOR COMBO R	STATUS	SEX	CP	BP	AGE	FECAL SAMPLE? (Y or N)	GENETIC SAMPLE? (Y or N)	WING CHORD (mm)	TAIL (mm)	CULMEN LENGTH (mm)	CULMEN WIDTH (mm)	FAT

Retained Feathers Present: Yes or No (circle) – if Yes use diagram below **Active Molt**: Yes or No (circle) – if Yes use diagram below

****** If a genetic sample or metric was not taken, explain why in notes ******

STATUS: NCP = new cap passive, NCT = new cap target, RCP = recap passive, RCT = recap target, NBN = nestling banded
SEX: U = unknown, F = female, M = male
CP: 0 = non-breeding, S = partial breeding, M = full breeding
BP: 0 = none, 1 = smooth, 2 = vascularized and filled with fluid, 3 = wrinkled, 4 = molting
AGE: AHY = after hatch year; SY = second year; L = nestling banded in nest; HY = hatch year/young of the year
FAT: 0 = no fat; 1 = trace of fat in furculum, deeply concave, scattered patches, less than 5 percent filled; 2 = thin layer of fat in furculum, less than a third filled, trace of thin layer of fat in abdomen; 3 = furculum is ½ filled or more; small patches, not covering some areas, on abdomen; 4 = furculum more than 2/3 filled, level with clavicles, slightly mounded on abdomen



DETAIL ALL MOLTS AND RETAINED FEATHERS ONTO DIAGRAM AND DETAIL IN NOTES

Date:_____ Page ____ of ____

				COLOR COMBO							
OBS	STUDY AREA	TERR	NEST	LEFT LEG	RIGHT LEG	CONF LEVL	CAP?	# WIFLS	SEX	NBN (__of__)	OBSERVATIONS AND COMMENTS: discuss observations & activities. **If you assign gender, explain!**
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =

Willow Flycatcher Territory/Nest Record Form

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Territory/Nest Location:
NAD:_____ Zone:_____

Territory UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest Height:_____m (approximate)

Nest Substrate:_____(e.g., TASP=tamarisk, SAGO=Goodding willow, POFR=cottonwood, SAEX = coyote willow, etc.)

Distance to standing water or saturated soil when nest found: _____(m)

How was distance determined?_____

Date distance to water determined: _____

Depth of surface water at nest (please circle how wet you got when nest was found):

dry damp muddy toes (<5cm) ankles (5-15 cm)
calves (15-40 cm) knees (40-60 cm) thighs (60-80 cm)
waist (100 cm) too deep to wade (>100 cm)

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	B D (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No.	Presumed	Confirmed	
			Eggs
			Nestlings
			Fledglings

Cowbird

Trans dates	B D (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledgling

Outcome (Record code & describe)**:**_____:_____

_____

_____

_____

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **PA**= parasitized, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **AD**= failure, entire clutch addled/infertile; **OT**= failure due to other, or unknown, causes.

Mayfield Success

(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S**= successful; **D**= depredated; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other than predation; **A**= abandoned with host egg(s) or young; **Z**= abandoned, no (zero) eggs laid.

Willow Flycatcher Territory/Nest Record Form (continued)

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Date	Time In	Time Out	Obs	Mon Type	Stage	Adult pres.	# WE	# CE	# WN	# CN	#WF	Age Yng	Comments

LCR SWFL – Vegetation Datasheet

Observers: _____

Study area | Survey site | Plot type | ID# | UTM: E N | Acc. m | Date

Canopy height | Direct measurement m | Using clinometer Top % - Bottom % × Dist m | Ground cover N E S W | Canopy closure N S

Species	TASP single	TASP multi	TASP skipped	SAEX single	SAEX multi	SAEX skipped	SAGO single	SAGO multi	SAGO skipped	SNAG single	SNAG multi	SNAG skipped
Stem Count By cm dbh category: <1												
1–2.5												
2.6–5.5												
5.6–8												
8.1–10.5												
10.5–15												
Measured Trees >15 cm dbh												

Species	OTSP1 single	OTSP1 multi	OTSP1 skipped	OTSP2 single	OTSP2 multi	OTSP2 skipped	OTSP3 single	OTSP3 multi	OTSP3 skipped
Stem Count By cm dbh category: <1									
1–2.5									
2.6–5.5									
5.6–8									
8.1–10.5									
10.5–15									
Measured Trees >15 cm dbh									

Other species (write out full name)

OTSP1_____

OTSP2_____

OTSP3_____

If stem splits below ankle height, measure and tally each stem in "single" column. If, at ankle height or above, stem splits into multiple branches, measure and tally the biggest stem in "multi" column and record how many stems you did not measure in the "skipped" column (in the size category of the stem you measured).

If stem is not at least breast height, do not count

Vertical Foliage Sampling

CENTER PLOT							
Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1*: ____	OTSP2*: ____	OTSP3*: ____
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10-cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

Notes:

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 1m								EAST 1m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 1m								WEST 1m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 2

AR063609

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 5m								EAST 5m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 5m								WEST 5m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 2

SWFL Microclimate at Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year) – (Territory #)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Date territory first occupied: _____ **Date territory vacated** _____

New Location ID (if this logger was already in the field) _____–_____–_____

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____.
Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

SWFL Microclimate at Old Nests

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year active) – (Nest #)

UTM coordinates: E 0_ _ _ _ _ _ **N** _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

How certain are you that the logger is hanging from the fork the nest was in? (check one)

_____Nest still visible, certain of location
_____Nest gone, but found nest flag and certain of location
_____Nest gone, no nest flag, but base of nest tree flagged and nest height adequate to determine exact location
_____Nest gone, base of nest tree flagged, certain in right tree but not sure if right fork
_____Nest gone, nest tree not flagged, not certain if in right tree.
_____Other: _____

Est. actual height of logger _____ m

Comments:

Take-down: Date:_____ Time:_____ Observer(s):_____

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

Habitat Monitoring Sites

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Survey site) – (Number)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **Accuracy**: _____ m

T/RH Downloads

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

Location ID codes: Study area codes – Topock Marsh = TM, Topock Gorge = TG, Ehrenberg = EH, Cibola = CI, Imperial = IM, Mittry = MI, Yuma = YU. Survey site codes – In Between = IB, Blankenship = BK., Havasu NE = HV, Ehrenberg = EH, Three Fingers Lake = TF, Cibola Lake = CL, Walker Lake = WL, Paradise = PV, Hoge Ranch = HR, Rattlesnake = RS, Clear Lake = LK, Ferguson Lake = FL, Ferguson Wash = FW, Great Blue Heron = GB, Mittry West = MW, Gila Confluence North = GC

Microclimate at Hydro Monitoring Sites – Topock

Study Area _TOPO___ Survey Site _____ LOCATION ID: TM –HM–_____
(Location ID)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____.
Column 1: _____ Column 2: _____ Column 3:_____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

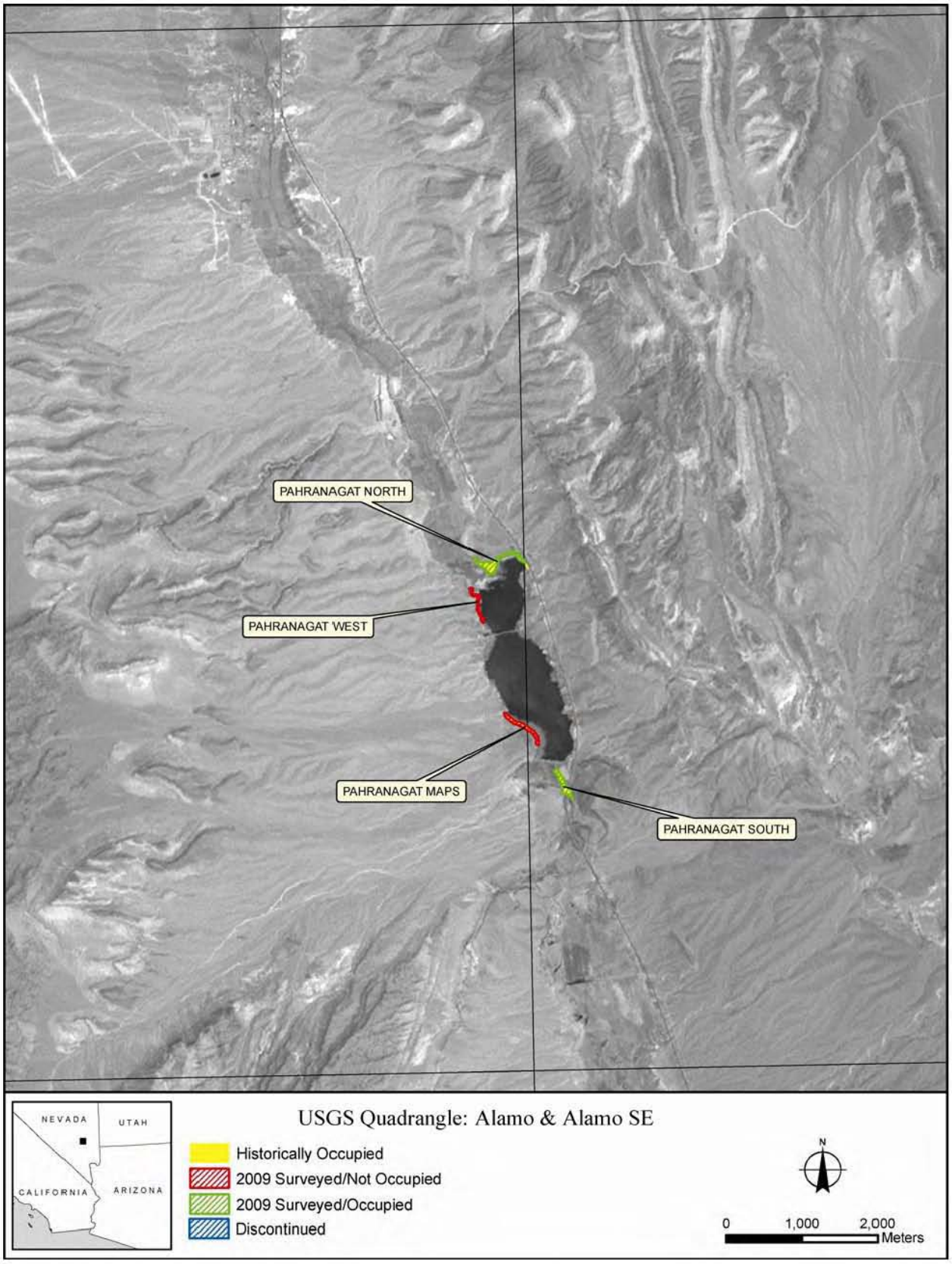
Soil moisture data collected on the following dates (enter SM data directly into database):

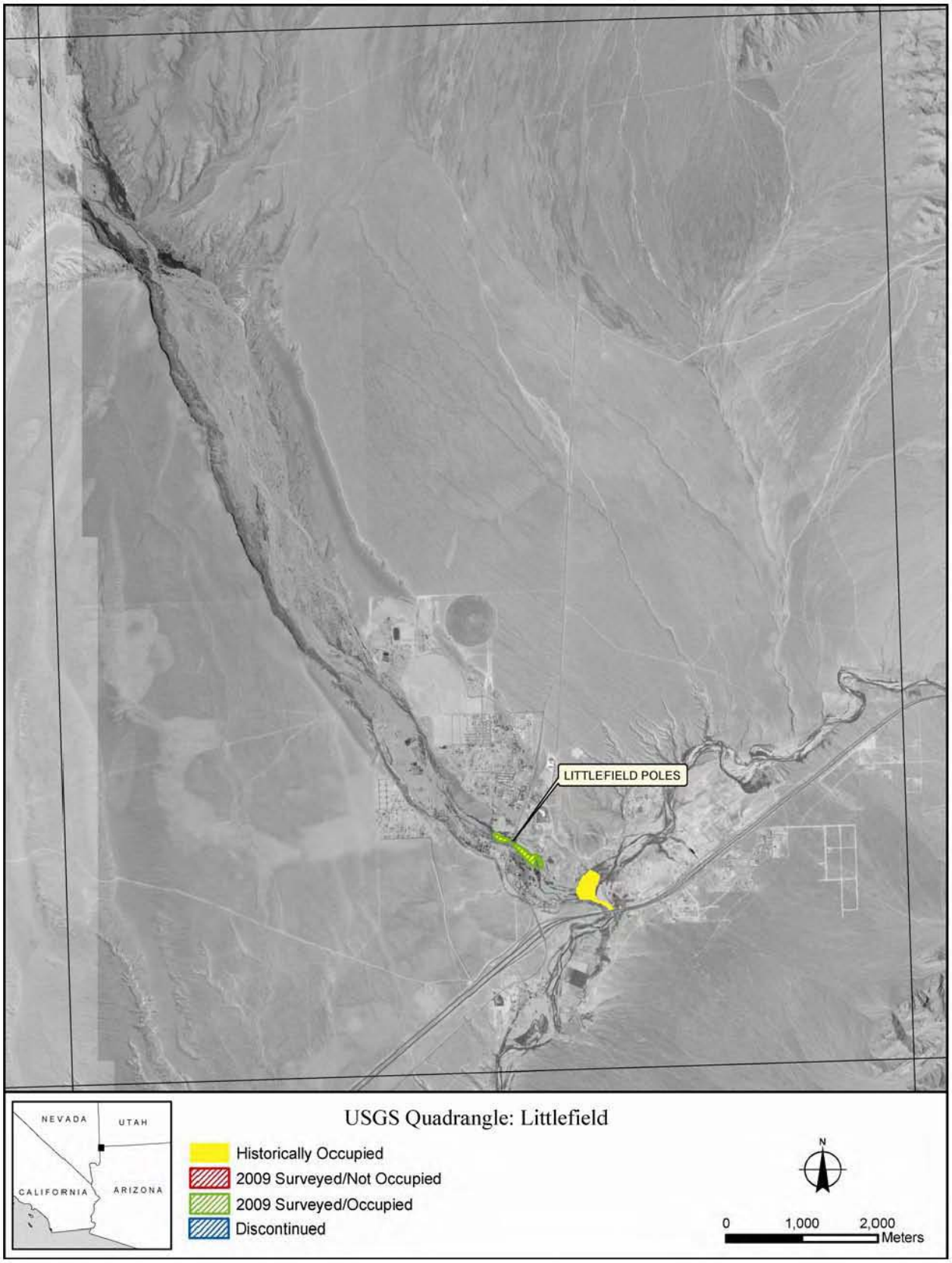
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____

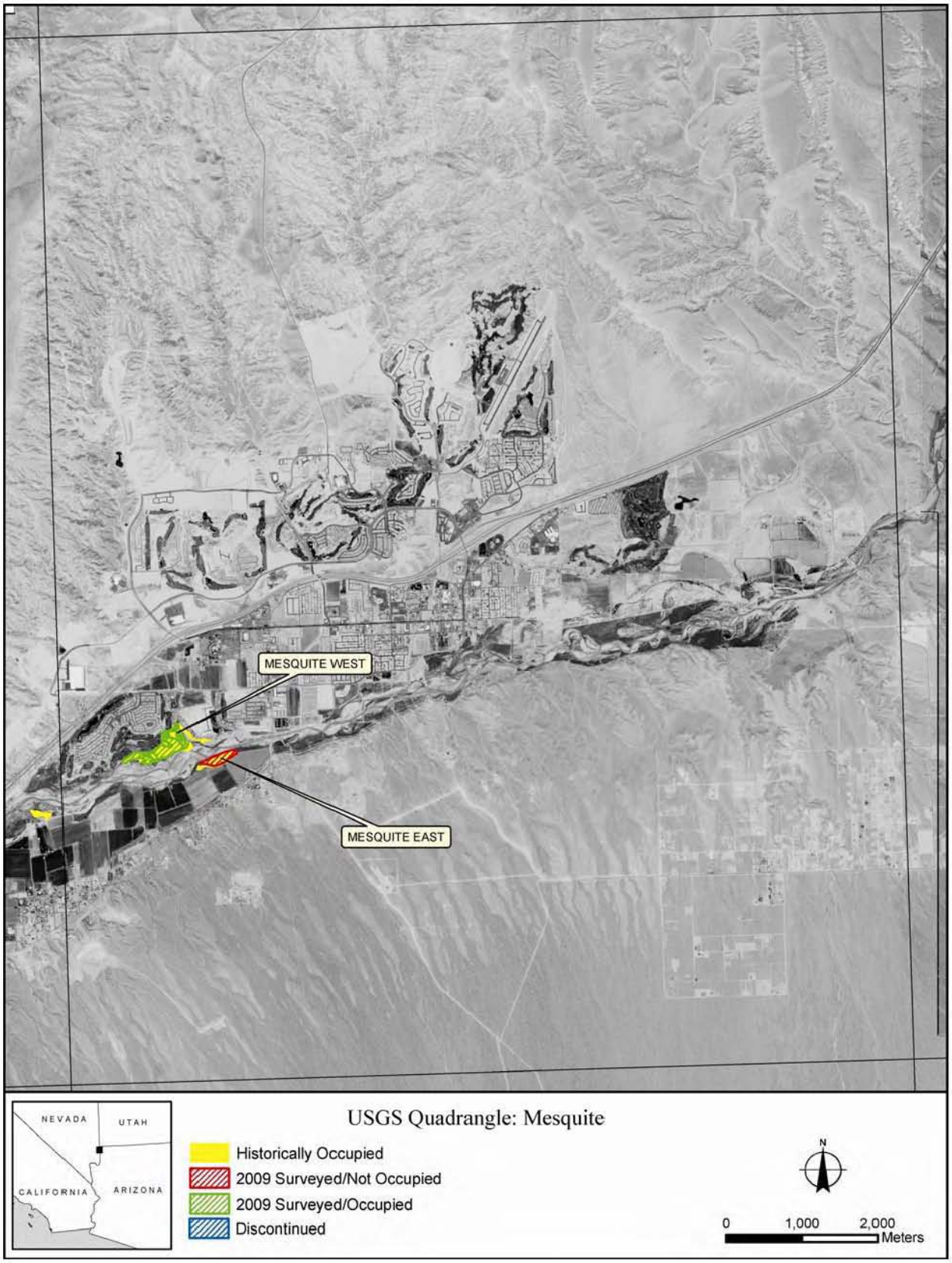
Appendix B

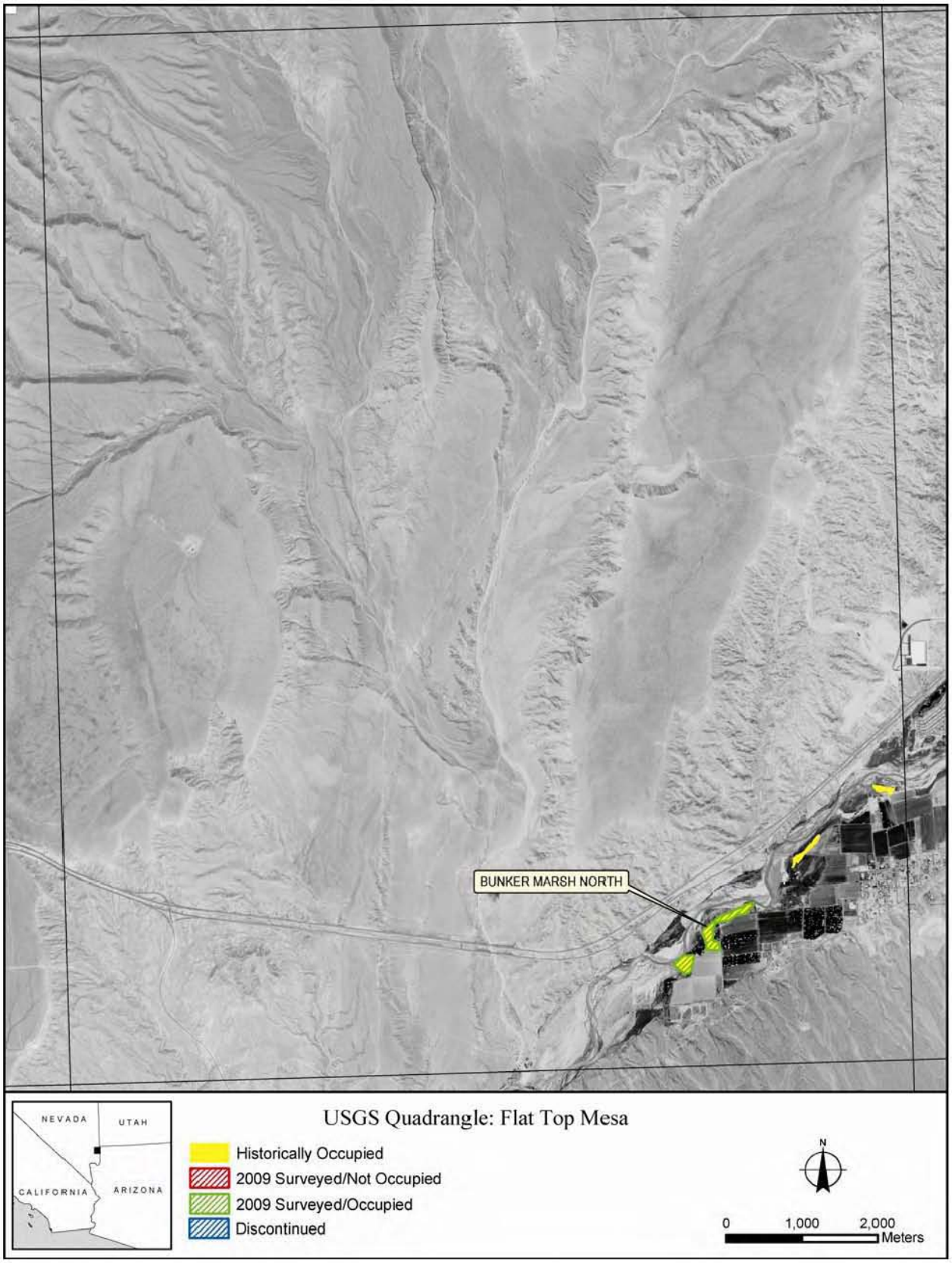
ORTHOPHOTOS SHOWING STUDY SITES

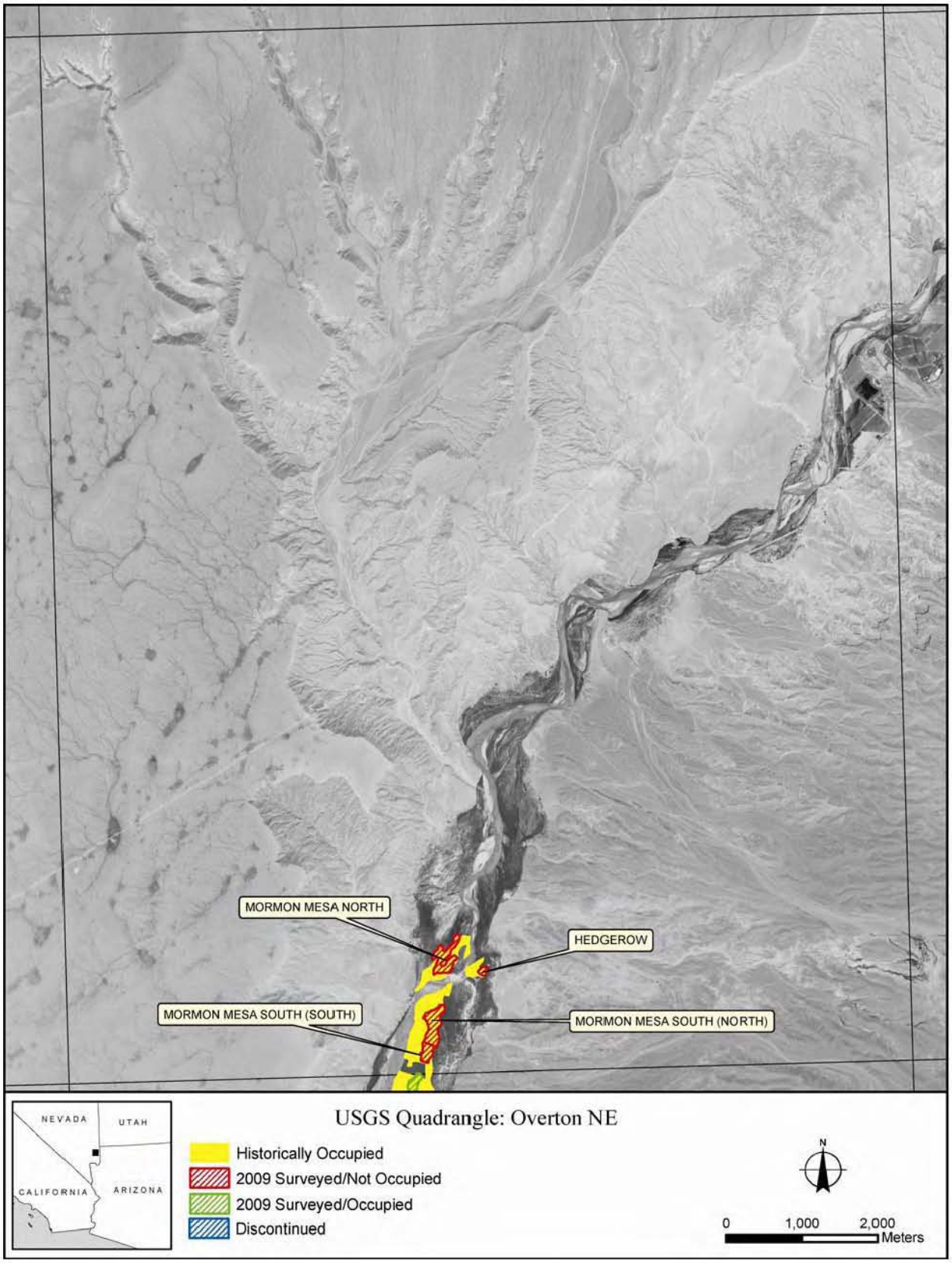

NEVADA
UTAH
CALIFORNIA
ARIZONA
MEXICO
PAHRANAGAT NWR
LITTLEFIELD
St. George
MESQUITE
Virgin River
Pahranagat Wash
MORMON MESA
MUDDY RIVER
Las Vegas
Lake Mead
Colorado River
Lake Mohave
Kingman
Flagstaff
TOPOCK MARSH
TOPOCK GORGE
Lake Havasu
Verde River
BILL WILLIAMS RIVER NWR
Bill Williams River
AHAKHAV
Colorado River
Palm Springs
BIG HOLE SLOUGH
Quartzsite
PVER
Salton Sea
Phoenix
CIBOLA NWR
IMPERIAL NWR
MITTRY LAKE
Gila River
Yuma
YUMA
Pacific Ocean
Gulf Of California
Lower Colorado River Southwestern
Willow Flycatcher Study 2009
City/Town
Study Area
Highway
N
0 25 50 75 Miles

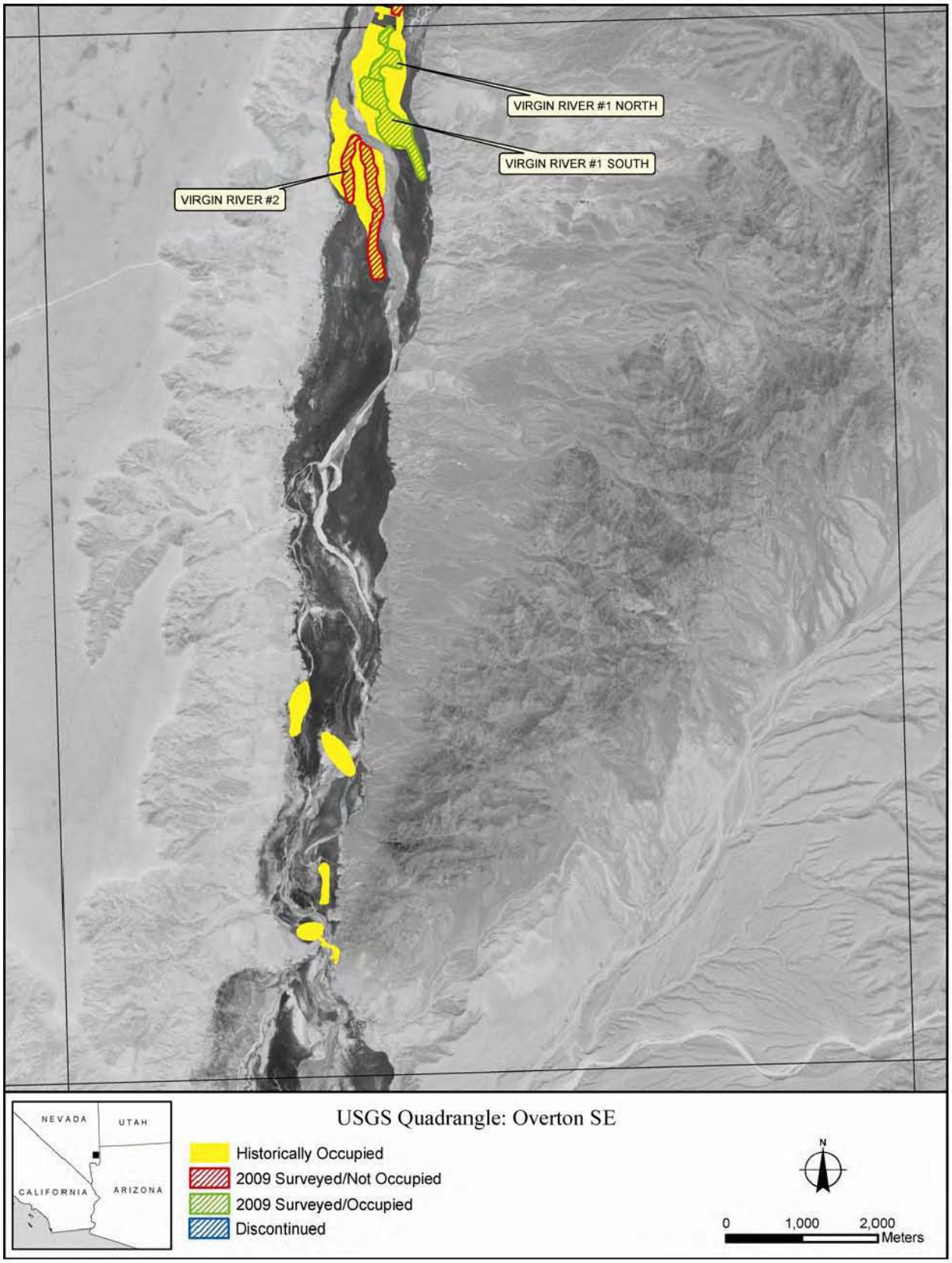

PAHRANAGAT NORTH
PAHRANAGAT WEST
PAHRANAGAT MAPS
PAHRANAGAT SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Alamo & Alamo SE
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

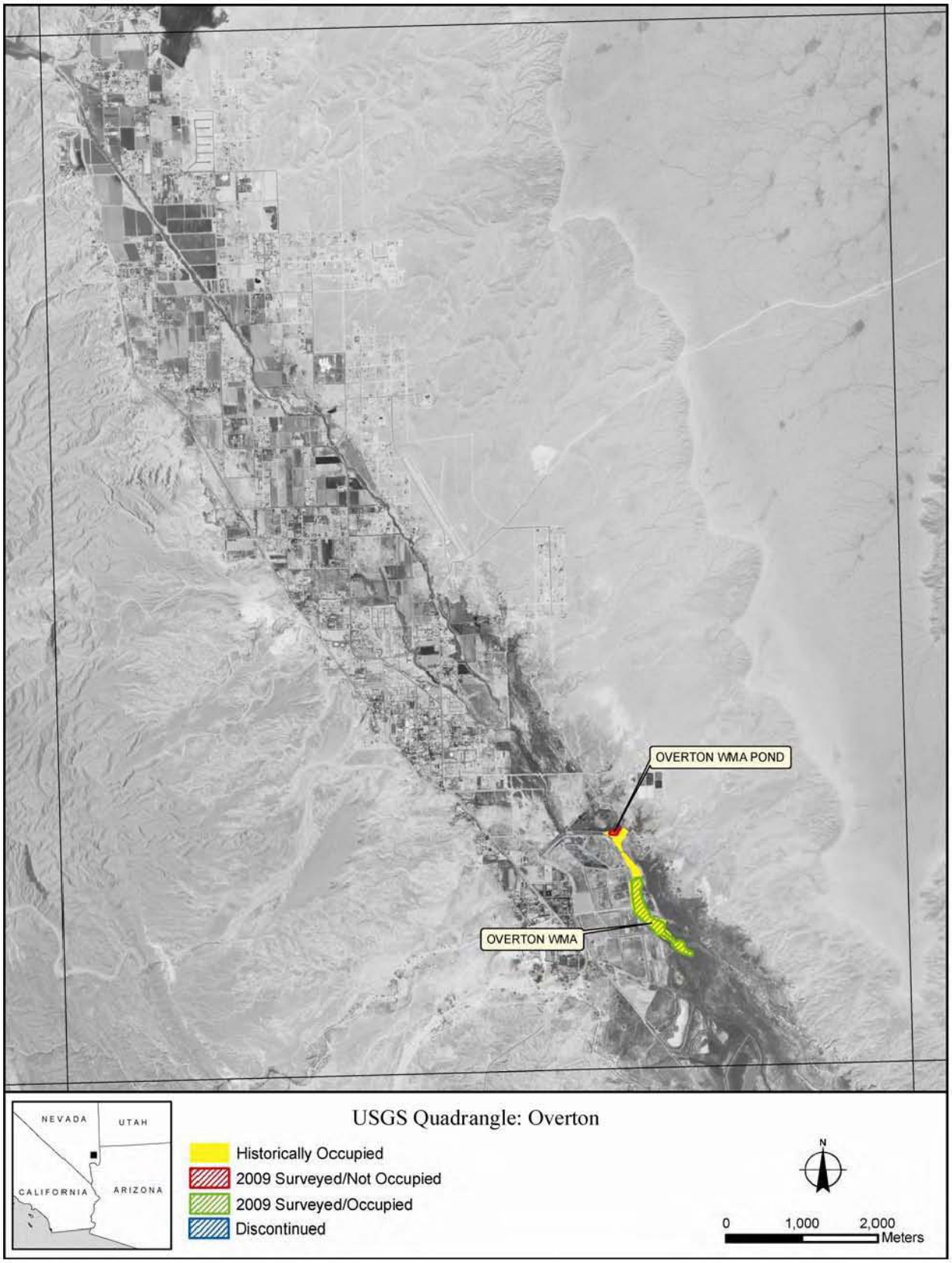

LITTLEFIELD POLES
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Littlefield
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

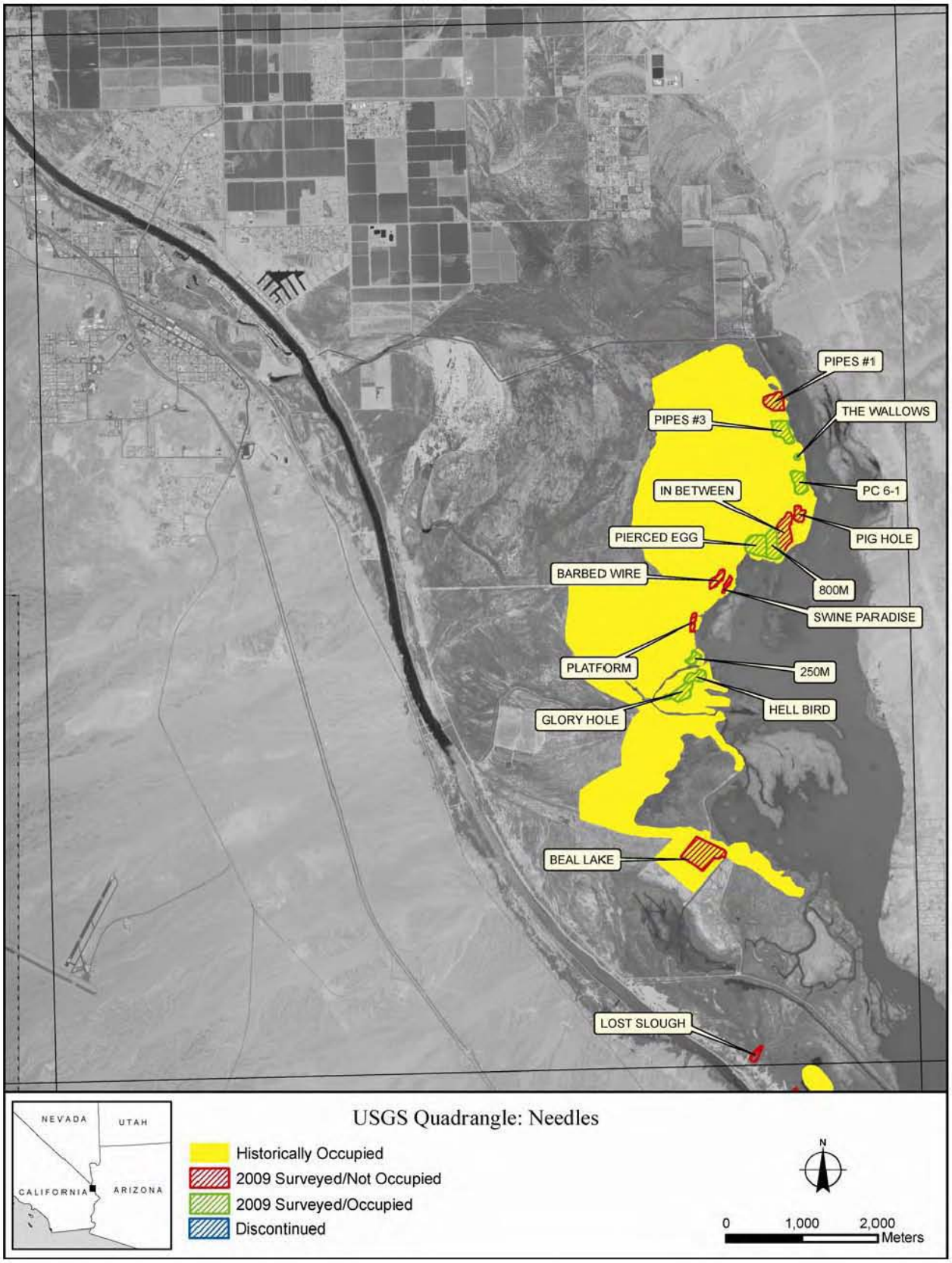

MESQUITE WEST
MESQUITE EAST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Mesquite
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

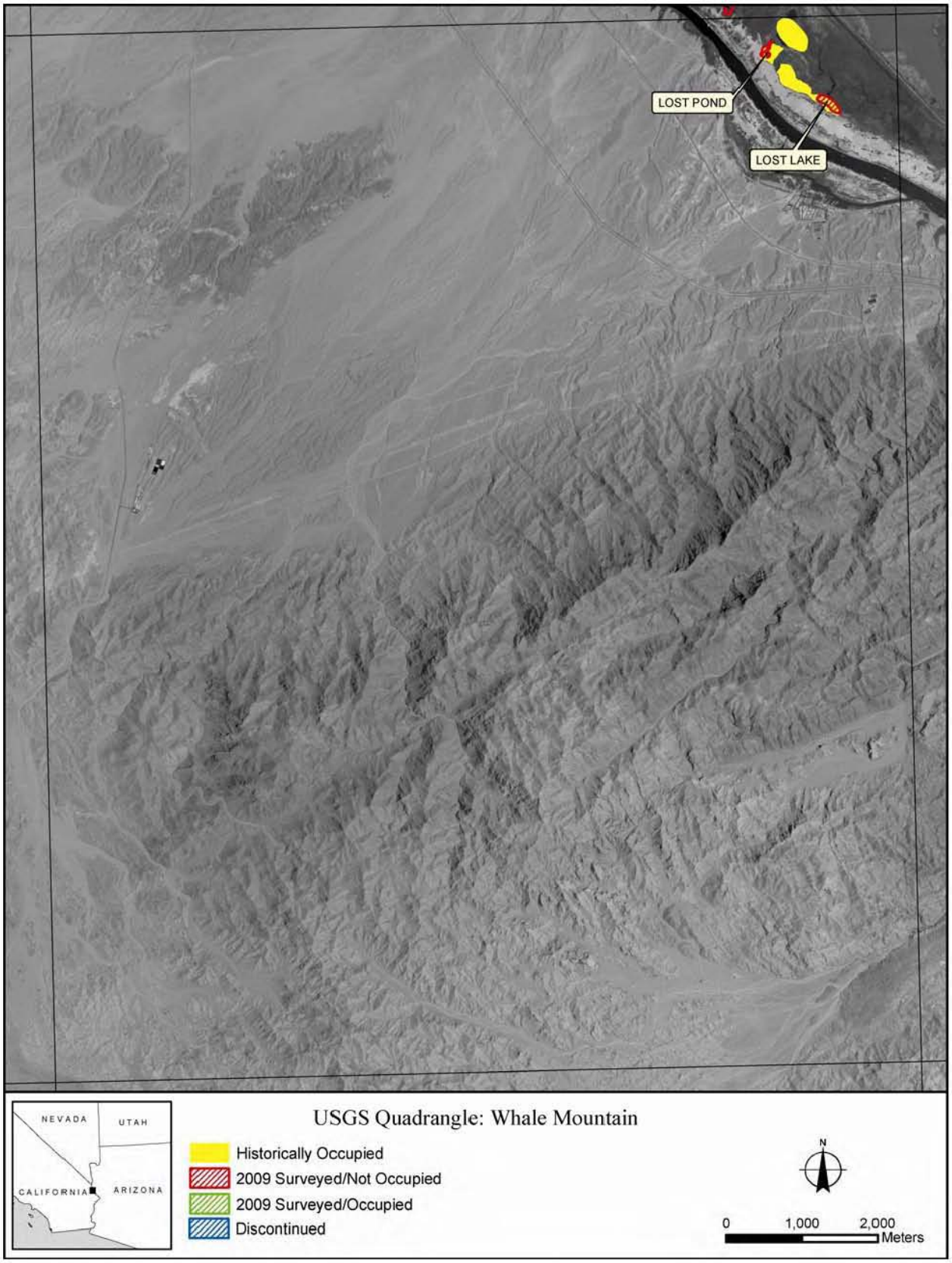

BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Flat Top Mesa
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

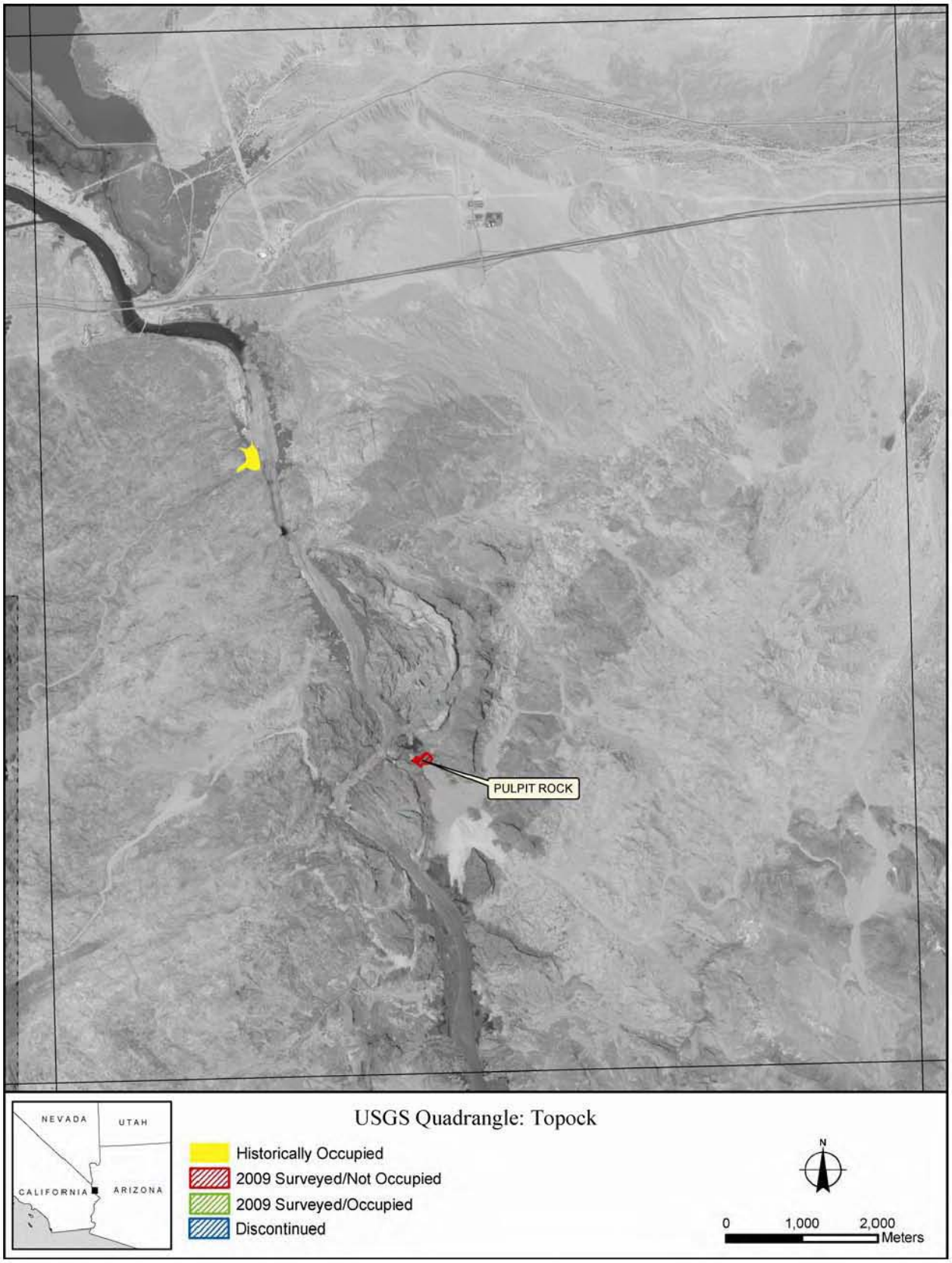

MORMON MESA NORTH
HEDGEROW
MORMON MESA SOUTH (SOUTH)
MORMON MESA SOUTH (NORTH)
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton NE
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

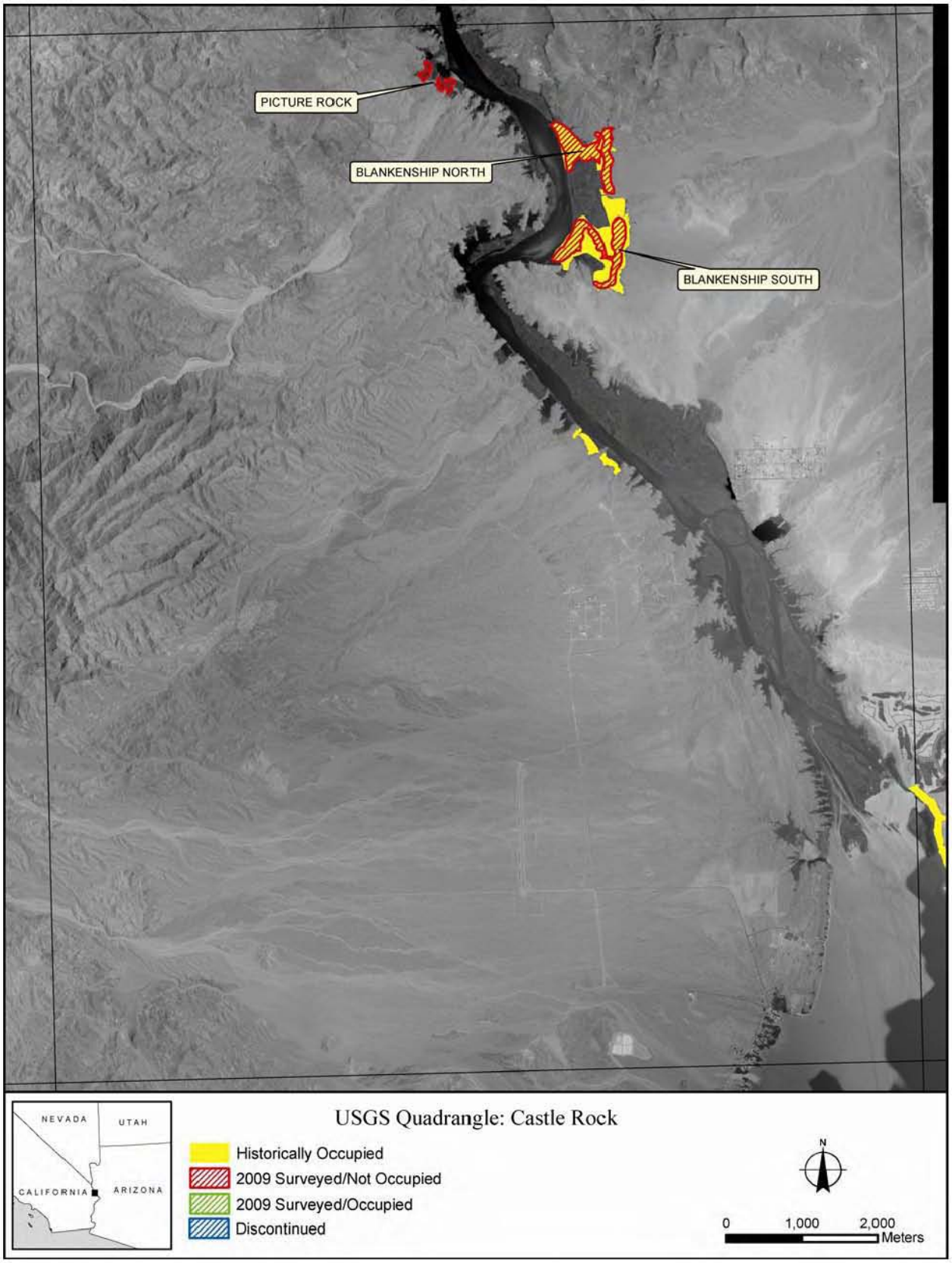

VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton SE
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

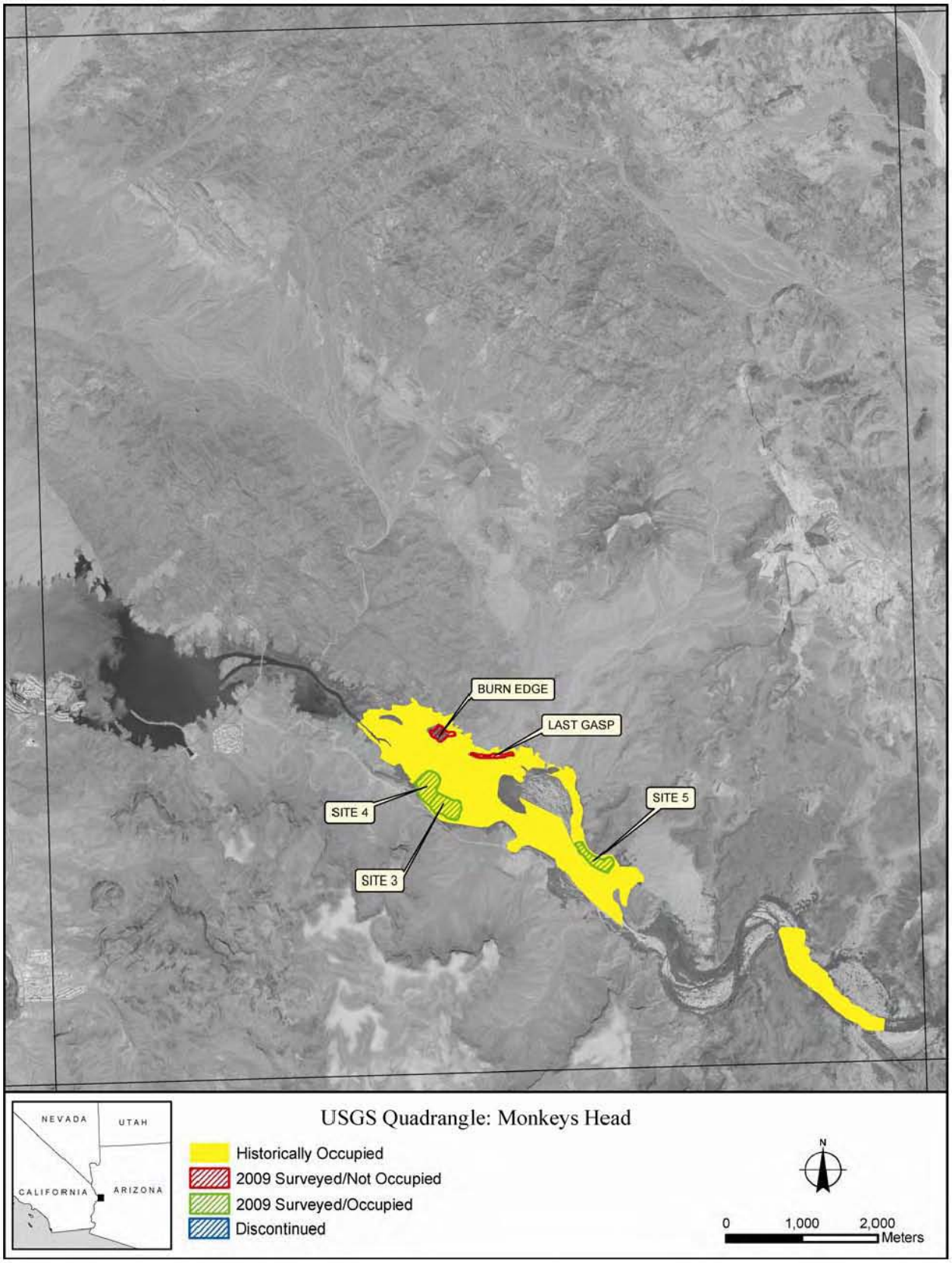

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

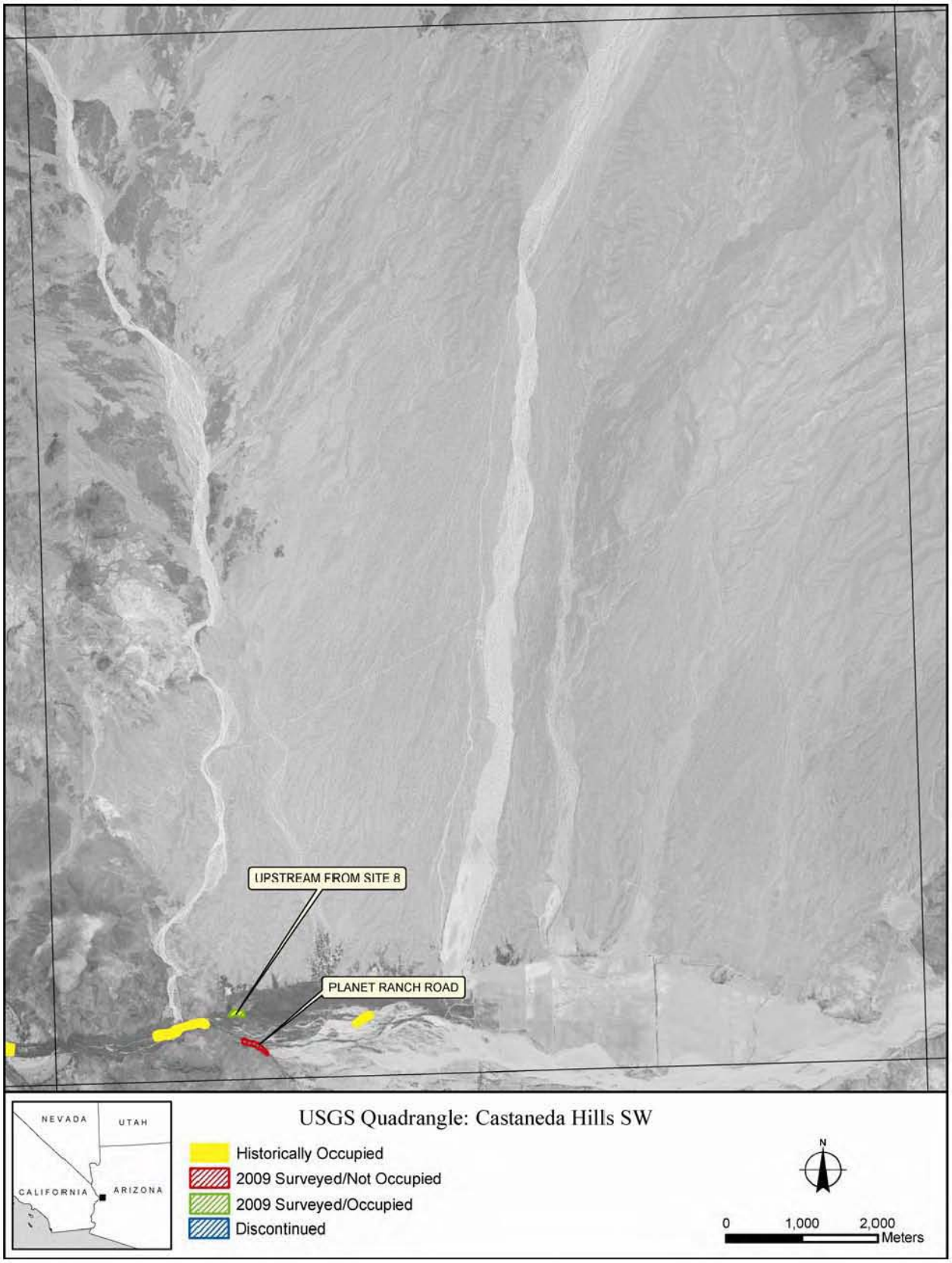

PIPES #1
THE WALLOWS
PIPES #3
PC 6-1
IN BETWEEN
PIG HOLE
PIERCED EGG
800M
BARBED WIRE
SWINE PARADISE
PLATFORM
250M
HELL BIRD
GLORY HOLE
BEAL LAKE
LOST SLOUGH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

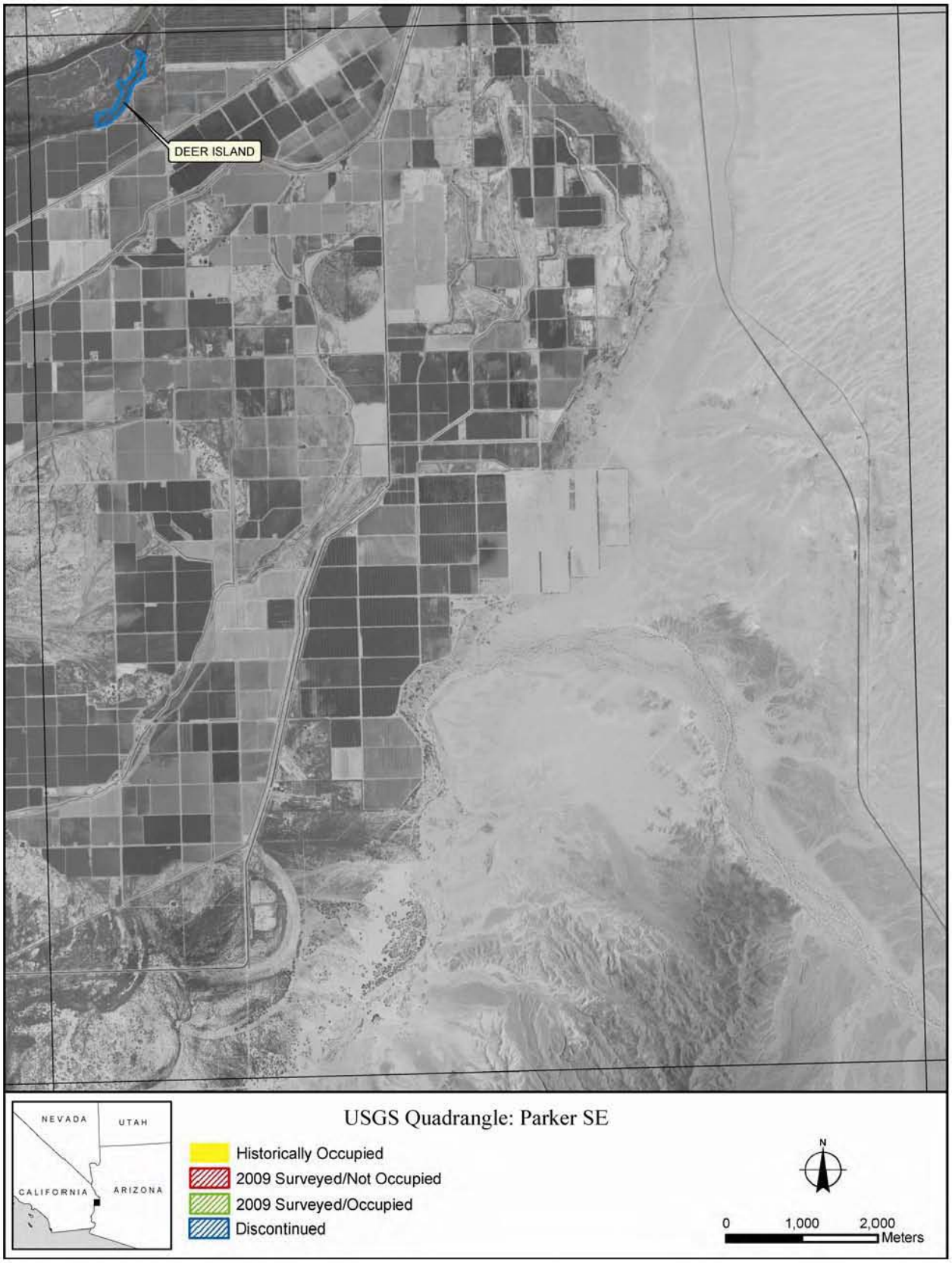

LOST POND
LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

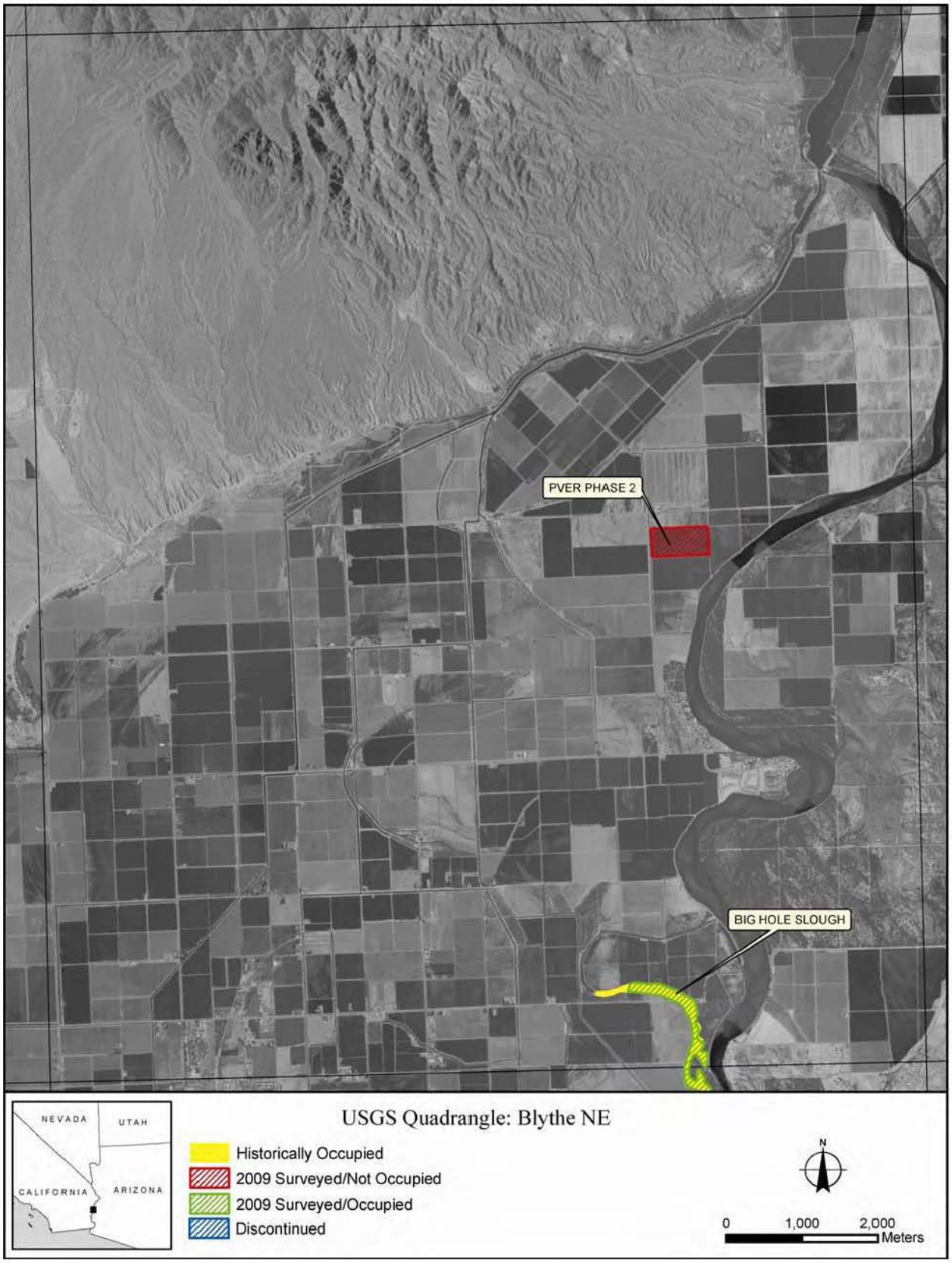

PULPIT ROCK
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Topock
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


PICTURE ROCK
BLANKENSHIP NORTH
BLANKENSHIP SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castle Rock
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

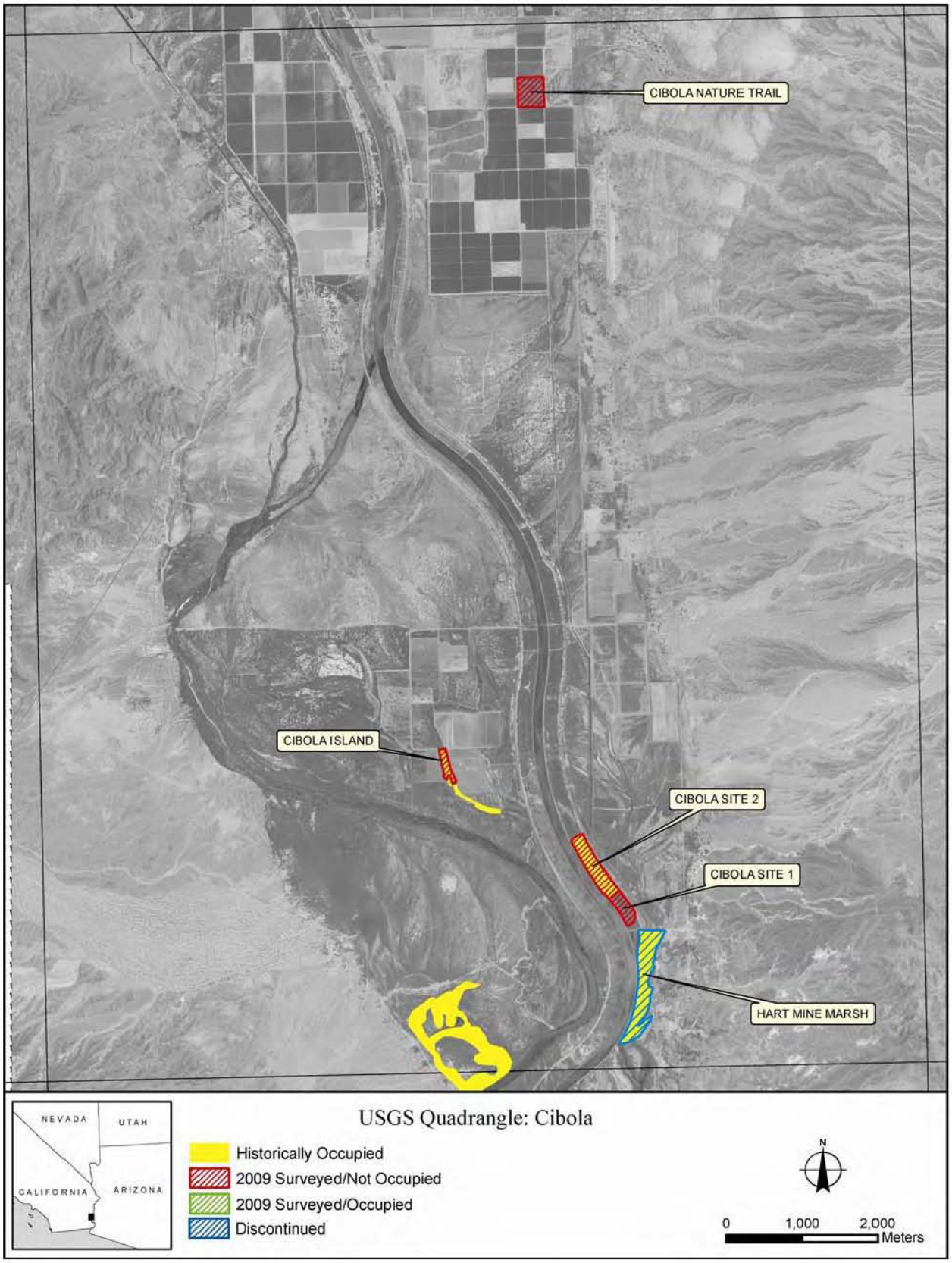

BURN EDGE
LAST GASP
SITE 4
SITE 5
SITE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

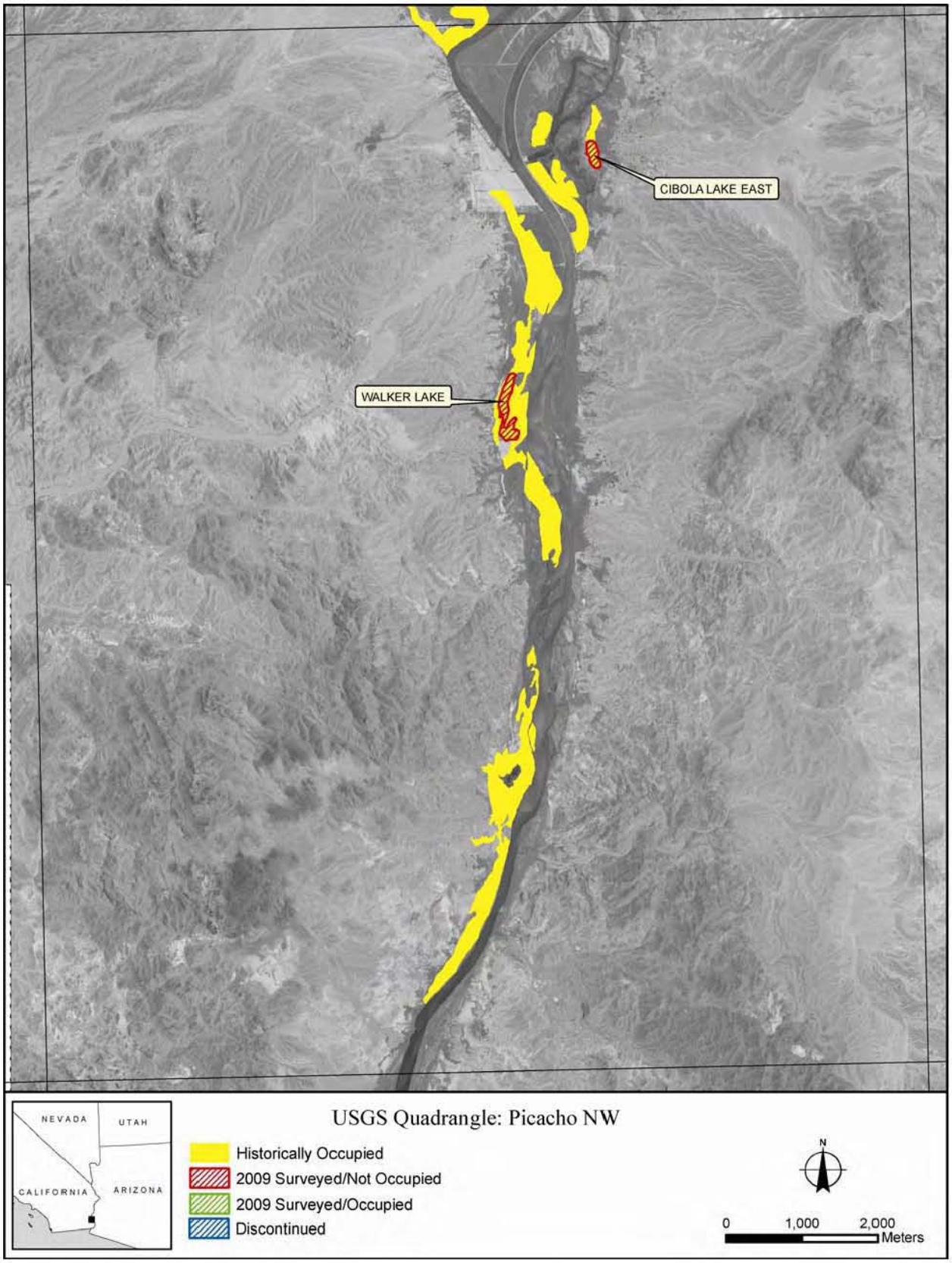

UPSTREAM FROM SITE 8
PLANET RANCH ROAD
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

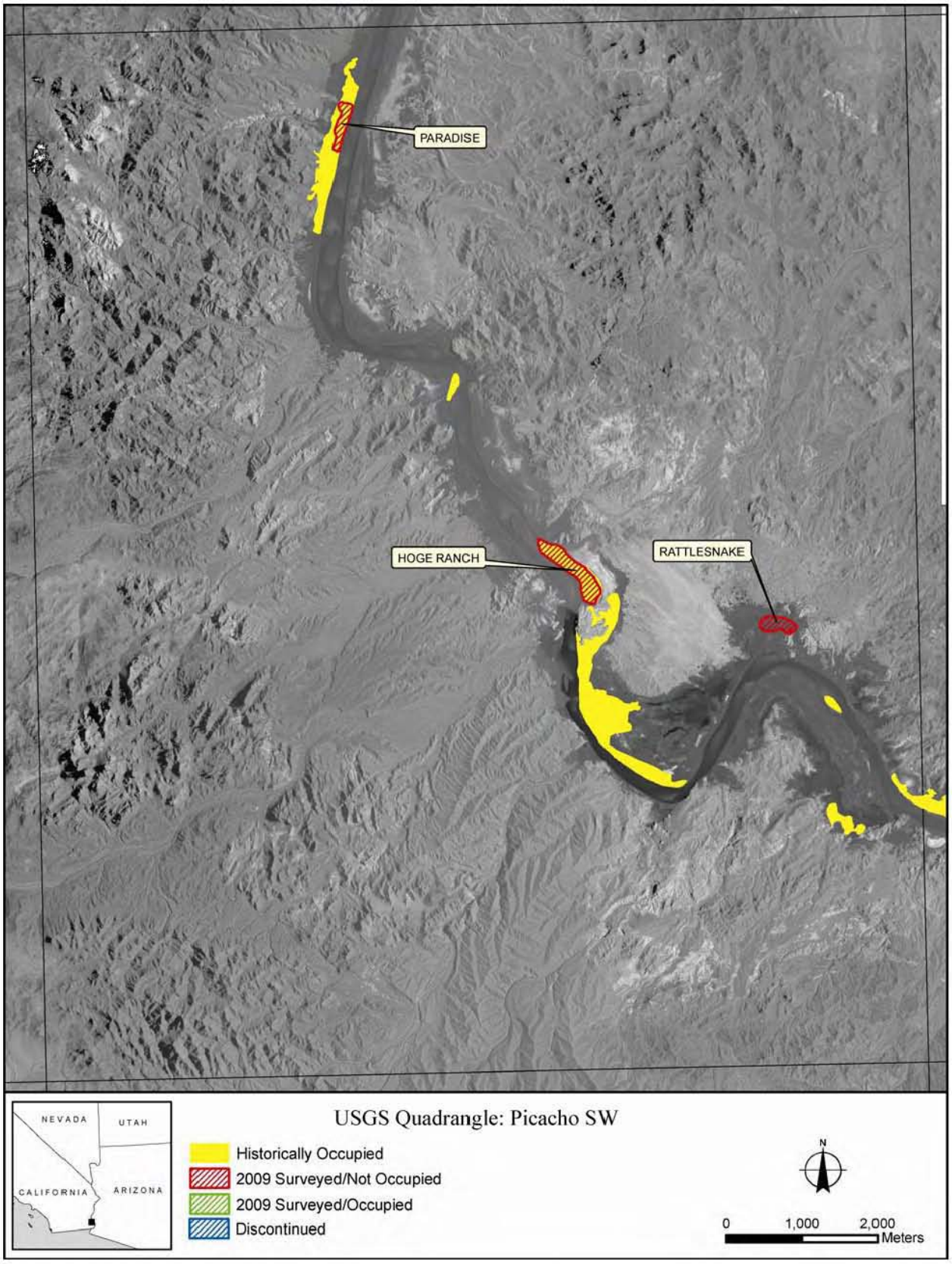

DEER ISLAND
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Parker SE
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

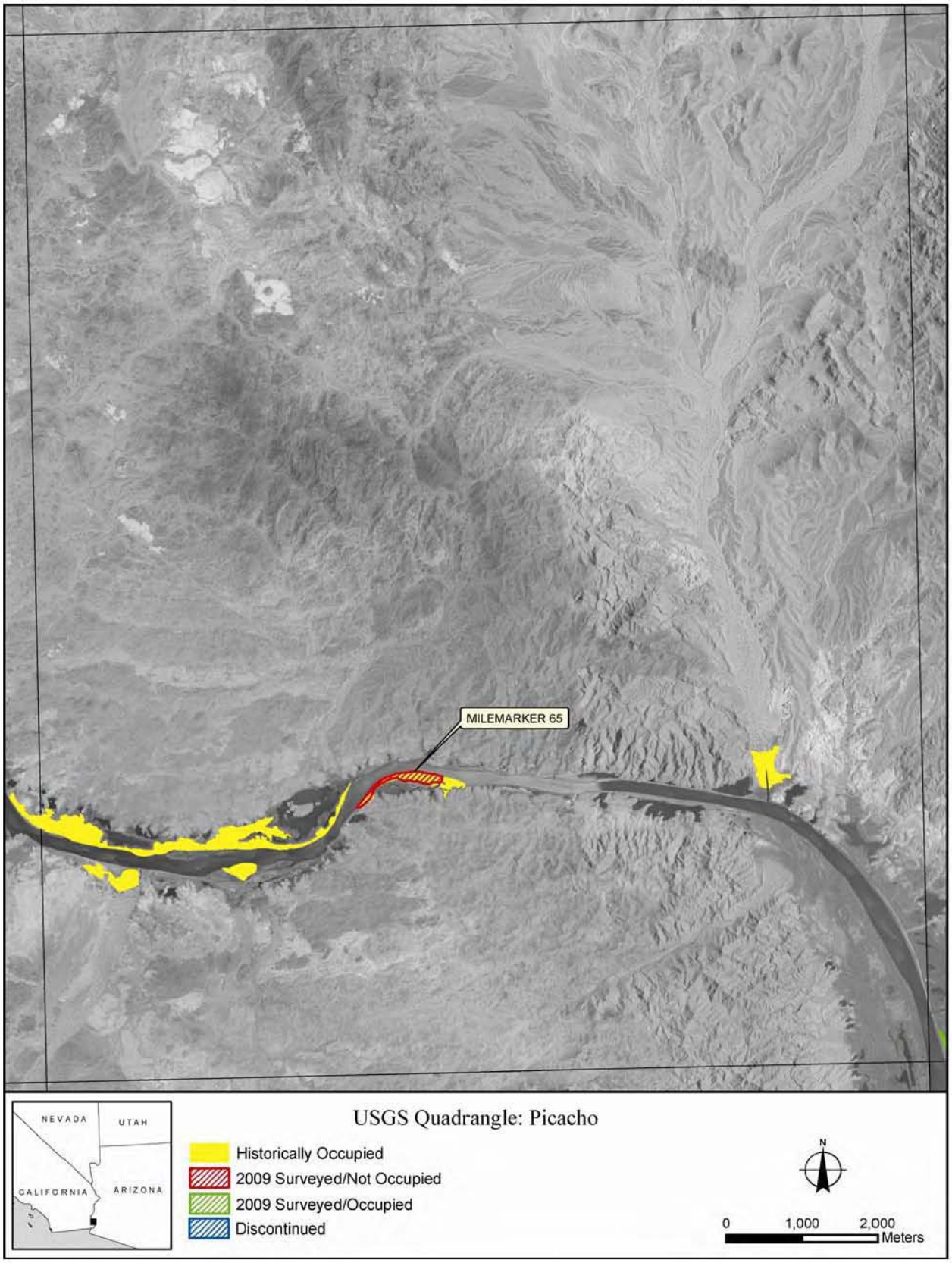

PVER PHASE 2
BIG HOLE SLOUGH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

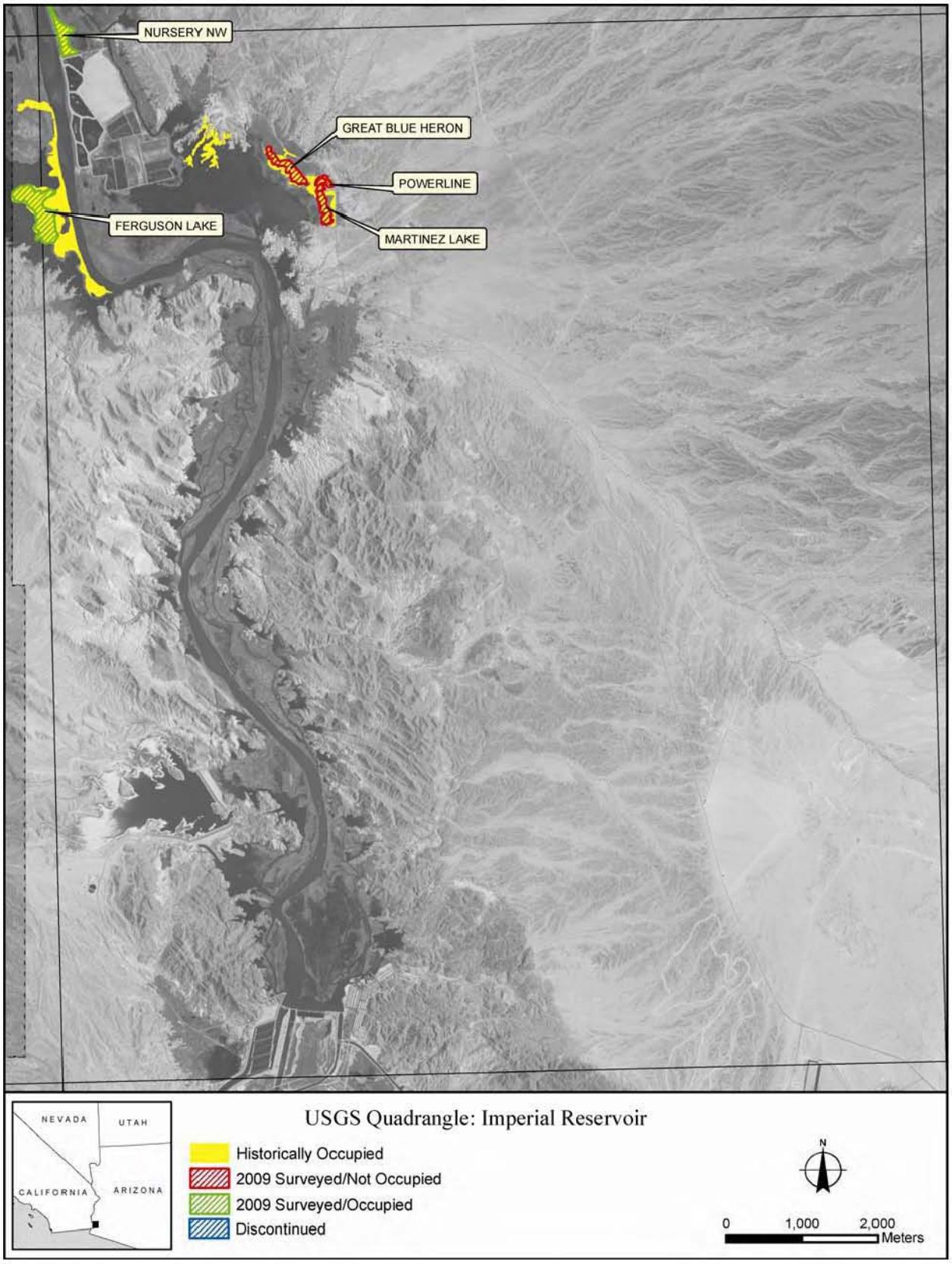

CVCA PHASE 1
CVCA PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

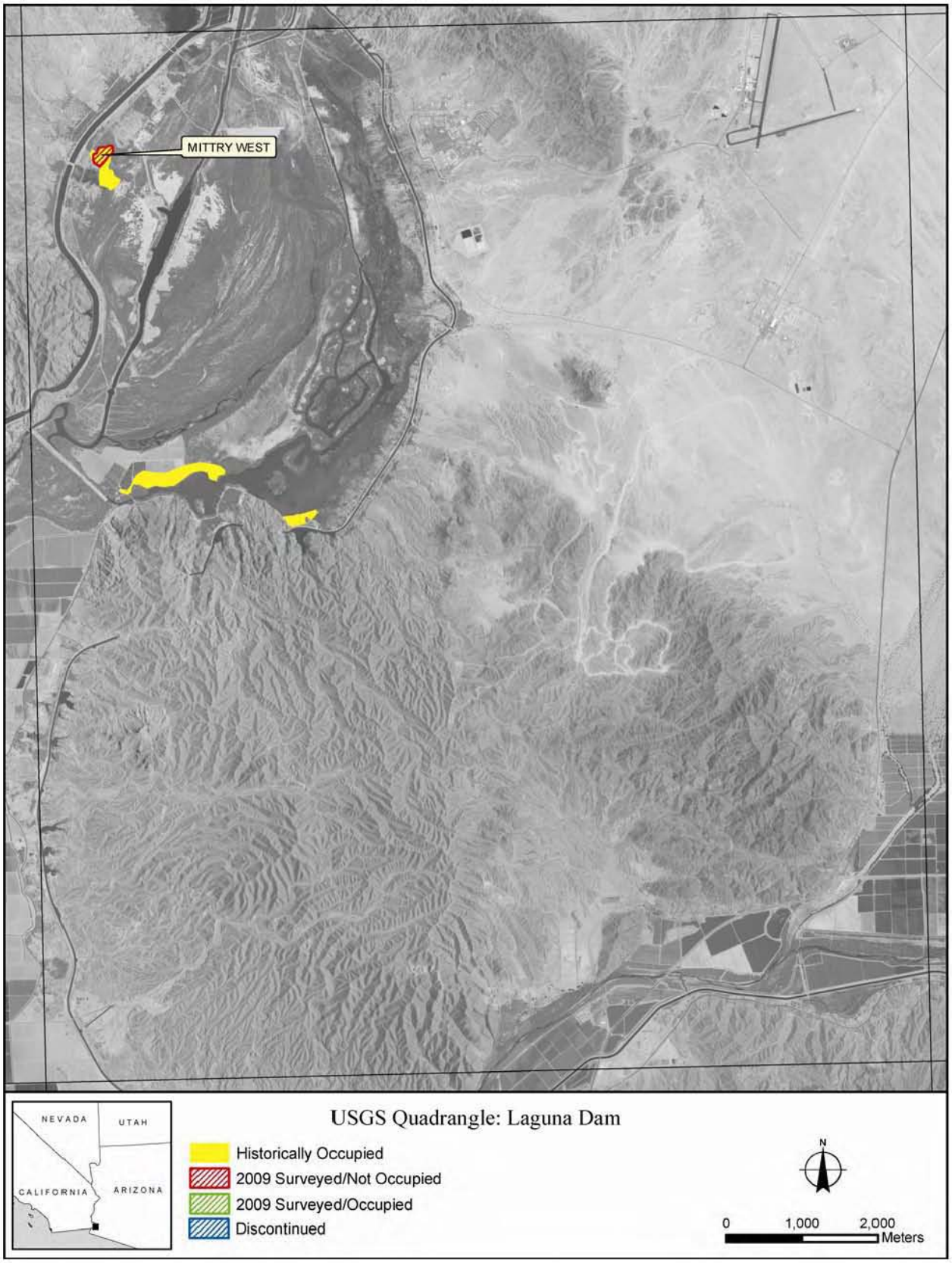

CIBOLA NATURE TRAIL
CIBOLA ISLAND
CIBOLA SITE 2
CIBOLA SITE 1
HART MINE MARSH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


CIBOLA LAKE EAST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


PARADISE
HOGE RANCH
RATTLESNAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


MILEMARKER 65
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


NURSERY NW
GREAT BLUE HERON
POWERLINE
FERGUSON LAKE
MARTINEZ LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


MITTRY WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


FORTUNA NORTH
GILA RIVER SITE 2
FORTUNA SITE 1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Fortuna
Historically Occupied
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

Appendix C

DETECTIONS OF SPECIAL CONCERN SPECIES, 2009

Appendix C. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2009

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
PAHR	North	0	0	0	0	0	0	0	0	0	85	1	4
	West	0	0	0	0	0	0	0	1	2	25	0	5
	MAPS	0	0	0	0	0	0	0	0	0	35	0	4
	South	0	0	0	0	0	0	0	0	1	16	0	18
LIFI	Poles	0	0	0	0	0	0	0	0	0	59	10	5
MESQ	East	0	0	0	0	0	0	0	0	1	75	1	40
	West	0	0	0	0	0	0	0	0	1	36	0	3
	Bunker Marsh	0	1	0	0	0	0	0	0	2	43	0	38
MOME	Mormon Mesa North	0	0	0	0	0	0	0	0	13	88	0	66
	Hedgerow	0	0	0	0	0	0	0	0	2	21	0	10
	Mormon Mesa South	0	0	0	0	0	0	0	0	24	114	1	97
	Virgin River #1	0	0	0	0	0	0	0	0	15	201	1	235
	Virgin River #2	0	0	1	0	0	0	0	0	21	197	1	209
MUDD	Overton WMA Pond	0	0	0	0	0	0	0	0	0	26	0	6
	Overton WMA	0	0	0	0	0	0	0	0	4	66	0	50
TOPO	Pipes #1	0	0	0	0	0	0	0	0	0	0	2	18
	Pipes #3	0	0	0	0	0	0	1	0	0	1	1	19
	The Wallows	0	0	0	0	0	0	0	0	5	8	4	14
	PC6-1	0	0	0	0	0	0	5	0	1	8	1	29
	Pig Hole	0	0	0	0	0	0	0	0	0	0	0	7
	In Between	0	0	0	0	0	0	0	0	0	3	1	15
	800M	0	0	0	0	0	0	0	0	0	4	1	12
	Pierced Egg	0	0	0	0	0	0	3	0	0	7	4	17
	Swine Paradise	0	0	0	0	0	0	0	0	0	7	4	14
	Barbed Wire	0	0	0	0	0	0	1	0	0	4	4	20
	Platform	0	0	0	0	0	0	0	0	0	3	2	7
	250M	0	1	0	0	0	0	7	0	0	7	3	13
	Hell Bird	0	2	0	0	0	0	10	0	0	23	6	57
	Glory Hole	1	0	0	0	0	0	2	0	0	4	4	11

AR063644

Study Area[1]	Survey Site	Special Concern Species[2]										
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
TOPO	Beal Lake	0	1	0	0	0	0	0	0	36	9	1	21
	Lost Slough	0	0	0	0	0	0	0	0	1	2	0	10
	Lost Pond	0	0	0	0	0	0	0	0	0	3	0	2
	Lost Lake	0	0	0	0	0	0	0	0	1	3	1	10
TOGO	Pulpit Rock	0	0	0	0	0	0	0	0	0	0	0	4
	Picture Rock	0	1	0	0	0	0	0	0	2	8	1	14
	Blankenship Bend North	2	3	0	0	0	0	0	0	13	0	2	38
	Blankenship Bend South	4	4	4	0	0	0	0	0	9	0	0	25
BIWI	Burn Edge	0	0	0	0	0	0	13	0	7	3	0	31
	Site #4	0	0	0	1	0	0	2	0	32	31	3	66
	Site #3	0	0	0	0	0	0	6	0	8	26	4	50
	Last Gasp	0	0	0	0	0	0	8	0	22	0	1	61
	Site #5	0	0	0	3	0	0	13	0	10	7	2	30
	Upstream from Site #8	3	0	1	5	0	0	6	0	3	5	0	14
	Planet Ranch Road	0	0	0	4	0	0	1	0	23	21	1	19
AHAK	Deer Island	0	0	1	0	0	0	0	0	1	0	0	3
PVER	PVER Phase 2	0	0	0	0	0	0	0	0	2	3	0	5
BIHO	Big Hole Slough	0	0	0	0	0	0	1	0	0	0	0	12
CIBO	CVCA Phase 1	0	0	0	0	0	0	0	0	0	21	0	9
	CVCA Phase 3	0	0	0	0	0	0	0	0	0	5	0	2
	Cibola Nature Trail	0	0	0	0	0	0	0	0	2	4	0	7
	Cibola Island	0	0	0	0	0	0	0	0	0	3	1	7
	Cibola Site #2	0	0	0	0	0	0	1	0	0	0	0	12
	Cibola Site #1	0	0	0	0	0	0	3	0	0	0	0	14
	Hart Mine Marsh	0	3	2	0	0	0	2	0	0	0	0	7
	Cibola Lake #2 (East)	0	1	0	0	0	0	0	0	0	0	0	10
	Walker Lake	0	0	0	0	0	0	5	0	0	0	0	18
IMPE	Paradise	0	0	0	0	0	0	7	0	0	0	0	12
	Hoge Ranch	0	0	0	0	0	0	1	0	0	0	3	25

Study Area[1]	Survey Site	Special Concern Species[2]										
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
IMPE	Rattlesnake	0	0	0	0	0	0	0	0	0	2	3	22
	Milemarker 65	0	0	0	0	0	0	0	0	0	0	0	7
	Nursery NW	0	0	0	0	0	0	0	0	0	0	1	24
	Ferguson Lake	0	2	5	0	0	0	8	0	0	0	0	25
	Great Blue Heron	0	0	1	0	0	0	4	0	1	3	0	31
	Powerline	0	1	1	0	0	0	3	0	0	0	0	15
	Martinez Lake	0	0	0	0	0	0	2	0	0	0	1	11
MITT	Mittry West	0	0	0	0	0	0	5	0	1	1	0	15
YUMA	Gila River Site #2	0	0	0	0	0	0	1	0	0	1	0	5
	Fortuna Site #1	0	1	0	0	0	0	1	0	0	3	0	9
	Fortuna North	0	1	2	0	0	0	0	0	0	0	0	2

[1] PAHR = Pahranagat NWR; LIFI = Littlefield; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams River NWR; AHAK = Ahakhav Tribal Preserve; PVER = Palo Verde Ecological Reserve; BIHO = Big Hole Slough; CIBO = Cibola NWR; IMPE = Imperial NWR; MITT = Mittry Lake; YUMA = Yuma.

[2] BLRA = Black Rail, CLRA = Clapper Rail, LEBI = Least Bittern, YBCU = Yellow Billed Cuckoo, ELOW = Elf Owl, GIFL = Gilded Flicker, GIWO = Gila Woodpecker, VEFL = Vermilion Flycatcher, BEVI = Bell's Vireo, YWAR = Yellow Warbler, SUTA = Summer Tanager, YBCH = Yellow-breasted Chat.

Appendix D

ALL WILLOW FLYCATCHERS COLOR-BANDED AND/OR RESIGHTED, 2003–2009

Appendix D. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2009. Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA.

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1490-89889	M	J							R		D	D	D	D	
1590-97338	M	A	P				P	P	P	P					
1710-20312	M	J							R		T				
1710-20638	M	A		G	M	M	M	M	M	M	M				
2090-42022	F	J		M					Q						
2110-78841	F	J						T	T	T	T				
2110-78842	M	A						Q	Q	Q					
2110-78855	M	J						T	T						
2110-78861	M	J						T	M[4]	Q					
2110-78863	M	J						T	T	T					
2140-66502	M	J						Q	Q						
2140-66503	F	J						Q		Q					
2140-66517	F	A						Q	Q	Q	D				
2140-66518	M	A						Q	Q						
2140-66561	M	A						P			P	P	P	P	
2140-66564	F	J						P	P						
2140-66566	M	J						P			P				
2140-66568	M	A						P	P		P	P	P	P	
2140-66606	M	J		M		Q	Q		Q						
2140-66621	F	A				P	P	P	P	P					
2140-66627	F	A				P	P	P		P					
2140-66690	F	J					P								S
2140-66693	M	J					M	Q	Q						
2140-66696	F	J					Q		Q						
2140-66697	M	J					Q			P	P	P	P	P	P
2140-66709	M	A						Q	Q	Q		Q[5]	M	M	M
2140-66728	M	J					T			T					
2140-66743	M	J			T					T					
2140-66775	M	J				T	M		Q	Q	Q				
2190-76604	M	A					P		P	P	P	P			
2320-31401	M	A							B						
2320-31402	M	A							B						
2320-31403	M	A							Y						
2320-31404	F	A							B						
2320-31405	F	A							B						
2320-31406	U	J							B						
2320-31407	F	J							B	T					
2320-31408	U	J							B						
2320-31409	U	J							B						
2320-31410	U	J							B						
2320-31411	U	J							B						
2320-31412	M	A							B	B					
2320-31413	U	A							Q						

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2320-31414	M	A								T	T				
2320-31415	F	A								T					
2320-31416	U	J								T					
2320-31417	U	J								T					
2320-31418	M	A								T	T				
2320-31419	U	J								T					
2320-31420	U	J								T					
2320-31421	U	J								T					
2320-31422	U	J								T					
2320-31423	U	A								T					
2320-31424	M	J								T	T				
2320-31425	U	J								T					
2320-31426	F	A							M						
2320-31427	M	A							M						
2320-31428	M	J							Q	M	Q[6]		M	M	
2320-31429	U	J							Q						
2320-31430	U	J							P						
2320-31431	U	J							Q						
2320-31432	U	J							P						
2320-31433	U	J							Q						
2320-31434	U	J							Q						
2320-31435	U	J							P						
2320-31436	U	J							P						
2320-31437	U	J							P						
2320-31438	M	J							Q	Q					
2320-31439	U	J							Q						
2320-31440	F	J							Q	M					
2320-31441	U	J							M						
2320-31443	U	J							Q						
2320-31444	F	A							Q	Q	Q	Q			M
2320-31445	F	A							Q	Q	Q	Q	Q	Q	Q
2320-31446	U	J								P					
2320-31447	U	J								P					
2320-31448	U	J								P					
2320-31449	U	J								P					
2320-31450	U	J								P					
2320-31451	M	A							P	P	P	P			
2320-31452	M	A							P						
2320-31453	M	A							P	P					
2320-31454	M	A							P	P					
2320-31455	M	A							P						
2320-31456	U	J							P						
2320-31457	M	J							P	K					
2320-31458	M	J							P		P				
2320-31459	M	J							P	P					
2320-31460	U	J							P						
2320-31461	U	J							P						

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2320-31462	U	J							P						
2320-31463	F	J							P			K	K		
2320-31464	U	J							P						
2320-31465	U	J							P						
2320-31466	F	A							P						
2320-31467	M	J							P		P	P			
2320-31468	M	J							P		P	P		K	
2320-31469	U	J							P						
2320-31470	U	J							P						
2320-31471	M	J							Q	Q			M		M
2320-31472	U	J							Q						
2320-31473	M	J							Q	Q					
2320-31474	U	J							Q						
2320-31475	M	J							P	L					
2320-31476	F	A							Q						
2320-31477	U	J							Q						
2320-31479	F	A							Q	Q					
2320-31480	F	J							Q	Q					
2320-31481	U	J							P						
2320-31482	U	J							P						
2320-31483	U	J								Q					
2320-31484	M	J								P	P			K	K
2320-31485	F	A								M		M	M	M	
2320-31486	F	J							Q	L	Q	M	M	M	
2320-31487	U	J							Q						
2320-31488	U	J							Q						
2320-31489	U	A								M					
2320-31490	M	A								L	L[7]	Q	Q	Q	Q
2320-31491	M	A								Q					
2320-31493	M	A								D					
2320-31494	U	A								Q					
2320-31495	M	A								T					
2320-31496	U	J								M					
2320-31497	U	J								M					
2320-31498	F	J								M		G[8]	Q	Q	Q
2320-31499	M	A								Q					
2320-31500	U	J								Q					
2320-31501	M	A							B						
2320-31502	F	A							T	T					
2320-31503	U	A								I					
2320-31504	U	A								I					
2320-31505	M	A								T					
2320-31506	U	J								T					
2320-31507	U	J								T					
2320-31508	U	J								T					
2320-31510	U	J								T					
2320-31511	U	J								T					

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2320-31512	U	J								T					
2320-31513	U	J								T					
2320-31514	U	J								T					
2320-31515	F	A								T	T	T			
2320-31516	F	A								G					
2320-31517	M	A								G	M	M			M
2320-31518	U	J								T					
2320-31519	U	J								T					
2320-31520	U	J								T					
2320-31521	F	A								T	T				
2320-31522	U	J											Q		
2320-31523	U	J											M		
2320-31524	U	J											P		
2320-31525	U	J											P		
2320-31526	F	A							T	T	T				
2320-31527	F	A								T					
2320-31528	M	A								T					
2320-31529	U	J								T					
2320-31530	U	J								T					
2320-31531	U	J								T					
2320-31532	U	J								T					
2320-31533	U	J								T					
2320-31534	U	J								T					
2320-31535	U	J								T					
2320-31536	U	J								T					
2320-31537	U	J								T					
2320-31538	M	A								T					
2320-31539	M	A								B					
2320-31540	F	A								T					
2320-31541	M	A								T	T				
2320-31542	U	J								T					
2320-31543	U	J								T					
2320-31544	U	J								T					
2320-31545	U	J											P		
2320-31546	U	J											P		
2320-31547	U	J											P		
2320-31548	U	J											P		
2320-31549	U	J											P		
2320-31550	U	J											P		
2320-31551	M	A								Q					
2320-31552	M	A								M					
2320-31553	M	A								M		M			
2320-31554	U	J								T					
2320-31555	U	J								T					
2320-31556	U	J								T					
2320-31557	U	J								T					
2320-31558	U	J								T					

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2320-31559	M	A								T	T	T	T		
2320-31560	M	A								T	T	T	T	T	
2320-31561	U	J								T					
2320-31562	M	J								T		T		T	T
2320-31563	U	J								T					
2320-31564	U	J								T					
2320-31565	F	A								T	T				
2320-31566	U	J										T			
2320-31567	M	A								T	T				
2320-31568	F	A								P					
2320-31569	U	J								P					
2320-31570	U	J								P					
2320-31571	U	J								P					
2320-31572	M	A								M					
2320-31573	F	A								Q	Q	Q	Q	Q	
2320-31574	U	J									P				
2320-31575	U	J										Q			
2320-31576	M	A							T	T					
2320-31577	F	A							T	T	T				
2320-31578	U	A							Y						
2320-31579	U	A							Y						
2320-31580	U	A							Y						
2320-31581	U	J							T						
2320-31582	U	J							T						
2320-31583	U	J							T						
2320-31584	F	A							T	T	T	T			
2320-31585	U	J							T						
2320-31586	U	J							T						
2320-31587	U	J							T						
2320-31588	U	J							T						
2320-31589	M	A								P	P	P	P		
2320-31590	M	A								P	P	P	P	P	
2320-31591	M	A								P	P	P	P		
2320-31593	M	A								P	P	P			
2320-31594	M	A								P					
2320-31595	M	A								P	P	P	P	P	P
2320-31596	M	A								P					
2320-31598	M	A								T					
2320-31599	U	A								I					
2320-31600	U	A								I					
2320-31601	U	J								P					
2320-31602	U	J								P					
2320-31603	U	J								P					
2320-31604	M	J								P		K	K		
2320-31605	U	J								P					
2320-31606	U	J								P					
2320-31607	U	J								P					

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2320-31608	U	J								P					
2320-31609	U	J								P					
2320-31610	U	J								P					
2320-31611	U	J								Q					
2320-31612	U	J								Q					
2320-31616	F	J								Q		D			
2320-31617	U	J								Q					
2320-31618	F	J								Q	M	M	M		
2320-31619	U	J								M					
2320-31620	U	J								M					
2320-31621	F	A								M					
2320-31622	M	A								Q					
2320-31623	U	J								M					
2320-31624	U	J								M					
2320-31625	F	A								M					
2320-31627	M	A								Q					
2320-31628	U	A								M					
2320-31629	U	J								M					
2320-31630	U	J								Q					
2320-31631	F	J								Q		D	D		
2320-31632	F	A								Q		M	M	M[9]	
2320-31633	U	J								Q					
2320-31634	U	J								Q					
2320-31635	M	A								K					
2320-31636	U	J								K					
2320-31637	F	J								K	P				
2320-31638	U	J								K					
2320-31639	U	J											P		
2320-31640	U	J											Q		
2320-31641	U	J											Q		
2320-31642	U	J											Q		
2320-31643	U	J											P		
2320-31644	U	J											M		
2320-31645	U	J											M		
2320-31646	U	J											P		
2320-31649	U	J											P		
2320-31650	F	J										T	T		
2320-31651	M	A								M					
2320-31652	M	A								M	Q	Q			
2320-31653	M	A								M	M	M	M		
2320-31654	M	A								Q					
2320-31655	F	A								Q	Q	Q			
2320-31656	F	A								P	P	P			
2320-31657	F	A								P	P	P	P	P	P
2320-31658	F	A								P					
2320-31659	M	J								Q		D	D	D	
2320-31660	F	J								Q			M	S	S

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2320-31661	F	A								P	P	P	P	P	
2320-31662	F	A								P					
2320-31663	F	A								P	P	P	P	P	
2320-31664	F	A								P					
2320-31665	U	J								P					
2320-31666	U	J								P					
2320-31667	U	J								P					
2320-31668	F	A								P					
2320-31669	F	A								P					
2320-31670	U	J											Q		
2320-31671	U	J										M			
2320-31672	U	J											P		
2320-31673	U	J										T			
2320-31674	M	J										P		K	K
2320-31675	U	J									T				
2320-31676	U	J									T				
2320-31677	U	J										T			
2320-31678	U	J										P			
2320-31679	U	J											P		
2320-31680	U	J									T				
2320-31681	U	J									T				
2320-31682	U	J									P				
2320-31683	M	J									P		K		
2320-31684	U	J									P				
2320-31685	U	J									P				
2320-31686	M	J									P	P			
2320-31687	U	J									P				
2320-31688	M	J									Q	Q	Q	Q	Q
2320-31689	U	J									Q				
2320-31690	U	J									Q				
2320-31691	U	J									Q				
2320-31692	M	J									P	K			
2320-31693	U	J									P				
2320-31694	M	J									P		K	K	
2320-31695	F	J									P	P			
2320-31696	U	J									Q				
2320-31697	U	J									P				
2320-31698	F	J									P		P	P	P
2320-31699	U	J									P				
2320-31700	U	J									P				
2360-59701	F	J									Q	Q			
2360-59702	M	J									Q	D	M		
2360-59703	U	J									Q				
2360-59704	U	J									M				
2360-59705	U	J									M				
2360-59706	U	J									K				
2360-59707	F	J									P	P			

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2360-59708	F	J									P	P			
2360-59709	U	J									P				
2360-59710	U	J									P				
2360-59711	M	J									K			P	P
2360-59712	M	J									K			P	
2360-59713	U	J									K				
2360-59714	U	J									Q				
2360-59715	U	J									Q				
2360-59716	U	J									Q				
2360-59717	M	A								Q					
2360-59718	U	J									P				
2360-59719	U	J									T				
2360-59720	U	J									T				
2360-59721	U	J								P					
2360-59722	U	J									T				
2360-59723	U	J								P					
2360-59724	F	J								P		P			
2360-59725	U	J									B				
2360-59727	M	J									B		B		
2360-59728	U	J									B				
2360-59729	U	J									T				
2360-59730	U	J									T				
2360-59731	U	J									T				
2360-59732	U	J									T				
2360-59733	U	J									T				
2360-59734	U	J									T				
2360-59735	U	J										P			
2360-59736	U	J										P			
2360-59737	U	J										D			
2360-59738	U	J										D			
2360-59739	U	J										Q			
2360-59740	U	J									P				
2360-59741	U	J									Q				
2360-59742	U	J									Q				
2360-59743	F	J											P	K	
2360-59744	U	J										T			
2360-59745	U	J										P			
2360-59746	U	J								G					
2360-59747	U	J										D			
2360-59748	U	J										D			
2360-59749	M	J										D	D[10]	M	
2360-59750	F	J										M	Q		
2360-59751	M	J										M	Q	Q	Q
2360-59752	M	J										Q		Q	M
2360-59753	U	J										Q			
2360-59754	M	J										Q	Q	Q	Q
2360-59755	U	J										Q			

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2360-59756	U	J										P			
2360-59757	U	J								K					
2360-59758	U	J										P			
2360-59759	U	J										P			
2360-59760	U	J								L					
2360-59761	U	J								L					
2360-59762	U	J								Q					
2360-59763	U	J								Q					
2360-59764	U	J											P		
2360-59765	U	J											P		
2360-59766	U	J								Q					
2360-59767	U	J								K					
2360-59768	U	J										T			
2360-59769	U	J										M			
2360-59770	U	J								K					
2360-59771	U	J								G					
2360-59772	F	A								K					
2360-59773	U	J											Q		
2360-59775	U	J											Q		
2360-59776	U	J											Q		
2360-59777	U	J											Q		
2360-59778	U	J											Q		
2360-59779	U	J											K		
2360-59780	U	J											K		
2360-59781	U	J											K		
2360-59782	U	J											K		
2360-59785	U	J									D				
2360-59786	U	J									D				
2360-59787	U	J									D				
2360-59788	F	J									D	D	M	M	M
2360-59789	U	J										Q			
2360-59790	U	J										Q			
2360-59791	U	J										P			
2360-59792	U	J										P			
2360-59793	U	J										P			
2360-59794	U	J										P			
2360-59795	U	J										P			
2360-59796	U	J										P			
2360-59797	M	J										P	P		
2360-59798	U	J										P			
2360-59799	M	J										M	D	M	
2360-59800	U	J								G					
2370-39901	U	A								P					
2370-39902	U	J								P					
2370-39904	U	J								P					
2370-39911	M	A									P				
2370-39912	M	A									Q		Q		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2370-39913	M	A									G				
2370-39914	U	J									P				
2370-39915	M	A									P	P	P	P[11]	P
2370-39916	M	A										T	T	T	
2370-39917	U	A										Y			
2370-39918	U	A										Y			
2370-39919	U	A										Y			
2370-39920	U	A										Y			
2370-39921	U	A										Y			
2370-39922	U	A										Y			
2370-39923	U	A										Y			
2370-39924	U	A										Y			
2370-39925	U	A										Y			
2370-39926	U	A										Y			
2370-39927	U	A										Y			
2370-39928	U	A										Y			
2370-39929	M	A										G	G		
2370-39930	U	J													M
2370-39932	F	A									B	B	B		
2370-39933	U	A									Y				
2370-39934	U	A									Y				
2370-39935	U	A									Y				
2370-39937	M	A										Q	Q	Q	
2370-39938	M	A										M	M	M	M
2370-39939	F	A										Q	Q		
2370-39940	M	A										M	M	M	Q
2370-39941	M	J										Q	L[12]		
2370-39942	U	J										D			
2370-39943	U	J										D			
2370-39944	U	J										D			
2370-39945	U	J										P			
2370-39946	M	J										P	P		
2370-39947	U	J										P			
2370-39948	F	A										M			
2370-39949	U	J										Q			
2370-39950	U	J										Q			
2370-39951	M	A									P	P	P	P	
2370-39953	M	A									P	P	P	P	
2370-39954	M	A									Q	Q	Q	Q	
2370-39956	F	A									D	D	D		
2370-39957	F	A									Q	Q			
2370-39958	F	A									P				
2370-39959	M	A									P		A		
2370-39960	M	A									K				
2370-39961	M	A									P				
2370-39962	F	A									P				
2370-39964	F	A									P	P	P		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2370-39965	U	A									D				
2370-39966	M	J									D		M		
2370-39967	M	A										M	D[13]	Q	Q
2370-39969	F	A													B
2370-39971	U	A									P				
2370-39972	U	A									I				
2370-39973	U	A									Y				
2370-39974	U	A									I				
2370-39975	M	A									D	M			
2370-39976	M	A									D				
2370-39977	U	J									P				
2370-39978	F	A									P				
2370-39979	U	J									P				
2370-39980	M	J									P	K	K	K	K
2370-39981	U	J									P				
2370-39982	U	A										Y			
2370-39983	U	A										Y			
2370-39984	U	A										Y			
2370-39985	U	A										Y			
2370-39986	M	A										G			
2370-39987	M	A										G			
2370-39988	M	A										G	M	M	M
2370-39989	M	A										G			
2370-39990	F	A										G			
2370-39992	M	A										T			
2370-39993	U	A										Y			
2370-39994	U	A										Y			
2370-39995	U	A										Y			
2370-39996	U	A										Y			
2370-39997	U	A										Y			
2370-39998	U	A										Y			
2370-40003	M	A										T			
2370-40004	F	A										B			B
2370-40012	M	A									Q	Q	Q		
2370-40013	M	A									P	P			
2370-40014	F	A									P	P	P		
2370-40016	U	J									P				
2370-40017	M	A									M	M			
2370-40019	U	J									P				
2370-40020	U	J									P				
2370-40021	M	A									P	P			
2370-40023	U	J													M
2370-40024	U	J													K
2370-40025	U	J													K
2370-40026	U	J													P
2370-40027	U	J													P
2370-40029	U	J													M

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2370-40030	U	J													M
2370-40031	U	J													K
2370-40032	M	A									B				
2370-40033	U	A									Y				
2370-40034	U	A									Y				
2370-40035	U	A									Y				
2370-40036	M	A										G[14]			
2370-40037	F	A										G	M		M
2370-40038	M	A										G			
2370-40039	U	A										Y			
2370-40040	U	A										Y			
2370-40041	U	A										Y			
2370-40042	U	A										Y			
2370-40043	U	A										Y			
2370-40044	U	A										Y			
2370-40045	U	A										Y			
2370-40046	M	A										G	G[15]	M	M
2370-40047	F	A										P	P	P	P
2370-40048	U	J													T
2370-40049	U	J													T
2370-40050	U	J													T
2370-40052	M	A									B	B	B	B	
2370-40053	M	A									B				
2370-40054	M	A									B				
2370-40055	F	A									T				
2370-40056	M	A									T				
2370-40057	M	A										D			
2370-40058	M	A										M	B		
2370-40059	F	A										D	D	D	
2370-40060	M	A										P		P	P
2370-40061	F	A										P			
2370-40062	F	A										P	P		
2370-40063	U	J										Q			
2370-40064	U	J										P			
2370-40065	U	J										Q			
2370-40066	F	A										Q	Q	Q	Q
2370-40067	U	J										Q			
2370-40068	U	J										Q			
2370-40069	U	J										M			
2370-40070	U	J										M			
2370-40071	U	J										P			
2370-40072	U	J													M
2370-40073	F	A													P
2370-40074	U	J													P
2370-40075	U	J													P
2370-40076	U	J													P
2370-40080	U	J										Q			

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2370-40081	M	A										K			
2370-40082	F	A										K			
2370-40083	U	J										Q			
2370-40084	U	J										Q			
2370-40085	U	J											Q		
2370-40086	U	J											Q	M	M
2370-40087	F	A											Q	Q	Q
2370-40096	U	J												K	
2370-40097	U	J												K	
2370-40098	U	J												K	
2370-40099	U	J													S
2370-40100	U	J										K			
2370-40101	U	J										K			
2370-40102	U	J										K			
2370-40103	U	J										Q			
2370-40104	U	J										Q			
2370-40105	U	J										Q			
2370-40106	U	J										Q			
2370-40107	U	J										Q			
2370-40108	U	J										Q			
2370-40110	U	J											T		
2370-40111	U	J											T		
2370-40112	U	J											T		
2370-40113	U	J											B		
2370-40114	M	J											T		T
2370-40115	U	J											T		
2370-40116	U	J											T		
2370-40117	U	J											T		
2370-40118	U	J											T		
2370-40119	U	J											T		
2370-40120	U	J											T		
2370-40121	U	J											T		
2370-40122	U	J											T		
2370-40123	U	J											T		
2370-40124	M	J											T		M
2370-40125	U	J											T		
2370-40126	M	A											G		
2370-40127	M	A											G		
2370-40129	M	A											G		
2370-40130	F	A													B
2370-40132	F	A											T		
2370-40133	F	A											B		
2370-40134	U	A											B		
2370-40135	F	A											B		
2370-40136	F	A											T		
2370-40137	M	A											B		
2370-40138	M	A											T		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2370-40139	M	A											T	T	
2370-40140	F	A													P
2370-40141	U	A													K
2370-40142	U	J													M
2370-40143	U	J													Q
2370-40144	U	J													M
2370-40145	U	J													M
2370-40146	U	J													S
2370-40147	F	J												S	D
2370-40148	F	J												S	S
2370-40149	U	J												S	
2370-40150	U	J													M
2370-40151	U	J													M
2370-40152	U	J													M
2370-40153	U	J													S
2370-40154	U	J													S
2370-40155	M	A													L
2370-40156	M	A													B
2370-40157	M	A											P		P
2370-40158	M	J											B		T
2370-40159	U	J											B		
2370-40160	F	A											G		
2370-40161	M	A											M	M	M
2370-40162	U	J													B
2370-40163	U	J													B
2370-40164	U	J											Q		
2370-40165	M	A													B
2370-40166	U	A											P		
2370-40167	U	J											P		
2370-40168	F	A											P	P	P
2370-40169	U	J											M		
2370-40170	F	A											Q	Q	
2370-40171	F	A											D		
2370-40173	M	A											M	M	M
2370-40174	U	J													M
2370-40175	U	J													M
2370-40176	M	A													M
2370-40180	M	A													B
2370-40181	M	A													T
2370-40182	U	J													B
2370-40183	F	A											M		
2370-40184	M	A											D		
2370-40185	M	A											P		
2370-40186	M	A											D		
2370-40187	M	A											K		
2370-40188	U	J											Q		
2370-40190	U	J											P		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2370-40191	F	A											M	M	M
2370-40192	F	A											D		
2370-40193	F	A											Q	Q	Q
2370-40194	F	A											P	P	P
2370-40195	F	A											P	P	P
2370-40197	M	A											M	Q	Q
2370-40199	U	J											P		
2390-92348	F	J		T						T					
2390-92350	M	A				M	Q		Q	Q					
2390-92365	M	J				D			Q	Q	Q				
2390-92410	M	A					Q		Q						
2390-92420	M	J					Q	Q	Q						
2390-92421	M	J					Q	Q	Q	Q	M	M			
2390-92427	F	J					M		Q						
2390-92433	M	J					Q		Q	Q					
2390-92434	M	J					Q	Q		Q	Q	Q	Q	Q	Q
2390-92451	F	J			M	M		Q		Q					
2390-92470	F	J					Q			Q					
2390-92475	M	J					M	Q	Q	Q	Q	Q	Q	Q	
2430-31015	U	A											Y		
2430-31017	U	A											Y		
2430-61006	U	A											Y		
2430-61007	U	A											Y		
2430-61008	U	A											Y		
2430-61009	U	A											Y		
2430-61010	U	A											Y		
2430-61011	U	A											Y		
2430-61012	U	A											Y		
2430-61013	U	A											Y		
2430-61014	U	A											Y		
2430-61016	U	A											Y		
2430-61018	U	A											Y		
2430-61019	U	A											Y		
2430-61020	U	A											Y		
2430-61021	U	A											Y		
2430-61023	U	A											Y		
2430-61024	U	A											Y		
2430-61025	U	A											Y		
2430-61026	U	A											Y		
2430-61027	U	A											Y		
2430-61028	U	A											Y		
2430-61029	U	A											Y		
2430-61030	U	A											Y		
2430-61031	U	A											Y		
2430-61032	U	A											Y		
2430-61033	U	A											Y		
2430-61034	U	A											Y		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2430-61035	U	A											Y		
2430-61036	U	A											Y		
2430-61037	U	A											Y		
2430-61038	U	A											Y		
2430-61039	U	A											Y		
2430-61040	U	A											Y		
2430-61041	U	A											Y		
2430-61042	U	A											Y		
2430-61043	U	A											Y		
2430-61044	U	A											Y		
2430-61045	U	A											Y		
2430-61046	U	A											Y		
2430-61047	U	A											Y		
2430-61048	U	A											Y		
2430-61049	U	A											Y		
2430-61050	U	A											Y		
2430-61051	U	A											Y		
2430-61052	U	A											Y		
2430-61053	U	A											Y		
2430-61054	U	A											Y		
2430-61055	U	A											Y		
2430-61056	U	A											Y		
2430-61058	U	A											Y		
2430-61059	U	A											Y		
2430-61060	U	A											Y		
2430-61061	U	A											Y		
2430-61062	U	A											Y		
2430-61063	U	A											Y		
2430-61064	U	A											Y		
2430-61065	U	A											Y		
2430-61067	U	A											Y		
2430-61068	U	A											Y		
2430-61069	U	A											Y		
2430-61070	U	A											Y		
2430-61071	U	A											Y		
2430-61072	M	A												G	
2430-61073	M	A												B	
2430-61074	U	J												B	
2430-61075	U	J												B	
2430-61076	U	J												B	
2430-61077	U	J												M	
2430-61078	U	J												Q	
2430-61079	F	A												M	
2430-61080	M	A												P	P
2430-61081	U	J												M	
2430-61082	U	J												Q	
2430-61083	M	A												P	P

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2430-61084	U	J												Q	
2430-61085	M	A													D
2430-61086	U	J													M
2340-61087	F	A													P
2430-61101	U	J												K	
2430-61102	U	J												K	
2430-61103	M	A												D	
2430-61104	M	A												M	
2430-61105	M	A												Q	
2430-61106	U	J												P	
2430-61107	U	J												P	
2430-61108	U	J												P	
2430-61109	F	A												K	
2430-61110	U	J												K	
2430-61111	U	J												P	
2430-61112	U	J												P	
2430-61113	U	J												P	
2430-61114	U	J												P	
2430-61115	U	J												P	
2430-61116	F	A												M	M
2430-61117	U	J												P	
2430-61118	M	J												P	M
2430-61119	U	J												P	
2430-61120	F	J												P	P
2430-61121	U	J												Q	
2430-61122	U	J												P	
2430-61123	U	J												P	
2430-61124	U	J												P	
2430-61125	M	A												K	
2430-61126	U	J												S	
2430-61127	M	A												P	P
2430-61128	U	J												M	
2430-61129	U	J												Q	
2430-61130	U	J												Q	
2430-61131	U	J												M	
2430-61132	U	J												M	
2430-61133	U	J												M	
2430-61134	M	A												T	
2430-61135	M	A												T	T
2430-61136	M	A												B	B
2430-61137	F	A												B	B
2430-61138	F	A												B	
2430-61139	F	A												T	
2430-61140	U	J												B	
2430-61141	U	J												B	
2430-61142	U	J												B	
2430-61143	U	J												T	

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2430-61144	U	J												T	
2430-61145	U	J												T	
2430-61153	F	A													M
2430-61154	U	J													Q
2430-61155	U	J													Q
2430-61156	U	J													K
2430-61157	U	J													K
2430-61158	M	A													K
2430-61159	U	J													M
2430-61160	U	J													M
2430-61161	U	J													D
2430-61162	M	A													S
2430-61165	M	J												Q	Q
2430-61167	M	A												M	M
2430-61168	U	J												M	
2430-61169	U	J												M	
2430-61170	U	J												M	
2430-61171	U	J												M	
2430-61172	F	J												M	M
2430-61173	U	J												M	M
2430-61174	M	J												M	M
2430-61175	U	J												Q	
2430-61176	U	J												Q	
2430-61177	U	J												Q	
2430-61178	M	A												K	
2430-61179	M	A												K	P
2430-61180	M	A												K	
2430-61181	F	A												K	K
2430-61182	M	A												K	
2430-61183	M	A												K	
2430-61184	U	J												Q	
2430-61185	F	J												Q	M
2430-61186	U	J												Q	
2430-61187	M	J												Q	L
2430-61188	U	J												Q	
2430-61189	U	J												Q	
2430-61190	U	J												Q	
2430-61191	M	J												M	D
2430-61192	U	J												M	
2430-61193	U	J												M	
2430-61194	U	J												Q	Q
2430-61195	U	J												Q	
2430-61196	U	J												Q	
2430-61197	U	J												P	
2430-61198	U	J												P	Q
2430-61199	U	J												P	
2430-61200	U	J												P	

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2430-61202	U	J												M	
2430-61203	U	J												M	
2430-61204	U	J												M	
2430-61205	U	J												M	
2430-61206	U	J												M	
2430-61207	F	J												M	D
2430-61208	U	J												D	
2430-61209	M	A												V	D
2430-61210	U	A												K	
2430-61211	U	J												S	
2430-61212	U	J												M	
2430-61223	U	J												D	
2430-61224	U	J												D	
2430-61225	U	J												D	
2430-61271	U	J													P
2430-61277	U	J													P
2430-61278	U	J													P
2430-61279	U	J													P
2430-61285	U	J													M
2540-58132	M	A													S
2540-58141	U	J													M
2540-58142	U	J													M
2540-58143	M	A													D
2540-58144	U	J													K
2540-58145	U	J													K
2540-58146	M	A													B
2540-58154	U	J													M
2540-58155	U	J													M
2540-58185	U	J													P
2540-58186	M	A													S
2540-58187	F	A													P
2540-58188	U	J													P
2540-58189	U	A													P
2540-58216	U	J													M
2540-58217	M	A													S
2540-58218	U	J													S
2540-58219	U	J													Q
3500-68963	U	J								T					
3500-68968	U	J								P					
3500-68969	U	J								P					
3500-68972	F	J								P	P	P			

[1] K = Key Pittman, P = Pahranagat NWR, W = Meadow Valley Wash, L = Littlefield, Q = Mesquite, M = Mormon Mesa, D = Muddy River, G = Grand Canyon, T = Topock Marsh, B = Bill Williams River NWR, I = Imperial NWR, Y = Yuma, S = St. George, V = Las Vegas Wash, R = Roosevelt Lake, A = Ash Meadows. Study area indicated is the study area where the individual was first detected during the given season. Within-season movements are indicated with individual footnotes.

[2] M = male, F = female, U = unknown.

[3] A = adult, J = juvenile.

[4] Within-season movement from Mormon Mesa to Mesquite.

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]												
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009

[5] Within-season movement from Mesquite to Mormon Mesa.

[6] Within-season movement from Mesquite to Mormon Mesa.

[7] Within-season movement from Littlefield to Mesquite.

[8] Within-season movement from Grand Canyon to Mesquite.

[9] Within-season movement from Mormon Mesa to Muddy River.

[10] Within-season movement from Muddy River to Mormon Mesa.

[11] Within-season movement from Pahranagat to Key Pittman.

[12] Within-season movement from Littlefield to Mesquite.

[13] Within-season movement from Muddy River to Mesquite.

[14] Within-season movement from Grand Canyon to Mesquite.

[15] Within-season movement from Grand Canyon to Mormon Mesa.

Appendix E

HYDROGRAPHS FOR PIEZOMETERS AT HABITAT MONITORING SITES

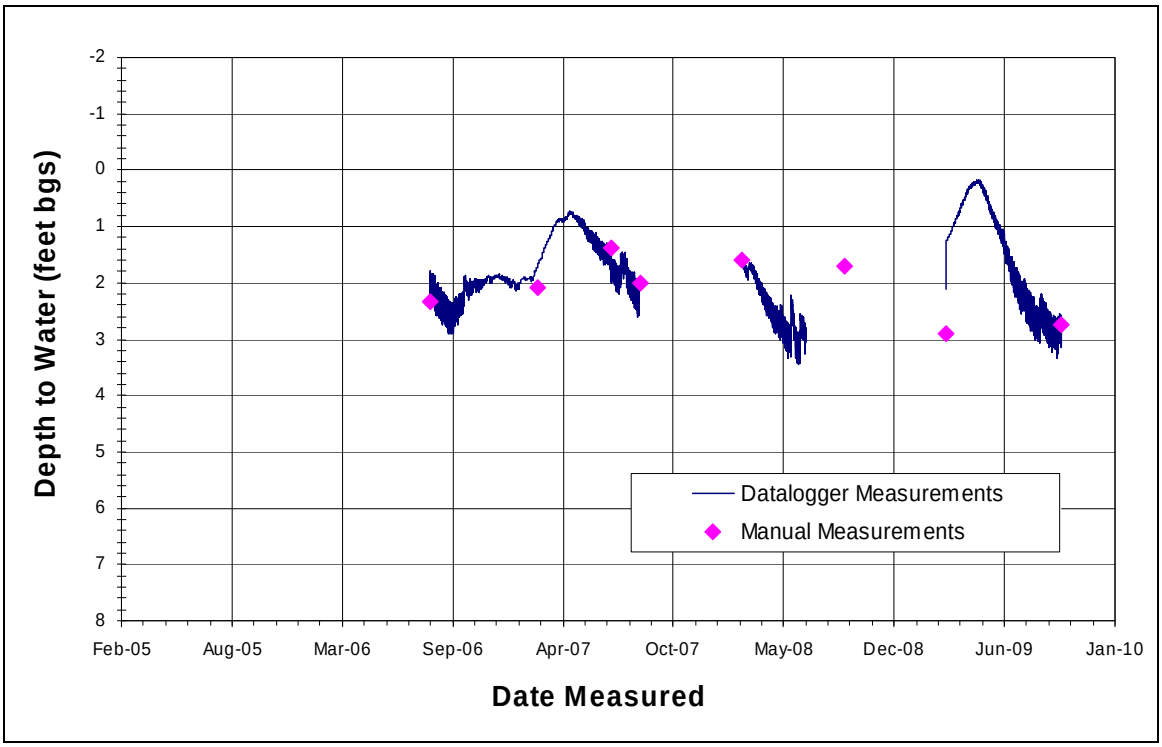


Figure E1. Hydrograph for piezometer at Topock Marsh.

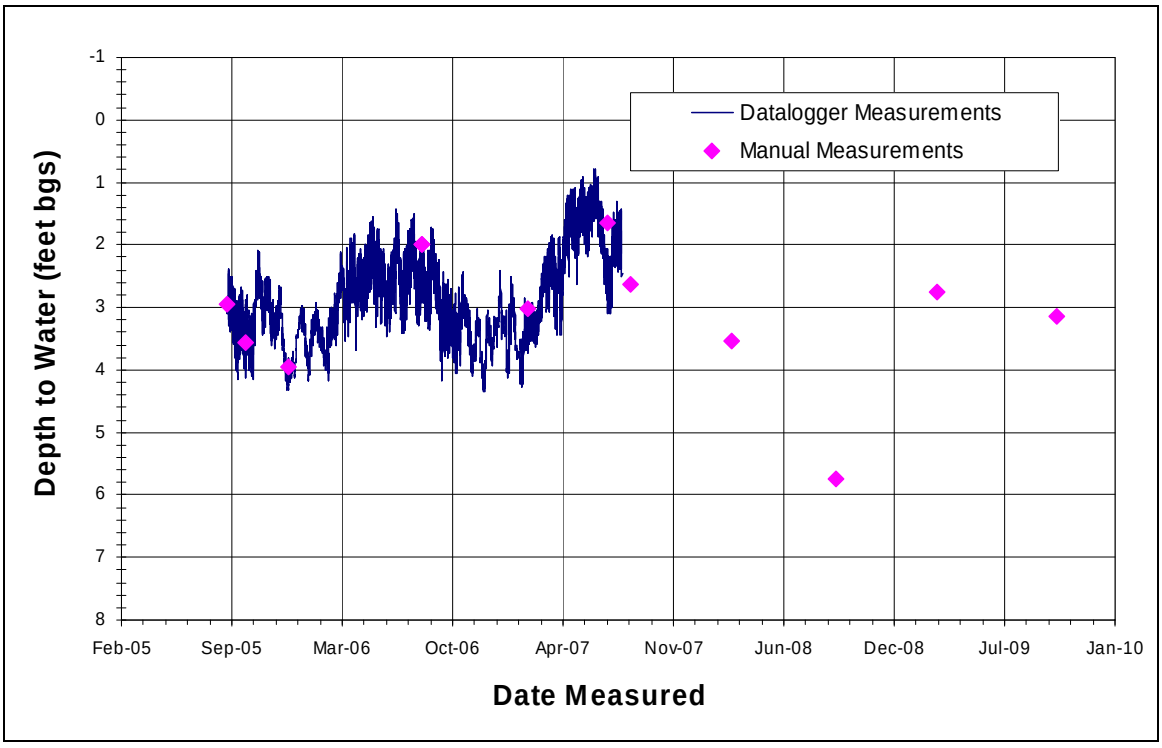


Figure E2. Hydrograph for piezometer at Blankenship Bend.

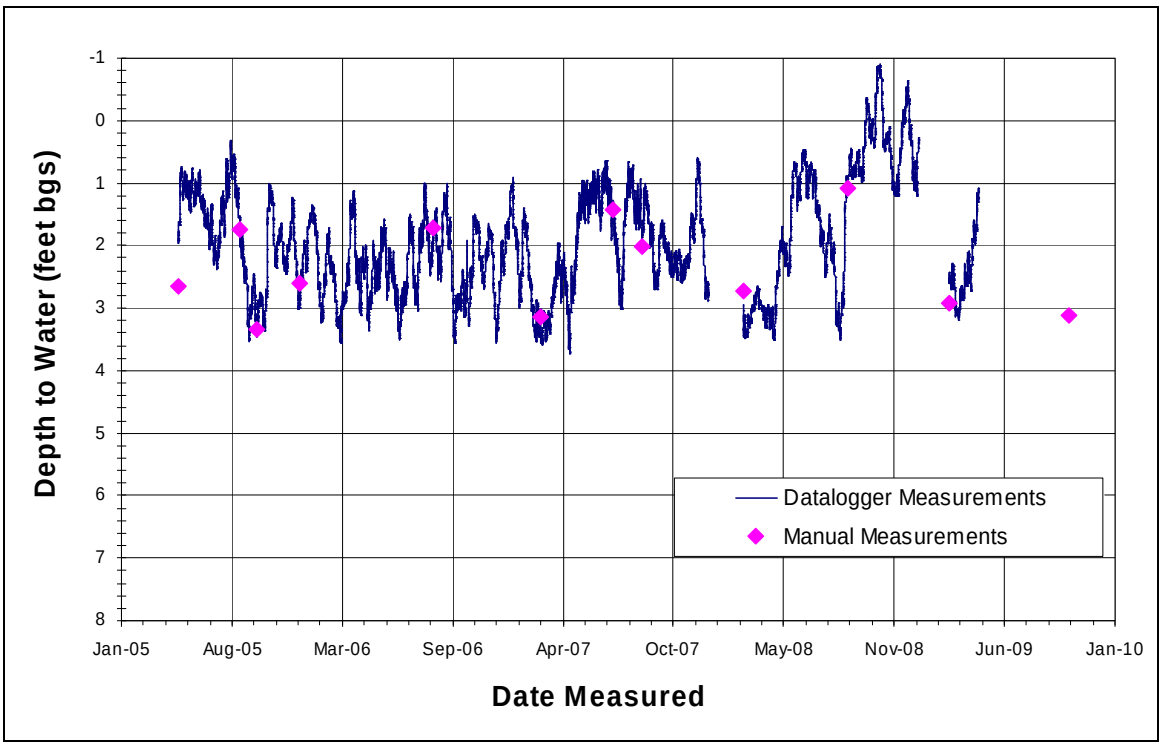


Figure E3. Hydrograph for piezometer at Havasu NE.

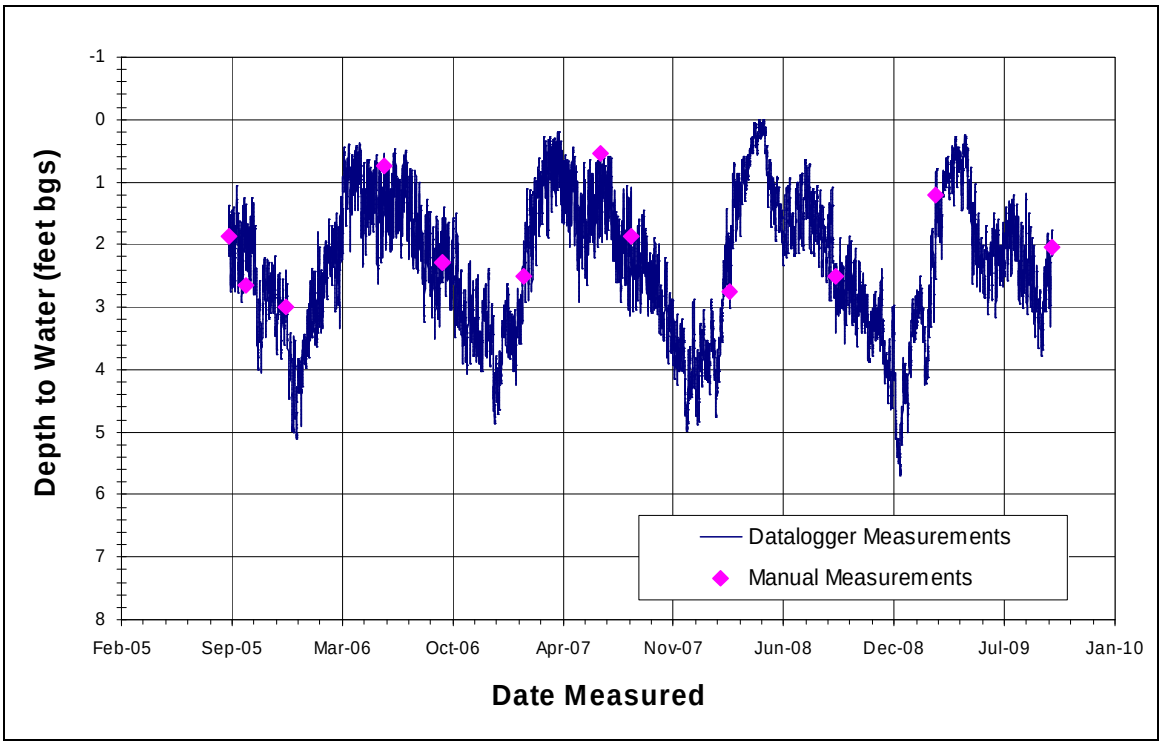


Figure E4. Hydrograph for piezometer at Ehrenberg.

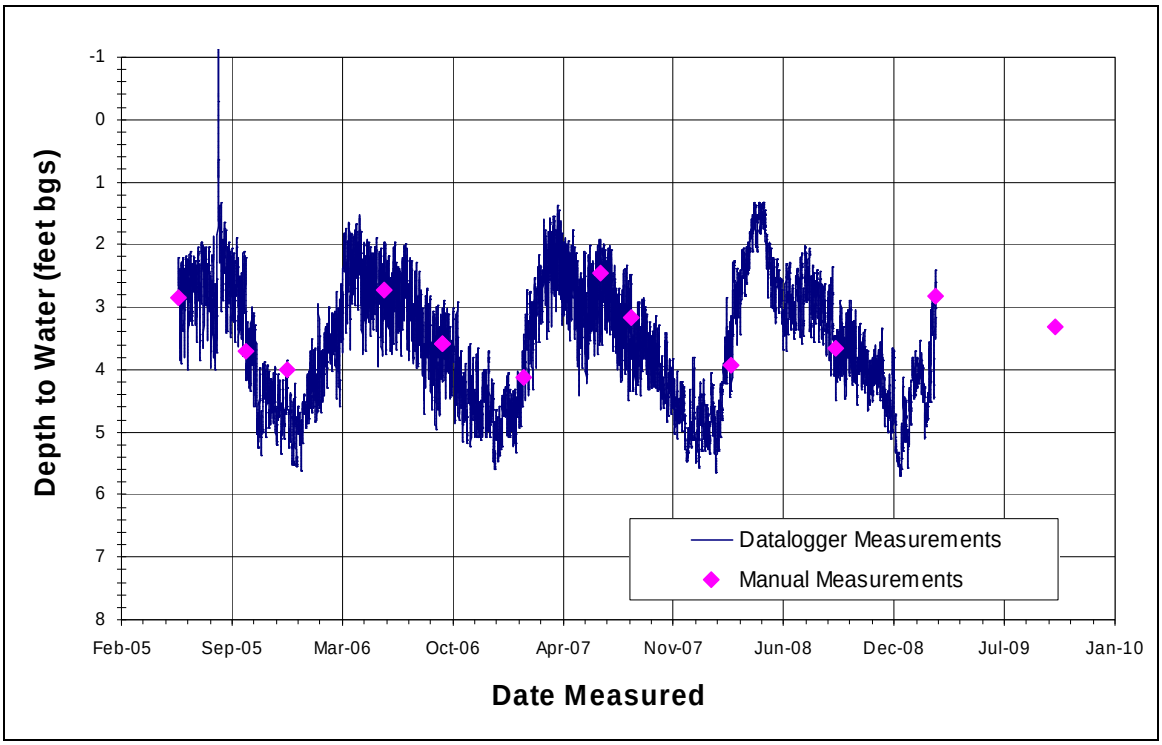


Figure E5. Hydrograph for piezometer at Three Fingers Lake.

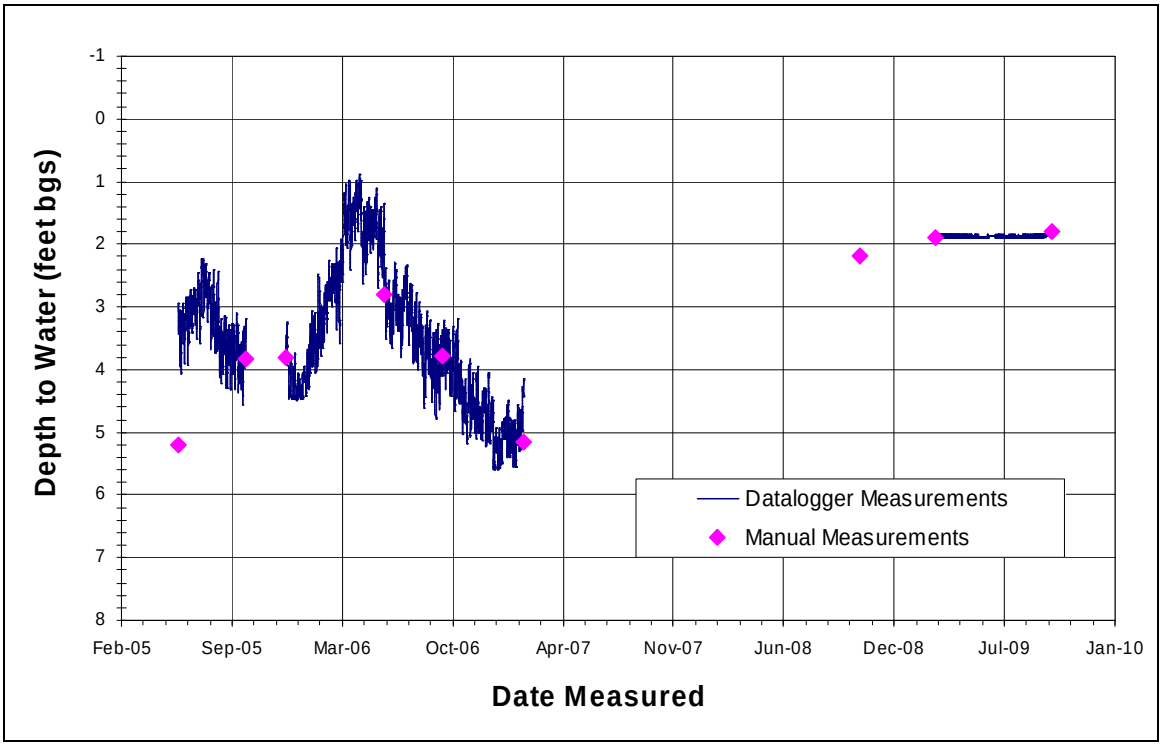


Figure E6. Hydrograph for piezometer at Cibola Lake.

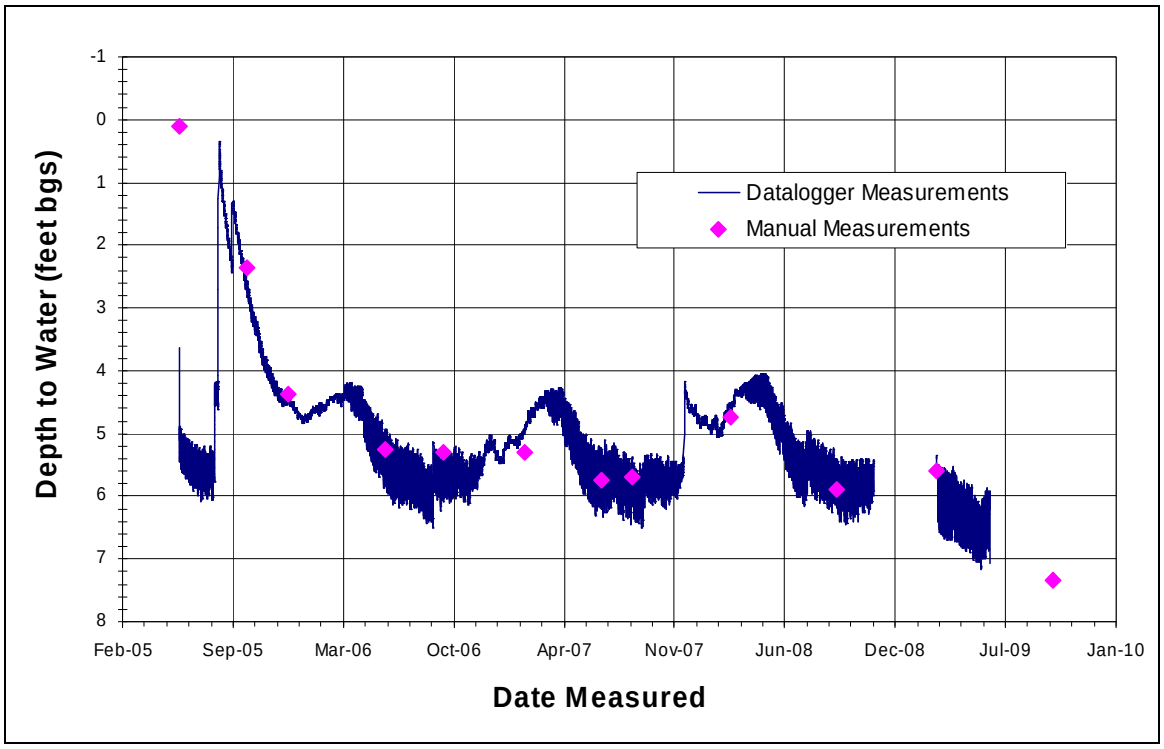


Figure E7. Hydrograph for piezometer at Walker Lake.

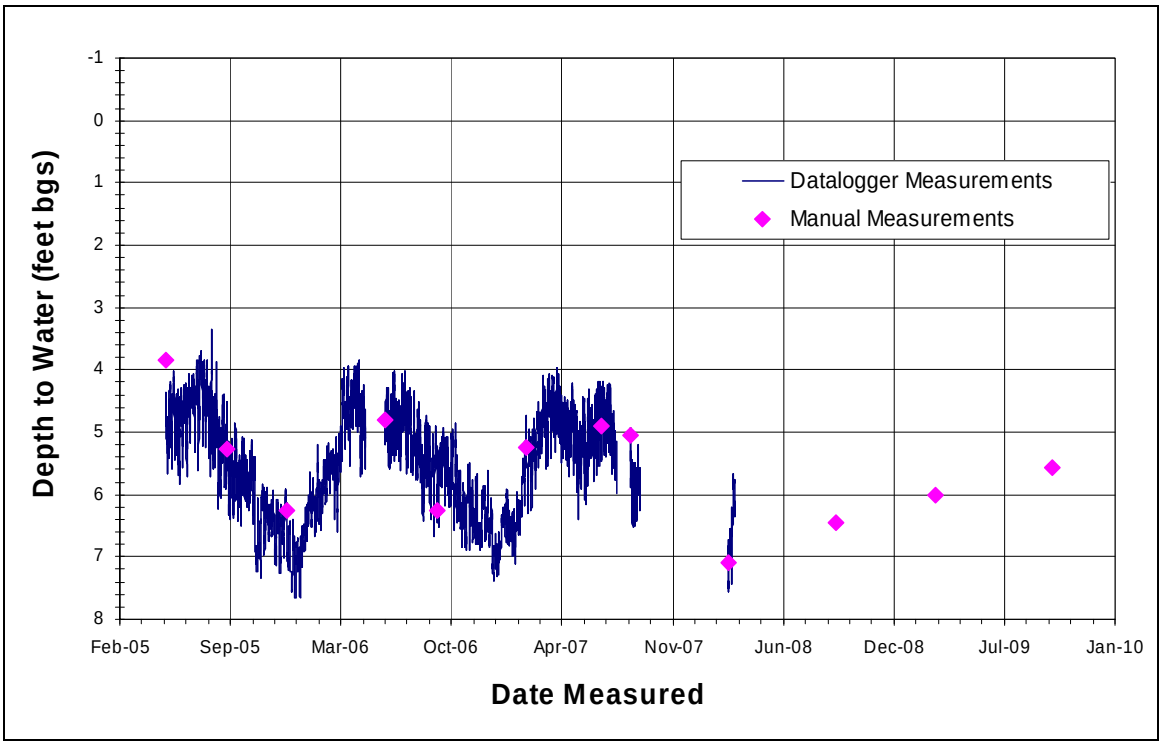


Figure E8. Hydrograph for piezometer at Paradise.

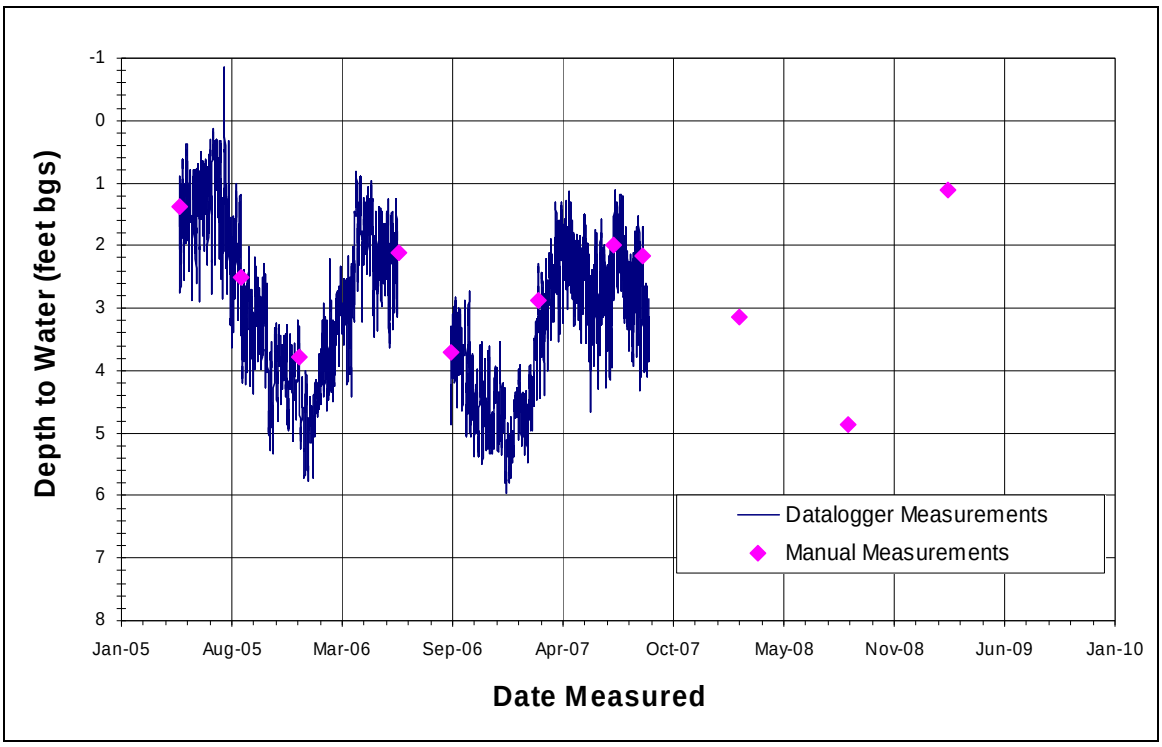


Figure E9. Hydrograph for piezometer at Hoge Ranch.

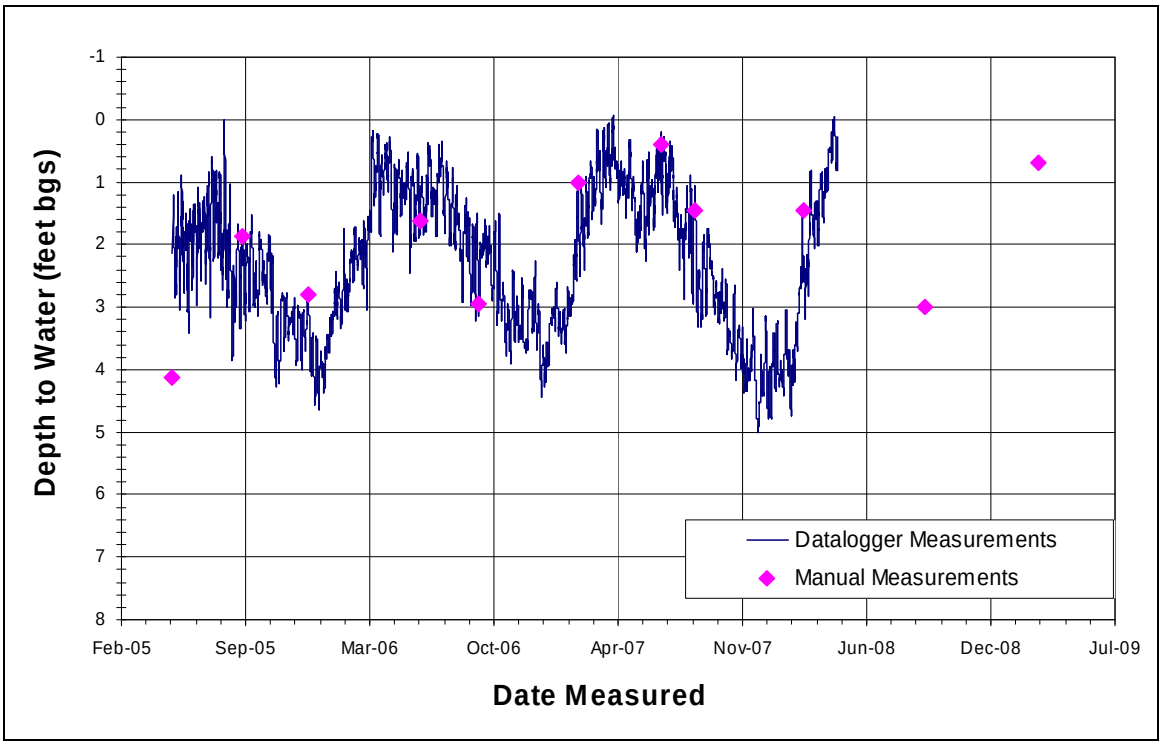


Figure E10. Hydrograph for piezometer at Rattlesnake.

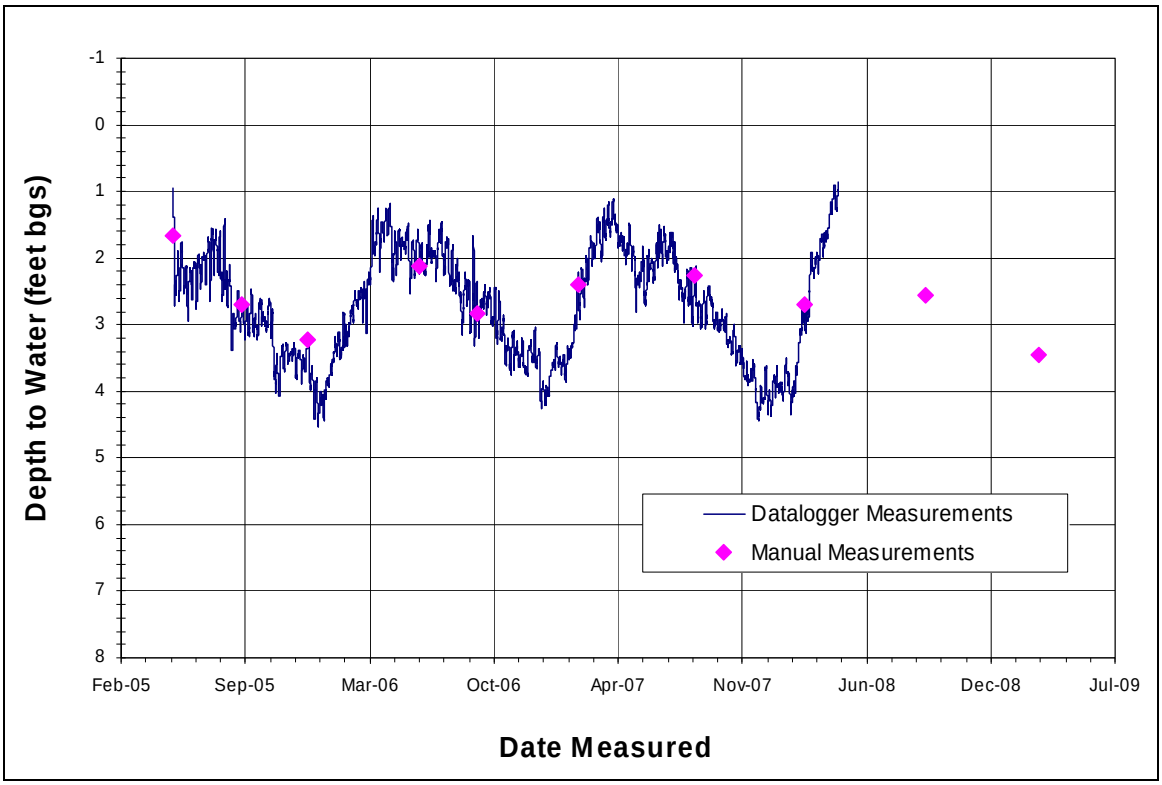


Figure E11. Hydrograph for piezometer at Clear Lake.

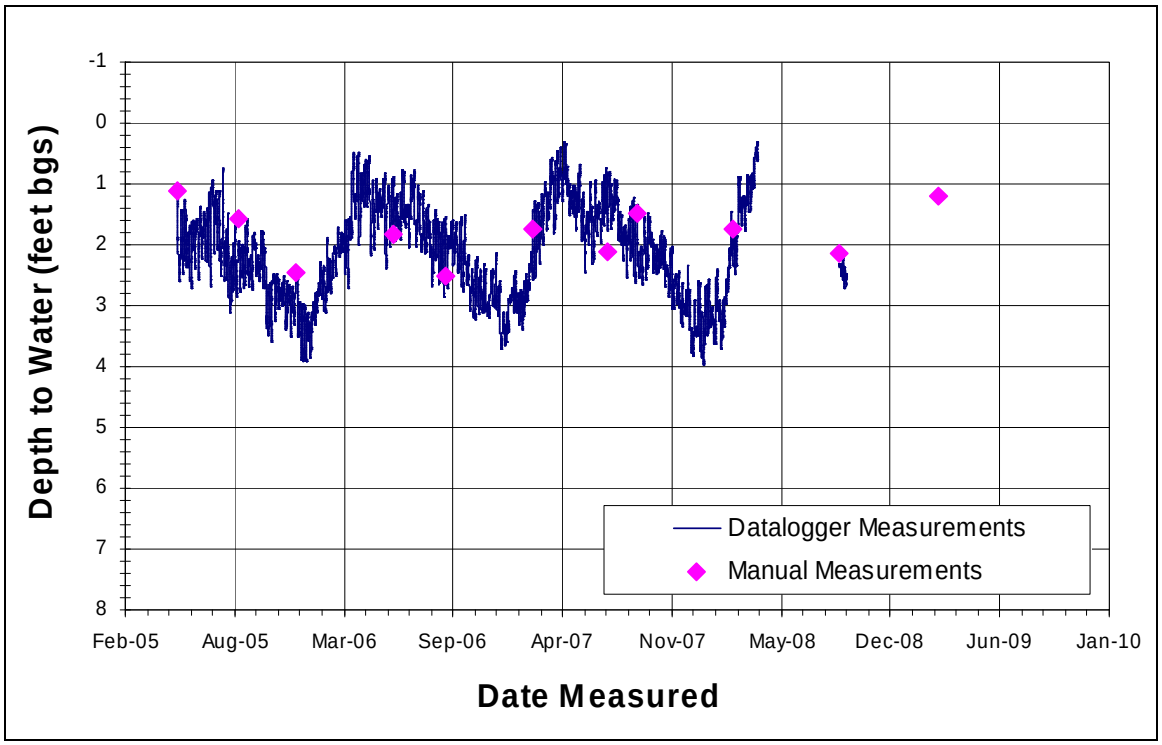


Figure E12. Hydrograph for piezometer at Ferguson Lake.

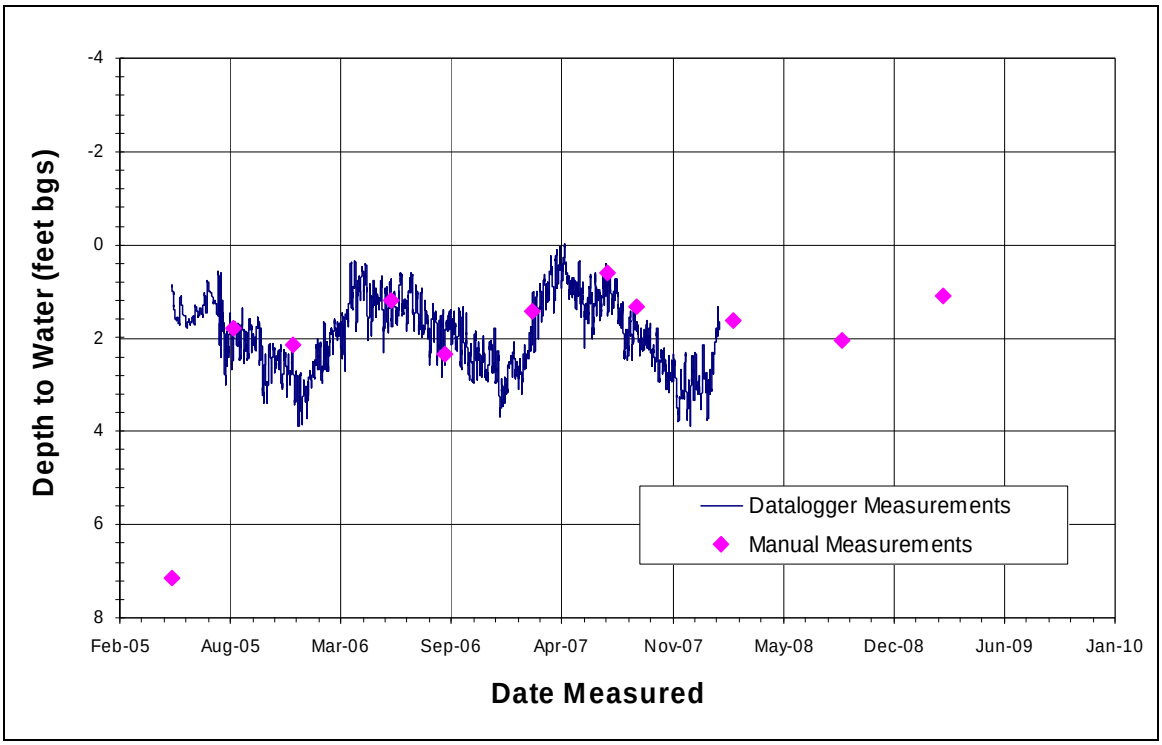


Figure E13. Hydrograph for piezometer at Ferguson Wash.

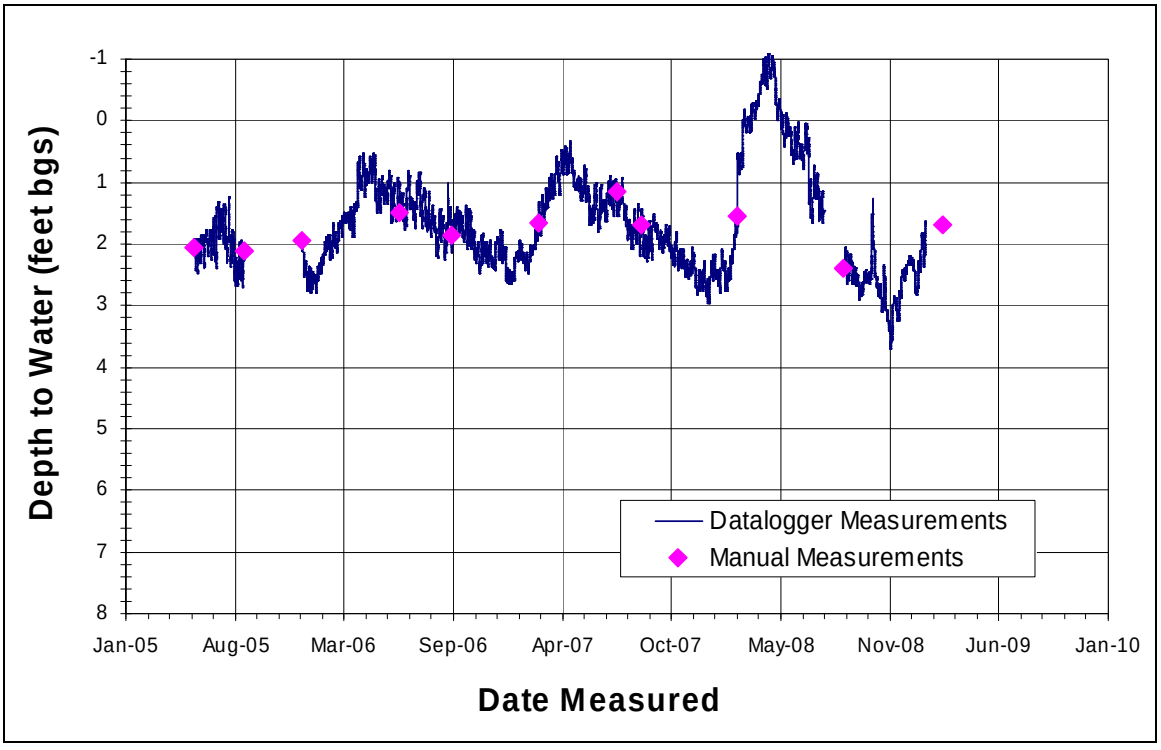


Figure E14. Hydrograph for piezometer at Great Blue Heron.

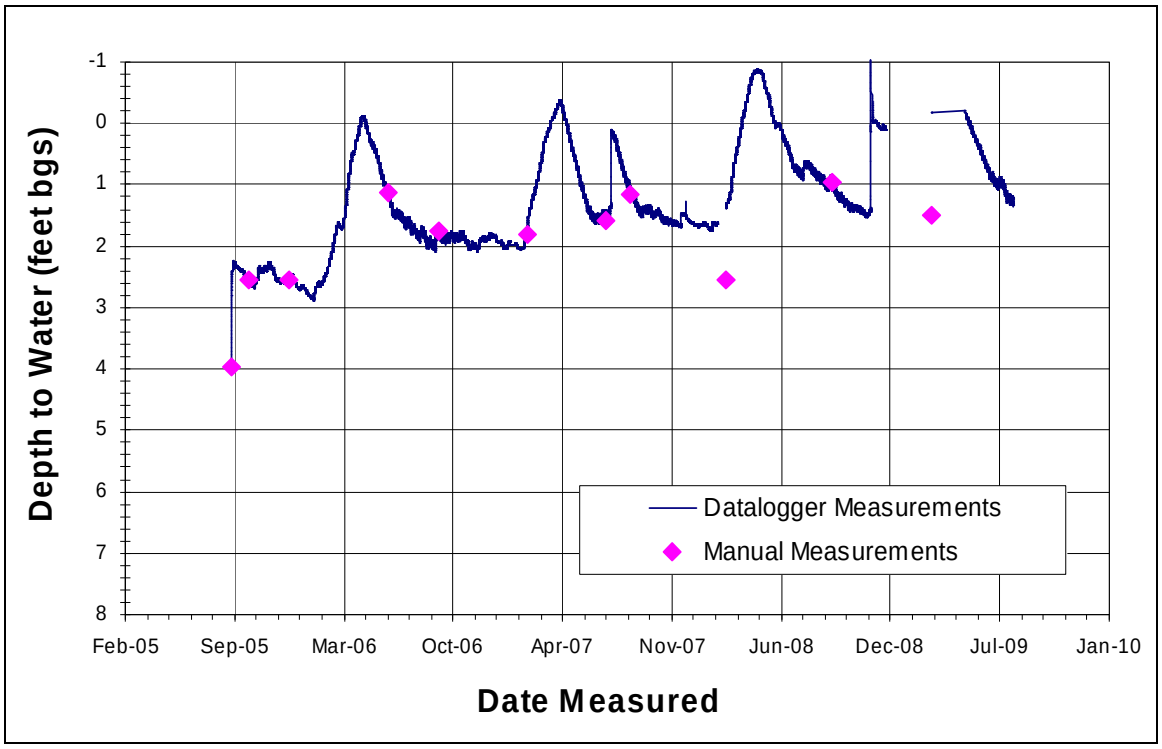


Figure E15. Hydrograph for piezometer at Mittry West.

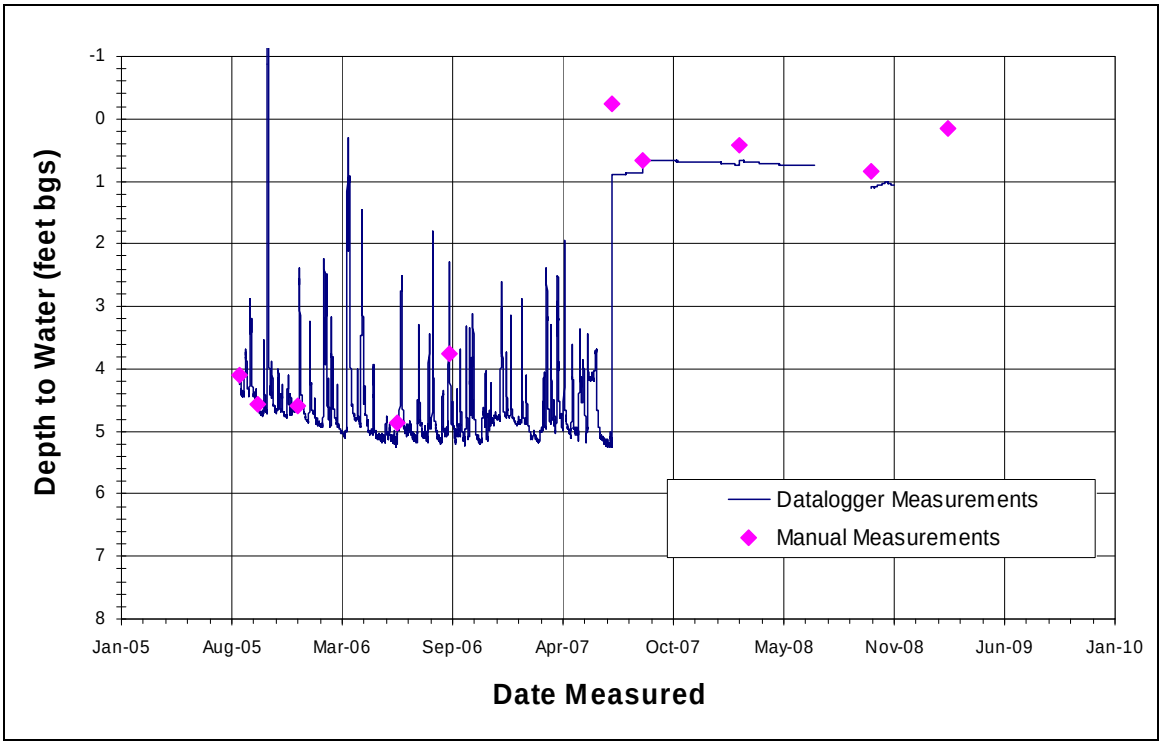


Figure E16. Hydrograph for piezometer at Gila Confluence North.

Appendix E

HYDROGRAPHS FOR PIEZOMETERS AT HABITAT MONITORING SITES

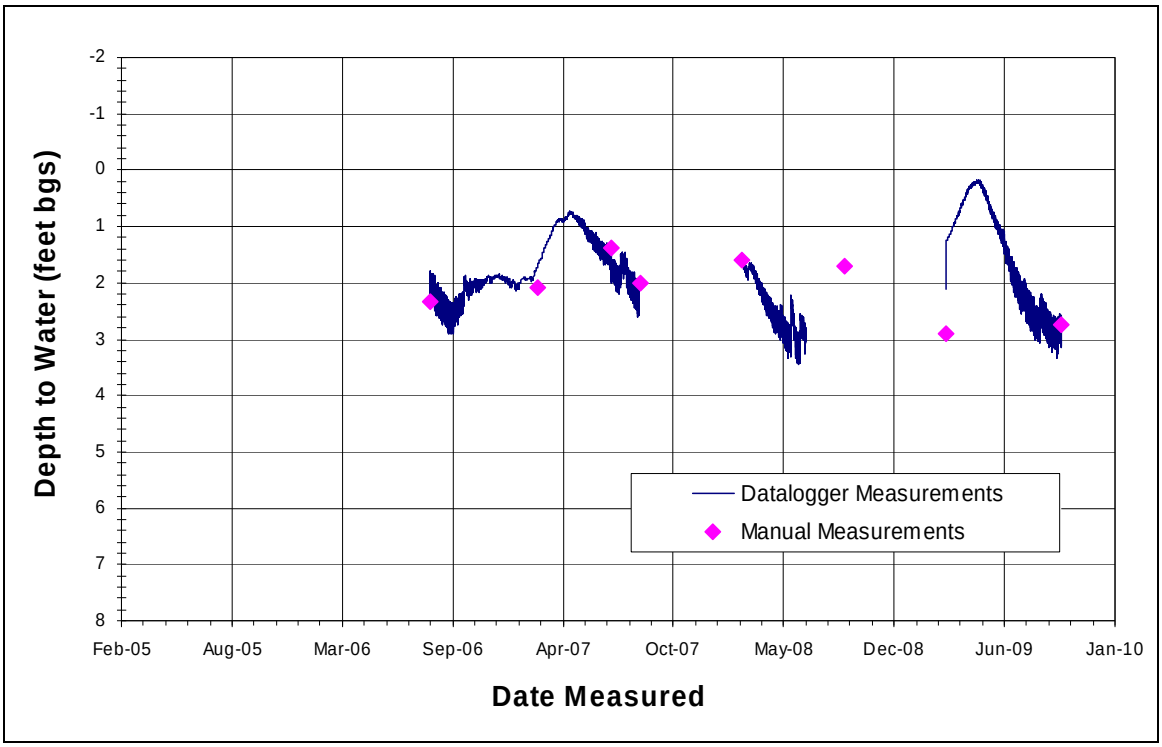


Figure E1. Hydrograph for piezometer at Topock Marsh.

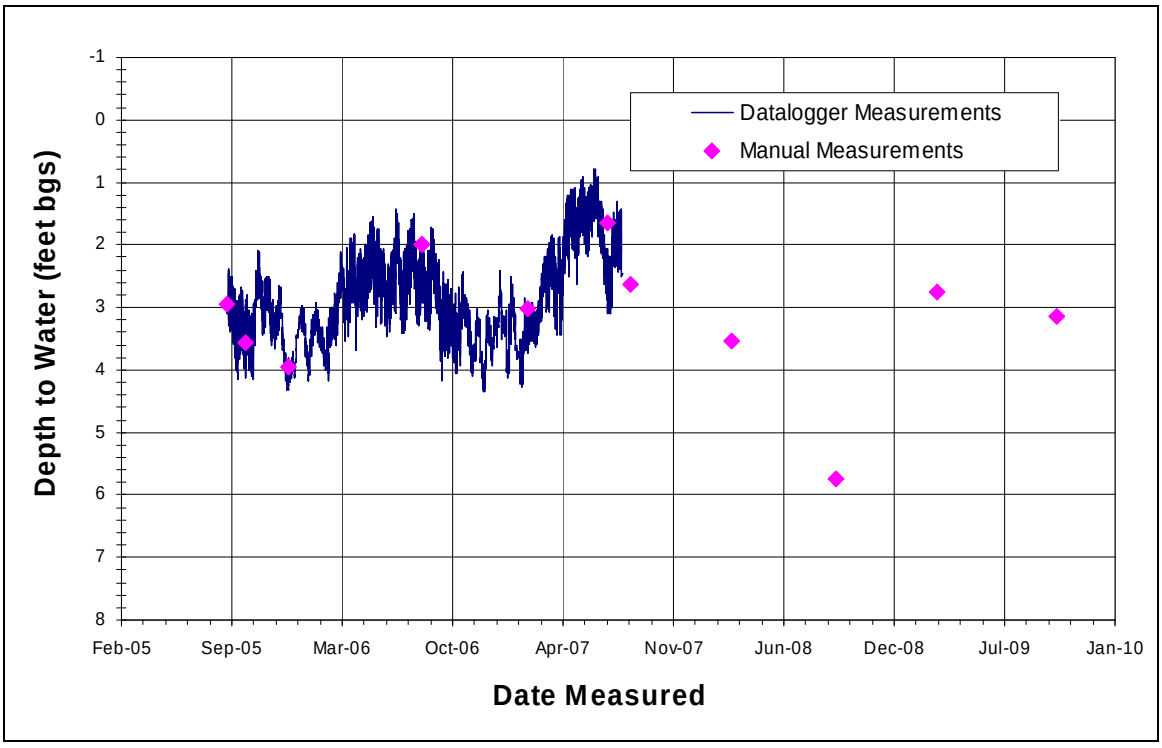


Figure E2. Hydrograph for piezometer at Blankenship Bend.

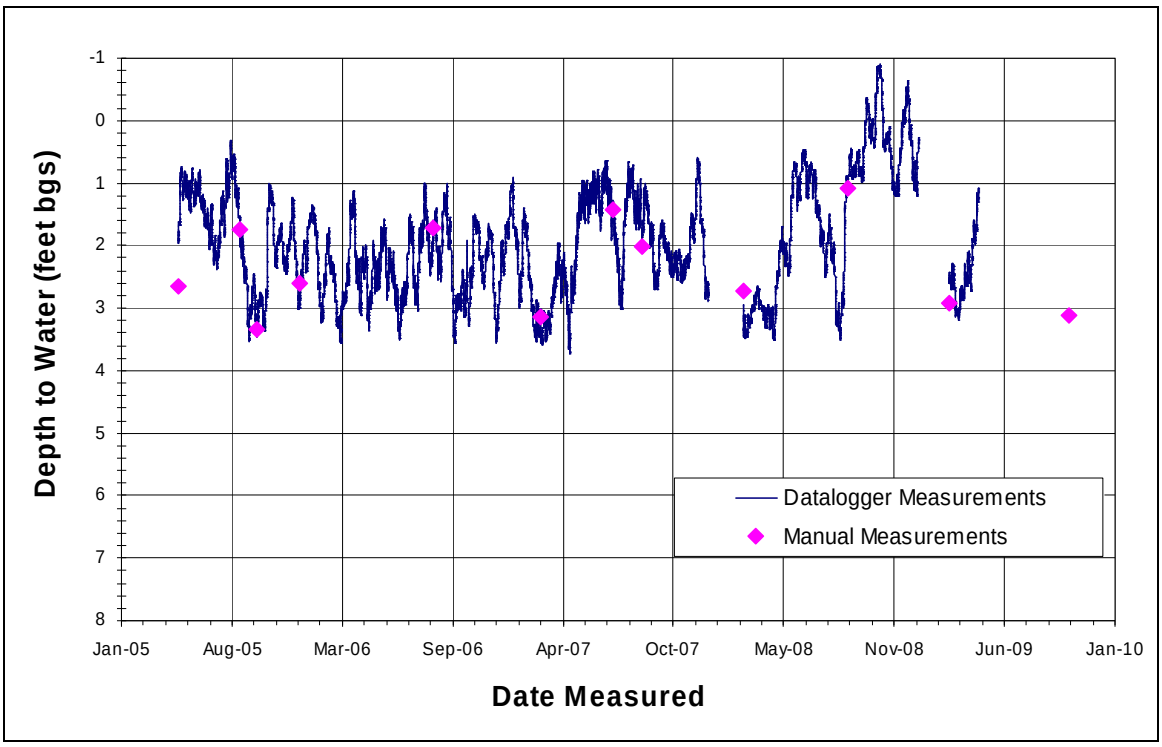


Figure E3. Hydrograph for piezometer at Havasu NE.

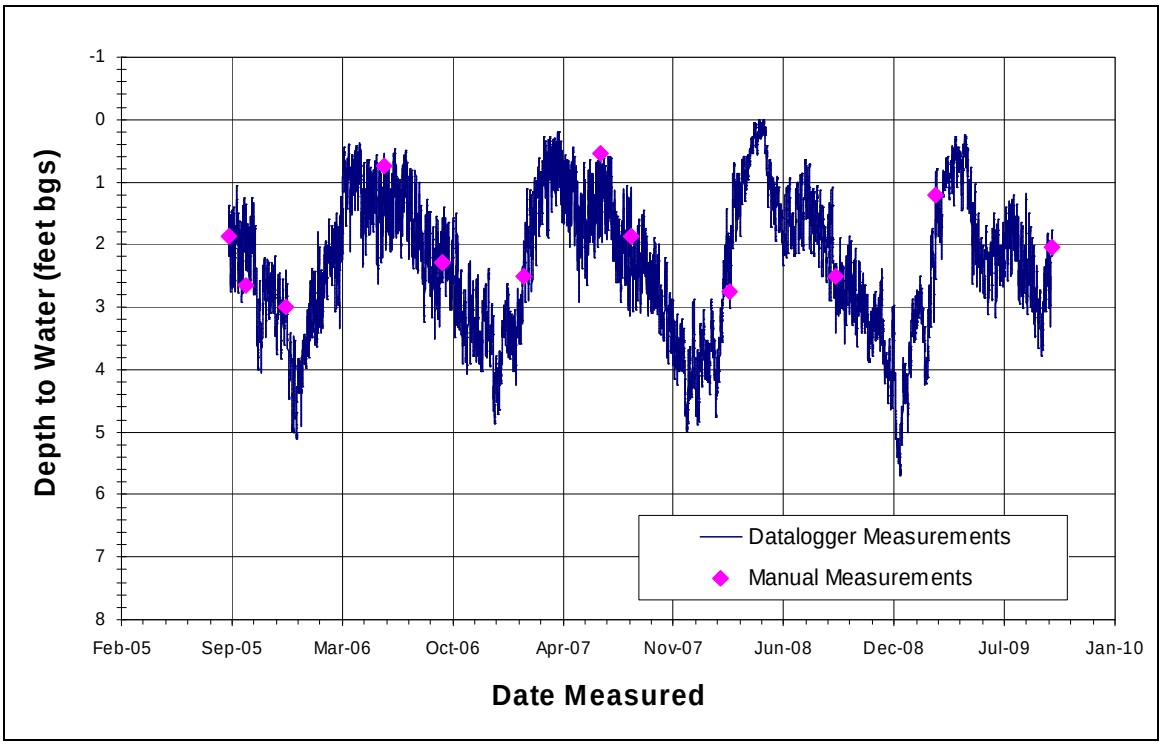


Figure E4. Hydrograph for piezometer at Ehrenberg.

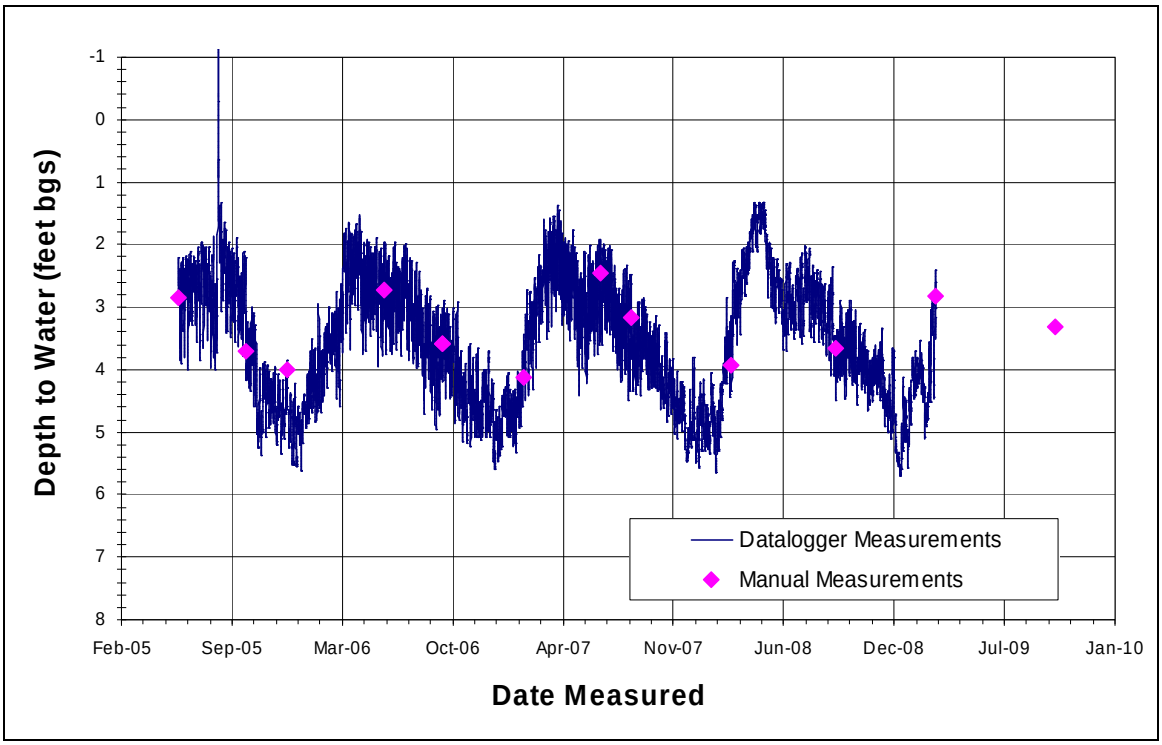


Figure E5. Hydrograph for piezometer at Three Fingers Lake.

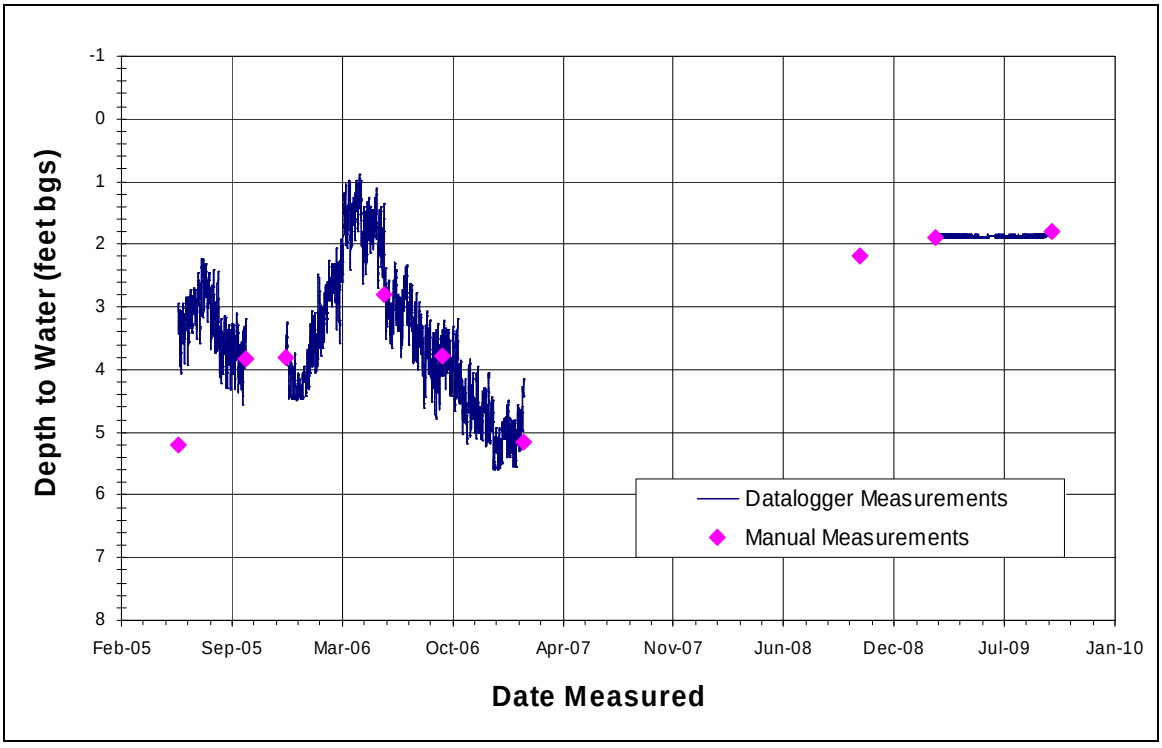


Figure E6. Hydrograph for piezometer at Cibola Lake.

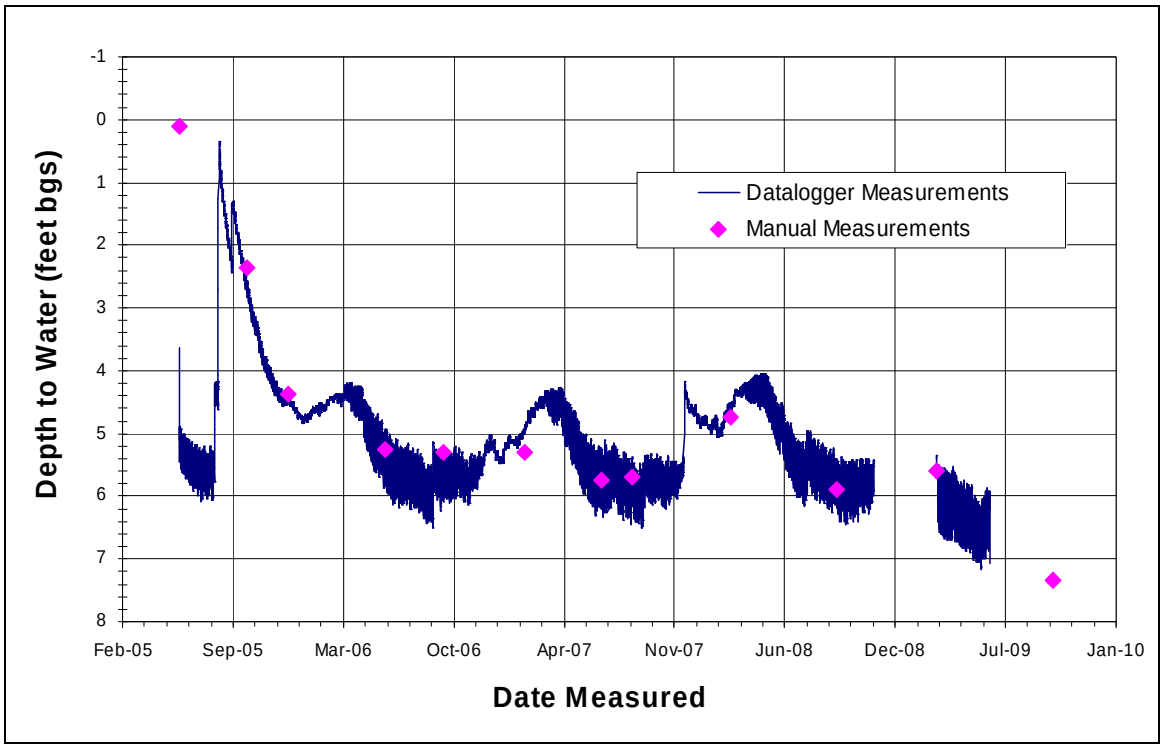


Figure E7. Hydrograph for piezometer at Walker Lake.

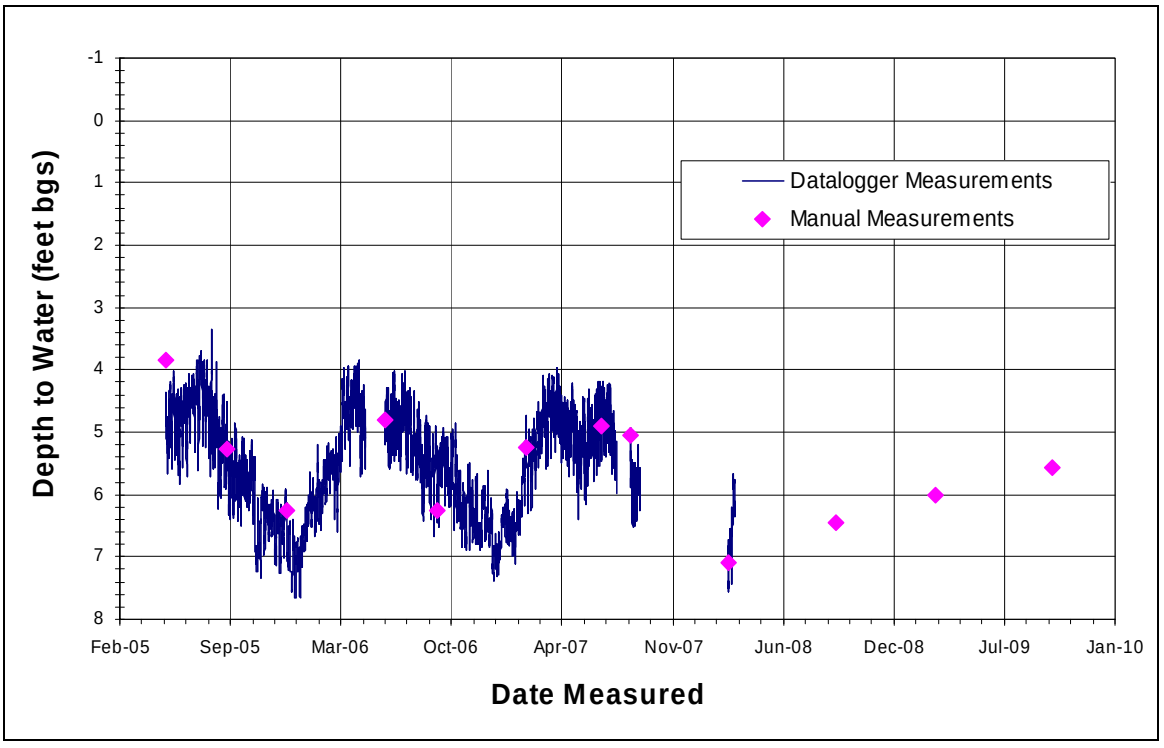


Figure E8. Hydrograph for piezometer at Paradise.

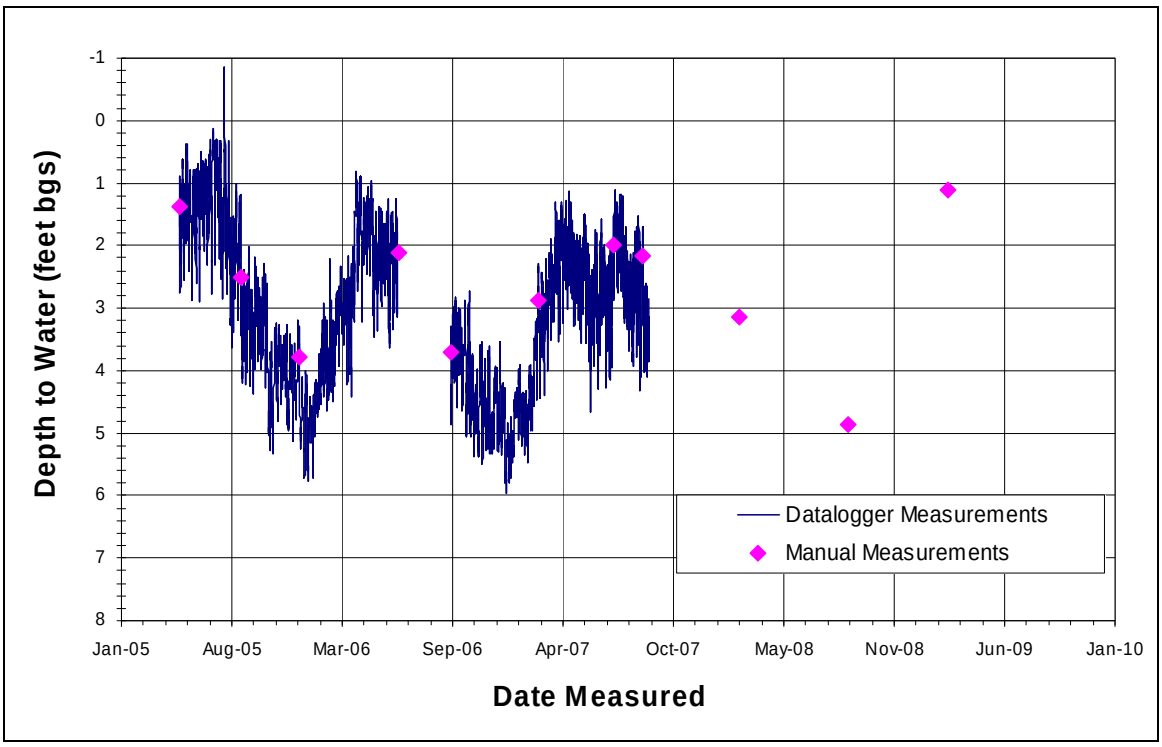


Figure E9. Hydrograph for piezometer at Hoge Ranch.

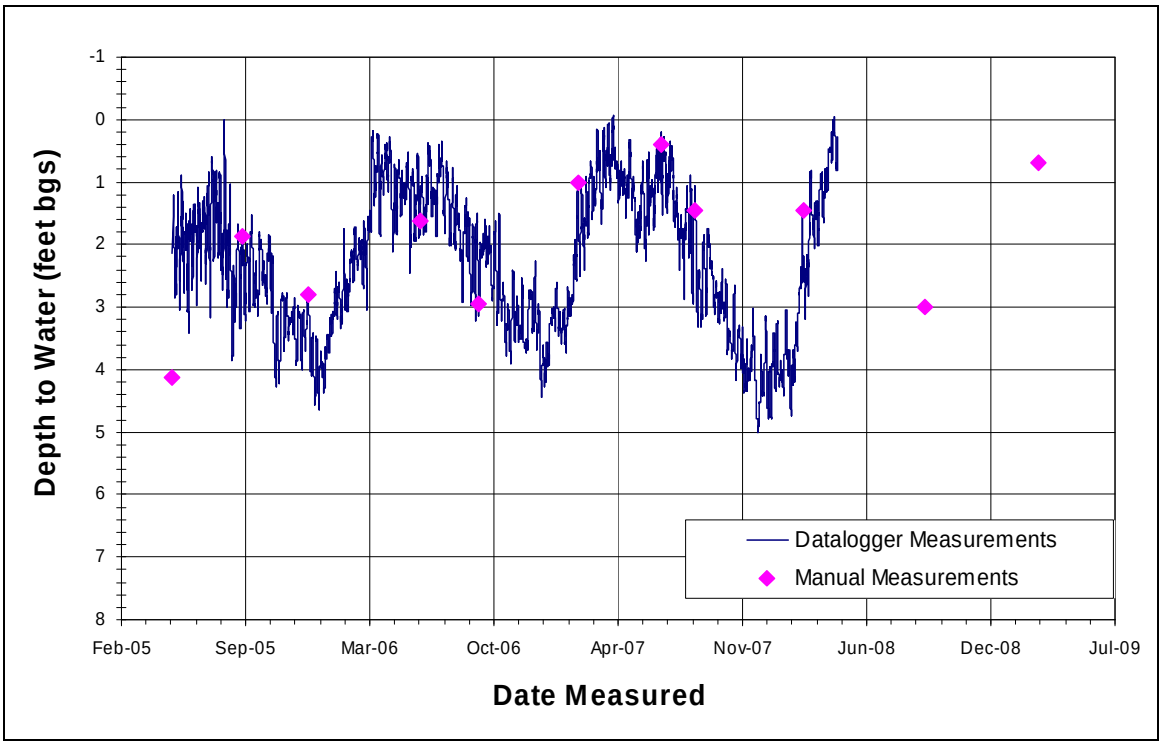


Figure E10. Hydrograph for piezometer at Rattlesnake.

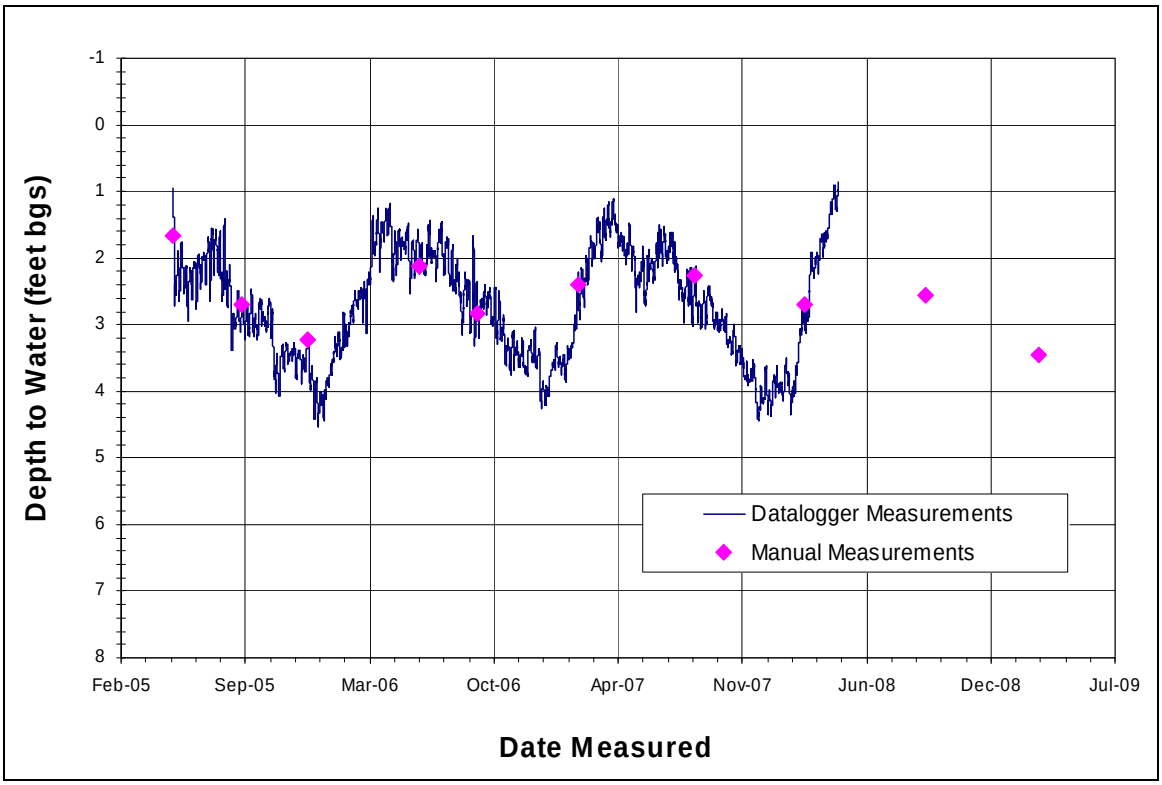


Figure E11. Hydrograph for piezometer at Clear Lake.

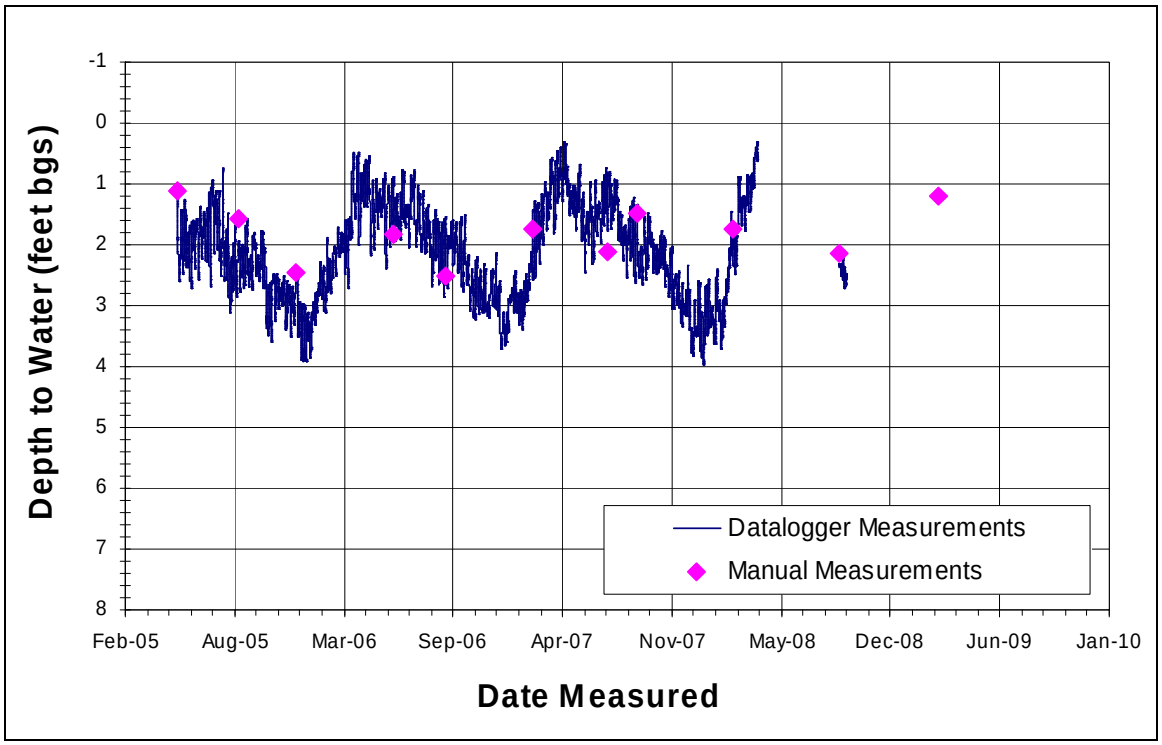


Figure E12. Hydrograph for piezometer at Ferguson Lake.

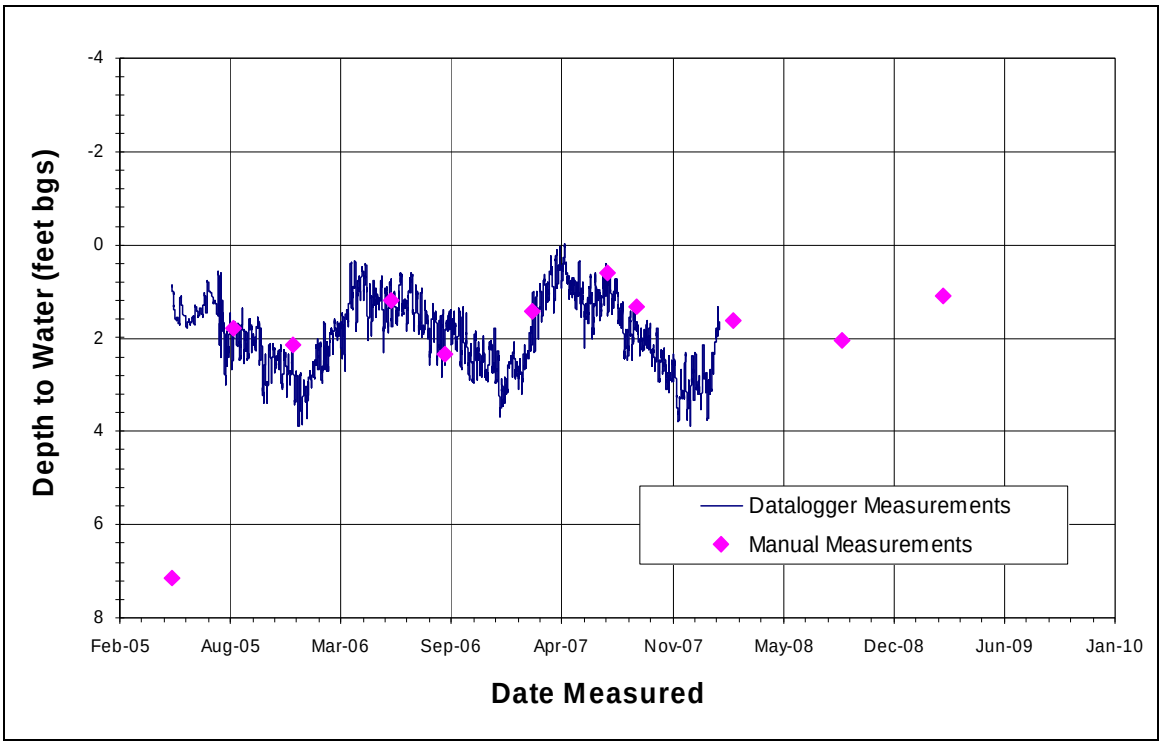


Figure E13. Hydrograph for piezometer at Ferguson Wash.

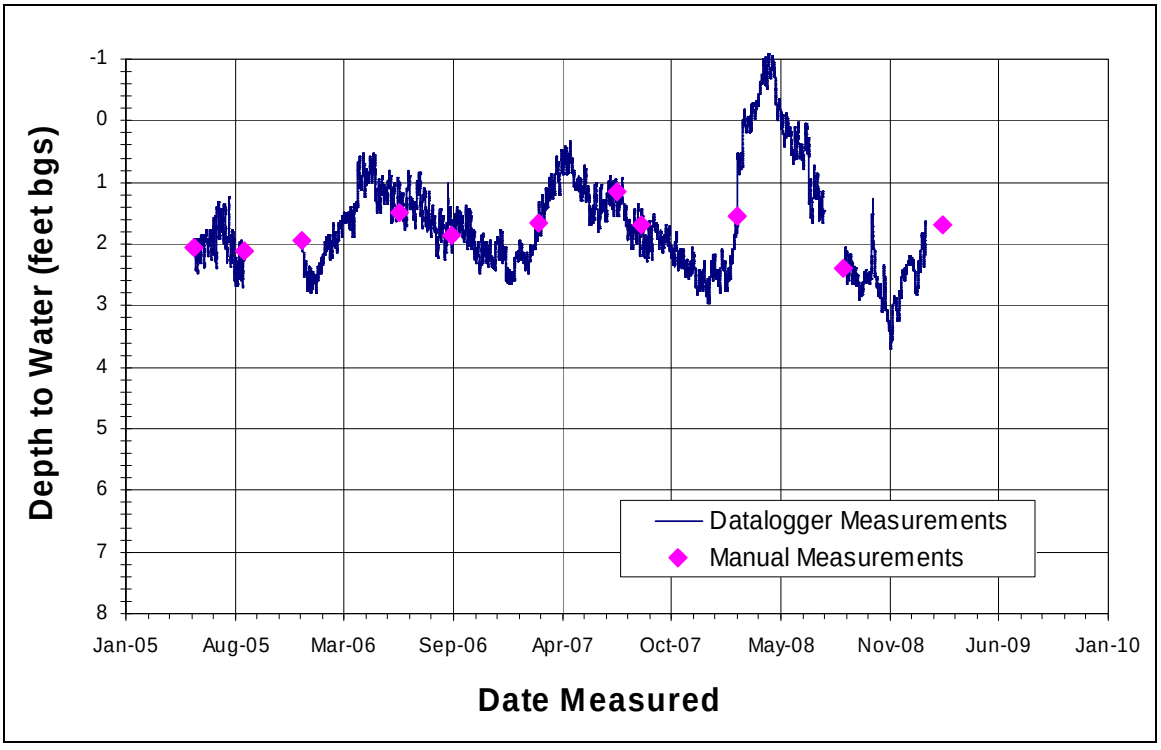


Figure E14. Hydrograph for piezometer at Great Blue Heron.

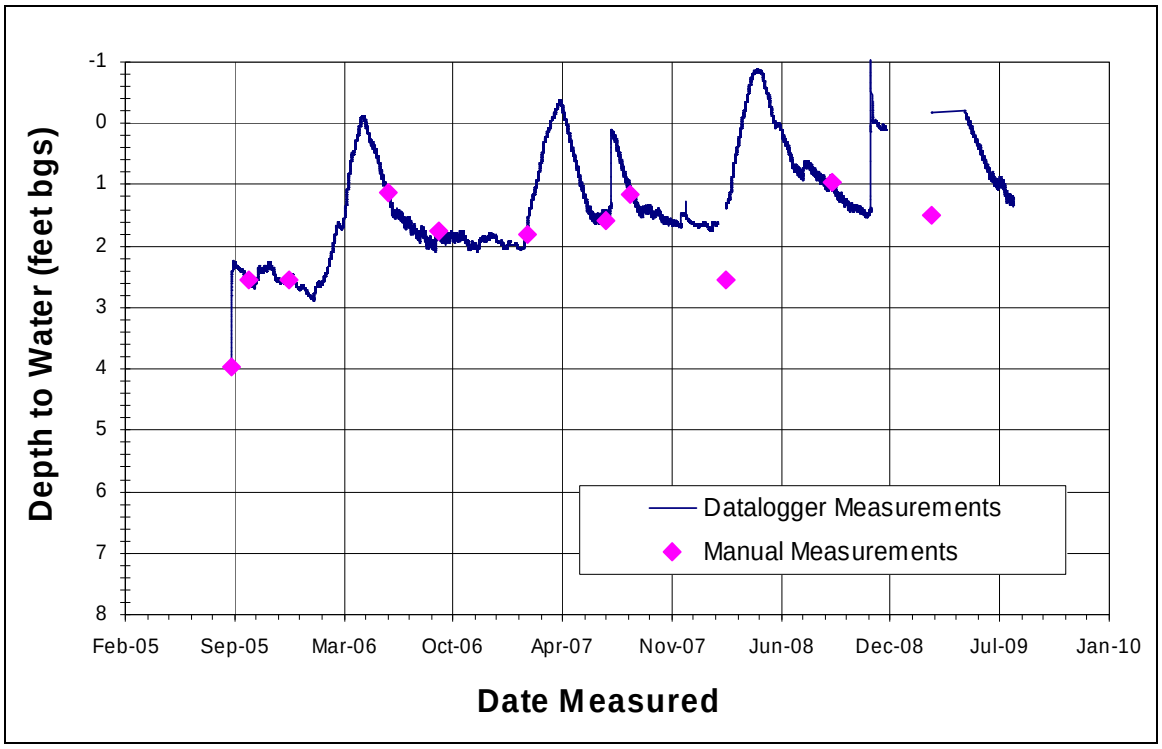


Figure E15. Hydrograph for piezometer at Mittry West.

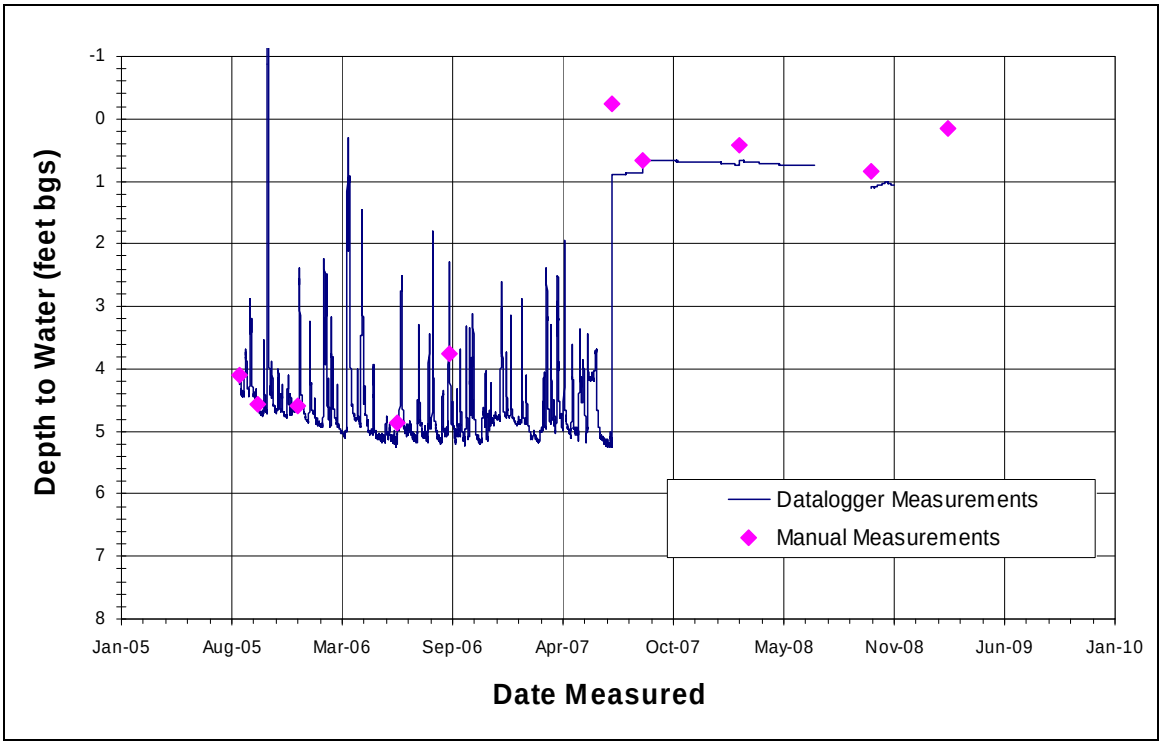


Figure E16. Hydrograph for piezometer at Gila Confluence North.

Appendix F

CONTRIBUTING PERSONNEL

Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Field Supervisor
Wendy Langeberg, Ph.D.	Statistician
Glenn A. Dunno, M.A.	GIS Specialist
Christopher J. Garrett, P. HGW.	Hydrologist
DeAnne Rietz, M.S.	Hydrologist
Lisa R. Baca	Database Development/Formatting Specialist
Jessica Maggio	Project Administrator/Data Entry/Formatting
Kimberly MacMillan	Administrative Assistant/Data Entry
Dorothy A. House, M.A.	Technical Editor
Tracy Borneman	Field Coordinator
Jillian Johnston	Field Coordinator
Alana Demko	Bander/Nest Monitor
Elly Knight	Bander/Nest Monitor
Anne Pellegrini	Bander/Nest Monitor
Corina Anderson	Surveyor/Nest Monitor
Alicia Andes	Surveyor/Nest Monitor
Ryan Davis	Surveyor/Nest Monitor
Dayna LeClair	Surveyor/Nest Monitor
David Cranmer	Surveyor
Kathryn Riley	Surveyor
Devin Keane	Piezometer Maintenance/Data Entry

Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations Along the Virgin and Lower Colorado River Regions, 2009.



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2010

AR063693

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

Lower Colorado River Multi-Species Conservation Program

Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations along the Virgin and Lower Colorado River Regions, 2009. Annual Report

Prepared by Mary Anne McLeod and Thomas J. Koronkiewicz,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2010

AR063697

PREFACE

This document is one of the deliverables submitted to the U.S. Bureau of Reclamation under contract # GS-10F-0209L to complete Southwestern Willow Flycatcher (*Empidonax traillii extimus*) studies along the lower Colorado River and tributaries in 2009. The document comprises a list of all sites surveyed for willow flycatchers in 2009 and the UTM coordinates (Zone 11, NAD 83) of the centroid of each site (Table 1), along with a compilation of aerial photographs. These aerial photographs include the location, identity, and breeding status of each willow flycatcher detected at study areas where resident flycatchers were detected during 2009 (Figure 1). For additional information regarding methodology and willow flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries in 2009 refer to:

> McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 165 pp.

This document is intended for use only by the U.S. Fish and Wildlife Service, the U.S. Geological Survey, Nevada Division of Wildlife, California Department of Fish and Game, and the Arizona Game and Fish Department. Specific locations of Southwestern Willow Flycatcher territories and nests may be considered by some agencies as sensitive information. Therefore, this document is not intended for general distribution. Please contact the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service for permission to copy and distribute this document.

Color Leg Band Combination Codes:

Color-band codes used on each aerial photograph follow the conventions presented below:

Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band and color-band designations for right and left legs are separated with a colon. **EE** = electric yellow federal band, **PU** = pumpkin federal band, **TQ** = turquoise federal band, **XX** = standard silver federal band, **Bs** = blue federal band, **R** = red, **D** = dark/navy blue, **B** = light blue, **K** = black, **V** = violet, **Z** = gold, **Y** = yellow, **G** = green, **W** = white, **O** = orange, **UB** = unbanded, **(M)** = metal pin striped band.

Nest and Willow Flycatcher Location Codes:

Nest and willow flycatcher location codes on each aerial photograph follow the conventions presented below:

Blue	the approximate use area center for individual willow flycatchers detected at the site for less than 7 days
Yellow	a willow flycatcher nest location
Red	the approximate territory center for a single, territorial willow flycatcher detected at the site for 7 or more days
Green	the approximate territory center for a willow flycatcher pair for which no nesting was confirmed

All locations on the aerial photographs were based on UTM coordinates (Zone 11, NAD 83) obtained in the field in 2009 using a Garmin Rino 110 GPS unit.

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2009

Study Area[1]	Survey Site	Area (ha)	UTM Coordinate of Site Centroid
PAHR	North	4.6	665781E 4130976N
	West	1.5	665539E 4130426N
	MAPS	2.7	666143E 4128798N
	South	2.5	666689E 4128037N
LIFI	Poles	4.7	773348E 4088303N
MESQ	East	4.4	758641E 4075312N
	West	11.5	757886E 4075442N
	Bunker Marsh North	13.6	753981E 4072599N
MOME	Mormon Mesa North	8.2	739718E 4058156N
	Hedgerow	1.1	740216E 4057982N
	Mormon Mesa South (North half)	8.9	739566E 4057258N
	Mormon Mesa South (South half)	3.4	739476E 4056901N
	Virgin River #1 (North half)	12.0	739312E 4056211N
	Virgin River #1 (South half)	34.7	739385E 4055343N
	Virgin River #2	36.9	739050E 4054326N
MUDD	Overton WMA Pond	0.7	731155E 4045638N
	Overton WMA	14.9	731660E 4044514N
TOPO	Pipes #1	5.2	726906E 3856907N
	Pipes #3	5.7	727012E 3856517N
	The Wallows	0.4	727209E 3856173N
	PC6-1	4.8	727235E 3855838N
	Pig Hole	2.4	727233E 3855415N
	In Between	7.7	727036E 3855171N
	800M	6.1	726882E 3854999N
	Pierced Egg	6.7	726668E 3855001N
	Swine Paradise	1.0	726288E 3854489N
	Barbed Wire	2.4	726152E 3854551N
	Platform	1.3	725831E 3853980N
	250M	1.9	725838E 3853503N
	Hell Bird	3.3	725868E 3853255N
	Glory Hole	5.0	725671E 3853043N
	Beal Lake	13.9	725957E 3850916N
	Lost Slough	1.5	726658E 3848259N
	Lost Pond	1.2	727134E 3847698N
	Lost Lake	3.3	727971E 3846984N

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2009 (Continued)

Study Area[1]	Survey Site	Area (ha)	UTM Coordinate of Site Centroid
TOGO	Pulpit Rock	2.1	734056E 3838576N
	Picture Rock	4.6	734586E 3833723N
	Blankenship Bend North	26.7	736561E 3832765N
	Blankenship Bend South	25.9	736682E 3831524N
BIWI	Burn Edge	3.7	769868E 3798257N
	Site #4	9.9	769684E 3797558N
	Site #3	9.5	769928E 3797286N
	Last Gasp	2.1	770525E 3797965N
	Site #5	6.8	771903E 3796595N
	Upstream from Site #8	1.5	778658E 3794902N
	Planet Ranch Road	2.1	778887E 3794478N
AHAK	Deer Island	15.2	743367E 3778371N
PVER	PVER Phase 2	28.7	728644E 3730265N
BIHO	Big Hole Slough	29.0	728672E 3723808N
CIBO	CVCA Phase 1	26.2	717274E 3699263N
	CVCA Phase 3	41.2	714375E 3698081N
	Cibola Nature Trail	13.7	716008E 3694360N
	Cibola Island	4.2	714894E 3685438N
	Cibola Site #2	16.4	716845E 3684106N
	Cibola Site #1	7.7	717233E 3683564N
	Hart Mine Marsh	31.6	717492E 3682569N
	Cibola Lake #2 (East)	4.5	717146E 3679673N
	Walker Lake	11.4	716003E 3676276N
IMPE	Paradise	7.8	714120E 3666214N
	Hoge Ranch	20.7	717175E 3660307N
	Rattlesnake	7.6	719879E 3659586N
	Milemarker 65	10.0	726646E 3657774N
	Nursery NW	7.0	733900E 3654066N
	Ferguson Lake	21.1	733587E 3651733N
	Great Blue Heron	7.1	736876E 3652307N
	Powerline	2.0	737353E 3652098N
	Martinez Lake	4.6	737362E 3651773N
MITT	Mittry West	4.4	734967E 3638617N
YUMA	Gila River Site #2	5.1	736493E 3623789N
	Fortuna Site #1	2.5	737633E 3623619N
	Fortuna North	3.4	739756E 3625561N

[1] PAHR = Pahranagat National Wildlife Refuge (NWR); LIFI = Littlefield; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River, TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams River NWR; AHAK = Ahakhav Tribal Preserve, PVER = Palo Verde Ecological Reserve, BIHO = Big Hole Slough; EHRE = Ehrenberg; CIBO = Cibola NWR; IMPE = Imperial NWR; MITT = Mittry Lake; YUMA = Yuma.

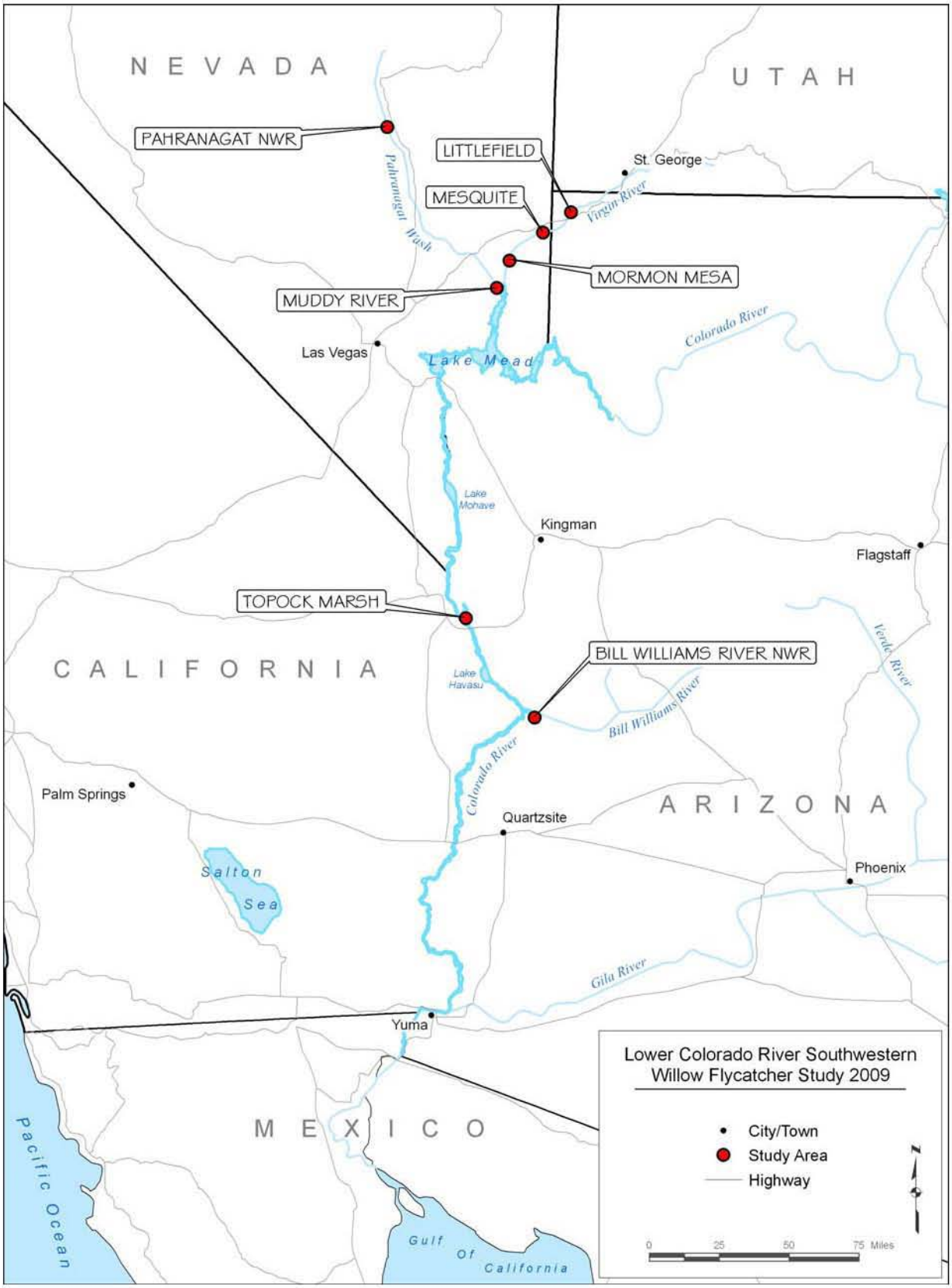
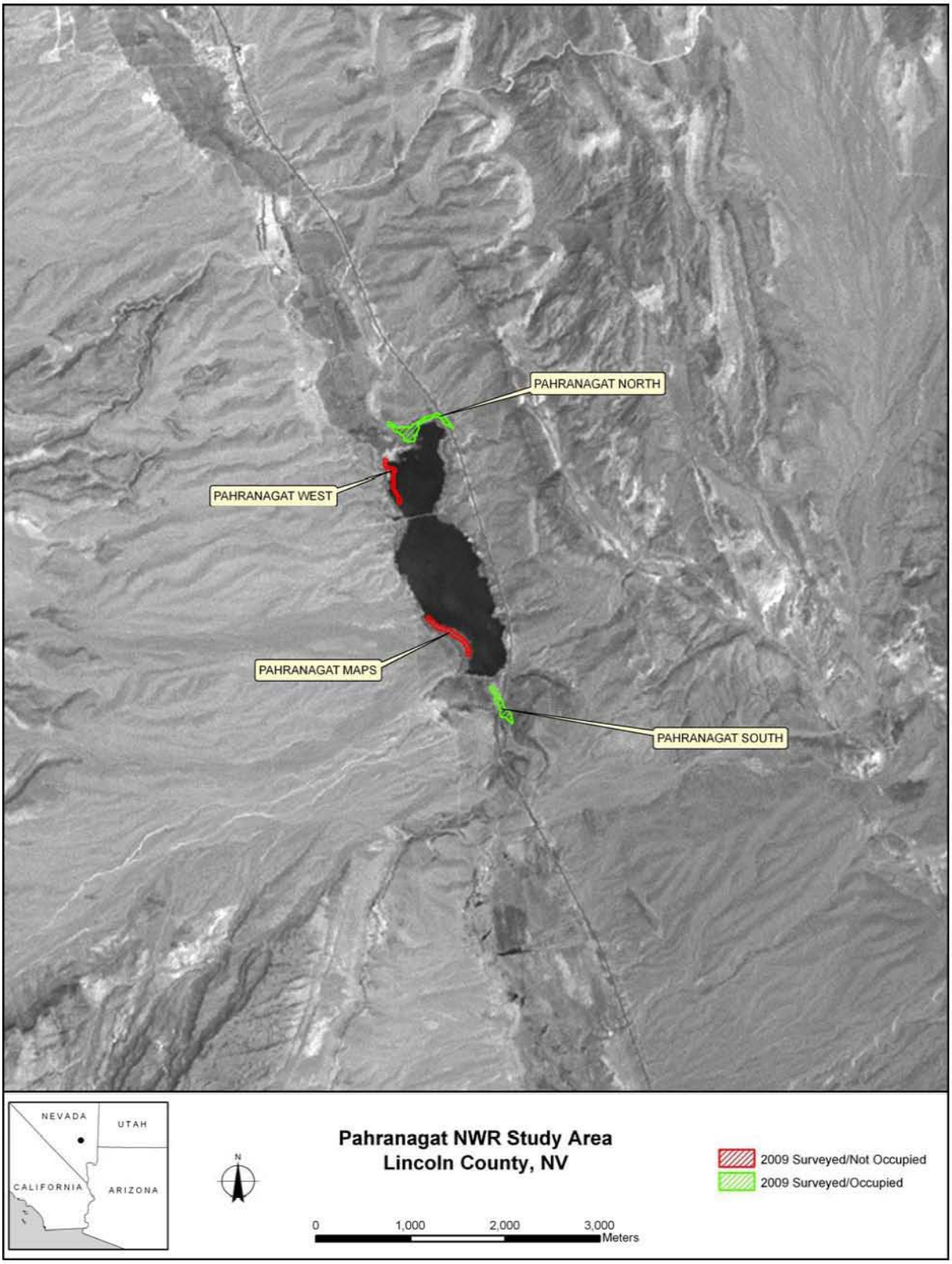
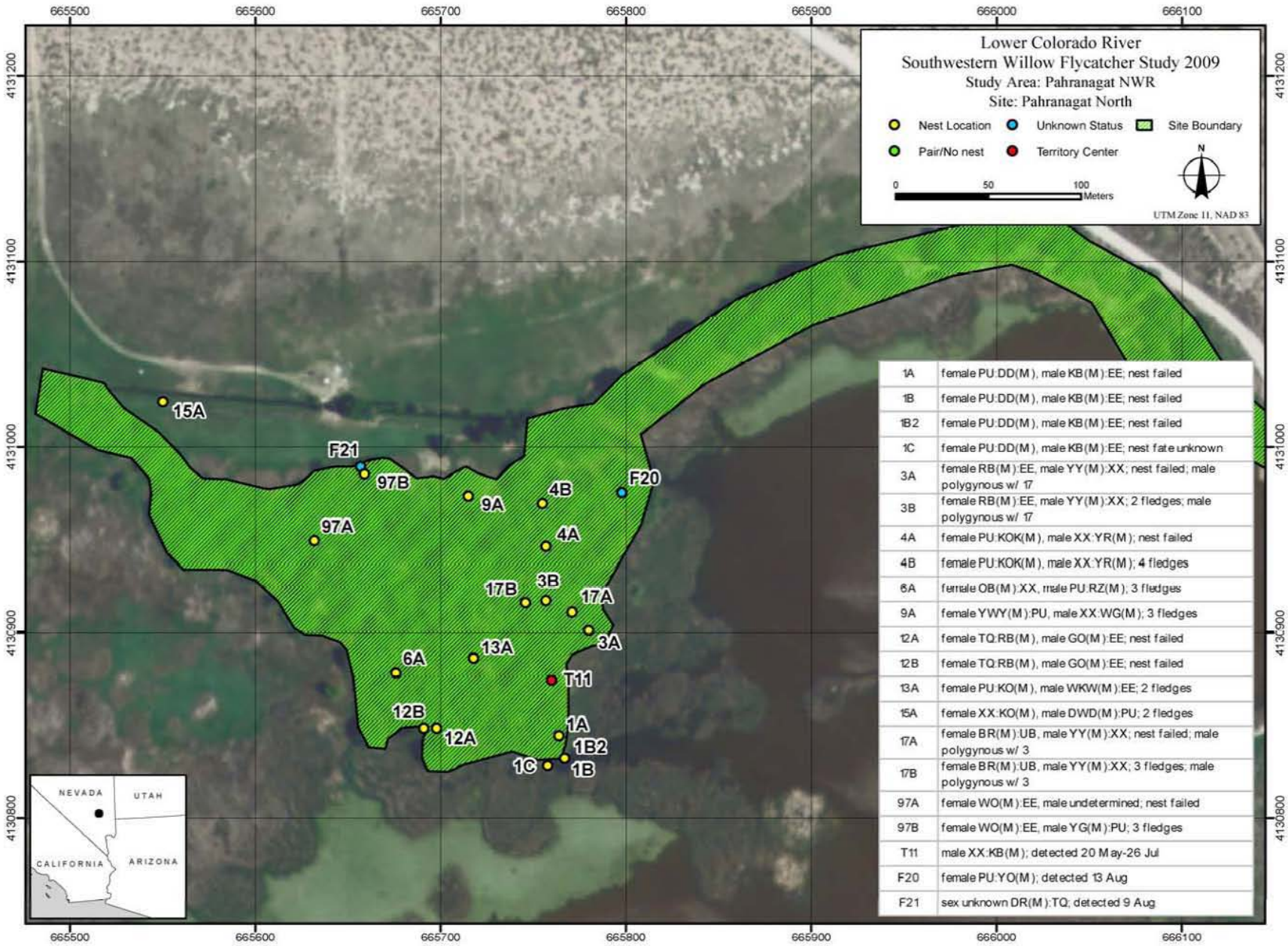
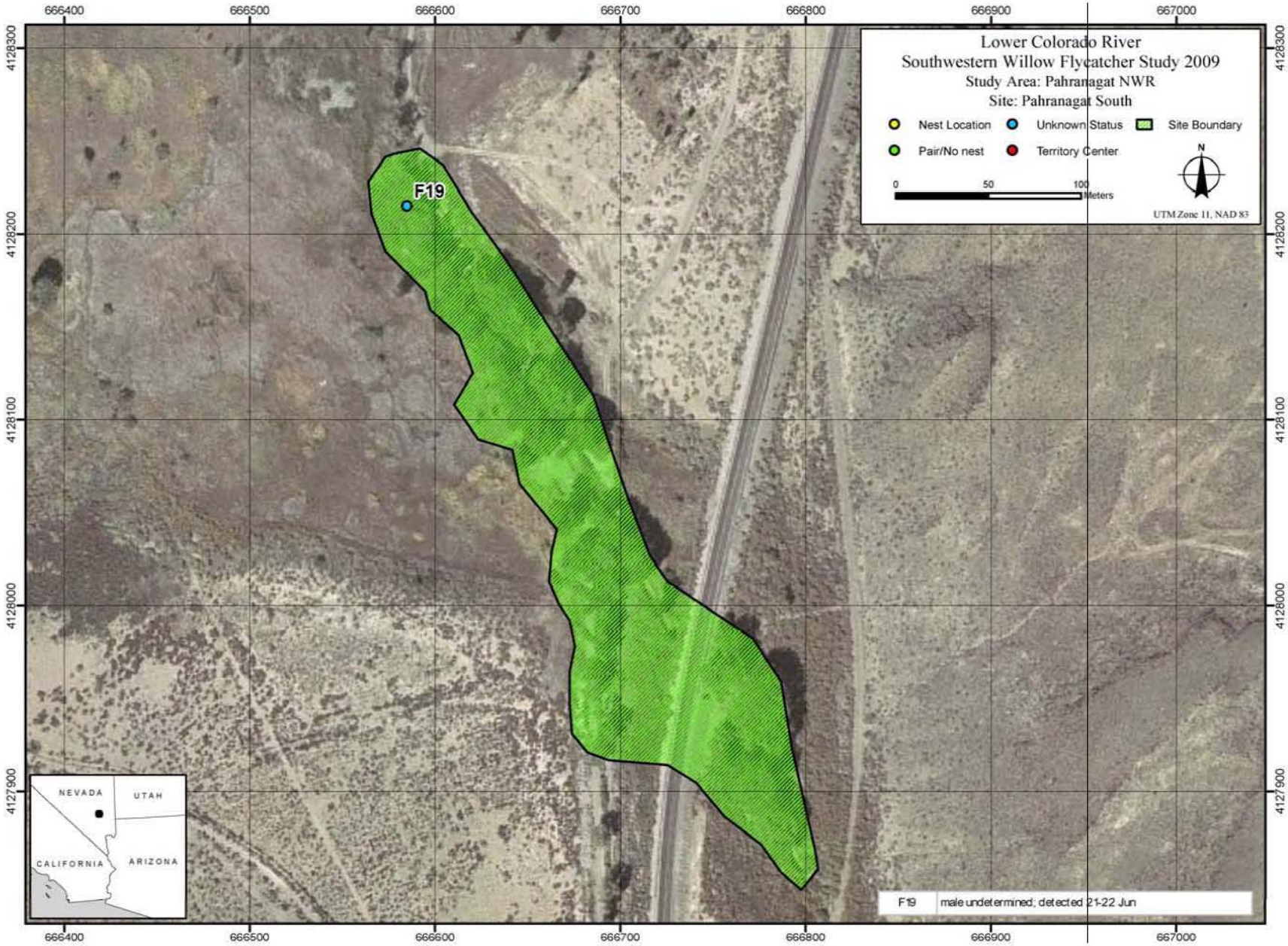


Figure 1. Locations of resident Southwestern Willow Flycatcher populations along the Virgin and lower Colorado Rivers, 2009.

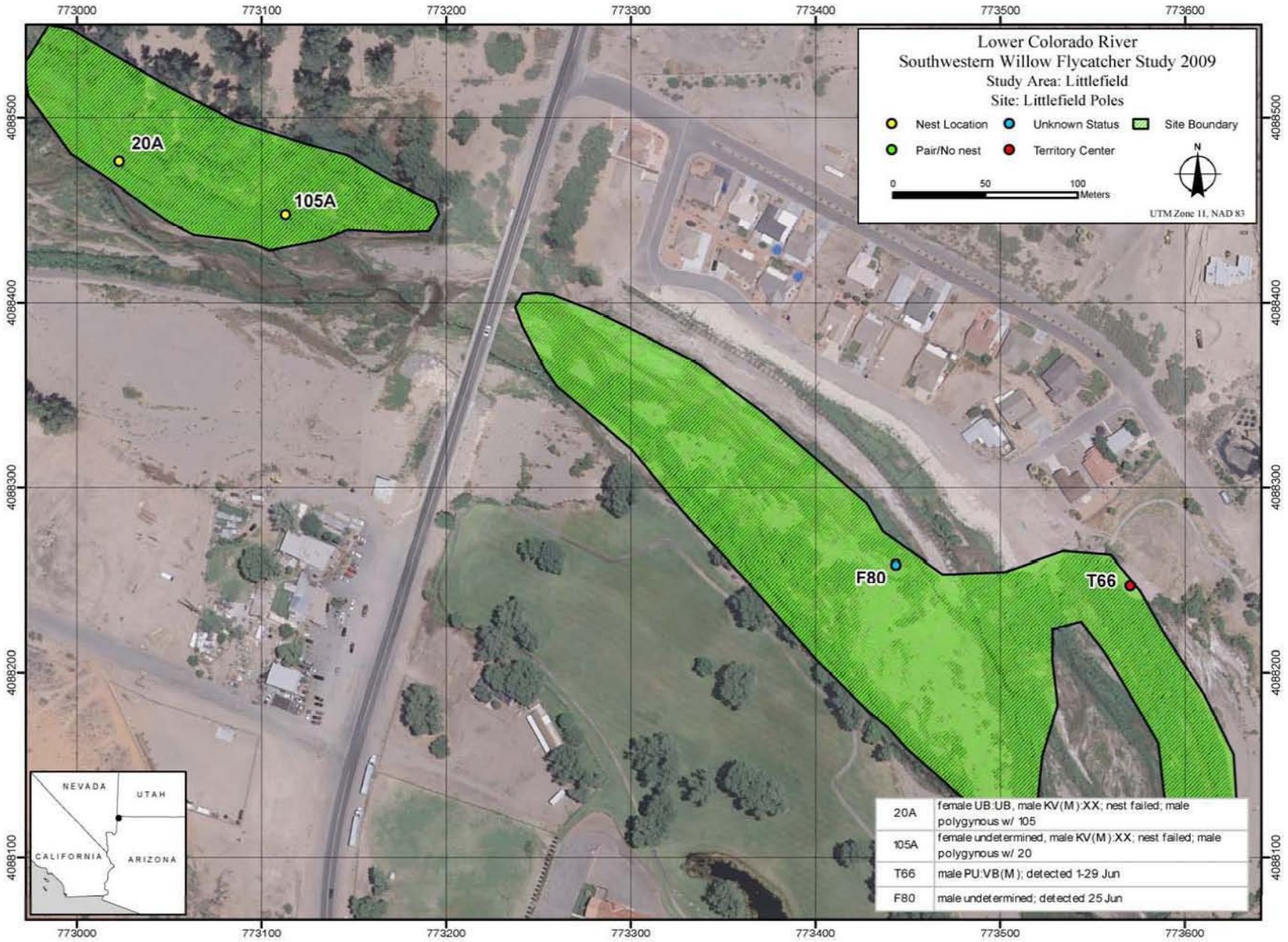

PAHRANAGAT NORTH
PAHRANAGAT WEST
PAHRANAGAT MAPS
PAHRANAGAT SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Pahranagat NWR Study Area
Lincoln County, NV
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
0
1,000
2,000
3,000
Meters

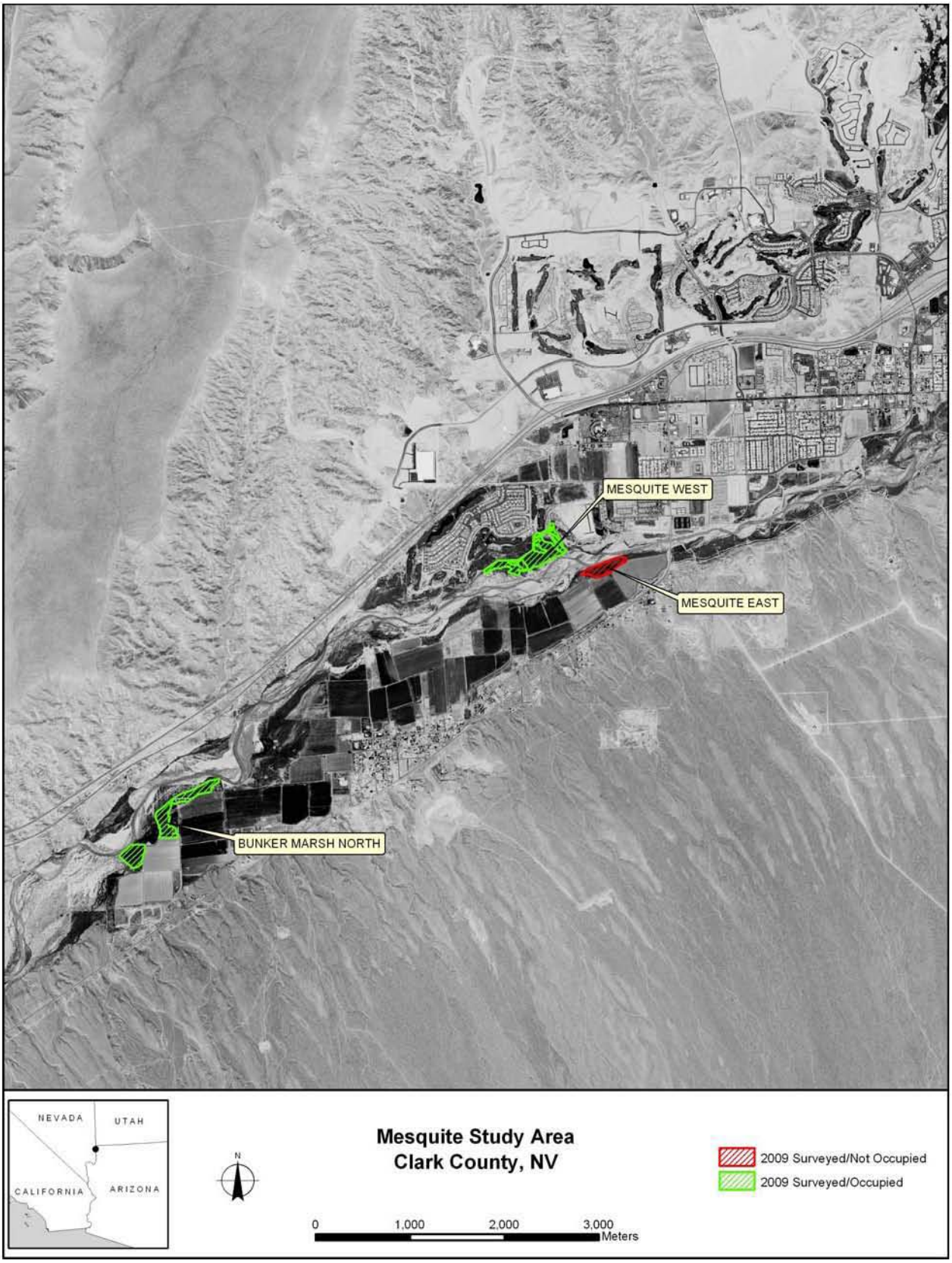

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Pahranagat NWR
Site: Pahranagat North
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
665500
665600
665700
665800
665900
666000
666100
4131200
4131100
4131000
4130900
4130800
15A
F21
97B
9A
4B
F20
97A
4A
17B
3B
17A
3A
6A
13A
T11
12B
12A
1A
1B2
1C
1B
NEVADA
UTAH
CALIFORNIA
ARIZONA
1A female PU:DD(M), male KB(M):EE; nest failed
1B female PU:DD(M), male KB(M):EE; nest failed
1B2 female PU:DD(M), male KB(M):EE; nest failed
1C female PU:DD(M), male KB(M):EE; nest fate unknown
3A female RB(M):EE, male YY(M):XX; nest failed; male polygynous w/ 17
3B female RB(M):EE, male YY(M):XX; 2 fledges; male polygynous w/ 17
4A female PU:KOK(M), male XX:YR(M); nest failed
4B female PU:KOK(M), male XX:YR(M); 4 fledges
6A female OB(M):XX, male PU:RZ(M); 3 fledges
9A female YWY(M):PU, male XX:WG(M); 3 fledges
12A female TQ:RB(M), male GO(M):EE; nest failed
12B female TQ:RB(M), male GO(M):EE; nest failed
13A female PU:KO(M), male WKW(M):EE; 2 fledges
15A female XX:KO(M), male DWD(M):PU; 2 fledges
17A female BR(M):UB, male YY(M):XX; nest failed; male polygynous w/ 3
17B female BR(M):UB, male YY(M):XX; 3 fledges; male polygynous w/ 3
97A female WO(M):EE, male undetermined; nest failed
97B female WO(M):EE, male YG(M):PU; 3 fledges
T11 male XX:KB(M); detected 20 May-26 Jul
F20 female PU:YO(M); detected 13 Aug
F21 sex unknown DR(M):TQ; detected 9 Aug

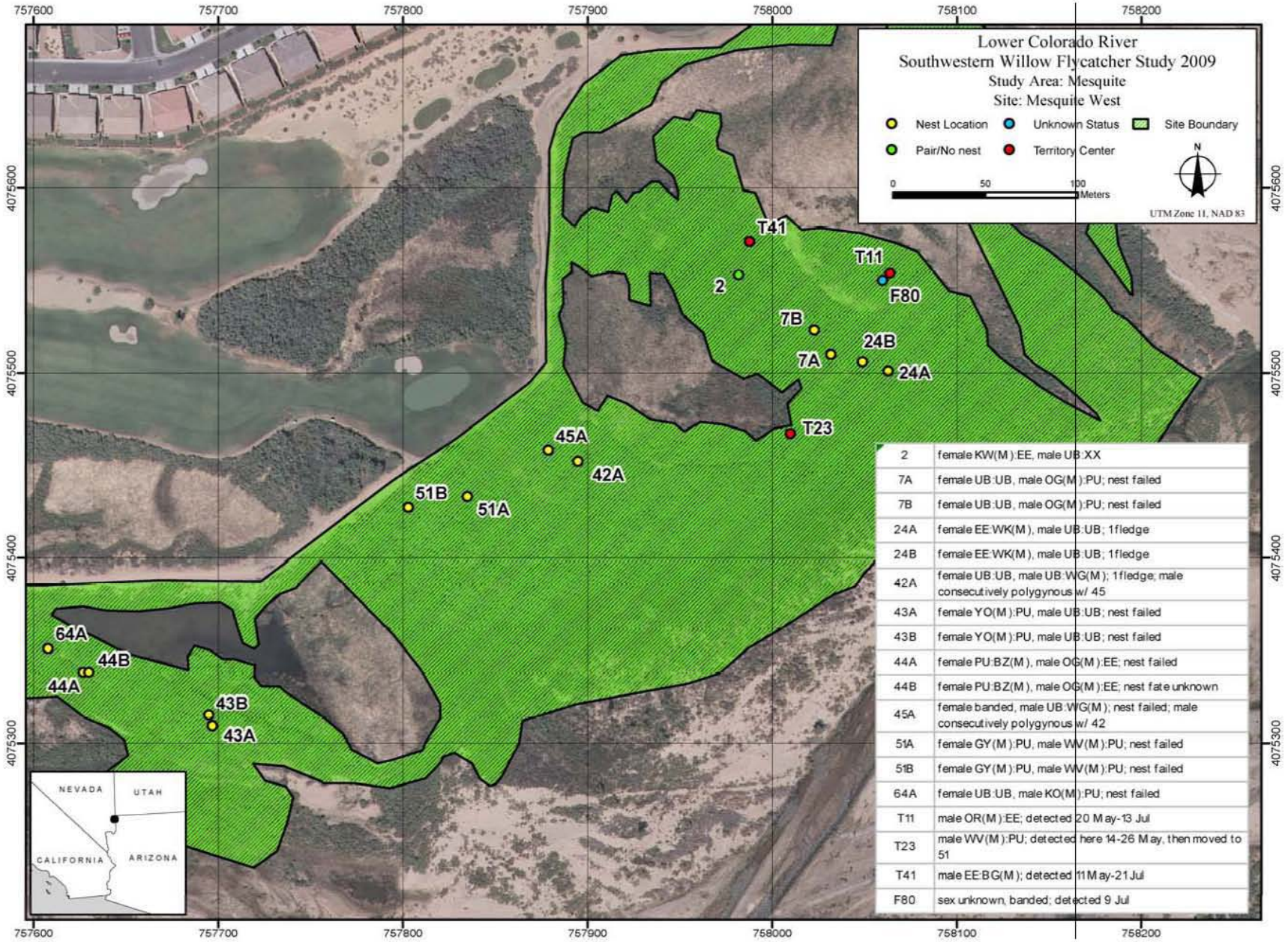
2


Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Pahranagat NWR
Site: Pahranagat South
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F19
F19 male undetermined; detected 21-22 Jun
NEVADA
UTAH
CALIFORNIA
ARIZONA
666400
666500
666600
666700
666800
666900
667000
4128300
4128200
4128100
4128000
4127900

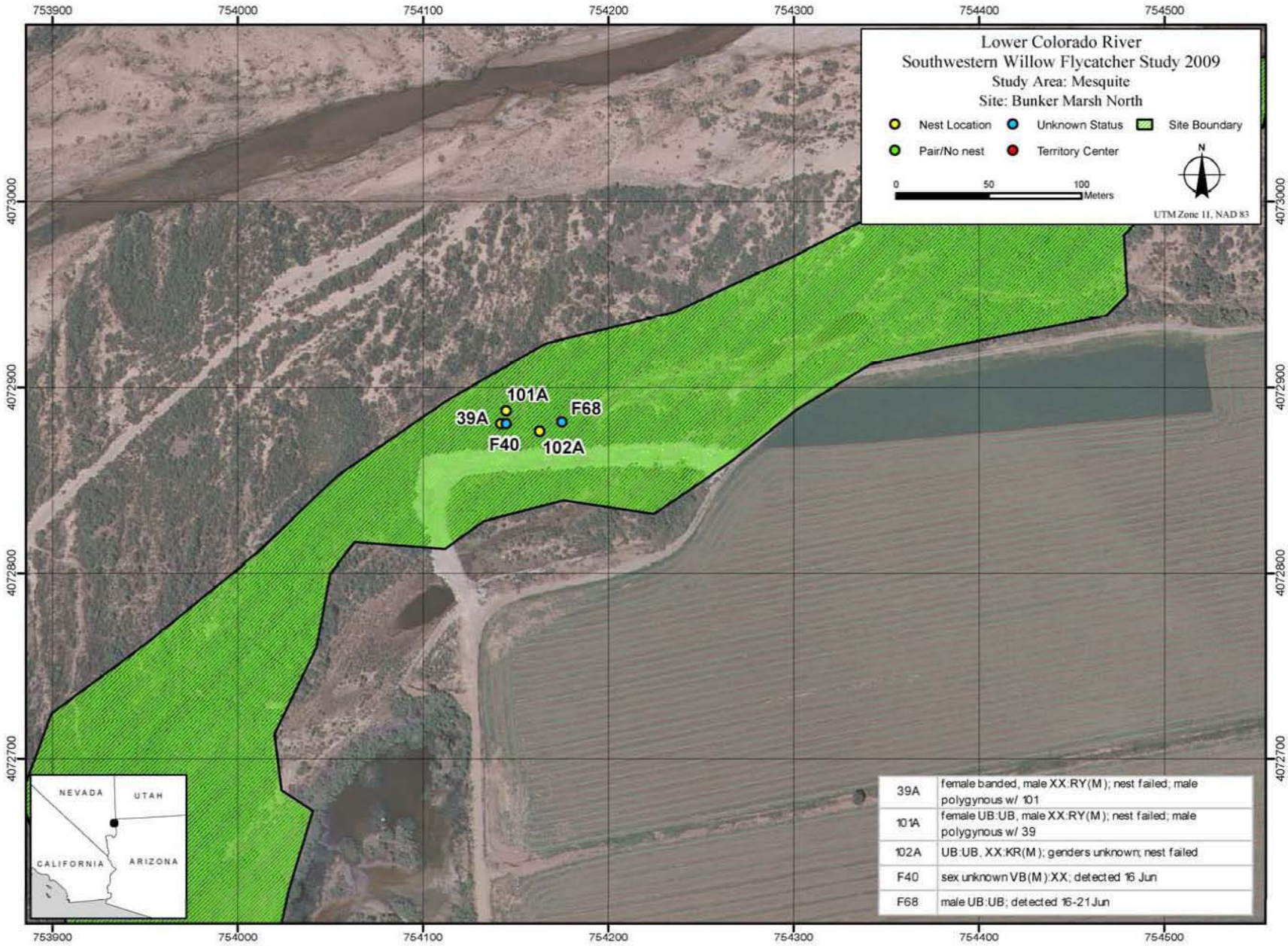

LITTLEFIELD POLES
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Littlefield Study Area
Mohave County, AZ
0
1,000
2,000
3,000
Meters
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied

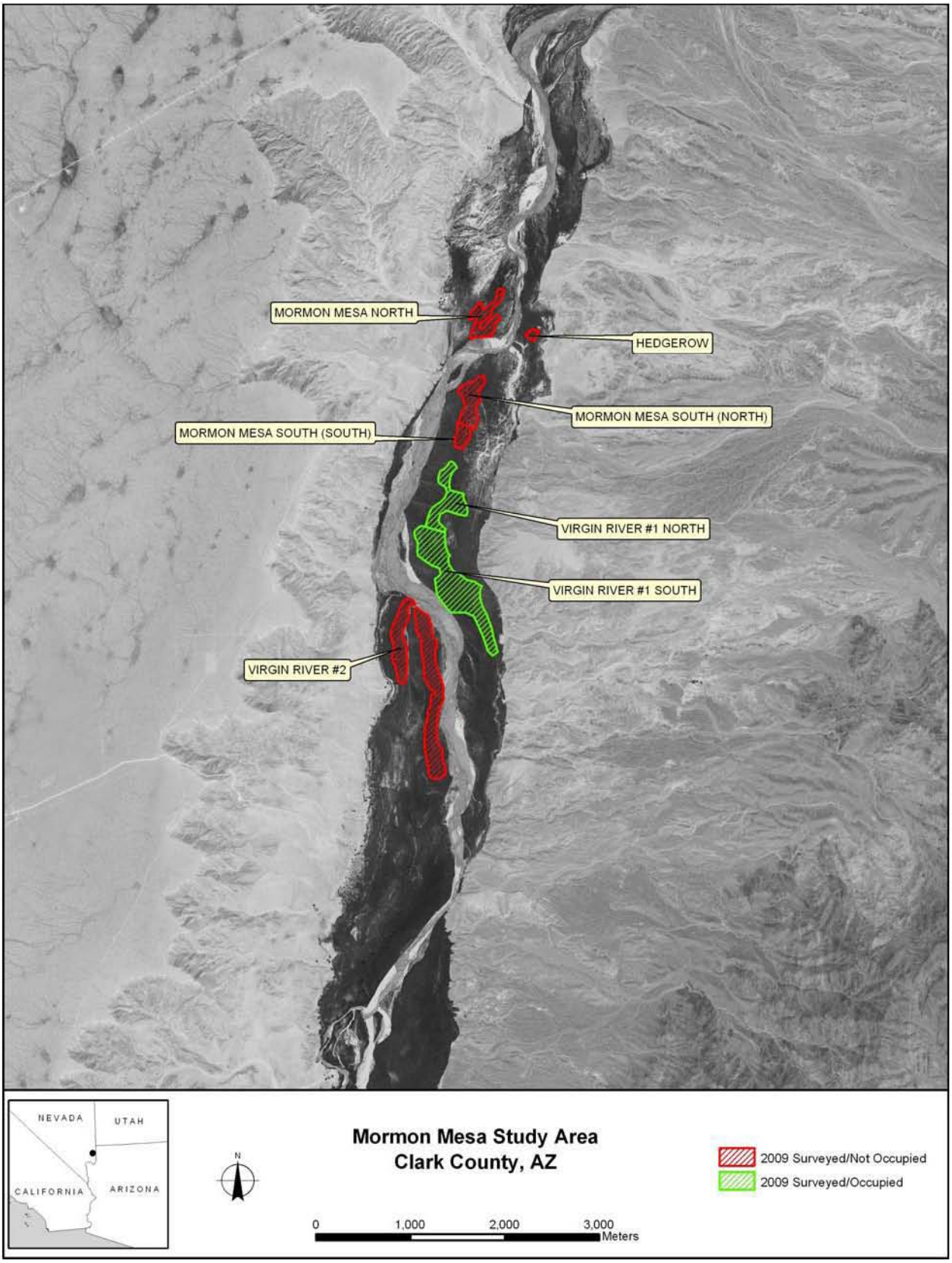

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Littlefield
Site: Littlefield Poles
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
20A
105A
F80
T66
NEVADA
UTAH
CALIFORNIA
ARIZONA
20A female UB:UB, male KV(M):XX; nest failed; male polygynous w/ 105
105A female undetermined, male KV(M):XX; nest failed; male polygynous w/ 20
T66 male PU:VB(M); detected 1-29 Jun
F80 male undetermined; detected 25 Jun
773000
773100
773200
773300
773400
773500
773600
4088500
4088400
4088300
4088200
4088100

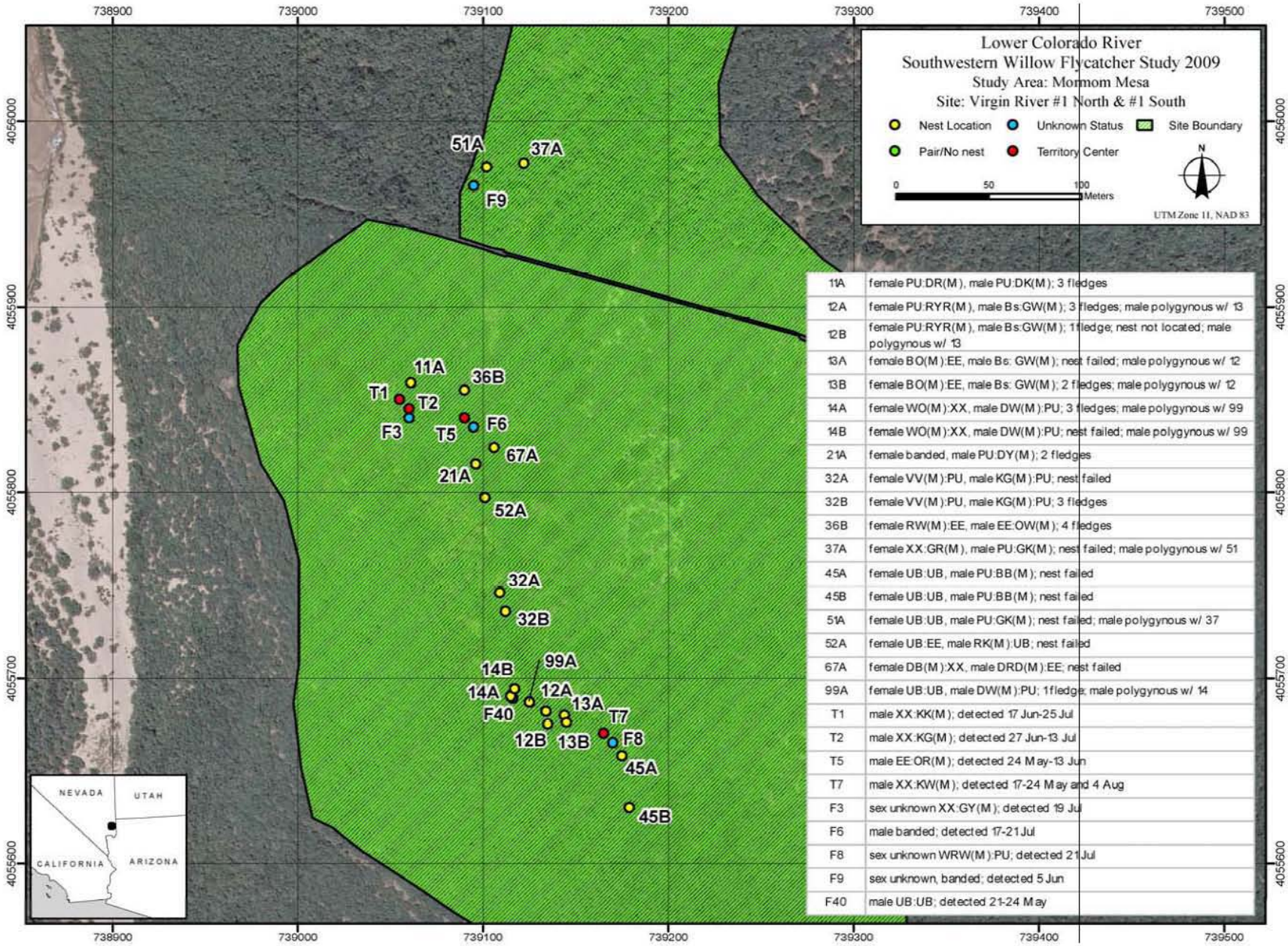

MESQUITE WEST
MESQUITE EAST
BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Mesquite Study Area
Clark County, NV
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
0
1,000
2,000
3,000
Meters



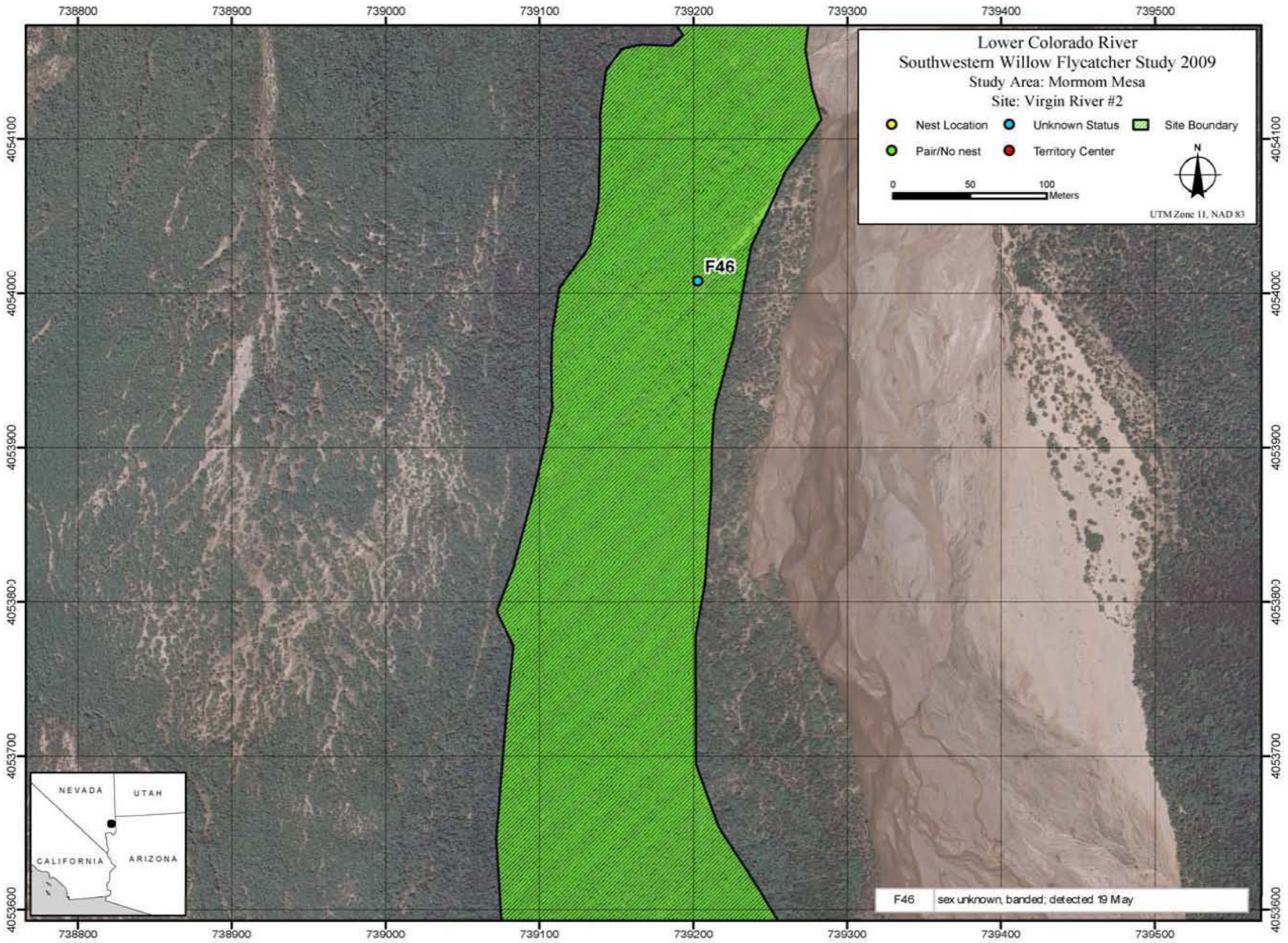
2	female KW(M):EE, male UB:XX
7A	female UB:UB, male OG(M):PU; nest failed
7B	female UB:UB, male OG(M):PU; nest failed
24A	female EE:WK(M), male UB:UB; 1fledge
24B	female EE:WK(M), male UB:UB; 1fledge
42A	female UB:UB, male UB:WG(M); 1fledge; male consecutively polygynous w/ 45
43A	female YO(M):PU, male UB:UB; nest failed
43B	female YO(M):PU, male UB:UB; nest failed
44A	female PU:BZ(M), male OG(M):EE; nest failed
44B	female PU:BZ(M), male OG(M):EE; nest fate unknown
45A	female banded, male UB:WG(M); nest failed; male consecutively polygynous w/ 42
51A	female GY(M):PU, male WV(M):PU; nest failed
51B	female GY(M):PU, male WV(M):PU; nest failed
64A	female UB:UB, male KO(M):PU; nest failed
T11	male OR(M):EE; detected 20 May-13 Jul
T23	male WV(M):PU; detected here 14-26 May, then moved to 51
T41	male EE:BG(M); detected 11 May-21 Jul
F80	sex unknown, banded; detected 9 Jul

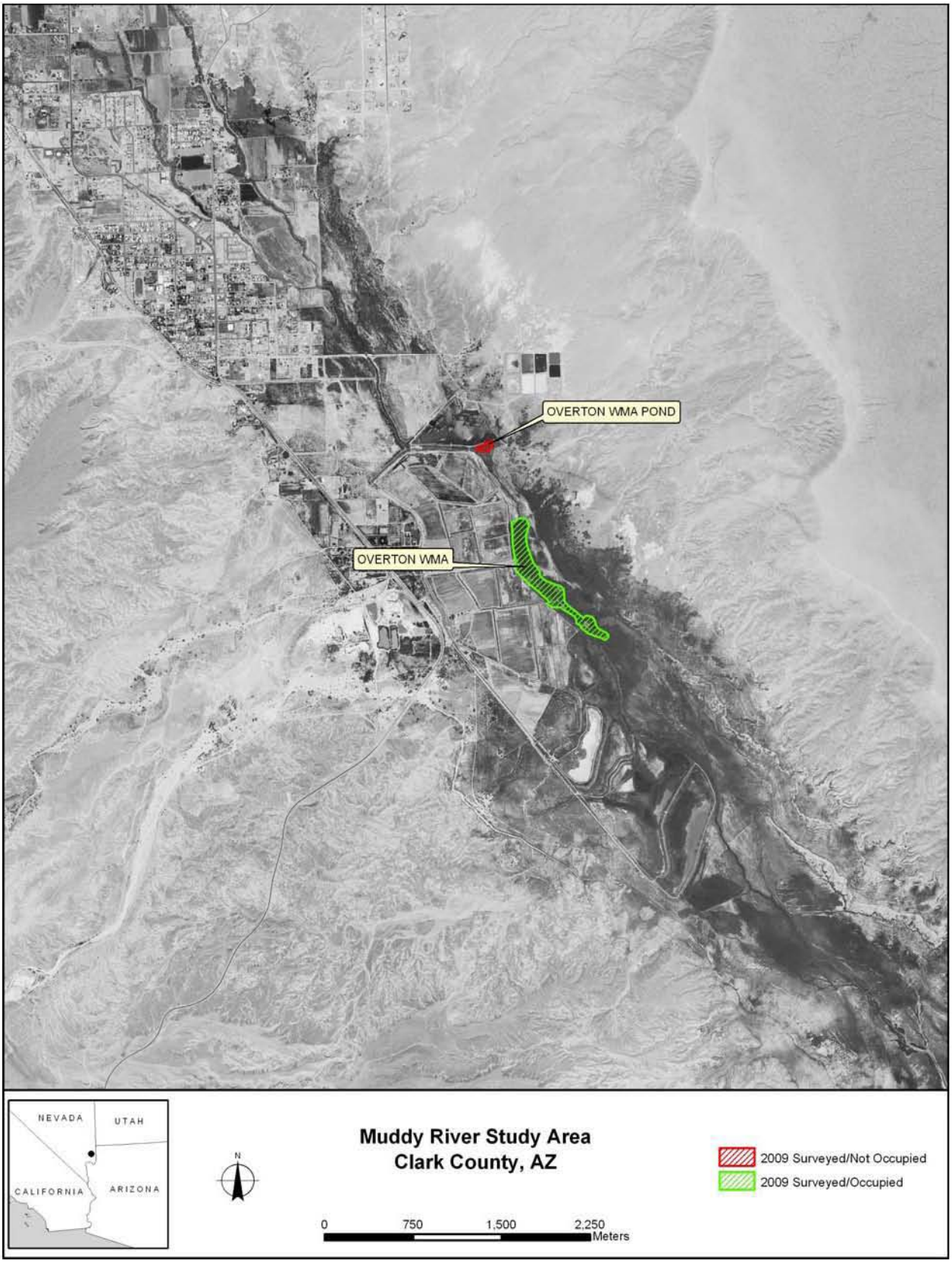

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Mesquite
Site: Bunker Marsh North
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
753900
754000
754100
754200
754300
754400
754500
4073000
4072900
4072800
4072700
101A
39A
F68
F40
102A
NEVADA
UTAH
CALIFORNIA
ARIZONA
39A female banded, male XX:RY(M); nest failed; male polygynous w/ 101
101A female UB:UB, male XX:RY(M); nest failed; male polygynous w/ 39
102A UB:UB, XX:KR(M); genders unknown; nest failed
F40 sex unknown VB(M):XX; detected 16 Jun
F68 male UB:UB; detected 16-21 Jun

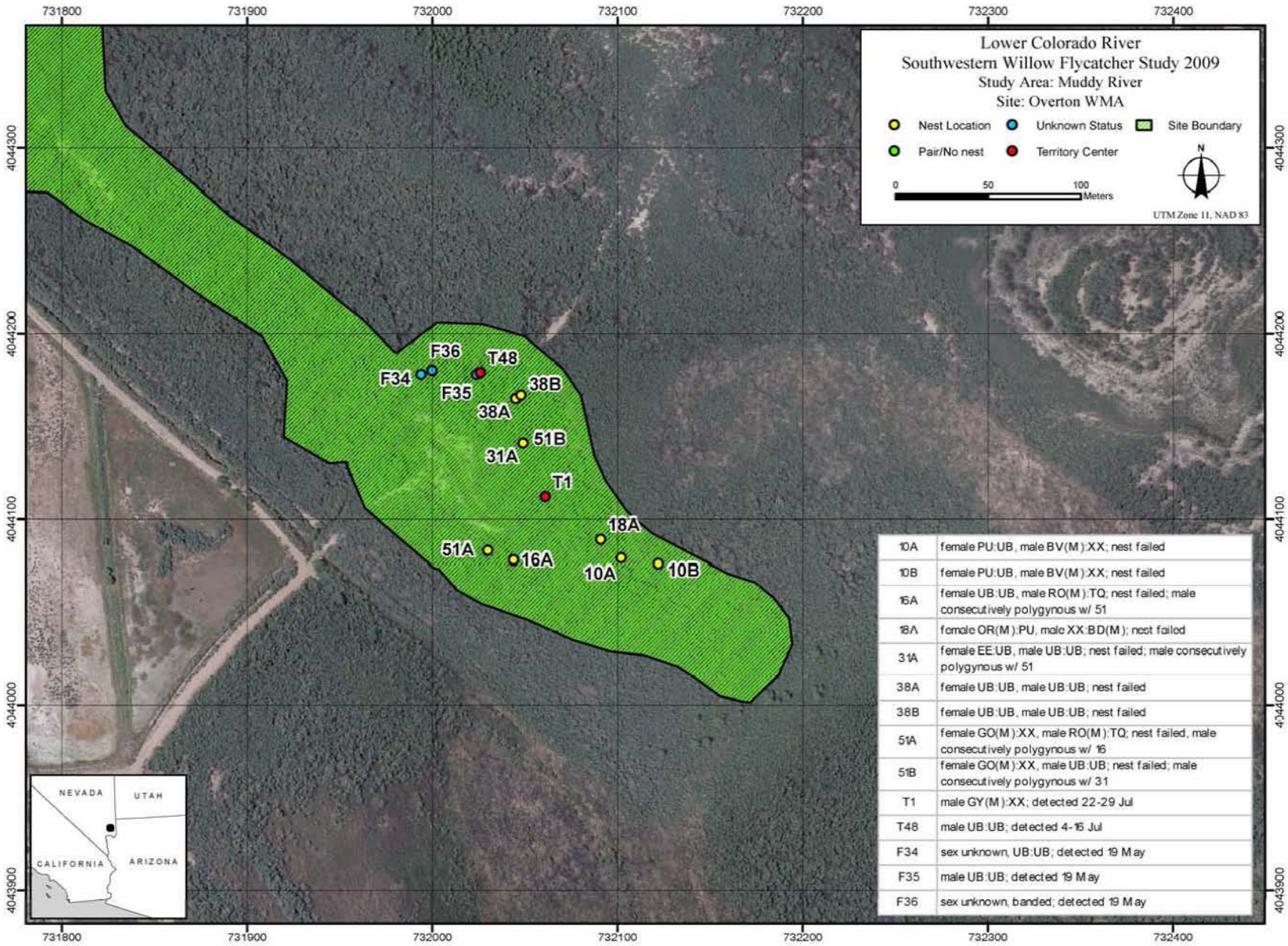

MORMON MESA NORTH
HEDGEROW
MORMON MESA SOUTH (NORTH)
MORMON MESA SOUTH (SOUTH)
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Mormon Mesa Study Area
Clark County, AZ
0
1,000
2,000
3,000
Meters
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied



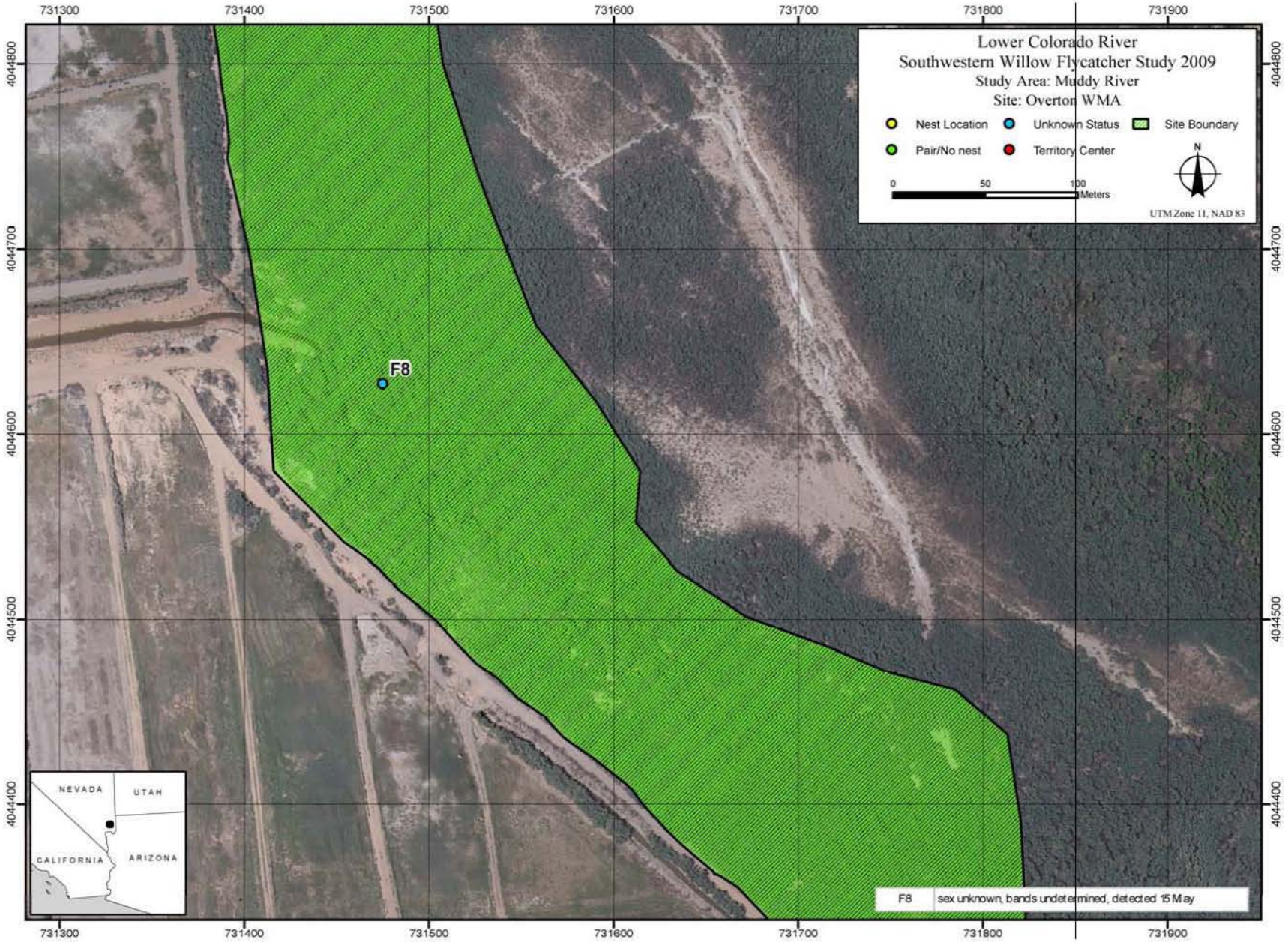
11A	female PU:DR(M), male PU:DK(M); 3 fledges
12A	female PU:RYR(M), male Bs:GW(M); 3 fledges; male polygynous w/ 13
12B	female PU:RYR(M), male Bs:GW(M); 1 fledge; nest not located; male polygynous w/ 13
13A	female BO(M):EE, male Bs: GW(M); nest failed; male polygynous w/ 12
13B	female BO(M):EE, male Bs: GW(M); 2 fledges; male polygynous w/ 12
14A	female WO(M):XX, male DW(M):PU; 3 fledges; male polygynous w/ 99
14B	female WO(M):XX, male DW(M):PU; nest failed; male polygynous w/ 99
21A	female banded, male PU:DY(M); 2 fledges
32A	female VV(M):PU, male KG(M):PU; nest failed
32B	female VV(M):PU, male KG(M):PU; 3 fledges
36B	female RW(M):EE, male EE:OW(M); 4 fledges
37A	female XX:GR(M), male PU:GK(M); nest failed; male polygynous w/ 51
45A	female UB:UB, male PU:BB(M); nest failed
45B	female UB:UB, male PU:BB(M); nest failed
51A	female UB:UB, male PU:GK(M); nest failed; male polygynous w/ 37
52A	female UB:EE, male RK(M):UB; nest failed
67A	female DB(M):XX, male DRD(M):EE; nest failed
99A	female UB:UB, male DW(M):PU; 1 fledge; male polygynous w/ 14
T1	male XX:KK(M); detected 17 Jun-25 Jul
T2	male XX:KG(M); detected 27 Jun-13 Jul
T5	male EE:OR(M); detected 24 May-13 Jun
T7	male XX:KW(M); detected 17-24 May and 4 Aug
F3	sex unknown XX:GY(M); detected 19 Jul
F6	male banded; detected 17-21 Jul
F8	sex unknown WRW(M):PU; detected 21 Jul
F9	sex unknown, banded; detected 5 Jun
F40	male UB:UB; detected 21-24 May

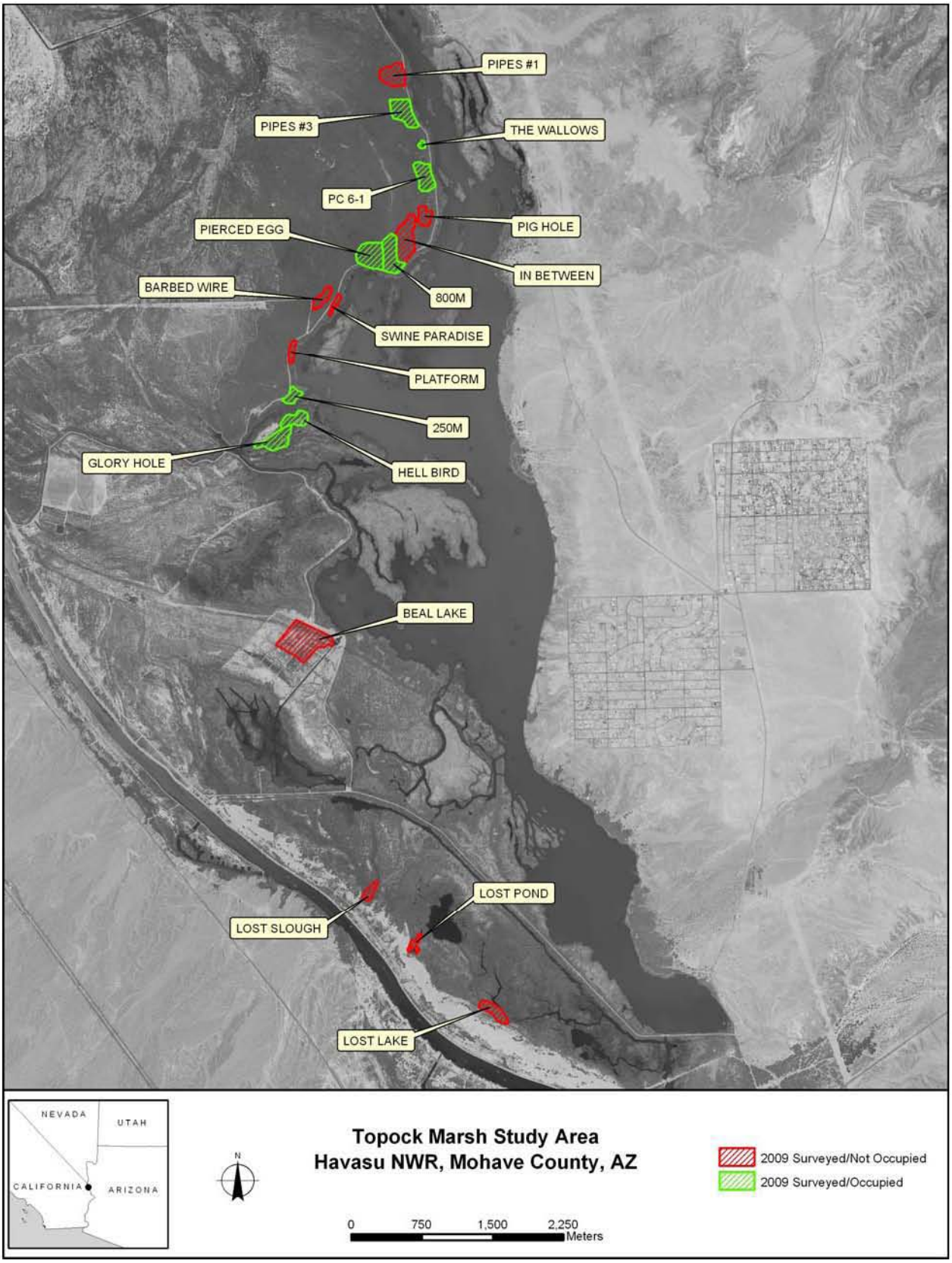

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Mormom Mesa
Site: Virgin River #2
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F46
F46 sex unknown, banded; detected 19 May
NEVADA
UTAH
CALIFORNIA
ARIZONA
738800
738900
739000
739100
739200
739300
739400
739500
4054100
4054000
4053900
4053800
4053700
4053600


OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Muddy River Study Area
Clark County, AZ
0
750
1,500
2,250
Meters
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied

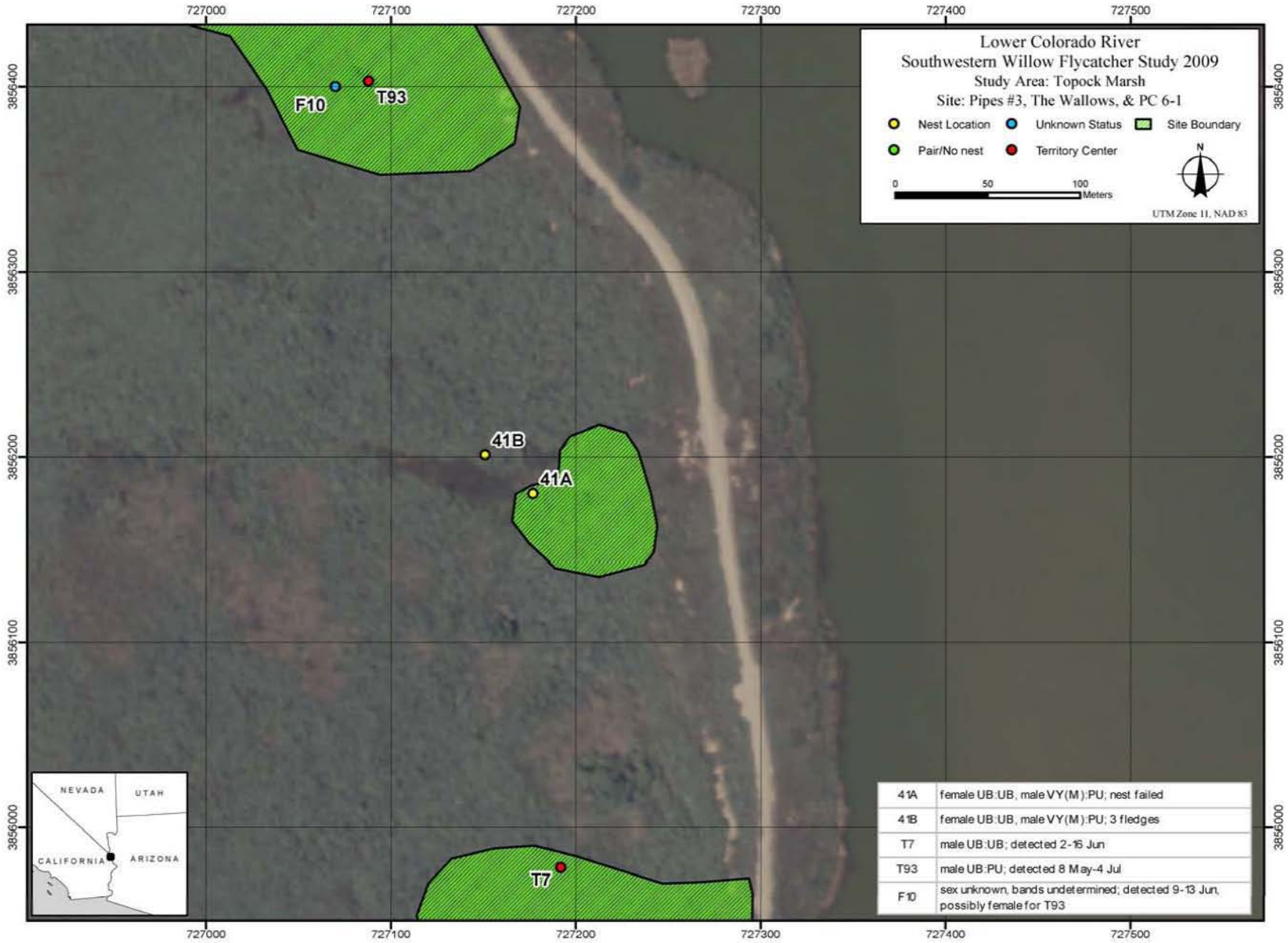


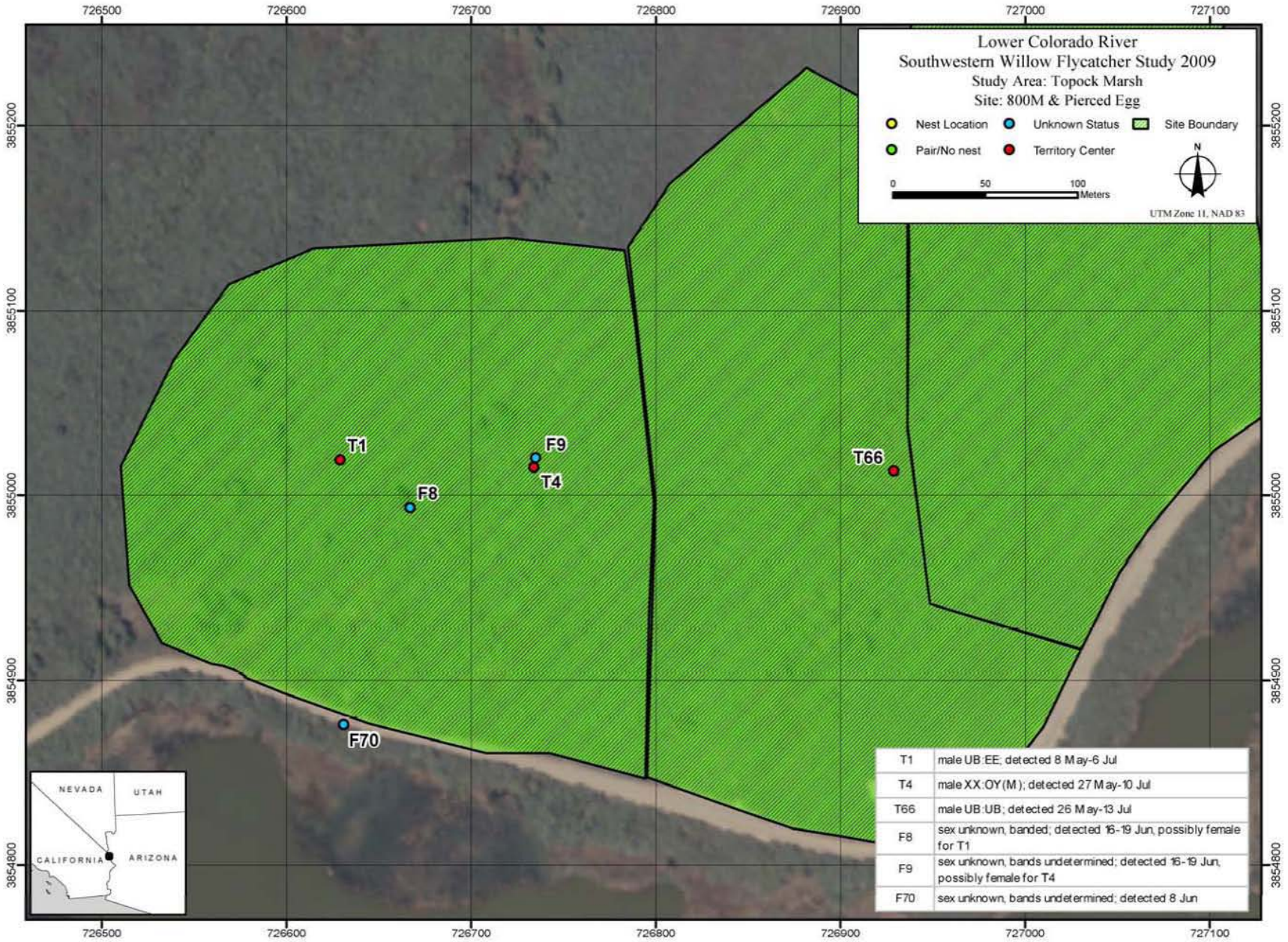
10A	female PU:UB, male BV(M):XX; nest failed
10B	female PU:UB, male BV(M):XX; nest failed
16A	female UB:UB, male RO(M):TQ; nest failed; male consecutively polygynous w/ 51
18A	female OR(M):PU, male XX:BD(M); nest failed
31A	female EE:UB, male UB:UB; nest failed; male consecutively polygynous w/ 51
38A	female UB:UB, male UB:UB; nest failed
38B	female UB:UB, male UB:UB; nest failed
51A	female GO(M):XX, male RO(M):TQ; nest failed, male consecutively polygynous w/ 16
51B	female GO(M):XX, male UB:UB; nest failed; male consecutively polygynous w/ 31
T1	male GY(M):XX; detected 22-29 Jul
T48	male UB:UB; detected 4-16 Jul
F34	sex unknown, UB:UB; detected 19 May
F35	male UB:UB; detected 19 May
F36	sex unknown, banded; detected 19 May

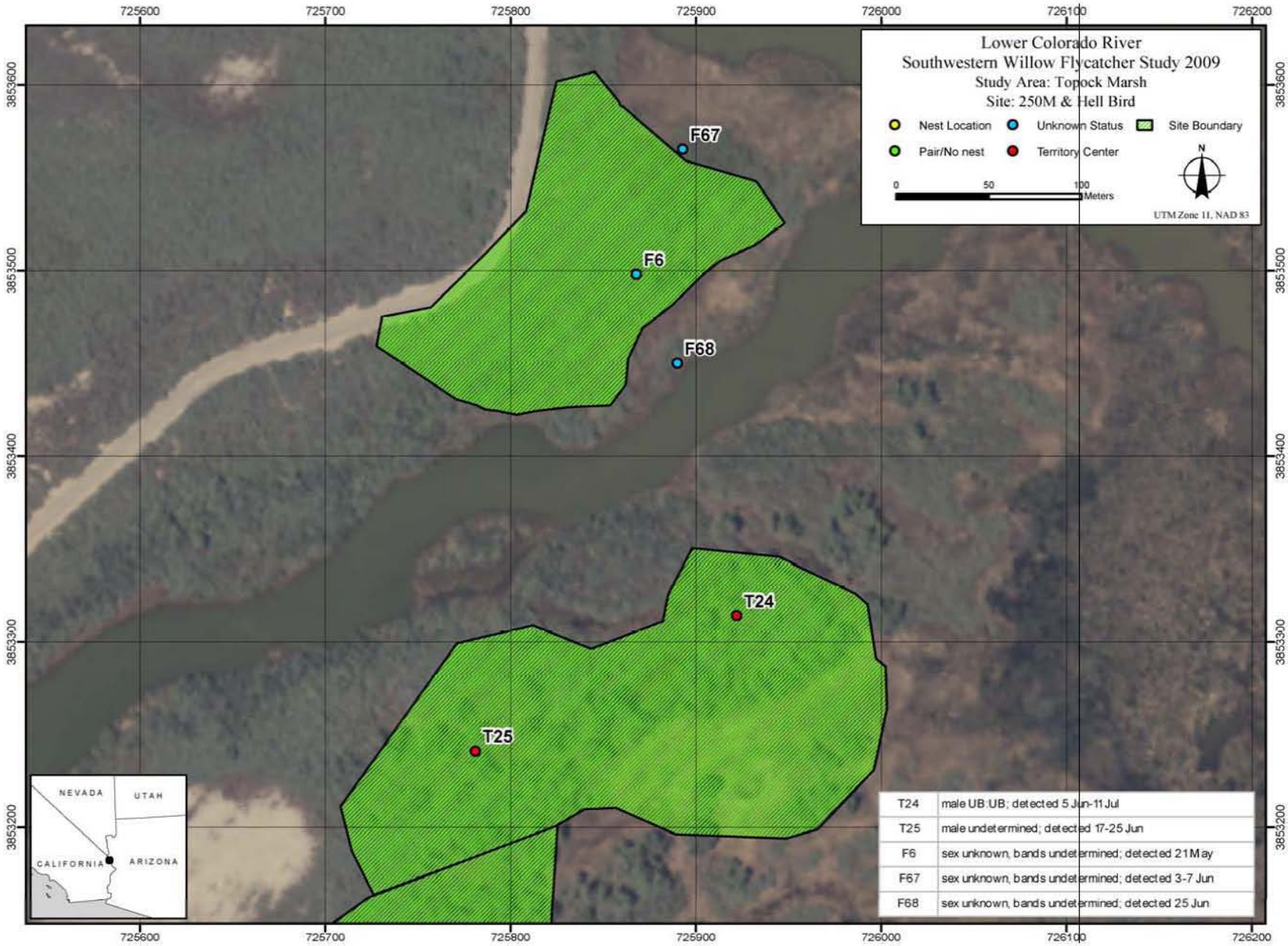

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Muddy River
Site: Overton WMA
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F8
F8 sex unknown, bands undetermined, detected 15 May
731300
731400
731500
731600
731700
731800
731900
4044800
4044700
4044600
4044500
4044400
NEVADA
UTAH
CALIFORNIA
ARIZONA

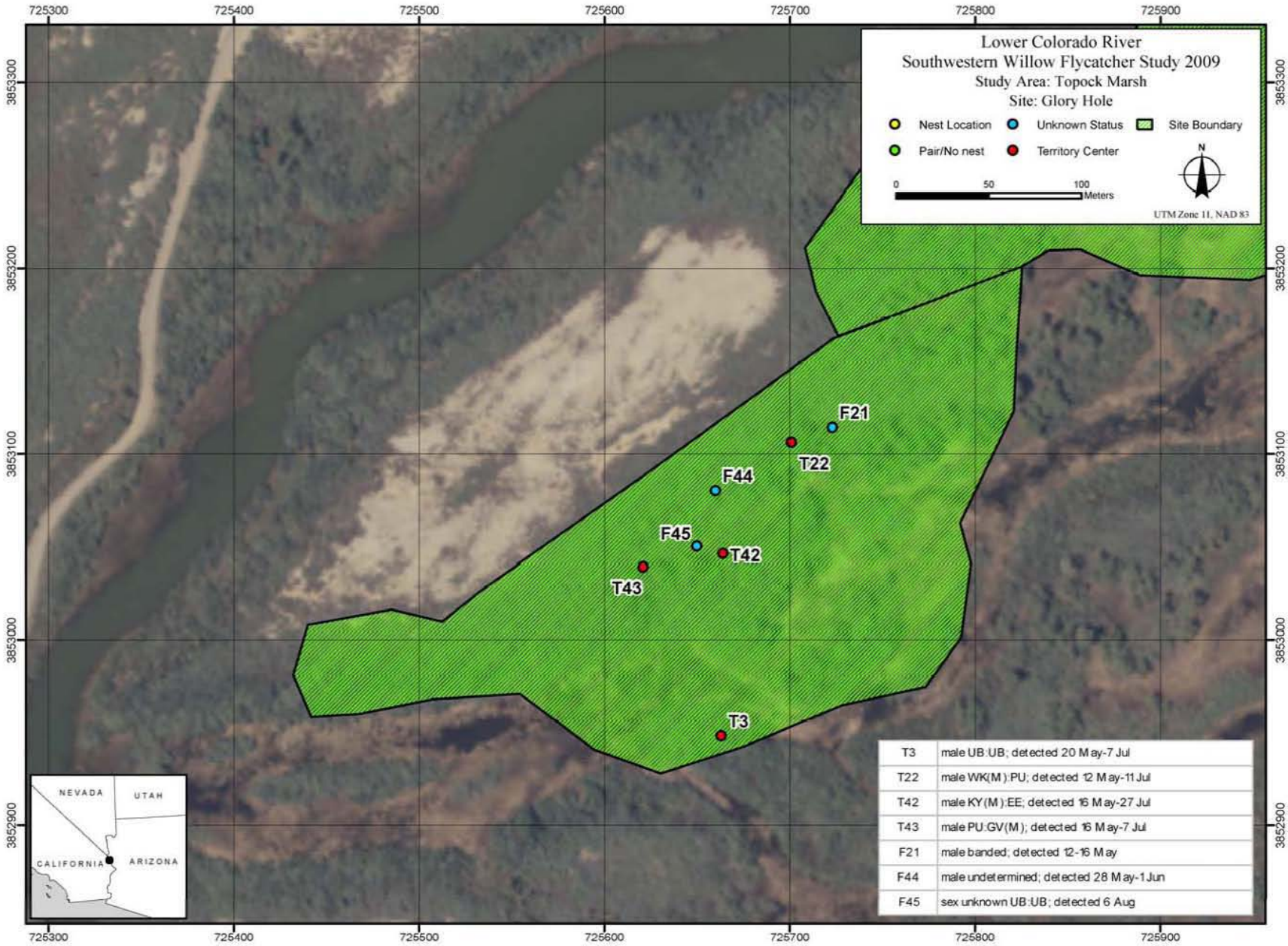

PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
PIERCED EGG
PIG HOLE
IN BETWEEN
BARBED WIRE
800M
SWINE PARADISE
PLATFORM
250M
GLORY HOLE
HELL BIRD
BEAL LAKE
LOST POND
LOST SLOUGH
LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Topock Marsh Study Area
Havasu NWR, Mohave County, AZ
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied
0
750
1,500
2,250
Meters

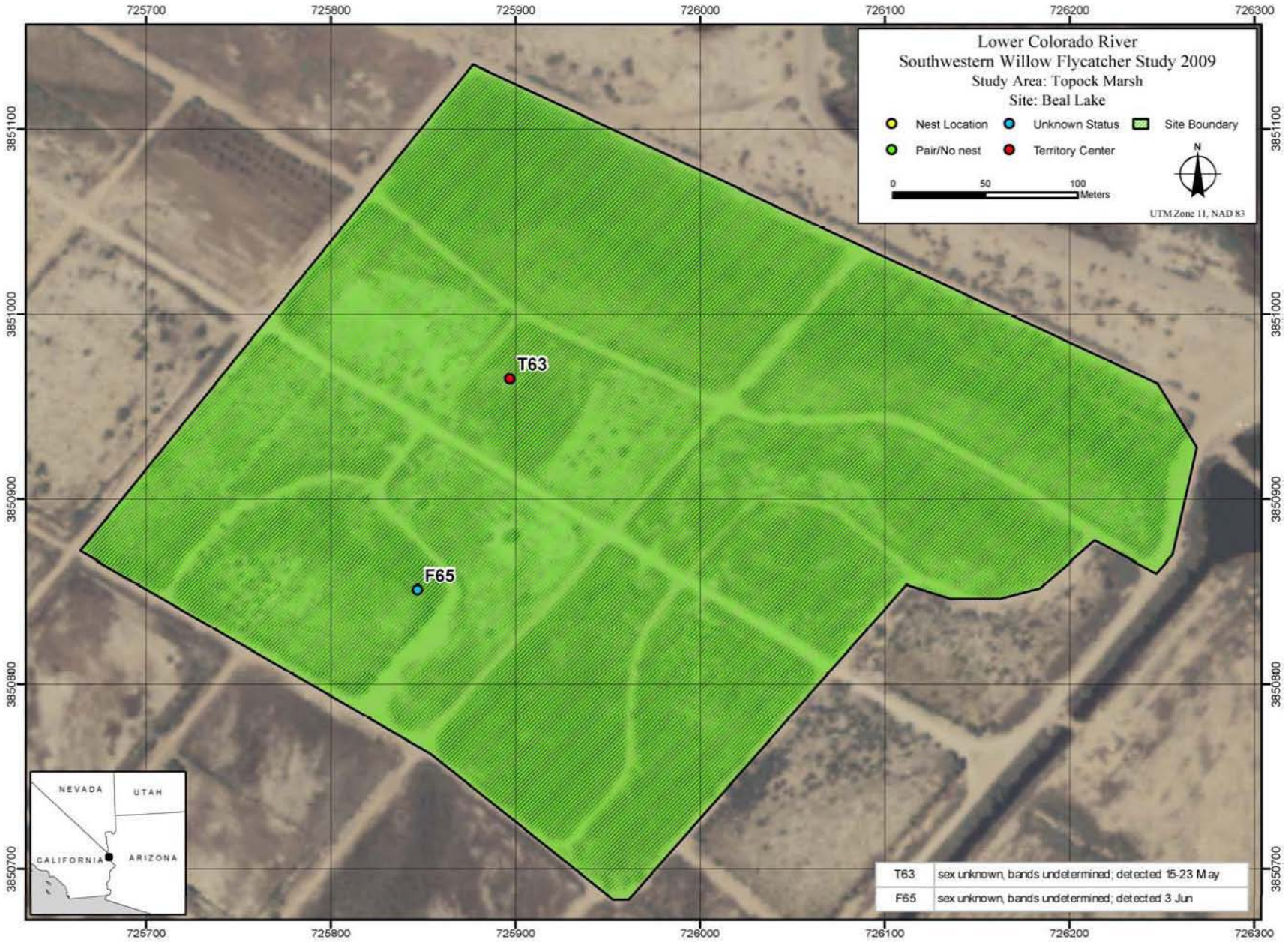

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: Pipes #1
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F2
F2 sex unknown, bands undetermined, detected 15 May
726800
726900
727000
727100
727200
727300
3857000
3856900
3856800
3856700
3856600
NEVADA
UTAH
CALIFORNIA
ARIZONA

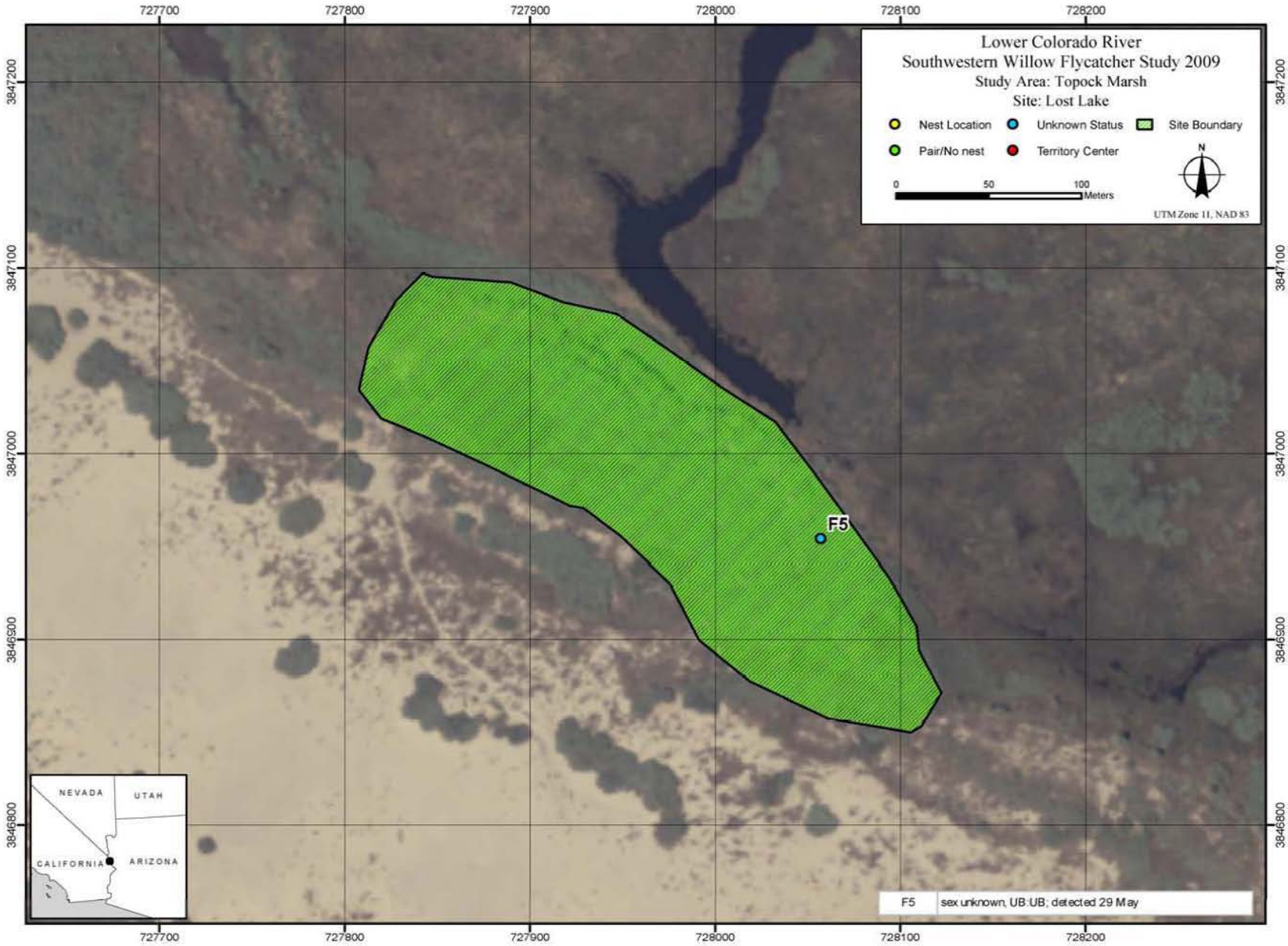

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: Pipes #3, The Wallows, & PC 6-1
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F10
T93
41B
41A
T7
NEVADA
UTAH
CALIFORNIA
ARIZONA
41A female UB:UB, male VY(M):PU; nest failed
41B female UB:UB, male VY(M):PU; 3 fledges
T7 male UB:UB; detected 2-16 Jun
T93 male UB:PU; detected 8 May-4 Jul
F10 sex unknown, bands undetermined; detected 9-13 Jun, possibly female for T93
727000
727100
727200
727300
727400
727500
3856400
3856300
3856200
3856100
3856000

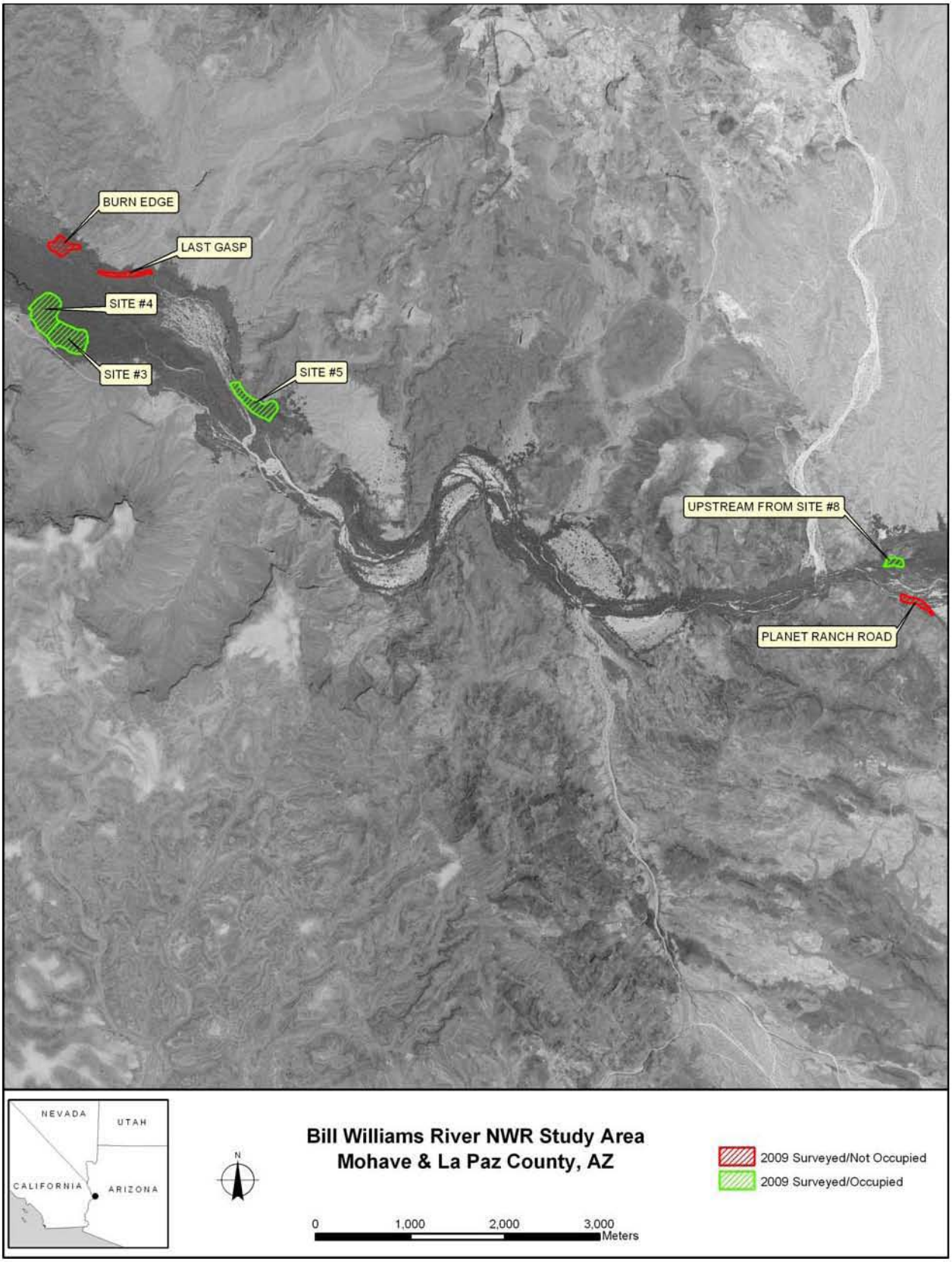

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: 800M & Pierced Egg
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
726500
726600
726700
726800
726900
727000
727100
3855200
3855100
3855000
3854900
3854800
T1
F9
T4
F8
T66
F70
NEVADA
UTAH
CALIFORNIA
ARIZONA
T1 male UB:EE; detected 8 May-6 Jul
T4 male XX:OY(M); detected 27 May-10 Jul
T66 male UB:UB; detected 26 May-13 Jul
F8 sex unknown, banded; detected 16-19 Jun, possibly female for T1
F9 sex unknown, bands undetermined; detected 16-19 Jun, possibly female for T4
F70 sex unknown, bands undetermined; detected 8 Jun

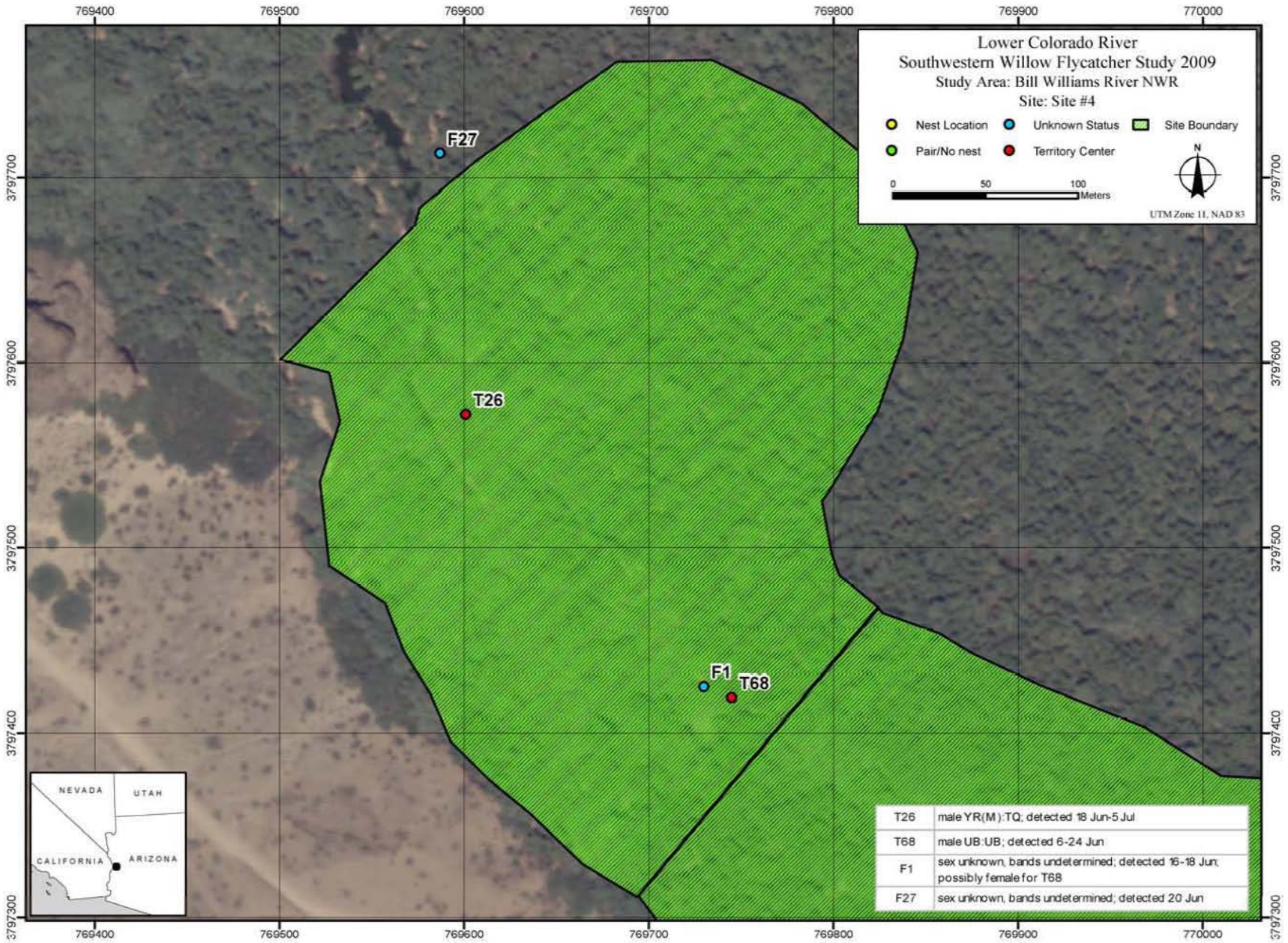

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: 250M & Hell Bird
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F67
F6
F68
T24
T25
NEVADA
UTAH
CALIFORNIA
ARIZONA
T24 male UB:UB; detected 5 Jun-11 Jul
T25 male undetermined; detected 17-25 Jun
F6 sex unknown, bands undetermined; detected 21 May
F67 sex unknown, bands undetermined; detected 3-7 Jun
F68 sex unknown, bands undetermined; detected 25 Jun
725600
725700
725800
725900
726000
726100
726200
3853600
3853500
3853400
3853300
3853200

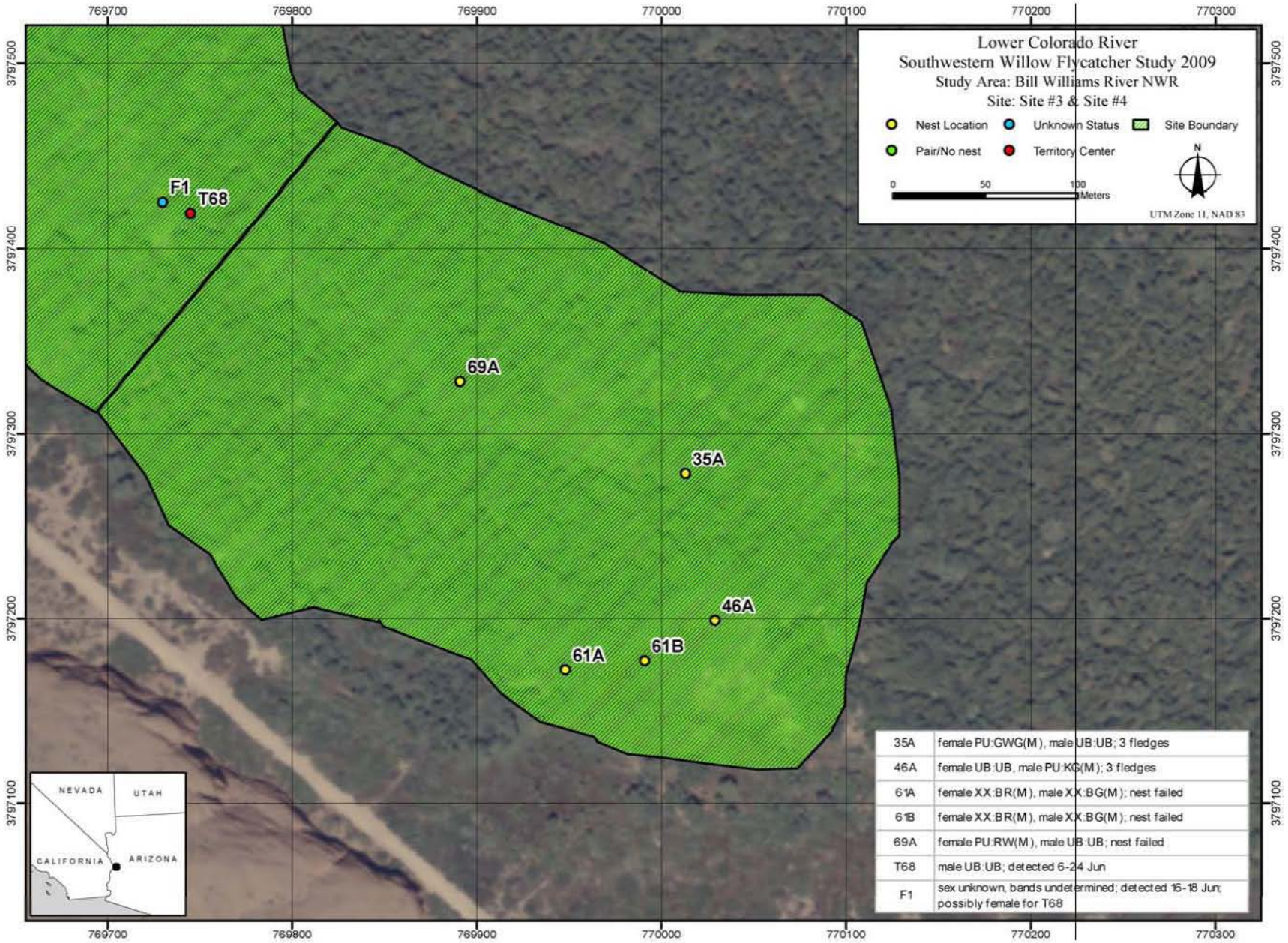

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: Glory Hole
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
725300
725400
725500
725600
725700
725800
725900
3853300
3853200
3853100
3853000
3852900
F21
T22
F44
F45
T42
T43
T3
NEVADA
UTAH
CALIFORNIA
ARIZONA
T3 male UB:UB; detected 20 May-7 Jul
T22 male WK(M):PU; detected 12 May-11 Jul
T42 male KY(M):EE; detected 16 May-27 Jul
T43 male PU:GV(M); detected 16 May-7 Jul
F21 male banded; detected 12-16 May
F44 male undetermined; detected 28 May-1 Jun
F45 sex unknown UB:UB; detected 6 Aug

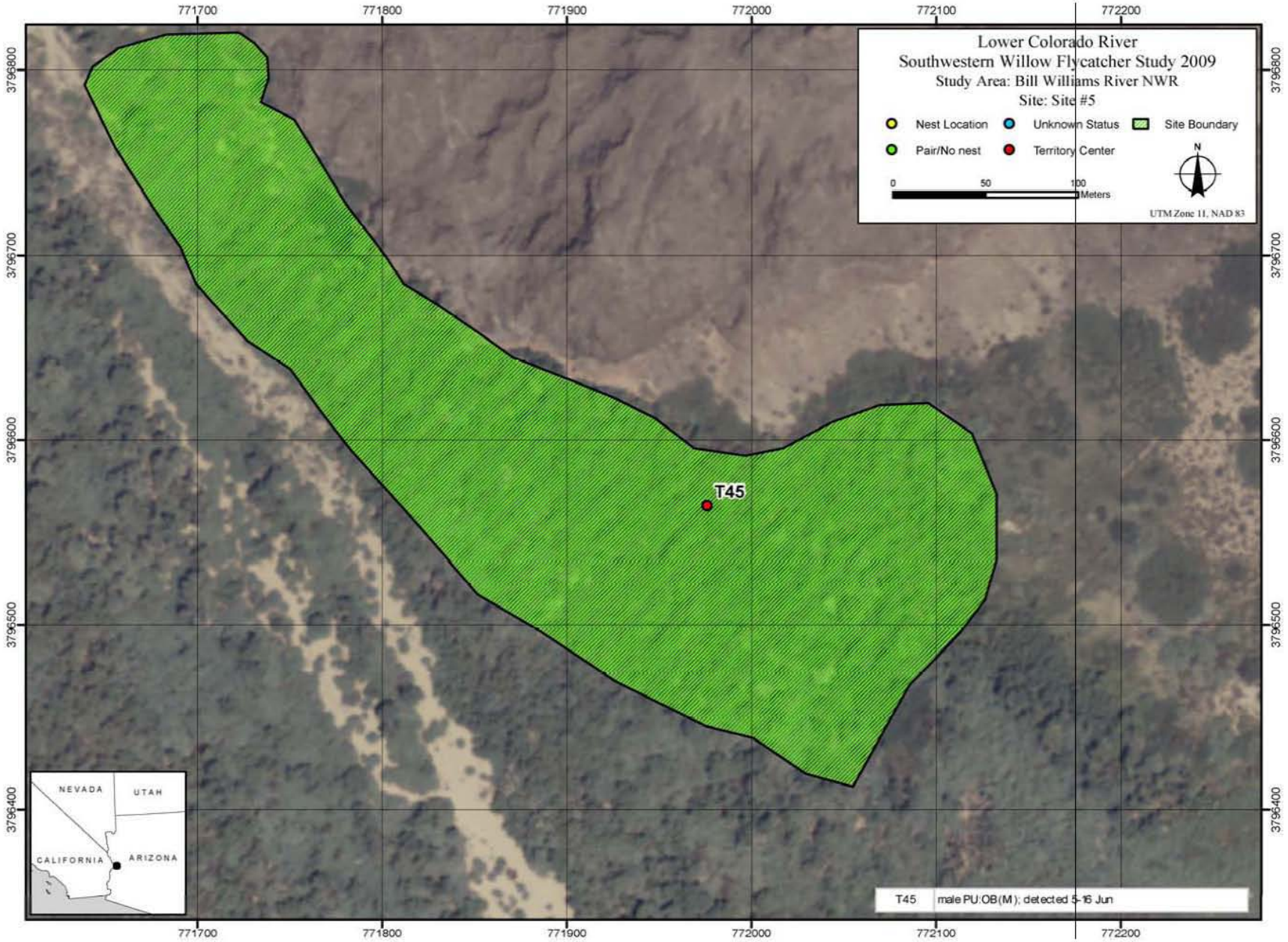

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: Beal Lake
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
T63
F65
NEVADA
UTAH
CALIFORNIA
ARIZONA
T63 sex unknown, bands undetermined; detected 15-23 May
F65 sex unknown, bands undetermined; detected 3 Jun
725700
725800
725900
726000
726100
726200
726300
3851100
3851000
3850900
3850800
3850700

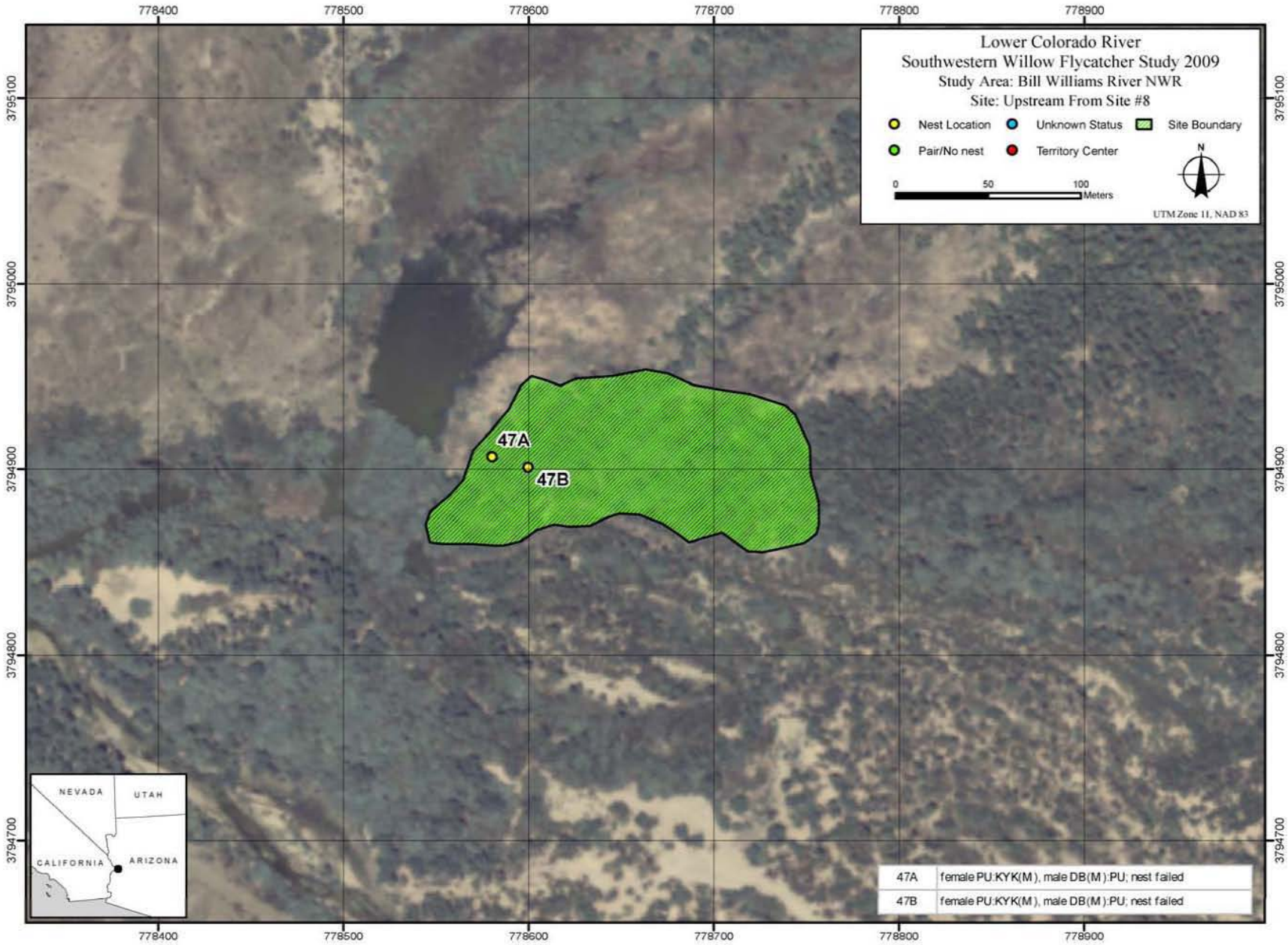

Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Topock Marsh
Site: Lost Lake
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
F5
F5 sex unknown, UB:UB; detected 29 May
727700
727800
727900
728000
728100
728200
3847200
3847100
3847000
3846900
3846800
NEVADA
UTAH
CALIFORNIA
ARIZONA


BURN EDGE
LAST GASP
SITE #4
SITE #3
SITE #5
UPSTREAM FROM SITE #8
PLANET RANCH ROAD
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Bill Williams River NWR Study Area
Mohave & La Paz County, AZ
0
1,000
2,000
3,000
Meters
2009 Surveyed/Not Occupied
2009 Surveyed/Occupied


Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Bill Williams River NWR
Site: Site #4
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
769400
769500
769600
769700
769800
769900
770000
3797700
3797600
3797500
3797400
3797300
F27
T26
F1
T68
NEVADA
UTAH
CALIFORNIA
ARIZONA
T26 male YR(M):TQ; detected 18 Jun-5 Jul
T68 male UB:UB; detected 6-24 Jun
F1 sex unknown, bands undetermined; detected 16-18 Jun; possibly female for T68
F27 sex unknown, bands undetermined; detected 20 Jun


Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Bill Williams River NWR
Site: Site #3 & Site #4
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
769700
769800
769900
770000
770100
770200
770300
3797500
3797400
3797300
3797200
3797100
F1
T68
69A
35A
46A
61A
61B
NEVADA
UTAH
CALIFORNIA
ARIZONA
35A female PU:GWG(M), male UB:UB; 3 fledges
46A female UB:UB, male PU:KG(M); 3 fledges
61A female XX:BR(M), male XX:BG(M); nest failed
61B female XX:BR(M), male XX:BG(M); nest failed
69A female PU:RW(M), male UB:UB; nest failed
T68 male UB:UB; detected 6-24 Jun
F1 sex unknown, bands undetermined; detected 16-18 Jun; possibly female for T68


Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Bill Williams River NWR
Site: Site #5
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
T45
771700
771800
771900
772000
772100
772200
3796800
3796700
3796600
3796500
3796400
NEVADA
UTAH
CALIFORNIA
ARIZONA
T45 male PU:OB(M); detected 5-16 Jun


Lower Colorado River
Southwestern Willow Flycatcher Study 2009
Study Area: Bill Williams River NWR
Site: Upstream From Site #8
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
778400
778500
778600
778700
778800
778900
3795100
3795000
3794900
3794800
3794700
47A
47B
NEVADA
UTAH
CALIFORNIA
ARIZONA
47A female PU:KYK(M), male DB(M):PU; nest failed
47B female PU:KYK(M), male DB(M):PU; nest failed

SOUTHWESTERN WILLOW FLYCATCHER (*Empidonax traillii extimus*) SURVEYS, COLOR-BANDING, AND NEST MONITORING ALONG THE LOWER COLORADO RIVER AND TRIBUTARIES IN NEVADA, CALIFORNIA, AND ARIZONA, 2009

Annual Report of Activities
Federal Fish and Wildlife Permit Number TE028605-2

Submitted to

U.S. Fish and Wildlife Service

Division of Endangered Species – Permits
P.O. Box 1306
Albuquerque, New Mexico 87103

Arizona Ecological Services Field Office
2321 W. Royal Palms Road, Suite 103
Phoenix, Arizona 85021-4951

Southern Nevada Field Office
4701 N. Torrey Pines Dr.
Las Vegas, Nevada 89130

Carlsbad Ecological Services Field Office
6010 Hidden Valley Road
Carlsbad, California 92009

Submitted by

SWCA Environmental Consultants
114 N. San Francisco St., Suite 100
Flagstaff, Arizona 86001
(928) 774-5500
www.swca.com

December 14, 2009

PRESENCE/ABSENCE SURVEYS

Field personnel spent 661.2 observer-hours conducting willow flycatcher broadcast surveys at 77 sites along the Virgin and lower Colorado Rivers and tributaries, with sites located in Nevada, California and Arizona (Table 1). Willow flycatcher survey results are summarized and presented below along with site descriptions. The UTM coordinates presented (Table 2) are the centroid of each survey area. All UTM coordinates were obtained in NAD 83 using a Garmin Rino 110 GPS unit. All UTM coordinates in this report are presented in NAD 83 to comply Federal Geographic Data Committee standards.

Table 1. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2]
PAHR	North	4.6	23 (6 May–13 Aug)
	West	1.5	ND
	MAPS	2.7	ND
	South	2.5	1 (22 Jun)
LIFI	Poles	4.7	5 (1 Jun–26 Jul)
MESQ	East	4.4	ND

Table 1. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2]
MESQ	West	11.5	21 (10 May–13 Aug)
	Bunker Marsh North	13.6	7 (16 Jun–16 Jul)
MOME	Mormon Mesa North	8.2	ND
	Hedgerow	1.1	ND
	Mormon Mesa South	12.3	ND
	Virgin River #1	46.7	32 (12 May–8 Aug)
	Virgin River #2	36.9	1 (19 May)
MUDD	Overton WMA Pond	0.7	ND
	Overton WMA	14.9	17 (11 May–29 Jul)
TOPO	Pipes #1	5.2	1 (15 May)
	Pipes #3	5.7	2 (8 May–4 Jul)
	The Wallows	0.4	3 (15 May–8 Aug)
	PC6-1	4.8	1 (2–16 Jun)
	Pig Hole	2.4	ND
	In Between	7.7	ND
	800M	6.1	1 (26 May–13 Jul)
	Pierced Egg	6.7	5 (8 May–10 Jul)
	Swine Paradise	1.0	ND
	Barbed Wire	2.4	ND
	Platform	1.3	ND
	250M	1.9	1 (21 May) 1 (3–7 Jun), 1 (25 Jun)
	Hell Bird	3.3	2 (5 Jun–11 Jul)
	Glory Hole	5.0	7 (12 May–6 Aug)
	Beal Lake	13.9	1 (15–23 May), 1 (3 Jun)
	Lost Slough	1.5	ND
	Lost Pond	1.2	ND
	Lost Lake	3.3	1 (29 May)
TOGO	Pulpit Rock	2.1	ND
	Picture Rock	4.6	ND
	Blankenship Bend North	26.7	ND
	Blankenship Bend South	25.9	ND
BIWI	Burn Edge	3.7	ND
	Site #4	9.9	4 (4 Jun–5 Jul)
	Site #3	9.5	8 (10 May–19 Jul)
	Last Gasp	2.1	ND
	Site #5	6.8	1 (5–16 Jun)
	Upstream from Site #8	1.5	2 (12 Jun–14 Jul)
	Planet Ranch Road	2.1	ND

Table 1. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2009* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2]
AHAK	Deer Island[3]	15.2	ND
PVER	PVER Phase 2	28.7	1 (27 May), 1 (3 Jun)
BIHO	Big Hole Slough	29.0	1 (17 Jun)
CIBO	CVCA Phase 1[4]	26.2	1 (27 May)
	CVCA Phase 3	41.2	1 (16 May), 1 (27 May), 2 (10 Jun)
	Cibola Nature Trail	13.7	1 (16 May), 2 (27 May), 1 (10 Jun)
	Cibola Island	4.2	4 (26 May), 3 (4 Jun)
	Cibola Site #2	16.4	ND
	Cibola Site #1	7.7	1 (9 Jun)
	Hart Mine Marsh[5]	31.6	ND
	Cibola Lake #2 (East)	4.5	1 (4 Jun)
	Walker Lake	11.4	ND
IMPE	Paradise	7.8	1 (19 May)
	Hoge Ranch	20.7	3 (20 May), 1 (15 Jun)
	Rattlesnake	7.6	1 (19 May)
	Milemarker 65	10.0	ND
	Nursery NW	7.0	1 (16 Jun)
	Ferguson Lake	21.1	3 (21 May), 2 (16 Jun)
	Great Blue Heron	7.1	1 (28 May), 1 (12 Jun)
	Powerline	2.0	1 (28 May)
	Martinez Lake	4.6	ND
MITT	Mittry West	4.4	2 (11 Jun)
YUMA	Gila River Site #2	5.1	3 (30 May), 1 (14 Jun)
	Fortuna Site #1	2.5	2 (31 May)
	Fortuna North	3.4	ND
	Morelos Dam[6]	11.4	ND

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River , TOPO = Topock Marsh, TOGO = Topock Gorge, BIWI = Bill Williams River NWR, AHAK = Ahakhav Tribal Preserve, PVER = Palo Verde Ecological Reserve, BIHO = Big Hole Slough, EHRE = Ehrenberg, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

[2] ND = No willow flycatchers were detected.

[3] Majority of site burned between 2 and 8 July; surveys discontinued.

[4] Named CVCA in previous reports.

[5] Surveys discontinued after 4th survey because of poor quality habitat.

[6] Site completely bulldozed prior to the start of survey season; no surveys completed.

Table 2. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2009

Study Area[1]	Survey Site	Area (ha)	UTM coordinate of site centroid
PAHR	North	4.6	665781E 4130976N
	West	1.5	665539E 4130426N
	MAPS	2.7	666143E 4128798N
	South	2.5	666689E 4128037N
LIFI	Poles	4.7	773348E 4088303N
MESQ	East	4.4	758641E 4075312N
	West	11.5	757886E 4075442N
	Bunker Marsh North	13.6	753981E 4072599N
MOME	Mormon Mesa North	8.2	739718E 4058156N
	Hedgerow	1.1	740216E 4057982N
	Mormon Mesa South (North half)	8.9	739566E 4057258N
	Mormon Mesa South (South half)	3.4	739476E 4056901N
	Virgin River #1 (North half)	12.0	739312E 4056211N
	Virgin River #1 (South half)	34.7	739385E 4055343N
	Virgin River #2	36.9	739050E 4054326N
MUDD	Overton WMA Pond	0.7	731155E 4045638N
	Overton WMA	14.9	731660E 4044514N
TOPO	Pipes #1	5.2	726906E 3856907N
	Pipes #3	5.7	727012E 3856517N
	The Wallows	0.4	727209E 3856173N
	PC6-1	4.8	727235E 3855838N
	Pig Hole	2.4	727233E 3855415N
	In Between	7.7	727036E 3855171N
	800M	6.1	726882E 3854999N
	Pierced Egg	6.7	726668E 3855001N
	Swine Paradise	1.0	726288E 3854489N
	Barbed Wire	2.4	726152E 3854551N
	Platform	1.3	725831E 3853980N
	250M	1.9	725838E 3853503N
	Hell Bird	3.3	725868E 3853255N
	Glory Hole	5.0	725671E 3853043N
	Beal Lake	13.9	725957E 3850916N
	Lost Slough	1.5	726658E 3848259N
	Lost Pond	1.2	727134E 3847698N
	Lost Lake	3.3	727971E 3846984N

Table 2. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2009 (Continued)

Study Area[1]	Survey Site	Area (ha)	UTM coordinate of site centroid
TOGO	Pulpit Rock	2.1	734056E 3838576N
	Picture Rock	4.6	734586E 3833723N
	Blankenship Bend North	26.7	736561E 3832765N
	Blankenship Bend South	25.9	736682E 3831524N
BIWI	Burn Edge	3.7	769868E 3798257N
	Site #4	9.9	769684E 3797558N
	Site #3	9.5	769928E 3797286N
	Last Gasp	2.1	770525E 3797965N
	Site #5	6.8	771903E 3796595N
	Upstream from Site #8	1.5	778658E 3794902N
	Planet Ranch Road	2.1	778887E 3794478N
AHAK	Deer Island	15.2	743367E 3778371N
PVER	PVER Phase 2	28.7	728644E 3730265N
BIHO	Big Hole Slough	29.0	728672E 3723808N
CIBO	CVCA Phase 1	26.2	717274E 3699263N
	CVCA Phase 3	41.2	714375E 3698081N
	Cibola Nature Trail	13.7	716008E 3694360N
	Cibola Island	4.2	714894E 3685438N
	Cibola Site #2	16.4	716845E 3684106N
	Cibola Site #1	7.7	717233E 3683564N
	Hart Mine Marsh	31.6	717492E 3682569N
	Cibola Lake #2 (East)	4.5	717146E 3679673N
	Walker Lake	11.4	716003E 3676276N
IMPE	Paradise	7.8	714120E 3666214N
	Hoge Ranch	20.7	717175E 3660307N
	Rattlesnake	7.6	719879E 3659586N
	Milemarker 65	10.0	726646E 3657774N
	Nursery NW	7.0	733900E 3654066N
	Ferguson Lake	21.1	733587E 3651733N
	Great Blue Heron	7.1	736876E 3652307N
	Powerline	2.0	737353E 3652098N
	Martinez Lake	4.6	737362E 3651773N
MITT	Mittry West	4.4	734967E 3638617N
YUMA	Gila River Site #2	5.1	736493E 3623789N
	Fortuna Site #1	2.5	737633E 3623619N
	Fortuna North	3.4	739756E 3625561N

[1] PAHR = Pahranagat National Wildlife Refuge (NWR); LIFI = Littlefield; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River, TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams River NWR; AHAK = Ahakhav Tribal Preserve, PVER = Palo Verde Ecological Reserve, BIHO = Big Hole Slough; EHRE = Ehrenberg; CIBO = Cibola NWR; IMPE = Imperial NWR; MITT = Mittry Lake; YUMA = Yuma.

NEVADA

Pahranagat North

Area: 4.6 ha Elevation: 1,026 m

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*; hereafter cottonwood) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lakebed. Canopy height within the patch is 15–18 m, and canopy closure is approximately 70%, similar to that recorded in 2008. Canopy closure from 2003 to 2007 was >90%. Reduced canopy closure in 2008–2009 occurred mostly in the northeastern section of the site, where many of the large trees are now dead or dying. During the survey season, standing water and saturated soils were present only in an inflow channel that runs along the northern side of the site and drains into the lakebed at the southeastern corner of the site. The water channel is vegetated with bulrush (*Schoenoplectus* sp.) where it enters the lakebed. Saturated soils were also present within patches of bulrush that border the southern edges of the site.

We detected 20 breeding willow flycatchers, as well as 1 resident, unpaired male. In addition to resident adults, we detected two individuals for which residency and breeding status could not be confirmed. Areas of Pahranagat North not known to be occupied by willow flycatchers were surveyed five times, totaling 6.1 observer-hours. The site lies immediately adjacent to a cattle pasture, but livestock have access only to the cottonwood stringer on the northwestern corner of the lake, which is separated from the survey site by a fence. Cowbirds were detected during one survey and were detected regularly during nest monitoring activities.

Pahranagat West

Area: 1.5 ha Elevation: 1,026 m

This native site consists of a stringer of cottonwood, one to three trees wide and 20 m in height, on the western edge of Upper Pahranagat Lake. The site has no significant understory vegetation, and canopy closure varies from <50 to 80%. The eastern edge of the site is vegetated with bulrush, which extends into the lakebed to the east. During the survey season, the interior of the site was dry, but surface water was present nearby in the lakebed.

We detected no willow flycatchers. We surveyed the site five times, totaling 3.2 observer-hours. No cowbirds were detected, and there was no sign of livestock use.

Pahranagat MAPS

Area: 2.7 ha Elevation: 1,026 m

Pahranagat MAPS is a stringer of cottonwood on the western edge of the bed of Upper Pahranagat Lake. Canopy height is 15–20 m, and canopy closure is approximately 60%. There is very little woody vegetation in the understory. Cattail (*Typha* sp.) and bulrush line the eastern edge of the tree line and extend into the lakebed; much of this vegetation is dead. The site was dry throughout the survey season, with the nearest water or saturated soil being at least 20 and up to 200 m away in the lakebed.
No willow flycatchers were detected. We surveyed the site five times, totaling 3.5 observer-hours. Cowbird were detected on two surveys, and there was no evidence of livestock use.

Pahranagat South

Area: 2.5 ha Elevation: 1,023 m

Pahranagat South consists of a relatively small stringer of Goodding willow, coyote willow (*Salix exigua*), and cottonwood lining a human-made channel that carries the outflow from Upper Pahranagat Lake. The cottonwoods reach approximately 20 m in height, while the willows are generally less than 10 m. In 2005, we noted that dense coyote willow was increasing on the western side of the site; this area of willow had very sparse canopy in 2006 and 2007, and the coyote willow was almost completely dead by 2008. The site is bordered to the west by an open marsh and to the east by upland scrub. Tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*) form a sparse understory. Overall canopy closure at this site is approximately 50%. The channel held water during site visits in May and June but was dry in mid-July.

We detected one willow flycatcher, for which residency and breeding status could not be confirmed, on 22 June after receiving a report from field personnel from an unrelated project that a flycatcher had been detected at the site. The flycatcher was not detected on any of three subsequent territory monitoring visits or on any of the surveys. We surveyed the site five times, totaling 2.8 observer-hours. Cowbirds were detected during two surveys, and no sign of livestock was observed.

Mesquite East

Area: 4.4 ha Elevation: 468 m

This mixed-native site lies on several terraces within the floodplain of the Virgin River in Mesquite, Nevada. Vegetation on the lowest terrace, on the northern edge of the site adjacent to the river, consists of cottonwood and Goodding willow generally less than 10 m in height. The central portion of the site lies on a slightly higher terrace and is vegetated entirely by dense tamarisk 7–8 m in height with canopy closure around 80%. The uppermost terrace is vegetated with Goodding willow and a few cottonwood 18–25 m in height and an understory of dense clumps of coyote willow about 8 m in height. Canopy closure on this terrace varies from 50% in the cottonwood/Goodding willow areas to over 90% in the coyote willow clumps. The western half of the upper terrace burned over the 2004–2005 winter and grew back with thick stands of coyote willow and cottonwood. The site was completely dry throughout the survey season, and the coyote willow was dead or dying.

We detected no willow flycatchers. We surveyed the site five times throughout the flycatcher breeding season, totaling 8.6 observer-hours. Cowbirds were detected on all surveys. Cattle trails and scat were observed on all surveys, and domestic pigs were seen in the site on one occasion.

Mesquite West

Area: 11.5 ha Elevation: 470 m

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Golf courses and housing developments border the site to the north, and the Virgin River borders the site to the south. This large site is primarily a mosaic of cattail and bulrush marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The coyote willows are generally 5–6 m in height, and canopy closure varies from 50 to >90%. Hydrology at the site is influenced by irrigation runoff from adjacent golf courses and agriculture. In previous years, the majority of the site was regularly or continuously inundated. At the beginning of the 2009 breeding season, the site was completely dry, and the pond at the western end of the site, which had previously been too deep to wade, had completely dry

soil with deep cracks. Water had previously entered the northeastern corner of the site from a deep trench, but in 2009, what little water was flowing had been diverted down the eastern edge of the site in a trench that had been dug the previous year. During the first site visit in early May, we noted premature leaf abscission in the coyote willows. In the last week of June, we noted surface water within the site for the first time during the season, and it was confined to the eastern portion of the site. This portion of the site received surface water for one day at approximately weekly intervals for the remainder of the breeding season, and the willows appeared to respond with new growth. The rest of the site remained dry, though the cracks in the soil at the western end of the site became shallower, suggesting subsurface water.

We detected 16 breeding willow flycatchers, 1 pair for which no nest was located, and 2 resident, unpaired males. In addition to resident adults, we detected one individual for which residency and breeding status could not be determined. Areas of Mesquite West not known to be occupied by flycatchers were surveyed once at the beginning of the flycatcher breeding season, totaling 2.0 observer-hours. After the initial survey, all areas of the site were covered by territory monitoring, and surveys were discontinued. Cowbirds were detected on the survey and were detected regularly during territory monitoring. Fresh cattle scat was also observed within the site.

Bunker Marsh North

Area: 13.6 ha Elevation: 456 m

This mixed-exotic site lies within the floodplain of the Virgin River near Bunkerville, Nevada, approximately 4 km downstream of Mesquite West. The site is between agricultural fields to the southeast and the Virgin River to the northwest. We explored and surveyed the riparian vegetation along an approximately 1-km reach of the river. The southern end of the site consists of tamarisk 6 m in height with 50–70% canopy closure. This portion of the site is bordered to the north by a small cattail marsh and a strip of 4–5-m-tall Goodding and coyote willow. The tamarisk area was very dry throughout the season and does not represent suitable flycatcher habitat. The willows surrounding the cattail marsh may provide habitat in future years if the area expands and matures. The remainder of the site is a mosaic of 4–6-m-tall tamarisk, scattered Goodding willow, patches of coyote willow 4–5 m in height, and stream channels and marshy areas. Canopy closure ranges from 25 to 90%. One small patch of coyote willow near the center of the site had surface water beneath the woody vegetation; otherwise, the only portions of the site that contained surface water were the marshes, and soils were dry beneath the woody vegetation. The streams and marshes contained surface water through mid-June but were dry in July.

We detected five breeding willow flycatchers and two flycatchers for which residency and breeding status could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 17.0 observer-hours. Cowbirds were detected on four surveys, and cows were observed in the site on multiple occasions.

Mormon Mesa North

Area: 8.2 ha Elevation: 390 m

This mixed-exotic site consists primarily of tamarisk 3–5 m in height with areas of emergent Goodding willow up to 12 m in height and patches of coyote willow. Overall canopy closure is around 50%. The western edge of the site has a 100 x 50 m patch of Goodding willow, 8 m in height, with up to 75% canopy closure and dead cattails in the understory. No standing water or saturated soils were present within the site during the survey season, but surface water was adjacent to the site in May and June in the river channel to the south. The site is perched up to 2 m above the water level. Mormon Mesa North has

been completely dry throughout the breeding seasons of 2004 to present, and no flycatchers have been detected at the site in 2006–2009. Portions of the site, particularly the Goodding willows on the western edge of the site, might provide suitable flycatcher habitat with wetter soil conditions but in recent years have been dry. We recommend visiting this site at the beginning of the survey season to assess hydrologic conditions and discontinuing surveys for the season if the site is completely dry.

We did not detect any flycatchers. We surveyed the site five times, totaling 16.4 observer-hours. Cowbirds were detected on all surveys as was evidence of livestock use.

Hedgerow

Area: 1.1 ha Elevation: 390 m

This mixed-exotic site is east of Mormon Mesa North, on the eastern side of the Virgin River. The site consists of a continuous understory of tamarisk 4–5 m in height with scattered emergent Goodding willow up to 12 m in height. Many of the willows have dead branches. The site is surrounded by tamarisk and arrowweed (*Pluchea sericea*) 2–3 m in height. Canopy closure at the site varies from about 50% on the edges of the site up to 80% in the denser areas. Soils within the site were dry throughout the survey season. No flycatchers have been detected in Hedgerow since we began surveys in 2005, and the site has been completely dry in each year. We recommend visiting this site at the beginning of the survey season to assess hydrologic conditions and discontinuing surveys for the season if the site is completely dry.
We did not detect any flycatchers. We surveyed the site five times, totaling 2.3 observer-hours. Cowbirds were detected on three visits.

Mormon Mesa South

North half: Area: 8.9 ha Elevation: 385 m
South half: Area: 3.4 ha Elevation: 385 m

This mixed-exotic site was split into two contiguous areas to facilitate tracking of survey activity. Habitat evaluation at the beginning of the survey season revealed that the Goodding willow in the western third of the area that had been surveyed in previous years was entirely dead, and we discontinued surveys in this portion of the site. The remainder of the site has scattered Goodding willow up to 20 m in height and a patchy understory of tamarisk 4–7 m in height. Clumps of coyote willow are present on the eastern edge of the site, and dead cattail is present in the understory in this area. Canopy closure is widely variable, ranging from >90% in tamarisk thickets to <50% in openings. There was no surface water within the site, but damp soils were noted on the eastern edge of the site in May and June. The presence of dead cattails and deadfall suggest that this site was formerly considerably wetter, and portions of the site still have the structure to provide potential flycatcher habitat with wetter soil conditions.

No willow flycatchers were detected. We surveyed the northern and southern halves of the site five times each, totaling 12.3 and 7.5 observer-hours, respectively. Cowbirds were detected on all but one survey.

Virgin River #1

North half: Area: 12.0 ha Elevation: 380 m
South half: Area: 34.7 ha Elevation: 380 m

Virgin River #1 was also divided into two areas, Virgin River #1 North and Virgin River #1 South, to facilitate streamlining of field logistics. Habitat assessment in Virgin River #1 North at the beginning of the survey season revealed most of the Goodding willow in the northwestern finger of the area that had

been surveyed in 2008 were dead, and surveys in this area were discontinued. The southeastern corner of the formerly surveyed Virgin River #1 North consists of clumps of tamarisk 4–6 m in height, dry soil, and 60% canopy closure; surveys were discontinued in this area as well. The remainder of Virgin River #1 North is primarily tamarisk 4–6 m in height, with areas of emergent Goodding willow and patches of coyote willow in the central and southwestern portions of the site. Canopy closure throughout the site is 50–70%. Surface water and mud were present in May in channels running north to south through the center of the site, and the southwestern corner of the site also contained surface water in May and June.

We detected three breeding flycatchers and one individual for which residency and breeding status could not be confirmed in the southwestern corner of Virgin River #1 North. Areas of this site not known to be occupied by flycatchers were surveyed five times, totaling 23.5 observer-hours. Cowbirds were detected on all but one survey.

We expanded Virgin River #1 South approximately 600 m to the south and east to explore areas where stream channels were noted on the aerial photograph and during aerial reconnaissance. This new area consists of monotypic tamarisk up to 5 m in height with 70–90% canopy closure. Some of the stream channels contained surface water in May and June and damp soil in July. The channels are incised 1–2 m, and soils beneath the tamarisk were entirely dry throughout the survey season. We do not recommend continuing surveys in this area in future years. The northwestern portion of the site has coyote and Goodding willows interspersed with tamarisk 4–5 m in height. Goodding and coyote willows average 8 and 5 m in height, respectively. This portion of the site contained surface water throughout the survey season and has open, marshy areas. Canopy closure varies from >90% in areas of dense willow and tamarisk to 25% in marshy openings. The middle portion of the site consists of sparser tamarisk 4 m in height with dry, open areas, and the southwestern part of the site consists primarily of tamarisk 3–5 m in height and canopy closure from 60 to 80%. The southwestern part of the site also contains one cluster of emergent Goodding willow 10 m in height with dead coyote willow in the understory, and tamarisk in this area is up to 8 m in height. Soils in this area were damp, but no surface water was noted. For future years we recommend surveying only the northern third of the site and the area immediately around the Goodding willow cluster in the southwestern portion of the site.

We detected 19 breeding willow flycatchers and 4 unpaired, resident males in the northwestern portion of Virgin River #1 South. We detected six additional willow flycatchers for which residency and breeding status could not be confirmed. Areas of the site not known to be occupied by willow flycatchers were surveyed five times, totaling 29.5 observer-hours. Cowbirds were observed on all surveys.

Virgin River #2

Area: 36.9 ha Elevation: 380 m

This site is primarily a monotypic stand of tamarisk 6 m in height with 70–90% canopy closure. Widely scattered emergent Goodding willow up to 10 m in height are present in the northern half of the site. A clump of Goodding willow occurs halfway down the eastern edge of the site, and scattered willows extend to the southern end of the site. The tamarisk in the willow area was dry and brittle, and a greater proportion of mid-sized tamarisk stems were dead than had been in previous years (see Chapter 5). The site contained no surface water during the breeding season, though portions of the site contained damp soils. The Virgin River, on the eastern edge of the site, had surface water throughout the season. No flycatchers have been detected in the northern half of the site from 2003 to present, and we recommend discontinuing surveys in this area.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 51.5 observer-hours. Cowbirds were observed on all surveys.

Overton WMA Pond

Area: 0.7 ha Elevation: 378 m

This site consists of a patch of mixed-native vegetation approximately 150 m long and 150 m wide at the north end of Overton WMA just south of Honeybee Reservoir. The dominant vegetation consists of 10-m-tall Goodding willow with a sparse 5-m-tall tamarisk understory. Cattail and sedges (*Carex* sp.) are also present on the edges of the site. Canopy closure is variable, ranging up to 90%. A small stream channel runs through the site, and it held surface water throughout the season.

We detected no willow flycatchers. We surveyed the site five times for a total of 3.4 observer-hours. Cowbirds were detected two visits, and no sign of livestock use was observed.

Overton WMA

Area: 14.9 ha Elevation: 378 m

This site consists of a 150-m-wide strip of riparian vegetation spanning both sides of the Muddy River. The site is bordered to the southwest by open agricultural fields and to the northeast by sparser areas of riparian vegetation. The site flooded heavily during the 2004–2005 winter, but vegetation at the site was relatively unchanged. The northern portion of the site is dominated by very dense tamarisk up to 7 m in height with canopy closure of 70–90%. The southern portion of the site consists primarily of a stand of Goodding willow 10–12 m in height with an understory of tamarisk and cattail and canopy closure up to 90%. Flowing water was present in the channel of the Muddy River throughout the survey season, and extensive beaver activity resulted in the southern portion of the site being flooded with approximately 30 cm of water through mid-July, at which time water was restricted to channels and the area that had previously been flooded was only muddy. Beavers have felled swaths of Goodding willow in the southern portion of the site, resulting in gaps in the canopy. Approximately 0.3 ha of the southern portion of the site was bulldozed in 2005 as part of Overton WMA efforts to repair flood damage to their water control system. Two stretches of the channel of the Muddy River within the site were dredged with heavy equipment over the 2007–2008 winter, resulting in a cleared swath 10–15 m wide on the western bank of the river.

We located 11 breeding willow flycatchers and 2 unpaired, resident males. We also detected four flycatchers for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 21.9 observer-hours. We observed no signs of livestock but detected cowbirds on all surveys.

AR063747

ARIZONA

Littlefield Poles

Area: 4.7 ha Elevation: 565 m

Littlefield Poles consists of primarily native vegetation located on Beaver Dam Wash, immediately upstream and downstream of the Highway 91 Bridge. Vegetation upstream of the bridge consists of a scattered overstory of cottonwood averaging 25 m in height. Cottonwood and Goodding willow averaging 10 m in height are present below the overstory but do not form a continuous canopy. Lower strata vegetation approximately 6 m in height consists of coyote willow, tamarisk, and some Russian olive. Dense stands of coyote willow border the southern edge of the patch, along the stream. Downstream of the bridge, young stringers of Goodding and coyote willow reach 5 m in height and form linear patches 10–15 m wide on the edges of multiple stream channels. Larger Goodding willow is present along the southwestern edge of the site on the edge of a golf course, and a dense patch of Goodding willow is present on the northern edge of the downstream end of the site. The downstream end of the site borders a cattail marsh. Canopy closure in the densest areas of Goodding and coyote willow is >90%, though overall canopy closure ranges from 50 to 70%. Surface water was present in stream channels and in the cattail marsh throughout the survey season.

We detected three breeding willow flycatchers; one resident, unpaired male; and one willow flycatcher for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 14.5 observer-hours. Cowbirds were detected on all surveys, and cattle scat and trails were observed in the site.

Topock Marsh, Arizona

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow. Seasonally wet, low-lying areas are interspersed throughout the riparian area. Feral pigs are present throughout the Topock study area, and evidence of pigs was observed in all survey sites.

Pipes #1

Area: 5.2 ha Elevation: 140 m

This exotic site is bordered to the east by the refuge road and consists primarily of monotypic tamarisk 5–7 m in height. Arrowweed occurs in dense patches within 50 m of the refuge road. The tamarisk is densest within 100 m of the refuge road and becomes more open toward the western edge of the site. The northern edge of the site has the tallest canopy, and there is relatively little deadfall in this area compared to the rest of the site. The central and southern portions of the site have many dead stems and clusters of fallen trees. Canopy closure is 70–90%. The site contained no standing water during the survey season but did contain damp soils along the southern edge of the site throughout the season.

AR063748

We detected one willow flycatcher, for which residency was not confirmed, on 15 May. Three subsequent territory monitoring visits and four subsequent surveys failed to detect the flycatcher again. We surveyed the site five times, totaling 9.0 observer-hours. Cowbirds were detected on all surveys.

Pipes #3

Area: 5.7 ha Elevation: 140 m

This site is bordered to the east by the refuge road. Arrowweed occurs in dense patches within 50 m of the road. Most of the site is vegetated by tamarisk 4–6 m in height. The southeastern portion of the site has a few emergent Goodding willow up to 15 m in height and open, marshy areas. Canopy closure generally exceeds 70%. In May, the portion of the site with Goodding willow and marshes was inundated with up to 10 cm of water, and the central portion of the site had water up to 30 cm in depth beneath the tamarisk. The site progressively dried out through the season but still contained damp soils and standing water in pig wallows in July.

We detected one territorial male flycatcher in Pipes #3. We also detected a second flycatcher at the site on 9 and 13 June. The second flycatcher was interacting with the territorial male and was possibly a female. The second flycatcher was not detected on any of nine territory monitoring visits after 13 June, however. Portions of Pipes #3 not known to be occupied by flycatchers were surveyed five times, totaling 5.3 observer-hours. Cowbirds were detected on three surveys.

The Wallows

Area: 0.4 ha Elevation: 140 m

The Wallows is primarily vegetated by tamarisk 5–6 m in height with emergent Goodding willow on the western side of the site. The northwestern edge of the site borders an open cattail marsh. Overall canopy closure ranges from 50% in the marshy area to 90% in the tamarisk. Half the site was inundated in May, but by mid-June water was present only in intermittent puddles in the marsh, and by mid-July the only remaining surface water was in pig wallows.

We detected two breeding flycatchers and detected another individual on a single occasion on 15 May. Portions of the site not known to be occupied were surveyed 5 times, totaling 5.0 hours. Cowbirds were detected on four surveys.

PC6-1

Area: 4.8 ha Elevation: 140 m

PC6-1 is a mixed-exotic site consisting primarily of tamarisk 6–7 m in height, with a few patches of arrowweed and cattails present in the understory. A scattered overstory of Goodding willow approximately 10–15 m in height is present in the southwestern corner of the site. Arrowweed 1–2 m in height is present under the willow. A portion of the site within approximately 50 m of the refuge road contains thick stands of arrowweed. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the refuge road is approximately 50%. Approximately 60% of PC6-1 contained standing water and saturated soils in May. By mid-June only small puddles remained, and <1% of the site had saturated soil in July.

We detected one willow flycatcher between 2 and 6 June. The site was surveyed five times, totaling 11.0 observer-hours. Cowbirds were detected on three surveys.

Pig Hole

Area: 2.4 ha Elevation: 140 m

Pig Hole consists of monotypic tamarisk 6–7 m in height, with canopy closure ranging from 70 to 90%. The northern edge of the site has smaller-diameter tamarisk, with many wispy branches, than the remainder of the site. Approximately 5% of the site consists of dense patches of arrowweed. Approximately 15% of the site had standing water in May, and another 15% of the site had saturated soils. The standing water had disappeared and only 10% of the site contained saturated soils by mid-June, and by mid-July there was no saturated soil in Pig Hole.

No willow flycatchers were detected. The site was surveyed five times, totaling 5.3 observer-hours. Cowbirds were detected on two surveys.

In Between

Area: 7.7 ha Elevation: 140 m

In Between consists of monotypic tamarisk 6–8 m in height. The lowest 3 m of the stand generally lacks foliage, resulting in a relatively open understory. Canopy closure is 70–90%, and the western edge of the site borders a marsh. Approximately 25% of the site was inundated in May, but no standing water remained by mid-July.

We detected no flycatchers in In Between. We surveyed the site five times, totaling 9.8 observer-hours. Cowbirds were observed on all surveys.

800M

Area: 6.1 ha Elevation: 140 m

800M adjoins the western edge of In Between, and the eastern half of the site consists of a cattail and bulrush marsh with clumps of tamarisk 5–7 m in height and scattered, emergent Goodding willow. The remainder of the site is vegetated by tamarisk 4–7 m in height. Canopy closure in the tamarisk is generally >90%, while canopy closure in the marsh is around 50%. The far southern end of the site, within 50 m of the refuge road, consists of very dry tamarisk 3-5 m in height and is not suitable flycatcher habitat. Approximately 40% of the site was inundated in May, but surface water was restricted to a few puddles within the marsh by mid-June.

We detected one resident male flycatcher. Portions of the site not known to be occupied were surveyed five times, totaling 6.5 observer-hours. Cowbirds were observed on all surveys.

Pierced Egg

Area: 6.7 ha Elevation: 140 m

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height, with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to have a more open understory and contain patches of cattail and bulrush. Overall canopy closure is approximately 80%. Approximately 40% of the site was inundated in May, but by mid-June, the only remaining water was in deep pig wallows.

We located two resident male flycatchers and three additional flycatchers for which residency could not be confirmed. Two of the additional flycatchers were detected on 16 and 19 June, one in each of the occupied territories, and were suspected to be females. They were not detected on any of eight territory monitoring visits after 19 June. The third flycatcher for which occupancy could not be determined was detected along the refuge road on 8 June. We surveyed portions of the site not known to be occupied by flycatchers five times for a total of 8.5 observer-hours. Cowbirds were observed on all surveys.

Swine Paradise

Area: 1.0 ha Elevation: 140 m

This mixed-exotic site borders the open water of Topock Marsh. Vegetation at the site consists of tamarisk 6–8 m in height and scattered, emergent Goodding willow up to 15 m in height, with patches of coyote willow. Overall canopy closure is approximately 80%. The interior of the site was dry throughout the survey season, but standing water and saturated soils persisted throughout the season in the marsh on the eastern edge of the site.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.0 observer-hours. We detected cowbirds on four visits.

Barbed Wire

Area: 2.4 ha Elevation: 140 m

One large, emergent Goodding willow occurs at the site; otherwise, the site is vegetated by tamarisk 6–10 m in height and of varying density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy openings than the southwestern portion of the site. Canopy closure is approximately 90%. Standing water was present in pig wallows in May and June.
We detected no willow flycatchers. We surveyed the site five times, totaling 7.3 observer-hours. Cowbirds were detected on three visits.

Platform

Area: 1.3 ha Elevation: 140 m

This site forms a narrow strip of vegetation between the main refuge road and the open marsh. Vegetation at the site consists of tamarisk 7 m in height with a few isolated, emergent Goodding willow. Overall canopy closure is approximately 90%. Bulrush and cattail line the eastern edge of the site adjacent to the marsh. The interior of the site was dry in June and July.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.5 observer-hours. Cowbirds were detected on three visits.

250M

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is dominated by mesquite trees (*Prosopis* sp.) with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and one

emergent Goodding willow approximately 12 m in height. Canopy closure within the site ranges from 70 to 90%. The patch of coyote willow on the northern border of the site was inundated in May and June but dry in July. The remainder of the site was dry throughout the survey season.

We detected three willow flycatchers; one on 21 May, one on 3–7 Jun, and one on 25 Jun. Residency could not be confirmed for any of these individuals. The site was surveyed five times, totaling 5.3 observer-hours. Cowbirds were detected on all surveys.

Hell Bird and Glory Hole

Hell Bird: Area: 3.3 ha Elevation: 140 m
Glory Hole: Area: 5.0 ha Elevation: 140 m

These contiguous mixed-exotic sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure are highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6–8 m in height and Goodding willow 15 m in height. Canopy closure ranges from 50 to 90%. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush. Large swampy areas vegetated by cattail and bulrush are interspersed throughout the survey areas. The proportion of Hell Bird covered by surface water declined from 70% in May to 10% in mid-June and 0% in mid-July. Water levels in Glory Hole declined similarly throughout the season, with 30% of the site being inundated with up to 70 cm of water in early June and only damp soils remaining by mid-July.

We detected two unpaired, resident male flycatchers in Hell Bird and four unpaired, resident males in Glory Hole. In Glory Hole, we detected three additional flycatchers for which residency was not confirmed. Hell Bird was surveyed five times, totaling 10.0 observer-hours. Portions of Glory Hole not known to be occupied by flycatchers were surveyed five times, totaling 1.9 observer-hours. Cowbirds were detected on all surveys in Hell Bird and two surveys in Glory Hole.

Beal Lake

Area: 13.9 ha Elevation: 140 m

This mixed-native restoration site consists of a mosaic of cottonwood, Goodding willow, coyote willow, and arrowweed, with some tamarisk and mesquite scattered throughout the site. Canopy height is highly variable and averages approximately 5 m; canopy closure is sparse, averaging 35%. The amount of standing water and saturated soil is highly variable because it is flood irrigated. Sandy soil at the site allows the water to drain rapidly after irrigation, and the site was dry on all survey visits.

We detected one willow flycatcher on 15–23 May and another on 3 Jun. A third flycatcher was caught in a mist net at Reclamation's MAPS station on 15 May; this flycatcher was later confirmed to be the breeding male in The Wallows. We surveyed this site five times, totaling 9.3 observer-hours. Cowbirds were detected on four surveys.

Lost Slough

Area: 1.5 ha Elevation: 140 m

Lost Slough is located approximately 4 km south of Glory Hole and Hell Bird. This mixed-exotic site runs northeast to southwest for approximately 250 m, and measures 100 m wide at the broadest point. There is a marshy area in the center of the site; a small area of bulrush is present in the marsh, along with

AR063752

stands of coyote willow 6 m in height. Vegetation around the marsh is composed mainly of 6- to 8-m-tall tamarisk with a few emergent Goodding willow and scattered screwbean mesquite (*Prosopis pubescens*). Arrowweed up to 2 m in height makes up the understory vegetation. Canopy closure at the site is variable, with open areas toward the edges of the site and over 70% closure in areas with thick vegetation. Hydrologic conditions at the site were not assessed in May. In mid-June, the marshy area was inundated, and by mid-July small pools remained in the marsh.

We did not detect any willow flycatchers. We surveyed Lost Slough five times, totaling 5.0 observer-hours. Cowbirds were detected during one survey.

Lost Pond

Area: 1.2 ha Elevation: 140 m

This mixed-exotic site is located approximately 700 m southeast of Lost Slough. The site is approximately 200 m long and 125 m wide, with a small pond at the southern edge of the site and a marshy area at the northern end of the site. The edges of the pond are vegetated with a 30-m-wide border of cattail, bulrush, and sedges. Vegetation within the site consists primarily of tamarisk 4 to 7 m in height with canopy closure approximately 90%. The area surrounding the site consists of arrowweed, 3-m-tall tamarisk, and screwbean mesquite. In May, 75% of the site was inundated, but by mid-June water remained only in the pond and marshy areas adjacent to the site.

No willow flycatchers were detected. We surveyed the site five times, totaling 6.3 observer-hours. Cowbirds were detected during one survey.

Lost Lake

Area: 3.3 ha Elevation: 140 m

This site lies approximately 850 m southeast of Lost Pond. It is a narrow (<100-m-wide) strip of riparian vegetation separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. The northern edge of the site consists of an overstory of planted cottonwoods 10–15 m in height, with an understory of tamarisk 5 m in height, on the edge of a cattail marsh. South of the cottonwoods, the site is primarily tamarisk, 5–8 m in height, with small openings vegetated by arrowweed. In previous years, the southeastern end of the site was dominated by dense stands of coyote willow. These willows are now all dead, dramatically reducing the suitability of the site for breeding flycatchers. Overall canopy closure is approximately 80%. The only surface water or saturated soil at Lost Lake was immediately adjacent to the marsh on the northern edge of the site; the interior of the site was dry throughout the survey season.

We detected one willow flycatcher on 29 May. The flycatcher responded to broadcasts but did not vocalize spontaneously. The flycatcher was not detected on three subsequent territory monitoring visits or any of the four subsequent surveys. We surveyed the site five times, totaling 4.5 observer-hours. Cowbirds were detected on four visits.

Pulpit Rock

Area: 2.1 ha Elevation: 140 m

This mixed-exotic site lies where an unnamed wash enters the Colorado River from the Mohave Mountains. The northwestern edge of the site is vegetated by cattails and borders a backwater, and the

upland edge is vegetated by arrowweed, honey mesquite (*Prosopis glandulosa*), and ironwood (*Olneya tesota*). Vegetation within the site consists primarily of tamarisk up to 5 m in height, with small patches of coyote willow near the marsh edge. Canopy closure is around 80% near the marsh but only 30% at the upland edges of the site. Hydrologic conditions at the marsh interface were not assessed, but the majority of site appeared to by dry.

No willow flycatchers were detected. We surveyed the site five times, for a total of 2.5 observer-hours. Cowbirds were detected on one survey, and we observed burro tracks and trails around the site. One migrant willow flycatcher has been detected at this site since we began surveying it in 2003. The small size of the site, its isolation from other riparian habitat, and its predominantly dry soils make this site unlikely to support resident flycatchers, and we recommend discontinuing surveys at this site.

Picture Rock

Area: 4.6 ha Elevation: 138 m

This mixed-exotic site consists of two patches of riparian vegetation where an unnamed wash enters the Colorado River from the west. Vegetation within the site consists primarily of tamarisk 5–6 m in height, scattered Goodding willow 12 m in height, and one small patch of coyote willow. Bulrush and cattail are present on the edge of the site along the river, and the upland edges of the site contain arrowweed, mesquite, and paloverde (*Parkinsonia* sp.). Canopy closure within the tamarisk is 70–90%. Surface water was confined to the edge of the site adjacent to the marsh and did not extend under the woody vegetation.

No willow flycatchers were detected. We surveyed the site five times, for a total of 7.3 observer-hours. Cowbirds were detected on two surveys, and burro tracks and trails were observed around the site.

Blankenship Bend North

Area: 26.7 ha Elevation: 138 m

Blankenship Bend contains riparian and marsh vegetation along the eastern bank of the Colorado River adjacent to the Blankenship Valley. The eastern edge of Blankenship Bend North consists of a 100-m-wide strip of vegetation that grades from mesquite 7 m in height at the upland edge to tamarisk and then to a narrow strip of coyote willow 5 m in height. The coyote willow borders a bulrush marsh, and the western edge of the marsh is also vegetated by a narrow (5–10-m-wide) strip of coyote willow as well as several emergent Goodding willow 12 m in height. The remainder of Blankenship Bend North extends for another 400 m to the west until it reaches the open water of the Colorado River. This portion of the site consists of a mosaic of marshes, tamarisk, coyote willow, arrowweed, and mesquite. Vegetation height generally does not exceed 5 m, and canopy closure within the woody vegetation varies between 60 and 80%.

We detected no flycatchers at Blankenship Bend North. We surveyed the site five times, totaling 18.3 observer-hours. We detected cowbirds on all surveys, and evidence of feral pigs and burros was observed.

Blankenship Bend South

Area: 25.9 ha Elevation: 138 m

The eastern edge of Blankenship Bend South consists of a 100-m-wide strip of tamarisk up to 6 m in height with clumps of emergent Goodding willow up to 12 m in height. This strip of vegetation is bordered to the east by dry, upland vegetation and to the west by bulrush marsh and open water. Between this strip of vegetation and the river, approximately 600 m to the west, the site consists primarily of bulrush marsh with widely scattered clumps of tamarisk up to 5 m in height. Canopy closure is approximately 80% in the eastern portion of the site and less than 50% in the remainder of the site. Because woody vegetation in the western portion of the site is widely scattered, we recommend discontinuing surveys in this portion of the site in future years. The site contained standing water throughout the survey season, with up to 80% of the site inundated.

We detected no flycatchers at Blankenship Bend South. We surveyed the site five times, totaling 14.3 observer-hours. We detected cowbirds on all surveys but did not observe signs of livestock.

Bill Williams River National Wildlife Refuge, Arizona

The Bill Williams River NWR contains the last expanse of native cottonwood-willow forest in the LCR region. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream. We did not observe evidence of livestock use at any of the Bill Williams sites.
In addition to the regularly scheduled surveys, we revisited one site located in previous years that was determined to be potentially suitable flycatcher habitat. Results of this habitat evaluation are presented following the survey results.

Burn Edge

Area: 3.7 ha Elevation: 140 m

Burn Edge is near the northern edge of the Bill Williams riparian corridor, on the eastern edge of an area that burned in 2006. A cattail marsh with Goodding willow and cottonwood 15 m in height runs east-west through the center of the site. This portion of the site also has clumps of tamarisk up to 6 m in height. Canopy closure in the marshy area varies from around 60% at the eastern end to 25% at the western end. The area on either side of the marsh consists of tamarisk 6 m in height with up to 90% canopy closure. The entire marshy area was inundated in May to a depth up to 40 cm. Intermittent pools were present in mid-June, and by late July only two puddles remained.

No willow flycatchers were detected at Burn Edge. We surveyed the site five times, totaling 5.8 observer-hours. Cowbirds were detected on four visits.

Bill Williams Site #4 and Site #3

Site #4: Area: 9.9 ha Elevation: 140 m
Site #3: Area: 9.5 ha Elevation: 140 m

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow 15–20 m in height and patches of monotypic tamarisk up to 8 m in height. Patches of coyote willow are also present. Canopy closure is variable and overall is approximately 50%. Stands of cattails and marshy areas occupy approximately 10% of Site #3. The understory in some areas is very open, and the ground in these areas is covered with herbaceous vegetation. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Mosquito Flats had a

network of small, flowing streams in May, but these had dried to damp soil by July. The marshes in Site #3 were dry by July, and the only surface water remaining in Mosquito Flats was in the northwestern corner of Site #4 in a deep backwater channel.

We detected two resident, male flycatchers in Site #4 and detected two additional flycatchers for which residency was not confirmed. One of these was observed on 16–18 June in one of the occupied territories and was suspected to be a female, though it was not observed on any of five subsequent territory monitoring visits. Eight breeding flycatchers were detected in Site #3. Portions of the sites not known to be occupied by flycatchers were visited five times, totaling 14.3 observer-hours at Site #4 and 7.3 observer-hours at Site #3. Cowbirds were detected on all surveys of Mosquito Flats.

Last Gasp

Area: 2.1 ha Elevation: 140 m

Last Gasp is a narrow, mixed-native site along a channel on the northern edge of the Bill Williams riparian area, approximately 250 m east of Burn Edge. Vegetation within the site consists of a broken overstory of cottonwood and Goodding willow 15–20 m in height and a tamarisk understory 5–7 m in height. The bottom of the channel is 1–2 m below the surrounding ground surface. Canopy closure varies from 50% in the channel to 80–90% in the surrounding tamarisk. The channel contained intermittent pools in May. One pool remained in mid-June and by mid-July no surface water was present. No willow flycatchers were detected at Last Gasp. We surveyed the site five times, totaling 7.0 observer-hours. Cowbirds were detected on all visits.

Bill Williams Site #5

Area: 6.8 ha Elevation: 143 m

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the northeast by steep cliffs and to the west by a dry river channel. The survey site was expanded in 2008 approximately 350 m upstream, and in 2009 we ceased surveying the most downstream 250 m of the site. The discontinued area consists of deep pools surrounded by completely dry, patchy tamarisk 4 m in height and does not resemble occupied flycatcher habitat. Vegetation in the site is mixed-native, with Goodding willow and cottonwood 15–20 m in height in the overstory. The understory consists of tamarisk 7 m in height as well as some young Goodding willow and cottonwood. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure in the site is variable, ranging from 25% in open areas to 70–90% in the denser vegetation. Soils in the majority of the site were dry, although a couple of small ponds and marshy areas along the cliff on the northeastern edge of the site contained water through July.

We detected one unpaired, male flycatcher in Site #5. Portions of the site not known to be occupied were surveyed five times, totaling 10.0 observer-hours. Cowbirds were detected on four surveys.

Upstream from Site #8

Area: 1.5 ha Elevation: 170 m

Vegetation in the majority of the site consists of an overstory of cottonwood and Goodding willow up to 15 m in height and an understory of tamarisk. The western third and southern edge of the site are vegetated by Goodding willow and cottonwood up to 10 m in height. The northern edge of the site

borders a cattail marsh. Canopy cover is variable and ranges from 50 to 80%. The central portion of the site was inundated throughout the breeding season.

We detected two breeding flycatchers. Portions of the site not known to be occupied were surveyed five times, totaling 4.0 observer-hours. Cowbirds were detected on three visits.

Planet Ranch Road

Area: 2.1 ha Elevation: 170 m

This mixed-native site follows the Bill Williams River at the southern edge of the riparian area. The northern bank of the river is steep and is vegetated by tamarisk and arrowweed perched well above the level of the river. The southern bank is more gradual, and beaver activity along the river has resulted in flooding on this bank. Vegetation on this side of the river consists of an overstory of Goodding willow and cottonwood up to 15 m in height and an understory of tamarisk 5 m in height. Overall canopy closure in this portion of the site is 70–90%. The river and the willow stand on the southern bank had surface water throughout the survey season.

No flycatchers were detected. We surveyed the site five times, totaling 5.8 observer-hours. We detected cowbirds on all surveys.

Ahakhav Tribal Preserve

The Ahakhav Tribal Preserve encompasses backwater areas along the Colorado River near Parker, Arizona, and includes restoration sites. We surveyed a portion of Deer Island.

Deer Island

Area: 15.2 ha Elevation: 104 m

This site consists of a narrow strip of mixed-native vegetation on the edge of a long backwater slough. The only dense, woody vegetation occurs in a strip approximately 5 m wide on the edge of the slough and consists of tamarisk and screwbean mesquite up to 6 m in height and an understory of arrowweed. More than 5 m from the water, vegetation is primarily arrowweed with widely scattered tamarisk and mesquite. Canopy closure is <50%. The southern side of the slough has a steep, high bank, and woody vegetation is perched several meters above the water level. The north bank is not as high, with woody vegetation approximately 1 m above the water level. Although extensive areas of inundated soils existed in the slough and the adjacent cattails, water did not extend into the woody vegetation at any time during the survey season. The majority of the site burned between 2 and 8 July, and surveys were discontinued.
We detected no willow flycatchers. We surveyed the site four times, totaling 4.0 observer-hours. Cowbirds were detected on all visits. No evidence of livestock use was observed.

CVCA Phase 1

Area: 26.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. Each cell generally contains a single species and age class. The tallest cottonwoods and willows are around 9 m in height, and canopy closure in the densest areas is 80–90%. Coyote willow reaches 3–5 m in height. The site is flood irrigated but did not contain standing water during any of our site description visits. The Colorado River is about 100 m from the northern edge

of the site, and the remaining three sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected one willow flycatcher on 27 May. The site was surveyed five times, totaling 17.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA Phase 3

Area: 41.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods reach 7–8 m, Goodding willow reach 6 m, and coyote willow reach 3 m. Canopy closure varies from 20 to 80%. The site is flood irrigated but did not contain standing water during any of our site description visits. The site is surrounded by agricultural fields. The irrigation canal adjacent to the site held water throughout the season.

We detected one willow flycatcher on 16 May, one on 27 May, and two on 10 June. The site was surveyed five times, totaling 15.8 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

Cibola Nature Trail

Area: 13.7 ha Elevation: 70 m

This habitat creation site consists of a mosaic of cottonwood, Goodding willow, and mesquite. Approximately half the site consists of scattered screwbean and honey mesquite up to 5 m in height with a thick understory of seep willow. The northern half of the site contains an extensive stand of Goodding willow 8 m in height. The northern edge of the willow stand has canopy closure <25% and many of the willow are dead. The southern half of the willow stand has canopy closure around 70%. The southwestern corner of the site has a small stand of cottonwoods, and stringers of cottonwoods up to 18 m in height occur throughout the site. The site is flood irrigated and contained varying amounts of surface water through the season.

We detected one willow flycatcher on 16 May, two on 27 May, and one on 10 June. The site was surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Cibola Site #2 and Cibola Site #1

Cibola Site #2: Area: 16.4 ha Elevation: 65 m
Cibola Site #1: Area 7.7 ha Elevation: 65 m

These adjacent, mixed-exotic sites consist of a 200-m-wide strip of riparian vegetation between the channelized Colorado River to the west and a levee road to the east. Woody vegetation consists of a mix of tamarisk and arrowweed, 3–4 m in height, which is dry and scrubby on the eastern edge of the sites and becomes denser toward cattail marshes on the western edge of the sites. Emergent Goodding willow and cottonwood are scattered along the eastern edge of the marshes. Overall canopy closure is less than 50%. No surface water was present within the sites during the survey season.

We detected one willow flycatcher on 9 June at Cibola Site #1. We surveyed each site five times, totaling 7.1 hours at Cibola Site #2 and 5.3 hours at Cibola Site #1. Numerous cowbirds were detected on all surveys, and burros were observed using the periphery of the sites.

Hart Mine Marsh

Area: 31.6 ha Elevation: 65 m

This mixed-exotic site parallels the channelized Colorado River immediately south of Cibola Site #1. The site consists of a mix of tamarisk and linear stretches of marsh, which make up about 30% of the site. Height of the tamarisk does not exceed approximately 5 m, and reaches this height only within 20 m of the marshes. Away from the marshes, the tamarisk is 3 m in height and partially dead. Canopy closure within the densest tamarisk is 80–90%. An open channel had been dredged down the middle of the northern third of the site. The marshes contained standing water throughout the survey season, but water did not extend under the woody vegetation. The site lacks the height and extent of woody vegetation typical of occupied flycatcher habitat along the LCR, and surveys were discontinued in July.

No willow flycatchers were detected. We surveyed the site four times, for total of 7.8 observer-hours. Cowbirds were detected on all surveys and burros were observed on the periphery of the site.

Cibola Lake East

Area: 4.5 ha Elevation: 64 m

This site borders the marsh on the eastern edge of Cibola Lake. Vegetation within the site consists primarily of tamarisk. Within 30 m of the marsh edge, tamarisk reaches 6–7 m in height and 90% canopy closure. As distance from the marsh increases, the height and density of the tamarisk decreases, and the tamarisk becomes mixed with arrowweed. Soil within the site was dry throughout the survey season.
We detected one willow flycatcher on 4 June. We surveyed the site five times, totaling 6.3 observer-hours. Cowbirds were detected on all visits, and burro sign was observed on the periphery of the site.

Hoge Ranch

Area: 20.7 ha Elevation: 61 m

This mixed-exotic site is dominated by tamarisk 4–6 m in height, with a few emergent cottonwood and Goodding willow (15 to 18 m in height) at the southern end of the site near the old ranch. Linear marshes with cattail, bulrush, and common reed occupy less than 20% of the interior of the site, and there are a few patches of coyote willow. Canopy closure is variable and reaches 70–90% in areas of dense, woody vegetation. The marshes in the interior of the site contained small pools of water in July. The site also borders the Colorado River.

We detected three willow flycatchers on 20 May and one on 15 June. The site was surveyed five times, totaling 9.7 observer-hours. Cowbirds were detected on four surveys, and there was evidence of burros using the site.

Rattlesnake

Area: 7.6 ha Elevation: 60 m

AR063759

This mixed-exotic site is a patchwork of tamarisk 7 m in height with emergent Goodding willow up to 15 m in height and strips of dense coyote willow 6–8 m in height. Canopy closure is 70–90%. Extensive cattail marshes separate this site from the Colorado River. The interior of the site contained no standing water during the survey season.

We detected one willow flycatcher on 19 May. The site was surveyed five times, totaling 6.1 observer-hours. Cowbirds were detected on all surveys, and there was no evidence of livestock use.

Nursery NW

Area: 7.0 ha Elevation: 58 m

This mixed-exotic site lies between the Colorado River and a cattail marsh. The dominant vegetation is tamarisk approximately 5 m in height with an understory of common reed. Mesquite trees are scattered along the western edge of the site. The eastern edge of the site, adjacent to the cattail marsh, has a stand of Goodding willow 9 m in height. Overall canopy closure is around 70%, and the densest portions of the site have canopy closure >90%. Surface water was present in the adjacent marsh in May and June.

We detected one willow flycatcher on 16 June. The site was surveyed five times, totaling 4.4 observer-hours. Cowbirds were detected on all visits, and there was no evidence of livestock use.

Great Blue Heron

Area: 7.1 ha Elevation: 58 m

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willow forms an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. Portions of the site contain thickets of willow deadfall. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. The site and the adjacent marsh were dry in May and June. Pools of water within the woody vegetation were noted in July after thunderstorms the previous night.

We detected one willow flycatcher on 28 May and one on 12 June. The site was surveyed five times, totaling 19.4 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Powerline

Area: 2.0 ha Elevation: 58 m

This mixed-native site consists of a strip of Goodding willow and cottonwood along the border of a cattail marsh. Overstory height is approximately 12 m and canopy closure is <50%. Tamarisk and arrowweed are present in the understory, and honey mesquite is mixed with the tamarisk on the upland edge of the site. Small pools of water were present within the marsh in May and July, but the marsh was dry in June. We detected one willow flycatcher on 28 May. We surveyed the site five times, totaling 6.3 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were noted within the site.

Martinez Lake

Area: 4.6 ha Elevation: 58 m

This mixed-native site borders the eastern shore of Martinez Lake. The eastern edge of the site, adjacent to the upland, is dominated by arrowweed with scattered Goodding willow, cottonwood, and tamarisk. Goodding willow <10 m in height and cottonwood up to 15 m in height are more prevalent on the western edge of the site, adjacent to cattails and common reed along the lakeshore. Canopy closure is highly variable. No surface water was recording within the site at any time during the survey season, and the marsh edge adjacent to the site was also dry.

No willow flycatchers were detected. We surveyed the site five times, totaling 6.0 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were observed at the site.

Gila River Site #2

Area: 5.1 ha Elevation: 45 m

The center of this mixed-native site consists of an overstory of cottonwood up to 15 m in height and Goodding willow approximately 8 m in height, with an understory of arrowweed. Canopy closure in the center of the site is 70–90%. The remainder of the site is vegetated by tamarisk 4 m in height and arrowweed, with canopy closure <50%. The site is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. There was no standing water within the vegetation during the survey season, but the northwestern edge of the site borders a marsh, which held water throughout the season.

We detected three willow flycatchers on 30 May and one on 14 June. The site was surveyed five times, totaling 8.2 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Fortuna Site #1

Area: 5.1 ha Elevation: 45 m

This mixed-native site consists of a narrow strip of cottonwood and Goodding willow up to 15 m in height with 50–70% canopy closure. Tamarisk and arrowweed form a patchy understory on the periphery of the site. Within the densest cottonwood/willow areas, there is little understory but many downed branches. The site is bordered to the north by agricultural fields and to the south by a cattail marsh and the Gila River. Surface water was recorded in the lowest portion of the site in May, but the entire site was dry in June and July.

We detected two willow flycatchers on 31 May. We surveyed the site five times, totaling 5.3 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was observed.

Fortuna North

Area: 3.4 ha Elevation: 46 m

This site is vegetated primarily by mature tamarisk approximately 7 m in height. Goodding willow and mesquite, also 7 m in height, are scattered throughout the site but make up less than 10% of the vegetation. Canopy closure is approximately 80%. The western edge of the site borders the Gila River. No surface water was noted within the site during the survey season.

We detected no willow flycatchers at this site. We surveyed the site five times, totaling 6.3 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was observed.

AR063762

CALIFORNIA

Palo Verde Ecological Reserve, PVER Phase 2

Area: 28.7 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of cottonwood, Goodding willow, and coyote willow, which reach heights of 8, 7, and 4 m, respectively. Height and density of the vegetation varies within as well as between cells of the site. Canopy closure is highly variable, ranging from <25 to 80%. The entire site has a ground covering of alfalfa (*Medicado sativa*). The site is flood irrigated but did not contain surface water during any of our site description visits. The irrigation canal adjacent to the site contained water throughout the season.

We detected one willow flycatcher on 27 May and one on 3 June. We surveyed the site five times, totaling 15.0 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was recorded.

Big Hole Slough

Area: 29.0 ha Elevation: 82 m

This mixed-native site consists of cattail marshes edged with narrow bands of coyote willow 5 m in height. In upland areas away from the marshes, the site contains tamarisk and honey and screwbean mesquite up to 8 m in height with an understory of arrowweed. A few tall Goodding willow and cottonwood are present at the site. Overall canopy closure is approximately 50%. The site is surrounded by agricultural fields. The marsh contained standing water throughout the survey season.
We detected one willow flycatcher on 17 June. The site was surveyed five times, totaling 17.0 observer-hours. Cowbirds were detected on all visits, often in large flocks. No livestock use was observed.

Cibola Island

Area: 4.2 ha Elevation: 70 m

This mixed-native site is approximately 9.5 km southwest of Cibola Nature Trail. The site runs north to south, extending approximately 500 m lengthwise, with a width of 100 m. Dirt roads border the site to the north, east, and west. Open farm fields lie across the eastern road, with irrigation channels alongside the road. An irrigation canal empties into the northern end of the site, creating an open, marshy area down the center of the site. Between this marshy area and the western road, vegetation consists of an overstory of Goodding willow 10–12 m in height with an understory of tamarisk 5–7 m in height. Canopy closure within the willows is 80%. The eastern edge of the marsh is lined with a narrow strip of tamarisk 5–6 m in height with a few emergent Goodding willows on the marsh edge. Between the tamarisk strip and the eastern road, vegetation consists of honey mesquite and bushy arrowweed. The marsh was inundated with up to 50 cm of water in May, but in June and July the marsh contained only small pools.

We detected four willow flycatchers on 26 May and three on 4 June. The site was surveyed five times, totaling 5.1 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

AR063763

Walker Lake

Area: 11.4 ha Elevation: 64 m

This mixed-exotic site is located along the northeastern edge of Walker Lake. The majority of the site consists of very dense tamarisk approximately 5 m in height with 90% canopy closure. The southeastern end of the site contains scattered emergent Goodding willow up to 20 m in height, as well as a couple of emergent cottonwoods. This portion of the site also contains a small opening with dead cattails and a small patch of half-dead coyote willow. Walker Lake contained standing water and saturated soil throughout the survey season. Areas of the site adjacent to Walker Lake had saturated soils in May, though these soils were only damp in June and July. Soils in the interior of the site were dry throughout the survey season.

We detected no willow flycatchers. The site was visited five times, totaling 11.4 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Paradise

Area: 7.8 ha Elevation: 62 m

The center of this mixed-native site consists of stringers of cottonwood and Goodding willow 15–20 m in height. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. The cottonwoods and willows are separated from the Colorado River by a narrow (50-m-wide) strip of dense tamarisk. A marsh borders the western side of the southern third of the site. This marsh had been vegetated by cattails in previous years but now consists primarily of common reed (*Phragmites australis*). Canopy closure within the site is variable. Standing water was present within the marsh in May.

We detected one willow flycatcher on 20 May. The site was surveyed five times, totaling 6.8 observer-hours. Cowbirds were detected on every visit, and burros were noted near the site.

Milemarker 65

Area: 10.0 ha Elevation: 58 m

The site is a narrow strip of mixed-exotic vegetation between the Colorado River and a backwater marsh. Vegetation at the site consists primarily of dense tamarisk 6 m in height. Dense common reed, approximately 3 m in height, also occurs throughout the site and together with the tamarisk creates almost complete canopy closure. Because of the impenetrable vegetation at the site, we surveyed it from the river, and hydrologic conditions in the interior of the site were unknown.

No willow flycatchers were detected. We surveyed the site five times for a total of 2.9 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Ferguson Lake

Area: 21.1 ha Elevation: 57 m

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with scattered, emergent Goodding willow 10 m in height along the western edge of the site bordering Ferguson Lake. Tamarisk 5–6 m in height is the dominant understory species, and it forms a continuous canopy in portions of the site. The site also contains patches of arrowweed with scattered

AR063764

screwbean mesquite and little canopy cover. The northwestern corner of the site up to 50 m from the lakeshore had damp soils in May and standing water in June and July.

We detected three willow flycatchers on 21 May and two on 16 June. The site was surveyed five times, totaling 16.8 observer-hours. Cowbirds were detected on all visits, and no signs of livestock use were observed.

Mittry West

Area: 4.4 ha Elevation: 48 m

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Canopy closure is approximately 80%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. Surface water was present in the site during May, but the site was dry in June and July and a small patch of cattails within the site was noted in June as being primarily dead.

We detected two willow flycatchers on 11 June. The site was visited five times, totaling 7.9 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

AR063765

COLOR-BANDING AND RESIGHTING

At monitoring sites in Nevada and Arizona, SWCA field personnel color-banded 17 new adult flycatchers and recaptured 8 individuals previously banded as adults (Table 3). An additional 55 adults were identified to individual via resighting, while 10 individuals were resighted but did not have their color combinations confirmed. One individual had federal band on one leg and an injury on the other leg, and one adult had a duplicate color-band combination. We detected eight individuals identified as returning nestlings by the presence of a single federal band, with three (38%) identified to individual via recapture. Thirty-one adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 19 adults. We banded 44 nestlings from 21 nests. We banded flycatchers opportunistically at Key Pittman Wildlife Management Area and St. George, capturing and color-banding six new adults and recapturing one returning nestling; twelve nestlings from five nests were banded (Table 4).

For all captured adults and nestlings we collected blood samples.

Banding results by state and site are summarized below. For UTMs of captured and resighted individuals, please refer to the Presence/Absence Surveys section above (UTM coordinates presented are the centroid of each site).

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	1-Jul-06	2370-40047	PU:DD(M)	N/A	A5Y	F	1	RS
	North	6-Jul-05	236059711	KB(M):EE	N/A	5Y	M	1	RS
	North	3-Aug-09	2430-61271	XX:WD(M)	N/A	L	U	1	N
	North	30-Jun-05	2320-31698	RB(M):EE	N/A	5Y	F	3	RS
	North	19-Jul-08	2430-61080	YY(M):XX	N/A	3Y	M	3, 17	RS
	North	14-Jul-09	2370-40074	PU:KB(M)	N/A	L	U	3	N, R 8 Aug
	North	14-Jul-09	2430-61279	XX:DW(M)	N/A	L	U	3	N
	North	26-Jul-07	2370-40168	PU:KOK(M)	N/A	4Y	F	4	RS
	North	24-Jul-08	2430-61083	XX:YR(M)	XX:RW(M)	3Y	M	4	R 28 Jul
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	4	RS
	North	26-Jun-09	2430-61087	OB(M):XX	N/A	AHY	F	6	N
	North	25-Jul-05	2370-39915	PU:RZ(M)	N/A	A6Y	M	6	R 26 Jun
	North	N/A	N/A	UB:UB	N/A	HY	U	6	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	6	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	6	RS
	North	19-Jun-07	2370-40195	YWY(M):PU	N/A	4Y	F	9	R 13 Aug
	North	3-Aug-08	2430-61127	XX:WG(M)[9]	N/A	A3Y	M	9	R 20 Jul
	North	20-Jul-09	2370-40076	BR(M):PU	N/A	L	U	9	N
	North	20-Jul-09	2430-61277	XX:DB(M)	N/A	L	U	9	N
	North	20-Jul-09	2540-58188	TQ:VY(M)	N/A	L	U	9	N, R 13 Aug
	North	20-Jul-09	2540-58187	TQ:RB(M)	N/A	SY	F	12	N

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	6-Aug-01	2320-31592	GO(M):EE	N/A	9Y	M	12	RS
	North	30-Jun-09	2370-40073	PU:KO(M)	N/A	AHY	F	13	N
	North	18-May-04	2320-31595	WKW(M):EE	N/A	A7Y	M	13	R 30 Jun
	North	6-Jul-09	2370-40026	PU:RK(M)	N/A	L	U	13	N
	North	6-Jul-09	2370-40027	YY(M):PU	N/A	L	U	13	N
	North	1-Jul-08	2430-61120	XX:KO(M)	N/A	SY	F	15	RS
	North	29-Jul-07	2370-40157	DWD(M):PU	N/A	A4Y	M	15	RS
	North	14-Jul-09	2370-40075	OW(M):PU	N/A	L	U	15	N[10]
	North	14-Jul-09	2430-61278	XX:GO(M)	N/A	L	U	15	N
	North	14-Jul-09	2540-58185	TQ:RG(M)	N/A	L	U	15	N
	North	17-Jun-07	2370-40194[11]	BR(M):UB	PU:BR(M)	4Y	F	17	R 8 Aug
	North	N/A	N/A	UB:UB	N/A	HY	U	17	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	17	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	17	RS
	North	20-Jun-04	2320-31657	WO(M):EE	N/A	A7Y	F	97[12]	RS
	North	INA	INA	undetermined	N/A	AHY	M	97	
	North	21-Jun-06	2370-40060	YG(M):PU	N/A	A5Y	M	T5, 97	RS; unpaired at T5, then displaced male at 97
	North	N/A	N/A	UB:UB	N/A	HY	U	97	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	97	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	97	RS
	North	25-Jul-08	2430-61179	XX:KB(M)	N/A	A3Y	M	T11	RS; detected 20 May–26 Jul
	South	INA	INA	undetermined	N/A	AHY	U	F19	Detected 22 Jun
	North	13-Aug-09	2370-40140	PU:YO(M)	N/A	AHY	F	F20	N; not detected before or after capture; underside of bill dark, possibly not *extimus*

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	9-Aug-09	2540-58189	DR(M):TQ	N/A	AHY	U	F21	N; not detected before or after capture
LIFI	Poles	N/A	N/A	UB:UB	N/A	AHY	F	20	RS
	Poles	28-Jun-08	2430-61187	KV(M):XX	N/A	SY	M	20, 105	RS
	Poles	INA	INA	undetermined	N/A	AHY	F	105	
	Poles	8-Jun-09	2370-40155	PU:VB(M)	N/A	AHY	M	T66	N; detected 1–29 Jun
	Poles	INA	INA	undetermined	N/A	AHY	M	F80	Detected 25 Jun
MESQ	West	23-Jun-04	2320-31498	KW(M):EE	N/A	6Y	F	2	RS
	West	4-Jul-01	2390-92434[13]	UB:XX	N/A	9Y	M	2	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	7	RS
	West	3-Jun-07	2370-40197	OG(M):PU	N/A	A4Y	M	7	RS
	West	1-Aug-03	2320-31445	EE:WK(M)	N/A	A8Y	F	24	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	24	RS
	West	27-Jun-09	2430-61155	BB(M):XX	N/A	L	U	24	N
	West	6-Aug-09	2540-58219	TQ:RW(M)	N/A	L	U	24	N
	Bunker Marsh North	INA	INA	banded	N/A	AHY	F	39	RS
	Bunker Marsh North	1-Jul-08	2430-61165	XX:RY(M)	N/A	SY	M	39, 101	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	42	RS
	West	23-Jun-04	2320-31490[11]	UB:WG(M)	EE:OO(M)	A7Y	M	42, 45	R 28 Jun
	West	28-Jun-08	2430-61154	RO(M):XX	N/A	L	U	42	N
	West	20-Jul-06	2370-40066	YO(M):PU	N/A	5Y	F	43	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	43	RS
	West	26-Jul-07	2370-40087	PU:BZ(M)	N/A	A4Y	F	44	RS
	West	6-Jul-06	2360-59751	OG(M):EE	N/A	4Y	M	44	RS
	West	7-Jul-09	2370-40143	PU:RY(M)	N/A	L	U	44	N

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	INA	INA	banded	N/A	AHY	F	45	RS
	West	5-Jul-07	2370-40193	GY(M):PU	N/A	A4Y	F	51[12]	RS
	West	INA	INA	GW(M):PU[14]	N/A	AHY	M	51	RS
	West	23-Jun-06	2370-39940	WV(M):PU	GY(M):PU	A5Y	M	T23, 51	R 26 Jun; unpaired at T23 14–26 May, then displaced male at 51
	West	N/A	N/A	UB:UB	N/A	AHY	F	64	RS
	West	7-Jul-06	2370-39967	KO(M):PU	N/A	A5Y	M	64	RS
	Bunker Marsh North	N/A	N/A	UB:UB	N/A	AHY	F	101	RS
	Bunker Marsh North	N/A	N/A	UB:UB	N/A	AHY	U	102	RS
	Bunker Marsh North	6-Jul-08	2430-61198	XX:KR(M)	N/A	SY	U	102	RS
	West	7-Jul-06	2360-59754	OR(M):EE	N/A	4Y	M	T11	RS; detected 20 May–13 Jul
	West	15-Jul-05	2320-31688	EE:BG(M)	N/A	5Y	M	T41	RS; detected 11 May–21 Jul
	Bunker Marsh North	2-Jul-08	2430-61194	VB(M):XX	N/A	SY	U	F40	RS; detected 16 Jun
	Bunker Marsh North	N/A	N/A	UB:UB	N/A	AHY	M	F68	RS; detected 16–21 Jun
	West	INA	INA	banded	N/A	AHY	U	F80	RS; detected 9 Jul
MOME	Virgin River #1 South	2-Jun-06	2370-40037	PU:DR(M)	N/A	A5Y	F	11	RS
	Virgin River #1 South	14-Jun-06	2370-40046	PU:DK(M)	N/A	5Y	M	11	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	L	U	11	RS
	Virgin River #1 South	19-Jun-09	2370-40175	PU:UB[15]	N/A	L	U	11	N
	Virgin River #1 South	19-Jun-09	2370-40174	XX:KG(M)	N/A	L	U	11	N
	Virgin River #1 South	21-Jun-07	2370-40191	PU:RYR(M)	N/A	A4Y	F	12	RS
	Virgin River #1 South	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A9Y	M	12, 13	RS
	Virgin River #1 South	18-Jun-09	2370-40145	PU:YW(M)	N/A	L	U	12	N[16]
	Virgin River #1 South	18-Jun-09	2540-58216	TQ:GB(M)	N/A	L	U	12	N

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	18-Jun-09	2430-61086	BO(M):XX	N/A	L	U	12	N
	Virgin River #1 South	18-Jun-09	2370-40144	OKO(M):PU	N/A	L	U	12	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	L	U	12	RS
	Virgin River #1 South	6-Aug-05	2360-59788	BO(M):EE	N/A	5Y	F	13	RS
	Virgin River #1 South	15-Jul-09	2370-40029	KOK(M):PU	N/A	L	U	13	RS
	Virgin River #1 South	15-Jul-09	2370-40030	PU:RO(M)	N/A	L	U	13	RS
	Virgin River #1 South	29-Jun-09	2430-61153	WO(M):XX	N/A	AHY	F	14	N
	Virgin River #1 South	21-Jun-06	2370-39988	DW(M):PU	N/A	5Y	M	14, 99	RS
	Virgin River #1 South	23-Jun-09	2370-40151	RR(M):PU	N/A	L	U	14	N
	Virgin River #1 South	23-Jun-09	2430-61159	OK(M):XX	N/A	L	U	14	N
	Virgin River #1 South	23-Jun-09	2370-40152	PU:BW(M)	N/A	L	U	14	N
	Virgin River #1 South	INA	INA	banded	N/A	AHY	F	21	RS
	Virgin River #1 South	15-May-07	2370-40161	PU:DY(M)	N/A	A4Y	M	21	RS
	Virgin River #1 South	23-Jun-09	2370-40023	PU:BO(M)	N/A	L	U	21	N
	Virgin River #1 South	23-Jun-09	2370-40150	WG(M):PU	N/A	L	U	21	N
	Virgin River #1 South	2-Jul-08	2430-61116	VV(M):XX	N/A	A3Y	F	32	RS
	Virgin River #1 South	8-Jun-06	2370-39938	KG(M):PU	N/A	5Y	M	32	RS
	Virgin River #1 South	27-Jun-09	2540-58141	TQ:DD(M)	N/A	L	U	32	N[17]
	Virgin River #1 South	27-Jun-09	2540-58142	BV(M):TQ	N/A	L	U	32	N[17]
	Virgin River #1 South	31-Jul-09	2430-61160	KD(M):XX	N/A	L	U	32	N
	Virgin River #1 South	31-Jul-09	2540-58154	DO(M):TQ	N/A	L	U	32	N
	Virgin River #1 South	31-Jul-09	2540-58155	GG(M):TQ	N/A	L	U	32	N
	Virgin River #1 South	31-Jul-03	2320-31444	RW(M):EE	N/A	A8Y	F	36	RS
	Virgin River #1 South	06/29/03	2320-31471	EE:OW(M)	N/A	7Y	M	36	RS

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	19-Jun-09	2370-40072	OO(M):PU	N/A	U	L	36	N
	Virgin River #1 South	19-Jun-09	2430-61285	XX:GK(M)	N/A	U	L	36	N
	Virgin River #1 South	19-Jun-09	2370-39930	PU:GO(M)	N/A	U	L	36	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	U	L	36	RS
	Virgin River #1 North	23-Jun-08	2430-61172	XX:GR(M)	N/A	SY	F	37	RS
	Virgin River #1 North	7-Jun-09	2370-40176	PU:GK(M)	N/A	AHY	M	37, 51	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	45	RS
	Virgin River #1 South	29-Jun-07	2370-40124	PU:BB(M)	PU:UB	3Y	M	45	R 27 Jun
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	F	51	RS
	Virgin River #1 South	INA	INA	UB:EE	N/A	AHY	F	52	RS
	Virgin River #1 South	12-Jun-07	none[18]	RK(M):UB	N/A	A3Y	M	52	RS
	Virgin River #1 South	28-Jun-08	2430-61185	DB(M):XX	N/A	SY	F	67	RS
	Virgin River #1 South		2360-59752	DRD(M):EE	N/A	4Y	M	67	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	99	RS
	Virgin River #1 South	13-Jul-09	2370-40142	PU:VV(M)	N/A	L	U	99	N
	Virgin River #1 South	1-Jul-08	2430-61118	XX:KK(M)	N/A	SY	M	T1	RS; detected 17 Jun–25 Jul
	Virgin River #1 South	23-Jun-08	2430-61174	XX:KG(M)	N/A	SY	M	T2	RS; detected 27 Jun–13 Jul
	Virgin River #1 South	15-Jul-04	2320-31517	EE:OR(M)	N/A	7Y	M	T5	RS; detected 24 May–16 Jun
	Virgin River #1 South	19-Jun-08	2430-61167	XX:KW(M)	N/A	A3Y	M	T7	RS; detected 17 May–4 Aug
	Virgin River #1 South	23-Jun-08	2430-61173	XX:GY(M)	N/A	SY	U	F3	RS; detected 19 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	M	F4	RS; detected 21–24 May
	Virgin River #1 South	INA	INA	banded	N/A	AHY	M	F6	RS; detected 17–21 Jul
	Virgin River #1 South	26-Jul-07	2370-40086	WRW(M):PU	N/A	3Y	U	F8	RS; detected 21 Jul
	Virgin River #1 North	INA	INA	banded	N/A	AHY	U	F9	RS; detected 6 Jun

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #2	INA	INA	banded	N/A	AHY	U	F46	RS; detected 19 May
MUDD	Overton WMA	INA	INA	PU:UB	N/A	AHY	F	10	RS
	Overton WMA	21-May-09	2430-61085	BV(M):XX	N/A	SY	M	10	N
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	16	RS
	Overton WMA	28-Jun-09	2540-58143	RO(M):TQ	N/A	SY	M	16, 51	N
	Overton WMA	27-Jul-08	2370-40147	OR(M):PU	N/A	SY	F	18	RS
	Overton WMA	1-Jul-08	2430-61191	XX:BD(M)	N/A	SY	M	18	RS
	Overton WMA	17-Jul-09	2430-61161	WB(M):XX	N/A	L	U	18	N[17]
	Overton WMA	INA	INA	EE:UB	N/A	AHY	F	31	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	31, 51	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	38	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	38	RS
	Overton WMA	23-Jun-08	2430-61207	GO(M):XX	N/A	SY	F	51[12]	RS
	Overton WMA	25-Jun-09	2430-61209	GY(M):XX	N/A	A3Y	M	T1	RS; detected 22–29 Jul
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	T48	RS, detected 4–16 Jul
	Overton WMA	INA	INA	undetermined	N/A	AHY	U	F8	Detected 15 May
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	U	F34	RS; detected 19 May
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	F35	RS; detected 19 May
	Overton WMA	INA	INA	banded	N/A	AHY	U	F36	RS; detected 19 May
TOPO	The Wallows	N/A	N/A	UB:UB	N/A	AHY	F	41	RS
	The Wallows	13-Jul-07	2370-40114	VY(M):PU	UB:PU	3Y	M	41	R 15 May and 11 Jun
	The Wallows	29-Jul-09	2370-40048	BG(M):PU	N/A	L	U	41	N
	The Wallows	29-Jul-09	2370-40049	YDY(M):PU	N/A	L	U	41	N
	The Wallows	29-Jul-09	2370-40050	PU:RKR(M)	N/A	L	U	41	N

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pierced Egg	INA	INA	UB:EE	N/A	AHY	M	T1	RS; detected 8 May–6 Jul
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	M	T3	RS; detected 20 May–7 Jul
	Pierced Egg	22-May-08	2430-61135	XX:OY(M)	N/A	3Y	M	T4	RS; detected 27 May–10 Jul
	PC6-1	N/A	N/A	UB:UB	N/A	AHY	M	T7	RS; detected 2–16 Jun
	Glory Hole	18-Jul-07	2370-40158	WK(M):PU	UB:PU	3Y	M	T22	R 1 Jun; detected 12 May–11 Jul
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	M	T24	RS; detected 5 Jun–11 Jul
	Hell Bird	INA	INA	undetermined	N/A	AHY	M	T25	Detected 17–25 Jun
	Glory Hole	22-Jul-04	2320-31562	KY(M):EE	N/A	6Y	M	T42	RS; detected 16 May–27 Jul
	Glory Hole	28-May-09	2370-40181	PU:GV(M)	N/A	AHY	M	T43	N; detected 16 May–7 Jul
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	T63	Detected 15–23 May
	800M	N/A	N/A	UB:UB	N/A	AHY	M	T66	RS; detected 26 May–13 July
	Pipes #3	INA	INA	UB:PU	N/A	AHY	M	T93	RS; detected 8 May–4 Jul
	Pipes #1	INA	INA	undetermined	N/A	AHY	U	F2	Detected 15 May
	Lost Lake	N/A	N/A	UB:UB	N/A	AHY	U	F5	Detected 29 May
	250M	INA	INA	undetermined	N/A	AHY	U	F6	Detected 21 May
	Pierced Egg	INA	INA	banded	N/A	AHY	U	F8	RS; detected 16–19 Jun, possibly female for T1
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F9	Detected 16–19 Jun; possibly female for T4
	Pipes #3	INA	INA	undetermined	N/A	AHY	U	F10	Detected 9–13 Jun; possibly female for T93
	Glory Hole	INA	INA	banded	N/A	AHY	M	F21	Detected 12–16 May
	Glory Hole	INA	INA	undetermined	N/A	AHY	M	F44	Detected 28 May–1 Jun
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	U	F45	Detected 6 Aug
	The Wallows	INA	INA	undetermined	N/A	AHY	M	F46	Detected 15 May
	Beal Lake	INA	INA	undetermined	N/A	AHY	M	F65	Detected 3 Jun

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	250M	INA	INA	undetermined	N/A	AHY	U	F67	Detected 3–7 Jun
	250M	INA	INA	undetermined	N/A	AHY	U	F68	Detected 25 Jun
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F70	Detected 8 Jun
BIWI	Site #3	N/A	N/A	UB:UB	N/A	AHY	F	46	RS
	Site #3	11-Jun-09	2370-40180	PU:KG(M)	N/A	AHY	M	46	N
	Site #3	7-Jul-09	2370-40162	PU:DB(M)	N/A	L	U	46	N
	Site #3	7-Jul-09	2370-40163	OK(M):PU	N/A	L	U	46	N
	Site #3	7-Jul-09	2370-40182	GV(M):PU	N/A	L	U	46	N
	Upstream from Site #8	16-Jun-09	2370-40165	DB(M):PU	N/A	AHY	F	47	N
	Upstream from Site #8	4-Jul-09	2370-39969	PU:KYK(M)	N/A	AHY	M	47	N
	Site #3	6-Jun-08	2430-61137	XX:BR(M)	N/A	3Y	F	61	RS
	Site #3	6-Jun-08	2430-61136	XX:BG(M)	N/A	3Y	M	61	RS
	Site #3	4-Jun-09	2370-40130	PU:GWG(M)	N/A	AHY	F	65	N
	Site #3	N/A	N/A	UB:UB	N/A	AHY	M	65	RS
	Site #3	N/A	N/A	UB:UB	N/A	L	U	65	RS
	Site #3	N/A	N/A	UB:UB	N/A	L	U	65	RS
	Site #3	N/A	N/A	UB:UB	N/A	L	U	65	RS
	Site #3	2-Jul-06	2370-40004	PU:RW(M)	N/A	A5Y	F	69	RS
	Site #3	N/A	N/A	UB:UB	N/A	AHY	M	69	RS
	Site #4	5-Jul-09	2540-58146	YR(M):TQ	N/A	SY	M	T26	N; detected 18 Jun–5 Jul
	Site #5	10-Jun-09	2370-40156	PU:OB(M)	N/A	SY	M	T45	N; detected 5–16 Jun
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	T68	RS; detected 6–24 Jun
	Site #4	INA	INA	undetermined	N/A	AHY	U	F1	Detected 16–18 Jun; possibly female for T68
	Site #4	INA	INA	undetermined	N/A	AHY	U	F27	Detected 20 Jun

Table 3. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2009 (Continued)

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2009.

[5] **Age in 2009**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Right leg injured, but color-band could not be removed.

[10] Nestling suspected to have died before fledging.

[11] This federal band removed.

[12] Female mated consecutively with two different males.

[13] Band number likely 2390-92434 but cannot be confirmed because bird was not captured in 2009. Bird had visible injury on left leg.

[14] Color combination is a duplicate; federal band number and identify of flycatcher unknown.

[15] Right leg not banded because of preexisting injury.

[16] Fledgling found dead near nest.

[17] Nestling died before fledging.

[17] Original federal band 2370-40173.

[17] Recapture on 15 May was in a passive net at the Beal Lake MAPS station.

Table 4. Banded Willow Flycatchers, Non-Monitoring Sites, 2009

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Old Color Combination[2,3]	Age[4]	Sex[5]	Observation Status[6]
KEPI	Patch 1	29-Jul-09	2370-40141	PU:YK(M)	N/A	SY	U	N
	Patch 2	30-Jun-05	2370-39980	WO(M):PU	N/A	5Y	M	RS
	Patch 7	27-Jun-06	2320-31674	BW(M):EE	N/A	4Y	M	RS
	Patch 7	23-Jun-04	2320-31484	YB(M):EE	N/A	6Y	M	RS
	Patch 7	27-Jun-09	2540-58145	TQ:DO(M)	N/A	L	U	N
	Patch 7	27-Jun-09	2540-58144	TQ:OG(M)	N/A	L	U	N
	Patch 8	2-Jul-09	2370-40024	PU:BV(M)	N/A	L	U	N
	Patch 8	2-Jul-09	2370-40025	YW(M):PU	N/A	L	U	N
	Patch 9	16-Jul-09	2370-40031	OGO(M):PU	N/A	L	U	N
	Patch 9	16-Jul-09	2430-61156	GK(M):XX	N/A	L	U	N
	Patch 9	16-Jul-09	2430-61157	YB(M):XX	N/A	L	U	N
	Patch 10	16-Jul-09	2430-61158	RB(M):XX	N/A	AHY	M	N
	Patch 10	26-Jun-08	2430-61181	XX:RD(M)	N/A	A3Y	F	RS
STGE	Seegmiller Marsh	2-Aug-01	2540-58131[7]	TQ:KY(M)	Rs:W(HP)/B(HP)	AHY	F	R 22 Jun
	Seegmiller Marsh	22-Jun-09	2540-58132	TQ:OD(M)	N/A	AHY	M	N
	Seegmiller Marsh	21-Jun-04	2320-31660	BZ(M):EE	N/A	6Y	F	RS
	Seegmiller Marsh	INA	INA	UB:PU	N/A	AHY	M	RS
	Seegmiller Marsh	22-Jun-09	2370-40099	PU:VW(M)	N/A	L	U	N[8]
	Seegmiller Marsh	22-Jun-09	2370-40146	PU:WV(M)	N/A	L	U	N[8]
	Seegmiller Marsh	22-Jun-09	2370-40154	PU:YV(M)	N/A	L	U	N[8]
	Seegmiller Marsh	22-Jun-09	2370-40153	PU:YY(M)	N/A	L	U	N[8]
	Riverside East	27-Jul-08	2370-40148	PU:KR(M)	N/A	SY	F	RS
	Riverside East	14-Jul-09	2540-58217	TQ:BR(M)	N/A	SY	M	N
	Riverside East	14-Jul-09	2540-58218	KG(M):TQ	N/A	L	U	N
	River Road Bridge	4-Aug-09	2430-61162	BW(M):XX	N/A	AHY	M	N
	Riverside	15-Jul-09	2540-58186	TQ:YB(M)	N/A	AHY	M	N

[1] KEPI = Key Pittman Wildlife Management Area, STGE = St. George.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, TQ = turquoise federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] Old combination included only if rebanded in 2009.

[4] **Age in 2009:** L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[5] **Sex codes**: M = male, F = female, U = unknown.

[6] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[7] Original federal band number 2140-66690.

[8] Nestling died before fledging.

AR063777

NEVADA

Monitoring Sites

Pahranagat – We detected 21 resident, adult willow flycatchers from 12 territories at Pahranagat. In addition to resident adults, we detected three individuals for which residency and/or breeding status could not be confirmed. Of the 12 territories recorded at Pahranagat, 11 consisted of breeding pairs and 1 consisted of an unpaired male. Of the breeding individuals, one male was polygynous with two females, and one female mated consecutively with two males.

Field personnel captured and color-banded five new adults and recaptured six flycatchers previously captured as an adult. We resighted and confirmed band combinations for an additional 11 adults. Of the resighted adults, one was originally banded as a nestling in 2008. The presence of bands could not be determined for two adults. We banded 11 nestlings from five nests, and 2 of these nestlings were recaptured as fledglings. We resighted 13 unbanded fledglings from four additional nests.

Mesquite – We detected 25 resident, adult willow flycatchers from 14 territories at Mesquite. In addition to resident adults, we detected three individuals for which residency and/or breeding status could not be determined. Of the 14 territories recorded at Mesquite, 12 consisted of paired individuals and 2 consisted of unpaired males. Of the breeding individuals, two males were polygynous with two females and one female mated consecutively with two males.

Field personnel recaptured two flycatchers previously captured as adults. We confirmed the identities of an additional 14 adults via resighting. One additional adult had a federal band on one leg and an injury on the opposite leg, and another adult had a duplicate color combination. Of the resighted adults, four were originally banded as nestlings in 2008. Eight adults remained unbanded, and three adults were banded but band combinations could not be confirmed. We banded four nestlings from four nests.

Mormon Mesa – We detected 27 resident, adult willow flycatchers from 17 territories at Mormon Mesa. In addition to resident adults, we detected six individuals for which residency could not be confirmed. Of the 17 territories recorded at Mormon Mesa, 13 consisted of breeding individuals and 4 consisted of unpaired males. Of the breeding individuals, three males were each polygynous with two females.

Field personnel captured and color-banded two new adults. We resighted and identified 21 additional returning adults; of these, five were banded as nestlings in 2008. We captured one returning nestling originally banded as a juvenile in 2007 and resighted one additional returning nestling with a single federal band that we were unable to recapture. Four adults remained unbanded, and band combinations could not be confirmed for four adults. We banded 22 nestlings from nine nests. Three of these nestlings were known to have died before fledging. We resighted three unbanded fledglings from three nests.

Muddy River – We detected 13 resident, adult willow flycatchers from eight territories at Muddy River. In addition to resident adults, we detected four individuals for which residency could not be confirmed. Of the eight territories recorded, six consisted of breeding individuals and two consisted of unpaired males. Of the resident individuals, one female mated consecutively with two males, both of which were consecutively mated with two females.

AR063778

Field personnel captured and color-banded two new adults. We resighted and identified four other adults, three of which were banded as nestlings in 2008. We resighted one adult for which the band combination could not be confirmed. We resighted two returning nestlings with single federal bands but could not capture these individuals to determine year and study area of origin. Seven adults remained unbanded, and band status could not be determined for one individual. We banded one nestling, which died before fledging.

Non-Monitoring Sites

These study areas were monitored by other agencies, and here we report only banded flycatchers that were captured or resighted. Unbanded individuals or those with unknown band status are not included.

Key Pittman Wildlife Management Area – Field personnel captured and color-banded two new adults. We resighted and identified four returning banded adults. We banded seven nestlings from three nests.

St. George – Field personnel captured and color-banded four new adults. We resighted and identified two adult flycatchers, one of which was banded as a nestling in 2008. We recaptured another adult that was banded as a nestling in 2001 and had not been identified since. Another adult was identified as a returning nestling, but we were unable to capture this individual to determine year and study area of origin. We banded five nestlings from two nests; four of these died before fledging.

ARIZONA

Littlefield – We detected four resident, adult willow flycatchers from three territories at Littlefield. In addition to resident adults, we detected one individual for which residency and/or breeding status could not be confirmed. Of the three territories, two consisted of breeding pairs and one consisted of an unpaired male. Of the breeding individuals, one male was polygynous with two females.

Field personnel captured and color-banded one new adult. We resighted and confirmed band combinations for an additional adult, which was originally banded as a nestling in 2008. One resident adult remained unbanded, and band status could not be determined for another. Band status could not be determined for the individual for which residency and/or breeding status could not be confirmed.

Topock – We detected 14 resident, adult willow flycatchers from 13 territories at Topock. In addition to resident adults, we detected 14 individuals for which residency and/or breeding status could not be confirmed. Of the 13 territories recorded at Topock, 1 consisted of paired individuals and 9 consisted of unpaired males. In each of the remaining three territories, a singing male was detected throughout the breeding season and an unchallenged flycatcher, suspected to be a female, was detected for only a few days in June.

Field personnel captured and color-banded one new adult and resighted and identified two other banded adults. We captured two returning nestlings originally banded in 2007 and resighted but were unable to recapture two additional returning nestlings with single federal bands. Seven adults remained unbanded, and the band status of 12 individuals could not be determined. The color combinations of two banded adults could not be confirmed. We banded three nestlings from one nest.

Bill Williams – We detected 13 resident willow flycatchers from eight territories at Bill Williams. In addition to resident adults, we detected two individuals for which residency and/or breeding status could not be determined. Of the eight territories recorded at Bill Williams, five consisted of paired individuals, two consisted of unpaired males, and in the remaining territory a singing male was detected through most of June and an unchallenged flycatcher, suspected to be a female, was detected for only a few days in June.

Field personnel captured and color-banded six new adults. We resighted and identified three returning banded adults. Four adults remained unbanded, and band status could not be determined for two adults. We banded three nestlings from one nest and resighted three unbanded fledglings from another nest.

AR063780

NEST MONITORING

In Nevada and Arizona, we documented 72 willow flycatcher nesting attempts, 65 of which contained eggs and were used in calculating nest success and productivity (Table 5). Twenty-three (35%) nests were successful and fledged young; 40 (62%) failed, and fate was unknown for 2 (3%). Mayfield survival probability ranged from 0.053 to 0.519 and was 0.368 for all sites combined. Depredation was the major cause of nest failure, accounting for 40% of all failed nests and 48% of nests that failed after flycatcher eggs were laid.

Sixteen of 56 nests (17%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds. Brood parasitism at all study areas ranged from 0 to 100% and was highest at Littlefield. We observed the seventh consecutive year of no brood parasitism at Pahranagat. Nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized.

Nest monitoring results by site are summarized below. For UTMs, please refer to the Presence/Absence Surveys section above (UTM coordinates presented are the centroid of each site).

Table 5. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
PAHR	North	10	18	17	8 (47)	8 (47)	1 (6)	0
	Total	*10*	*18*	*17*	*8 (47)*	*8 (47)*	*1 (6)*	*0*
LIFI	Poles	2	2	1	0	1 (100)	0	1 (100)
	Total	*2*	*2*	*1*	*0*	*1 (100)*	*0*	*1 (100)*
MESQ	West	9	13	11	3 (27)	7 (64)	1 (9)	6 (55)
	Bunker Marsh North	3	3	3	0	3 (100)	0	1 (33)
	Total	*12*	*16*	*14*	*3 (21)*	*10 (72)*	*1 (7)*	*7 (50)*

AR063781

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Littlefield, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2009 (Continued)

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
MOME	Virgin River #1 North	2	2	2	0	2 (100)	0	0
	Virgin River #1 South	11	16	15	9 (60)	6 (40)	0	0
	Total	*13*	*18*	*17*	*9 (53)*	*8 (47)*	*0*	*0*
MUDD	Overton WMA	6	9	8	0	8 (100)	0	6 (75)
	Total	*6*	*9*	*8*	*0*	*8 (100)*	*0*	*6 (75)*
TOPO	The Wallows	1	2	2	1 (50)	1 (50)	0	0
	Total	*1*	*2*	*2*	*1 (50)*	*1 (50)*	*0*	*0*
BIWI	Site 3	4	5	5	2 (40)	3 (60)	0	2 (40)
	Upstream from Site #8	1	2	1	0	1 (100)	0	0
	Total	*6*	*7*	*6*	*2 (33)*	*4 (67)*	*0*	*2 (33)*
OVERALL TOTAL		**49**	**72**	**65**	**23 (35)**	**40 (62)**	**2 (3)**	**16 (29)**

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

SWCA
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Flagstaff Office
114 North San Francisco Street, Suite 100
Flagstaff, AZ 86001
Tel 928.774.5500 Fax 928.779.2709
www.swca.com

December 12, 2008

R 11251
County Imperial
Year 2008
Spp SWWF (+) YCR (+)
Srv. Rpt.
D.B. 2/25/11
GIS monitoring
L+R

Sandra Marquez, Permit Coordinator
Carlsbad U.S. Fish and Wildlife Service
6010 Hidden Valley Road
Carlsbad, CA 92011

Re: SW Willow Flycatcher Studies 2008
T&E Species Permit TE028605-1, Final Permit Report Deliverable

Ms. Marquez:

In fulfillment of SWCA Environmental Consultant's Federal Fish and Wildlife permit (TE028605-1) deliverable requirement with your department, please find enclosed on CD an annual report titled *Southwestern Willow Flycatcher Surveys, Color-banding and Nest Monitoring in Nevada, California, and Arizona,* 2008. This report details all of our Southwestern Willow Flycatcher studies conducted in California in 2008, and is presented in a site-by-site format to facilitate locating information of interest.

If you or your department requires any additional information, please do not hesitate contacting me directly: (928) 774-5500 ext. 201; tkoronkiewicz@swca.com.

Many thanks for your continuing support, sincerely,

Tom Koronkiewicz
Avian Ecologist

TJK
Enclosure

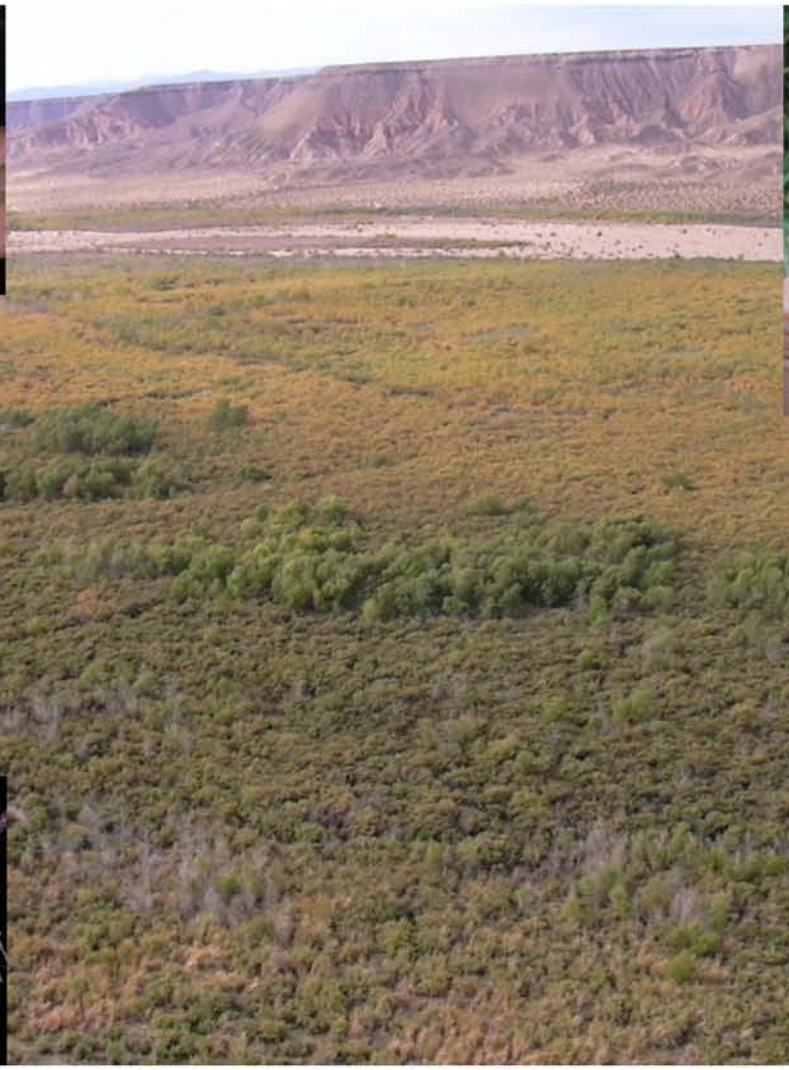
RECEIVED
CFTC ... D, CA
2008 DEC 15 PM 12: 18

Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2008. Annual Report









U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2009

AR063785

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

Lower Colorado River Multi-Species Conservation Program

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2008. Annual Report

Prepared by Mary Anne McLeod and Thomas J. Koronkiewicz,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2009

AR063789

RECOMMENDED CITATION:

McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 153 pp.

CONTENTS

Executive Summary xi

1. INTRODUCTION 1
PROJECT HISTORY 1
SPECIES INTRODUCTION 2
PURPOSE AND DESCRIPTION OF STUDY 3

2. PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS 5
INTRODUCTION 5
Special Concern Species 5
METHODS 7
Site Selection 7
Additional Site Evaluation 9
Broadcast Surveys 10
Site Description 10
RESULTS 11
Pahranagat National Wildlife Refuge, Nevada 17
Pahranagat North 18
Pahranagat West 18
Pahranagat MAPS 18
Pahranagat South 19
Littlefield, Arizona 19
Littlefield Poles 19
Mesquite, Nevada 20
Mesquite East 20
Mesquite West 20
Electric Avenue North 21
Electric Avenue South 21
Bunker Farm 21
Mormon Mesa, Nevada 22
Mormon Mesa North 22
Hedgerow 22
Mormon Mesa South 23
Virgin River #1 23
Virgin River #2 24
Ground Reconnaissance Results 24
Muddy River, Nevada 25
Overton WMA Pond 25
Overton WMA 26
Grand Canyon, Arizona 26
Burnt Springs (RM 259.5N) 29
RM 274.5N 29
RM 285.3N 29
Iceberg Canyon 30
Topock Marsh, Arizona 30
Pipes #1 30

Pipes #3 30
The Wallows 31
PC6-1 31
Pig Hole 31
In Between 31
800M 32
Pierced Egg 32
Swine Paradise 32
Barbed Wire 32
IRFB03 and IRFB04 33
Platform 33
250M 33
Hell Bird and Glory Hole 34
Beal Lake 34
Lost Slough 34
Lost Pond 35
Lost Lake 35
Ground Reconnaissance Results 35
Topock Gorge, Arizona and California 35
Blankenship Bend 36
Havasu NE 36
Bill Williams River National Wildlife Refuge, Arizona 36
Bill Williams Site #2 37
Bill Williams Site #11 37
Bill Williams Site #4 and Site #3 37
Bill Williams Site #5 38
Mineral Wash Complex 38
Beaver Pond 38
Bill Williams Site #8 39
Ground Reconnaissance Results 39
Ahakhav Tribal Preserve, Arizona 46
Willow Beach 46
Deer Island 47
Ground Reconnaissance Results 47
Big Hole Slough, California 47
Big Hole Slough 47
Ehrenberg, Arizona 48
Ehrenberg 48
Cibola National Wildlife Refuge, Arizona and California 48
CVCA 48
Cibola Nature Trail 48
Cibola Island 49
Three Fingers Lake 49
Cibola Lake North and West 49
Walker Lake 50
Imperial National Wildlife Refuge, Arizona and California 50
Draper Lake 50
Paradise 50
Hoge Ranch 51
Adobe Lake 51

Rattlesnake 51
Clear Lake/The Alley 51
Nursery NW 52
Imperial Nursery 52
Ferguson Lake 52
Ferguson Wash 53
Great Blue Heron 53
Mittry Lake, Arizona and California 53
Mittry West 53
Mittry South 54
Yuma, Arizona 54
Gila Confluence North 54
DISCUSSION 54

3. COLOR-BANDING AND RESIGHTING 57
INTRODUCTION 57
METHODS 57
Color-banding 57
Resighting 58
RESULTS 59
All Monitoring Sites 59
Site-by-Site Color-Banding and Resighting 59
Monitoring Sites 59
Non-Monitoring Sites 72
Adult Between-Year Return and Dispersal 74
Juvenile Between-Year Return and Dispersal 74
Within-Year, Between-Study Area Movements 75
DISCUSSION 75
Color-Banding Effort 75
Adult and Juvenile Between-Year Dispersal 76
Adult and Juvenile Survivorship 76

4. NEST MONITORING 77
INTRODUCTION 77
METHODS 77
RESULTS 78
Nest Monitoring 78
Nest Failure 80
Brood Parasitism 81
Mayfield Nest Success and Nest Productivity 81
DISCUSSION 83
Nest Success 83
Nest Failure 83
Brood Parasitism 84
Mayfield Nest Success and Nest Productivity 85

5. VEGETATION AND HABITAT CHARACTERISTICS 87
INTRODUCTION 87
METHODS 87
Currently Occupied Territories 87
Nests in Formerly Occupied Areas 88
Data Analyses 88
RESULTS 89
Currently Occupied Territories 89
Nests in Formerly Occupied Areas 90
DISCUSSION 98
Currently Occupied Territories 98
Nests in Formerly Occupied Areas 99

6. MICROCLIMATE 101
INTRODUCTION 101
METHODS 101
Currently Occupied Territories 101
Temperature and Relative Humidity (T/RH) Measurements 101
Soil Moisture (SM) Measurements 102
Statistical Analyses 103
Nests in Formerly Occupied Areas 103
Statistical Analyses 104
RESULTS 104
Currently Occupied Territories 104
Nests in Formerly Occupied Areas 118
DISCUSSION 121
Currently Occupied Territories 121
Nests in Formerly Occupied Territories 121

7. HABITAT MONITORING: PARKER TO IMPERIAL DAMS 123
INTRODUCTION 123
METHODS 124
Temperature/Humidity (T/RH) Loggers 124
Soil Moisture (SM) Measurements 125
Vegetation Measurements 125
Groundwater Measurements 125
Piezometer Installation 125
Data Collection 125
Statistical Analyses 126
Microclimate 126
Vegetation 127
Groundwater Levels 127
RESULTS 128
HOBO Logger Maintenance 128
Piezometer Installation and Maintenance 128

Microclimate 129
2008 Microclimate Descriptive Statistics 129
Between-year Comparisons of Microclimate Characteristics 130
Comparison of Parker/Imperial to Topock: Microclimate 132
Vegetation Measurements 132
Between-year Comparisons of Vegetation Characteristics 132
Groundwater Monitoring 136
Overview of Piezometer Groundwater Levels 136
Correlation of Piezometer Groundwater Levels with Reservoir Releases 137
Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements 139
Presence of Standing Water 140
Evapotranspiration Signature 140
DISCUSSION 142
Microclimate 142
Comparison of Parker/Imperial to Topock 142
Between-year Comparisons of Microclimate Characteristics 142
Vegetation 143
Groundwater Levels 143
Piezometer Groundwater Levels 143
Correlation of Piezometer Groundwater Levels with Reservoir Releases 144
Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements 145
Presence of Standing Water 145
Evapotranspiration Signature 145

8. LITERATURE CITED 147

Appendices

A. Field Data Forms
B. Orthophotos Showing Study Sites
C. Detections of Special Concern Species, 2008
D. All Willow Flycatchers Color-Banded and/or Resighted, 2003–2008
E. Hydrographs for Piezometers at Habitat Monitoring Sites
F. Contributing Personnel

Figures

1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*) 2

2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2008..... 6
2.2. Reconnaissance areas near the mouth of the Virgin River, 2008..... 27
2.3. Bill Williams River NWR habitat evaluation 2008. 41
2.4. Bill Williams River NWR habitat evaluation 2008, continued..... 43

5.1. Vertical foliage density at occupied willow flycatcher territories in coyote willow habitat type, 2008..... 92
5.2. Vertical foliage density at occupied willow flycatcher territories in tamarisk/coyote willow habitat type, 2008..... 92
5.3. Vertical foliage density at occupied willow flycatcher territories in Goodding willow habitat type, 2008..... 93
5.4. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2008 93
5.5. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Mormon Mesa, 2008 94
5.6. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Topock Marsh, 2008 94
5.7. Vertical foliage density at occupied willow flycatcher territories in tamarisk habitat type, 2008..... 95
5.8. Vertical foliage density at occupied willow flycatcher territories in tamarisk/mesquite habitat type, 2008..... 95

6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008 109
6.2. Mean distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008. 110
6.3. Mean percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2008..... 111
6.4. Mean percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2008..... 112
6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008..... 113
6.6. Mean minimum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008..... 114
6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008..... 115
6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008..... 116
6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008..... 117

7.1. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2008..... 134
7.2. Correlation of Havasu NE piezometer and Lake Havasu water levels, October 2005–September 2008..... 138

Tables

2.1. Proposed Survey Schedule for Sites Where No Resident Flycatchers Have Been Detected since 1996 7
2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2008 11
2.3. Detections of Willow Flycatchers Recorded after 15 June 2008 at Sites Where Breeding or Residency Was Not Confirmed..... 14
2.4. Yellow-Billed Cuckoo Detections along the Virgin, Bill Williams, and Lower Colorado Rivers, 2008 14
2.5. Yuma Clapper Rail Detections along the Bill Williams and Lower Colorado Rivers, 2008..... 15
2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2008 15

3.1. Summary of Willow Flycatchers Detected at Monitored Sites during the 2008 Breeding Season 61
3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 62
3.3. Willow Flycatchers Color-Banded and Resighted, Non-Monitoring Sites, 2008..... 73
3.4. Resident Adult Willow Flycatcher Annual Return from 2007 to 2008 74
3.5. Summary of Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2008..... 74
3.6. Summary of Juvenile Flycatchers Banded as Hatch Year Birds in 2005, 2006, or 2007 and Recaptured for the First Time in 2008 75

4.1. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008 78
4.2. Willow Flycatcher Percent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers and Tributaries from 1996 to 2008..... 79
4.3. Summary of Causes of Willow Flycatcher Nest Failure at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008 80
4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-Headed Cowbirds, 2008..... 81
4.5. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008 82
4.6. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008..... 82

5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2008..... 91

5.2. Proportion of Stems Omitted from Stem Counts 91
5.3. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mesquite and Mormon Mesa 96
5.4 Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Muddy River and Topock Marsh 97
5.5. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined 98

6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Coyote Willow (n = 7), 2008 105
6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Coyote Willow (n = 4), 2008 105
6.3. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow (n = 2), 2008 106
6.4. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory (n = 2), 2008 106
6.5. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Mormon Mesa (n = 11), 2008 107
6.6. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Topock Marsh (n = 8), 2008 107
6.7. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk (n = 3), 2008 108
6.8. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Mesquite (n = 1), 2008 108
6.9. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mesquite, NV 119
6.10. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mormon Mesa, NV 119
6.11. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Muddy River, NV 119
6.12. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Topock Marsh, AZ 120
6.13. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined 120

7.1. Summary of Piezometer Construction and Data Collection at Habitat Monitoring Sites, Lower Colorado River, 2005–2008 128
7.2. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, May–July 2008 131

7.3. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2008 131
7.4. Comparison of Microclimatic Variables at Habitat Monitoring Sites to Territories at Topock Marsh, 2008 132
7.5. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2008..... 133
7.6. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2008..... 135
7.7. High and Low Average Monthly Water Depths Recorded at Piezometers at Habitat Monitoring Sites, August 2005–August 2008..... 137
7.8. Correlation (R^2 Statistic) of Parker Dam Daily Releases (cfs) with Average Daily Groundwater Levels (feet bgs) of Piezometers at Habitat Monitoring Sites, September 2006–September 2008..... 138
7.9. Average Monthly Flows (cfs) Below Parker Dam, 2000–2008..... 139
7.10. Results of Linear Regression Between Average Daily Piezometer Groundwater Levels and Soil Moisture at Habitat Monitoring Sites, Lower Colorado River, 2005–2008 140
7.11. Magnitude of Daily Evapotranspiration Signature, January–December 2006..... 141
7.12. Magnitude of Daily Evapotranspiration Signature, January–December 2007..... 141
7.13. Difference in Magnitude of Evapotranspiration Signature from 2006 to 2007 142

EXECUTIVE SUMMARY

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*), listed as federally endangered in 1995, breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico. Historical breeding records and museum collections indicate a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region. Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Willow flycatcher studies have been conducted along the Virgin and lower Colorado Rivers and tributaries annually since 1996, in compliance with requirements set forth by the U.S. Fish and Wildlife Service (USFWS) regarding U.S. Bureau of Reclamation (Reclamation) routine operations and maintenance along the lower Colorado River. Biological Assessments and the resulting Biological Opinions on operations and maintenance were prepared as steps to developing a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). The LCR MSCP calls for continued surveys and monitoring of willow flycatchers along the lower Colorado River. The LCR MSCP was signed in April 2005, and implementation of the program began in October 2005.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet of California apportionment water for 75 years. The point of diversion, previously located below Parker Dam, would change to a point above Parker Dam. These changes in water regulation could cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less and have the potential to modify riparian habitats below Parker Dam. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams. In 2004, Reclamation biologists initiated studies of the microclimate within potentially affected areas. In 2005, these studies were continued and expanded by SWCA Environmental Consultants (SWCA) to address how the hydrological changes might affect riparian habitats along the Parker to Imperial reach.

From 1997 to 2008, breeding populations of Southwestern Willow Flycatchers were documented along the Virgin and lower Colorado Rivers and tributaries at eight study areas from Pahranagat National Wildlife Refuge, Nevada, south to the Bill Williams River in Arizona. Willow flycatchers also have been detected during the breeding season at many sites along the Colorado River south of the Bill Williams River to the Mexico border. Behavioral observations and timing of detections strongly suggest this section of the river corridor is a major flyway for migrant willow flycatchers in spring. The degree to which migrant Southwestern Willow Flycatchers use the lower Colorado River corridor is unknown.

SWCA was contracted by Reclamation to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the Virgin and lower Colorado River regions in 2008. Approximately 100 sites are included in the study, but a portion of them are surveyed on a biennial basis. We completed presence/absence surveys and site descriptions at 77 sites in 16 study areas from the Pahranagat National Wildlife Refuge (NWR), Nevada, south to Yuma, Arizona. We also conducted more intensive studies at the eight study areas where territorial flycatchers were detected: Pahranagat NWR, Mesquite, Mormon Mesa, and Muddy River Nevada; and Grand Canyon, Topock Marsh, Bill Williams River NWR, and Ahakhav Tribal Preserve, Arizona. At these study areas, we searched for nests in all areas occupied by territorial

flycatchers, monitored willow flycatcher nests to document nest fate, brood parasitism, and causes of nest failure; color-banded and resighted as many willow flycatchers as possible to determine the breeding status of territorial flycatchers and document movement and recruitment; and measured characteristics of vegetation and microclimate in occupied territories and at old flycatcher nests in abandoned areas where we had collected similar data when the nest was active.

We used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 77 sites, ranging in size from 1 to 92 ha, along the Virgin and lower Colorado Rivers and tributaries between 12 May and 28 July 2008, following a 5-survey protocol. We detected willow flycatchers on at least one occasion at 42 of these sites. Resident, breeding flycatchers were detected at nine sites within the following six study areas: Pahranagat NWR, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams. Resident flycatchers were also detected at Grand Canyon and Ahakhav, Arizona. South of Ahakhav, 90 willow flycatcher detections were recorded between 15 May and 22 June; no flycatcher detections were recorded at any of these sites after 22 June. Monitoring results suggest these flycatchers were not resident, breeding individuals and were most likely spring migrants.

We used targeted mist-net and passive netting techniques to capture and uniquely color-band adult and fledgling willow flycatchers at all survey sites where resident willow flycatchers were detected. Nestlings were banded between 8 and 10 days of age. We banded each willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and one pin-striped, aluminum band on the other. We used binoculars to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combinations on their legs.

We color-banded 18 new adult flycatchers and recaptured 6 individuals previously banded as adults. An additional 50 adults were identified to individual via resighting, while 4 individuals were resighted but did not have their color combinations confirmed, and 1 individual had federal band on one leg and an injury on the other leg. We detected 14 individuals identified as returning nestlings by the presence of a single federal band, with 4 (29%) identified to individual via recapture. Twenty-five adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 17 adults. We banded 74 nestlings from 29 nests. We banded flycatchers opportunistically at Key Pittman Wildlife Management Area, Seegmiller Marsh, and Las Vegas Wash, capturing and color-banding 10 new adults and recapturing 3 returning nestlings. Eleven nestlings from four nests were banded.

We recorded 72 territories at all monitored sites. Of these, 50 (69%) consisted of paired flycatchers and 22 (31%) consisted of unpaired individuals. Ten breeding males were polygynous; nine were paired with two females, and one was paired with three females. One female mated consecutively with two different males.

Of the 95 adult willow flycatchers identified to individual in 2007, 54 (57%) returned in 2008; 3 (6%) were detected at a different study area from where they were detected in 2007. We detected two within-year, between-study area movements in 2008. One male moved from Pahrangat North to Key Pittman, and one female moved from Mormon Mesa Virgin River #2 to Muddy River Overton WMA.

Of the 50 juveniles banded in 2007, 2 (4%) were recaptured or resighted and identified in 2008. Both were detected at a different study area from where originally banded. Two individuals originally banded as nestlings in 2005 and two banded in 2006 were also recaptured; of these, three returned to a different study area than where originally banded. The median dispersal distance for all returning juvenile flycatchers in 2008 was 30 km.

We documented 62 willow flycatcher nesting attempts, 55 of which contained eggs and were used in calculating nest success and productivity. Thirty (55%) nests were successful and fledged young; 23 (42%) failed, and fate was unknown for 2 (3%). Mayfield survival probability ranged from 0.194 to 0.705 and was 0.461 for all sites combined. Depredation was the major cause of nest failure, accounting for 40% of all failed nests and 52% of nests that failed after flycatcher eggs were laid.

Eight of 48 nests (17%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds. Brood parasitism at all study areas ranged from 0 to 57% and was highest at Muddy River. We observed the sixth consecutive year of no brood parasitism at Pahranagat. Nests that contained flycatcher eggs and were brood parasitized were not less likely to fledge flycatcher young than nests that were not parasitized.

At Mesquite, Mormon Mesa, Muddy River, Topock Marsh, Bill Williams, and Ahakhav, we gathered data on vegetation and microclimate characteristics at one location for each of 41 territorial male flycatchers we identified, regardless of the length of time the male was resident and whether or not he obtained a mate. We delineated the following habitat types: 1) coyote willow, 2) tamarisk with coyote willow, 3) Goodding willow, 4) Goodding willow with tamarisk understory, 5) tamarisk with scattered Goodding willow, 6) tamarisk, and 7) tamarisk with mesquite. Coyote willow and Goodding willow are the only habitat types likely to be created at restoration areas, but we summarize vegetation and microclimate characteristics for all habitat types. Sample sizes in 2008 are likely too small to provide an accurate representation of the range and variance in vegetation and microclimate characteristics in each habitat type.

Territories within all vegetation types exhibited moist or inundated soil conditions throughout the breeding season. Several habitat types showed a general drying trend in soil conditions as the breeding season progressed. Daily maximum temperatures spanned a range of approximately 15°C among habitat types while daily minimum temperatures spanned only 5°C. Habitat types with high daily maximum temperatures also tended to have low daily minimum temperatures and thus had the largest temperature ranges. In general, habitats with a significant native component tended to be cooler and more thermally moderate than those dominated by tamarisk.

In addition to collecting vegetation and microclimate data at occupied territories, we investigated whether changes in vegetation and microclimate might have contributed to the abandonment of some areas by flycatchers. We identified several areas that had been occupied by nesting flycatchers in at least one previous year from 2003 to 2007 but were unoccupied in 2008, and we relocated old nests at which we had collected vegetation and microclimate information in the year the nest was active. We resampled microclimate and vegetation at these nests in 2008. At Mesquite and Mormon Mesa, areas that had been abandoned were affected by flooding over the 2004–2005 winter, and we had noted the loss of native vegetation in these areas. These qualitative observations were supported by the vegetation data collected in 2008, which showed shorter canopy height, less canopy closure, and less native vegetation than when the nests were active. We observed corresponding changes in microclimate, with generally higher temperatures recorded in 2008.

We had not noted qualitative changes in vegetation in abandoned areas at Muddy River or Topock, though vegetation data showed a decrease in live stems <2.5 cm dbh, an increase in dead foliage density at nest height, and a decrease in the percent of native vegetation at Muddy River. There were no statistically significant changes in microclimate at Muddy River, though the direction of interannual change was consistent with what we observed at Mesquite. Bulldozing activities in the vicinity of the nests at Muddy River could have contributed to abandonment of the area, or the site could have been unoccupied in 2008 as the result of interannual variation in site occupancy. Monitoring of the site in

future years will help determine whether abandonment of the site was a temporary or long-term phenomenon.

We detected a decrease in the number of live stems 2.5–8 cm dbh and a decrease in dead foliage below the nest at Topock. A decrease in the number of live stems at Topock could reduce suitability of the sites for flycatchers. The microclimate changes observed at Topock were in a direction opposite to what we anticipated, with old nest sites being generally cooler and more humid in 2008 than when they were active. The number of territories at Topock has varied widely over the years, and the abandonment of certain sites may simply reflect a lower overall number of territorial flycatchers rather than a change in habitat suitability.

In 2005, we selected 11 sites between Parker and Imperial Dams for inclusion in the habitat monitoring study addressing how changes in water transfer actions might affect riparian habitat. We also selected two control sites above Parker Dam and two below Imperial Dam. At each site we installed 3–5 temperature/humidity data loggers and one groundwater observation well (piezometer). All logger and piezometer locations selected in 2005 were retained in 2006. Two loggers and one piezometer were damaged or destroyed in a fire in December 2006 and were replaced in 2007, and one piezometer that was destroyed by a bulldozer in 2007 was replaced in 2008. Soil moisture measurements were collected at each data logger location during each of approximately five flycatcher surveys between 15 May and 25 July. Vegetation measurements were also collected at each data logger location after surveys were completed.

Daily, weekly, and seasonal cycles in groundwater levels were apparent. Groundwater levels drop during afternoon hours when evapotranspiration is high and on the weekends when water releases from Parker Dam decline. The seasonal cycle in groundwater levels mirrors the seasonal fluctuation in river flow.

Analyses of groundwater data indicate a strong correlation between piezometer water levels and releases from Parker Dam. Data did not show strong correlations between piezometer water level and soil moisture within the habitat monitoring sites. Most microclimatic variables at the combined habitat monitoring sites differed significantly from those at Topock Marsh. Topock was cooler and exhibited lower diurnal/nocturnal relative humidity and lower diurnal/nocturnal vapor pressure than habitat monitoring sites.

Comparisons of microclimate characteristics among 2005, 2006, 2007, and 2008 at the habitat monitoring sites indicated generally hotter and more humid conditions in 2006 than in the other years. The interannual changes were generally similar between test and control sites, suggesting that changes in temperature and humidity conditions may have been regional, rather than being influenced by changes in river operations. Soil moisture was lower in 2006 than in 2005 or 2007, and while this pattern was exhibited at both test and control sites, the interannual change was greater at control than at test sites. In 2008, soil moisture at test sites increased while it remained the same at control sites. This suggests that local conditions, in addition to regional climatic conditions, influenced soil moisture.

We noted between-year differences at the habitat monitoring sites for canopy closure, woody ground cover, and number of dead stems 2.5–8 cm dbh. There was no evidence that the differences in canopy closure and number of dead stems 2.5–8 cm dbh occurred exclusively at control sites or at test sites; rather, the differences occurred across all sites. Across all sites, canopy closure decreased between 2005 and 2006 and then increased in 2007 and 2008 to values higher than those recorded in 2005. The number of dead stems 2.5–8 cm dbh was lower in 2006 and 2007 than in 2005 or 2008. Percent woody ground cover was higher in 2008 than in previous years. There was a significant interaction between year and location for woody ground cover, with woody ground cover increasing at control plots between 2005 and 2006 and then decreasing in 2007 while it did not change at test plots across those years.

There were no between-year differences for live vertical foliage density in any meter interval, but there were between-year differences for the first, second, third, and fourth meter intervals above the ground for dead vegetation. In all cases, density of dead vegetation was higher in 2008 than in 2007. There was a significant interaction between live vertical foliage density and location for the fourth meter interval, but there was no clear pattern. There was also a significant interaction between dead vertical foliage density and location for the first meter interval, with the density of dead vegetation increasing more in 2007 and 2008 at control plots relative to test plots.

Chapter 1

INTRODUCTION

PROJECT HISTORY

In 1995, the U.S. Bureau of Reclamation (Reclamation), other federal, state, and tribal agencies, and environmental and recreational interests agreed to form a partnership to develop and implement a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). As a step to developing the LCR MSCP, Reclamation prepared a Biological Assessment (BA) in August 1996, evaluating the effects of dam operations and maintenance activities on threatened, endangered, and sensitive (TES) species. These species included the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), which was listed by the U.S. Fish and Wildlife Service (USFWS) as endangered in 1995 (60 FR 10694–10715). In response to the BA, the USFWS issued a Biological Opinion (BO) in April 1997 outlining several terms and conditions Reclamation must implement in order not to jeopardize the species. Among these terms and conditions was the requirement to survey and monitor occupied and potential habitat for Southwestern Willow Flycatchers along the lower Colorado River for a period of five years. The studies were intended to determine the number of willow flycatcher territories, status of breeding pairs, flycatcher nest success, the biotic and abiotic characteristics of occupied willow flycatcher sites, and Brown-headed Cowbird (*Molothrus ater*) brood parasitism rates. In 2002, Reclamation reinitiated consultation with USFWS on the effects of continued dam operations and maintenance on TES species along the lower Colorado River. The USFWS responded with a BO in April 2002 requiring continued Southwestern Willow Flycatcher studies along the lower Colorado River through April 2005. The BO also required implementation of a study to evaluate the effectiveness of Brown-headed Cowbird trapping for conservation of the flycatcher.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet for 75 years. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams.

The LCR MSCP is a 50-year program that seeks to protect 26 TES species and their habitats along the lower Colorado River while maintaining river regulation and water management required by law. The LCR MSCP was approved in April 2005 with the signing of a Record of Decision by the Secretary of the Department of the Interior, and implementation of the program began in October 2005. Documentation for the LCR MSCP includes a Habitat Conservation Plan (HCP), BA/BO, and an Environmental Impact Statement. The HCP specifies monitoring and research measures that call for surveys and research to better define habitat requirements for the Southwestern Willow Flycatcher and studies to determine the effects of cowbird nest parasitism on flycatcher reproduction.

Reclamation initiated willow flycatcher studies along the lower Colorado River in 1996, in anticipation of the requirements outlined in the BOs that were part of LCR MSCP development. These studies have been conducted annually since 1996. In compliance with the consultation on Interim Surplus Criteria and Secretarial Implementation Agreements, Reclamation biologists deployed temperature/humidity data loggers in 2004 at a subset of sites currently monitored for Southwestern Willow Flycatcher along the Colorado River in California and Arizona. These studies were expanded in 2005 to include annual monitoring of groundwater levels, vegetation, and soil moisture in addition to temperature and humidity.

SPECIES INTRODUCTION

The Southwestern Willow Flycatcher is one of four subspecies of willow flycatcher currently recognized (Unitt 1987), although Browning (1993) posits a fifth subspecies (*E. t. campestris*) occurring in the central portions of the United States (Figure 1.1). The Southwestern Willow Flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987).

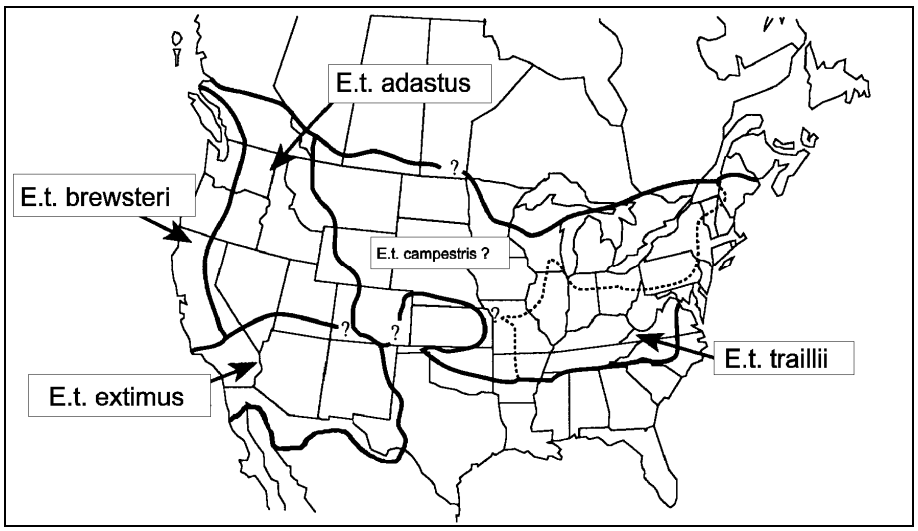


Figure 1.1. Breeding range distribution of the subspecies of the willow flycatcher (***Empidonax traillii***). Adapted from Unitt (1987), Browning (1993), and Sogge et al. (1997).

In the Southwest, most willow flycatcher breeding territories are found within small breeding sites containing five or fewer territories (Durst et al. 2006). One of the last long-distance Neotropical migrants to arrive in North America in spring, Southwestern Willow Flycatchers have a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in August (Sogge et al. 1997). All four subspecies of willow flycatchers spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995, Unitt 1997), with wintering ground habitat similar to the breeding grounds (Lynn et al. 2003). Willow flycatchers have been recorded on the wintering grounds from central Mexico to southern Central America as early as mid-August (Stiles and Skutch 1989, Howell and Webb 1995), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz et al. 2006b).

Historical breeding records and museum collections indicate that a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region (Unitt 1987). However, no nests have been located south of the Bill Williams River, Arizona, in over 65 years (Unitt 1987), though northbound and southbound migrant willow flycatchers use the riparian corridor (Phillips et al. 1964, Brown et al. 1987, McKernan and Braden 2002, McLeod et al. 2008a, this document). Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (USFWS 1995, Marshall and Stoleson 2000). Because of low population numbers range-wide, identifying and conserving willow flycatcher breeding sites is thought to be crucial to the recovery of the species (USFWS 2002).

From 1997 to 2008,[1] breeding populations of Southwestern Willow Flycatchers were documented at eight study areas along the Virgin and lower Colorado Rivers and tributaries: (1) Pahranagat National Wildlife Refuge (NWR), Nevada; (2) Beaver Dam Wash/Virgin River confluence at Littlefield, Arizona; (3) Mesquite and (4) Mormon Mesa on the Virgin River, Nevada; (5) Overton Wildlife Management Area (WMA) along the Muddy River, Nevada; (6) Grand Canyon, Arizona; (7) Topock Marsh on the Colorado River, Havasu NWR, Arizona; and (8) Bill Williams River NWR (Bill Williams), Arizona (McLeod et al. 2008a, Braden and McKernan unpubl. data). Willow flycatchers, including one banded migrant Southwestern Willow Flycatcher (Koronkiewicz et al. 2006a), were detected during the breeding season at several sites along the Colorado River south of the Bill Williams River to the Mexico border, but no nesting activity was confirmed.

PURPOSE AND DESCRIPTION OF STUDY

The purpose of the 2008 study is to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the lower Colorado and Virgin River region. This project encompasses three types of studies: (1) presence/absence surveys, including site descriptions, at pre-selected sites along the lower Colorado and Virgin Rivers and tributaries, including the lower Grand Canyon and Bill Williams River; (2) intensive life history studies at all study areas where breeding flycatchers are located to assess Southwestern Willow Flycatcher demographics and ecology, habitat selection, and the effects of Brown-headed Cowbird brood parasitism; and (3) monitoring of microclimate, vegetation, and groundwater conditions of currently occupied[2] Southwestern Willow Flycatcher habitat between Parker and Imperial Dams. SWCA's contract specifies the following field tasks:

Presence/absence Surveys. At approximately 100 sites along the lower Colorado River, conduct presence/absence surveys, following a 5-survey protocol (per USFWS 2000).

Site Descriptions. Provide a general site description for each site, including major types of vegetation and hydrological conditions, at least three times during the survey period.

Nest Monitoring. Search for nests in all areas occupied by territorial flycatchers, and monitor all nests to determine nest fate, brood parasitism, and causes of nest failure.

Banding. Band as many adult and juvenile flycatchers as possible at sites with territorial flycatchers.

Vegetation, Soils, and Microclimate. Collect vegetation, soil, and microclimate data at the within-territory level at breeding locations in order to quantify conditions at flycatcher territories for replication at restoration areas.

Habitat Monitoring. At 15 previously identified sites, monitor vegetation, microclimate, and groundwater conditions to determine how these may be affected by water transfers.

[1] Studies in 1996 did not include any sites in Nevada.

[2] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year, 1996–2007.

Each distinct aspect of the 2008 study is addressed in a separate chapter in this report, as follows:

Chapter 2 – Presence/absence Surveys and Site Descriptions. This chapter presents the methodology and results for presence/absence surveys and gives a general site description for each survey site.

Chapter 3 – Color-banding and Resighting. Details of banding activities in 2008 and resighting of previously banded flycatchers are presented in this chapter. Also included are discussions of within- and between-year movement of individual flycatchers.

Chapter 4 – Nest Monitoring. This chapter summarizes nesting attempts, nest fates, and productivity for all Southwestern Willow Flycatcher nesting activity.

Chapter 5 – Vegetation Sampling. Vegetation sampling methods are described, and vegetation characteristics are summarized for territories in different habitat types. We also compare vegetation characteristics at nest sites when the nest was active vs. vegetation at the same location after the area had been abandoned by flycatchers.

Chapter 6 – Microclimate. The methodology of monitoring temperature, humidity, and soil moisture is described, and microclimate characteristics are summarized for flycatcher territories in different habitat types. We also compare microclimate characteristics at nest sites when the nest was active vs. microclimate at the same location after the area had been abandoned by flycatchers.

Chapter 7 – Habitat Monitoring. The methodology and results of monitoring microclimate, vegetation, and groundwater conditions at occupied sites between Parker and Imperial Dams are presented.

Chapter 2

PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS

INTRODUCTION

Broadcasts of recorded conspecific vocalizations are useful in eliciting responses from nearby willow flycatchers, and multiple broadcast surveys conducted throughout the breeding season are the standard technique for determining the presence or absence of ***E. t. extimus*** (Sogge et al. 1997). According to Sogge et al. (1997) and USFWS (2002), willow flycatchers detected between approximately 15 June and 20 July in the breeding range of ***E. t. extimus*** probably belong to the southwestern subspecies. However, because northbound individuals of all western subspecies of the willow flycatcher migrate through areas where ***E. t. extimus*** are actively nesting, and southbound migrants occur where ***E. t. extimus*** are still breeding (Sogge et al. 1997, USFWS 2002), field confirmation of the southwestern subspecies is problematic.[1] For example, the northwestern ***E. t. brewsteri***, far more numerous than ***E. t. extimus***, has been documented migrating north in southern California as late as 20 June (Garrett and Dunn 1981 as cited in Unitt 1987), and Phillips et al. (1964 as cited in Unitt 1987) documented ***E. t. brewsteri*** collected in southern Arizona on 23 June. An understanding of willow flycatcher migration ecology in combination with multiple broadcast surveys conducted throughout the breeding season is therefore needed to assess the presence and residency of Southwestern Willow Flycatchers.

Migration routes used by ***E. t. extimus*** are not well documented, though more is known of northbound migration in spring than the southbound migration in fall because flycatchers are more vocal in spring and can therefore be distinguished from other ***Empidonax*** species. During northbound migration, all subspecies of willow flycatchers use riparian habitats similar to breeding habitat along major river drainages in the Southwest such as the Rio Grande (Finch and Kelly 1999), Colorado River (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson unpubl. data). Although migrating willow flycatchers may favor young, native willow habitats (Yong and Finch 1997), migrants are also found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, even though not used for breeding, are likely important for both reproduction and survival. For most long-distance Neotropical migrant passerines, migration stopover habitats are needed to replenish energy reserves to continue northbound or southbound migration.

In 2008, we completed multiple broadcast surveys at sites in 16 study areas[2] along the lower Colorado River and its tributaries to detect both migrant and resident willow flycatchers (Figure 2.1).

Special Concern Species

The Yuma Clapper Rail (***Rallus longirostris yumanensis***) is listed as federally endangered by the USFWS, and the Yellow-billed Cuckoo (***Coccyzus americanus occidentalis***) is a candidate for federal listing. Both species occur along the lower Colorado River and its tributaries and are of concern to managing agencies. Nine additional avian species [California Black Rail (***Laterallus jamaicensis coturniculus***), Western Least Bittern (***Ixobrychus exilis***), Elf Owl (***Micrathene whitneyi***), Gila Woodpecker (***Melanerpes uropygialis***), Gilded Northern Flicker (***Colaptes auratus chrysoides***), Vermilion Flycatcher (***Pyrocephalus rubinus***),

[1] Throughout this document, the terms "flycatcher" and "willow flycatcher" refer to ***E. t. extimus*** when individuals are confirmed as residents. For individuals for which residency is undetermined, subspecies is unknown.

[2] Study areas consist of 1–20 survey sites that are grouped geographically (see Table 2.2).



Figure 2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2008. (Note, study area labels represent the approximate center of multiple sites within that region; see Table 2.2)

Arizona Bell's Vireo (*Vireo bellii arizonae*), Yellow Warbler (*Dendroica petechia*), and Summer Tanager (*Piranga rubra*)] are considered to be special-concern species under the LCR MSCP. The Yellow-breasted Chat (*Icteria virens*) is also considered a special concern species in California. We did not survey specifically for these species but recorded all incidental detections.

METHODS

Site Selection

Survey sites were selected based on locations surveyed during previous years of willow flycatcher studies on the lower Colorado River (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; McLeod et al. 2008a) and reconnaissance by helicopter, by boat, and on foot prior to the start of the 2008 survey period. Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (>50%) and standing water or saturated soil under or adjacent to the vegetation were considered the most suitable habitats for flycatchers. Early successional stands of young riparian vegetation >3 m in height in proximity to surface water or saturated soil were also considered suitable flycatcher habitat. Riparian vegetation contiguous with suitable habitat was often included as part of survey areas. Reclamation biologist Theresa Olson guided and approved site selection. For sites surveyed in previous years, we retained original site names.

In 2008 we implemented a biennial survey schedule at selected sites in study areas where resident flycatchers have not been documented in the last 10 years of surveys. Sites were selected for biennial surveys based on the absence of damp or wet soils within the site and/or the relative absence of dense vegetation that might provide suitable nesting habitat for flycatchers (Table 2.1). The survey schedule is subject to revision based on conditions observed during the 2008 survey season and in future years.

Table 2.1. Proposed Survey Schedule for Sites Where No Resident Flycatchers Have Been Detected since 1996

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
TOGO	Pulpit Rock	Tiny. Wet soil adjacent to river; upland edge dry.			X
	Picture Rock	Wet soil adjacent to river, interior dry.			X
	Blankenship Bend North	Stand of Goodding willow adjacent to marsh.	X		
	Blankenship Bend South	Mosaic of cattail, bulrush, willow. Areas with water under vegetation.	X		
	Havasu NE	Mature vegetation; most of interior of site is very dry, willows near lakeshore – need to evaluate soil conditions in area with willows. Annual survey unless evaluation reveals no suitable habitat.	X		
BIHO	Big Hole Slough	Marshy, new willows coming in.	X		
EHRE	Ehrenberg	Decent structure; needs more water.	X		

Table 2.1. Proposed Survey Schedule for Sites Where No Resident Flycatchers Have Been Detected since 1996 (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
CIBO	CVCA	New restoration area.	X		
	Cibola Nature Trail	Generally dry and sparse, restoration area. Habitat improvements taking place, may improve.	X		
	Cibola Island	Only surveyed in 2007, need to evaluate. Annual schedule, pending results of evaluation.	X		
	Cibola Site 2	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Cibola Site 1	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Hart Mine Marsh	Mostly tamarisk, with linear stretches of marsh vegetation. Dry soil under the tamarisk.			X
	Three Fingers Lake	Very dry and hot in interior, vegetation short.		X	
	Cibola Lake #1 (North)	Patchy vegetation, hot and dry in interior.		X	
	Cibola Lake #2 (East)	Patchy vegetation, hot and dry in interior.			X
	Cibola Lake #3 (West)	Patchy vegetation, hot and dry in interior.		X	
	Walker Lake	Large willows and water under vegetation along lake edge.	X		
IMPE	Draper Lake	Recovering from fire. Need to evaluate. Annual survey, pending results of evaluation.	X		
	Paradise	Some big willows with tamarisk understory, sometimes has water in marshes.	X		
	Hoge Ranch	Mosaic of tamarisk, willow, and marshes. Sometimes wet.	X		
	Adobe Lake	Perched above river, very dry, dense tamarisk with many dead branches in understory.		X	
	Rattlesnake	Dense willows, wet soils.	X		
	Norton South	Very small, old plantation. Sometimes contains water.			X
	Milemarker 65	Very narrow strip (<50m) of tamarisk adjacent to bulrush marsh. Understory of ***Phragmites*** creates extremely dense vegetation within 3 m of ground.			X
	Clear Lake/The Alley	Mature tamarisk, very dense understory. Very dry except immediately next to backwater channel.		X	
	Nursery NW	Dense tamarisk interspersed with marsh areas.	X		
	Imperial Nursery	Plantation. No understory.		X	
	Ferguson Lake	Mix of willow and tamarisk with water under vegetation on west side of site. East side is dry and scrubby.	X		

Table 2.1. Proposed Survey Schedule for Sites Where No Resident Flycatchers Have Been Detected since 1996 (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
IMPE	Ferguson Wash	Mature tamarisk with emergent willow. Very dry in interior of site. Borders backwater channel and Ferguson Lake. Need to determine whether there are any moist soils under the mature vegetation. Annual survey pending results of evaluation.	X		
	Great Blue Heron	Good structure, moist soils.	X		
	Powerline	Very small, stringer of trees around cattail marsh that sometimes contains water. Sparse canopy.			X
	Martinez Lake	Scattered willows, tamarisk and arrowweed understory, sparse canopy closure.			X
MITT	Mittry West	Willow overstory, tamarisk understory, 80% canopy closure, sometimes wet.	X		
	Mittry South	Monotypic tamarisk, lots of deadfall. Interior is dry. Adjacent to lake.		X	
YUMA	Gila Confluence North	Patchy. A few small stands of mature willows around cattail marshes. Marshes sometimes contain water. Half of site burned in 2006. Overall canopy closure 50%.		X	
	Gila River Site #1	Recovering from fire. Still very sparse.			X
	Gila River Site #2	Cottonwood/willow overstory, tamarisk and arrowweed understory, dry soils in interior, canopy closure 50%.			X
	Fortuna Site #1	Narrow (30m) strip of cottonwood/willow. Patchy understory of tamarisk and arrowweed on periphery, no understory within cottonwood/willow. Interior is dry.			X
	Fortuna North	Mature tamarisk, 80% canopy closure. Interior very dry. Adjacent to Gila River.			X
	Morelos Dam	Recovering from fire, canopy closure less than 50%, widely spaced willow and cottonwood, dense patch of tamarisk on northern end of site.			X

[1] TOGO = Topock Gorge, BIHO = Big Hole Slough, EHRE = Ehrenberg, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

We provided field personnel with high-resolution aerial photographs of all selected survey sites. The photographs were overlain with a UTM grid (NAD 83) and an outline of the proposed survey area. The boundaries of all survey sites were refined to include potential flycatcher habitat actually present. New boundaries were delineated on the aerial photographs based on UTM coordinates obtained in the field. All UTM coordinates were obtained using a Garmin Rino 110 GPS unit and were in NAD 83 to comply with Federal Geographic Data Committee standards.

Additional Site Evaluation

During the survey season, we conducted on-the-ground habitat reconnaissance and evaluation to locate additional potentially suitable willow flycatcher habitat and to reevaluate areas we had visited in previous years and had noted as potentially suitable. Field personnel were provided high-resolution aerial

photographs overlain with a UTM grid to aide with navigation and the identification of potentially suitable flycatcher habitat. We focused habitat reconnaissance and evaluation in areas that contained or were adjacent to standing water or saturated soils, and that had vegetation characteristics similar to that of flycatcher breeding sites (i.e., dense vegetation within 2–4 m of the ground and high canopy closure). Broadcast surveys were conducted opportunistically during ground reconnaissance. Field personnel formulated qualitative site descriptions of all evaluated areas.

Broadcast Surveys

To elicit responses from nearby willow flycatchers, we broadcast conspecific vocalizations previously recorded throughout the Southwest from 1996 to 1998. All flycatcher surveys were conducted according to methods described in Sogge et al. (1997), and we followed a 5-survey protocol, as recommended by the U.S. Fish and Wildlife Service (USFWS 2000). We completed at least one survey between 15 and 31 May, at least one survey between 1 and 15 June, and three additional surveys between 16 June and 25 July. Surveys were separated by a minimum of five days whenever logistically possible. Field personnel surveyed within the habitat wherever possible, using a portable CD or MP3 player (various models were used) coupled to a Radio Shack 277-1008C mini amplified speaker. Surveyors stopped every 30–40 m and broadcast willow flycatcher primary song (***fitz-bew***) and calls (***breets***). Field personnel watched for flycatchers and listened for vocal responses for approximately one to two minutes before proceeding to the next survey station. Wherever territorial flycatchers were detected, broadcast surveys were discontinued within a radius of 50 m of territories, and territory and nest monitoring commenced (see Chapter 4). If a willow flycatcher was observed but did not respond with song to the initial broadcast, we broadcast other conspecific vocalizations including ***creets/breets***, ***wee-oos***, ***whitts***, ***churr/kitters***, and a set of interaction calls given by a mated pair of flycatchers (per Lynn et al. 2003). These calls were frequently effective in eliciting a ***fitz-bew*** song, thereby enabling surveyors to positively identify willow flycatchers. To produce a spatial representation of all survey areas, field personnel recorded survey start and stop UTM coordinates as well as the UTM coordinates of intermediate survey points. Observers recorded start and stop times and the location(s) and behavior of all willow flycatchers detected (see survey form, Appendix A). Field personnel also recorded the presence of Brown-headed Cowbirds (hereafter cowbirds) and livestock, as requested by the Arizona Game and Fish Department. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity (see Chapter 4), while livestock may substantially alter the vegetation in an area (USFWS 2002).

Site Description

Because vegetation structure and hydrology within riparian habitats are seasonally dynamic, field personnel completed site description forms (Appendix A) for each survey site at least three times throughout the survey season: early season (mid-May), mid-season (mid-June), and late season (mid-July). Vegetation composition (native vs. exotic) at survey sites followed the definitions of Sogge et al. (1997) and the Southwestern Willow Flycatcher Range-wide Database. Vegetation composition was defined as (1) native: >90% of the vegetation at a site was native; (2) exotic: >90% of the vegetation at a site was exotic/introduced; (3) mixed-native: 50 to 90% of the vegetation at a site was native; or (4) mixed-exotic: 50 to 90% of the vegetation at a site was exotic/introduced. Information from site description forms was used in conjunction with habitat photographs and comments in field notebooks and on survey forms to formulate qualitative site descriptions.

RESULTS

Field personnel spent 680.7 observer-hours conducting willow flycatcher broadcast surveys at 77 sites along the Virgin and lower Colorado Rivers and tributaries.[3] Willow flycatcher survey results are summarized in Table 2.2 and are presented below along with site descriptions. The boundaries of survey sites and occupancy in 2008 are shown on orthophotos in Appendix B, along with historically occupied habitat.[4] Each site that was not occupied by territorial flycatchers was formally surveyed between four and six times. Field personnel spent an additional 53.9 observer-hours completing habitat reconnaissance and evaluation and opportunistic surveys. The results of reconnaissance for each study area are presented below following the results for the regularly surveyed sites. Because subspecies identification of willow flycatchers detected between approximately 15 June and 20 July in the breeding range of ***E. t. extimus*** is problematic (Sogge et al. 1997, USFWS 2002), flycatcher detections after 15 June at sites where breeding or residency was not confirmed are summarized in Table 2.3. Yellow-billed Cuckoo and Yuma Clapper Rail detections are listed in Tables 2.4 and 2.5, respectively, and overall numbers of detections of all special concern species are listed in Appendix C. Hydrologic characteristics of each site are summarized in Table 2.6.

Table 2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2008*

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
PAHR	North	4.6	26 (14 May–12 Aug)
	West	1.5	ND
	MAPS	2.7	ND
	South	2.5	ND
LIFI	Poles	2.6	1 (22 Jul)
MESQ	East	4.4	1 (22 Jul)
	West	11.5	25 (10 May–12 Aug)
	Electric Avenue North[4]	1.8	ND
	Electric Avenue South[4]	3.9	ND
	Bunker Farm	1.9	1 (5 Jun)
MOME	Mormon Mesa North	8.2	ND
	Hedgerow	1.1	ND
	Mormon Mesa South	19.9	2 (12 Jun)
	Virgin River #1	41.4	21 (12 May–5 Aug)
	Virgin River #2	36.9	7 (12 May–2 Aug)
MUDD	Overton WMA Pond	0.7	1 (10 Jun)
	Overton WMA	14.9	10 (11 May–11 Aug)

[3] We started the survey season with 76 sites scheduled for surveys in 2008. We discontinued surveys at three sites because of poor habitat quality and added one site mid-season as the result of habitat reconnaissance.

[4] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June.

Table 2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2008* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
GRCA	Burnt Springs	11.0	ND
	RM 274.5N	18.3	ND
	RM 285.3N	8.6	ND
	Iceberg Canyon	3.1	1 (5–19 Jun)
TOPO	Pipes #1	5.2	ND
	Pipes #3	5.7	2 (14 May–29 Jul)
	The Wallows	0.4	1 (17 Jun)
	PC6-1	4.8	ND
	Pig Hole	2.4	ND
	In Between	7.7	1 (27 May–8 Jun)
	800M	6.1	ND
	Pierced Egg	6.7	12 (8 May–14 Jul)
	Swine Paradise	2.4	ND
	Barbed Wire	2.6	ND
	IRFB03	1.0	ND
	IRFB04	1.5	1 (27 May)
	Platform	1.3	ND
	250M	2.3	1 (18 Jun)
	Hell Bird	3.7	ND
	Glory Hole	5.0	8 (8 May–29 Jul)
	Beal Lake	13.9	2 (5 Jun), 1 (11 Jun)
	Lost Slough	1.5	ND
	Lost Pond	1.2	ND
	Lost Lake	3.3	ND
TOGO	Blankenship Bend North	26.7	ND
	Blankenship Bend South	25.9	ND
	Havasu NE	12.6	ND
BIWI	Site #2	3.1	ND
	Site #11	6.3	ND
	Site #4	9.9	1 (29–30 Jun)
	Site #3	9.5	7 (11 May–26 Jul)
	Site #5	9.0	ND
	Mineral Wash Complex	18.8	ND
	Beaver Pond	21.7	ND
	Site #8	10.3	ND
AHAK	Willow Beach[5]	2.0	ND
	Deer Island	91.6	2 (21 May–6 Jun)

Table 2.2. Willow Flycatcher Detections at Survey Sites along the Virgin and Colorado Rivers and Tributaries, 2008* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
BIHO	Big Hole Slough	16.6	1 (9 Jun)
EHRE	Ehrenberg	4.7	ND
CIBO	CVCA	26.2	2 (18 Jun)
	Cibola Nature Trail	13.7	1 (6 Jun)
	Cibola Island	4.2	1 (15 May), 2 (6 Jun), 2 (18 Jun)
	Three Fingers Lake	67.9	1 (18 May), 2 (7 Jun), 4 (19 Jun)
	Cibola Lake #1 (North)	8.5	1 (8 Jun), 1 (18 Jun)
	Cibola Lake #3 (West)	6.8	1 (20 May), 2 (9 Jun), 2 (18 Jun)
	Walker Lake	11.4	2 (7 Jun)
IMPE	Draper Lake[4]	4.6	1 (27 May)
	Paradise	7.8	2 (27 May)
	Hoge Ranch	20.7	2 (31 May), 4 (13 Jun), 1 (22 Jun)
	Adobe Lake	7.6	10 (31 May), 2 (15 Jun)
	Rattlesnake	7.6	3 (30 May), 1 (13 Jun)
	Clear Lake/The Alley	8.3	6 (1 June)
	Nursery NW	7.0	ND
	Imperial Nursery	1.4	ND
	Ferguson Lake	21.1	12 (29 May)
	Ferguson Wash	6.8	2 (29 May)
	Great Blue Heron	7.1	2 (23 May), 1 (14 Jun)
MITT	Mittry West	4.4	2 (28 May)
	Mittry South	15.2	2 (28 May)
YUMA	Gila Confluence North	2.2	5 (2 Jun), 5 (16 Jun), 2 (21 Jun)

* This table includes only sites where regular surveys were scheduled and does not include sites where habitat reconnaissance and opportunistic surveys were conducted.

[1] PAHR = Pahranagat National Wildlife Refuge, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River , GRCA = Grand Canyon, TOPO = Topock Marsh, TOGO = Topock Gorge, BIWI = Bill Williams River NWR, AHAK = Ahakhav Tribal Preserve, BIHO = Big Hole Slough, EHRE = Ehrenberg, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Surveys discontinued because of poor quality habitat.

[5] Surveys started 18 June.

Table 2.3. Detections of Willow Flycatchers Recorded after 15 June 2008 at Sites Where Breeding or Residency Was Not Confirmed

Study Area[1]	Site	Date	Comments
LIFI	Poles	22 Jul	Lone flycatcher responded vigorously to broadcast with primary song ***(fitz-bew)*** and ***wheeos***
MESQ	East	22 Jul	Lone flycatcher responded briefly to broadcast with primary song ***(fitz-bew)***
TOPO	The Wallows	17 Jun	Lone flycatcher, gave primary song (***fitz-bew***) spontaneously after survey was finished
	250M	18 Jun	Lone flycatcher responded briefly to broadcast with primary song (***fitz-bew***)
BIWI	Site #4	29–30 Jun	Flycatcher singing spontaneously
CIBO	CVCA	18 Jun	Two flycatchers. One responded briefly to broadcast with primary song ***(fitz-bew)*** and ***wheeos***; the other gave primary song spontaneously
	Cibola Island	18 Jun	Two flycatchers responded briefly to playback with primary song ***(fitz-bew)***
	Three Fingers Lake	19 Jun	Four flycatchers. Three responded to playback with primary song ***(fitz-bew)***, one gave primary song spontaneously
	Cibola Lake North	18 Jun	Lone flycatcher responded briefly to broadcast with primary song (***fitz-bew***)
	Cibola Lake West	18 Jun	Two flycatchers responded to broadcast with primary song ***(fitz-bew***) and ***brrr-kitters***
IMPE	Hoge Ranch	22 Jun	Lone flycatcher responded to broadcast with primary song ***(fitz-bew***)
YUMA	Gila Confluence North	16 Jun	Five flycatchers responded to broadcast with primary song ***(fitz-bew***)
		21 Jun	Two flycatchers responded to broadcast with primary song ***(fitz-bew***)

[1] LIFI = Littlefield, MESQ = Mesquite, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, CIBO = Cibola NWR, IMPE = Imperial NWR, YUMA = Yuma.

Table 2.4. Yellow-Billed Cuckoo Detections along the Virgin, Bill Williams, and Lower Colorado Rivers, 2008*

Study Area[1]	Site	Date	Behavioral Observations
KEPI	Key Pittman	26 Jun	One individual observed visually
PAHR	North	13 Jun	One individual observed visually
MOME	Virgin River #1 North	9 Jul	One individual seen and heard calling in northwestern corner of site
TOPO	Beal Lake	21 Jun	One individual observed visually
BIWI	Site #5	7 Jul	No notes taken
	Site #8	8 Jul	No notes taken
CIBO	Cibola Lake North	18 Jul	Individual heard calling

* Unless otherwise stated, number of individual cuckoos was undetermined.

[1] KEPI = Key=Pittman, PAHR = Pahranagat NWR, MOME = Mormon Mesa, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, CIBO = Cibola NWR.

Table 2.5. Yuma Clapper Rail Detections along the Bill Williams and Lower Colorado Rivers, 2008

Study Area[1]	Site	Date(s)	Behavioral Observations
TOPO	Swine Paradise	3 Jun	One individual heard calling
	IRFB03	12 May	One individual heard calling
	Platform	5 July	One individual heard calling
	Lost Lake	14 May	One individual heard calling
BIWI	Site #2	15 May	Two detections recorded, no notes taken
CIBO	Three Fingers Lake	18 May	One individual heard calling
		3 Jul	One individual heard calling
	Cibola Lake North	19 May	One individual heard calling
	Walker Lake	18 May	One individual heard calling
IMPE	Draper Lake	27 May	Pair heard calling
	Nursery NW	1 Jun	Four detections recorded, no notes taken
		14 Jun	One detection recorded, no notes taken
	Imperial Nursery	1 Jun	One individual heard calling
	Ferguson Lake	15 Jul	One detection recorded, no notes taken
MITT	Mittry South	28 Jun	One individual heard calling

TOPO = Topock Marsh, BIWI = Bill Williams River NWR, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake.

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2008*

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PAHR	North	8/5/0	5/10/0	20/10/0	0/0/0
	West	0/0/0	0/0/0	0/0/0	20/20/250
	MAPS	0/0/0	0/0/0	0/0/0	30/30/70
	South	10/10/10	25/25/10	0/0/0	0/0/0
LIFI	Poles[4]	10/10/10	20/20/20	10/10/10	0/0/0
MESQ	East[4]	1/1/1	35/5/--	0/0/1	0/0/0
	West[5]	65/35/65	25/25/15	10/10/20	0/0/0
	Bunker Farm	0/0/0	0/0/0	0/0/0	50/50/50
MOME	Mormon Mesa North[4]	0/0/0	0/0/0	0/0/0	0/0/200
	Hedgerow	0/0/0	0/0/0	0/0/0	100/100/100
	Mormon Mesa South[4]	0/0/0	0/0/0	1/0/0	--/10/10
	Virgin River #1[4]	10/10/0	10/10/0	5/5/0	0/0/2
	Virgin River #2[4]	0/0/0	0/0/0	0/0/0	10/10/650
MUDD	Overton WMA Pond	5/5/5	25/5/10	3/3/5	0/0//0
	Overton WMA	30/25/35	50/30/30[6]	1/10/10	0/0/0

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2008* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
GRCA	Burnt Springs[4]	10/10/0	10/10/0	5/10/0	0/0/15
	RM 274.5N[4]	70/70/60	30/30/30	10/10/15	0/0/0
	RM 285.3N[4]	0/0/0	0/0/0	10/15/3	0/0/0
	Iceberg Canyon[4]	--/10/5	--/10/--	--/20/30	--/0/0
TOPO	Pipes #1	0/0/0	0/0/0	0/0/0	50/50/50
	Pipes #3	80/10/1[7]	10/10/25	10/20/5	0/0/0
	The Wallows	40/10/10	25/3/10	15/10/10	0/0/0
	PC6-1	80/30/10	10/3/3	5/20/40	0/0/0
	Pig Hole	25/25/0	10/3/0	50/30/5	0/0/0
	In Between	10/5/5	3/3/5	5/10/5	0/0/0
	800M	35/3/0	10/10/0	15/20/0	0/0/55
	Pierced Egg	20/15/2[7]	10/10/10	15/50/3	0/0/0
	Swine Paradise[8]	10/10/10	25/25/25	2/0/3	0/0/0
	Barbed Wire	1[7]/0/0	10/0/0	5/0/0	0/100/100
	IRFB03	0/0/0	0/0/0	0/0/0	150/150/150
	IRFB04	0/0/0	0/0/0	0/0/0	75/75/75
	Platform[8]	--/--/--	--/--/--	--/--/--	0/0/0
	250M[8]	0/3/5	0/10/5	10/10/5	0/0/0
	Hell Bird	55/55/60	50/50/25	10/10/10	0/0/0
	Glory Hole	35/40/15	70/25/70	5/15/2	0/0/0
	Beal Lake[9]	0/0/0	0/0/0	0/0/0	10/100/100
	Lost Slough	30/3/10	25/3/10	10/3/10	0/0/0
	Lost Pond[4]	40/40/30	>100/>100/>100	5/3/5	0/0/0
	Lost Lake[8]	10/5/0	10/25/0	20/3/0	0/0/0
TOGO	Blankenship Bend North[4]	20/15/15	100/100/30	3/3/10	0/0/0
	Blankenship Bend South[4]	60/60/25	50/50/30	20/20/15	0/0/0
	Havasu NE[4]	0/0/0	0/0/0	0/0/0	0/0/0
BIWI	Site #2[4]	0/2/0	0/10/0	0/0/0	0/0/0
	Site #11[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Site #4[4]	15/3/3	10/25/25	20/3/3	0/0/0
	Site #3[4]	30/3/3	10/25/3	10/8/3	0/0/0
	Site #5	--/3/3	--/>100/>100	--/3/3	0/0/0
	Mineral Wash Complex[4]	30/10/10	25/25/25	15/13/0	0/0/0
	Beaver Pond[4]	30/10/20	25/25/25	10/10/5	0/0/0
	Site #8[4]	10/10/15	25/50/30	0/5/3	0/0/0

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site along the Virgin and Lower Colorado Rivers and Tributaries, 2008* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
AHAK	Willow Beach[4]	--/--/1	--/--/10	--/--/0	0/0/0
	Deer Island[4]	60/60/60	>100/>100/>100	10/10/10	0/0/0
BIHO	Big Hole Slough	40/30/25	30/10/50	15/10/20	0/0/0
EHRE	Ehrenberg	--/0/5	3/0/3	5/10/10	0/--/0
CIBO	CVCA[9]	10/1/5	10/3/3	50/0/20	0/0/0
	Cibola Nature Trail[9]	65/0/0	10/0/0	15/0/5	0/0/0
	Cibola Island	0/50/50	0/40/50	--/1/10	--/0/0
	Three Fingers Lake[4]	20/20/20	>100/>100/>100	5/5/5	0/0/0
	Cibola Lake #1 (North)[4]	3/3/3	10/3/10	0/0/0	0/0/0
	Cibola Lake #3 (West)[4]	3/3/3	3/3/3	3/3/3	0/0/0
	Walker Lake[4]	3/0/0	10/0/0	5/1/2	0/0/0
IMPE	Draper Lake[8]	0/--/--	0/--/--	0/--/--	0/0/0
	Paradise[4]	--/10/5	10/10/--	--/10/5	0/0/0
	Hoge Ranch[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Adobe Lake[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Rattlesnake[8]	5/5/5	3/3/10	80/10/20	0/0/0
	Clear Lake/The Alley[4]	2/2/2	50/50/50	0/2/2	0/0/0
	Nursery NW[7]	3/0/0	--/0/0	5/5/5	0/0/0
	Imperial Nursery[9]	0/0/40	0/0/0	0/20/20	30/0/0
	Ferguson Lake[4]	3/3/10	25/3/10	0/1/10	0/0/0
	Ferguson Wash[4]	1/1/5	--/3/3	5/0/10	0/0/0
	Great Blue Heron[4]	5/0/0	3/0/0	10/10/5	0/0/0
MITT	Mittry West	20/15/0	3/3/0	55/40/30	0/0/0
	Mittry South[4]	0/0/0	0/0/0	0/0/0	0/0/0
YUMA	Gila Confluence North[4]	1/1/5	3/3/3	10/5/20	0/0/0

* Values are given for each site as recorded in mid-May, mid-June, and mid-July.

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite West, MOME = Mormon Mesa, MUDD = Muddy River, GRCA = Grand Canyon, TOPO = Topock Marsh, TOGO = Topock Gorge, AHAK = Ahakhav Tribal Preserve, BIWI = Bill Williams River NWR, BIHO = Big Hole Slough, EHRE = Ehrenberg, CIBO = Cibola NWR, IMPE = Imperial NWR, MITT = Mittry Lake, YUMA = Yuma.

[2] -- = Hydrologic information not recorded.

[3] Percent of site with saturated soil does not include inundated areas.

[4] Site bordered by a river, lake, or pond.

[5] The amount of surface water present within the site varies daily and throughout the survey season; hydrology at the site is influenced by irrigation runoff from two golf courses immediately adjacent to the site.

[6] The deepest water occurred within a channel of the Muddy River that runs through the center of the site.

[7] Saturated soil or water was present in pig wallows.

[8] Site borders marsh.

[9] Site is irrigated as part of restoration efforts; amount of standing water highly variable throughout survey season.

Pahranagat National Wildlife Refuge, Nevada

Pahranagat National Wildlife Refuge consists of a series of lakes and marshes in Pahranagat Valley approximately 150 km north of Las Vegas, Nevada. Patches of primarily native vegetation exist at the

inflow and outflow of Upper Pahranagat Lake. Prior to the 2008 survey season, the majority of the riparian vegetation along the north side of the upper lake (Pahranagat North) was inundated annually with up to 1 m of water, with the highest water levels occurring in May. Major structural problems with the levee that impounds the upper lake resulted in the upper lake being drained in early 2008, and the riparian vegetation at the north end of the lake was not flooded during the 2008 breeding season as it had been in previous years.

Pahranagat North

Area: 4.6 ha Elevation: 1,026 m

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*; hereafter cottonwood) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lakebed. Canopy height within the patch is 15–18 m, and canopy closure is approximately 70%. During the survey season, standing water and saturated soils were present only in an inflow channel that runs along the northern side of the site and drains into the lakebed at the southeastern corner of the site. The water channel is vegetated with bulrush (*Schoenoplectus californicus*) where it enters the lakebed. Saturated soils were also present within patches of bulrush that border the southern edges of the site.

We detected 16 breeding willow flycatchers, as well as 8 resident, unpaired males. In addition to resident adults, we detected two individuals for which residency and/or breeding status could not be confirmed. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. Areas of Pahranagat North not known to be occupied by willow flycatchers were surveyed five times, totaling 6.9 observer-hours. The site lies immediately adjacent to a cattle pasture, but livestock have access only to the cottonwood stringer on the northwestern corner of the lake, which is separated from the survey site by a fence. Individual cows made incursions into the site on two known occasions but were removed within 24 hours. Cowbirds were detected during one survey.

Pahranagat West

Area: 1.5 ha Elevation: 1,026 m

This native site consists of a stringer of cottonwood, one to three trees wide and 20 m in height, on the western edge of Upper Pahranagat Lake. A few Goodding willow 2–4 m in height are also present, but the site has no significant understory vegetation. The eastern edge of the site is vegetated with bulrush, which extends into the lakebed to the east. During the survey season, the upland edge of the site was dry, while the bulrush along the lakebed edge had saturated soils until mid-June.

We detected no willow flycatchers. We surveyed the site five times, totaling 2.8 observer-hours. Cowbirds were detected on one survey, and there was no sign of livestock use.

Pahranagat MAPS

Area: 2.7 ha Elevation: 1,026 m

Pahranagat MAPS is a stringer of cottonwood on the western edge of the bed of Upper Pahranagat Lake. Canopy height is 15–20 m, and canopy closure is approximately 60%. There is no woody vegetation in the understory, and cattail (*Typha* sp.) and bulrush line the eastern edge of the tree line. The site was dry

throughout the survey season, with the nearest water or saturated soil being at least 25 m away in the lakebed.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.8 observer-hours. No cowbirds were detected and there was no evidence of livestock use.

Pahranagat South

Area: 2.5 ha Elevation: 1,023 m

Pahranagat South consists of a relatively small stringer of Goodding willow, coyote willow (*Salix exigua*), and cottonwood lining a human-made channel that carries the outflow from Upper Pahranagat Lake. The cottonwoods reach approximately 20 m in height, while the willows are generally less than 10 m. In 2005, we noted that dense coyote willow was increasing on the western side of the patch; this area of willow had very sparse canopy in 2006 and 2007, and the coyote willow was almost completely dead in 2008. The site is bordered to the west by an open marsh and to the east by upland scrub. Tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*) form a sparse understory. Overall canopy closure at this site is approximately 50%. The channel held varying amounts of water throughout the survey season.

We did not detect any willow flycatchers. We surveyed the site seven times, totaling 4.0 observer-hours. Cowbirds were detected during one survey, and no sign of livestock was observed.

Littlefield, Arizona

In 2007, our survey and monitoring activities focused on an area along Beaver Dam Wash immediately upstream of the Highway 91 Bridge. We expanded the survey area in 2008 to include young Goodding and coyote willow stringers downstream of the bridge.

Littlefield Poles

Area: 2.6 ha Elevation: 565 m

Littlefield Poles consists of two relatively small patches of mixed-native vegetation located on Beaver Dam Wash, immediately upstream and downstream of the Highway 91 Bridge. Vegetation upstream of the bridge consists of a scattered overstory of cottonwood averaging 25 m in height. Cottonwood and Goodding willow averaging 10 m in height are present below the overstory but do not form a continuous canopy. Lower strata vegetation approximately 6 m in height consists of coyote willow, tamarisk, and some Russian olive. Cattail is present along the southern edge of the patch, and the vegetation is bordered to the south by a stream. Downstream of the bridge, young stringers of Goodding and coyote willow reach 5 m in height and form linear patches 10–15 m wide on the edges of multiple stream channels. Larger Goodding willow is present on the edge of the golf course that borders the southwestern edge of the site. Canopy closure in the densest areas of Goodding and coyote willow is >90%, though overall canopy closure ranges from 50 to 70%. Surface water was present in stream channels throughout the survey season.

We detected one willow flycatcher for which residency could not be confirmed. Three subsequent territory monitoring visits failed to detect the flycatcher again. Details of occupancy and color-banding are presented in Chapter 3. We surveyed Littlefield Poles five times, totaling 5.5 observer-hours. Cowbirds were detected on all surveys. Cattle were observed in the site on two occasions, and cattle scat and trails were observed on all visits.

Mesquite, Nevada

The Mesquite study area is in the floodplain of the Virgin River near Mesquite and Bunkerville, Nevada. The entire area experience flooding, and some areas were scoured, during the 2004–2005 winter floods.

Mesquite East

Area: 4.4 ha Elevation: 468 m

This mixed-native site lies on several terraces within the floodplain of the Virgin River in Mesquite, Nevada. Vegetation on the lowest terrace, on the northern edge of the site adjacent to the river, consists of cottonwood and Goodding willow generally less than 10 m in height. The central portion of the site lies on a slightly higher terrace and is vegetated entirely by dense tamarisk 7–8 m in height with canopy closure around 80%. The uppermost terrace is vegetated with Goodding willow and a few cottonwood 18–25 m in height and an understory of dense clumps of coyote willow about 8 m in height. Canopy closure on this terrace varies from 50% in the cottonwood/Goodding willow areas to over 90% in the coyote willow clumps. The western half of the upper terrace burned over the 2004–2005 winter and has grown back with thick stands of coyote willow and cottonwood. A small drainage pond at the end of an irrigation ditch held standing water throughout the survey season.

We detected one willow flycatcher. Three subsequent territory monitoring visits failed to detect the flycatcher again. Details of occupancy and color-banding information are presented in Chapter 3. We surveyed Mesquite East five times throughout the flycatcher breeding season, totaling 8.8 observer-hours. Cowbirds were detected on all but one survey, and cattle trails and scat were observed on all surveys.

Mesquite West

Area: 11.5 ha Elevation: 470 m

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Golf courses and housing developments border the site to the north, and the Virgin River borders the site to the south. This large site is primarily a mosaic of cattail and bulrush marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The coyote willows are generally 5 m in height, and canopy closure varies from 50 to >90%. Hydrology at the site is influenced by irrigation runoff from the two adjacent golf courses, and the amount of surface water present under the vegetation varied daily and throughout the season. The site contained standing water and muddy soils throughout the survey season, and the irrigation runoff supports much of the vegetation within the site.

We detected 21 breeding willow flycatchers and 3 resident, unpaired males. In addition to resident adults, we detected three individuals for which residency and/or breeding status could not be determined. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. Areas of Mesquite West not known to be occupied by flycatchers were surveyed five times throughout the flycatcher breeding season, totaling 23.2 observer-hours. Cowbirds were detected on all but one survey. Evidence of livestock was observed on the last three surveys, and cattle were observed on the banks of the Virgin River immediately adjacent to the southern edge of the site. Cattle were observed within the site on at least one territory monitoring visit.

Electric Avenue North

Area: 1.8 ha Elevation: 460 m

This mixed-exotic site lies adjacent to an agricultural field within the floodplain of the Virgin River in Bunkerville, Nevada. During the summer of 2007, an area running northwest to southeast was bulldozed through the center of the site, removing approximately 20% of the vegetation present in previous years and creating a drainage ditch. Vegetation at the site consists of an overstory of cottonwood, Goodding willow, and tall coyote willow averaging 10 m in height. Shorter coyote willow and tamarisk averaging 8 m in height make up the understory. Most of the willows are dead, and the cottonwoods have sparse leaves, creating canopy closure less than 50%. A cattail marsh on the northwestern edge of the site is lined with narrow (<5 m wide) stringers of young coyote willow. The vegetation around the marsh is not currently mature or extensive enough to provide flycatcher habitat but should be evaluated in future years. The marsh held surface water in May.

We did not detect any flycatchers at this site. We surveyed the site one time, totaling 1.5 observer-hours. Cowbirds were detected, and evidence of livestock use was observed. Surveys were discontinued because most of the vegetation at the site is dead.

Electric Avenue South

Area: 3.9 ha Elevation: 460 m

This mixed-exotic site lies adjacent to an agricultural field within the floodplain of the Virgin River in Bunkerville, Nevada. Vegetation at the site consists of a scattered overstory of cottonwood and Goodding willow averaging 12 m in height with a predominantly tamarisk understory. Some coyote willow is scattered throughout the site, and arrowweed (*Pluchea sericea*) and mesquite (*Prosopis* sp.) trees mix with the tamarisk in some areas. A cluster of cottonwood is located at the northern end of the site. The cottonwoods have sparse leaves, many of the willows are dead, and approximately 50% of the tamarisk understory is dead. Canopy closure is less than 50%. The interior of the site was dry in May, though water was present in a marshy area along the southeastern edge of the site. A high embankment prevents water in the marsh from flowing into the site.

We did not detect any flycatchers at this site. We surveyed the site one time, totaling 1.6 observer-hours. Cowbirds were detected, but no evidence of livestock use was observed. Surveys were discontinued because most of the vegetation at the site is dead.

Bunker Farm

Area: 1.9 ha Elevation: 457 m

This exotic site lies within the floodplain of the Virgin River in Bunkerville, Nevada, approximately 3 km downstream of Mesquite West. The site is between an agricultural field to the southeast and the Virgin River to the northwest. Most of the southwestern third of the site was bulldozed prior to the start of surveys in 2008. Vegetation at the site consists of tamarisk 4–7 m in height and of varying density, with canopy closure not exceeding 60%. Many of the emergent Goodding willow are dead or dying. The coyote willow that had formed dense stands within the site in previous years was completely dead in 2008. The site was dry throughout the survey season. This is the fourth consecutive year that the agricultural field adjacent to the site was fallow, and the site did not receive agricultural runoff.

We detected one willow flycatcher for which residency could not be confirmed. Three territory monitoring visits as well as three subsequent surveys failed to detect the flycatcher again. Details of occupancy and color-banding are presented in Chapter 3. Although initial visits to the site revealed that the vegetation is no longer suitable for resident flycatchers, we visited the site regularly as part of our microclimate studies (see Chapter 6) and continued to survey the site. We surveyed the site five times, totaling 8.0 observer-hours. Cowbirds were detected only on the first survey. Evidence of livestock use was observed on all visits.

Mormon Mesa, Nevada

For approximately 15 km upstream of its outflow to Lake Mead, the Virgin River flows through a 1-km-wide floodplain with a mosaic of habitats, including cattail marshes and tamarisk and willow forest. Much of the area is typically seasonally inundated from snowmelt in the spring and monsoon rains in mid and late summer, and the entire study area experienced severe flooding over the 2004–2005 winter. All the areas surveyed at Mormon Mesa are at least 10 km upstream of Lake Mead, though we did complete habitat reconnaissance along the Virgin River near its mouth at the Overton Arm of Lake Mead.

Mormon Mesa North

Area: 8.2 ha Elevation: 390 m

This mixed-exotic site consists primarily of tamarisk 3–5 m in height with areas of emergent Goodding willow. Overall canopy closure is around 50%. The willows in the central and eastern portions of the site are primarily dead, while the northern end of the site has clumps of live Goodding willow 10–12 m in height with a 3-m tamarisk understory. The western edge of the site has a 100 x 50 m patch of Goodding willow, 8 m in height, with up to 75% canopy closure and dead cattails in the understory. The center of the site consists of dead coyote willow and was not surveyed. No standing water or saturated soils were present within the site during the survey season. Surface water was adjacent to the site throughout the survey season in a marsh to the west and in the river channel to the south. The site is perched up to 2 m above the water level.

We did not detect any flycatchers. We surveyed the site six times, totaling 18.2 observer-hours. Cowbirds were detected on all surveys as was evidence of livestock use. Cattle were observed in or adjacent to the site on at least four occasions.

Hedgerow

Area: 1.1 ha Elevation: 390 m

This mixed-exotic site is east of Mormon Mesa North, on the eastern side of the Virgin River. The site consists of a continuous understory of tamarisk 4–5 m in height with scattered emergent Goodding willow up to 12 m in height. The site is surrounded by tamarisk and arrowweed 2–3 m in height. Canopy closure at the site varies from about 50% on the edges of the site up to 80% in the denser areas. Soils within the site were dry throughout the survey season.

We did not detect any flycatchers. We surveyed the site five times, totaling 3.9 observer-hours. Cowbirds were not observed, but evidence of cattle was observed on each visit.

Mormon Mesa South

North half: Area: 12.9 ha Elevation: 385 m
South half: Area: 7.0 ha Elevation: 385 m

This mixed-exotic site was split into two contiguous areas to facilitate tracking of survey activity. Mormon Mesa South consists of a mosaic of tamarisk 4 m in height and patches of Goodding willow up to 12 m in height. A long stringer of willow runs north to south through the site. Canopy height of the willows is up to 12 m. Canopy closure varies throughout the site, averaging around 70%. There was no surface water within the site, but damp soils were noted in May and June.

We detected two willow flycatchers. Subsequent visits, including three territory monitoring visits, yielded no further detections. Details of banding and occupancy are presented in Chapter 3. We surveyed the northern half of the site five times, totaling 23.3 hours. The southern half was also surveyed five times, for a total of 18.3 observer-hours. Cowbirds were detected on all but one survey. Evidence of livestock was documented on all visits, and cattle were observed in the site on several occasions.

Virgin River #1

North half: Area: 16.5 ha Elevation: 380 m
South half: Area: 24.9 ha Elevation: 380 m

Virgin River #1 was also divided into two areas, Virgin River #1 North and Virgin River #1 South, to facilitate streamlining of field logistics. Virgin River #1 North is primarily tamarisk 4–5 m in height with areas of emergent Goodding willow and patches of coyote willow. Canopy closure throughout the site is 50–70%. The emergent willows in the northeastern portion of the site, which supported breeding flycatchers in 2003 and 2004, are now completely dead and many have fallen. The soil in most of the site is sandy, though during the surveys the center of the site had areas of damp, slippery clay, and standing water was present on cattle trails early in the season. The southwestern corner of the site also contained surface water in May and June.

We detected one breeding pair of willow flycatchers in the southwestern corner of Virgin River #1 North. Details of occupancy, color-banding, and breeding are presented in Chapters 3 and 4. Areas of this site not known to be occupied by flycatchers were surveyed five times, totaling 37.3 observer-hours. Cowbirds were detected on all but one survey. Evidence of livestock and/or live cattle were observed on all visits.

Virgin River #1 South is primarily dense tamarisk approximately 4–5 m in height. The northwestern portion of the site is a marsh, where coyote and Goodding willows are interspersed with the tamarisk. Goodding and coyote willows in the site average 8 and 5 m in height, respectively. The southern third of the site consists of dense tamarisk with a few emergent Goodding willows, while the middle third of the site consists of sparser tamarisk with dry, open areas. Canopy closure in vegetated areas is approximately 90%. Standing water was present through June both in the marsh and in a stream channel in the southern third of the site.

We detected 15 breeding willow flycatchers and 3 unpaired, resident males in the northwestern portion of Virgin River #1 South. One additional willow flycatcher was detected for which residency could not be confirmed. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Areas of the site not known to be occupied by willow flycatchers were surveyed five times, totaling 38.8 observer-hours. Cowbirds were observed on all but one survey as were cattle and/or evidence of cattle.

Virgin River #2

Area: 36.9 ha Elevation: 380 m

This site is primarily a monotypic stand of tamarisk 6 m in height with 70–90% canopy closure. Patches of emergent Goodding willow up to 10 m in height are also present. Most of the willows occur in a clump halfway down the eastern edge of the site, with widely scattered willows extending to the southern end of the site. The site contained no surface water during the breeding season, though about 10% of the site contained damp soils. The Virgin River, about 10 m from the eastern edge of the site, had surface water in May and June.

We detected five breeding willow flycatchers and one unpaired, resident male. We also detected one individual for which residency was not confirmed. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 35.3 observer-hours. Cowbirds were observed on all surveys as were live cattle and/or evidence of cattle.

Ground Reconnaissance Results

"STILLWATER FLAT"

We explored this mixed-exotic area, northwest of Mormon Mesa North, because emergent willows were visible from the bluff overlooking the floodplain. The area is primarily sparse tamarisk 4 m in height with a few emergent Goodding willow up to 10 m in height. The southeastern corner of the site contains a few willows 3 m in height and dense tamarisk. Overall canopy closure is <50%, and soils throughout the site were very dry. Because vegetation was generally sparse and soils were dry, this area does not represent suitable flycatcher habitat and we do not recommend surveying it in future years.

No willow flycatchers were observed. The site was surveyed once, totaling 11.5 observer-hours. No cowbirds were detected, but evidence of livestock use was observed.

"RIVER MILE 30"

This mixed-exotic area is along the Virgin River approximately 5 km upstream of the confluence of the Virgin River and the Overton Arm of Lake Mead (Figure 2.2). We had not noted this area during helicopter reconnaissance, but aerial photographs taken after the 2004–2005 winter flood showed side channels bisecting dense vegetation. The area consists of tamarisk 3 m in height and arrowweed 2 m in height, and canopy closure is <50%. The only water present during the site visit in early June was in the main channel of the Virgin River. All vegetated areas were perched approximately 2 m above the riverbed, and the side channels that contained water at the time the aerial photograph was taken were dry and sandy. The vegetation is too short and dry to provide suitable flycatcher habitat, and we do not recommend surveys of this area in future years.

"VIRGIN NARROWS NORTH"

This native area is on the Virgin River approximately 3 km upstream of the confluence of the Virgin River and the Overton Arm of Lake Mead (Figure 2.2). We noted this area during helicopter reconnaissance in April 2008. It consists of a band of Goodding willow approximately 30 m wide and 100 m long paralleling the river on a dry terrace 1–1.5 m above the water. The willows are 4–6 m in height and are densest close to the river, becoming mixed with arrowweed away from the river. Foliage on the willows is not very dense, and canopy closure is 70–90%. Of the areas explored at Mormon Mesa,

this one most closely resembled suitable flycatcher habitat, though the vegetation was too sparse and the soils too dry to warrant further surveys. Given that the site is perched well above the water table, habitat conditions in the area seem unlikely to improve in future years. We do not recommend surveys of this area in future years.

"VIRGIN NARROWS EAST"

This mixed-native area is on the Virgin River approximately 2.8 km upstream of the confluence of the Virgin River and the Overton Arm of Lake Mead (Figure 2.2). We noted this area during helicopter reconnaissance in April 2008. The area consists of a series of dry terraces adjacent to the river, with the lowest terrace perched approximately 2 m above the riverbed. Vegetation consists primarily of a mix of arrowweed and tamarisk 3 m in height with scattered clumps and bands of emergent Goodding willow. Canopy closure is <50%. The site is too dry and sparsely vegetated to provide suitable flycatcher habitat, and we do not recommend surveys of this area in future years.

"VIRGIN NARROWS WEST"

This mixed-native area is on the Virgin River approximately 2.5 km upstream of the confluence of the Virgin River and the Overton Arm of Lake Mead (Figure 2.2). We noted this area during helicopter reconnaissance in April 2008. Vegetation consists of a 10-m-wide band of Goodding willow, approximately 8 m in height, on a narrow terrace perched 2 m above the riverbed. Arrowweed forms an understory 2 m in height. Leaves on the willows are sparse, and overall canopy closure is 70–90%. This area has the vegetation structure of suitable flycatcher habitat but lacks the foliage density, areal extent, and damp soils typical of flycatcher habitat. We do not recommend surveys in future years.

Muddy River, Nevada

The Muddy River study area is along the Muddy River in the Overton Wildlife Management Area (WMA) near Overton, NV.

Overton WMA Pond

Area: 0.7 ha Elevation: 378 m

This site consists of a patch of mixed-native vegetation approximately 150 m long and 150 m wide at the north end of Overton WMA just south of Honeybee Reservoir. The dominant vegetation consists of 10-m-tall Goodding willow with a sparse 5-m-tall tamarisk understory. Cattail and sedges are also present on the edges of the site. Canopy closure is variable, ranging up to 90%. A small stream channel runs through the site, and it held surface water in May and June. The marshy edges of the site had standing water throughout the survey season.

We detected one willow flycatcher. Three territory monitoring visits as well as subsequent surveys failed to detect the individual again. Details of occupancy and banding are presented in Chapter 3. Overton WMA Pond was surveyed six times for a total of 5.1 observer-hours. Cowbirds were detected at the site on all but one survey. No sign of livestock use was observed.

Overton WMA

Area: 14.9 ha Elevation: 378 m

This site consists of a 150-m-wide strip of riparian vegetation spanning both sides of the Muddy River. The site is bordered to the southwest by open agricultural fields and to the northeast by sparser areas of riparian vegetation. The site flooded heavily during the 2004–2005 winter, but vegetation at the site was relatively unchanged. The northern portion of the site is dominated by very dense tamarisk up to 7 m in height with canopy closure of 70–90%. The southern portion of the site consists primarily of a stand of Goodding willow 10–12 m in height with an understory of tamarisk and cattail and canopy closure up to 90%. Flowing water was present in the channel of the Muddy River throughout the survey season, and extensive beaver activity resulted in the southern portion of the site being flooded with approximately 30 cm of water throughout the survey season. Approximately 0.3 ha of the southern portion of the site was bulldozed in 2005 as part of Overton WMA efforts to repair flood damage to their water control system. Two stretches of the channel of the Muddy River within the site were dredged with heavy equipment over the 2007–2008 winter, resulting in a cleared swath 10–15 m wide on the western bank of the river. The more upstream of the two dredged and cleared areas extended from the northern end of the site southward for approximately 350 m, ending approximately 10 m upstream of the most upstream flycatcher nest recorded in 2005–2007. Dredging resumed less than 5 m downstream of the most downstream nest in that portion of the site and continued southwest along the river channel for approximately 400 m, ending over 100 m from the flycatcher nesting area at the southern end of the site.

We located six breeding willow flycatchers and two unpaired, resident males. We also detected two males for which residency could not be confirmed. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 26.3 observer-hours. We observed no signs of livestock but detected cowbirds on all surveys.

Grand Canyon, Arizona

The Colorado River in lower Grand Canyon downstream of Separation Canyon is strongly influenced by water levels in Lake Mead. Potential willow flycatcher habitat in this area has changed dramatically in the last eight years as the result of a 33.8-m drop in the level of Lake Mead from 2000 to July 2008.[5] Much of the riparian vegetation in lower Grand Canyon from approximately RM 259.5 to RM 274 that was inundated and potentially suitable for flycatchers in the late 1990s is now terraced well above the current river level, and the existing vegetation in most of these areas is dead or unsuitable for flycatchers. New areas of willow and tamarisk developed along the Colorado River in Lake Mead National Recreation Area on newly exposed sediments over the last several years, and the vegetation in many of these areas subsequently died as the lake continued to drop.

Site names below indicate historical names (if applicable) and the river mile, as measured downstream from Lees Ferry. River left and river right are indicated by “S” (south) and “N” (north), respectively.

[5] The water level in Lake Mead Reservoir rose approximately 7 m from mid-2004 to early 2005 because of record precipitation during the winter of 2004–2005. Since mid-2005, the water level has continued to drop.

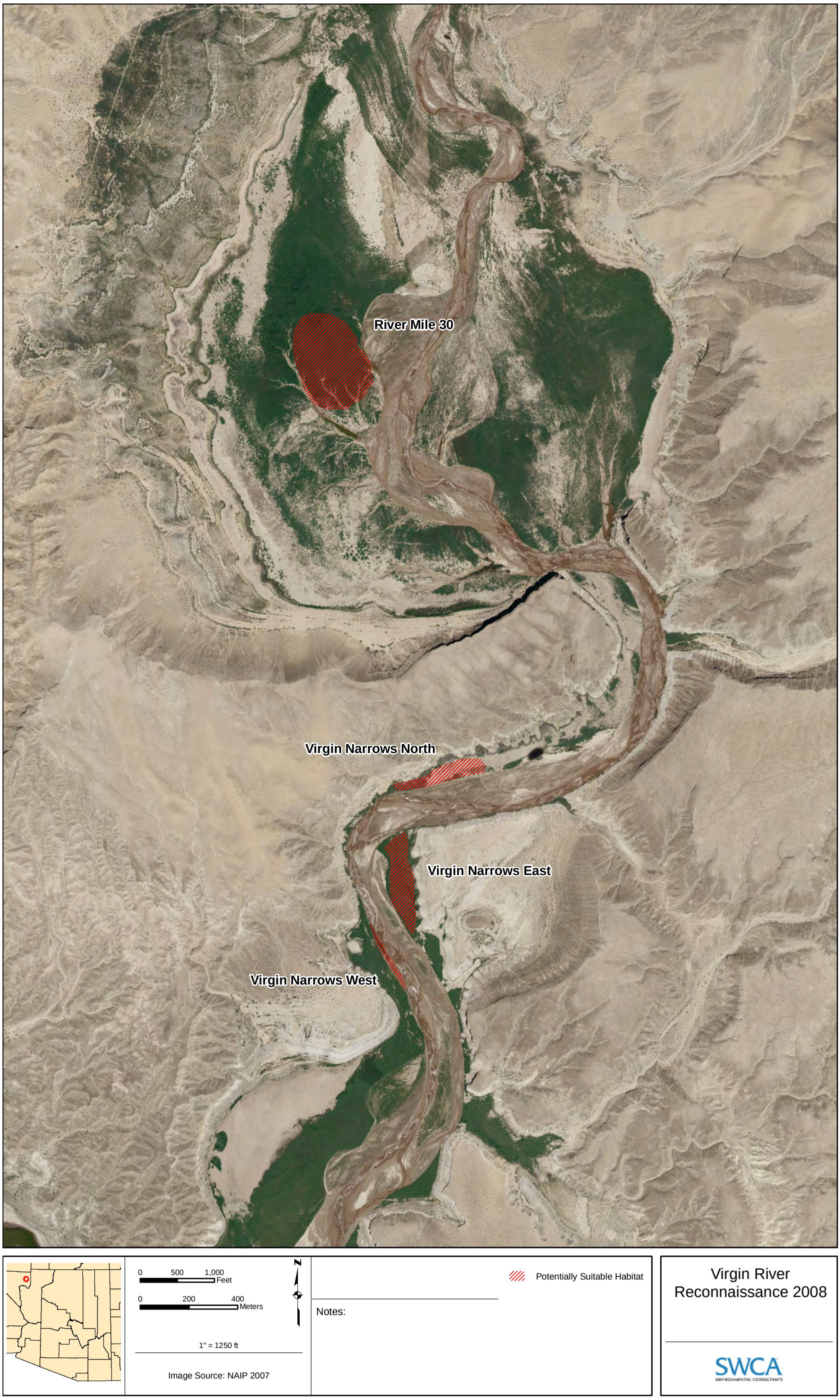


Figure 2.2. Reconnaissance areas near the mouth of the Virgin River, 2008.

Burnt Springs (RM 259.5N)

Area: 11.0 ha Elevation: 363 m

Vegetation within the first 200 m of Burnt Springs Canyon upstream from the Colorado River consists of extremely dense monotypic tamarisk approximately 5 m in height. The next 150 m of the canyon is vegetated by smaller tamarisk 3–4 m in height. This is followed by an approximately 700-m stretch of mature Goodding willow 15 m in height with an understory of cattails. Canopy closure is approximately 70–90%. Water was present in the streambed in the downstream half of the site through June.

We detected no willow flycatchers. We surveyed this site four times, totaling 3.5 observer-hours. Cowbirds were detected during two surveys, and no sign of livestock use was recorded.

RM 274.5N

Area: 18.3 ha Elevation: 354 m

This mixed-native site lies immediately adjacent to the Colorado River and contains several perennial springs, which feed small creeks, flooded willow and tamarisk forest, beaver ponds, and cattail marshes. Perennial creeks lined with coyote and Goodding willow connect the wetlands to the Colorado River. Throughout the survey season, deep pools of clear, standing water were present at springs, and large areas of the site contained muddy soils and standing water. Although the site has contained large areas of standing water since 2003, continued beaver activity has expanded the areas of standing water in the site compared to previous years. Vegetation at the site is a mosaic of well developed, mature Goodding willow forest, willow forest with tamarisk understory, and cattail marsh. Some cottonwoods are also present. Canopy height of the tamarisk is around 5 m, while the willows reach approximately 10 m. Canopy height and relative proportions of willow and tamarisk vary throughout the site. Canopy closure is highly variable but averages approximately 70%.

We detected no willow flycatchers. We surveyed this site four times, totaling 13.5 observer-hours. Cowbirds were detected on two surveys, and no sign of livestock use was observed.

RM 285.3N

Area: 8.6 ha Elevation: 343 m

This mixed-exotic site lies between the Colorado River and Grand Wash Bay, which was isolated from the Colorado River when the water level dropped in Lake Mead. Goodding willow and tamarisk developed on newly exposed soils, but the willows died as water levels continued to drop. The site has a steep, high bank adjacent to the river and slopes downward toward the bay. New vegetation continues to develop on the edge of the bay as additional soils are exposed. In 2008, the only dense vegetation at the site consisted of 3–4-m-tall willows in a narrow band on the edge of Grand Wash Bay. Vegetation in the rest of the site consisted of tamarisk 3 m in height with patches of dead willows. Canopy closure ranged from 25 to 70%. No standing water was present under the vegetation during the survey season, and saturated soils were present only in areas immediately adjacent to Grand Wash Bay.

No willow flycatchers were detected. We surveyed this site four times, totaling 2.6 observer-hours. Cowbirds were detected on one survey, and no evidence of livestock use was observed.

Iceberg Canyon

Area: 3.1 ha Elevation: 340 m

This small, mixed-native site is on recently exposed sediments along the Colorado River at the mouth of Iceberg Canyon. The site contains several small cattail ponds surrounded by bulrush, dense stands of Goodding willow averaging 6 m in height, and 3–4-m-tall tamarisk. Canopy closure ranges from 50 to 70%. The ponds contained standing water in June but were nearly dry by early July.

We detected one resident, unpaired male. Details of occupancy and color-banding are presented in Chapter 3. The site was surveyed three times, totaling 5.0 observer-hours. Cowbirds were detected on one survey, and no sign of livestock use was observed.

Topock Marsh, Arizona

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow. Seasonally wet, low-lying areas are interspersed throughout the riparian area.

Pipes #1

Area: 5.2 ha Elevation: 140 m

This exotic site is bordered to the east by the refuge road and consists primarily of monotypic tamarisk 5–7 m in height. Arrowweed occurs in dense patches within 50 m of the refuge road. The tamarisk is densest within 100 m of the refuge road and becomes more open toward the western edge of the site. The northern edge of the site has the tallest canopy, and there is relatively little deadfall in this area compared to the rest of the site. The central and southern portions of the site have many dead stems and clusters of fallen trees. Canopy closure is 50–70%. The site contained no standing water during the survey season but did contain damp soils through June.

No willow flycatchers were detected. We surveyed the site five times, totaling 9.5 observer-hours. Cowbirds were detected on all surveys, and evidence of feral pigs was observed.

Pipes #3

Area: 5.7 ha Elevation: 140 m

This site is bordered to the east by the refuge road. Arrowweed occurs in dense patches within 50 m of the road. Most of the site is vegetated by tamarisk 4–6 m in height. The southeastern portion of the site has two large Goodding willows and open, marshy areas. Canopy closure generally exceeds 70%. Most of the site was inundated in May. The site progressively dried out through the season but still contained damp soils and small areas of standing water in July.

Two breeding willow flycatchers were detected at Pipes #3. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. Portions of Pipes #3 not known to be occupied by flycatchers were surveyed five times, totaling 6.0 observer-hours. Cowbirds were detected and on three surveys, and evidence of feral pigs was observed on all surveys.

The Wallows

Area: 0.4 ha Elevation: 140 m

The Wallows is located between Pipes #3 and PC6-1 and is primarily vegetated by tamarisk 5–6 m in height with emergent Goodding willow on the western side of the site. Overall canopy closure ranges from 50 to 70%. The northwestern edge of the site borders an open cattail marsh. The Wallows contained standing water and saturated soils throughout the survey season.

One willow flycatcher was detected for which residency was not confirmed. Details of occupancy and color-banding are presented in Chapter 3. The site was surveyed six times, totaling 1.8 hours. Evidence of feral pigs was observed on all surveys. Cowbirds were not detected.

PC6-1

Area: 4.8 ha Elevation: 140 m

PC6-1 is a mixed-exotic site consisting primarily of tamarisk 6–7 m in height, with a few patches of arrowweed and cattails present in the understory. A scattered overstory of Goodding willow approximately 10–15 m in height is present in the southwestern corner of the site. Arrowweed 1–2 m in height is present under the willow. A portion of the site within approximately 50 m of the refuge road contains thick stands of arrowweed. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the refuge road is approximately 50%. PC6-1 contained standing water and saturated soils throughout the survey season, though the percentage of the site inundated declined from over 50% in May to 10% in July.

No willow flycatchers were detected. The site was surveyed six times, totaling 11.4 observer-hours. Evidence of feral pigs was found on all surveys as were cowbirds.

Pig Hole

Area: 2.4 ha Elevation: 140 m

Pig Hole consists of monotypic tamarisk 6–7 m in height, with canopy closure ranging from 70 to 90%. The northern edge of the site has smaller-diameter tamarisk, with many wispy branches, than the remainder of the site. Approximately 5% of the site consists of dense patches of arrowweed. Approximately 25% of the site had standing water in May, and another 50% of the site had saturated soils. By mid-July, the standing water had disappeared and only 5% of the site contained saturated soils.

No willow flycatchers were detected. The site was surveyed six times, totaling 4.8 observer-hours. Cowbirds were detected on all but one survey. Evidence of feral pigs was observed on all surveys.

In Between

Area: 7.7 ha Elevation: 140 m

In Between consists of approximately 50-m-wide linear patches of monotypic tamarisk separated by swampy areas. Canopy height is approximately 7 m, with the lowest 3 m of the stand generally lacking foliage, resulting in a relatively open understory. Canopy closure in the tamarisk areas is 70–90%. The western edge of the site borders an open marsh and contained standing water and damp soil throughout the survey season.

We located one unpaired, resident male at In Between. Details of occupancy and color-banding are presented in Chapter 3. Portions of In Between not known to be occupied by flycatchers were surveyed six times, totaling 11.5 observer-hours. Cowbirds were recorded on five surveys, and evidence of feral pigs was observed on all surveys.

800M

Area: 6.1 ha Elevation: 140 m

800M adjoins the western edge of In Between, and the eastern half of the site consists of an open marsh. The remainder of the site is vegetated by tamarisk 4–7 m in height. Canopy closure in the tamarisk stands varies between 70 and 90%. Standing water and/or saturated soil were present in and along small areas of marsh and in pig wallows through the survey season.

We did not detect any willow flycatchers. We surveyed the site six times, totaling 5.8 observer-hours. Cowbirds and evidence of feral pigs were observed on all surveys.

Pierced Egg

Area: 6.7 ha Elevation: 140 m

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height, with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to have a more open understory and contain patches of cattails. Overall canopy closure is approximately 80%. Standing water and saturated soils persisted in portions of the site throughout the season.

We located nine breeding willow flycatchers and three additional flycatchers for which occupancy could not be confirmed. Details of occupancy, color-banding, and nesting are presented in Chapters 3 and 4. We surveyed the site one time for a total of 2.25 observer-hours. Cowbirds and evidence of pigs were observed. After the initial survey, Pierced Egg was visited as part of territory monitoring.

Swine Paradise

Area: 2.4 ha Elevation: 140 m

This mixed-exotic site borders the open water of Topock Marsh. Near the marsh, vegetation at the site is dominated by Goodding willow up to 15 m in height, with some coyote willow and an understory of tamarisk. The remainder of the site, on both sides of the main refuge road, is vegetated by tamarisk 6–8 m in height. Overall canopy closure is approximately 80%. Standing water and saturated soils persisted throughout the season in a cattail marsh on the eastern edge of the site.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.0 observer-hours. Cowbirds were detected on all visits as was evidence of use by pigs.

Barbed Wire

Area: 2.6 ha Elevation: 140 m

This site is contiguous with Swine Paradise. One large, emergent Goodding willow occurs at the site; otherwise, the site is vegetated by tamarisk 5–8 m in height and of varying density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy

openings than the southwestern portion of the site. Canopy closure is approximately 90%. Standing water was present in pig wallows in May.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.5 observer-hours. Cowbirds were detected on three visits. Evidence of pig use was observed on all visits.

IRFB03 and IRFB04

IRFB03: Area: 1.0 ha Elevation: 140 m
IRFB04: Area: 1.5 ha Elevation: 140 m

These two contiguous sites are separated from the Barbed Wire site by a firebreak road. They are vegetated by a monotypic stand of tamarisk 7 m in height, which forms a dense canopy and relatively open understory. There is little deadfall, although many standing stems are dead, leaving dense areas of dead branches in the understory. Canopy closure is >90%. Soils within these sites were completely dry throughout the survey season. Soils within these sites have been completely dry throughout all survey seasons from 2003 to 2008, and the sites thus do not represent typical breeding habitat for flycatchers. Therefore, we recommend discontinuing surveys at these sites.

One willow flycatcher was detected at IRFB04 on 27 May. This individual was likely a migrant and was not detected on subsequent visits to the site. We surveyed these sites five times each, totaling 3.8 observer-hours. Cowbirds were detected on one survey at both sites. Evidence of pigs was observed on all surveys.

Platform

Area: 1.3 ha Elevation: 140 m

This site forms a narrow strip of vegetation between the main refuge road and the open marsh. Vegetation at the site consists of tamarisk 7 m in height with a few isolated, emergent Goodding willow. Overall canopy closure is approximately 80%. Bulrush and cattail line the eastern edge of the site adjacent to the marsh. Hydrologic conditions in the interior of the site were not recorded.

No willow flycatchers were detected. We surveyed the site five times, totaling 1.3 observer-hours. Cowbirds were not detected at this site, but evidence of pigs was observed on four surveys.

250M

Area: 2.3 ha Elevation: 140 m

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is dominated by mesquite trees with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and one large Goodding willow. Canopy closure within the site is approximately 70%. Small patches of saturated soil were present adjacent to the marsh throughout the flycatcher breeding season.

We detected one willow flycatcher on 18 June for which residency was not confirmed. The site was surveyed five times, totaling 4.0 observer-hours. Cowbirds were detected on three surveys, and we observed evidence of pigs on all surveys.

Hell Bird and Glory Hole

Hell Bird: Area: 3.7 ha Elevation: 140 m
Glory Hole: Area: 5.0 ha Elevation: 140 m

These contiguous mixed-exotic sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure are highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6 m in height and Goodding willow 12 m in height. Canopy closure ranges from 50 to 90%. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush. Large swampy areas vegetated by cattail and bulrush are interspersed throughout the survey areas. Hell Bird and Glory Hole both contained standing water throughout the flycatcher breeding season.

No willow flycatchers were found at Hell Bird. We detected six breeding flycatchers and two unpaired, resident males at Glory Hole. Details of occupancy, color-banding, and nesting activity are presented in Chapters 3 and 4. Hell Bird was surveyed five times, totaling 5.5 observer-hours. Portions of Glory Hole not known to be occupied by flycatchers were surveyed twice, totaling 5.0 observer-hours. Cowbirds and evidence of pigs were observed on all surveys at both sites.

Beal Lake

Area: 13.9 ha Elevation: 140 m

This mixed-native restoration site consists of a mosaic of relatively young cottonwood, Goodding willow, coyote willow, and arrowweed, with some tamarisk and mesquite scattered throughout the site. Canopy height is highly variable and averages approximately 5 m; canopy closure is sparse, averaging 35%. The amount of standing water and saturated soil at the site is highly variable because it is flood irrigated.

We detected two willow flycatchers on 5 June and one on 11 June. These individuals likely were migrants and were not detected on subsequent visits to the site. We surveyed this site five times, totaling 5.0 observer-hours. Cowbirds were detected on two surveys, and evidence of pigs was observed on three visits.

Lost Slough

Area: 1.5 ha Elevation: 140 m

Lost Slough is located approximately 4 km south of Glory Hole and Hell Bird. The site runs north-south for approximately 250 m, and measures 100 m wide at the broadest point. There is a marshy area in the center of the site that runs southwest to northeast; a small area of bulrush is present in the marsh, along with stands of coyote willow 6 m in height. Vegetation around the marsh is composed mainly of 6- to 8-m-tall tamarisk with a few emergent Goodding willow and mesquite scattered throughout.

Arrowweed up to 2 m in height makes up the understory vegetation. Canopy closure at the site is variable, with open areas toward the edges of the site and over 70% closure in areas with thick vegetation. Some surface water and saturated soils were present throughout the survey season.

We did not detect any willow flycatchers. We surveyed Lost Slough five times, totaling 4.5 observer-hours. Cowbirds were detected during one survey, and evidence of pigs was observed on four visits.

Lost Pond

Area: 1.2 ha Elevation: 140 m

This mixed-exotic site is located approximately 700 m southeast of Lost Slough. The site is approximately 200 m long and 125 m wide, with a small pond at the southern end of the site. The edges of the pond are vegetated with a 30-m-wide border of cattail, bulrush, and sedges. The pond is surrounded by tamarisk 4 to 7 m in height. Canopy closure in the tamarisk is approximately 90%. The area surrounding the site consists of arrowweed, 3-m tamarisk, and screwbean mesquite (*Prosopis pubescens*). Water remained in the pond throughout the flycatcher breeding season, and saturated soils and water were present under the tamarisk on the northeastern side of the pond.

No willow flycatchers were detected. We surveyed the site five times, totaling 2.1 observer-hours. Cowbirds were detected during one survey, and pig trails were present in the site.

Lost Lake

Area: 3.3 ha Elevation: 140 m

This site lies approximately 850 m southeast of Lost Pond. It is a narrow (<100-m-wide) strip of riparian vegetation separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. Lost Lake (a 200- × 500-m body of open water) is located northwest of the site. Vegetation at the site is variable. The northern edge of the site consists of an overstory of planted cottonwoods 10–15 m in height, with an understory of tamarisk 5 m in height, on the edge of a cattail marsh. South of the cottonwoods, the site is primarily tamarisk, 5–8 m in height, with small openings vegetated by arrowweed. In previous years, the southeastern end of the site was dominated by dense stands of coyote willow. These willows are now all dead, dramatically reducing the suitability of the site for breeding flycatchers. Overall canopy closure is approximately 80%. Areas adjacent to the marsh edges held some standing water through mid-June.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds and evidence of pigs were detected on all surveys.

Ground Reconnaissance Results

"NW OF PIPES #1"

We explored the area immediately northwest of Pipes #1 to determine whether the tall, dense tamarisk with relatively little deadfall that is present at the north end of Pipes #1 extends outside the area we currently survey. We encountered extremely dense tamarisk 8 m in height mixed with arrowweed. Canopy closure at the site is >90%. Soils within the site were completely dry. We abandoned attempts to explore this area because the dense vegetation made access very difficult.

No willow flycatchers were detected. We surveyed the site one time, totaling 3.8 observer-hours. Cowbirds and evidence of pigs were detected.

Topock Gorge, Arizona and California

Between Topock Marsh and Lake Havasu, the Colorado River winds through Topock Gorge. Throughout the Gorge, the river is confined between steep cliffs and high bluffs, and little vegetation grows along the river. We surveyed backwater areas that support marsh and riparian vegetation.

Blankenship Bend

Blankenship Bend North: Area: 26.7 ha Elevation: 138 m
Blankenship Bend South: Area: 25.9 ha Elevation: 138 m

Blankenship Bend is a 2-km-long strip of riparian and marsh vegetation that lies along the eastern bank of the Colorado River adjacent to the Blankenship Valley. The eastern, upland edge of the site is vegetated by a 100-m-wide strip of mature tamarisk and mesquite. The northern half of the site contains a stand of large Goodding willows adjacent to a cattail marsh. Between the river and the strip of tamarisk, the southern half of the site consists of a mosaic of cattail, bulrush, and scattered islands of small willows and tamarisk. Canopy closure and height are highly variable throughout this mixed-exotic site. Because of the proximity to the Colorado River, both sites contained standing water and saturated soils throughout the survey season.

No willow flycatchers were detected at either site at Blankenship Bend. We surveyed each site five times, totaling 7.5 observer-hours at Blankenship Bend North and 5.8 observer-hours at Blankenship Bend South. Cowbirds were detected on four surveys at North and on three surveys at South. Evidence of feral pigs and burros was observed at both locations.

Havasu NE

Area: 12.6 ha Elevation: 136 m

This mixed-native site consists of a 1.3-km-long and <100-m-wide strip of riparian vegetation along the northeastern shore of Lake Havasu. Vegetation at the site grades from cattails along the lakeshore to Goodding willow and tamarisk in the center of the site and a mix of tamarisk and mesquite on the upland edge. Canopy closure is approximately 80%. Many Goodding willows at the site are mature and stand 5 m above the 10-m-tall tamarisk and mesquite. Soils in the interior of the site were extremely dry throughout the survey season, and water from the lake does not extend under the vegetation. Based on our determination that no moist soils exist beneath the vegetation, we recommend biennial surveys for this site.

We did not detect any willow flycatchers. We surveyed the site five times, totaling 8.0 observer-hours. Cowbirds were detected on all visits as was evidence of use by pigs.

Bill Williams River National Wildlife Refuge, Arizona

The Bill Williams River NWR contains the last expanse of native cottonwood-willow forest on the lower Colorado River. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream.

In addition to the regularly scheduled surveys, we revisited sites located in previous years that were determined to be potentially suitable flycatcher habitat. Results of this habitat evaluation and opportunistic surveys are presented below following the survey results.

Bill Williams Site #2

Area: 3.1 ha Elevation: 140 m

This mixed-native site has an overstory of large Goodding willow and cottonwood up to 15 m in height and an understory of tamarisk 5 m in height. Overall canopy closure is approximately 70%. The northern portion of the site contains open cattail marshes. These cattails were dead in 2008, and the site contains much dead, woody vegetation in the understory. The site is bordered on the southwest by a narrow channel of open water where an arm of Lake Havasu follows the channel of the Bill Williams River, and vegetation is densest near this channel. The site is separated from the channel by a steep, high bank. There was a small amount of standing water in the cattail marsh in June, but soils under the woody vegetation were complete dry throughout the survey season. Because of dry soils within the site and the presence of large quantities of deadfall, this site does not represent typical occupied flycatcher habitat, and no resident willow flycatchers have been detected at this site since 2003. We recommend biennial surveys unless floods occur that have the potential to alter the hydrology of the area.

No willow flycatchers were detected. We surveyed the site six times, totaling 4.0 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Bill Williams Site #11

Area: 6.3 ha Elevation: 140 m

This mixed-native site has an overstory of Goodding willow and cottonwood trees up to 20 m in height. Tamarisk ranging from 3 to 5 m in height is the dominant species in the understory, and the ground is covered by thick deadfall. Canopy closure is approximately 75%. Large areas of standing water are present within the survey site because an arm of Lake Havasu follows the channel of the Bill Williams River through the center of the site. However, soils under the vegetation were very dry during the survey season. Because of dry soils within the site and the presence of large quantities of deadfall, this site does not represent typical occupied flycatcher habitat, and no resident willow flycatchers have been detected at this site since 2003. We recommend biennial surveys unless floods occur that have the potential to alter the hydrology of the area.

No willow flycatchers were observed. We surveyed the site five times, totaling 4.3 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock was observed.

Bill Williams Site #4 and Site #3

Site #4: Area: 9.9 ha Elevation: 140 m
Site #3: Area: 9.5 ha Elevation: 140 m

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow 15–20 m in height and patches of monotypic tamarisk up to 8 m in height. Patches of coyote willow are also present. Overall canopy closure is approximately 50%. Stands of cattails and marshy areas occupy approximately 10% of the sites. The understory in some areas is very open, and the ground in these areas is covered with herbaceous vegetation. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Mosquito Flats had a network of small, flowing streams in May, but these had largely dried to damp soil by July with only small puddles remaining.

We detected one willow flycatcher in Site #4 for which residency was not confirmed. Seven breeding flycatchers were detected in Site #3. Details of color-banding, occupancy, and nesting are presented in Chapters 3 and 4. Portions of the sites not known to be occupied by flycatchers were visited five times, totaling 7.2 observer-hours at Site #4 and 11.9 observer-hours at Site #3. Cowbirds were detected on all visits to Mosquito Flats, and no evidence of livestock was observed.

Bill Williams Site #5

Area: 9.0 ha Elevation: 143 m

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the east by upland desert. The survey site was expanded in 2008 approximately 350 m upstream. Vegetation in the site is mixed-native, with Goodding willow and cottonwood 15 m in height in the overstory. The understory consists of tamarisk 7 m in height as well as some young Goodding willow and cottonwood. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure in the site is variable, averaging 70%. Soils under the vegetation were mostly dry, with a couple of small ponds and small marshy areas containing water through July.

No willow flycatchers were detected. We visited the site five times, totaling 10.8 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Mineral Wash Complex

Area: 18.8 ha Elevation: 162 m

This mixed-native site is approximately 3 km upstream of Site #5. The northern third of the site is a sparse mix of tamarisk, honey mesquite (*Prosopis glandulosa*), and arrowweed with a few emergent cottonwood. The remainder of the site has an overstory of cottonwood and Goodding willow up to 20 m in height and an understory of tamarisk averaging 5 m in height. The site contains two channels of the Bill Williams River, one along the southwestern edge of the site and the other through the center of the site. Areas of bulrush and cattail are present in both channels, and patches of young Goodding willow and cottonwood are growing in sandy areas along the channel that runs along the southwestern edge of the site. Overall canopy closure is <50%. Both channels of the Bill Williams River contained surface water through July, but soils away from the channels were dry and sandy. Sparse canopy closure and lack of surface water or damp soils underneath the vegetation make this site unlikely to support resident flycatchers. No resident willow flycatchers have been detected at this site since 2003, and we recommend biennial surveys unless floods occur that have the potential to alter the hydrology or vegetation of the area.

No willow flycatchers were detected. We surveyed the site five times, totaling 8.0 observer-hours. Cowbirds were detected on all but one visit, and no evidence of livestock use was observed.

Beaver Pond

Area: 21.7 ha Elevation: 165 m

This mixed-native site consists of cottonwood and Goodding willow averaging 15 m in height with an understory of tamarisk along the Bill Williams River. Areas not immediately adjacent to the river channel are vegetated by tamarisk and honey mesquite 5–7 m in height. Cattail and bulrush are present along most of the river channel. Overall canopy closure at the site is <50%. A channel of the Bill Williams River was flowing along the edge of the site throughout the flycatcher breeding season, and an

old channel in the center of the site contained small pools of water. Soils under the vegetation, however, were completely dry. Sparse canopy closure and lack of surface water or damp soils underneath the vegetation make this site unlikely to support resident flycatchers. No resident willow flycatchers have been detected at this site since 2003, and we recommend biennial surveys unless floods occur that have the potential to alter the hydrology or vegetation of the area.

No willow flycatchers were detected. We surveyed the site five times, totaling 5.0 observer-hours. Cowbirds were detected on all visits. No signs of livestock were observed.

Bill Williams Site #8

Area: 10.3 ha Elevation: 168 m

This narrow, linear site encompasses the river channel approximately 3 km upstream from the Mineral Wash Complex, at the confluence of Mohave Wash and the Bill Williams River. This section of the river is confined between high cliffs on both banks. Cottonwood and willow trees 18 m in height line a flowing river channel, with clumps of tamarisk also present in the understory throughout the site. Overall canopy closure is 25–50%. This site had flowing water in the river channel throughout the flycatcher breeding season, but soils beneath the vegetation were very dry. Sparse canopy closure and lack of surface water or damp soils underneath the vegetation make this site unlikely to support resident flycatchers. No resident willow flycatchers have been detected at this site since 2003, and we recommend biennial surveys unless floods occur that have the potential to alter the hydrology or vegetation of the area.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.5 observer-hours. Cowbirds were detected on all but one visit and no evidence of livestock use was observed.

Ground Reconnaissance Results

Field personnel spent a total of 27.4 person-hours conducting habitat reconnaissance and/or habitat evaluation and opportunistic broadcast surveys along the Bill Williams River corridor. We revisited seven areas that had been identified in 2006 or 2007 and visited four new areas (Cliff Pond, Downstream of Site #8, New River, and East of Planet Ranch; see Figures 2.3 and 2.4). The following descriptions are organized from downstream to upstream along the Bill Williams River.

"BURN EDGE"

Burn Edge consists of two areas of riparian vegetation northeast of where an arm of Lake Havasu follows a channel of the Bill Williams River. The eastern patch is located approximately 100 m north of Site #2 and consists of tamarisk 8–10 m in height, with 14 m Goodding willow scattered throughout the site. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure averages 80%. Although no standing water or saturated soils were present under the vegetation, a small arm of Lake Havasu follows a channel of the Bill Williams River through the site.

The western patch of Burn Edge is located approximately 300 m northeast of Site #11. The northwestern end of the site is on the edge of an area that burned in 2006, and scattered 3-m-tall Goodding willow and tamarisk have sprouted in this area. The burned area ends at a small, grassy opening with a pond on the western end. To the southeast of the pond, the overstory comprises Goodding willow and cottonwood 12–15 m in height, and tamarisk 3–5 m in height forms the understory. An understory of 3–5 m tamarisk is present throughout the site, and ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure is highly variable, and ranges from 20% to 90%, depending on the

density of the tamarisk. The pond held standing water during site visits in late May and mid-June. Although soils under the vegetation were dry, there was evidence that water had been present under the vegetation at one time. This site should be visited in future years to assess any changes in hydrology that might increase the suitability of the area for flycatchers.

No willow flycatchers were detected at Burn Edge. We surveyed the eastern patch once and the western patch twice, totaling 5.0 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

"LAST GASP"

Last Gasp is depicted as a wetland on the U.S. Geological Survey (USGS) Monkey's Head 7.5-min topographic map. The area consists of an overstory of cottonwood and Goodding willow up to 15 m in height and a tamarisk understory 5 m in height. Canopy closure is highly variable. Stagnant surface water was present in small pools along a muddy channel during site visits in May and June. Soils under the vegetation and away from the muddy channels were dry. This site should be visited in future years to assess any changes in hydrology that might increase the suitability of the area for flycatchers.

No willow flycatchers were detected at Last Gasp. We surveyed the site twice, totaling 2.3 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

"RIVER END"

This site is approximately 350 m southeast of Last Gasp. The southeastern corner of the site is adjacent to standing water within the Bill Williams River, at the point where the river goes subsurface. The vegetation at River End consists of a mosaic of dense tamarisk 5 m in height, a sparse overstory of emergent willow and cottonwood, and clumps of mesquite trees, many of which are dead. Canopy closure ranges from 25 to 70%. Small islands of cattail marsh are confined to the river channel, and during site visits saturated soils were present only along the river channel. Because soils within the site were very dry, we do not recommend revisiting this site unless floods occur that have the potential to alter the hydrology of the area.

No willow flycatchers were detected. We surveyed the site twice, totaling 2.0 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

"FLOODED REFUGE ROAD"

Flooded Refuge Road is located approximately 300 m southeast of Site #5 along the old refuge road, which was washed out during a 2004–2005 winter flood. Vegetation at the site consists of scattered, emergent willows and cottonwoods and an understory of tamarisk. Vegetation throughout the site is patchy, with dry, sandy openings and dry river channels bisecting the area. Overall canopy closure is around 50%. No standing water or saturated soils were present during site visits in mid-May and late June. We do not recommend surveying this site in future years unless floods occur that have the potential to alter the hydrology of the site.

No willow flycatchers were detected. We surveyed the site twice, totaling 4.5 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.



Bill Williams Habitat Reconnaissance 2008

Site Boundary
Potentially Suitable Habitat

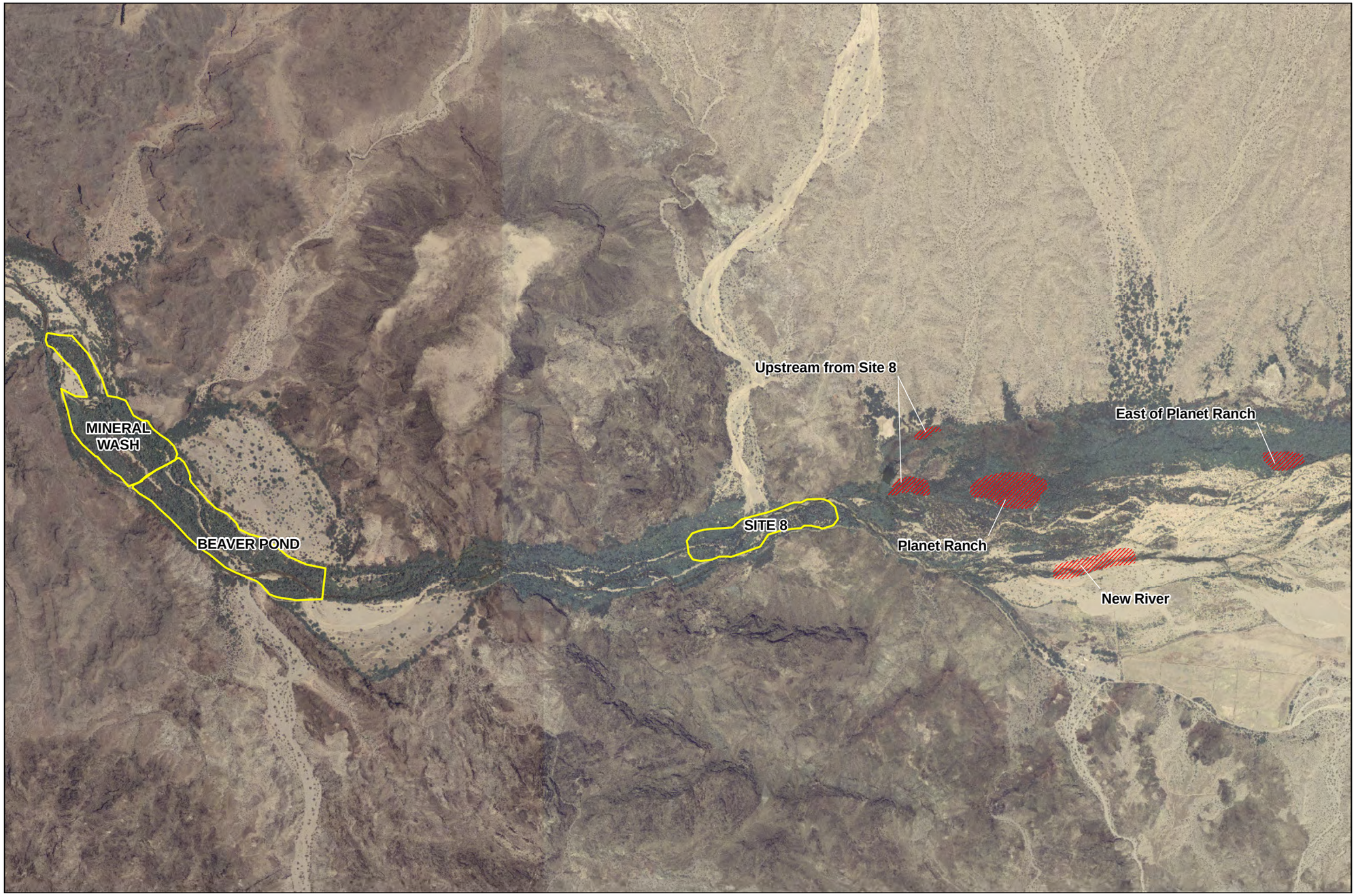
Image Source: NAIP 2007



0 750 1,500 Feet
0 200 400 Meters
1" = 1600 ft

SWCA ENVIRONMENTAL CONSULTANTS

Figure 2.3. Bill Williams River NWR habitat evaluation 2008.



Bill Williams Habitat Reconnaissance 2008

Site Boundary
Potentially Suitable Habitat

Image Source: NAIP 2007

0 750 1,500 Feet
0 200 400 Meters
1" = 1600 ft

SWCA ENVIRONMENTAL CONSULTANTS

Figure 2.4. Bill Williams River NWR habitat evaluation 2008, continued.

"NEW WILLOW"

This area is approximately 1.4 km southeast of Site #5. Goodding willow and cottonwood to heights of 10 m compose a patchy overstory in this area. Understory vegetation is primarily tamarisk of varying height, and canopy closure is around 70%. Cattail and honey mesquite are also present, and areas of young cottonwood and Goodding willow occur to the east of the site. Soils under the vegetation were dry to damp during site visits in late May and late June, with the nearest surface water approximately 200 m away. The areas of young vegetation should be reevaluated in future years.

No willow flycatchers were detected. We surveyed the site twice, totaling 2.5 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

"CLIFF POND"

Cliff Pond is located approximately 350 m south of New Willow and consists of a stand of Goodding willow and cottonwood 10–15 m in height with a dense, tamarisk understory. The site is bordered to the west by rocky cliffs and desert upland, and to the east by a dry wash. Standing water that was observed during helicopter reconnaissance in mid-April was not confirmed because dense vegetation prohibited access of the entire area. During the site visit, small areas of saturated soils were present in cattail stands along the wash. This area should be reevaluated in future years to determine the vegetation and hydrological characteristics of the interior of the site.

No willow flycatchers were detected. We surveyed the site once, totaling 0.8 observer-hours. Cowbirds were detected, and no evidence of livestock use was observed.

"DOWNSTREAM FROM SITE #8"

We started our habitat evaluation approximately 1 km west of Site #8 and evaluated approximately 600 m of vegetation along the Bill Williams River toward Site #8. The site consists primarily of Goodding willow and cottonwood 8–10 m in height with a tamarisk understory. Canopy closure is highly variable and ranges from 40 to 70%. Cattail and bulrush are present along the river, as are young willows. During the site visit, soils were dry under the vegetation away from the river. We do not recommend surveying this site in future years unless floods occur that have the potential to alter the hydrology of the site.

No willow flycatchers were detected. We surveyed the site once, totaling 0.3 observer-hours. Cowbirds were detected, and no evidence of livestock use was observed.

"UPSTREAM FROM SITE #8"

We evaluated two relatively small areas upstream of Site #8. The first is approximately 300 m east of Site #8 and is bordered by an open pond to the northwest and a marsh to the north. Vegetation in this area consists of an overstory of cottonwood up to 17 m in height and an understory of tamarisk. Arrowweed also occurs in the understory in areas with little canopy cover. Canopy cover is patchy and ranges from 50 to 70%. Surface water and saturated soils were limited to the marshy areas on the edge of the site, and soils in the remainder of the site were damp during the site visit in mid-May. Canopy closure in this area is generally too low to provide suitable flycatcher habitat.

The second area we evaluated is approximately 200 m north of the first and is bordered to the north by desert uplands. The overstory consists of scattered Goodding willow and cottonwood, while the understory consists of tamarisk up to 2 m in height and dead cattails. Canopy closure is <50%. Approximately 40% of the site was inundated during the site visit in early June, with another 30% having

saturated or damp soils. This area could become suitable flycatcher habitat if the tamarisk matures, and it should be evaluated in future years.

No willow flycatchers were detected. We surveyed the site twice, totaling 2.5 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

"PLANET RANCH"

We started our habitat evaluation approximately 200 m east of the southern portion of Upstream from Site #8, and evaluated an area extending 400 m east of the starting point. Goodding willow and cottonwood up to 20 m in height make up a scattered overstory, while tamarisk up to 7 m in height form a relatively continuous understory. The southern edge of the site is more sparsely vegetated than the center and has many fallen cottonwoods. The center of the site has small channels lined with dead sedges and cattails. No standing water or saturated soils were present in mid-May, though soils were damp in approximately 75% of the site. The central portion of the site has the structure typical of flycatcher habitat, and this area should be evaluated in future years to determine hydrologic conditions.

No willow flycatchers were detected. We surveyed the site once, totaling 2.3 observer-hours. Cowbirds were detected, and no evidence of livestock use was observed.

"NEW RIVER"

New River is located approximately 300 m south of Planet Ranch and consists of a stringer of young Goodding willow and cottonwood 3–6 m in height along the Bill Williams River. The stringer varies from 10 to 30 m wide. We evaluated a section 500 m long, and the habitat continues upstream beyond the area we evaluated. The stringer is surrounded by open, sandy areas. Cattail and bulrush are present along the river, which contained flowing water during the visit in mid-May. This area is currently too young and narrow to provide suitable flycatcher habitat but should be monitored in future years.

"EAST OF PLANET RANCH"

This area is approximately 1 km upstream from Planet Ranch. We evaluated this area because large trees are visible on the aerial photograph. The large trees are a scattered stringer of cottonwood approximately 25 m in height. The understory consists of dense tamarisk up to 10 m in height. The area was extremely dry during the site visit and does not resemble suitable flycatcher habitat.

Ahakhav Tribal Preserve, Arizona

The Ahakhav Tribal Preserve encompasses backwater areas along the Colorado River near Parker, Arizona, and includes restoration sites. We initially surveyed Deer Island and then added Willow Beach as a survey area midway through the season. We also visited the CRIT 9 restoration area.

Willow Beach

Area: 2.0 ha Elevation: 104 m

This site consists of an area of planted cottonwood bordering a backwater channel. The interior of the site consists of an understory of arrowweed and an overstory of cottonwoods up to 10 m in height. Many of the cottonwoods have sparse leaves, and overall canopy closure is <25%. The backwater channel is lined with seep willow (*Baccharis* sp.), and the edges of the restoration site have areas of tamarisk and mesquite. Surface water was present in the backwater channel and in a small pond during site visits in

June and July. This site does not resemble suitable flycatcher habitat and further surveys are not recommended.

No willow flycatchers were detected. We surveyed the site three times, totaling 1.5 observer-hours. Cowbirds were detected on two surveys, and no evidence of livestock use was present.

Deer Island

Area: 91.6 ha Elevation: 104 m

This site consists of a narrow strip of mixed-native vegetation on the edge of a long backwater slough with extensive areas of cattails. The only dense, woody vegetation occurs in a strip approximately 5 m wide on the edge of the slough and consists of tamarisk and screwbean mesquite up to 6 m in height and an understory of arrowweed. More than 5 m from the water, vegetation is primarily arrowweed with widely scattered tamarisk and mesquite. Canopy closure is <50%. The southern side of the slough has a steep, high bank, and woody vegetation is perched several meters above the water level. The north bank is not as high, with woody vegetation approximately 1 m above the water level. Although extensive areas of inundated and saturated soils existed in the slough and the adjacent cattails, water did not extend into the woody vegetation at any time during the survey season.

One unpaired, resident flycatcher was detected. One additional willow flycatcher was detected for which residency was not confirmed. Details of color-banding and occupancy are presented in Chapter 3. Five surveys were completed at the site, totaling 14.5 observer-hours. Cowbirds were detected on all visits. No evidence of livestock use was observed.

Ground Reconnaissance Results

"RESTORATION"

This site consists of planted stands of cottonwood and Goodding willow up to 15 m in height. The site also contains patches of honey mesquite 4–7 m tall. The edges of the site have coyote willow up to 3 m in height. Understory is minimal and consists of young willows and cottonwoods. Overall canopy closure is <50%. Soils within the site were dry and sandy during the site visit in mid-June. This restoration area does not currently provide suitable habitat for flycatchers, and we do not recommend further surveys unless additional management actions create a denser understory and greater canopy closure.

No willow flycatchers were detected. We surveyed the site once for a total of 0.8 observer-hours.

Big Hole Slough, California

Big Hole Slough

Area: 16.6 ha Elevation: 82 m

This mixed-native site consists of a cattail marsh edged with narrow bands of coyote willow 5 m in height. Away from the marsh, the site contains tamarisk and honey and screwbean mesquite 8 m in height with an understory of arrowweed. A few tall Goodding willow and cottonwood are present at the site. Overall canopy closure is approximately 50%. The marsh contained standing water throughout the survey season.

We detected one willow flycatcher on 9 June. The site was surveyed five times, totaling 9.8 observer-hours. Cowbirds were detected on all visits, often in large flocks. No livestock use was observed.

Ehrenberg, Arizona

Ehrenberg

Area: 4.7 ha Elevation: 78 m

This mixed-native site consists primarily of a canopy of cottonwood and Goodding willow 15 m in height with an understory of arrowweed. Approximately 5% of the site contains a cattail marsh surrounded by stands of coyote willow. Most of the coyote willows were leafless and dead by the end of the survey season. The periphery of the site is vegetated with a mix of tamarisk and mesquite. Canopy closure at the site is approximately 50%. The cattail marsh contained saturated soils in May and July, and the site is separated from the Colorado River by a levee. The coyote willows were the only dense understory taller than 3 m, and the death of the willow stands makes this site less suitable for flycatchers.

No willow flycatchers were detected. The site was surveyed five times, totaling 7.3 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Cibola National Wildlife Refuge, Arizona and California

CVCA

Area: 26.2 ha Elevation: 73 m

This restoration area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. Each cell generally contains a single species and age class. The tallest cottonwoods and willows are around 8 m in height, and canopy closure in the densest areas is 80–90%. The site is flood irrigated and contained varying amounts of surface water through the season.

Two willow flycatchers were detected on 18 June. The site was surveyed five times, totaling 8.3 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

Cibola Nature Trail

Area: 13.7 ha Elevation: 70 m

This restoration site consists of a mosaic of cottonwood, Goodding willow, and mesquite. Approximately half the site consists of scattered screwbean and honey mesquite up to 5 m in height with a thick understory of seep willow. The northern half of the site contains an extensive stand of Goodding willow 8 m in height. The northern edge of the willow stand has canopy closure <25% and many of the willow are dead. The southern half of the willow stand has canopy closure around 70%. The southwestern corner of the site has a small stand of cottonwoods, and stringers of cottonwoods up to 18 m in height occur throughout the site. The site is flood irrigated and contained varying amounts of surface water through the season.

We detected one willow flycatcher on 6 June. The site was surveyed five times, totaling 4.0 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Cibola Island

Area: 4.2 ha Elevation: 70 m

This mixed-native site is approximately 9.5 km southwest of Cibola Nature Trail. The site runs north to south, extending approximately 500 m lengthwise, with a width of 100 m. Dirt roads border the site to the north, east, and west. Open farm fields lie across the eastern road, with irrigation channels alongside the road. An irrigation canal empties into the northern end of the site, creating an open, marshy area down the center of the site. Between this marshy area and the western road, vegetation consists of an overstory of Goodding willow 10–12 m in height with an understory of tamarisk 5–7 m in height. Canopy closure within the willows is 80%. A narrow strip had been bulldozed along the western road and planted with Goodding willow and cottonwood poles that had barely sprouted in mid-June. The eastern edge of the marsh is lined with a narrow strip of tamarisk 5–6 m in height with a few emergent Goodding willows on the marsh edge. Between the tamarisk strip and the eastern road, vegetation consists of honey mesquite and bushy arrowweed. The marsh was dry in May but contained up to 50 cm of water in June and July.

We detected one willow flycatcher on 15 May, two on 6 June, and two on 18 June. The site was surveyed five times, totaling 5.7 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Three Fingers Lake

Area: 67.9 ha Elevation: 65 m

This mixed-exotic site consists of the area immediately surrounding a dredged backwater channel of the Colorado River. The edges of the channel are vegetated by cattail and bulrush. The dominant woody vegetation is tamarisk, which is densest immediately adjacent to the channel and reaches heights of 6 m. A few large Goodding willow are also present. Away from the channel, the tamarisk is shorter and sparser and is mixed with honey and screwbean mesquite with an understory of arrowweed. Canopy closure along the shore is approximately 50%. Water was present in the backwater channel throughout the season, but there was no water under the woody vegetation.

We detected one willow flycatcher on 18 May, two on 7 June, and four on 19 June. The site was surveyed five times, totaling 13.0 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was observed.

Cibola Lake North and West

Cibola Lake North: Area: 8.5 ha Elevation: 64 m
Cibola Lake West: Area: 6.8 ha Elevation: 64 m

These mixed-exotic sites border Cibola Lake. The perimeter of each site adjacent to the lake is vegetated by cattail and bulrush. Areas immediately inland from the cattail marshes are vegetated by dense tamarisk 4–6 m in height with scattered Goodding willow. The interiors of the sites have patchy vegetation with a mix of tamarisk, arrowweed, and open sandy areas. Canopy closure along the marsh edges is 50–70%, while the interiors of the sites have canopy closure <25%. Except for along the shores, soils within the interior of the sites were dry throughout the survey period.

We detected one willow flycatcher on 8 June and one on 18 June at Cibola Lake North. At Cibola Lake West we detected one flycatcher on 20 May, two on 9 June, and two on 18 June. Each site was surveyed

five times, totaling 11.0 observer-hours for Cibola Lake North and 11.5 observer-hours for Cibola Lake West. Cowbirds were detected on all visits to both sites, and no evidence of livestock use was observed.

Walker Lake

Area: 11.4 ha Elevation: 64 m

This mixed-exotic site is located along the northeastern edge of Walker Lake. The majority of the site consists of very dense tamarisk approximately 5 m in height. The southeastern end of the site contains scattered emergent Goodding willow up to 20 m in height, as well as a couple of emergent cottonwoods. This portion of the site also contains a small opening with dead cattails and a small patch of half-dead coyote willow. Walker Lake contained standing water and saturated soil throughout the survey season. Areas of the site adjacent to Walker Lake had standing water and saturated soils in May, though these soils were only damp in June and July. Soils in the interior of the site were dry throughout the survey season.

We detected two willow flycatchers on 7 June. The site was visited five times, totaling 13.0 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

Imperial National Wildlife Refuge, Arizona and California

Draper Lake

Area: 4.6 ha Elevation: 63 m

This site is on the northern edge of Draper Lake, which lies approximately 200 m west of the Colorado River and is surrounded by extensive areas of cattail marsh. This site burned prior to the 2003 survey season and was first surveyed again in 2006. Vegetation immediately adjacent to the cattail marsh consists of a narrow (5–10 m) strip of young, dense tamarisk up to 7 m in height with over 90% canopy closure. The central portion of the site consists of a stand of coyote willow approximately 100 m x 50 m. Many of these willows are dead, and canopy cover is around 70%. The northern end of the site consists of scattered tamarisk clumps up to 5 m in height, an understory of arrowweed, and many open areas. Canopy closure in this portion of the site is <25%. Standing water was present in Draper Lake during the site visit in May. Surveys at this site were discontinued because the stands of coyote willow are dying, and the site does not provide habitat suitable for resident flycatchers.

One willow flycatcher was detected on 27 May. The site was surveyed once, totaling 1.5 observer-hours. Cowbirds were detected, and there was no evidence of livestock use.

Paradise

Area: 7.8 ha Elevation: 62 m

This site is mixed-native habitat, with stringers of cottonwood and Goodding willow, 15–20 m in height, bordering a small cattail marsh. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. The cottonwoods and willows are separated from the Colorado River by a narrow (50-m-wide) strip of dense tamarisk. A cattail marsh borders the site to the south. Overall canopy closure is approximately 25%. Standing water was present within the marsh throughout the survey season.

We detected two willow flycatchers on 27 May. The site was surveyed five times, totaling 10.9 observer-hours. Cowbirds were detected on every visit, and no evidence of livestock use was observed.

Hoge Ranch

Area: 20.7 ha Elevation: 61 m

This mixed-exotic site is dominated by tamarisk 4–6 m in height, with a few emergent cottonwoods and Goodding willows (15 to 18 m in height) at the southern end of the site near the old ranch. Linear marshes with cattail, bulrush, and common reed (*Phragmites* sp.) occupy less than 20% of the interior of the site, and there are a few patches of coyote willow. Canopy closure is approximately 50%. The marshes in the interior of the site contained fluctuating amounts of standing water and saturated soil throughout the survey season, but the interior of the site was not explored sufficiently to determine the percentage of the site that was inundated. The site also borders the Colorado River.

We detected two willow flycatchers on 31 May, four on 13 June, and one on 22 June. The site was surveyed five times, totaling 9.8 observer-hours. Cowbirds were detected on all surveys, and there was evidence of burros using the site.

Adobe Lake

Area: 7.6 ha Elevation: 60 m

This mixed-exotic site consists primarily of dense tamarisk (5 to 7 m in height) with many dead branches in the understory. There are scattered Goodding willows up to 10 m in height. Canopy closure within the site is 70–90%. The site is adjacent to the Colorado River, but hydrological conditions in the interior of the site were undetermined.

We detected 10 willow flycatchers on 31 May and 2 on 15 June. One of the flycatchers detected on 31 May was banded on at least one leg. The site was surveyed five times, totaling 5.5 observer-hours. Cowbirds were detected on three visits, and no evidence of livestock use was observed.

Rattlesnake

Area: 7.6 ha Elevation: 60 m

This mixed-native site is a patchwork of emergent Goodding willow, strips of dense coyote willow 6–8 m in height, and tamarisk. Tamarisk is widespread in patches throughout the site but is not the dominant vegetation. Canopy closure is 70–90%. Large cattail marshes separate this site from the Colorado River. Portions of the site held standing water throughout the season.

We detected three willow flycatchers on 30 May and one on 13 June. The site was surveyed five times, totaling 8.9 observer-hours. Cowbirds were detected on all surveys, and there was no evidence of livestock use.

Clear Lake/The Alley

Area: 8.3 ha Elevation: 59 m

Vegetation at this site is primarily exotic, consisting of monotypic tamarisk 8–10 m in height. Emergent Goodding willows, up to 13 m in height, are scattered throughout the site. The tamarisk is mature, with large amounts of deadfall ground cover, and canopy closure is approximately 90%. The site is surrounded on the east, north, and west by upland desert and is bordered on the south by cattail marshes and common reed. A narrow, backwater channel runs northward from the Colorado River into the center

of the site, and soils immediately adjacent to the channel were inundated or saturated. Soils in the interior of the site, however, were dry throughout the survey season.

We detected six willow flycatchers on 1 June. We surveyed the site five times for a total of 11.6 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Nursery NW

Area: 7.0 ha Elevation: 58 m

This mixed-exotic site lies between the Colorado River and a cattail marsh. The dominant vegetation is tamarisk approximately 5 m in height with an understory of common reed. Mesquite trees are scattered along the western edge of the site. The eastern edge of the site, adjacent to the cattail marsh, has a stand of Goodding willow 9 m in height. Overall canopy closure is around 70%. Surface water was present under the willows in May.

No willow flycatchers were detected. The site was surveyed five times, totaling 3.1 observer-hours. Cowbirds were detected on all visits, and there was no evidence of livestock use.

Imperial Nursery

Area: 1.4 ha Elevation: 58 m

This site is a cottonwood planting managed by the Imperial NWR. The cottonwoods are approximately 12 m in height. The edges of the site are vegetated by arrowweed and seep willow, with a few honey mesquite in the northwestern corner of the site. The understory is very sparse, and canopy closure is approximately 90%. The site is bordered to the north by a patchwork of cattails, common reed, and tamarisk. This site is flood irrigated.

No willow flycatchers were detected. The site was surveyed five times, totaling 2.2 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Ferguson Lake

Area: 21.1 ha Elevation: 57 m

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with scattered, emergent Goodding willow 10 m in height along the western edge of the site bordering Ferguson Lake. Tamarisk 5–6 m in height is the dominant understory species, and it forms a continuous canopy in portions of the site. The site also contains patches of arrowweed with scattered screwbean mesquite and little canopy cover. The northwestern corner of the site up to 50 m from the lakeshore had damp soils in May and June and standing water in July. A cattail marsh is present in the southwestern corner of this site; it had standing water when it was visited in late May.

We detected 12 willow flycatchers on 29 May. The site was surveyed five times, totaling 6.8 observer-hours. Cowbirds were detected on all but one visit, and no signs of livestock use were observed.

Ferguson Wash

Area: 6.8 ha Elevation: 58 m

This mixed-exotic site, at the outflow of Ferguson Wash into Ferguson Lake, is dominated by dense, mature tamarisk approximately 7 m in height, with dense deadfall in the understory. A few scattered, emergent Goodding willows are present near the lake, and canopy closure is around 70%. The site is bordered on the lakeside by cattails and bulrush and on the upland side by desertscrub. A backwater channel penetrates to the interior of the site, although the banks along the channel are abrupt and do not allow water to flow under the vegetation in this area. Another backwater channel runs along the southeastern edge of the site. The banks along this channel are less abrupt, allowing water to penetrate a few meters into the woody vegetation in a few places along the channel edge. Soils in the interior of the site were dry throughout the survey season. Because the site contains so little water under mature vegetation, and soils in the majority of the site are completely dry, we recommend biennial surveys at this site.

We detected two willow flycatchers on 29 May. The site was surveyed five times, totaling 9.2 observer-hours. Cowbirds were recorded on all visits, and evidence of burros was present in the site.

Great Blue Heron

Area: 7.1 ha Elevation: 58 m

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willows form an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. The center of the site has several fallen willows. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. Standing water was present in May, and saturated soils were noted within the site throughout the survey season near Martinez Lake.

We detected two willow flycatchers on 23 May and one on 14 June. The site was surveyed five times, totaling 13.8 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

Mittry Lake, Arizona and California

Mittry West

Area: 4.4 ha Elevation: 48 m

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Canopy closure is approximately 80%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. There are patches of cattail within the site. Surface water was present in the site during May and June, with saturated soils present until July.

We detected two willow flycatchers on 28 May. The site was visited five times, totaling 10.5 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

Mittry South

Area: 15.2 ha Elevation: 46 m

This monotypic tamarisk site lies immediately adjacent to Mittry Lake. Vegetation at the site is very dense, with abundant dead branches and deadfall in the understory. Canopy closure within the tamarisk is >90%, and canopy height is approximately 8 m. The site is bordered to the south by Mittry Lake, and the edge of the lake is vegetated by cattail, bulrush, and common reed. Water from the lake does not extend under the woody vegetation, and soils in the site were very dry throughout the survey season.

We detected two willow flycatchers on 28 May. The site was visited five times, totaling 6.5 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

Yuma, Arizona

Gila Confluence North

Area: 2.2 ha Elevation: 40 m

This mixed-native site borders the northern side of the Colorado River at the confluence of the Gila and Colorado Rivers. Overstory vegetation at the site is a combination of Goodding willow and cottonwood 9 m in height. Dense stands of these trees surround a cattail marsh near the center of the site. Cattail marsh is also present along the river, and there is an open area of common reed in the center of the site. Canopy closure is variable and averages around 50%. Arrowweed, tamarisk, and seep willow are common in the understory. Surface water was present in the marshy areas along the edge of the river throughout the survey season, and shallow pools of water were also present in the common reed patch in July.

We detected five willow flycatchers on 2 June, five on 16 June, and two on 21 June. The site was surveyed five times, totaling 10.25 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

DISCUSSION

The areas occupied in 2008 by breeding flycatchers (Pahranagat NWR, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams River NWR) consistently held resident and breeding flycatchers in previous years (McKernan and Braden 2002, McLeod et al. 2008a; details of residency and breeding in 2008 are presented in Chapters 3 and 4 of this document). We detected unpaired, resident flycatchers in two new areas. One resident flycatcher was detected at Iceberg Canyon on the Lake Mead Delta. This site consists of newly developed vegetation and had not been previously surveyed. The development and persistence of vegetation at this site will likely be influenced by the level of Lake Mead. A resident flycatcher was also detected on the Ahakhav Tribal Preserve at Deer Island, which we had not surveyed prior to 2008. This was the first detection of a resident willow flycatcher south of Bill Williams since 2003, although we did not survey any areas between Bill Williams and Big Hole Slough in 2003–2007. Deer Island does not resemble typical occupied flycatcher habitat. Dense vegetation occurs only in a narrow strip on the edge of a long backwater slough, overall canopy closure is very sparse, and canopy height is low. Future surveys will reveal whether this area is typically occupied by flycatchers or if flycatcher occupancy at Deer Island was an anomalous occurrence.

The association between surface water and flycatcher occupancy and breeding is noted consistently in the literature, and we observed an association between the presence of breeding flycatchers and surface water at Bill Williams, with flycatchers breeding only in years when sites contained standing water (McLeod et al. 2008b, this document). Factors in addition to the presence of standing water during the breeding season appear to be influencing the presence and numbers of flycatchers at Topock Marsh. The amount of standing water throughout the entire Topock study area was markedly reduced in 2005 compared to 2003–2004 and 2006–2008, and sites in 2008 were as wet or wetter than in any previous year. The number of flycatchers recorded at Topock since 2003 does not appear to be related to the amount of standing water present during the breeding season, with 25, 67, 41, 37, 31, and 30 adults recorded in 2003–2008, respectively. Factors such as reproductive rates, survival, or other abiotic conditions may be influencing the demographics of this local population. Hydrologic conditions within the sites at Topock prior to mid-May of each year are unknown; conditions prior to flycatcher arrival could influence habitat conditions and flycatcher occupancy.

In an effort to locate all potentially suitable willow flycatcher habitat within the Bill Williams River NWR, we continued habitat reconnaissance and opportunistic surveys initiated in 2006 and 2007. We revisited most sites that had been identified in 2006 or 2007 as warranting further investigation and evaluated four additional areas. Although the Bill Williams River NWR contains the largest expanse of native cottonwood-willow forest on the lower Colorado River, at this time vegetation structure and hydrological conditions along most of the river corridor are not characteristic of willow flycatcher breeding habitat. We determined that several of the areas we revisited are unlikely to support flycatchers unless the Bill Williams River experiences floods that might alter hydrological conditions.

We continued to observe habitat changes in lower Grand Canyon and on the Lake Mead Delta as water levels in Lake Mead continued to decline between 2007 and 2008. Several sites that were occupied in 2006 but were dead or dying by the end of the 2007 survey season were not surveyed in 2008 because of the lack of live vegetation. Only one new site, at the mouth of Iceberg Canyon, had emerged between 2007 and 2008; this site had the only flycatcher detected in Grand Canyon in 2008. If Lake Mead continues to decline, we expect this pattern to continue, with once-suitable habitat becoming elevated above the water table and vegetation emerging on newly exposed sediments.

Although many flycatchers were recorded at sites surveyed south of the Colorado River Indian Reservation until 15 June, and 23 detections were recorded post 15 June, monitoring results at these sites suggest these flycatchers were not resident or breeding individuals. Based upon the variation in total numbers of flycatchers detected at a particular site over the survey period (e.g., 10 flycatcher detections at Adobe Lake on 31 May, 2 on 15 June, and 0 on three subsequent surveys), and the overall lack of territorial, aggressive behaviors exhibited toward conspecific broadcasts, willow flycatchers detected these sites were most likely migrants. These results are consistent with those recorded in 2003–2007 (McLeod et al. 2008a). One banded flycatcher was detected at Adobe Lake on 31 May, but the observer was unable to determine the color combination. We banded migrant willow flycatchers at sites on the extreme southern stretches of the Colorado River near Yuma in 2003–2007, and without confirmation of the color combination, we cannot determine whether the flycatcher was banded as a resident Southwestern Willow Flycatcher or whether it was banded during migration and might belong to a different subspecies.

In 2008 we implemented a biennial survey schedule at selected sites in study areas where resident flycatchers have not been documented in the last 10 years of surveys. Sites were selected for biennial surveys based on the absence of damp or wet soils within the site and/or the relative absence of dense vegetation that might provide suitable nesting habitat for flycatchers. Ground reconnaissance completed during the 2008 field season revealed that Havasu NE and Ferguson Wash do not contain wet soils within the vegetation, and we recommend that these sites be added to the biennial schedule. In addition, we

identified several sites at Bill Williams where no resident flycatchers have been detected since 2003 and where surface water exists only in river channels and not within the vegetation. We recommend that these sites (Site #2, Site #11, Beaver Pond, Mineral Wash, and Site #8) be surveyed on a biennial basis as well.

Chapter 3

COLOR-BANDING AND RESIGHTING

INTRODUCTION

Long-term monitoring of willow flycatchers of known identity, sex, and age is the only effective way to determine demographic life history parameters such as annual survivorship of adults and young, site fidelity, seasonal and between-year movements, and population structure. Thus, as an integral part of our studies, we captured and uniquely color-banded as many willow flycatchers as possible, allowing field personnel to resight individuals throughout the breeding season, as well as in subsequent years. Resighting consisted of using binoculars to determine the identity of a color-banded flycatcher by observing, from a distance, the unique color combination on its legs. This allowed field personnel to detect and monitor individuals without recapturing each bird. This was our sixth consecutive year of color-banding studies and builds upon color-banding initiated at these sites in 1997 (McKernan and Braden 1998).

METHODS

Color-banding

From early May through mid-August, we captured, uniquely color-banded, and subsequently monitored adult and nestling willow flycatchers at all study areas where resident willow flycatchers were detected. The color-banding effort also included opportunistic banding at Key Pittman Wildlife Management Area in Nevada (in cooperation with Nevada Division of Wildlife), along Las Vegas Wash (in cooperation with Southern Nevada Water Authority), and in St. George, Utah (in cooperation with Utah Division of Wildlife Resources).

Adult flycatchers were captured with mist-nets, which provide the most effective technique for live-capture of adult songbirds (Ralph et al. 1993). We used a targeted capture technique (per Sogge et al. 2001), whereby a variety of conspecific vocalizations were broadcast from a CD player and remote speakers to lure territorial flycatchers into the nets. In addition, we used "passive netting," whereby several mist-nets were erected and periodically checked, with no broadcast of conspecific vocalizations. We banded each adult willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and a colored metal band on the other. We coordinated all color combinations with the Federal Bird Banding Laboratory and all other Southwestern Willow Flycatcher banding projects to minimize replication of color combinations. For each color-banded bird recaptured, we visually inspected the legs and noted any evidence of irritation or injury that may be related to the presence of leg bands.

Nestlings were banded at 8 to 10 days of age, when they were large enough to retain the leg bands, yet young enough that they would not prematurely fledge from the nest (Whitfield 1990, Paxton et al. 1997). Nestlings were banded only when the location of the nest was such that nest access and removal/replacement of the nestlings would not endanger the nest, nest plant, or nestlings. Nestlings were also banded with a single, numbered federal band on one leg and a metal color-band on the other leg. In previous years, we banded each nestling only with a single federal band, identifying it as a returning nestling in the event it returned in a subsequent year.

For each captured adult willow flycatcher, we recorded morphological measurements including culmen, tail, wing, fat level, and molt onto standardized data forms (Appendix A). Sex was determined based on the presence of a cloacal protuberance in males or brood patch and/or egg(s) in the oviduct for females. Captured flycatchers lacking breeding characteristics and not observed engaging in male advertising song (see below) were sexed as unknown. Flycatchers with retained primary, secondary, and/or primary covert feathers (multiple aged remiges) were aged as second year adults, and those without (uniformly aged remiges) were aged as after second year (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). Individuals in juvenile plumage (unworn flight feathers and body plumage with broad, buff colored wing bars and fleshy gape) were aged as hatch year.

Resighting

We determined the identity of a color-banded flycatcher by observing with binoculars, from a distance, the unique color combination on its legs. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed. Field personnel typically spent the early part of each morning color-banding, and directed their efforts to resighting as daylight increased and flycatchers became more difficult to capture. All banding, monitoring, and survey field personnel coordinated resighting efforts and recorded observations of color-banded and unbanded flycatchers onto standardized data forms (Appendix A). For resighted flycatchers (i.e., one for which at least one leg was seen clearly enough to determine the presence or absence of a band), we recorded color-band combinations, territory number, site, standardized confidence levels of the resight, and behavioral observations. Willow flycatchers for which detections spanned one week or longer were considered resident at a site, regardless of the portion of the breeding season in which the bird was observed or whether a possible mate was observed. Flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male, and flycatchers observed carrying nest material or constructing or incubating a nest were sexed as female. Flycatchers not observed engaging in one of these diagnostic activities were sexed as unknown.

Inactive territories were visited at least three times (each visit four days apart) before territory visits stopped. All territories were assigned a unique alphanumeric code and were plotted onto high-resolution aerial photographs, thus producing a spatial representation of the flycatcher population at each study location. Flycatchers were determined to be unpaired if none of the following breeding behaviors were observed: presence of another unchallenged flycatcher in the immediate vicinity, counter calling (***whitts***) with a nearby flycatcher, interaction twitter calls (***churr/kitters***) with a nearby flycatcher, a flycatcher in the immediate vicinity carrying nesting material, a flycatcher in the immediate vicinity carrying food or fecal sac, or adult flycatchers feeding young (per Sogge et al. 1997).

Unbanded flycatchers could not be identified to individual, but an unbanded flycatcher detected in a given location on multiple, consecutive visits was assumed to be the same individual. If an unbanded flycatcher was detected at a given location on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered to be different individuals in the absence of behavioral observations indicating the flycatcher was actively defending a territory or was a member of a breeding pair.

RESULTS

All Monitoring Sites

Color-Banding and Resighting – Field personnel color-banded 18 new adult flycatchers and recaptured 6 individuals previously captured as adults. An additional 50 adults were identified to individual via resighting, while 4 individuals were resighted but did not have their color combinations confirmed, and 1 individual had federal band on one leg and an injury on the other leg. We detected 14 individuals identified as returning nestlings by the presence of a single federal band, with 4 (29%) identified to individual via recapture. Twenty-five adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 17 adults. Overall, 69% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.1). We banded 74 nestlings from 29 nests. Of the 74 nestlings banded, 4 were known or suspected to have died before fledging. For details on all banded flycatchers detected at the study areas from 2003 to 2008, see Appendix D.

Site-by-Site Color-Banding and Resighting

Monitoring Sites

Pahranagat – We detected 24 resident, adult willow flycatchers from 17 territories at Pahranagat. In addition to resident adults, we detected two individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Of the 17 territories recorded at Pahranagat, 9 consisted of breeding pairs and 8 consisted of unpaired males. Of the breeding individuals, two males were polygynous with two females.

Field personnel captured and color-banded three new adults and recaptured one flycatcher previously captured as an adult. We resighted and confirmed band combinations for an additional 16 adults. We recaptured two individuals originally banded as nestlings in 2005; both were unpaired males (see Table 3.6 for juvenile dispersal data). Two adults had bands but the combination could not be confirmed, and the presence of bands could not be determined for one adult. Of all the adults detected, one, for which residency and/or breeding status could not be confirmed, remained unbanded. We banded 19 nestlings from six nests. Of the banded nestlings, one was suspected to have died before fledging. We resighted four unbanded fledglings from two additional nests.

Littlefield – We detected one willow flycatcher at Littlefield. This individual was unbanded, and residency and breeding status could not be confirmed (Table 3.2).

Mesquite – We detected 24 resident, adult willow flycatchers from 14 territories at Mesquite. In addition to resident adults, we detected three individuals for which residency and/or breeding status could not be determined. Of the 14 territories recorded at Mesquite, 11 consisted of paired individuals and 3 consisted of unpaired males (Table 3.2). Of the breeding individuals, one male was polygynous with two females.

Field personnel captured and color-banded one new adult flycatcher and recaptured one flycatcher previously captured as an adult. We confirmed the identities of an additional 15 adults via resighting. One additional adult had a federal band on one leg and an injury on the opposite leg. We captured one returning nestling that was originally banded as a juvenile in 2006 and resighted another returning nestling for which study area and year banded could not be determined because we were unable to recapture this individual. Three additional resident adults remained unbanded, and band status could not be determined for two. Band status could also not be determined for two individuals for which residency

and/or breeding status could not be confirmed. We banded 20 nestlings from eight nests; two of these nestlings were suspected to have died before fledging. We resighted one unbanded fledgling from a ninth nest.

Mormon Mesa – We detected 26 resident, adult willow flycatchers from 17 territories at Mormon Mesa. In addition to resident adults, we detected four individuals for which residency could not be confirmed (Table 3.2). Of the 17 territories recorded at Mormon Mesa, 13 consisted of breeding individuals and 4 consisted of unpaired males. Of the resident individuals, one female nested at Virgin River #2 and then moved to Muddy River where she had a second nesting attempt. Of the breeding individuals, four males were each polygynous with two females.

Field personnel captured and color-banded four new adults and recaptured two flycatchers previously captured as adults. We resighted and identified 13 additional returning adults. We captured one returning nestling originally banded as a juvenile in 2007 and resighted an additional three returning nestlings that we were unable to recapture Six adults remained unbanded, and the band status of one individual, for which residency could not be confirmed, was undetermined. We banded 23 nestlings from nine nests. One of these nestlings was known to have died before fledging.

Muddy River – We detected eight resident, adult willow flycatchers from six territories at Muddy River. In addition to resident adults, we detected three individuals for which residency could not be confirmed. Of the six territories recorded, four consisted of breeding individuals and two consisted of unpaired males (Table 3.2). Of the resident individuals, one female nested at Mormon Mesa earlier in the season. Of the breeding individuals, one male was polygynous with three females.

Field personnel captured and color-banded two new adults and recaptured two individuals previously captured as adults. We resighted and identified two other adults and resighted one adult for which band combination could not be confirmed. We resighted one returning nestling but could not capture this individual to determine year and study area of origin. Three adults remained unbanded. We banded three nestlings from one nest and resighted one unbanded fledgling from another nest.

Grand Canyon – We detected one resident, adult willow flycatcher at Iceberg Canyon on the Lake Mead Delta (Table 3.2). Field personnel captured and color-banded this new adult.

Topock – We detected 20 resident, adult willow flycatchers from 12 territories at Topock. In addition to resident adults, we detected 10 individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Five of these individuals were detected for only one day in mid- to late May or early June and were suspected to be migrants. Of the 12 territories recorded at Topock, 9 consisted of paired individuals and 3 consisted of unpaired males. Of the breeding individuals, one male was consecutively polygynous with two females.

Field personnel captured and color-banded three new adults. We resighted and identified four other banded adults. We resighted five returning nestlings but were unable to capture these individuals to determine their identity. The band status of one resident individual could not be determined, and seven resident individuals remained unbanded. Eight of the ten individuals for which residency and/or breeding status could not be confirmed were of unknown band status and two were unbanded. We banded three nestlings from two nests.

Table 3.1. Summary of Willow Flycatchers Detected at Monitored Sites during the 2008 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Previously Captured as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Pahranagat	North	26	3	1	2	16	0	1	1	2	19(6)	0	**96**
	Study Area Total	**26**	**3**	**1**	**2**	**16**	**0**	**1**	**1**	**2**	**19(6)**	**0**	**96**
Littlefield	Poles	1	0	0	0	0	0	1	0	0	0	0	0
	Study Area Total	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Mesquite	East	1	0	0	0	0	0	0	1	0	0	0	0
	West	25	1	1	1	15	2[1]	3	2	0	20(8)	0	80
	Bunker Farm	1	0	0	0	0	0	0	1	0	0	0	0
	Study Area Total	**27**	**1**	**1**	**1**	**15**	**2**	**3**	**4**	**0**	**20(8)**	**0**	**74**
Mormon Mesa	Mormon Mesa South (North)	2	0	0	0	0	0	1	1	0	0	0	0
	Virgin River #1 (North)	2	1	0	0	1	0	0	0	0	3(1)	0	100
	Virgin River #1 (South)	19	2	2	1	9	2[2]	3	0	0	19(7)	0	84
	Virgin River #2	7	1	0	0	3[3]	1[2]	2	0	0	1(1)	0	71
	Study Area Total	**30**	**4**	**2**	**1**	**13**	**3**	**6**	**1**	**0**	**23(9)**	**0**	**77**
Muddy River	Overton WMA Pond	1	0	0	0	0	0	1	0	0	0	0	0
	Overton WMA	10	2	2	0	2[3]	1[2]	2	0	1	3(1)	0	80
	Study Area Total	**11**	**2**	**2**	**0**	**2**	**1**	**3**	**0**	**1**	**3(1)**	**0**	**73**
Grand Canyon	Iceberg Canyon	1	1	0	0	0	0	0	0	0	0	0	100
	Study Area Total	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**100**
Topock	Pipes #3	2	1	0	0	0	1[2]	0	0	0	2(1)	0	100
	The Wallows	1	0	0	0	0	0	0	1	0	0	0	0
	In Between	1	0	0	0	0	0	0	1	0	0	0	0
	Pierced Egg	12	2	0	0	1	3[2]	5	1	0	0	0	50
	IRFB04	1	0	0	0	0	0	0	1	0	0	0	0
	250M	1	0	0	0	0	0	0	1	0	0	0	0
	Channel[5]	1	0	0	0	0	0	0	1	0	0	0	0
	Glory Hole	8	0	0	0	3	1[2]	4	0	0	1(1)	0	50
	Beal Lake	3	0	0	0	0	0	0	3	0	0	0	0
	Study Area Total	**30**	**3**	**0**	**0**	**4**	**5**	**9**	**9**	**0**	**3(2)**	**0**	**40**
Bill Williams	Site #4	1	0	0	0	0	0	0	1	0	0	0	0
	Site #3	7	4	0	0	1	0	1	0	1	6(3)	0	86
	Study Area Total	**8**	**4**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**6(3)**	**0**	**75**
Ahakhav	Deer Island	2	0	0	0	0	0	1	1	0	0	0	0
	Study Area Total	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**
Total		**135**[4]	**18**	**6**	**4**	**50**[4]	**11**	**25**	**17**	**4**	**74(29)**	**0**	**69**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Tables 3.2–3.16.

[1] One individual had silver federal band only and had a visible injury on the unbanded left leg; a male with silver federal band number 2390-92434 and a visible injury on the unbanded left leg was captured at Mesquite in 2005, and this is likely the same individual. Other individual was a returning nestling.

[2] Returning nestling(s).

[3] One individual moved from Mormon Mesa Virgin River #2 to Muddy River Overton WMA.

[4] The individual that moved between study areas is tallied only once in the total.

[5] Not a formal survey site. Flycatchers detected en route.

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	20-Jun-04	2320-31657	WO(M):EE	N/A	A6Y	F	1	RS
	North	4-Jun-02	2370-40015	PU:WG(M)	N/A	A8Y	M	1	RS
	North	1-Jul-08	2430-61114	WR(M):XX	N/A	L	U	1	N
	North	1-Jul-08	2430-61113	XX:OO(M)	N/A	L	U	1	N
	North	1-Jul-08	2430-61112	BD(M):XX	N/A	L	U	1	N
	North	INA	INA	undetermined	N/A	AHY	F	2	
	North	6-Aug-01	2320-31592	GO(M):EE	N/A	8Y	M	2	RS
	North	30-Jun-08	2430-61107	WY(M):XX	N/A	L	U	2	N[9]
	North	30-Jun-08	2430-61108	XX:OD(M)	N/A	L	U	2	N[9]
	North	30-Jun-08	2430-61106	XX:KV(M)	N/A	L	U	2	N[9]
	North	30-Jun-08	2430-61115	XX:GV(M)	N/A	L	U	2	N[9]
	North	26-Jul-07	2370-40168	PU:KOK(M)	N/A	3Y	F	4	RS
	North	15-May-04	2320-31590	GR(M):EE	N/A	A6Y	M	4, 26	RS
	North	1-Jul-08	2430-61118	XX:KK(M)	N/A	L	U	4	N
	North	1-Jul-08	2430-61117	VY(M):XX	N/A	L	U	4	N
	North	3-Jul-08	2430-61197	XX:VY(M)	N/A	L	U	4	N
	North	19-Jun-07	2370-40195	YWY(M):PU	N/A	3Y	F	5	RS
	North	23-Jul-02	2370-39952	BB(M):PU	N/A	A8Y	M	5	RS
	North	6-Jul-08	2430-61198	XX:KR(M)	N/A	L	U	5	N
	North	6-Jul-08	2430-61199	RW(M):XX	N/A	L	U	5	N
	North	6-Jul-08	2430-61200	XX:WW(M)	N/A	L	U	5	N
	North	18-Jun-04	none	RR(M):no foot	N/A	A6Y	F	24	R 29 Jun
	North	19-Jul-08	2430-61080	YY(M):XX	N/A	SY	M	24, 27	N
	North	N/A	N/A	UB:UB	N/A	HY	U	24	RS

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	30-Jun-05	2320-31698	RB(M):EE	N/A	4Y	F	26	RS
	North	15-Jul-08	2430-61124	OY(M):XX	N/A	L	U	26	N
	North	15-Jul-08	2430-61123	XX:VK(M)	N/A	L	U	26	N
	North	15-Jul-08	2430-61122	YW(M):XX	N/A	L	U	26	N
	North	17-Jun-07	2370-40194	PU:BR(M)	N/A	3Y	F	27	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	27	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	27	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	27	RS
	North	1-Jul-06	2370-40047	PU:DD(M)	N/A	A4Y	F	85	RS
	North	2-Jun-05	2370-39953	OB(M):PU	N/A	A5Y	M	85	RS
	North	1-Jul-08	2430-61111	WV(M):XX	N/A	L	U	85	N
	North	1-Jul-08	2430-61120	XX:KO(M)	N/A	L	U	85	N
	North	1-Jul-08	2430-61119	WK(M):XX	N/A	L	U	85	N
	North	17-Jun-04	None[10]	no foot:DW(M)	EE:DW(M)	6Y	F	86	RS
	North	21-Jun-06	2370-40060	YG(M):PU	N/A	A4Y	M	86	RS
	North	6-Jul-05	2360-59711	KB(M):EE	UB:EE	4Y	M	T3	R 20 May and 28 Jun; detected 19 May–25 Jul
	North	25-Jul-05	2370-39915	PU:RZ(M)	N/A	A5Y	M	T23	RS; detected 19 May–11 Jul
	North	INA	INA	banded	N/A	AHY	M	T25	RS; detected 13 Jun–6 Jul
	North	3-Aug-08	2430-61127	XX:WG(M)	N/A	AHY	M	T28	N; detected 23 Jul–3 Aug
	North	24-Jul-08	2430-61083	XX:RW(M)	N/A	SY	M	T61	N; detected 21–31 Jul
	North	1-Jun-05	2370-39951	PU:OZ(M)	N/A	A5Y	M	T83	RS; detected 14 May–13 Jul
	North	6-Jul-05	2360-59712	EE:GKG	EE:UB	4Y	M	T84	R 6 Jun; detected 29 May–19 Jul
	North	18-May-04	2320-31595	WKW(M):EE	N/A	A6Y	M	T99	RS; detected 19 May–12 Jul
	North	INA	INA	banded	N/A	AHY	U	F23	RS; detected 23 Jul

AR063871

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	N/A	N/A	UB:UB	N/A	AHY	M	F88	RS; detected 16 Jul
LIFI	Poles	N/A	N/A	UB:UB	N/A	AHY	M	F89	RS; detected 22 Jul
MESQ	West	5-Jul-07	2370-40193	GY(M):PU	N/A	A3Y	F	2	RS
	West	8-Jun-05	2370-39954	BO(M):PU	N/A	A5Y	M	2	RS
	West	N/A	N/A	UB:UB	N/A	HY	U	2	RS
	West	27-Jun-07	2370-40170	RG(M):PU	N/A	A3Y	F	3	RS
	West	3-Jun-04	2320-31490	EE:OO(M)	N/A	A6Y	M	3, 97	RS
	West	28-Jun-08	2430-61184	GV(M):XX	N/A	L	U	3	N
	West	28-Jun-08	2430-61186	KO(M):XX	N/A	L	U	3	N
	West	28-Jun-08	2430-61185	DB(M):XX	N/A	L	U	3	N
	West	1-Aug-03	2320-31445	EE:WK(M)	N/A	A7Y	F	20	RS
	West	26-Jul-01	2390-92475	XX:WY(M)	N/A	8Y	M	20	RS
	West	28-Jun-08	2430-61187	KV(M):XX	N/A	L	U	20	N[11]
	West	28-Jun-08	2430-61188	BG(M):XX	N/A	L	U	20	N[11]
	West	28-Jun-08	2430-61189	KB(M):XX	N/A	L	U	20	N[11]
	West	6-Jul-04	2320-31573	WY(M):EE	N/A	A6Y	F	21	RS
	West	15-Jul-05	2320-31688	EE:BG(M)	N/A	4Y	M	21	RS
	West	1-Jul-08	2430-61190	XX:DB(M)	N/A	L	U	21	N[6]
	West	1-Jul-08	2430-61165	XX:RY(M)	N/A	L	U	21	N[6]
	West	INA	INA	undetermined	N/A	AHY	F	22	
	West	18-May-06	2370-39937	KK(M):PU	N/A	4Y	M	22	RS
	West	INA	INA	UB:EE	N/A	AHY	F	40	RS
	West	30-May-08	2430-61105	XX:YY(M)	N/A	AHY	M	40	N
	West	18-Jul-08	2430-61121	YO(M):XX	N/A	L	U	40	N

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	18-Jul-08	2430-61078	BY(M):XX	N/A	L	U	40	N
	West	23-Jun-04	2320-31498	KW(M):EE	N/A	5Y	F	82	RS
	West	4-Jul-01	2390-92434[12]	UB:XX	N/A	8Y	M	82	RS
	West	8-Jul-08	2430-61130	VK(M):XX	N/A	L	U	82	N
	West	8-Jul-08	2430-61129	XX:KD(M)	N/A	L	U	82	N
	West	N/A	N/A	UB:UB	N/A	AHY	F	84	RS
	West	7-Jun-06	2370-39967	KO(M):PU	N/A	A4Y	M	84	R 20 Jun
	West	24-Jun-08	2430-61175	BR(M):XX	N/A	L	U	84	N
	West	24-Jun-08	2430-61176	DK(M):XX	N/A	L	U	84	N
	West	24-Jun-08	2430-61177	XX:OW(M)	N/A	L	U	84	N
	West	20-Jul-06	2370-40066	YO(M):PU	N/A	4Y	F	85	RS
	West	6-Jul-06	2360-59751	OG(M):EE	N/A	3Y	M	85	RS
	West	2-Jul-08	2430-61194	VB(M):XX	N/A	L	U	85	N
	West	2-Jul-08	2430-61195	RY(M):XX	N/A	L	U	85	N
	West	2-Jul-08	2430-61196	XX:WV(M)	N/A	L	U	85	N
	West	N/A	N/A	UB:UB	N/A	AHY	F	88	RS
	West	INA	INA	undetermined	N/A	AHY	M	88	
	West	25-Jul-08	2430-61082	XX:VG(M)	N/A	L	U	88	N
	West	25-Jul-08	2430-61084	XX:BO(M)	N/A	L	U	88	N
	West	26-Jul-07	2370-40087	PU:BZ(M)	N/A	A3Y	F	97	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	T23	RS; detected 10 Jul–1 Aug
	West	3-Jun-07	2370-40197	OG(M):PU	N/A	A3Y	M	T86	RS; detected 30 May–12 Jul
	West	7-Jul-06	2360-59754	OR(M):EE	N/A	3Y	M	T87	RS; detected 30 May–8 Jul
	Bunker Farm	INA	INA	undetermined	N/A	AHY	U	F41	Detected 5 Jun

AR063873

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	7-Jul-06	2360-59752	DRD(M):EE	UB:EE	3Y	M	F43	R 27 Jul; detected 25–27 Jul
	East	INA	INA	undetermined	N/A	AHY	U	F90	Detected 22 Jul
MOME	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	1	RS
	Virgin River #1 South	29-Jun-06	2360-59749	BG(M):EE	N/A	3Y	M	1	RS
	Virgin River #1 South	23-Jun-08	2430-61206	XX:BW(M)	N/A	L	U	1	N
	Virgin River #1 South	23-Jun-08	2430-61207	GO(M):XX	N/A	L	U	1	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	3	RS
	Virgin River #1 South	14-Jun-06	2370-40046	PU:DK(M)	N/A	4Y	M	3, 87	R 24 Jul
	Virgin River #1 South	17-Jul-08	2430-61132	OR(M):XX	N/A	L	U	3	N
	Virgin River #1 South	17-Jul-08	2430-61131	VW(M):XX	N/A	L	U	3	N
	Virgin River #1 South	17-Jul-08	2430-61128	XX:WO(M)	N/A	L	U	3	N
	Virgin River #2	N/A	N/A	UB:UB	N/A	AHY	F	25	RS
	Virgin River #2	19-Jun-08	2430-61167	XX:KW(M)	N/A	AHY	M	25	N
	Virgin River #2	13-Jul-08	2430-61133	WD(M):XX	N/A	L	U	25	N
	Virgin River #1 South	23-Jul-03	2320-31486	YV(M):EE	N/A	6Y	F	28	RS
	Virgin River #1 South	6-Jul-06	2360-59799	EE:OZ(M)	N/A	3Y	M	28, 30	RS
	Virgin River #1 South	28-Jun-08	2430-61168	XX:YW(M)	N/A	L	U	28	N
	Virgin River #1 South	28-Jun-08	2430-61169	XX:YV(M)	N/A	L	U	28	N
	Virgin River #1 South	28-Jun-08	2430-61170	XX:YO(M)	N/A	L	U	28	N
	Virgin River #1 South	28-Jun-08	2430-61171	XX:YG(M)	N/A	L	U	28	N
	Virgin River #1 South	20-Jul-08	2430-61079	RR(M):XX	N/A	SY	F	30	N
	Virgin River #1 South	20-Jul-08	2430-61077	GB(M):XX	N/A	L	U	30	N
	Virgin River #1 South	20-Jul-08	2430-61081	UB:XX	N/A	L	U	30	N
	Virgin River #1 North	2-Jul-08	2430-61116	VV(M):XX	N/A	AHY	F	40	N

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 North	15-May-07	2370-40161	PU:DY(M)	N/A	A3Y	M	40	RS
	Virgin River #1 North	1-Jul-08	2430-61193	VG(M):XX	N/A	L	U	40	N
	Virgin River #1 North	1-Jul-08	2430-61191	XX:BD(M)	N/A	L	U	40	N
	Virgin River #1 North	1-Jul-08	2430-61192	XX:OB(M)	N/A	L	U	40	N
	Virgin River #1 South	21-Jun-07	2370-40191	PU:RYR(M)	N/A	A3Y	F	63	RS
	Virgin River #1 South	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A8Y	M	63, 96	RS
	Virgin River #1 South	23-Jun-08	2430-61203	XX:GB(M)	N/A	L	U	63	N
	Virgin River #1 South	23-Jun-08	2430-61204	XX:YB(M)	N/A	L	U	63	N
	Virgin River #1 South	23-Jun-08	2430-61202	DR(M):XX	N/A	L	U	63	N
	Virgin River #1 South	23-Jun-08	2430-61205	DY(M):XX	N/A	L	U	63	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	64	RS
	Virgin River #1 South	8-Jun-06	2370-39938	KG(M):PU	N/A	4Y	M	64	RS
	Virgin River #1 South	INA	INA	EE:UB	N/A	AHY	F	65	RS
	Virgin River #1 South	12-Jun-07	2370-40172[13]	RK(M):UB	PU:RO(M)	A3Y	M	65	R 24 Jul
	Virgin River #1 South	27-Jul-08	2430-61212	KG(M):XX	N/A	L	U	65	N[14]
	Virgin River #2	16-Jul-04	2320-31632	RZ(M):EE	N/A	6Y	F	86	RS; moved to Muddy River
	Virgin River #2	23-Jun-03	2370-39940	GY(M):PU	N/A	A4Y	M	86, 88	RS
	Virgin River #1 South	6-Aug-05	2360-59788	BO(M):EE	N/A	4Y	F	87	RS
	Virgin River #1 South	23-Jun-08	2430-61172	XX:GR(M)	N/A	L	U	87	N
	Virgin River #1 South	23-Jun-08	2430-61173	XX:GY(M)	N/A	L	U	87	N
	Virgin River #1 South	23-Jun-08	2430-61174	XX:KG(M)	N/A	L	U	87	N
	Virgin River #2	N/A	N/A	UB:UB	N/A	AHY	F	88	RS
	Virgin River #1 South	30-Jun-04	2320-31485	EE:WO(M)	N/A	A6Y	F	96	RS
	Virgin River #1 South	12-Jun-08	2340-61104	YD(M):XX	N/A	SY	M	T2	N; detected 2–21 Jun

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #2	21-Jun-06	2370-39988	DW(M):PU	N/A	4Y	M	T61	RS; detected 12 May–25 Jun
	Virgin River #1 South	12-Jun-03	2320-31428	EE:DB(M)	N/A	6Y	M	T97	RS; detected 12–29 May
	Virgin River #1 South	INA	INA	PU:UB	N/A	AHY	M	T98	RS; detected 23 Jun–1 Jul
	Mormon Mesa South (North)	INA	INA	undetermined	N/A	AHY	M	F4	Detected 12 Jun
	Mormon Mesa South (North)	N/A	N/A	UB:UB	N/A	AHY	M	F5	RS; detected 12 Jun
	Virgin River #2	INA	INA	PU:UB	N/A	AHY	U	F29	RS; detected 17 Jun
	Virgin River #1 South	26-Jul-07	2370-40086	WRW(M):PU	UB:PU	SY	U	F95	R 19 Jun; not detected pre- or post-capture
MUDD	Overton WMA	INA	INA	banded	N/A	AHY	F	1	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	1, 80, 94	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	HY	U	1	RS
	Overton WMA	14-Jun-06	2370-40059	PU:BY(M)	N/A	A4Y	F	20	R 29 Jul
	Overton WMA	26-Jun-03	2370-39955[13]	BV(M):no foot	BV(M):PU	6Y	M	20	R 29 Jul
	Overton WMA	26-Jul-08	2430-61223	XX:YD(M)	N/A	L	U	20	N
	Overton WMA	26-Jul-08	2430-61224	XX:YK(M)	N/A	L	U	20	N
	Overton WMA	26-Jul-08	2430-61225	WG(M):XX	N/A	L	U	20	N
	Overton WMA	INA	INA	PU:UB	N/A	AHY	F	80	RS
	Overton WMA	16-Jun-04	2320-31632	RZ(M):EE	N/A	6Y	F	94	RS; at Mormon Mesa until 29 Jun
	Overton WMA	24-Jun-08	2430-61103	XX:DR(M)	N/A	SY	M	T40	N; detected 14–24 Jun
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	T95	RS; detected 14 Jul–5 Aug
	Overton WMA	21-Jun-04	2320-31615	EE:OY(M)	N/A	5Y	M	F60	RS; detected 11 May
	Overton Pond	N/A	N/A	UB:UB	N/A	AHY	U	F61	RS; detected 10 Jun
	Overton WMA	24-Jun-08	2430-61208	XX:BV(M)	N/A	SY	M	F62	N; detected 22–24 Jun
GRCA	Iceberg Canyon	12-Jun-08	2430-61072	XX:RK(M)	N/A	SY	M	T22	N, unpaired, detected 6 May–19 Jun

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	F	1	RS
	Pierced Egg	INA	INA	UB:EE	N/A	AHY	M	1	RS
	Pipes #3	INA	INA	PU:UB	N/A	AHY	F	2	RS
	Pipes #3	20-May-08	2430-61134	XX:OG(M)	N/A	AHY	M	2	N
	Pipes #3	10-Jul-08	2430-61143	XX:VB(M)	N/A	L	U	2	N
	Pipes #3	10-Jul-08	2430-61144	GR(M):XX	N/A	L	U	2	N
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	9	RS
	Glory Hole	22-Jul-04	2320-31562	KY(M):EE	N/A	5Y	M	9	RS
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	10	RS
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	M	10	RS
	Glory Hole	N/A	N/A	UB:UB	N/A	AHY	F	11	RS
	Glory Hole	25-Jul-04	2320-31560	EE:GY(M)	N/A	6Y	M	11	RS
	Glory Hole	10-Jul-08	2430-61145	GW(M):XX	N/A	L	U	11	N
	Pierced Egg	INA	INA	EE:UB	N/A	AHY	F	21	RS
	Pierced Egg	INA	INA	UB:EE	N/A	AHY	M	21,22	RS
	Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	F	22	RS
	Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	F	30	RS
	Pierced Egg	1-Jun-06	2370-39916	PU:YD	N/A	A4Y	M	30	RS
	Pierced Egg	26-Jun-08	2430-61139	XX:BY(M)	N/A	SY	F	32	N
	Pierced Egg	22-May-08	2430-61135	XX:OY(M)	N/A	SY	M	32	N
	In Between	INA	INA	undetermined	N/A	AHY	M	T6	Detected 27 May–4 Jun
	Glory Hole	17-May-07	2370-40139	PU:ZB(M)	N/A	A3Y	M	T13	RS; detected 11 Jun–13 Jul
	Glory Hole	INA	INA	UB:PU	N/A	AHY	M	T84	RS; detected 5–17 Jun
	IRFB04	INA	INA	undetermined	N/A	AHY	U	F5	Detected 27 May, probable migrant

AR063877

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	U	F7	RS; detected 6-11 Jun
	Pierced Egg	N/A	N/A	UB:UB	N/A	AHY	U	F8	RS; detected 21 Jun
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F12	Detected 21 Jun
	The Wallows	INA	INA	undetermined	N/A	AHY	M	F23	Detected 17–18 Jun
	250M	INA	INA	undetermined	N/A	AHY	U	F36	Detected 18 Jun
	Channel[15]	INA	INA	undetermined	N/A	AHY	M	F56	Detected 9 Jun, probable migrant
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	F100	Detected 5 Jun, probable migrant
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	F101	Detected 5 Jun, probable migrant
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	F102	Detected 11 Jun, probable migrant
BIWI	Site #3	18-Jun-08	2430-61138	XX:BK(M)	N/A	SY	F	8	N
	Site #3	6-Jun-08	2430-61136	XX:BG(M)	N/A	SY	M	8	N
	Site #3	1-Jul-08	2430-61075	XX:DK(M)	N/A	L	U	8	N
	Site #3	1-Jul-08	2430-61076	XX:RG(M)	N/A	L	U	8	N
	Site #3	N/A	N/A	UB:UB	N/A	AHY	F	12	RS
	Site #3	24-May-05	2370-40052	KV(M):PU	N/A	A5Y	M	12, 66	RS
	Site #3	6-Jun-08	2430-61137	XX:BR(M)	N/A	SY	F	31	N
	Site #3	14-Jun-08	2430-61073	XX:DO(M)	N/A	SY	M	31	N
	Site #3	29-Jun-08	2430-61074	KY(M):XX	N/A	L	U	31	N
	Site #3	INA	INA	banded	N/A	AHY	F	66	RS
	Site #3	6-Jul-08	2430-61140	XX:WB(M)	N/A	L	U	66	N
	Site #3	6-Jul-08	2430-61141	XX:BB(M)	N/A	L	U	66	N
	Site #3	6-Jul-08	2430-61142	XX:RO(M)	N/A	L	U	66	N
	Site #4	INA	INA	undetermined	N/A	AHY	M	F24	Detected 29–30 Jun

Table 3.2. Willow Flycatchers Detected at All Monitored Study Areas with Resident Flycatchers, 2008 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
AHAK	Deer Island	N/A	N/A	UB:UB	N/A	AHY	U	T4	RS; detected 21 May–6 Jun
	Deer Island	INA	INA	undetermined	N/A	AHY	U	F3	Detected 21–24 May

[1] PAHR = Pahranagat NWR, LIFI = Littlefield, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, GRCA = Grand Canyon, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, AHAK = Ahakhav Tribal Preserve.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2008.

[5] **Age in 2008**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] One of these four nestlings suspected to have died before fledging.

[10] This female was resighted missing her left foot. Former band combination is EE:DW(M), federal band number 2320-31661.

[11] One of the nestlings suspected to have died before fledging.

[12] Band number likely 2390-92434 but cannot be confirmed because bird was not captured in 2008. Bird had a visible injury on left leg.

[13] This band was removed.

[14] Nestling died before fledging.

[15] Not a formal survey site.

Bill Williams – We detected seven resident willow flycatchers from four territories at Bill Williams. In addition to resident adults, we detected one individual for which residency and/or breeding status could not be determined (Table 3.2). All four territories recorded at Bill Williams consisted of paired individuals. Of the breeding individuals, one male was polygynous with two females.

Field personnel captured and color-banded four new adults. We resighted and identified one returning banded adult, and resighted one additional banded adult but could not confirm the color combination. One resident adult remained unbanded, and band status could not be determined for one adult for which residency status could not be determined. We banded six nestlings from three nests.

Ahakhav Tribal Preserve – We detected one resident willow flycatcher and one individual for which residency could not be determined (Table 3.2). The resident flycatcher was unbanded, and band status could not be determined for the other adult.

Non-Monitoring Sites

These study areas were monitored by other agencies, and here we report only banded flycatchers that were captured or resighted. Unbanded individuals or those with unknown band status are not included.

Key Pittman Wildlife Management Area – Field personnel captured and color-banded nine new adults (Table 3.3). An additional adult was captured with a single federal band; this individual had been captured but not rebanded previously as an adult. We resighted and identified four returning banded adults. We recaptured two returning nestlings, one each from 2006 and 2007 (see Table 3.6 for juvenile dispersal data). We banded six nestlings from two nests.

St. George – Field personnel resighted and identified one adult flycatcher. A second adult was identified as a returning nestling, but we were unable to capture this individual to determine year and study area of origin. We banded five nestlings from two nests (Table 3.3).

Las Vegas Wash – Field personnel captured and color-banded one adult (Table 3.3).

Table 3.3. Willow Flycatchers Color-Banded and Resighted, Non-Monitoring Sites, 2008

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Old Color Combination[2,3]	Age[4]	Sex[5]	Observation Status[6]
KEPI	Patch 1	30-Jul-05	2370-39980	WO(M):PU	N/A	4Y	M	RS
	Patch 3	25-Jun-08	2430-61178	DO(M):XX	N/A	AHY	M	N; R 26 Jun
	Patch 4	25-Jun-08	2430-61179	XX:KB(M)	N/A	AHY	M	N; R 26 Jun
	Patch 5	26-Jul-08	2430-61210	OD(M):XX	N/A	AHY	U	N
	Patch 6	30-Jun-08	2430-61109	WW(M):XX	N/A	AHY	F	N
	Patch 6	3-Jul-05	2320-31694	EE:BK(M)	N/A	4Y	M	RS
	Patch 6	3-Aug-08	2370-40098	PU:KD(M)	N/A	L	U	N
	Patch 6	3-Aug-08	2370-40097	PU:GY(M)	N/A	L	U	N
	Patch 6	3-Aug-08	2370-40096	PU:WY(M)	N/A	L	U	N
	Patch 7	27-Jun-06	2320-31674	BW(M):EE	UB:EE	3Y	M	R 26 Jun
	Patch 8	27-Jun-03	2320-31468	EE:RO(M)	N/A	6Y	M	RS
	Patch 8	30-Jun-08	2430-61110	XX:OK(M)	N/A	L	U	N
	Patch 8	30-Jun-08	2430-61101	XX:GW(M)	N/A	L	U	N
	Patch 8	30-Jun-08	2430-61102	YG(M):XX	N/A	L	U	N
	Patch 9	26-Jun-08	2430-61180	RD(M):XX	N/A	SY	M	N
	Patch 9	23-Jun-04	2320-31484	YB(M):EE	UB:EE	5Y	M	R 26 Jun
	Patch 10	25-Jul-05	2370-39915	PU:RZ(M)	N/A	A5Y	M	RS; at PAHR through 11 Jul
	Patch 10	26-Jun-08	2430-61181	XX:RD(M)	N/A	AHY	F	N
	Patch 10	26-Jun-08	2430-61182	XX:OR(M)	N/A	SY	M	N
	Patch 11	29-Jun-07	2360-59743	EE:GRG(M)	EE:UB	SY	F	R 15 Jul
	Patch 11	26-Jun-08	2430-61183	XX:RB(M)	N/A	AHY	M	N; R 15 Jul
	Patch 12	15-Jul-08	2430-61125	XX:WK(M)	N/A	AHY	M	N
STGE	Seegmiller Marsh	INA	INA	UB:PU	N/A	AHY	M	RS
	Seegmiller Marsh	21-Jun-04	2320-31660	BZ(M):EE	N/A	5Y	F	RS
	Seegmiller Marsh	27-Jul-08	2370-40149	PU:KK(M)	N/A	L	U	N
	Seegmiller Marsh	27-Jul-08	2370-40148	PU:KR(M)	N/A	L	U	N
	Seegmiller Marsh	27-Jul-08	2370-40147	OR(M):PU	N/A	L	U	N
	Seegmiller Marsh	31-Jul-08	2430-61126	XX:VW(M)	N/A	L	U	N
	Seegmiller Marsh	31-Jul-08	2430-61211	BK(M):XX	N/A	L	U	N
LVWA	Upstream Pabco South Lower Plateau	25-Jun-08	2430-61209	GY(M):XX	N/A	AHY	M	N; detected 28 May–30 Jun

[1] KEPI = Key Pittman Wildlife Management Area, STGE = St. George, LVWA = Las Vegas Wash.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] Old combination included only if rebanded in 2008.

[4] **Age in 2008:** L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[5] **Sex codes**: M = male, F = female, U = unknown.

[6] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

Adult Between-Year Return and Dispersal

In 2007 we identified 95 adult, resident willow flycatchers at our monitored study areas, of which 54 (57%) were detected in 2008 (Table 3.4). Of the returning adults, three (6%) were detected at a different study area than where they were last detected in 2007, and two of those were detected at study areas (Key Pittman and St. George) monitored by other agencies (Table 3.5). Two additional adults, one of which was last detected in 2005 and the other in 2006, exhibited between-year movement in 2008. The median dispersal distance for all returning adult flycatchers exhibiting between-year movements in 2008 was 32 km (min = 13 km, max = 61 km).

Table 3.4. Resident Adult Willow Flycatcher Annual Return from 2007 to 2008

Study Area	# Identified in 2007	# of 2007 Birds Detected in 2008	% Return	% Return to Same Study Area
Pahranagat	23	15	65	100
Mesquite	21	16	76	100
Mormon Mesa	22	15	68	88
Muddy River	10	4	40	75
Grand Canyon	3	0	0	--
Topock	8	3	38	100
Bill Williams	8	1	13	100
Total	**95**	**54**	**57**	**94**

Table 3.5. Summary of Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2008

Study Area/Site/Year Detected [1]	Study Area/Site Detected 2008[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/MAPS/2005	KEPI/Patch 9	32	2320-31484	YB(M):EE	M
PAHR/South/2006	KEPI/Patch 8	33	2320-31468	EE:RO(M)	M
MOME/VR#2/2007	STGE/Seegmiller Marsh	61	2320-31660	BZ(M):EE	F
MOME/VR#2/2007	MESQ/West	29	2370-40197	OG(M):PU	M
MUDD/Overton Pond/2007	MOME/VR #1S	13	2360-59799	EE:OZ(M)	M

[1] PAHR = Pahranagat NWR, KEPI = Key Pittman WMA, STGE = St. George, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.
[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, (M) = metal pin striped band, B = light blue, G = green, O = orange, R = red, Z = gold, Y = yellow. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.
[3] **Sex codes**: F = female, M = male.

Juvenile Between-Year Return and Dispersal

In 2007, we banded 55 nestlings and 1 fledgling at the monitored study areas. Six of these nestlings were known to have died before fledging. Of the 50 remaining juveniles, 2 (4%) were recaptured and identified in 2008. Both were detected at a different study area from where originally banded. Two individuals originally banded as nestlings in 2005 and two banded in 2006 were also recaptured for the first time; of these, three returned to a different study area than where originally banded (Table 3.6). The median dispersal distance for all returning juvenile flycatchers in 2008 was 30 km (min = 0.15 km, max = 30 km).

Table 3.6. Summary of Juvenile Flycatchers Banded as Hatch Year Birds in 2005, 2006, or 2007 and Recaptured for the First Time in 2008

Study Area/ Site Banded	Year Hatched	Study Area/Site Detected 2008	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/North	2006	KEPI/Patch 7	30	2320-31674	BW(M):EE	M
KEPI	2005	PAHR/North	30	2360-59711	KB(M):EE	M
KEPI	2005	PAHR/North	30	2360-59712	EE:GKG(M)	M
MESQ/West	2006	MESQ/West	0.15	2360-59752	DRD(M):EE	M
MESQ/West	2007	MOME/Virgin River #1 South	28	2370-40086	WRW(M):PU	U
PAHR/North	2007	KEPI/Patch 11	30	2360-59743	EE:GRG(M)	F

[1] KEPI = Key Pittman WMA, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, (M) = metal pin striped band, B = light blue, D = dark blue, G = green, R = red, W = white, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

Ten additional returning nestlings from 2003–2007 were resighted in 2008 (one each at Mesquite and Muddy River, three at Mormon Mesa, and five at Topock), but the identity of these individuals was undetermined because we were unable to recapture them.

Within-Year, Between-Study Area Movements

We detected two within-year, between study area movements in 2008. One male held a territory at Pahranagat North from 19 May to 11 July and then was detected at Key Pittman on 26 July. A female had an unsuccessful nesting attempt at Mormon Mesa Virgin River #2 (25 May–29 June) and then moved to Muddy River Overton WMA where she had another unsuccessful nesting attempt (14–19 July).

DISCUSSION

Color-Banding Effort

Overall, 69% of the adult flycatchers detected at the monitoring sites during 2008 were banded by the end of the breeding season. This compares to 55, 57, 75, 70, and 73% in 2003–2007, respectively. Unbanded migrant willow flycatchers are included in calculating these percentages; therefore, in most cases, these numbers under-represent the actual proportion of resident banded flycatchers at a given site. We have maintained high overall percentages of banded birds annually over the five years, which has enabled us to detect movements, generate dispersal data, and determine survival and detection probabilities across study areas (McLeod et al. 2008a). Differences between study areas in the percentage of banded individuals are directly related to vegetation density and overall structure, which affect our ability to erect mist-nets in the habitat. Topock Marsh typically has the lowest percentage of color-banded flycatchers because dense vegetation limits the number and size of possible net locations.

Prior to 2008, we banded all nestlings with a single anodized federal band, identifying the bird as a returning nestling in the event it was sighted in a subsequent year. The individual would then have to be recaptured to determine its individual identity and to apply a unique color combination so the bird could be individually identified via resighting. Returning nestlings were particularly difficult to recapture at Topock. To eliminate the need to recapture returning nestlings, in 2008 we applied unique color

combinations to all nestlings. These nestlings will not need to be recaptured in subsequent years, and the use of full color combinations on nestlings should increase the proportion of adults that can be individually identified and yield more information on juvenile dispersal and survivorship.

Adult and Juvenile Between-Year Dispersal

Ninety-four percent of all adults detected in both 2007 and 2008 were detected at the same study area in both years. From 1998 to 2007, 92% of all between-year adult returns were to the same study area. Of the six individuals that were banded as juveniles in 2005–2007 and detected for the first time in 2008, 50% returned to the same study area where originally banded. From 1997 to 2007, 41% of all returning juveniles dispersed away from the natal area (McKernan and Braden unpubl. data, McLeod et al. 2008a). Adult and juvenile dispersal data show high site fidelity exhibited by adult flycatchers and lower natal site fidelity exhibited by juveniles, with juveniles dispersing among study areas annually. These dispersal data are consistent with range-wide data (Paxton et al. 2007), with adult flycatchers exhibiting high site fidelity to breeding areas. Juvenile dispersal within the Virgin/lower Colorado River population(s) is largely limited to this region, and while reciprocal juvenile movements among geographically isolated flycatcher populations of the greater Southwest do occur, they are rare. Only three instances of willow flycatcher immigration from sites outside the Virgin/lower Colorado River region have been recorded since 1997 (McKernan and Braden unpubl. data, McLeod et al. 2008a), with two males originally banded as nestlings in 2003 at Roosevelt Lake recaptured in 2005 at Muddy River and Topock, and one male banded as a nestling in 1999 at Roosevelt Lake recaptured in 2002 in Grand Canyon. Although movements of this magnitude are infrequent, other instances of dispersal distances greater than 140 km have been reported for the Southwestern Willow Flycatcher (Paxton et al. 2007).

The observed dispersal patterns fit well with the tenets of contemporary metapopulation theory (Hanski and Simberloff 1997), suggesting the Virgin/lower Colorado River population may be a panmictic sub-population of a greater metapopulation. Occasional juvenile dispersal between sub-populations is likely an important population variable in terms of both gene flow and possibly the establishment of new flycatcher populations. These juvenile movements contribute to an understanding of the observed patterns of high genetic diversity within and low genetic isolation among Southwestern Willow Flycatcher populations (Busch et al. 2000). Physical connectivity of riparian habitats within the greater landscape is crucial in enabling these long-distance movements. Without adequate stop-over habitats and foraging areas, flycatchers attempting long-distance movements are more likely to be exposed to adverse environmental conditions.

Adult and Juvenile Survivorship

Annual survivorship is defined as the number of individuals that survive from one year to the next, and accurate estimates depend on year-to-year detection of uniquely marked birds. Fifty-seven percent of the adult, resident willow flycatchers identified in 2007 were detected again in 2008, while of the 50 juveniles banded in 2007, only 2 (4%) were identified in 2008. Thus, minimum estimated adult and juvenile survival from 2007 to 2008 was 57 and 4%, respectively. These simple annual percent survivorship calculations assume that all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. This is the lowest juvenile return rate recorded since 2004, with an average return rate of 13% recorded in 2004–2007 for the juveniles from the previous year. Flycatchers sometimes go undetected for up to three years after being banded as juveniles, and banding data collected in future years will determine if low survival rates, low detection rates, or both contributed to the low number of juveniles from 2007 identified in 2008.

Chapter 4

NEST MONITORING

INTRODUCTION

Documentation of nest success and productivity is critical to understanding local population status and demographic patterns of the Southwestern Willow Flycatcher. In 2008, at all sites where willow flycatcher breeding activity was suspected, we conducted intensive nest searches and nest monitoring. Specific objectives of nest monitoring included identifying breeding individuals (see Chapter 3, Color-banding and Resighting), calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Nest monitoring results from 2008 were compared with those at the study areas from 1996 to 2007 (Braden and McKernan unpubl. data, McLeod et al. 2008a). Although aspects of willow flycatcher breeding ecology can vary widely across its broad geographical and elevational ranges throughout the Southwest (Whitfield et al. 2003), we compared monitoring results with range-wide data to identify specific variables that may contribute to the characterization of flycatcher breeding ecology throughout the lower Colorado and Virgin River riparian systems.

METHODS

Upon locating territorial willow flycatchers, regardless of whether a possible mate was observed, we conducted intensive nest searches following the methods of Rourke et al. (1999). Nest monitoring followed a modification of the methods described by Rourke et al. (1999) and the Breeding Biology Research and Monitoring Database (BBIRD) protocol by Martin et al. (1997).

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites. Nests were monitored every two to four days after nest building was complete and incubation was confirmed. During incubation and after hatching, nest contents were observed directly using a telescoping mirror pole to determine nest contents and transition dates. Nest monitoring during nest building and egg laying stages was limited to reduce the chance of abandonment during these periods. To reduce the risk of depredation (Martin et al. 1997), brood parasitism by the Brown-headed Cowbird, and premature fledging of young (Rourke et al. 1999), we observed nests from a distance with binoculars once the number and age of nestlings were confirmed. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

Per instructions from Reclamation biologists, we considered a willow flycatcher nest successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted based on the number of fledglings actually observed. This method of determining success differs from that recommended by some nest monitoring protocols (e.g., Martin et al. 1997, Rourke et al. 1999), which consider a nest as successful if chicks are observed in the nest within two days of the estimated fledge date. The method we follow produces a conservative estimate of both nest success rate and number of fledges.

We considered a nest to have failed if (1) the nest was abandoned prior to egg laying (abandoned); (2) the nest was deserted with flycatcher eggs or young remaining (deserted); (3) the nest was found empty or

destroyed more than two days prior to the estimated fledge date (depredated); (4) the nest was destroyed due to weather (weather); or (5) the entire clutch was incubated for an excess of 20 days (infertile/addled). For nests containing flycatcher eggs, parasitism was considered the cause of nest failure if (1) cowbird young outlived any flycatcher eggs or young, or (2) the nest was parasitized during egg laying and the disappearance of flycatcher eggs coincided with the appearance of cowbird eggs.

During each nest check, we recorded date and time of the visit, observer initials, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and number and behavior of adults and/or fledges present onto standardized data forms (Appendix A) that included the nest or territory number and UTM coordinates. We calculated flycatcher nest success using both simple nesting success (number of successful nests/total number of nests containing at least one flycatcher egg) and the Mayfield method (Mayfield 1961, 1975), which calculates daily nest survival to account for nests that failed before they were found. We assumed one egg was laid per day, and incubation was considered to start the day the last egg was laid (per Martin et al. 1997). The nestling period was considered to start the day the first egg hatched and end the day the first nestling fledged. If exact transition dates or dates of depredation events were unknown, we estimated the transition date as halfway between observations. For nests where fate was unknown, we used the last known date of activity to determine the number of observation days. To calculate Mayfield survival probabilities (MSP), we used the average length of each nest stage (2.12, 12.90, and 13.71 days for laying, incubation, and nestling stages, respectively) as observed in this study in 2003–2008 for nests where transition dates were known. Nest productivity was calculated as the number of young fledged per nesting attempt that produced at least one flycatcher egg. Fecundity was calculated as number of young produced per female over the breeding season. Parasitism rates were calculated as the number of nests that contained at least one cowbird egg/number of nests containing at least one flycatcher egg and having known contents.

RESULTS

Nest Monitoring

We documented 62 willow flycatcher nesting attempts at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams; 55 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Thirty (55%) nests were successful and fledged young, 23 (42%) failed, and fate was unknown for 2 (3%). Nest success ranged from 13% at Topock Marsh to 82% at Mesquite (Table 4.1). For a comparison of nest success at all monitoring sites from 1997 to 2008, see Table 4.2.

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
PAHR	North	9	12	10	8 (80)	2 (20)	0	0
	Total	*9*	*12*	*10*	*8 (80)*	*2 (20)*	*0*	*0*
MESQ	West	11	11	11	9 (82)	2 (18)	0	1 (10)
	Total	*11*	*11*	*11*	*9 (82)*	*2 (18)*	*0*	*1 (10)*

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008 (Continued)

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
MOME	Virgin River #1 North	1	1	1	1 (100)	0	0	0
	Virgin River #1 South	9	10	9	6 (67)	3 (33)	0	1 (11)
	Virgin River #2	3	3	3	1 (33)	2 (67)	0	0
	Total	*13*	*14*	*13*	*8 (62)*	*5 (38)*	*0*	*1 (8)*
MUDD	Overton WMA	4	8	8	2 (25)	6 (75)	0	4 (57)
	Total	*4*	*8*	*8*	*2 (25)*	*6 (75)*	*0*	*4 (57)*
TOPO	Pipes #3	1	1	1	0	0	1 (100)	0
	Pierced Egg	5	5	4	0	4 (100)	0	0
	Glory Hole	3	6	3	1 (33)	2 (67)	0	1 (33)
	Total	*9*	*12*	*8*	*1 (13)*	*6 (75)*	*1 (13)*	*1 (13)*
BIWI	Site 3	4	5	5	2 (40)	2 (40)	1 (20)	1 (25)
	Total	*4*	*5*	*5*	*2 (40)*	*2 (40)*	*1 (20)*	*1 (25)*
Overall Total		**50**	**62**	**55**	**30 (55)**	**23 (42)**	**2 (3)**	**8 (17)**

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Forty-eight nesting females, of which all but three were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was detected for which no nesting attempt could be confirmed. Of the 48 nesting females, 36 had one nesting attempt, 10 had two nesting attempts, and 2 had three nesting attempts. All 12 females who had multiple nesting attempts renested after unsuccessful nests.

Table 4.2. Willow Flycatcher Percent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers and Tributaries from 1996 to 2008*

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
1996	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nc[7]	Nc[6]	Nm[3]
1997	Nm[3]	Nd[4]	67 (3)	42 (12)	Bc[9]	Nc[7]	Nc[6]	Nd[4]
1998	47 (19)	Nd[4]	0 (7)	70 (10)	Nm[3]	Nd[4]	53 (15)	Nd[4]
1999	60 (15)	Nm[3]	Nm[3]	45 (11)	Nm[3]	Nc[5]	38 (16)	100 (1)
2000	63 (16)	Nd[4]	50 (8)	38 (13)	100 (1)	Nc[5]	36 (11)	100 (1)
2001	50 (18)	Nd[4]	53 (17)	54 (13)	Nc[6]	Nc[6]	36 (14)	50 (4)
2002	33 (12)	Nd[4]	59 (17)	0 (9)	Nd[4]	Nd[4]	50 (6)	78 (9)
2003	91 (11)	Nd[4]	44 (18)	0 (10)	Nd[4]	Nd[4]	78 (9)	100 (2)
2004	76 (17)	50 (2)	24 (17)	50 (6)	Nd[4]	Bc[7]	45 (38)	Nd[4]
2005	58 (19)	Nd[4]	42 (12)	17 (6)	38 (8)	Nd[4]	24 (34)	100 (2)
2006	60 (15)	Nd[4]	55 (20)	50 (8)	44 (9)	0 (3)	23 (17)[8]	20 (5)

Table 4.2. Willow Flycatcher Percent Nest Success Recorded at Breeding Sites along the Virgin and Lower Colorado Rivers and Tributaries from 1996 to 2008* (Continued)

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
2007	67 (12)	Nd[4]	57 (14)	27 (11)	0 (6)	0 (1)	75 (8)	25 (8)
2008	80 (10)	Nd[4]	82 (11)	62 (13)	25 (8)	Nd[4]	13 (8)[9]	40 (5)[9]

* Data from 1997 to 2002 are from Braden and McKernan (unpubl. data); these numbers have been verified with the raw data and may differ from those presented in earlier annual reports. Data from 2003 to 2007 are from McLeod et al. 2008a, and data from 2008 can be found in this document. Total number of nests containing at least one flycatcher egg is indicated in parentheses.

[1] Study area includes the Mesquite East, Mesquite West, and Bunker Farm sites.

[2] Study area includes the Virgin River Delta at Lake Mead.

[3] Study area not monitored.

[4] Study area surveyed, no breeding documented.

[5] Breeding suspected, nest success not calculated.

[6] Breeding confirmed, nest success not calculated.

[7] Breeding confirmed, undetermined if nestlings from a single nest fledged.

[8] An additional three nests (18%) were suspected to have fledged but fledglings were not visually confirmed.

[9] Fate of one nest was unknown.

Nest Failure

Depredation was the major cause of nest failure, accounting for 40% (12 of 30) of all failed nests (Table 4.3) and 52% (15 of 23) of nests that failed after flycatcher eggs were laid. Seven nesting attempts (23% of all failed nests) were abandoned prior to willow flycatcher eggs being laid and nine nests (30%) were deserted. Two nests (7%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism).

Table 4.3. Summary of Causes of Willow Flycatcher Nest Failure at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized
PAHR	12	4	2 (50)	0	2 (50)	0
MESQ	11	2	0	1 (50)[2]	1 (50)	0
MOME	14	6	1 (17)	3 (50)[3]	1 (17)	1 (17)
MUDD	8	6	0	1 (17)[4]	4 (67)	1 (17)
TOPO	12	10	4 (10)	2 (20)[5]	4 (40)	0
BIWI	5	2	0	2 (100)[6]	0	0
Total	**62**	**30**	**7 (23)**	**9 (30)**	**12 (40)**	**2 (7)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] Nest deserted during incubation.

[3] One nest deserted after 18 days incubation, one nest already deserted when found, one nest deserted during laying.

[4] Nest deserted after being parasitized.

[5] One nest deserted during laying, one nest deserted after at least 20 days incubation.

[6] One nest deserted after video camera was set up at nest, one nest deserted during incubation.

Brood Parasitism

Eight of 48[1] nests (17%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.4). For nests containing flycatcher eggs, parasitism caused nest failure at two nests. In one case, the nest was parasitized during laying, and appearance of the cowbird egg coincided with disappearance of the flycatcher egg. In the other case, the nest fledged a cowbird and the severely underdeveloped flycatcher nestling was found dead under the nest. One parasitized nest fledged a flycatcher but no cowbirds, and two nests fledged both a cowbird and a flycatcher. Two parasitized nests were depredated during incubation, and one nest was deserted after at least 20 days incubation. Brood parasitism ranged from 0 to 57% and was highest at Muddy River (see Table 4.1). In 2008, three of eight (38%) parasitized nests successfully fledged flycatchers, and nests that contained flycatcher eggs and were brood parasitized were not less likely to fledge flycatcher young than nests that were not parasitized (Chi-square = 1.10, $P = 0.293$). However, when data were pooled for all years from 2003 to 2008 to obtain a larger sample size and greater statistical power, parasitized nests were less likely to fledge flycatcher young, with 18 of 80 (23%) parasitized nests fledging flycatcher young vs. 148 of 284 (52%) non-parasitized nests (Chi-square = 22.06, . $P < 0.001$). In addition, parasitized nests that did succeed in fledging flycatcher young produced on average fewer fledges (1.2 per nest) than non-parasitized nests (2.2 fledges per nest; $F_{1,164} = 19.0$, $P < 0.001$). From 2003 to 2008, 7 of 17 nests that fledged cowbirds also fledged flycatcher young.

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-Headed Cowbirds, 2008*

Study Area[1]	Nest ID Code	Outcome[2]
MESQ	21A	Fledged one cowbird and one flycatcher
MOME	65B	Parasitized during laying; fledged one cowbird; flycatcher nestling found dead under nest
MUDD	1A	Fledged one cowbird and one flycatcher
	1B	Nest depredated during incubation
	1C	Nest depredated during incubation
	20A	Parasitized during laying; WE disappeared and CE appeared; nest abandoned
TOPO	9A	Parasitized after at least 6 days incubation; nest deserted after at least 20 days incubation; no eggs hatched
BIWI	31B	Fledged one flycatcher; CE did not hatch

* All nesting attempts are included.
[1] MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.
[2] WE = willow flycatcher egg, CE = cowbird egg.

Mayfield Nest Success and Nest Productivity

Mayfield survival probability (MSP) ranged from 0.194 at Muddy River to 0.705 at Mesquite and was 0.461 for all sites combined (Table 4.5). At all sites, 66 nestlings were confirmed to have fledged from 53 nests of known outcome (mean number of nestlings/nest = 1.25, SE = 0.17). Fecundity across study areas ranged from 0.13 to 2.33 young per female and averaged 1.40 (SE = 0.18) (Table 4.6).

[1] Table 4.1 shows a total of 55 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, seven nests whose contents could not be determined were excluded from calculations (i.e., nests that were too high to check contents to determine presence/absence of cowbird eggs).

Table 4.5. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Pahranagat	1	1/9	0.889	0.779
	2	1/52	0.981	0.778
	3	0/84	1.000	1.000
	MSP all stages = 0.606			
Mesquite	1	1/11	0.909	0.817
	2	1/88	0.989	0.863
	3	0/110	1.000	1.000
	MSP all stages = 0.705			
Mormon Mesa	1	1/13	0.923	0.844
	2	1/125	0.992	0.902
	3	2/124	0.984	0.800
	MSP all stages = 0.609			
Muddy River	1	1/8	0.875	0.753
	2	5/50	0.900	0.257
	3	0/24	1.000	1.000
	MSP all stages = 0.194			
Topock	1	2/14.5	0.62	0.730
	2	4/50	0.920	0.341
	3	0/13.5	1.000	1.000
	MSP all stages = 0.249			
Bill Williams	1	0/1	1.000	1.000
	2	2/41.5	0.952	0.529
	3	0/26	1.000	1.000
	MSP all stages = 0.529			
Total	**1**	**6/56.5**	**0.894**	**0.788**
	2	**14/406.5**	**0.966**	**0.628**
	3	**2/381.5**	**0.995**	**0.932**
	MSP all stages = 0.461			

* Mayfield survival probability was calculated using 2.12-day egg laying, 12.90-day incubation, and 13.71-day nestling stages.
[1] 1 = egg laying, 2 = incubation, 3 = nestling.

Table 4.6. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams Study Areas, 2008*

Study Area	Young Fledged (# Nests)	Productivity Mean (SE)	Fecundity Mean (SE)
Pahranagat	21 (10)	2.10 (0.41)	2.33 (0.37)
Mesquite	18 (11)	1.64 (0.34)	1.64 (0.34)
Mormon Mesa	19 (13)	1.46 (0.37)	1.46 (0.37)
Muddy River	3 (8)	0.38 (0.26)	0.75 (0.48)
Topock	1 (7)	0.14 (0.14)	0.13 (0.13)
Bill Williams	4 (4)	1.00 (0.71)	1.33 (0.88)
Total	**66 (53)**	**1.25 (0.17)**	**1.40 (0.18)[1]**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome.
[1] The female that moved from Mormon Mesa to Muddy River is counted only once in the total.

DISCUSSION

In 2008, willow flycatcher nesting was documented at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams. The number of breeding pairs recorded at Pahranagat, Mesquite, Mormon Mesa, and Topock Marsh were consistent with those recorded in 2007. The number of breeding pairs at Bill Williams in 2008 (3) was identical to that recorded in 2006 but less than half the number observed in 2007 (7). Muddy River had the lowest number of breeding pairs recorded since 2005; this decline in breeding activity could be related to recent habitat modifications within the site (see Chapter 2), which may have affected occupancy in the northern portion of the site in 2008. Given that southwestern riparian ecosystems experience dynamic change and are not ecologically static (Periman and Kelly 2000), willow flycatcher occupancy and nesting are likely to be affected by changes in habitat suitability, with breeding flycatchers detected at a given site in one year and not in another.

Nest Success

As in 2003–2007, Pahranagat continued to exhibit high nest success. Nest success at Mesquite was the highest observed since monitoring began in 1997, and nest success at Mormon Mesa was the highest recorded since 1998. Nest success at Topock Marsh, however, was the lowest ever recorded. Nest success at the remaining study areas continued to exhibit the yearly fluctuations observed since nest monitoring began in 1996. Nest success results again illustrate that the demographic patterns of passerine populations often vary year to year, and sometimes to a very large degree (Wiens 1989a). The variable patterns of nest success observed at the study areas over many years further demonstrate the need for long-term data.

Nest Failure

As in 2003–2007, depredation was the major cause of willow flycatcher nest failure, accounting for 40% of all failed nests in 2008 (see Table 4.3). These results are consistent with those reported at the life history study areas from 1998 to 2007 (Braden and McKernan unpubl. data, McLeod et al. 2008a) and at monitored sites across Arizona from 2000 to 2006 (Paradzick et al. 2001; Smith et al. 2002, 2003, 2004; Munzer et al. 2005; English et al. 2006; Graber et al. 2007; Ellis et al. 2008), which indicate depredation as accounting for the majority of all willow flycatcher nest failures. Factors influencing the increases and decreases in nest depredation at the life history study areas are inherently complex and at this time remain undetermined. For open-cup nesting passerines, it has been shown that nest depredation rates can vary year to year, and sometimes substantially, with depredation of eggs and young ultimately linked to landscape characteristics and fluctuations in predator densities, abundance, and richness (Wiens 1989b, Robinson 1992, Howlett and Stutchbury 1996).

In 2008, Northern Arizona University (NAU) initiated a nest camera study in cooperation with SWCA on open-cup nesting passerines at selected study areas along the lower Colorado River and tributaries. The study used video and still cameras on real and artificial nests to identify depredation rates and nest predators. Problems with both video and still cameras affected the detection of depredation events and the identification of nest predators, but both Brown-headed Cowbirds and Yellow-breasted Chats were identified by still cameras as depredating artificial nests (NAU unpubl. data). Ellis et al. (2008) also identified Yellow-breasted Chats depredating flycatcher nests at sites in Arizona. The camera study will be continued in 2009 and may provide additional information on the identity and relative importance of nest predators.

Brood Parasitism

Brood parasitism by Brown-headed Cowbirds across all study areas ranged from 0 to 57% and averaged 17% (see Table 4.1). These results are consistent with those reported at the study areas from 1998 to 2007 (Braden and McKernan unpubl. data, McLeod et al. 2008a), but these parasitism rates are higher than those reported at monitored sites across Arizona, which averaged 4, 5, 11, 2, 6, 7, and 13% in 2000, 2001, 2002, 2003, 2004, 2005, and 2006, respectively (Paradzick et al. 2001; Smith et al. 2002, 2003, 2004; Munzer et al. 2005; English et al. 2006; Graber et al. 2007). We observed the sixth consecutive year of no brood parasitism at Pahranagat, and Mesquite experienced the lowest parasitism rate recorded since 2003. Muddy River continued to have high parasitism rates.

Cowbird trapping and removal studies were initiated at Pahranagat, Mesquite, and Topock Marsh in 2003 and continued through 2007. Results of these studies showed that cowbird trapping appeared to lower parasitism rates in comparison to the pre-trapping period of 1998–2002 only at Pahranagat, with no parasitism detected during trapping years (McLeod et al. 2008a). No cowbird trapping was completed in 2008, the first year of a planned five-year post-trapping monitoring period. Even in the absence of cowbird trapping, no parasitism events were detected at Pahranagat in 2008. This suggests that cowbird trapping may have lingering effects beyond the years in which trapping is completed, though a single year of data at one study area is insufficient to draw strong conclusions.

We observed one occasion in which the disappearance of flycatcher eggs coincided with the parasitism event. In this case, cowbirds were suspected of ejecting the eggs. Female Brown-headed Cowbirds are known to physically attack willow flycatcher nestlings (Woodward and Stoleson 2002), remove single eggs, and occasionally destroy entire broods after laying is complete or after hatching (Lowther 1993 as cited in Woodward and Stoleson 2002), and cowbirds were photographed removing eggs from artificial nests during the 2008 camera study. Therefore, it is likely that some depredation events on eggs and nestlings are attributable to cowbirds.

Parasitism does not invariably cause nest failure, but the success rate for parasitized nests in 2003–2008 was less than half that of unparasitized nests. A similar result was recorded for willow flycatchers in Oregon, with parasitism resulting in a 50% decrease in success rates compared to unparasitized nests (Sedgwick and Iko 1999). Parasitized nests that do succeed in fledging flycatcher young produced on average fewer young than unparasitized nests; cowbirds may eject flycatcher eggs during the parasitism event, thus reducing clutch size, and cowbird young also cause interspecific nestling competition, as evidenced by the presence of severely underdeveloped nestlings in parasitized nests. For all nests monitored from 2003 to 2008, 41% of nests that fledged a cowbird also fledged flycatcher young. This is a higher rate of success than that observed in other Southwestern Willow Flycatcher populations, with 9% and 0% reported for the Kern River, California, and various Arizona sites, respectively (Whitfield and Sogge 1999).

Female flycatchers may desert their nests after parasitism events and thus expend energy renesting and laying additional eggs. Given that adult flycatchers exhibit high site fidelity to breeding areas (Braden and McKernan unpubl. data, McLeod et al. 2008a, this document) and renest most often after failed nests (Sedgwick 2000), females returning to sites with high brood parasitism are likely to reduce lifetime fecundity because they are expending energy on multiple failed nesting attempts over many years. In addition, willow flycatchers that fledge late in the season have been shown to have a lower survival rate than those that fledge early in the season (Paxton et al. 2007, McLeod et al. 2008a), suggesting additional hidden effects of parasitism and subsequent renesting on flycatcher demography.

Mayfield Nest Success and Nest Productivity

Overall MSP in 2008 (0.461) was nearly identical to that recorded in 2007 (0.459), though the relative contributions of various study areas to overall MSP differed between years. MSP alone, however, is an incomplete measure of the production of young. Successful nests produce from one to four young, and variations in nest productivity are not reflected in MSP. In addition, although every failed nest attempt lowers percent nest success and MSP, success of a subsequent nesting attempt may result in the same number of young produced as if the initial nesting attempt had been successful. Thus, nest productivity (young produced per nesting attempt) and fecundity (young produced per female), in conjunction with nest success, provide additional information on the success of a given breeding season. Overall fecundity in 2008 (1.40) did not differ statistically from that recorded in 2003–2007 ($F_{5,308} = 0.916$, $P = 0.47$).

Chapter 5

VEGETATION AND HABITAT CHARACTERISTICS

INTRODUCTION

Our objective for vegetation sampling is to provide a quantitative summary of the floristic and structural conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if they resemble occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the vegetation consists primarily of very large and widely spaces trees, and these characteristics are unique to the site and not likely to be replicated in restoration areas.

In addition, we investigated whether changes in vegetation characteristics might have contributed to the abandonment of some areas by flycatchers. We identified several areas that had been occupied by nesting flycatchers in at least one previous year from 2003 to 2007 but were unoccupied in 2008, and we relocated old nest sites at which we had collected vegetation information in the year the nest was active. We resampled the vegetation at these nests and compared the vegetation data collected in 2008 to that collected when the nest site was active to elucidate how changes in vegetation through time may influence flycatcher occupancy. These results will provide additional quantitative information on the characteristics of vegetation within flycatcher nesting territories.

METHODS

Currently Occupied Territories

We described and measured vegetation and habitat features following a modification of the methods of James and Shugart (1970). Vegetation characteristics were measured within a 5-m-radius circle. To avoid disrupting flycatcher breeding activities, we measured vegetation late in the summer when the nest, territory, and adjacent flycatcher territories were inactive.

We measured vegetation and habitat characteristics at one plot for each resident (i.e., detected for at least one week) male flycatcher we identified, regardless of whether or not he obtained a mate. Plot center locations were determined as soon as territories were identified. We estimated the center of the male's activity by observing his use of singing perches and selecting a location that was approximately equidistant from the perches at the perimeter of his use area. We then proceeded in a randomly selected compass direction for a randomly selected distance between 0 and 20 m. We used additional random numbers to select the exact location in which to hang a temperature/humidity data logger (see Chapter 6) and used that location as plot center. This process resulted in the random selection of a point that was still within the male's territory.

At each plot, we laid out four 5-m-long ropes from plot center, one in each of the four cardinal directions. Each rope was marked at 1 m and 5 m from the center of the plot. At plot center and at 1 m and 5 m from the center of the plot in each cardinal direction, we measured vertical foliage density using a 7.5-m-tall survey rod. Working our way up the rod, we recorded the presence of vegetation, by species, within a 10-cm radius of the rod in 0.1-m intervals (presence of the species within the 0.1-m interval equaled one "hit" on the rod), and summed all hits in 1-m intervals. Presence of dead vegetation (snags) was recorded

in the same manner, but not identified to species. If canopy vegetation continued above 8.0 m, we estimated the number of hits as zero, greater than five, or less than five hits per 1-m interval until the canopy vegetation stopped (modified from Rotenberry 1985).

We measured total canopy closure using a Model-A spherical densiometer at 1 m north and south of the center of each plot and averaged these measurements to obtain a single canopy closure value for each plot. We measured average canopy height within each plot by selecting a representative tree and using a survey rod or a clinometer and measuring tape to measure the height of the selected tree. We estimated percent woody ground cover, alive and dead, within 0.5 m of the ground using a Daubenmire-type frame with the lower edge of the frame centered at 1 m north, south, east, and west of plot center. These percentages were averaged to obtain a single measure of percent woody ground cover for each plot.

We tallied the number of live stems for each species within 5 m of the center of the plot. Stems were tallied if they were at least 1.4-m tall and >2.5 cm in diameter at 10 cm above the ground. Stems were tallied by the following diameter at breast height (dbh) categories: <1 cm, 1–2.5 cm, 2.6–5.5 cm, 5.6–8 cm, 8.1–10.5 cm, and 10.5–15 cm. Any stems >15 cm dbh were measured and the exact dbh was recorded. Dead stems were also tallied in these categories, but not identified to species. In previous years of vegetation sampling, if a stem branched above 10 cm but below 1.4 m above the ground, only the largest stem was tallied. In habitats (e.g., tamarisk) where stems frequently branch in this height interval, this method of counting stems may underestimate the density of stems that form an important part of the habitat structure. Therefore, in 2008 we tallied stems as we had in previous years and then for each stem that branched between 10 cm and 1.4 m from the ground, we tallied the number of additional stems that were at least 2.5 cm in diameter at 10 cm above the point where it branched from the main stem.

Additional information recorded at each plot included the date when the measurements were taken, observer initials, and UTM coordinates for each plot center.

Several habitat variables that were measured in previous years were not measured in 2008 because they were not useful in differentiating habitats or because logistical difficulties precluded accurate data collection. These variables were distance to canopy gap, distance to broadleaf tree, distance to water, and number of stems >8 cm dbh between 5 and 11.3 m of plot center.

Nests in Formerly Occupied Areas

The same measurements that were completed at occupied territories were also taken at old nest sites. We used the UTM coordinates of the nest, nest tree species, nest height, and nest flags that remained in the field to locate the old nests. Vegetation plots were centered on the nest location.

Data Analyses

We used high-resolution aerial photography and field knowledge of each study area to delineate clusters of territories that occur within habitat patches of similar floristics and canopy height. Vegetation characteristics were then summarized for each habitat type. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses. Data presented are means ± standard error (SE) unless otherwise stated.

Stem counts were grouped into the following size categories for analysis: <2.5 cm dbh, 2.5–8 cm dbh, and >8 cm dbh. For each size category, stem counts are reported separately for live and dead stems; the sum of these is the equivalent of the stem counts per size category that were reported in the 2003–2007 summary report (McLeod et al. 2008a). Vertical foliage density measurements above 8.0 m that were recorded as < or >5 hits per meter were converted to 2.5 and 7.5 hits, respectively, to allow analyses of

these data as continuous rather than categorical. Vertical foliage density was calculated for each meter interval as the mean of the number of hits recorded within the interval at the nine locations in the plot. In previous years, we had measured vertical foliage density only at plot center and 1 m from plot center in each cardinal direction, and foliage density measures per meter interval were presented as the sum of the hits recorded at the five locations in the plot. Thus, vertical foliage data presented in previous reports should be divided by 5 to be comparable to data presented here. In the five-year summary report (McLeod et al. 2008a), vertical foliage data were grouped into three categories of above, at, and below the nest. Vegetation data were not collected at nest sites in 2008, so we used average nest height as measured in 2003–2007 in each vegetation type to demarcate vertical foliage categories. As with stem counts, vertical foliage data are reported separately for live and dead vegetation.

Percent native vegetation was calculated as the average of the percent basal area that was native and the percent native vertical foliage hits. For data collected in 2003–2007 and reported in McLeod et al. 2008a), we did not use vertical foliage data to calculate percent native because all vertical foliage data were collected within 1 m of plot center and represented only a small portion of the plot. We included vertical foliage data in the percent native calculations in 2008 to account for the influence of stems that were too small to be tallied or were rooted outside the 5-m-radius circle but overhung the plot. All exotic vegetation consisted of tamarisk.

We used non-parametric Wilcoxon signed rank tests for related samples to compare vegetation measurements collected at old nests to the measurements collected during the year the nest was active. We chose non-parametric tests because several parameters had non-normal distributions. Vertical foliage data used in these comparisons were restricted to data collected within 1 m of plot center so as to be directly comparable to data collected prior to 2008. A statistical significance level of $P \leq 0.05$ was chosen to reject null hypotheses.

RESULTS

Currently Occupied Territories

We measured vegetation at 41 occupied territories at Mesquite, Mormon Mesa, Muddy River, Topock Marsh, Bill Williams, and Ahakhav. We delineated the following habitat types: 1) coyote willow, 2) tamarisk/coyote willow mix, 3) Goodding willow, 4) Goodding willow with tamarisk understory, 5) tamarisk with scattered Goodding willow, 6) tamarisk, and 7) tamarisk/mesquite mix. Coyote willow and tamarisk/coyote willow mix occurred only at Mesquite, with coyote willow dominating the eastern half of the site while tamarisk and coyote willow were mixed in the western half of the site. Goodding willow occurred in the southern portion of Muddy River, in a small stand readily discernible on high-resolution aerial photographs. Large Goodding willow with tamarisk understory occurred at Bill Williams. Tamarisk with scattered, emergent Goodding willow occurred both at Mormon Mesa and Topock; these two study areas were summarized separately because several variables, including canopy height and canopy closure, differed between the two areas. Tamarisk habitats lacking emergent willows occurred both at Muddy River and Topock, while tamarisk with mesquite occurred at Ahakhav. Average nest height recorded in 2003–2007 and used to assign vertical foliage strata for each vegetation category were 2.0, 2.4, 2.4, 4.5, 2.6, 3.4, and 4.0 m for coyote willow, tamarisk/coyote willow mix, Goodding willow, Goodding willow with tamarisk understory, tamarisk with scattered Goodding willow at Mormon Mesa, tamarisk with scattered Goodding willow at Topock, and tamarisk, respectively. No nests were known from tamarisk/mesquite habitat, so the overall mean nest height of 3.2 m was used to assign vertical foliage categories for that vegetation type.

Vegetation characteristics of each habitat type are summarized in Table 5.1. Habitat types varied widely in many characteristics, and plots within each habitat type also showed a wide range in most habitat variables.

The proportion of stems omitted from stem counts by counting only the largest stem of a cluster that branched between 10 cm and 1.4 m above the ground varied both by size and species of the main stem (Table 5.2). Tamarisk had the highest proportion of omitted stems, and larger stems had more branches that were omitted.

Including vertical foliage data in the calculation of percent native had, overall, little effect when compared to percent native as calculated solely from basal area. For plots that were <25% native by basal area (21 of 41 plots), including vertical foliage in the calculations increased percent native by an average of 5.5% (median 1.0%). This was generally because for some plots, vertical foliage data included large Goodding willow that were rooted outside but overhung the vegetation plot. For plots that were >75% native by basal area (15 of 41 plots), including vertical foliage decreased the percent native by an average of 3.6% (median 1.5%).

Vertical foliage profiles for each habitat type are shown in Figures 5.1–5.8. Average nest height in each habitat type, as recorded in 2003–2007, is also shown on each graph. No nests were recorded in tamarisk-mesquite habitat, so average nest height across all habitat types is shown on this graph. In all habitat types, the proportion of dead vegetation in the vertical profile was highest immediately above the ground and declined with increasing height. With the exception of the Goodding willow and tamarisk-mesquite habitats, the densest live foliage occurred between 3 and 4 m above the ground and was at or immediately above average nest height. In Goodding willow, the densest foliage occurred above 7 m above the ground, approximately 5 m above average nest height. In tamarisk-mesquite, the densest foliage was below 2 m above the ground; this was the only habitat type where the densest foliage was below average nest height.

Nests in Formerly Occupied Areas

We gathered vegetation data at 44 old nests at Mesquite, Mormon Mesa, Muddy River, and Topock. We were able to locate the exact nest fork in 28 cases and located the nest tree but were unsure of the correct fork in 12 additional cases. In three cases we located the nest vicinity (within 5 m of the nest location) but were unable to verify that we had located the exact nest tree, and in one case the nest tree was clearly no longer there, and we centered the vegetation plot on the nearest adjacent tree.

Vegetation at nest sites differed between occupied and unoccupied periods in more than one variable at each study area; however, the characteristics that differed were not consistent among sites (Tables 5.3 and 5.4). At Mesquite, nest sites had greater canopy closure, more live stems <2.5 cm dbh, fewer dead stems 2.5–8 cm dbh, more live foliage at nest level, and less dead foliage at and below nest level when they were active compared to when the area was abandoned. Vegetation at nest sites at Mesquite also consisted of a larger proportion of native vegetation when the territory was occupied than when it was abandoned. At Mormon Mesa, nest sites had greater canopy closure, more live stems <2.5 cm dbh, more live foliage above the nest, and more dead foliage at nest level when they were occupied versus when territories had been abandoned. At Muddy River, nest sites had more live stems <2.5 cm dbh, less dead foliage at nest level, and a greater percentage of native vegetation when they were occupied, while at Topock Marsh, nests had more live stems 2.5–8 cm dbh and more dead foliage below nest level when they were occupied. When all study areas were combined (Table 5.5), nest sites had greater canopy closure, more live stems <2.5 cm dbh, fewer dead stems 2.5–8 cm dbh, more live foliage at and below nest level, and a greater percentage of native vegetation when they were active versus when the territory was abandoned.

Table 5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2008*

Parameter	SAEX (n=8)	TASP and SAEX (n=4)	SAGO (n=2)	SAGO with TASP understory (n=3)	TASP with scattered SAGO (MOME) (n=11)	TASP with scattered SAGO (TOPO) (n=9)	TASP (n=3)	TASP and PRSP (n=1)
Average canopy height (m)	5.0 (0.3)	4.7 (0.4)	8.0 (0.2)	10.8 (1.6)	4.4 (0.2)	6.5 (31.4)	4.8 (0.2)	5.2
	3.9–6.2	3.9–5.5	7.8–8.2	7.7–12.5	3.3–6.2	6.0–6.9	4.6–5.2	
% total canopy closure	86.7 (4.3)	82.2 (8.9)	90.1 (1.6)	97.6 (1.0)	79.8 (3.5)	93.7 (1.6)	63.7 (15.8)	56.8
	59.4–94.3	57.8–95.8	88.5–91.7	96.4–99.5	57.3–92.7	83.3–98.4	41.1–94.3	
% woody ground cover	18.3 (6.5)	18.6 (8.1)	13.9 (12.4)	30.8 (9.1)	34.6 (7.7)	31.4 (7.9)	25.6 (16.0)	100
	5.0–58.8	3.0–41.2	1.5–26.2	13.0–42.8	3.5–77.8	2.8–78.8	8.0–57.5	
# live stems <2.5 cm dbh per ha	4647 (930)	2324 (500)	1846 (1719)	934 (571)	1181 (180)	2023 (359)	1995 (810)	2165
	891–9677	1019–3438	127–3565	127–2037	637–2419	127–3820	382–2928	
# live stems 2.5–8 cm dbh per ha	7974 (414)	5539 (782)	1082 (955)	2165 (641)	2905 (577)	4202 (690)	2504 (1213)	1019
	6112–9423	3692–7130	127–2037	1401–3438	509–5857	1401–7385	382–4584	
# live stems >8 cm dbh per ha	477 (275)	255 (116)	955 (64)	1146 (515)	208 (88)	1287 (337)	509 (509)	127
	0–2292	0–509	891–1019	255–2037	0–764	0–2928	0–1528	
# dead stems <2.5 cm dbh per ha	5268 (1678)	1146 (172)	2737 (64)	3735 (1587)	1898 (423)	2957 (969)	2462 (473)	12478
	891–12732	891–1655	2674–2801	1146–6621	382–4711	1146–10441	1528–3056	
# dead stems 2.5–8 cm dbh per ha	2913 (743)	2769 (326)	2483 (1464)	1570 (297)	2141 (591)	2207 (417)	1825 (695)	2292
	127–7385	1910 3438	1019–3947	1019–2037	255–6239	764–5220	891–3183	
# dead stems >8 cm dbh per ha	16 (16)	0 (0)	127 (127)	0 (0)	93 (60)	156 (82)	42 (42)	127
	0–127	0–0	0–255	0–0	0–637	0–637	0–127	
Percent native	92.9 (2.3)	36.1 (6.5)	93.8 (3.7)	50.4 (28.3)	32.7 (10.0)	4.3 (3.0)	6.1 (3.6)	62.1
	81.7–98.0	16.6–43.0	90.0–97.5	0–98.0	0–96.6	0–27.5	0–12.5	
Live vertical foliage (hits) below nest	3.7 (0.6)	4.4 (1.2)	0.2 (0.2)	14.0 (6.0)	1.4 (0.4)	3.4 (0.7)	0.7 (0.2)	17.8
	1.9–7.3	0.9–6.4	0–0.4	3.8–24.6	0–3.6	1.0–7.0	0.40–1.0	
Live vertical foliage (hits) at nest	4.3 (0.6)	4.4 (0.7)	0.8 (0.2)	3.8 (1.8)	2.5 (0.4)	3.7 (0.6)	3.0 (0.2)	2.2
	1.9–7.7	2.6–5.8	0.6–1.0)	0.2–60	1.1–4.8	1.8–7.3	2.7–3.2	
Live vertical foliage (hits) above nest	9.8 (0.9)	8.0 (0.5)	19.7 (4.3)	12.7 (3.9)	7.4 (1.2)	6.8 (1.3)	7.3 (3.0)	0.8
	6.3–13.8	6.8–9.1	15.4–23.9	5.1–17.8	2.6–13.9	1.4–11.9	1.7–12.1	
Dead vertical foliage (hits) below nest	4.8 (0.7)	5.7 (0.4)	4.1 (0.9)	12.8 (2.7)	4.8 (0.7)	10.9 (1.7)	6.9 (1.6)	10.7
	2.6–7.7	4.87–6.7	3.2–5.0	7.4–16.1	1.7–9.8	5.4–17.8	4.4–9.8	
Dead vertical foliage (hits) at nest	2.1 (0.2)	2.7 (0.7)	3.3 (1.1)	0.7 (0.6)	2.6 (0.4)	1.4 (0.4)	2.8 (0.8)	0.4
	1.3–2.9	0.8–4.2	2.2–4.3	0–1.9	0.4–5.2	0.6–4.0	1.2–3.8	
Dead vertical foliage (hits) above nest	1.1 (0.3)	0.9 (0.4)	2.9 (0.3)	0.6 (0.6)	1.2 (0.3)	0.9 (0.3)	0.6 (0.2)	0.3
	0.2–2.8	0–1.7	2.6–3.2	0–1.9	0–3.0	0.1–2.8	0.3–0.9	

* Data are presented as mean, standard error, and range. Stem counts include only the largest stem of any cluster that branched above 10 cm above the ground. SAEX = coyote willow, SAGO = Goodding willow, TASP = tamarisk, PRSP = mesquite.

Table 5.2. Proportion of Stems Omitted from Stem Counts

Size category[1]	Species			
	Tamarisk	Coyote willow	Goodding willow	Dead stems
<2.5 cm dbh	0.16	0.03	0.00	0.08
2.5–8 cm dbh	0.44	0.17	0.00	0.25
>8 cm dbh	1.70	0.48	0.12	0.27

[1] Size category indicates the size of the main stem that was tallied. All stems that were omitted from the stem count are equal to or smaller than the size of the main stem.

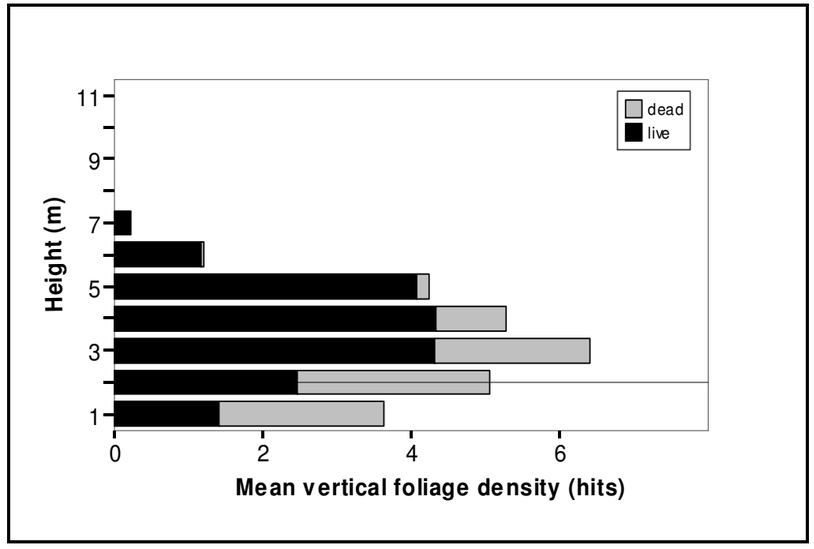


Figure 5.1. Vertical foliage density at occupied willow flycatcher territories in coyote willow habitat type, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

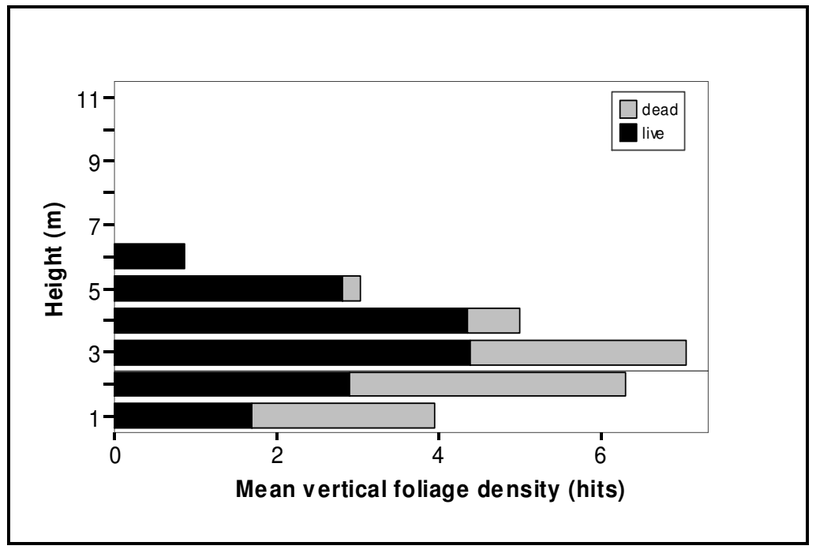


Figure 5.2. Vertical foliage density at occupied willow flycatcher territories in tamarisk/coyote willow habitat type, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

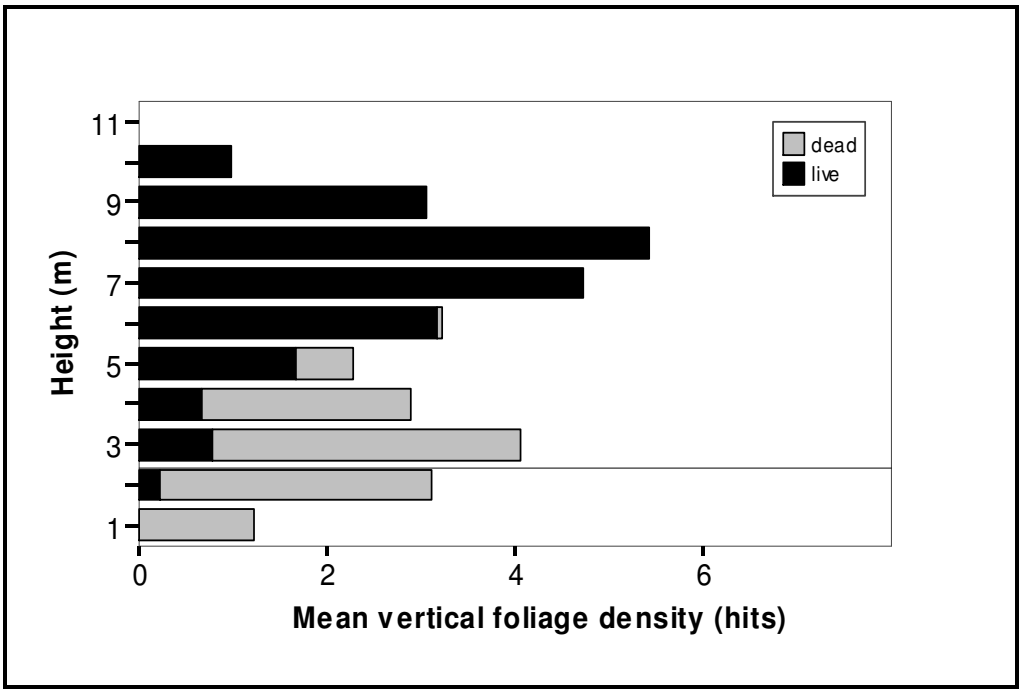


Figure 5.3. Vertical foliage density at occupied willow flycatcher territories in Goodding willow habitat type, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

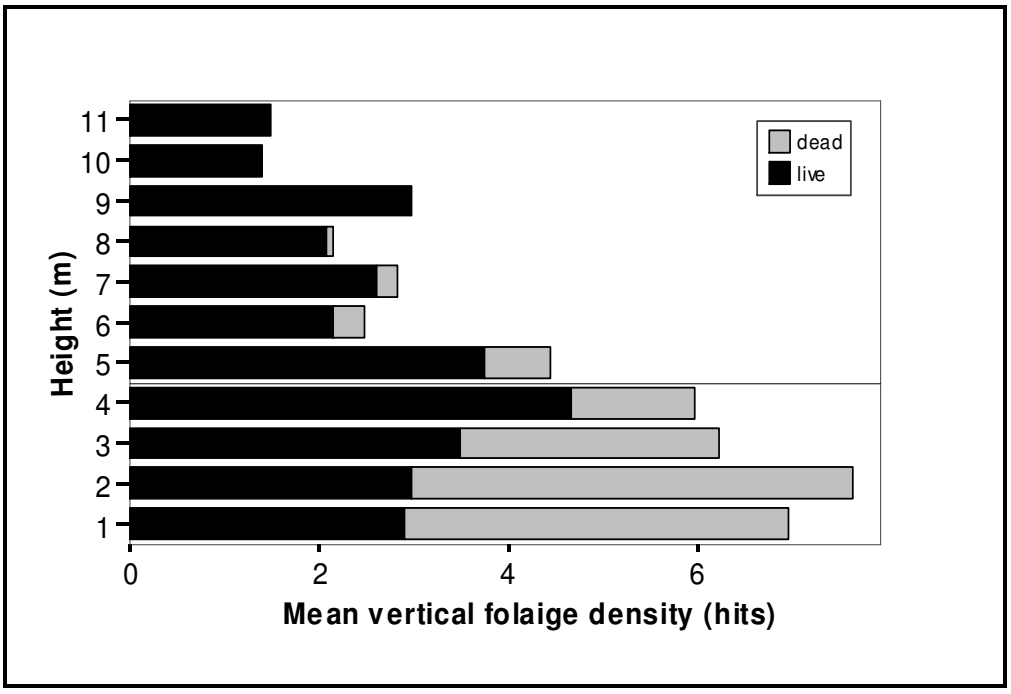


Figure 5.4. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

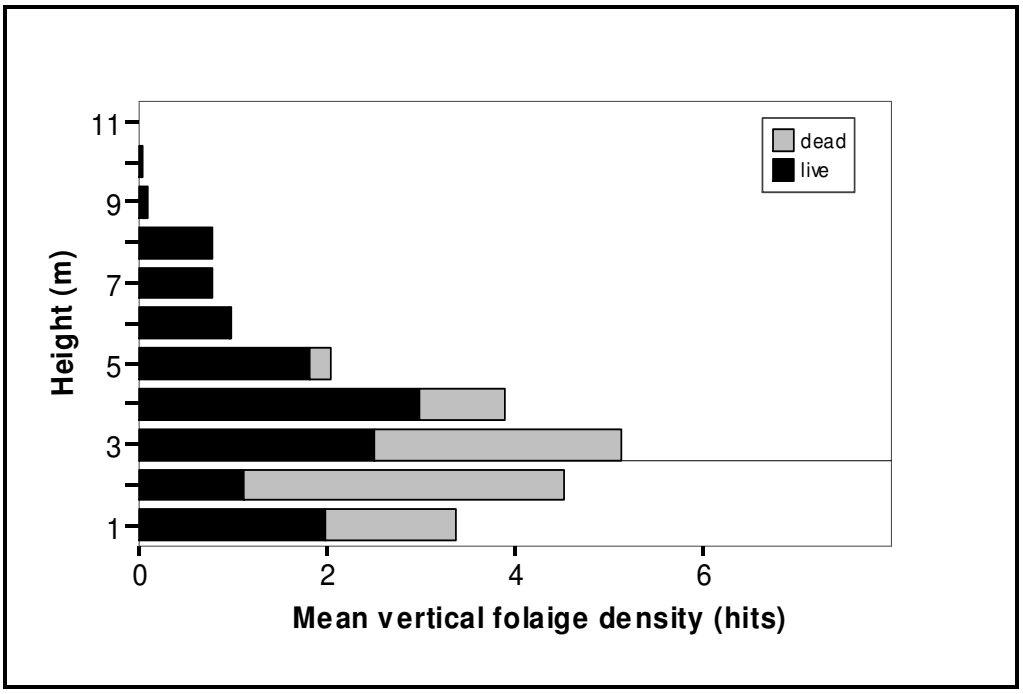


Figure 5.5. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Mormon Mesa, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

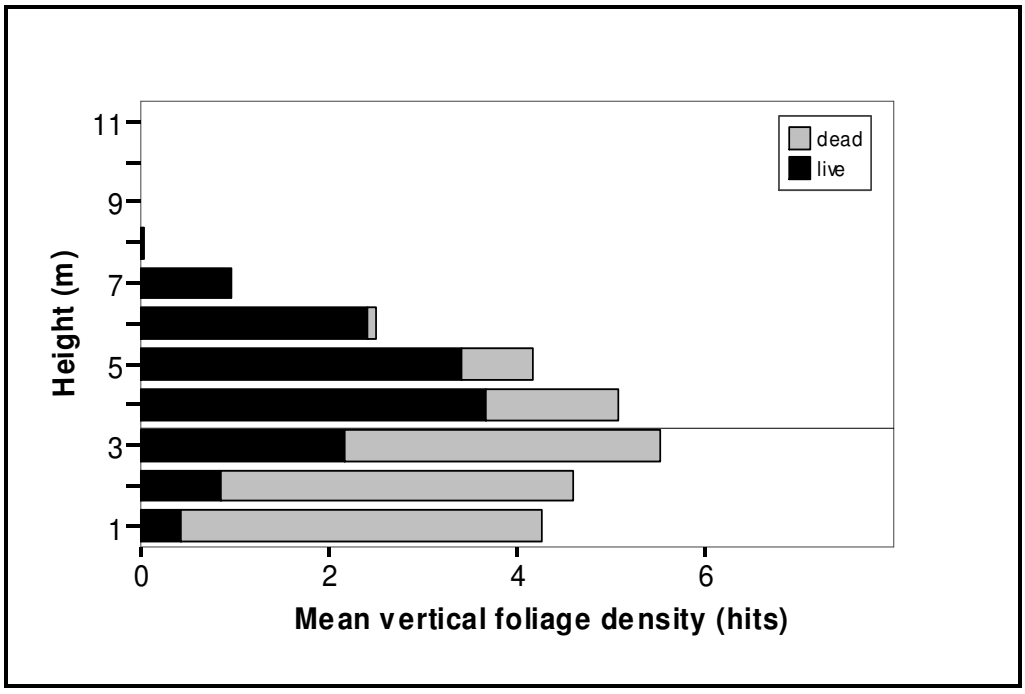


Figure 5.6. Vertical foliage density at occupied willow flycatcher territories in tamarisk with scattered Goodding willow habitat type, Topock Marsh, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

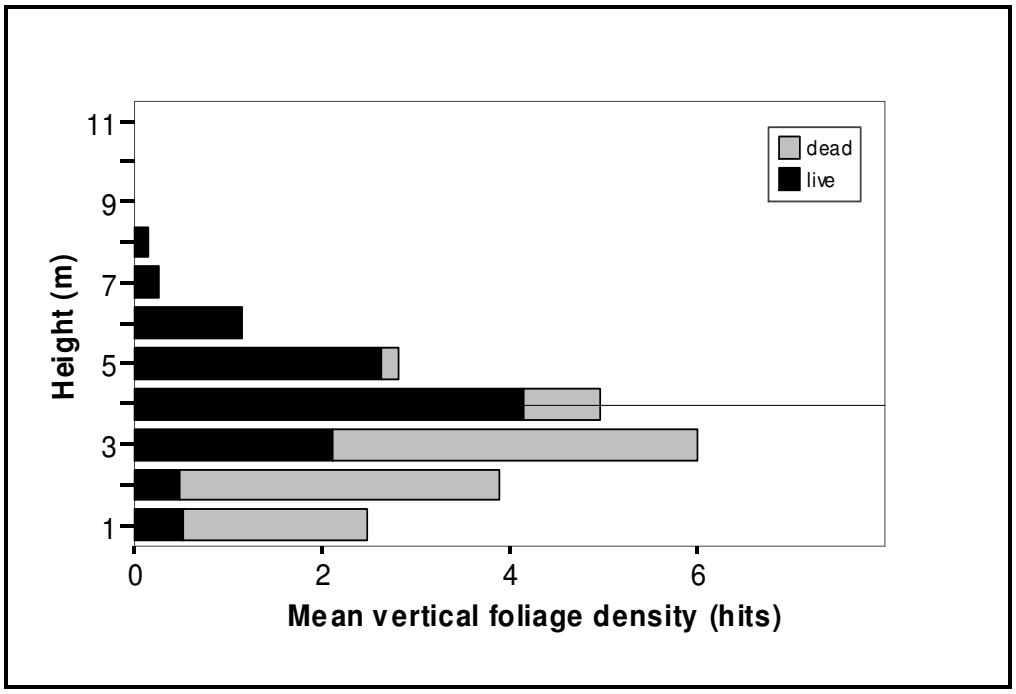


Figure 5.7. Vertical foliage density at occupied willow flycatcher territories in tamarisk habitat type, 2008. Horizontal line shows average nest height in this habitat type in 2003–2007.

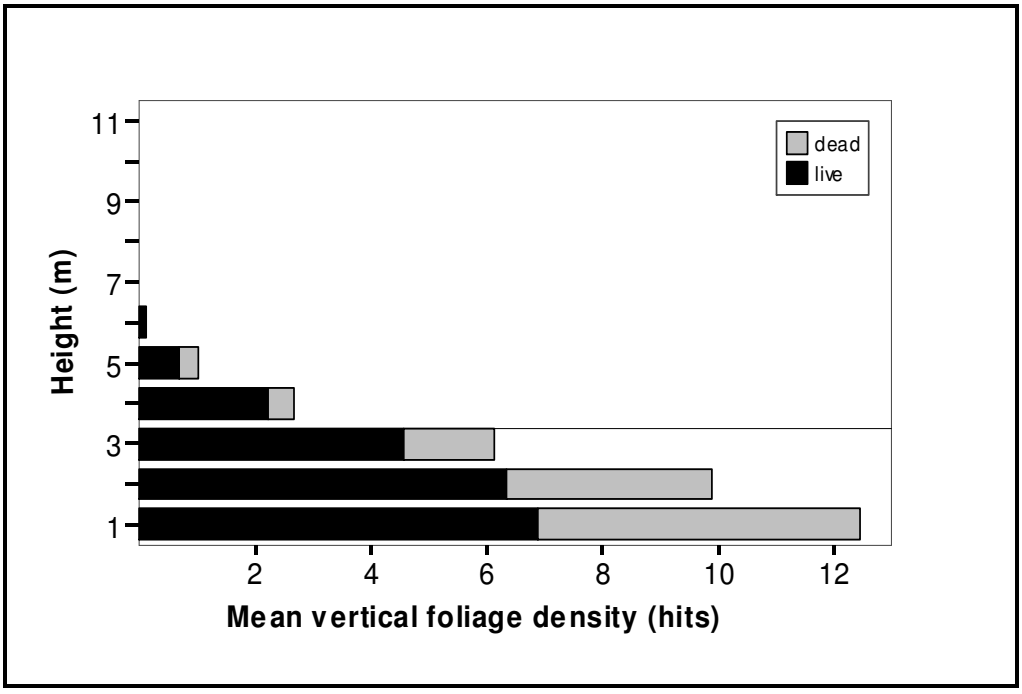


Figure 5.8. Vertical foliage density at occupied willow flycatcher territories in tamarisk/mesquite habitat type, 2008. Horizontal line shows average nest height across all habitat types in 2003–2007.

Table 5.3. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mesquite and Mormon Mesa*

Variable	Mesquite (n = 15)				Mormon Mesa (n = 8)			
	Occupied	Unoccupied	Difference	*P*	Occupied	Unoccupied	Difference	*P*
Canopy height (m)	5.3 (0.2)	4.9 (0.2)	-0.3 (0.2)	0.096	8.0 (1.4)	4.9 (0.4)	-3.1 (1.6)	0.080
% canopy closure	95.2 (0.9)	71.3 (6.5)	-23.9 (6.5)	**0.001**	95.5 (2.8)	58.5 (10.7)	-37.0 (11.9)	**0.017**
% woody ground cover	14.6 (3.9)	16.4 (2.7)	1.8 (2.5)	0.426	8.3 (3.3)	13.9 (2.5)	5.6 (4.0)	0.123
# live stems <2.5 cm dbh per ha	4100 (1136)	2071 (387)	-2029 (1134)	**0.027**	2944 (1259)	493 (171)	-2451 (1157)	**0.028**
# live stems 2.5–8 cm dbh per ha	6816 (726)	6451 (810)	-365 (929)	0.530	3454 (1666)	1591 (451)	-1862 (1556)	0.327
# live stems >8 cm dbh per ha	178 (61)	475 (157)	297 (146)	0.062	653 (141)	414 (146)	-239 (121)	0.114
# dead stems <2.5 cm dbh per ha	2283 (731)	4524 (734)	2241 (1213)	0.112	3884 (582)	2960 (895)	-923 (1293)	0.484
# dead stems 2.5–8 cm dbh per ha	2343 (508)	9719 (1299)	7376 (1438)	**0.001**	1607 (683)	2260 (1090)	652 (1330)	0.674
# dead stems > 8cm dbh per ha	110 (51)	255 (120)	144 (139)	0.395	0 (0)	143 (81)	143 (81)	0.102
Live vertical foliage density (hits) below nest	3.0 (1.1)	0.6 (0.2)	-2.4 (1.2)	0.059	2.9 (1.5)	1.2 (0.7)	-1.7 (1.8)	0.465
Live vertical foliage density (hits) at nest	3.2 (0.6)	1.7 (0.6)	-1.5 (0.4)	**0.005**	2.1 (0.8)	1.9 (0.8)	-0.2 (0.7)	0.345
Live vertical foliage density (hits) above nest	11.9 (1.3)	10.0 (1.0)	-1.9 (1.2)	0.167	16.6 (4.4)	5.8 (2.6)	-10.8 (4.3)	**0.050**
Dead vertical foliage density (hits) below nest	1.8 (0.5)	3.3 (0.7)	1.5 (0.6)	**0.011**	7.1 (1.3)	4.8 (1.0)	-2.4 (1.5)	0.161
Dead vertical foliage density (hits) at nest	1.4 (0.3)	3.0 (0.4)	1.6 (0.5)	**0.013**	3.6 (0.7)	1.8 (0.6)	-1.9 (0.4)	**0.017**
Dead vertical foliage density (hits) above nest	1.9 (0.7)	3.4 (0.6)	1.5 (1.0)	0.069	1.7 (0.8)	2.1 (0.8)	0.4 (1.2)	0.866
Percent native	73.5 (5.5)	49.7 (9.4	-23.7 (6.9)	**0.006**	68.0 (13.3)	47.5 (16.8)	-20.6 (12.5)	0.091

* Data are presented as means (standard error).

Table 5.4 Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Muddy River and Topock Marsh*

Variable	Muddy River (n = 11)				Topock Marsh (n = 10)			
	Occupied	Unoccupied	Difference	P	Occupied	Unoccupied	Difference	P
Canopy height (m)	6.1 (0.3)	6.0 (0.3)	-0.1 (0.4)	0.959	6.1 (0.3)	5.9 (0.4)	-0.1 (0.6)	0.878
% canopy closure	92.1 (1.7)	83.1 (6.1)	-9.0 (6.3)	0.075	90.2 (2.1)	92.7 (1.2)	2.5 (2.3)	0.445
% woody ground cover	26.3 (7.9)	19.5 (5.1)	-6.8 (7.3)	0.534	19.8 (6.4)	20.0 (4.5)	0.2 (5.0)	0.799
# live stems <2.5 cm dbh per ha	2558 (438)	1701 (327)	-856 (350)	**0.038**	2470 (482)	2572 (272)	102 (605)	0.859
# live stems 2.5–8 cm dbh per ha	4572 (615)	5197 (576)	625 (583)	0.350	7168 (647)	4201 (455)	-2967 (780)	**0.009**
# live stems >8 cm dbh per ha	799 (226)	1215 (168)	417 (277)	0.110	1006 (190)	968 (197)	-38 (304)	0.959
# dead stems <2.5 cm dbh per ha	1123 (302)	1181 (172)	57.9 (278)	0.964	3450 (605)	2050 (353)	-1401 (814)	0.202
# dead stems 2.5–8 cm dbh per ha	2280 (480)	2014 (272)	-266 (609)	1.000	1337 (315)	1859 (339)	522 (391)	0.153
# dead stems >8 cm dbh per ha	150 (78)	69 (26)	-81 (69)	0.339	25 (25)	25 (17)	0 (19)	1.000
Live vertical foliage density (hits) below nest	2.0 (0.7)	2.5 (0.5)	0.5 (0.6)	0.475	7.1 (2.3)	3.4 (0.6)	-3.7 (2.1)	0.083
Live vertical foliage density (hits) at nest	2.0 (0.4)	1.7 (0.5)	-0.2 (0.4)	0.406	3.1 (0.6)	2.0 (0.5)	-1.1 (0.6)	0.102
Live vertical foliage density (hits) above nest	10.4 (1.6)	14.8 (1.8)	4.3 (2.0)	0.066	12.1 (2.2)	7.0 (5.8)	-5.1 (2.7)	0.093
Dead vertical foliage density (hits) below nest	4.3 (0.7)	5.4 (0.5)	1.1 (1.0)	0.398	10.8 (1.3)	8.0 (0.9)	-2.8 (1.2)	**0.047**
Dead vertical foliage density (hits) at nest	2.3 (0.5)	4.0 (0.6)	1.7 (0.5)	**0.016**	3.1 (0.7)	2.1 (0.6)	-1.1 (0.5)	0.075
Dead vertical foliage density (hits) above nest	2.8 (0.7)	3.2 (0.9)	0.4 (0.4)	0.357	1.5 (0.7)	1.5 (0.5)	-0.1 (0.4)	0.726
Percent native	38.1 (7.9)	26.1 (7.5)	-12.0 (4.6)	**0.028**	4.7 (3.0)	10.4 (4.9)	5.8 (4.7)	0.345

* Data are presented as means (standard error).

Table 5.5. Wilcoxon Signed Rank Test Results Comparing Vegetation Characteristics at Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined*

Variable	All Sites (n = 44)				Direction and Magnitude of Change[1]			
	Occupied	Unoccupied	Difference	P	MESQ	MOME	MUDD	TOPO
Canopy height (m)	6.1 (0.2)	5.4 (0.2)	-0.6 (0.3)	0.080	↓	↓	↓	↓
% canopy closure	93.4 (0.9)	76.8 (3.7)	-16.6 (4.0)	**<0.001**	↓	↓	↓	↑
% woody ground cover	17.6 (2.9)	17.5 (1.9)	-0.0 (2.4)	0.363	↑	↑	↓	↑
# live stems <2.5 cm dbh per ha	3134 (474)	1806 (196)	-1328 (478)	**0.002**	↓	↓	↓	↑
# live stems 2.5–8 cm dbh per ha	5724 (482)	4743 (419)	-981 (508)	0.071	↓	↓	↑	↓
# live stems >8 cm dbh per ha	608 (91)	761 (97)	153 (114)	0.151	↑	↓	↑	↓
# dead stems <2.5 cm dbh per ha	2549 (341)	2842 (365)	292 (548)	0.674	↑	↓	↑	↓
# dead stems 2.5–8 cm dbh per ha	1965 (255)	4650 (736)	2685 (760)	**0.001**	↑	↑	↓	↑
# dead stems >8 cm dbh per ha	81 (27)	136 (45)	55 (54)	0.412	↑	↑	↓	--
Live vertical foliage density (hits) below nest	3.7 (0.8)	1.8 (0.3)	-1.8 (0.7)	**0.029**	↓	↓	↑	↓
Live vertical foliage density (hits) at nest	2.7 (0.3)	1.8 (0.3)	-0.9 (0.3)	**0.001**	↓	↓	↓	↓
Live vertical foliage density (hits) above nest	12.4 (1.1)	9.7 (0.9)	-22.7 (1.4)	0.090	↓	↓	↑	↓
Dead vertical foliage density (hits) below nest	5.4 (0.7)	5.2 (0.5)	-0.3 (0.6)	0.777	↑	↓	↑	↓
Dead vertical foliage density (hits) at nest	2.4 (0.3)	2.8 (0.3)	0.4 (0.3)	0.334	↑	↓	↑	↓
Dead vertical foliage density (hits) above nest	2.0 (0.4)	2.7 (0.4)	0.7 (0.4)	0.065	↑	↑	↑	↓
Percent native	48.0 (5.5)	34.5 (5.4)	-13.5 (3.9)	**0.001**	↓	↓	↓	↑

* Data are presented as means (standard error).

[1] Arrows indicate the direction of change of the variable between occupied and unoccupied periods for each study area (MESQ = Mesquite, MOME = Mormon Mesa,
MUDD = Muddy River, TOPO = Topock Marsh, while color indicates the statistical significance of the change as follows: red is P <0.05, blue is 0.05< P <0.10, black is P >0.10.

DISCUSSION

Currently Occupied Territories

The purpose of vegetation measurements of occupied habitat is to provide quantitative guidelines for restoration efforts. Coyote willow and Goodding willow are the two habitat types that are most likely to be replicated in restoration areas. Mesquite West contains the only extensive stand of coyote willow known to be occupied by territorial willow flycatchers along the lower Colorado River and tributaries in any year since 2003. Occupied coyote willow habitat at Mesquite encompasses approximately 3 ha in the eastern and central portions of Mesquite West and is surrounded by cattail marsh and mixed coyote

willow and tamarisk. Occupied even-age Goodding willow habitat occurred in 2008 on less than 1 ha on the southern end of the Overton WMA site at Muddy River and at Iceberg Canyon in Grand Canyon; however, vegetation data were not collected at Iceberg Canyon. Occupied Goodding willow habitat also occurred in previous years at RM 274.5 and RM 285.3 in Grand Canyon.

Sample sizes for the coyote willow and Goodding willow habitat types in 2008 are small (eight and two, respectively) and likely do not provide an accurate representation of the range and variance in vegetation characteristics in each habitat type. In future reports, data from 2008 will be combined with data collected in future years as well as data collected within active territories between 2003 and 2005 to provide a more comprehensive description of each habitat type.

Although other vegetation types occupied by willow flycatchers are not likely to be created in restoration areas, descriptive data are provided for these habitats to assist in the evaluation of areas to determine their suitability as flycatcher breeding habitat. Data from these other vegetation types may also be useful in illustrating structural similarities between occupied areas in different habitat types. Small sample sizes preclude meaningful comparisons of the 2008 data across habitat types.

Nests in Formerly Occupied Areas

The areas of Mesquite and Mormon Mesa that contained flycatcher nests in previous years but were abandoned in 2008 primarily consisted of areas that were affected by the winter floods of 2004–2005. The eastern edge of Mesquite West experienced flooding and deposition, which appeared to change the flow of water such that the area was no longer inundated. In 2005 we noted that this portion of Mesquite West had reduced foliage density and many of the willows were yellow and dying (Koronkiewicz et al. 2006a). The vegetation did not recover in subsequent years, and this area has not been occupied by flycatchers since 2005. The vegetation at Bunker Farm has also changed noticeably since it was last occupied by breeding flycatchers in 2005. The adjacent agricultural field, which supplied runoff to the site, has been fallow since 2005, and the stands of coyote willow and many of the Goodding willow at Bunker Farm were dead by 2008.

Areas of Mormon Mesa containing most of the old nests were also affected by the 2004–2005 winter floods, which deposited sediment and changed water flow patterns such that nesting areas were no longer inundated. We sampled old nests in Mormon Mesa North and the eastern half of Virgin River #1 North, both of which experienced progressive death of native vegetation since the flood and have not been occupied by flycatchers since 2005. We also sampled one nest from 2006 in the southern end of Virgin River #2; this area was unoccupied in 2007–2008, though no obvious changes in vegetation were noted.

The changes in vegetation that were noted in qualitative site descriptions were also apparent in the vegetation data, with both Mesquite and Mormon Mesa showing less canopy closure, fewer live stems, less live foliage, and more dead foliage in 2008 than when the nests were occupied. Both sites also showed a trend toward decreased canopy height. Nest sites at Mesquite had also lost a significant percentage of their native vegetation, while nest sites at Mormon Mesa showed a trend in this same direction. Canopy closure, canopy height, and the percent native vegetation were all found to be important in differentiating nest sites from non-use areas (McLeod et al. 2008a), and it is likely that decreases in canopy cover and canopy height and the death of native vegetation at Mesquite and Mormon Mesa made portions of those sites unsuitable for nesting flycatchers.

Flycatcher nests at Muddy River have occurred primarily in two areas, one in the northern half of Overton WMA and the other at the southern tip of Overton WMA. The northern portion was occupied each year from 2004 to 2007 but was abandoned in 2008, and the majority of the old nests occurred in this area. We sampled one additional nest at Overton Pond, which was occupied in 2007 but not 2008.

Areas adjacent to the old nests sites at Overton WMA were bulldozed prior to the 2008 breeding season (see Chapter 2), but no obvious habitat changes were noted at the old nest sites themselves. However, vegetation data showed a decrease in live stems <2.5 cm dbh, an increase in dead foliage density at nest height, and a decrease in the percent of native vegetation. There was also a trend toward decreased canopy closure. It is possible that vegetation in the area has changed, although this was not obvious from qualitative descriptions of the site, decreasing the suitability of the area for flycatchers. Bulldozing activities in the vicinity of old nests could also have contributed to abandonment of the area, or the site could have been unoccupied in 2008 as the result of interannual variation in site occupancy. Monitoring of the site in future years will help determine whether abandonment of the site was a temporary or long-term phenomenon.

Old nests at Topock occurred in PC6-1, Pig Hole, and 250M all of which were occupied in 2004 and/or 2005. No obvious changes in vegetation have been noted in any of these sites, though vegetation measurements showed a decrease in the number of live stems 2.5–8 cm dbh and a decrease in dead foliage below the nest. There were also trends toward decreased live foliage below the nest and decreased dead foliage at nest height. A decrease in the number of live stems and decreases in foliage density could reduce suitability of the sites for flycatchers. The number of territories at Topock has varied widely over the years, and the abandonment of certain sites may also reflect a lower overall number of territorial flycatchers. Territorial individuals would be expected to occupy optimal habitats first, and the areas that have not been occupied since 2005 may represent sub-optimal habitat.

The overall habitat changes between occupied and unoccupied periods for all study areas combined, along with an examination of which habitat variables changed in a consistent direction across study areas, lend further insight into which vegetation characteristics seem to be important to flycatcher occupancy. Live foliage density below, at, and above nest height; canopy height; canopy closure; number of live stems <2.5 cm dbh and 2.5–8 cm dbh; and percent native decreased in three or four study areas between occupied and unoccupied periods. Number of dead stems 2.5–8 cm dbh, dead vertical foliage density above nest height, and percent woody ground cover increased in three or four study areas between occupied and unoccupied periods. These trends are all consistent with abandoned areas having experienced a temporal decrease in the density of live vegetation, particularly of native species. McLeod et al. (2008a) reported similar differences between occupied and unoccupied areas when habitat patches were sampled to identify spatial habitat variation that affected flycatcher occupancy. Flycatchers typically occupied areas that had greater canopy height, canopy closure, foliage density, stem density, and percent native vegetation than unoccupied areas.

Chapter 6

MICROCLIMATE

INTRODUCTION

Our objective for microclimate sampling is to provide a quantitative summary of microclimate conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if the microclimate resembles that in occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the study area is approximately 650 m higher in elevation and experiences a cooler climate than the LCR MSCP study area.

In addition, we investigated whether changes in microclimate characteristics might have contributed to the abandonment of some areas by flycatchers. We identified several areas that had been occupied by nesting flycatchers in at least one previous year from 2003 to 2007 but were unoccupied in 2008, and we relocated old nest sites at which we had collected microclimate information in the year the nest was active. We resampled the microclimate at these nests to see whether microclimate characteristics had changed. Comparison of microclimate data collected when a nest site was active versus when the area was abandoned may elucidate how changes in microclimate through time may influence flycatcher occupancy. These results will provide additional quantitative information on the characteristics of microclimate within flycatcher nesting territories.

METHODS

Currently Occupied Territories

We collected microclimate measurements at one location for each territorial male flycatcher we identified, regardless of the length of time the male was resident and whether or not he obtained a mate.

Temperature and Relative Humidity (T/RH) Measurements

Measurements of temperature and relative humidity (T/RH) were recorded automatically every 15 minutes using a HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) that combines a thermometer (degrees Celsius), relative humidity monitor, and digital data logger. We camouflaged all HOBO units by placing them in an inverted small, plastic container coated with spray adhesive and local vegetation. The opening at the bottom was covered with shadecloth, allowing free air circulation around the unit. One HOBO unit was placed within each active flycatcher territory. We estimated the center of the male's territory (see Chapter 5) and then determined the location of the HOBO unit by means of the following instructions and the use of random number sequences:

(1) The compass direction to walk from the territory center, given in degrees from north, was determined from a random number sequence.

(2) The distance (between 0 and 20 m) to walk in the designated direction was determined from a random number sequence. Once that distance was traveled, the closest woody tree or shrub was selected for data logger placement.

(3) The HOBO unit was placed at a randomly selected height within the range of flycatcher nest heights documented at that study area in 2003–2007 (McLeod et al. 2008a). The distribution of random numbers followed the distribution of nest heights. If the chosen tree or shrub was of insufficient height to accept the height from the random number sequence, then field personnel placed the HOBO unit at the first height in the sequence that was less than the height of the tree or shrub. If no nests had been previously recorded at that study area, field personnel used the height sequences from the nearest study area with known nests.

(4) The distance (0–2 m) at which the HOBO was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If the tree or shrub was of insufficient radius to accept the distance from the random number sequence, then field personnel placed the unit at the first number in the sequence that was less than the radius of the tree or shrub.

(5) The compass direction, given in degrees from north, at which the unit was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If there was no branch in this compass direction that would support the data logger at the height and distance specified in (3) and (4), field personnel proceeded clockwise around the tree or shrub until a suitable branch was located.

If, as presented in (3) and (4), a number from a subsequent random number sequence (sequence meaning a row in the random number table) was used because the number in the initial sequence was too high, then both sequences were considered used and no longer available for future use. If these directions took field personnel outside of the riparian zone or to a site without trees or shrubs, they returned to the territory center and used the next sequence of random numbers.

HOBO data loggers were deployed as soon as the male was confirmed as being resident and were left in place throughout the breeding season. The logger was downloaded when vegetation measurements were collected at the end of the breeding season, and the logger was left in place to collect data until the start of the 2009 breeding season.

Soil Moisture (SM) Measurements

A ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively) was used to gather soil moisture (SM) data. The SM readings (nine per site) were recorded directly beneath the HOBO logger (plot center) and at 1.0 and 2.0 m from plot center in each cardinal direction. Soil moisture readings were collected when the HOBO logger was deployed and at two-week intervals throughout the breeding season until the HOBO logger was downloaded. Soil moisture was recorded both as voltage (mV) and as volumetric water content (%).[1] Soil type on the HH2 was set to mineral soil. For any SM measurement point that was underwater, we recorded the depth of standing water and assigned a value of 994 mV, which is equivalent to 50% volumetric water content, or fully saturated soil. All mV values greater than 994 were also reassigned as 994 mV, because this reading represents fully saturated soil and because the mV to percent relationship becomes excessively nonlinear for mV readings above this point. Each time we collected soil moisture data, we also recorded the distance to the nearest standing water or saturated soil and recorded the approximate percentage, as estimated in the field, of the site within 20 and 50 m of the data logger that contained inundated or saturated soil.

[1] The soil moisture logger measures the dielectric constant of moist soil via a direct current voltage, which is converted to volumetric soil moisture with conversion tables. For very high (above ~1000 mV) or low (below ~90 mV) voltage readings, the HH2 reports volumetric soil moisture as "above" or "below" the table, respectively. To eliminate these qualitative readings, we recorded both mV and volumetric soil moisture.

A soil sample was collected from beneath each HOBO data logger. Samples were approximately the size of a medium apple, collected from the surface down to and including a depth of 5 cm, and placed in a heavy zip-lock plastic bag labeled with the site designation. These samples will contribute to an ongoing analysis of soil texture, which strongly influences capillary action and therefore overall SM (Sumner 2000).

Statistical Analyses

Soil moisture data were entered into a database as they were collected during the field season. We downloaded data from the HOBO data loggers into databases at the end of the field season. We merged all data to create one dataset for further analysis. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Distance to nearest standing water or saturated soil
- % of the site within 20 m that was inundated or saturated
- % of the site within 50 m that was inundated or saturated
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[2]
- Mean nocturnal vapor pressure

Soil moisture variables were summarized per visit, and temperature/humidity variables were summarized on a daily basis. We determined diurnal and nocturnal periods by using the actual daily sunrise and sunset times reported for the region by the National Weather Service (2008). We selected the above measures of temperature and humidity for analysis because they were the most highly correlated with other variables or were the most useful in distinguishing use areas from non-use locations (McLeod et al. 2008a). Territories were grouped according to vegetation type (see Chapter 5), and microclimate variables were averaged for each vegetation type over the following two-week periods to show how microclimate conditions changed throughout the breeding season: 12–31 May, 1–15 June, 15–30 June, 1–15 July, 16–31 July, and 1–15 August.

Analyses were conducted using SAS® v.9.1.3 (SAS Institute 2003) and Stata® v.9.2 (StataCorp 2006). Data are presented as mean (standard error) unless otherwise noted.

Nests in Formerly Occupied Areas

We used the UTM coordinates of the nest, nest tree species, nest height, and nest flags that remained in the field to locate old nests. We hung a HOBO logger at the old nest location in May, and the logger remained in place until the end of the breeding season. Soil moisture measurements were taken at two-week intervals as described above.

[2] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

Statistical Analyses

During the year when each nest was active, microclimate data were collected for a two-week period immediately following the nest being vacated. We selected data from the same two-week period for each nest in 2008. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[3]
- Mean nocturnal vapor pressure

We used paired t-tests to compare measures of microclimate at old nests to the measurements collected during the year the nest was active. P-values were similar to those obtained when a non-parametric test (Wilcoxon signed rank sum) was used to compare matched sites. Analyses were conducted using SAS® v.9.1.3 (SAS Institute 2003) and Stata® v.9.2 (StataCorp 2006). Missing data were excluded test-wise. Data are presented as mean (standard error) unless otherwise noted.

To address whether any observed changes in microclimate between occupied and unoccupied periods could be the result of overall changes in regional climate, we obtained weather station data from the National Climate Data Center (www.ncdc.noaa.gov/oa/ncdc.html) for Overton, Nevada (Station ID #265846) and Needles, California (Station ID #723805) for 2003–2008. Maximum and minimum daily temperature data were available for both weather stations, and dew point data were available for Needles. We used one-way ANOVA to test whether temperature and dew point variables differed between years for the June–August period. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

RESULTS

Currently Occupied Territories

We deployed HOBO data loggers and collected soil moisture data at 41 active territories. HOBO loggers failed to collect data at three locations, and soil moisture data could not be collected at one location because thick piles of arrowweed and bulrush prevented access to the soil. Microclimate variables are summarized by two-week periods for each vegetation type in Tables 6.1–6.8. These same variables are plotted in Figures 6.1–6.9 to facilitate comparisons between vegetation types.

All vegetation types exhibited moist soil conditions throughout the breeding season. Goodding willow had the wettest conditions, with fully saturated soil throughout the season and a minimum of 60% of the surrounding area within 50 m having surface water at each visit through the end of July. Soil conditions showed a general drying trend, with the inundated percentage of the surrounding area declining through the season, in Goodding willow with tamarisk understory, tamarisk with scattered Goodding willow at Mormon Mesa, and tamarisk with scattered Goodding willow at Topock.

[3] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

Table 6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Coyote Willow (n = 7), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	790.9 (51.9)	914.7 (25.0)	781.6 (39.8)	757.3 (68.2)	662.8 (51.2)	757.5 (61.2)
Mean distance to nearest standing water	36.3 (13.3)	0.2 (0.2)	17.2 (6.9)	27.8 (10.9)	36.2 (9.6)	95.8 (31.0)
% of the site within 20 m that was inundated	28.9 (11.9)	55.0 (10.0)	46.7 (8.2)	21.6 (11.5)	8.2 (3.5)	10.6 (6.7)
% of the site within 50 m that was inundated	35.1 (12.2)	40.0 (7.6)	50.0 (7.6)	25.8 (11.3)	10.1 (4.0)	11.3 (6.0)
Temperature						
Mean maximum diurnal temperature (°C)	49.0 (0.1)	42.9 (0.1)	42.9 (0.1)	44.9 (0.1)	44.4 (0.1)	44.9 (0.1)
Mean minimum nocturnal temperature (°C)	6.2 (0.1)	7.0 (0.1)	11.0 (0.1)	14.9 (0.1)	16.0 (0.0)	14.9 (0.0)
Mean daily temperature range (°C)	35.4 (1.7)	31.0 (1.1)	28.6 (0.9)	25.1 (0.9)	24.3 (1.0)	25.6 (0.9)
Humidity						
Mean diurnal vapor pressure (Pa)	1276.7 (6.6)	1359.9 (5.5)	1811.0 (6.8)	2441.4 (6.1)	2383.2 (6.3)	2640.7 (8.4)
Mean nocturnal vapor pressure (Pa)	1131.4 (4.9)	1128.3 (4.8)	1401.2 (4.6)	1926.0 (4.7)	1972.5 (4.5)	2205.8 (6.2)

Table 6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Coyote Willow (n = 4), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	885.8 (49.8)	963.0 (26.0)	842.8 (61.9)	941.2 (14.9)	908.4 (21.2)	932.7 (21.6)
Mean distance to nearest standing water	1.4 (0.5)	1.0 (1.0)	1.0 (0.6)	1.3 (0.8)	1.6 (0.3)	1.5 (0.5)
% of the site within 20 m that was inundated	42.0 (18.7)	67.5 (7.5)	40.0 (20.9)	31.3 (4.3)	24.2 (6.2)	31.0 (4.3)
% of the site within 50 m that was inundated	39.0 (14.1)	57.5 (2.5)	35.0 (18.9)	28.8 (4.3)	28.3 (5.3)	30.0 (4.7)
Temperature						
Mean maximum diurnal temperature (°C)	48.0 (0.2)	43.4 (0.1)	45.9 (0.2)	44.9 (0.1)	44.4 (0.1)	44.4 (0.1)
Mean minimum nocturnal temperature (°C)	8.6 (0.1)	8.2 (0.1)	12.2 (0.1)	16.0 (0.1)	17.1 (0.1)	15.6 (0.1)
Mean daily temperature range (°C)	36.8 (1.8)	32.0 (2.0)	29.5 (1.9)	25.6 (2.3)	22.5 (2.4)	24.9 (2.5)
Humidity						
Mean diurnal vapor pressure (Pa)	1124.1 (9.3)	1140.6 (7.8)	1565.6 (10.9)	2257.0 (11.6)	2210.7 (11.0)	2428.9 (13.3)
Mean nocturnal vapor pressure (Pa)	1101.9 (7.9)	1092.2 (7.8)	1376.0 (8.6)	1952.5 (9.4)	1965.8 (9.1)	2165.3 (9.7)

Table 6.3. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow (n = 2), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	994.0 (0.0)	994.0 (0.0)	956.0 (0.0)	994.0 (0.0)	994.0 (0.0)	925.0 (16.5)
Mean distance to nearest standing water	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	2.1 (2.0)
% of the site within 20 m that was inundated	85.0 (0.0)	95.0 (0.0)	90.0 (0.0)	70.0 (0.0)	100.0 (0.0)	57.0 (13.8)
% of the site within 50 m that was inundated	70.0 (0.0)	75.0 (0.0)	85.0 (0.0)	60.0 (0.0)	80.0 (0.0)	46.0 (12.0)
Temperature						
Mean maximum diurnal temperature (°C)	32.8 (0.4)	39.2 (0.2)	39.7 (0.2)	40.1 (0.2)	41.5 (0.2)	42.0 (0.1)
Mean minimum nocturnal temperature (°C)	12.9 (0.3)	12.6 (0.2)	16.0 (0.1)	17.5 (0.1)	19.0 (0.1)	17.1 (0.1)
Mean daily temperature range (°C)	19.8 (0.0)	26.7 (0.0)	23.7 (0.0)	22.6 (0.0)	17.1 (5.4)	22.5 (0.9)
Humidity						
Mean diurnal vapor pressure (Pa)	984.8 (12.4)	1058.4 (9.8)	1464.1 (12.0)	2125.7 (16.2)	2128.5 (13.5)	2068.6 (12.2)
Mean nocturnal vapor pressure (Pa)	1242.3 (18.1)	1221.6 (16.6)	1751.5 (14.3)	2172.9 (18.1)	2228.8 (15.4)	2137.4 (12.3)

Table 6.4. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory (n = 2), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	920.6 (15.7)	887.1 (34.6)	887.4 (7.3)	920.5 (5.7)	853.7 (27.5)	N/A
Mean distance to nearest standing water	14.0 (4.0)	10.0 (0.0)	10.0 (0.0)	225.0 (25.0)	225.0 (25.0)	N/A
% of the site within 20 m that was inundated	7.5 (7.5)	10.0 (5.0)	5.0 (0.0)	4.0 (0.0)	0.0 (0.0)	N/A
% of the site within 50 m that was inundated	10.0 (10.0)	15.0 (5.0)	8.5 (1.5)	4.0 (0.0)	0.0 (0.0)	N/A
Temperature						
Mean maximum diurnal temperature (°C)	39.7 (0.2)	43.4 (0.2)	41.5 (0.2)	38.8 (0.1)	38.8 (0.4)	N/A
Mean minimum nocturnal temperature (°C)	9.0 (0.1)	10.6 (0.2)	14.1 (0.1)	18.3 (0.1)	19.8 (0.2)	N/A
Mean daily temperature range (°C)	28.9 (1.7)	30.6 (0.6)	25.2 (1.4)	18.6 (1.2)	16.8 (1.8)	N/A
Humidity						
Mean diurnal vapor pressure (Pa)	1417.1 (12.0)	1642.4 (13.7)	2398.3 (15.1)	3020.6 (11.2)	3004.1 (37.9)	N/A
Mean nocturnal vapor pressure (Pa)	1326.6 (7.8)	1406.4 (10.2)	1852.7 (8.8)	2513.4 (8.9)	2459.8 (15.4)	N/A

Table 6.5. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Mormon Mesa (n = 11), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	902.9 (34.9)	886.8 (25.3)	843.7 (40.8)	779.1 (31.4)	752.5 (47.4)	791.4 (54.0)
Mean distance to nearest standing water	29.8 (18.6)	23.3 (8.5)	131.4 (68.4)	795.8 (197.5)	40.4 (10.4)	50.2 (14.3)
% of the site within 20 m that was inundated	50.0 (17.9)	50.3 (9.9)	34.2 (12.1)	0.0 (0.0)	6.3 (4.2)	4.8 (1.8)
% of the site within 50 m that was inundated	42.5 (16.6)	49.3 (8.8)	32.5 (11.6)	1.9 (1.6)	6.7 (3.7)	6.1 (2.8)
Temperature						
Mean maximum diurnal temperature (°C)	49.0 (0.1)	53.5 (0.1)	56.0 (0.1)	57.2 (0.1)	54.1 (0.1)	53.0 (0.1)
Mean minimum nocturnal temperature (°C)	6.6 (0.1)	7.0 (0.1)	10.6 (0.1)	13.7 (0.1)	14.5 (0.1)	13.7 (0.1)
Mean daily temperature range (°C)	34.0 (2.5)	36.9 (1.6)	35.0 (1.9)	33.0 (1.7)	30.4 (1.5)	30.5 (1.5)
Humidity						
Mean diurnal vapor pressure (Pa)	975.3 (4.9)	859.9 (3.7)	1324.8 (6.2)	1716.2 (5.3)	1744.2 (5.6)	1950.3 (8.0)
Mean nocturnal vapor pressure (Pa)	1100.6 (6.1)	1026.0 (5.3)	1449.7 (5.0)	1753.1 (4.9)	1809.5 (4.4)	1988.4 (6.1)

Table 6.6. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Scattered Goodding Willow – Topock Marsh (n = 8), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	766.6 (111.9)	794.3 (105.5)	725.0 (113.3)	781.7 (72.2)	653.7 (85.1)	N/A
Mean distance to nearest standing water	7.7 (2.8)	12.5 (3.1)	15.5 (5.4)	26.8 (5.8)	18.0 (1.9)	N/A
% of the site within 20 m that was inundated	38.0 (10.4)	20.0 (11.1)	12.4 (3.3)	6.8 (1.7)	6.3 (1.5)	N/A
% of the site within 50 m that was inundated	44.5 (9.6)	30.0 (8.1)	28.1 (5.3)	15.0 (3.4)	14.0 (3.6)	N/A
Temperature						
Mean maximum diurnal temperature (°C)	52.4 (0.1)	50.7 (0.1)	51.8 (0.1)	46.9 (0.1)	45.9 (0.1)	N/A
Mean minimum nocturnal temperature (°C)	6.6 (0.1)	7.4 (0.1)	12.2 (0.1)	16.4 (0.0)	17.5 (0.0)	N/A
Mean daily temperature range (°C)	37.6 (1.6)	33.9 (1.5)	31.1 (1.6)	23.8 (1.4)	20.9 (1.5)	N/A
Humidity						
Mean diurnal vapor pressure (Pa)	1142.3 (5.2)	1481.9 (7.7)	2245.9 (8.8)	2950.9 (6.9)	2869.7 (9.1)	N/A
Mean nocturnal vapor pressure (Pa)	1092.2 (4.3)	1299.3 (5.7)	1757.5 (5.4)	2380.4 (5.1)	2450.2 (6.1)	N/A

Table 6.7. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk (n = 3), 2008

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)	908.7 (0.0)	899.9 (10.2)	907.8 (26.9)	902.4 (25.9)	936.4 (19.3)	853.0 (53.8)
Mean distance to nearest standing water	23.0 (0.0)	20.3 (6.5)	13.3 (4.7)	10.3 (4.1)	8.8 (4.3)	15.7 (7.5)
% of the site within 20 m that was inundated	0.0 (0.0)	15.0 (5.0)	23.8 (19.1)	10.0 (3.5)	34.5 (22.1)	13.3 (8.8)
% of the site within 50 m that was inundated	20.0 (0.0)	23.3 (6.0)	28.8 (12.8)	23.8 (4.3)	40.0 (17.8)	30.0 (10.0)
Temperature						
Mean maximum diurnal temperature (°C)	38.3 (1.1)	41.5 (0.2)	50.7 (0.2)	51.2 (0.1)	51.8 (0.2)	50.7 (0.2)
Mean minimum nocturnal temperature (°C)	16.0 (0.8)	9.0 (0.2)	12.6 (0.1)	15.2 (0.1)	17.1 (0.1)	16.4 (0.1)
Mean daily temperature range (°C)	22.3 (0.0)	32.1 (0.0)	32.6 (2.6)	28.5 (3.5)	27.4 (3.8)	30.7 (3.6)
Humidity						
Mean diurnal vapor pressure (Pa)	1359.1 (31.4)	1251.4 (13.2)	1781.5 (12.4)	2339.2 (12.6)	2196.0 (13.7)	2045.6 (14.2)
Mean nocturnal vapor pressure (Pa)	1405.5 (23.4)	1201.2 (11.1)	1567.1 (8.0)	2030.4 (9.9)	2046.5 (9.5)	2021.3 (9.9)

Table 6.8. Microclimate Measures in Southwestern Willow Flycatcher Territories in Tamarisk with Mesquite (n = 1), 2008*

Microclimate measure	May 12-31	June 1-15	June 16-30	July 1-15	July 16-31	August 1-15
Soil Moisture						
Mean soil moisture (mV)[1]	N/A	N/A	N/A	N/A	N/A	N/A
Mean distance to nearest standing water	N/A	15 (0.0)	15 (0.0)	N/A	15 (0.0)	N/A
% of the site within 20 m that was inundated	N/A	5 (0.0)	5 (0.0)	N/A	5 (0.0)	N/A
% of the site within 50 m that was inundated	N/A	20 (0.0)	15 (0.0)	N/A	15 (0.0)	N/A
Temperature						
Mean maximum diurnal temperature (°C)	N/A	54.7 (0.6)	57.2 (0.4)	57.9 (0.3)	54.7 (1.4)	N/A
Mean minimum nocturnal temperature (°C)	N/A	9.8 (0.4)	13.3 (0.2)	19.0 (0.1)	22.5 (0.4)	N/A
Mean daily temperature range (°C)	N/A	44.9 (0.0)	43.9 (0.0)	38.9 (0.0)	32.3 (0.0)	N/A
Humidity						
Mean diurnal vapor pressure (Pa)	N/A	1376.2 (32.8)	1733.0 (16.1)	2659.1 (14.7)	2180.2 (42.2)	N/A
Mean nocturnal vapor pressure (Pa)	N/A	1252.3 (16.6)	1540.1 (13.1)	2264.9 (11.9)	2059.6 (9.1)	N/A

N/A = data not available or not applicable.

[1] Soil moisture data were not collected for this location because thick piles of arrowweed and bulrush prevented access to the soil.

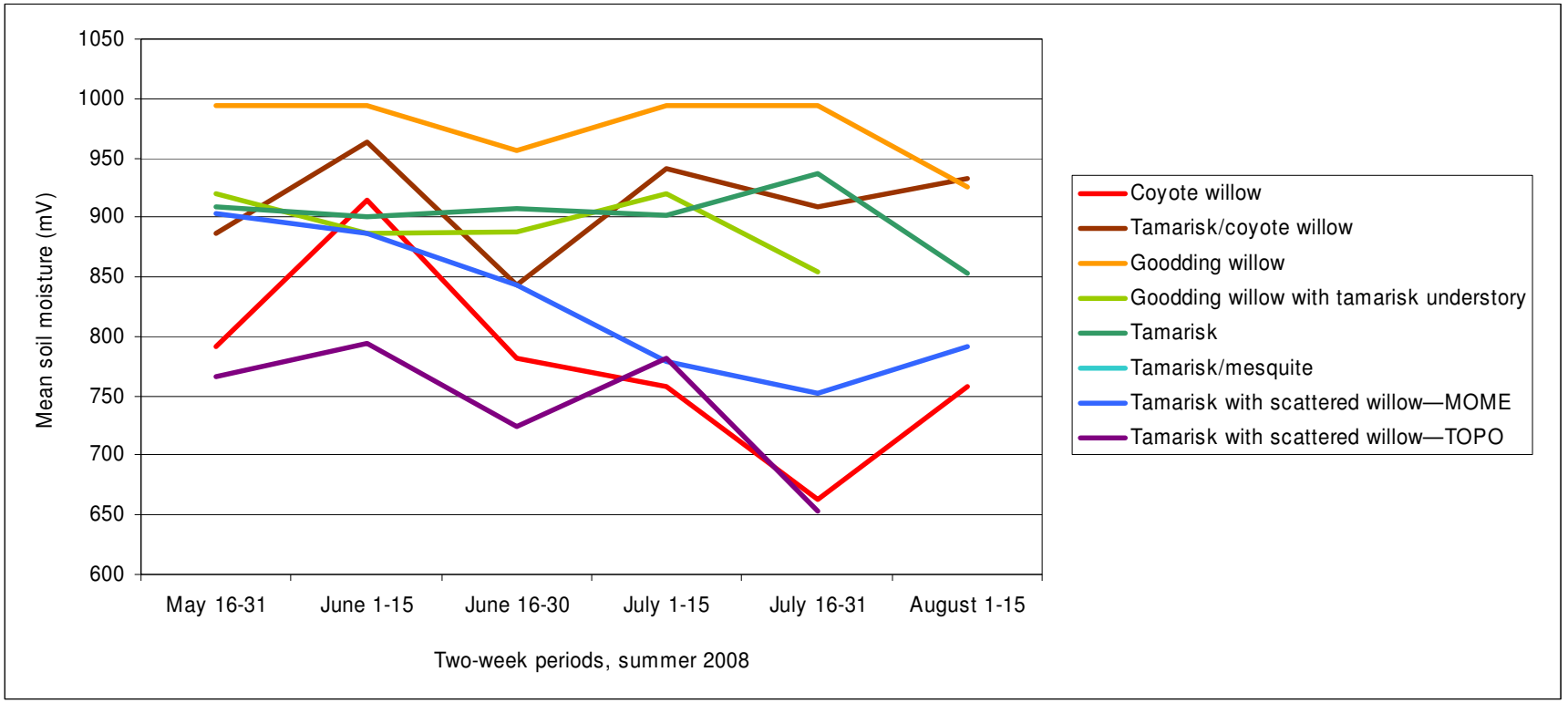


Figure 6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008. No soil moisture data are available for the tamarisk/mesquite habitat type because dense arrowweed and bulrush prevented access to the soil.

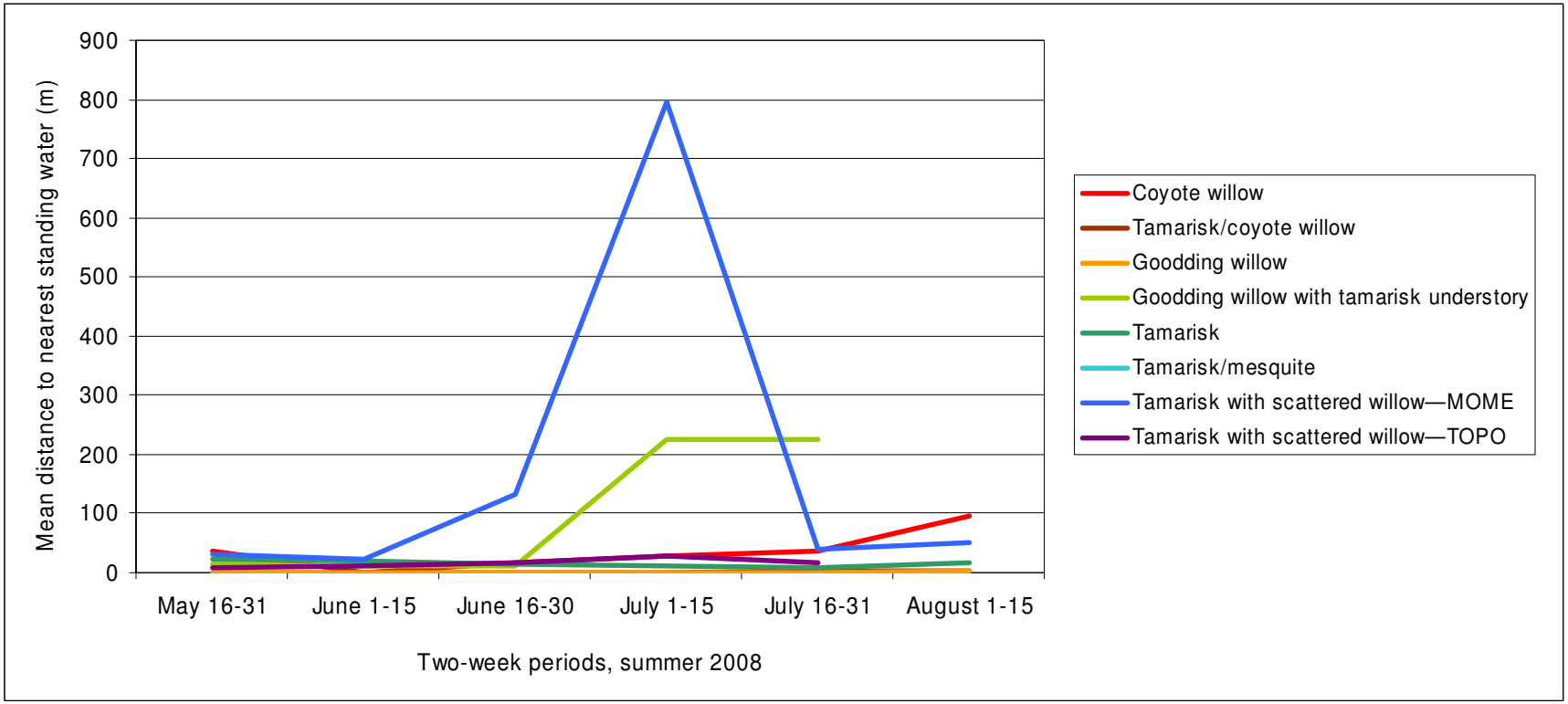


Figure 6.2. Mean distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008.

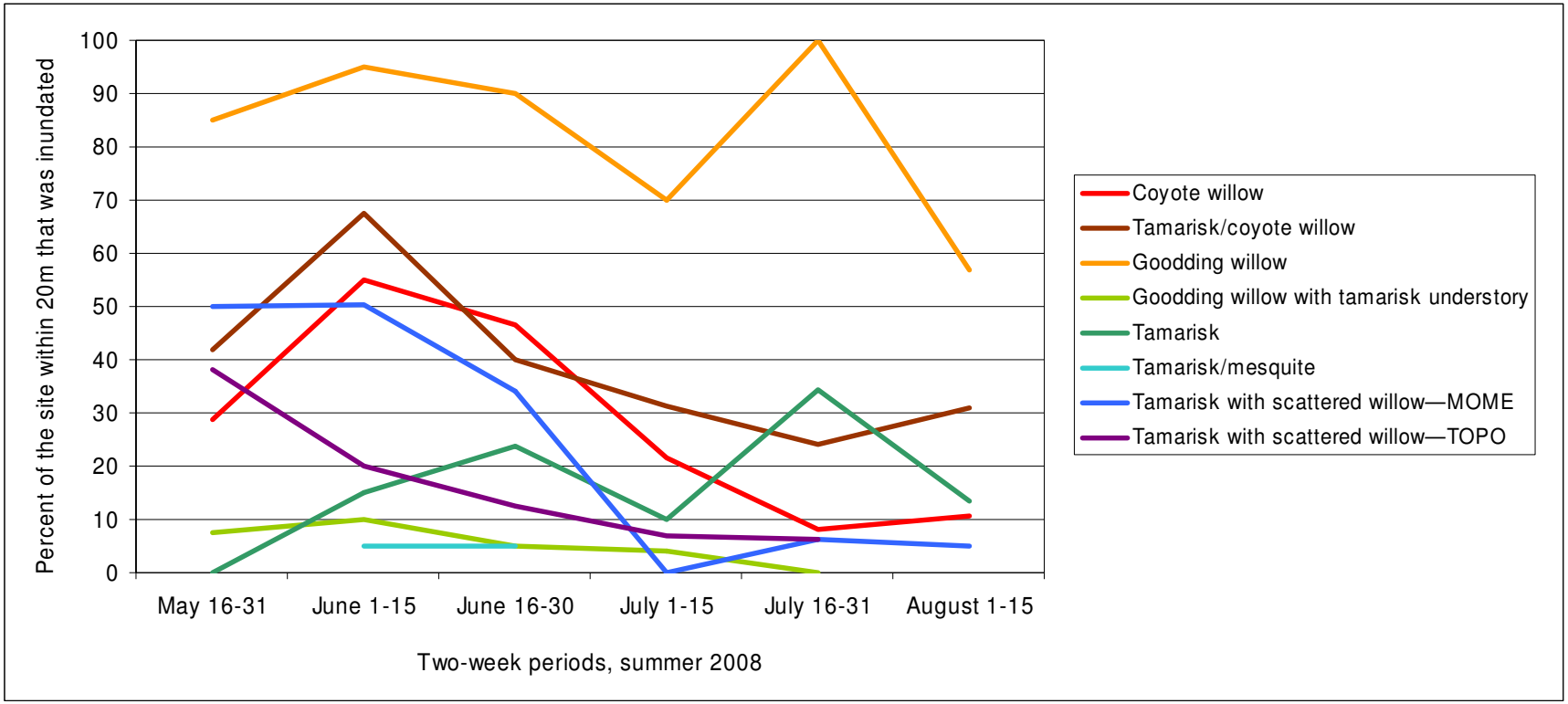


Figure 6.3. Mean percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2008.

AR063919

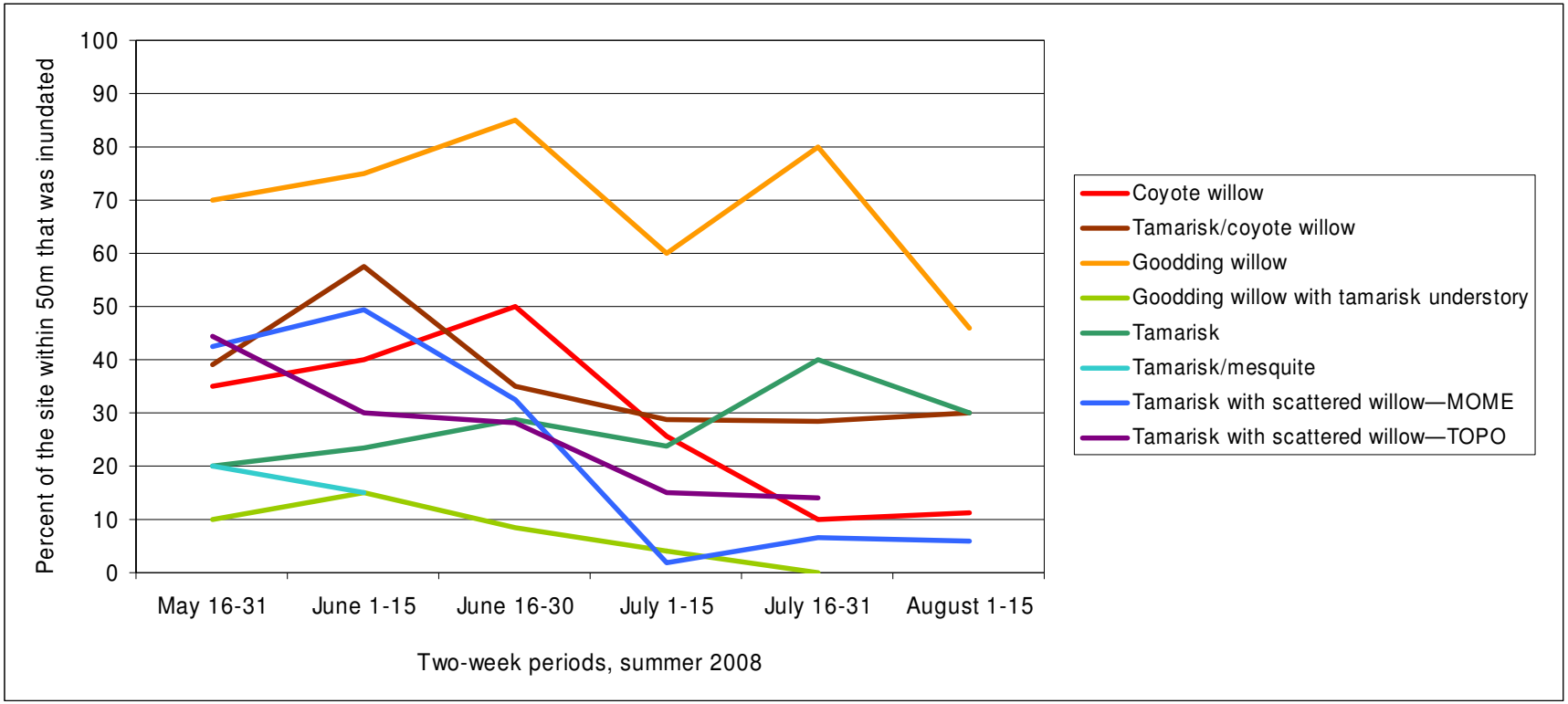


Figure 6.4. Mean percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, Lower Colorado River and tributaries, 2008. Data are summarized by two-week periods.

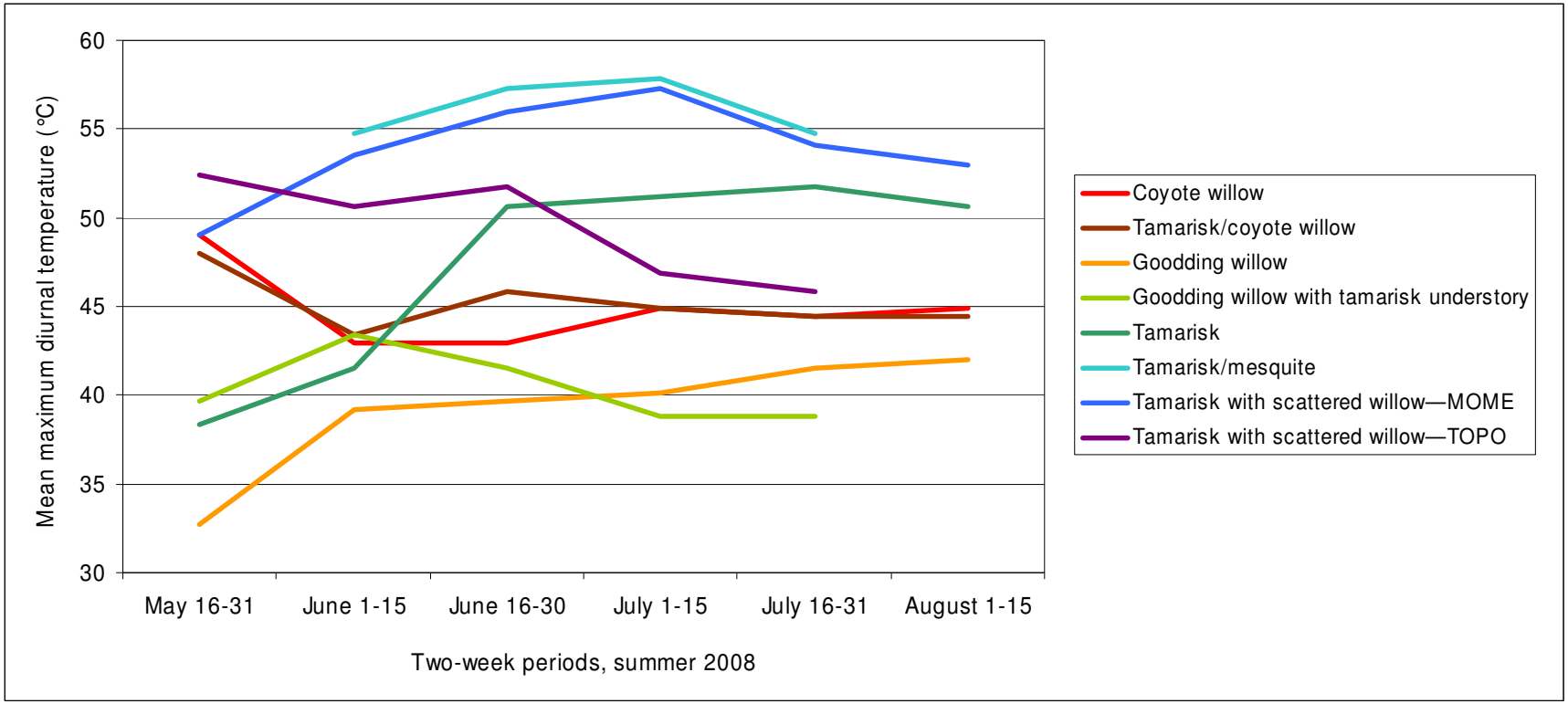


Figure 6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008.

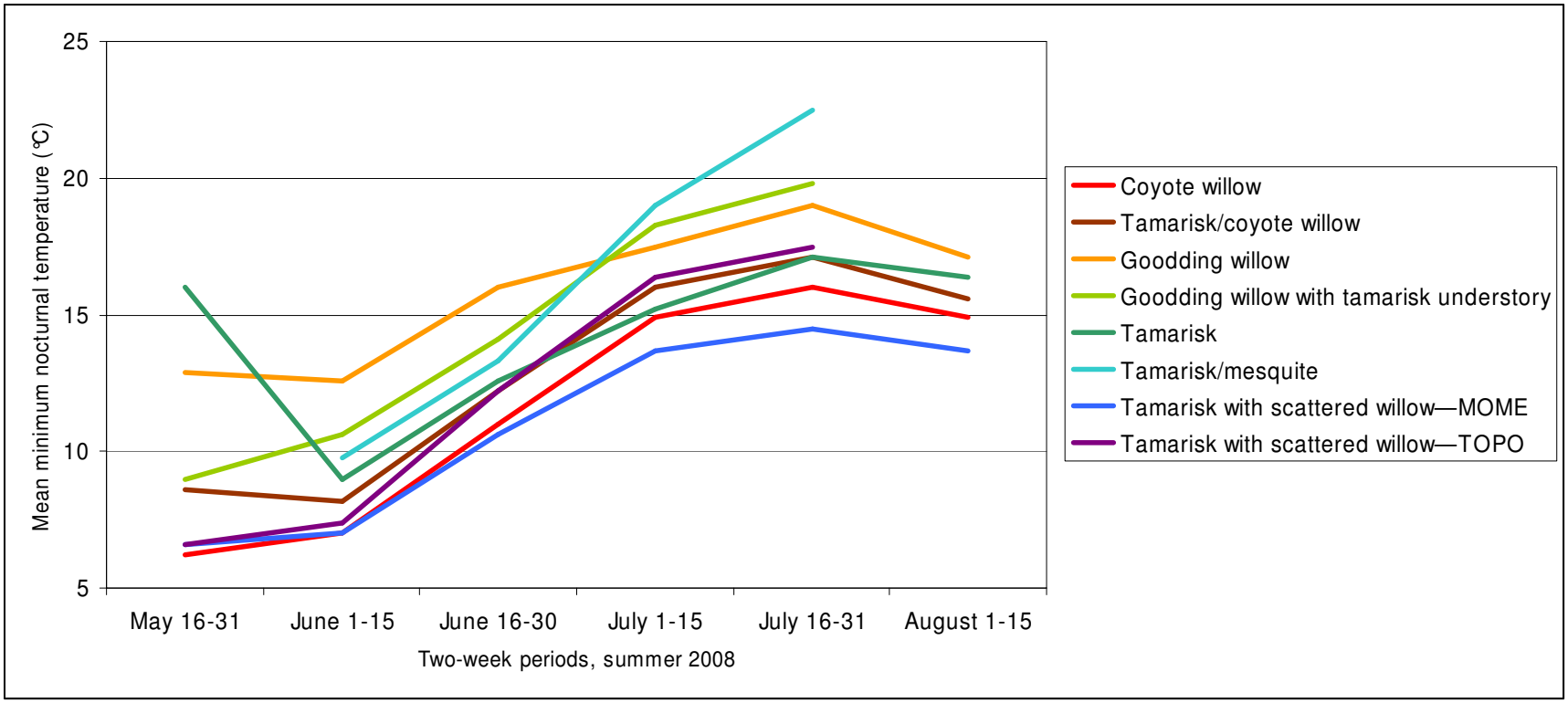


Figure 6.6. Mean minimum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008.

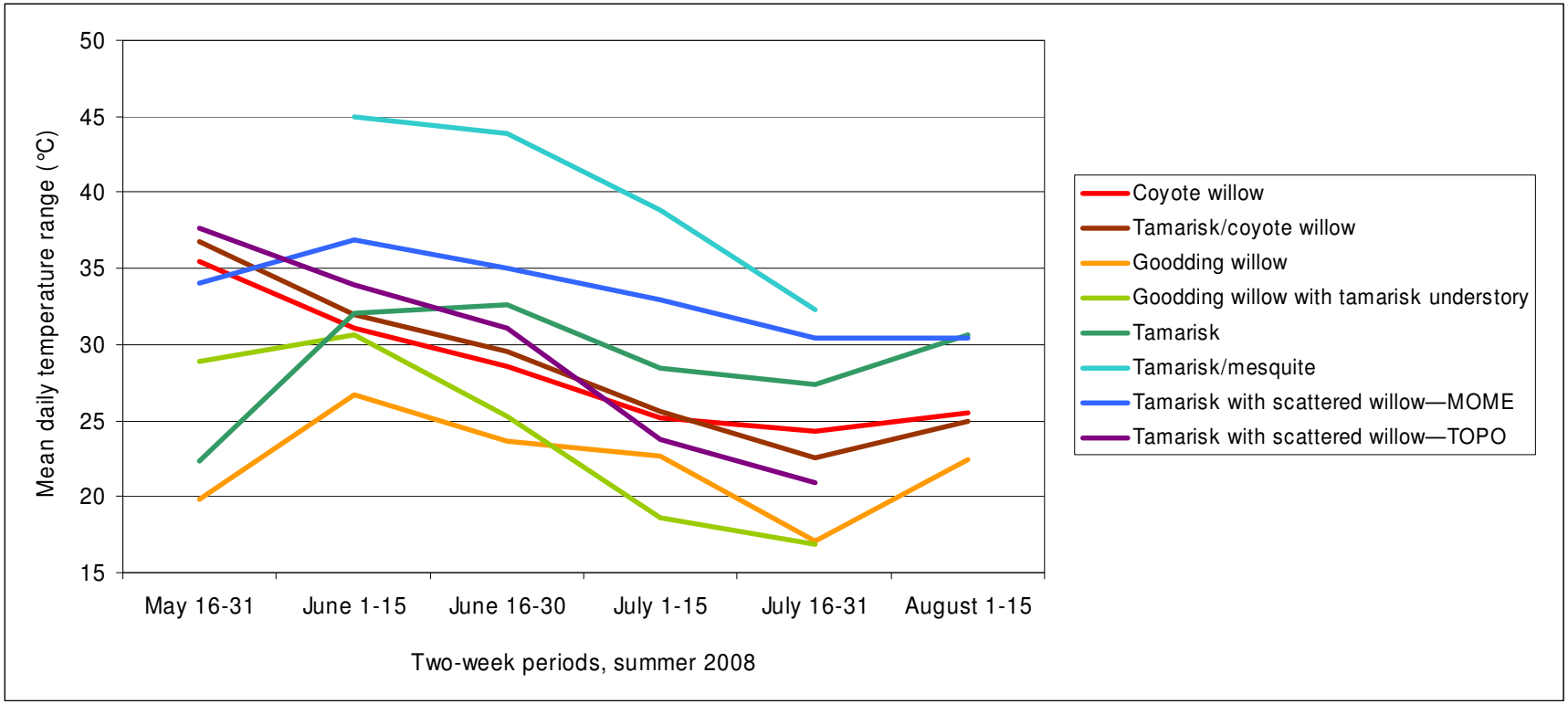


Figure 6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008.

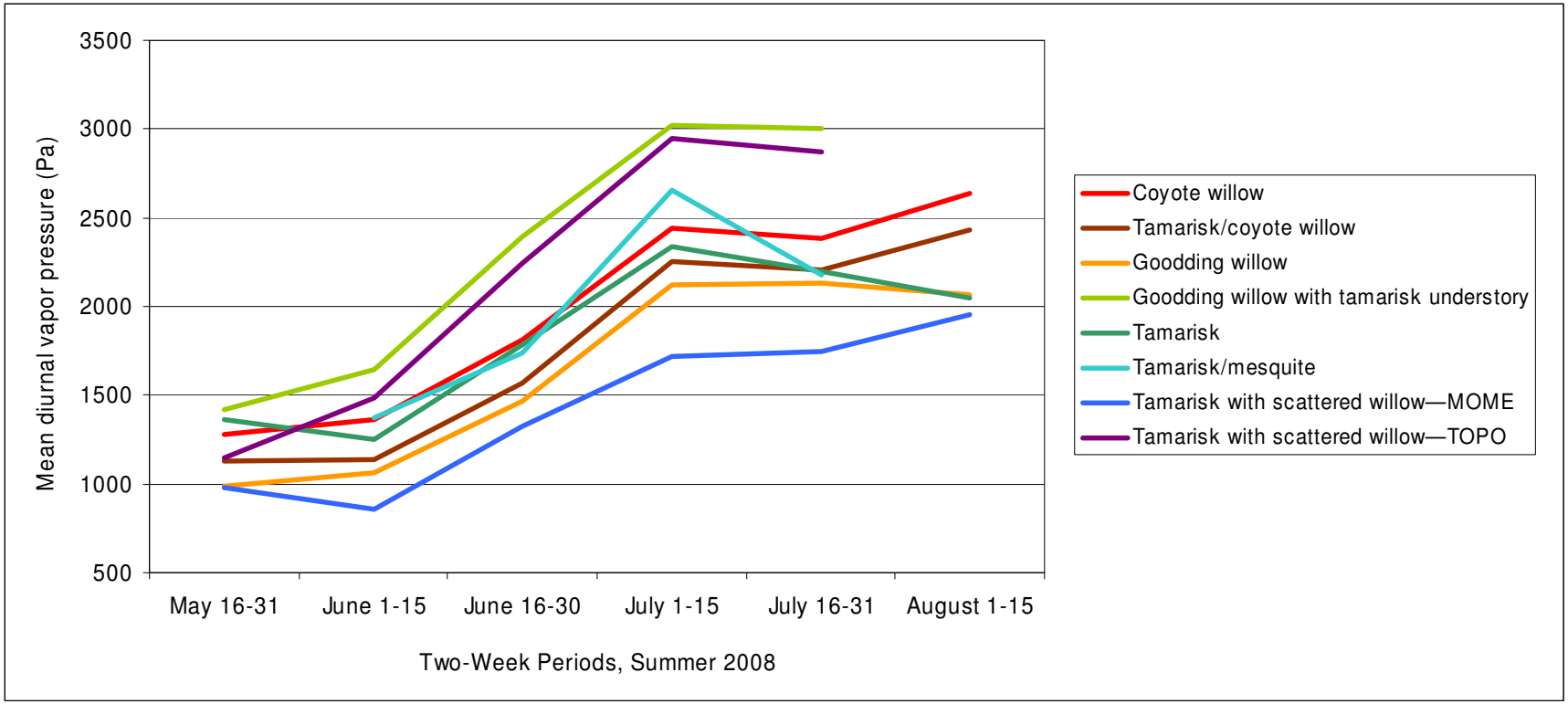


Figure 6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008.

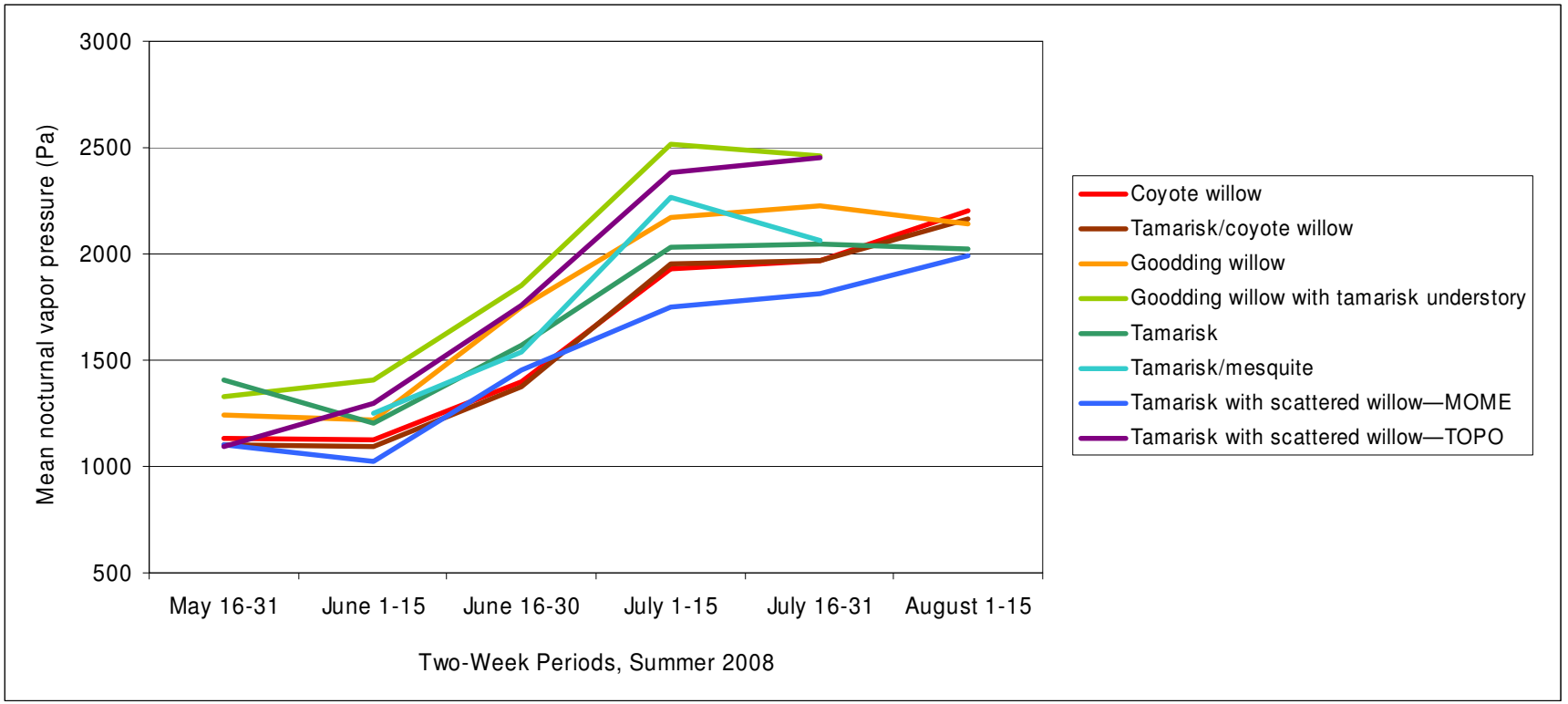


Figure 6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, Lower Colorado River and tributaries, 2008.

Daily maximum temperatures spanned a range of approximately 15°C among habitat types. Daily minimum temperatures showed a much smaller range, spanning only 5°C. Habitat types with high daily maximum temperatures also tended to have low daily minimum temperatures and thus had the largest temperature ranges. Tamarisk/mesquite and tamarisk with scattered Goodding willow at Mormon Mesa showed the highest daily temperature ranges, while Goodding willow and Goodding willow with tamarisk understory had the most moderate temperature ranges.

Vapor pressure increased throughout the season for all habitat types. Vapor pressure was highest in Goodding willow with tamarisk understory and in tamarisk with emergent Goodding willow at Topock. Vapor pressure was lowest in tamarisk with emergent Goodding willow at Mormon Mesa.

Nests in Formerly Occupied Areas

We located 44 old nests at Mesquite, Mormon Mesa, Muddy River, and Topock Marsh. We were able to locate the exact nest fork in 28 cases and located the nest tree but were unsure of the correct fork in 12 additional cases. In three cases we located the nest vicinity (within 5 m of the nest location) but were unable to verify that we had located the exact nest tree, and in one case the nest tree was clearly no longer there, and we placed the data logger on the nearest adjacent tree. Five of the 44 HOBO data loggers failed to collect data, while two data loggers collected temperature but no humidity data. Soil moisture data from the occupied period were unavailable for the three nests that were active in 2003.

Microclimate at old nests sites differed between occupied and unoccupied periods in at least one variable at both Mesquite (Table 6.9) and Mormon Mesa (Table 6.10). At Mesquite, nest sites had higher soil moisture when they were occupied versus when they were abandoned, while at Mormon Mesa nest sites had wetter soils in 2008 versus when the nest was occupied. Mean maximum diurnal temperature and mean daily temperature range were greater during the unoccupied period at Mormon Mesa. No statistically significant differences in microclimate variables were detected at Muddy River (Table 6.11) or Topock (Table 6.12) between occupied and unoccupied periods, but general trends were evident when data from all sites were examined together (Table 6.13). At three of the four study areas, nest sites had higher measures of all three temperature variables and lower measures of both humidity variables when the sites were unoccupied versus when they were occupied. Topock was the study area that generally countered these trends, with lower temperatures and higher humidity during the unoccupied period. When all sites were considered together, mean maximum diurnal temperature was significantly higher during the unoccupied period. Soil moisture, daily temperature range, and diurnal humidity all showed trends (P-values <0.1), with nest sites having more extreme temperatures and lower soil moisture and humidity during the unoccupied period.

Mean daily maximum and minimum temperature recorded at the Overton weather station did not differ between 2008 and any of the preceding five years for the June–August period. At the Needles weather station, mean maximum daily temperature was higher ($F_{5,537} = 7.6$, $P < 0.001$) in June–August 2008 (109.3 °F) than during the same period in 2004 (106.9 °F), while mean minimum daily temperature in 2008 (83.2 °F) was lower than in 2006 (86.2 °F) and higher than in 2004 (81.4 °F; $F_{5,537} = 7.8$, $P < 0.001$). Average dew point at Needles was lower ($F_{5,537} = 11.4$, $P < 0.001$) in 2008 (42.6 °F) than in 2003 (55.3 °F) or 2004 (48.6 °F).

Table 6.9. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mesquite, NV

Microclimate measure	Occupied	Unoccupied	Difference	*P*
Soil Moisture (n = 14)				
Mean soil moisture (mV)	656.6 (82.7)	319.4 (37.8)	-326.2	**<0.01**
Temperature (n = 13)				
Mean maximum diurnal temperature (°C)	42.5 (1.7)	45.8 (1.0)	3.3	0.09
Mean minimum nocturnal temperature (°C)	15.6 (0.6)	16.1 (0.6)	0.5	0.35
Mean daily temperature range (°C)	19.7 (1.2)	22.0 (0.9)	2.2	0.12
Humidity (n = 13)				
Mean diurnal vapor pressure (Pa)	1916.4 (113.7)	1803.6 (60.7)	-112.9	0.15
Mean nocturnal vapor pressure (Pa)	1681.8 (97.7)	1609.9 (56.7)	-71.9	0.21

Table 6.10. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Mormon Mesa, NV

Microclimate measure	Occupied	Unoccupied	Difference	*P*
Soil Moisture (n = 5)				
Mean soil moisture (mV)	454.1 (135.6)	602.8 (91.1)	148.7	**0.04**
Temperature (n = 8)				
Mean maximum diurnal temperature (°C)	45.7 (1.6)	53.3 (2.7)	7.6	**0.01**
Mean minimum nocturnal temperature (°C)	16.8 (0.7)	14.9 (0.9)	-1.9	0.05
Mean daily temperature range (°C)	22.2 (1.6)	30.1 (3.7)	7.9	**0.02**
Humidity (n = 7)				
Mean diurnal vapor pressure (Pa)	1606.9 (131.9)	1587.3 (78.5)	-83.6	0.35
Mean nocturnal vapor pressure (Pa)	1671.3 (131.6)	1627.7 (101.4)	-93.5	0.20

Table 6.11. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Muddy River, NV

Microclimate measure	Occupied	Unoccupied	Difference	*P*
Soil Moisture (n = 10)				
Mean soil moisture (mV)	687.1 (42.5)	586.4 (49.9)	-90.1	0.30
Temperature (n = 9)				
Mean maximum diurnal temperature (°C)	41.1 (0.6)	42.2 (1.1)	1.1	0.33
Mean minimum nocturnal temperature (°C)	17.8 (1.1)	18.0 (1.0)	0.3	0.73
Mean daily temperature range (°C)	16.4 (1.2)	17.4 (1.5)	1.0	0.37
Humidity (n = 9)				
Mean diurnal vapor pressure (Pa)	2095.7 (133.6)	1882.9 (98.7)	-212.8	0.13
Mean nocturnal vapor pressure (Pa)	1854.8 (144.9)	1703.9 (86.0)	-151.0	0.27

Table 6.12. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, Topock Marsh, AZ

Microclimate measure	Occupied	Unoccupied	Difference	*P*
Soil Moisture (n = 10)				
Mean soil moisture (mV)	798.1 (81.3)	915.3 (20.7)	132.7	0.11
Temperature (n = 6)				
Mean maximum diurnal temperature (°C)	40.8 (1.4)	38.0 (0.8)	-2.8	0.13
Mean minimum nocturnal temperature (°C)	15.4 (1.2)	17.8 (1.2)	2.4	0.10
Mean daily temperature range (°C)	19.4 (1.6)	13.8 (1.3)	-5.7	**0.04**
Humidity (n = 5)				
Mean diurnal vapor pressure (Pa)	2342.4 (262.4)	2603.4 (183.4)	81.9	0.74
Mean nocturnal vapor pressure (Pa)	2033.2 (183.8)	2328.7 (98.8)	170.4	0.36

Table 6.13. Paired T-test Results Comparing Microclimate Characteristics at Willow Flycatcher Nest Sites When the Nest Was Occupied Versus When the Nest Area Was Abandoned, All Sites Combined

Microclimate measure	Occupied	Unoccupied	Difference	*P*	Direction and Magnitude of Change			
					MESQ	MOME	MUDD	TOPO
Soil Moisture (n = 39)								
Mean soil moisture (mV)	674.7 (43.2)	536.4 (42.6)	-93.1	0.09	↓	↑	↓	↑
Temperature (n = 36)								
Mean maximum diurnal temperature (°C)	42.6 (0.8)	45.3 (1.1)	2.7	**0.01**	↑	↑	↑	↓
Mean minimum nocturnal temperature (°C)	16.4 (0.4)	16.6 (0.5)	0.2	0.60	↑	↓	↑	↑
Mean daily temperature range (°C)	19.4 (0.7)	21.3 (1.3)	1.9	0.09	↑	↑	↑	↓
Humidity (n = 34)								
Mean diurnal vapor pressure (Pa)	1963.5 (81.7)	1897.7 (69.9)	-104.7	0.07	↓	↓	↓	↑
Mean nocturnal vapor pressure (Pa)	1781.3 (66.9)	1744.1 (57.5)	-61.6	0.22	↓	↓	↓	↑

DISCUSSION

Currently Occupied Territories

The hydrological conditions recorded in occupied territories in 2008 showed that flycatcher territories contained damp or wet soils, with the distance to surface water generally being less than 30 m, and in most cases between 10 and 50% of the surrounding area within 50 m containing saturated or inundated soils during each visit to the site. The soil moisture conditions observed in occupied territories generally mirrored those observed at the same sites in previous years.

Tamarisk with scattered Goodding willow at Topock Marsh had the wettest conditions in May and became progressively drier through the rest of the season. Soils within the Goodding willow with tamarisk understory vegetation type also showed a general drying trend through the season, with distance to water increasing and the percentage of inundated soils decreasing. Tamarisk with scattered Goodding willow at Mormon Mesa was the only vegetation type that was influenced by an undammed river, and soil moisture conditions showed a steady drying trend until the arrival of monsoon storms in late July. In early July, prior to monsoon storms, the river went subsurface in much of the Mormon Mesa study area and there was virtually no surface water within 50 m of the active territories. After the arrival of monsoons, surface flow was restored in the river and the inundated percentage around the territories increased, though both soil moisture and inundated percentages were markedly lower than in May and June.

Coyote willow and tamarisk with coyote willow showed fluctuating soil moisture levels throughout the flycatcher breeding season, with soil moisture levels being the highest in early June and lowest in the second half of July. These habitat types are influenced by irrigation runoff, and in previous years we observed highly variable water levels within the site, with fluctuations sometimes occurring on a daily basis.

Goodding willow habitat at Overton WMA was wetter than in some previous years because of recent beaver activity that resulted in the flooding of most of the site.

Temperature and humidity varied across habitat types but followed the same patterns we had observed in some of the habitat types in previous years, with tamarisk with emergent willow at Mormon Mesa being hot and dry relative to other habitat types, and tamarisk with emergent willow at Topock being relatively humid. In general, habitats with a significant native component tended to be cooler and more thermally moderate than those dominated by tamarisk.

Nests in Formerly Occupied Territories

Willow flycatchers along the lower Colorado River and tributaries selected nest sites that were cooler, wetter, and more thermally moderate than unused sites in the adjacent landscape (McLeod et al. 2008a), and we anticipated seeing similar differences when we examined temporal, rather than spatial, variation in habitat use. We observed changes in microclimate in the direction we anticipated at Mesquite, with abandoned nest sites having drier soils and a trend toward higher maximum daily temperatures than they had when they were occupied. The change in soil moisture was likely caused by flood deposition, which altered water flow patterns in the area. These hydrological changes contributed to changes in the vegetation (see Chapter 5), with nest sites having taller canopy height, greater canopy closure, and a higher percentage of native vegetation when they were occupied. Changes in both hydrology and vegetation likely influenced microclimate; canopy height, canopy closure, and percent native vegetation are all inversely related to maximum daily temperature (McLeod et al. 2008a). There were no differences

in average maximum or minimum temperature between 2008 and any of the five preceding years as recorded at the weather station in Overton; therefore, temporal differences observed at old nests in the Virgin and Muddy River area are unlikely to be the result of overall changes in regional climate.

We observed similar vegetation and temperature changes at Mormon Mesa, with abandoned nest sites having less canopy closure and more extreme temperatures than when they were occupied. We did not observe the same shift in soil moisture conditions, however, with abandoned nest sites actually having higher soil moisture than when they were occupied. Soil moisture in 2008 was likely influenced by a rain storm immediately prior to collecting soil moisture readings in late July. Soil moisture at the nests at Mormon Mesa when they were occupied was lower than in any of the other study areas. It is possible that these areas at Mormon Mesa were already dry and in decline when they were occupied in 2003 and 2004.

We did not observe any statistically significant changes in microclimate at old nests at Muddy River, although the direction of change of all variables was consistent with what we observed at Mesquite. As discussed in Chapter 5, occupancy at Muddy River may have been influenced by bulldozing activity in the vicinity, rather than by changes at the nest sites themselves.

Temporal changes in microclimate at Topock were opposite those we would have expected, with old nest sites having a smaller temperature range when unoccupied. The direction of change in soil moisture and humidity was also counter to what would be anticipated, with nest sites having higher soil moisture and higher humidity when unoccupied. These changes are also counter to what was observed at the Needles weather station, which had higher maximum temperature and lower dew point in 2008 than in 2004; thus, regional climate is unlikely to have influenced the changes we observed at the old nests. The data from Topock show no evidence that nest sites were abandoned because of changes in moisture or temperature that led to less suitable microclimate conditions. As discussed in Chapter 5, changes in occupancy patterns at Topock may be related to varying numbers of territorial individuals rather than to temporal changes in habitat suitability.

Chapter 7

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

INTRODUCTION

Southwestern Willow Flycatcher nests and breeding territories are typically located near rivers, streams, and open water (Sogge and Marshall 2000) or over wet soil (Flett and Sanders 1987, Harris et al. 1987, Harris 1991). Nest substrate plants are often rooted in or overhang standing water. Although the association between breeding flycatchers and open water or wet soil is widely recognized by managers and scientists alike, the exact nature of the association is poorly quantified. Water may be a direct environmental cue for flycatcher nesting behavior or it may be the ultimate cause of proximate factors such as vegetation composition and structure, prey base, and microclimate.

Anthropogenic or natural modifications to surface water resources (i.e., fluvial hydrology and geomorphology) can modify existing and potential flycatcher breeding habitat and therefore have the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). For example, nine flycatcher territories at San Marcial on the middle Rio Grande in New Mexico exhibited a near absence of nesting attempts in 1996 when a combination of drought, upstream dam operations, and upstream withdrawals for irrigation removed all surface water (Johnson et al. 1999). This was in contrast to previous (1994, 1995) and subsequent (1997) years when active nests were documented at the site, with the river flowing in those years. A nearby control site that contained water exhibited multiple nesting attempts during all four years, leading Johnson et al. (1999) to suggest that the presence of water was a fundamental requirement for nesting. A similar pattern was observed along the Gila River in Arizona when decreased streamflow from 2002 to 2004 coincided with the number of flycatcher territories declining by nearly half each year (Munzer et al. 2005). Since 2004, flows within the Gila River have been greater and more consistent, and correspond with a continuing increase in flycatcher territories (14 to 62) from 2004 to 2008 (Graber and Koronkiewicz 2008). The high degree to which willow flycatchers are associated with standing water can also be seen by correlating flycatcher habitat occupancy and breeding patterns with the presence/absence of standing water in areas like Bill Williams, with flycatchers breeding only in years when sites contained standing water (this document Chapter 2).

Flow characteristics of the lower Colorado River have been modified by numerous dams and irrigation withdrawals (Rosenberg et al. 1991). The river reach between Parker Dam and Imperial Dam is regulated by releases from Parker Dam, which has been in operation since 1939. Existing riparian habitat in the Parker to Imperial reach has likely adjusted to historical water release patterns from Parker Dam and appears to be in a stable or declining condition (Lower Colorado River Multi-Species Conservation Program 2004). Implementation of the Secretarial Implementation Agreements/California 4.4 Plan (hereafter SIAs) by Reclamation would change the point of diversion for up to 400,000 acre-feet of California apportionment water for up to 75 years (USFWS 2001). The point of diversion, previously located below Parker Dam at Imperial Dam, would change to a point above Parker Dam, resulting in lower water levels in the river between Parker and Imperial. The change in point of diversion was scheduled to begin in 2002.

River flow changes related to the change in point of diversion have the potential to further modify riparian habitats below Parker Dam, habitats that are presently considered potentially suitable for willow flycatcher (USFWS 2001:47). Reclamation (2000) estimated that implementation of the SIAs will cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less. As a result, 372 acres (151 ha) of

occupied[1] Southwestern Willow Flycatcher habitat could lose their moist soils. This loss could influence plant species composition (loss of cottonwood and willow) and structure (loss of vegetation volume) over an undetermined length of time. In addition, Reclamation estimated that 5,404 acres (2,187 ha) of potential flycatcher habitat could be influenced by the drop in groundwater level. These changes may affect the distribution, abundance, occupancy, and prey base of Southwestern Willow Flycatchers in the Parker to Imperial reach.

In 2004, Reclamation completed a pilot year of habitat monitoring by deploying temperature/ humidity data loggers at several sites in the Parker to Imperial reach. Reclamation then initiated a more comprehensive, long-term study in 2005 for the purpose of addressing how the above hydrological changes might affect riparian habitats along the Parker to Imperial reach. The objective is to monitor 372 acres (151 ha) of occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams for 10–15 years to determine how microclimate, vegetation, and groundwater conditions might be affected by the SIAs water transfer actions. Monitoring did not commence until after diversions started; therefore, antecedent conditions are unknown and monitoring analyses focus on detecting change through time rather than comparing current conditions to a baseline. An additional objective was to compare microclimate characteristics of sites in the Parker to Imperial reach with those at flycatcher breeding areas. This chapter reports the results of this study to date.

METHODS

In 2005, we selected a subset of sites that are currently surveyed for the presence of willow flycatchers for inclusion in the habitat monitoring study. We chose 11 sites distributed along the Parker to Imperial reach that are reasonably accessible, and where we believed groundwater levels were influenced primarily by river levels and not by outside sources such as irrigation return flows. Chosen sites equated to at least 75.3 ha (186 acres) on the California side of the lower Colorado River and at least 75.3 ha (186 acres) on the Arizona side. We also chose four control sites, two above Parker Dam and two below Imperial Dam, to distinguish any changes in microclimate, groundwater, or vegetation caused by water transfer actions from those caused by fluctuations in climate or rainfall. We monitored these same 15 sites from 2005 to 2008. In August of 2006, we initiated habitat monitoring within a consistently occupied breeding site at Topock Marsh to obtain groundwater levels and patterns with which we can compare results obtained at the habitat monitoring sites.

Temperature/Humidity (T/RH) Loggers

In 2005, we deployed HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) temperature/humidity data loggers at several locations within each site selected for habitat monitoring. All loggers collected data at 15-minute intervals and were placed in inverted plastic containers and camouflaged as described in Chapter 6. All 60 logger locations selected in 2005 were retained in 2006. Two additional data loggers were installed in the Topock Marsh monitoring site in August 2006. A portion of Gila Confluence North, one of the control sites below Imperial Dam, burned in December 2006. As a result of the fire, all vegetation at one HOBO location at the site was killed, and vegetation at another HOBO location was dramatically reduced. These two HOBOs were replaced in May 2007 with HOBOs at new locations within unburned portions of the site.

[1] As per the USFWS, occupied Southwestern Willow Flycatcher habitat is defined as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year since surveys began in 1996.

Soil Moisture (SM) Measurements

Soil moisture beneath each HOBO logger was measured and recorded using a hand-held ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively). Soil moisture measurements were collected during each presence/absence survey between 15 May and 25 July and when HOBO data were downloaded. Soil moisture measurements, percent of the area containing inundated or saturated soil, and distance to water were recorded as described in Chapter 6.

Vegetation Measurements

We completed vegetation measurements, following the methods described in Chapter 5, at each HOBO location after flycatcher surveys were completed in late July. All HOBO loggers were also downloaded at this time. Vegetation measurements were completed at the same locations as in 2005–2007, with the exception of Gila Confluence North, where vegetation measurements were collected at the two new HOBO locations established in 2007.

Groundwater Measurements

A small-diameter shallow well, or piezometer, was installed in May–August 2005 near each of the 15 sites selected for habitat monitoring to monitor groundwater levels. These 15 piezometers are described in Koronkiewicz et al. (2006a) and were initially downloaded in August–September 2005. One additional piezometer was installed at Topock Marsh in 2006. The piezometer at the Gila Confluence North monitoring site was moved to a new location in July 2007 because the original station was damaged in the brush fire referred to above. In March 2008, a new piezometer was installed at the Cibola Lake monitoring site to replace the original station, which was bulldozed sometime during the summer of 2007.

Piezometer Installation

Installation of the Cibola Lake replacement piezometer employed the same installation process as described in previous reports. The specific model of pressure transducer installed in the original 16 piezometers (In-Situ MiniTroll 500) is no longer manufactured. The Cibola Lake piezometer now makes use of the newest generation of pressure transducer (In-Situ LevelTroll 500), as will any replacement equipment in the future.

Data Collection

A pressure transducer/data logger (15 mini-Troll Standard-P, 5psi and one level-troll 500, 5psi, manufactured by In-Situ Corporation) collected data at each piezometer. These devices measure and record pressure of the water column present in the well, and these pressure measurements are then converted into water levels (in distance below top of casing). Vented cables with data-transfer ports were also used for each data logger. With these cables there is no need to correct measurements for atmospheric pressure changes, and the data can be downloaded at the wellhead without disturbing the pressure transducer in the well.

During the initial installation of the pressure transducers, as well as at each data download thereafter, water levels were manually measured in the piezometers using an electric water level sounder (Solinst-brand). These known water levels were then used to program the pressure transducer with a baseline

measurement from which all other automatically recorded water levels were calculated. The pressure transducers recorded water levels in the piezometers every hour.

Because the pressure transducer is almost the same diameter as the inside of the piezometer, inserting the pressure transducers tends to change the water levels in the piezometer temporarily but drastically. This disturbance persists until the water levels in the piezometer come back into equilibrium with water levels in the aquifer. In areas where there are tight, clayey soils, there can be a slight discrepancy between the pressure transducer measurement of water levels and actual water levels. This discrepancy can be adjusted with a simple correction.

We obtained additional hydrologic data from the U.S. Geological Survey (USGS) regarding streamflow and stage height in the Colorado River at several gages: Colorado River below Parker Dam (09427520) and Colorado River below Imperial Dam (09429500). Lake water levels were also obtained from the USGS for Lake Havasu. In addition, daily water releases were obtained from the Bureau of Reclamation for Parker Dam.[2] Our goal was to define the relationship between the water levels in the piezometers and operation of the reservoirs on the Colorado River.

Statistical Analyses

Microclimate

The following values were calculated for all 15 habitat monitoring sites:

- Mean soil moisture from plot center to 2.0 m from plot center
- Mean distance to saturated/inundated soil
- Mean diurnal temperature
- Mean number of 15-minute intervals above 41°C each day
- Mean nocturnal temperature
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal relative humidity
- Mean diurnal vapor pressure
- Mean nocturnal relative humidity
- Mean nocturnal vapor pressure

The diurnal and nocturnal periods were determined from the daily sunrise and sunset times reported for the region by the National Weather Service (2008).

These values were then calculated for all sites combined and compared to the same values for territory locations at Topock Marsh combined with two sensors placed near the piezometer at Topock Marsh, which was within 50 m of a territory center. These analyses were restricted to 6 May–31 July 2008, the dates during which microclimate data were collected both within territories at Topock and at habitat monitoring locations. One-way ANOVA tests were used to test the difference in means for the T/RH and SM values.

[2] Because hydrologic data are generally collected and presented in English units, hydrologic data within this chapter are in English, rather than metric, units.

We assigned all plots as a control site (above Parker Dam or below Imperial Dam) or as a test site (between Parker and Imperial), then analyzed between-year differences in T/RH and SM values within these two groups using paired t-tests. We then analyzed the between-year differences among the test sites compared to the control sites using one-way repeated measures ANOVA. These analyses were restricted to 1 June–1 August. Analyses were conducted using SAS® Version 9.1 (SAS Institute 2003).

Vegetation

We analyzed the between-year differences among the test sites compared to the control sites using one-way repeated measures ANOVA. These analyses and all descriptive statistics were produced using SPSS® Version 16.0 (SPSS Inc.) software. We excluded vertical foliage density measurements at 5 m from plot center from the analysis so as to have comparable data across years.

Groundwater Levels

We examined the following correlations between piezometer levels and reservoir operations:
1) correlation of the Havasu NE piezometer (control site) with Lake Havasu water levels; and
2) correlation of nine test site piezometers between Parker and Imperial Dams (Ehrenberg, Three Fingers Lake, Walker Lake, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Wash, Ferguson Lake, and Great Blue Heron) with releases (in cubic feet per second, or cfs) from Parker Dam, which largely regulates streamflow in the lower Colorado River between Parker and Imperial Dams.

Groundwater fluctuations under potential flycatcher habitat are expected to be tied most closely to the water level, or stage, rather than to the streamflow of the Colorado River. The relationship between stage and streamflow is not necessarily linear; however, initial analyses from 2005 indicate it is close enough to a linear relationship to allow a very close match between Parker releases and piezometer water levels. To account for the travel time of river water from Parker Dam, several regression analyses were conducted with time lags varying from zero to four days.

We examined monthly river flow data from below Parker Dam from 2000 to 2008 to determine whether there has been a decrease in water levels since the scheduled implementation of the change in point of diversion from Imperial Dam to above Parker Dam, which began in early 2001.

Reclamation (2000) estimated the expected change in river stage between Parker and Imperial Dams that would result from a 400,000 acre-foot reduction in releases from Parker Dam. In previous reports (McLeod et al. 2007), this expected reduction in river stage was extended using regression equations developed from the piezometer measurements to predict the corresponding change in groundwater level below each habitat polygon. This analysis was not repeated for this report.

In addition to correlating piezometer levels with reservoir operations, we used linear regression to examine potential relationships between average daily piezometer level and average daily soil moisture. These analyses were conducted using the built-in analysis functions of Microsoft Excel. Piezometer water levels were also compared to ground surface to determine whether any inundation or standing water was observed at the piezometer locations.

Groundwater fluctuations are the reflection of various inflows or outflows from the shallow aquifer system below the habitat. Longer-term fluctuations, on the weekly or seasonal scale, are mostly linked to variation in reservoir releases and flow in the Colorado River. Shorter-term fluctuations, those that take place over the course of a single day, are the result of the removal of water from the shallow aquifer through evapotranspiration by riparian habitat. The magnitude of these fluctuations can potentially be used to estimate changes in vegetation density or vegetation cover over time. The magnitude of the daily

evapotranspiration signature was calculated from the difference between the minimum and maximum water levels that occurred during each day, and the median of the daily results was calculated for each month during 2006 (the first full season of data) and 2007. Changes in the magnitude of the evapotranspiration signature over time will be correlated to actual field measurements of vegetation density or cover.

RESULTS

HOBO Logger Maintenance

HOBO loggers have been downloaded three times per year since installation. At each download, we examine the data to determine if there are any problems with data logger function. Data loggers are replaced whenever a potential problem with the sensors is detected. Battery level is also checked at each download, and the battery is replaced if needed.

Piezometer Installation and Maintenance

Table 7.1 lists details on installation parameters for all piezometers. Data from all piezometers were downloaded in December 2005; June and September 2006; February, July, and August of 2007; and February and September of 2008. All pressure transducers except those at Three Fingers Lake and Walker Lake have experienced some data breaks over their lifetime, primarily due to battery failure (Table 7.1). Isolated incidents of battery failure are expected in field equipment, and battery voltage is routinely monitored at the time of each download. However, such widespread and consistent failure appears to be systemic and is currently being addressed with the equipment manufacturer.

Table 7.1. Summary of Piezometer Construction and Data Collection at Habitat Monitoring Sites, Lower Colorado River, 2005–2008*

Site	Depth (ft)	Stickup height (ft)	Date installed	Data breaks	Distance (ft) from habitat
Topock Marsh	INA	2.5	13-Aug-06	16 Dec 2007–27 Feb 2008 After 24 Jun 2008	Within
Blankenship Bend	7.2	3.4	28-Aug-05	After 12 Aug 2007	Within
Havasu NE	6.1	2.2	09-May-05	26 Dec 2007–26 Feb 2008	Within
Ehrenburg	7.4	2.6	29-Aug-05	5 Jul–28 Aug 2007	Within
Three Fingers Lake	7.7	4.1	31-May-05	N/A	540
Cibola Lake	7.2	3.4	30-May-05[1]	29 Sep–13 Dec 2005 After 15 Feb 2007	Within
Walker Lake	7.4	2.9	30-May-05	N/A	230
Paradise	11.7	0.6	11-May-05	7 May–12 Jun 2006 3–29 Aug 2007 15 Sep 2007–28 Feb 2008 After 5 Mar 2008	Within
Hoge Ranch	8.7	2.8	11-May-05	10 Sep 2007–21 Feb 2008 After 17 Jun 2008	Within
Rattlesnake	7.0	2.8	10-May-05	After 15 Apr 2008	1,080

Table 7.1. Summary of Piezometer Construction and Data Collection at Habitat Monitoring Sites, Lower Colorado River, 2005–2008* (Continued)

Site	Depth (ft)	Stickup height (ft)	Date installed	Data breaks	Distance (ft) from habitat
Clear Lake	8.7	2.4	10-May-05	After 17 Apr 2008	Within
Ferguson Lake	7.6	2.7	10-May-05	After 7 Apr 2008	Within
Ferguson Wash	INA	2.2	10-May-05	24 Jan–20 Feb 2008 After 7 Aug 2008	Within
Great Blue Heron	7.3	1.7	31-May-05	30 Aug–15 Dec 2005 After 28 Jul 2008	60
Mittry West	5.0	3.0	29-Aug-05	4–19 Feb 2008	270
Gila Confluence North	7.9	2.7	29-Aug-05[2]	After fire 5 Jul 2007	50

* INA = information not available, N/A = not applicable.

[1] Piezometer destroyed by clearing activity between February and July 2007; replaced 27 March 2008.

[2] Location of original piezometer burned in December 2006; piezometer replaced on 5 July 2007.

In addition to the battery failure incidents that resulted in complete failure of the unit to collect data, some periods of data from Blankenship and Paradise are suspect. The Blankenship pressure transducer began to return anomalous data and stopped collecting data altogether shortly after the August 2007 download. Batteries were changed during the February 2008 download and the unit was restarted. During the September 2008 download, the pressure transducer failed to communicate with the Rugged Reader and after numerous attempts the download process was abandoned. The Paradise pressure transducer stopped collecting data shortly after both the August 2007 download and the February 2008 download; fresh batteries were installed at each download. For the purposes of analysis, all data after August 2007 were disregarded for both Blankenship and Paradise.

In July 2007, a replacement piezometer at the Gila Confluence North station was installed approximately 0.1 mile north of the original location. This station used the original pressure transducer, which was not damaged in the fire; however, a replacement cable was installed. The pressure transducer appears to have been malfunctioning since reinstallation; it is collecting data but there are no fluctuations in the data, and the data do not match the manual measurements. For the purposes of analysis, all post-fire data have been disregarded.

During the 2007 field season, the Cibola Lake piezometer had been cleared and bulldozed, and no trace of the piezometer could be located. On 27 March 2008, a replacement piezometer was installed on an island within Cibola Lake, adjacent to one of the HOBO monitoring sites. As of this report, the station is operational but no data has been downloaded from the site. One attempt was made in October 2008, but there was a hardware compatibility issue with the driver for the serial cable adapter that connects the field laptop to the pressure transducer, thus impeding any download attempts.

Microclimate

2008 Microclimate Descriptive Statistics

Soil moisture, temperature, relative humidity, and vapor pressure parameters from the 15 study sites monitored in 2008 exhibited substantial variation among sites (Table 7.2). Soil moisture varied by a factor of six among the 2008 study sites, from a low of 194.7 mV at Havasu NE to a high of 951.3 at Great Blue Heron.

Mean diurnal temperatures ranged from a low of 28.3°C at Rattlesnake and a high of 37.4°C at Cibola Lake. Mean nocturnal temperatures ranged from a low of 20.2°C again at Rattlesnake and a high of 26.0°C at Ferguson Wash. Mean number of 15-minute intervals above 41°C each day varied from 1.8 at Rattlesnake to 24.7 at Cibola Lake. Mean daily temperature range varied from 21.3°C at Ferguson Lake to 33.3°C at Three Fingers Lake.

Mean diurnal relative humidity ranged from 23.5% at Cibola Lake to 52.6% at Rattlesnake. Mean diurnal vapor pressure was lowest at Cibola Lake (1,047.6 Pa) and highest at Rattlesnake (1,900.9 Pa). Mean nocturnal vapor pressure was lowest at Havasu NE (974.4 Pa) and highest at Rattlesnake (1,683.7 Pa).

Between-year Comparisons of Microclimate Characteristics

Microclimatic characteristics at habitat monitoring sites varied significantly over time at test sites (Cibola Lake, Clear Lake, Ehrenberg, Ferguson Lake, Ferguson Wash, Great Blue Heron, Hoge Ranch, Paradise, Rattlesnake, Three Fingers Lake, and Walker Lake; Table 7.3). At control sites (Blankenship Bend, Gila Confluence North, Havasu NE, Mittry West), only mean nocturnal temperature and nocturnal vapor pressure varied significantly over time. In 2007 and 2008, mean soil moisture increased at both test and control sites. Mean diurnal temperature, mean number of 15 minute intervals above 41°C each day, and mean nocturnal temperature all decreased slightly in 2008 for control sites, but remained about the same as in 2007 for test sites. For both test and control sites, all measures of humidity and vapor pressure decreased in 2007 compared to 2006, but increased in 2008. Except for soil moisture, the changes over time were the same for test sites and controls (right-most column of Table 7.3).

Table 7.2. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, May–July 2008*

Descriptive Statistics	Blankenship Bend	Havasu NE	Ehrenberg	Three Fingers Lake	Cibola Lake	Walker Lake	Paradise	Hoge Ranch	Rattlesnake	Clear Lake	Ferguson Lake	Ferguson Wash	Great Blue Heron	Mittry West	Gila Confluence North
Soil Moisture															
Mean soil moisture (mV)	795.3 (72.1)	194.7 (34.1)	642.3 (46.6)	672.1 (36.2)	458.3 (47.8)	928.6 (14.9)	791.1 (69.5)	868.2 (9.4)	867.7 (11.0)	453.3 (78.9)	936.2 (11.0)	213.1 (16.6)	951.3 (2.5)	914.2 (6.2)	498.4 (57.1)
Temperature/Humidity															
Mean diurnal temperature (°C)	32.9 (0.3)	31.4 (0.3)	36.2 (0.3)	34.6 (0.3)	37.4 (0.3)	30.1 (0.2)	32.9 (0.3)	32.2 (0.3)	28.3 (0.2)	29.4 (0.2)	31.6 (0.2)	31.9 (0.2)	30.2 (0.2)	32.1 (0.2)	33.5 (0.3)
Mean no. of 15-min. intervals above 41°C each day	13.3 (0.8)	7.9 (0.6)	19.2 (0.7)	21.6 (0.6)	24.7 (0.7)	7.5 (0.4)	13.4 (0.8)	12.4 (0.5)	1.8 (0.2)	3.6 (0.3)	9.0 (0.5)	11.2 (0.6)	5.2 (0.3)	9.6 (0.6)	13.6 (0.7)
Mean nocturnal temperature (°C)	23.1 (0.3)	23.6 (0.3)	23.3 (0.3)	23.0 (0.3)	23.3 (0.3)	22.3 (0.3)	24.1 (0.3)	23.2 (0.3)	20.2 (0.2)	23.0 (0.3)	24.7 (0.3)	26.0 (0.3)	21.9 (0.2)	22.9 (0.3)	22.0 (0.3)
Mean daily temperature range (°C)	25.8 (0.4)	22.6 (0.5)	29.0 (0.4)	33.3 (0.4)	30.6 (0.3)	24.7 (0.4)	26.0 (0.5)	28.0 (0.4)	22.2 (0.3)	22.4 (0.4)	21.3 (0.3)	22.3 (0.4)	23.9 (0.3)	25.0 (0.4)	28.7 (0.4)
Mean diurnal relative humidity (%)	32.1 (0.8)	26.5 (0.6)	23.6 (0.5)	28.3 (0.6)	23.5 (0.5)	43.5 (0.7)	35.9 (0.6)	39.8 (0.7)	52.6 (0.8)	47.4 (0.9)	39.2 (0.6)	39.5 (0.7)	45.1 (0.7)	39.6 (0.6)	35.8 (0.6)
Mean diurnal vapor pressure (Pa)	1316.9 (38.0)	1079.8 (29.2)	1175.1 (29.3)	1116.1 (30.0)	1047.6 (26.5)	1606.9 (37.8)	1495.5 (31.1)	1596.4 (29.2)	1900.9 (43.1)	1832.4 (45.5)	1555.1 (31.8)	1601.4 (32.3)	1772.3 (38.9)	1632.8 (35.8)	1503.2 (36.8)
Mean nocturnal relative humidity (%)	46.6 (0.9)	33.4 (0.7)	45.9 (0.8)	47.8 (0.6)	46.6 (0.7)	55.9 (0.7)	48.5 (0.6)	53.3 (0.7)	68.9 (0.7)	54.3 (0.8)	50.8 (0.6)	42.5 (0.7)	58.8 (0.6)	53.5 (0.6)	57.2 (0.6)
Mean nocturnal vapor pressure (Pa)	1299.3 (34.1)	974.4 (25.7)	1287.8 (29.5)	1228.1 (26.2)	1284.8 (24.6)	1475.6 (30.8)	1432.1 (28.9)	1476.1 (26.0)	1683.7 (32.8)	1555.1 (36.5)	1542.7 (27.2)	1378.9 (28.8)	1583.2 (30.3)	1494.2 (28.1)	1509.3 (33.3)

* Soil moisture and temperature/humidity values are means (standard error in parentheses).

Table 7.3. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2008*

Parameter	Test (n=45)								Control (n=15)								P-value for difference between years among test sites compared to control sites
	2005	2006	2007	2008	Change 2005 to 2006	Change 2006 to 2007	Change 2007 to 2008	P-value for the difference between years	2005	2006	2007	2008	Change 2005 to 2006	Change 2006 to 2007	Change 2007 to 2008	P-value for the difference between years	
Soil Moisture																	
Mean soil moisture (mV)	645.7	634.4	662.9	702.2	-11.3	28.5	39.3	<0.001	694.4	582.9	635.3	638.8	-111.5	52.4	3.5	0.175	<0.001
Temperature/Humidity																	
Mean diurnal temperature (°C)	33.8	36.2	34.3	34.7	2.4	-1.9	0.4	<0.001	33.9	36.8	34.6	34.3	2.9	-2.2	-0.3	0.073	0.344
Mean no. of 15 min. intervals above 41°C each day	14.9	17.1	16.1	16.4	2.2	-1	0.3	0.002	15.0	19.8	16.5	13.7	4.8	-3.3	-2.8	0.406	0.253
Mean nocturnal temperature (°C)	25.9	28.8	25.3	26.1	2.9	-3.5	0.8	<0.001	24.8	28.2	25.0	25.7	3.4	-3.2	0.7	<0.001	0.734
Mean daily temperature range (°C)	24.4	21.5	25.6	25.7	-2.9	4.1	0.1	<0.001	25.2	24.0	26.9	24.7	-1.2	2.9	-2.2	0.153	0.237
Mean diurnal relative humidity (%)	40.0	45.3	37.5	39.6	5.3	-7.8	2.1	<0.001	37.0	39.7	35.1	36.8	2.7	-4.6	1.7	0.151	0.451
Mean diurnal vapor pressure (Pa)	1,745.0	2,304.4	1,620.3	1765.5	559.4	-684.1	145.2	<0.001	1,654.9	2,083.5	1,593.2	1676.3	428.6	-490.3	83.1	0.131	0.485
Mean nocturnal relative humidity (%)	50.8	55.4	49.4	51.7	4.6	-6	2.3	<0.001	51.5	51.5	46.9	48.2	0	-4.6	1.3	0.490	0.796
Mean nocturnal vapor pressure (Pa)	1,634.4	2,100.5	1,540.4	1675.5	466.1	-560.1	135.1	<0.001	1,576.0	1,898.8	1,452.3	1559.4	322.8	-446.5	107.1	0.015	0.514

* The analysis was restricted to 1 June–1 August each year.

Comparison of Parker/Imperial to Topock: Microclimate

All microclimate parameters except for mean soil moisture were significantly different between Topock Marsh and the habitat monitoring sites (Table 7.4). Topock was cooler and exhibited higher relative humidity and vapor pressure than habitat monitoring sites.

Table 7.4. Comparison of Microclimatic Variables at Habitat Monitoring Sites to Territories at Topock Marsh, 2008*

Response Variable	Habitat Monitoring Sites	Topock Marsh	*P*
N (Temp./Humidity Sensor Arrays)	57	11[1]	N/A
Soil Moisture			
Mean soil moisture (mV)	683.6 (39.7)	783.3 (73.9)	0.301
Temperature/Humidity			
Mean diurnal temperature (°C)	32.9 (0.4)	29.0 (0.6)	<0.001
Mean no. of 15 min. intervals above 41°C each day	13.0 (1.2)	3.1 (1.2)	0.001
Mean nocturnal temperature (°C)	23.6 (0.3)	21.7 (0.5)	0.005
Mean daily temperature range (°C)	25.9 (0.8)	21.6 (0.9)	0.019
Mean diurnal relative humidity (%)	36.8 (1.3)	55.7 (2.5)	<0.001
Mean diurnal vapor pressure (Pa)	1500.4 (46.2)	2,101.1 (73.2)	<0.001
Mean nocturnal relative humidity (%)	50.9 (1.2)	67.2 (2.6)	<0.001
Mean nocturnal vapor pressure (Pa)	1,441.1 (28.9)	1,760.4 (48.0)	<0.001

* Soil moisture and temperature/humidity values are means (standard error in parentheses). N/A = data not available or not applicable. The analysis was restricted to 6 May–31 July 2008.

[1] This includes nine territory locations and two HOBOs placed near the piezometer.

Vegetation Measurements

Vegetation characteristics varied widely both between and within the selected habitat monitoring sites (Table 7.5). Average canopy height ranged from 3.5 m (Three Fingers Lake) to 10.4 m (Ehrenberg), and average canopy closure ranged from 69.9% (Ehrenberg) to 98.0% (Ferguson Lake). Measures of other habitat characteristics were similarly variable. Vertical foliage profiles for each site are shown in Figure 7.1. Sites typically exhibited the densest foliage within 4–5 m of the ground, and the majority of vegetation within 2–3 m of the ground typically consisted of dead branches.

Between-year Comparisons of Vegetation Characteristics

Average values of canopy height, canopy closure, woody ground cover, percent of the basal area in each plot that consisted of native vegetation, and live and dead stems in <2.5 cm, 2.5–8.0 cm, and >8 cm dbh size categories for both test and control sites by year are shown in Table 7.6. Repeated measures ANOVA comparing these variables between years showed an overall between-year difference in canopy closure ($P = 0.001$), woody ground cover ($P < 0.001$), and number of dead stems 2.5–8 cm dbh ($P = 0.003$) for all plots combined. There were no significant interactions between canopy closure or number of dead stems 2.5–8 cm dbh and location (test vs. control sites), meaning the change in these variables between years among test sites was not significantly different from the change at control sites. Across all sites, canopy closure decreased between 2005 and 2006 and then increased in 2007 and 2008 to values higher than those recorded in 2005. The number of dead stems 2.5–8 cm dbh was lower in 2006 and 2007 than in 2005 or 2008. Percent woody ground cover was higher in 2008 than in previous years.

Table 7.5. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2008*

Parameter	Blankenship Bend (n=4)	Havasu NE (n=4)	Ehrenberg (n=4)	Cibola Lake (n=5)	Three Fingers Lake (n=5)	Walker Lake (n=3)	Paradise (n=4)	Hoge Ranch (n=4)	Rattlesnake (n=4)	Clear Lake (n=3)	Ferguson Lake (n=5)	Ferguson Wash (n=4)	Great Blue Heron (n=4)	Mittry West (n=4)	Gila Confluence North (n=3)
Average canopy height (m)	7.8 (2.4)	5.2 (0.9)	10.4 (4.4)	5.1 (0.9)	3.5 (0.1)	4.8 (0.8)	8.4 (2.3)	6.5 (1.6)	7.5 (1.3)	7.6 (0.2)	5.6 (0.2)	6.0 (0.5)	8.3 (1.2)	10.0 (2.2)	7.8 (0.4)
	5.1–15.0	3.4–7.5	2.5–20.7	3.4–8.5	3.2–3.8	4.0–5.5	3.4–14.0	4.0–11.3	5.5–10.0	7.4–8.0	5.0–6.0	5.2–7.5	6.0–11.6	6.0–14.4	7.0–8.5
% total canopy closure	76.0 (12.5)	87.8 (2.6)	69.9 (5.2)	76.4 (10.0)	72.5 (9.7)	94.8 (0.3)	89.6 (5.3)	95.7 (0.9)	95.4 (2.7)	97.4 (0.8)	93.9 (2.9)	98.0 (0.2)	94.7 (2.5)	93.1 (2.0)	84.9 (8.1)
	39.1–92.7	82.3–93.2	60.4–83.9	37.5–90.6	43.2–94.3	94.3–95.3	74.0–97.9	94.3–97.9	87.5–99.0	96.4–99.0	84.9–99.0	97.4–98.4	87.5–97.9	89.6–96.9	68.9–94.8
% woody ground cover	78.4 (11.3)	53.8 (13.5)	22.4 (2.7)	32.9 (6.2)	14.4 (3.3)	59.9 (8.8)	73.2 (14.3)	60.3 (4.5)	65.1 (8.3)	35.4 (19.2)	23.4 (4.3)	57.2 (9.8)	29.9 (9.7)	48.2 (9.8)	24.6 (3.6)
	53.8–98.8	30.0–82.5	17.5–28.8	19.8–56.0	5.5–23.8	46.0–76.2	36.8–100.0	47.5–68.8	41.2–79.2	15.0–73.8	11.5–32.5	37.8–83.8	8.0 (47.5)	18.8–58.8	17.5–28.8
# live stems <2.5 cm dbh per ha	1178 (262)	255 (90)	1178 (272)	1019 (420)	4711 (2230)	1188 (679)	1178 (660)	2324 (1906)	159 (95)	467 (297)	738 (136)	350 (175)	764 (214)	891 (382)	1316 (699)
	509–1655	127–509	509–1782	255–2547	1146–13496	509–2546	0–3056	0–8021	0–382	0–1019	382–1146	0–764	509–1401	255–1783	127–2547
# live stems 2.5–8 cm dbh per ha	2133 (466)	828 (184)	191 (82)	5220 (1180)	10008 (2090)	1740 (667)	3565 (2455)	4361 (2226)	2515 (1011)	2037 (1528)	4304 (797)	2292 (227)	3692 (807)	2546 (1346)	3353 (1154)
	1146–2929	382–1273	0–382	764–7257	5220–15788	891–3056	127–10823	127–10186	764–4329	509–5093	1910–6366	1910–2801	1655–5602	0–6239	1783–5602
# live stems >8 cm dbh per ha	859 (131)	668 (334)	159 (61)	713 (435)	102 (102)	334 (42)	318 (152)	95 (61)	1401 (425)	1612 (542)	637 (139)	1401 (392)	923 (204)	668 (354)	722 (42)
	509–1445	255–1655	0–255	0–2419	0–509	255–383	127–764	0–255	509–2546	891–2674	382–1146	764–2546	637–1528	0–1655	637–764
# dead stems <2.5 cm dbh per ha	1241 (80)	1846 (663)	2419 (1561)	764 (255)	3743 (1094)	85 (85)	318 (184)	1814 (607)	64 (64)	170 (112)	1120 (321)	223 (80)	127 (90)	1082 (282)	1358 (478)
	1019–1401	0–2928	255–6875	0–1528	1655–7768	0–255	0–637	764–3565	0–255	0–382	127–2037	0–382	0–382	637–1910	509–2164
# dead stems 2.5–8 cm dbh per ha	1273 (375)	987 (383)	2101 (1848)	2063 (453)	4736 (1187)	478 (478)	32 (32)	2196 (772)	350 (217)	2122 (170)	2827 (959)	1528 (308)	700 (278)	2069 (516)	1188 (594)
	509–2037	0–1655	0–7639	382–3056	2928–9422	0–1655	0–127	255–3947	0–891	1783–2292	1019–6239	1019–2419	0–1146	891–3056	0–1783
# dead stems >8 cm dbh per ha	127 (90)	64 (64)	0 (0)	51 (51)	0 (0)	0 (0)	0 (0)	95 (95)	0 (0)	722 (405)	0 (0)	382 (138)	127 (90)	32 (32)	0 (0)
	0–382	0–255	0–0	0–255	0–0	0–0	0–0	0–382	0–0	0–1401	0–0	127–764	0–382	0–127	0–0
Percent basal area native	26.9 (23.9)	13.5 (10.4)	83.1 (16.8)	0.0 (0.0)	0.0 (0.0)	32.6 (32.6)	23.5 (23.2)	63.9 (18.1)	27.5 (24.3)	0.0 (0.0)	3.5 (3.5)	25.8 (17.6)	38.6 (22.9)	70.4 (23.7)	100.0 (0)
	0–98.4	0–44.0	32.8–100.0	0–0	0–0.1	0–97.8	0–93.0	29.7–98.8	0–100.0	0–0	0–17.5	0–75.5	0–95.8	0–100.0	100.0–100.0

* Data presented are means, (standard error), and range.

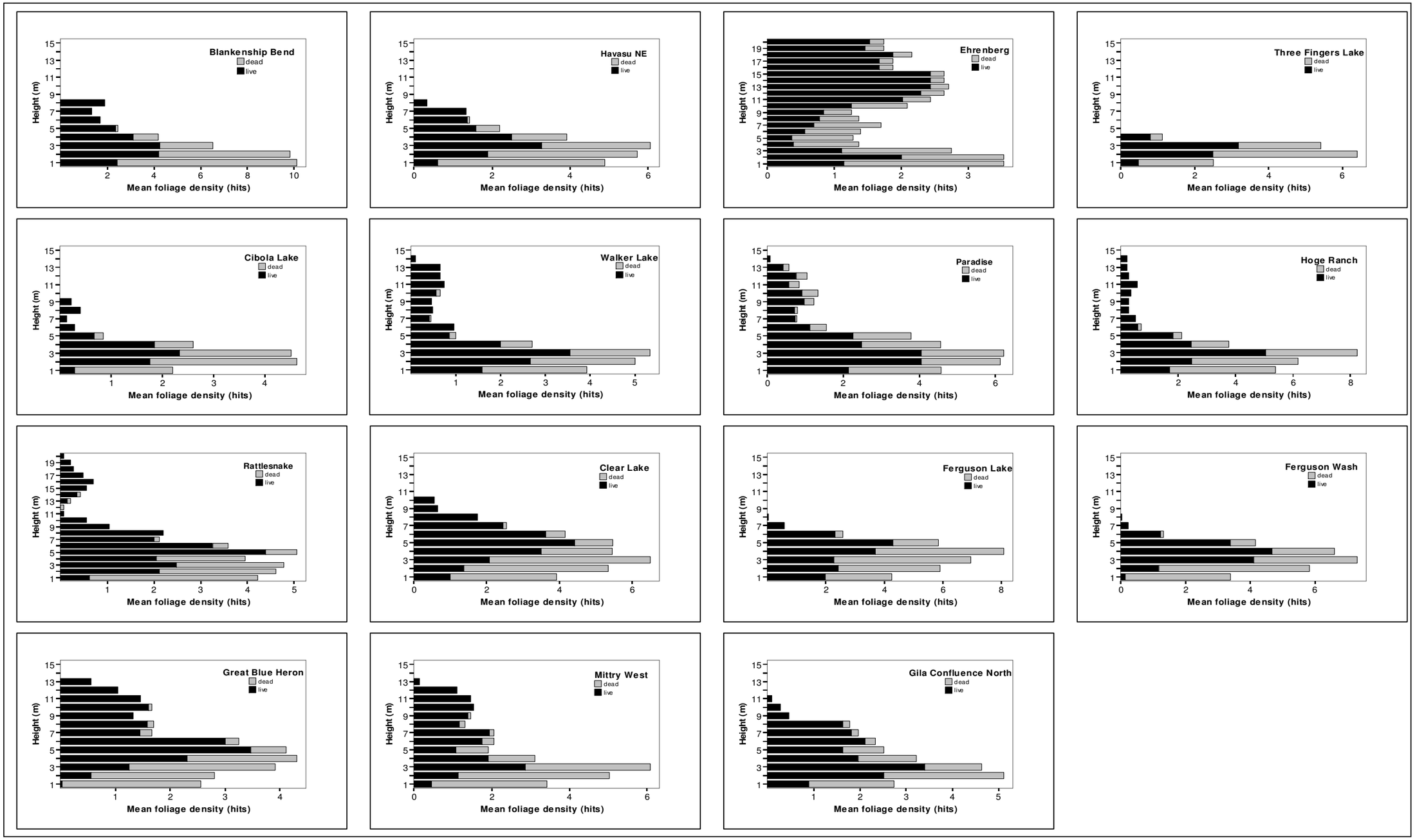


Figure 7.1. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2008.

Table 7.6. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2008

Parameter	Test				Control				P-value for overall difference in means between years	P-value for difference in means between years among test sites compared to control sites
	2005	2006	2007	2008	2005	2006	2007	2008		
Average canopy height (m)	6.4	6.8	5.7	6.6	6.3	6.6	6.9	7.1	0.666	0.545
% total canopy closure	84.7	78.3	87.9	88.1	81.1	76.1	87.1	84.3	0.001	0.869
% woody ground cover	31.1	27.2	29.8	41.6	27.3	48.8	39.3	56.8	<0.001	0.002
# live stems <2.5 cm dbh per ha	1933	2272	2515	1358	955	2186	1655	743	0.013	0.627
# live stems 2.5–8 cm dbh per ha	3107	2722	3143	3899	1613	1984	1910	1963	0.376	0.440
# live stems >8 cm dbh per ha	481	430	654	673	668	594	690	753	0.081	0.838
# dead stems <2.5 cm dbh per ha	340	1282	1259	1084	803	1305	1294	1422	0.058	0.786
# dead stems 2.5–8 cm dbh per ha	1234	821	925	1879	1284	456	711	1528	0.003	0.836
# dead stems >8 cm dbh per ha	48	59	96	108	64	95	148	74	0.243	0.526
Percent basal area native	27.2	20.3	28.9	25.9	36.7	39.5	58.1	45.2	0.017	0.148

There was a significant interaction between year and location for woody ground cover ($P = 0.002$). Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years.

Repeated measures ANOVAs for vertical foliage in each meter interval showed no significant between-year differences in live vegetation but showed between-year differences for the first, second, third, and fourth meter intervals above the ground for dead vegetation. In all cases, density of dead vegetation was higher in 2008 than in 2007. There was a significant interaction ($P = 0.037$) between live vertical foliage density and location (test vs. control sites) for the fourth meter interval, but there was no clear pattern, with density increasing at control plots in years it decreased at test plots, and vice versa. There was also a significant interaction ($P < 0.001$) between dead vertical foliage density and location for the first meter interval, with the density of dead vegetation increasing more in 2007 and 2008 at control plots relative to test plots.

Groundwater Monitoring

Overview of Piezometer Groundwater Levels

More than two full years of data have been collected at 15 of the 16 piezometers (excluding Topock Marsh, which has nearly two full years of data), with the exception of the data breaks noted in Table 7.1.

The piezometer hydrographs generally exhibit some common characteristics. Two general trends, a weekly trend and a daily cycle, are apparent. Groundwater levels were lowest during the afternoon hours and on weekends, while high groundwater levels were observed in early morning hours and in the middle of the week. The weekly trend is the result of reservoir operation and changes in river water levels; the daily trend is the result of evapotranspiration of water from the aquifer. Both trends are useful for analysis.

A third general trend, a seasonal pattern, has appeared in the hydrographs as multiple years of data have been recorded. In the majority of the hydrographs, the lowest groundwater levels occurred in the winter and highest groundwater levels occurred in the spring (Table 7.7). Average monthly groundwater level ranges from inundated conditions at Mittry West to over 6 feet below ground surface at Paradise, with an average seasonal water level change of just over 2 feet. Hydrographs for all piezometers are included in Appendix E. For 2008, the data trend is very similar to that of previous years, with some sites having slightly higher and lower maximum and minimum groundwater levels.

Table 7.7. High and Low Average Monthly Water Depths Recorded at Piezometers at Habitat Monitoring Sites, August 2005–August 2008

Location	Shallowest water level (ft bgs)	Month occurred	Deepest water level (ft bgs)	Month occurred
Topock	1.52	March	2.1	September
Blankenship Bend	1.99	June	3.70	December
Havasu NE	1.55	June	2.82	February
Ehrenburg	0.72	April	3.75	December
Three Fingers Lake	2.1	April	4.81	December
Cibola Lake	2.16	April	4.59	November
Walker Lake	4.15	March	5.32	July
Paradise	4.61	April	6.66	December
Hoge Ranch	1.4	April	4.68	December
Rattlesnake	0.52	April	3.40	December
Clear Lake	1.47	April	3.81	January
Ferguson Lake	0.97	April	3.15	December
Ferguson Wash	1.14	April	3.11	December
Great Blue Heron	0.63	April	2.43	December
Mittry West	-0.22	April	2.13	January
Gila Confluence North[1]	2.94	October	4.29	August

[1] Data from two locations

Correlation of Piezometer Groundwater Levels with Reservoir Releases

Lake Havasu Water Levels – There is a strong correlation ($R^2 = 0.96$) between water levels in Lake Havasu as measured by the USGS and groundwater levels below the habitat as measured in the Havasu NE piezometer (Figure 7.2). Data prior to August 2007 (before erroneous data collection) indicated that the piezometer at Blankenship Bend appears to be too far upstream to be strongly correlated with lake levels, showing a correlation through the same period with an R^2 value of only 0.09.

Colorado River Water Levels – Data were collected between August 2005 and September 2008 in hourly intervals and averaged by the day. The "best fit" time lag varied from two days for the upstream piezometers (Hoge Ranch, Cibola, Ehrenberg, Paradise and Three Fingers Lake) to three days for the downstream piezometers (Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron). The best fit R^2 statistics varied from 0.71 to 0.94 (Table 7.8). Piezometer levels at Walker Lake had no correlation ($R^2 = 0.15$–0.16) to releases from Parker Dam. Additionally, the relationship between piezometer levels at Mittry West and releases from Imperial Dam was examined for the entire time period (May 2005–September 2008). There was no correlation between releases and water levels (best $R^2 = 0.003$).

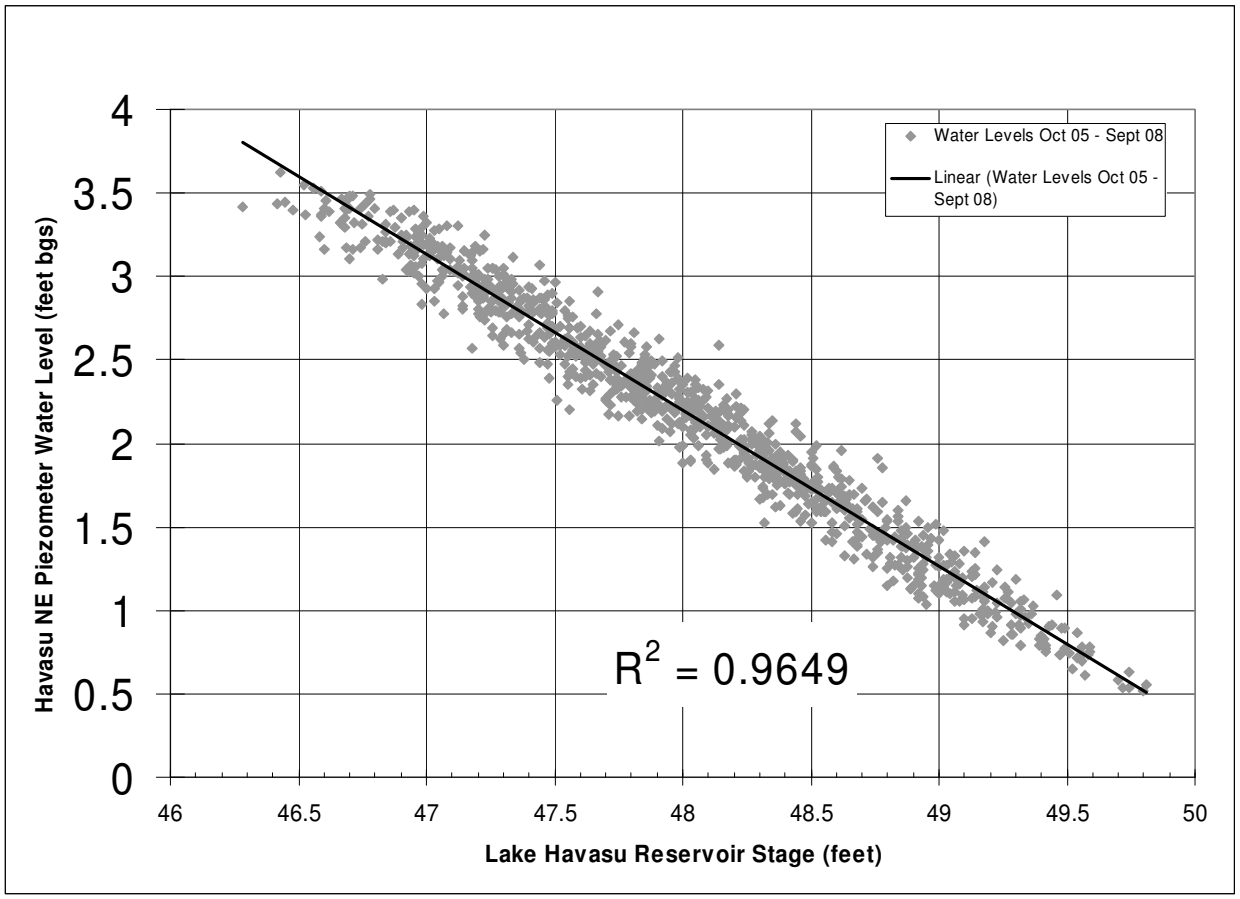


Figure 7.2. Correlation of Havasu NE piezometer and Lake Havasu water levels, October 2005–September 2008. Line shows linear regression.

Table 7.8. Correlation (R^2 Statistic) of Parker Dam Daily Releases (cfs) with Average Daily Groundwater Levels (feet bgs) of Piezometers at Habitat Monitoring Sites, September 2006–September 2008*

Site	Time Lag				
	None	1 day	2 days	3 days	4 days
Ehrenberg	0.82	0.92	0.93	0.85	0.78
Cibola Lake	0.26	0.45	0.66	0.47	0.29
Three Fingers Lake	0.78	0.87	0.94	0.84	0.77
Walker Lake	0.16	0.16	0.15	0.15	0.16
Paradise	0.69	0.79	0.91	0.82	0.72
Hoge Ranch	0.66	0.75	0.84	0.74	0.66
Rattlesnake	0.66	0.71	0.77	0.80	0.74
Clear Lake	0.77	0.81	0.89	0.92	0.87
Ferguson Lake	0.68	0.72	0.88	0.93	0.83
Ferguson Wash	0.56	0.60	0.68	0.71	0.63
Great Blue Heron	0.67	0.71	0.79	0.86	0.83

* Shaded cells indicate best correlation.

Planned Declines in Parker Releases – An examination of monthly river flows below Parker Dam from 2000 to 2008 (Table 7.9) revealed there has been a noticeable decline in reservoir releases during most months. While there is moderate variation, average monthly flow decreased from 2001 (the year prior to the scheduled change in point of diversion) to present, with the percent decrease ranging from 13.4% in January 2008 to 31.7% in December of 2007. The decreases occurred throughout the year except for February–April. March experienced an increase of average flow for 2008; releases for February and April were roughly equivalent to those in 2001.

Table 7.9. Average Monthly Flows (cfs) Below Parker Dam, 2000–2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Difference (2001–present)	% Change (2001–present)
January	6,820	5,599	6,478	6,327	5,536	4,166	5,842	5,945	4,850	-749	-13.4%
February	9,123	8,505	8,978	6,881	7,129	4,888	7,798	8,491	8,232	-273	-3.2%
March	11,594	10,524	11,334	12,360	11,523	9,699	9,752	11,122	12,180	1,656	15.7%
April	14,613	14,090	13,610	13,803	12,824	11,356	11,985	12,618	14,293	203	1.4%
May	14,174	14,068	12,826	11,990	12,252	11,428	11,998	11,718	11,339	-2,729	-19.4%
June	13,803	14,733	13,713	12,778	12,741	12,444	12,383	12,116	11,957	-2,776	-18.8%
July	14,210	14,974	14,439	13,100	12,331	13,842	11,688	12,180	12,226	-2,748	-18.4%
August	11,441	12,047	12,118	10,803	11,420	10,316	10,141	10,317	10,720	-1,327	-11.0%
September	11,233	10,837	10,429	11,159	9,566	9,048	7,334	9,195	9,072	-1,765	-16.3%
October	9,362	8,852	8,765	9,761	7,405	6,967	7,424	7,204	7,568	-1,284	-14.5%
November	7,437	7,357	7,049	6,153	5,163	6,335	6,094	5,420		-1,937	-26.3%
December	6,706	5,970	5,615	5,737	4,129	4,841	5,507	4,079		-1,891	-31.7%

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

Linear regressions between the average soil moisture measurements and the average daily groundwater level in the piezometer for that site show little to no correlation between these two variables (R^2 = 0.0–0.50; Table 7.10). Analysis included all available data from 2005 to 2008.

Table 7.10. Results of Linear Regression Between Average Daily Piezometer Groundwater Levels and Soil Moisture at Habitat Monitoring Sites, Lower Colorado River, 2005–2008

Site	Number of data points	Range of soil moisture values (mV)	Median soil moisture value (mV)	R^2
Blankenship Bend	15	393–1070	960	0.24
Havasu NE	27	12–907	188	0.02
Ehrenburg	23	51–1018	624	0.00
Cibola Lake	22	11–994	296	0.04
Three Fingers Lake	40	49–1012	477	0.00
Walker Lake	36	519–1504	931	0.04
Paradise	26	45–1020	683	0.00
Hoge Ranch	34	452–1313	877	0.01
Rattlesnake	34	99–994	816	0.37
Clear Lake	29	54–1017	404	0.03
Ferguson Lake	34	437–1020	938	0.50
Ferguson Wash	39	34–643	167	0.01
Great Blue Heron	30	336–991	920	0.00
Mittry West	30	431–1018	909	0.22
Gila Confluence North	17	96–937	332	0.00
Topock	27	864–975	908	0.01

Presence of Standing Water

Data from Gila Confluence North indicate that the piezometer location was inundated from 18 to 20 October 2005 to a depth up to 1.4 feet. Data from Mittry West indicate that piezometer location was inundated four times in three different years: 22 April–2 May 2006 to a depth up to 0.2 feet; 5 April–5 May 2007; 20 March–19 May 2008; and 24–25 May 2008. Data from two other sites, Three Fingers Lake and Rattlesnake, also indicated possible inundation, but repeated differences between data logger and manual measurements suggest these data may not be accurate. Topock did not appear to have encountered standing water based on piezometer measurements.

Evapotranspiration Signature

Nearly all the sites exhibit a typical seasonal trend in evapotranspiration, with the magnitude of the daily evapotranspiration signature peaking between June and September (Tables 7.11 and 7.12). The Ehrenberg piezometer exhibited duplicate measurements occurring in a 23-hour cycle beginning in November 2005; this equipment malfunction was investigated with the manufacturer but was not able to be resolved until July 2007. Ehrenberg data are not presented here for 2006 or 2007. The difference between 2006 and 2007 is shown in Table 7.13.

Table 7.11. Magnitude of Daily Evapotranspiration Signature, January–December 2006

Site	Median of Daily Water Level Fluctuation (feet)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blankenship Bend	0.231	0.294	0.499	0.769	0.812	0.732	0.802	0.834	0.841	0.680	0.407	0.241
Havasu NE	0.150	0.180	0.236	0.277	0.304	0.288	0.302	0.300	0.243	0.208	0.157	0.177
Cibola Lake	0.331	0.434	0.417	0.394	0.476	0.535	0.488	0.538	0.544	0.462	0.498	0.321
Three Fingers Lake	0.418	0.586	0.637	0.820	0.972	0.982	0.900	0.878	0.817	0.651	0.626	0.416
Walker Lake	0.043	0.044	0.066	0.432	0.759	0.896	0.847	0.792	0.677	0.612	0.442	0.075
Paradise	0.373	0.411	0.464	0.488	0.611	0.716	0.646	0.609	0.562	0.526	0.489	0.356
Hoge Ranch	0.587	0.707	0.725	0.702	0.895	0.903	0.800	0.889	0.839	0.786	0.666	0.529
Rattlesnake	0.224	0.215	0.202	0.256	0.272	0.327	0.239	0.285	0.319	0.273	0.237	0.261
Clear Lake	0.129	0.126	0.117	0.148	0.138	0.148	0.126	0.162	0.168	0.145	0.119	0.116
Ferguson Lake	0.221	0.202	0.218	0.236	0.247	0.279	0.182	0.257	0.253	0.201	0.226	0.183
Ferguson Wash	0.239	0.221	0.219	0.225	0.271	0.254	0.176	0.239	0.270	0.235	0.248	0.209
Great Blue Heron	0.073	0.093	0.102	0.105	0.154	0.154	0.174	0.205	0.184	0.142	0.133	0.080
Mittry West	0.014	0.023	0.041	0.042	0.077	0.108	0.131	0.140	0.122	0.083	0.058	0.019
Gila Confluence North	0.061	0.130	0.062	0.084	0.090	0.110	0.108	0.113	0.106	0.145	0.083	0.039
Topock	-	-	-	-	-	-	-	0.510	0.515	0.239	0.092	0.017

Table 7.12. Magnitude of Daily Evapotranspiration Signature, January–December 2007

Site	Median of Daily Water Level Fluctuation (feet)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blankenship Bend	0.271	0.461	0.432	0.789	0.737	0.650	0.722	-	-	-	-	-
Havasu NE	0.173	0.184	0.186	0.311	0.310	0.305	0.308	0.313	0.231	0.187	0.145	0.135
Cibola Lake	0.316	0.335	-	-	-	-	-	-	-	-	-	-
Three Fingers Lake	0.401	0.582	0.742	0.975	1.049	1.024	0.932	1.016	0.750	0.578	0.426	0.324
Walker Lake	0.047	0.051	0.105	0.462	0.788	0.875	0.868	0.790	0.719	0.619	0.438	0.060
Paradise	0.306	0.378	0.473	0.614	0.704	0.677	0.680	-	-	-	-	-
Hoge Ranch	0.458	0.673	0.710	0.877	0.976	0.978	0.922	1.089	0.731	-	-	-
Rattlesnake	0.165	0.306	0.314	0.279	0.256	0.357	0.385	0.315	0.203	0.209	0.237	0.289
Clear Lake	0.078	0.141	0.139	0.125	0.127	0.143	0.185	0.143	0.115	0.099	0.095	0.110
Ferguson Lake	0.159	0.192	0.256	0.242	0.209	0.282	0.233	0.219	0.190	0.180	0.200	0.208
Ferguson Wash	0.161	0.210	0.240	0.231	0.194	0.263	0.232	0.242	0.201	0.183	0.215	0.287
Great Blue Heron	0.071	0.093	0.123	0.099	0.113	0.138	0.142	0.173	0.165	0.146	0.112	0.100
Mittry West	0.012	0.019	0.037	0.026	0.076	0.112	0.138	0.104	0.112	0.091	0.065	0.016
Gila Confluence North	0.050	0.035	0.448	0.070	0.115	0.067	0.085	-	-	-	-	-
Topock	0.041	0.017	0.021	0.034	0.141	0.282	0.366	0.461	0.491	0.280	0.093	0.020

Table 7.13. Difference in Magnitude of Evapotranspiration Signature from 2006 to 2007*

Site	Difference in Median Daily Water Level Fluctuation (feet)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blankenship Bend	0.040	0.168	-0.067	0.020	-0.075	-0.082	-0.080	INA	INA	INA	INA	INA
Havasu NE	0.023	0.004	-0.050	0.034	0.006	0.017	0.006	0.013	-0.012	-0.021	-0.013	-0.042
Cibola Lake	-0.015	-0.099	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA
Three Fingers Lake	-0.017	-0.005	0.105	0.155	0.077	0.041	0.032	0.138	-0.067	-0.073	-0.200	-0.092
Walker Lake	0.004	0.007	0.039	0.030	0.029	-0.020	0.021	-0.002	0.042	0.007	-0.004	-0.015
Paradise	-0.067	-0.033	0.009	0.126	0.093	-0.039	0.034	INA	INA	INA	INA	INA
Hoge Ranch	-0.129	-0.034	-0.015	0.175	0.081	0.075	0.122	0.200	-0.108	INA	INA	INA
Rattlesnake	-0.059	0.091	0.112	0.023	-0.016	0.030	0.146	0.030	-0.117	-0.064	0.000	0.028
Clear Lake	-0.051	0.015	0.022	-0.024	-0.011	-0.004	0.059	-0.019	-0.053	-0.046	-0.024	-0.006
Ferguson Lake	-0.062	-0.010	0.038	0.007	-0.038	0.003	0.051	-0.038	-0.063	-0.021	-0.026	0.025
Ferguson Wash	-0.078	-0.011	0.021	0.007	-0.077	0.009	0.056	0.003	-0.070	-0.052	-0.033	0.078
Great Blue Heron	-0.002	0.000	0.021	-0.006	-0.041	-0.016	-0.032	-0.032	-0.019	0.004	-0.021	0.020
Mittry West	-0.002	-0.004	-0.004	-0.016	-0.001	0.005	0.007	-0.036	-0.010	0.008	0.007	-0.003
Gila Confluence North	-0.011	-0.095	0.386	-0.014	0.025	-0.043	-0.023	INA	INA	INA	INA	INA
Topock	INA	INA	INA	INA	INA	INA	INA	-0.049	-0.024	0.041	0.001	0.004

* Shaded cells show a decline from 2006 to 2007; INA = information not available.

DISCUSSION

Microclimate

Comparison of Parker/Imperial to Topock

Most microclimatic variables at the combined habitat monitoring sites differed significantly from those at Topock Marsh. The habitat monitoring sites were lower in elevation and at lower latitudes than Topock and therefore were more likely to be warmer, an expectation confirmed by all measures of diurnal temperature parameters compared in Table 7.4.

Between-year Comparisons of Microclimate Characteristics

Comparisons of microclimate characteristics among 2005, 2006, 2007, and 2008 at the habitat monitoring sites indicated generally hotter and more humid conditions in 2006 than in the other years. The interannual changes were generally similar between test and control sites, suggesting that changes in temperature and humidity conditions may have been regional, rather than being influenced by changes in river operations. Soil moisture was lower in 2006 than in 2005 or 2007, and while this pattern was exhibited at both test and control sites, the interannual change was greater at control than at test sites. In 2008, soil moisture at test sites increased while it remained the same at control sites. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. The role of river flows in influencing soil moisture within the sites is still unclear, given that no strong relationship was

found between piezometer levels and soil moisture (see Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements below).

Vegetation

Between-year differences across all sites were noted for canopy closure, woody ground cover, and number of dead stems 2.5–8 cm dbh. None of these variables showed unidirectional trends from 2005 to 2008, suggesting that the differences are not indicative of long-term, regional habitat changes during that time period. Changes in canopy closure could be caused by changes in overall weather conditions between the years or could be the result of systematic observer variation.

Woody ground cover showed an overall increase in 2008; the number of dead stems 2.5–8 cm dbh was higher in 2008 and 2005 than in the intervening years; and the vertical density of dead vegetation was greater in 2008 than in 2007 within 4 m of the ground. The increases in these variables in 2008 suggest there may have been more dead vegetation in 2008. No corresponding change in the number of live stems or canopy closure was observed, and additional years of monitoring will help determine whether the changes observed in 2008 represent a real increase in the amount of dead vegetation.

Few variables showed changes that were specific to control or test sites. Ground cover did not differ between 2005 and 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts did not show any consistent differences between control and test locations. Measurable changes in vegetation as a response to water availability may take several years to develop, and future years of monitoring will help determine whether water diversions are affecting potential flycatcher habitat.

Groundwater Levels

Piezometer Groundwater Levels

The general daily and weekly cycles that were attributed to evapotranspiration and river operations, respectively, in the 2005 data are still visible in the 2006–2008 data. Groundwater levels drop during afternoon hours and on the weekends, while higher groundwater levels occur in early morning hours and in the middle of the week. The daily small-scale groundwater level fluctuations are caused by evapotranspiration of plants. During the day, the riparian vegetation removes water from aquifer storage, which is then replenished as evapotranspiration lessens near the end of the day. These fluctuations occur at similar times of day regardless of distance downstream from Parker Dam and are thus unlikely to be the result of daily fluctuations in releases, which would exhibit a lag effect with increasing distance downstream. In addition, similar daily fluctuations occur at the control sites both upstream and downstream of Parker Dam, and follow typical evapotranspiration patterns (White 1932, Freeze and Cherry 1979).

The seasonal cycle in groundwater levels mirrors the seasonal fluctuation in river flow. This is driven primarily by the operational decrease in releases from Parker Dam. Evapotranspiration would be expected to decrease during the winter months, which should result in higher river and groundwater levels during the winter; however, this trend is not observed. Any seasonal effect of evapotranspiration appears to be overwhelmed by operations at Parker Dam.

Several anomalous hydrograph features deserve discussion:

Walker Lake – The Walker Lake piezometer recovered slowly from two apparent inundations in the late summer of 2005 and went through a period of declining groundwater levels until the 5 December 2005 download. From the point of restart, this piezometer began to show the same general seasonal trend as seen in the other piezometers, with a seasonal high occurring in winter 2006 and seasonal low occurring in spring 2006. Groundwater levels, however, have continued to drop from the seasonal high spring levels to levels more like those first recorded before the summer 2005 inundation, suggesting this lower groundwater level is closer to the seasonal low than that recorded in the winter 2006. We speculated in the 2006 report that Walker Lake represented a backwater area that gets periodically inundated, but otherwise does not respond strongly to fluctuations in the Colorado River. However, since the spike in summer 2005, the seasonal pattern appears to match the pattern at most of the piezometer locations between Parker and Imperial dams, including Rattlesnake, Ferguson Lake, and Clear Lake. The spike, which we speculated may have been an inundation of a backwater lake, does not appear to have repeated.

Mittry West – While the hydrograph for the Mittry West piezometer was almost flat from installation through December 2005, the data now show a seasonal trend. A peak in groundwater level occurred on 29 April 2006, from which point water levels declined into the summer months. Weekly fluctuations and daily fluctuations are not as apparent on the rising leg of the 2006 seasonal curve, but reappear on the declining leg of the curve. This may be attributed to the onset of evapotranspiration with the regrowth of vegetation in the immediate area surrounding the piezometer. Because of the inexplicable flat data from the first data downloads, we considered reinstalling the Mittry West piezometer at a different location within the habitat polygon. It now appears that this piezometer is functioning properly, and the flat data likely reflect the true groundwater levels at the site. The data have remained consistent through 2008.

Havasu NE – Daily and weekly changes in groundwater level are apparent in the Havasu NE hydrograph; however, there is no seasonal trend common in the other hydrographs. This lack of a seasonal trend at the Havasu NE piezometer can be attributed to the highly regulated water level at Lake Havasu.

Gila Confluence North, Paradise, and Blankenship – These piezometers appear to be malfunctioning or inoperative. Gila Confluence North has been returning nearly flat data since its relocation in July 2007, which is drastically different from the data collected prior to reinstallation. It is unclear whether it is a hardware or installation problem. Paradise has had massive battery failure since August 2007. It will likely need to be replaced, although the systemic problems with battery life are also being investigated with the manufacturer. Blankenship, as mentioned, began returning erratic measurements in August 2007. It has not functioned properly since and will no longer communicate with our download interface. It will likely need to be replaced.

Topock – Nearly two years of data exist for Topock. Data from 2007 showed high groundwater levels in spring, followed by declining water levels through the summer. Data gaps in 2008 make it difficult to determine whether this pattern continued.

Correlation of Piezometer Groundwater Levels with Reservoir Releases

Regression analyses indicated that, as would be expected, piezometer readings were best correlated with flow release data that had been time-lagged to allow for the progression of releases downstream.

The most upstream site included in the analyses (Ehrenberg) showed a two-day lag, while the most downstream site (Great Blue Heron) showed a three-day lag.

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

With two to three years of data at most sites, we have not found a linear relationship between piezometer water levels and soil moisture measurements at the subset of habitat monitoring sites for which we have complete data sets. The highest correlations between groundwater levels and soil moisture occurred at sites where soil moisture is relatively high and surface water is sometimes present, suggesting that soil moisture is most strongly affected by groundwater when distance to groundwater is shallow. Soil texture influences the capillary rise of groundwater from a shallow aquifer, and variability in soil texture among sites may confound the relationship between piezometer groundwater levels and soil moisture. Soil samples collected during various field activities over the last three years are currently being analyzed for soil texture. Future analyses will examine soil texture and incorporate these data into a more complex analysis of the influence of groundwater levels on soil moisture.

Presence of Standing Water

Standing water appears to be consistent at Mittry West in the spring but does not appear to be a factor at any other site. Based on anecdotal observations, Topock was considered likely to experience inundation, and we expected such inundation could show up during the piezometer monitoring. However, that has not yet occurred, despite surface water being observed less than 10 m from the piezometer during May 2008.

Evapotranspiration Signature

The usefulness of the evapotranspiration signature is in assessing the relative change in evapotranspiration, and thus vegetation density, at a given site over time. With only two years of data, it is not yet useful to look for trends at individual sites. However, the comparison of 2006 to 2007 data suggests that variations in temperature between the years may need to be incorporated into the future analysis, as these could also account for differences in evapotranspiration signature. Almost all of the sites exhibited less evapotranspiration during the latter half of 2007; such a regional change is more suggestive of climate variation than vegetation growth or decline at individual sites.

LITERATURE CITED

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. The University of Arizona Press, Tucson, Arizona. 302 pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241–257.

Busch, J.D., M.P. Miller, E.H. Paxton, M.K. Sogge, and P. Keim. 2000. Genetic variation in the endangered Southwestern Willow Flycatcher. Auk 117:586–595.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher breeding site and territory summary – 2005. USGS Southwest Biological Science Center report to the U.S. Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern willow flycatcher final survey and monitoring report. Arizona Game and Fish Department, Research Technical Guidance Bulletin #10, Phoenix, Arizona.

English, H.C., A.E. Graber, S.D. Stump, H.E. Telle, and L.A. Ellis. 2006. Southwestern willow flycatcher 2005 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 248. Arizona Game and Fish Department, Phoenix, Arizona.

Finch, D.M., and J.F. Kelly. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197–203 *in* Finch, D.M., J.C. Whitney, J.F. Kelly and S.R. Loftin (eds.). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings, RMRS-P-7.

Flett, M.A., and S.D. Sanders. 1987. Ecology of a Sierra Nevada population of Willow Flycatchers. Western Birds 18:37–42.

Freeze, R.A., and J.A. Cherry. 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 604 pp.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

Graber, A.E., and T.J. Koronkiewicz. 2008. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte, 2008. Final summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona by SWCA Environmental Consultants, Flagstaff, Arizona.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern willow flycatcher 2006 survey and nest monitoring report. Nongame and Endangered Wildlife Program. Technical report 249. Arizona Game and Fish Department, Phoenix, Arizona.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and willow flycatchers: a summary of their science and policy connections. Geomorphology 47:169–188.

Hanski, I.A., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pages 5–26 *in* Hanski, I.A. and Gilpin, M.E. (eds.). Metapopulation biology: Ecology, genetics, and evolution. Academic Press, San Diego, California.

Harris, J.H. 1991. Effects of Brown-headed Cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13–26.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds 18:27–36.

Howell, N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Howlett, J.S., and B.J. Stutchbury. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover.

James, F.C., and H.H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

Johnson, K., P. Mahlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered Southwestern Willow Flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44:226–231.

Johnson, M.J., and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Kenwood, K.E., and E.H. Paxton. 2001. Survivorship and movements of Southwestern Willow Flycatchers in Arizona – 2001. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 44 pp.

Koronkiewicz, T.J., S.N. Cardinal, M.K. Sogge, and E.H. Paxton. 2002. Survivorship and movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2002. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. USGS Southwest Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. 43 pp.

Koronkiewicz, T.J., M.A. McLeod, B.T. Brown, and S.W. Carothers. 2006a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff,Arizona. 176 pp.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper III, and E.H. Paxton. 2006b. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. Condor 108:558–570.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, California.

Lowther, P.E. 1993. Brown-headed Cowbird (Molothrus ater). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 47. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* Sogge, M.K., B.E. Kus, S.J. Sferra and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M., and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, ecology, and conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bulletin 73(3):255–261.

Mayfield, H. 1975. Suggestions for calculating nest success. Wilson Bulletin 87(4):456–466.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 1 – 1996. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, [and] the U.S. Fish and Wildlife Service, Carlsbad, California by the San Bernardino County Museum, Redlands, California. 42 pp.

McKernan, R.L., and G. Braden. 1998. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 2 – 1997. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada [and] the U.S. Fish and Wildlife Service, Carlsbad, California, by the San Bernardino County Museum, Redlands, California. 64 pp.

McKernan, R.L., and G. Braden. 1999. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 3 – 1998. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 pp.

McKernan, R.L., and G. Braden. 2001a. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the Lower Colorado River: Year 4 – 1999. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 83 pp.

McKernan, R.L., and G. Braden. 2001b. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 5 – 2000. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 86 pp.

McKernan, R.L., and G. Braden. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 6 – 2001. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada by San Bernardino County Museum, Redlands, California. 58 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, Arizona. 194 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, Arizona. 206 pp.

McLeod, M.A., T.J. Koronkiewicz, S.R. Nichols, B.T. Brown, and S.W. Carothers. 2008b. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2007. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, Arizona. 182 pp.

Munzer, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. Arizona Game and Fish Department, Phoenix, Arizona.

National Weather Service. 2008. Online: http://aa.usno.navy.mil/data/docs/RS_OneYear.html.

Paradzick, C.E., T.D. McCarthey, R.F. Davidson, J.W. Rourke, M.W. Sumner, and A.B. Smith. 2001. Southwestern Willow Flycatcher 2000 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 175. Arizona Game and Fish Department, Phoenix, Arizona.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 Summary Report. USGS Colorado Plateau Research Station / Northern Arizona University report. 63 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in Central Arizona – a 10-year synthesis report. USGS Open-File Report 2007-1381.

Periman, R.D., and J.F. Kelly. 2000. The dynamic environmental history of Southwest Willow Flycatcher habitat: A survey of changing riparian conditions through time. Pages 25–42 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, Arizona. 212 pp.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. General Technical Report PSW-GTR-144. U.S. Forest Service Pacific Southwest Research Station, Albany, California. 41 pp.

Ridgely, R.S., and G. Tudor. 1994. The birds of South America; Volume II: the Suboscine passerines. University of Texas Press, Austin, Texas.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in Illinois. Pages 408–418. *In* J.M. Hagan III and D.W. Johnston (eds.). Ecology and Conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Rosenberg, K. V., R. C. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson, Arizona.

Rotenberry, J.T. 1985. The role of habitat in avian community composition: Physiognomy or floristics? Oecologia 67:213–217.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix, Arizona.

SAS Institute Inc. 2003. SAS OnlineDoc®, Version 9.1. Cary, North Carolina.

Sedgwick, J.A. 2000. Willow flycatcher (*Empidonax traillii*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 533. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Sedgwick, J.A., and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to willow flycatchers. Pages 167–181 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.).Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Smith, A.B., C.E. Paradzick, A.A. Woodward, P.E.T. Dockens, and T.D. McCarthey. 2002. Southwestern Willow Flycatcher 2001 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 191. Arizona Game and Fish Department, Phoenix, Arizona.

Smith, A.B., A.A. Woodward, P.E.T. Dockens, J.S. Martin, and T.D. McCarthey. 2003. Southwestern Willow Flycatcher 2002 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 210. Arizona Game and Fish Department, Phoenix, Arizona.

Smith, A.B., P.E.T. Dockens, A.A. Tudor, H.C. English, and B.L. Allen. 2004. Southwestern Willow Flycatcher 2003 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 210. Arizona Game and Fish Department, Phoenix, Arizona.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbits. 1997. A Southwestern Willow Flycatcher natural history summary and survey protocol. National Park Service Technical Report USGS/NAUCPRS/NRTR-97/12.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. Western Birds 32:167–172.

StataCorp LP. 2006. Stata for Windows®, Version 9.2. College Station, Texas.

Stiles, F.G., and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, New York.

Sumner, M.E. (ed.). 2000. Handbook of soil science. CRC Press, Boca Raton, Florida.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. San Diego Natural History Museum report to U.S. Bureau of Reclamation, Phoenix, Arizona.

U.S. Bureau of Reclamation (Reclamation). 1999. Long-term restoration program for the historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat along the lower Colorado River. Report submitted by USBR Lower Colorado Region to Lower Colorado Multi-Species Conservation Program. USBR: Boulder City, Nevada. 70 pp.

U.S. Bureau of Reclamation (Reclamation). 2000. Biological Assessment for proposed Interim Surplus Criteria, Secretarial Implementation Agreements for California Water Plan components and conservation measures on the Lower Colorado River (Lake Mead to the Southerly International Boundary). Prepared by U.S. Bureau of Reclamation, Lower Colorado Region. 80 pp.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. Federal Register 60:10694–10715.

U.S. Fish and Wildlife Service (USFWS). 2000. Southwestern willow flycatcher protocol revision 2000. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2001. Biological opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures on the Lower Colorado River, Lake Mead to the Southerly International Boundary, Arizona, California, and Nevada. Final Biological Opinion, U.S. Fish and Wildlife Service, Phoenix, Arizona. 90 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax trailli extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup, August 2002.

White, W.N. 1932. A method of estimating ground-water supplies based on discharge by plants and evapotranspiration from soil: results of investigations in Escalante Valley, Utah. USGS Water-Supply Paper 659-A.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to Brown-headed Cowbird parasitism. M.S. Thesis, California State University, Chico, California. 25 pp.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Pages 182–190 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.). Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Whitfield, M.J., M.K. Sogge, S.J. Sferra, and B.E. Kus. 2003. Ecology and behavior —Introduction. Pages 53–55 *in* Sogge, M.K., B.E. Kus, S.J. Sferra, and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Wiens, J.A. 1989a. The ecology of bird communities. Volume 1: Foundations and patterns. Cambridge University Press, New York.

Wiens, J.A. 1989b. The ecology of bird communities. Volume 2: Processes and variations. Cambridge University Press, New York.

Woodward, H.D., and S.H. Stoleson. 2002. Brown-headed Cowbird attacks on Southwestern Willow Flycatcher nestlings. The Southwestern Naturalist 47(4):626–628.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

Appendix A

FIELD DATA FORMS

Willow Flycatcher Survey and Detection Form (revised April, 2004)

Site Name_____ State_____ County _____
USGS Quad Name _____ Elevation _____ feet / meters (circle one)

Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? ☐ *Yes* ☐ *No*

Site Coordinates: Start: N_____ E_____ UTM Datum_____ (NAD27 preferred)
Stop: N_____ E_____ UTM Zone _____

***** Fill in additional site information on back of this page *****

Survey # / Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N	Cowbirds Detected? Y or N	Presence of Livestock, Recent sign, If Yes, Describe Y or N	Comments about this survey (e.g., bird behavior, evidence of pairs or breeding, number of nests, nest contents or number of fledges seen; potential threats)
1_____	Date Start Stop Total hrs ____							
2_____	Date Start Stop Total hrs ____							
3_____	Date Start Stop Total hrs ____							
4_____	Date Start Stop Total hrs ____							
5_____	Date Start Stop Total hrs ____							
Overall Site Summary (Total **resident** WIFLs only) Total survey hrs_____		Adults	Pairs	Territories	Nests	Were any WIFLs color-banded? Yes No If yes, report color combination(s) in the comments section on back of form		

Reporting Individual _____ Date Report Completed _____
US Fish and Wildlife Service Permit #_____ AZ Game and Fish Department (or other state) Permit # _____

Submit original form by August 1st. Retain a copy for your records.

Fill in the following information completely. Submit original form by August 1st. Retain a copy for your records.

Reporting Individual _____ Phone # _____
Affiliation _____ E-mail _____
Site Name _____ Date Report Completed _____

Did you verify that this site name is consistent with that used in previous years? Yes / No (circle one)
If name is different, what name(s) was used in the past? _____
If site was surveyed last year, did you survey the same general area this year? Yes / No If no, summarize in comments below.
Did you survey the same general area during each visit to this site this year? Yes / No If no, summarize in comments below.

Management Authority for Survey Area (circle one): Federal Municipal/County State Tribal Private
Name of Management Entity or Owner (e.g., Tonto National Forest) _____

Length of area surveyed: _____ (specify units, e.g., miles = mi, kilometers = km, meters = m)

Vegetation Characteristics: Overall, are the species in tree/shrub layer at this site comprised predominantly of (check one):

☐ Native broadleaf plants (entirely or almost entirely, includes high-elevation willow)

☐ Mixed native and exotic plants (mostly native)

☐ Mixed native and exotic plants (mostly exotic)

☐ Exotic/introduced plants (entirely or almost entirely)

Identify the 2-3 predominant tree/shrub species: _____

Average height of canopy (Do not put a range): _____ (specify units)

Was surface water or saturated soil present at or adjacent to site? Yes / No (circle one)
Distance from the site to surface water or saturated soil: _____ (specify units)

Did hydrological conditions change significantly among visits (did the site flood or dry out)? Yes / No (circle one)
If yes, describe in comments section below.

Remember to attach a copy of a USGS quad/topographical map (REQUIRED) of the survey area, outlining the survey site and location of WIFL detections. Also include a sketch or aerial photograph showing details of site location, patch shape, survey route in relation to patch, and location of any willow flycatchers or willow flycatcher nests detected. Such sketches or photographs are welcomed, but DO NOT substitute for the required USGS quad map. Please include photos of the interior of the patch, exterior of the patch, and overall site and describe any unique habitat features.

Comments (attach additional sheets if necessary)

_____
_____
_____
_____
_____
_____
_____

WIFL Detection Locations:

Date Detected	N UTM	E UTM	Date Detected	N UTM	E UTM

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (10–25 July)]

General Info

Study Area: _____ **Survey Site:** _____ **Date:** _____

Observer(s): _____ **early**_____ **mid**_____ **late**_____ **other**_____

Vegetation

Vegetation at site: >90% native 50–90% native 50–90% exotic >90% exotic

Canopy closure: <25% 25–50% 50–70% 70–90% >90%

Overstory height (m): _____ **Dominant overstory species:** TASP SAGO SAEX POFR Other _____

Understory height (m): _____ **Dominant understory species**: TASP SAGO SAEX PLSE Other _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

Hydrology

% of site inundated: _____

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc):
_____

Average depth of surface water:
toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils (do not include inundated areas in percentage!): _____

% of site with damp soils (do not include inundated or saturated areas): _____

If not inundated or saturated, distance (m) to standing water or saturated soil:_____

How was distance determined? Visually estimated in field Measured in field using GPS
Measured from aerial photograph Other _____

Describe type of nearest surface water: _____

Narrative and Pictorial Description

Does this description cover the entire site? Y N **If not, which portion is described?**_____
_____

On the reverse, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats:
_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____

STUDY AREA: _____ **SITE:** _____ **BANDER:** _____ **DATE:** _____ **TIME:** _____ **TERR/NEST #:** _____

UTM: NAD_____ **Zone**_____ _____**E** _____**N** **NBN:** ____ of ____ nestlings banded.

NOTES:_____

FEDERAL BAND #	COLOR COMBO L	COLOR COMBO R	STATUS	SEX	CP	BP	AGE	FECAL SAMPLE? (Y or N)	GENETIC SAMPLE? (Y or N)	WING CHORD (mm)	TAIL (mm)	CULMEN LENGTH (mm)	CULMEN WIDTH (mm)	FAT

Retained Feathers Present: Yes or No (circle) – if Yes use diagram below **Colorimeter sample:** Yes or No (circle)

Active Molt: Yes or No (circle) – if Yes use diagram below

****** If a genetic sample or metric was not taken, explain why in notes ******

STATUS: NCP = new cap passive, NCT = new cap target, RCP = recap passive, RCT = recap target, NBN = nestling banded

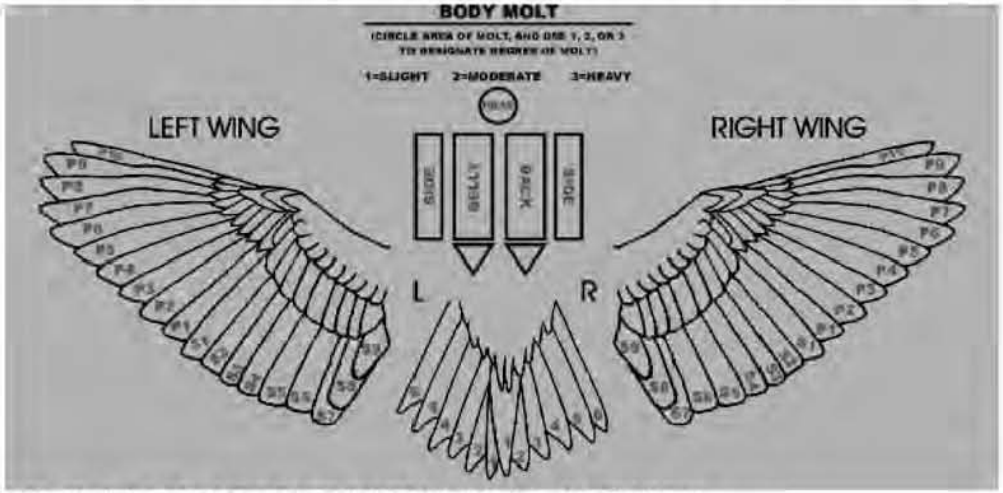
SEX: U = unknown, F = female, M = male

CP: 0 = non-breeding, S = partial breeding, M = full breeding

BP: 0 = none, 1 = smooth, 2 = vascularized and filled with fluid, 3 = wrinkled, 4 = molting

AGE: AHY = after hatch year; SY = second year; L = nestling banded in nest; HY = hatch year/young of the year

FAT: 0 = no fat; 1 = trace of fat in furculum, deeply concave, scattered patches, less than 5 percent filled; 2 = thin layer of fat in furculum, less than a third filled, trace of thin layer of fat in abdomen; 3 = furculum is ½ filled or more; small patches, not covering some areas, on abdomen; 4 = furculum more than 2/3 filled, level with clavicles, slightly mounded on abdomen



DETAIL ALL MOLTS AND RETAINED FEATHERS ONTO DIAGRAM AND DETAIL IN NOTES

Colorimetry Data Sheet

SITE: _____ DATE: _____

BANDER: _____ FED BAND NUMBER: _____

CROWN MEASUREMENTS

PAGE: _____

	L*	a*	b*
1			
2			
3			
4			
5			
6			
7			
8			
MAX			
MIN			
AVG			
SD			

BACK MEASUREMENTS

PAGE: _____

	L*	a*	b*
1			
2			
3			
4			
5			
6			
7			
8			
MAX			
MIN			
AVG			
SD			

NOTES:

_____
_____
_____
_____
_____
_____
_____

Date: Page of

OBS	STUDY AREA	TERR	NEST	COLOR COMBO LEFT LEG (Top/ Bottom)	RIGHT LEG (Top/ Bottom)	CONF LEVL	ASSOC WITH A NEST?	CAPTURE?	# WIFLS PRESENT	SEX	NBN (__of__)	OBSERVATIONS AND COMMENTS: discuss observations & activities.
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =
												Service Band Number =

Entered by: _____ Date entered: _____

Willow Flycatcher Territory/Nest Record Form

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Territory/Nest Location:
NAD:_____ Zone:_____

Territory UTMs:

Easting:_____

Northing:_____

GPS Accuracy: _____m

Nest UTMs:

Easting:_____

Northing:_____

GPS Accuracy: _____m

Nest Height:_____m (approximate)

Nest Substrate:_____(e.g., TASP=tamarisk, SAGO=Goodding willow, POFR=cottonwood, SAEX = coyote willow, etc.)

Distance to standing water or saturated soil when nest found: _____(m)

How was distance determined?_____

Date distance to water determined: _____

Depth of surface water at nest (please circle how wet you got when nest was found):

dry damp muddy toes (<5cm) ankles (5-15 cm)
calves (15-40 cm) knees (40-60 cm) thighs (60-80 cm)
waist (100 cm) too deep to wade (>100 cm)

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	B D (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No.	Presumed	Confirmed	
			Eggs
			Nestlings
			Fledglings

Cowbird

Trans dates	B D (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledgling

Outcome (Record code & describe)**:**_____:_____

_____

_____

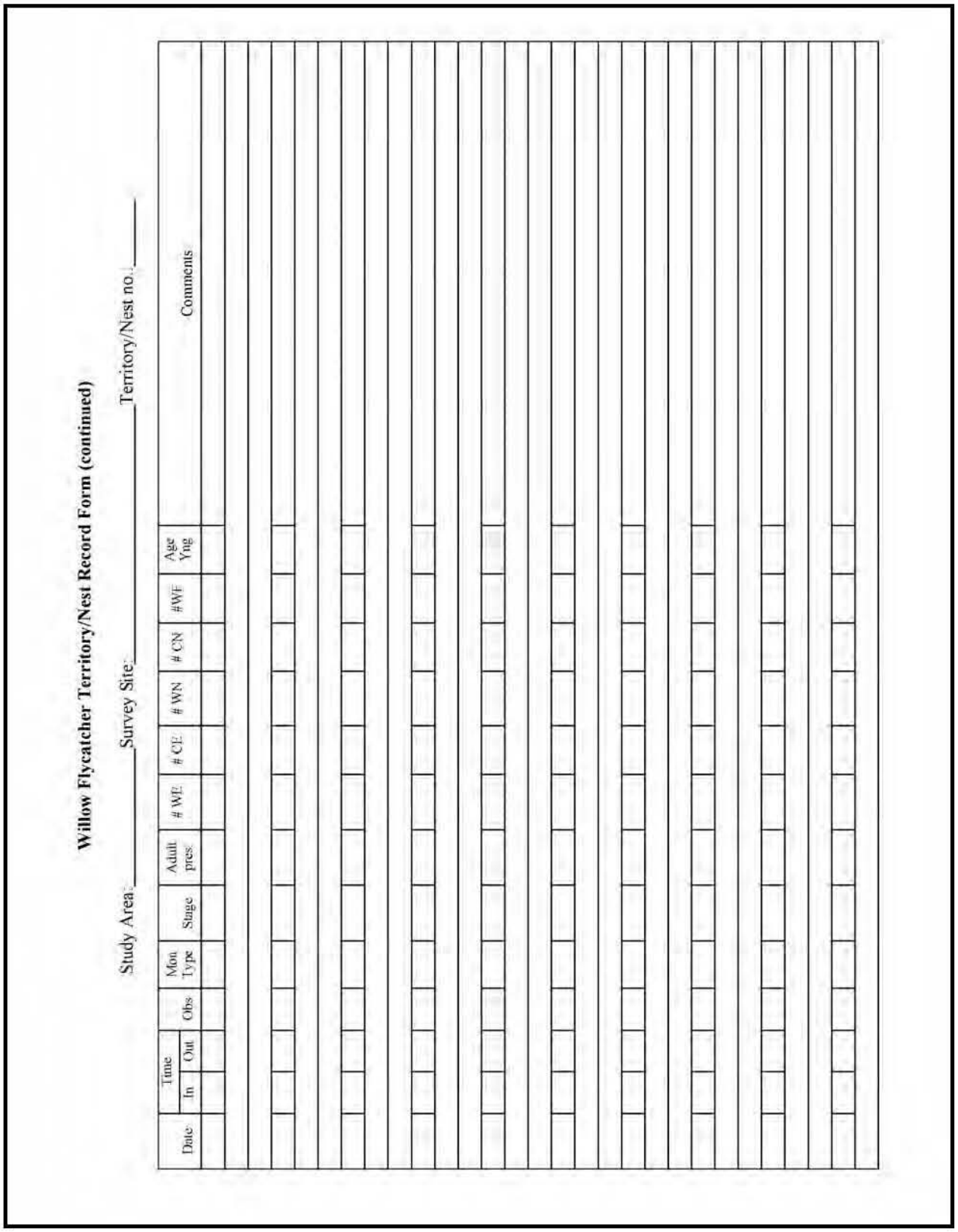
_____

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **PA**= parasitized, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **AD**= failure, entire clutch addled/infertile; **OT**= failure due to other, or unknown, causes.

Mayfield Success

(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S**= successful; **D**= depredated; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other than predation; **A**= abandoned with host egg(s) or young; **Z**= abandoned, no (zero) eggs laid.



Willow Flycatcher Territory/Nest Record Form (continued)

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Date	Time In	Time Out	Obs	Mon Type	Stage	Adult pres.	# WE	# CE	# WN	# CN	#WF	Age Yng	Comments

LCR SWFL – Vegetation Datasheet

Observers: _____

Study area	Survey site	Plot type	ID#	UTM: E N	Acc. m	Date
Canopy height	Direct measurement m	Using clinometer: Top % - Bottom % × Dist m	**Ground cover**	N E S W	**Canopy closure**	N S

Species		TASP single	TASP multi	TASP skipped	SAEX single	SAEX multi	SAEX skipped	SAGO single	SAGO multi	SAGO skipped	SNAG single	SNAG multi	SNAG skipped
Stem Count By cm dbh category	<1												
	1–2.5												
	2.6–5.5												
	5.6–8												
	8.1–10.5												
	10.5–15												
	Measured Trees >15 cm dbh												

Species		OTSP1 single	OTSP1 multi	OTSP1 skipped	OTSP2 single	OTSP2 multi	OTSP2 skipped	OTSP3 single	OTSP3 multi	OTSP3 skipped
Stem Count By cm dbh category	<1									
	1–2.5									
	2.6–5.5									
	5.6–8									
	8.1–10.5									
	10.5–15									
	Measured Trees >15 cm dbh									

Other species (write out full name)

OTSP1_____

OTSP2 _____

OTSP3_____

If stem splits below ankle height, measure and tally each stem in "single" column. If, at ankle height or above, stem splits into multiple branches, measure and tally the biggest stem in "multi" column and record how many stems you did not measure in the "skipped" column (in the size category of the stem you measured).

If stem is not at least breast height, do not count

Vertical Foliage Sampling

CENTER PLOT							
Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1*:	OTSP2*:	OTSP3*:
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10-cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

Notes:

Vertical Foliage Sampling

Study Area:		Survey Site:					Plot type:		ID#		Date:		
NORTH 1m							EAST 1m						
Height (m)	Hits/Species						Height (m)	Hits/Species					
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval
*Use same **OTSP (1,2,3)** as listed on main record.

SIDE 1

Vertical Foliage Sampling

SOUTH 1m								WEST 1m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 5m								EAST 5m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 1

Vertical Foliage Sampling

SOUTH 5m								WEST 5m							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

Page 1 of ____

SWFL Microclimate at Currently Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year) – (Territory #)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____

Est. actual height of logger _____ m Date territory first occupied _____ Date territory vacated _____

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____
Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date:_____ Time:_____ Observer(s)_____

6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____

Soil sample taken? Yes No If no, why not? (put it on the calendar for the next person to collect!)_____

Distance to saturated/inundated soil: _____ m How distance was measured: _____

% of area w/in 20 m with inundated/saturated soil: _____ % of site w/in 50 m with inundated/saturated soil:_____

SM readings: Plot center _____%_____mV

N: 1.0 m _____%_____mV	2.0 m _____%_____mV	**S:** 1.0 m _____%_____mV	2.0 m _____%_____mV
E: 1.0 m _____%_____mV	2.0 m _____%_____mV	**W:** 1.0 m _____%_____mV	2.0 m _____%_____mV

Comments:

Date:_____ Time:_____ Observer(s):_____

6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____

Distance to saturated/inundated soil: _____ m How distance was measured: _____

% of site w/in 20 m with inundated/saturated soil: _____ % of site w/in 50 m with inundated/saturated soil:_____

SM readings: Plot center _____%_____mV

N: 1.0 m _____%_____mV	2.0 m _____% _____mV	**S:** 1.0 m _____%_____mV	2.0 m _____%_____mV
E: 1.0 m _____%_____mV	2.0 m _____%_____mV	**W:** 1.0 m _____%_____mV	2.0 m _____%_____mV

Comments:

Page 1 of ____

SWFL Microclimate at Formerly Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year active) – (Nest #)

UTM coordinates: E 0_ _ _ _ _ _ **N** _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

How certain are you that the logger is hanging from the fork the nest was in? (check one)

_____Nest still visible, certain of location
_____Nest gone, but found nest flag and certain of location
_____Nest gone, no nest flag, but base of nest tree flagged and nest height adequate to determine exact location
_____Nest gone, base of nest tree flagged, certain in right tree but not sure if right fork
_____Nest gone, nest tree not flagged, not certain if in right tree.
_____Other: _____

Est. actual height of logger _____ m

Comments:

Take-down: Date:_____ Time:_____ Observer(s):_____

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?

No Yes If yes, explain:

Comments:

Soil Moisture (SM)

Date:_____ Time:_____ Observer(s)_____

6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____

Distance to saturated/inundated soil: _____ m **How distance was measured**: _____

SM readings: Plot center _____%_____mV

N: 1.0 m _____%_____mV	2.0 m _____%_____mV	**S:** 1.0 m _____%_____mV	2.0 m _____%_____mV
E: 1.0 m _____%_____mV	2.0 m _____%_____mV	**W:** 1.0 m _____%_____mV	2.0 m _____%_____mV

Comments:

Date:_____ Time:_____ Observer(s):_____

6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____

Distance to saturated/inundated soil: _____ m **How distance was measured**: _____

SM readings: Plot center _____%_____mV

N: 1.0 m _____%_____mV	2.0 m _____%_____mV	**S:** 1.0 m _____%_____mV	2.0 m _____%_____mV
E: 1.0 m _____%_____mV	2.0 m _____%_____mV	**W:** 1.0 m _____%_____mV	2.0 m _____%_____mV

Comments:

Page 1 of ____

SWFL Microclimate
Soil Moisture Supplement

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____

UTM coordinates: E 0_ _ _ _ _ _ **N** _ _ _ _ _ _ _

Date:_____ Time:_____ Observer(s):_____
6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____
Distance to saturated/inundated soil: _____ m **How distance was measured**: _____
% of area w/in 20 m with inundated/saturated soil: _____ % of site w/in 50 m with inundated/saturated soil:_____
SM readings: Plot center _____%_____mV
N: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **S:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
E: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **W:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
Comments:

Date:_____ Time:_____ Observer(s):_____
6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____
Distance to saturated/inundated soil: _____ m **How distance was measured**: _____
% of area w/in 20 m with inundated/saturated soil: _____ % of site w/in 50 m with inundated/saturated soil:_____
SM readings: Plot center _____%_____mV
N: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **S:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
E: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **W:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
Comments:

Date:_____ Time:_____ Observer(s):_____
6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____
Distance to saturated/inundated soil: _____ m **How distance was measured**: _____
% of area w/in 20 m with inundated/saturated soil: _____ % of site w/in 50 m with inundated/saturated soil:_____
SM readings: Plot center _____%_____mV
N: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **S:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
E: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **W:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
Comments:

Date:_____ Time:_____ Observer(s):_____
6-digit sensor serial number (on cord of probe): _____ logger number (on back of HH2) : _____
Distance to saturated/inundated soil: _____ m **How distance was measured**: _____
% of area w/in 20 m with inundated/saturated soil: _____ % of site w/in 50 m with inundated/saturated soil:_____
SM readings: Plot center _____%_____mV
N: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **S:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
E: 1.0 m _____%_____mV | 2.0 m _____%_____mV | **W:** 1.0 m _____%_____mV | 2.0 m _____%_____mV
Comments:

Habitat Monitoring Sites – T/RH Downloads

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Survey site) – (Number)

UTM coordinates: E 0_ _ _ _ _ _ **N** _ _ _ _ _ _ _ **Accuracy**: _____ m

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

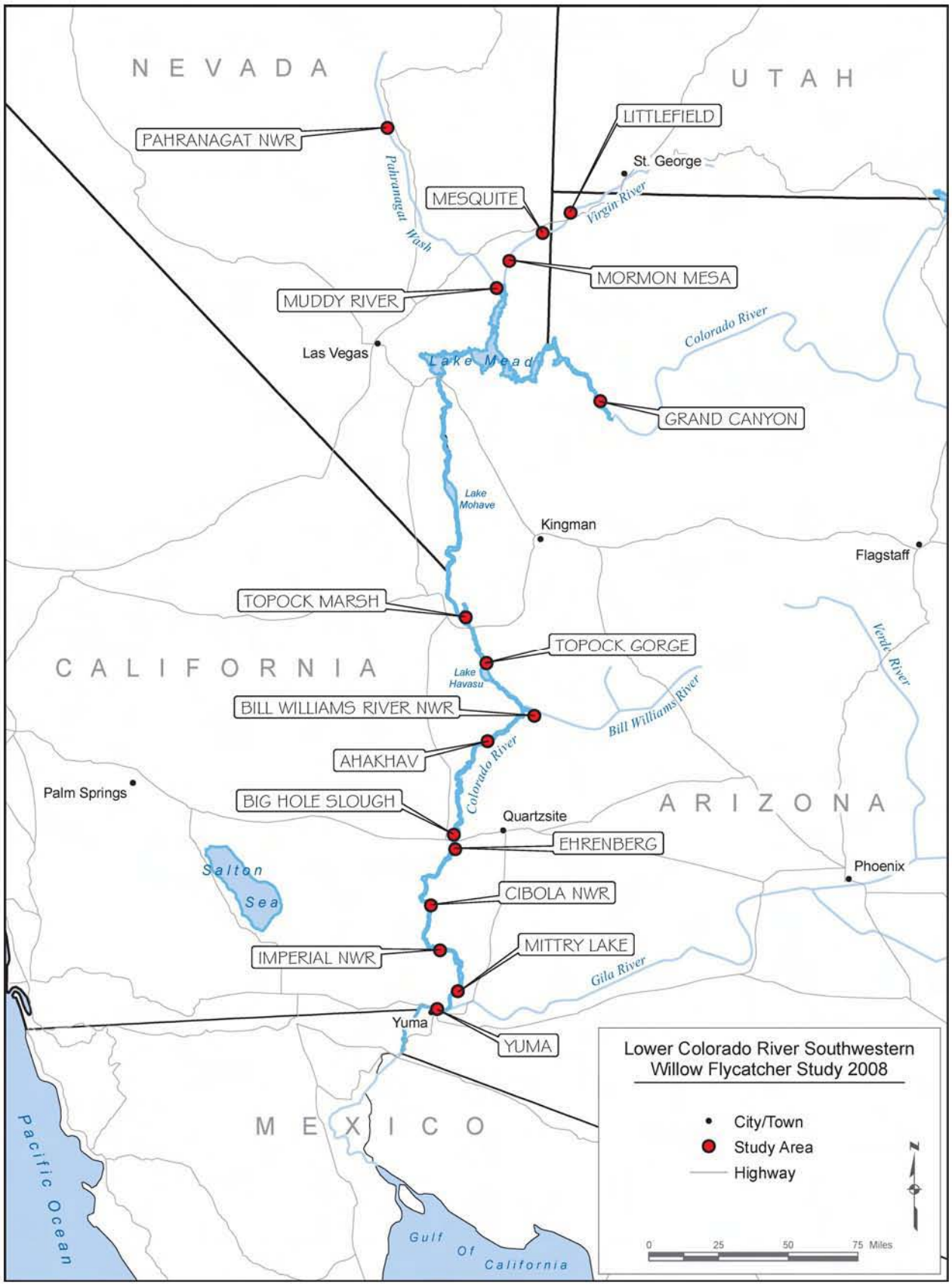
Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

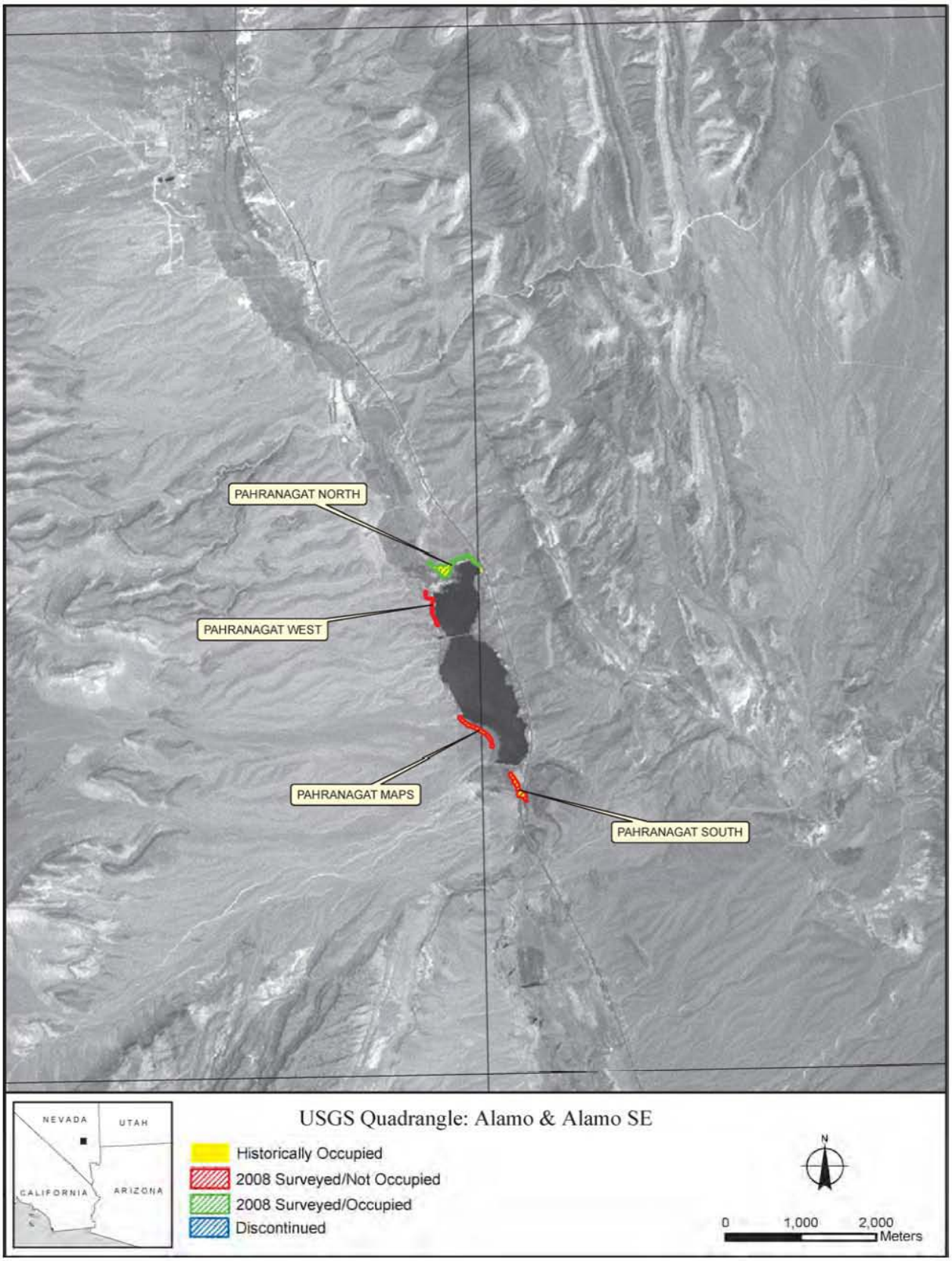
Comments:

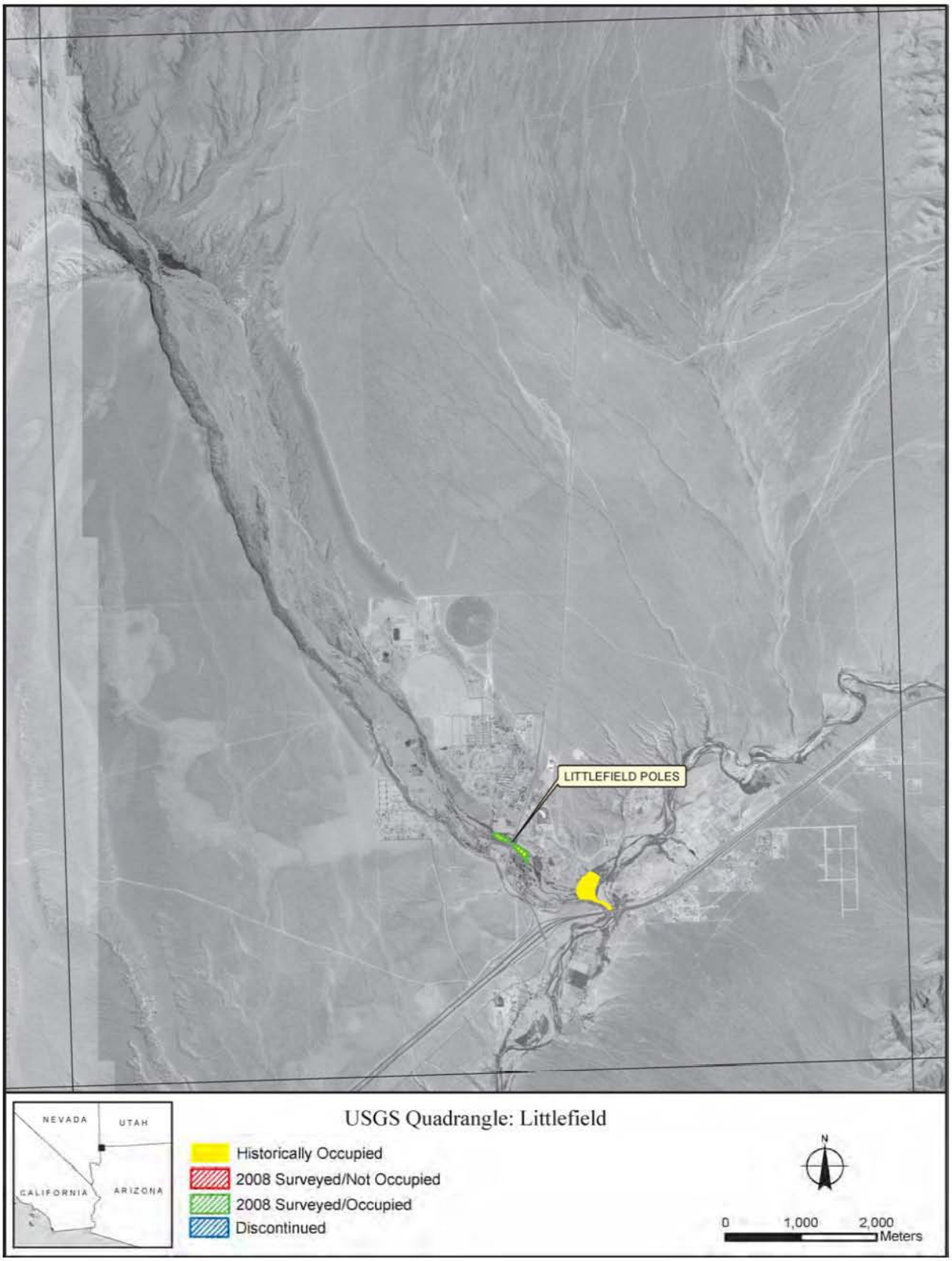
Location ID codes: Study area codes – Topock Marsh = TM, Topock Gorge = TG, Ehrenberg = EH, Cibola = CI, Imperial = IM, Mittry = MI, Yuma = YU. Survey site codes – In Between = IB, Blankenship = BK, Havasu NE = HV, Ehrenberg = EH, Three Fingers Lake = TF, Cibola Lake = CL, Walker Lake = WL, Paradise = PV, Hoge Ranch = HR, Rattlesnake = RS, Clear Lake = LK, Ferguson Lake = FL, Ferguson Wash = FW, Great Blue Heron = GB, Mittry West = MW, Gila Confluence North = GC

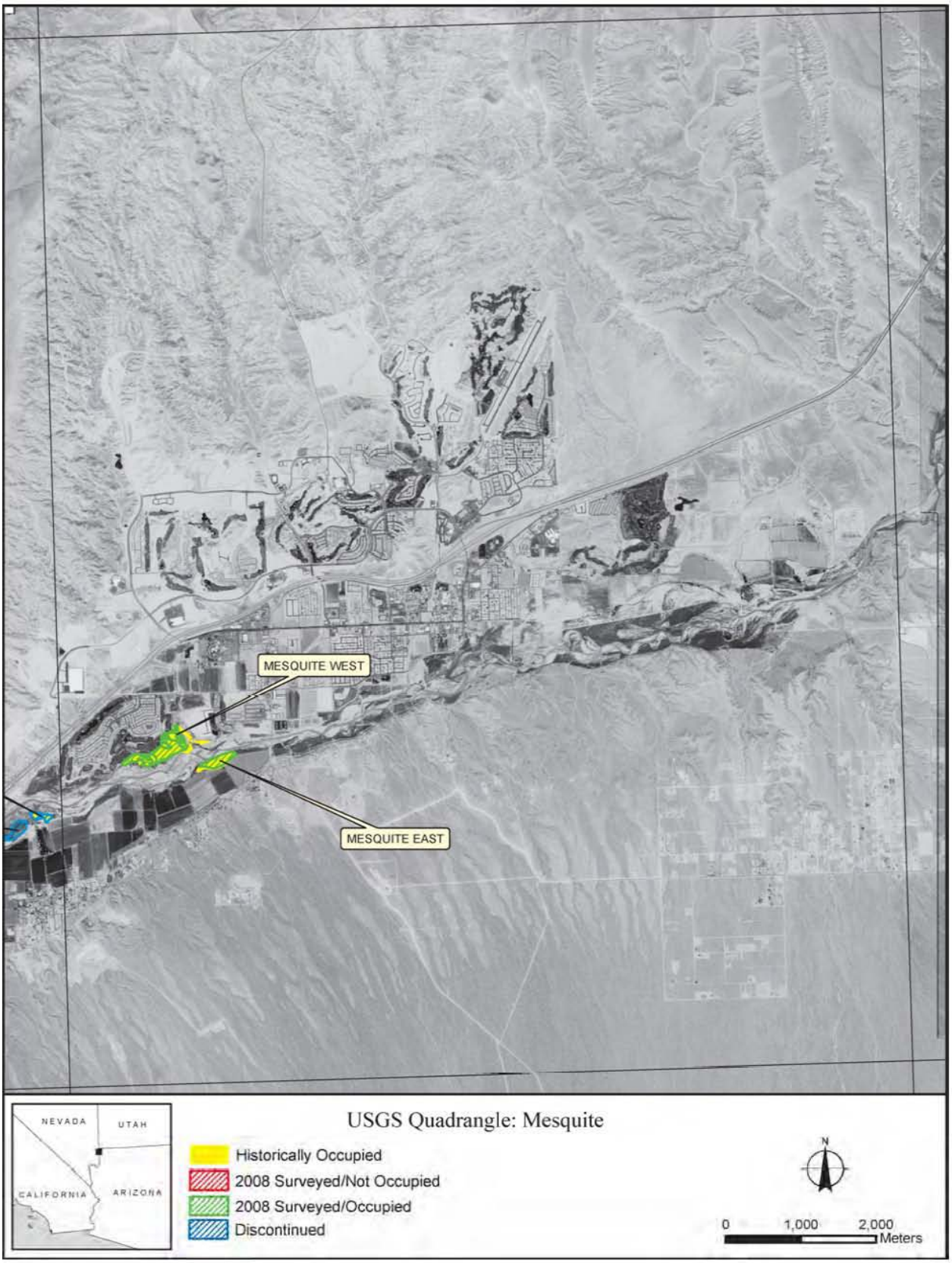
Appendix B

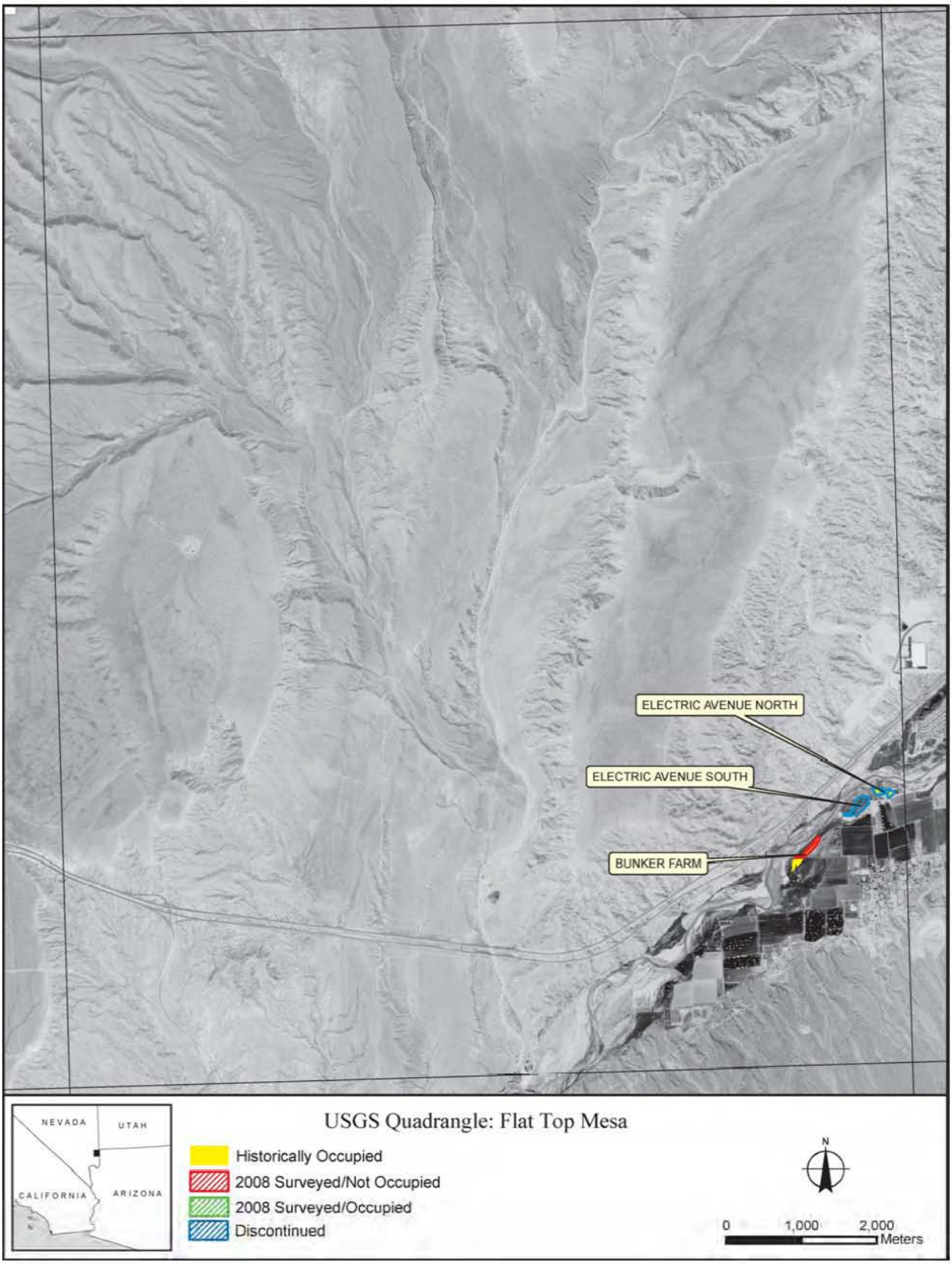
ORTHOPHOTOS SHOWING STUDY SITES

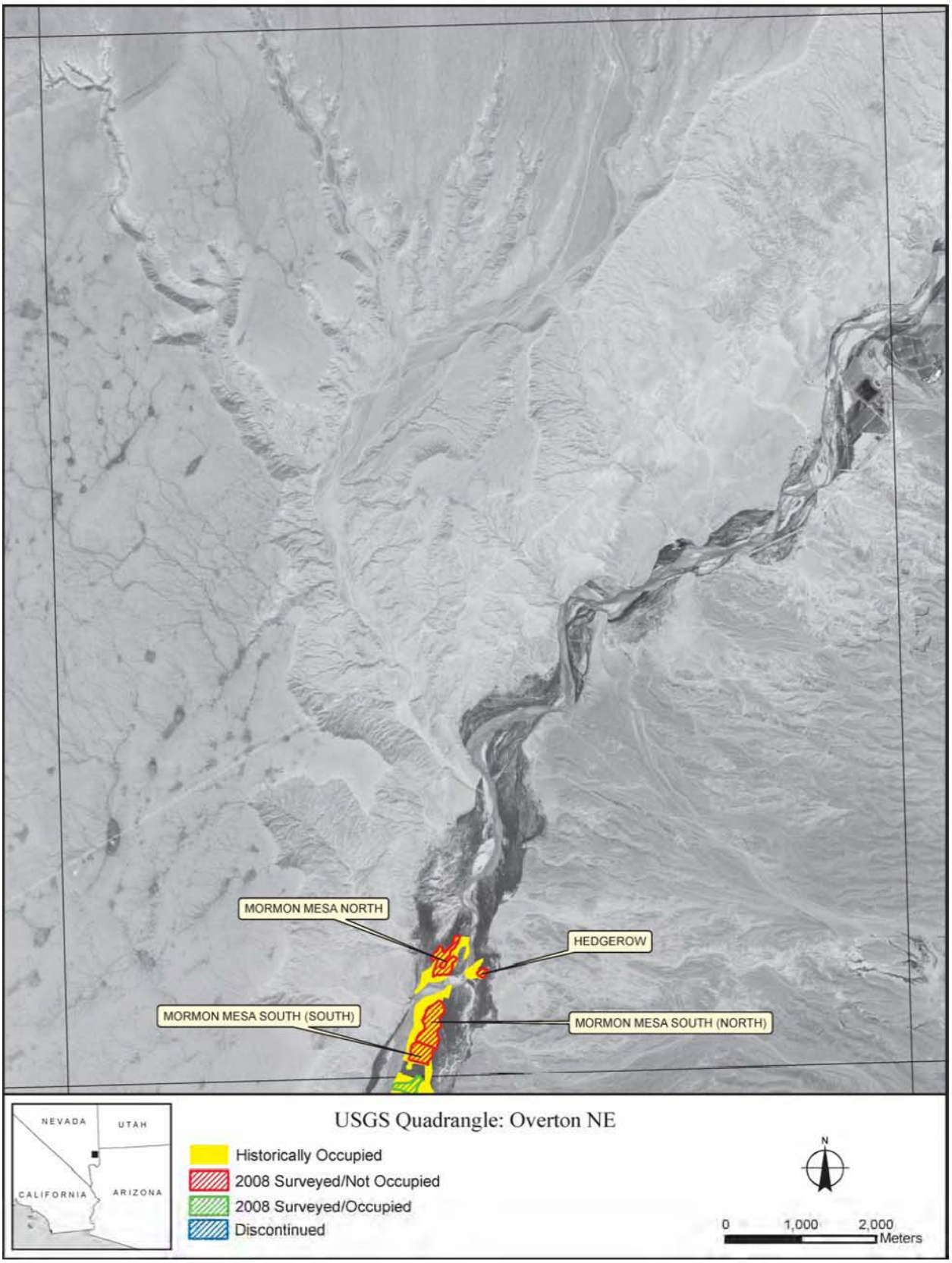

NEVADA
UTAH
CALIFORNIA
ARIZONA
MEXICO
PAHRANAGAT NWR
LITTLEFIELD
St. George
MESQUITE
Virgin River
Pahranagat Wash
MORMON MESA
MUDDY RIVER
Las Vegas
Lake Mead
Colorado River
GRAND CANYON
Lake Mohave
Kingman
Flagstaff
TOPOCK MARSH
TOPOCK GORGE
Lake Havasu
Verde River
BILL WILLIAMS RIVER NWR
Bill Williams River
AHAKHAV
Colorado River
Palm Springs
BIG HOLE SLOUGH
Quartzsite
EHRENBERG
Phoenix
Salton Sea
CIBOLA NWR
IMPERIAL NWR
MITTRY LAKE
Gila River
Yuma
YUMA
Pacific Ocean
Gulf Of California
Lower Colorado River Southwestern Willow Flycatcher Study 2008
City/Town
Study Area
Highway
N
0 25 50 75 Miles

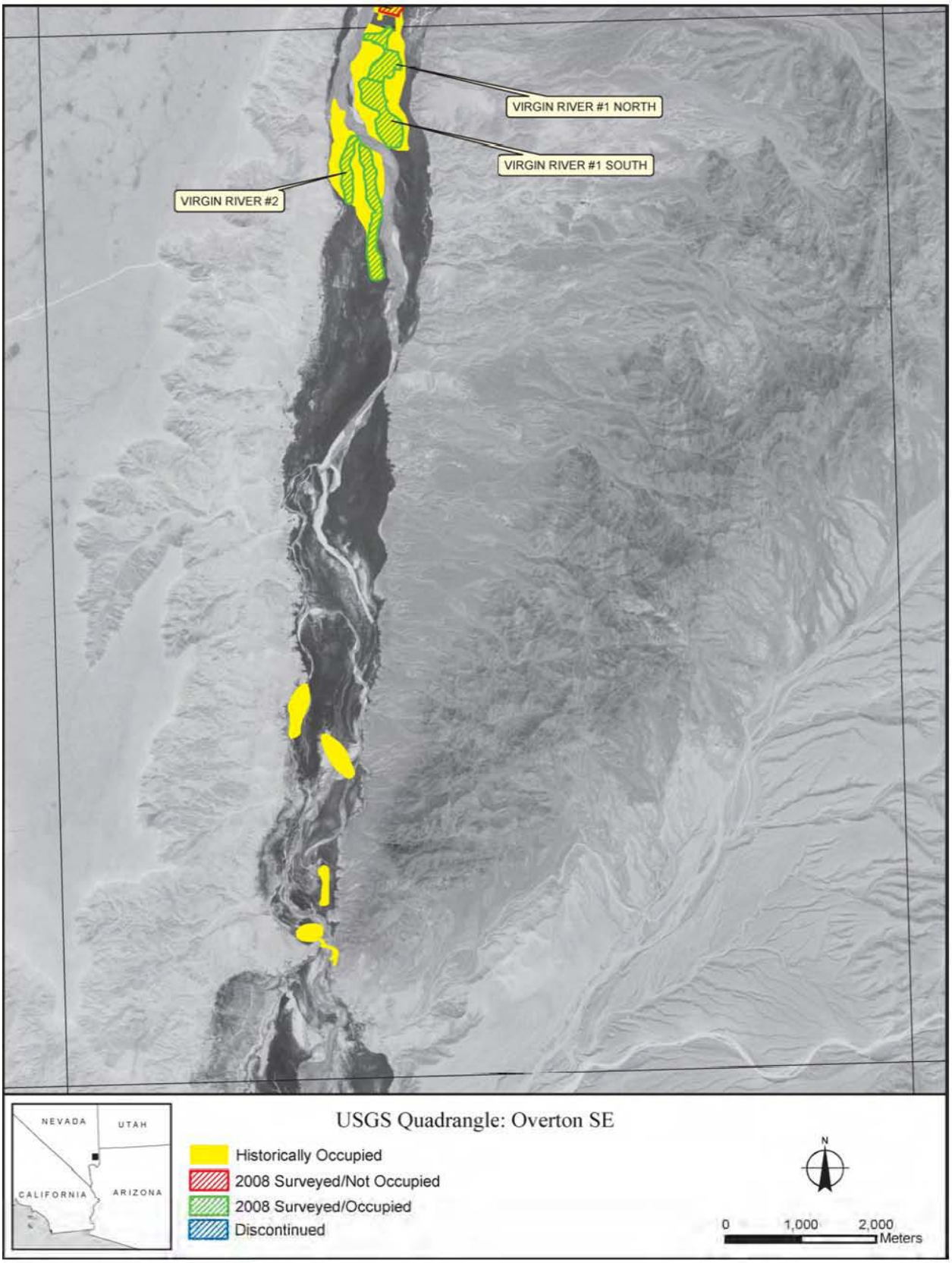

PAHRANAGAT NORTH
PAHRANAGAT WEST
PAHRANAGAT MAPS
PAHRANAGAT SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Alamo & Alamo SE
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

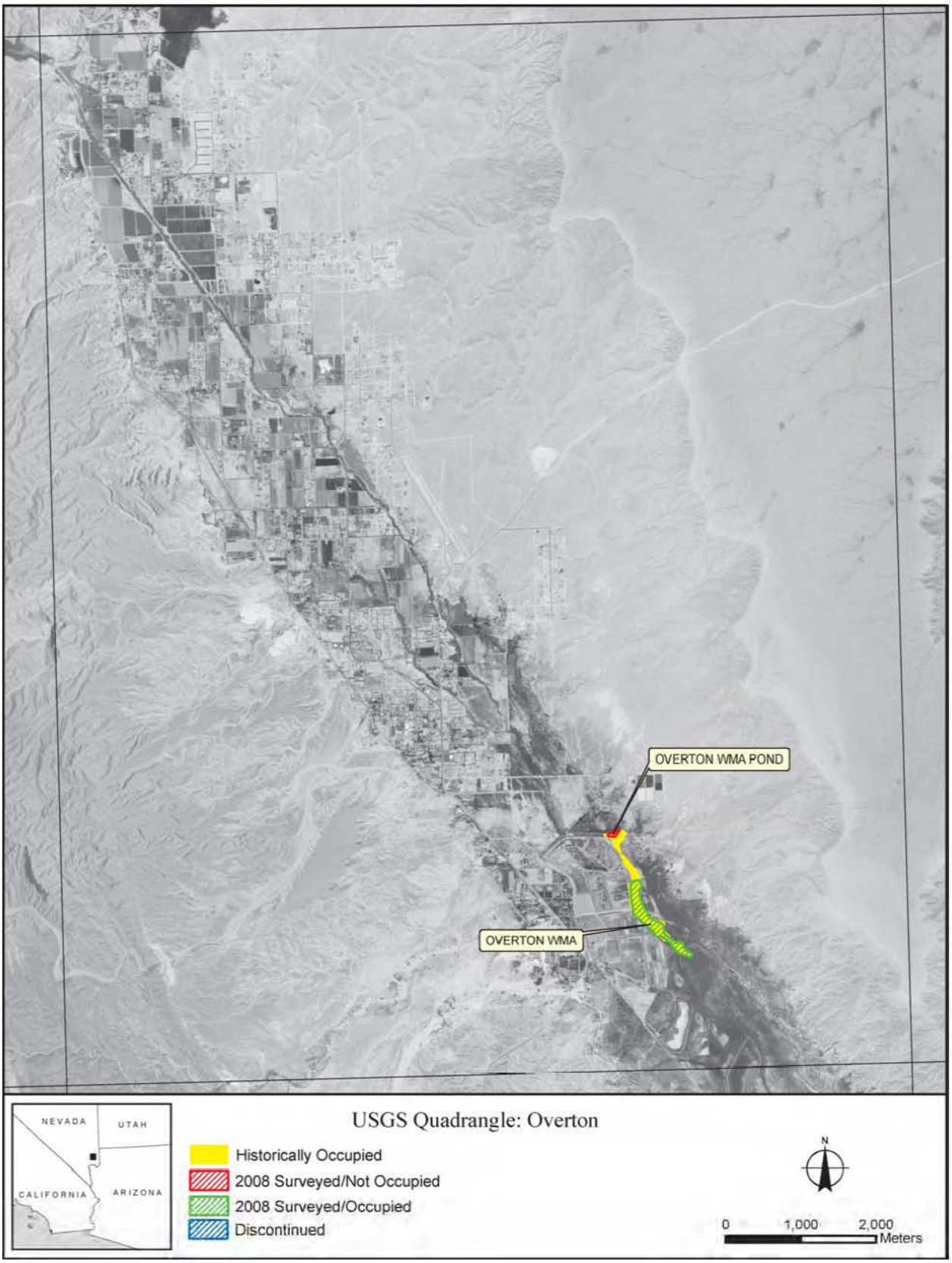

LITTLEFIELD POLES
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Littlefield
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

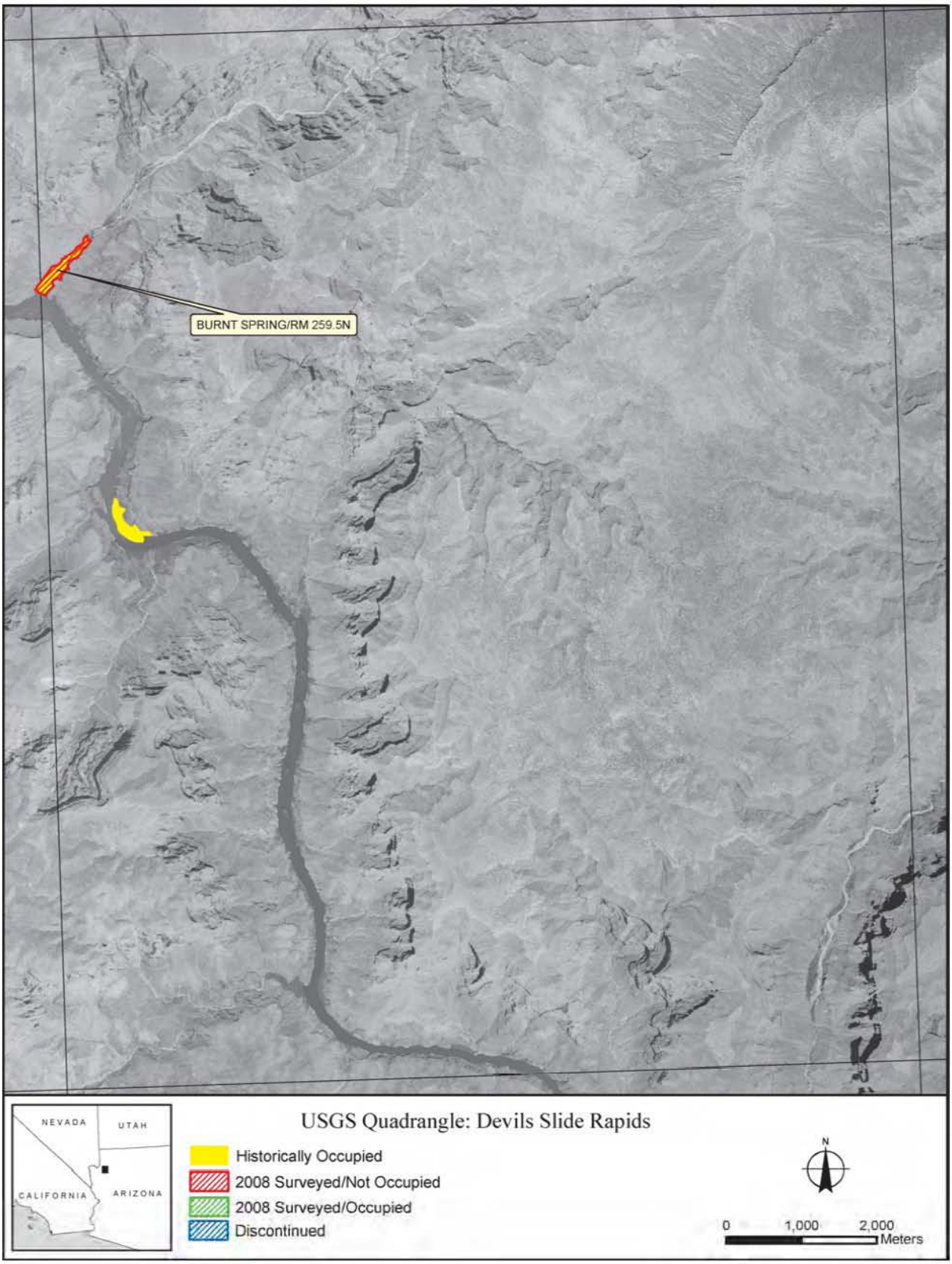

MESQUITE WEST
MESQUITE EAST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Mesquite
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

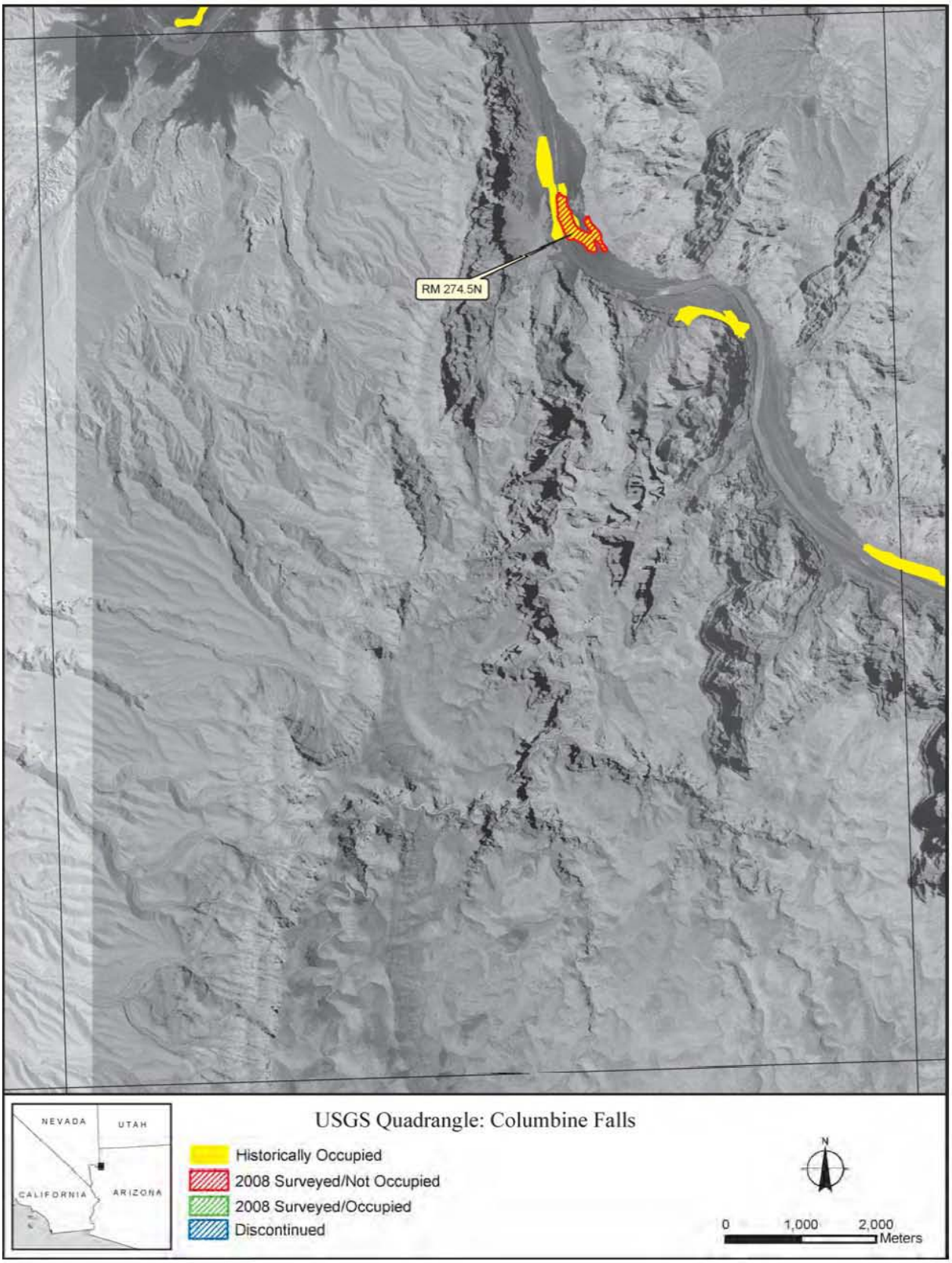

ELECTRIC AVENUE NORTH
ELECTRIC AVENUE SOUTH
BUNKER FARM
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Flat Top Mesa
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

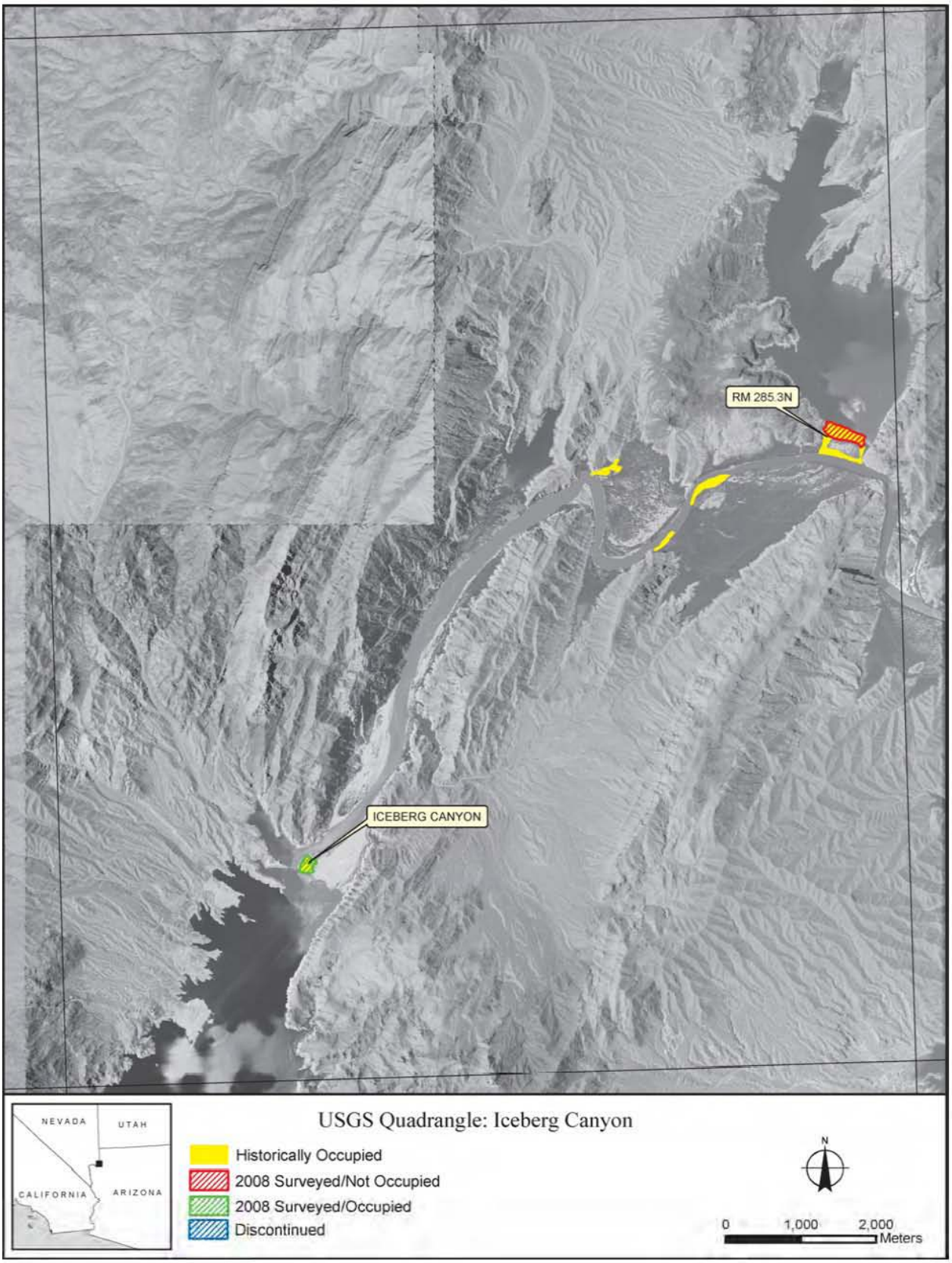

MORMON MESA NORTH
HEDGEROW
MORMON MESA SOUTH (SOUTH)
MORMON MESA SOUTH (NORTH)
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton NE
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

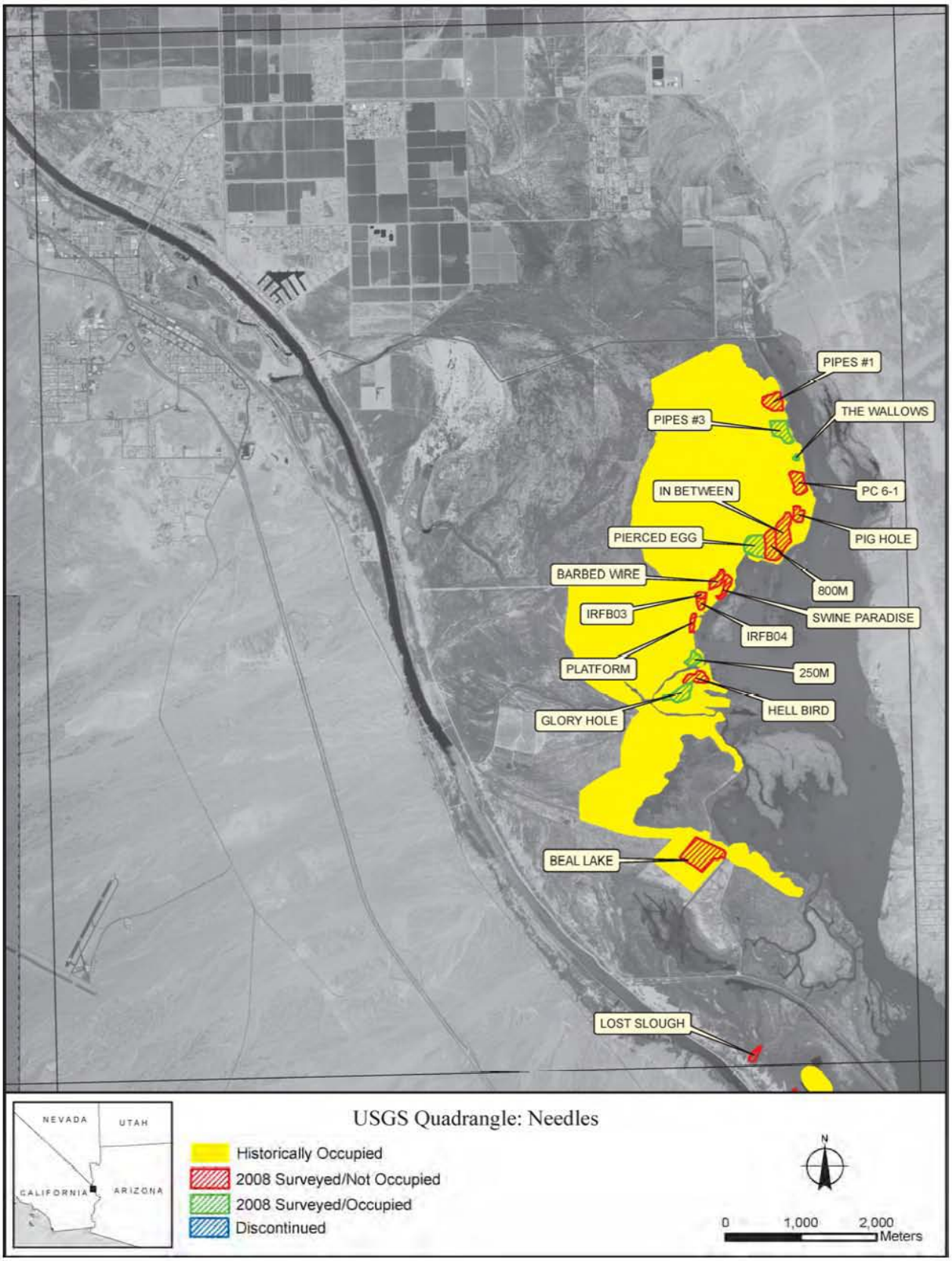

VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton SE
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

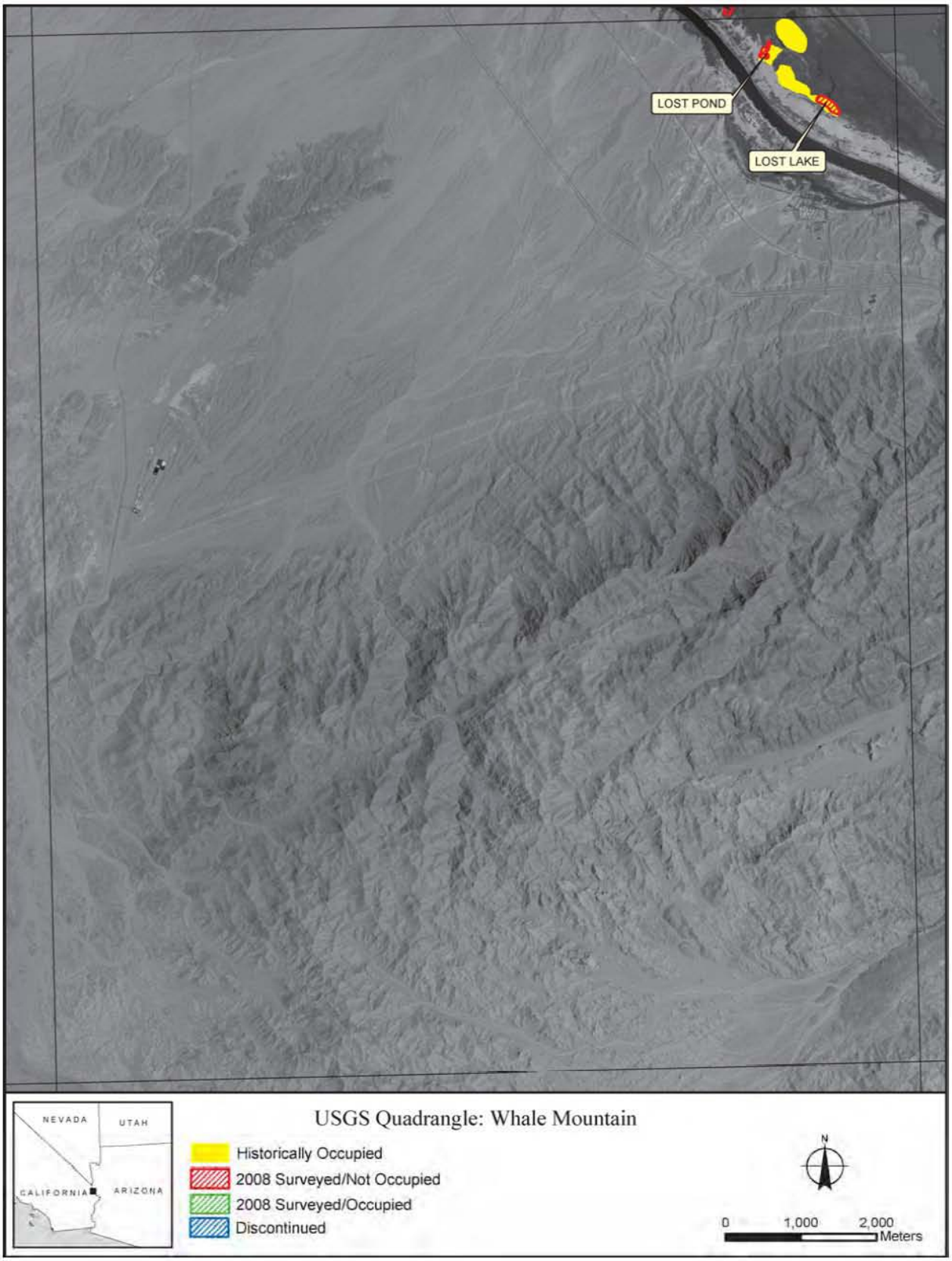

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

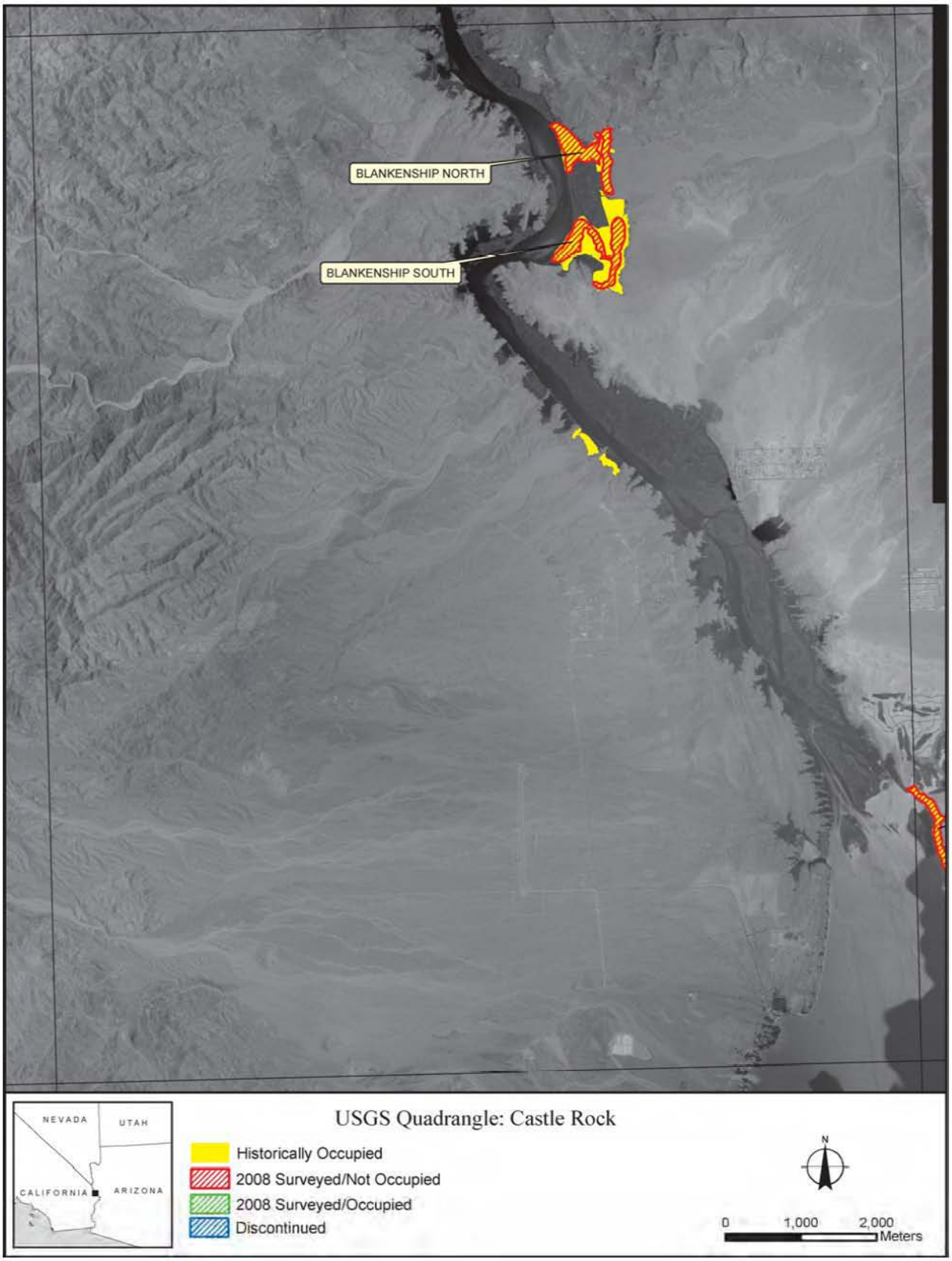

BURNT SPRING/RM 259.5N
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Devils Slide Rapids
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

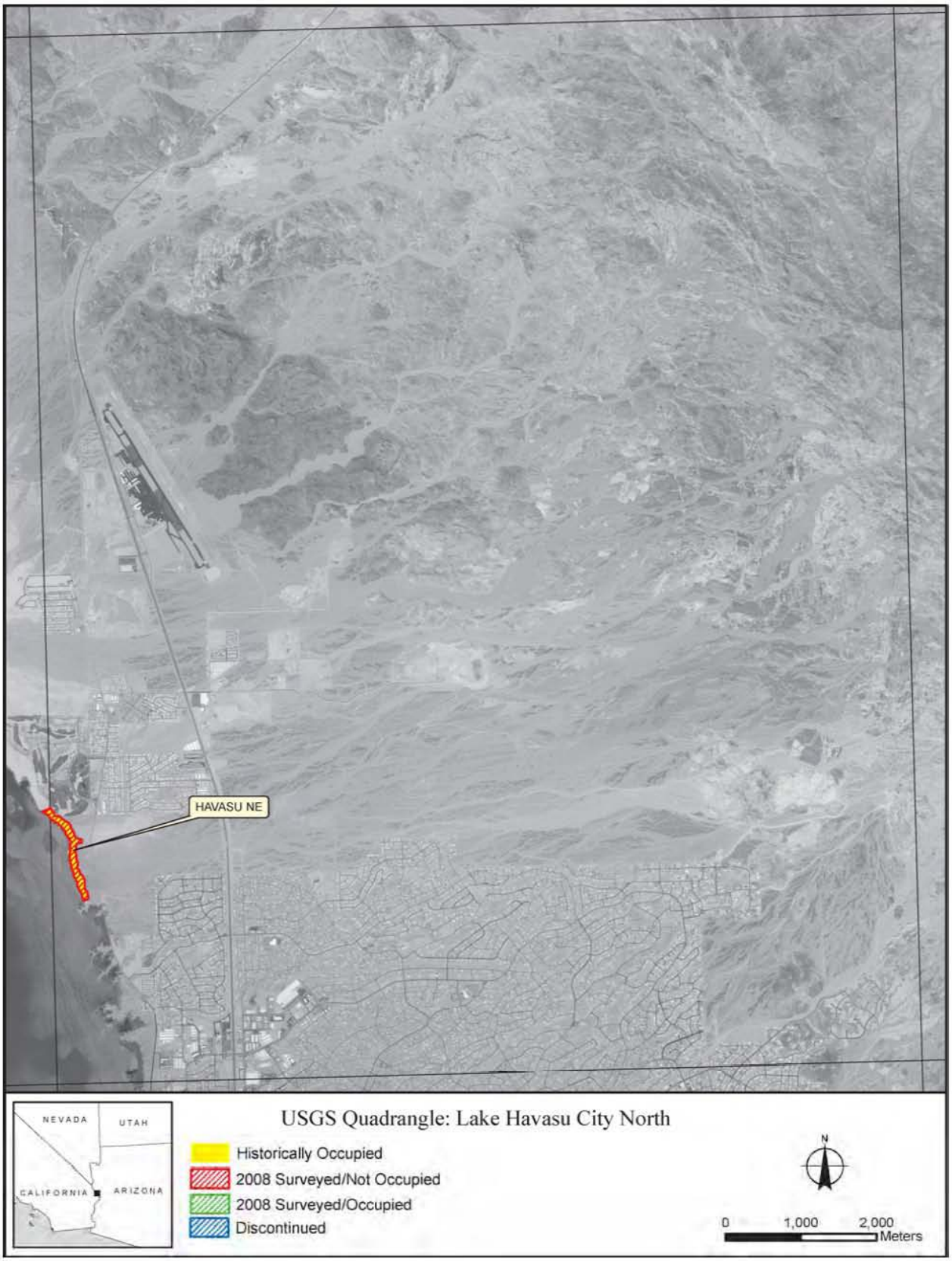

RM 274.5N
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Columbine Falls
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

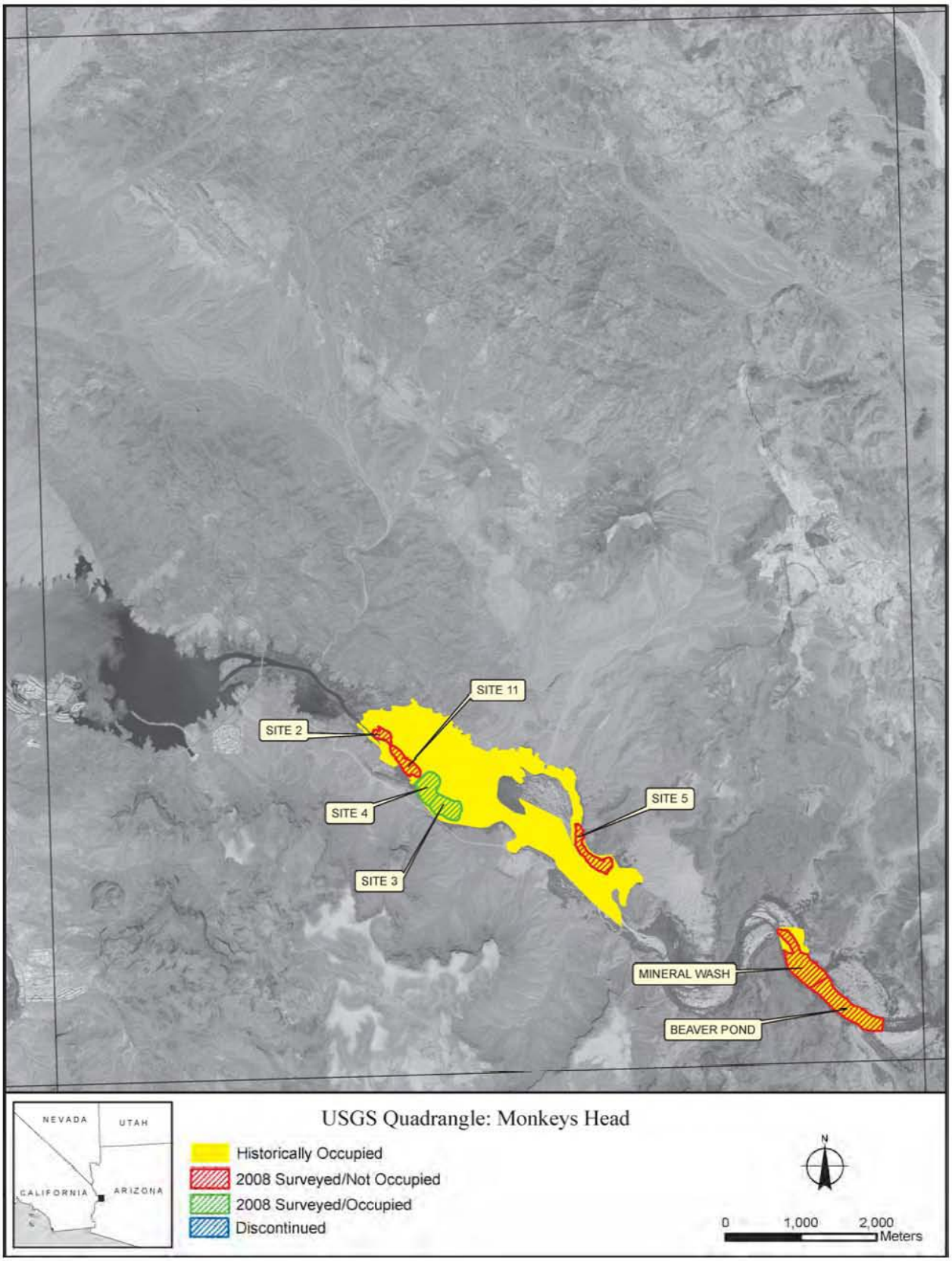

RM 285.3N
ICEBERG CANYON
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Iceberg Canyon
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

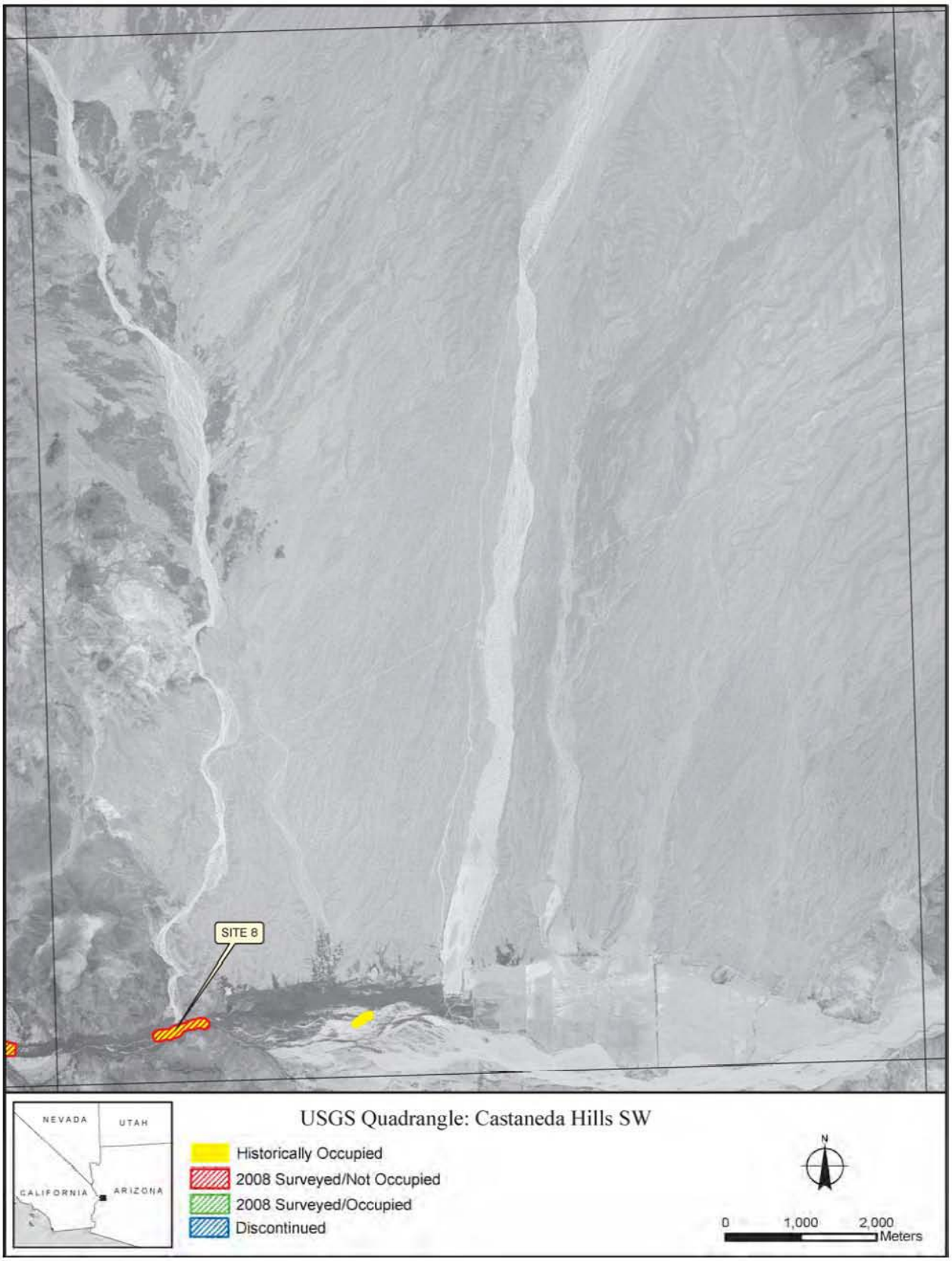

PIPES #1
THE WALLOWS
PIPES #3
PC 6-1
IN BETWEEN
PIG HOLE
PIERCED EGG
800M
BARBED WIRE
SWINE PARADISE
IRFB03
IRFB04
PLATFORM
250M
HELL BIRD
GLORY HOLE
BEAL LAKE
LOST SLOUGH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


LOST POND
LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

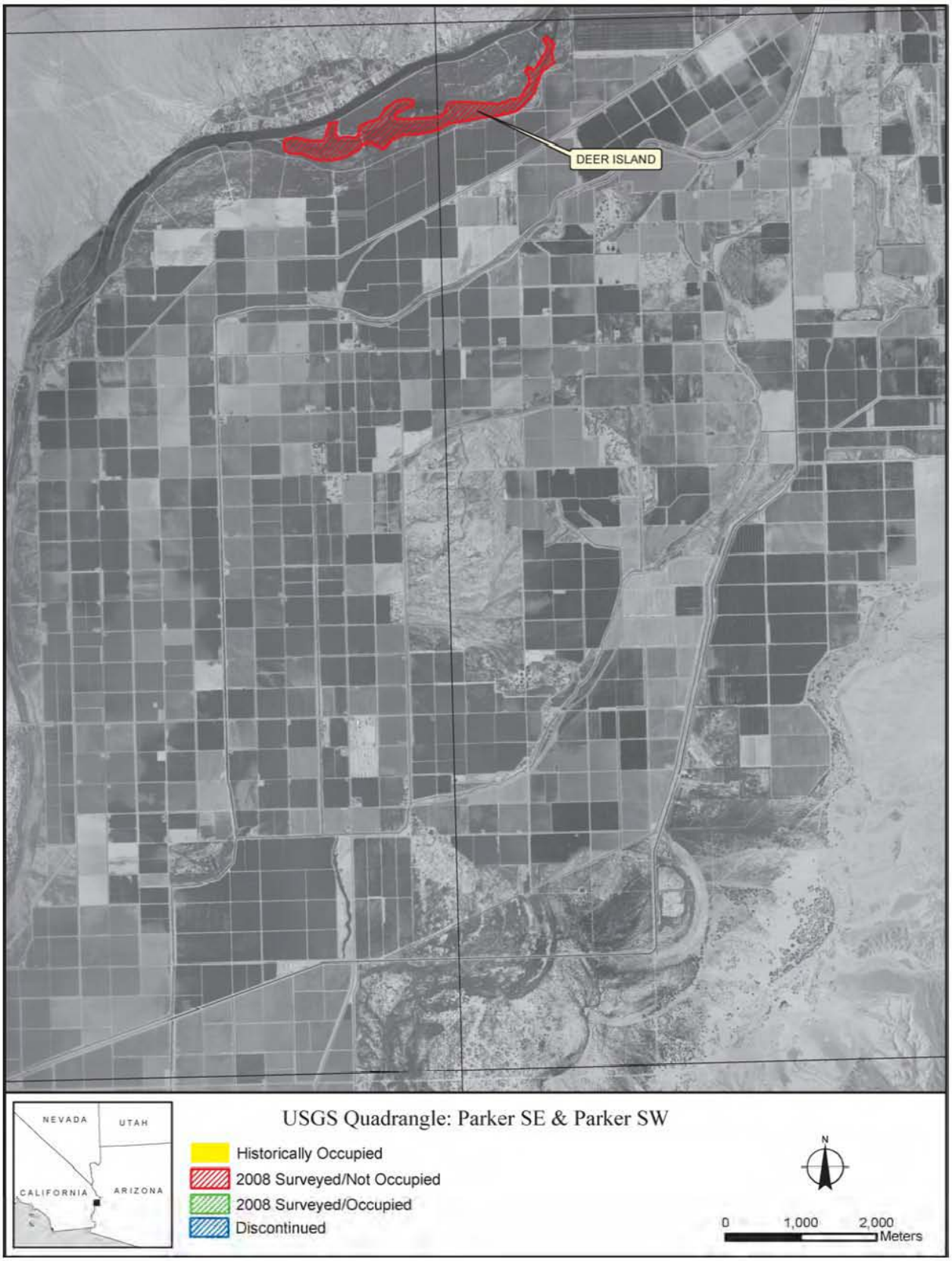

BLANKENSHIP NORTH
BLANKENSHIP SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castle Rock
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


HAVASU NE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Lake Havasu City North
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


SITE 11
SITE 2
SITE 4
SITE 5
SITE 3
MINERAL WASH
BEAVER POND
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


SITE 8
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

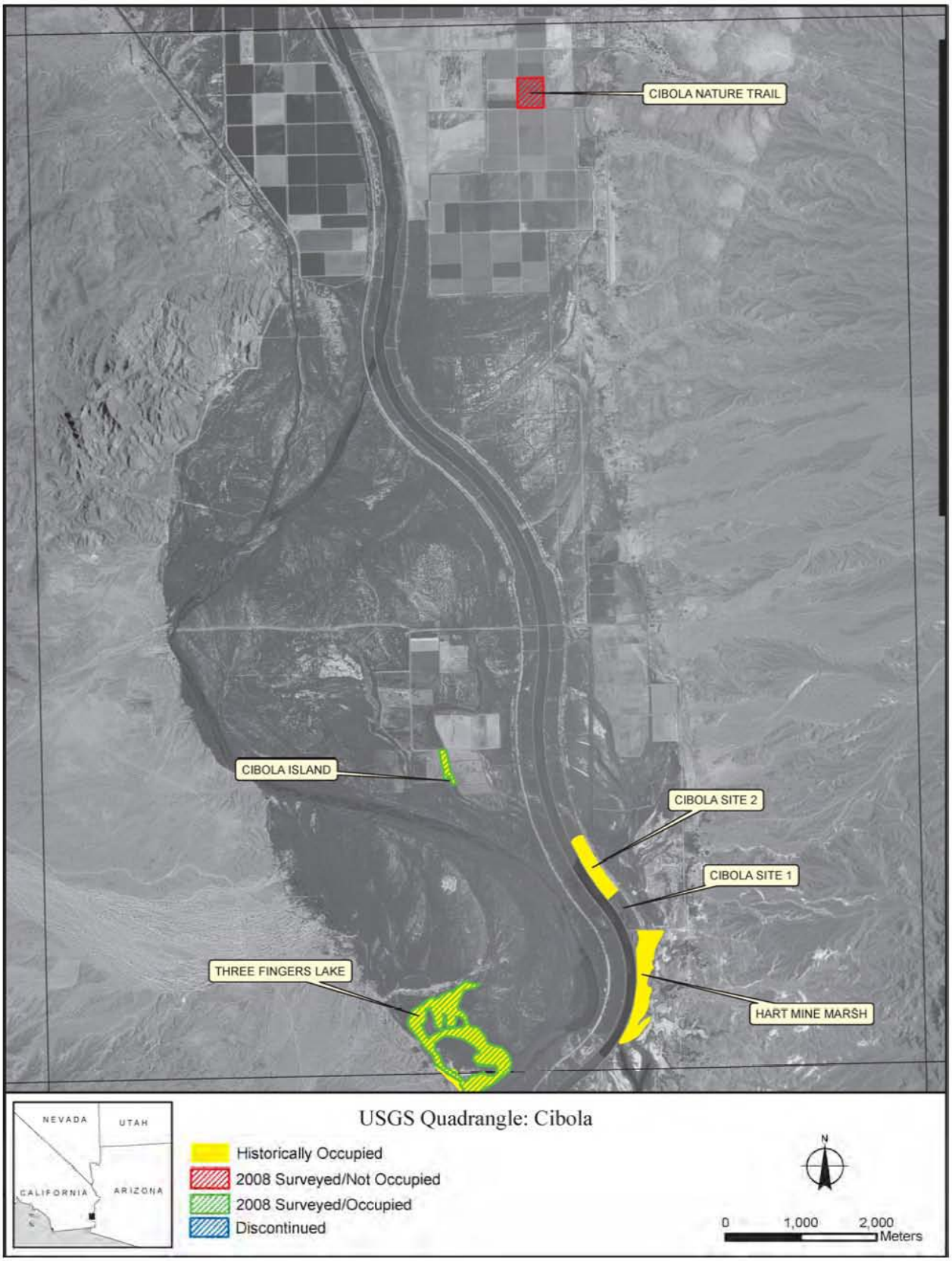

WILLOW BEACH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Parker
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

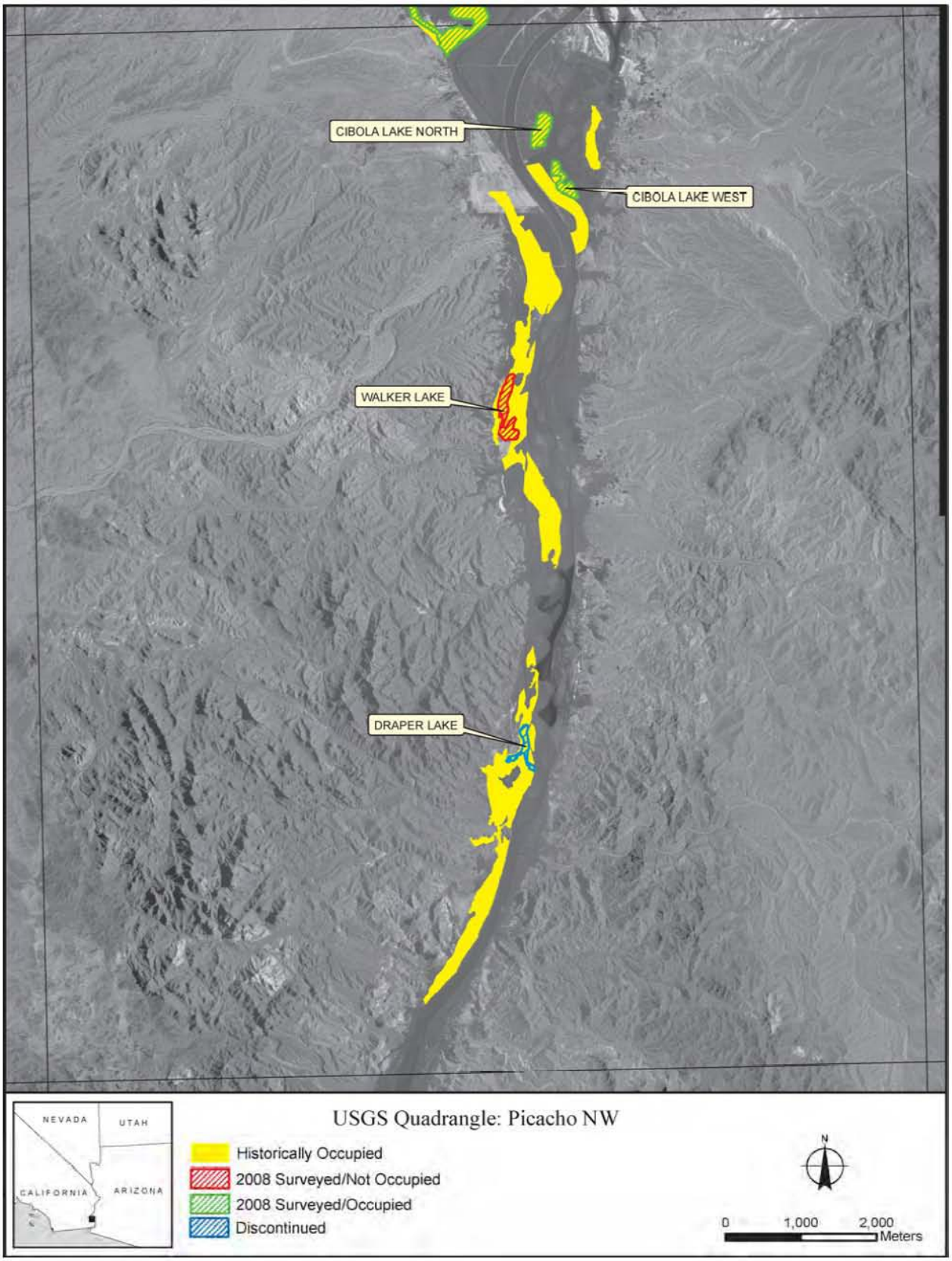

DEER ISLAND
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Parker SE & Parker SW
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

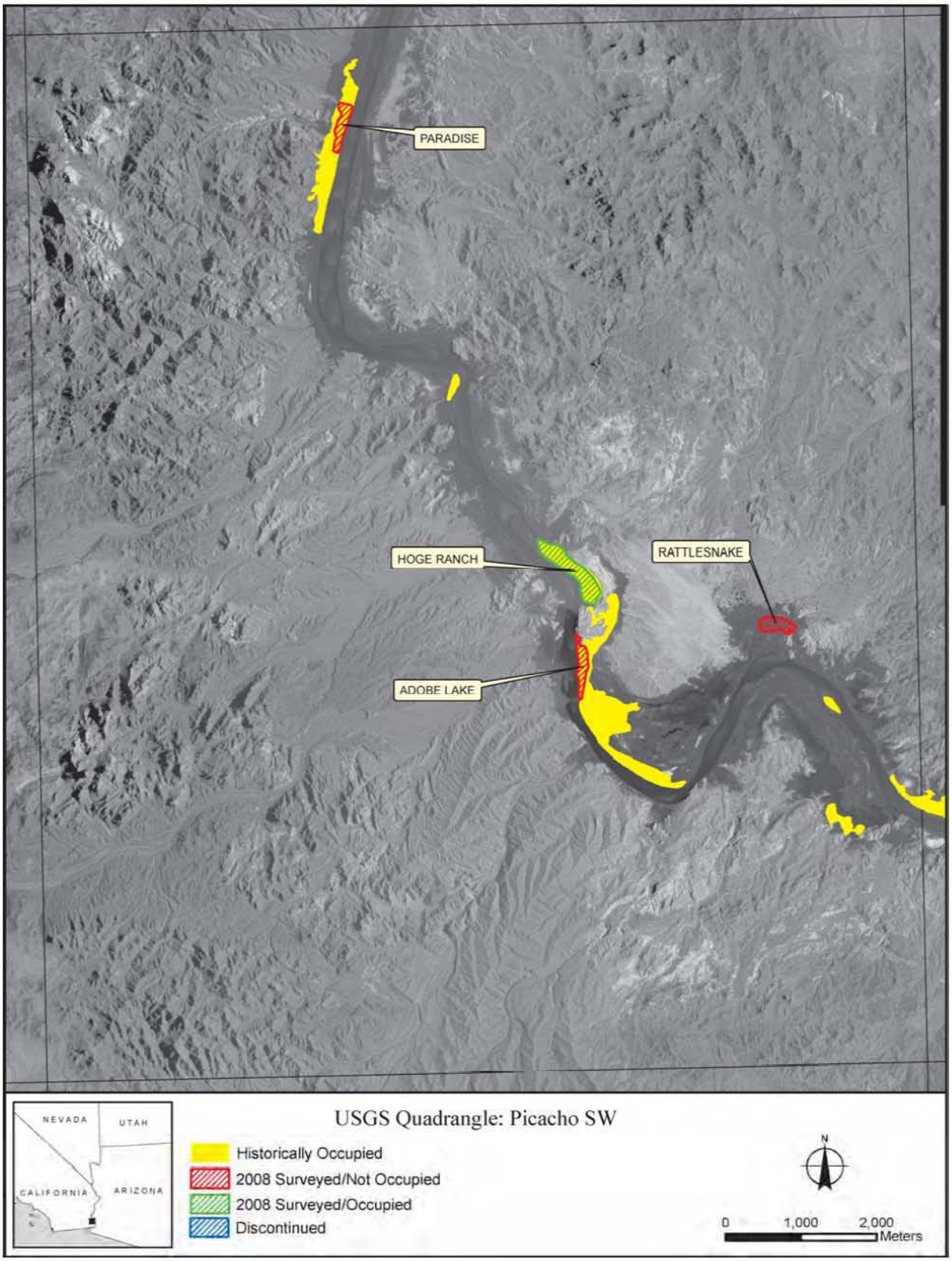

BIG HOLE SLOUGH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

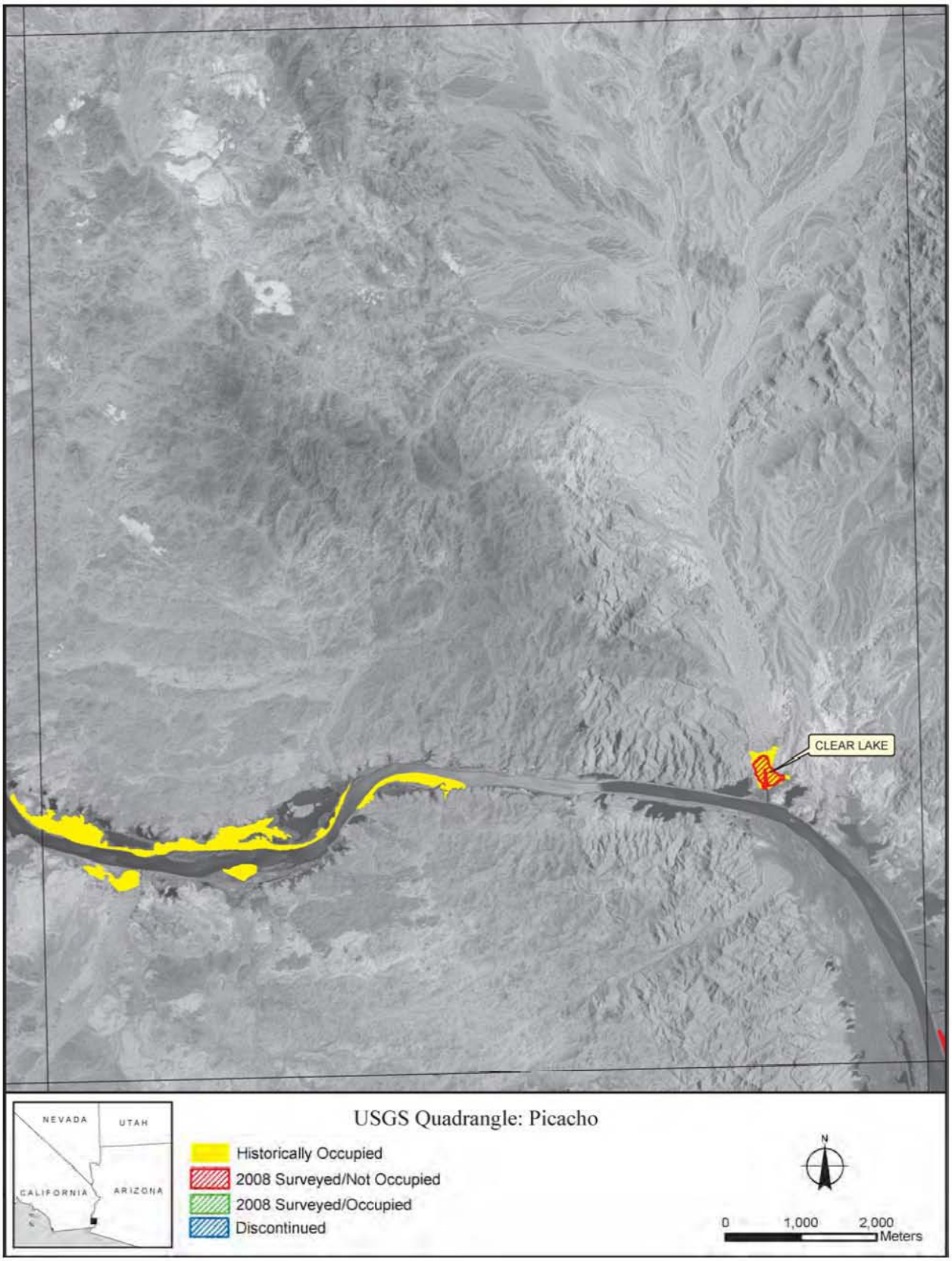

EHRENBERG
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

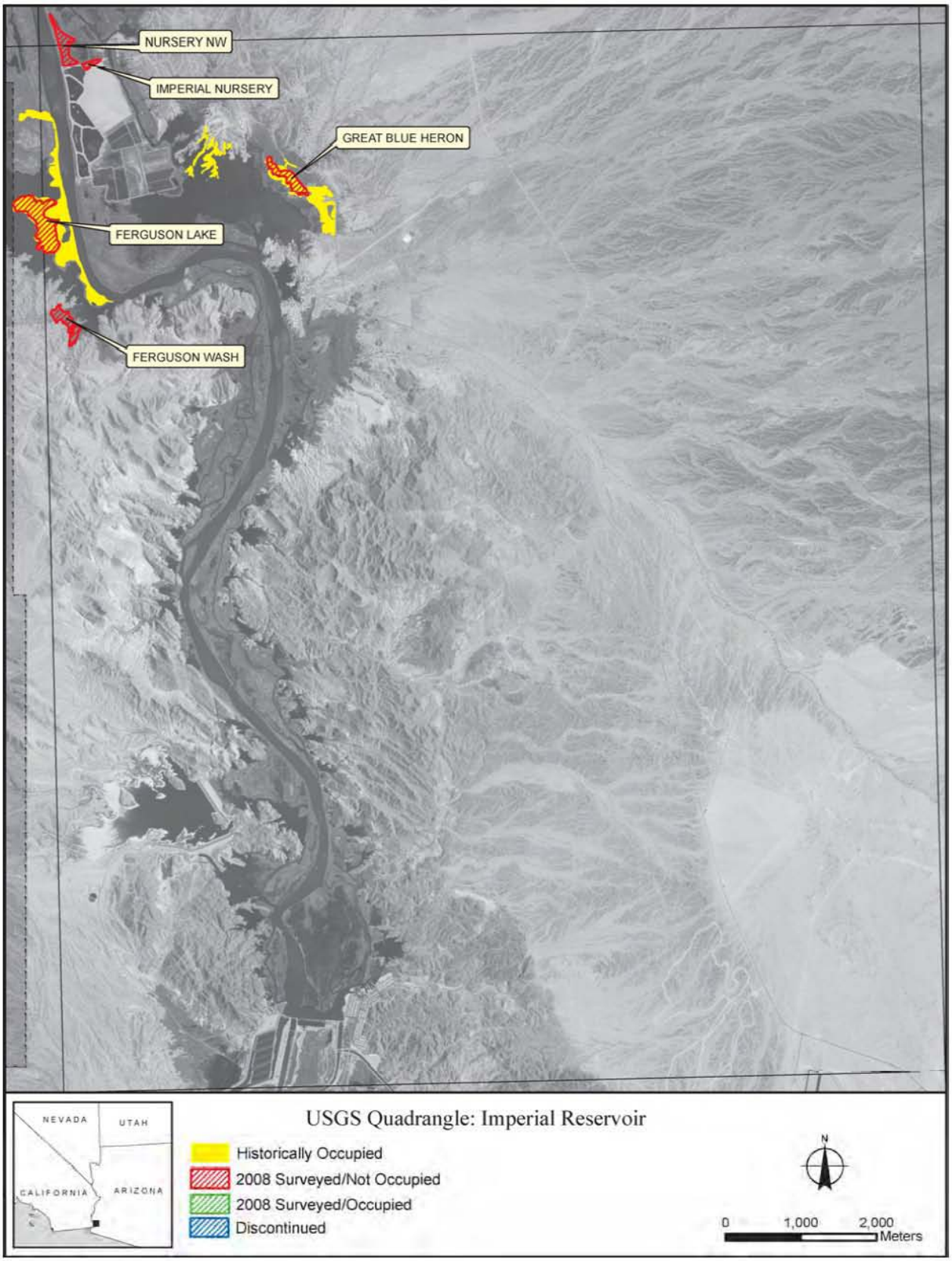

CVCA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

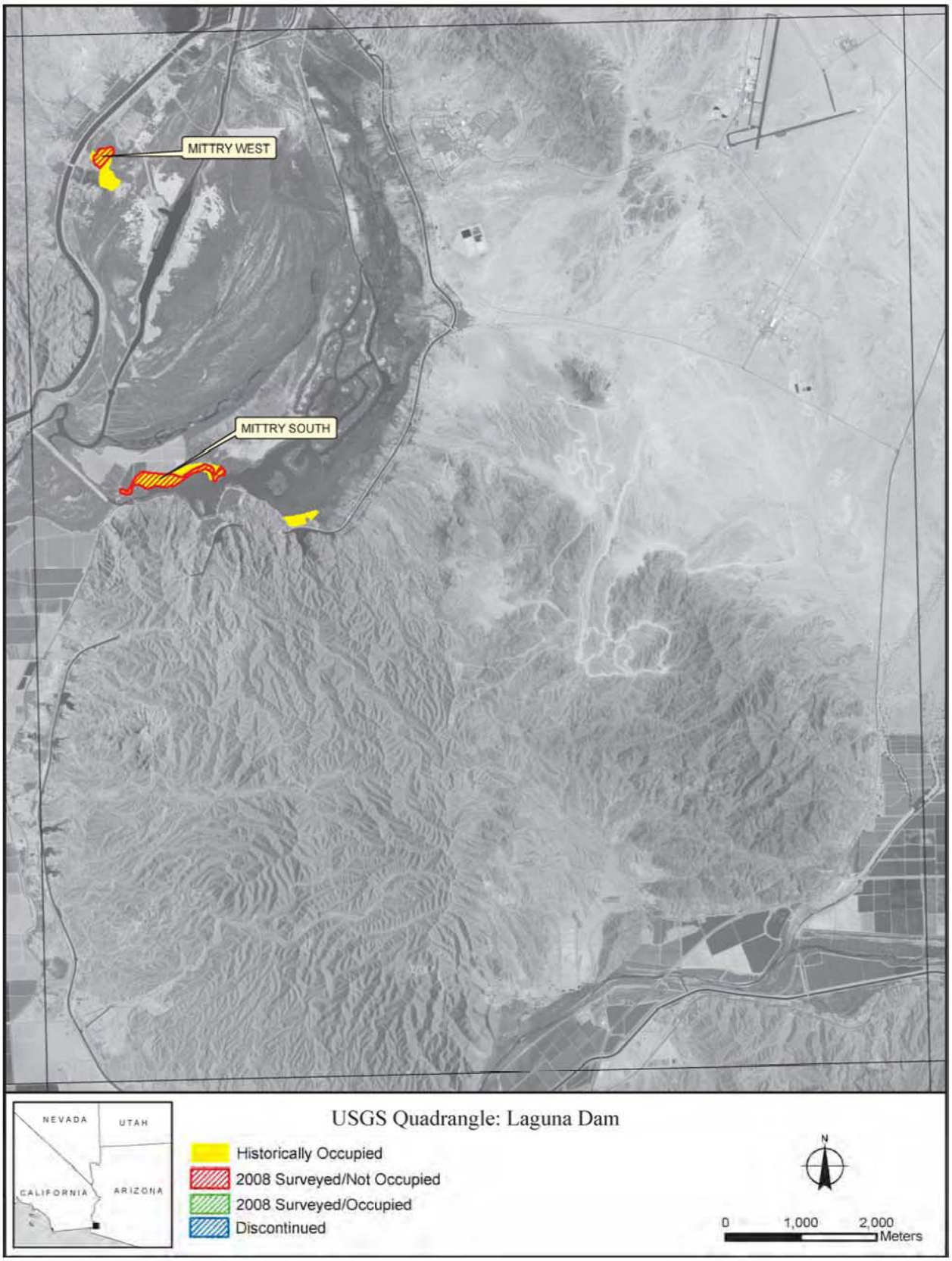

CIBOLA NATURE TRAIL
CIBOLA ISLAND
CIBOLA SITE 2
CIBOLA SITE 1
THREE FINGERS LAKE
HART MINE MARSH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

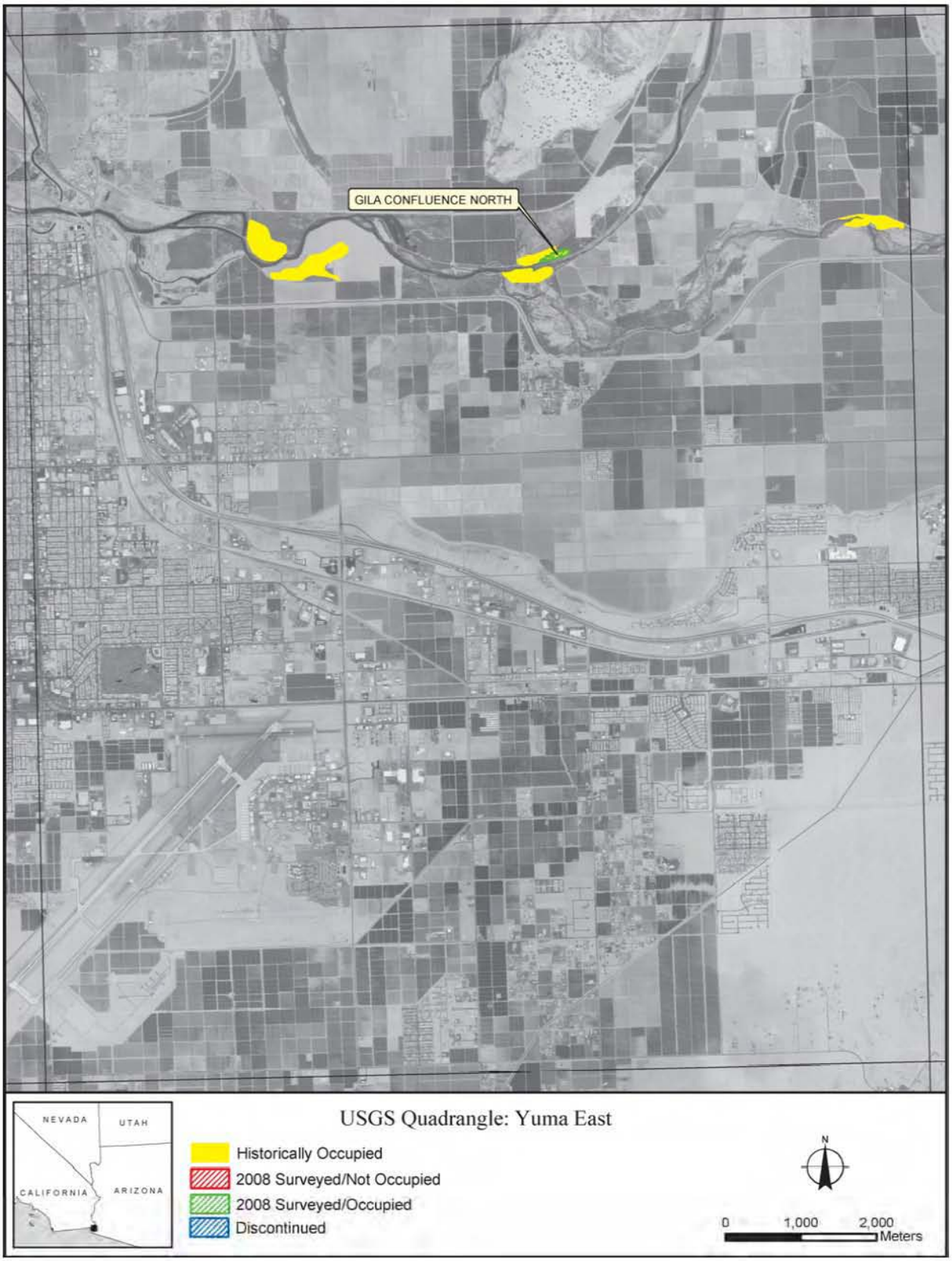

CIBOLA LAKE NORTH
CIBOLA LAKE WEST
WALKER LAKE
DRAPER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


PARADISE
HOGE RANCH
RATTLESNAKE
ADOBE LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


CLEAR LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


NURSERY NW
IMPERIAL NURSERY
GREAT BLUE HERON
FERGUSON LAKE
FERGUSON WASH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


MITTRY WEST
MITTRY SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters


GILA CONFLUENCE NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Yuma East
Historically Occupied
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
Discontinued
N
0
1,000
2,000
Meters

Appendix C

DETECTIONS OF SPECIAL CONCERN SPECIES, 2008

Appendix C. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2008

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
PAHR	North	0	0	0	1	0	0	0	0	0	24	0	3
	West	0	0	0	0	0	0	0	0	0	9	0	1
	MAPS	0	0	0	0	0	0	0	1	0	7	0	2
	South	0	0	0	0	0	0	0	0	1	15	1	7
LIFI	Poles	0	0	0	0	0	0	0	0	4	13	2	6
MESQ	East	0	0	0	0	0	0	0	0	2	18	2	17
	West	0	0	0	0	0	0	0	0	1	45	1	3
	Electric Avenue North	0	0	0	0	0	0	0	0	1	0	0	0
	Electric Avenue South	0	0	0	0	0	0	0	0	2	12	0	10
	Bunker Farm	0	0	0	0	0	0	0	0	1	20	2	5
MOME	Mormon Mesa North	0	0	0	0	0	0	0	0	4	63	0	42
	Hedgerow	0	0	0	0	0	0	0	0	1	18	1	10
	Mormon Mesa South	0	0	0	0	0	0	0	0	15	104	3	134
	Virgin River #1	0	0	0	0	0	0	0	0	8	117	0	100
	Virgin River #2	0	0	0	0	0	0	0	0	9	69	8	75
MUDD	Overton WMA Pond	0	0	0	0	0	0	0	0	0	21	1	3
	Overton WMA	0	0	0	0	0	0	0	0	2	60	0	37
GRCA	Burnt Springs	0	0	0	0	0	0	0	0	23	20	6	23
	RM 274.5N	1	0	2	0	0	0	0	0	33	34	2	27
	RM 285.3N	0	0	0	0	0	0	0	0	9	0	0	2
	Iceberg Canyon	0	0	0	0	0	0	0	0	2	1	0	2
TOPO	Pipes #1	0	0	0	0	0	0	0	0	3	5	0	27
	Pipes #3	0	0	0	0	0	0	0	0	4	7	4	24
	The Wallows	0	0	0	0	0	0	1	0	1	0	0	11
	PC6-1	0	0	0	0	0	0	3	0	0	8	3	29
	Pig Hole	0	0	0	0	0	0	1	0	0	4	0	11
	In Between	0	0	0	0	0	0	1	0	0	13	0	15
	800M	0	0	1	0	0	0	3	0	1	5	4	15
	Pierced Egg	0	0	0	0	0	0	2	0	1	4	5	14

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
TOPO	Swine Paradise	0	1	0	0	0	0	2	0	1	9	0	14
	Barbed Wire	0	0	0	0	0	0	1	0	2	3	0	14
	IRFB03	0	1	0	0	0	0	0	0	0	0	0	5
	IRFB04	0	0	0	0	0	0	0	0	0	0	0	5
	Platform	0	1	0	0	0	0	1	0	1	5	1	11
	250M	0	0	0	0	0	0	0	0	0	13	0	16
	Hell Bird	0	0	0	0	0	0	0	0	0	14	1	12
	Glory Hole	0	0	2	0	0	0	8	0	3	10	4	10
	Beal Lake	0	0	0	0	0	0	0	0	2	4	0	10
	Lost Slough	0	0	0	0	0	0	0	0	0	0	0	11
	Lost Pond	0	0	1	0	0	0	0	0	0	0	0	5
	Lost Lake	0	1	1	0	0	0	0	0	1	5	1	17
TOGO	Blankenship Bend North	0	0	0	0	0	0	0	0	11	3	0	18
	Blankenship Bend South	0	0	2	0	0	0	0	0	7	0	0	17
	Havasu NE	0	0	0	0	0	0	0	0	0	4	0	16
BIWI	Site #2	1	2	4	0	0	0	3	0	4	10	0	24
	Site #11	0	0	0	0	0	0	3	0	2	11	0	26
	Site #4	0	0	0	0	0	0	13	0	13	10	2	49
	Site #3	6	0	0	0	0	0	8	0	13	17	7	46
	Site #5	0	0	0	1	0	2	10	0	11	22	3	57
	Mineral Wash Complex	3	0	0	0	0	0	5	1	17	2	1	21
	Beaver Pond	3	0	0	0	0	0	3	1	18	5	0	24
	Site #8	1	0	0	1	0	0	2	0	16	11	1	20
AHAK	Willow Beach	0	0	0	0	0	0	0	0	0	3	0	2
	Deer Island	0	0	6	0	0	0	0	0	2	8	0	2
BIHO	Big Hole Slough	0	0	1	0	0	0	3	0	0	0	0	3
EHRE	Ehrenberg	0	0	0	0	0	0	1	0	1	2	1	7
CIBO	CVCA	0	0	0	0	0	0	0	0	1	4	0	2
	Cibola Nature Trail	0	0	0	0	0	0	0	0	0	0	0	2

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
CIBO	Cibola Island	0	0	0	0	0	0	0	0	0	2	0	7
	Three Fingers Lake	0	2	15	0	0	1	1	0	8	0	1	30
	Cibola Lake #1 (North)	0	1	4	1	0	1	2	0	3	0	3	15
	Cibola Lake #3 (West)	1	0	4	0	0	2	1	0	6	0	0	18
	Walker Lake	0	1	0	0	0	0	2	0	0	0	1	9
IMPE	Draper Lake	0	2	0	0	0	0	0	0	1	0	0	2
	Paradise	2	0	0	0	0	1	10	0	1	1	1	14
	Hoge Ranch	0	0	0	0	0	1	0	0	5	2	3	21
	Adobe Lake	0	0	0	0	0	0	1	0	1	3	5	16
	Rattlesnake	0	0	0	0	0	0	3	0	3	2	10	27
	Clear Lake/The Alley	0	0	4	0	0	0	4	0	6	0	1	33
	Nursery NW	1	5	1	0	0	0	2	0	4	0	0	10
	Imperial Nursery	0	2	0	0	0	0	3	0	0	1	2	3
	Ferguson Lake	0	1	4	0	0	0	7	0	5	0	0	14
	Ferguson Wash	0	0	4	0	0	0	0	0	1	1	0	13
	Great Blue Heron	0	0	0	0	0	0	3	0	3	0	0	13
MITT	Mittry West	0	0	0	0	0	0	12	0	5	0	1	22
	Mittry South	0	1	1	0	0	0	1	0	2	0	0	3
YUMA	Gila Confluence North	0	0	0	0	0	0	2	0	0	0	2	8

[1] PAHR = Pahranagat NWR; LIFI = Littlefield; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; GRCA = Grand Canyon; TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams River NWR; AHAK = Ahakhav Tribal Preserve; BIHO = Big Hole Slough; EHRE = Ehrenberg; CIBO = Cibola NWR; IMPE = Imperial NWR; MITT = Mittry Lake; YUMA = Yuma.

[2] BLRA = Black Rail, CLRA = Clapper Rail, LEBI = Least Bittern, YBCU = Yellow Billed Cuckoo, ELOW = Elf Owl, GIFL = Gilded Flicker, GIWO = Gila Woodpecker, VEFL = Vermilion Flycatcher, BEVI = Bell's Vireo, YWAR = Yellow Warbler, SUTA = Summer Tanager, YBCH = Yellow-breasted Chat

AR064019

Appendix D

ALL WILLOW FLYCATCHERS COLOR-BANDED AND/OR RESIGHTED, 2003–2008

Appendix D. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2008. Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA.

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1490-89889	M	J							R		D	D	D	D
1590-97338	M	A	P				P	P	P	P				
1710-20312	M	J							R		T			
1710-20638	M	A		G	M	M	M	M	M	M	M			
2090-42022	F	J		M					Q					
2110-78841	F	J						T	T	T	T			
2110-78842	M	A						Q	Q	Q				
2110-78855	M	J						T	T					
2110-78861	M	J						T	M[4]	Q				
2110-78863	M	J						T	T	T				
2140-66502	M	J						Q	Q					
2140-66503	F	J						Q		Q				
2140-66517	F	A						Q	Q	Q	D			
2140-66518	M	A						Q	Q					
2140-66561	M	A						P			P	P	P	P
2140-66564	F	J						P	P					
2140-66566	M	J						P			P			
2140-66568	M	A						P	P		P	P	P	P
2140-66606	M	J		M		Q	Q		Q					
2140-66621	F	A				P	P	P	P	P				
2140-66627	F	A				P	P	P		P				
2140-66693	M	J					M	Q	Q					
2140-66696	F	J					Q		Q					
2140-66697	M	J					Q			P	P	P	P	P
2140-66709	M	A						Q	Q	Q		Q[5]	M	M
2140-66728	M	J					T			T				
2140-66743	M	J			T					T				
2140-66775	M	J				T	M		Q	Q	Q			
2190-76604	M	A					P		P	P	P	P		
2320-31401	M	A							B					
2320-31402	M	A							B					
2320-31403	M	A							Y					
2320-31404	F	A							B					
2320-31405	F	A							B					
2320-31406	U	J							B					
2320-31407	F	J							B	T				
2320-31408	U	J							B					
2320-31409	U	J							B					
2320-31410	U	J							B					
2320-31411	U	J							B					
2320-31412	M	A							B	B				
2320-31413	U	A							Q					
2320-31414	M	A								T	T			

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2320-31415	F	A								T				
2320-31416	U	J								T				
2320-31417	U	J								T				
2320-31418	M	A								T	T			
2320-31419	U	J								T				
2320-31420	U	J								T				
2320-31421	U	J								T				
2320-31422	U	J								T				
2320-31423	U	A								T				
2320-31424	M	J								T	T			
2320-31425	U	J								T				
2320-31426	F	A							M					
2320-31427	M	A							M					
2320-31428	M	J							Q	M	Q[6]		M	M
2320-31429	U	J							Q					
2320-31430	U	J							P					
2320-31431	U	J							Q					
2320-31432	U	J							P					
2320-31433	U	J							Q					
2320-31434	U	J							Q					
2320-31435	U	J							P					
2320-31436	U	J							P					
2320-31437	U	J							P					
2320-31438	M	J							Q	Q				
2320-31439	U	J							Q					
2320-31440	F	J							Q	M				
2320-31441	U	J							M					
2320-31443	U	J							Q					
2320-31444	F	A							Q	Q	Q	Q		
2320-31445	F	A							Q	Q	Q	Q	Q	Q
2320-31446	U	J								P				
2320-31447	U	J								P				
2320-31448	U	J								P				
2320-31449	U	J								P				
2320-31450	U	J								P				
2320-31451	M	A							P	P	P	P		
2320-31452	M	A							P					
2320-31453	M	A							P	P				
2320-31454	M	A							P	P				
2320-31455	M	A							P					
2320-31456	U	J							P					
2320-31457	M	J							P	K				
2320-31458	M	J							P		P			
2320-31459	M	J							P	P				
2320-31460	U	J							P					
2320-31461	U	J							P					
2320-31462	U	J							P					

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2320-31463	F	J							P			K	K	
2320-31464	U	J							P					
2320-31465	U	J							P					
2320-31466	F	A							P					
2320-31467	M	J							P		P	P		
2320-31468	M	J							P		P	P		K
2320-31469	U	J							P					
2320-31470	U	J							P					
2320-31471	M	J							Q	Q			M	
2320-31472	U	J							Q					
2320-31473	M	J							Q	Q				
2320-31474	U	J							Q					
2320-31475	M	J							P	L				
2320-31476	F	A							Q					
2320-31477	U	J							Q					
2320-31479	F	A							Q	Q				
2320-31480	F	J							Q	Q				
2320-31481	U	J							P					
2320-31482	U	J							P					
2320-31483	U	J								Q				
2320-31484	M	J								P	P			K
2320-31485	F	A								M		M	M	M
2320-31486	F	J							Q	L	Q	M	M	M
2320-31487	U	J							Q					
2320-31488	U	J							Q					
2320-31489	U	A								M				
2320-31490	M	A								L	L[7]	Q	Q	Q
2320-31491	M	A								Q				
2320-31493	M	A								D				
2320-31494	U	A								Q				
2320-31495	M	A								T				
2320-31496	U	J								M				
2320-31497	U	J								M				
2320-31498	F	J								M		G[8]	Q	Q
2320-31499	M	A								Q				
2320-31500	U	J								Q				
2320-31501	M	A							B					
2320-31502	F	A							T	T				
2320-31503	U	A								I				
2320-31504	U	A								I				
2320-31505	M	A								T				
2320-31506	U	J								T				
2320-31507	U	J								T				
2320-31508	U	J								T				
2320-31510	U	J								T				
2320-31511	U	J								T				
2320-31512	U	J								T				

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2320-31513	U	J								T				
2320-31514	U	J								T				
2320-31515	F	A								T	T	T		
2320-31516	F	A								G				
2320-31517	M	A								G	M	M		
2320-31518	U	J								T				
2320-31519	U	J								T				
2320-31520	U	J								T				
2320-31521	F	A								T	T			
2320-31522	U	J											Q	
2320-31523	U	J											M	
2320-31524	U	J											P	
2320-31525	U	J											P	
2320-31526	F	A							T	T	T			
2320-31527	F	A								T				
2320-31528	M	A								T				
2320-31529	U	J								T				
2320-31530	U	J								T				
2320-31531	U	J								T				
2320-31532	U	J								T				
2320-31533	U	J								T				
2320-31534	U	J								T				
2320-31535	U	J								T				
2320-31536	U	J								T				
2320-31537	U	J								T				
2320-31538	M	A								T				
2320-31539	M	A								B				
2320-31540	F	A								T				
2320-31541	M	A								T	T			
2320-31542	U	J								T				
2320-31543	U	J								T				
2320-31544	U	J								T				
2320-31545	U	J											P	
2320-31546	U	J											P	
2320-31547	U	J											P	
2320-31548	U	J											P	
2320-31549	U	J											P	
2320-31550	U	J											P	
2320-31551	M	A								Q				
2320-31552	M	A								M				
2320-31553	M	A								M		M		
2320-31554	U	J								T				
2320-31555	U	J								T				
2320-31556	U	J								T				
2320-31557	U	J								T				
2320-31558	U	J								T				
2320-31559	M	A								T	T	T	T	

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2320-31560	M	A								T	T	T	T	T
2320-31561	U	J								T				
2320-31562	M	J								T		T		T
2320-31563	U	J								T				
2320-31564	U	J								T				
2320-31565	F	A								T	T			
2320-31566	U	J										T		
2320-31567	M	A								T	T			
2320-31568	F	A								P				
2320-31569	U	J								P				
2320-31570	U	J								P				
2320-31571	U	J								P				
2320-31572	M	A								M				
2320-31573	F	A								Q	Q	Q	Q	Q
2320-31574	U	J									P			
2320-31575	U	J										Q		
2320-31576	M	A							T	T				
2320-31577	F	A							T	T	T			
2320-31578	U	A							Y					
2320-31579	U	A							Y					
2320-31580	U	A							Y					
2320-31581	U	J							T					
2320-31582	U	J							T					
2320-31583	U	J							T					
2320-31584	F	A							T	T	T	T		
2320-31585	U	J							T					
2320-31586	U	J							T					
2320-31587	U	J							T					
2320-31588	U	J							T					
2320-31589	M	A								P	P	P	P	
2320-31590	M	A								P	P	P	P	P
2320-31591	M	A								P	P	P	P	
2320-31593	M	A								P	P	P		
2320-31594	M	A								P				
2320-31595	M	A								P	P	P	P	P
2320-31596	M	A								P				
2320-31598	M	A								T				
2320-31599	U	A								I				
2320-31600	U	A								I				
2320-31601	U	J								P				
2320-31602	U	J								P				
2320-31603	U	J								P				
2320-31604	M	J								P		K	K	
2320-31605	U	J								P				
2320-31606	U	J								P				
2320-31607	U	J								P				
2320-31608	U	J								P				

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2320-31609	U	J								P				
2320-31610	U	J								P				
2320-31611	U	J								Q				
2320-31612	U	J								Q				
2320-31616	F	J								Q		D		
2320-31617	U	J								Q				
2320-31618	F	J								Q	M	M	M	
2320-31619	U	J								M				
2320-31620	U	J								M				
2320-31621	F	A								M				
2320-31622	M	A								Q				
2320-31623	U	J								M				
2320-31624	U	J								M				
2320-31625	F	A								M				
2320-31627	M	A								Q				
2320-31628	U	A								M				
2320-31629	U	J								M				
2320-31630	U	J								Q				
2320-31631	F	J								Q		D	D	
2320-31632	F	A								Q		M	M	M[9]
2320-31633	U	J								Q				
2320-31634	U	J								Q				
2320-31635	M	A								K				
2320-31636	U	J								K				
2320-31637	F	J								K	P			
2320-31638	U	J								K				
2320-31639	U	J											P	
2320-31640	U	J											Q	
2320-31641	U	J											Q	
2320-31642	U	J											Q	
2320-31643	U	J											P	
2320-31644	U	J											M	
2320-31645	U	J											M	
2320-31646	U	J											P	
2320-31649	U	J											P	
2320-31650	F	J										T	T	
2320-31651	M	A								M				
2320-31652	M	A								M	Q	Q		
2320-31653	M	A								M	M	M	M	
2320-31654	M	A								Q				
2320-31655	F	A								Q	Q	Q		
2320-31656	F	A								P	P	P		
2320-31657	F	A								P	P	P	P	P
2320-31658	F	A								P				
2320-31659	M	J								Q		D	D	D
2320-31660	F	J								Q			M	S
2320-31661	F	A								P	P	P	P	P

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2320-31662	F	A								P				
2320-31663	F	A								P	P	P	P	P
2320-31664	F	A								P				
2320-31665	U	J								P				
2320-31666	U	J								P				
2320-31667	U	J								P				
2320-31668	F	A								P				
2320-31669	F	A								P				
2320-31670	U	J											Q	
2320-31671	U	J										M		
2320-31672	U	J											P	
2320-31673	U	J										T		
2320-31674	M	J										P		K
2320-31675	U	J									T			
2320-31676	U	J									T			
2320-31677	U	J										T		
2320-31678	U	J										P		
2320-31679	U	J											P	
2320-31680	U	J									T			
2320-31681	U	J									T			
2320-31682	U	J									P			
2320-31683	M	J									P		K	
2320-31684	U	J									P			
2320-31685	U	J									P			
2320-31686	M	J									P	P		
2320-31687	U	J									P			
2320-31688	M	J									Q	Q	Q	Q
2320-31689	U	J									Q			
2320-31690	U	J									Q			
2320-31691	U	J									Q			
2320-31692	M	J									P	K		
2320-31693	U	J									P			
2320-31694	M	J									P		K	K
2320-31695	F	J									P	P		
2320-31696	U	J									Q			
2320-31697	U	J									P			
2320-31698	F	J									P		P	P
2320-31699	U	J									P			
2320-31700	U	J									P			
2360-59701	F	J									Q	Q		
2360-59702	M	J									Q	D	M	
2360-59703	U	J									Q			
2360-59704	U	J									M			
2360-59705	U	J									M			
2360-59706	U	J									K			
2360-59707	F	J									P	P		
2360-59708	F	J									P	P		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2360-59709	U	J									P			
2360-59710	U	J									P			
2360-59711	M	J									K			P
2360-59712	M	J									K			P
2360-59713	U	J									K			
2360-59714	U	J									Q			
2360-59715	U	J									Q			
2360-59716	U	J									Q			
2360-59717	M	A								Q				
2360-59718	U	J									P			
2360-59719	U	J									T			
2360-59720	U	J									T			
2360-59721	U	J								P				
2360-59722	U	J									T			
2360-59723	U	J								P				
2360-59724	F	J								P		P		
2360-59725	U	J									B			
2360-59727	M	J									B		B	
2360-59728	U	J									B			
2360-59729	U	J									T			
2360-59730	U	J									T			
2360-59731	U	J									T			
2360-59732	U	J									T			
2360-59733	U	J									T			
2360-59734	U	J									T			
2360-59735	U	J										P		
2360-59736	U	J										P		
2360-59737	U	J										D		
2360-59738	U	J										D		
2360-59739	U	J										Q		
2360-59740	U	J									P			
2360-59741	U	J									Q			
2360-59742	U	J									Q			
2360-59743	F	J											P	K
2360-59744	U	J										T		
2360-59745	U	J										P		
2360-59746	U	J								G				
2360-59747	U	J										D		
2360-59748	U	J										D		
2360-59749	M	J										D	D[10]	M
2360-59750	F	J										M	Q	
2360-59751	M	J										M	Q	Q
2360-59752	M	J										Q		Q
2360-59753	U	J										Q		
2360-59754	M	J										Q	Q	Q
2360-59755	U	J										Q		
2360-59756	U	J										P		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2360-59757	U	J								K				
2360-59758	U	J										P		
2360-59759	U	J										P		
2360-59760	U	J								L				
2360-59761	U	J								L				
2360-59762	U	J								Q				
2360-59763	U	J								Q				
2360-59764	U	J											P	
2360-59765	U	J											P	
2360-59766	U	J								Q				
2360-59767	U	J								K				
2360-59768	U	J										T		
2360-59769	U	J										M		
2360-59770	U	J								K				
2360-59771	U	J								G				
2360-59772	F	A								K				
2360-59773	U	J											Q	
2360-59775	U	J											Q	
2360-59776	U	J											Q	
2360-59777	U	J											Q	
2360-59778	U	J											Q	
2360-59779	U	J											K	
2360-59780	U	J											K	
2360-59781	U	J											K	
2360-59782	U	J											K	
2360-59785	U	J									D			
2360-59786	U	J									D			
2360-59787	U	J									D			
2360-59788	F	J									D	D	M	M
2360-59789	U	J										Q		
2360-59790	U	J										Q		
2360-59791	U	J										P		
2360-59792	U	J										P		
2360-59793	U	J										P		
2360-59794	U	J										P		
2360-59795	U	J										P		
2360-59796	U	J										P		
2360-59797	M	J										P	P	
2360-59798	U	J										P		
2360-59799	M	J										M	D	M
2360-59800	U	J								G				
2370-39901	U	A								P				
2370-39902	U	J								P				
2370-39904	U	J								P				
2370-39911	M	A									P			
2370-39912	M	A									Q		Q	
2370-39913	M	A									G			

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2370-39914	U	J									P			
2370-39915	M	A									P	P	P	P[11]
2370-39916	M	A										T	T	T
2370-39917	U	A										Y		
2370-39918	U	A										Y		
2370-39919	U	A										Y		
2370-39920	U	A										Y		
2370-39921	U	A										Y		
2370-39922	U	A										Y		
2370-39923	U	A										Y		
2370-39924	U	A										Y		
2370-39925	U	A										Y		
2370-39926	U	A										Y		
2370-39927	U	A										Y		
2370-39928	U	A										Y		
2370-39929	M	A										G	G	
2370-39932	F	A									B	B	B	
2370-39933	U	A									Y			
2370-39934	U	A									Y			
2370-39935	U	A									Y			
2370-39937	M	A										Q	Q	Q
2370-39938	M	A										M	M	M
2370-39939	F	A										Q	Q	
2370-39940	M	A										M	M	M
2370-39941	M	J										Q	L[12]	
2370-39942	U	J										D		
2370-39943	U	J										D		
2370-39944	U	J										D		
2370-39945	U	J										P		
2370-39946	M	J										P	P	
2370-39947	U	J										P		
2370-39948	F	A										M		
2370-39949	U	J										Q		
2370-39950	U	J										Q		
2370-39951	M	A									P	P	P	P
2370-39953	M	A									P	P	P	P
2370-39954	M	A									Q	Q	Q	Q
2370-39956	F	A									D	D	D	
2370-39957	F	A									Q	Q		
2370-39958	F	A									P			
2370-39959	M	A									P		A	
2370-39960	M	A									K			
2370-39961	M	A									P			
2370-39962	F	A									P			
2370-39964	F	A									P	P	P	
2370-39965	U	A									D			
2370-39966	M	J									D		M	

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2370-39967	M	A										M	D[13]	Q
2370-39971	U	A									P			
2370-39972	U	A									I			
2370-39973	U	A									Y			
2370-39974	U	A									I			
2370-39975	M	A									D	M		
2370-39976	M	A									D			
2370-39977	U	J									P			
2370-39978	F	A									P			
2370-39979	U	J									P			
2370-39980	M	J									P	K	K	K
2370-39981	U	J									P			
2370-39982	U	A										Y		
2370-39983	U	A										Y		
2370-39984	U	A										Y		
2370-39985	U	A										Y		
2370-39986	M	A										G		
2370-39987	M	A										G		
2370-39988	M	A										G	M	M
2370-39989	M	A										G		
2370-39990	F	A										G		
2370-39992	M	A										T		
2370-39993	U	A										Y		
2370-39994	U	A										Y		
2370-39995	U	A										Y		
2370-39996	U	A										Y		
2370-39997	U	A										Y		
2370-39998	U	A										Y		
2370-40003	M	A										T		
2370-40004	F	A										B		
2370-40012	M	A									Q	Q	Q	
2370-40013	M	A									P	P		
2370-40014	F	A									P	P	P	
2370-40016	U	J									P			
2370-40017	M	A									M	M		
2370-40019	U	J									P			
2370-40020	U	J									P			
2370-40021	M	A									P	P		
2370-40032	M	A									B			
2370-40033	U	A									Y			
2370-40034	U	A									Y			
2370-40035	U	A									Y			
2370-40036	M	A										G[14]		
2370-40037	F	A										G	M	
2370-40038	M	A										G		
2370-40039	U	A										Y		
2370-40040	U	A										Y		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2370-40041	U	A										Y		
2370-40042	U	A										Y		
2370-40043	U	A										Y		
2370-40044	U	A										Y		
2370-40045	U	A										Y		
2370-40046	M	A										G	G[15]	M
2370-40047	F	A										P	P	P
2370-40052	M	A									B	B	B	B
2370-40053	M	A									B			
2370-40054	M	A									B			
2370-40055	F	A									T			
2370-40056	M	A									T			
2370-40057	M	A										D		
2370-40058	M	A										M	B	
2370-40059	F	A										D	D	D
2370-40060	M	A										P		P
2370-40061	F	A										P		
2370-40062	F	A										P	P	
2370-40063	U	J										Q		
2370-40064	U	J										P		
2370-40065	U	J										Q		
2370-40066	F	A										Q	Q	Q
2370-40067	U	J										Q		
2370-40068	U	J										Q		
2370-40069	U	J										M		
2370-40070	U	J										M		
2370-40071	U	J										P		
2370-40080	U	J										Q		
2370-40081	M	A										K		
2370-40082	F	A										K		
2370-40083	U	J										Q		
2370-40084	U	J										Q		
2370-40085	U	J											Q	
2370-40086	U	J											Q	M
2370-40087	F	A											Q	Q
2370-40096	U	J												K
2370-40097	U	J												K
2370-40098	U	J												K
2370-40100	U	J										K		
2370-40101	U	J										K		
2370-40102	U	J										K		
2370-40103	U	J										Q		
2370-40104	U	J										Q		
2370-40105	U	J										Q		
2370-40106	U	J										Q		
2370-40107	U	J										Q		
2370-40108	U	J										Q		

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2370-40110	U	J											T	
2370-40111	U	J											T	
2370-40112	U	J											T	
2370-40113	U	J											B	
2370-40114	U	J											T	
2370-40115	U	J											T	
2370-40116	U	J											T	
2370-40117	U	J											T	
2370-40118	U	J											T	
2370-40119	U	J											T	
2370-40120	U	J											T	
2370-40121	U	J											T	
2370-40122	U	J											T	
2370-40123	U	J											T	
2370-40124	U	J											T	
2370-40125	U	J											T	
2370-40126	M	A											G	
2370-40127	M	A											G	
2370-40129	M	A											G	
2370-40132	F	A											T	
2370-40133	F	A											B	
2370-40134	U	A											B	
2370-40135	F	A											B	
2370-40136	F	A											T	
2370-40137	M	A											B	
2370-40138	M	A											T	
2370-40139	M	A											T	T
2370-40147	U	J												S
2370-40148	U	J												S
2370-40149	U	J												S
2370-40157	M	A											P	
2370-40158	U	J											B	
2370-40159	U	J											B	
2370-40160	F	A											G	
2370-40161	M	A											M	M
2370-40164	U	J											Q	
2370-40166	U	A											P	
2370-40167	U	J											P	
2370-40168	F	A											P	P
2370-40169	U	J											M	
2370-40170	F	A											Q	Q
2370-40171	F	A											D	
2370-40173	M	A											M	M
2370-40183	F	A											M	
2370-40184	M	A											D	
2370-40185	M	A											P	
2370-40186	M	A											D	

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2370-40187	M	A											K	
2370-40188	U	J											Q	
2370-40190	U	J											P	
2370-40191	F	A											M	M
2370-40192	F	A											D	
2370-40193	F	A											Q	Q
2370-40194	F	A											P	P
2370-40195	F	A											P	P
2370-40197	M	A											M	Q
2370-40199	U	J											P	
2390-92348	F	J		T						T				
2390-92350	M	A				M	Q		Q	Q				
2390-92365	M	J				D			Q	Q	Q			
2390-92410	M	A					Q		Q					
2390-92420	M	J					Q	Q	Q					
2390-92421	M	J					Q	Q	Q	Q	M	M		
2390-92427	F	J					M		Q					
2390-92433	M	J					Q		Q	Q				
2390-92434	M	J					Q	Q		Q	Q	Q	Q	Q
2390-92451	F	J			M	M		Q		Q				
2390-92470	F	J					Q			Q				
2390-92475	M	J					M	Q	Q	Q	Q	Q	Q	Q
2430-31015	U	A											Y	
2430-31017	U	A											Y	
2430-61006	U	A											Y	
2430-61007	U	A											Y	
2430-61008	U	A											Y	
2430-61009	U	A											Y	
2430-61010	U	A											Y	
2430-61011	U	A											Y	
2430-61012	U	A											Y	
2430-61013	U	A											Y	
2430-61014	U	A											Y	
2430-61016	U	A											Y	
2430-61018	U	A											Y	
2430-61019	U	A											Y	
2430-61020	U	A											Y	
2430-61021	U	A											Y	
2430-61023	U	A											Y	
2430-61024	U	A											Y	
2430-61025	U	A											Y	
2430-61026	U	A											Y	
2430-61027	U	A											Y	
2430-61028	U	A											Y	
2430-61029	U	A											Y	
2430-61030	U	A											Y	
2430-61031	U	A											Y	

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2430-61032	U	A											Y	
2430-61033	U	A											Y	
2430-61034	U	A											Y	
2430-61035	U	A											Y	
2430-61036	U	A											Y	
2430-61037	U	A											Y	
2430-61038	U	A											Y	
2430-61039	U	A											Y	
2430-61040	U	A											Y	
2430-61041	U	A											Y	
2430-61042	U	A											Y	
2430-61043	U	A											Y	
2430-61044	U	A											Y	
2430-61045	U	A											Y	
2430-61046	U	A											Y	
2430-61047	U	A											Y	
2430-61048	U	A											Y	
2430-61049	U	A											Y	
2430-61050	U	A											Y	
2430-61051	U	A											Y	
2430-61052	U	A											Y	
2430-61053	U	A											Y	
2430-61054	U	A											Y	
2430-61055	U	A											Y	
2430-61056	U	A											Y	
2430-61058	U	A											Y	
2430-61059	U	A											Y	
2430-61060	U	A											Y	
2430-61061	U	A											Y	
2430-61062	U	A											Y	
2430-61063	U	A											Y	
2430-61064	U	A											Y	
2430-61065	U	A											Y	
2430-61067	U	A											Y	
2430-61068	U	A											Y	
2430-61069	U	A											Y	
2430-61070	U	A											Y	
2430-61071	U	A											Y	
2430-61072	M	A												G
2430-61073	M	A												B
2430-61074	U	J												B
2430-61075	U	J												B
2430-61076	U	J												B
2430-61077	U	J												M
2430-61078	U	J												Q
2430-61079	F	A												M
2430-61080	M	A												P

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2430-61081	U	J												M
2430-61082	U	J												Q
2430-61083	M	A												P
2430-61084	U	J												Q
2430-61101	U	J												K
2430-61102	U	J												K
2430-61103	M	A												D
2430-61104	M	A												M
2430-61105	M	A												Q
2430-61106	U	J												P
2430-61107	U	J												P
2430-61108	U	J												P
2430-61109	F	A												K
2430-61110	U	J												K
2430-61111	U	J												P
2430-61112	U	J												P
2430-61113	U	J												P
2430-61114	U	J												P
2430-61115	U	J												P
2430-61116	F	A												M
2430-61117	U	J												P
2430-61118	U	J												P
2430-61119	U	J												P
2430-61120	U	J												P
2430-61121	U	J												Q
2430-61122	U	J												P
2430-61123	U	J												P
2430-61124	U	J												P
2430-61125	M	A												K
2430-61126	U	J												S
2430-61127	M	A												P
2430-61128	U	J												M
2430-61129	U	J												Q
2430-61130	U	J												Q
2430-61131	U	J												M
2430-61132	U	J												M
2430-61133	U	J												M
2430-61134	M	A												T
2430-61135	M	A												T
2430-61136	M	A												B
2430-61137	F	A												B
2430-61138	F	A												B
2430-61139	F	A												T
2430-61140	U	J												B
2430-61141	U	J												B
2430-61142	U	J												B
2430-61143	U	J												T

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2430-61144	U	J												T
2430-61145	U	J												T
2430-61165	U	J												Q
2430-61167	M	A												M
2430-61168	U	J												M
2430-61169	U	J												M
2430-61170	U	J												M
2430-61171	U	J												M
2430-61172	U	J												M
2430-61173	U	J												M
2430-61174	U	J												M
2430-61175	U	J												Q
2430-61176	U	J												Q
2430-61177	U	J												Q
2430-61178	M	A												K
2430-61179	M	A												K
2430-61180	M	A												K
2430-61181	F	A												K
2430-61182	M	A												K
2430-61183	M	A												K
2430-61184	U	J												Q
2430-61185	U	J												Q
2430-61186	U	J												Q
2430-61187	U	J												Q
2430-61188	U	J												Q
2430-61189	U	J												Q
2430-61190	U	J												Q
2430-61191	U	J												M
2430-61192	U	J												M
2430-61193	U	J												M
2430-61194	U	J												Q
2430-61195	U	J												Q
2430-61196	U	J												Q
2430-61197	U	J												P
2430-61198	U	J												P
2430-61199	U	J												P
2430-61200	U	J												P
2430-61202	U	J												M
2430-61203	U	J												M
2430-61204	U	J												M
2430-61205	U	J												M
2430-61206	U	J												M
2430-61207	U	J												M
2430-61208	U	J												D
2430-61209	M	A												V
2430-61210	U	A												K
2430-61211	U	J												S

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]											
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2430-61212	U	J												M
2430-61223	U	J												D
2430-61224	U	J												D
2430-61225	U	J												D
3500-68963	U	J								T				
3500-68968	U	J								P				
3500-68969	U	J								P				
3500-68972	F	J								P	P	P		

[1] K = Key Pittman, P = Pahranagat NWR, W = Meadow Valley Wash, L = Littlefield, Q = Mesquite, M = Mormon Mesa, D = Muddy River, G = Grand Canyon, T = Topock Marsh, B = Bill Williams River NWR, I = Imperial NWR, Y = Yuma, S = St. George, V = Las Vegas Wash, R = Roosevelt Lake, A = Ash Meadows. Study area indicated is the study area where the individual was first detected during the given season. Within-season movements are indicated with individual footnotes.

[2] M = male, F = female, U = unknown.

[3] A = adult, J = juvenile.

[4] Within-season movement from Mormon Mesa to Mesquite.

[5] Within-season movement from Mesquite to Mormon Mesa.

[6] Within-season movement from Mesquite to Mormon Mesa

[7] Within-season movement from Littlefield to Mesquite.

[8] Within-season movement from Grand Canyon to Mesquite.

[9] Within-season movement from Mormon Mesa to Muddy River.

[10] Within-season movement from Muddy River to Mormon Mesa.

[11] Within-season movement from Pahranagat to Key Pittman.

[12] Within-season movement from Littlefield to Mesquite.

[13] Within-season movement from Muddy River to Mesquite.

[14] Within-season movement from Grand Canyon to Mesquite.

[15] Within-season movement from Grand Canyon to Mormon Mesa.

Appendix E

HYDROGRAPHS FOR PIEZOMETERS AT HABITAT MONITORING SITES

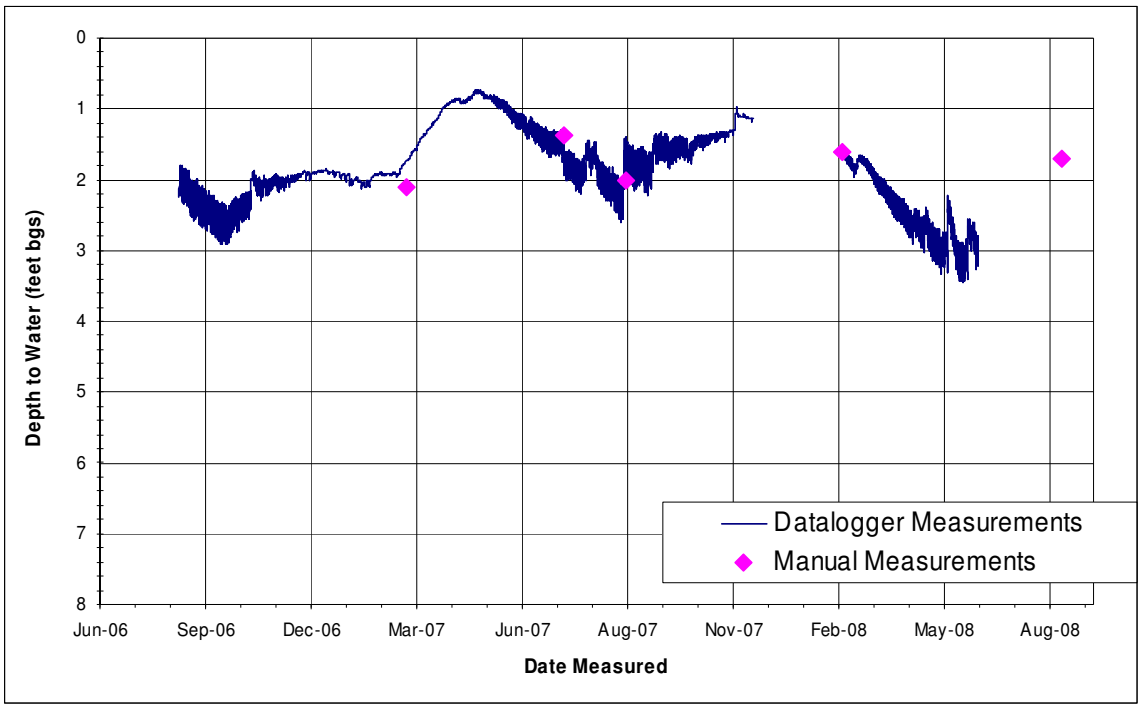


Figure E1. Hydrograph for piezometer at Topock Marsh.

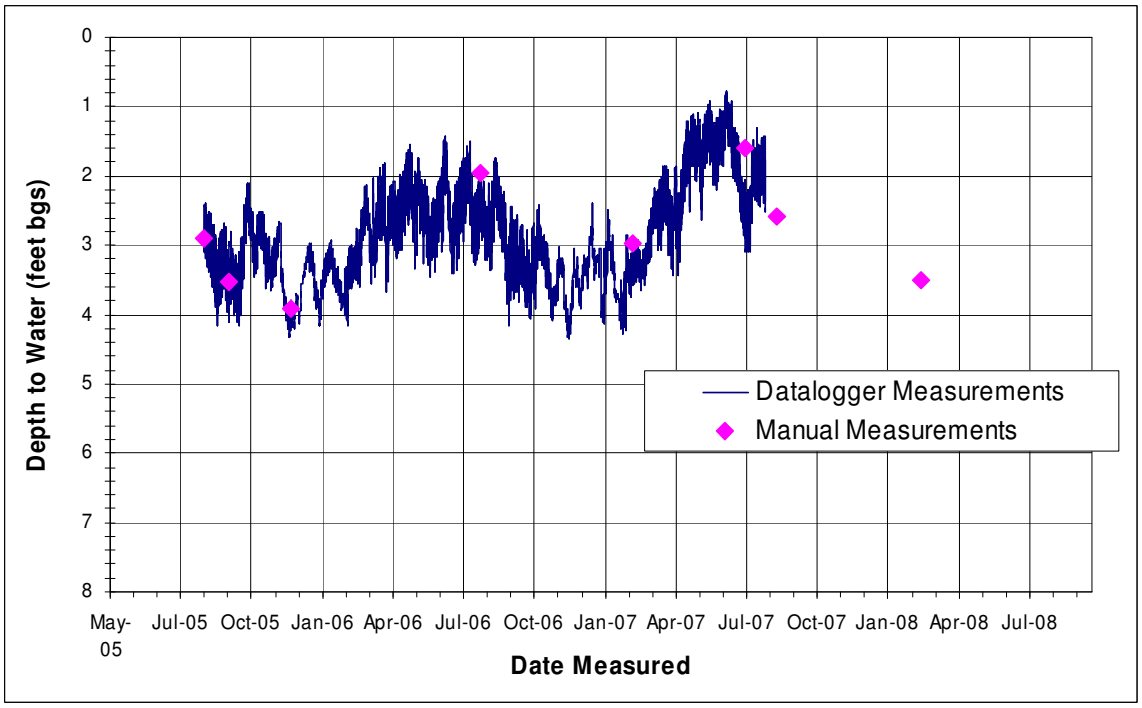


Figure E2. Hydrograph for piezometer at Blankenship Bend.

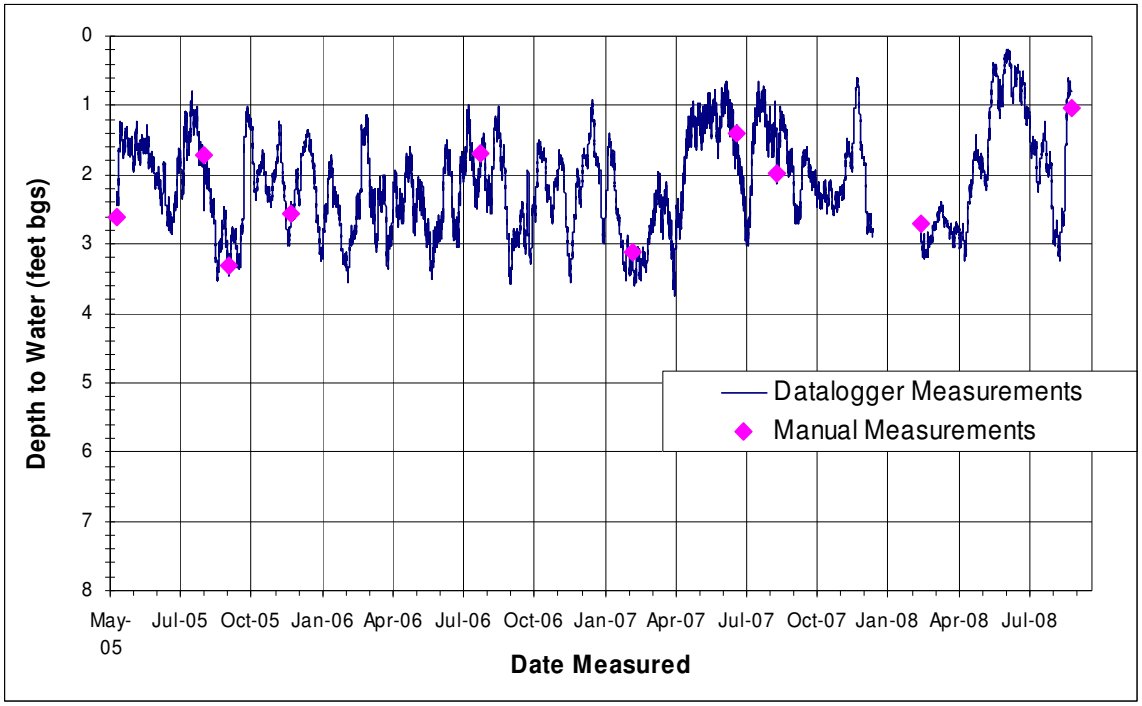


Figure E3. Hydrograph for piezometer at Havasu NE.

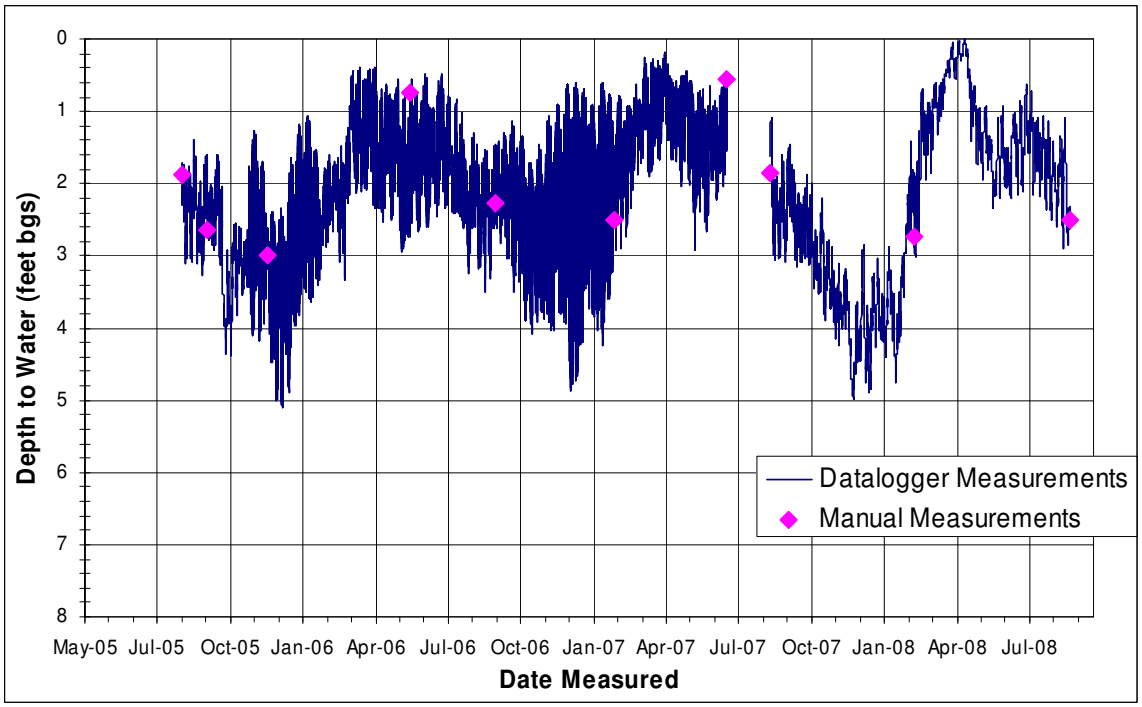


Figure E4. Hydrograph for piezometer at Ehrenberg.

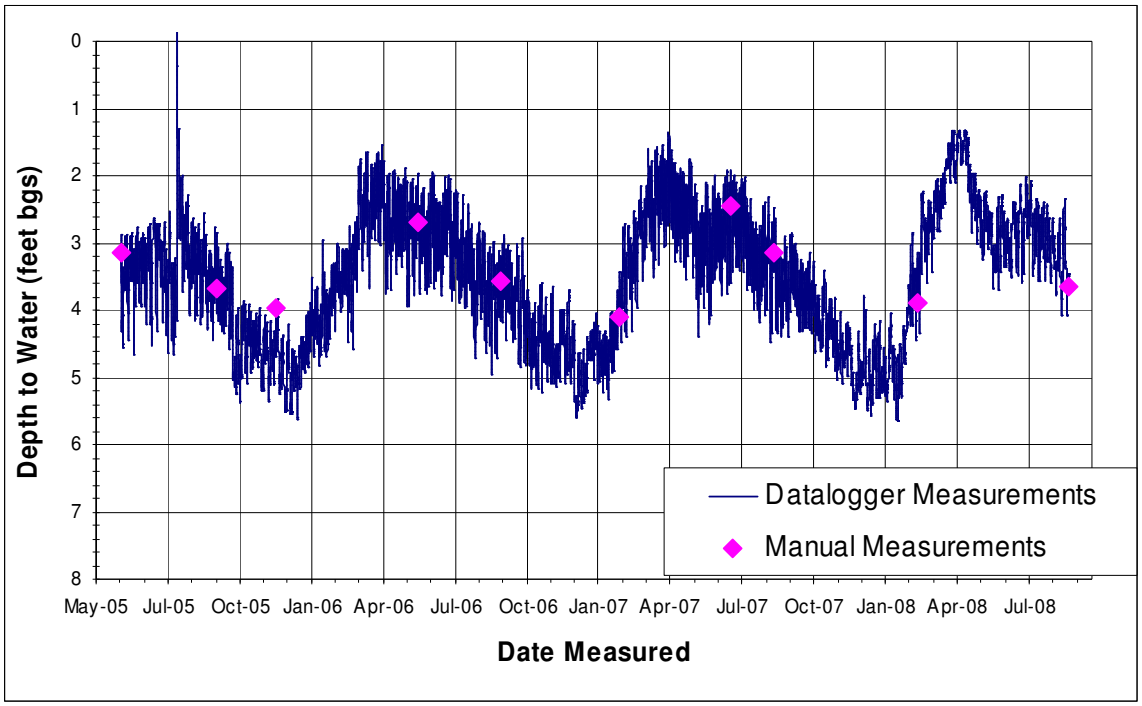


Figure E5. Hydrograph for piezometer at Three Fingers Lake.

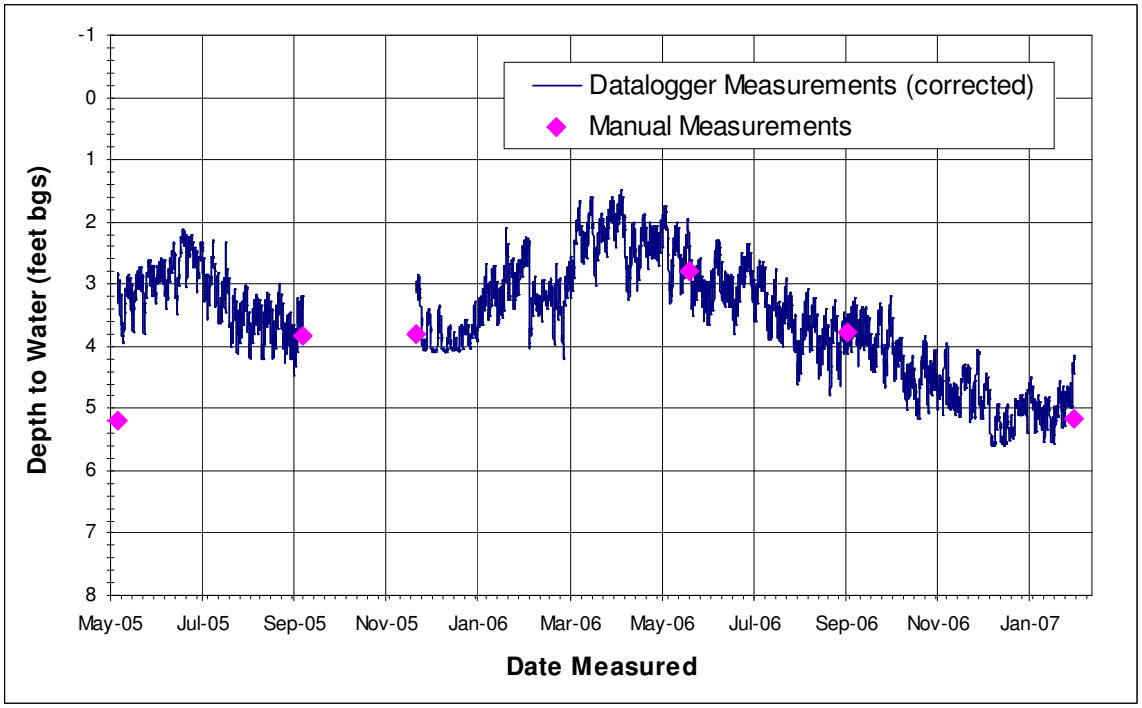


Figure E6. Hydrograph for piezometer at Cibola Lake.

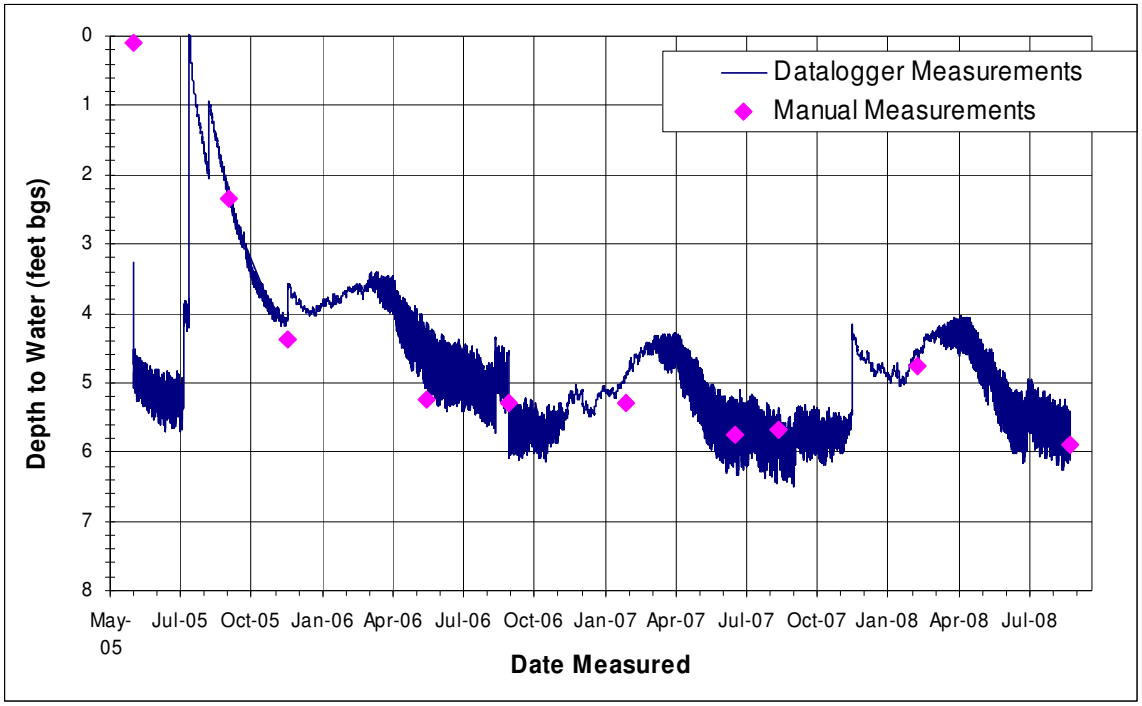


Figure E7. Hydrograph for piezometer at Walker Lake.

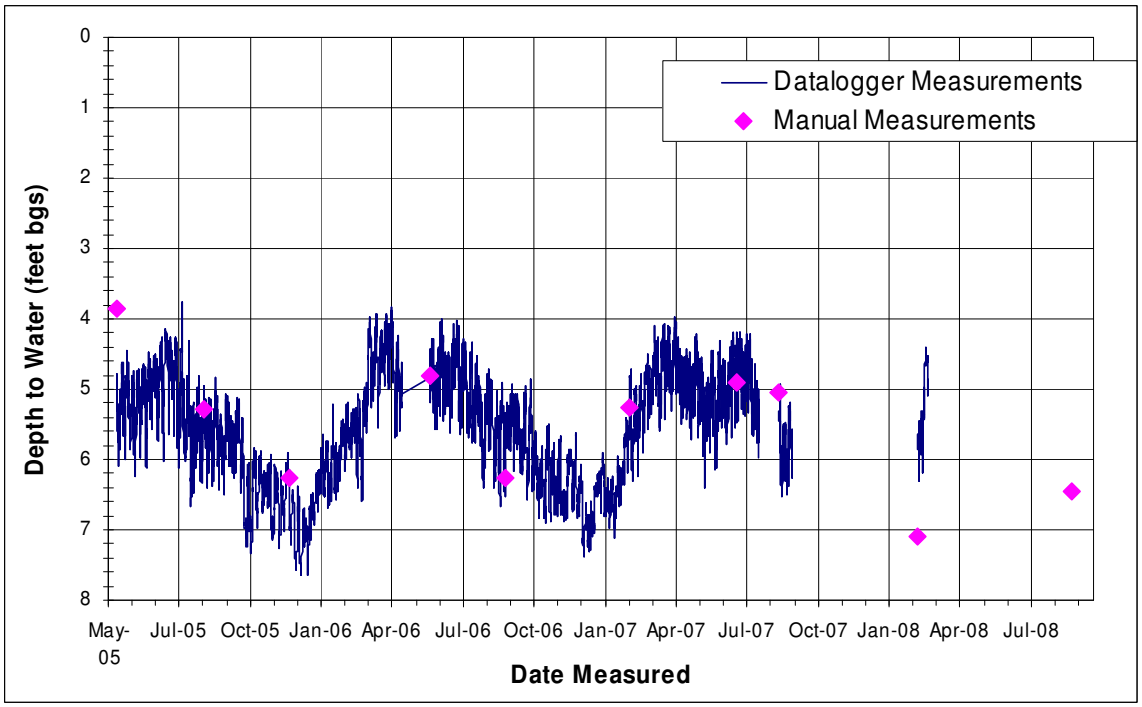


Figure E8. Hydrograph for piezometer at Paradise.

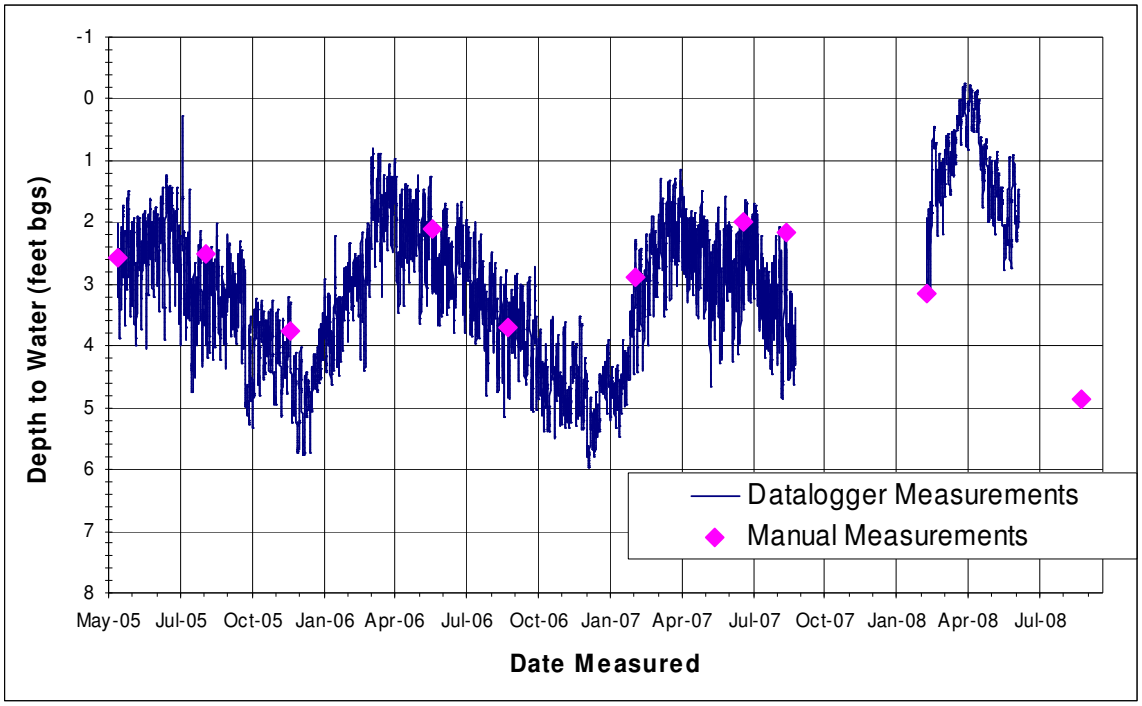


Figure E9. Hydrograph for piezometer at Hoge Ranch.

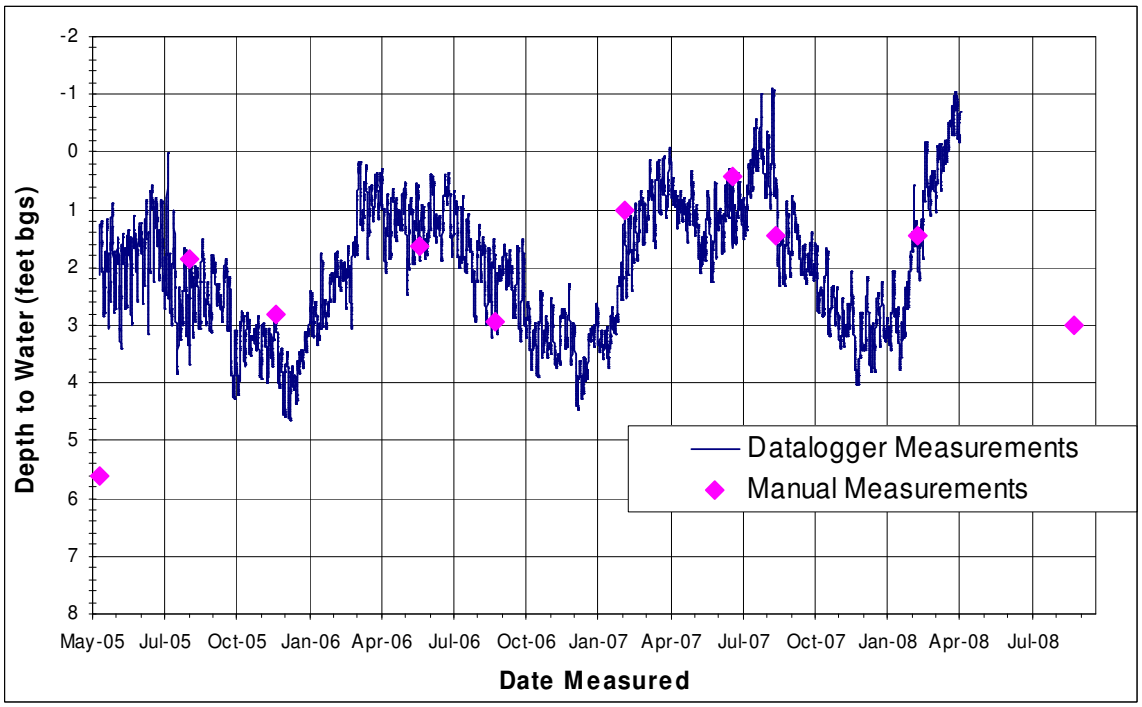


Figure E10. Hydrograph for piezometer at Rattlesnake.

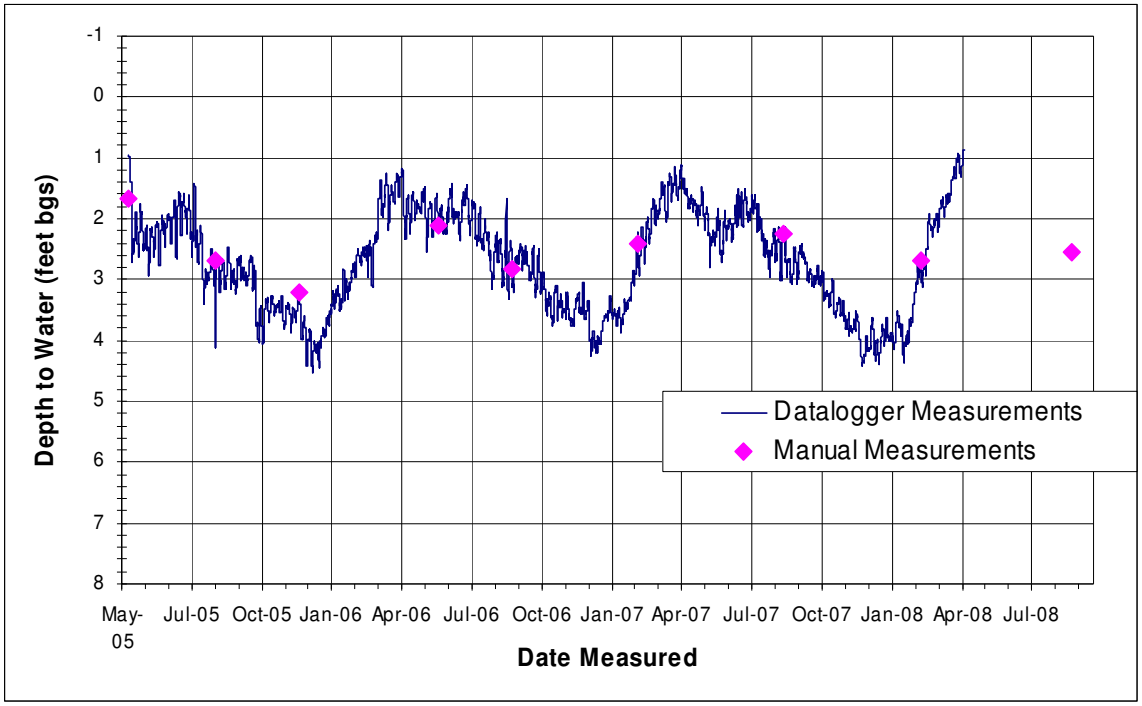


Figure E11. Hydrograph for piezometer at Clear Lake.

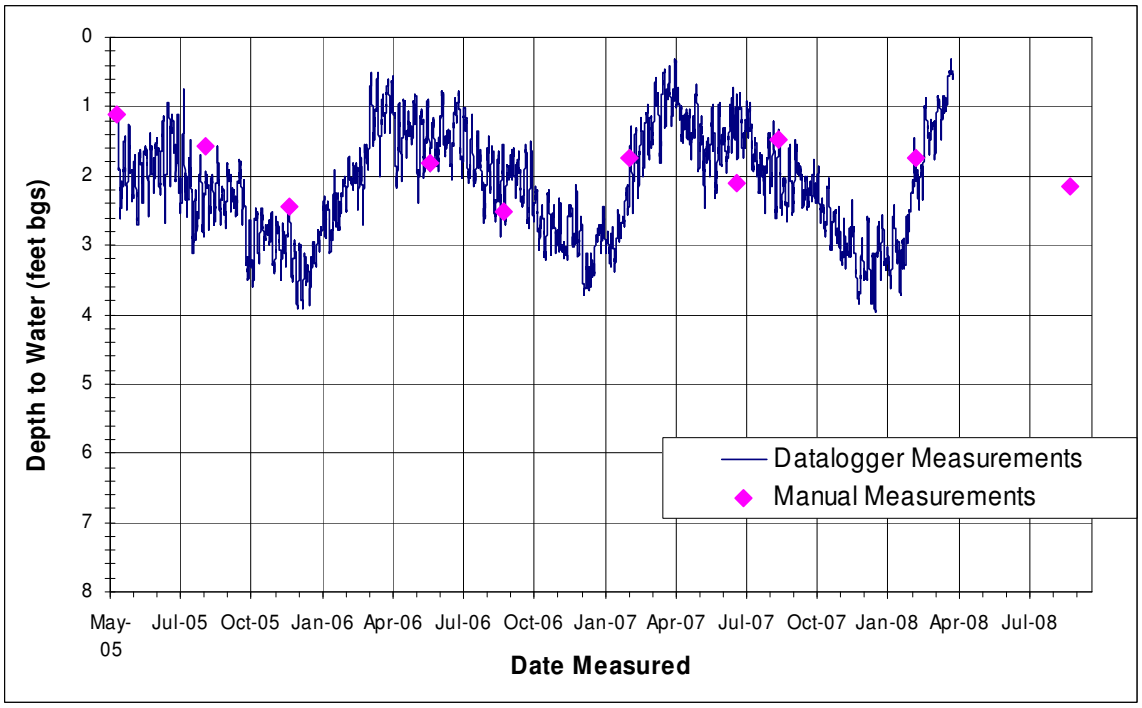


Figure E12. Hydrograph for piezometer at Ferguson Lake.

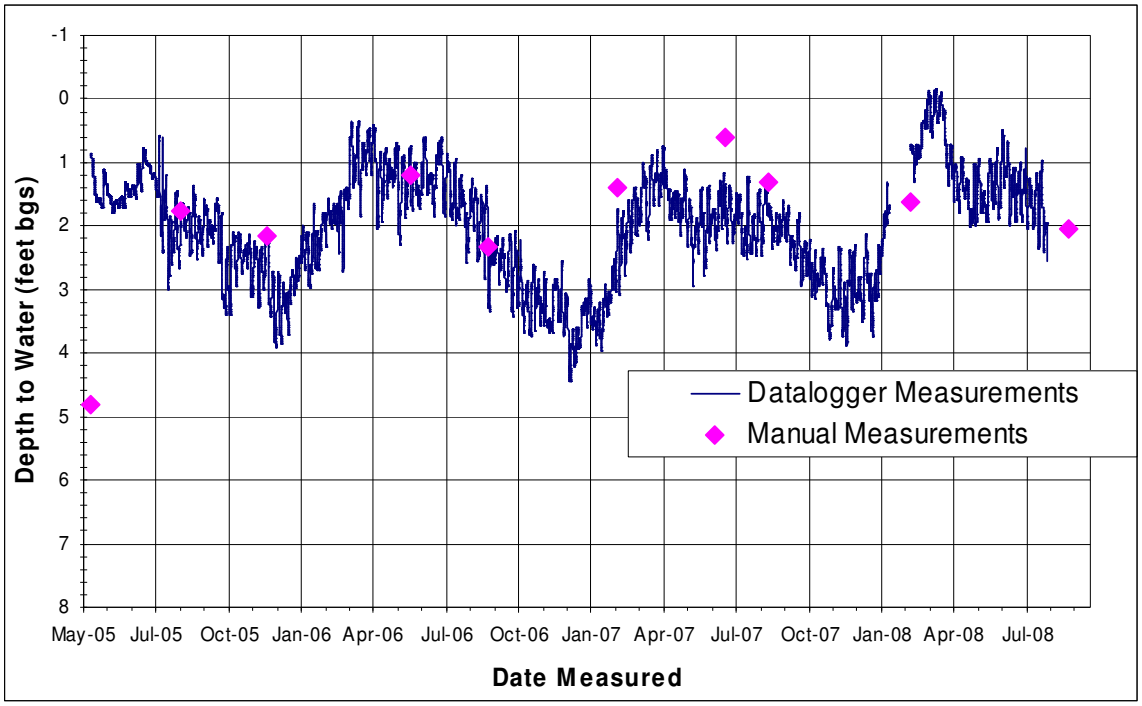


Figure E13. Hydrograph for piezometer at Ferguson Wash.

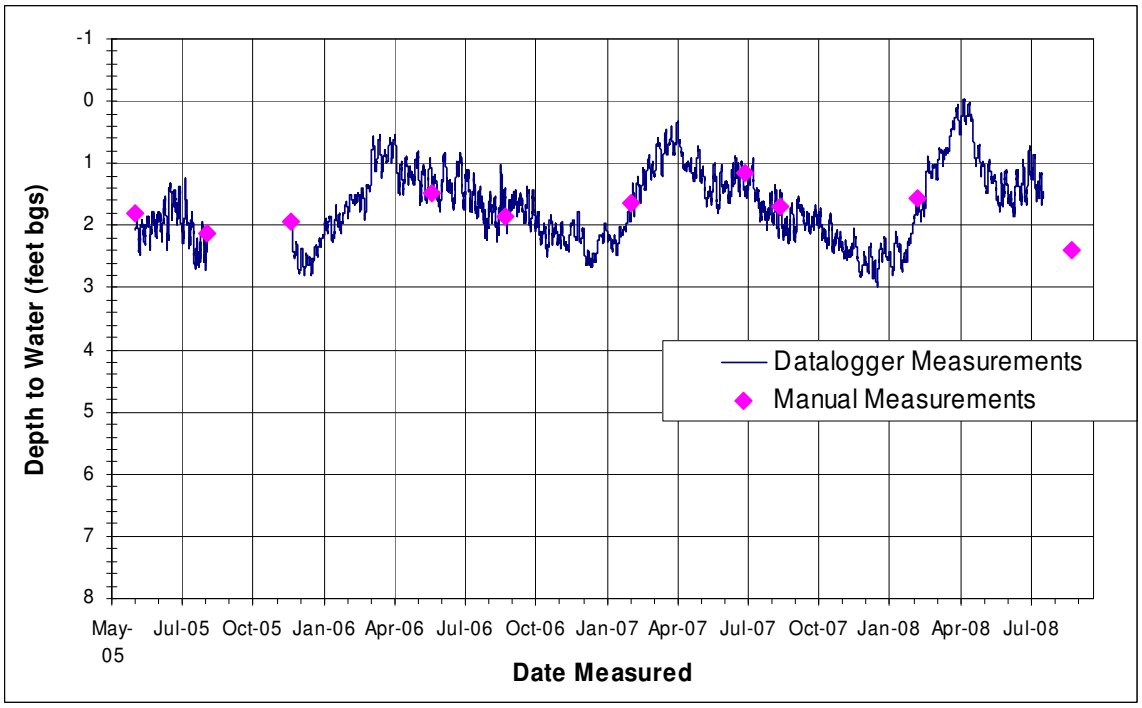


Figure E14. Hydrograph for piezometer at Great Blue Heron.

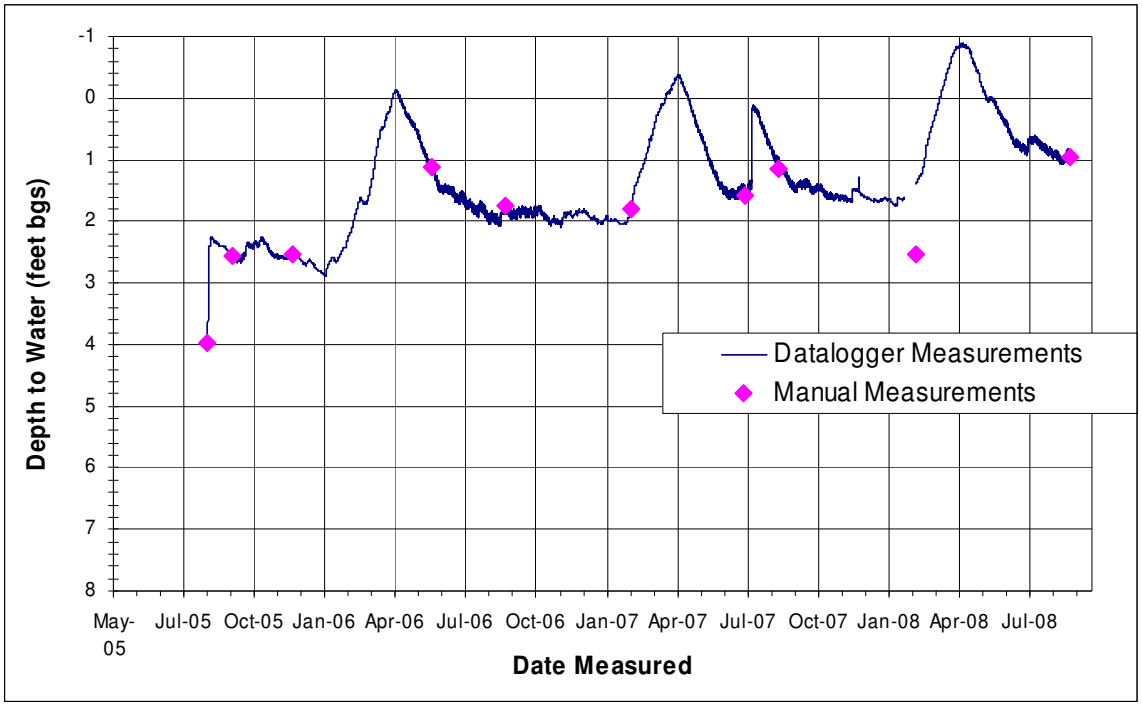


Figure E15. Hydrograph for piezometer at Mittry West.

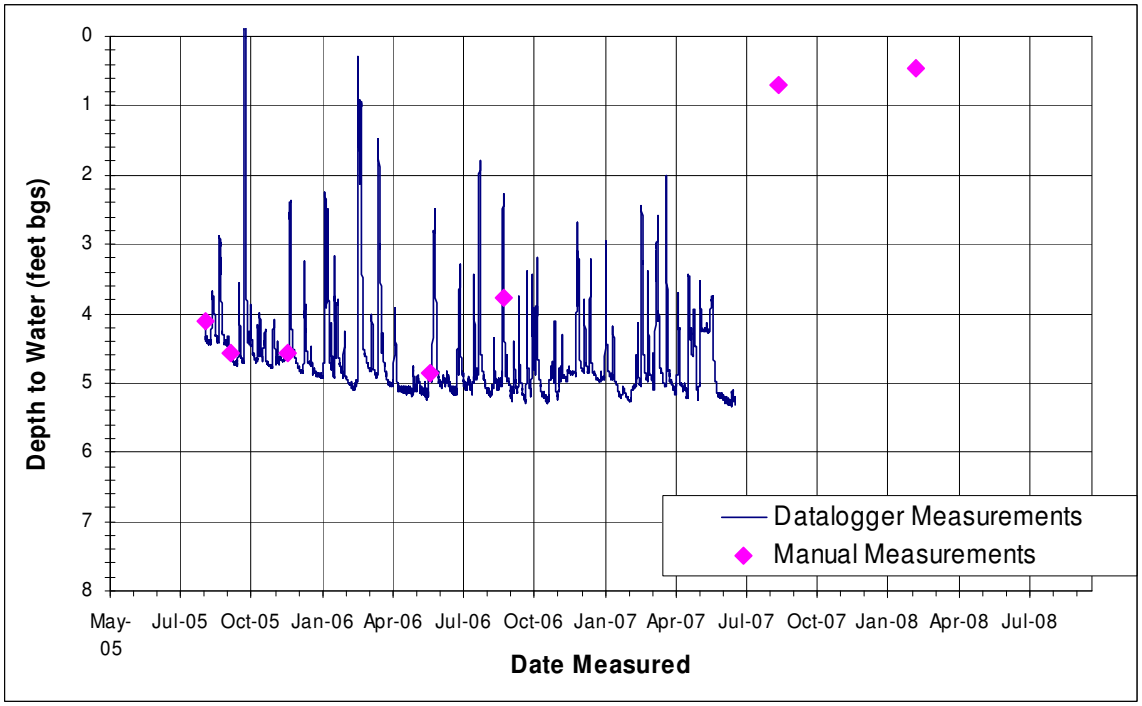


Figure E16. Hydrograph for piezometer at Gila Confluence North.

Appendix F

CONTRIBUTING PERSONNEL

Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Field Supervisor
Wendy Langeberg, M.S.	Statistician
Glenn A. Dunno, M.A.	GIS Specialist
Christopher J. Garrett, P. HGW.	Hydrologist
DeAnne Rietz, M.S.	Hydrologist
Lisa R. Baca	Database Development/Formatting Specialist
Jessica Maggio	Project Administrator/Data Entry
Kimberly MacMillan	Administrative Assistant/Data Entry
Dorothy A. House, M.A.	Technical Editor
Cheryl Schweizer.	Field Coordinator
Laura Stewart.	Field Coordinator
Emma DeLeon	Bander/Nest Monitor
Zachary Kaiser	Bander/Nest Monitor
Ryan Pottinger	Bander/Nest Monitor
Jason Thomas	Bander/Nest Monitor
Kristen Dillon	Surveyor/Nest Monitor
Angelina Robinson	Surveyor/Nest Monitor
Gregory Ainsworth	Surveyor
Corina Anderson	Surveyor
Jonathon West	Surveyor
Jeremy Doschka	Vegetation Field Assistant
Devin Keane	Piezometer Maintenance/Data Entry
Kevin Serrato	Piezometer Maintenance

Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations Along the Virgin and Lower Colorado River Regions, 2008.



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2009

AR064055

Lower Colorado River Multi-Species Conservation Program
Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

Lower Colorado River Multi-Species Conservation Program

Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations along the Virgin and Lower Colorado River Regions, 2008. Annual Report

Prepared by Mary Anne McLeod and Thomas J. Koronkiewicz,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2009

PREFACE

This document is one of the deliverables submitted to the U.S. Bureau of Reclamation under contract # GS-10F-0209L to complete Southwestern Willow Flycatcher (*Empidonax traillii extimus*) studies along the lower Colorado River and tributaries in 2008. The document comprises a list of all sites surveyed for willow flycatchers in 2008 and the UTM coordinates (Zone 11, NAD 83) of the centroid of each site (Table 1), along with a compilation of aerial photographs. These aerial photographs include the location, identity, and breeding status of each willow flycatcher detected at study areas where resident flycatchers were detected during 2008 (Figure 1). For additional information regarding methodology and willow flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries in 2008 refer to:

> McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 153 pp.

This document is intended for use only by the U.S. Fish and Wildlife Service, the U.S. Geological Survey, Nevada Division of Wildlife, California Department of Fish and Game, and the Arizona Game and Fish Department. Specific locations of Southwestern Willow Flycatcher territories and nests may be considered by some agencies as sensitive information. Therefore, this document is not intended for general distribution. Please contact the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service for permission to copy and distribute this document.

Color Leg Band Combination Codes:

Color-band codes used on each aerial photograph follow the conventions presented below:

Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band and color-band designations for right and left legs are separated with a colon. **EE** = electric yellow federal band, **PU** = pumpkin federal band, **XX** = standard silver federal band, **Bs** = blue federal band, **R** = red, **D** = dark/navy blue, **B** = light blue, **K** = black, **V** = violet, **Z** = gold, **Y** = yellow, **G** = green, **W** = white, **O** = orange, **UB** = unbanded, **(M)** = metal pin striped band.

Nest and Willow Flycatcher Location Codes:

Nest and willow flycatcher location codes on each aerial photograph follow the conventions presented below:

Blue	the approximate use area center for individual willow flycatchers detected at the site for less than 7 days
Yellow	a willow flycatcher nest location
Red	the approximate territory center for a single, territorial willow flycatcher detected at the site for 7 or more days
Green	the approximate territory center for a willow flycatcher pair for which no nesting was confirmed

All locations on the aerial photographs were based on UTM coordinates (Zone 11, NAD 83) obtained in the field in 2008 using a Garmin Rino 110 GPS unit.

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2008

Study Area[1]	Survey Site	Area (ha)	UTM coordinate of site centroid
PAHR	North	4.6	665781E 4130976N
	West	1.5	665539E 4130426N
	MAPS	2.7	666143E 4128798N
	South	2.5	666689E 4128037N
LIFI	Poles	2.6	773248E 4088378N
MESQ	East	4.4	758641E 4075312N
	West	11.5	757886E 4075442N
	Electric Avenue North	1.8	756284E 4074571N
	Electric Avenue South	3.9	755963E 4074390N
	Bunker Farm	1.9	755313E 4073821N
MOME	Mormon Mesa North	8.2	739718E 4058156N
	Hedgerow	1.1	740216E 4057982N
	Mormon Mesa South (North half)	12.9	739545E 4057280N
	Mormon Mesa South (South half)	7.0	739405E 4056915N
	Virgin River #1 (North half)	16.5	739296E 4056211N
	Virgin River #1 (South half)	24.9	739272E 4055482N
	Virgin River #2	36.9	739050E 4054326N
MUDD	Overton WMA Pond	0.7	731155E 4045638N
	Overton WMA	14.9	731660E 4044514N
GRCA	Burnt Springs	11.0	793321E 3985796N
	RM 274.5N	18.3	777192E 3999487N
	RM 285.3N	8.6	769035E 4010274N
	Iceberg Canyon	3.1	761931E 4004569N
TOPO	Pipes #1	5.2	726906E 3856907N
	Pipes #3	5.7	727012E 3856517N
	The Wallows	0.4	727209E 3856173N
	Pig Hole	2.4	727233E 3855415N
	PC6-1	4.8	727235E 3855838N
	In Between	7.7	727036E 3855171N
	800M	6.1	726882E 3854999N
	Pierced Egg	6.7	726668E 3855001N
	Swine Paradise	2.4	726269E 3854475N
	Barbed Wire	2.6	726155E 3854547N
	IRFB03	1.0	725948E 3854349N
	IRFB04	1.5	725944E 3854243N
	Platform	1.3	725831E 3853980N
	250M	2.3	725849E 3853499N
	Hell Bird	3.7	725883E 3853252N

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2008 (Continued)

Study Area[1]	Survey Site	Area (ha)	UTM coordinate of site centroid
TOPO	Glory Hole	5.0	725671E 3853043N
	Beal Lake	13.9	725957E 3850916N
	Lost Slough	1.5	726658E 3848259N
	Lost Pond	1.2	727134E 3847698N
	Lost Lake	3.3	727971E 3846984N
TOGO	Blankenship Bend North	26.7	736561E 3832765N
	Blankenship Bend South	25.9	736682E 3831524N
	Havasu NE	12.6	741198E 3823810N
BIWI	Site #2	3.1	769086E 3798243N
	Site #11	6.3	769386E 3797881N
	Site #4	9.9	769684E 3797558N
	Site #3	9.5	769928E 3797286N
	Site #5	9.0	771850E 3796677N
	Mineral Wash Complex	18.8	774643E 3795231N
	Beaver Pond	21.7	775240E 3794649N
	Site #8	10.3	777902E 3794686N
AHAK	Willow Beach	2.0	744912E 3780068N
	Deer Island	91.6	741800E 3777831N
BIHO	Big Hole Slough	16.6	728522E 3724192N
EHRE	Ehrenberg	4.7	729946E 3715773N
CIBO	CVCA	26.2	717274E 369926N
	Cibola Nature Trail	13.7	716008E 3694360N
	Cibola Island	4.2	714894E 3685438N
	Three Fingers Lake	67.9	715070E 3681825N
	Cibola Lake #1 (North)	8.5	716458E 3680005N
	Cibola Lake #3 (West)	6.8	716750E 3679324N
	Walker Lake	11.4	716003E 3676276N
IMPE	Draper Lake	4.6	716225E 3671832N
	Paradise	7.8	714120E 3666214N
	Hoge Ranch	20.7	717175E 3660307N
	Adobe Lake	7.6	717301E 3659042N
	Rattlesnake	7.6	719879E 3659586N
	Clear Lake/The Alley	8.3	731425E 3657901N
	Nursery NW	7.0	733900E 3654066N
	Imperial Nursery	1.4	734247E 3653822N
	Ferguson Lake	21.1	733587E 3651733N
	Ferguson Wash	6.8	733936E 3650383N
	Great Blue Heron	7.1	736876E 3652307N

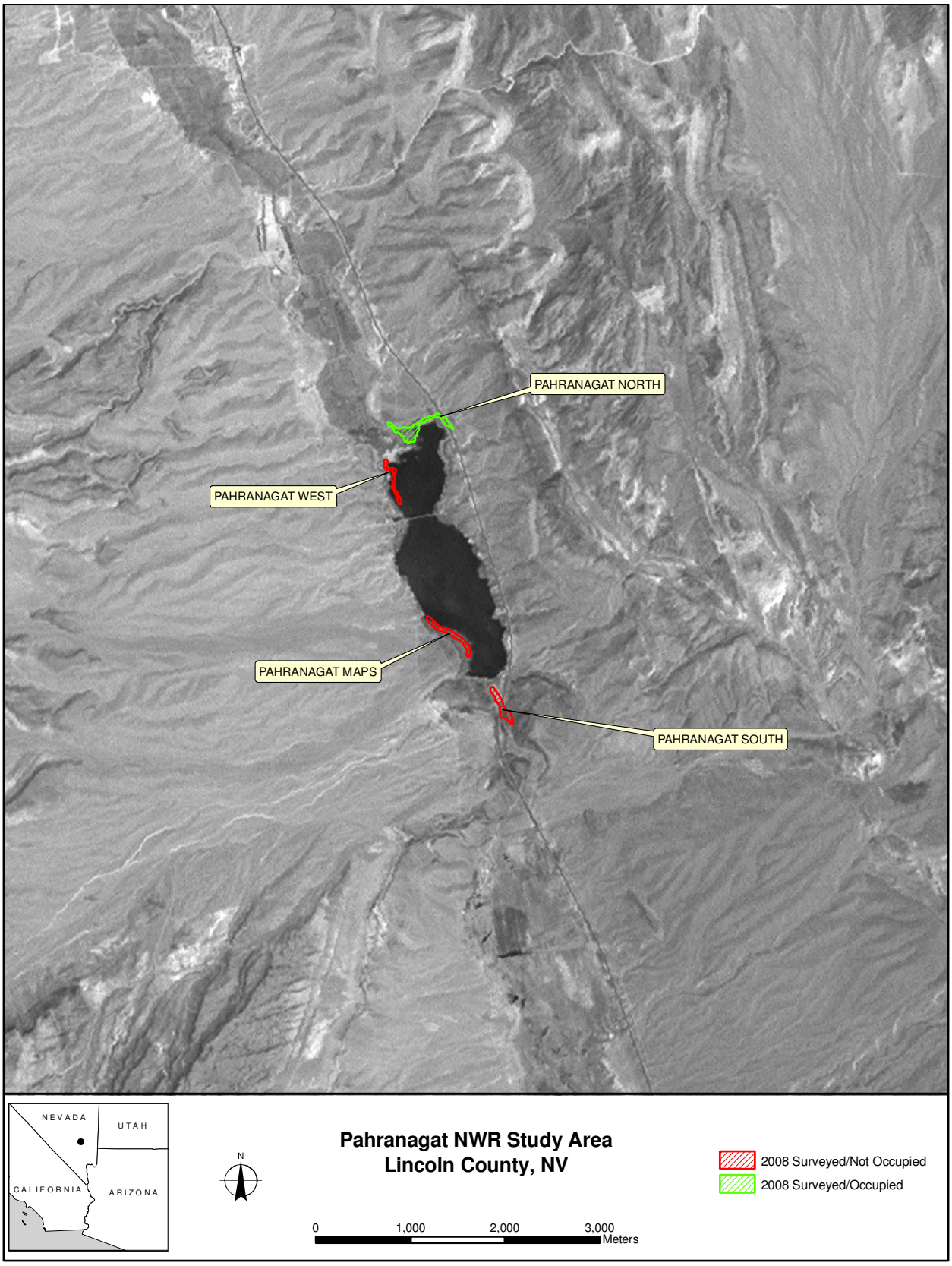
Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2008 (Continued)

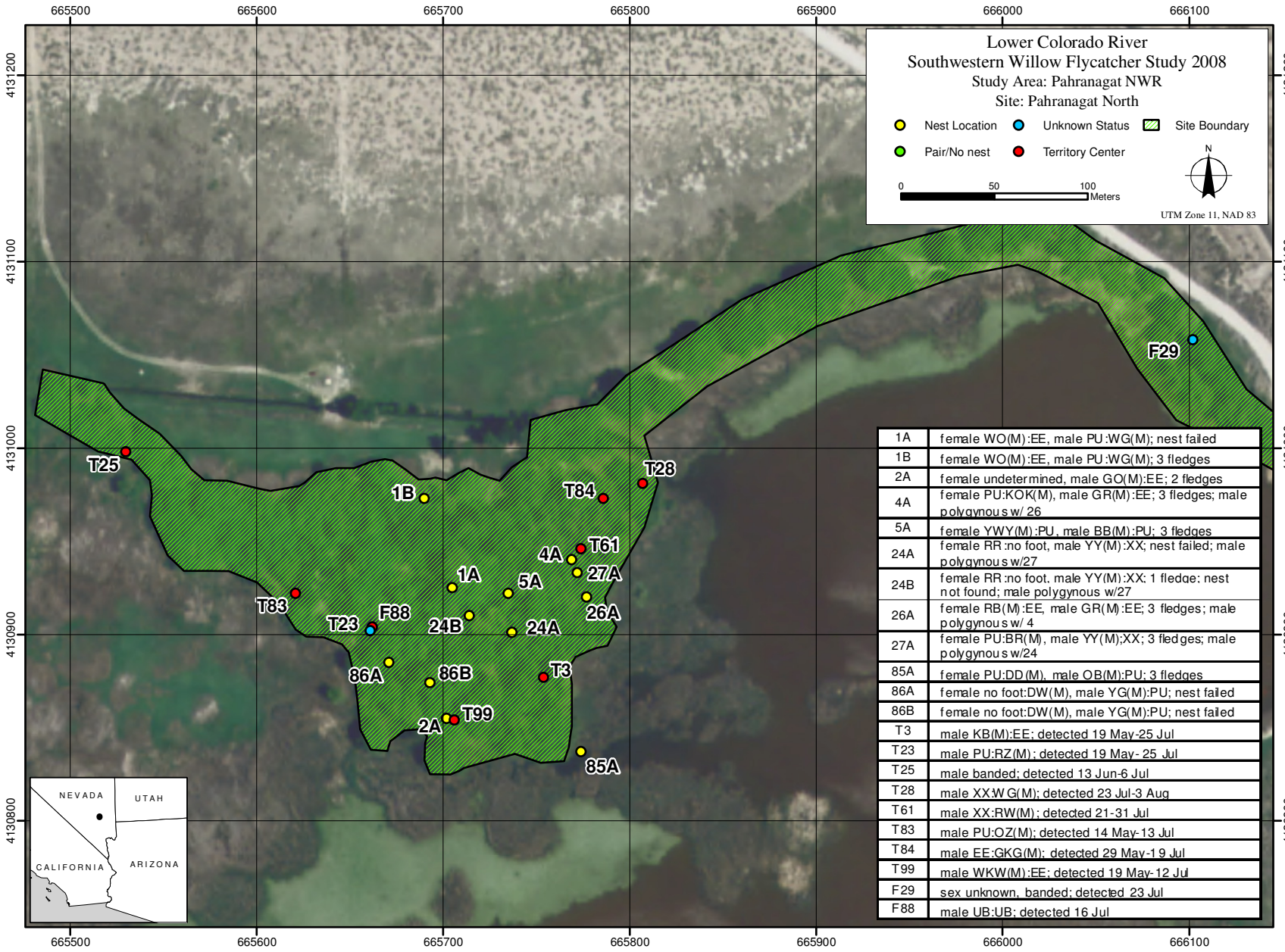
Study Area[1]	Survey Site	Area (ha)	UTM coordinate of site centroid
MITT	Mittry West	4.4	734967E 3638617N
	Mittry South	15.2	735825E 3634342N
YUMA	Gila Confluence North	2.2	729604E 3623167N

[1] PAHR = Pahranagat National Wildlife Refuge (NWR); LIFI = Littlefield; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River, GRCA = Grand Canyon; TOPO = Topock Marsh; TOGO = Topock Gorge; BIWI = Bill Williams River NWR; AHAK = Ahakhav Tribal Preserve, BIHO = Big Hole Slough; EHRE = Ehrenberg; CIBO = Cibola NWR; IMPE = Imperial NWR; MITT = Mittry Lake; YUMA = Yuma.



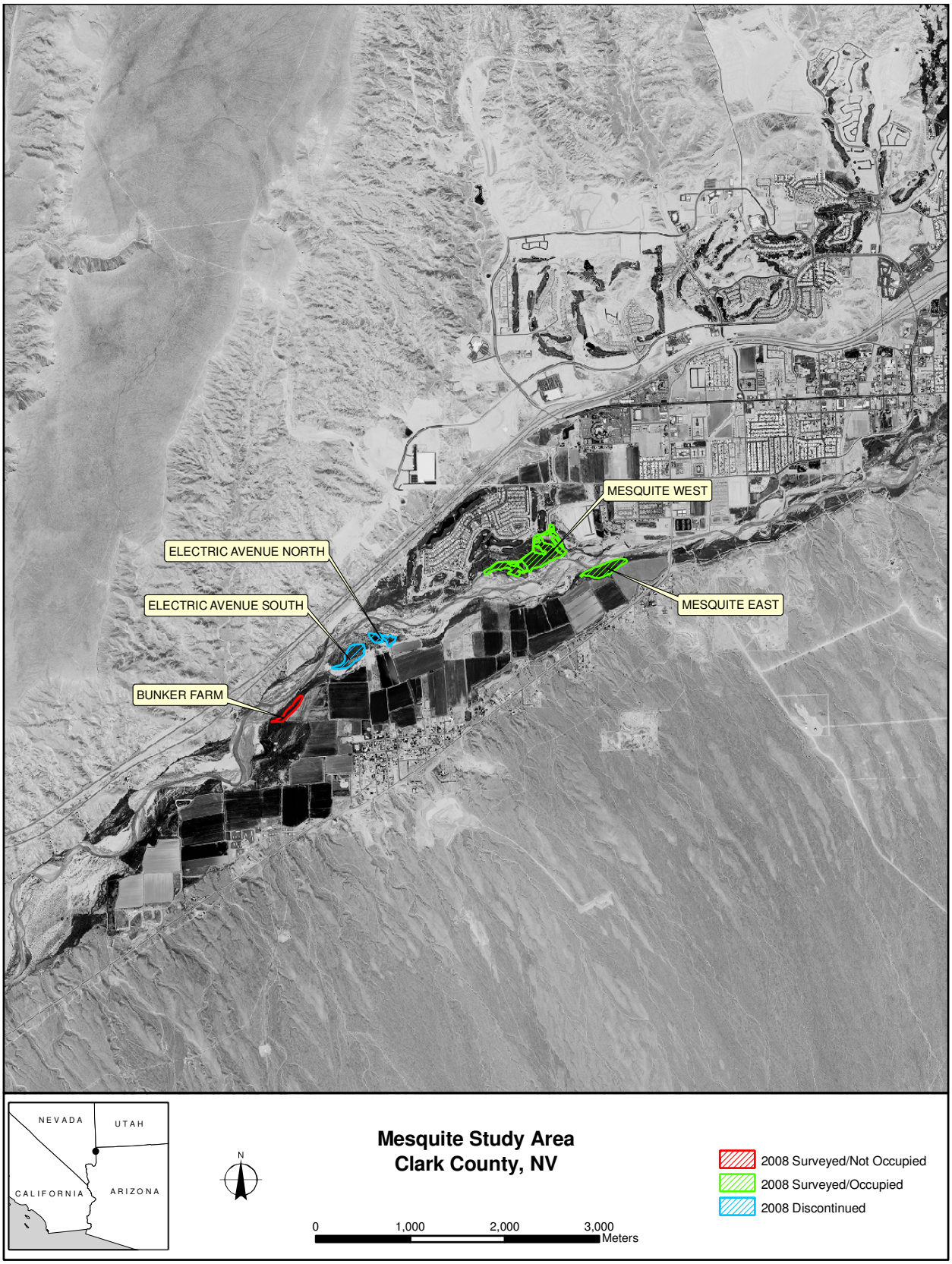
Figure 1. Locations of resident Southwestern Willow Flycatcher populations along the Virgin and lower Colorado Rivers, 2008.

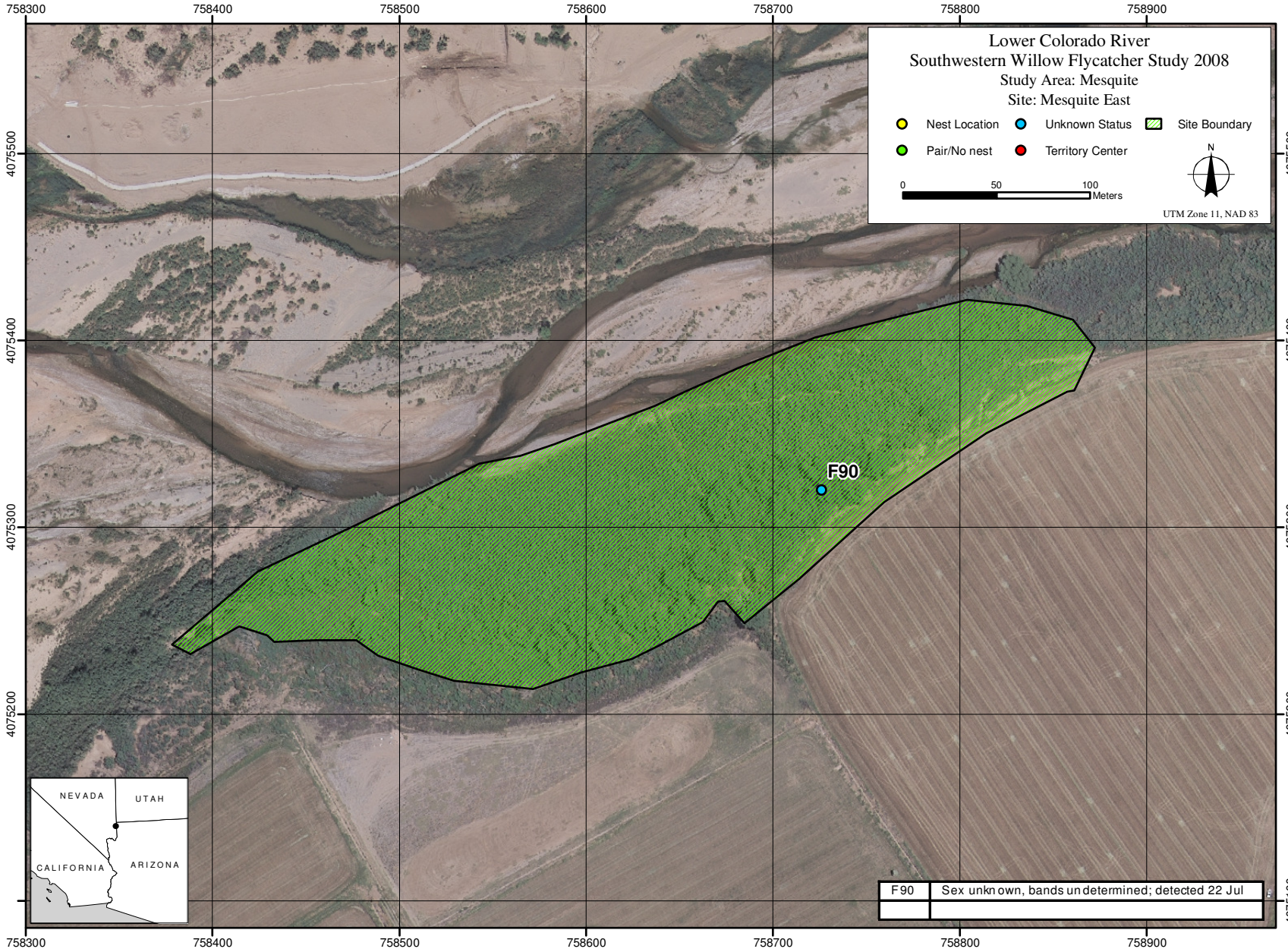

PAHRANAGAT NORTH
PAHRANAGAT WEST
PAHRANAGAT MAPS
PAHRANAGAT SOUTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Pahranagat NWR Study Area
Lincoln County, NV
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
0
1,000
2,000
3,000
Meters

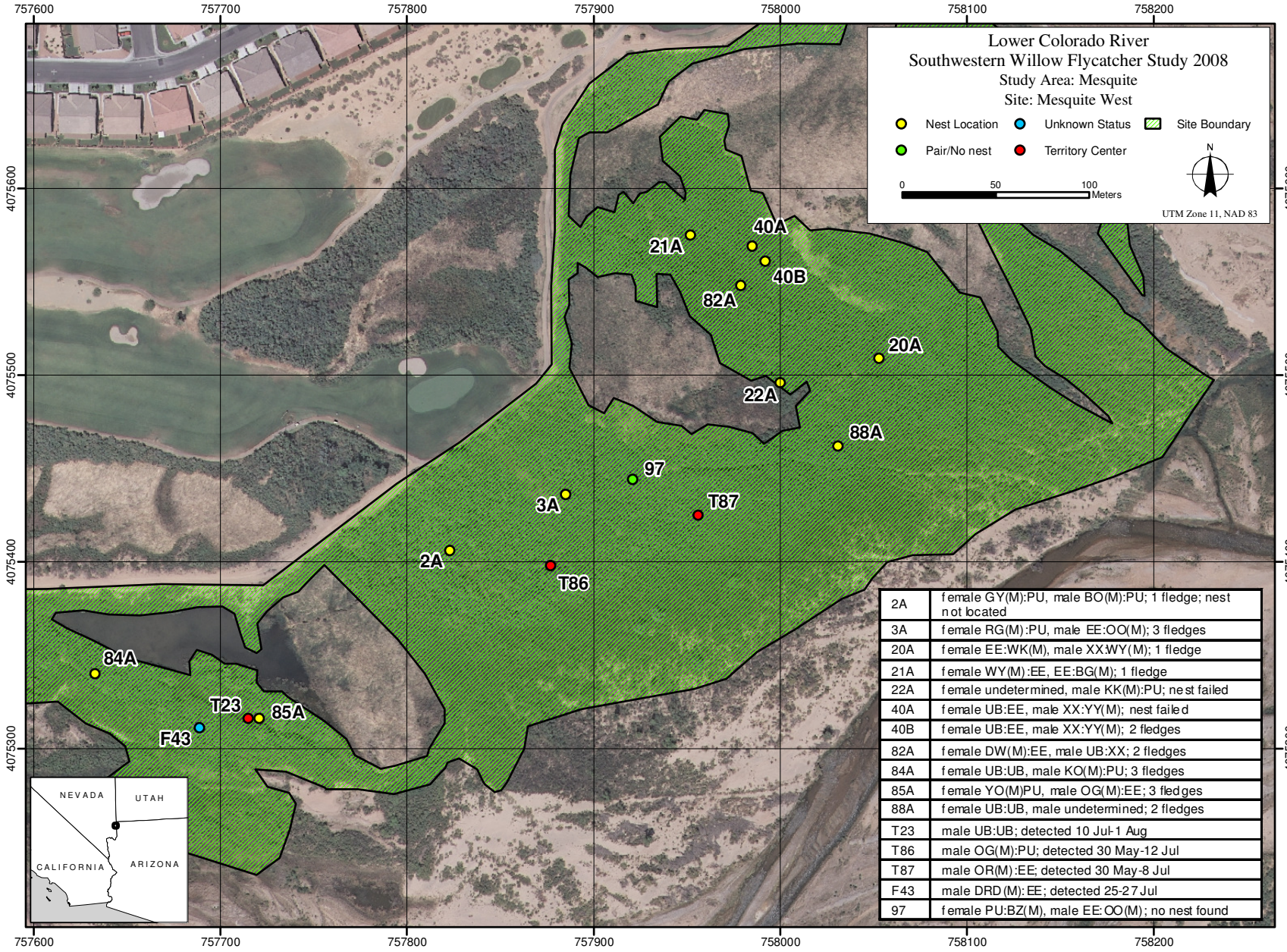


1A	female WO(M):EE, male PU:WG(M); nest failed
1B	female WO(M):EE, male PU:WG(M); 3 fledges
2A	female undetermined, male GO(M):EE; 2 fledges
4A	female PU:KOK(M), male GR(M):EE; 3 fledges; male polygynous w/ 26
5A	female YWY(M):PU, male BB(M):PU; 3 fledges
24A	female RR:no foot, male YY(M):XX; nest failed; male polygynous w/27
24B	female RR:no foot, male YY(M):XX; 1 fledge; nest not found; male polygynous w/27
26A	female RB(M):EE, male GR(M):EE; 3 fledges; male polygynous w/ 4
27A	female PU:BR(M), male YY(M);XX; 3 fledges; male polygynous w/24
85A	female PU:DD(M), male OB(M):PU; 3 fledges
86A	female no foot:DW(M), male YG(M):PU; nest failed
86B	female no foot:DW(M), male YG(M):PU; nest failed
T3	male KB(M):EE; detected 19 May-25 Jul
T23	male PU:RZ(M); detected 19 May- 25 Jul
T25	male banded; detected 13 Jun-6 Jul
T28	male XX:WG(M); detected 23 Jul-3 Aug
T61	male XX:RW(M); detected 21-31 Jul
T83	male PU:OZ(M); detected 14 May-13 Jul
T84	male EE:GKG(M); detected 29 May-19 Jul
T99	male WKW(M):EE; detected 19 May-12 Jul
F29	sex unknown, banded; detected 23 Jul
F88	male UB:UB; detected 16 Jul

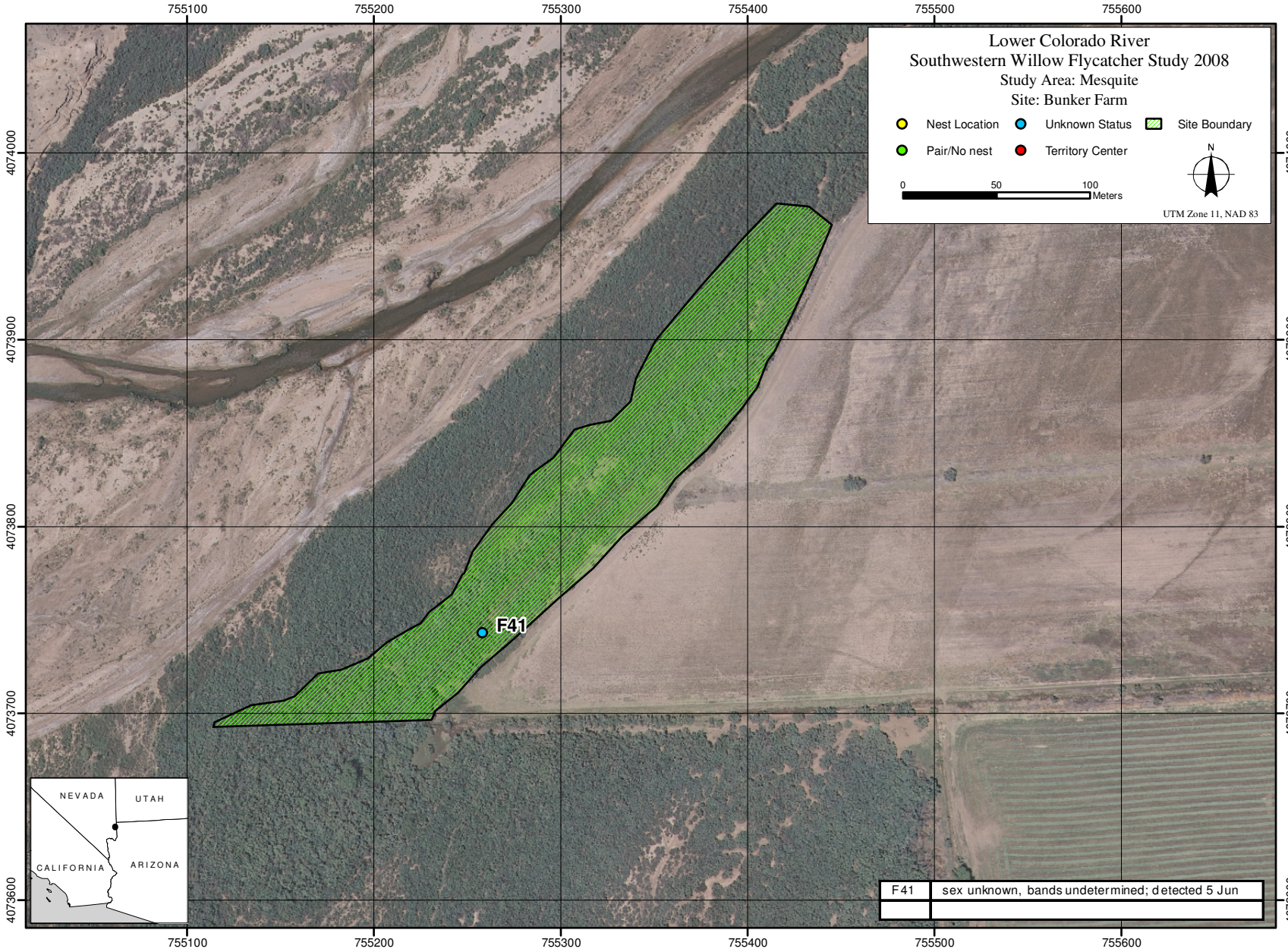
2

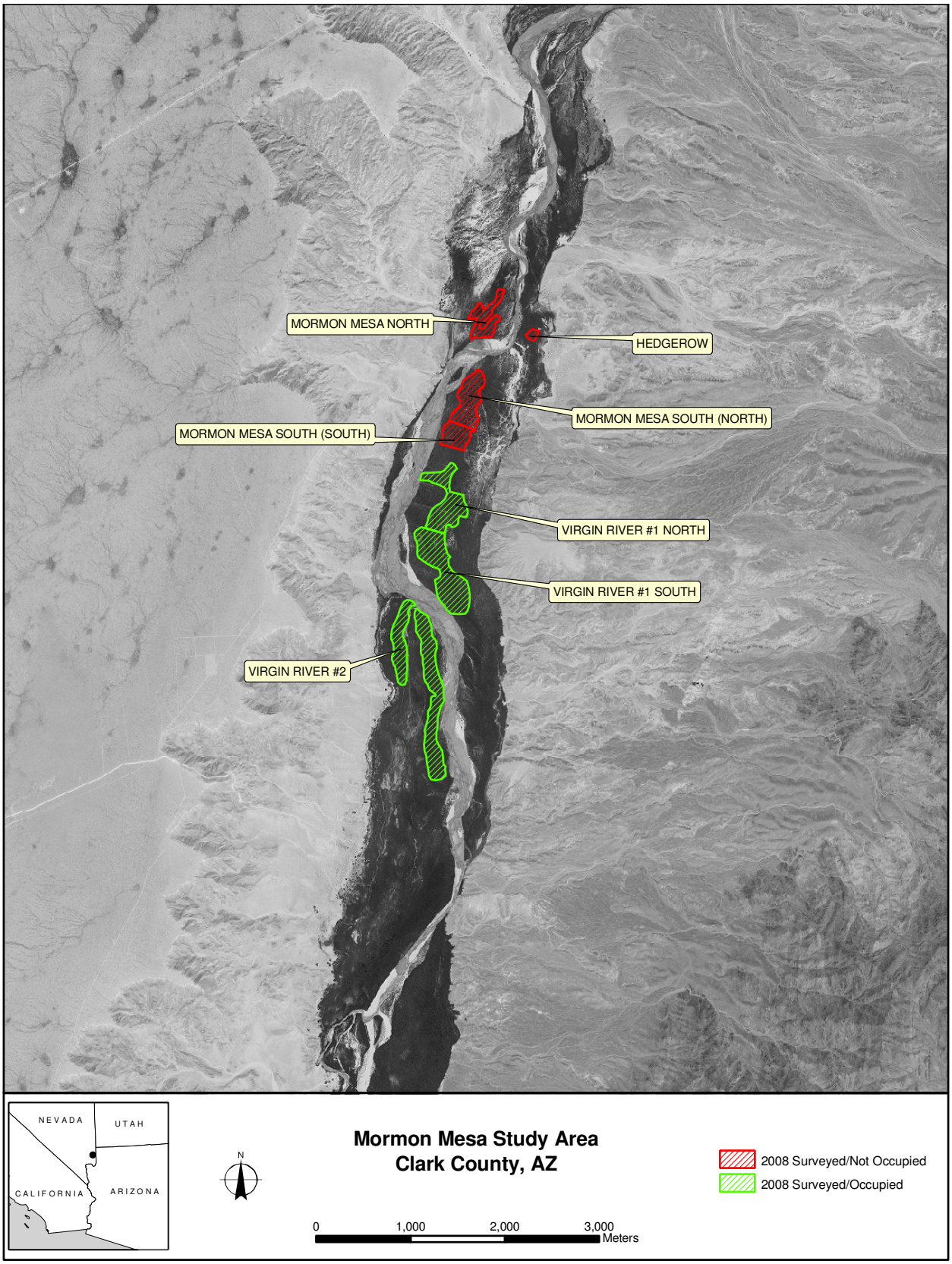

MESQUITE WEST
ELECTRIC AVENUE NORTH
ELECTRIC AVENUE SOUTH
MESQUITE EAST
BUNKER FARM
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Mesquite Study Area
Clark County, NV
0
1,000
2,000
3,000
Meters
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
2008 Discontinued

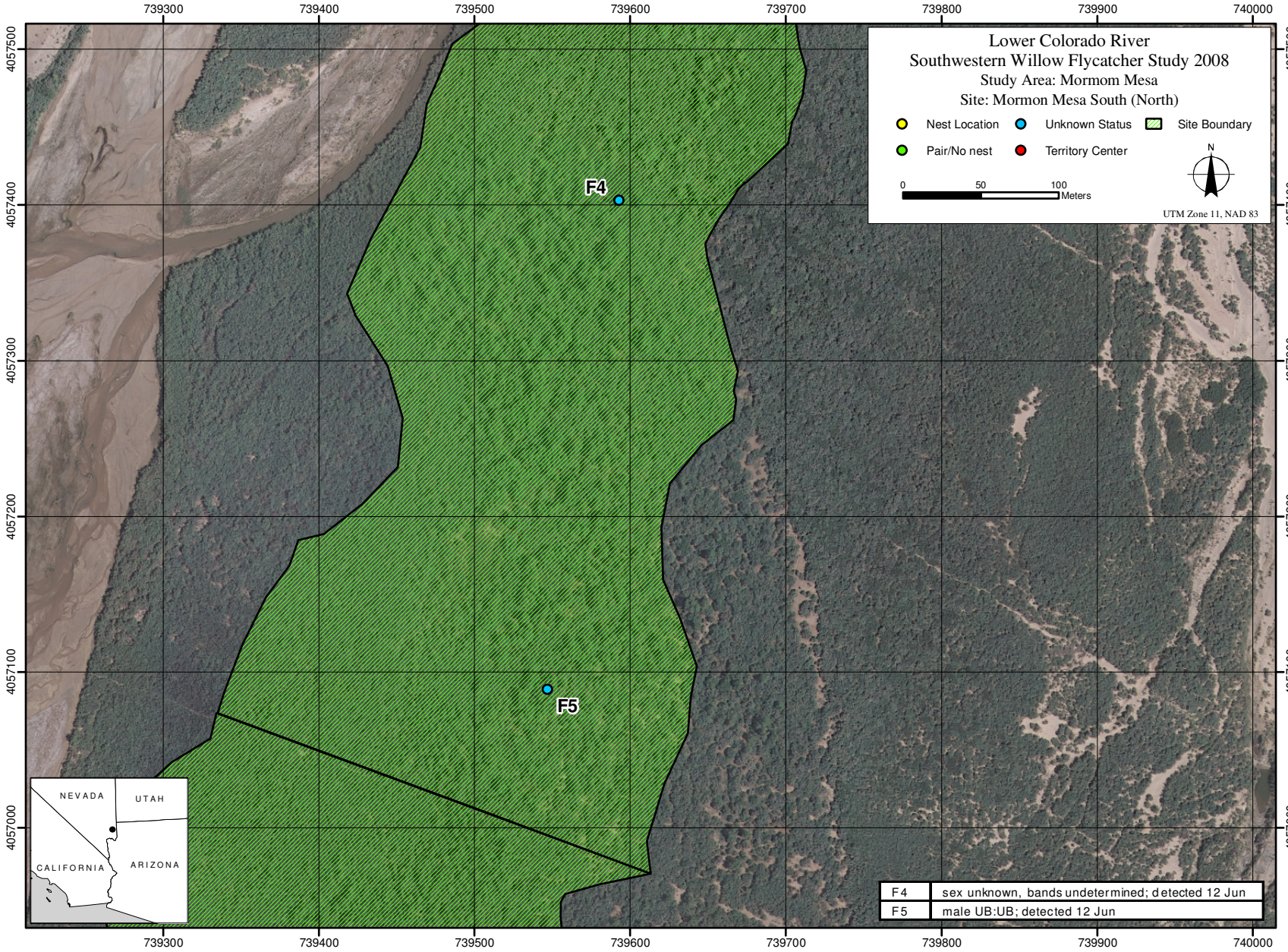

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Mesquite
Site: Mesquite East
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
F90
758300
758400
758500
758600
758700
758800
758900
4075500
4075400
4075300
4075200
4075100
NEVADA
UTAH
CALIFORNIA
ARIZONA
F90
Sex unknown, bands undetermined; detected 22 Jul



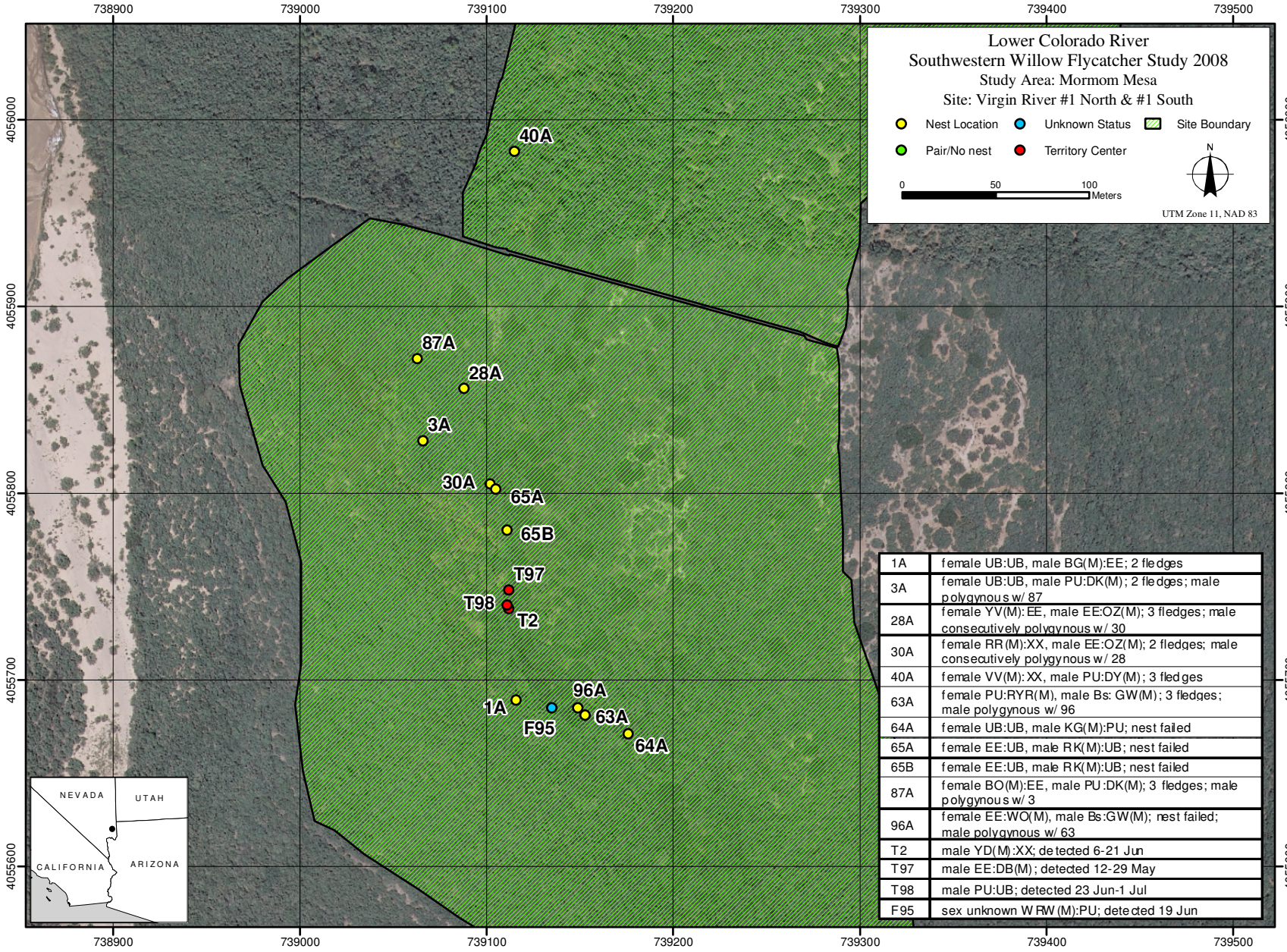
2A	female GY(M):PU, male BO(M):PU; 1 fledge; nest not located
3A	female RG(M):PU, male EE:OO(M); 3 fledges
20A	female EE:WK(M), male XX:WY(M); 1 fledge
21A	female WY(M):EE, EE:BG(M); 1 fledge
22A	female undetermined, male KK(M):PU; nest failed
40A	female UB:EE, male XX:YY(M); nest failed
40B	female UB:EE, male XX:YY(M); 2 fledges
82A	female DW(M):EE, male UB:XX; 2 fledges
84A	female UB:UB, male KO(M):PU; 3 fledges
85A	female YO(M)PU, male OG(M):EE; 3 fledges
88A	female UB:UB, male undetermined; 2 fledges
T23	male UB:UB; detected 10 Jul-1 Aug
T86	male OG(M):PU; detected 30 May-12 Jul
T87	male OR(M):EE; detected 30 May-8 Jul
F43	male DRD(M):EE; detected 25-27 Jul
97	female PU:BZ(M), male EE:OO(M); no nest found


Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Mesquite
Site: Bunker Farm
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
755100
755200
755300
755400
755500
755600
4074000
4073900
4073800
4073700
4073600
F41
NEVADA
UTAH
CALIFORNIA
ARIZONA
F41
sex unknown, bands undetermined; detected 5 Jun

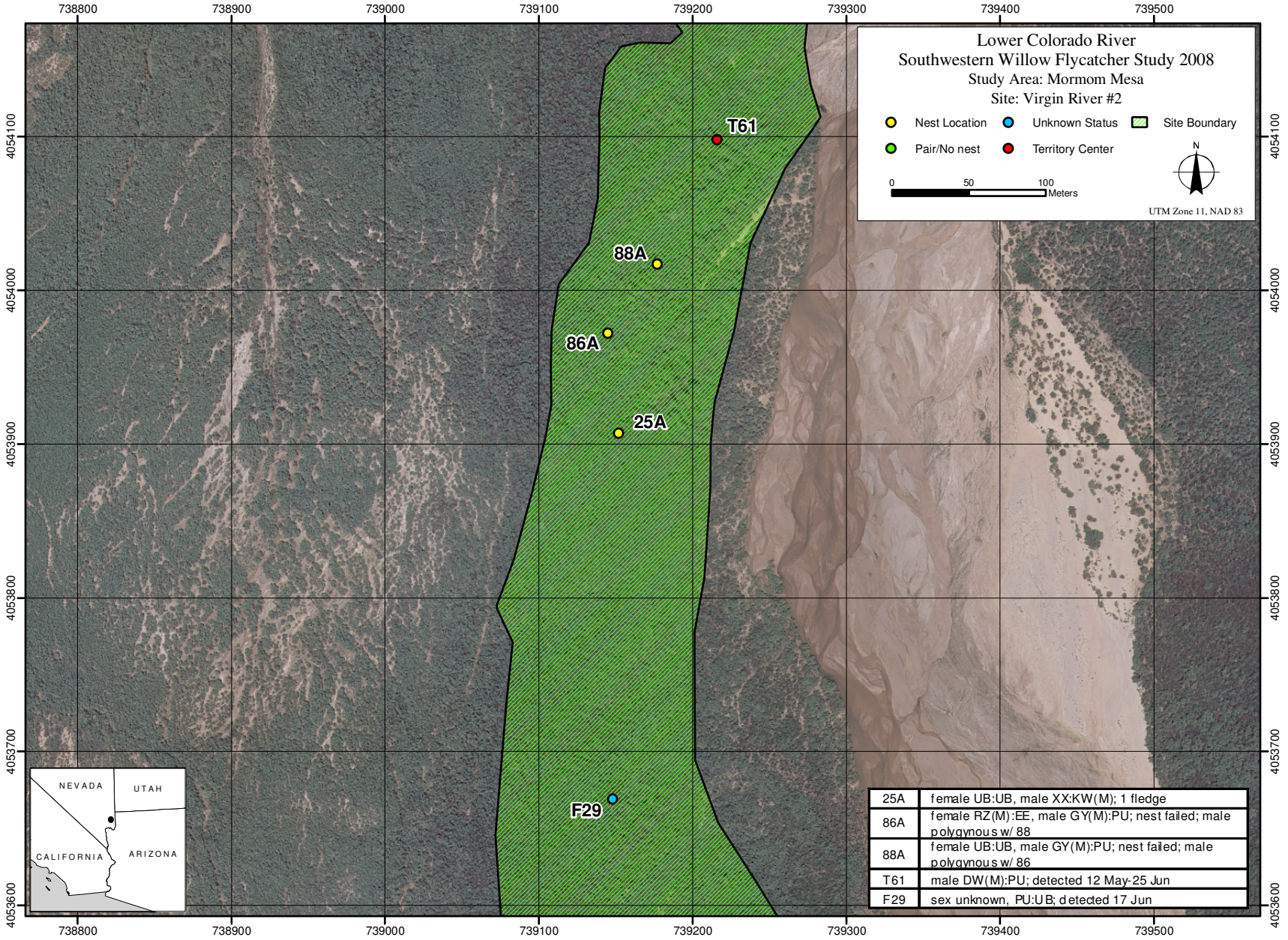

MORMON MESA NORTH
HEDGEROW
MORMON MESA SOUTH (NORTH)
MORMON MESA SOUTH (SOUTH)
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Mormon Mesa Study Area
Clark County, AZ
0
1,000
2,000
3,000
Meters
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied


Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Mormom Mesa
Site: Mormon Mesa South (North)
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
F4
F5
NEVADA
UTAH
CALIFORNIA
ARIZONA
F4 sex unknown, bands undetermined; detected 12 Jun
F5 male UB:UB; detected 12 Jun
739300
739400
739500
739600
739700
739800
739900
740000
4057500
4057400
4057300
4057200
4057100
4057000

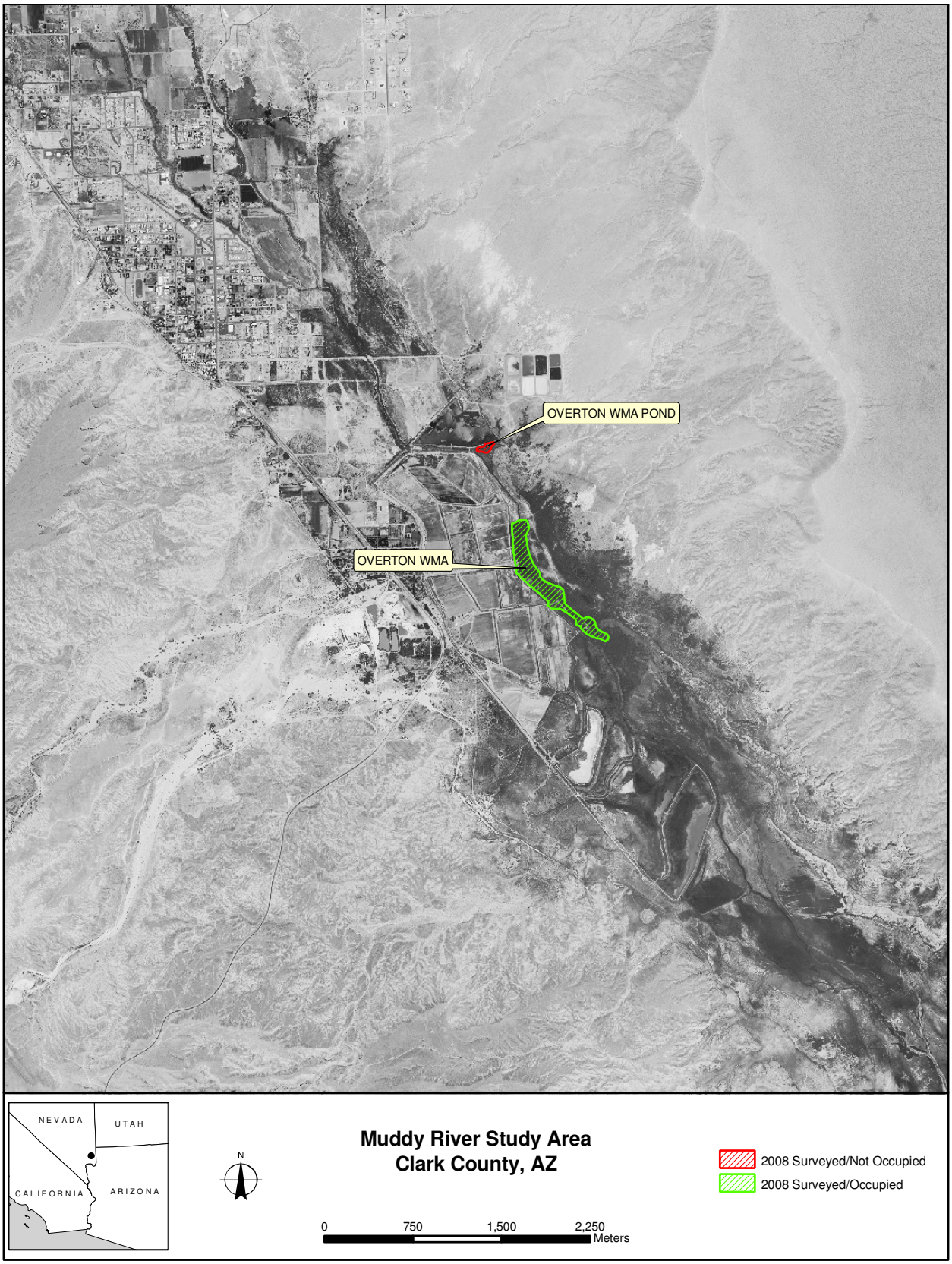
8

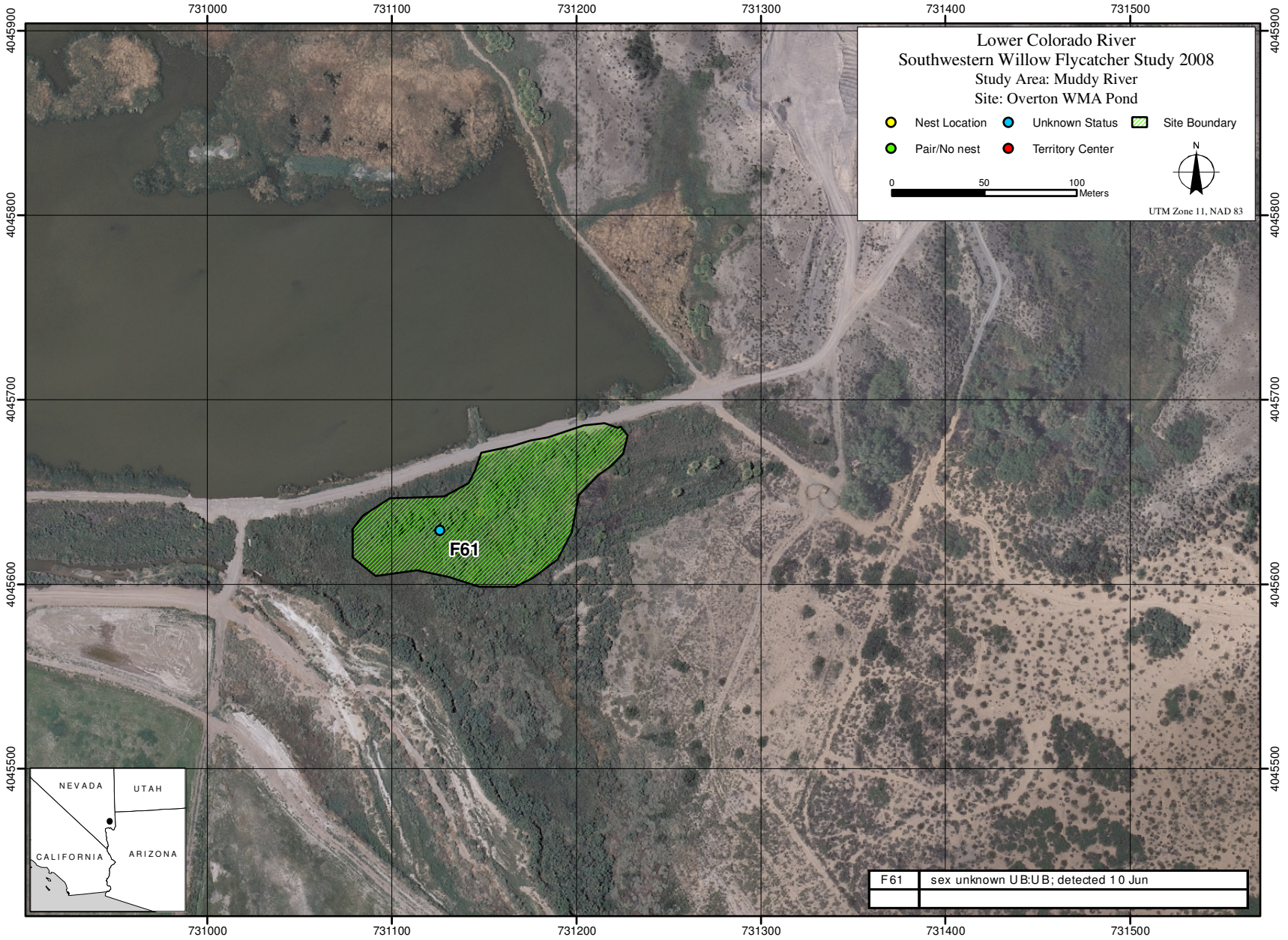


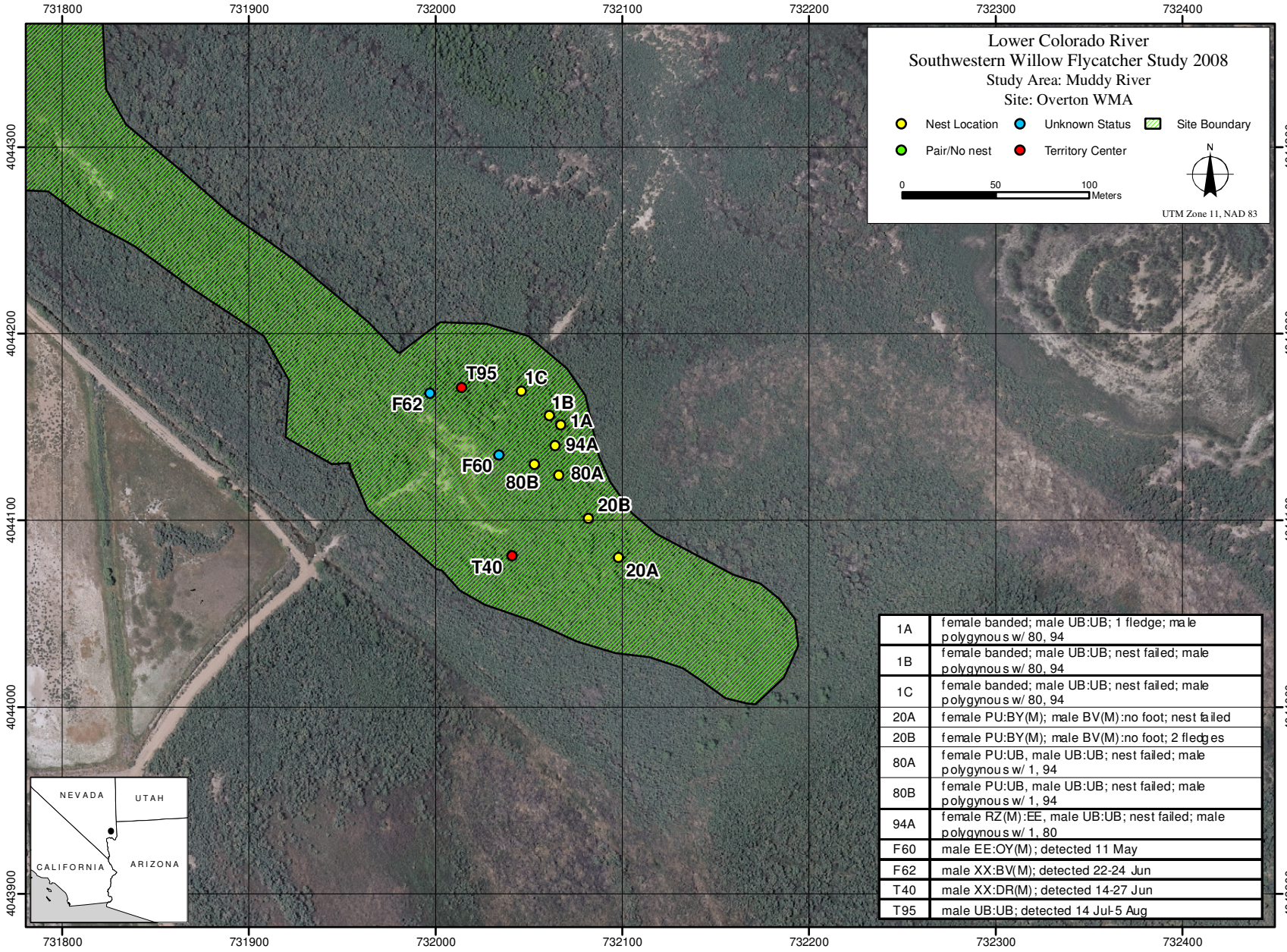
1A	female UB:UB, male BG(M):EE; 2 fledges
3A	female UB:UB, male PU:DK(M); 2 fledges; male polygynous w/ 87
28A	female YV(M):EE, male EE:OZ(M); 3 fledges; male consecutively polygynous w/ 30
30A	female RR(M):XX, male EE:OZ(M); 2 fledges; male consecutively polygynous w/ 28
40A	female VV(M):XX, male PU:DY(M); 3 fledges
63A	female PU:RYR(M), male Bs: GW(M); 3 fledges; male polygynous w/ 96
64A	female UB:UB, male KG(M):PU; nest failed
65A	female EE:UB, male RK(M):UB; nest failed
65B	female EE:UB, male RK(M):UB; nest failed
87A	female BO(M):EE, male PU:DK(M); 3 fledges; male polygynous w/ 3
96A	female EE:WO(M), male Bs:GW(M); nest failed; male polygynous w/ 63
T2	male YD(M):XX; detected 6-21 Jun
T97	male EE:DB(M); detected 12-29 May
T98	male PU:UB; detected 23 Jun-1 Jul
F95	sex unknown WRW(M):PU; detected 19 Jun



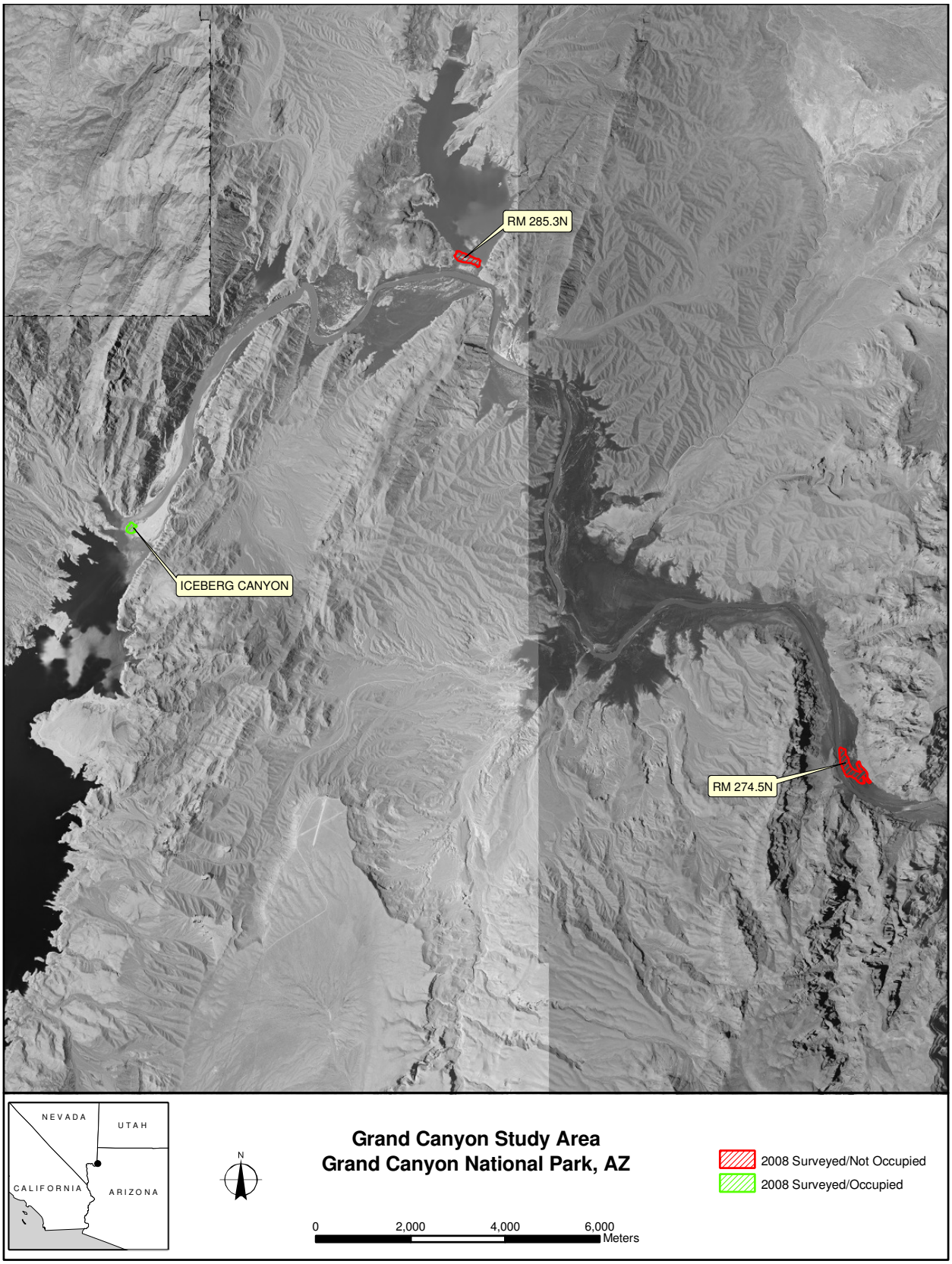
25A	female UB:UB, male XX:KW(M); 1 fledge
86A	female RZ(M):EE, male GY(M):PU; nest failed; male polygynous w/ 88
88A	female UB:UB, male GY(M):PU; nest failed; male polygynous w/ 86
T61	male DW(M):PU; detected 12 May-25 Jun
F29	sex unknown, PU:UB; detected 17 Jun

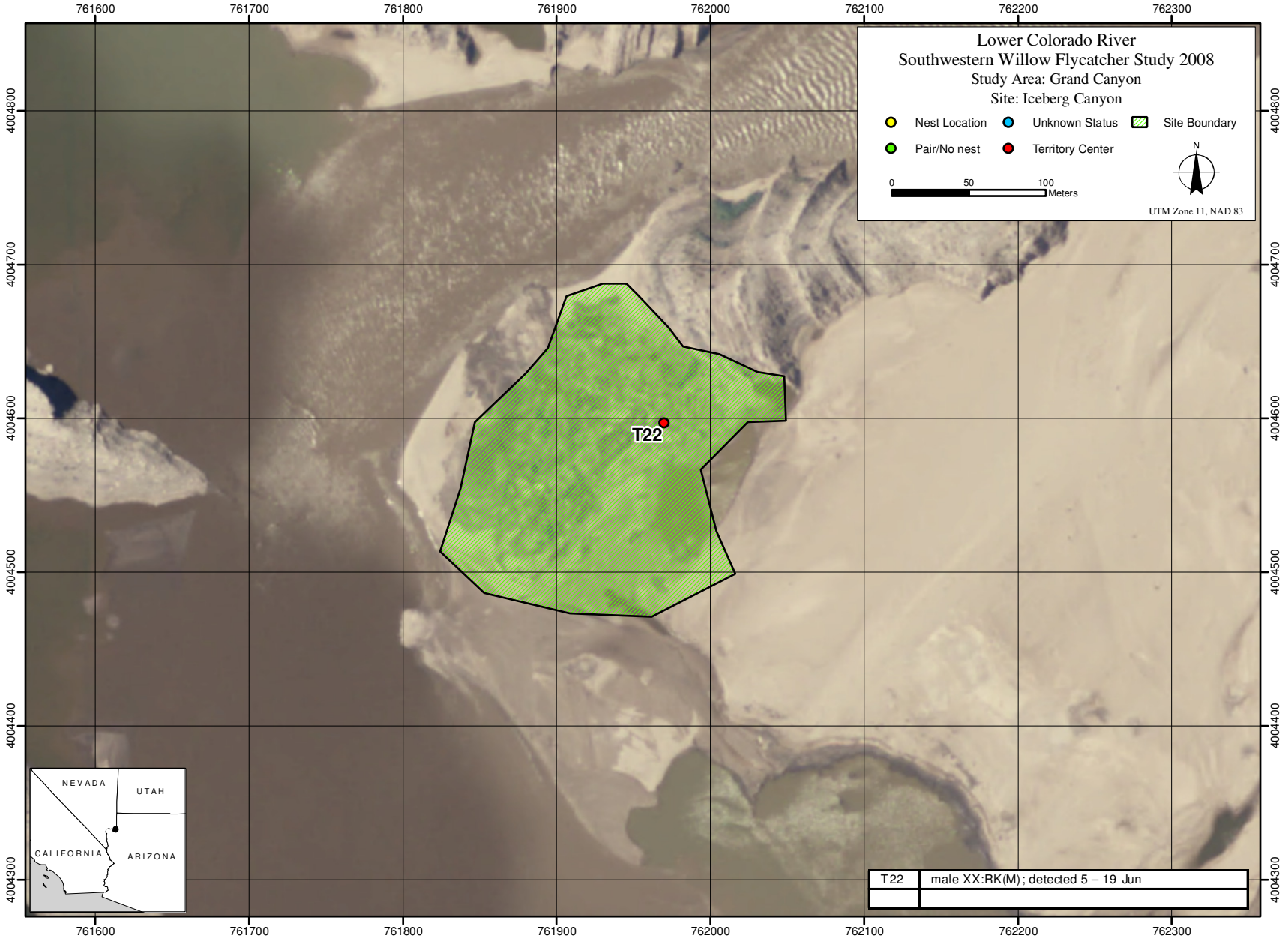

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Muddy River Study Area
Clark County, AZ
0
750
1,500
2,250
Meters
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied

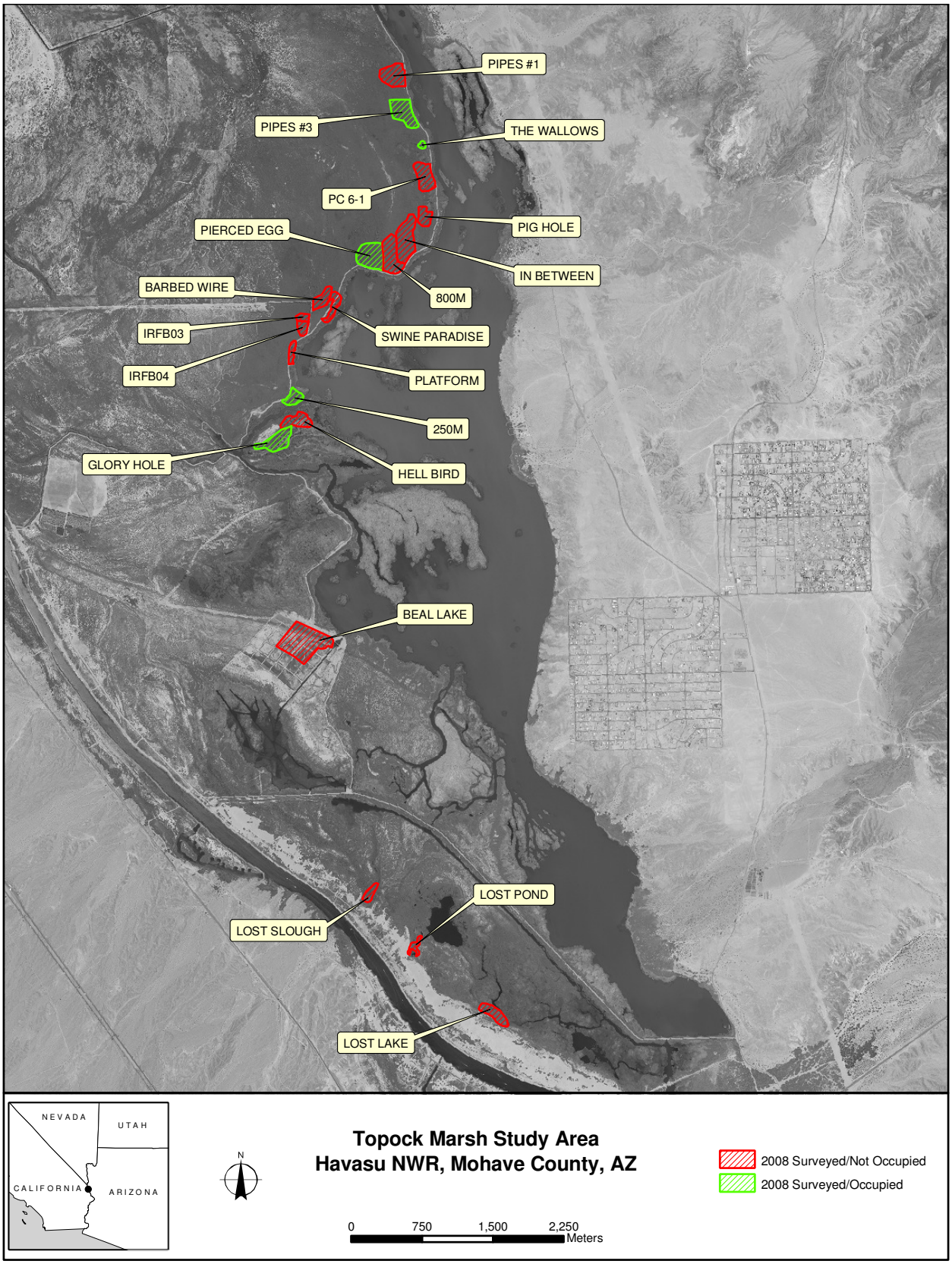

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Muddy River
Site: Overton WMA Pond
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
731000
731100
731200
731300
731400
731500
4045900
4045800
4045700
4045600
4045500
F61
NEVADA
UTAH
CALIFORNIA
ARIZONA
F61
sex unknown UB:UB; detected 10 Jun

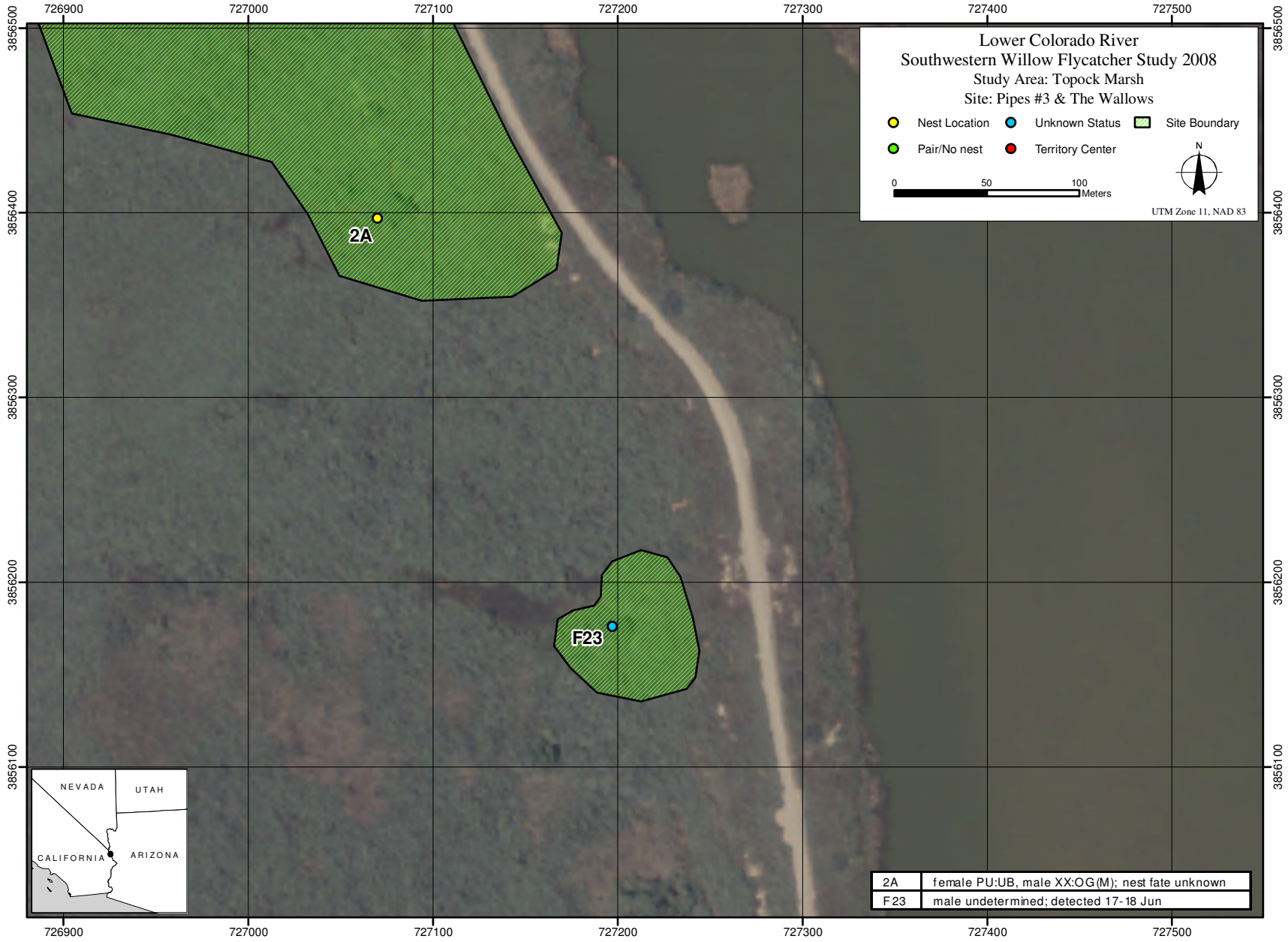


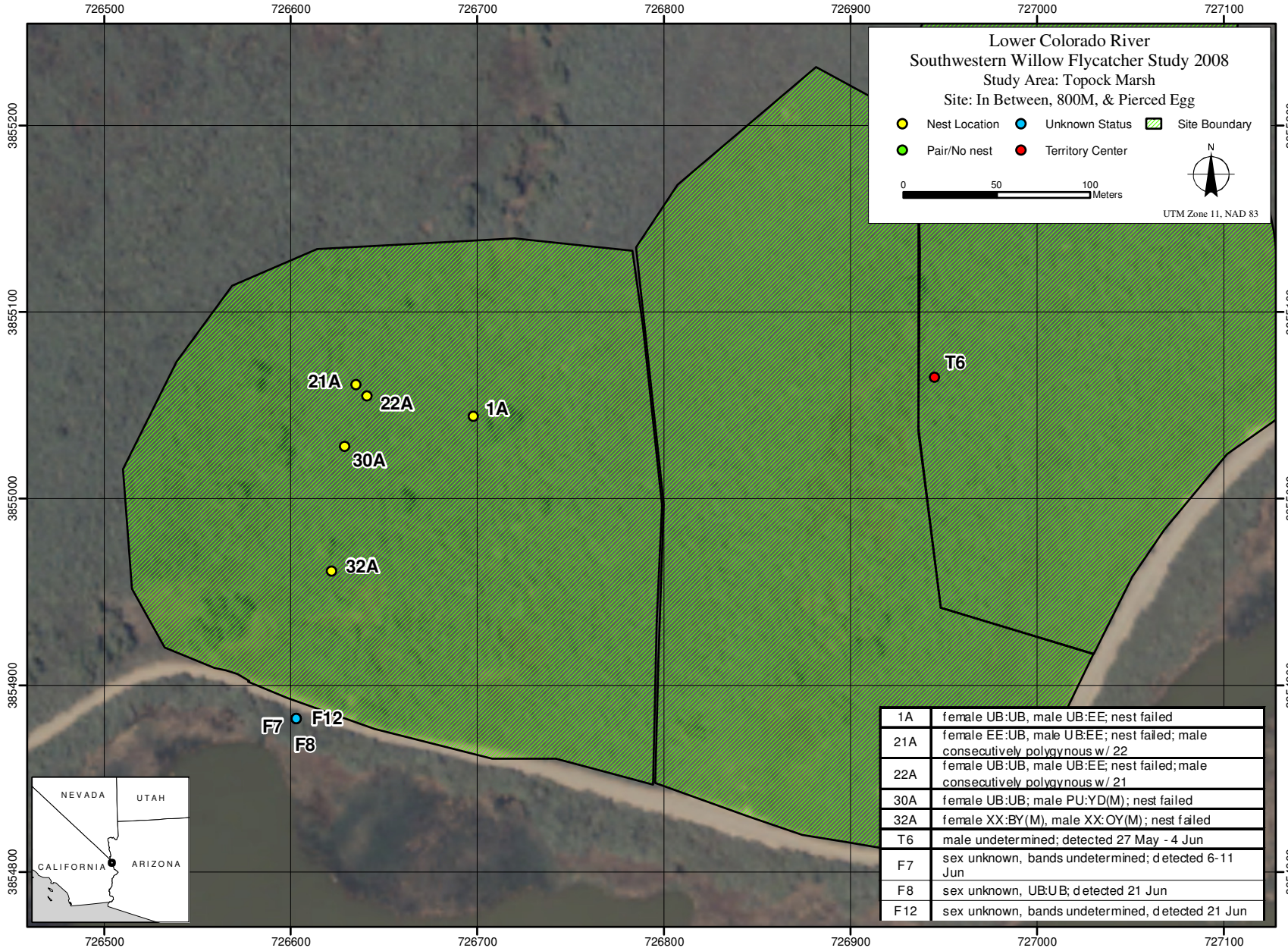
1A	female banded; male UB:UB; 1 fledge; male polygynous w/ 80, 94
1B	female banded; male UB:UB; nest failed; male polygynous w/ 80, 94
1C	female banded; male UB:UB; nest failed; male polygynous w/ 80, 94
20A	female PU:BY(M); male BV(M):no foot; nest failed
20B	female PU:BY(M); male BV(M):no foot; 2 fledges
80A	female PU:UB, male UB:UB; nest failed; male polygynous w/ 1, 94
80B	female PU:UB, male UB:UB; nest failed; male polygynous w/ 1, 94
94A	female RZ(M):EE, male UB:UB; nest failed; male polygynous w/ 1, 80
F60	male EE:OY(M); detected 11 May
F62	male XX:BV(M); detected 22-24 Jun
T40	male XX:DR(M); detected 14-27 Jun
T95	male UB:UB; detected 14 Jul-5 Aug

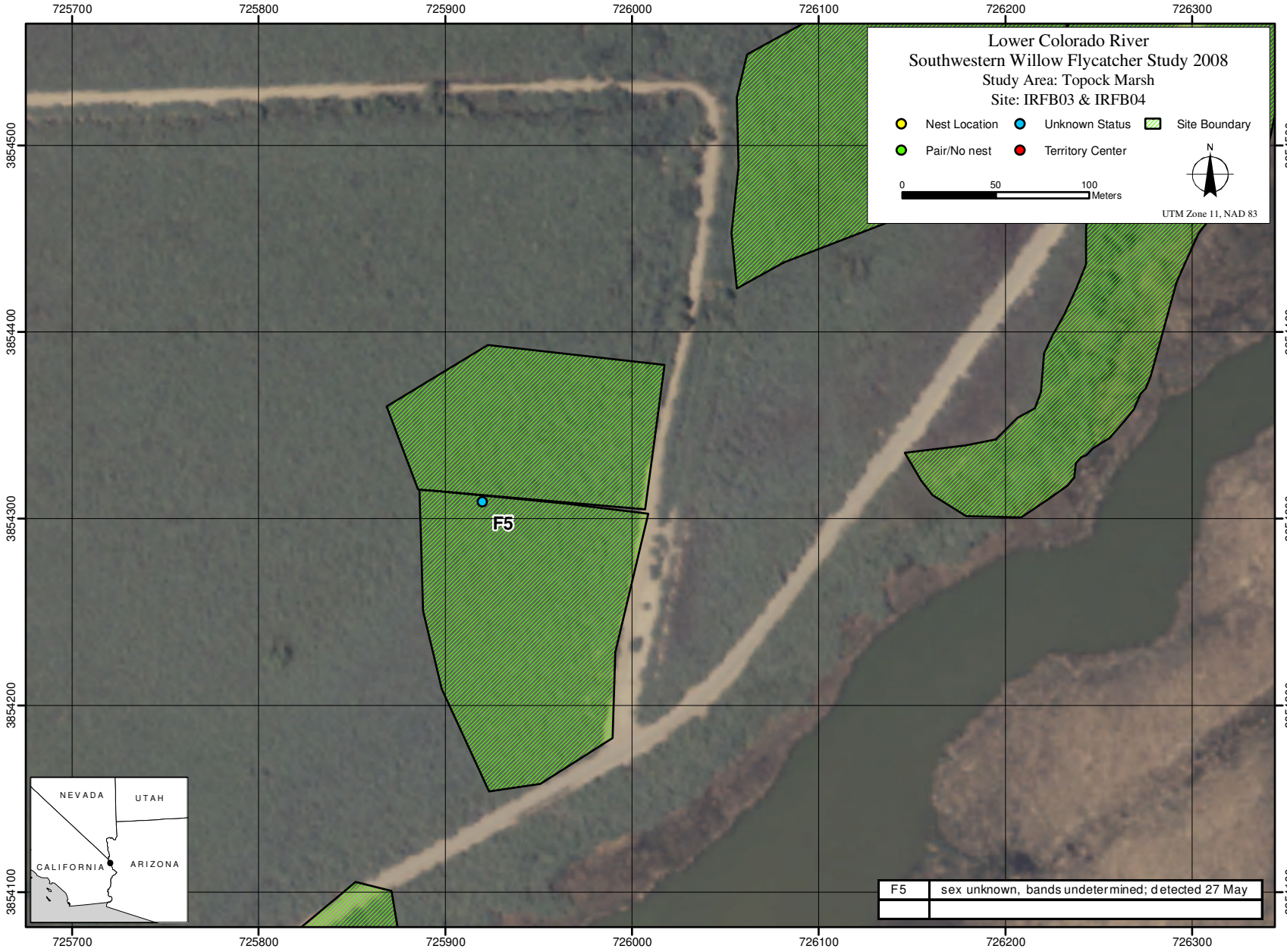

RM 285.3N
ICEBERG CANYON
RM 274.5N
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Grand Canyon Study Area
Grand Canyon National Park, AZ
0
2,000
4,000
6,000
Meters
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied

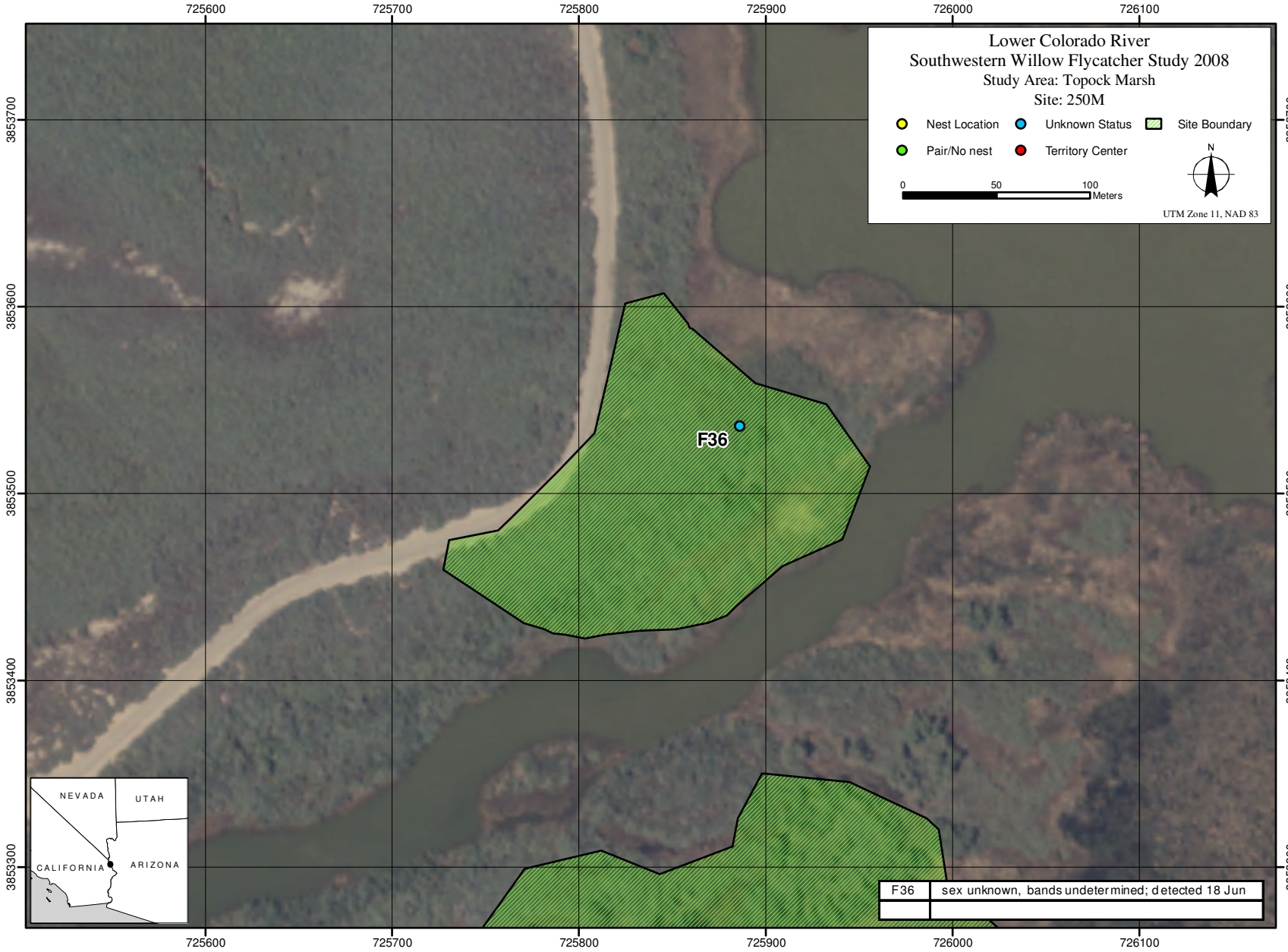

761600
761700
761800
761900
762000
762100
762200
762300
4004800
4004700
4004600
4004500
4004400
4004300
Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Grand Canyon
Site: Iceberg Canyon
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
T22
NEVADA
UTAH
CALIFORNIA
ARIZONA
T22
male XX:RK(M); detected 5 – 19 Jun

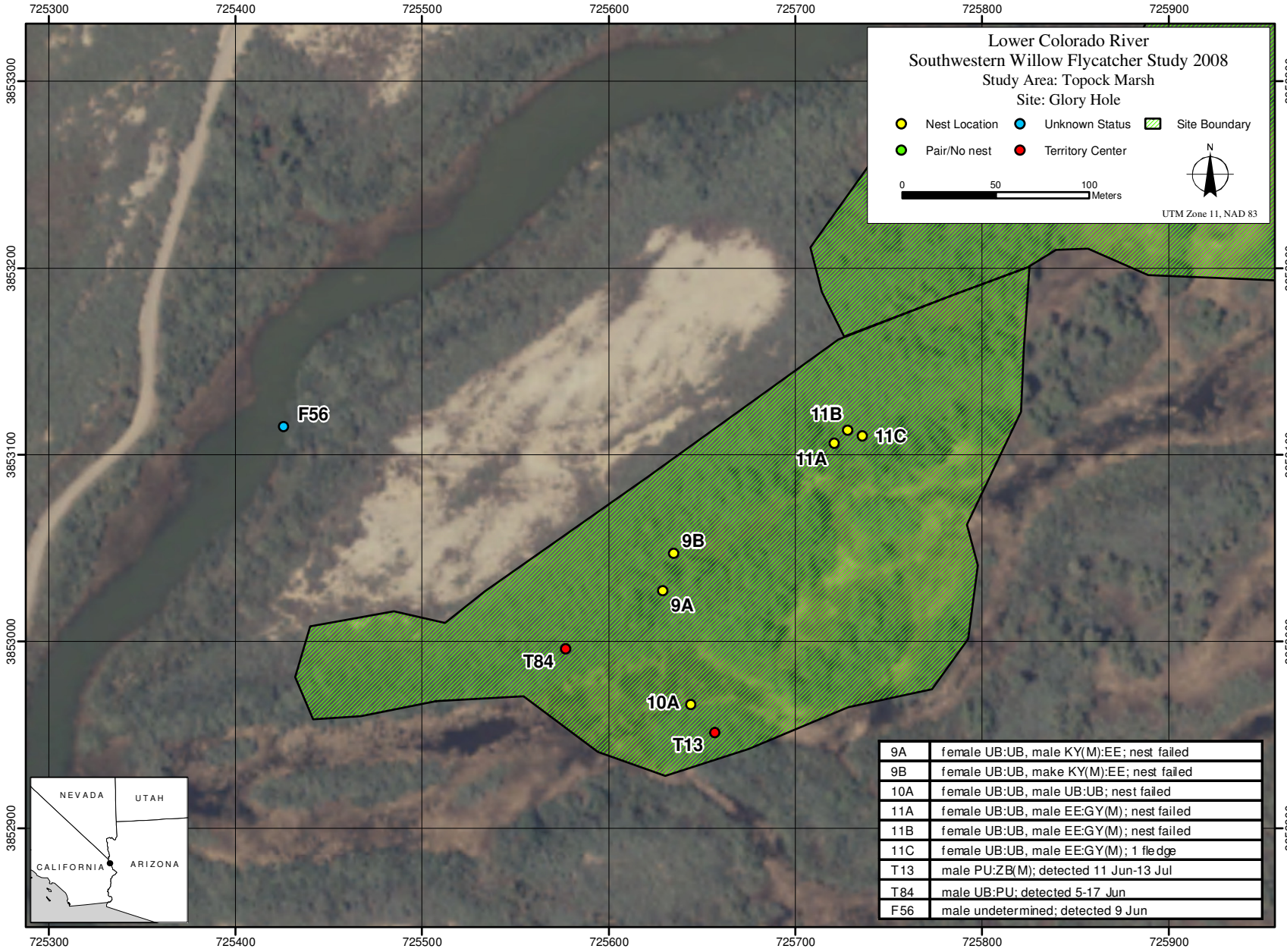

PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
PIERCED EGG
PIG HOLE
IN BETWEEN
800M
BARBED WIRE
IRFB03
SWINE PARADISE
IRFB04
PLATFORM
250M
GLORY HOLE
HELL BIRD
BEAL LAKE
LOST POND
LOST SLOUGH
LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Topock Marsh Study Area
Havasu NWR, Mohave County, AZ
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
0
750
1,500
2,250
Meters

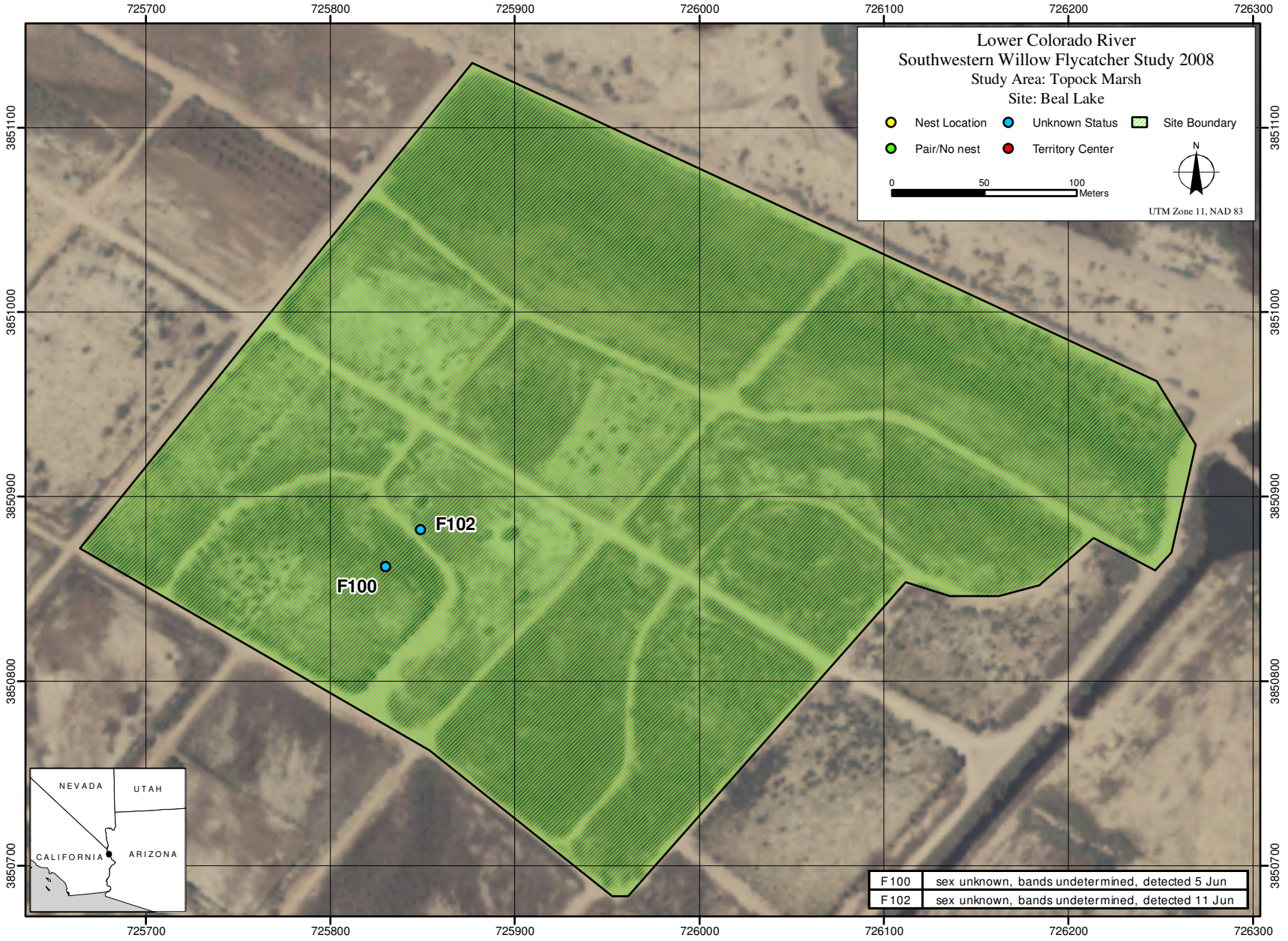

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Topock Marsh
Site: Pipes #3 & The Wallows
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
2A
F23
726900
727000
727100
727200
727300
727400
727500
3856500
3856400
3856300
3856200
3856100
NEVADA
UTAH
CALIFORNIA
ARIZONA
2A female PU:UB, male XX:OG(M); nest fate unknown
F23 male undetermined; detected 17-18 Jun

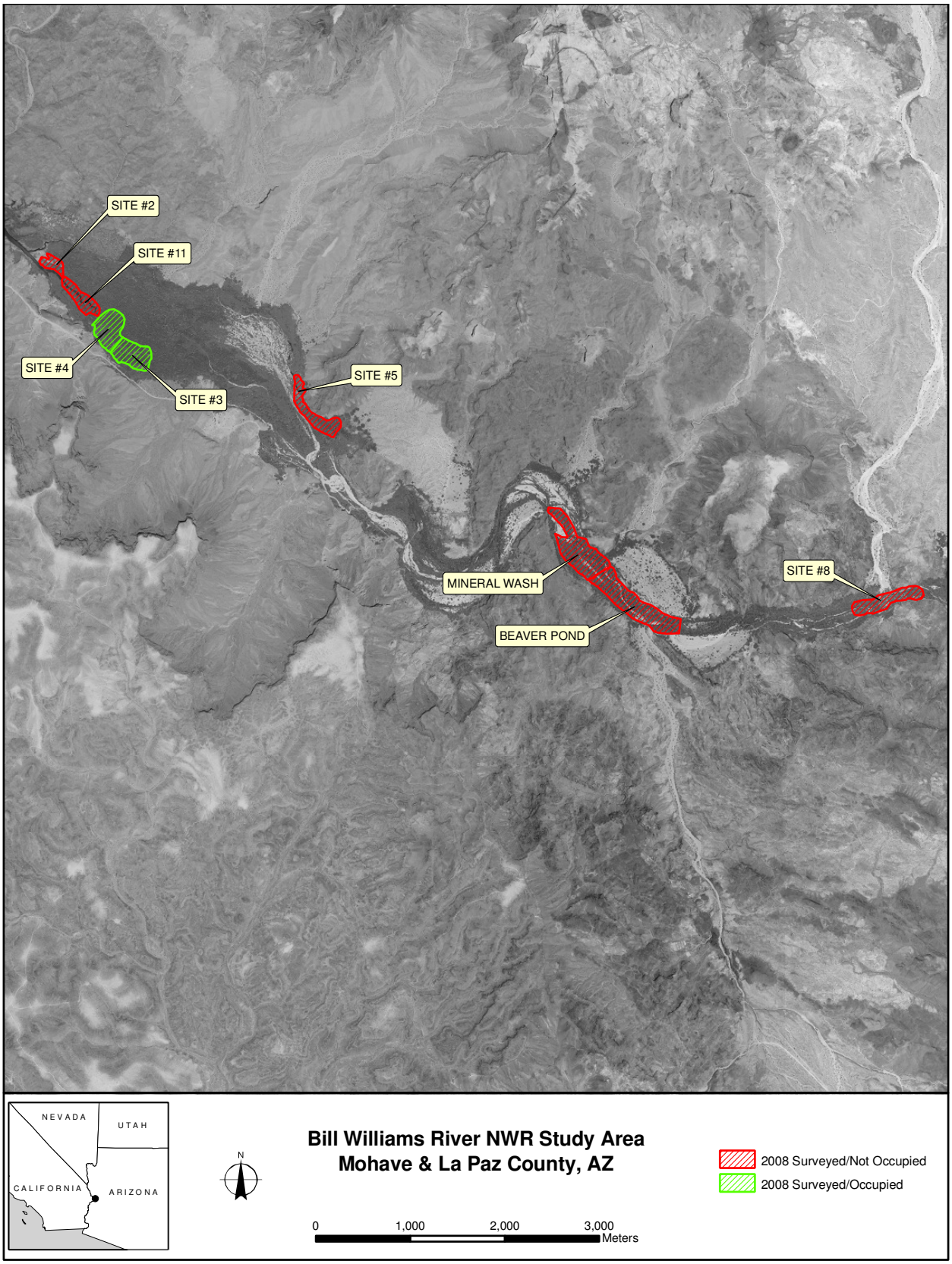

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Topock Marsh
Site: In Between, 800M, & Pierced Egg
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
726500
726600
726700
726800
726900
727000
727100
3855200
3855100
3855000
3854900
3854800
21A
22A
1A
30A
32A
T6
F7
F12
F8
NEVADA
UTAH
CALIFORNIA
ARIZONA
1A female UB:UB, male UB:EE; nest failed
21A female EE:UB, male UB:EE; nest failed; male consecutively polygynous w/ 22
22A female UB:UB, male UB:EE; nest failed; male consecutively polygynous w/ 21
30A female UB:UB; male PU:YD(M); nest failed
32A female XX:BY(M), male XX:OY(M); nest failed
T6 male undetermined; detected 27 May - 4 Jun
F7 sex unknown, bands undetermined; detected 6-11 Jun
F8 sex unknown, UB:UB; detected 21 Jun
F12 sex unknown, bands undetermined, detected 21 Jun

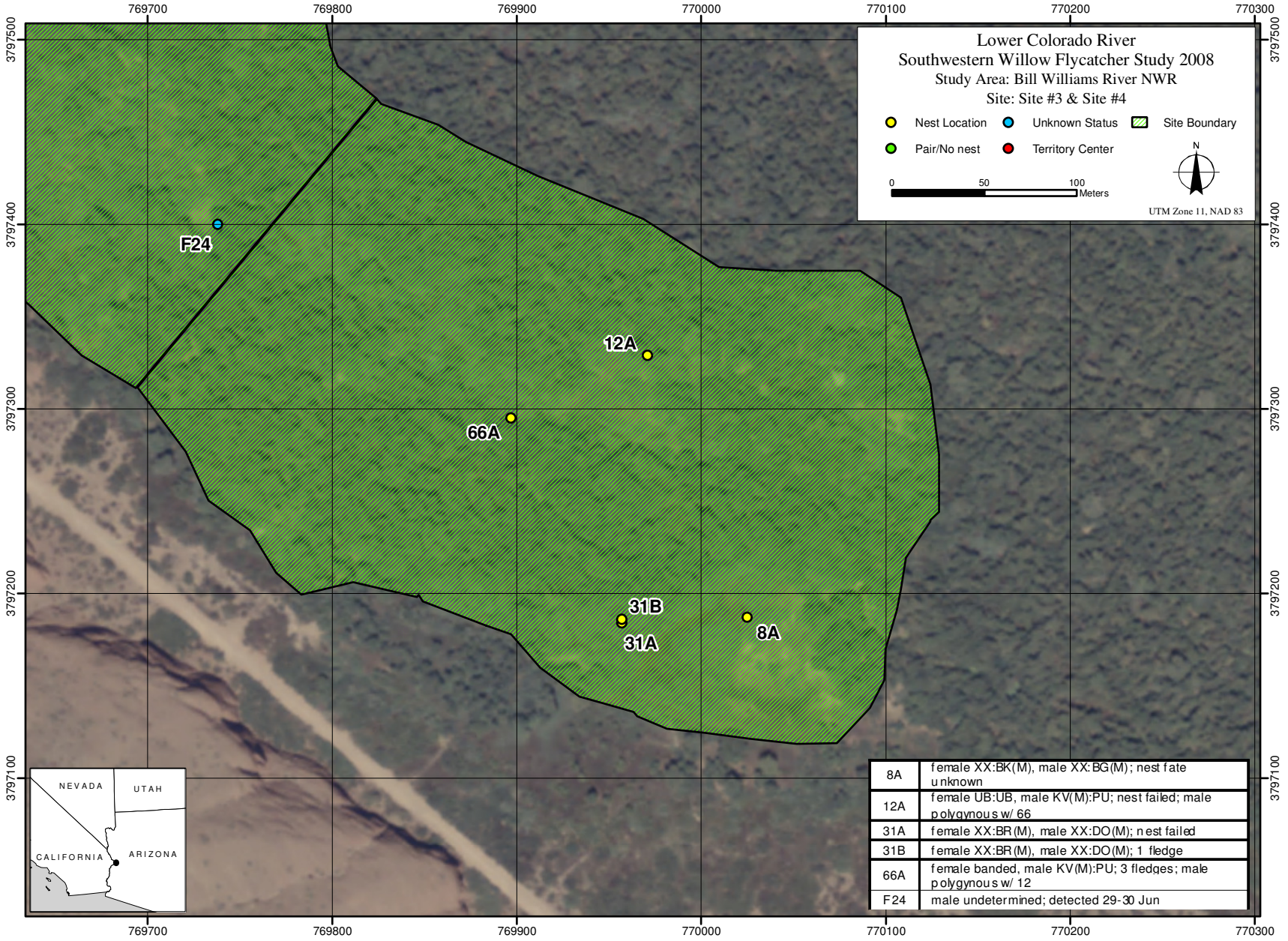

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Topock Marsh
Site: IRFB03 & IRFB04
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
725700
725800
725900
726000
726100
726200
726300
3854500
3854400
3854300
3854200
3854100
F5
NEVADA
UTAH
CALIFORNIA
ARIZONA
F5
sex unknown, bands undetermined; detected 27 May

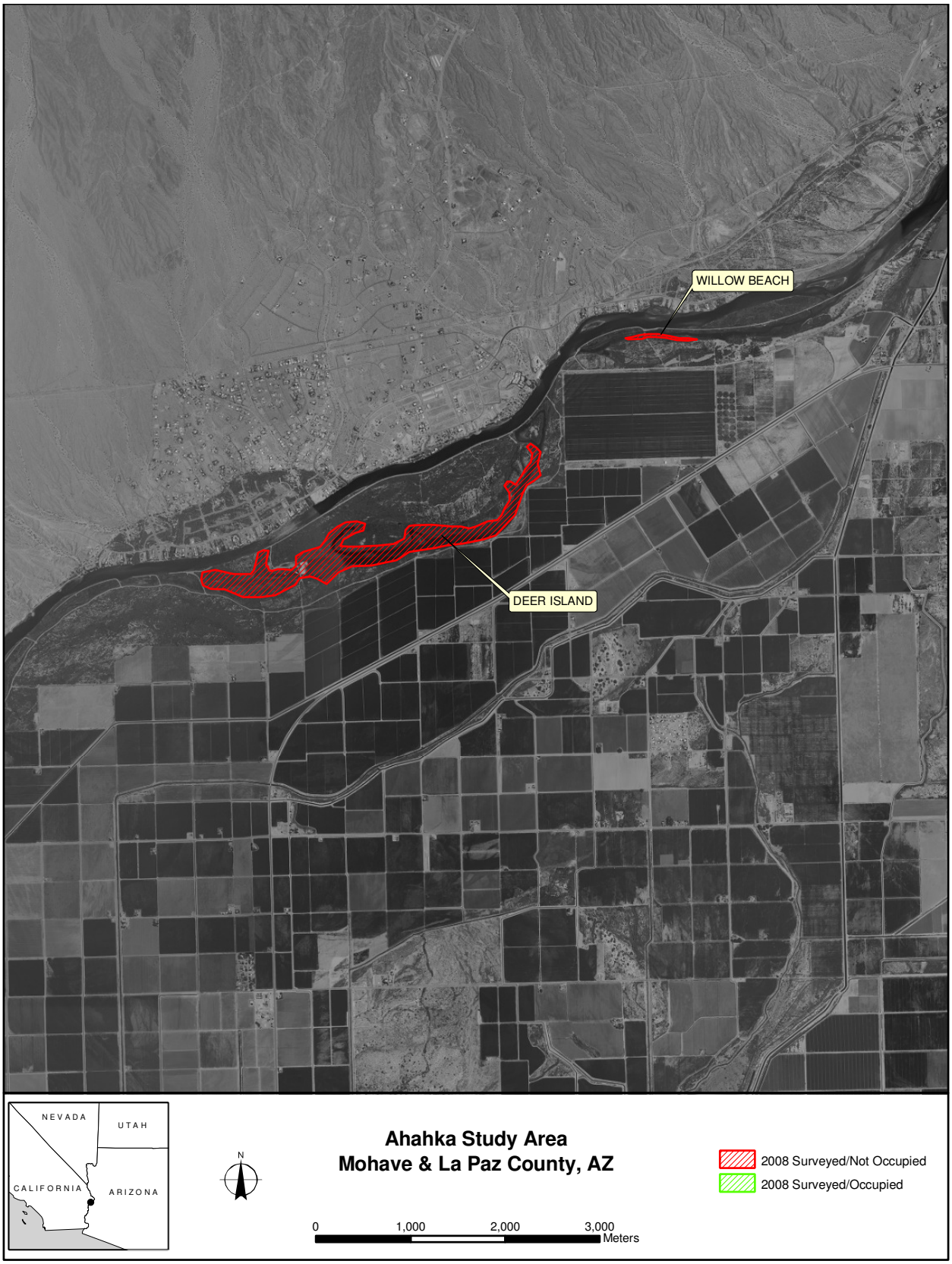

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Topock Marsh
Site: 250M
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
F36
725600
725700
725800
725900
726000
726100
3853700
3853600
3853500
3853400
3853300
NEVADA
UTAH
CALIFORNIA
ARIZONA
F36
sex unknown, bands undetermined; detected 18 Jun

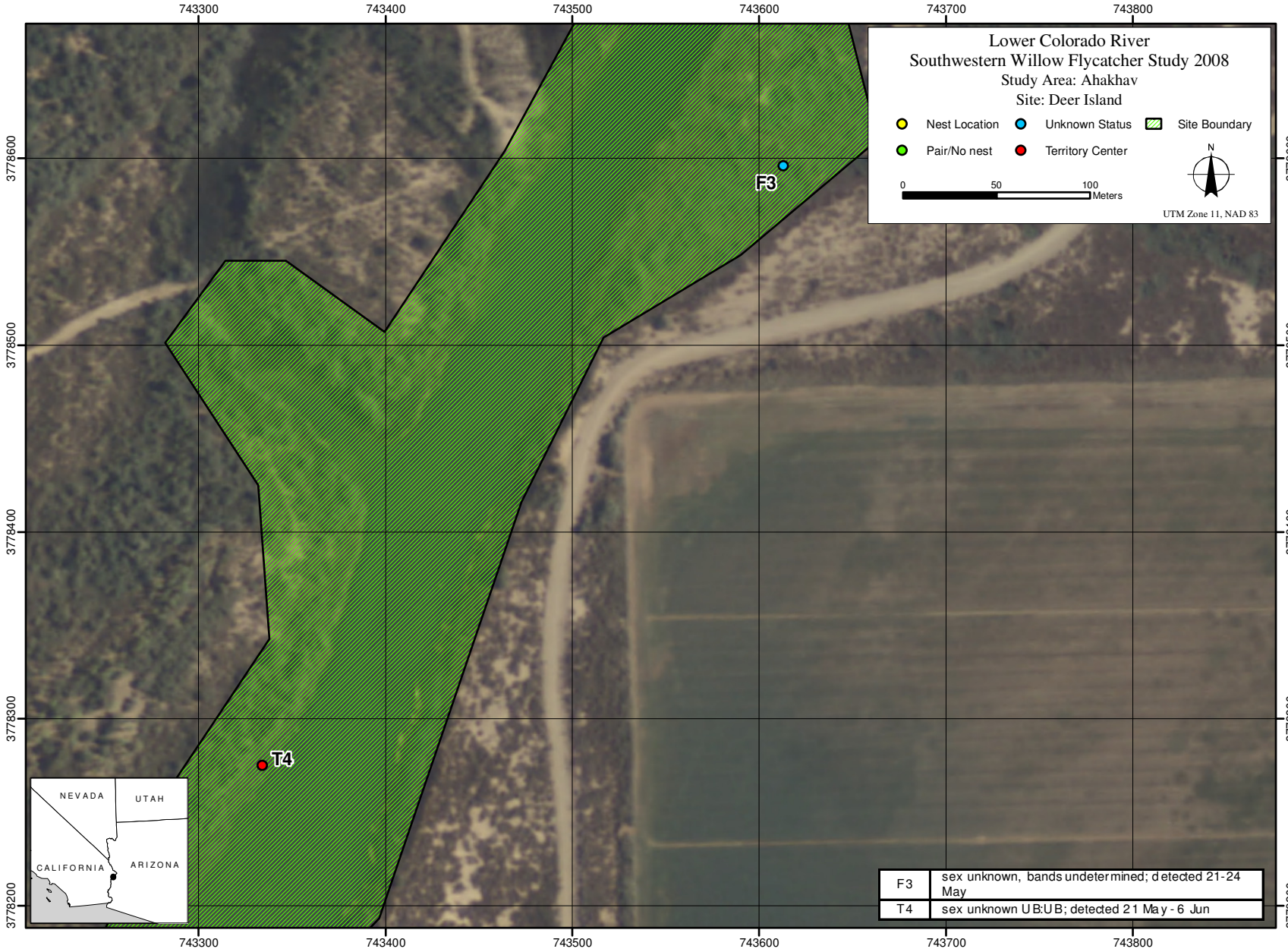

Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Topock Marsh
Site: Glory Hole
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
725300
725400
725500
725600
725700
725800
725900
3853300
3853200
3853100
3853000
3852900
F56
11B
11C
11A
9B
9A
T84
10A
T13
NEVADA
UTAH
CALIFORNIA
ARIZONA
9A female UB:UB, male KY(M):EE; nest failed
9B female UB:UB, make KY(M):EE; nest failed
10A female UB:UB, male UB:UB; nest failed
11A female UB:UB, male EE:GY(M); nest failed
11B female UB:UB, male EE:GY(M); nest failed
11C female UB:UB, male EE:GY(M); 1 fledge
T13 male PU:ZB(M); detected 11 Jun-13 Jul
T84 male UB:PU; detected 5-17 Jun
F56 male undetermined; detected 9 Jun


Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Topock Marsh
Site: Beal Lake
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
N
0
50
100
Meters
UTM Zone 11, NAD 83
725700
725800
725900
726000
726100
726200
726300
3851100
3851000
3850900
3850800
3850700
F102
F100
NEVADA
UTAH
CALIFORNIA
ARIZONA
F100 sex unknown, bands undetermined, detected 5 Jun
F102 sex unknown, bands undetermined, detected 11 Jun


SITE #2
SITE #11
SITE #4
SITE #3
SITE #5
MINERAL WASH
BEAVER POND
SITE #8
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Bill Williams River NWR Study Area
Mohave & La Paz County, AZ
0
1,000
2,000
3,000
Meters
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied


Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Bill Williams River NWR
Site: Site #3 & Site #4
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
769700
769800
769900
770000
770100
770200
770300
3797500
3797400
3797300
3797200
3797100
F24
12A
66A
31B
31A
8A
NEVADA
UTAH
CALIFORNIA
ARIZONA
8A female XX:BK(M), male XX:BG(M); nest fate unknown
12A female UB:UB, male KV(M):PU; nest failed; male polygynous w/ 66
31A female XX:BR(M), male XX:DO(M); nest failed
31B female XX:BR(M), male XX:DO(M); 1 fledge
66A female banded, male KV(M):PU; 3 fledges; male polygynous w/ 12
F24 male undetermined; detected 29-30 Jun


WILLOW BEACH
DEER ISLAND
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Ahahka Study Area
Mohave & La Paz County, AZ
2008 Surveyed/Not Occupied
2008 Surveyed/Occupied
0
1,000
2,000
3,000
Meters


Lower Colorado River
Southwestern Willow Flycatcher Study 2008
Study Area: Ahakhav
Site: Deer Island
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
743300
743400
743500
743600
743700
743800
3778600
3778500
3778400
3778300
3778200
F3
T4
NEVADA
UTAH
CALIFORNIA
ARIZONA
F3 sex unknown, bands undetermined; detected 21-24 May
T4 sex unknown UB:UB; detected 21 May - 6 Jun

Permit file
Copy made
11926

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Flagstaff Office
114 North San Francisco Street, Suite 100
Flagstaff, AZ 86001
Tel 928.774.5500 Fax 928.779.2709
www.swca.com

December 14, 2011

Erin McCarthy, Recovery Permit Coordinator
Carlsbad U.S. Fish and Wildlife Service
6010 Hidden Valley Road, Suite 101
Carlsbad, CA 92011

Re: SW Willow Flycatcher Studies 2011
T&E Species Permit TE028605-4, Final Permit Report Deliverable

Ms. McCarthy:

In fulfillment of SWCA Environmental Consultant's Federal Fish and Wildlife permit (TE028605-4) deliverable requirement with your department, please find enclosed on CD an annual report titled *Southwestern Willow Flycatcher Surveys, Color-banding and Nest Monitoring along the Lower Colorado River and Tributaries in Nevada, California, Arizona, and Utah, 2011*. This report details all of our Southwestern Willow Flycatcher studies conducted in California in 2011, and is presented in a site-by-site format to facilitate locating information of interest. Please note that only presence/absence surveys were conducted under this permit in California (see Chapter 1).

No field activities for the Desert Tortoise (*Gopherus agassizii*) were conducted in 2011 in California.

If you or your department requires any additional information, please do not hesitate contacting me directly: (928) 774-5500 ext. 4201; tkoronkiewicz@swca.com.

Many thanks for your continuing support, sincerely,

Tom Koronkiewicz
Avian Ecologist

TJK
Enclosure

Record Id 11926
County Riverside Imperial
Year 2011
Spp SWWF (+) YBC (+) YCR (+)
Srv. Rpt.
D.B. DIC 4/20/12
GIS Monitoring
L+R
File



CD
Report 1 of 2

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Flagstaff Office
114 North San Francisco Street, Suite 100
Flagstaff, AZ 86001
Tel 928.774.5500 Fax 928.779.2709
www.swca.com

2136

29 February, 2012

Susie Tharratt, Recovery Permit Coordinator
Carlsbad U.S. Fish and Wildlife Service
6010 Hidden Valley Road
Carlsbad, CA 92011

Re: SW Willow Flycatcher Studies 2011
T&E Species Permit TE028605-4, Final Report Deliverables

Ms. Tharratt:

In fulfillment of SWCA Environmental Consultant's Federal Fish and Wildlife permit deliverable requirement with your department, please find enclosed on CDs the annual report titled *Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2011;* and the confidential annual report, *Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations along the Virgin and Lower Colorado River Regions, 2011.* These reports detail all of our Southwestern Willow Flycatcher studies conducted in southern Nevada and California in 2011 and are part of our final deliverable to U.S. Bureau of Reclamation. They are supplemental to our annual report delivered to your department in December 2011. Both reports are presented in a site-by-site format to facilitate locating information of interest.

If you or your department requires any additional information, please do not hesitate contacting me directly: (928) 774-5500 ext. 4201; tkoronkiewicz@swca.com.

Many thanks for your continuing support, sincerely,

Tom Koronkiewicz
Avian Ecologist

TJK
Enclosures – CD

Record Id 11926
County Riverside Imperial
Year 2011
Spp SWWF (+) YBC (+) YCR (+)
Srv. Rpt.
D.B. DC 4/26/12
GIS monitoring
L+R

Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2011. Annual Report







U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2012

AR064096

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy

Lower Colorado River Multi-Species Conservation Program

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2011 Annual Report

Prepared by Mary Anne McLeod and Anne Pellegrini,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2012

AR064100

RECOMMENDED CITATION:

McLeod, M.A., and A.R. Pellegrini. 2012. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2011. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 167 pp.

CONTENTS

Executive Summary xi

1. INTRODUCTION 1
PROJECT HISTORY 1
RELATED STUDIES 2
SPECIES INTRODUCTION 2
PURPOSE AND DESCRIPTION OF STUDY 4

2. PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS 7
INTRODUCTION 7
Special Concern Species 7
METHODS 9
Site Selection 9
Additional Site Evaluation 12
Broadcast Surveys 12
Site Description 12
RESULTS 13
Reclamation Study Areas 13
Pahranagat National Wildlife Refuge, Nevada 18
Littlefield, Arizona 20
Mesquite, Nevada 20
Mormon Mesa, Nevada 21
Muddy River, Nevada 23
Topock Marsh, Arizona 24
Bill Williams River National Wildlife Refuge, Arizona 29
Palo Verde Ecological Reserve, California 32
Cibola, Arizona and California 33
Imperial, Arizona and California 35
Mittry Lake, California 38
Yuma, Arizona 38
NDOW Study Areas 39
Key Pittman Wildlife Management Area, Nevada 40
River Ranch 41
Warm Springs Natural Area 42
DISCUSSION 43

3. COLOR-BANDING AND RESIGHTING 45
INTRODUCTION 45
METHODS 45
Color-Banding 45
Resighting 46
RESULTS 47
Reclamation Study Areas 47
Site-by-Site Color-Banding and Resighting 47
NDOW Study Areas 58
Site-by-Site Color-Banding and Resighting 58

Non-Monitoring Sites 64
Adult Between-Year Return and Dispersal 64
Juvenile Between-Year Return and Dispersal 65
Within-Year, Between-Study Area Movements 66
DISCUSSION 67
Color-Banding Effort 67
Adult and Juvenile Between-Year Dispersal 67
Within-year, Between Study Area Movement 69
Adult and Juvenile Survivorship 69

4. NEST MONITORING 71
INTRODUCTION 71
METHODS 71
RESULTS 73
Reclamation Study Areas 73
Nest Monitoring 73
Nest Failure 74
Brood Parasitism 74
Cowbird Egg Addling 75
Mayfield Nest Success and Nest Productivity 77
NDOW Study Areas 78
Nest Monitoring 78
Nest Failure 79
Brood Parasitism 79
Cowbird Egg Addling 80
Mayfield Nest Success and Productivity 80
DISCUSSION 81
Reclamation Study Areas 81
Number of Breeding Flycatchers 81
Nest Success 82
Nest Failure 82
Brood Parasitism 83
Cowbird Egg Addling 84
NDOW Study Areas 84

5. VEGETATION AND HABITAT CHARACTERISTICS 87
INTRODUCTION 87
METHODS 87
Data Analyses 88
RESULTS 89
DISCUSSION 92

6. MICROCLIMATE 93
INTRODUCTION 93
METHODS 93
Temperature and Humidity Measurements 93
Soil Moisture Measurements 94
Statistical Analyses 95

RESULTS 95
DISCUSSION 107

7. HABITAT MONITORING: PARKER TO IMPERIAL DAMS 109
INTRODUCTION 109
METHODS 110
Temperature/Humidity Loggers 110
Soil Moisture Measurements 112
Vegetation Measurements 112
Groundwater Measurements 112
Statistical Analyses 112
Microclimate 112
Vegetation 113
RESULTS 113
Temperature/Humidity Logger Maintenance 113
Microclimate 113
2011 Microclimate Descriptive Statistics 113
Between-year Comparisons of Microclimate Characteristics 114
Vegetation Measurements 114
Between-year Comparisons of Vegetation Characteristics 114
DISCUSSION 121
Microclimate 121
Between-year Comparisons of Microclimate Characteristics 121
Vegetation 121
Groundwater Levels 123
Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements 123

8. SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 125
INTRODUCTION 125
METHODS 125
Water Delivery 125
Surface Water Mapping 126
Groundwater Measurements 126
Data Collection 127
Data Validation 127
Microclimate 127
Vegetation 128
Data Analyses 128
Microclimate 128
Vegetation 128
RESULTS 129
Water Delivery 129
Surface Water Mapping 129
Groundwater Monitoring 130
Microclimate 130
Vegetation 153
DISCUSSION 156

9. MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS 159
BROADCAST SURVEYS 159
COWBIRD CONTROL 160
HABITAT MONITORING: PARKER TO IMPERIAL DAMS 160
SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 160

10. LITERATURE CITED 161

Appendices

A. Field Data Forms
B. Orthophotos Showing Study Sites
C. Southwestern Willow Flycatcher Survey Results, 2011
D. Detections of Special Concern Species, 2011
E. All Willow Flycatchers Color-Banded and/or Resighted, 2003–2011
F. Contributing Personnel

Figures

1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*).. 3
2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2011..... 8
5.1. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2011. 91
5.2. Vertical foliage density at occupied willow flycatcher territories in cottonwood/willow habitat type, 2011..... 92
6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 98
6.2. Distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 99
6.3. Percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011..... 100
6.4. Percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011..... 101
6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 102
6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 103
6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 104
6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 105
6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 106
7.1. Locations of test and control sites, habitat monitoring study, 2005–2011..... 111
7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011..... 118
7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120

7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011. 122
8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011. 126
8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011. 131
8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. 132
8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011. 133
8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011. 134
8.6. Topock Marsh hydrograph, 2006–2011. 135
8.7. Topock Marsh hydrograph, February–July, 2011. 135
8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011. 137

8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011 141
8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 142
8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011. 142
8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 142
8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011. 142
8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 144
8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 144
8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 144
8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 144
8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 145
8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 145
8.18a. Difference between the day before and day after each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011. 148
8.18b. Difference between flood groups in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011. 148
8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 148
8.19a. Difference between the day before and day after each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011. 149

8.19b. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011. 149
8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 149
8.20a. Difference between the day before and day after each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011. 150
8.20b. Difference between flood groups in difference in daily temperature range before and after each flood event, Topock Marsh, 2011. 150
8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 150
8.21a. Difference between the day before and day after each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011. 151
8.21b. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011. 151
8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011. 151
8.22a. Difference between the day before and day after each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011. 152
8.22b. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011. 152
8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011. 152
8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010.. 154
8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010.. 154
8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. 155
8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011.. 155

Tables

2.1. Proposed Survey Schedule for Selected Sites 9
2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011 13
2.3. Detections of Willow Flycatchers Recorded after 15 June 2011 at Sites Where Breeding or Residency Was Not Confirmed 15
2.4. Yellow-billed Cuckoo Detections at Reclamation Study Areas, 2011 16
2.5. Yuma Clapper Rail Detections at Reclamation Study Areas, 2011 16
2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas,
2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011 39
3.1. Willow Flycatchers Detected at Reclamation Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season 49
3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 50
3.3. Willow Flycatchers Detected at NDOW Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season 59
3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 60
3.5. Banded Willow Flycatchers, Non-Monitoring Sites, 2011 64
3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011 64
3.7. Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2011 65
3.8. Juvenile Flycatchers Banded as Hatch Year Birds in 2007, 2009, or 2010 and Identified for the First Time in 2011 66
3.9. Adult Willow Flycatcher Within-Year Movements for All Individuals Identified at Two Different Study Areas in 2011 67
4.1. Summary of Willow Flycatcher Nest Monitoring Results at Reclamation Study Areas, 2011 73
4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Reclamation Study Areas from 1996 to 2011 74
4.3. Summary of Causes of Willow Flycatcher Nest Failure at Reclamation Study Areas, 2011 75
4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds, 2011 75
4.5. Brown-headed Cowbird Annual Hatch Rate in Willow Flycatcher Nests at Reclamation Study Areas from 2003 to 2011 76
4.6. Willow Flycatcher Nesting Success for Parasitized Nests at Reclamation Study Areas from 2003 to 2011 76
4.7. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Reclamation Study Areas, 2011 77
4.8. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Reclamation Study Areas, 2011 78
4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011 78
4.10. Summary of Causes of Willow Flycatcher Nest Failure at NDOW Study Areas, 2011 79
4.11. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds in Key Pittman, River Ranch, and Warm Springs Study Areas, 2011 80
4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011 80

4.13. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at NDOW Study Areas, 2011 81
5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2011 90
5.2. Proportion of Stems Omitted from Stem Counts 91
6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory, 2011 96
6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Willow, 2011 97
7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011 115
7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011 115
7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011 117
7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011 119
7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011 119
8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011 129
8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010 138
8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010 138
8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011 139
8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011 139
8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011 146
8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011 147
8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011 153

EXECUTIVE SUMMARY

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*), listed as federally endangered in 1995, breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico. Historical breeding records and museum collections indicate a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region. Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Willow flycatcher studies have been conducted along the Virgin and lower Colorado Rivers and tributaries annually since 1996, in compliance with requirements set forth by the U.S. Fish and Wildlife Service (USFWS) regarding U.S. Bureau of Reclamation (Reclamation) routine operations and maintenance along the lower Colorado River. Biological Assessments and the resulting Biological Opinions on operations and maintenance were prepared as steps to developing a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). The LCR MSCP was signed in April 2005, and implementation of the program began in October 2005. The LCR MSCP calls for continued surveys and monitoring of willow flycatchers along the lower Colorado River. SWCA Environmental Consultants (SWCA) was contracted by Reclamation to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the Virgin and lower Colorado River regions in 2011.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet of California apportionment water for 75 years. The point of diversion, previously located below Parker Dam, would change to a point above Parker Dam. These changes in water regulation could cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less and have the potential to modify riparian habitats below Parker Dam. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams. In 2004, Reclamation biologists initiated studies of the microclimate within potentially affected areas. In 2005, these studies were continued and expanded by SWCA to address how the hydrological changes might affect riparian habitats along the Parker to Imperial reach.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. Water delivery commenced 1 March 2011 and continued into July. Baseline conditions of vegetation, microclimate, and hydrology in the target area were documented in 2009 and 2010, and these studies were continued in 2011 to document conditions during the water delivery period.

SWCA was retained by Nevada Department of Wildlife (NDOW) in 2011 to complete flycatcher surveys, site descriptions, nest monitoring and color-banding at Key Pittman Wildlife Management Area, River Ranch, and Warm Springs Natural Area. We also completed surveys for Yellow-billed Cuckoos at these study areas.

Approximately 100 sites are included in the Reclamation study of flycatchers along the Virgin and lower Colorado Rivers, but a portion of the sites are surveyed biennially rather than annually. In 2011, we completed presence/absence surveys, following a 5-survey protocol, and site descriptions at a subset of the 100 sites. At study areas where territorial flycatchers were detected in 2011, we searched for nests in all areas occupied by territorial flycatchers; monitored willow flycatcher nests to document nest fate, brood parasitism, and causes of nest failure; and color-banded and resighted as many willow flycatchers as possible to determine the breeding status of territorial flycatchers and document movement and recruitment. We also measured characteristics of vegetation and microclimate in occupied territories at one study area.

We used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 59 Reclamation sites, ranging in size from <1 to 38 ha, along the Virgin and lower Colorado Rivers and tributaries from Pahranagat National Wildlife Refuge (NWR), Nevada, south to Yuma, Arizona between 15 May and 24 July 2011. We detected willow flycatchers on at least one occasion at 47 of these sites. Breeding or resident flycatchers were detected at 13 sites within the Pahranagat NWR, Mesquite, Mormon Mesa, and Muddy River, Nevada; and Topock Marsh and Bill Williams River NWR, Arizona, study areas. South of Bill Williams, 154 willow flycatcher detections were recorded between 15 May and 20 June; no flycatcher detections were recorded at any of these sites after 20 June. Monitoring results suggest these flycatchers were not resident, breeding individuals and were most likely spring migrants.

We completed broadcast surveys for flycatchers at 3 sites and monitored an additional 17 sites within the three NDOW study areas and detected breeding flycatchers within 15 sites. We also completed surveys for Yellow-billed Cuckoos at these study areas. No cuckoos were detected during surveys or incidentally.

We used targeted mist-net and passive netting techniques to capture and uniquely color-band adult and fledgling willow flycatchers at all sites where resident willow flycatchers were detected. Nestlings were banded between 8 and 10 days of age. We banded each willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and one pin-striped, aluminum band on the other. We used binoculars to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combinations on their legs.

At Reclamation study areas, we color-banded 15 new adult flycatchers and recaptured 11 individuals detected in previous years as adults. An additional 31 adults were identified to individual via resighting, while 3 individuals were resighted but did not have their color combinations confirmed. We detected two individuals identified as returning nestlings by the presence of a single federal band, with one (50%) identified to individual via recapture. Two additional returning nestlings with full combinations were recaptured. Thirty adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 30 adults. We banded 40 nestlings from 17 nests. Of the 40 nestlings banded, 5 were known or suspected to have died before fledging. We banded flycatchers opportunistically at St. George, Utah, capturing and color-banding two new adults and one nestling.

At NDOW study areas, we color-banded 13 new adult flycatchers and recaptured 3 individuals detected in previous years as adults. An additional 25 adults were identified to individual via resighting, while 2 individuals were resighted but did not have their color combinations confirmed. We recaptured one individual identified as a returning nestling by the presence of a single federal band. Three additional adults were captured with a full color combination and identified as returning nestlings from 2009 or 2010. Five adult flycatchers remained unbanded, and banding status was undetermined for one adult. We banded 34 nestlings from 13 nests. Of the 34 nestlings banded, 3 were suspected to have died before fledging.

Of the 96 resident, adult willow flycatchers identified to individual at monitored study areas in 2010, 55 (57%) were identified in 2011; 5 (9%) were detected at a different study area from where they were last detected in 2010. We detected seven within-year, between-study area movements in 2011.

Of the 51 juveniles banded and not known or suspected to have died at Reclamation study areas in 2010, 2 (4%) were identified in 2011. An additional 36 juveniles were banded at NDOW study areas and not known or suspected to have died in 2010; nine (25%) were identified in 2011. Sixteen individuals originally banded as nestlings in previous years were identified for the first time in 2011. Of the 16 returning nestlings identified in 2011, 12 (75%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2011 was 12.8 km.

We recorded 50 territories at all Reclamation study areas. Of these, 36 (72%) consisted of paired flycatchers and 14 (28%) consisted of unpaired individuals. Eight breeding males were polygynous, two pairing with three females and six pairing with two females. One female mated consecutively with two different males. One male moved and established a second territory within the same study area. We recorded 24 territories at NDOW study areas. Of these, 21 (88%) consisted of breeding individuals, 1 (4%) consisted of paired individuals with no documented breeding activity, and 2 (8%) consisted of unpaired males. Three males were polygynous; each mated with two females.

At Reclamation study areas, we documented 49 willow flycatcher nesting attempts, 43 of which contained eggs and were used in calculating nest success and productivity. Eighteen (42%) nests were successful and fledged young; and 25 (58%) failed. Mayfield survival probability ranged from 0.198 to 1.000, and was 0.467 for all sites combined (except Topock Marsh where Mayfield nest success could not be calculated due to a lack of data). Depredation was the major cause of nest failure, accounting for 52% of all failed nests and 65% of nests that failed after flycatcher eggs were laid.

We documented 38 flycatcher nesting attempts at NDOW study areas; 36 of these were known to contain flycatcher eggs and were used in calculating nest success and productivity. Of nests known to contain flycatcher eggs, fourteen (39%) were successful and fledged young, and 22 (61%) failed. Depredation accounted for the majority (59%) of all nest failures. Mayfield survival probability was 0.447 at Key Pittman and could not be calculated at River Ranch or Warm Springs due to lack of data.

At Reclamation study areas, 7 of 37 nests (19%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds. Brood parasitism at Reclamation study areas ranged from 0 to 60% and was highest at Muddy River. At NDOW study areas, 4 of 34 nests (12%) with flycatcher eggs and known contents were brood parasitized. Brood parasitism was 11% at Key Pittman, 75% at River Ranch, and 0% at Warm Springs. We addled cowbird eggs via vigorous shaking at all easily accessible flycatcher nests. Egg addling appeared to reduce the hatch rate of cowbird eggs, though small sample size precluded rigorous comparisons. Nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized. This is not necessarily due to the success or failure of the addling program as parasitized nests often failed for other reasons (e.g., depredation or failure of flycatcher eggs to hatch).

At Bill Williams River NWR, we gathered data on microclimate characteristics at one location each for two of the territorial male flycatchers we identified; both males obtained mates and had nesting attempts. We also gathered data on vegetation characteristics at these two territories, plus an additional two territories; one of the additional territories was occupied by a nesting pair and the other by an unpaired male. We delineated the following habitat types: 1) Goodding willow with tamarisk understory, and 2) cottonwood/willow. Both of these vegetation types fall within the definition of cottonwood-willow habitat (cottonwoods and willows constituting at least 10% of total trees) as used in the LCR MSCP. We present results for each of our delineated habitat types as well as for the cottonwood-willow vegetation types used in the LCR MSCP. Sample sizes in 2011 are too small to provide an accurate

representation of the range and variance in vegetation and microclimate characteristics in each habitat type.

Both vegetation types (Goodding willow with tamarisk understory and cottonwood/willow) exhibited moist or inundated soil conditions at some point in the breeding season. Daily maximum temperatures spanned a range of ~5°C among habitat types, while daily minimum temperatures spanned <3°C. Vapor pressure increased through the end of July for both habitat types and was higher in Gooding willow with tamarisk understory than in cottonwood/willow.

In 2005, we selected 11 sites between Parker and Imperial Dams for inclusion in the habitat monitoring study addressing how changes in water transfer actions might affect riparian habitat. We also selected two control sites above Parker Dam and two below Imperial Dam. At each site we installed 3–5 temperature/humidity data loggers. Soil moisture measurements were collected at each data logger location in 2011 during each flycatcher survey at the site and when logger data were downloaded. Vegetation measurements were also collected at each data logger location after surveys were completed.

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 and cooler conditions in 2009 than in the other years. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional, rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station. Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

We noted between-year differences at the habitat monitoring sites for several vegetation variables, but none of the variables exhibited a unidirectional change across time. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years. Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred.

Supplemental water delivery to support habitat enhancement commenced at Topock Marsh in 2011, periodically flooding portions of In Between and 800M. The flooded area at those two sites was the only area surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season. Water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy. Water delivery had the expected effect of raising soil moisture, decreasing distance to water, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also increased humidity within the flooded area. Flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area, but these effects did not seem to persist across two-week periods. Areas occupied by flycatchers typically have higher soil moisture, higher humidity, and more moderate temperatures than unoccupied areas; thus, water delivery appeared to change the conditions within the flooded area in ways that would favor flycatcher occupancy. Water delivery was the most effective at creating conditions favored by flycatchers when the underlying water table was high. Despite the presence of favorable conditions, flycatcher occupancy in the target area did not increase in 2011, possibly because dry conditions elsewhere in Topock Marsh and a low flycatcher population may have limited the ability of flycatchers to colonize the area.

Chapter 1

INTRODUCTION

PROJECT HISTORY

In 1995, the U.S. Bureau of Reclamation (Reclamation), other federal, state, and tribal agencies, and environmental and recreational interests agreed to form a partnership to develop and implement a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). As a step to developing the LCR MSCP, Reclamation prepared a Biological Assessment (BA) in August 1996, evaluating the effects of dam operations and maintenance activities on threatened, endangered, and sensitive (TES) species. These species included the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), which was listed by the U.S. Fish and Wildlife Service (USFWS) as endangered in 1995 (60 FR 10694–10715). In response to the BA, the USFWS issued a Biological Opinion (BO) in April 1997 outlining several terms and conditions Reclamation must implement in order not to jeopardize the species. Among these terms and conditions was the requirement to survey and monitor occupied and potential habitat for Southwestern Willow Flycatchers along the LCR for a period of five years. The studies were intended to determine the number of willow flycatcher territories, status of breeding pairs, flycatcher nest success, the biotic and abiotic characteristics of occupied willow flycatcher sites, and Brown-headed Cowbird (*Molothrus ater*) brood parasitism rates. In 2002, Reclamation reinitiated consultation with USFWS on the effects of continued dam operations and maintenance on TES species along the LCR. The USFWS responded with a BO in April 2002 requiring continued Southwestern Willow Flycatcher studies along the LCR through April 2005. The BO also required implementation of a study to evaluate the effectiveness of Brown-headed Cowbird trapping for conservation of the flycatcher.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet for 75 years. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams.

The LCR MSCP is a 50-year program that seeks to protect 26 TES species and their habitats along the LCR while maintaining river regulation and water management required by law. The LCR MSCP was approved in April 2005 with the signing of a Record of Decision by the Secretary of the Department of the Interior, and implementation of the program began in October 2005. Documentation for the LCR MSCP includes a Habitat Conservation Plan (HCP), BA/BO, and an Environmental Impact Statement. The HCP specifies monitoring and research measures that call for surveys and research to better define habitat requirements for the Southwestern Willow Flycatcher and studies to determine the effects of cowbird nest parasitism on flycatcher reproduction.

Reclamation initiated willow flycatcher studies along the LCR in 1996, in anticipation of the requirements outlined in the BOs that were part of LCR MSCP development. These studies have been conducted annually since 1996. From 1997 to 2010,[1] breeding populations of Southwestern Willow Flycatchers were documented at eight study areas along the Virgin and lower Colorado Rivers and tributaries: (1) Pahranagat National Wildlife Refuge (NWR), Nevada; (2) Beaver Dam Wash at Littlefield, Arizona; (3) Mesquite and (4) Mormon Mesa on the Virgin River, Nevada; (5) Overton

[1] Studies in 1996 did not include any sites in Nevada.

Wildlife Management Area (WMA) along the Muddy River, Nevada; (6) Grand Canyon, Arizona; (7) Topock Marsh on the Colorado River, Havasu NWR, Arizona; and (8) Bill Williams River NWR (Bill Williams), Arizona (McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; Braden and McKernan unpubl. data). From 1997 to 2010, willow flycatchers, including one banded migrant Southwestern Willow Flycatcher (Koronkiewicz et al. 2006a), were detected during the breeding season at several sites along the Colorado River south of the Bill Williams River to the Mexico border, but no nesting activity was confirmed.

In compliance with the consultation on Interim Surplus Criteria and Secretarial Implementation Agreements, Reclamation biologists deployed temperature/humidity data loggers in 2004 at a subset of sites currently monitored for Southwestern Willow Flycatcher along the Colorado River in California and Arizona. These studies were expanded in 2005 to include annual monitoring of groundwater levels, vegetation, and soil moisture in addition to temperature and humidity.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh in 2004–2008, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. The selected area at Topock had seen the greatest decline in numbers of resident flycatchers but had not experienced any dramatic changes in vegetation. Water delivery was anticipated to commence in 2010, and monitoring of vegetation, microclimate, and hydrologic condition in the target area was initiated in 2009 to obtain baseline conditions in the target area. Water delivery was delayed until 2011, so additional monitoring of baseline conditions occurred in 2010.

RELATED STUDIES

Prior to 2010, Nevada Department of Wildlife (NDOW) completed nest monitoring at Key Pittman WMA, and SWCA Environmental Consultants (SWCA) banded flycatcher nestlings and adults opportunistically in cooperation with the monitoring efforts. In 2010, NDOW retained SWCA to conduct surveys, site descriptions, nest monitoring, and banding at flycatcher breeding areas at Key Pittman WMA and Warm Springs Natural Area. This work was expanded in 2011 to include River Ranch in the Pahranagat Valley. SWCA also completed surveys for Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) at Key Pittman and River Ranch. Results of surveys, site descriptions, nest monitoring, and banding efforts at Key Pittman, River Ranch, and Warm Springs are presented in Chapters 2, 3, and 4.

Utah Division of Wildlife Resources monitored breeding flycatchers in St. George, Utah. SWCA banded adults and nestlings opportunistically in St. George in cooperation with the monitoring efforts. Banding results from St. George are presented in a separate table in Chapter 3.

SPECIES INTRODUCTION

The Southwestern Willow Flycatcher is one of four subspecies of willow flycatcher currently recognized (Unitt 1987), although Browning (1993) posits a fifth subspecies (*E. t. campestris*) occurring in the central portions of the United States (Figure 1.1). The Southwestern Willow Flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987).

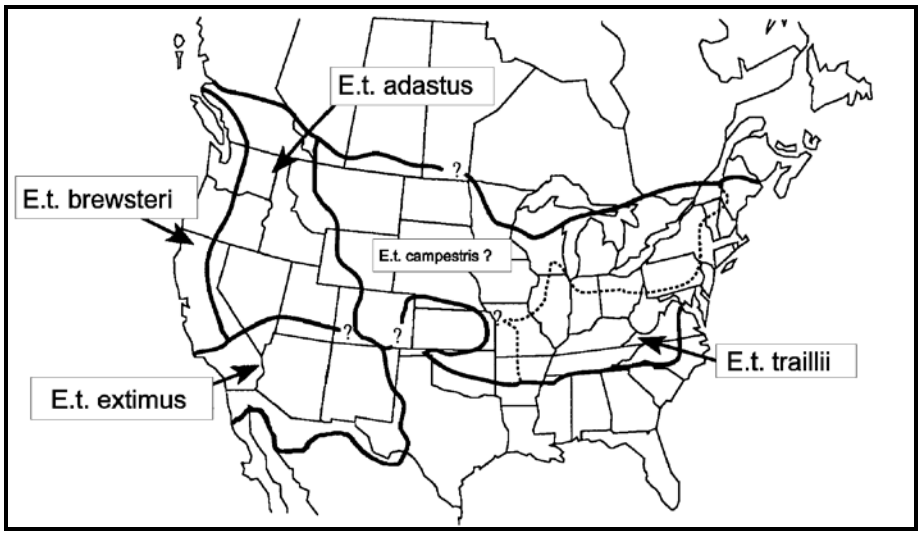


Figure 1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*). Adapted from Unitt (1987), Browning (1993), and Sogge et al. (1997).

In the Southwest, most willow flycatcher breeding territories are found within small breeding sites containing five or fewer territories (Durst et al. 2006). One of the last long-distance Neotropical migrants to arrive in North America in spring, Southwestern Willow Flycatchers have a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in August (Sogge et al. 1997). All four subspecies of willow flycatchers spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995, Unitt 1997), with wintering ground habitat similar to the breeding grounds (Lynn et al. 2003). Willow flycatchers have been recorded on the wintering grounds from central Mexico to southern Central America as early as mid-August (Stiles and Skutch 1989, Howell and Webb 1995), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz et al. 2006b).

Historical breeding records and museum collections indicate that a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the LCR region (Unitt 1987). However, no nests have been located south of the Bill Williams River, Arizona, in over 65 years (Unitt 1987), though northbound and southbound migrant willow flycatchers use the riparian corridor (Phillips et al. 1964; Brown et al. 1987; McKernan and Braden 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; this document). Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (USFWS 1995, Marshall and Stoleson 2000). Because of low population numbers range-wide, identifying and conserving willow flycatcher breeding sites is thought to be crucial to the recovery of the species (USFWS 2002).

Tamarisk beetles (*Diorhabda* spp.) may pose an additional threat to Southwestern Willow Flycatchers. Tamarisk beetles defoliate tamarisk (*Tamarix* spp.) plants during flycatcher breeding season, likely exposing flycatcher nests to adverse microclimate conditions and increased risk of depredation and parasitism. Tamarisk beetles were released in St. George, Utah, in 2006, and widespread defoliation was first observed in St. George in 2008. The area of defoliation on the Virgin River has expanded downstream annually since then, encompassing Littlefield, Arizona, in 2009; the Highway 170 bridge

downstream of Bunkerville, Nevada, in 2010; and the entire stretch of the Virgin River to Lake Mead by the end of the breeding season in 2011.

PURPOSE AND DESCRIPTION OF STUDY

The purpose of the 2011 study is to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the lower Colorado and Virgin River region. Lower Grand Canyon was not visited in 2009–2011 because the declining level of Lake Mead dramatically reduced the amount of potential flycatcher habitat, and the formation of rapids at Pearce Ferry and Iceberg Canyon made access difficult and dangerous. This project encompasses four types of studies: (1) presence/absence surveys, including site descriptions, at preselected sites along the lower Colorado River and portions of major tributaries; (2) intensive studies at all study areas where breeding flycatchers are located to assess Southwestern Willow Flycatcher demographics and ecology, habitat selection, and the effects of Brown-headed Cowbird brood parasitism; (3) monitoring of microclimate, vegetation, and groundwater conditions of currently occupied[2] Southwestern Willow Flycatcher habitat between Parker and Imperial Dams; and (4) monitoring microclimate, vegetation, and surface hydrology in a selected portion of flycatcher habitat within Topock Marsh to document the effects of habitat enhancement efforts. SWCA's contract specifies the following field tasks:

Presence/absence Surveys. At approximately 100 sites along the LCR, conduct presence/absence surveys, following a 5-survey protocol (per USFWS 2000).

Site Descriptions. Provide a general site description for each site, including major types of vegetation and hydrological conditions, at least three times during the survey period.

Nest Monitoring. Search for nests in all areas occupied by territorial flycatchers, and monitor all nests to determine nest fate, brood parasitism, and causes of nest failure.

Banding. Band as many adult and juvenile flycatchers as possible at sites with territorial flycatchers.

Vegetation, Soils, and Microclimate. Collect vegetation, soil, and microclimate data at the within-territory level at breeding locations in order to quantify conditions at flycatcher territories for replication at restoration areas.

Habitat Monitoring. At 15 previously identified sites, monitor vegetation, microclimate, and groundwater conditions to determine how these may be affected by water transfer actions at Parker Dam.

Surface Hydrology, Vegetation, and Microclimate Monitoring. Within a selected portion of Topock Marsh, monitor surface hydrology, microclimate, and vegetation conditions.

Each distinct aspect of the 2011 study is addressed in a separate chapter in this report, as follows:

Chapter 2 – Presence/absence Surveys and Site Descriptions. This chapter presents the methodology and results for presence/absence surveys and gives a general site description for each survey site.

[2] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year, 1996–2011.

Chapter 3 – Color-banding and Resighting. Details of banding activities and resighting of previously banded flycatchers are presented in this chapter. Also included are discussions of within- and between-year movement of individual flycatchers.

Chapter 4 – Nest Monitoring. This chapter summarizes nesting attempts, nest fates, and productivity for all Southwestern Willow Flycatcher nesting activity.

Chapter 5 – Vegetation and Habitat Characteristics. Vegetation sampling methods are described, and vegetation characteristics are summarized for territories in different habitat types.

Chapter 6 – Microclimate. The methodology of monitoring temperature, humidity, and soil moisture is described, and microclimate characteristics are summarized for flycatcher territories in different habitat types.

Chapter 7 – Habitat Monitoring: Parker to Imperial Dams. The methodology and results of monitoring microclimate, vegetation, and groundwater conditions at occupied sites between Parker and Imperial Dams are presented.

Chapter 8 – Surface Hydrology, Microclimate, and Vegetation Monitoring: Topock Marsh. This chapter describes sampling methods and compares baseline conditions documented in 2009 and 2010 to those documented in 2011 in an area targeted for habitat enhancement.

Chapter 9 – Management and Study Design Recommendations. Recommendations from all previous report chapters are summarized for ease of reference.

This page intentionally left blank.

Chapter 2

PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS

INTRODUCTION

Broadcasts of recorded conspecific vocalizations are useful in eliciting responses from nearby willow flycatchers, and multiple broadcast surveys conducted throughout the breeding season are the standard technique for determining the presence or absence of *E. t. extimus* (Sogge et al. 2010). According to Sogge et al. (2010) and USFWS (2002), willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* probably belong to the southwestern subspecies. However, because northbound individuals of all western subspecies of the willow flycatcher migrate through areas where *E. t. extimus* are actively nesting, and southbound migrants occur where *E. t. extimus* are still breeding (Sogge et al. 2010, USFWS 2002), field confirmation of the southwestern subspecies is problematic.[1] For example, the northwestern *E. t. brewsteri*, far more numerous than *E. t. extimus*, has been documented migrating north in southern California as late as 20 June (Garrett and Dunn 1981 as cited in Unitt 1987), and Phillips et al. (1964 as cited in Unitt 1987) documented *E. t. brewsteri* collected in southern Arizona on 23 June. An understanding of willow flycatcher migration ecology in combination with multiple broadcast surveys conducted throughout the breeding season is therefore needed to assess the presence and residency of Southwestern Willow Flycatchers.

Migration routes used by *E. t. extimus* are not well documented, though more is known of northbound migration in spring than the southbound migration in fall because flycatchers are more vocal in spring and can therefore be distinguished from other *Empidonax* species. During northbound migration, all subspecies of willow flycatchers use riparian habitats similar to breeding habitat along major river drainages in the Southwest such as the Rio Grande (Finch and Kelly 1999), Colorado River (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson unpubl. data). Although migrating willow flycatchers may favor young, native willow habitats (Yong and Finch 1997), migrants are also found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, even though not used for breeding, are likely important for both reproduction and survival. For most long-distance Neotropical migrant passerines, migration stopover habitats are needed to replenish energy reserves to continue northbound or southbound migration.

In 2011, as part of our contract with Reclamation, we completed multiple broadcast surveys at sites in 11 study areas[2] (hereafter Reclamation study areas) along the LCR and its tributaries to detect both migrant and resident willow flycatchers (Figure 2.1). We also completed surveys in three additional study areas (Key Pittman, River Ranch, and Warm Springs; hereafter NDOW study areas) as part of our contract with NDOW.

Special Concern Species

The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is listed as federally endangered by the USFWS, and the Yellow-billed Cuckoo is a candidate for federal listing. Both species occur along the LCR and its tributaries and are of concern to managing agencies. Nine additional avian species [California Black Rail (*Laterallus jamaicensis coturniculus*), Least Bittern (*Ixobrychus exilis*), Elf Owl (*Micrathene whitneyi*),

[1] Throughout this document, the terms "flycatcher" and "willow flycatcher" refer to *E. t. extimus* when individuals are confirmed as residents. For individuals for which residency is undetermined, subspecies is unknown.

[2] Study areas consist of 1–18 survey sites that are grouped geographically (see Table 2.2).



Figure 2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2011. (Note, study area labels represent the approximate center of multiple sites within that region; see Table 2.2)

Gila Woodpecker (*Melanerpes uropygialis*), Gilded Flicker (*Colaptes auratus chrysoides*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Arizona Bell's Vireo (*Vireo bellii arizonae*), Sonoran Yellow Warbler (*Setophaga petechia sonorana*), and Summer Tanager (*Piranga rubra*)] are considered to be special-concern species under the LCR MSCP. The Yellow-breasted Chat (*Icteria virens*) is also considered a special concern species in California. We did not survey specifically for these species at the 11 Reclamation study areas but recorded all incidental detections. We recorded all incidental detections of special concern species at all three NDOW study areas and completed surveys for Yellow-billed Cuckoos at Key Pittman and River Ranch.

METHODS

Site Selection

Survey sites were selected based on locations surveyed during previous years of willow flycatcher studies on the LCR (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011) and reconnaissance on foot prior to the start of the 2011 survey period. Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (>50%) and standing water or saturated soil under or adjacent to the vegetation were considered the most suitable habitats for flycatchers. Early successional stands of young riparian vegetation >3 m in height in proximity to surface water or saturated soil were also considered potentially suitable flycatcher habitat. Riparian vegetation contiguous with suitable habitat was often included as part of survey areas. Reclamation biologist Chris Dodge guided and approved site selection at the 11 Reclamation study areas. For sites surveyed in previous years, we retained original site names.

In 2008 we implemented a biennial survey schedule at selected sites in study areas where resident flycatchers had not been documented in the previous 10 years of surveys. Sites were selected for biennial surveys based on the absence of damp or wet soils within the site and/or the relative absence of dense vegetation that might provide suitable nesting habitat for flycatchers. After the 2008 survey season, we revised the survey schedule based on conditions observed in the field and added several sites at Bill Williams to the biennial schedule. These sites were ones at which no resident flycatchers had been detected since 2003. The proposed schedule at the beginning of the 2011 survey season is given in Table 2.1 and may be further revised based on conditions observed during 2011.

Table 2.1. Proposed Survey Schedule for Selected Sites

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
TOGO[2]	Pulpit Rock	Tiny. Wet soil adjacent to river; upland edge dry.			X
	Picture Rock	Wet soil adjacent to river; interior dry.			X
	Blankenship Bend North	Stand of willow adjacent to marsh.	X		
	Blankenship Bend South	Mosaic of cattail, bulrush, willow. Areas with water under vegetation.	X		
	Havasu NE	Mature vegetation; interior of site is completely dry, no water beneath the vegetation.		X	

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
BIWI	Site #1	Mixed-native vegetation; dry soils and stands of dense arrowweed in the center of the site; coyote willow and surface water along the site edge, bordering an arm of Lake Havasu.		X	
	Site #2	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Site #11	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Black Rail	Mixed-native vegetation; generally sparse understory; narrow strip of dense vegetation.		X	
	Mineral Wash	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Beaver Pond	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Site #8	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within the river channel.		X	
PVER	PVER Phase 2	Restoration area.	X		
	PVER Phase 3	Restoration area.	X		
EHRE	Ehrenberg	Emergent cottonwood and Goodding willow; understory primarily arrowweed and *Baccharis* sp.; formerly contained a dense stand of coyote willow but these willows have all died.		X	
CIBO	CVCA Phase 1	Restoration area.	X		
	CVCA Phase 2	Restoration area.	X		
	CVCA Phase 3	Restoration area.	X		
	Cibola Nature Trail	Generally dry and sparse. Restoration area; habitat improvements taking place, may improve.	X		
	Cibola Island	Narrow, linear site; patches of dense Goodding willow adjacent to marsh.	X		
	Cibola Site 2	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Cibola Site 1	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Three Fingers Lake	Vegetation short, very dry and hot in interior.		X	
	Cibola Lake #1 (North)	Patchy vegetation, hot and dry in interior.		X	
	Cibola Lake #2 (East)	Patchy vegetation, hot and dry in interior.			X
	Cibola Lake #3 (West)	Patchy vegetation, hot and dry in interior.		X	
	Walker Lake	Tamarisk with emergent willows; water under vegetation along lake edge.	X		
IMPE	Paradise	Some big willows with tamarisk understory, sometimes has water in marshes.	X		
	Hoge Ranch	Mosaic of tamarisk, willow, and marshes. Sometimes wet.	X		
	Adobe Lake	Perched above river, very dry; dense tamarisk with many dead branches in understory.		X	
	Rattlesnake	Dense willows, wet soils.	X		

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
IMPE	Milemarker 65	Very narrow strip (<50m) of tamarisk adjacent to bulrush marsh. Understory of *Phragmites* creates extremely dense vegetation within 3 m of ground.			X
	Clear Lake/The Alley	Mature tamarisk, very dense understory. Very dry except immediately next to backwater channel.		X	
	Nursery NW	Dense tamarisk interspersed with marsh areas.	X		
	Imperial Nursery	Plantation. No understory.		X	
	Ferguson Lake	Mix of willow and tamarisk with water under vegetation on west side of site. East side dry and scrubby.	X		
	Ferguson Wash	Mature tamarisk with emergent willow. Very dry in interior of site. Borders backwater channel and Ferguson Lake. Moist soils only along channel edge.		X	
	Great Blue Heron	Goodding willow overstory, tamarisk understory; moist soils in parts of the site.	X		
	Powerline	Very small. Stringer of trees around cattail marsh that sometimes contains water. Sparse canopy.			X
	Martinez Lake	Scattered willows, tamarisk and arrowweed understory, sparse canopy closure.			X
MITT	Mittry West	Willow overstory, tamarisk understory, 80% canopy closure; sometimes wet.	X		
	Mittry South	Monotypic tamarisk, lots of deadfall. Interior dry. Adjacent to lake.		X	
YUMA	Gila Confluence North	Patchy. A few small stands of mature willows around cattail marshes. Marshes sometimes contain water. Half of site burned in 2006. Overall canopy closure 50%.		X	
	Gila River Site #2	Cottonwood/willow overstory, tamarisk and arrowweed understory; dry soils in interior; canopy closure 50%.			X
	Fortuna Site #1	Narrow (30m) strip of cottonwood/willow. Patchy understory of tamarisk and arrowweed on periphery, no understory within cottonwood/willow. Interior dry.			X
	Fortuna North	Mature tamarisk, 80% canopy closure. Interior very dry. Adjacent to Gila River.			X

[1] TOGO = Topock Gorge, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, EHRE = Ehrenberg, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] No surveys were completed in Topock Gorge in 2011 because effort was redirected to hydrology monitoring at Topock Marsh (see Chapter 8).

We provided field personnel with high-resolution aerial photographs of all selected survey sites. The photographs were overlain with a UTM grid (NAD 83) and an outline of the proposed survey area. The boundaries of all survey sites were refined to include potential flycatcher habitat actually present. New boundaries were delineated on the aerial photographs based on UTM coordinates obtained in the field. All UTM coordinates were obtained using a Garmin Rino 110 GPS unit and were in NAD 83 to comply with Federal Geographic Data Committee standards.

Additional Site Evaluation

During the survey season, we conducted on-the-ground habitat reconnaissance and evaluation to locate additional potentially suitable willow flycatcher habitat and to reevaluate areas we had visited in previous years and had noted as having the potential to become suitable habitat. Field personnel were provided high-resolution aerial photographs overlain with a UTM grid to aide with navigation and the identification of potentially suitable flycatcher habitat. We focused habitat reconnaissance and evaluation in areas that contained or were adjacent to standing water or saturated soils, and that had vegetation characteristics similar to that of flycatcher breeding sites (i.e., dense vegetation within 2–4 m of the ground and high canopy closure). Broadcast surveys were conducted opportunistically during ground reconnaissance. Field personnel formulated qualitative site descriptions of all evaluated areas.

Broadcast Surveys

To elicit responses from nearby willow flycatchers, we broadcast conspecific vocalizations previously recorded throughout the Southwest from 1996 to 1998. All flycatcher surveys were conducted according to methods described in Sogge et al. (2010), and we followed a 5-survey protocol, as recommended by the U.S. Fish and Wildlife Service (USFWS 2000). We completed at least one survey between 15 and 31 May, at least one survey between 1 and 15 June, and three additional surveys between 16 June and 25 July. Surveys were separated by a minimum of five days whenever logistically possible. Field personnel surveyed within the habitat wherever possible, using a Sansa® ClipMP3 player coupled to a Radio Shack 277-1008C mini amplified speaker. Surveyors stopped every 30–40 m and broadcast willow flycatcher primary song (*fitz-bew*) and calls (*breets*). Field personnel watched for flycatchers and listened for vocal responses for approximately one to two minutes before proceeding to the next survey station. Wherever territorial flycatchers were detected, we discontinued broadcast surveys within a radius of 50 m of territories and commenced territory and nest monitoring, which involves more frequent visits (see Chapter 4). If an unidentified *Empidonax* flycatcher was observed but did not respond with song to the initial broadcast, we broadcast other conspecific vocalizations including *creets/breets*, *wee-oos*, *whitts*, *churr/kitters*, and a set of interaction calls given by a mated pair of flycatchers (per Lynn et al. 2003). These calls are frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify willow flycatchers. To produce a spatial representation of all survey areas, field personnel recorded survey start and stop UTM coordinates as well as the UTM coordinates of intermediate survey points. Observers recorded start and stop times and the location(s) and behavior of all willow flycatchers detected (see survey form, Appendix A). Field personnel also recorded the presence of Brown-headed Cowbirds (hereafter cowbirds) and livestock, as requested by the Arizona Game and Fish Department. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity (see Chapter 4), while livestock may substantially alter the vegetation in an area (USFWS 2002).

Site Description

Because vegetation structure and hydrology within riparian habitats are seasonally dynamic, field personnel completed site description forms (Appendix A) for each survey site at least three times throughout the survey season: early season (mid-May), mid-season (mid-June), and late season (mid-July). Vegetation composition (native vs. exotic) at survey sites followed the definitions of Sogge et al. (2010) and the Southwestern Willow Flycatcher Range-wide Database. Vegetation composition was defined as (1) native: >90% of the vegetation at a site was native; (2) exotic: >90% of the vegetation at a site was exotic/introduced; (3) mixed-native: 50 to 90% of the vegetation at a site was native; or (4) mixed-exotic: 50 to 90% of the vegetation at a site was exotic/introduced. Information from site

description forms was used in conjunction with habitat photographs and comments in field notebooks and on survey forms to formulate qualitative site descriptions.

RESULTS

Reclamation Study Areas

Field personnel spent 469.6 observer-hours conducting willow flycatcher broadcast surveys at 59 sites along the Virgin and lower Colorado Rivers and tributaries.[3] Willow flycatcher survey and monitoring results are summarized in Table 2.2 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2011 are shown on orthophotos in Appendix B, along with historically occupied habitat.[4] We did not complete surveys at sites in Topock Gorge because effort was redirected toward hydrology monitoring within Topock (see Chapter 8). Each site that was not occupied by territorial flycatchers was formally surveyed three to six times. A summary of willow flycatcher survey effort and survey site occupancy status is presented in Appendix C. Field personnel spent an additional 24.3 observer-hours completing habitat reconnaissance and evaluation and opportunistic surveys. The results of reconnaissance for each study area are presented below following the results for the regularly surveyed sites. Because subspecies identification of willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* is problematic (Sogge et al. 2010, USFWS 2002), flycatcher detections after 15 June at sites where breeding or residency was not confirmed are summarized in Table 2.3. Yellow-billed Cuckoo and Yuma Clapper Rail detections are listed in Tables 2.4 and 2.5, respectively, and overall numbers of detections of all special concern species are listed in Appendix D. Hydrologic characteristics of each site are summarized in Table 2.6.

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011*

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
PAHR	North	4.6	14 (15 May–16 Aug), 2 (18 May), 1 (17–19 Jun), 2 (12 Jul), 1 (13 Jul), 1 (4 Aug)
	West	1.5	1 (21 Jul)[6]
MESQ	Hafen Lane	6.1	2 (30 Jun–23 Jul), 1 (21–23 Jul)
	West	10.4	11 (17 May–17 Aug)
	Bunker Marsh North	7.1	ND[7]
MOME	Mormon Mesa South	11.8	ND
	Virgin River #1	22.5	23 (14 May–17 Aug), 1 (26 Jun), 1 (10–14 Jul), 1 (24 Jul)
	Virgin River #2	11.2	ND
MUDD	Overton WMA Pond	0.7	1 (2–5 Jul)
	Overton WMA	14.9	13 (14 May–7 Aug), 1 (6 Jul), 1 (2–3 Aug)

[3] We started the survey season with 57 sites scheduled for surveys in 2011. Two sites were added after reconnaissance revealed potential flycatcher habitat. We discontinued surveys at one site because of poor habitat quality.

[4] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June.

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4]
TOPO	Pipes #1	5.2	1 (23 Jun–1 Jul)
	Pipes #3	5.7	2 (23–27 Jun), 1 (6–8 Jul)[8]
	The Wallows	0.7	1 (1–5 Jun), 1 (9–13 Jun), 1 (25 Jun–9 Jul)[9]
	PC6-1	4.8	1 (1 Jun)
	Pig Hole	2.4	ND
	In Between	7.7	1 (21 May)
	800M	4.7	1 (7 May–28 Jun)[8], 1 (5–7 Jun), 1 (18 Jun)
	Pierced Egg	6.7	1 (24 May), 2 (29 May), 1 (3 Jun)
	Swine Paradise	0.9	1 (9 Jun)
	Barbed Wire	2.1	ND
	Platform	1.9	1 (16 May–10 Jun)[9]
	250M	1.9	ND
	Hell Bird	6.3	2 (16 May), 4 (29 May), 2 (4 Jun), 2 (8 Jun)
	Glory Hole	5.0	ND
	Spaghetti	5.4	2 (30 May)
	Beal Lake	18.0	1 (7 Jun)
	Lost Lake	3.3	1 (26 May)
	Dock[10]		3 (29 May)
BIWI	Wispy Willow[11]	0.5	1 (27 May)
	Burn Edge	4.1	1 (30 Jun)
	Site #4	9.9	1 (16 Jun), 1 (20–26 Jun), 1 (20 Jun–5 Jul)
	Site #3	13.0	2 (13 May–1 Aug), 1 (27 May)
	Last Gasp	2.1	ND
	Site #5	6.8	1 (21 May), 1 (29 May)
	Cougar Point[12]	1.3	2 (10–16 Jul)[13]
	Upstream from Site #8	1.5	ND
	Planet Ranch Road	3.3	3 (15 May–30 Jul), 1 (1 Jun), 1 (1–6 Jun)
	New River	0.6	ND
PVER	PVER Phase 2	21.4	3 (16 May), 6 (26 May), 2 (9 Jun)
	PVER Phase 3	21.4	1 (16 May), 3 (26 May)
CIBO	CVCA Phase 1	26.2	6 (23 May), 3 (31 May), 3 (8 Jun)
	CVCA Phase 2	25.5	11 (23 May)
	CVCA Phase 3	38.4	16 (24 May), 2 (1 Jun)
	Cibola Nature Trail	13.7	1 (1 Jun)
	Cibola Island	4.2	ND
	Cibola Site #2	16.4	3 (25 May), 2 (14 Jun)
	Cibola Site #1	7.7	ND
	Cibola Lake #2 (East)	4.5	1 (25 May), 1 (20 Jun)
	Walker Lake	11.4	1 (15 Jun)

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
IMPE	Paradise	7.8	3 (18 May)
	Hoge Ranch	20.7	8 (21 May), 6 (2 Jun)
	Rattlesnake	7.6	3 (21 May), 2 (2 Jun)
	Milemarker 65	10.0	1 (18 May)
	Nursery NW	7.0	4 (22 May), 2 (5 Jun)
	Ferguson Lake	21.1	2 (19 May)
	Great Blue Heron	7.1	3 (17 May), 9 (20 May), 4 (3 Jun), 5 (5 Jun)
	Powerline	1.0	2 (17 May), 1 (3 Jun)
	Martinez Lake	4.6	2 (3 Jun)
MITT	Mittry West	4.4	3 (17 May)
YUMA	Gila River Site #2	2.9	7 (4 Jun)
	Fortuna Site #1	3.2	15 (4 Jun)
	Fortuna North	3.8	6 (4 Jun), 1 (5 Jun)

* This table includes only sites where regular surveys were scheduled or where flycatcher were detected and does not include sites where habitat reconnaissance or opportunistic surveys were conducted and no flycatchers were detected.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Flycatchers in territories that were occupied throughout the breeding season are shown as being present throughout the season. Flycatchers detected on a single occasion or for a short period of time are listed separately.

[5] We detected several within-season movements between study areas in 2011. For details on movements see Table 3.9.

[6] Detection was of a banded family group (one adult with fledges) from Pahranagat North.

[7] Surveys discontinued because of poor quality habitat.

[8] This individual detected 7 May–28 Jun in 800M and 6–8 Jul in Pipes #3.

[9] This individual detected 16 May–10 Jun in Platform and 25 Jun–9 Jul in The Wallows.

[10] Not an official survey site. Incidental detections recorded.

[11] Site surveyed at beginning of season for reconnaissance. Not added to formal survey list due to unsuitable habitat.

[12] Site discovered with breeding flycatchers toward end of survey season.

[13] A singing male was reported at this territory by personnel from an unrelated field crew prior to 10 Jul; only the female was detected during nest monitoring visits 10–16 Jul.

Table 2.3. Detections of Willow Flycatchers Recorded after 15 June 2011 at Sites Where Breeding or Residency Was Not Confirmed

Study Area[1]	Site	Date	Comments
MUDD	Overton WMA Pond	2 Jul	Singing spontaneously (*fitz-bew*)
BIWI	Burn Edge	30 Jun	Occasional unsolicited vocalizations (*fitz-bew* and *wheeo*)
CIBO	Cibola Lake #2 (East)	20 Jun	Brief primary song (*fitz-bew*)

[1] MUDD = Muddy River, BIWI = Bill Williams River NWR, CIBO = Cibola.

Table 2.4. Yellow-billed Cuckoo Detections at Reclamation Study Areas, 2011

Study Area[1]	Site	Date	Behavioral Observations
MESQ	Hafen Lane	23 Jun	One individual detected
	West	19–22 Jul	Repeated detections of one or two individuals
MUDD	Overton WMA	14 Jul	One individual heard
TOPO	Beal Lake	29 Jun	One individual detected
		13 Jul	Two individuals detected
BIWI	Site #3	30 Jun	One individual heard
		16 Jul	Two individuals heard (*coo* and *kowlp*)
	Site #5	10 Jul	One individual detected
	Planet Ranch Road	2–17 Jul	Repeated detections of one or two cuckoos
	New River	7 Jul	One individual detected
		17 Jul	One individual detected
PVER	Phase 2	13 Jun	One individual seen and heard (*kuk* and *kowlp*)
		12 Jul	Two or three individuals heard (*kuk* and *coo*)
	Phase 3	12 Jul	One individual heard
CIBO	CVCA Phase 1	17 Jun	One individual detected
		13 Jul	Two individuals heard
	CVCA Phase 2	17 Jun	One individual heard (*coo*)
		13 Jul	Three or four individuals detected
	CVCA Phase 3	8 Jun	One individual seen
	Cibola Island	7 Jul	Two individuals heard (*kuk* and *coo*), one silent cuckoo seen

[1] MESQ = Mesquite, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve; CIBO = Cibola.

Table 2.5. Yuma Clapper Rail Detections at Reclamation Study Areas, 2011

Study Area[1]	Site	Date(s)	Behavioral Observations
BIWI	Wispy Willow	13 Jun	One individual heard
CIBO	Cibola Site #2	28 Jun	One individual heard
IMPE	Powerline	5 Jul	One individual heard

[1] BIWI = Bill Williams River NWR, CIBO = Cibola, IMPE = Imperial.

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011*

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PAHR	North[4]	8/--/2	15/--/5	4/--/1	0/--/0
	West[4]	0/0/0	0/0/0	0/0/0	2/5/15
MESQ	Hafen Lane[4]	0/0/0	0/0/0	0/0/0	1/1/1
	West[4]	2/--/0	15/--/0	15/--/0	0/--/0
	Bunker Marsh North[4]	5/--/--	15/--/--	0/--/--	0/--/--

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
MOME	Mormon Mesa North	0/--/--	0/--/--	0/--/--	40/--/--
	Hedgerow	0/--/--	0/--/--	0/--/--	300/--/--
	Mormon Mesa South[4]	--/0/0	--/0/0	--/0/0	--/0/0
	Virgin River #1	--/10/10	--/10/20	--/5/8	--/--/0
	Virgin River #2	0/0/0	0/0/0	0/0/0	20/20/20
MUDD	Overton WMA Pond	2/--/2	40/--/10	0/--/0	0/--/0
	Overton WMA	--/--/10	--/--/30	--/--/8	--/0/0
TOPO	Pipes #1	0/0/0	0/0/0	0/0/0	40/40/40
	Pipes #3	0/0/0	0/0/0	0/0/0	40/40/40
	The Wallows	0/0/0	0/0/0	1/0/0	0/80/80
	PC6-1	0/0/0	0/0/0	0/0/0	40/40/40
	Pig Hole	0/0/0	0/0/0	0/0/0	120/120/120
	In Between	25/15/20	30/40/10	30/10/5	0/0/0
	800M	0/0/0	0/0/0	0/10/0	70/0/70
	Pierced Egg	1[5]/1[5]/0	10/3/0	0/0/0	0/0/30
	Swine Paradise[6]	0/0/0	0/0/0	0/0/0	40/40/40
	Barbed Wire	0/2/0	0/10/0	0/0/0	150/0/150
	Platform[6]	0/0/0	0/0/0	0/0/0	20/20/20
	250M[6]	0/0/0	0/0/0	0/0/0	0/0/0
	Hell Bird[6]	0/0/0	0/0/0	0/0/0	0/0/0
	Glory Hole	0/0/0	0/0/0	0/0/0	70/70/70
	Spaghetti	--/--/--	--/--/--	--/--/--	0/0/0
	Beal Lake[7]	0/0/45	0/0/3	0/0/0	20/20/0
	Lost Lake[6]	0/0/0	0/0/0	0/0/0	20/20/20
BIWI	Burn Edge	20/1/<1	10/10/40	30/1/0	0/0/0
	Site #4[4]	5/1/1	10/>100/>100	0/2/0	0/0/0
	Site #3	4/0/0	10/0/0	2/5/0	0/0/250
	Last Gasp	10/1/0	30/3/0	5/0/0	0/0/>1000
	Site #5	10/5/5	30/100/100	3/0/0	0/0/0
	Cougar Point[8]	--/--/70	--/--/10	--/--/25	--/--/0
	Upstream from Site #8[6]	10/10/10	10/10/10	5/5/5	0/0/0
	Planet Ranch Road	50/40/50	40/60/50	30/10/3	0/0/0
	New River	15/15/15	10/10/10	5/10/--	0/0/0

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PVER	PVER Phase 2[7]	0/10/0	0/3/0	0/5/0	300/0/5
	PVER Phase 3[7]	0/25/30	0/10/10	0/40/10	10/0/0
CIBO	CVCA Phase 1[7]	20/0/15	10/0/10	40/0/5	0/10/0
	CVCA Phase 2[7]	0/0/0	0/0/0	0/0/5	5/5/0
CIBO	CVCA Phase 3[7]	0/75/0	0/10/0	0/15/0	10/0/5
	Cibola Nature Trail[7]	0/0/0	0/0/0	0/0/0	12/15/15
	Cibola Island	--/0/0	--/0/0	--/0/0	--/--/5
	Cibola Site #2	0/10/10	0/10/--	--/5/5	100/0/0
	Cibola Site #1	30/15/30	10/10/--	--/10/3	0/0/0
	Cibola Lake #2 (East)[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Walker Lake[4]	--/20/5	--/3/3	--/--/5	--/0/0
IMPE	Paradise[4]	40/--/0	25/--/0	--/--/3	0/0/0
	Hoge Ranch[4]	--/5/5	--/25/20	--/3/3	0/0/0
	Rattlesnake[6]	0/10/0	0/10/0	30/10/0	0/0/5
	Milemarker 65[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Nursery NW[6]	30/50/15	30/30/10	10/10/10	0/0/0
	Ferguson Lake[4]	5/--/25	25/--/25	5/--/5	0/0/0
	Great Blue Heron[6]	0/0/--	0/0/--	0/0/--	100/100/--
	Powerline[6]	10/20/--	10/25/--	40/10/--	0/0/--
	Martinez Lake	0/10/--	0/10/--	25/8/--	0/0/--
MITT	Mittry West	90/5/--	40/5/--	5/25/--	0/0/--
YUMA	Gila River Site #2[4]	--/0/0	--/0/0	--/0/0	--/5/5
	Fortuna Site #1[4]	--/0/0	--/0/0	--/5/0	--/0/0
	Fortuna North[4]	--/10/10	--/10/15	--/5/5	--/0/0

* Values are given for each site as recorded in mid-May, mid-June, and mid-July.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] -- = Hydrologic information not recorded.

[3] Percent of site with saturated soil does not include inundated areas.

[4] Site bordered by a river, lake, or pond.

[5] Saturated soil or water was present only in pig wallows.

[6] Site borders marsh.

[7] Site is irrigated as part of restoration efforts; amount of standing water highly variable throughout survey season.

[8] Site not visited until July; not formally surveyed.

Pahranagat National Wildlife Refuge, Nevada

Pahranagat National Wildlife Refuge consists of a series of lakes and marshes in Pahranagat Valley approximately 150 km north of Las Vegas, Nevada. Patches of primarily native vegetation exist at the inflow and outflow of Upper Pahranagat Lake and along the lakeshore. Prior to the 2008 survey season, the majority of the riparian vegetation along the north side of the upper lake (Pahranagat North) was

inundated annually with up to 1 m of water, with the highest water levels occurring in May. Major structural problems with the dam that impounds the upper lake resulted in the upper lake being drained in early 2008, and the riparian vegetation at the north end of the lake was not flooded during the 2008 or 2009 breeding seasons. The dam was repaired prior to the 2010 breeding season, and lake levels in 2010 and 2011 were higher than they had been in the two previous years but not as high as they had been prior to 2008.

PAHRANAGAT NORTH

Area: 4.6 ha Elevation: 1,026 m

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*; hereafter cottonwood) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lakebed. Canopy height within the patch is around 20 m, and canopy closure is approximately 80%. Many of the large trees in the northeastern section of the site are dead or dying. Additional scattered cottonwood trees have fallen throughout the site creating multiple small clearings. Standing water and saturated soils were present within the southern portion of the site in May, and the site slowly dried out during the survey season, with no water or saturated soils present by the middle of July except in an inflow channel that runs along the northern side of the site and drains into the lakebed at the southeastern corner of the site.

We detected 10 breeding willow flycatchers, as well as 4 resident, unpaired males and 7 individuals for which residency could not be determined. The site lies immediately adjacent to a cattle pasture, and a lack of fencing coupled with low lake levels allowed cattle to periodically access to the site for a portion of the breeding season. We surveyed the unoccupied east arm of the site four times, totaling 1.5 observer-hours.

PAHRANAGAT WEST

Area: 1.5 ha Elevation: 1,026 m

This native site consists of a stringer of cottonwood, one to three trees wide and 20 m in height, on the western edge of Upper Pahranagat Lake. The site has no significant understory vegetation, and canopy closure varies from <50 to 80%. The eastern edge of the site is vegetated with bulrush, which extends into the lakebed to the east. The western edge of the site is vegetated in yerba mansa (*Anemopsis californica*) extending into dry, upland desert. During the survey season, the interior of the site was dry, but surface water was present adjacent to the site in the lakebed.

We detected one adult and one hatch year willow flycatcher on 21 July and two additional hatch year willow flycatchers on 21–25 July; all individuals were known or suspected to have come from Pahranagat North. We surveyed the site five times, totaling 3.1 observer-hours. No cowbirds were detected, and there was no sign of livestock use.

GROUND RECONNAISSANCE RESULTS

Pahranagat South

The majority of this site was affected by a fire prior to the start of the 2010 survey season. The fire removed all understory vegetation and charred the trunks and lower branches of the overstory trees. The site now consists of a stringer of cottonwood, 20 m tall, along a human-made channel that carries the outflow from Upper Pahranagat Lake. The understory contains Indian hemp (*Apocynum cannabinum*) and some small patches of coyote willow (*Salix exigua*) 3 m in height. Canopy closure within the cottonwood stringer is approximately 50%. The channel held water during the site visit in May; surrounding soils were dry. While suitable understory components are now present, they are not currently of sufficient size

to resemble typical occupied willow flycatcher habitat. We recommend reassessing this site in future years. We surveyed the site once, totaling 0.25 observer-hours. No willow flycatchers were detected.

Littlefield, Arizona

In recent years, our survey and monitoring activities focused on Beaver Dam Wash near the Highway 91 Bridge. In December 2010, a flood scoured much of the area, and we evaluated the site (Littlefield Poles) at the beginning of the season for suitability.

GROUND RECONNAISSANCE RESULTS

Littlefield Poles

The site consists of primarily native vegetation and is located on Beaver Dam Wash, immediately upstream of the Highway 91 Bridge. Overall changes to the site as a result of the flood in December 2010 include a reduction in vegetation density and height and a significant change in hydrology. Vegetation along the northern edge of the site consists of a scattered overstory of cottonwood averaging 25 m in height. The previously documented lower strata vegetation of tamarisk and Russian olive (*Elaeagnus angustifolia*) in the cottonwood area are significantly reduced or absent. The southern portion of the site consists of stands of coyote willow and young Goodding willow and cottonwood approximately 5 m in height. These stands have thinned significantly, and canopy closure is now 30 to 50% overall. Extensive sedimentation of the site has also reduced canopy height. No surface water was present in May or June, and the nearest water was Beaver Dam Wash, which was restricted to a channel roughly 80 m from the site. We surveyed the site twice, totaling 1.0 observer-hours. No willow flycatchers were detected. Because of the lack of surface water within the site and the reduction in vegetation density, this site does not currently resemble typical occupied flycatcher breeding habitat. We recommend reassessing the site at the beginning of future breeding seasons.

Mesquite, Nevada

The Mesquite study area is in the floodplain of the Virgin River near Mesquite and Bunkerville, Nevada.

HAFEN LANE

Area: 6.1 ha Elevation: 475 m

This mixed-exotic site lies within the floodplain of the Virgin River in Mesquite, Nevada, between Hafen Lane and the active river channel. Two drainage ditches that pass underneath Hafen Lane flow into the site; the eastern inflow supports a dense stand of cottonwood and Goodding willow, 10 m in height, with some coyote willow 5 m in height in the understory. The western inflow supports a stringer of coyote willow 4–6 m in height and scattered Goodding willow 15–18 m in height, with 70% canopy closure. The coyote willow in the western stringer is of varying health and density. Between the stringers, the site is vegetated by 6-m-tall tamarisk with 90% canopy closure. No water was documented within the site, but damp soils were noted on all visits within the drainage ditches. Tamarisk beetles and heavily defoliated tamarisk were noted at the site in mid-June.

We detected three breeding flycatchers, one of which was a male from Muddy River that displaced the resident male. Portions of the site not known to be occupied were surveyed five times for a total of 16.2 observer-hours. Cowbirds were detected on all surveys, and no sign of livestock use was observed.

MESQUITE WEST

Area: 10.4 ha Elevation: 470 m

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Golf courses and housing developments border the site to the north, and the Virgin River borders the site to the south. This large site is primarily a mosaic of cattail (*Typha* spp.) and bulrush (*Schoenoplectus californicus*) marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The coyote willows are generally 5–6 m in height, and canopy closure varies from 50 to >90%. The eastern portion of the site is primarily coyote willow, while the western portion contains a mix of willow and tamarisk. Hydrology at the site is influenced by irrigation runoff from adjacent golf courses and agriculture. The site was regularly inundated through early June. Thereafter, a change in the access point of water into the site diverted all water straight into the Virgin River, bypassing the site altogether. Tamarisk beetles and defoliated tamarisk were noted within the site in mid- to late June.

We detected 10 breeding willow flycatchers and 1 resident, unpaired male. Areas of Mesquite West not known to be occupied by flycatchers were surveyed five times, totaling 7.4 observer-hours. Cowbirds were detected on all surveys. Some signs of cattle were observed early in the season in the eastern portion of the site near the river.

BUNKER MARSH NORTH

Area: 7.1 ha Elevation: 456 m

This mixed-exotic site lies within the floodplain of the Virgin River near Bunkerville, Nevada, approximately 4 km downstream of Mesquite West. The site is between agricultural fields to the southeast and the Virgin River to the northwest. The site is primarily 5–7-m-tall tamarisk, with scattered Goodding willow primarily in the southern portion of the site. Some Goodding willows are also present along the western and northern ends of the site. Canopy closure ranges from 25 to 80%. Surface water was noted within the site in May in a small stream in the northern portion of the site and a small puddle in the center of the site, but no water was noted in mid-June. Dry marshes were present adjacent to the site. Tamarisk beetle larvae but no defoliation were observed in mid-May, and extensive defoliation was observed by mid-June. Surveys at this site were discontinued in mid-June because of the lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

We detected no willow flycatchers. The site was visited twice, for a total of 3.7 observer-hours. Cowbirds were detected on both surveys, and signs of cattle were observed within the site.

Mormon Mesa, Nevada

For approximately 15 km upstream of its confluence with the Muddy River, the Virgin River flows through a 1-km-wide floodplain with a mosaic of habitats, including cattail marshes and tamarisk and willow forest. Much of the area is typically seasonally inundated from snowmelt in the spring and monsoon rains in mid and late summer, and the entire study area experienced severe flooding over the 2004–2005 winter. All the areas surveyed at Mormon Mesa are at least 10 km upstream of the Muddy River confluence. In December 2010, the study area experienced another severe flood. Part of the river shifted its course, and river levels remained elevated (in the 75th percentile) throughout the breeding season, limiting access to portions of the study area during May and early June. Tamarisk beetles and heavy defoliation were noted throughout the study area by mid-July.

MORMON MESA SOUTH

North half: Area: 8.4 ha Elevation: 385 m

South half: Area: 3.4 ha Elevation: 385 m

This mixed-exotic site was split into two contiguous areas to facilitate tracking of survey activity. The site has scattered Goodding willow up to 20 m, but more typically 12–15 m, in height and a patchy understory of tamarisk 3–6 m in height. Dead cattail and arrowweed (*Pluchea sericea*) are present in the understory in this area. Canopy closure is widely variable, ranging from >80% in tamarisk thickets to <50% in openings. There was no surface water within the site, but damp soils were noted in the center of the northern half of the site in May and June. The presence of dead cattails and deadfall suggests that this site was formerly considerably wetter, and portions of the site still have the structure to provide potential flycatcher habitat with wetter soil conditions.

No willow flycatchers were detected. Due to elevated river levels, we surveyed the northern half four times and the southern half three times, totaling 9.3 and 4.8 observer-hours, respectively. Cowbirds were detected on all surveys in the northern half and none of the surveys in the southern half. Signs of cattle were noted within the site on all occasions.

VIRGIN RIVER #1

North half: Area: 11.4 ha Elevation: 380 m

South half: Area: 11.1 ha Elevation: 380 m

Virgin River #1 was also divided into two areas, Virgin River #1 North and Virgin River #1 South, to facilitate streamlining of field logistics. Virgin River #1 North is primarily tamarisk 4–6 m in height, with areas of emergent Goodding willow in the central and southwestern portions of the site. Canopy closure throughout the site is 70–90%. Some surface water was present in June in channels running north to south through the center of the site and in the southwestern corner of the site. By July only a few spots of saturated soil remained in these areas.

We detected four breeding willow flycatchers in the southwestern corner of Virgin River #1 North. We also detected one additional flycatcher for which residency and breeding status could not be determined. Areas of this site not known to be occupied by flycatchers were surveyed four times, totaling 12.9 observer-hours. Cowbirds were detected on all surveys and cattle were observed in the site on multiple occasions.

Virgin River #1 South consists of two disjunct sections; the northern section is immediately south of Virgin River #1 North, while the southern portion is approximately 700 m SSE of Virgin River #1 North. The northern section is primarily tamarisk 4–6 m in height with patches of coyote willow 6 m in height and scattered Goodding willow 8–12 m in height. Canopy closure varies from >90% in areas of dense willow and tamarisk to 25% in marshy openings. The northern section contained standing water throughout the survey season. The southern section consists of tamarisk 6–7 m in height, with a cluster of emergent Goodding willow and dead coyote willow. Canopy closure is 70–90%. Soils in the southern section were dry throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion if soils are dry.

We detected 18 breeding willow flycatchers and one unpaired, resident male in the northern section of Virgin River #1 South. We detected two additional willow flycatchers for which residency and breeding status could not be confirmed. Areas of the site not known to be occupied by willow flycatchers were surveyed three times, totaling 5.5 observer-hours. Cowbirds were observed on two surveys, and signs of cattle were observed.

VIRGIN RIVER #2

Area: 11.2 ha Elevation: 380 m

This site received extensive sedimentation from the flood in December 2010. The depth of new sediment ranged from 15 to 60 cm and was most extensive in the southern portion of the site. The site consists of mixed-exotic vegetation with tamarisk 4–6 m in height with a cluster of emergent Goodding willow at the northern end of the site and scattered, emergent Goodding willow at the southern end of the site. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in this portion of the site. Overall canopy closure is 70–90%. The site contained no surface water during the breeding season, though a small area at the very northern end of the site contained damp soil in May and June. The Virgin River, on the eastern edge of the site, had surface water throughout the season.

No willow flycatchers were detected. We surveyed the site five times, totaling 16.8 observer-hours. Cowbirds were observed on all surveys, and cattle sign were observed at the site.

GROUND RECONNAISSANCE RESULTS

Mormon Mesa North

We discontinued surveys after the initial visit at this site in 2010 due to dry conditions and a lack of flycatcher detections since 2005. In December 2010, the study area experienced significant flooding, with the potential to alter the hydrology within the site. We reassessed the site at the beginning of 2011. This site consists of mixed-exotic vegetation, primarily tamarisk 3–5 m in height with areas of emergent Goodding willow up to 12 m in height and patches of coyote willow. Canopy closure varies from 70% in the taller tamarisk to around 50% in the shorter tamarisk. The western edge of the site has a 100 x 50-m patch of Goodding willow, 8 m in height, with up to 75% canopy closure and dead cattails in the understory. Soils were completely dry within the site during a visit in early June, and the nearest water was in the river channel approximately 40 m away. We did not formally survey the site in 2011, though no flycatchers were detected during the site visit. We recommend discontinuing surveys at this site until another flood event occurs that has the potential to alter the hydrology within the site.

Hedgerow

We discontinued surveys after the initial visit at this site in 2010 because of completely dry conditions and a lack of flycatcher detections since surveys began in 2005. In December 2010, the entire study area experienced a significant flood that had the potential to change the hydrology within the site. We reassessed the site at the beginning of 2011. The site is east of Mormon Mesa North, on the eastern side of the Virgin River. It consists of mixed-exotic vegetation with a continuous understory of tamarisk 4–5 m in height and scattered emergent Goodding willow up to 12 m in height. Many of the willows have dead branches. The site is surrounded by tamarisk and arrowweed 2–3 m in height. Canopy closure in the tamarisk varies from about 50% on the edges of the site up to 80% in the denser areas. Soils within the site were completely dry during a visit in May. We did not formally survey the site in 2011, but no flycatchers were detected during the May site visit. We recommend discontinuing surveys at this site until another flood event occurs that has the potential to alter hydrologic conditions.

Muddy River, Nevada

The Muddy River study area is along the Muddy River in the Overton Wildlife Management Area (WMA) near Overton, Nevada.

OVERTON WMA POND

Area: 0.7 ha Elevation: 378 m

This site consists of a patch of mixed-native vegetation approximately 150 m long and 75 m wide at the north end of Overton WMA just south of Honeybee Reservoir. The dominant vegetation consists of 12-m-tall Goodding willow with a sparse 5-m-tall tamarisk understory. Cattail and sedges (*Carex* sp.) are also present on the edges of the site. Arrowweed is present in scattered, dense patches within and along the edges of the site. Canopy closure is variable, ranging up to 90%. A small stream channel runs through the site, and it held surface water throughout the season.

We detected one willow flycatcher for which residency could not be determined. We surveyed the site five times for a total of 2.5 observer-hours. Cowbirds were detected on two visits, and no sign of livestock use was observed.

OVERTON WMA

Area: 14.9 ha Elevation: 378 m

This site consists of a 150-m-wide strip of riparian vegetation spanning both sides of the Muddy River. The site is bordered to the southwest by open agricultural fields and to the northeast by sparser areas of riparian vegetation. The site flooded heavily during the 2004–2005 winter, but vegetation at the site was relatively unchanged. The northern portion of the site is dominated by very dense tamarisk up to 7 m in height with canopy closure of 70–90%. The southern portion of the site consists primarily of a stand of Goodding willow 10–15 m in height with an understory of tamarisk and cattail. Canopy closure in this area is up to 90%. Flowing water was present in the channels of the Muddy River throughout the survey season. Soils in the northern portion of the site outside of the river channel were dry throughout the season. Soils in the southern portion were saturated early in the season and dry at the end of the season in areas adjacent to the channels. Beavers have felled swaths of Goodding willow in the southern portion of the site, resulting in gaps in the canopy. Approximately 0.3 ha of the southern portion of the site was bulldozed in 2005 as part of Overton WMA efforts to repair flood damage to their water control system. Two stretches of the channel of the Muddy River within the site were dredged with heavy equipment over the 2007–2008 winter, resulting in a cleared swath 10–15 m wide on the western bank of the river.

We located 10 breeding willow flycatchers and three unpaired, resident males. We also detected two flycatchers for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed six times, totaling 18.0 observer-hours. We observed no signs of livestock but detected cowbirds on all surveys.

Topock Marsh, Arizona

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow. Seasonally wet, low-lying areas are interspersed throughout the riparian area. Water levels within Topock Marsh were unusually low in 2011 because the intake valve at the upstream end of the marsh was closed for construction purposes. Feral pigs are present throughout the Topock study area, and evidence of pigs was observed in most survey sites.

PIPES #1

Area: 5.2 ha Elevation: 140 m

This exotic site is bordered to the east by the refuge road and consists primarily of monotypic tamarisk 6–9 m in height. Arrowweed occurs in dense patches within 50 m of the refuge road. The tamarisk is densest within 100 m of the refuge road and becomes more open toward the western edge of the site. The northern edge of the site has the tallest canopy, and there is relatively little deadfall in this area compared to the rest of the site. The central and southern portions of the site have many dead stems and clusters of fallen trees. Canopy closure is 70–90%. The site contained no standing water during the survey season.

We detected one unpaired, resident willow flycatcher from 23 June to 1 July. We surveyed the site five times, totaling 8.5 observer-hours. Cowbirds were detected on all surveys.

PIPES #3

Area: 5.7 ha Elevation: 140 m

This site is bordered to the east by the refuge road. Arrowweed occurs in dense patches within 50 m of the road. Most of the site is vegetated by tamarisk 5–7 m in height. The southeastern portion of the site has a few emergent Goodding willow up to 15 m in height and open areas with marsh vegetation. Canopy closure generally exceeds 70%. The site contained no standing water during the survey season.

We detected two breeding flycatchers and one individual that moved to Pipes #3 after holding a territory in 800M. Portions of Pipes #3 not known to be occupied by flycatchers were surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all surveys.

THE WALLOWS

Area: 0.7 ha Elevation: 140 m

The Wallows is primarily vegetated by tamarisk 5–6 m in height with emergent Goodding willow on the western side of the site. The northwestern edge of the site borders an open cattail marsh. The eastern side is dry and grades from 2-m-tall arrowweed along the refuge road to tamarisk up to 8 m in height in the center of the site. Overall canopy closure ranges from 50% in the marshy area to 90% in the tamarisk. Approximately 1% of the site had saturated soil in mid-May, but the site was entirely dry by mid-June.

We detected one resident, unpaired male that moved to The Wallows from Platform. We also detected two individuals for which residency could not be confirmed. Portions of the site not known to be occupied were surveyed five times, totaling 2.1 hours. Cowbirds were detected on three surveys.

PC6-1

Area: 4.8 ha Elevation: 140 m

PC6-1 is a mixed-exotic site consisting primarily of tamarisk 6–7 m in height, with a few patches of arrowweed and cattails present in the understory. A scattered overstory of Goodding willow approximately 10–15 m in height is present in the southwestern corner of the site. Arrowweed 1–2 m in height is present under the willow. A portion of the site within approximately 50 m of the refuge road contains thick stands of arrowweed. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the refuge road is approximately 50%. The site was completely dry throughout the survey season.

We detected one willow flycatcher across the road from PC6-1 on 1 June. The site was surveyed five times, totaling 8.1 observer-hours. Cowbirds were detected on all surveys.

PIG HOLE

Area: 2.4 ha Elevation: 140 m

Pig Hole consists of monotypic tamarisk 6–7 m in height, with canopy closure ranging from 70 to 90%. Tamarisk along the northern edge has many wispy branches and smaller diameter stems than the rest of the site. A few dense patches of arrowweed are present on the eastern edge. No standing water or saturated soil was observed within the site during the survey season.

No willow flycatchers were detected. The site was surveyed five times, totaling 5.1 observer-hours. Cowbirds were detected on all surveys.

IN BETWEEN

Area: 7.7 ha Elevation: 140 m

In Between consists of monotypic tamarisk 6–8 m in height. The lowest 3 m of the stand generally lacks foliage, resulting in a relatively open understory. Canopy closure is 70–90%, and the western edge of the site borders a marsh. In Between was affected by water delivery in 2011 (see Chapter 8) and contained varying amounts of surface water through the middle of July.

We detected one flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 9.9 observer-hours. Cowbirds were observed on four surveys.

800M

Area: 4.7 ha Elevation: 140 m

800M adjoins the western edge of In Between, and the eastern half of the site consists of a cattail and bulrush marsh with clumps of tamarisk 5–7 m in height and scattered, emergent Goodding willow. The remainder of the site is vegetated by tamarisk 4–7 m in height. Canopy closure in the tamarisk is generally >90%, while canopy closure in the marsh is around 50%. 800M was affected by water delivery in 2011 (see Chapter 8) and contained varying amounts of surface water and saturated soil in the marsh through early July.

We located one resident, unpaired male flycatcher and two additional individuals for which residency could not be confirmed. Portions of the site not known to be occupied were surveyed five times, totaling 4.7 observer-hours. Cowbirds were observed on all surveys.

PIERCED EGG

Area: 6.7 ha Elevation: 140 m

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height, with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to have a more open understory and contain patches of cattail and bulrush. Overall canopy closure is approximately 80%. The only water or saturated soil within the site was in deep pig wallows.

We detected four flycatchers for which residency could not be confirmed. We surveyed the site five times for a total of 8.5 observer-hours. Cowbirds were observed on all surveys.

SWINE PARADISE

Area: 0.9 ha Elevation: 140 m

Vegetation at this mixed-exotic site consists of tamarisk 6–8 m in height and scattered, emergent Goodding willow up to 15 m in height, with patches of coyote willow. Overall canopy closure is approximately 80%. The northern tip of the site was bulldozed prior to the survey season for a new water conveyance channel. The site was dry throughout the survey season.

We detected one willow flycatcher for which residency could not be determined. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds were detected on three visits.

BARBED WIRE

Area: 2.1 ha Elevation: 140 m

One large, emergent Goodding willow occurs at the site; otherwise, the site is vegetated by tamarisk 6–10 m in height and of varying density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy openings than the southwestern portion of the site. A 40-m-wide strip was bulldozed through the center of the site east to west for a new water conveyance channel prior to the start of the survey season. Canopy closure outside the bulldozed area is approximately 70–90%. The only standing water or saturated soil observed in the site was within the new channel.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds were detected on four visits.

PLATFORM

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road to the west and open bulrush and cattail marsh to the east. Vegetation at the site consists of tamarisk 8 m in height with a few emergent Goodding willow. A narrow line of 5-m-tall coyote willow approximately 5 m wide runs along the eastern edge of portions of the site. Overall canopy closure is approximately 90%. Soils within the site were very dry throughout the survey season.

We detected one resident, unpaired male willow flycatcher. Portions of the site not known to be occupied were surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all visits.

250M

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is dominated by mesquite trees (*Prosopis* sp.) with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and a few emergent Goodding willows approximately 12 m in height. Canopy closure within the site ranges from 70 to 90%. The site was completely dry throughout the survey season.

No willow flycatchers were detected. The site was surveyed five times, totaling 3.3 observer-hours. Cowbirds were detected on three surveys.

HELL BIRD AND GLORY HOLE

Hell Bird: Area: 6.3 ha Elevation: 140 m
Glory Hole: Area: 5.0 ha Elevation: 140 m

These contiguous mixed-exotic sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure are highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6–8 m in height and Goodding willow 15 m in height. Screwbean mesquite (*Prosopis pubescens*) is also scattered throughout the sites. Canopy closure ranges from 50 to 90%. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush. Areas vegetated by cattail and bulrush are interspersed throughout the survey sites. Extremely low water levels in Topock Marsh resulted in increased accessibility in 2011, and Hell Bird was expanded approximately 100 m to the northeast to encompass areas of coyote willow. Both sites were completely dry throughout the survey season.

We detected 10 flycatchers in Hell Bird for which residency could not be confirmed. No flycatchers were detected in Glory Hole. Hell Bird and Glory Hole were surveyed five times each, totaling 6.0 and 8.3 observer-hours, respectively. Cowbirds were detected during four surveys in each site.

SPAGHETTI

Area: 5.4 ha Elevation: 140 m

Spaghetti is a long, narrow site, generally no more than 30 m wide, running along the Farm Ditch to the west of Glory Hole. The site is vegetated by patches of dense coyote willow up to 7 m in height, scattered Goodding willow up to 12 m in height, and mesquite approximately 8 m in height, with tamarisk interspersed throughout the site. Canopy closure in the coyote willow patches is approximately 80%. Deep water in the ditch made the site inaccessible on foot throughout the survey season, and hydrologic conditions within the site were not assessed.

We detected two willow flycatchers for which residency could not be confirmed. We surveyed this site five times, totaling 3.4 observer-hours. Cowbirds were detected on two visits.

BEAL LAKE

Area: 18.0 ha Elevation: 140 m

This mixed-native restoration site consists of a mosaic of cottonwood, Goodding willow, coyote willow, mesquite, and arrowweed, with some tamarisk scattered throughout the site. Canopy height is highly variable and averages approximately 3–4 m over most of the site and up to 10 m in the cottonwood stands; canopy closure is sparse and averages 35%, reaching 85% in the cottonwood stands. The amount of standing water and saturated soil is highly variable because the site is flood irrigated. Sandy soil at the site allows the water to drain rapidly after irrigation.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed this site five times, totaling 10.6 observer-hours. Cowbirds were detected on all surveys.

LOST LAKE

Area: 3.3 ha Elevation: 140 m

This site consists of a narrow (<100-m-wide) strip of riparian vegetation separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. The northern edge of the site consists of an overstory of planted cottonwoods 10–15 m in height, with an

understory of tamarisk 5 m in height, on the edge of a cattail marsh. South of the cottonwoods, the site is primarily tamarisk, 5–8 m in height, with small openings vegetated by arrowweed. Overall canopy closure is approximately 80%. Surface water or saturated soil was present in the marsh on the northern edge of the site throughout the season, but the interior of the site was dry.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 3.4 observer-hours. Cowbirds were detected on four visits.

GROUND RECONNAISSANCE RESULTS

Tractor

This mixed-native site is approximately 1 km north of the inlet ditch at the northern end of Topock Marsh and consists of a 300-m-long stringer of cottonwood 15 m in height with an understory of *Baccharis* sp., mesquite, and 4-m-tall tamarisk bordering a 15-m-wide cattail marsh. The site is bordered by hayfields to the north and south, a dry concrete channel to the west, and a road and a slough to the east. The site was dry during our visit on 26 May except for one small puddle at the far western end of the site, and surveys were discontinued. We visited the site once, totaling 0.3 observer hours. No willow flycatchers or cowbirds were detected. We do not recommend future visits to this site.

Bill Williams River National Wildlife Refuge, Arizona

The Bill Williams River NWR contains the last expanse of native cottonwood-willow forest in the LCR region. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream. We did not observe evidence of livestock use at any of the Bill Williams sites.

BURN EDGE

Area: 4.1 ha Elevation: 140 m

Burn Edge is near the northern edge of the Bill Williams riparian corridor, on the eastern edge of an area that burned in 2006. A cattail marsh with Goodding willow and cottonwood 15 m in height runs east-west through the center of the site. This portion of the site also has clumps of tamarisk up to 6 m in height. Canopy closure in the marshy area varies from around 60% at the eastern end to 25% at the western end. The area on either side of the marsh consists of tamarisk 6 m in height with up to 90% canopy closure. An area of the marsh approximately 100 m long was inundated or saturated in May, but only a small puddle remained at the western end of the marsh in June and July.

On 30 June, we detected one willow flycatcher for which residency could not be confirmed. The site was surveyed five times, totaling 6.3 observer-hours. Cowbirds were detected on four visits.

BILL WILLIAMS SITE #4 AND SITE #3

Site #4: Area: 9.9 ha Elevation: 140 m

Site #3: Area: 13.0 ha Elevation: 140 m

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow 15–20 m in height and patches of monotypic tamarisk up to 8 m in height. Patches of coyote willow are also present. Canopy closure is variable and overall is approximately 50%. Stands of cattails and marshy areas occupy approximately 10% of Site #3.

The understory in some areas is very open, and the ground in these areas is covered with herbaceous vegetation. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Mosquito Flats had a network of small, flowing streams with some open marshes in May. By mid-June, the streams and marshes were muddy but contained no standing water, and the only surface water remaining was in a deep, backwater channel on the western side of Site #4.

We detected one resident, unpaired flycatcher and two flycatchers for which residency could not be confirmed in Site #4. Two breeding flycatchers and one individual for which residency could not be confirmed were detected in Site #3. Portions of the sites not known to be occupied by flycatchers were visited five times, totaling 16.8 observer-hours at Site #4 and 19.6 observer-hours at Site #3. Cowbirds were detected on all surveys of Mosquito Flats.

LAST GASP

Area: 2.1 ha Elevation: 140 m

Last Gasp is a narrow, mixed-native site along a channel on the northern edge of the Bill Williams riparian area, approximately 250 m east of Burn Edge. Vegetation within the site consists of a broken overstory of cottonwood and Goodding willow 15–20 m in height and a tamarisk understory 5–7 m in height. Canopy closure varies from 50% in the channel to 80–90% in the surrounding tamarisk. Surface water was present in ponds and puddles within the channel in May. One small puddle remained in mid-June, and the site was completely dry in July.

No willow flycatchers were detected at Last Gasp. We surveyed the site five times, totaling 4.6 observer-hours. Cowbirds were detected on all visits.

BILL WILLIAMS SITE #5

Area: 6.8 ha Elevation: 143 m

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the northeast by steep cliffs and to the west by a dry river channel. Vegetation in the site is mixed-native, with Goodding willow and cottonwood 15–20 m in height in the overstory. The understory consists of tamarisk 7 m in height as well as some young Goodding willow and cottonwood. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure in the site is variable, ranging from 25% in open areas to 70–90% in the denser vegetation. Standing water was present throughout the survey season along the northeastern edge of the site in the form of a small stream with deep beaver ponds. Soils in the majority of the site were dry.

We detected one willow flycatcher on 21 May and one individual on 29 May; residency could not be determined for these individuals. We surveyed the site five times, totaling 8.9 observer-hours. Cowbirds were detected on all surveys.

COUGAR POINT

Area: 1.3 ha Elevation: 157 m

This site was visited in early July after personnel from an unrelated field crew reported hearing a willow flycatcher singing. The site consists of dense, young, even-age stands of Goodding willow and cottonwood approximately 6 m in height along a channel of the Bill Williams River. Seep willow (*Baccharis salicifolia*) is present in the understory but appears to be dying back as it becomes shaded by the taller cottonwoods and willows. Cattail marshes are present within and around the site. Canopy

closure within the woody vegetation exceeds 80%. Surface water was present within the marshes and the woody vegetation when the site was visited in July and August.

We detected one nesting female flycatcher, but the male was not detected during nest monitoring visits. No formal surveys were completed.

UPSTREAM FROM SITE #8

Area: 1.5 ha Elevation: 170 m

Vegetation in the majority of the site consists of an overstory of cottonwood and Goodding willow up to 15 m in height and an understory of tamarisk. The western third and southern edge of the site are vegetated by Goodding willow and cottonwood up to 10 m in height. The eastern third is dominated by dry tamarisk 4–6 m in height with scattered, emergent Goodding willow and cottonwoods. The northern edge of the site borders a cattail marsh. Canopy cover is variable and ranges from 50 to 80%. The western portion of the site contained surface water throughout the breeding season.

We detected no willow flycatchers. We surveyed the site five times, totaling 5.1 observer-hours. Cowbirds were detected on two visits.

PLANET RANCH ROAD

Area: 3.3 ha Elevation: 170 m

This mixed-native site follows the Bill Williams River at the southern edge of the riparian area. The vegetation immediately adjacent to the river is dominated by Goodding willow and cottonwood up to 15 m in height. Both riverbanks are steep, and vegetation on top of the banks more than a few meters from the water is dominated by arrowweed and tamarisk 4–5 m in height. Canopy closure within the site is highly variable, ranging from <50% on the dry banks to 90% within dense willow and cottonwood stands. The river had surface water throughout the survey season and was impounded in multiple locations by beaver dams.

We detected three breeding willow flycatchers and two individuals for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 12.0 observer-hours. We detected cowbirds on four surveys.

NEW RIVER

Area: 0.6 ha Elevation: 180 m

We first visited this site in 2008, at which time the vegetation appeared too young and sparse to support willow flycatchers, and determined that the site should be reevaluated in future years. The site consists of narrow stringers of cottonwood and Goodding willow along both sides of a channel of the Bill Williams River. Some patches of vegetation reach 8 m in height, but average height is approximately 5 m. Vegetation closest to the water is typically 3–4 m in height with 90% canopy closure, while the cottonwoods and willows on the periphery of the site reach 8 m in height but only 25% canopy closure. Soils within and around the site are very sandy. The western portion of the site contained surface water within the river channel throughout the survey season. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.9 observer-hours. Cowbirds were detected on one survey.

GROUND RECONNAISSANCE AND OPPORTUNISTIC SURVEY RESULTS

Wispy Willow

This site is approximately 200 m downstream of Site #1 along the north bank of the Bill Williams River. The site consists of a patch of coyote willow approximately 60 x 30 m in size. Canopy height is 4–5 m, and stem diameter is generally ~ 3 cm. Canopy closure is 70–90%. Water from the channel extended under the willows during the site visit in May. The vegetation is not currently of sufficient size to resemble typical occupied willow flycatcher habitat along the LCR, but the site should be evaluated in future years. We surveyed the site three times, totaling 2.8 observer-hours. We detected one flycatcher on 27 May between Wispy Willow and Site #1.

Site #1, Site #2, and Site #11

These sites are scheduled for biennial surveys in 2012. We completed one opportunistic survey on 13 June at each site, as the field schedule allowed. All three sites are at the mouth of the Bill Williams River, along an arm of Lake Havasu that follows the river channel, and are vegetated by Goodding willow and cottonwood up to 20 m in height and an understory of tamarisk. Canopy closure is approximately 70%. No flycatchers were detected, but cowbirds were detected at all three sites. The survey totaled 1.8 observer-hours for the three sites combined.

Mineral Wash and Beaver Pond

These sites are scheduled for biennial surveys in 2012. We completed one opportunistic survey on 12 June at each site, as the field schedule allowed. Mineral Wash and Beaver Pond are adjacent sites, approximately 3 km upstream of Site #5, and follow channels of the Bill Williams River. Both sites contain mixed-native vegetation consisting of an overstory of Goodding willow and cottonwood up to 18 m in height and an understory of tamarisk averaging 5 m in height. Each site contained surface water within at least one river channel at the time of the survey. We detected no willow flycatchers but did detect cowbirds at both sites. The survey of Mineral Wash and Beaver Pond totaled 2.3 and 5.5 observer-hours, respectively.

Palo Verde Ecological Reserve, California

PVER PHASE 2

Area: 21.4 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of cottonwood, Goodding willow, and coyote willow, which reach heights of 10, 8, and 5 m, respectively. Height and density of the vegetation varies within and between cells of the site. Canopy closure is highly variable, ranging from <25 to 85%. The entire site has a ground covering of alfalfa (*Medicado sativa*). The site is flood irrigated and contained surface water in a portion of the site during one visit in June.

We detected three willow flycatchers on 16 May, six on 26 May, and two on 9 June. One of the flycatchers detected on 9 June was determined to be color-banded. The combination could not be confirmed with 100% confidence, but it was likely an individual originally banded in southern Nevada. We could not relocate the banded individual on subsequent visits to the site. We surveyed the site six times, totaling 16.5 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was recorded.

PVER PHASE 3

Area: 21.4 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow that reach heights of approximately 10, 5, and 4 m, respectively. Height and density of the vegetation varies within and between the cells of the site. Canopy closure is highly variable, ranging from 50 to 80%. The entire site has a ground covering of alfalfa. The site is flood irrigated and contained surface water in approximately one quarter of the site on visits in June and July.

We detected one willow flycatcher on 16 May and three on 26 May. We surveyed the site six times, totaling 14.5 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock was recorded.

Cibola, Arizona and California

CVCA PHASE 1

Area: 26.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. Each cell generally contains a single species and age class. The tallest cottonwoods and willows are around 12 m in height, and canopy closure in the densest areas is 85–90%. Coyote willow reaches 3–6 m in height. The site is flood irrigated and contained standing water in approximately 20% of the site during visits in May and July. The Colorado River is about 100 m from the northern edge of the site; the southern edge is adjacent to CVCA Phase 2; and the remaining two sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected six willow flycatchers on 23 May, three on 31 May, and three on 8 June. The site was surveyed six times, totaling 16.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA PHASE 2

Area: 25.5 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods and Goodding willow reach approximately 12 m, and canopy closure reaches 95% in the densest areas. Coyote willow reaches 3–6 m in height. The site is flood irrigated but did not contain standing water during any of our site description visits. The northern edge of the site is adjacent to CVCA Phase 1, and the remaining sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected 11 willow flycatchers on 23 May. The site was surveyed six times totaling 16.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA PHASE 3

Area: 38.4 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods reach approximately 10 m in height,

Goodding willows reach 7 m, and coyote willows reach 4 m. Canopy closure varies from 20 to 80%. The site is flood irrigated and contained surface water during a visit in June. The irrigation canal adjacent to the site held water during a visit in July. The site is surrounded by agricultural fields.

We detected 16 willow flycatchers on 24 May and 2 on 1 June. The site was surveyed five times, totaling 14.0 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

CIBOLA NATURE TRAIL

Area: 13.7 ha Elevation: 70 m

This habitat creation site consists of a mosaic of cottonwood, Goodding willow, and mesquite. Approximately half the site consists of scattered screwbean and honey mesquite (*Prosopis glandulosa*) up to 5 m in height with a thick understory of Emory baccharis (*Baccharis emoryii*). The northern half of the site contains an extensive stand of Goodding willow 8 m in height. The northern edge of the willow stand has canopy closure <25%, and many of the willow are dead. The southern half of the willow stand has canopy closure around 70%. The southwestern corner of the site has a small stand of cottonwoods, and stringers of cottonwoods up to 18 m in height occur throughout the site. The site is flood irrigated but did not contain surface water during any of our site description visits.

We detected one willow flycatcher on 1 June. The site was surveyed five times, totaling 6.0 observer-hours. Large numbers of cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA ISLAND

Area: 4.2 ha Elevation: 70 m

This mixed-native site is approximately 9.5 km southwest of Cibola Nature Trail. Dirt roads border the site to the north, east, and west. Open farm fields lie to the east and west, with irrigation channels alongside the roads. An irrigation canal empties into the northern end of the site, creating an open, marshy area down the center of the site. Between this marshy area and the western road, vegetation consists of an overstory of Goodding willow 10–12 m in height with an understory of tamarisk 5–7 m in height. Canopy closure within the willows is 80%. The eastern edge of the marsh is lined with a narrow strip of tamarisk 5–6 m in height with a few emergent Goodding willows on the marsh edge. Between the tamarisk strip and the eastern road, vegetation consists of honey mesquite and bushy arrowweed. The marsh was dry in mid-June and mid-July but had some surface water in early July. The irrigation canal running along the northern border of the site held water in mid-July. This site burned in a fire that started at the end of August.

No willow flycatchers were detected. The site was surveyed three times, totaling 2.3 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA SITE #2 AND CIBOLA SITE #1

Cibola Site #2: Area: 16.4 ha Elevation: 65 m

Cibola Site #1: Area: 7.7 ha Elevation: 65 m

These adjacent, mixed-exotic sites consist of a 200-m-wide strip of riparian vegetation between the channelized Colorado River to the west and a levee road to the east. Woody vegetation consists of a mix of tamarisk and arrowweed, 3–4 m in height, which is dry and scrubby on the eastern edge of the sites and becomes denser toward cattail marshes on the western edge of the sites. Emergent Goodding willow and

cottonwood are scattered along the eastern edge of the marshes. Overall canopy closure is less than 50%. The marshes contained surface water throughout the survey season.

We detected three willow flycatchers at Cibola Site #2 on 25 May and two on 14 June. No willow flycatchers were detected at Cibola Site #1. We surveyed each site five times, totaling 6.2 and 4.1 observer-hours for Cibola Site #2 and Cibola Site #1, respectively. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA LAKE EAST

Area: 4.5 ha Elevation: 64 m

This site borders the marsh on the eastern edge of Cibola Lake. Vegetation within the site consists primarily of tamarisk. Within 30 m of the marsh edge, tamarisk reaches 6–7 m in height and 90% canopy closure. As distance from the marsh increases, the height and density of the tamarisk decreases, and the tamarisk becomes mixed with arrowweed. Soil within the site was dry throughout the survey season.

We detected one willow flycatcher on 25 May and one on 20 June. The site was surveyed five times, totaling 5.0 observer-hours. Cowbirds were detected on four visits, and burros were heard on the periphery of the site.

WALKER LAKE

Area: 11.4 ha Elevation: 64 m

This mixed-exotic site is located along the northeastern edge of Walker Lake. The majority of the site consists of very dense tamarisk approximately 5 m in height with 90% canopy closure. The southeastern end of the site contains scattered emergent Goodding willow up to 20 m in height, as well as a couple of emergent cottonwoods. This portion of the site also contains a small opening with dead cattails and a small patch of half-dead coyote willow. Walker Lake contained standing water and saturated soil throughout the survey season, and the interior of the southern end of the site also contained surface water in both June and July.

We detected one willow flycatcher on 15 June. The site was visited three times, totaling 4.9 observer-hours. Cowbirds were detected on two surveys, and no evidence of livestock use was observed.

Imperial, Arizona and California

PARADISE

Area: 7.8 ha Elevation: 62 m

The center of this mixed-native site consists of stringers of cottonwood and Goodding willow 15–20 m in height. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. The cottonwoods and willows are separated from the Colorado River by a 50-m-wide strip of dense tamarisk. A marsh borders the western side of the southern third of the site. This marsh had been vegetated by cattails in previous years but now consists primarily of common reed (*Phragmites australis*). Canopy closure within the site is variable. Standing water was present within the marsh in May.

We detected three willow flycatchers on 18 May. The site was surveyed three times, totaling 3.3 observer-hours. Cowbirds were detected on every visit, and no evidence of livestock was noted.

HOGE RANCH

Area: 20.7 ha Elevation: 61 m

This mixed-exotic site borders the Colorado River and is dominated by tamarisk 4–6 m in height, with a few emergent cottonwood and Goodding willow (15 to 18 m in height) at the southern end of the site near the old ranch. Linear marshes with cattail, bulrush, and common reed occupy less than 20% of the interior of the site, and there are a few patches of coyote willow. Canopy closure is variable and reaches 70–90% in areas of dense, woody vegetation. The marshes in the interior of the site were inundated in June and July.

We detected eight willow flycatchers on 21 May and six on 2 June. The site was surveyed five times, totaling 5.9 observer-hours. Cowbirds were detected on every visit, and burros were heard near the site.

RATTLESNAKE

Area: 7.6 ha Elevation: 60 m

This mixed-exotic site is a patchwork of tamarisk 7 m in height with emergent Goodding willow up to 15 m in height and strips of dense coyote willow 6–8 m in height. Dense deadfall and debris within the coyote willows reduce the suitability of the area for willow flycatchers. Canopy closure is 70–90%. Extensive cattail marshes separate this site from the Colorado River. Standing water was present in the interior of the site in June.

We detected three willow flycatchers on 21 May and two on 2 June. The site was surveyed five times, totaling 6.4 observer-hours. Cowbirds were detected on all surveys, and burros were heard at the site.

MILEMARKER 65

Area: 10.0 ha Elevation: 58 m

The site is a narrow strip of mixed-exotic vegetation between the Colorado River and a backwater marsh. Vegetation at the site consists primarily of dense tamarisk 6 m in height. Dense common reed, approximately 3 m in height, also occurs throughout the site and together with the tamarisk creates almost complete canopy closure. Because of the impenetrable vegetation at the site, we surveyed it from the river, and hydrologic conditions in the interior of the site during the surveys are unknown.

We detected one willow flycatcher on 18 May. We surveyed the site twice for a total of 0.9 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

NURSERY NW

Area: 7.0 ha Elevation: 58 m

This mixed-exotic site lies between the Colorado River and a cattail marsh. The dominant vegetation is tamarisk approximately 5 m in height with an understory of common reed. Mesquite trees are scattered along the western edge of the site. The eastern edge of the site, adjacent to the cattail marsh, has a stand of Goodding willow 9 m in height. Overall canopy closure is around 70%, and the densest portions of the site have canopy closure >90%. Surface water was present in marsh and the eastern edge of the site throughout the survey season.

We detected four willow flycatchers on 22 May and two on 5 June. The site was surveyed five times, totaling 6.9 observer-hours. Cowbirds were detected on four visits, and there was no evidence of livestock use.

FERGUSON LAKE

Area: 21.1 ha Elevation: 57 m

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with scattered, emergent Goodding willow 10 m in height along the western edge of the site bordering Ferguson Lake. Tamarisk 5–6 m in height is the dominant understory species, and it forms a continuous canopy in portions of the site. The site also contains patches of arrowweed with scattered screwbean mesquite and little canopy cover. The western edge of the site up to 50 m from the lakeshore had standing water in June and July.

We detected two willow flycatchers on 19 May. The site was surveyed three times, totaling 7.4 observer-hours. Cowbirds were detected on all visits, and no signs of livestock use were observed.

GREAT BLUE HERON

Area: 7.1 ha Elevation: 58 m

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willow forms an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. Portions of the site contain thickets of willow deadfall. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. Soils within the site were dry throughout the survey season.

We detected three willow flycatchers on 17 May, nine on 20 May, four on 3 June, and five on 5 June. The site was surveyed five times, totaling 15.9 observer-hours. Cowbirds were detected on all visits, and burros were detected on the periphery of the site.

POWERLINE

Area: 1.0 ha Elevation: 58 m

This mixed-native site consists of a strip of Goodding willow and cottonwood along the border of a cattail marsh. Overstory height is approximately 12 m and canopy closure is approximately 50%. Tamarisk and arrowweed are present in the understory, and honey mesquite is mixed with the tamarisk on the upland edge of the site. Surface water was present in the marsh and in the southern portion of the site in May and June.

We detected two willow flycatchers on 17 May and one on 3 June. We surveyed the site five times, totaling 4.2 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were noted within the site.

MARTINEZ LAKE

Area: 4.6 ha Elevation: 58 m

This mixed-native site borders the eastern shore of Martinez Lake. The eastern edge of the site, adjacent to the upland, is dominated by arrowweed with scattered Goodding willow, cottonwood, and tamarisk. Goodding willow <10 m in height and cottonwood up to 15 m in height are more prevalent on the western edge of the site, adjacent to cattails and common reed along the lakeshore. Canopy closure is highly variable. The western edge of the site contained saturated soil in May and surface water in June.

We detected two willow flycatchers on 3 June. We surveyed the site five times, totaling 8.8 observer-hours. Cowbirds were detected on all visits, and burros were heard on the periphery of the site.

Mittry Lake, California

MITTRY WEST

Area: 4.4 ha Elevation: 48 m

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Deadfall is common throughout the site, and canopy closure varies from 30 to 70%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. A clump of coyote willow 6 m in height and 50 m in diameter is present in the northeastern corner of the site. Surface water was extensive in the site in May with a few puddles remaining in June.

We detected three willow flycatchers on 17 May. The site was visited three times, totaling 4.3 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

GROUND RECONNAISSANCE RESULTS

Laguna

Laguna encompasses 449 ha between Imperial and Laguna Dams, on the east side of the Laguna dredge discharge area. This area will be included in future riparian restoration efforts, and we evaluated the existing habitat to determine whether it is suitable for willow flycatchers. Vegetation at the site consists primarily of tamarisk < 4 m in height, arrowweed, and quail bush (*Atriplex lentiformis*). A small cattail marsh is present on the eastern edge of the site; surrounding vegetation consists of tamarisk, arrowweed, and a few 5-m-tall Goodding willow. A patch of Goodding willow 7 m in height with an understory of common reed and tamarisk is present along an old backwater channel in the north-central part of the site, but soils in this area were completely dry during the site visit on 6 June. Overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat, and surface water was present only in one small area. Soils in most of the site were complete dry. We visited the site once, for a total of 8.0 observer-hours. No willow flycatchers were detected. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

Yuma, Arizona

GILA RIVER SITE #2

Area: 2.9 ha Elevation: 45 m

The center of this mixed-native site consists of an overstory of cottonwood up to 15 m in height and Goodding willow approximately 8 m in height, with an understory of arrowweed. Canopy closure in the center of the site is approximately 50%, and there is deadfall in the understory. The remainder of the site is vegetated by tamarisk 4 m in height and arrowweed, with canopy closure <50%. The site is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. There was no standing water within the vegetation during the survey season, but the northwestern edge of the site borders a marsh, which held water throughout the season.

We detected seven willow flycatchers on 4 June. The site was surveyed four times, totaling 5.3 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

FORTUNA SITE #1

Area: 3.2 ha Elevation: 45 m

This mixed-native site consists of a narrow strip of cottonwood and Goodding willow up to 15 m in height with 50–70% canopy closure. Tamarisk and arrowweed form a patchy understory on the periphery of the site. Within the densest cottonwood/willow areas, there is little understory but many downed branches. The site is bordered to the north by agricultural fields and to the south by a cattail marsh and the Gila River. The interior of the site was dry in June and July, but the adjoining marsh contained surface water.

We detected 15 willow flycatchers on 4 June. We surveyed the site four times, totaling 6.1 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

FORTUNA NORTH

Area: 3.8 ha Elevation: 46 m

This site is vegetated primarily by mature tamarisk approximately 7 m in height. Goodding willow and mesquite, also 7 m in height, are scattered throughout the site but make up less than 10% of the vegetation. Canopy closure is approximately 80% in the densest areas. The Gila River runs along the western edge and through the northwestern corner of the site. No surface water was noted within the woody vegetation during the survey season, but the river contained water.

We detected six willow flycatchers on 4 June and one on 5 June. We surveyed the site four times, totaling 9.5 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

NDOW Study Areas

Field personnel spent 1.0 observer-hour completing broadcast surveys for willow flycatchers at 3 of 19 sites at Key Pittman WMA, River Ranch, and Warm Springs Natural Area. The remaining 17 sites were occupied by resident flycatchers from the beginning of the season and were monitored but not surveyed. Willow flycatcher survey and monitoring results are summarized in Table 2.7 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2011 are shown on orthophotos in Appendix B.

In addition to willow flycatcher surveys, field personnel spent 9.0 observer-hours completing broadcast surveys for Yellow-billed Cuckoo at both Key Pittman and River Ranch. The results of cuckoo surveys are summarized below.

Table 2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
KEPI	Patch 0	0.04	2 (6 Jun–8 Aug)
	Patch 1	0.1	2 (29 May–4 Aug)
	Patch 2	0.1	2 (18 May–8 Aug)
	Patch 3	0.1	1 (16 May–27 Jul)[6], 1 (31 Jul)
	Patch 4	0.1	2 (25 May–31 Jul), 3 (27 Jul)[6,7]
	Patch 4.5	0.02	ND

Table 2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
KEPI	Patch 5	0.1	2 (21 May–11 Aug)
	Patch 6	0.2	2 (16 May–6 Jul), 3 (18 Jun–31 Jul), 1 (12 Jul)[8]
	Patch 7	0.1	2 (16 May–11 Aug)
	Patch 8	0.1	2 (1 Jun–4 Aug)
	Patch 9	0.3	2 (16 May–31 Jul), 2 (18 Jun–2 Aug)
	Patch 10	0.1	3 (16 May–8 Aug)
	Patch 10.5	0.02	1 (26 Jun)[9], 1 (24 Jul)[7]
	Patch 11	0.1	4 (6 Jun – 11 Aug), 1 (30 Jun)[8]
	Patch 12	0.1	3 (21 May–14 Aug), 1 (30 Jun), 2 (27 Jul)[9]
	Fence[10]		1 (29 May)
RIRA	West Side	0.3	2 (15 Jun–3 Jul), 1 (23 Jun–13 Jul), 1 (19 Jun), 1 (23–27 Jul)
	East Side	0.4	2 (15 Jun–27 Jul)
	Smalls	0.5	1 (15 Jun–16 Jul), 1 (27–29 Jun)
WMSP	Muddy Mac	0.7	2 (15 May–28 Jul), 3 (26 May)

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Flycatchers in territories that were occupied throughout the breeding season are shown as being present throughout the season. Flycatchers detected on a single occasion or for a short period of time are listed separately.

[5] We detected several within-season movements between study areas in 2011. See Table 3.9 for details.

[6] One individual detected 16 May–27 Jul in Patch 3 and recaptured 27 Jul in Patch 4.

[7] One individual detected 26 Jun in Patch 10.5 and recaptured 27 Jul in Patch 4

[8] This individual detected 30 Jun in Patch 11 and12 Jul in Patch 6.

[9] One individual recaptured 26 Jun in Patch 10.5 and 27 Jul in Patch 12.

[10] Not an official survey site. Incidental detections recorded.

Key Pittman Wildlife Management Area, Nevada

PATCHES 0–12

Area: 1.4 ha Elevation: 1,169 m

This study area is divided into 15 small stands of coyote willow. These stands form a strip of habitat between bulrush marsh on the edge of Nesbitt Lake to the east and dry upland scrub dominated by saltbush and grasses to the west. Most of the stands are independent of each other, but four stands (Patches 6–9) have grown together, forming a larger contiguous stand. Each stand is characterized by very dense, large-diameter stems of coyote willow. Some areas have fallen or leaning stems with wispy growth in the lower 2 m, making traversing those areas difficult. Canopy height ranges from 4 to 8 m with the taller stems occurring in the center of each site, giving each stand a rounded look. Canopy closure is 70–90%. Surface water was present along the eastern edge in May and June, though no more than 10% of the area within the sites was inundated, with an additional 5% saturated. Soils were damp in July with no saturated soil or standing water.

We located 33 breeding willow flycatchers across 13 of the 15 sites. We detected one resident, unpaired male and an additional seven individuals for which we could not determine residency. An additional individual of undetermined residency was detected on a fence adjacent to the sites. Only the unoccupied site, Patch 4.5, was surveyed, totaling 0.3 observer-hours. Cowbirds were detected during one survey but were noted throughout the season during nest monitoring activities. Signs of cattle were present in the dry upland scrub, but the sites have been fenced off to prevent damage. Deer were present within the sites, but do not appear to heavily impact the vegetation structure.

YELLOW-BILLED CUCKOO SURVEYS

We completed four surveys for Yellow-billed Cuckoo at Key Pittman, totaling 6.5 observer-hours. The first survey included Patches 0–4.5 as well as the cottonwood stand at the southern end of Nesbitt Lake. The final three surveys covered the cottonwood stand and Patches 0–12. No Yellow-billed Cuckoos were detected.

River Ranch

River Ranch is in the Pahranagat Valley, approximately 12 km south of Key Pittman, and consists of several isolated patches of vegetation. Each patch is surrounded on all sides by grazed, irrigated cattle pasture, and the perimeter of each site has a distinct browse line at 1.5 m in height.

WEST SIDE

Area: 0.3 ha Elevation: 1,100 m

This site is composed primarily of dense, large-diameter coyote willow 7 m in height. Shorter coyote willow approximately 4 m in height is present around the perimeter, giving the site a rounded look. A gap 3 to 5 m wide runs diagonally through the site from the northwestern to the southeastern corner. Some Russian olive is scattered along the perimeter of this gap. There is little to no understory, except where willows are regenerating and in the gap, where grasses and other herbaceous plants dominate. Canopy closure is 90% throughout most of the site, except in the gap where it varies from 0 to 30%. Areas of deadfall up to 1 m deep are scattered throughout the site, making travel difficult in places. Water levels fluctuated throughout the season depending on irrigation activity. Maximum water extent included flowing, 10-cm-deep water covering approximately 50% of the site, saturated soils covering an additional 30%, and 20% with damp soils. Minimum water extent included damp soils throughout the site. Water tended to pool in a ditch approximately 1 m wide and 0.2 m deep surrounding the site.

We detected two breeding flycatchers and one male for which breeding status could not be confirmed. We also detected an additional two individuals for which residency could not be determined. Due to flycatcher occupancy, this site was surveyed only once, totaling 0.4 observer-hours. No cowbirds were detected during the survey, but they were noted intermittently throughout the breeding season in low numbers. Signs of cattle were present in and surrounding the site, but the cattle do not appear to use the interior of the site extensively.

EAST SIDE

Area: 0.4 ha Elevation: 1,100 m

This site is composed primarily of dense, large-diameter coyote willow 6 to 7 m in height. Tree height is shorter at the perimeter, giving the site a rounded appearance. Russian olive and velvet ash (*Fraxinus velutina*) occur in low numbers. There are numerous piles of deadfall scattered throughout the site. Little to no understory is present, except where the willow is able to regenerate and also in some small clearings

where herbaceous vegetation dominates. Canopy closure is primarily 70–80%, except in a few scattered clearings where it ranges from 0 to 25%. Water levels fluctuated throughout the season depending on irrigation activity. Maximum water extent included damp to almost saturated soils throughout and a ditch of water 1 m wide and 0.2 m deep surrounding the site. Minimum water extent included dry soils throughout the site.

We detected two breeding flycatchers. Due to flycatcher occupancy, no formal surveys were conducted. Brown-headed cowbirds were noted intermittently throughout the breeding season in low numbers. Signs of cattle were present throughout and surrounding the site, with cattle trails throughout the interior of the site.

SMALLS

Area: 0.5 ha Elevation: 1,100 m

This site is composed primarily of coyote willow 5 m tall. There is little understory except sparse, regenerating willow in the densely vegetated areas. A large gap in the vegetation, totaling approximately 25% of the site, dominates the northern half of the site. This gap is ringed by a stand of shorter coyote willow approximately 4 m in height and 4 m wide on the western, northern, and eastern sides. Canopy closure averages 80-85% in the vegetated areas. Deadfall is scattered throughout the site but typically does not occur in piles as it does in West Side and East Side. Water levels were variable throughout the season depending on irrigation activity. Maximum water extent included a pool of water at the northern end of the site and saturated soils throughout the remainder of the site. Minimum water extent included completely dry soils throughout the site.

We detected one male for which breeding status could not be confirmed and an additional individual for which we could not determine residency. Due to flycatcher occupancy, this site was surveyed only once, totaling 0.4 observer-hours. No cowbirds were detected during the survey, though they were noted at other times during the breeding season. Signs of heavy cattle use were present throughout the site.

YELLOW-BILLED CUCKOO SURVEYS

We completed three surveys for Yellow-billed Cuckoo at River Ranch, totaling 2.5 observer-hours. All suitable habitat was covered in each survey. No Yellow-billed Cuckoos were detected.

Warm Springs Natural Area

On 1 July 2010, a wildfire burned at least part of all the survey sites at Warm Springs. At the beginning of the breeding season of 2011, ground reconnaissance was conducted at all sites to assess the extent of the damage and suitability of habitat for flycatchers. The degree of damage varied from site to site and ranged from almost complete consumption of all vegetation to consumption of the understory with overstory structure intact but the canopy reduced by 80–90%. Regeneration of woody vegetation was noted at all sites, but vegetation was generally sparse and less than 2 m in height. One site was partially damaged in the fire with the remainder largely undamaged. Due to the degree of fire damage, surveys were discontinued at all sites except for the one partially damaged site.

MUDDY MAC

Area: 0.7 ha Elevation: 548 m

This native site is near the head of Apcar Stream. The northern portion of the site was heavily damaged in the 2010 fire, with the overstory being completely killed. Dense basal regeneration of velvet ash is occurring, but live vegetation is only 2 m in height. The southern half of the site is characterized by a

very dense velvet ash stand 8–9 m in height with no understory and ≥80% canopy closure. The extreme southern end of this site was also damaged in the 2010 fire with most of the trees consumed and only grass growing under the snags. Surface water was present throughout the survey season in the form of a flowing stream near the southern edge of the site. Soils were saturated in May with some standing water, but by June interior soils were completely dry.

We detected two breeding flycatchers and three individuals for which residency could not be determined. Due to flycatcher occupancy, this site was not formally surveyed. A cowbird was detected during one nest monitoring visit. No evidence of livestock was observed.

YELLOW-BILLED CUCKOO SURVEYS

No Yellow-billed Cuckoo surveys were conducted at Warm Springs in 2011 due to lack of suitable habitat.

DISCUSSION

The six Reclamation study areas occupied in 2011 by breeding flycatchers (Pahranagat NWR, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams River NWR) consistently held resident and breeding flycatchers in previous years (McKernan and Braden 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; details of residency and breeding in 2011 are presented in Chapters 3 and 4 of this document). In 2009 and 2010, breeding flycatchers were recorded along Beaver Dam Wash at Littlefield (Littlefield Poles) for the first time since 2004. Vegetation at Littlefield Poles was scoured during floods in December 2010, and the hydrology was altered so that no surface water was present at the site during visits in May and June. Surveys were discontinued at the site after the visit in June because of these changes. No flycatchers were recorded at the site in 2011.

A single pair of breeding flycatchers was detected at a new site in 2011. Along the Bill Williams River, breeding flycatchers were detected at Cougar Point, which had not previously been surveyed. The site consists of young, even-aged vegetation that likely only recently reached sufficient size to be suitable flycatcher breeding habitat.

Hydrologic conditions at Mesquite West in May and early June 2011 were similar to those observed in all prior years except 2009. In 2009, the site was largely dry, and premature leaf abscission was observed as early as May. In 2011, the site was wet through the beginning of the breeding season In mid-June, earthwork at the inflow to the site diverted water along the edge of the site and into the Virgin River. Although the site became dry, the canopy remained largely intact with only a minor amount of leaf abscission detected in August. Despite the presence of wet conditions in early 2011, the number of resident flycatchers (11) detected at Mesquite West in 2011 was lower than the numbers detected in previous years (25, 25, 24, 20, and 16 in 2006 through 2010, respectively). The decline in flycatcher numbers between 2009 and 2010 was likely influenced by poor nest success and poor habitat conditions in 2009 (McLeod and Pellegrini 2011). Reasons for the continued decline remain undetermined, but habitat suitability in the western portion of Mesquite West, which was not occupied in 2011, may be influenced by the defoliation of tamarisk.

Marsh elevations at Topock were lower than in any year since 2005. The number of resident adults detected at Topock continued to decline, with 5 resident adults detected in 2011, versus 36, 29, 18, 20, 14, and 11 detected in each year in 2005 through 2010, respectively. Changes over the years in the timing and magnitude of fluctuations in marsh levels may have contributed to the decline in the Topock flycatcher population (see Chapter 8). We continued our efforts to locate all potentially suitable willow

flycatcher habitat at Topock Marsh. We revisited two sites that were visited briefly in 2010; one site was surveyed regularly, and visits to the other site were discontinued because of lack of suitable habitat.

Tamarisk beetles were present at both Mesquite and Mormon Mesa in 2011. Extensive defoliation was noted in the vicinity of the Mesquite sites in June, but the areas currently occupied by willow flycatchers are primarily native, and defoliation did not have any noticeable effect on breeding. Defoliation was noted in the Mormon Mesa study area at all sites starting in July, with extensive defoliation noted by late July. Roughly half of the nests in Mormon Mesa are located in primarily native stands. The remaining nests are located in either mixed stands with a primarily native canopy, or in primarily non-native vegetation. Defoliation from tamarisk beetle activity therefore potentially affected only some of the nest stands at Mormon Mesa. In addition, the majority of flycatcher nesting attempts had either fledged or failed by the time defoliation became widespread, and there was no evidence that flycatcher nesting was affected by defoliation. Defoliation will presumably occur earlier in the year in 2012 at the Mormon Mesa sites now that tamarisk beetles are established in the area and thus may have greater effects on flycatcher nesting next year. Tamarisk beetles were noted as far downstream on the Virgin River as Lake Mead by the end of August, and defoliation was also observed on the Muddy River as far downstream as Overton and as far upstream as Warm Springs. The Muddy River study area may be affected by tamarisk beetles in 2012.

Although 154 flycatcher detections were recorded at sites surveyed south of the Bill Williams, monitoring results and behavioral observations (lack of territorial, aggressive behaviors exhibited toward conspecific broadcasts) at these sites suggest these flycatchers were not resident or breeding individuals but migrants. These results are consistent with those recorded in 2003–2010 (McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Banding studies in the Yuma area completed in 2003–2007 also suggested that willow flycatchers detected in mid-June were migrants (McLeod et al. 2008a). Migrant willow flycatchers along the lower Colorado River could belong to one of several subspecies (*E. t. extimus*, *E. t. adastus*, or *E. t. brewsteri*), and unless an individual is banded, it is impossible to determine in the field whether a migrant is *E. t. extimus* or one of the other two subspecies. A model based on plumage color variation predicted that approximately half of 96 willow flycatchers captured in the Yuma area in mid-June in 2004–2007 were *E. t. extimus* (Paxton et al. 2010), indicating that the southwestern subspecies does use the lower Colorado River as a migration corridor. In addition, two flycatchers banded at breeding sites monitored as part of the lower Colorado River study have been detected at sites south of the Bill Williams. Both individuals were detected for only one day and did not exhibit territorial behavior, suggesting they were migrants. The first individual was detected along the Gila River in Yuma in May 2005. It was identified by the presence of a single anodized federal band as having been banded as a nestling at one of the Reclamation study areas in either 2003 or 2004. In June 2011, a fully banded flycatcher was detected in PVER 2, one of the Reclamation habitat creation sites along the LCR. While the identity of the individual could not be confirmed by repeated observations, it was very likely banded in southern Nevada. This is the first confirmed sighting of a Southwestern Willow Flycatcher in one of the habitat creation sites south of the Bill Williams. Although the bird was likely a migrant, this detection demonstrates the importance of the habitat creation sites as stopover habitat for migrating Southwestern Willow Flycatchers. Flycatchers from breeding areas along the lower Colorado River and its tributaries may also provide a potential source population for the colonization of habitat creation sites (see Discussion in Chapter 3).

Chapter 3

COLOR-BANDING AND RESIGHTING

INTRODUCTION

Long-term monitoring of willow flycatchers of known identity, sex, and age is the only effective way to determine demographic life history parameters such as annual survivorship of adults and young, site fidelity, seasonal and between-year movements, and population structure. Thus, as an integral part of our studies, we captured and uniquely color-banded as many willow flycatchers as possible, allowing field personnel to resight individuals throughout the breeding season, as well as in subsequent years. Resighting consisted of using binoculars to determine the identity of a color-banded flycatcher by observing, from a distance, the unique color combination on its legs. This allowed field personnel to detect and monitor individuals without recapturing each bird. This was our ninth consecutive year of color-banding studies and builds upon color-banding initiated at these sites in 1997 (McKernan and Braden 1998).

METHODS

Color-Banding

From early May through mid-August, we captured, uniquely color-banded, and subsequently monitored adult and nestling willow flycatchers at all study areas where resident willow flycatchers were detected. The color-banding effort also included Key Pittman Wildlife Management Area, River Ranch, and Warm Springs Natural Area in Nevada (in cooperation with Nevada Department of Wildlife) and opportunistic banding in St. George, Utah (in cooperation with Utah Division of Wildlife Resources).

Adult flycatchers were captured with mist-nets, which provide the most effective technique for live-capture of adult songbirds (Ralph et al. 1993). We used a targeted capture technique (per Sogge et al. 2001), whereby a variety of conspecific vocalizations were broadcast from a CD player and remote speakers to lure territorial flycatchers into the nets. In addition, we used “passive netting,” whereby several mist-nets were erected and periodically checked, with no broadcast of conspecific vocalizations. We banded each adult willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and a colored metal band on the other. We coordinated all color combinations with the Federal Bird Banding Laboratory and all other Southwestern Willow Flycatcher banding projects to minimize duplication of color combinations. For each color-banded bird recaptured, we visually inspected the legs and noted any evidence of irritation or injury that may be related to the presence of leg bands.

Nestlings were banded at 8 to 10 days of age, when they were large enough to retain the leg bands, yet young enough that they would not prematurely fledge from the nest (Whitfield 1990, Paxton et al. 1997). Nestlings were banded only when the location of the nest was such that nest access and removal/replacement of the nestlings would not endanger the nest, nest plant, or nestlings. Nestlings were also banded with a single, numbered federal band on one leg and a metal color-band on the other leg. Prior to 2008, we banded each nestling only with a single federal band, identifying it as a returning nestling in the event it returned in a subsequent year.

For each captured adult willow flycatcher, we recorded morphological measurements, including culmen, tail, wing, fat level, and molt onto standardized data forms (Appendix A). Sex was determined based on the presence of a cloacal protuberance in males or brood patch and/or egg(s) in the oviduct for females. Captured flycatchers lacking breeding characteristics and not observed engaging in male advertising song (see below) were sexed as unknown. Flycatchers with retained primary, secondary, and/or primary covert feathers (multiple aged remiges) were aged as second year adults, and those without (uniformly aged remiges) were aged as after second year (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). Individuals in juvenile plumage (unworn flight feathers and body plumage with broad, buff-colored wing bars and fleshy gape) were aged as hatch year.

Resighting

We determined the identity of a color-banded flycatcher by observing with binoculars, from a distance, the unique color combination on its legs. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed. Field personnel typically spent the early part of each morning color-banding, and directed their efforts to resighting as daylight increased and flycatchers became more difficult to capture. All banding, monitoring, and survey field personnel coordinated resighting efforts and recorded observations of color-banded and unbanded flycatchers onto standardized data forms (Appendix A). For resighted flycatchers (i.e., ones for which at least one leg was seen clearly enough to determine the presence or absence of a band), we recorded color-band combinations, territory number, site, standardized confidence levels of the resight, and behavioral observations. Willow flycatchers for which detections spanned one week or longer were considered resident at a site, regardless of the portion of the breeding season in which the bird was observed or whether a possible mate was observed. Flycatchers observed engaging in breeding behaviors (e.g., carrying nest material) were also considered resident regardless of the period of time over which they were observed. Flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male, and flycatchers observed carrying nest material or constructing or incubating a nest were sexed as female. Flycatchers not observed engaging in one of these diagnostic activities were sexed as unknown.

Inactive territories were visited at least three times (each visit four days apart) before territory visits stopped. All territories were assigned a unique alphanumeric code and were plotted onto high-resolution aerial photographs, thus producing a spatial representation of the flycatcher population at each study location. If multiple females were paired with a single male, each female received a unique territory number. Flycatchers were determined to be unpaired if none of the following breeding behaviors were observed: presence of another unchallenged flycatcher in the immediate vicinity, counter calling (*whitts*) with a nearby flycatcher, interaction twitter calls (*churr/kitters*) with a nearby flycatcher, a flycatcher in the immediate vicinity carrying nesting material, a flycatcher in the immediate vicinity carrying food or fecal sac, or adult flycatchers feeding young (per Sogge et al. 1997).

Unbanded flycatchers could not be identified to individual, but an unbanded flycatcher detected in a given location on multiple, consecutive visits was assumed to be the same individual. If an unbanded flycatcher or a flycatcher whose legs were not observed was detected at a given location on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered to be different individuals in the absence of behavioral observations indicating the flycatcher was actively defending a territory or was a member of a breeding pair.

RESULTS

Reclamation Study Areas

Color-Banding and Resighting – Field personnel color-banded 15 new adult flycatchers and recaptured 11 individuals previously captured as adults. An additional 31 adults were identified to individual via resighting, while 3 individuals were resighted but did not have their color combinations confirmed. Of the 31 adults that were resighted and identified, one was identified for the first time since it was banded as a nestling. We identified two additional individuals as returning nestlings by the presence of a single federal band, with one (50%) identified to individual via recapture. We recaptured two additional returning nestlings with full color combinations. Thirty adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 30 adults. Overall, 52% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.1). We banded 40 nestlings from 17 nests. Of the 40 nestlings banded, 5 were known or suspected to have died before fledging. We resighted an additional 10 unbanded fledglings from six nests; one fledgling was captured and banded. For details on all banded flycatchers detected at the study areas from 2003 to 2011, see Appendix E.

Site-by-Site Color-Banding and Resighting

Pahranagat – We detected 14 resident, adult willow flycatchers from 10 territories at Pahranagat. In addition to resident adults, we detected seven individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Of the 10 territories recorded at Pahranagat, 6 consisted of breeding pairs, and 4 consisted of unpaired males. Of the breeding individuals, one male was polygynous with three females. One resident female moved from her territory in Pahranagat North and was resighted at Pahranagat West along with three banded fledges.

Field personnel captured and color-banded four new adults and recaptured three flycatchers previously captured as adults. We resighted and identified an additional 10 adults. Three adults remained unbanded. Of the resighted adults, one was originally banded as a nestling in 2010 (see Table 3.8 for juvenile dispersal data). The color combination could not be determined for one adult. We banded 11 nestlings from four nests. We resighted seven unbanded fledglings from three additional nests; one fledgling was captured and banded.

Mesquite – We detected 14 resident, adult willow flycatchers from eight territories at Mesquite. Of the eight territories recorded at Mesquite, seven consisted of paired individuals and one consisted of an unpaired male (Table 3.2). Of the breeding individuals, two males were each polygynous with two females. The male at one territory was displaced by another male that moved from Muddy River (Table 3.9).

Field personnel captured and color-banded three new adults and confirmed the identities of an additional six adults via resighting. Three adults remained unbanded, and band status could not be determined for two adults. We banded five nestlings from two nests.

Mormon Mesa – We detected 23 resident, adult willow flycatchers from 14 territories at Mormon Mesa. In addition to resident adults, we detected three individuals for which residency could not be confirmed (Table 3.2). Of the 14 territories recorded at Mormon Mesa, 13 consisted of breeding individuals and 1 consisted of an unpaired male. One breeding male moved from Muddy River, and one male for which residency could not be confirmed moved from Mesquite West (Table 3.9). One female mated

consecutively with two males and four males were polygynous, one with three females and three with two females.

Field personnel captured and color-banded one new adult and recaptured five flycatchers previously captured as adults. We resighted and identified nine additional adults. We captured one returning nestling originally banded as a juvenile in 2007 (see Table 3.8) and resighted one returning nestling with a single federal band that we were unable to recapture. Eight adults remained unbanded, and band combination could not be confirmed for one adult. We banded 16 nestlings, two of which were suspected to have died before fledging, from seven nests and resighted three unbanded fledglings from three nests.

Muddy River – We detected 13 resident, adult willow flycatchers from eight territories at Muddy River. In addition to resident adults, we detected three individuals for which residency could not be confirmed. Of the eight territories recorded, five consisted of breeding pairs and three consisted of unpaired males (Table 3.2). One breeding male moved to Mormon Mesa and one unpaired male moved to Mesquite (Table 3.9).

Field personnel captured and color-banded three new adults and recaptured two flycatchers previously captured as adults. We recaptured two returning nestlings; one was originally banded in 2009 and the other in 2010 (see Table 3.8). We resighted and identified four other adults. Four adults remained unbanded, and band status could not be confirmed for one adult. We banded four nestlings from two nests; three of these nestlings died before fledging.

Topock – We detected five resident, adult willow flycatchers from five territories at Topock. In addition to resident adults, we detected 28 individuals for which residency could not be confirmed (Table 3.2). Of the five territories recorded at Topock, one consisted of a breeding pair and four consisted of unpaired males. One of the unpaired males established a territory at Platform and then moved to The Wallows and established a second territory.

Field personnel captured and color-banded two new adults and recaptured one flycatcher originally captured as an adult. We resighted and identified one other banded adult. Nine adults remained unbanded, and the band status of 19 individuals could not be determined. The color combination of one banded adult could not be confirmed.

Bill Williams – We detected eight resident willow flycatchers from five territories at Bill Williams. In addition to resident adults, we detected nine individuals for which residency could not be determined (Table 3.2). Of the five territories recorded at Bill Williams, four consisted of breeding individuals and one consisted of an unpaired male. One male was polygynous with two females. At one breeding territory, personnel from an unrelated field crew reported a singing male, but only the female was detected during nest monitoring visits.

Field personnel captured and color-banded two new adults. We resighted and identified four returning banded adults. Three adults remained unbanded, and band status could not be determined for eight adults. We banded four nestlings from two nests.

Table 3.1. Willow Flycatchers Detected at Reclamation Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Detected in Previous Year(s) as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Pahranagat	North	21	4	3	0	10	0	3	0	1	11(4)	1	86
	West	1[1]	0	0	0	1[1]	0	0	0	0	0	3[2]	100
	Study Area Total	**21**	**4**	**3**	**0**	**10**	**0**	**3**	**0**	**1**	**11(4)**	**1**	**86**
Mesquite	Hafen Lane	3	2	0	0	1[3]	0	0	0	0	0	0	100
	West	11	1	0	0	5[4]	0	3	2	0	5(2)	0	55
	Study Area Total	**14**	**3**	**0**	**0**	**6**	**0**	**3**	**2**	**0**	**5(2)**	**0**	**64**
Mormon Mesa	Virgin River #1 (North)	5	0	0	0	1	0	3	0	1	0	0	40
	Virgin River #1 (South)	21	1	5[4]	1	8[5]	1[6]	5	0	0	16(7)[7]	0	76
	Study Area Total	**26**	**1**	**5**	**1**	**9**	**1**	**8**	**0**	**1**	**16(7)**	**0**	**69**
Muddy River	Overton Pond	1	0	0	0	0	0	1	0	0	0	0	0
	Overton WMA	15	3	2[3,5]	2	4	0	3	1	0	4(2)[8]	0	73
	Study Area Total	**16**	**3**	**2**	**2**	**4**	**0**	**4**	**1**	**0**	**4(2)**	**0**	**69**
Topock	Pipes #1	1	0	0	0	0	0	0	0	1	0	0	100
	Pipes #3	3	1	0	0	1[9]	0	0	1	0	0	0	67
	The Wallows	3	0	0	0	1[10]	0	2	0	0	0	0	33
	PC6-1	1	0	0	0	0	0	1	0	0	0	0	0
	In Between	1	0	0	0	0	0	0	1	0	0	0	0
	800M	3	0	1[9]	0	0	0	1	1	0	0	0	33
	Pierced Egg	4	0	0	0	0	0	0	4	0	0	0	0
	Swine Paradise	1	0	0	0	0	0	1	0	0	0	0	0
	Platform	1	0	0	0	1[10]	0	0	0	0	0	0	100
	Hell Bird	10	1	0	0	0	0	2	7	0	0	0	10
	Spaghetti	2	0	0	0	0	0	0	2	0	0	0	0
	Beal Lake	1	0	0	0	0	0	0	1	0	0	0	0
	Lost Lake	1	0	0	0	0	0	1	0	0	0	0	0
	Dock[11]	3	0	0	0	0	0	1	2	0	0	0	0
	Study Area Total	**33**	**2**	**1**	**0**	**1**	**0**	**9**	**19**	**1**	**0**	**0**	**15**
Bill Williams	Wispy Willow	1	0	0	0	0	0	0	1	0	0	0	0
	Burn Edge	1	0	0	0	0	0	0	1	0	0	0	0
	Site #4	3	0	0	0	0	0	2	1	0	0	0	0
	Site #3	3	0	0	0	2	0	0	1	0	1(1)	0	67
	Site #5	2	0	0	0	0	0	0	2	0	0	0	0
	Cougar Point	2	1	0	0	0	0	0	1	0	0	0	50
	Planet Ranch Rd	5	1	0	0	2	0	1	1	0	3(1)	0	60
	Study Area Total	**17**	**2**	**0**	**0**	**4**	**0**	**3**	**8**	**0**	**4(2)**	**0**	**35**
Total		**124**	**15**	**11**	**3**	**31**	**1**	**30**	**30**	**3**	**40(17)**	**1**	**52**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.2.

[1] One individual moved from North to West and is tallied only once in the total.

[2] Three HY individuals moved from North to West. These individuals were resighted, not captured, at West and are not tallied in the total.

[3] One individual moved from Muddy River Overton WMA to Mesquite Hafen Lane and is tallied only once in the total.

[4] One individual moved from Mesquite West to Mormon Mesa Virgin River #1 South and is tallied only once in the total.

[5] One individual moved from Muddy River Overton WMA to Mormon Mesa Virgin River #1 South and is tallied only once in the total.

[6] Returning nestling.

[7] Two nestlings suspected to have died before fledging.

[8] Three nestlings died before fledging.

[9] One individual moved from 800M to Pipes #3 and is tallied only once in the total.

[10] One individual moved from Platform to The Wallows and is tallied only once in the total.

[11] Not a formal survey site. Flycatchers detected en route.

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	26-Jun-09	2430-61087	OB(M):XX	N/A	A4Y	F	12	R 12 Jul
	North	24-Jun-08	2430-61176	DK(M):XX	N/A	4Y	M	12	R 19 Jun
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	26-Jun-11	2540-58111	TQ:RYR(M)	N/A	AHY	F	13	N
	North	19-Jul-08	2430-61080	YY(M):XX	N/A	5Y	M	13	RS
	North	8-Jul-11	2590-53104	XX:GVG(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53102	XX:RV(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53103	XX:BRB(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53101	XX:DOD(M)	N/A	L	U	13	N
	North	24-Jun-11	2540-58110	RKR(M):TQ	N/A	AHY	F	23,F84	N; detected 21 Jul at F84 in PAHR West
	North	25-Jun-08	2430-61179	XX:KB(M)	N/A	A5Y	M	23,43,128	RS
	North	2-Jul-11	2430-61215	WBW(M):XX	N/A	L	U	23	N
	North	2-Jul-11	2430-61218	XX:OYO(M)	N/A	L	U	23,F81	N; detected 21–25 Jul at F81 in PAHR West
	North	1-Jul-08	2430-61120	XX:KO(M)	N/A	4Y	F	31	R 12 Jul
	North	21-Jun-06	2370-40060	YG(M):PU	N/A	A7Y	M	31	RS
	North	20-Jul-11	2590-53109	XX:WKW(M)	N/A	HY	U	31	N
	North	N/A	N/A	UB:UB	N/A	HY	U	31	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	31	RS
	North	1-Jul-06	2370-40047	PU:DD(M)	N/A	A7Y	F	43	RS
	North	3-Jul-11	2430-61220	RGR(M):XX	N/A	L	U	43	N
	North	3-Jul-11	2540-58114	YDY(M):TQ	N/A	L	U	43	N
	North	18-Jul-10	2540-58293	BO(M):TQ	N/A	3Y	F	128	RS
	North	6-Jul-11	2540-58286	TQ:DYD(M)	N/A	L	U	128	N

AR064169

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	6-Jul-11	2540-58284	GW(M):TQ	N/A	L	U	128	N
	North	6-Jul-11	2540-58285	TQ:YG(M)	N/A	L	U	128	N
	North	24-Jul-08	2430-61083	XX:YR(M)	N/A	5Y	M	T21	RS; detected 18 May–28 Jul
	North	7-Jul-06	2360-59754	OR(M):EE	N/A	6Y	M	T41	RS; detected 28 May–9 Jun
	North	18-May-04	2320-31595	WKW(M):EE	N/A	A9Y	M	T48	RS; detected 24 May–1 Aug
	North	6-Jul-05	2360-59712	EE:GKG(M)	N/A	7Y	M	T64	RS; detected 28 May–19 Jul
	North	13-Jun-11	2540-58245	TQ:KYK(M)	N/A	SY	M	F73	N; detected 13 Jun
	North	N/A	N/A	UB:UB	N/A	AHY	U	F76	RS; detected 18 May
	North	21-Jul-10	2540-58201	TQ:BO(M)	N/A	SY	U	F77	RS; detected 12 Jul
	North	INA	INA	banded	N/A	AHY	M	F78	RS; detected 4 Aug
	North	N/A	N/A	UB:UB	N/A	AHY	M	F79	RS; detected 18 May
	West	INA	INA	banded	N/A	HY	U	F80	RS; detected 21–25 Jul, probably from 128
	West	N/A	N/A	UB:UB	N/A	HY	U	F82	RS; detected 21 Jul, probably from PAHR North
	North	N/A	N/A	UB:UB	N/A	AHY	U	F83	RS; detected 12 Jul
	North	17-Jun-11	2540-58109	WK(M):TQ	N/A	SY	M	F120	N; detected 17–19 Jun, detected 23 Jun–13 Jul at T109 in RIRA West Side
MESQ	West	N/A	N/A	UB:UB	N/A	AHY	F	30	RS
	West	15-Jul-05	2320-31688	EE:BG(M)	N/A	7Y	M	30	RS
	West	13-Aug-11	2590-53152	XX:OKO(M)	N/A	L	U	30	N
	West	13-Aug-11	2590-53154	XX:GRG(M)	N/A	L	U	30	N
	Hafen Lane	22-Jul-11	2540-58152	TQ:KWK(M)	N/A	AHY	F	32	N
	Hafen Lane	30-Jun-11	2540-58176	TQ:WG(M)	N/A	SY	M	32	N; detected 30 Jun–17 Jul
	Hafen Lane	19-Jun-09	2370-39930	PU:GO(M)	N/A	3Y	M	32	RS; detected 21–23 Jul, detected 17 May–17 Jul at T22 in MUDD Overton WMA
	West	INA	INA	undetermined	N/A	AHY	F	40	
	West	6-Jun-10	2540-58192	TQ:BG(M)	N/A	A3Y	M	40, 103	RS; captured 24 Jul at F20 in MOME Virgin River #1 South

AR064170

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	26-Jul-07	2370-40087	PU:BZ(M)	N/A	A6Y	F	72	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	72	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	80	RS
	West	16-Jun-09	2370-40175	PU:OKO(M)	N/A	3Y	M	80, 127	RS
	West	21-Jul-10	2430-61234	XX:WGW(M)	N/A	A3Y	F	103	RS
	West	1-Jul-11	2430-61216	OKO(M):XX	N/A	L	U	103	N
	West	1-Jul-11	2430-61217	XX:YVY(M)	N/A	L	U	103	N
	West	1-Jul-11	2540-58112	WW(M):TQ	N/A	L	U	103	N
	West	INA	INA	undetermined	N/A	AHY	F	127	
	West	14-Jun-11	2540-58172	TQ:VV(M)	N/A	AHY	M	T102	N
MOME	Virgin River #1 South	6-Aug-05	2360-59788	BO(M):EE	N/A	7Y	F	1	RS
	Virgin River #1 South	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A11Y	M	1, 91	RS
	Virgin River #1 South	15-Jun-11	2540-58174	TQ:WK(M)	N/A	L	U	1	N
	Virgin River #1 South	15-Jun-11	2540-58173	TQ:VW(M)	N/A	L	U	1	N, R 12 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	1	RS
	Virgin River #1 South	25-Jun-07	2360-59777	EE:YKY(M)	EE:UB	5Y	F	2	R 19 Jul
	Virgin River #1 South	4-Jul-01	none[9]	UB:GY(M)	UB:XX	11Y	M	2, 7, 90	R 20 Jun and 19 Jul
	Virgin River #1 South	22-Jul-11	2590-53116	YDY(M):XX	N/A	L	U	2	N
	Virgin River #1 South	22-Jul-11	2590-56115	RKR(M):XX	N/A	L	U	2	N
	Virgin River #1 South	22-Jul-11	2590-53117	YGY(M):XX	N/A	L	U	2	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	5	RS
	Virgin River #1 South	3-Jun-07	2370-40197	OG(M):PU	N/A	A6Y	M	5, 50	RS
	Virgin River #1 South	INA	INA	PU:UB	N/A	AHY	F	7	RS
	Virgin River #1 North	INA	INA	banded	N/A	AHY	F	19	RS
	Virgin River #1 North	19-Jun-08	none[10]	UB:KW(M)	XX:KW(M)	A5Y	M	19	RS
	Virgin River #1 South	29-Jun-10	2540-58231	TQ:GR(M)	N/A	3Y	F	50	RS
	Virgin River #1 South	2-Jul-11	2590-53141	RK(M):XX	N/A	L	U	50	N; suspected to have died

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	2-Jul-11	2590-53142	XX:BWB(M)	N/A	L	U	50	N; suspected to have died
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	65	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	M	65	RS
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	F	66	RS
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	M	66	RS
	Virgin River #1 South	2-Jun-06	2370-40037	PU:DR(M)	N/A	A7Y	F	70	R 19 Jul
	Virgin River #1 South	14-Jun-06	2370-40046	PU:DK(M)	N/A	7Y	M	70, 104	RS
	Virgin River #1 South	19-Jul-11	2370-39970	PU:RWR(M)	N/A	L	U	70	N
	Virgin River #1 South	19-Jul-11	2540-58213	KWK(M):TQ	N/A	L	U	70	N
	Virgin River #1 South	9-Jun-05	2370-39956	PU:YWY(M)	PU:ZZ(M)	8Y	F	90	R 24 and 25 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	90	RS
	Virgin River #1 South	16-Jul-04	2320-31632	RZ(M):EE	N/A	9Y	F	91	RS; mated consecutively with 2 males
	Virgin River #1 South	31-Jul-09	2540-58154	DO(M):TQ	N/A	3Y	M	91	RS; breeding through 17 Jul at 18 in MUDD Overton WMA
	Virgin River #1 South	3-Jul-11	2540-58113	WY(M):TQ	N/A	L	U	91	N
	Virgin River #1 South	3-Jul-11	2430-61219	BVB(M):XX	N/A	L	U	91	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	91	RS
	Virgin River #1 South	12-Aug-11	2590-53119	GWG(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Aug-11	2590-53151	GDG(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Aug-11	2590-53150	KVK(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Jul-11	2540-58184	YGY(M):TQ	N/A	SY	F	92	N 12 Jul
	Virgin River #1 South	30-Jun-08	2430-61106	XX:KV(M)	N/A	4Y	M	92	R 2 and 12 Jul
	Virgin River #1 South	12-Jul-11	2590-53106	XX:OGO(M)	N/A	L	U	92	N
	Virgin River #1 South	12-Jul-11	2590-53107	XX:VKV(M)	N/A	L	U	92	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	104	RS
	Virgin River #1 South	8-Jun-06	2370-39938	KG(M):PU	N/A	7Y	M	T51	RS; detected 19 May–18 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	U	F8	RS; detected 26 Jun

AR064172

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	6-Jun-10	2540-58192	TQ:BG(M)	N/A	A3Y	M	F20	R 24 Jul; breeding through 19 Jul at 40 and 103 in MESQ West
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	M	F199	RS; detected 10–14 Jul
MUDD	Overton WMA	14-Jul-11	2590-53108	XX:YOY(M)	N/A	SY	F	3	N
	Overton WMA	25-Jul-09	2370-40029	KOK(M):PU	N/A	3Y	M	3	R 11Jul
	Overton WMA	18-Jul-11	2590-53126	XX:GOG(M)	N/A	L	U	3	N
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	4	RS
	Overton WMA	21-Jun-10	2370-40088	PU:VG(M)	N/A	3Y	M	4	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	11	RS
	Overton WMA	21-May-09	2430-61085	BV(M):XX	N/A	4Y	M	11	RS
	Overton WMA	11-Jul-11	2590-53105	XX:KGK(M)	N/A	SY	F	18	N
	Overton WMA	31-Jul-09	2540-58154	DO(M):TQ[11]	N/A	3Y	M	18	R 11 Jul; breeding 2–17 Aug at 91 in MOME Virgin River #1 South
	Overton WMA	22-Jun-10	2370-40091	PU:DRD(M)	N/A	SY	F	101	R 18 Jul
	Overton WMA	18-Jul-11	2370-39968	VG(M):PU	N/A	SY	M	101	N
	Overton WMA	20-Jul-11	2590-53147	YKY(M):XX	N/A	L	U	101	N; died before fledging
	Overton WMA	20-Jul-11	2540-58279	TQ:WW(M)	N/A	L	U	101	N; died before fledging
	Overton WMA	20-Jul-11	2540-58278	RR(M):TQ	N/A	L	U	101	N; died before fledging
	Overton WMA	8-Jun-10	2430-61088	XX:BKB(M)	N/A	A3Y	M	T10	RS; detected 14 May–13 Jul
	Overton WMA	19-Jun-09	2370-39930	PU:GO(M)	N/A	3Y	M	T22	R 25 Jun; detected 17 May–17 Jul, detected 21–23 Jul at 32 in MESQ Hafen Lane
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	T42	RS; detected 19 May–29 Jun
	Overton WMA	25-Jun-10	2370-40000	PU:WW(M)	N/A	3Y	M	F5	RS; detected 2–3 Aug
	Overton WMA	INA	INA	undetermined	N/A	AHY	U	F9	Detected 6 Jul
	Overton Pond	N/A	N/A	UB:UB	N/A	AHY	M	F111	RS; detected 2–5 Jul

AR064173

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pipes #3	INA	INA	undetermined	N/A	AHY	F	8	
	Pipes #3	27-Jun-11	2590-53162	XX:GD(M)	N/A	SY	M	8	N
	800M	12-Jun-08	2430-61072	XX:RK(M)	N/A	5Y	M	T1, F9	R 8 May; detected 7 May–28 Jun, detected 6–8 Jul at F9 in Pipes #3
	Platform	20-Jun-10	2540-58228	TQ:KO(M)	N/A	3Y	M	T3, T18, F72	RS; detected 16 May–10 June, detected 9–15 June at F72 north of Platform; detected 25 Jun–9 Jul at T18 in The Wallows
	Pipes #1	INA	INA	banded	N/A	AHY	M	T7	RS; detected 23 Jun–1 Jul
	800M	INA	INA	undetermined	N/A	AHY	U	F2	Detected 5–7 Jun
	In Between	INA	INA	undetermined	N/A	AHY	U	F4	Detected 21 May
	800M	N/A	N/A	UB:UB	N/A	AHY	U	F5	Detected 18 Jun
	PC6-1	N/A	N/A	UB:UB	N/A	AHY	U	F6	RS: detected 1 Jun
	Lost Lake	N/A	N/A	UB:UB	N/A	AHY	U	F11	RS: detected 26 May
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	F22	Detected 7 Jun
	Hell Bird	16-May-11	2540-58108	TQ:GK(M)	N/A	AHY	U	F42	N; detected 16 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	M	F43	Detected 16 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F44	Detected 29 May
	Dock	INA	INA	undetermined	N/A	AHY	U	F45	Detected 28 May
	Dock	N/A	N/A	UB:UB	N/A	AHY	U	F46	RS; detected 28 May
	Dock	INA	INA	undetermined	N/A	AHY	U	F47	Detected 28 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F48	Detected 29 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F49	Detected 29 May
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	M	F50	RS; detected 29 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F51	Detected 29 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F52	Detected 29 May
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	U	F53	RS: detected 4 Jun
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F54	Detected 4 Jun

AR064174

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F55	Detected 8 Jun
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F56	Detected 8 Jun
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F57	Detected 3 Jun
	Spaghetti	INA	INA	undetermined	N/A	AHY	U	F70	Detected 30 May
	Swine Paradise	N/A	N/A	UB:UB	N/A	AHY	M	F71	RS; detected 9 Jun
	Spaghetti	INA	INA	undetermined	N/A	AHY	U	F73	Detected 30 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F100	Detected 24 May
	The Wallows	N/A	N/A	UB:UB	N/A	AHY	U	F101	RS; detected 1–5 Jun
	The Wallows	N/A	N/A	UB:UB	N/A	AHY	M	F102	RS; detected 9–13 Jun
BIWI	Site #3	6-Jun-08	2430-61137	XX:BR(M)	N/A	5Y	F	2	RS
	Site #3	6-Jun-08	2430-61136	XX:BG(M)	N/A	5Y	M	2	RS
	Site #3	14-Jul-11	2590-53164	RV(M):XX	N/A	L	U	2	N
	Cougar Point	14-Jul-11	2540-58120	TQ:YKY(M)	N/A	AHY	F	33	N
	Cougar Point	INA	INA	undetermined	N/A	AHY	M	33	Detected by an unrelated field crew; not detected during nest monitoring
	Planet Ranch Road	10-Jul-10	2540-58230	YD(M):TQ	N/A	3Y	F	41	RS
	Planet Ranch Road	12-Jun-10	2540-58220	TQ:DY(M)	N/A	A3Y	M	41, 103	RS
	Planet Ranch Road	2-Jul-11	2590-53163	XX:KVK(M)	N/A	SY	F	103	N
	Planet Ranch Road	17-Jul-11	2590-53182	XX:RBR(M)	N/A	L	U	103	N
	Planet Ranch Road	17-Jul-11	2430-61237	XX:VRV(M)	N/A	L	U	103	N
	Planet Ranch Road	17-Jul-11	2540-58115	TQ:WKW(M)	N/A	L	U	103	N
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	T17	RS; detected 20 Jun–5 Jul
	Planet Ranch Road	INA	INA	undetermined	N/A	AHY	U	F12	Detected 1 Jun
	Planet Ranch Road	N/A	N/A	UB:UB	N/A	AHY	U	F13	RS; detected 1–6 Jun
	Site #4	INA	INA	undetermined	N/A	AHY	U	F15	Detected 16 Jun
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	F16	RS; detected 20–26 Jun
	Site #5	INA	INA	undetermined	N/A	AHY	U	F21	Detected 21 May

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
BIWI	Site #5	INA	INA	undetermined	N/A	AHY	U	F22	Detected 29 May
	Wispy Willow	INA	INA	undetermined	N/A	AHY	U	F31	Detected 27 May
	Burn Edge	INA	INA	undetermined	N/A	AHY	M	F32	Detected 30 Jun
	Site #3	INA	INA	undetermined	N/A	AHY	U	F44	Detected 27 May

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2011.

[5] **Age in 2011**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Original federal band number 2390-92434.

[10] Original federal band number 2430-61167. Individual resighted at the beginning of the season with XX:KW(M) with an injured left leg but subsequently lost the left foot and federal band.

[11] Further review of data suggests this individual likely present at MUDD 9 Jul–3 Aug 2010 and erroneously reported (McLeod and Pellegrini 2011) as DR(M):TQ.

AR064176

NDOW Study Areas

Color-Banding and Resighting – Field personnel color-banded 13 new adult flycatchers and recaptured 3 individuals previously captured as adults. An additional 25 adults were identified to individual via resighting, while 2 individuals were resighted but did not have color combinations confirmed. We recaptured one individual identified as a returning nestling by the presence of a single federal band from 2007. Three additional adults were captured with full color combinations and identified as returning nestlings from 2009 or 2010 (Table 3.8). Five adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for one adult. Overall, 89% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.3). We banded 34 nestlings from 13 nests. Of the 34 nestlings banded, 3 were suspected to have died before fledging. For details on all banded flycatchers detected at the study areas from 2003 to 2011, see Appendix E.

Site-by-Site Color-Banding and Resighting

Key Pittman Wildlife Management Area – We detected 34 resident willow flycatchers from 19 territories at Key Pittman Wildlife Management Area. In addition to resident adults, we detected eight individuals for which residency and/or breeding status could not be determined (Table 3.4). Of the 19 territories at Key Pittman, 18 consisted of breeding individuals and 1 consisted of an unpaired male. Three males were each polygynous with two females.

Field personnel captured and color-banded 11 new adults and recaptured five flycatchers previously seen as adults (Table 3.4). We resighted and identified 20 additional adults; 5 of these individuals were detected for the first time since they were banded as nestlings in 2010 (see Table 3.8). We captured two returning nestlings originally banded as juveniles in 2007 and 2009. Two adults remained unbanded, and color combinations could not be confirmed for two adults. We banded 31 nestlings from 12 nests; we suspect three of these nestlings from two nests died before fledging. We resighted four unbanded fledglings from three additional nests.

River Ranch – We detected seven resident willow flycatchers from four territories at River Ranch. In addition to resident adults, we detected two individuals for whom residency and/or breeding status could not be determined (Table 3.4). Of the four territories at River Ranch, two consisted of breeding individuals, one consisted of a pair with no documented breeding activity, and one consisted of an unpaired male.

Field personnel captured and color-banded two new adult flycatchers. We resighted and identified six additional adults, five of which were banded as nestlings in 2010 (Table 3.8). One adult remained unbanded.

Warm Springs Natural Area – We detected two resident willow flycatchers from one territory at Warm Springs Natural Area. In addition to resident adults, we detected three individuals for whom residency and/or breeding status could not be determined (Table 3.4). The single territory at Warm Springs consisted of breeding individuals.

Field personnel did not capture or recapture any adult flycatchers. We resighted and identified two adults. Two adults remained unbanded, and the presence of bands could not be confirmed for one adult. We banded three nestlings from one nest.

Table 3.3. Willow Flycatchers Detected at NDOW Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Detected in Previous Year(s) as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Key Pittman WMA	Patch 0	2	0	0	0	2[1]	0	0	0	0	1(1)[2]	0	100
	Patch 1	2	1	0	0	1	0	0	0	0	3(1)	0	100
	Patch 2	2	0	0	0	2	0	0	0	0	2(1)	0	100
	Patch 3	2	0	0	0	1[3]	0	0	0	1	0	0	100
	Patch 4	5	1	1[3]	2[4,5]	0	0	1	0	0	2(1)	0	67
	Patch 5	2	0	1	0	0	0	1	0	0	0	0	50
	Patch 6	6	2	0	0	4[6]	0	0	0	0	5(2)[8]	0	100
	Patch 7	2	1	0	1	0	0	0	0	0	4(1)	0	100
	Patch 8	2	0	0	0	2	0	0	0	0	0	0	100
	Patch 9	4	1	0	0	3	0	0	0	0	4(1)	0	100
	Patch 10	3	1	1	0	1	0	0	0	0	5(2)	0	100
	Patch 10.5	2	0	0	1[7]	1[5]	0	0	0	0	0	0	100
	Patch 11	5	1	0	0	4[6]	0	0	0	0	3(1)	0	100
	Patch 12	6	3	0	1[7]	1	0	0	0	1	2(1)	0	100
	Fence[9]	1	0	0	0	1	0	0	0	0	0	0	100
	Study Area Total	**42**	**11**	**3**	**4**	**20**	**0**	**2**	**0**	**2**	**31(12)**	**0**	**95**
River Ranch	East Side	2	0	0	0	2[4]	0	0	0	0	0	0	100
	West Side	5	0	0	0	4[1,5]	0	1	0	0	0	0	80
	Smalls	2	2	0	0	0	0	0	0	0	0	0	100
	Study Area Total	**9**	**2**	**0**	**0**	**6**	**0**	**1**	**0**	**0**	**0**	**0**	**89**
Warm Springs Natural Area	Muddy Mac	5	0	0	0	2	0	2	1	0	3(1)	0	40
	Study Area Total	**5**	**0**	**0**	**0**	**2**	**0**	**2**	**1**	**0**	**3(1)**	**0**	**40**
Total		**53**	**13**	**3**	**4**	**25**	**0**	**5**	**1**	**2**	**34(13)**	**0**	**89**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.4.

[1] One individual moved from River Ranch West Side to Key Pittman WMA Patch 0 and is tallied only once in the total.

[2] Nestling suspected to have died in nest.

[3] One individual resighted in Key Pittman Patch 3 was recaptured in Patch 4, and is tallied only once in the total.

[4] One individual moved from River Ranch East Side to Key Pittman WMA Patch 4 and is only tallied once in the total.

[5] One individual moved from River Ranch West Side to Key Pittman WMA Patch 10.5 and is only tallied once in the total. This individual was resighted in Patch 10.5 and later recaptured in Patch 4, and is tallied only once in the total.

[6] One individual was detected in Patch 11 and Patch 6 and is tallied only once in the total.

[7] One individual recaptured in Patch 10.5 and Patch 12 and is tallied only once in the total.

[8] Two nestlings suspected to have died before fledging in one nest.

[9] Not a formal survey area. Individual detected in passing between Patches 5 and 6 on fence-line that runs along highway.

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 10	6-Jul-11	2540-58177	TQ:KRK(M)	N/A	AHY	F	15	N
	Patch 10	16-Jul-09	2430-61158	RB(M):XX	N/A	A4Y	M	15,93	R 28 Jun and 6 Jul
	Patch 10	16-Jul-11	2370-40078	YV(M):PU	N/A	L	U	15	N
	Patch 10	16-Jul-11	2590-53144	XX:GDG(M)	N/A	L	U	15	N
	Patch 7	21-Jul-11	2590-53110	OW(M):XX	N/A	AHY	F	16	N
	Patch 7	14-Jul-07	2370-40190	RY(M):PU	UB:PU	5Y	M	16	R 21 Jul
	Patch 7	21-Jul-11	2590-53111	VD(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53112	BKB(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53113	BYB(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53114	KOK(M):XX	N/A	L	U	16	N
	Patch 6	25-Jul-10	2540-58241	TQ:BY(M)	N/A	A3Y	F	17	RS
	Patch 6	18-Jun-11	2430-61214	DV(M):XX	N/A	SY	M	17	N
	Patch 12	28-Jun-11	2540-58175	TQ:WO(M)	N/A	AHY	F	44	N
	Patch 12	27-Jul-11	2540-58387	GWG(M):TQ	N/A	AHY	M	44,107	N
	Patch 12	N/A	N/A	UB:UB	N/A	HY	U	44	RS
	Patch 11	27-Jul-11	2540-58386	OGO(M):TQ	N/A	AHY	F	45	N
	Patch 11	3-Aug-08	2370-40097	PU:GY(M)	N/A	4Y	M	45	RS
	Patch 11	28-Jul-11	2590-53118	RDR(M):XX	N/A	L	U	45	N
	Patch 11	28-Jul-11	2590-53149	YRY(M):XX	N/A	L	U	45	N
	Patch 11	28-Jul-11	2540-58280	OD(M):TQ	N/A	L	U	45	N
	Patch 8	28-Jul-10	2540-58165	DB(M):TQ	N/A	SY	F	46	RS
	Patch 8	1-Jul-08	2430-61118	XX:KK(M)	N/A	4Y	M	46	RS
	Patch 5	N/A	N/A	UB:UB	N/A	AHY	F	47	RS
	Patch 5	16-Jul-09	2370-40031	OGO(M):PU	N/A	3Y	M	47	R 28 Jun
	Patch 5	N/A	N/A	UB:UB	N/A	HY	U	47	RS
	Patch 5	N/A	N/A	UB:UB	N/A	HY	U	47	RS
	Patch 1	14-Jul-11	2590-53173	YBY(M):XX	N/A	SY	F	49	N

AR064179

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 1	29-Jul-09	2370-40140	PU:YK(M)	N/A	4Y	M	49	RS
	Patch 1	17-Jul-11	2540-58211	TQ:OW(M)	N/A	L	U	49	N
	Patch 1	17-Jul-11	2540-58212	YWY(M):TQ	N/A	L	U	49	N
	Patch 1	17-Jul-11	2590-53125	VBV(M):XX	N/A	L	U	49	N
	Patch 0	30-Jun-10	2540-58238	TQ:GOG(M)	N/A	SY	F	57	RS; breeding 23–27 Jun at RIRA West Side then moved to KEPI
	Patch 0	8-Jul-10	2540-58158	RB(M):TQ	N/A	SY	M	57	RS
	Patch 0	2-Aug-11	2540-58298	TQ:RO(M)	N/A	L	U	57	N; suspected to have died in nest
	Patch 2	8-Jul-10	2540-58159	KB(M):TQ	N/A	SY	F	61	RS
	Patch 2	2-Jul-09	2370-40024	PU:BV(M)	N/A	3Y	M	61	RS
	Patch 2	1-Aug-11	2540-58214	TQ:YRY(M)	N/A	L	U	61	N
	Patch 2	1-Aug-11	2590-53127	WGW(M):XX	N/A	L	U	61	N
	Patch 9	8-Jul-10	2540-58156	BG(M):TQ	N/A	A3Y	F	62	RS
	Patch 9	1-Jul-08	2430-61114	WR(M):XX	N/A	4Y	M	62	RS
	Patch 9	7-Jul-11	2540-58182	GR(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58183	KK(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58282	KV(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58283	KW(M):TQ	N/A	L	U	62	N
	Patch 10	21-Jul-10	2430-61100	XX:YKY(M)	N/A	3Y	F	93	RS
	Patch 10	16-Jul-11	2370-40079	PU:KRK(M)	N/A	L	U	93	N
	Patch 10	16-Jul-11	2540-58276	VW(M):TQ	N/A	L	U	93	N
	Patch 10	16-Jul-11	2540-58277	TQ:YY(M)	N/A	L	U	93	N
	Patch 4	27-Jul-11	2540-58297	RYR(M):TQ	N/A	AHY	F	100	N
	Patch 4	N/A	N/A	UB:UB	N/A	AHY	M	100	RS
	Patch 4	10-Jul-11	2540-58247	OKO(M):TQ	N/A	L	U	100	N
	Patch 4	10-Jul-11	2590-53172	XX:VYV(M)	N/A	L	U	100	N; R 27 Jul
	Patch 11	28-Jul-10	2540-58203	TQ:WD(M)	N/A	3Y	F	106	RS

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 11	10-Jul-10	2540-58223	YV(M):TQ	N/A	3Y	M	106	RS
	Patch 11	N/A	N/A	UB:UB	N/A	HY	U	106	RS
	Patch 12	10-Jul-10	2540-58224	TQ:RD(M)	N/A	SY	F	107	RS
	Patch 12	8-Aug-11	2540-58378	WD(M):TQ	N/A	L	U	107	N
	Patch 12	8-Aug-11	2540-58299	TQ:YO(M)	N/A	L	U	107	N
	Patch 6	14-Jul-09	2430-61279	XX:DW(M)	N/A	3Y	F	121	RS
	Patch 6	17-Jul-11	2590-53124	XX:VGV(M)	N/A	AHY	M	121,122	N
	Patch 6	16-Jul-11	2590-53122	XX:KWK(M)	N/A	L	U	121	N; suspected to have died in nest
	Patch 6	16-Jul-11	2590-53123	BRB(M):XX	N/A	L	U	121	N; suspected to have died in nest
	Patch 6	20-Jul-09	2540-58187	TQ:RB(M)	N/A	A4Y	F	122	RS[9]
	Patch 6	7-Jul-11	2540-58180	TQ:WY(M)	N/A	L	U	122	N
	Patch 6	7-Jul-11	2540-58178	BD(M):TQ	N/A	L	U	122	N
	Patch 6	7-Jul-11	2540-58179	GK(M):TQ	N/A	L	U	122	N
	Patch 9	5-Jul-11	2590-53121	XX:WRW(M)	N/A	AHY	F	123	N
	Patch 9	26-Jun-08	2430-61180	RD(M):XX	N/A	5Y	M	123	RS
	Patch 3	3-Jul-08	2430-61197	XX:VY(M)	N/A	4Y	M	T14	RS; detected 16 May–27 Jul; R 27 Jul in Patch 4
	Patch 4	13-Jul-10	2430-61099	XX:WOW(M)	N/A	SY	U	F18	R 27 Jul; not detected post capture; breeding 15 Jun–25 Jul at RIRA East Side
	Fence	6-Jul-09	2370-40027	YY(M):PU	N/A	3Y	U	F19	RS; detected 29 May on fence between Patches 5 and 6
	Patch 11	29-Jun-10	2370-40010	KRK(M):PU	N/A	AHY	U	F20	RS; detected 30 Jun, detected 12 Jul in Patch 6
	Patch 3	INA	INA	banded	N/A	AHY	U	F21	RS; detected 31 Jul
	Patch 12	27-Jul-11	2590-53148	RYR(M):TQ	N/A	AHY	U	F22	N; detected 27 Jul
	Patch 12	INA	INA	banded	N/A	AHY	U	F23	RS; detected 30 Jun
	Patch 10.5	23-Jun-09	2430-61159	OK(M):XX	N/A	3Y	M	F75	R 26 Jun, also 27 Jul in Patch 12; otherwise not detected
	Patch 10.5	12-Jul-09	2430-61098	XX:WDW(M)	N/A	SY	M	F112	RS; detected 24 Jul; R 27 Jul in Patch 4; breeding 23 Jun–1 Jul at RIRA West Side

AR064181

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
RIRA	West Side	30-Jun-10	2540-58238	TQ:GOG(M)	N/A	SY	F	95	RS; detected 23–27 Jun; moved to KEPI Patch 0
	West Side	12-Jul-10	2430-61098	XX:WDW(M)	N/A	SY	M	95	RS; detected 24–27 July at KEPI
	Smalls	27-Jun-11	2590-53171	XX:ORO(M)	N/A	SY	F	108	N; detected 27–29 Jun
	Smalls	27-Jun-11	2540-58246	BR(M):TQ	N/A	SY	M	108	N; detected 15 Jun–16 Jul
	East Side	30-Jun-10	2540-58240	KYK(M):TQ	N/A	SY	F	110	RS
	East Side	13-Jul-10	2430-61099	XX:WOW(M)	N/A	SY	U	110	RS; detected 15 Jun–25 Jul; detected 27 Jul at KEPI Patch 4
	West Side	17-Jun-11	2540-58109	WK(M):TQ	N/A	SY	M	T109	RS; detected 23 Jun–13 Jul; detected 17–19 Jun at PAHR North
	West Side	8-Jul-10	2540-58157	OY(M):TQ	N/A	SY	U	F111	RS; detected 23–27 Jul
	West Side	N/A	N/A	UB:UB	N/A	AHY	M	F112	RS; detected 19 Jun
WMSP	Muddy Mac	8-Jun-10	2540-58193	TQ:DB(M)	N/A	A3Y	F	71	RS
	Muddy Mac	20-May-08	2540-58234[10]	KD(M):TQ	N/A	A5Y	M	71	RS
	Muddy Mac	13-Jul-11	2590-53143	XX:RV(M)	N/A	L	U	71	N
	Muddy Mac	13-Jul-11	2540-58275	TQ:YD(M)	N/A	L	U	71	N
	Muddy Mac	13-Jul-11	2540-58274	VG(M):TQ	N/A	L	U	71	N
	Muddy Mac	INA	INA	undetermined	N/A	AHY	M	F54	Detected 26 May
	Muddy Mac	N/A	N/A	UB:UB	N/A	AHY	M	F55	RS; detected 26 May
	Muddy Mac	N/A	N/A	UB:UB	N/A	AHY	U	F56	RS; detected 26 May

[1] KEPI = Key Pittman WMA; RIRA = River Ranch; WMSP = Warm Springs Natural Area.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2011.

[5] **Age in 2011**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Further review of data suggests this individual likely present at KEPI during the 2010 breeding season, but this cannot be confirmed.

[10] Original federal band number 2430-61134.

AR064182

Non-Monitoring Sites

This study area was monitored by another agency, and here we report only banded flycatchers that were captured or resighted. Unbanded individuals or those with unknown band status are not included.

St. George – Field personnel captured and color-banded two new adults and recaptured one individual previously captured as an adult (Table 3.5). We banded one nestling. Personnel from Utah Division of Wildlife Resources resighted and identified an additional four adult flycatchers. Two more banded adults were resighted, but their identities could not be confirmed.

Table 3.5. Banded Willow Flycatchers, Non-Monitoring Sites, 2011

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Age[3]	Sex[4]	Observation Status[5]
STGE	Snipe Pond	28-Jun-09	2430-61154	RO(M):XX	3Y	F	R 20 Jul
	Snipe Pond	20-Jul-11	2590-53145	XX:RWR(M)	AHY	M	N
	Snipe Pond	20-Jul-11	2540-58385	TQ:KGK(M)	L	U	N
	Snipe Pond	20-Jul-11	2590-53287	OO(M):TQ	AHY	M	N
	Riverside East	27-Jul-08	2370-40148	PU:KR(M)	4Y	F	RS
	Riverside East	22-Jun-09	2540-58132	TQ:OD(M)	A4Y	M	RS
	Riverside Marsh	9-Jul-10	2430-61230	XX:GWG(M)	A3Y	F	RS
	Riverside Marsh	29-Jun-10	2430-61093	XX:VBV(M)	A3Y	M	RS
	Riverside Marsh	INA	INA	banded	AHY	F	RS
	Riverside Marsh	INA	INA	banded	AHY	M	RS

[1] STGE = St. George.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, TQ = turquoise federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2011:** L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[4] **Sex codes**: M = male, F = female, U = unknown.

[5] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

Adult Between-Year Return and Dispersal

In 2010 we individually identified 96 adult, resident willow flycatchers at all monitored study areas, of which 55 (57%) were detected in 2011 (Table 3.6). Of the returning resident adults, five (9%) were detected at a different study area than where they were last detected in 2010 (Table 3.7). One adult flycatcher that was detected in 2010 at a site monitored by NDOW was detected at a different study area in 2011. Two additional flycatchers that were last detected in 2008 or 2009 exhibited between-year movement in 2011. The median dispersal distance for all returning adult flycatchers exhibiting between-year movements in 2011 was 86.8 km (min = 11.9 km, max = 203.1 km).

Table 3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011

Study Area	# Identified in 2010	# of 2010 Birds Detected in 2011	% Return	% Return to Same Study Area
Key Pittman	21	13	62	100
Pahranagat	19	12	63	100
Littlefield	2	0	0	--

Table 3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011 (Continued)

Study Area	# Identified in 2010	# of 2010 Birds Detected in 2011	% Return	% Return to Same Study Area
Mesquite	11	6	55	83
Mormon Mesa	19	12	63	92
Muddy River	6	3	50	100
Warm Springs	3	2	67	50
Topock	8	3	38	33
Bill Williams	7	4	57	100
Total	**96**	**55**	**57**	**91**

Table 3.7. Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2011

Study Area/Site/Year Detected[1]	Study Area/Site Detected 2011[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
GRCA/Iceberg Canyon/2008	TOPO/800M	153.6	2430-61072	XX:RK(M)	M
PAHR/North/2009	KEPI/Patch 6	30.1	2540-58187	TQ:RB(M)[4]	F
MOME/Virgin River #1 South/2010	KEPI/Patch 8	132.7	2430-61118	XX:KK(M)	M
RIRA/West Side/2010	KEPI/Patch 5	11.9	2370-40027	YY(M):PU	F
TOPO/Glory Hole/2010	MOME/Virgin River #1 South	203.1	2540-58231	TQ:GR(M)	F
MESQ/West/2010	MUDD/Overton WMA	40.9	2370-39930	PU:GO(M)	M
WMSP/Muddy Mac/2010	MUDD/Overton WMA	35.4	2430-61088	XX:BKB(M)	M
TOPO/800M/2010	MUDD/Overton WMA	189.3	2540-58154	DO(M):TQ[5]	M

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, WMSP = Warm Springs Natural Area, MUDD = Muddy River, TOPO = Topock Marsh.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male.

[4] Further review of data suggests this individual likely present at KEPI during the 2010 breeding season, but this cannot be confirmed.

[5] Further review of data suggests this individual moved from TOPO to MUDD during the 2010 breeding season but this cannot be confirmed.

Juvenile Between-Year Return and Dispersal

In 2010, we banded 52 nestlings at the Reclamation study areas. One of these nestlings was known to have died before fledging. Of the remaining 51 juveniles, 2 (4%) were identified in 2011. Two individuals originally banded as nestlings in 2007 and two individuals originally banded as nestlings in 2009 were identified for the first time in 2011 (Table 3.8). In 2010, we banded an additional 41 nestlings at the NDOW study areas. Five of these nestlings were known to have died before fledging. Of the remaining 36 juveniles, 9 (25%) were identified in 2011 (Table 3.8). No additional nestlings banded in prior years at NDOW sites were identified. Of the 16 returning nestlings identified in 2010, 12 (75%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2011 was 12.8 km (min = 0.03 km, max = 138.0 km).

One additional returning nestling from 2003–2007 was resighted in 2011 at Mormon Mesa, but the identity of this individual was undetermined because we were unable to recapture it.

Table 3.8. Juvenile Flycatchers Banded as Hatch Year Birds in 2007, 2009, or 2010 and Identified for the First Time in 2011

Study Area/ Site Banded[1]	Year Hatched	Study Area/Site Detected 2011[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/North	2007	KEPI/Patch 7	30.1	2370-40190	RY(M):PU	M
MESQ/West	2007	MOME/Virgin River #1 South	27.4	2360-59777	EE:YKY(M)	F
MOME/Virgin River #1 South	2009	KEPI/Patch 10.5	132.8	2430-61159	OK(M):XX	M
MOME/Virgin River #1 South	2009	MUDD/Overton WMA	13.6	2370-40029	KOK(M):PU	M
KEPI/Patch 10.5	2010	PAHR/North	30.1	2540-58201	TQ:BO(M)	U
KEPI/Patch 9	2010	KEPI/Patch 12	0.3	2540-58224	TQ:RD(M)	F
KEPI/Patch 9	2010	RIRA/East Side	12.0	2430-61099	XX:WOW(M)	U
KEPI/Patch 8	2010	KEPI/Patch 8	0.03	2540-58165	DB(M):TQ	F
KEPI/Patch 7	2010	RIRA/West Side	11.9	2540-58238	TQ:GOG(M)	F
KEPI/Patch 7	2010	RIRA/East Side	11.9	2540-58240	KYK(M):TQ	F
KEPI/Patch 6	2010	KEPI/Patch 2	0.6	2540-58159	KB(M):TQ	F
KEPI/Patch 6	2010	KEPI/Patch 0	0.7	2540-58158	RB(M):TQ	M
KEPI/Patch 6	2010	RIRA/West Side	11.9	2540-58157	OY(M):TQ	U
PAHR/North	2010	RIRA/West Side	18.2	2430-61098	XX:WDW(M)	M
MOME/Virgin River #1 South	2010	MUDD/Overton WMA	13.6	2370-40091	PU:DRD(M)	F
MUDD/Overton WMA	2010	KEPI/Patch 6	138.0	2370-40010	KRK(M):PU	U

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, G = green, B = light blue, D = dark blue, W = white, Y = yellow, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

Within-Year, Between-Study Area Movements

We detected seven within-year, between-study area movements in 2011 (Table 3.9). Three individuals moved from River Ranch to Key Pittman WMA. One male held a territory in River Ranch West Side (23 June – 1 July), was detected on 24 July at Key Pittman Patch 10.5, and recaptured passively on 27 July in Patch 4. The female from the same territory in River Ranch West Side moved after a failed nesting attempt (23 – 27 June) to Key Pittman Patch 0 where she had another nesting attempt of unknown fate (8 July – 4 August). Another individual, likely a male, was present in River Ranch East Side (15 June – 25 July) and was recaptured passively at Key Pittman Patch 4 on 27 July. A male at Pahranagat North was detected 17 – 19 June and moved to River Ranch West Side where he held a territory from 23 June to 13 July. One male held a territory at Mesquite West (17 May – 19 July) and was recaptured passively on 24 July in Mormon Mesa Virgin River #1 South. Two males moved from Muddy River Overton WMA after holding territories. One male held his territory from 17 May to 17 July and was then detected at Mesquite Hafen Lane from 21 to 23 July. The other male held his territory from 17 June to 17 July and then moved to Mormon Mesa Virgin River #1 South where he was detected from 2 to 17 August.

Table 3.9. Adult Willow Flycatcher Within-Year Movements for All Individuals Identified at Two Different Study Areas in 2011

Start Study Area/Site[1]	End Study Area/Site[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
RIRA/West Side	KEPI/Patch 4	11.4	2430-61098	XX:WDW(M)	M
RIRA/East Side	KEPI/Patch 4	11.4	2430-61099	XX:WOW(M)	U
RIRA/West Side	KEPI/Patch 0	11.2	2540-58238	TQ:GOG(M)	F
PAHR/North	RIRA/West Side	18.2	2540-58109	WK(M):TQ	M
MESQ/West	MOME/Virgin River #1 South	27.2	2540-58192	TQ:BG(M)	M
MUDD/Overton WMA	MESQ/Hafen Lane	43.9	2370-39930	PU:GO(M)	M
MUDD/Overton WMA	MOME/Virgin River #1 South	13.5	2540-58154	DO(M):TQ	M

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

DISCUSSION

Color-Banding Effort

Overall, 52% of the adult flycatchers detected at the monitoring sites during 2011 were banded by the end of the breeding season. This compares to 55, 57, 75, 70, 73, 69, 67 and 66% in 2003–2010, respectively. Unbanded willow flycatchers with an undetermined residency status are included in calculating these percentages; therefore, in most cases, these numbers under-represent the actual proportion of resident banded flycatchers at a given site. Differences between study areas in the percentage of banded individuals are related to vegetation density and overall structure, which affect our ability to erect mist-nets in the habitat, and the percentage of adults that are residents. Topock Marsh typically has the lowest percentage of color-banded flycatchers because dense vegetation limits the number and size of possible net locations and because, particularly in recent years, the number of resident adults is low in comparison to the total number of flycatchers detected.

Prior to 2008, we banded all nestlings with a single anodized federal band, identifying the bird as a returning nestling in the event it was sighted in a subsequent year. The individual would then have to be recaptured to determine its individual identity and to apply a unique color combination so the bird could be individually identified via resighting. The rationale for banding nestlings with a single anodized band was that the majority of nestlings do not return in subsequent years, resulting in the loss of a large number of unique color combinations. To eliminate the need to recapture returning nestlings, in 2008–2011 we applied unique color combinations to all nestlings. The use of full color combinations on nestlings in 2008–2010 has greatly reduced the number of adults with single federal bands, with only three detected across all study areas in 2011. Banding nestlings with full color combinations also allows us to record juvenile dispersal movements that might otherwise go undetected.

Adult and Juvenile Between-Year Dispersal

Resident adults detected at Topock have historically shown very high site fidelity. Until 2010, when we documented between-year movement of an adult male from Topock to Warm Springs, no between-year movements of resident Topock adults to another study area had been detected. In 2011, two additional between-year movements of resident Topock adults to other study areas were documented. One was a

breeding female identified in Mormon Mesa who had last been identified in 2010 as a breeding female in Topock. The other was a breeding male from Muddy River who was last documented in 2010 as a resident, unpaired male in Topock. These two movements provide further evidence that individuals who do not return to Topock after being documented in a given year may be moving to other locations. When an individual is not identified in a given year, there is no way to distinguish between going undetected, mortality, or emigration from the study area. Documenting emigration allows for an estimation of emigration rates, thereby improving the accuracy of survival estimates. It is possible that there have been movements of resident, unbanded Topock adults to other monitored study areas, but there would be no way to detect these movements. Furthermore, the movement of the female to Mormon Mesa may also be indicative of the poor habitat conditions present in Topock in 2011. Females who breed successfully in a given year typically demonstrate high site fidelity the following year. This female successfully fledged two nestlings in 2010 and was not detected in Topock in 2011.

Adult and juvenile dispersal data for the 2011 field season show overall high site fidelity exhibited by adult flycatchers and lower natal site fidelity exhibited by juveniles, with juveniles dispersing among study areas. These dispersal data are consistent with the patterns observed in the LCR region from 1998 to 2011, over which period 90% of adult returns were to the same study area, while only 48% of all juvenile returns were to the natal study area (McKernan and Braden unpubl. data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). These dispersal data are also consistent with range-wide data (Paxton et al. 2007), with adult flycatchers exhibiting high site fidelity to breeding areas. Juvenile dispersal within the Virgin/lower Colorado River population(s) is largely limited to this region, and while reciprocal juvenile movements among geographically isolated flycatcher populations of the greater Southwest do occur, they are rare. Only three instances of willow flycatcher immigration from sites outside the Virgin/lower Colorado River region have been recorded since 1997 (McKernan and Braden unpubl. data, McLeod et al. 2008a), with two males originally banded as nestlings in 2003 at Roosevelt Lake recaptured in 2005 at Muddy River and Topock, and one male banded as a nestling in 1999 at Roosevelt Lake recaptured in 2002 in Grand Canyon. Although movements of this magnitude are infrequent, other instances of dispersal distances greater than 140 km have been reported for the Southwestern Willow Flycatcher (Paxton et al. 2007) and have been noted within the Virgin/lower Colorado River population (McLeod et al. 2008a, McLeod and Koronkiewicz 2010, McLeod and Pellegrini 2011). Banding studies at Roosevelt Lake and along the San Pedro River were discontinued after 2005, so immigration of juveniles produced in those areas after 2005 would have gone undetected.

The observed dispersal patterns fit well with the tenets of contemporary metapopulation theory (Hanski and Simberloff 1997), suggesting the Virgin/lower Colorado River population may be a panmictic sub-population of a greater metapopulation. Occasional juvenile dispersal between sub-populations is likely an important population variable in terms of gene flow, with movements contributing to an understanding of the observed patterns of high genetic diversity within and low genetic isolation among Southwestern Willow Flycatcher populations (Busch et al. 2000). Dispersal by juveniles or adults is required for the colonization of new breeding sites, and long-distance movements will be required if newly established Reclamation habitat creation sites are to be colonized. The closest known breeding sites are at Bill Williams River NWR and Topock Marsh, approximately 75–150 km from the PVER and CVCA habitat creation sites (see Chapter 2). The habitat creation sites could also be colonized by individuals from more distant breeding areas, such as those along the Virgin River. Although such long-distance movements are relatively infrequent, two adult movements between the lower Colorado and the Virgin River were documented in 2011, and multiple instances of adult and juvenile dispersal between the Virgin River and Topock Marsh and Bill Williams River NWR have been documented in recent years (McLeod et al. 2008b; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Physical connectivity of riparian habitats within the greater landscape is crucial in enabling these long-distance movements. Without adequate stop-over habitats and foraging areas, flycatchers attempting long-distance movements are more likely to be exposed to adverse environmental conditions.

Within-year, Between Study Area Movement

Within-year, between study area movements typically occur at low rates in any given year. In 2003–2010, we detected between zero and four (median = 1.5) movements per year. In 2011, we documented the largest number of individuals (seven) moving between study areas within a given year. The increase in the number of documented movements may have been affected by the addition in 2011 of River Ranch to the monitored study areas. Movements to and from River Ranch accounted for four (57%) of the seven movements. One additional within-year movement, which would otherwise likely have gone undetected, was detected via passive netting. Thus, the detection of an unusually high number of within-year movements in 2011 is not necessarily indicative of there being more movements, but rather that we were better able to detect them.

The movement of three of the seven resident or paired adults at River Ranch to another study area is suggestive of poor habitat quality at River Ranch. In addition, eight of the nine individuals detected at River Ranch were known to be second-year individuals (age of the ninth individual was unknown). A high proportion of second-year birds could also be indicative of poor habitat quality. This pattern is seen in multiple species where the best habitat is typically occupied by older individuals, who may be more competitive or arrive sooner on the breeding grounds, leaving habitat of lesser quality for younger birds (Hill 1988, Holmes et al. 1996). Higher proportions of second-year birds also tend to be seen in young, newly developed habitat, such as that seen in the lower Grand Canyon in 2006–2008, possibly as a result of dispersal and colonization (McLeod et al. 2007, McLeod et al. 2008b, McLeod and Koronkiewicz 2009). However, the habitat at River Ranch has been established for several years (C. Tomlinson, NDOW, pers. comm.), and the high proportion of second-year birds is more likely due to habitat quality than stand age.

Adult and Juvenile Survivorship

Annual survivorship is defined as the number of individuals that survive from one year to the next, and accurate estimates depend on year-to-year detection of uniquely marked birds. Fifty-seven percent of the adult, resident willow flycatchers identified in 2010 were detected again in 2011, while of the 87 juveniles banded in 2010, only 11 (13%) were identified in 2011. Thus, minimum estimated adult and juvenile survival from 2010 to 2011 at all monitored sites was 57 and 13%, respectively. These simple annual percent survivorship calculations assume that all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. To provide more robust estimates of annual survival, demographic data acquired from 2003 to 2012 will be combined with data collected during 1997–2002. Survival and detection probabilities will be estimated using program MARK (White and Burnham 1999) and presented in a summary report in 2012.

This page intentionally left blank.

Chapter 4

NEST MONITORING

INTRODUCTION

Documentation of nest success and productivity is critical to understanding local population status and demographic patterns of the Southwestern Willow Flycatcher. In 2011, at all sites where willow flycatcher breeding activity was suspected, we conducted intensive nest searches and nest monitoring. Specific objectives of nest monitoring included identifying breeding individuals (see Chapter 3, Color-banding and Resighting), calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Nest monitoring results from 2011 were compared with those at the study areas from 1996 to 2010 (Braden and McKernan unpubl. data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Although aspects of willow flycatcher breeding ecology can vary widely across its broad geographical and elevational ranges throughout the Southwest (Whitfield et al. 2003), we compared monitoring results with range-wide data to identify specific variables that may contribute to the characterization of flycatcher breeding ecology throughout the lower Colorado and Virgin River riparian systems.

METHODS

Upon locating territorial willow flycatchers, regardless of whether a possible mate was observed, we conducted intensive nest searches following the methods of Rourke et al. (1999). Nest monitoring followed a modification of the methods described by Rourke et al. (1999) and the Breeding Biology Research and Monitoring Database (BBIRD) protocol by Martin et al. (1997).

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites. Nests were monitored every two to four days after nest building was complete and incubation was confirmed. Nests at NDOW study areas were monitored less frequently (every four days or more) because of budgetary restrictions. During incubation and after hatching, nest contents were observed directly using a telescoping mirror pole to determine nest contents and transition dates. Nest monitoring during nest building and egg laying stages was limited to reduce the chance of abandonment during these periods. To reduce the risk of depredation (Martin et al. 1997), brood parasitism by the Brown-headed Cowbird, and premature fledging of young (Rourke et al. 1999), we observed nests from a distance with binoculars once the number and age of nestlings were confirmed. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

Per instructions from Reclamation biologists, we considered a willow flycatcher nest successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted based on the number of fledglings actually observed. This method of determining success differs from that recommended by some nest monitoring protocols (e.g., Martin et al. 1997, Rourke et al. 1999), which consider a nest as successful if chicks are observed in the nest within two days of the estimated fledge date. The method we follow produces a conservative estimate of both nest success rate and number of fledges.

We considered a nest to have failed if (1) the nest was abandoned prior to egg laying (abandoned); (2) the nest was deserted with flycatcher eggs or young remaining (deserted); (3) the nest was found empty or destroyed more than two days prior to the estimated fledge date (depredated); (4) nestlings died in the nest despite being tended by the adults(nestlings died in nest); or (5) the entire clutch was incubated for an excess of 20 days (infertile/addled). For nests containing flycatcher eggs, parasitism was considered the cause of nest failure if (1) cowbird young outlived any flycatcher eggs or young, or (2) the nest was parasitized during egg laying and the disappearance of flycatcher eggs coincided with the appearance of cowbird eggs.

During each nest check, we recorded date and time of the visit, observer initials, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and number and behavior of adults and/or fledges present onto standardized data forms (Appendix A) that included the nest or territory number and UTM coordinates. We calculated flycatcher nest success using both apparent nesting success (number of successful nests/total number of nests containing at least one flycatcher egg) and the Mayfield method (Mayfield 1961, 1975), which calculates daily nest survival to account for nests that failed before they were found. We assumed one egg was laid per day, and incubation was considered to start the day the last egg was laid (per Martin et al. 1997). The nestling period was considered to start the day the first egg hatched and end the day the first nestling fledged. If exact transition dates or dates of depredation events were unknown, we estimated the transition date as halfway between observations. For nests where fate was unknown, we used the last known date of activity to determine the number of observation days. To calculate Mayfield survival probabilities (MSP), we used the average length of each nest stage (2.14, 12.85, and 13.76 days for laying, incubation, and nestling stages, respectively) as observed in this study in 2003–2011 for nests where transition dates were known. Nest productivity was calculated as the number of young fledged per nesting attempt that produced at least one flycatcher egg. Fecundity was calculated as number of young produced per female over the breeding season. Parasitism rates were calculated as the percentage of nests with known contents that included at least one flycatcher egg and one cowbird egg.

In 2011, we attempted to addle cowbird eggs in easily accessible flycatcher nests at all study areas except Pahranagat. If the nest was accessible without a ladder, the cowbird egg was addled as soon as it was discovered. If a ladder was required, the cowbird egg was addled on the next regularly scheduled nest visit. Cowbird eggs were addled only if we could obtain a direct view of the nest contents from a secure location, either on the ground on or a ladder. We carefully removed the cowbird egg from the nest and placed it in a padded film canister. We then shook the canister vigorously for about one minute, incorporating sharp, jerky movements. The egg was then returned to the nest. The cowbird egg was not permanently removed from the nest so as not to mimic a partial depredation event, which might result in nest desertion. If a nest was found with a cowbird nestling already in the nest, or if a shaken cowbird egg still hatched, we removed the cowbird nestling from the nest.

All field personnel practiced egg addling with several button quail (*Coturnix chinensis*) eggs at the start of field season to determine how vigorously they could shake an egg without breaking it. Button quail eggs are slightly larger than cowbird eggs (19 x 25 mm vs. 16 x 21 mm) but provide a reasonable and easily available substitute. Shaken eggs were carefully opened to determine whether any damage to the internal structure of the egg was apparent. Field personnel varied in their ability to shake an egg to the point of causing internal damage without breaking the shell.

RESULTS

Reclamation Study Areas

Nest Monitoring

We documented 49 willow flycatcher nesting attempts at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams; 43 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Eighteen (42%) nests were successful and fledged young, and 23 (53%) failed. The fate of two nests (5%) was unknown. Nest success ranged from 0% at Topock Marsh to 100% at Pahranagat (Table 4.1). For a comparison of apparent nest success at all monitoring sites from 1997 to 2011, see Table 4.2.

Thirty-five nesting females, of which all but three were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was documented for which no nesting attempt could be confirmed. Of the 35 nesting females, 23 had one nesting attempt, 10 had two nesting attempts, and 2 had three nesting attempts. Of the 12 females with multiple nesting attempts, 9 renested after failed nests and 3 renested after a successful nest.

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Reclamation Study Areas, 2011

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate	Parasitized Nests[4]
PAHR	North	6	7	7	7 (100)	0	0	0
	Total	*6*	*7*	*7*	*7 (100)*	*0*	*0*	*0*
MESQ	Hafen Lane	1	1	1	0	1 (100)	0	1 (100)
	West	6	8	6	2 (33)	4 (67)	0	1 (20)
	Total	*7*	*9*	*7*	*2 (29)*	*5 (71)*	*0*	*2 (33)*
MOME	Virgin River #1 North	2	1	1	0	1 (100)	0	0
	Virgin River #1 South	11	19	17	7 (41)	9 (53)	1 (6)	1 (7)
	Total	*13*	*20*	*18*	*7 (39)*	*10 (55)*	*1 (6)*	*1 (7)*
MUDD	Overton WMA	5	6	5	0	4 (80)	1 (20)	3 (60)
	Total	*5*	*6*	*5*	*0*	*4 (80)*	*1 (20)*	*3 (60)*
TOPO	Pipes #3	1	1	1	0	1	0	0
	Total	*1*	*1*	*1*	*0*	*1 (100)*	*0*	*0*
BIWI	Site #3	1	2	2	1 (50)	1 (50)	0	0
	Cougar Point	1	1	1	0	1 (100)	0	1 (100)
	Planet Ranch Rd	2	3	2	1 (50)	1 (50)	0	0
	Total	*4*	*6*	*5*	*2 (40)*	*3 (60)*	*0*	*1 (20)*
Overall Total		**36**	**49**	**43**	**18 (42)**	**23 (53)**	**2 (5)**	**7 (19)**

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Table 4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Reclamation Study Areas from 1996 to 2011*

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
1996	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nc[5]	Nc[5]	Nm[3]
1997	Nm[3]	Nd[4]	67 (3)	42 (12)	Nc[5]	Nc[5]	Nc[5]	Nd[4]
1998	47 (19)	Nd[4]	0 (7)	70 (10)	Nm[3]	Nc[5]	53 (15)	Nd[4]
1999	60 (15)	Nm[3]	Nd[4]	45 (11)	Nm[3]	Nc[5]	38 (16)	100 (1)
2000	63 (16)	Nd[4]	50 (8)	38 (13)	100 (1)	Nc[5]	36 (11)	100 (1)
2001	50 (18)	Nd[4]	53 (17)	54 (13)	Nc[5]	Nc[5]	36 (14)	50 (4)
2002	33 (12)	Nd[4]	59 (17)	0 (9)	Nd[4]	Nd[4]	50 (6)	78 (9)
2003	91 (11)	Nd[4]	44 (18)	0 (10)	Nd[4]	Nd[4]	78 (9)	100 (2)
2004	76 (17)	50 (2)	24 (17)	50 (6)	Nd[4]	Bc[6]	45 (38)	Nd[4]
2005	58 (19)	Nd[4]	42 (12)	17 (6)	38 (8)	Nd[4]	24 (34)	100 (2)
2006	60 (15)	Nd[4]	55 (20)	50 (8)	44 (9)	0 (3)	23 (17)[7]	20 (5)
2007	67 (12)	Nd[4]	57 (14)	27 (11)	0 (6)	0 (1)	75 (8)	25 (8)
2008	80 (10)	Nd[4]	82 (11)	62 (13)	25 (8)	Nd[4]	13 (8)[8]	40 (5)[8]
2009	47 (17)[8]	0 (1)	21 (14)[8]	53 (17)	0 (8)	Nm[3]	50 (2)	33 (6)
2010	59 (17)	50 (2)	31 (13)	42 (12)	100 (3)	Nm[3]	50 (2)	18 (11)
2011	100 (7)	Nd[4]	29 (7)	39 (18)[8]	0 (5)[8]	Nm[3]	0 (1)	40 (5)

* Data from 1997 to 2002 are from Braden and McKernan (unpubl. data); these numbers have been verified with the raw data and may differ from those presented in earlier annual reports. Data from 2003 to 2007 are from McLeod et al. 2008a; data from 2008 are in McLeod and Koronkiewicz 2009; data from 2009 are in McLeod and Koronkiewicz 2010; data from 2010 are in McLeod and Pellegrini 2011, and data from 2011 are in this document. Total number of nests containing at least one flycatcher egg is indicated in parentheses.

[1] Study area includes the Hafen Lane, Mesquite East, Mesquite West, and Bunker Farm sites.

[2] Study area includes the Virgin River Delta at Lake Mead.

[3] Nm = study area not monitored.

[4] Nd = study area surveyed, no breeding documented.

[5] Nc = breeding confirmed, nest success not calculated.

[6] Bc = breeding confirmed, undetermined if nestlings from a single nest fledged.

[7] An additional three nests (18%) were suspected to have fledged but fledglings were not visually confirmed.

[8] Fate of one nest was unknown.

Nest Failure

Depredation was the major cause of nest failure, accounting for 52% (15 of 29) of all failed nests (Table 4.3) and 65% (15 of 23) of nests that failed after flycatcher eggs were laid. Six nesting attempts (21% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, three nests (10%) were deserted, and three nests (10%) were incubated in excess of 20 days. Two nests (7%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism).

Brood Parasitism

Seven of 37[1] nests (19%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.4). For nests containing flycatcher eggs, parasitism caused nest failure at two nests. In one case, the parasitism event coincided with the disappearance of all flycatcher eggs; in the other, the nest contained one cowbird nestling when it was found. No parasitized nests were known to

[1] Table 4.1 shows a total of 43 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, six nests whose contents could not be determined were excluded from calculations (e.g., nests that were too high to check contents to determine presence/absence of cowbird eggs or nesting attempts that were discovered late in the nesting cycle).

fledge a flycatcher, but the fate of one nest was unknown. Of the remaining four parasitized nests that contained flycatcher eggs, two were depredated and two contained addled flycatcher eggs. Brood parasitism ranged from 0 to 60% and was highest at Muddy River (see Table 4.1). In 2011, nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized (one-sided Fisher's exact test, $P = 0.038$).

Table 4.3. Summary of Causes of Willow Flycatcher Nest Failure at Reclamation Study Areas, 2011*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled
PAHR	7	0	0	0	0	0	0
MESQ	9	7	2 (29)	0	4 (57)	0	1 (14)
MOME	20	12	2 (17)	3 (25)[2]	6 (50)	0	1 (8)
MUDD	6	5	1 (20)	0	2 (40)	1 (20)	1 (20)
TOPO	1	1	0	0	1 (100)	0	0
BIWI	6	4	1 (25)	0	2 (50)	1 (25)	0
Total	**49**	**29**	**6 (21)**	**3 (10)**	**15 (52)**	**2 (7)**	**3 (10)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] One nest deserted after partial depredation, one deserted after 18 days incubation, one deserted during incubation with one flycatcher egg.

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds, 2011*

Study Area[1]	Nest ID Code	Outcome[2]
MESQ	32A	Incubated >20 days. CE was addled and never hatched
	72B	Depredated during incubation
MOME	90A	Depredated during incubation
MUDD	3A	Fate unknown. One 14-day-old WN seen on nest rim, but fledging not confirmed. CE was addled and never hatched
	11A	3 WE disappeared and CE appeared 17 days into incubation
	18A	Incubated >20 days. CE was addled and never hatched
BIWI	33A	Nest found with one CN and no flycatcher nestlings or WE

* All nesting attempts are included.

[1] MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg, CE = cowbird egg, WN = willow flycatcher nestling, CN = cowbird nestling.

Cowbird Egg Addling

We attempted to addle cowbird eggs at three of the seven parasitized nests. Two of the remaining four nests were too high to reach; both these nests were depredated during incubation. One nest was found with a cowbird nestling and no other nest contents; the nestling was removed. At the seventh nest, the parasitism event caused nest failure. All three parasitized nests where we attempted to addle cowbird eggs were incubated long enough for any viable cowbird eggs to hatch, though none did (Table 4.5). The 2011 hatch rate of 0% is markedly lower than annual hatch rates of un-addled eggs in 2003–2009 (min = 60; max = 89; median = 75).

In 2011, only one of three parasitized nests that were incubated full-term hatched flycatcher nestlings (Table 4.6); the other two nests were incubated in excess of 20 days without any flycatcher eggs hatching. The fate of the parasitized nest that hatched a flycatcher nestling was unknown; we detected a 14-day-old flycatcher nestling on the nest rim but were unable to confirm that the nestling fledged. Success rates of parasitized nests that hatched at least one flycatcher nestling in 2003–2009 ranged from 44 to 100%. In parasitized nests that hatched flycatchers, the number of nestlings that survived to at least eight days old in 2011 (1.0/nest) was comparable to the numbers seen in 2003–2009 (min = 0.6; max = 1.5; median = 1.3).

Table 4.5. Brown-headed Cowbird Annual Hatch Rate in Willow Flycatcher Nests at Reclamation Study Areas from 2003 to 2011

Year	# Nests[1]	# CE	# CN	Hatch Rate
2003	4	4	3	75
2004	9	9	8	89
2005	9	9	7	78
2006	2	3	2	67
2007	6	8	6	75
2008	5	5	3	60
2009	8	8	5	63
2010[2]	4	4	1	25
2011[2]	3	3	0	0

[1] Total number of nests in which the cowbird egg hatched or was incubated full term (>10 days) are included.

[2] All cowbird eggs were addled at least once.

Table 4.6. Willow Flycatcher Nesting Success for Parasitized Nests at Reclamation Study Areas from 2003 to 2011

Year	# Nests[1]	# Nests with Flycatcher Nestlings[2]	# Nests with Flycatcher Fledges[3]	# Flycatcher Nestlings of Banding Age[4]	# Flycatcher Fledges[5]
2003	3	2 (67)	2 (100)	2 (1.0)	2 (1.0)
2004	10	9 (90)	4 (44)	5 (0.6)	5 (0.6)
2005	10	10 (100)	5 (50)	8 (0.8)	6 (0.6)
2006	4	4 (100)	2 (50)	6 (1.5)	3 (0.8)
2007	5	2 (40)	2 (100)	3 (1.5)	3 (1.5)
2008	5	4 (80)	3 (75)	5 (1.3)	3 (0.8)
2009	6	4 (67)	2 (50)	6 (1.5)	4 (1.0)
2010[6]	4	4 (100)	3 (75)	7 (1.8)	5 (1.3)
2011[6]	3	1 (33)[7]	--[8]	1 (1.0)	--

[1] Total number of parasitized nests in which flycatcher eggs hatched or were incubated long enough to hatch (>14 days).

[2] Total number of parasitized nests that hatched flycatcher nestlings. Percentage of total nests is indicated in parentheses.

[3] Total number of parasitized nests that produced flycatcher fledges. Percentage of nests with nestlings is indicated in parentheses.

[4] Total number of nestlings that reached at least banding age (8 days). Number of nestlings per nest with nestlings is indicated in parentheses.

[5] Total number of nestlings that fledged. Number of nestlings per parasitized nest with nestlings is indicated in parentheses.

[6] All cowbird eggs were addled in these nests.

[7] The eggs in the other two nests failed to hatch; both were incubated at least 20 days.

[8] The flycatcher nestling was last seen in the nest on day 14. It is unclear whether it successfully fledged.

Mayfield Nest Success and Nest Productivity

Mayfield survival probability (MSP) ranged from 0.198 at Mesquite to 1.000 at Pahranagat and was 0.467 for all sites combined (Table 4.7). At all sites, 40 nestlings were confirmed to have fledged from 41 nests of known outcome (mean number of fledglings/nest = 0.98, SE = 0.19). Fecundity across study areas ranged from 0.00 to 2.83 young per female and averaged 1.18 (SE = 0.25) (Table 4.8).

Table 4.7. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Reclamation Study Areas, 2011*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Pahranagat	1	0/15	1.000	1.000
	2	0/77.5	1.000	1.000
	3	0/98	1.000	1.000
	MSP all stages = 1.000			
Mesquite	1	1/10	0.900	0.798
	2	2/63.5	0.969	0.663
	3	2/29	0.931	0.374
	MSP all stages = 0.198			
Mormon Mesa	1	0/22	1.000	1.000
	2	10/154.5	0.935	0.423
	3	0/98.5	1.000	1.000
	MSP all stages = 0.423			
Muddy River	1	0/10	1.000	1.000
	2	3/70	0.957	0.570
	3	1/24.5	0.959	0.564
	MSP all stages = 0.321			
Topock	1	0/0		
	2	1/1	0.000	0.000
	3	0/0		
	MSP all stages = N/A[2]			
Bill Williams	1	0/6	1.000	1.000
	2	2/42.5	0.953	0.538
	3	0/28.5	1.000	1.000
	MSP all stages = 0.538			
Total	**1**	**1/63**	**0.984**	**0.966**
	2	**18/409**	**0.956**	**0.561**
	3	**3/278.5**	**0.989**	**0.862**
	MSP all stages = 0.467			

* Mayfield survival probability was calculated using 2.14-day egg laying, 12.85-day incubation, and 13.76-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

[2] MSP cannot be calculated for all stages because of lack of data.

Table 4.8. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Reclamation Study Areas, 2011*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Pahranagat	17	7	2.43 (0.30)	6	2.83 (0.31)
Mesquite	3	7	0.43 (0.30)	7	0.43 (0.30)
Mormon Mesa	16	16	0.94 (0.30)	12	1.33 (0.48)
Muddy River	0	4	0.00 (0.00)	4	0.00 (0.00)
Topock	0	1	0.00	1	0.00
Bill Williams	4	5	0.80 (0.58)	4	1.00 (0.71)
Total	**40**	**41**	**0.98 (0.19)**	**34**	**1.18 (0.25)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females for which nest outcome was known.

NDOW Study Areas

Nest Monitoring

We documented 38 willow flycatcher nesting attempts at Key Pittman, River Ranch, and Warm Springs; 36 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Fourteen (39%) nests were successful and fledged young, and 20 (56%) failed. Fate was unknown at two (5%) nests. Nest success was 42% at Key Pittman, 0% at River Ranch, and 100% at Warm Springs (Table 4.9).

Twenty-one nesting females, all of which were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was documented for which no nesting attempt was found. Of the 21 nesting females, 9 had one nesting attempt, 7 had two nesting attempts, and 5 had three nesting attempts. All 12 females with multiple nesting attempts renested after failed nests.

Table 4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
KEPI	Patch 0	1	1	1	0	0	1 (100)	0
	Patch 1	1	1	1	1 (100)	0	0	0
	Patch 2	1	2	2	1 (50)	1 (50)	0	0
	Patch 4	1	1	1	1 (100)	0	0	0
	Patch 5	1	2	2	1 (50)	1 (50)	0	0
	Patch 6	3	3	3	1 (33)	1 (33)	1 (33)	0
	Patch 7	1	2	2	1 (50)	1 (50)	0	0
	Patch 8	1	2	2	0	2 (100)	0	1 (50)
	Patch 9	2	3	3	1 (33)	2 (67)	0	0
	Patch 10	2	4	4	2 (50)	2 (50)	0	0
	Patch 11	2	6	5	2 (40)	3 (60)	0	0
	Patch 12	2	6	5	2 (40)	3 (60)	0	0
	Total	*18*	*33*	*31*	*13 (42)*	*16 (52)*	*2 (6)*	*1 (11)*

Table 4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
RIRA	East Side	1	3	3	0	3(100)	0	3 (100)
	West Side	1	1	1	0	1(100)	0	0
	Smalls	1	0	--	--	--	--	--
	Total	*3*	*4*	*4*	*0*	*4 (100)*	*0*	*3 (75)*
WMSP	Muddy Mac	1	1	1	1 (100)	0	0	0
	Total	*1*	*1*	*1*	*1 (100)*	*0*	*0*	*0*
Overall Total		**22**	**38**	**36**	**14 (39)**	**20 (56)**	**2 (5)**	**4 (12)**

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Nest Failure

Depredation was the major cause of nest failure, accounting for 59% (13 of 22) of all failed nests (Table 4.10) and 65% (13 of 20) of nests that failed after flycatcher eggs were laid. Two nesting attempts (9% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, and four nests (18%) were deserted. One nest (5%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism), and all nestlings died in two nests (9%) that were still being tended by adult flycatchers.

Table 4.10. Summary of Causes of Willow Flycatcher Nest Failure at NDOW Study Areas, 2011*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled	Nestling(s) died in nest
KEPI	33	18	2 (11)	3 (17)[2]	11 (61)	0	0	2 (11)
RIRA	4	4	0	1 (25)	2 (50)	1 (25)	0	0
WMSP	1	0	0	0	0	0	0	0
Total	**38**	**22**	**2 (9)**	**4 (18)**	**13 (59)**	**1 (5)**	**0**	**2 (9)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] All nests deserted during incubation; structure of one nest damaged, possibly from a depredation attempt.

Brood Parasitism

Four of 34[2] nests (12%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.11). All four nests failed. In one case, the parasitism event coincided with the disappearance of any flycatcher eggs. In another, the parasitism event coincided with the disappearance of two of three flycatcher eggs, and the remaining flycatcher egg disappeared a few days later. The female

[2] Table 4.9 shows 36 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, two nests whose contents could not be determined were excluded from calculations (e.g., nesting attempts that were discovered late in the nesting cycle).

flycatcher continued to incubate the cowbird egg, which had been addled. One nest was deserted with two flycatcher eggs and a cowbird egg. In the remaining nest, the cowbird nestling was removed but the flycatcher nestling developed very slowly and eventually died in the nest. Brood parasitism was 11% at Key Pittman, 75% at River Ranch, and 0% at Warm Springs (see Table 4.9).

Table 4.11. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds in Key Pittman, River Ranch, and Warm Springs Study Areas, 2011*

Study Area[1]	Nest ID Code	Outcome[2]
KEPI	46B	CN removed shortly after hatching. WN developed very slowly and eventually died in the nest.
RIRA	110A	WE disappeared when CE appeared.
	110B	Nest deserted with two WE and one CE.
	110C	Two of three WE disappeared when CE appeared. Last WE disappeared a few days later.

* All nesting attempts are included.

[1] KEPI = Key Pittman WMA, RIRA = River Ranch.

[2] WE = willow flycatcher egg, CE = cowbird egg, WN = willow flycatcher nestling, CN = cowbird nestling.

Cowbird Egg Addling

Three nests at River Ranch were parasitized; one nest was too high to reach but was deserted during incubation, and the parasitism event caused failure at another nest. We addled the cowbird egg at the third nest at River Ranch. Partial depredation of this nest resulted in the loss of the remaining flycatcher egg; the female flycatcher continued to incubate the cowbird egg, which never hatched. We removed one cowbird nestling from a nest at Key Pittman that was found late in incubation. This nest also failed, with a lone flycatcher nestling developing very slowly and eventually dying in the nest.

Mayfield Nest Success and Productivity

Mayfield survival probability (MSP) was 0.447 at Key Pittman. MSP could not be calculated across all nest stages at River Ranch and Warm Springs because of lack of data for some stages. MSP was 0.375 for all three sites combined (Table 4.12). At all sites, 33 nestlings were confirmed to have fledged from 34 nests of known outcome (mean number of fledglings/nest = 0.97, SE = 0.22). Fecundity across study areas ranged from 0 to 3.0 young per female and averaged 1.65 (SE = 0.28) (Table 4.13).

Table 4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Key Pittman	1	1/42	0.976	0.950
	2	12/277	0.957	0.566
	3	3/224	0.987	0.831
	MSP all stages = 0.447			
River Ranch	1	2/5	0.600	0.335
	2	2/13.5	0.852	0.127
	3	0/0		
	MSP all stages = N/A[2]			

Table 4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011* (Continued)

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Warm Springs	1	0/0		
	2	0/13	1.000	1.000
	3	1/14	1.000	1.000
	MSP all stages = N/A[2]			
Total	**1**	**3/47**	**0.936**	**0.868**
	2	**14/303.5**	**0.954**	**0.545**
	3	**4/238**	**0.983**	**0.792**
	MSP all stages = 0.375			

* Mayfield survival probability was calculated using 2.14-day egg laying, 12.85-day incubation, and 13.76-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

[2] MSP cannot be calculated for all stages because of lack of data.

Table 4.13. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at NDOW Study Areas, 2011*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Key Pittman	30	29	1.03 (0.24)	16	1.88 (0.29)
River Ranch	0	4	0.00 (0.00)	3	0.00 (0.00)
Warm Springs	3	1	3.00	1	3.00
Total	**33**	**34**	**0.97 (0.22)**	**20**	**1.65 (0.28)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females.

DISCUSSION

Reclamation Study Areas

Number of Breeding Flycatchers

In 2011, willow flycatcher nesting was documented at six Reclamation study areas (Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams). No flycatchers were documented at Littlefield, which held breeding flycatchers in 2009 and 2010 but was scoured by floods in December 2010. Given that southwestern riparian ecosystems experience dynamic change and are not ecologically static (Periman and Kelly 2000), willow flycatcher occupancy and nesting are likely to be affected by changes in habitat suitability, with breeding flycatchers detected at a given site in one year and not in another. The number of flycatcher pairs recorded at Mormon Mesa, Muddy River, and Bill Williams was comparable to that recorded over the last several years. Mesquite had seven pairs in both 2011 and 2010, which was a drop from the number of pairs recorded in the previous four years (range 11–15). The main breeding site at Mesquite was dry in 2009 and nesting success was poor that year (McLeod and Koronkiewicz 2010). Flycatchers appeared to respond to the poor conditions by returning to other breeding sites in 2010 rather than returning to Mesquite (McLeod and Pellegrini 2011), and the number of breeding flycatchers at Mesquite was consequently reduced. It is unclear why the number of breeding pairs at Mesquite remained low in 2011 despite wet conditions at Mesquite West (see Chapter 2) at the beginning of the breeding season. It is possible that habitat suitability in the western portion of

Mesquite West, which is a mix of tamarisk and coyote willow and was unoccupied in 2011, has been reduced by tamarisk beetle defoliation.

Pahranagat had six breeding pairs in 2011, the lowest number recorded since 2003 (range 8–15 pairs). Monitoring in future years will help determine whether this is a temporary decline at Pahranagat or whether the amount of suitable habitat could be decreasing because of the reduced amount of surface water at the site in 2008–2011(see Chapter 2). There is evidence that the spatial distribution of nests within the main breeding site at Pahranagat has shifted over the years, moving away from the interior of the site, which was formerly inundated, and toward the periphery of the site, which is still in close proximity to surface water (NAU, unpubl. data).

Topock Marsh had five resident flycatchers, consisting of three unpaired males and one pair, the lowest number of resident individuals recorded since monitoring began in 1998. The number of resident flycatchers at Topock has been declining steadily since 2004. Water levels were exceptionally low in 2011 (see Chapter 2), which may have contributed to the continuing decline.

Nest Success

Nest success alone is an incomplete measure of the production of young. Successful nests produce from one to four young, and variations in nest productivity are not reflected in nest success rates. In addition, although every failed nest attempt lowers percent nest success and MSP, success of a subsequent nesting attempt may result in the same number of young produced as if the initial nesting attempt had been successful. Thus, nest productivity (young produced per nesting attempt) and fecundity (young produced per female) in conjunction with nest success provide additional information on the success of a given breeding season. Nest success at Pahranagat (100%) was, as it has been every year since 2003, higher than the average for all study areas. Productivity (2.43 young per nest) and fecundity (2.83 young per female) at Pahranagat in 2011 were also the highest recorded at any Reclamation study area, demonstrating that Pahranagat continues to be a highly productive site for willow flycatchers.

Percent nest success was essentially unchanged at Mesquite compared to 2010, but fecundity in 2011 (0.43) was less than half that of 2010 (1.00), and only three fledglings were produced. Fecundity was also low in 2009 (0.25). The main breeding site at Mesquite was dry during much of the breeding season in 2009 and after mid-June 2011, and dry conditions may be related to poor flycatcher reproduction (Moore and Ahlers 2008). Percent nest success, productivity, and fecundity at Mormon Mesa were all similar to what they had been in 2010. Muddy River, Topock, and Bill Williams continued to exhibit annual fluctuations in reproductive metrics, but sample sizes are too low to attribute much significance to the rates observed in 2011. Nest success results again illustrate that the demographic patterns of passerine populations often vary year to year, and sometimes to a very large degree (Wiens 1989a). The variable patterns of nest success observed at the study areas over many years demonstrate the need for long-term data.

Nest Failure

As in 2003–2010, depredation was the major cause of willow flycatcher nest failure, accounting for 52% of all failed nests in 2011. These results are consistent with those reported at the Reclamation study areas from 1998 to 2002 (Braden and McKernan unpubl. data) and at sites across Arizona from 1996 to 2008 (Graber et al. 2007, Ellis et al. 2008, Graber and Koronkiewicz 2009a), which indicate depredation as accounting for the majority of all willow flycatcher nest failures. Factors influencing the increases and decreases in nest depredation at the monitored study areas are inherently complex and at this time remain undetermined. For open-cup nesting passerines, nest depredation rates can vary year to year, and sometimes substantially, with depredation of eggs and young ultimately linked to landscape

characteristics and fluctuations in predator densities, abundance, and richness (Wiens 1989b, Robinson 1992, Howlett and Stutchbury 1996).

In 2008, Northern Arizona University (NAU) initiated a nest camera study in cooperation with SWCA on open-cup nesting passerines at selected study areas along the lower Colorado River and tributaries. The study used video and still cameras on real and artificial nests to identify depredation rates and nest predators. The study continued in 2009 and 2010, with video cameras deployed at flycatcher nests and still cameras at artificial nests. Marks on clay eggs indicated that most depredation events at Mesquite were from birds, while at Pahranagat both birds and rodents depredated artificial nests (NAU unpubl. data). Both Brown-headed Cowbirds and Yellow-breasted Chats were identified by still cameras as depredating artificial nests. Cowbirds were also documented on video depredating flycatcher nests at Mesquite in both 2009 and 2010. A variety of avian predators were documented depredating flycatcher nests at Pahranagat. The study was continued in 2011, with video cameras deployed at real flycatcher nests at Pahranagat, but all flycatcher nests were successful and no depredation events were documented. Results of this study suggest that avian species may be important predators on flycatcher nests at Reclamation study areas. Ellis et al. (2008) also identified Cooper's Hawks (*Accipiter cooperii*) and Yellow-breasted Chats depredating flycatcher nests at sites in Arizona.

Brood Parasitism

Brood parasitism by Brown-headed Cowbirds across all Reclamation study areas ranged from 0 to 60% and averaged 19% (see Table 4.1). These results are consistent with those reported at the study areas from 1998 to 2010 (Braden and McKernan unpubl. Data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011), but these parasitism rates are higher than those reported at other monitored sites across Arizona in 1996–2006, which were less than 10% at most sites in most years (Graber et al. 2007, Ellis et al. 2008).

We observed multiple occasions in which the disappearance of flycatcher eggs coincided with the parasitism event. In this case, cowbirds were suspected of ejecting the eggs. Female Brown-headed Cowbirds are known to physically attack willow flycatcher nestlings (Woodward and Stoleson 2002), remove single eggs, and occasionally destroy entire broods after laying is complete or after hatching (Lowther 1993 as cited in Woodward and Stoleson 2002). In addition, cowbirds were photographed removing eggs from artificial nests during the 2008–2010 camera study, and cowbirds were documented on video depredating flycatcher nests during both the incubation and nestling phases. Therefore, it is likely that other depredation events on eggs and nestlings are attributable to cowbirds.

Parasitism does not invariably cause nest failure, but the success rate (18%) for parasitized nests at all study areas in 2003–2011 was less than half that of unparasitized nests (49%). Similar results were recorded for willow flycatchers in Oregon, with parasitism resulting in a 50% decrease in success rates compared to unparasitized nests (Sedgwick and Iko 1999) and at other sites in Arizona, where in 1996–2005, 20% of parasitized nests fledged flycatcher young vs. 57% of unparasitized nests (Ellis et al. 2008). Parasitized nests that did succeed in fledging flycatcher young at all study areas in 2003–2011 produced on average fewer young (1.3 young/nest) than did unparasitized nests (2.2 young/nest; $F_{1,249} = 21.24$, $P < 0.001$). Cowbirds may eject flycatcher eggs during the parasitism event, thus reducing clutch size, and cowbird young also cause interspecific nestling competition, as evidenced by the presence of severely underdeveloped nestlings in some parasitized nests. For all nests monitored from 2003 to 2011, 44% of nests that fledged a cowbird also fledged flycatcher young. This is a higher rate of success than that observed in Southwestern Willow Flycatchers at Kern River, California (9%; Whitfield and Sogge 1999), but comparable to that observed at other Arizona sites (40%; Ellis et al. 2008).

Female flycatchers may desert their nests after parasitism events and thus expend energy renesting and laying additional eggs. Given that adult flycatchers exhibit high site fidelity to breeding areas (Braden and McKernan unpubl. data, McLeod et al. 2008a, McLeod and Koronkiewicz 2009, this document) and renest most often after failed nests (Sedgwick 2000), females returning to sites with high brood parasitism may have reduced lifetime fecundity because they are expending energy on multiple failed nesting attempts over many years. An analysis of lifetime fecundity of females will be included in the summary report in 2012. In addition, willow flycatchers that fledge late in the season have been shown to have a lower survival rate than those that fledge early in the season (Paxton et al. 2007, McLeod et al. 2008a), suggesting additional hidden effects of parasitism and subsequent renesting on flycatcher demography.

Cowbird trapping and removal studies were initiated at Pahranagat, Mesquite, and Topock Marsh in 2003 and continued through 2007. Results of these studies showed that cowbird trapping appeared to lower parasitism rates in comparison to the pre-trapping period of 1998–2002 only at Pahranagat, with no parasitism detected during trapping years (McLeod et al. 2008a). No cowbird trapping was completed in 2008–2011, but even in the absence of cowbird trapping, no parasitism events were detected at Pahranagat in 2008, 2009, or 2011. One parasitism event was noted in 2010, and the nest was abandoned before flycatcher eggs were laid. This nest was located on the very edge of the site, adjacent to open, upland habitat, possibly increasing parasitism probability. These observations suggest that cowbird trapping may have lingering effects beyond the years in which trapping is completed.

We speculated that trapping might have affected the parasitism rate at Pahranagat but not the other study areas because Pahranagat consists of relatively small, isolated patches of riparian habitat rather than existing in a large, contiguous riparian corridor. The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 26%, well below the average of 46% across all other study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

Cowbird Egg Addling

We addled cowbird eggs and removed cowbird nestlings in all study areas except Pahranagat in 2011. Pahranagat was not included because it is still part of the 5-year post-cowbird-trapping experiment. Though sample size is small, addling cowbird eggs seemed to reduce the hatch rate of cowbird eggs. Furthermore, none of the females deserted their nests after we addled cowbird eggs. One female in a non-Reclamation study area from whose nest a cowbird nestling was removed also continued to raise the remaining flycatcher nestling. While flycatcher hatch rates and productivity were not improved by the program in 2011, this is not necessarily due to the program itself so much as low parasitism rates and high rates of nest failure due to addling where parasitism did occur. We recommend this program be continued in the future. Field personnel should also continue to practice egg addling at the beginning of the season with button quail eggs to maximize the effectiveness of shaking eggs in preventing hatching.

NDOW Study Areas

At Warm Springs, a fire during the breeding season of 2010 affected all sites and reduced the availability of suitable habitat (see Chapter 2), and the number of breeding pairs declined correspondingly from three to one in 2010 and 2011, respectively. Many measures of nesting (number of breeding pairs, Mayfield nest success, and rate of brood parasitism) were similar at Key Pittman between 2010 and 2011.

Productivity and fecundity were lower in 2011 (1.03 and 1.88, respectively) than in 2010 (1.23 and 2.03, respectively), but there was no statistically significant difference in either fecundity or productivity between years.

Cowbird parasitism was high (75%) at River Ranch, and none of the four nests at this site was successful. Low nest success is further indication of poor habitat quality at River Ranch (see Chapter 3 for a discussion of within-year movement and the presence of second-year individuals at River Ranch).

Video cameras were deployed on flycatcher nests in both 2010 and 2011 at Key Pittman. Two depredation events were recorded on video in 2011 (NAU unpubl. data), one by a kingsnake (*Lampropeltis getulus*) and the other by a Sharp-shinned Hawk (*Accipiter striatus*). Field personnel also witnessed a depredation event by a short-tailed weasel (*Mustela frenata*).

This page intentionally left blank.

Chapter 5

VEGETATION AND HABITAT CHARACTERISTICS

INTRODUCTION

Our objective for vegetation sampling is to provide a quantitative summary of the floristic and structural conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if they resemble occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the vegetation consists primarily of very large and widely spaces trees, and these characteristics are unique to the site and not likely to be replicated in restoration areas. In 2011, we completed vegetation sampling within occupied territories only at Bill Williams because of the relatively low sample size of vegetation plots obtained at this study area over previous years. Sampling at all other study areas was discontinued because of adequate sample sizes from previous years. A combined analysis of all years of vegetation data will be presented in a summary report in 2012.

METHODS

We described and measured vegetation and habitat features following a modification of the methods of James and Shugart (1970). Vegetation characteristics were measured within a 5-m-radius circle. To avoid disrupting flycatcher breeding activities, we measured vegetation late in the summer when the nest, territory, and adjacent flycatcher territories were inactive.

In 2008, we measured vegetation and habitat characteristics at one plot for each resident (i.e., detected for at least one week) male flycatcher we identified, regardless of whether or not he obtained a mate. Plot center locations were determined as soon as territories were identified. We estimated the center of the male's activity by observing his use of singing perches and selecting a location that was approximately equidistant from the perches at the perimeter of his use area. We then proceeded in a randomly selected compass direction for a randomly selected distance between 0 and 20 m. We used additional random numbers to select the exact location in which to hang a temperature/humidity data logger (see Chapter 6) and used that location as plot center. This process resulted in the random selection of a point that was still within the male's territory. The sampling points were marked in the field with flagging that remained in place over the winter.

In 2009, we identified the territory center for each resident male as described above. If an existing sampling point from 2008 was within 20 m of the territory center identified in 2009, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. All sampling points that were assigned to active territories in 2009 were marked with flagging that remained in the field over the winter. We repeated this point selection procedure for territories that were active in 2010 and 2011, assigning a sampling point that was used in the previous year if one was within 20 m of the current territory and selecting a new sampling point if no existing point were available. Sampling points that were identified in 2010 but were not within 20 m of a territory center in 2011 were resampled in 2011.

At each plot, we laid out four 5-m-long ropes from plot center, one in each of the four cardinal directions. Each rope was marked at 1 m and 5 m from the center of the plot. At plot center and at 1 m and 5 m from

the center of the plot in each cardinal direction, we measured vertical foliage density using a 7.5-m-tall survey rod. Working our way up the rod, we recorded the presence of vegetation, by species, within a 10-cm radius of the rod in 0.1-m intervals (presence of the species within the 0.1-m interval equaled one "hit" on the rod), and summed all hits in 1-m intervals. Presence of dead vegetation (snags) was recorded in the same manner, but not identified to species. If canopy vegetation continued above 8.0 m, we estimated the number of hits as zero, greater than five, or less than five hits per 1-m interval until the canopy vegetation stopped (modified from Rotenberry 1985).

We measured total canopy closure using a Model-A spherical densiometer at 1 m north and south of the center of each plot and averaged these measurements to obtain a single canopy closure value for each plot. We measured average canopy height within each plot by selecting a representative tree and using a survey rod or a clinometer and measuring tape to measure the height of the selected tree. We estimated percent woody ground cover, alive and dead, within 0.5 m of the ground using a Daubenmire-type frame with the lower edge of the frame centered at 1 m north, south, east, and west of plot center. These percentages were averaged to obtain a single measure of percent woody ground cover for each plot.

We tallied the number of live stems for each species within 5 m of the center of the plot. Stems were tallied if they were at least 1.4-m tall and >2.5 cm in diameter at 10 cm above the ground. Stems were tallied by the following diameter at breast height (dbh) categories: <1 cm, 1–2.5 cm, 2.6–5.5 cm, 5.6–8 cm, 8.1–10.5 cm, and 10.6–15 cm. Any stems >15 cm dbh were measured and the exact dbh was recorded. Dead stems were also tallied in these categories, but not identified to species. We marked each stem with a piece of chalk after it was tallied to facilitate accurate stem counts.

During vegetation sampling in 2003–2007, if a stem branched above 10 cm but below 1.4 m above the ground, only the largest stem was tallied. In habitats (e.g., tamarisk) where stems frequently branch in this height interval, this method of counting stems may underestimate the density of stems that form an important part of the habitat structure. Therefore, in 2008–2011 we tallied stems as we had in previous years and then for each stem that branched between 10 cm and 1.4 m from the ground, we tallied the number of additional stems that were at least 2.5 cm in diameter at 10 cm above the point where it branched from the main stem.

Additional information recorded at each plot included the date when the measurements were taken, observer initials, and UTM coordinates for each plot center.

Data Analyses

We used high-resolution aerial photography and field knowledge of each study area to delineate clusters of territories that occur within habitat patches of similar floristics and canopy height. Vegetation characteristics were then summarized for each habitat type. For each habitat type, we give the corresponding vegetation classification as defined in Younker and Andersen (1986) and used in the LCR MSCP. We also pooled data across habitat types that fell under a single vegetation classification and present summary statistics for each vegetation classification. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

Stem counts were grouped into the following size categories for analysis: ≤2.5 cm dbh, 2.6–8 cm dbh, and >8 cm dbh. For each size category, stem counts are reported separately for live and dead stems; the sum of these is the equivalent of the stem counts per size category that were reported in the 2003–2007 summary report (McLeod et al. 2008a). Vertical foliage density measurements above 8.0 m that were recorded as < or >5 hits per meter were converted to 2.5 and 7.5 hits, respectively, to allow analyses of these data as continuous rather than categorical. Vertical foliage density was calculated for each meter interval as the mean of the number of hits recorded within the interval at the nine locations in the plot.

In 2003–2007, we had measured vertical foliage density only at plot center and 1 m from plot center in each cardinal direction, and foliage density measures per meter interval were presented as the sum of the hits recorded at the five locations in the plot. Thus, vertical foliage data presented in reports from 2003 to 2007 should be divided by 5 to be comparable to data presented here. In the five-year summary report (McLeod et al. 2008a), vertical foliage data were grouped into three categories of above, at, and below the nest. We used average nest height as measured in 2003–2011 in each vegetation type to demarcate vertical foliage categories in 2011. As with stem counts, vertical foliage data are reported separately for live and dead vegetation.

Percent native vegetation was calculated as the average of the percent basal area that was native and the percent native vertical foliage hits. To obtain basal area, we multiplied the number of stems tallied in each size class by the average basal area of a stem in that class, given an even distribution of stems within each size class. For data collected in 2003–2007 (reported in McLeod et al. 2008a), we did not use vertical foliage data to calculate percent native because all vertical foliage data were collected within 1 m of plot center and represented only a small portion of the plot. We included vertical foliage data in the percent native calculations in 2008–2011 to account for the influence of stems that were too small to be tallied or were rooted outside the 5-m-radius circle but overhung the plot.

RESULTS

We measured vegetation at Bill Williams at four occupied territories and four territories that were occupied in 2010 but not in 2011. The eight territories are located in five survey sites at Bill Williams: Site #3, Site #4, Burn Edge, Planet Ranch Road, and Cougar Point. Of the four occupied territories, three had nesting flycatchers and one was occupied by an unpaired male. Small sample sizes preclude any comparison between territories occupied by nesting pairs versus those occupied by unpaired males; data collected in 2011 will be combined with data collected in previous years for this comparison, which will be presented in a five-year summary report in 2012. Data from territories that were occupied in 2010 but not in 2011 are not included in the 2011 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. This analysis would also be presented in the summary report.

We delineated the following habitat types: 1) Goodding willow with tamarisk understory, and 2) cottonwood/willow. Goodding willow with tamarisk understory occurred in Site #3, Site #4, and Burn Edge, while cottonwood/willow was present at Planet Ranch Road and Cougar Point. Average nest height recorded in 2003–2011 and used to assign vertical foliage strata for each vegetation category were 4.2 m for Goodding willow with tamarisk understory and 2.5 m for cottonwood/willow.

Although the vegetation types delineated in this report differ from one another in vertical structure and floristic composition, all fall within the definition of cottonwood-willow habitat (cottonwoods and willows constituting at least 10% of total trees) as described in Younker and Anderson (1986) and used in the LCR MSCP. The cottonwood/willow habitat type as delineated in this report falls under the definition of cottonwood-willow Type III (no understory, with the canopy layer from 4.5–6.0 m), while Goodding willow with tamarisk understory as delineated in this report falls under the definition of cottonwood-willow Type I (three definitive layers of vegetation with the majority of the vegetation volume at 6.0 m or more).

Vegetation characteristics of each habitat type are summarized in Table 5.1. Habitat characteristics varied between and within habitat types.

Table 5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2011*

Parameter	SAGO with TASP understory (C-W Type I) (n=2)	POFR and SAGO (C-W Type III) (n=2)
Average canopy height (m)	6.3 (0.5)	7.4 (0.7)
	5.8–6.8	6.7–8.0
% total canopy closure	90.9 (3.9)	97.4 (1.6)
	87.0–94.8	95.8–99.0
% woody ground cover	33.9 (21.4)	37.1 (31.6)
	12.5–55.3	5.5–68.8
# live stems ≤2.5 cm dbh per ha	1846 (1210)	1210 (1210)
	637–3056	0–2419
# live stems 2.6–8 cm dbh per ha	3183 (764)	9486 (446)
	2419–3947	9040–9931
# live stems >8 cm dbh per ha	573 (318)	1210 (64)
	255–891	1146–1273
# dead stems ≤2.5 cm dbh per ha	446 (191)	1337 (955)
	255–891	382–2292
# dead stems 2.6–8 cm dbh per ha	827 (191)	764 (255)
	637–1019	509–1019
# dead stems >8 cm dbh per ha	64 (64)	0 (0)
	0–127	0–0
Percent native	1.7 (1.2)	99.1 (0.6)
	0.4–2.9	98.8–100.0
Live vertical foliage (hits) below average nest height	6.3 (0.4)	1.9 (1.1)
	5.9–6.7	0.8–3.0
Live vertical foliage (hits) at average nest height	2.7 (0.0)	3.9 (1.9)
	2.7–2.7	2.0–5.8
Live vertical foliage (hits) above average nest height	2.2 (0.8)	13.7 (2.4)
	1.4–3.0	11.2–16.1
Dead vertical foliage (hits) below average nest height	12.7 (1.8)	3.4 (2.7)
	10.9–14.4	0.8–6.1
Dead vertical foliage (hits) at average nest height	0.6 (0.4)	1.8 (1.7)
	0.1–1.0	0.1–3.6
Dead vertical foliage (hits) above average nest height	0.2 (0.2)	1.0 (1.0)
	0–0.4	0–2

* Data are presented as mean, standard error, and range. Stem counts include only the largest stem of any cluster that branched above 10 cm above the ground. SAGO = Goodding willow, TASP = tamarisk, POFR = cottonwood, C-W = cottonwood-willow.

The proportion of stems omitted from stem counts by counting only the largest stem of a cluster that branched between 10 cm and 1.4 m above the ground varied both by size and species of the main stem (Table 5.2). Larger stems typically had more branches that were omitted.

Vertical foliage profiles for each habitat type are shown in Figures 5.1–5.2. Average nest height in each habitat type, as recorded in 2003–2011, is also shown on each graph. In both habitat types, the proportion of dead vegetation in the vertical profile was highest immediately above the ground and declined with increasing height. The densest live foliage occurred 3–5 m above the ground, at or above average nest height.

Table 5.2. Proportion of Stems Omitted from Stem Counts

Size category[1]	Species			
	Tamarisk	Coyote willow	Goodding willow	Dead stems
≤2.5 cm dbh	0.12	--	0.0	0.05
2.6–8 cm dbh	0.67	--	0.0	0.52
>8 cm dbh	1.46	--	0.0	2.0

[1] Size category indicates the size of the main stem that was tallied. All stems that were omitted from the stem count are equal to or smaller than the size of the main stem.

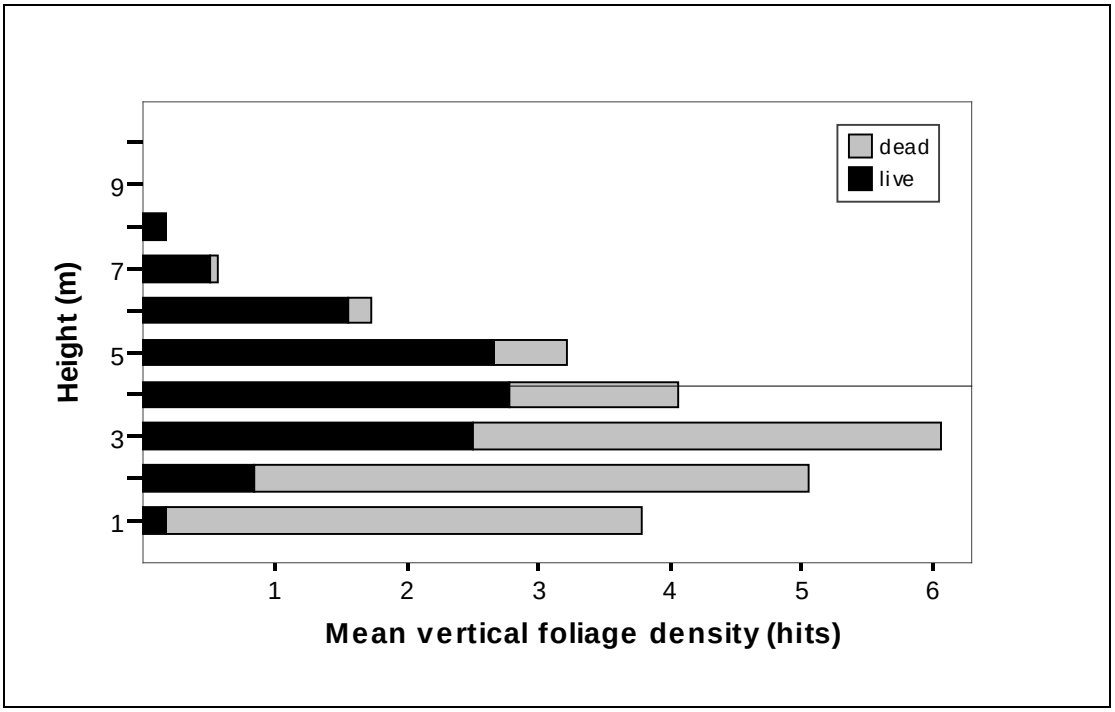


Figure 5.1. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2011. Horizontal line shows average nest height in this habitat type in 2003–2011. This habitat type is also cottonwood-willow Type I.

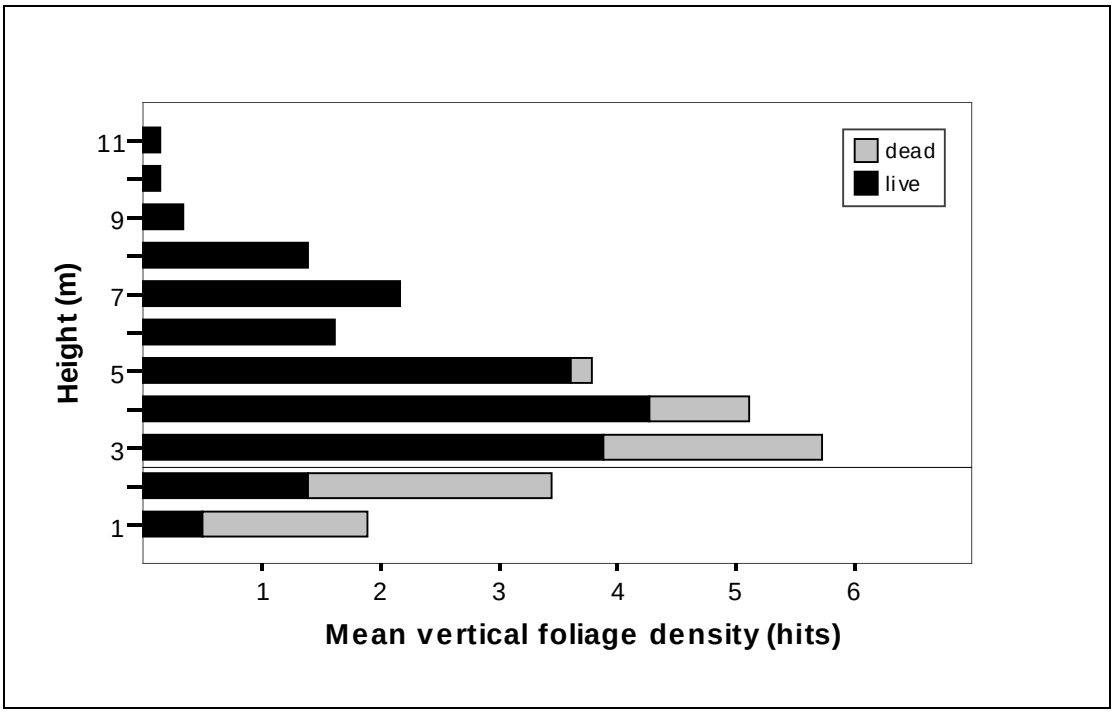


Figure 5.2. Vertical foliage density at occupied willow flycatcher territories in cottonwood/willow habitat type, 2011. Horizontal line shows average nest height in this habitat type in 2010–2011. This habitat type is also cottonwood-willow Type III.

DISCUSSION

The purpose of vegetation measurements of occupied habitat is to provide quantitative guidelines for restoration efforts. The limited data collected in 2011 preclude any meaningful summary of habitat characteristics and any comparison between vegetation types. In a summary report to be completed in 2012, data from 2011 will be combined with other data collected within active territories in prior years to provide a more comprehensive description of each habitat type.

Chapter 6

MICROCLIMATE

INTRODUCTION

Our objective for microclimate sampling is to provide a quantitative summary of microclimate conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if the microclimate resembles that in occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the study area is approximately 650 m higher in elevation and experiences a cooler climate than the LCR MSCP planning area. In 2011, we collected microclimate data only at Bill Williams; adequate sample sizes had been achieved at all other study areas in previous years.

METHODS

Temperature and Humidity Measurements

Measurements of temperature and humidity were recorded automatically every 15 minutes using a HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) that combines a thermometer (degrees Celsius), humidity monitor, and digital data logger. We camouflaged all HOBO units by placing them in an inverted small, plastic container coated with spray adhesive and local vegetation. The opening at the bottom was covered with shadecloth, allowing free air circulation around the unit.

In 2010, we collected microclimate measurements at one location for each resident male flycatcher we identified, regardless of the length of time the male was resident and whether or not he obtained a mate. One HOBO unit was placed within each active flycatcher territory. We estimated the center of the male's territory (see Chapter 5) and then determined the location of the HOBO unit by means of the following instructions and the use of random number sequences:

1) The compass direction to walk from the territory center, given in degrees from north, was determined from a random number sequence.

2) The distance (between 0 and 20 m) to walk in the designated direction was determined from a random number sequence. Once that distance was traveled, the closest woody tree or shrub was selected for data logger placement.

3) The HOBO unit was placed at a randomly selected height within the range of flycatcher nest heights documented at that study area in 2003–2007 (McLeod et al. 2008a). The distribution of random numbers followed the distribution of nest heights. If the chosen tree or shrub was of insufficient height to accept the height from the random number sequence, then field personnel placed the HOBO unit at the first height in the sequence that was less than the height of the tree or shrub. If no nests had been previously recorded at that study area, field personnel used the height sequences from the nearest study area with known nests.

4) The distance (0–2 m) at which the HOBO was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If the tree or shrub was of insufficient radius to accept the distance from the random number sequence, then field personnel placed the unit at the first number in the sequence that was less than the radius of the tree or shrub.

5) The compass direction, given in degrees from north, at which the unit was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If there was no branch in this compass direction that would support the data logger at the height and distance specified in (3) and (4), field personnel proceeded clockwise around the tree or shrub until a suitable branch was located.

If, as presented in (3) and (4), a number from a subsequent random number sequence (sequence meaning a row in the random number table) was used because the number in the initial sequence was too high, then both sequences were considered used and no longer available for future use. If these directions took field personnel outside of the riparian zone or to a site without trees or shrubs, they returned to the territory center and used the next sequence of random numbers.

The HOBO logger locations representing active territories in 2010 at Bill Williams were marked in the field with flagging, which remained in place over the 2010–2011 winter. HOBO loggers were redeployed in these same locations in early May 2011. During the breeding season of 2011, we identified the territory center for each resident male. If an existing sampling point was within 20 m of the territory center identified in 2010, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. Sampling points that were identified in 2010 but were not within 20 m of a territory center in 2011 were resampled in 2011. Data from these points are not included in the 2011 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. All HOBO units were removed from the field at the end of the breeding season.

Soil Moisture Measurements

A ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively) was used to gather soil moisture data. The soil moisture readings (nine per site) were recorded directly beneath the HOBO logger (plot center) and at 1.0 and 2.0 m from plot center in each cardinal direction. Soil moisture readings were collected when the HOBO logger was deployed and at two-week intervals throughout the breeding season until the HOBO logger was removed at the end of the season. Soil moisture was recorded both as voltage (mV) and as volumetric water content (%).[1] Soil type on the HH2 was set to mineral soil. For any soil moisture measurement point that was underwater, we recorded the depth of standing water and assigned a value of 994 mV, which is equivalent to 50% volumetric water content, or fully saturated soil. All mV values greater than 994 were also reassigned as 994 mV, because this reading represents fully saturated soil and because the mV to percent relationship becomes excessively nonlinear for mV readings above this point. Each time we collected soil moisture data, we also recorded the distance to the nearest standing water or saturated soil (as measured by visual estimate, GPS, or aerial photo) and recorded the approximate percentage, as estimated in the field by visual observation in combination with aerial photo, of the site within 20 and 50 m of the data logger that contained inundated or saturated soil.

A soil sample was collected from beneath each HOBO location that was new in 2011. Samples were approximately the size of a medium apple, collected from the surface down to and including a depth of 5 cm, and placed in a heavy zip-lock plastic bag labeled with the site designation. These samples will contribute to an ongoing analysis of soil texture, which strongly influences capillary action and therefore

[1] The soil moisture logger measures the dielectric constant of moist soil via a direct current voltage, which is converted to volumetric soil moisture with conversion tables. For very high (above ~1000 mV) or low (below ~90 mV) voltage readings, the HH2 reports volumetric soil moisture as "above" or "below" the table, respectively. To enable the use of all data, we analyzed and report only the mV readings. Both mV and percentage were recorded in the field to facilitate data proofing. Voltage is related to soil moisture as follows: $1.07 + 6.4V - 6.4V^2 + 4.7V^3 = 1.6 + 8.4\theta$, where θ = volumetric soil moisture.

overall soil moisture (Sumner 2000). Results of the soil texture analysis will be presented in the 2012 summary report.

Statistical Analyses

Soil moisture data were entered into a database as they were collected during the field season. We downloaded data from the HOBO data loggers into databases at the end of the field season. We merged all data to create one dataset for further analysis. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Distance to nearest standing water or saturated soil
- % of the area within 20 m of plot center that was inundated or saturated
- % of the area within 50 m of plot center that was inundated or saturated
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[2]
- Mean nocturnal vapor pressure

Soil moisture variables were summarized per visit, and temperature/humidity variables were summarized on a daily basis. We determined diurnal and nocturnal periods by using the actual daily sunrise and sunset times reported for the region by the National Weather Service (2011). We selected the above measures of temperature and humidity for analysis because they were the most highly correlated with other variables or were the most useful in distinguishing use areas from non-use locations (McLeod et al. 2008a). Territories were grouped according to habitat type (see Chapter 5), and microclimate variables were averaged for each habitat type over the following two-week periods to show how microclimate conditions changed throughout the breeding season: 16–31 May, 1–15 June, 15–30 June, 1–15 July, and 16–31 July. Data were also summarized by vegetation classification (see Chapter 5).

Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009). Data are presented as mean (standard error) unless otherwise noted.

RESULTS

We collected microclimate data at two active territories that contained nesting pairs and four territories that were occupied in 2010 but not in 2011. Data from territories that were occupied in 2010 but not in 2011 are not included in the 2011 data presented below but may be used in future analyses to identify any changes in microclimate that may lead to territory abandonment. This analysis would be presented in a five-year summary report in 2012. One active territory was in Goodding willow with tamarisk understory, which falls under the cottonwood-willow Type I vegetation classification, and the other territory was in cottonwood/willow, which falls under cottonwood-willow Type III (see Chapter 5). Microclimate variables are summarized by two-week periods for each vegetation type in Tables 6.1 and 6.2. These same variables are plotted in Figures 6.1–6.9 to facilitate comparisons between vegetation types.

[2] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

Table 6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory, 2011*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture (n=1)[1]						
Mean soil moisture (mV)	894.7	831.7	750.7	758.0	752.8	731.3
Mean distance to nearest standing water	15.0	15.0	15.0	375.0	393.0	470.0
% of area within 20 m that was inundated	25.0	20.0	5.0	0.0	0.0	0.0
% of area within 50 m that was inundated	30.0	35.0	15.0	0.0	0.0	0.0
Temperature (n=1)[2]						
Mean maximum diurnal temperature (°C)	35.3 (0.8)	37.9 (0.6)	39.7 (0.3)	41.6 (0.7)	39.2 (0.5)	N/A
Mean minimum nocturnal temperature (°C)	11.8 (0.7)	12.3 (0.5)	16.5 (0.6)	19.7 (0.9)	20.6 (0.8)	N/A
Mean daily temperature range (°C)	23.4 (1.0)	25.6 (0.7)	23.2 (0.5)	21.9 (0.9)	18.7 (0.9)	N/A
Humidity (n=1)[2]						
Mean diurnal vapor pressure (Pa)	1309.5 (67.2)	1726.9 (118.4)	2249.5 (113.7)	2991.2 (126.2)	3063.0 (84.2)	N/A
Mean nocturnal vapor pressure (Pa)	1037.0 (48.0)	1308.9 (52.3)	1562.9 (72.3)	2297.7 (116.8)	2339.8 (94.6)	N/A

* Data are presented as mean (standard error). This habitat type is also cottonwood-willow Type I.
[1] Sample size indicates the number of data logger locations. No standard error is reported for periods in which soil moisture variables were measured only once.
[2] Sample size indicates the number of data logger locations. Mean and standard error are reported for daily readings within each time period.

Table 6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Willow, 2011*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture (n=1)[1]						
Mean soil moisture (mV)	951.3	986.7 (0.1)	921.0	957.0	965.3	904.9
Mean distance to nearest standing water	1.0	1.3 (0.3)	0.0	1.0	1.0	1.0
% of area within 20 m that was inundated	55.0	60.0 (20.0)	40.0	85.0	50.0	60.0
% of area within 50 m that was inundated	70.0	50.0 (10.0)	65.0	45.0	60.0	50.0
Temperature (n=1)[2]						
Mean maximum diurnal temperature (°C)	29.9 (0.8)	32.6 (0.6)	35.2 (0.5)	35.0 (0.5)	35.3 (0.7)	N/A
Mean minimum nocturnal temperature (°C)	14.5 (1.0)	13.6 (0.7)	19.1 (0.8)	21.0 (1.0)	22.4 (0.8)	N/A
Mean daily temperature range (°C)	15.4 (1.3)	19.0 (0.9)	16.1 (0.6)	13.9 (1.1)	13.0 (0.9)	N/A
Humidity (n=1)[2]						
Mean diurnal vapor pressure (Pa)	1112.0 (43.0)	1269.8 (64.8)	1516.9 (50.4)	2312.6 (164.7)	2245.6 (114.6)	N/A
Mean nocturnal vapor pressure (Pa)	806.2 (25.2)	904.9 (42.3)	1114.3 (47.0)	1937.9 (147.3)	1873.1 (111.8)	N/A

* Data are presented as mean (standard error). This habitat type is also cottonwood-willow Type III.
[1] Sample size indicates the number of data logger locations. Mean and standard error are reported for time periods in which soil moisture variables were measured twice. No standard error is reported for periods in which soil moisture variables were measured only once.
[2] Sample size indicates the number of data logger locations. Mean and standard error are reported for daily readings within each time period.

AR064216

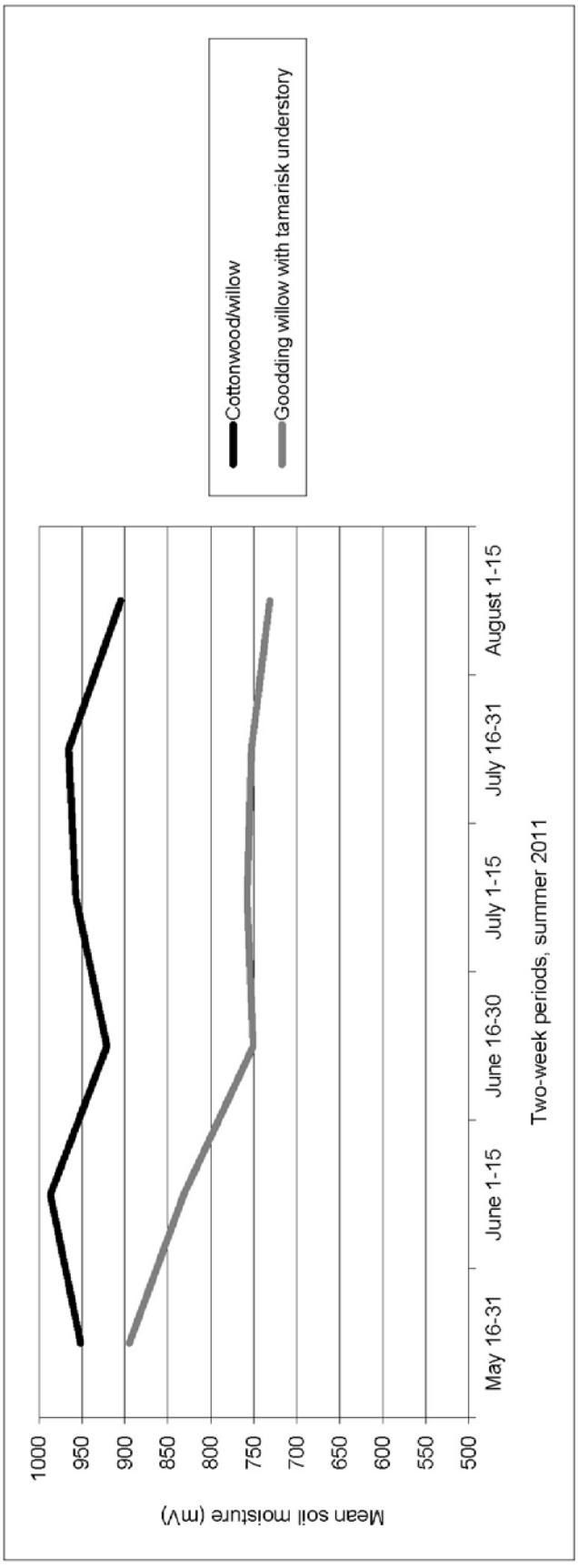


Figure 6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory.

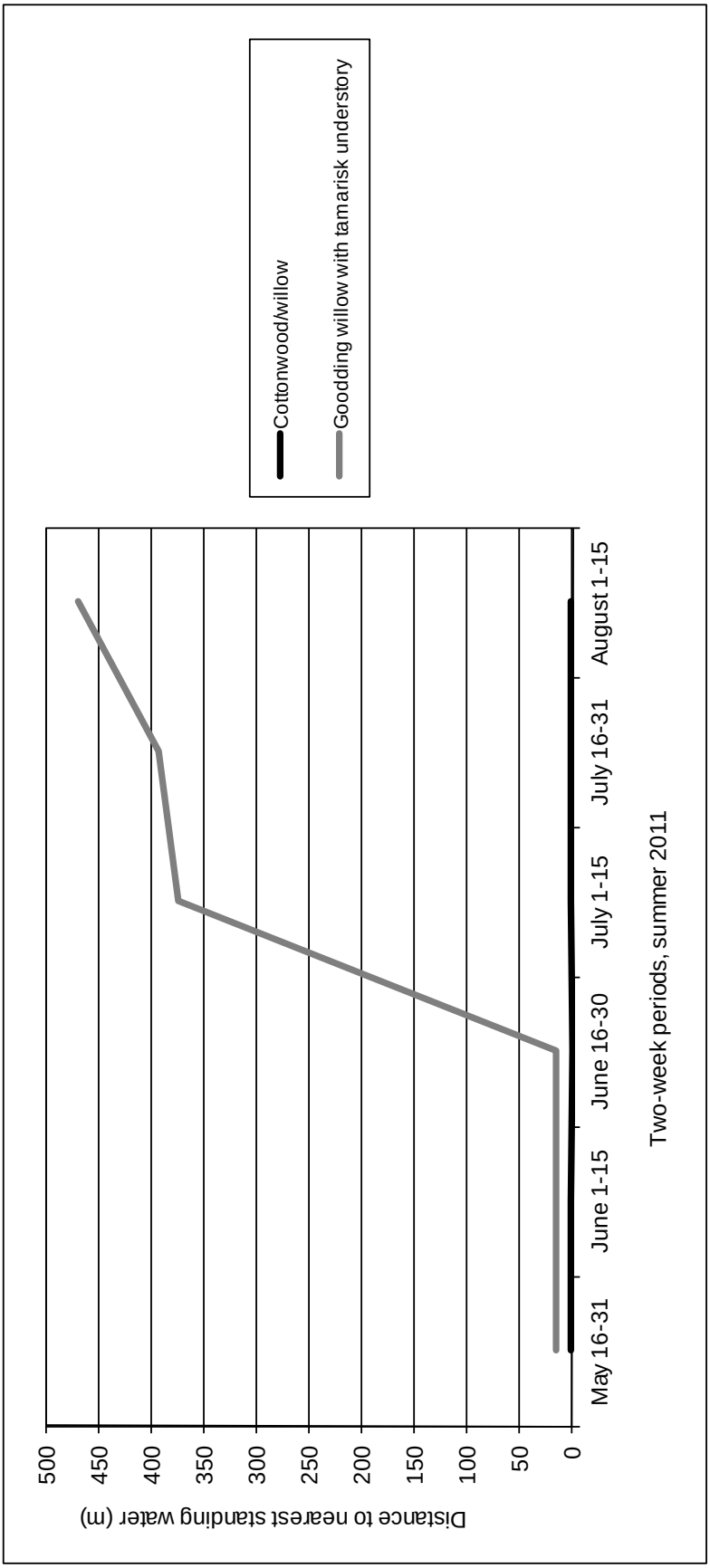


Figure 6.2. Distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which distance to water was measured more than once in a given two-week period.

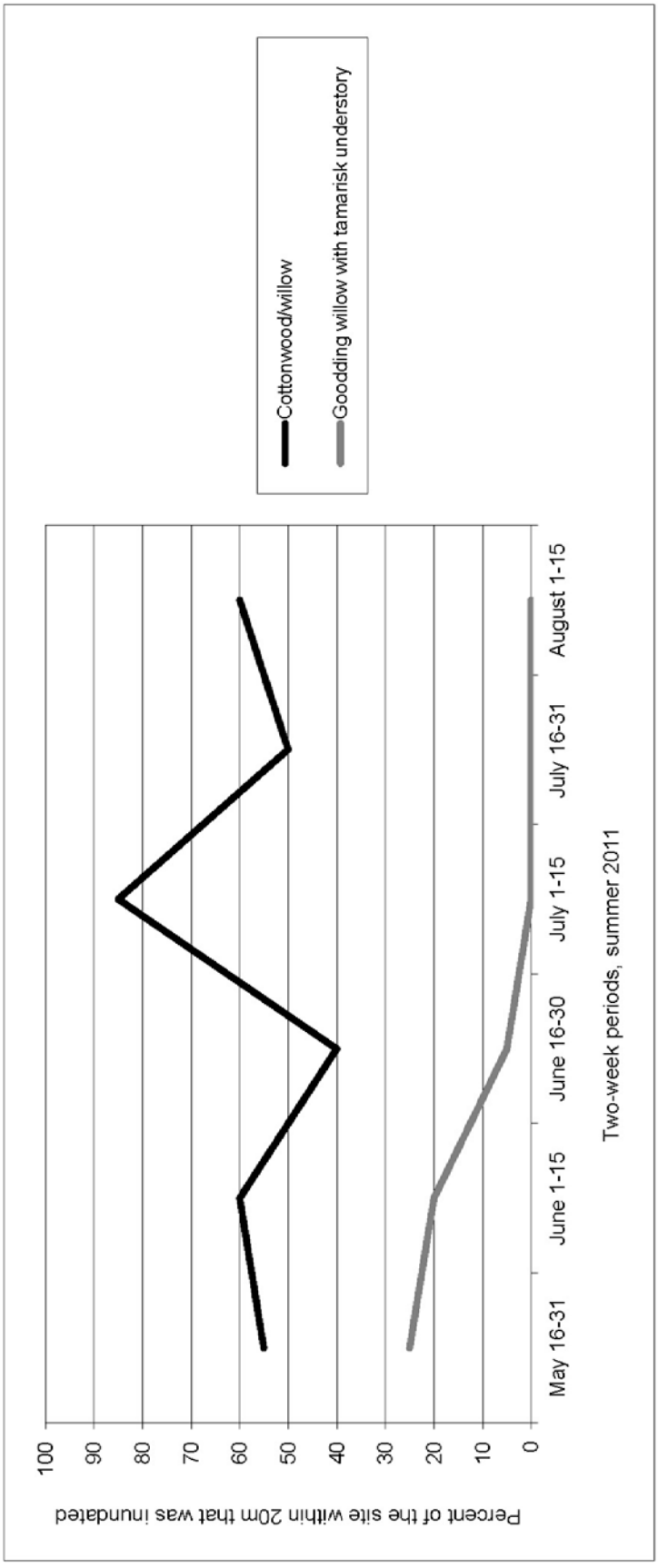


Figure 6.3. Percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which percent inundated was measured more than once in a given two-week period.

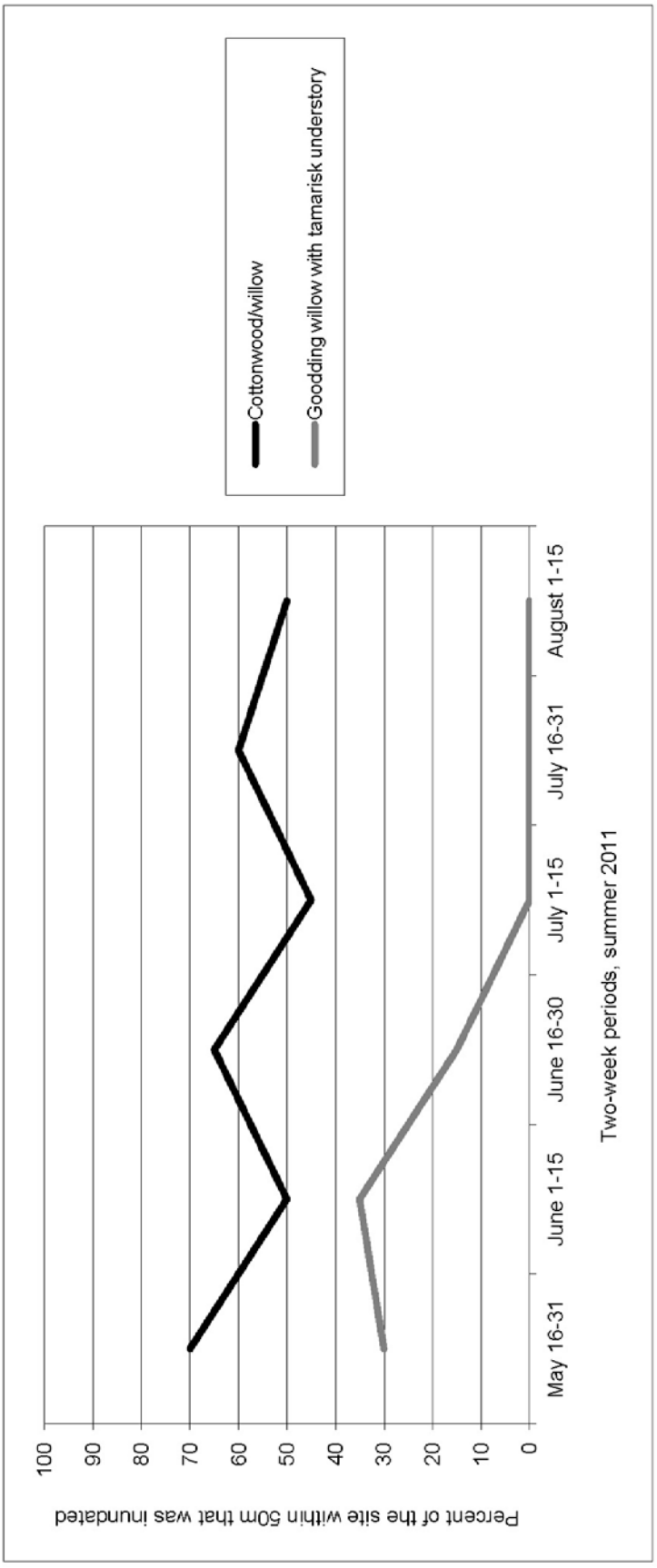


Figure 6.4. Percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which percent inundated was measured more than once in a given two-week period.

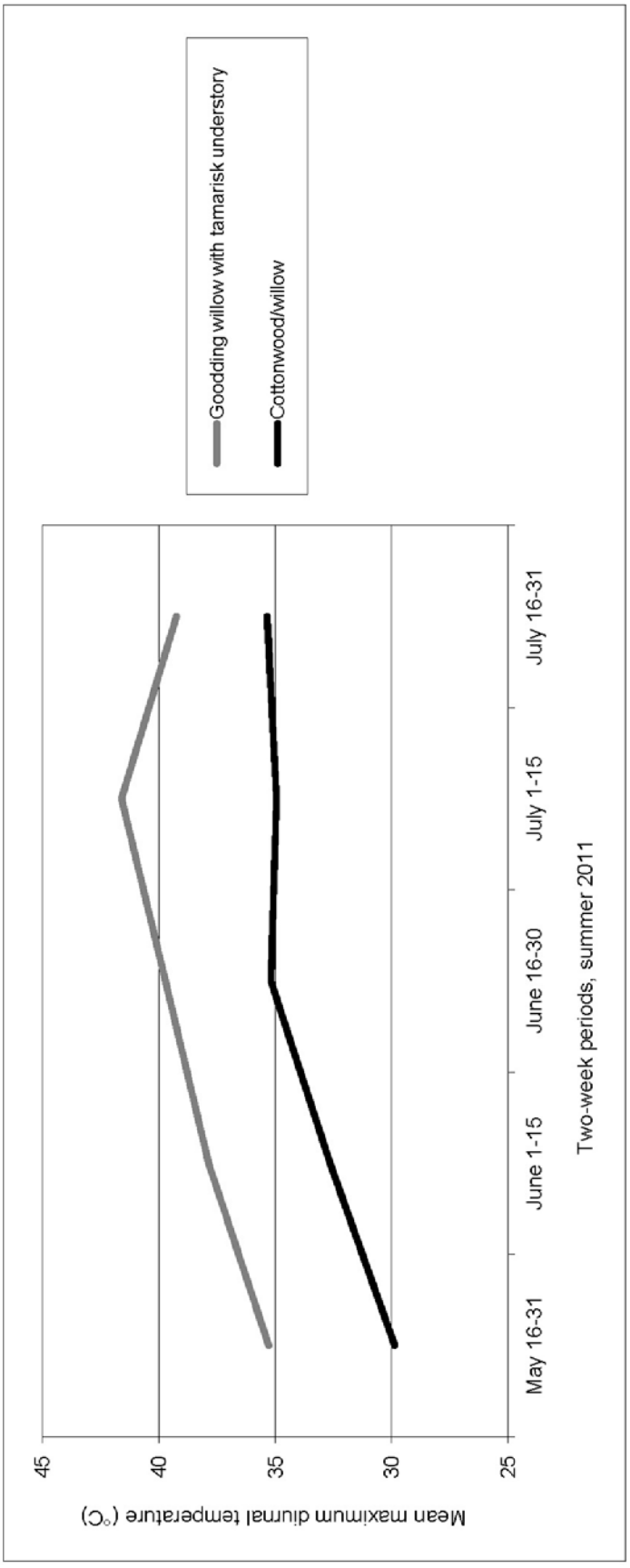


Figure 6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

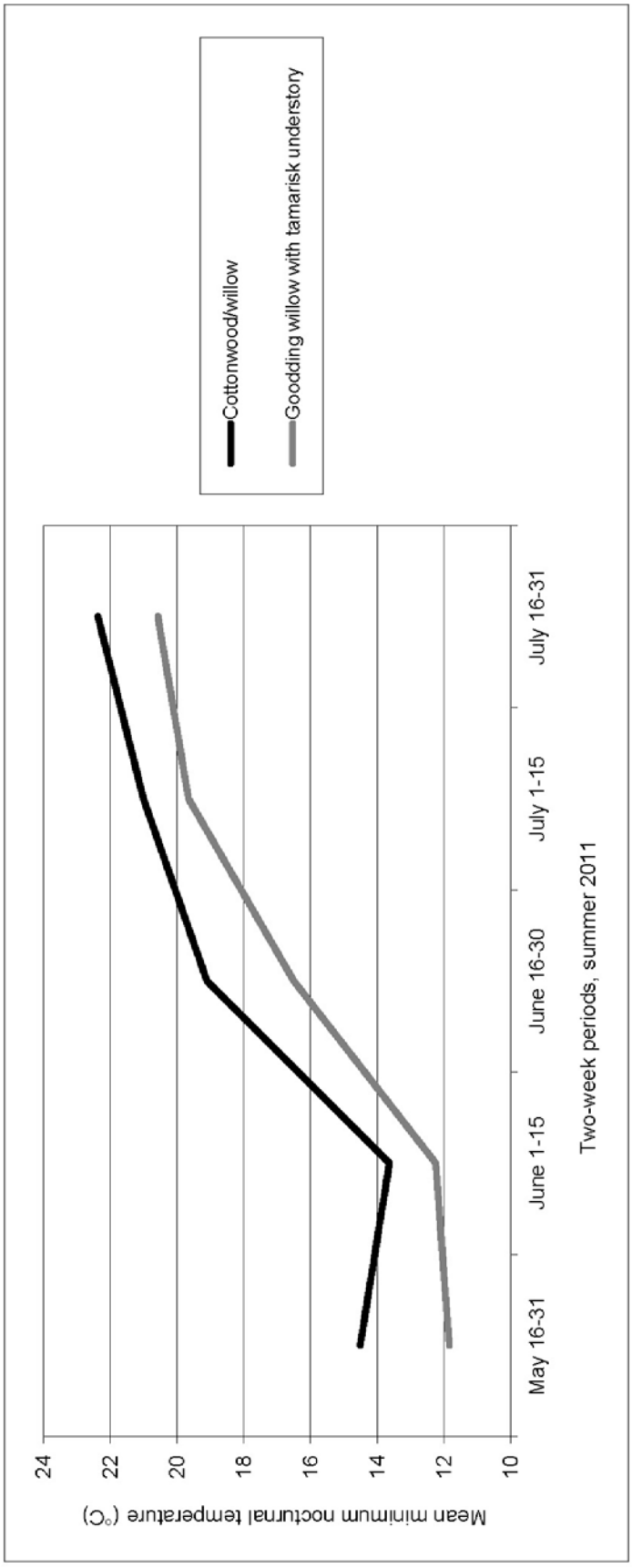


Figure 6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

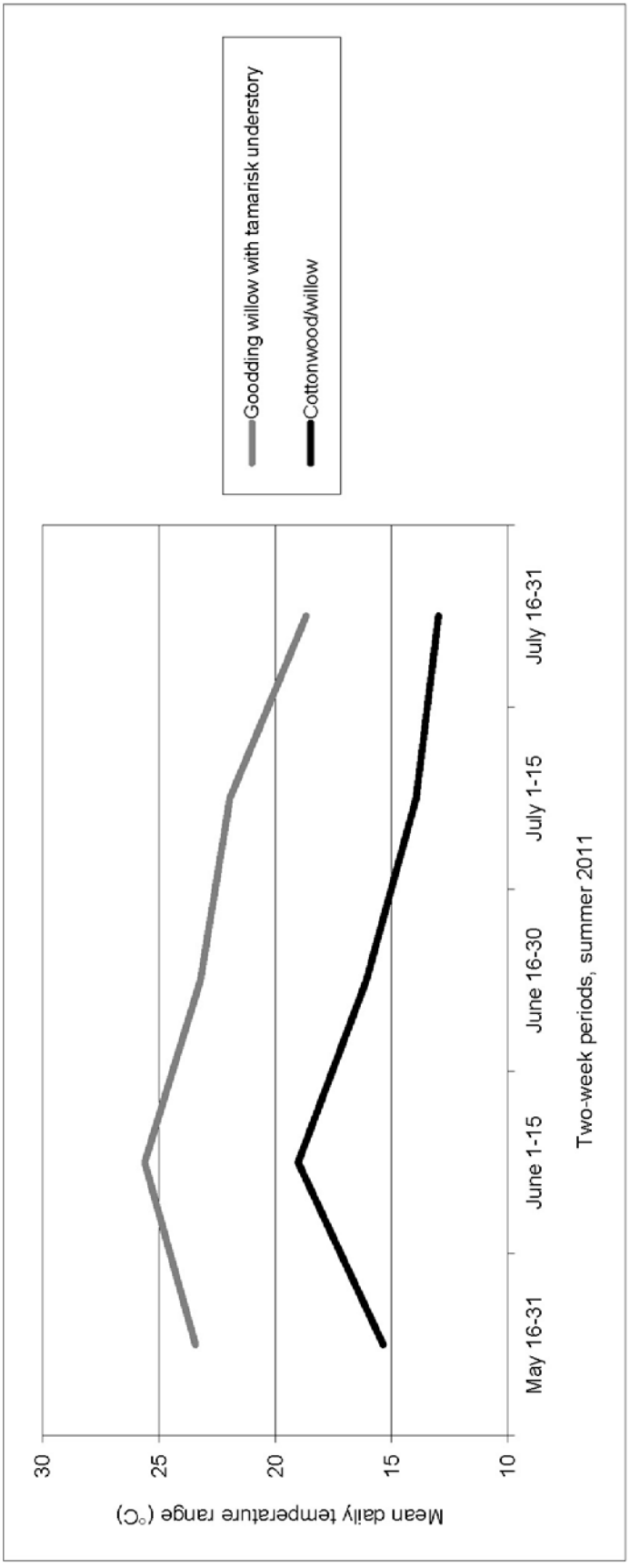


Figure 6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

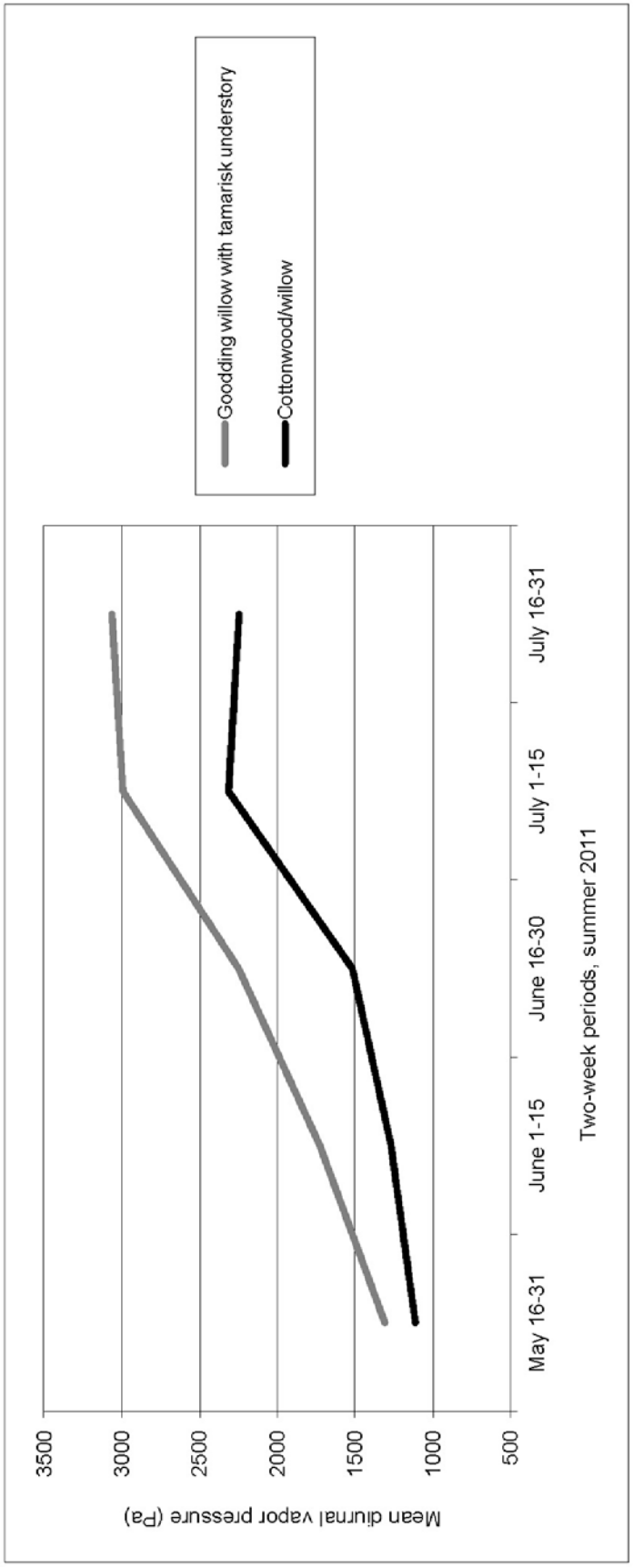


Figure 6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

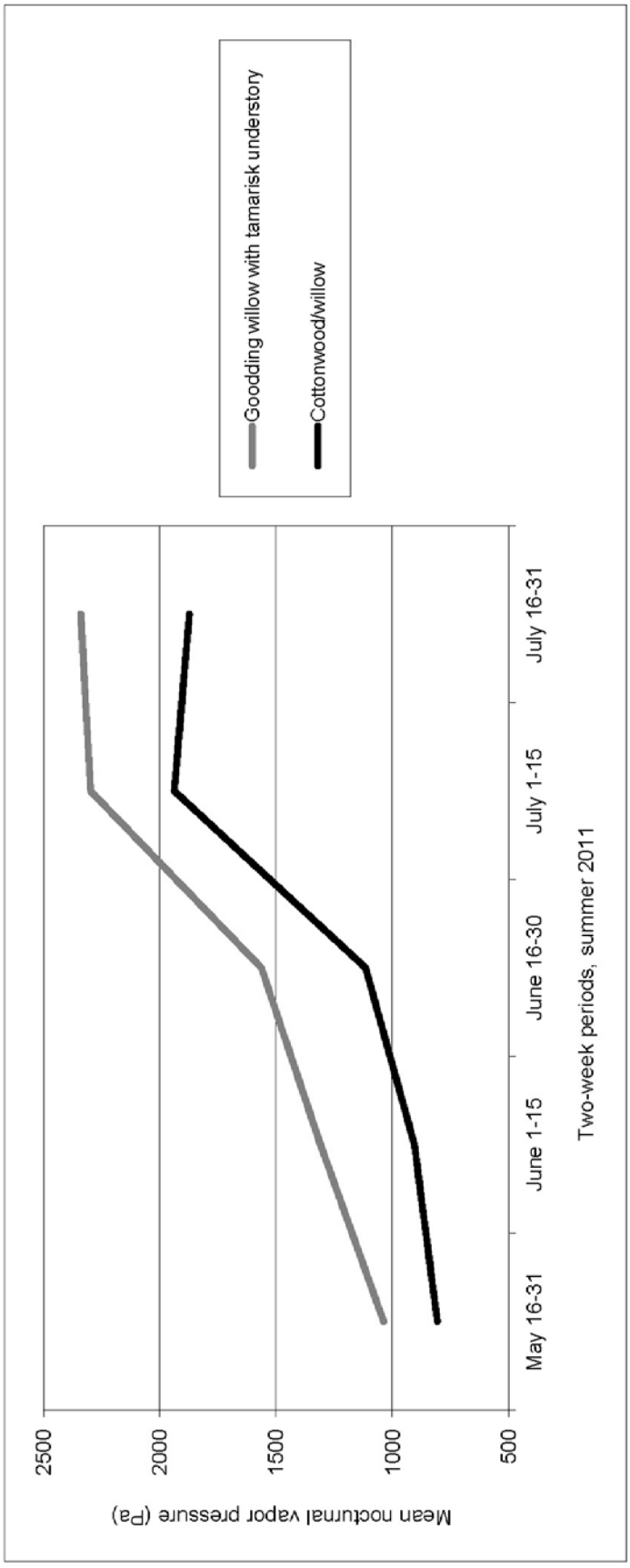


Figure 6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

Both vegetation types exhibited moist soil conditions at some point during the breeding season. Goodding willow with tamarisk understory had high soil moisture content at the beginning of the breeding season and standing water within the territory through late June. The inundated percentage of the surrounding area declined steadily through May and June, and distance to surface water was over 300 m in July and August. Cottonwood/willow had consistently high soil moisture, and the inundated percentage of the surrounding area was at least 50% throughout the breeding season.

Mean daily maximum temperatures spanned a range of ~5°C among habitat types. Daily minimum temperatures showed a smaller range of <3°C. The daily temperature range in cottonwood/willow was consistently smaller than in Goodding willow with tamarisk understory. Vapor pressure increased through the end of July for both habitat types and was higher in Goodding willow with tamarisk understory than in cottonwood/willow.

DISCUSSION

The limited data collected in 2011 preclude any meaningful comparison between habitat types and any summary of overall microclimate characteristics in flycatcher territories. Data collected in 2011 will be added to data collected in prior years for a combined analysis to be presented in the summary report in 2012.

This page intentionally left blank.

Chapter 7

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

INTRODUCTION

Southwestern Willow Flycatcher nests and breeding territories are typically located near rivers, streams, and open water (Sogge and Marshall 2000) or over wet soil (Flett and Sanders 1987, Harris et al. 1987, Harris 1991). Nest substrate plants are often rooted in or overhang standing water. Although the association between breeding flycatchers and open water or wet soil is widely recognized by managers and scientists alike, the exact nature of the association is poorly quantified. Water may be a direct environmental cue for flycatcher nesting behavior or it may be the ultimate cause of proximate factors such as vegetation composition and structure, prey base, and microclimate.

Anthropogenic or natural modifications to surface water resources (i.e., fluvial hydrology and geomorphology) can modify existing and potential flycatcher breeding habitat and therefore have the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). For example, nine flycatcher territories at San Marcial on the middle Rio Grande in New Mexico exhibited a near absence of nesting attempts in 1996 when a combination of drought, upstream dam operations, and upstream withdrawals for irrigation removed all surface water (Johnson et al. 1999). This was in contrast to previous (1994, 1995) and subsequent (1997) years when active nests were documented at the site, with the river flowing in those years. A nearby control site that contained water exhibited multiple nesting attempts during all four years, leading Johnson et al. (1999) to suggest that the presence of water was a fundamental requirement for nesting. A similar pattern was observed along the Gila River in Arizona when decreased streamflow from 2002 to 2004 coincided with the number of flycatcher territories declining by nearly half each year (Munzer et al. 2005). Since 2004, flows within the Gila River have been greater and more consistent, and correspond with a continuing increase in flycatcher territories (14 to 97) from 2004 to 2009 (Graber and Koronkiewicz 2009b).

Flow characteristics of the lower Colorado River have been modified by numerous dams and irrigation withdrawals (Rosenberg et al. 1991). The river reach between Parker Dam and Imperial Dam is regulated by releases from Parker Dam, which has been in operation since 1939. Existing riparian habitat in the Parker to Imperial reach has likely adjusted to historical water release patterns from Parker Dam and appears to be in a stable or declining condition (LCR MSCP 2004). Implementation of the Secretarial Implementation Agreements/California 4.4 Plan (hereafter SIAs) by Reclamation would change the point of diversion for up to 400,000 acre-feet of California apportionment water for up to 75 years (USFWS 2001). The point of diversion, previously located below Parker Dam at Imperial Dam, would change to a point above Parker Dam, resulting in lower water levels in the river between Parker and Imperial. The change in point of diversion was scheduled to begin in 2002.

River flow changes related to the change in point of diversion have the potential to further modify riparian habitats below Parker Dam, habitats that are presently considered potentially suitable for willow flycatcher (USFWS 2001:47). Reclamation (2000) estimated that implementation of the SIAs will cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less. As a result, 372 acres (151 ha) of occupied[1] Southwestern Willow Flycatcher habitat could lose their moist soils. This loss could influence plant species composition (loss of cottonwood and willow) and structure (loss of vegetation volume) over an undetermined length of time. In addition, Reclamation estimated that 5,404 acres (2,187 ha) of

[1] As per the USFWS, occupied Southwestern Willow Flycatcher habitat is defined as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year since surveys began in 1996.

potential flycatcher habitat could be influenced by the drop in groundwater level. These changes may affect the distribution, abundance, occupancy, and prey base of Southwestern Willow Flycatchers in the Parker to Imperial reach.

In 2004, Reclamation completed a pilot year of habitat monitoring by deploying temperature/humidity data loggers at several sites in the Parker to Imperial reach. Reclamation then initiated a more comprehensive, long-term study in 2005 for the purpose of addressing how the above hydrological changes might affect riparian habitats along the Parker to Imperial reach. The objective is to monitor 151 ha (372 acres) of occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams for 10–15 years to determine how microclimate, vegetation, and groundwater conditions might be affected by the SIAs water transfer actions. Monitoring did not commence until after diversions started; therefore, antecedent conditions are unknown and monitoring analyses focus on detecting change through time rather than comparing current conditions to a baseline. An additional objective was to compare microclimate characteristics of sites in the Parker to Imperial reach with those at flycatcher breeding areas. This analysis was completed in previous years and is not repeated here. This chapter reports the results of habitat monitoring to date.

METHODS

In 2005, we selected a subset of sites that are currently surveyed for the presence of willow flycatchers for inclusion in the habitat monitoring study. We chose 11 sites distributed along the Parker to Imperial reach that are reasonably accessible, and where we believed groundwater levels were influenced primarily by river levels and not by outside sources such as irrigation return flows. Chosen sites equated to at least 75.3 ha (186 acres) on the California side of the lower Colorado River and at least 75.3 ha (186 acres) on the Arizona side. We also chose four control sites, two above Parker Dam and two below Imperial Dam, to distinguish any changes in microclimate, groundwater, or vegetation caused by water transfer actions from those caused by fluctuations in climate or rainfall. The 11 test sites are Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron, and the four control sites are Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North (Figure 7.1). We monitored these same 15 sites from 2005 to 2011. In August of 2006, we initiated habitat monitoring within a consistently occupied breeding site at Topock Marsh to obtain groundwater levels and patterns with which we can compare results obtained at the habitat monitoring sites. The analysis comparing Topock to the 15 habitat monitoring sites was completed in previous years and is not repeated here.

Temperature/Humidity Loggers

In 2005, we deployed HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) temperature/humidity data loggers at several locations within each site selected for habitat monitoring. All loggers collected data at 15-minute intervals and were placed in inverted plastic containers and camouflaged as described in Chapter 6. All 60 logger locations selected in 2005 were retained in 2006. Two additional data loggers were installed in the Topock Marsh monitoring site in August 2006. A portion of Gila Confluence North, one of the control sites below Imperial Dam, burned in December 2006. As a result of the fire, all vegetation at one HOBO location at the site was killed, and vegetation at another HOBO location was dramatically reduced. These two HOBOs were replaced in May 2007 with HOBOs at new locations within unburned portions of the site.

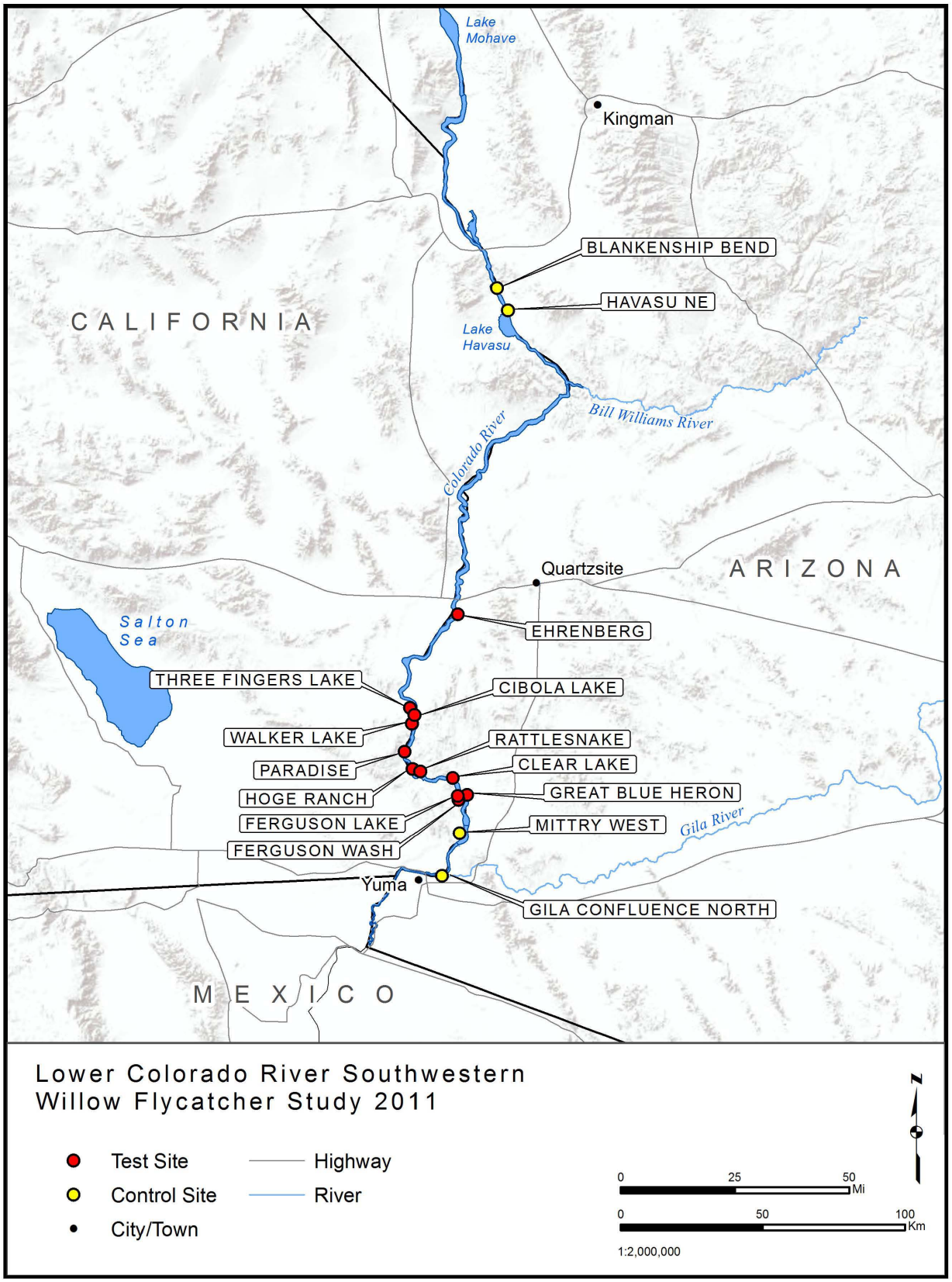


Figure 7.1. Locations of test and control sites, habitat monitoring study, 2005–2011.

HOBO loggers have been downloaded two or three times per year since installation. At each download, we examined the data to determine if there are any problems with data logger function. Data loggers were replaced whenever a potential problem with the sensors was detected. Battery level was also checked at each download, and the battery was replaced if needed.

Soil Moisture Measurements

Soil moisture beneath each HOBO logger was measured and recorded using a hand-held ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively). Soil moisture measurements were collected during each presence/absence survey between 15 May and 25 July and when HOBO data were downloaded. Soil moisture measurements, percent of the area containing inundated or saturated soil, and distance to water were recorded as described in Chapter 6.

Vegetation Measurements

We completed vegetation measurements, following the methods described in Chapter 5, at each HOBO location after flycatcher surveys were completed in late July. All HOBO loggers were also downloaded at this time. Vegetation measurements were completed at the same locations as in 2005–2010 with the exception of Gila Confluence North, where vegetation measurements were collected at the two new HOBO locations established in 2007.

Groundwater Measurements

Piezometers were installed in May–August 2005 near each of the 15 sites selected for habitat monitoring. Analyses of groundwater data in previous years showed that releases from Parker Dam can be used to predict the groundwater level beneath the habitat polygons (e.g., McLeod et al. 2007, McLeod and Koronkiewicz 2009); consequently, these piezometers were removed in 2010. Analyses of the piezometer data are not repeated here. One additional piezometer was installed at Topock Marsh within occupied flycatcher habitat in 2006; see Chapter 8 for information regarding this piezometer.

Statistical Analyses

Microclimate

The following values were calculated for all 15 habitat monitoring sites:

- Mean soil moisture from plot center to 2.0 m from plot center
- Mean maximum diurnal temperature
- Mean minimum nocturnal temperature
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure
- Mean nocturnal vapor pressure

The diurnal and nocturnal periods were determined from the daily sunrise and sunset times reported for the region by the National Weather Service (2011).

We assigned all plots as a control site (above Parker Dam or below Imperial Dam) or as a test site (between Parker and Imperial). We analyzed between-year differences in humidity and soil moisture values within these two groups using linear mixed models and analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models. These analyses were restricted to 1 June–1 August. Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

We analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models for canopy height, canopy closure, percent woody ground cover, three categories of stem sizes for both live and dead stems, the percentage of each stem size category that consisted of live stems, and the percentage of the basal area within the plot that consisted of native vegetation. In prior years we used repeated measures ANOVA for these analyses; however, repeated measures ANOVA excludes cases with missing values whereas linear mixed models allow for the inclusion of all data. We also used repeated measures linear mixed models to examine foliage density for live and dead vegetation summed over all height intervals. These analyses and all descriptive statistics were produced using SPSS® Version 16.0 (SPSS Inc.) software. We excluded vertical foliage density measurements at 5 m from plot center from the analysis so as to have comparable data across years.

RESULTS

Temperature/Humidity Logger Maintenance

All HOBO loggers were downloaded at the beginning and end of the 2011 field season. Four loggers had fallen to the ground over the winter because of sun damage to the logger housing. Five loggers that were in place over the winter had bad humidity sensors but useable temperature data, and one logger failed to collect data. Of the HOBO loggers in place May–August 2011, three failed to collect data, four had faulty humidity data, and four fell to the ground. Data from fallen loggers were not used in the analysis.

Microclimate

2011 Microclimate Descriptive Statistics

Soil moisture, temperature, and vapor pressure parameters from the 15 study sites monitored in 2011 exhibited substantial variation among sites (Table 7.1). Soil moisture varied from a low of 140.9 mV at Ferguson Wash to a high of 939.4 at Mittry West.

Mean maximum diurnal temperatures ranged from a low of 37.4^{o}C at Rattlesnake to a high of 48.2^{o}C at Cibola Lake. Mean minimum nocturnal temperatures ranged from a low of 15.1^{o}C at Gila Confluence North to a high of 20.0^{o}C at Three Fingers Lake. Mean daily temperature range varied from 19.5^{o}C at Ferguson Lake to 28.9^{o}C at Paradise.

Mean diurnal vapor pressure was lowest at Blankenship Bend (1106.6 Pa) and highest at Three Fingers Lake (1953.5 Pa). Mean nocturnal vapor pressure was lowest at Ferguson Wash (1080.9 Pa) and highest at Three Fingers Lake (1849.7 Pa).

Between-year Comparisons of Microclimate Characteristics

All microclimate characteristics varied significantly over time at test sites (Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron; Table 7.2). At control sites (Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North), mean minimum nocturnal temperature varied significantly over time, along with measures of soil moisture and humidity. Neither test nor control sites showed a unidirectional change in any of the microclimate measures in 2005–2011 (Figures 7.2–7.7), although both measures of humidity showed a generally decreasing trend at both test and control sites since 2006. The changes over time differed between test and control sites for soil moisture, mean diurnal vapor pressure, and mean nocturnal vapor pressure (right-most column of Table 7.2).

Soil moisture fluctuated among years at both test and control sites, but the patterns did not mirror one another (Figure 7.2). Between 2005 and 2006, soil moisture decreased more dramatically at control sites than at test sites, while between 2007 and 2008, soil moisture decreased at control sites but rose at test sites. Between 2009 and 2010, soil moisture decreased at test sites but rose at control sites. Diurnal vapor pressure rose more sharply at test sites than at control sites between 2005 and 2006 and then fell more sharply at test sites than at control sites between 2006 and 2007 (Figure 7.6), and nocturnal vapor pressure also showed larger fluctuations at test sites than at control sites.

Vegetation Measurements

Vegetation characteristics varied widely both between and within the selected habitat monitoring sites (Table 7.3). Average canopy height ranged from 3.3 m (Three Fingers Lake) to 9.8 m (Ehrenberg), and average canopy closure ranged from 66.9% (Ehrenberg) to 98.6% (Clear Lake). Measures of other habitat characteristics were similarly variable. Vertical foliage profiles for each site are shown in Figure 7.8. Sites typically exhibited the densest foliage within 3–5 m of the ground, and the majority of vegetation within 2–3 m of the ground typically consisted of dead branches.

Between-year Comparisons of Vegetation Characteristics

Many vegetation variables varied between years within the test and control groups (Table 7.4), but none of the variables exhibited change in a consistent direction over time (Figures 7.9–7.24). There was a significant interaction between year and location (meaning that the change between years among test sites was significantly different from the change at control sites) for woody ground cover ($P = 0.004$), number of live stems ≤2.5 cm dbh ($P = 0.043$), number of dead stems ≤ 2.5 cm dbh ($P = 0.040$), percent of live stems ≤2.5 cm dbh ($P = 0.022$), and dead vertical foliage hits ($P = 0.003$). Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years. Overall, the number of live stems ≤2.5 cm dbh decreased through time at both test and control plots (Figure 7.12), while the number of dead stems ≤ 2.5 cm dbh decreased only at control plots (Figure 7.15), though there was considerable annual fluctuation for both variables. The percentage of live stems increased at control plots but decreased at test plots (Figure 7.18). The amount of dead vertical foliage hits increased through time at both test and control plots, but increased more rapidly at test plots (Figure 7.23).

Table 7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011*

Descriptive Statistics	Blankenship Bend	Havasu NE	Ehrenberg	Three Fingers Lake	Cibola Lake	Walker Lake	Paradise	Hoge Ranch	Rattlesnake	Clear Lake	Ferguson Lake	Ferguson Wash	Great Blue Heron	Mittry West	Gila Confluence North
Soil Moisture															
Mean soil moisture (mV)	850.2 (89.7)	267.4 (74.5)	641.3 (106.7)	425. (61.3)	494.6 (114.5)	900.7 (28.6)	707.0 (50.7)	829.5 (21.5)	735.1 (44.4)	424.7 (157.2)	925.7 (15.0)	140.9 (5.5)	876.0 (9.6)	939.4 (10.8)	399.3 (104.2)
Temperature															
Mean maximum diurnal temperature (°C)	42.4 (0.3)	44.9 (0.5)	45.6 (0.4)	46.4 (0.6)	48.2 (0.3)	44.1 (0.3)	45.7 (0.4)	45.1 (0.4)	37.4 (0.2)	40.1 (0.3)	38.9 (0.3)	40.0 (0.3)	39.7 (0.3)	42.2 (0.3)	42.9 (0.4)
Mean minimum nocturnal temperature (°C)	17.2 (0.3)	18.6 (0.3)	18.2 (0.4)	20.0 (0.6)	19.9 (0.3)	16.7 (0.3)	16.8 (0.3)	17.0 (0.3)	16.2 (0.3)	18.4 (0.3)	19.4 (0.2)	19.1 (0.3)	16.3 (0.3)	17.8 (0.3)	15.1 (0.4)
Mean daily temperature range (°C)	25.2 (0.4)	26.4 (0.6)	27.4 (0.5)	26.4 (1.0)	28.3 (0.4)	27.4 (0.4)	28.9 (0.5)	28.2 (0.4)	21.2 (0.3)	21.7 (0.4)	19.5 (0.3)	20.9 (0.3)	23.5 (0.3)	25.4 (0.4)	27.8 (0.4)
Humidity															
Mean diurnal vapor pressure (Pa)	1106.6 (33.8)	1342.7 (38.2)	1133.4 (42.1)	1953.5 (92.7)	1216.0 (44.5)	1139.2 (29.8)	1336.9 (43.3)	1318.2 (33.1)	1670.7 (42.8)	1334.5 (38.9)	1359.7 (30.1)	1244.9 (30.1)	1306.1 (38.3)	1297.5 (34.1)	1269.0 (34.6)
Mean nocturnal vapor pressure (Pa)	1185.3 (32.8)	1215.5 (34.0)	1197.1 (40.0)	1849.7 (81.7)	1321.3 (38.3)	1154.9 (26.0)	1332.9 (34.8)	1316.2 (30.4)	1620.5 (37.8)	1239.3 (32.3)	1378.6 (27.3)	1080.9 (26.3)	1292.7 (33.6)	1235.8 (28.9)	1236.4 (31.8)

* Data are presented as mean (standard error).

Table 7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011*

Parameter	Test (n=45)								Control (n=15)								P-value for difference between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Soil Moisture																	
Mean soil moisture (mV)	645.7 (44.8)	634.4 (48.6)	662.9 (44.8)	705.8 (42.7)	699.2 (35.7)	651.4 (20.8)	636.2 (46.5)	<0.001	694.4 (89.8)	582.9 (98.1)	635.3 (98.4)	607.5 (90.7)	591.7 (90.6)	687.5 (36.3)	631.3 (96.4)	<0.001	<0.001
Temperature																	
Mean maximum diurnal temperature (°C)	44.9 (0.1)	46.1 (0.1)	45.2 (0.1)	46.5 (0.1)	43.8 (0.1)	45.0 (0.1)	44.0 (0.1)	<0.001	45.6 (0.2)	48.0 (0.2)	46.4 (0.2)	45.7 (0.2)	44.2 (0.2)	46.2 (0.2)	45.1 (0.2)	0.065	0.245
Mean minimum nocturnal temperature (°C)	20.7 (0.1)	22.7 (0.1)	20.4 (0.1)	20.7 (0.1)	21.2 (0.1)	20.4 (0.1)	20.1 (0.1)	<0.001	20.2 (0.2)	22.1 (0.2)	20.3 (0.2)	20.8 (0.2)	21.2 (0.1)	20.9 (0.2)	19.5 (0.2)	<0.001	0.423
Mean daily temperature range (°C)	24.2 (0.2)	23.5 (0.2)	24.8 (0.2)	25.8 (0.2)	22.6 (0.2)	24.6 (0.2)	23.9 (0.2)	<0.001	25.4 (0.2)	26.0 (0.3)	26.1 (0.3)	24.9 (0.3)	23.0 (0.2)	25.3 (0.3)	25.6 (0.3)	0.345	0.138
Humidity																	
Mean diurnal vapor pressure (Pa)	1797.2 (13.0)	2028.4 (13.5)	1737.9 (16.6)	1770.4 (12.8)	1758.9 (13.4)	1588.3 (12.6)	1556.0 (14.8)	<0.001	1726.3 (20.4)	1863.9 (21.9)	1696.9 (21.7)	1692.3 (20.5)	1701.1 (18.9)	1582.8 (17.3)	1493.4 (23.0)	<0.001	0.010
Mean nocturnal vapor pressure (Pa)	1686.3 (11.2)	1860.4 (10.5)	1852.7 (14.0)	1679.8 (10.2)	1618.0 (10.5)	1484.0 (10.3)	1507.7 (13.0)	<0.001	1638.2 (17.6)	1703.4 (18.7)	1559.9 (20.7)	1582.9 (18.4)	1583.2 (17.0)	1479.8 (15.8)	1431.0 (20.9)	<0.001	0.002

*Data are presented as means (standard error). The analysis was restricted to 1 June–1 August each year.

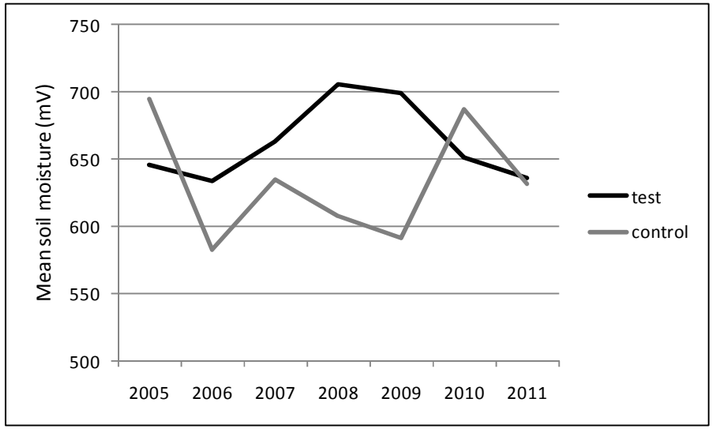


Figure 7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

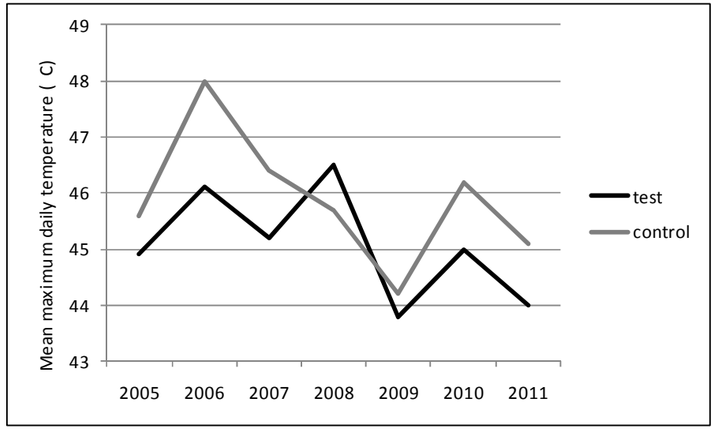


Figure 7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

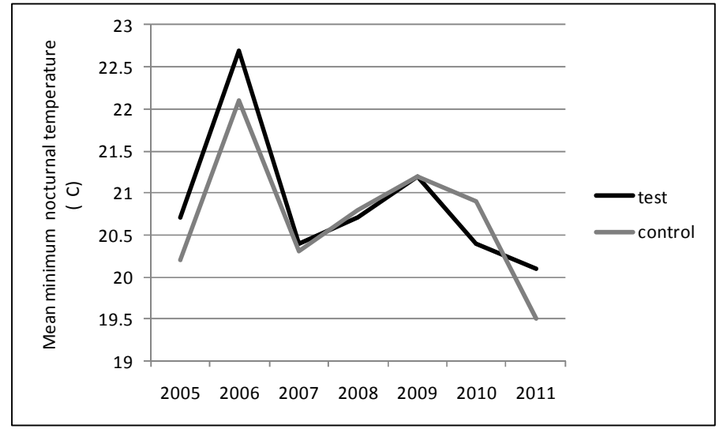


Figure 7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

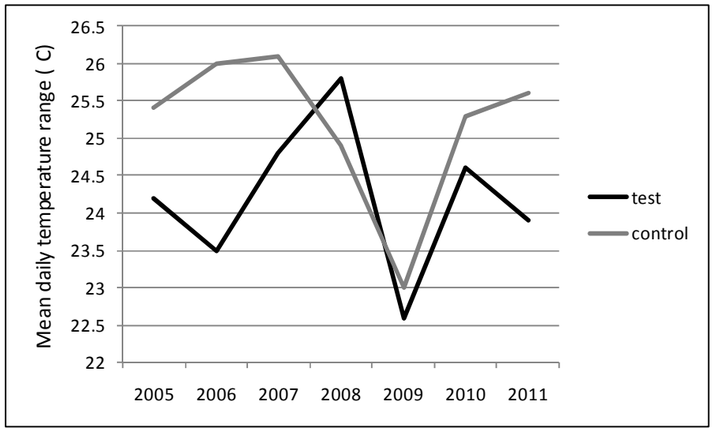


Figure 7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

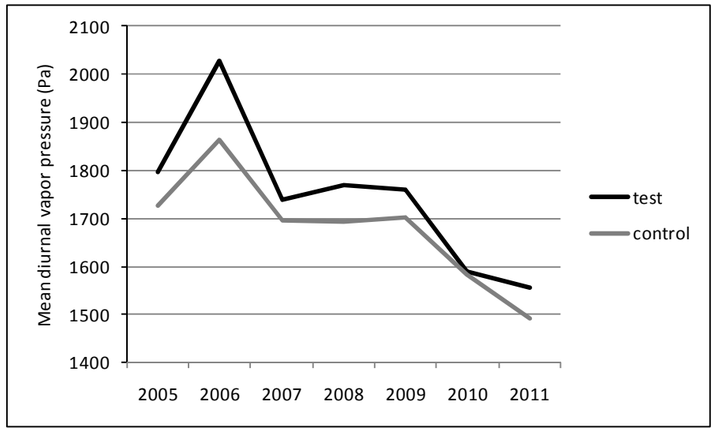


Figure 7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

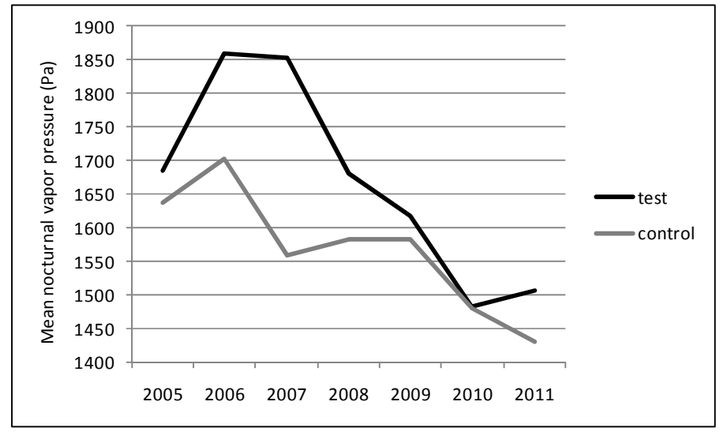


Figure 7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

Table 7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011*

Parameter	Blankenship Bend (n=4)	Havasu NE (n=4)	Ehrenberg (n=4)	Three Fingers Lake (n=5)	Cibola Lake (n=5)	Walker Lake (n=3)	Paradise (n=4)	Hoge Ranch (n=4)	Rattlesnake (n=4)	Clear Lake (n=3)	Ferguson Lake (n=5)	Ferguson Wash (n=4)	Great Blue Heron (n=4)	Mittry West (n=4)	Gila Confluence North (n=3)
Average canopy height (m)	6.2 (1.1)	3.9 (0.7)	9.8 (2.9)	3.3 (0.3)	3.9 (0.4)	7.2 (1.8)	7.8 (3.0)	4.6 (0.6)	8.1 (1.1)	7.1 (0.1)	5.2 (0.3)	5.9 (0.4)	7.7 (1.3)	7.5 (2.2)	7.4 (2.0)
	4.2–9.0	3.0–6.0	2.1–15.8	2.7–4.3	2.2–4.5	5.3–10.7	4.1–16.7	3.6–6.1	6.5–11.4	7.0–7.2	4.5–5.9	4.7–6.6	5.6–10.9	3.6–13.1	4.8–11.3
% total canopy closure	81.9 (9.6)	88 (6.6)	66.9 (14.5)	82.9 (6)	78.8 (14.5)	93.1 (3.3)	95.1 (2.3)	90.0 (3.5)	98.3 (0.7)	98.6 (1.7)	96.8 (1.6)	96.4 (1.7)	96.2 (1)	88.7 (6.4)	86.3 (6.7)
	53.1–92.2	69.3–97.4	41.1–95.8	59.4–92.7	20.8–96.9	87–98.4	89.6–99.5	82.3–98.4	96.4–100.0	95.3–100.5	92.2–100.0	92.7–99.5	93.2–97.9	69.8–97.4	75.5–98.4
% woody ground cover	76.3 (13.7)	44.7 (13.8)	38.9 (12.1)	13.9 (4.5)	34 (7.5)	79.7 (11.9)	90.9 (7.9)	60.1 (17.8)	65.1 (6.0)	51.6 (12.2)	47.2 (15.8)	35.4 (8.8)	39.8 (8.4)	41.7 (8.2)	55.4 (3.4)
	43.8–99.0	6.3–70.0	9.3–58.8	3.5–30.0	7.5–53.8	57.0–97.0	67.5–100.0	26.3–92.0	51.3–78.8	30.0–72.3	3.5–92.5	21.3–61.3	14.8–50.8	27.5–65.0	48.8–60.0
# live stems ≤2.5 cm dbh per ha	509 (360)	64 (64)	446 (331)	2266 (646)	229 (117)	212 (153)	350 (223)	796 (210)	509 (260)	255 (255)	1171 (415)	286 (210)	223 (109)	1910 (1069)	1188 (112)
	0–1528	0–255	0–1401	382–3820	0–509	0–509	127–1019	382–1273	0–1019	0–764	382–2419	0–891	0–509	0–3947	1019–1401
# live stems 2.6–8 cm dbh per ha	1432 (439)	509 (289)	668 (318)	5628 (1696)	3132 (816)	2080 (552)	3247 (2368)	2674 (597)	2324 (1216)	849 (612)	5195 (1045)	1910 (260)	3629 (1349)	3310 (909)	2928 (1083)
	255–2165	0–1273	0–1528	1783–11968	891–5984	1146–3056	382–10313	1655–3947	0–5475	0–2037	2165–8403	1401–2419	1783–7639	1401–5730	1273–4966
# live stems >8 cm dbh per ha	318 (82)	764 (172)	159 (61)	229 (199)	255 (90)	340 (278)	573 (489)	350 (109)	1337 (433)	1188 (363)	586 (154)	1114 (204)	1050 (141)	637 (356)	1316 (331)
	127–509	255–1019	0–255	0–1019	0–509	0–891	0–2037	127–637	127–2165	764–1910	127–1019	764–1528	637–1273	0–1655	764–1910
# dead stems ≤2.5 cm dbh per ha	95 (61)	0 (0)	159 (159)	331 (154)	76 (31)	0 (0)	191 (152)	64 (37)	255 (116)	0 (0)	306 (204)	127 (127)	127 (90)	1464 (667)	679 (405)
	0–255	0–0	0–637	0–764	0–127	0–0	0–637	0–127	0–509	0–0	0–1019	0–509	0–382	127–3183	0–1401
# dead stems 2.6–8 cm dbh per ha	859 (445)	32 (32)	700 (391)	942 (154)	840 (532)	127 (127)	509 (429)	2260 (1656)	796 (427)	170 (170)	764 (401)	541 (390)	541 (223)	318 (198)	1019 (515)
	0–2037	0–127	0–1655	509–1401	0–2928	0–382	0–1783	0–7130	0–1655	0–509	127–2292	0–1655	0–1019	0–891	0–1655
# dead stems >8 cm dbh per ha	95 (61)	64 (64)	0 (0)	0 (0)	25 (25)	0 (0)	0 (0)	0 (0)	127 (127)	297 (297)	0 (0)	64 (37)	159 (61)	64 (64)	42 (42)
	0–255	0–255	0–0	0–0	0–127	0–0	0–0	0–0	0–509	0–891	0–0	0–127	0–255	0–255	0–127
Percent basal area native	31.7 (19.5)	32.8 (23.6)	96.1 (2.4)	0.5 (0.5)	1.6 (1.3)	29.3 (29.3)	18.7 (18.3)	31.2 (19.2)	39.5 (21.4)	0.0 (0.0)	2.0 (1.9)	22.7 (13.7)	36.1 (15.7)	53.4 (22.4)	100.0 (0.0)
	0–80.0	0–100.0	89.1–99.5	0.0–2.3	0.0–6.8	0.0–87.9	0.0–73.5	0.0–85.1	0.0–100.0	0.0–0.0	0.0–9.6	0.0–55.1	0.0–76.4	0.0–91.4	100.0–100.0

* Data presented are means, (standard error), and range.

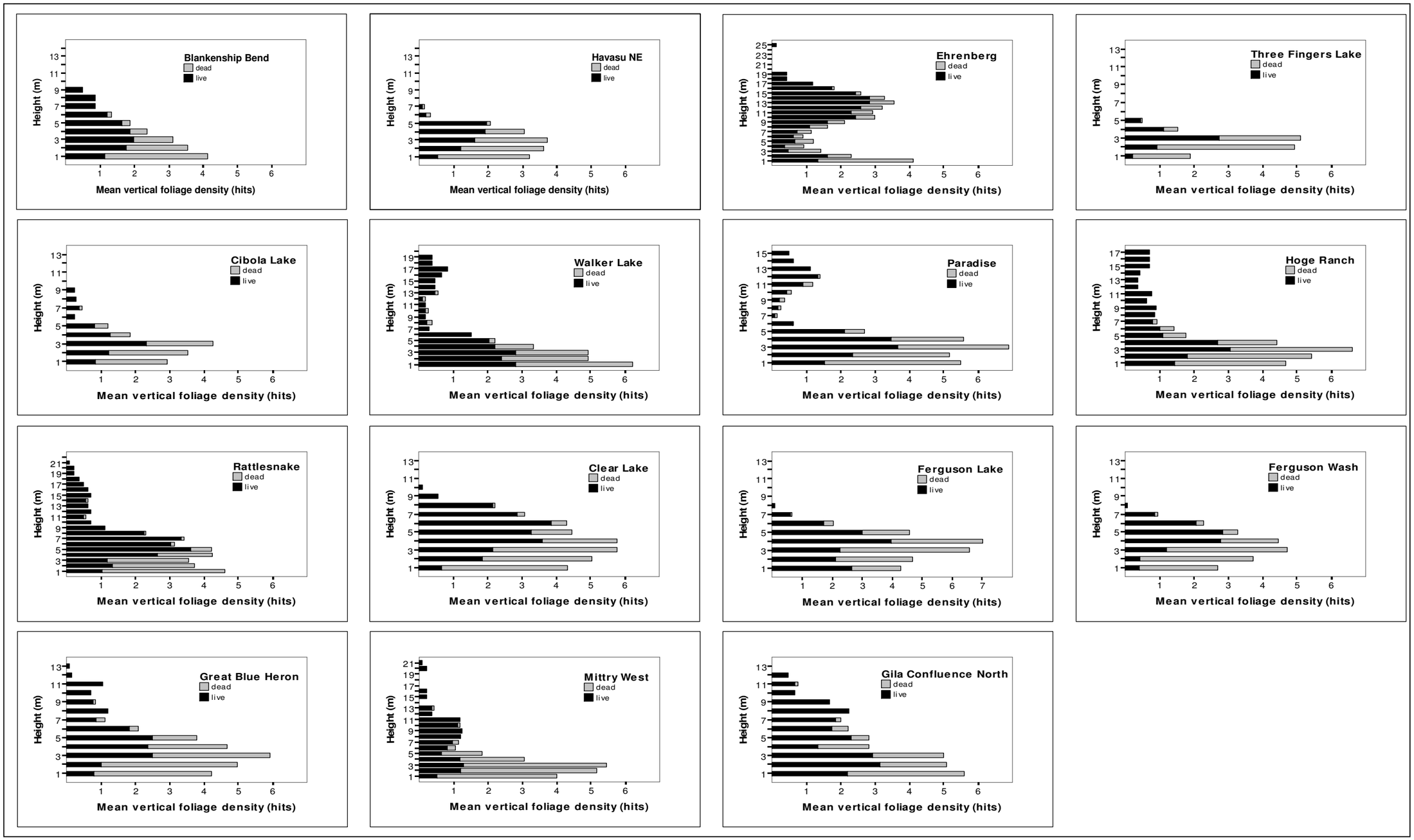


Figure 7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011.

Table 7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011

Parameter	Test (n=45)								Control (n=15)								P-value for difference in means between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Average canopy height (m)	6.6	7.0	5.8	6.7	7.1	6.5	6.2	0.055	6.6	7.0	6.8	7.7	7.0	6.9	6.2	0.004	0.493
% total canopy closure	84.7	78.3	87.9	88.1	86.7	85.3	89.7	<0.001	80.8	76.9	85.7	85.5	82.5	80.5	86.2	0.008	0.963
% woody ground cover	31.1	27.3	30.0	41.6	23.5	35.6	48.7	<0.001	24.4	46.7	40.2	53.0	31.4	38.0	54.5	<0.001	0.004
# live stems ≤2.5 cm dbh per ha	1932	2272	2515	1358	2530	1316	671	<0.001	985	2574	1842	883	1210	1010	900	<0.001	0.043
# live stems 2.6–8 cm dbh per ha	3107	2722	3143	3899	2314	3271	3030	<0.001	1655	2310	1918	2139	1401	1859	1986	0.002	0.517
# live stems >8 cm dbh per ha	481	430	654	671	597	637	628	0.025	603	646	730	730	546	586	722	0.048	0.587
# dead stems ≤2.5 cm dbh per ha	340	1282	1259	1084	1949	1075	161	<0.001	1214	1492	1367	1384	1455	552	552	<0.001	0.040
# dead stems 2.6–8 cm dbh per ha	1234	821	925	1879	1081	1310	778	0.015	1061	437	747	1392	609	475	526	<0.001	0.790
# dead stems >8 cm dbh per ha	48	59	96	108	91	110	54	0.096	59	82	127	59	118	85	68	0.892	0.866
% live stems ≤2.5 cm dbh	81.7	66.1	66.3	61.0	52.4	57.2	75.2	<0.001	51.9	63.2	55.7	41.4	41.8	70.3	65.8	0.082	0.022
% live stems 2.6–8 cm dbh	72.8	74.6	77.1	68.3	66.1	69.1	77.8	0.033	70.8	79.2	70.2	58.6	64.6	79.5	76.0	<0.001	0.139
% live stems >8 cm dbh	92.8	84.6	87.7	91.8	89.0	88.4	96.0	N/A[1]	90.8	89.1	89.4	89.9	81.9	84.5	86.0	N/A[1]	0.540
Percent basal area native	27.2	20.3	28.9	23.8	21.6	22.1	24.1	0.195	42.7	52.8	59.9	46.9	45.0	57.9	51.4	0.274	0.090
Total live foliage hits	17.4	17.7	11.3	17.0	19.3	17.1	17.8	<0.001	18.1	15.5	16.5	18.4	17.5	16.9	14.3	0.335	0.375
Total dead foliage hits	9.3	10.0	5.1	10.8	9.1	14.1	10.5	<0.001	8.4	6.6	6.1	11.0	6.3	8.5	9.2	0.042	0.003
Percent live foliage hits	62.7	62.0	65.8	58.7	63.8	56.1	59.3	0.006	69.1	70.0	69.6	64.8	72.9	67.6	58.7	0.065	0.281

[1] Model failed to converge; no P-value.

Table 7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Difference (2001–present)	% Change (2001–present)
January	6,820	5,599	6,478	6,327	5,536	4,166	5,842	5,945	4,850	6,177	3,794	5,983	384	6.9%
February	9,123	8,505	8,978	6,881	7,129	4,888	7,798	8,491	8,232	7,137	5,960	6,470	-2,035	-23.9%
March	11,594	10,524	11,334	12,360	11,523	9,699	9,752	11,122	12,180	11,973	10,879	10,881	357	3.4%
April	14,613	14,090	13,610	13,803	12,824	11,356	11,985	12,618	14,293	13,184	11,259	12,594	-1,496	-10.6%
May	14,174	14,068	12,826	11,990	12,252	11,428	11,998	11,718	11,339	10,533	10,765	10,798	-3,270	-23.2%
June	13,803	14,733	13,713	12,778	12,741	12,444	12,383	12,116	11,957	9,992	10,931	11,394	-3,339	-22.7%
July	14,210	14,974	14,439	13,100	12,331	13,842	11,688	12,180	12,226	10,645	12,098	11,438	-3,536	-23.6%
August	11,441	12,047	12,118	10,803	11,420	10,316	10,141	10,317	10,720	9,459	10,508	8,951	-3,096	-25.7%
September	11,233	10,837	10,429	11,159	9,566	9,048	7,334	9,195	9,072	8,492	9,803	7,637	-3,200	-29.5%
October	9,362	8,852	8,765	9,761	7,405	6,967	7,424	7,204	7,568	7,241	7,562	7,111	-1,741	-19.7%
November	7,437	7,357	7,049	6,153	5,163	6,335	6,094	5,420	6,369	6,136	6,435		-922	-12.5%
December	6,706	5,970	5,615	5,737	4,129	4,841	5,507	4,079	3,829	4,872	4,315		-1,655	-27.7%

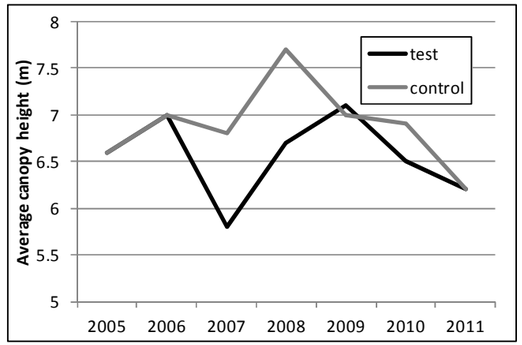


Figure 7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

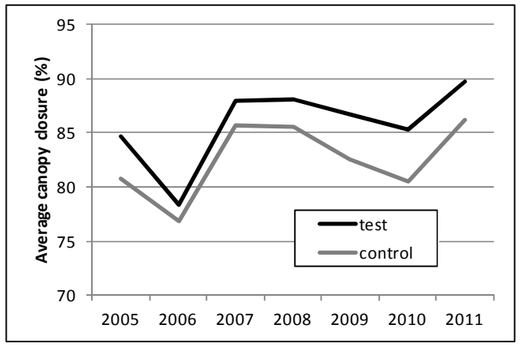


Figure 7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

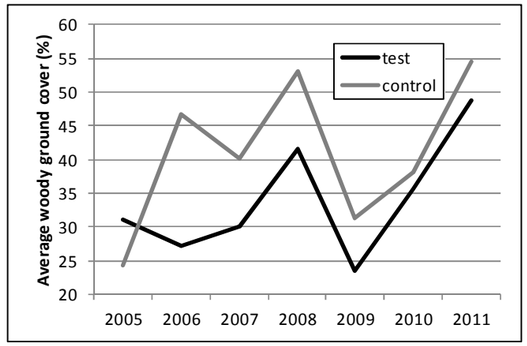


Figure 7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

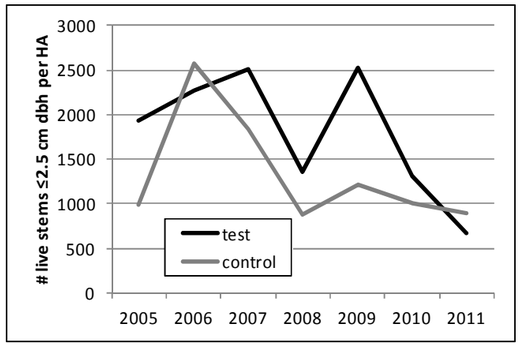


Figure 7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

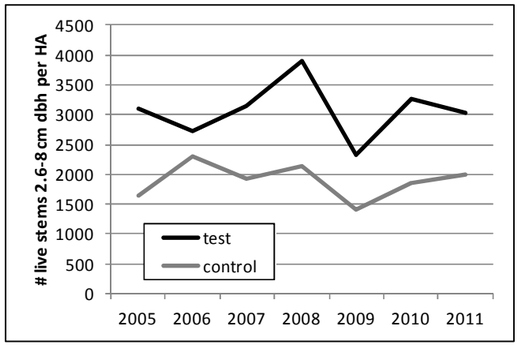


Figure 7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

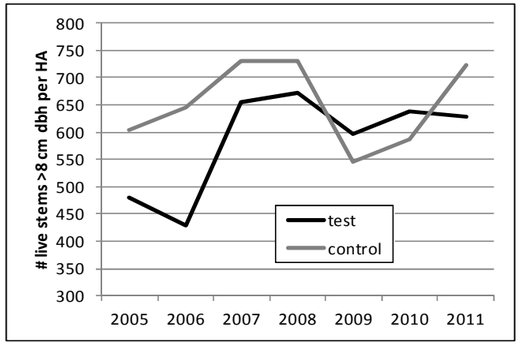


Figure 7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

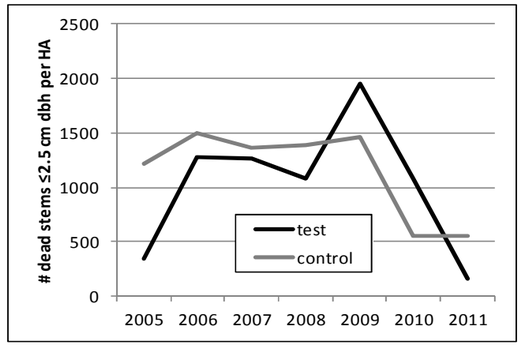


Figure 7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

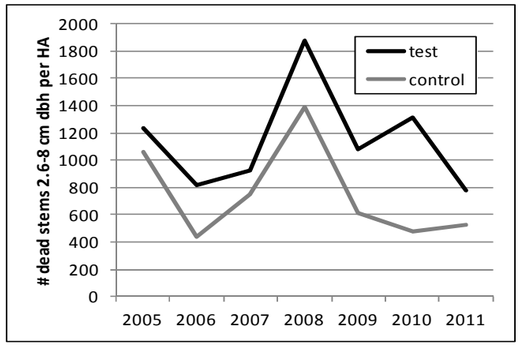


Figure 7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

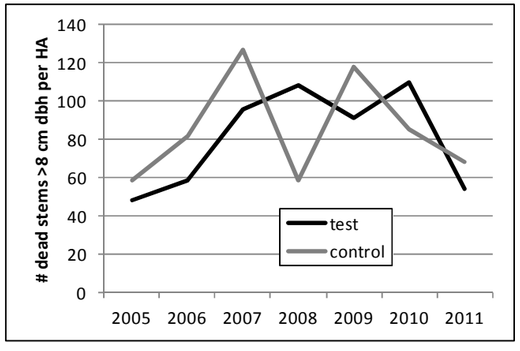


Figure 7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

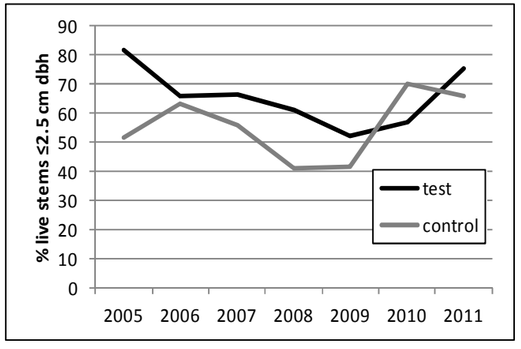


Figure 7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

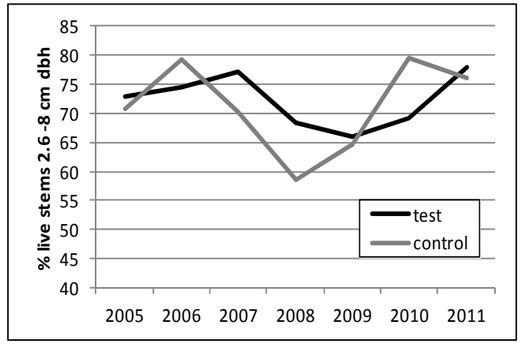


Figure 7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

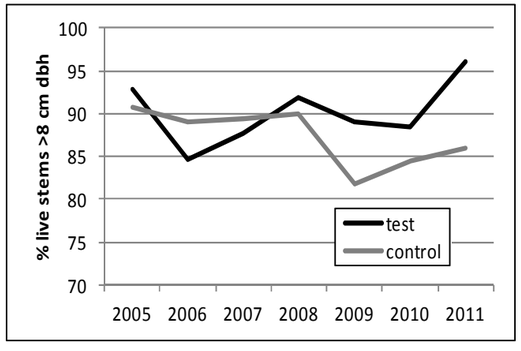


Figure 7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

DISCUSSION

Microclimate

Between-year Comparisons of Microclimate Characteristics

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 than in the other years and cooler conditions in 2009. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. However, the role of river flows in influencing soil moisture is unclear, given that no strong relationship was found between piezometer levels and soil moisture (McLeod and Koronkiewicz 2009). Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station (Coop ID 46118; Figure 7.25). Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

Vegetation

Between-year differences across all sites were noted for many variables, but none showed unidirectional trends over time, suggesting there has been no overall, detectable change in vegetation. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years.

Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality (but see discussion of stem counts, below).

The pooling of all sites into a test vs. control analysis may obscure changes in vegetation at specific sites. For example, one vegetation plot at Ehrenberg contained a significant coyote willow component (98% of the total basal area) in 2005. The willow gradually died over the next several years until no live willow remained in 2009. Most of the vegetation along the LCR, including at the sites selected for habitat monitoring, consists primarily of tamarisk, which is less sensitive than willow to changes in water availability. Measurable changes in overall vegetation as a response to reduced groundwater levels may take several years to develop in tamarisk, or the tamarisk may change very little if at all.

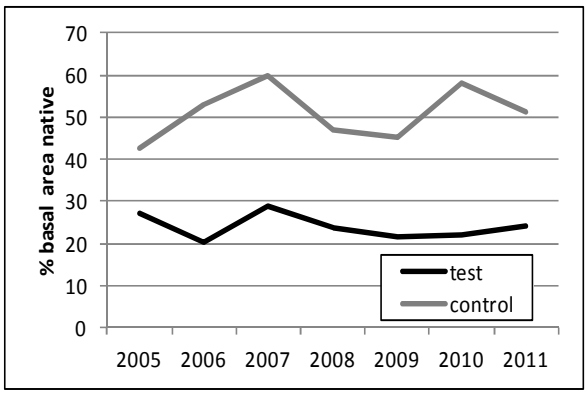


Figure 7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

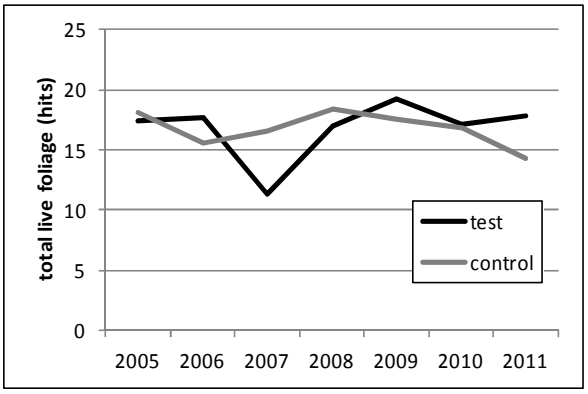


Figure 7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

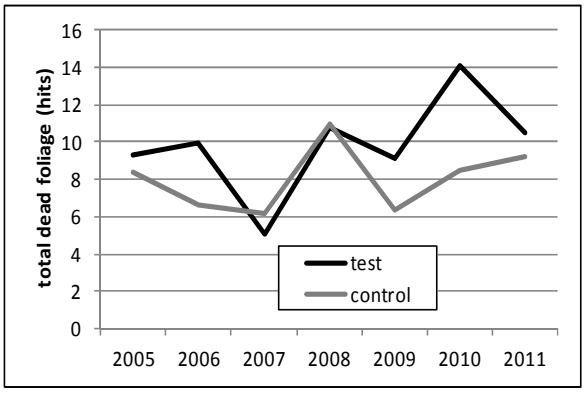


Figure 7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

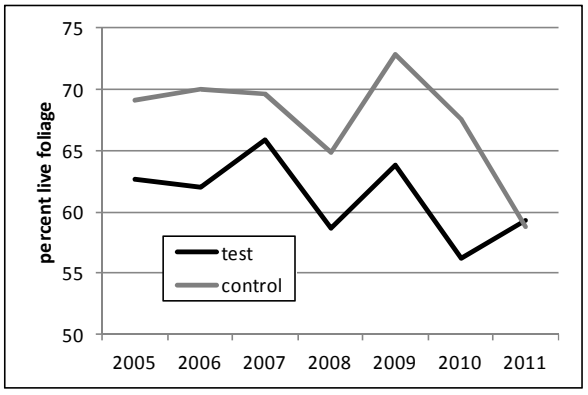


Figure 7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

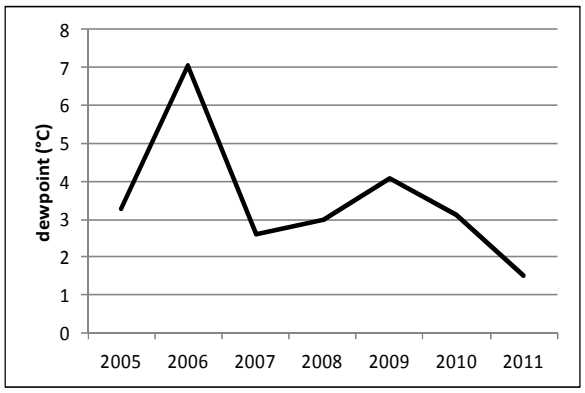


Figure 7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Repeatability of stem counts depends on having a plot of fixed size. Each plot is divided into quadrants, with a rope having the 5-m distance (the edge of the plot) clearly marked extended in each cardinal direction from plot center. It can be nearly impossible to extend the rope flat or straight, introducing variability into the size of the plot. Even more problematic than this, however, is the inability of the observers, in very dense vegetation, to see the cardinal ropes from the center of the quadrant or to see the center of the plot from the edge to be able to envision an arc connecting the ends of two adjacent cardinal ropes and delineating the edge of the circular plot. Observers vary widely in their ability to estimate distance, and when reference points are not visible, it is very difficult to determine whether a stem near the edge of the plot falls within the plot or not. In 2009, we explicitly instructed observers to use a measuring tape to determine the distance from plot center for any stem for which inclusion in or exclusion from the plot seemed questionable.

This method should help reduce difficulties in producing repeatable stem counts but still depends on observers being able to tell when they are near the edge of the plot and taking the extra time to measure distance if the inclusion of a stem is in question. Another factor that inhibits accurate stem counts in dense vegetation is the difficulty in keeping track of which stems have been counted already and which have not. In 2009, we began using chalk to mark stems that had already been counted to try to minimize omission or double-counting of stems.

Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred as the result of decreasing flows from 2001 to 2005 (see Table 7.5). Other methods, such as analysis of satellite imagery, would have to be used to detect any changes in vegetation that might have occurred prior to 2005.

Groundwater Levels

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

In previous years we correlated piezometer ground water levels and soil moisture measurements and found no strong linear relationship. The strongest relationships were found at sites that had the highest soil moisture values. This suggests that at sites where soil moisture is low, surface soil moisture content is not influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

This page intentionally left blank.

Chapter 8

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

INTRODUCTION

Monitoring of Southwestern Willow Flycatcher populations at Topock Marsh began in 1997, and data on number of flycatcher pairs and nest success are available for 1998–2011. The breeding population at Topock declined from a high of 29 pairs in 2004 to fewer than 10 pairs in 2007 and 2008. This decline prompted concern from USFWS about the flycatcher population at Topock, which was presumed to be the likely source population for any flycatchers that would colonize restoration areas on the lower Colorado River. USFWS and Reclamation initiated discussions after the breeding season of 2008 to identify habitat enhancement measures that could be implemented at Topock Marsh in an attempt to raise the number and productivity of flycatchers.

The affinity of breeding Southwestern Willow Flycatchers with standing water and saturated soil is noted consistently in the literature (e.g., Johnson et al. 1999, Munzer et al. 2005, McLeod et al. 2008a, Graber and Koronkiewicz 2009b), and flycatcher nests along the Middle Rio Grande that were above inundated or saturated soil all season produced more young per successful nest than nests that were above dry soil all season (Moore and Ahlers 2008). An examination of water levels within Topock Marsh from 1997 to the present shows that after 2004, water levels peaked at lower levels, high water levels were of shorter duration, and over-winter lows were lower than was the case prior to 2004 (Figure 8.1). Because of the influence of surface water on flycatcher occupancy and productivity, USFWS and Reclamation developed a plan to pump water into a portion of the flycatcher habitat at Topock Marsh.

Two adjacent areas within Topock, known as In Between and 800M, were selected in 2008 as the location for habitat enhancement via supplemental water delivery. The number of breeding flycatcher pairs in these areas declined steadily from 10 in 2004 to 0 in 2008, but the vegetation in the area had not changed markedly during that time (McLeod and Koronkiewicz 2010). The addition of surface water and saturated soil to this area might make it more attractive to flycatchers and increase nest success and productivity of any flycatchers that nest in the area. In addition, widespread inundation could make portions of In Between, 800M, and the surrounding area that typically had been dry during surveys since 2003 and not occupied by flycatchers more suitable for flycatcher occupancy.

Supplemental water delivery commenced in March 2011. We monitored hydrological, microclimate, and vegetation conditions at In Between, 800M, and the adjacent area of Pierced Egg in 2009 and 2010 to assess baseline habitat conditions. We completed the same monitoring in 2011 during water delivery.

METHODS

Water Delivery

Over the winter of 2010–2011, the water delivery system was installed. The system consisted of a Crisafulli trailer pump, modified to be hydraulically driven and capable of moving approximately 41.6 m^3 (11,000 gallons) of water per minute, along with a 0.61 m (24 inch) diameter pipe carrying the water into the target area (In Between, 800M, and Pierced Egg) from the open water of Topock Marsh.

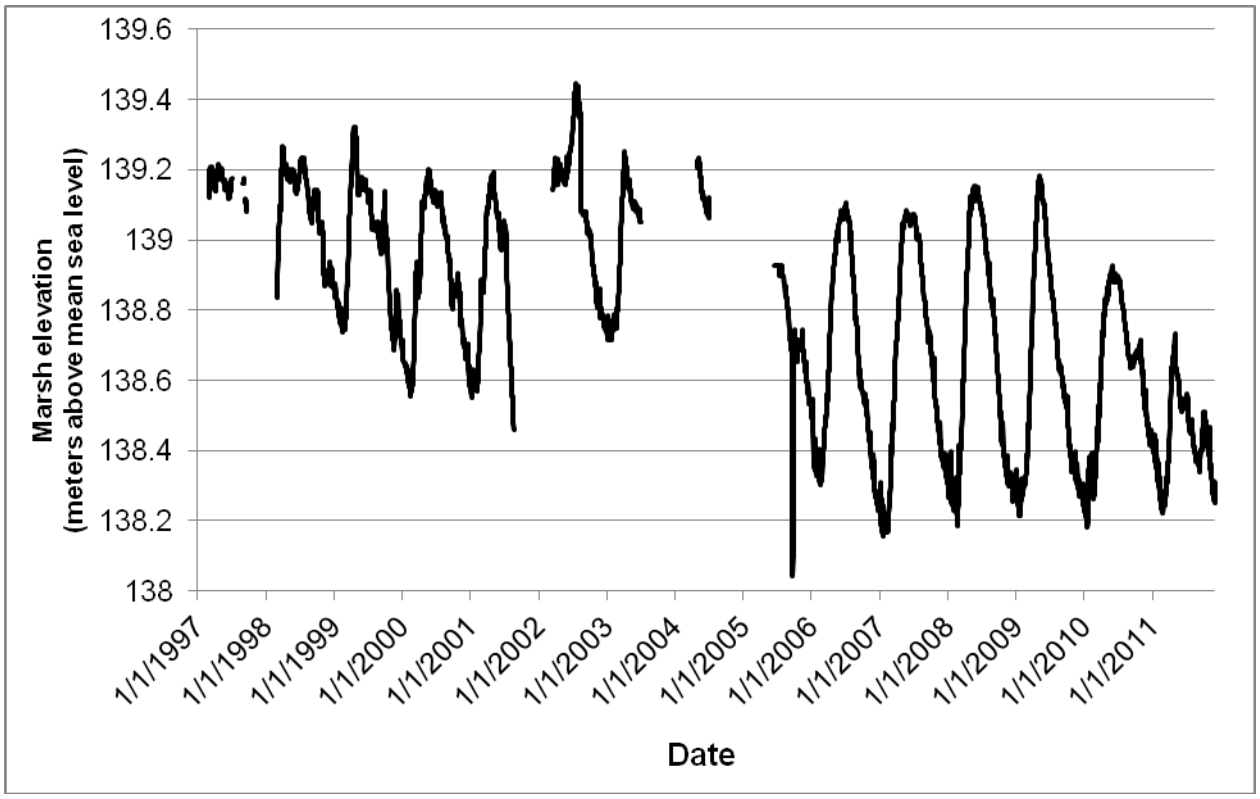


Figure 8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011.

Surface Water Mapping

We mapped surface water at weekly intervals between 14 March and 21 July 2010. In 2011, we mapped water within the target area immediately prior to the initiation of water delivery on 1 March and for three days following the initial pumping. This provided baseline data on water levels, the maximum extent of water, and the longevity of water within the target area. We continued visiting In Between, 800M, and Pierced Egg at approximately weekly intervals through mid-July. During each visit, we traversed trails throughout each site and used GPS and aerial photographs to map the extent and depth of surface water within the sites. At the conclusion of each visit, we compiled our GPS points and field notes to prepare a hardcopy map of the sites, with areas of surface water and saturated soils delineated on the map and indexed to a key detailing the nature (e.g., pig wallow, open marsh, flooded forest) and depth of each wet area. All hardcopy maps were digitized after the field season using ArcGIS. From the digitized shapefiles, we calculated the percentage of the target area that contained surface water at each visit.

Groundwater Measurements

A 0.02 m (¾-inch) diameter shallow well, or piezometer, equipped with a pressure transducer and data logger was installed in 2006 in In Between at Topock Marsh as part of habitat monitoring between Parker and Imperial Dams (see Chapter 7). This piezometer is within the target area of water delivery and thus was left in place when the other piezometers used in the study were removed. This piezometer is described in McLeod et al. (2007) and has been downloaded approximately three times per year since installation. At each download we checked the battery level and function of the data logger. Batteries were replaced as necessary and data were examined to ascertain potential equipment malfunction.

Data Collection

A pressure transducer/data logger equipped with a vented cable collected data hourly at the piezometer. These devices measure and record pressure of the water column present in the well, and these pressure measurements are then converted into water levels (in distance below top of casing). With vented cables and data transfer ports there is no need to correct measurements for atmospheric pressure changes, and the data can be downloaded at the wellhead without disturbing the pressure transducer in the well.

During the initial installation of the pressure transducer, as well as at each data download thereafter, water level was manually measured in the piezometer using an electric water level sounder (Solinst-brand). This known water level was then used to program the pressure transducer with a baseline measurement from which all other automatically recorded water levels were calculated.

Data Validation

We have identified several potential sources of error in the water levels recorded by piezometers. We developed a rigorous protocol to validate each data download, determine if any errors exist with the data, and correct the raw data if possible. Specific sources of error are identified below.

Install Drift. Because piezometers are constructed such that the pressure transducer is almost the same diameter as the inside of the piezometer, removing and inserting the pressure transducers to change batteries can change the water levels in the piezometer temporarily but drastically.

Operational Drift. In rare cases, the accuracy of the data loggers can change in the time period between downloads.

Improper Setup. After downloading data, the data logger is reset for the next round of measurements. Conducting the startup procedure improperly can lead to errors; fortunately, most of these setup errors can be corrected. Common errors include mistakenly setting the type of reference used (i.e., recording water level elevation instead of depth), not resetting the starting water level reference value to the water level value measured manually in the field, and not restarting the data logger but continuing with the previous setup.

At each download, we compared the water level recorded by the piezometer with the manual measurement. We also checked the data logger parameters to determine whether the data logger was initialized properly. If a discrepancy >0.09 m (0.3 feet) existed between the data logger and the manual measurement, and this discrepancy could not be accounted for and corrected by examining the setup parameters and applying an appropriate correction factor, the data were not used for analysis.

Microclimate

In 2009, the In Between, 800M, and Pierced Egg polygons were stratified into use (occupied by flycatchers) and non-use (unoccupied by flycatchers) areas, as observed in 2003–2008. Use areas tend to be wetter than non-use areas and thus are presumably low-lying and more likely to be affected by water delivery into the habitat. We excluded the cattail marsh in the center of the 800M polygon from either the use or non-use areas. We superimposed a 25- x 25-m grid on a GIS software shapefile of the use and non-use areas, numbered the grid blocks, and selected blocks using a random number generator. We used the centroid of the selected block as the sample point and located each point in the field by navigating to the given coordinates using a Rino 110 GPS unit. We determined the exact location of each sample point by means of random number sequences as described in Chapter 6. All sample points used in 2009 were marked in the field with flagging that remained in place over the 2009–2010 and 2010–2011 winters,

allowing for relocation at the beginning of each subsequent season. We relocated each sample point in 2011 and redeployed a data logger in the same location. We used HOBO H8 Pro data loggers (see Chapter 6) to record temperature and humidity at each sample point at 15-minute intervals. Each logger remained in place until the end of the flycatcher breeding season. We collected soil moisture readings, as described in Chapter 6, below each data logger at bi-weekly intervals.

Vegetation

In late July of each year 2009–2011, at the end of the flycatcher breeding season, we collected vegetation measurements at each HOBO logger location. Vegetation plots were centered on the logger, and we collected the vegetation measurements described in Chapter 5, with the exception of stem counts. Given the relatively short time span between the implementation of water delivery and the subsequent vegetation measurements, any responses in vegetation are more likely to be apparent in canopy closure and vertical foliage density than in stem counts.

Data Analyses

We had originally stratified the sample points into use and non-use areas on the assumption that the use areas were more likely to be inundated during water delivery. The water that was pumped into the target area did not reach all the use areas; therefore, we reclassified the points into flooded and non-flooded areas (also referred to as flood groups) according to whether the point was within 20 m (i.e., within a distance that would be encompassed by a flycatcher territory [Sedgwick and Knopf 1992]) of the maximum extent of water recorded immediately post water delivery in 2011. We compared data collected during 2011 to those collected in 2010. We did not include data from 2009 in the comparison because temperature and humidity data collected at the Needles, California weather station (Coop ID 46118) indicated that weather conditions in 2011 were overall more similar to those in 2010 than in 2009, and similar weather data between years may facilitate interpretation of between-year comparisons.

Microclimate

Microclimate data were summarized as described in Chapter 6. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures analysis using a linear mixed model to compare the seasonal changes in flooded versus non-flooded areas in 2010 and 2011. We also used a repeated measures analysis using a linear mixed model to compare temperature and humidity variables the day after a flood event to those recorded the day before the flood event in flooded versus non-flooded areas in 2011. All analyses were completed using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

Vertical foliage data were summarized as described in Chapter 5. Percent native vegetation was calculated as the percent of the foliage hits that consisted of native vegetation. We used the average nest height (3.78 m) recorded at In Between, 800M, and Pierced Egg from 2003 to 2008 to delineate the below, at, and above nest height categories. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures linear mixed model to compare the conditions measured in each flood group in 2011 versus those measured at those same points in 2010. We also used this model to detect any year*flood group interactions, which indicate that the between-year change detected for a given variable in the flooded area differed from the change detected in the non-flooded areas. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

RESULTS

Water Delivery

Water delivery was initiated on 1 March and continued through 7 July. The pump was operated once a week for several hours (Table 8.1), and the hours of operation and flowmeter readings were recorded in a log book.

Table 8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011

Date of Pumping	Hours Operated	Total Pump Output (millions of gallons)	Total Pump Output (cubic meters)	Date(s) of Water Mapping
1 Mar	4.7	3.10	11735	27–28 Feb, 1–3 Mar
10 Mar	5.9	3.89	14725	11 Mar
17 Mar	3.3	2.18	8252	18 Mar
24 Mar	4.8	3.17	12000	25 Mar
31 Mar	5.3	3.50	13249	1 Apr
7 Apr	4.5	2.97	11243	8 Apr
13 Apr	4.3	2.84	10751	15 Apr
21 Apr	4.3	2.84	10751	22 Apr
28 Apr	4.5	2.97	11243	29 Apr
5 May	5.6	3.70	10221	---
12 May	4.0	2.64	9994	14 May
19 May	4.1	2.71	10258	20 May
26 May	1.8	1.19	4505	24 and 29 May
2 Jun	3.5	2.31	8744	3 Jun
9 Jun[1]	4.2	2.77	10493	8 Jun
16 Jun[1]	4.2	2.77	10493	17 Jun
23 Jun	4.0	2.64	9994	22 Jun
30 Jun	4.5	2.97	11243	1 Jul
7 Jul	4.0	2.64	9994	6 and 15 Jul

[1] No data recorded, hours and pump output estimated from flowmeter reading on 23 Jun.

Surface Water Mapping

Immediately prior to the start of water delivery on 1 March, surface water was limited to pig wallows in Pierced Egg (Figure 8.2, map from 28 February). Surface water covered portions of In Between and 800M immediately after pumping on 1 March (Figure 8.2, map from 1 March). There was a noticeable decrease in water extent over the following two days (Figure 8.2, maps from 2 and 3 March; and Figure 8.3), but we determined that weekly pumping would be sufficient to maintain elevated water levels within the target area. From March to late May, all weekly visits occurred on the day immediately following water delivery. Starting in late May, we alternated our weekly visits to fall on the day before water delivery and the day after water delivery so we could document minimum and maximum extent of water (Table 8.1). During this latter part of the season, the extent of the inundated and saturated area in In

Between and 800M remained relatively constant throughout each week following pumping (Figure 8.4). In general, water delivery maintained water levels above those of 2010 (Figure 8.3), despite the markedly lower water levels within Topock Marsh in 2011 compared to 2010 (see Chapter 2).

We noted an increase in surface water within Pierced Egg starting in March and peaking by mid-April; by the end of April, Pierced Egg was completely dry (Figure 8.5). Surface water from the pumping did not flow into Pierced Egg, and the fluctuation of water levels in Pierced Egg was likely the result of a rise in local groundwater levels, which typically peak in April (see Groundwater Monitoring, below) and could also have been influenced by water delivery. The peak in groundwater levels is reflected in the overall percentage of In Between, 800M, and Pierced Egg that was inundated or saturated, which also peaked in mid-April and fell rapidly by early May (Figure 8.3). Water delivery appeared to result in a greater extent of surface water early in the season when overall groundwater levels throughout the area were relatively high. Later in the season, when overall groundwater levels had dropped, surface water was generally restricted to In Between, with portions of 800M sometimes having saturated soil.

Groundwater Monitoring

The piezometer at Topock Marsh shows that local groundwater levels typically peak each year in April (Figure 8.6). Daily cycles are apparent in the hydrograph across all years, showing low water levels during the afternoon hours when vegetation water demands and evapotranspiration are greatest and high water levels in early morning hours. The magnitude of the daily cycle is greatest during the summer months when vegetation demands are greatest and lowest during the winter months when cooler daily temperatures and dormant vegetation result in lower water demands.

Weekly trends in groundwater levels were apparent in March–July 2011 (Figure 8.7) and paralleled the pumping schedule, with groundwater rising on the day of pumping and falling through the week until the next pumping. When groundwater levels were at relatively high levels in March and April, each pumping session increased the groundwater level at the piezometer approximately 0.08 m (0.25 feet) and then the water level fell linearly through the week until the next pumping session. As water levels dropped in May and June, the effect of each pumping session on the water level at the piezometer increased; each pumping session increased the water level by up to 0.23 m (0.75 feet), and water levels fell more rapidly immediately following pumping than they did later in the week. The groundwater level recorded by the piezometer peaked at the highest level recorded in any year since 2006, showing that water delivery raised the local groundwater table within the target area despite the overall lower water table in the marsh (see Chapter 2).

Microclimate

In 2010, we deployed 15 HOBO loggers in the flooded area and 17 loggers in the non-flooded area between 14 and 29 March (Figure 8.8). All loggers functioned correctly in 2010. In 2011, we deployed HOBO loggers in these same locations between 27 February and 11 March. In 2011, two loggers, one in the flooded area and one in the non-flooded area, failed to launch and collected no data; one logger in the flooded area had a faulty humidity sensor, and humidity data from this logger were excluded from the analysis. Data analyses were restricted to the period between 1 April and 15 July to encompass the dates when all loggers were deployed in both years. In 2010, soil conditions became progressively drier throughout the season for both the flooded and non-flooded areas, while temperatures rose throughout the season and vapor pressure values showed the typical rise seen in July with the onset of summer monsoons

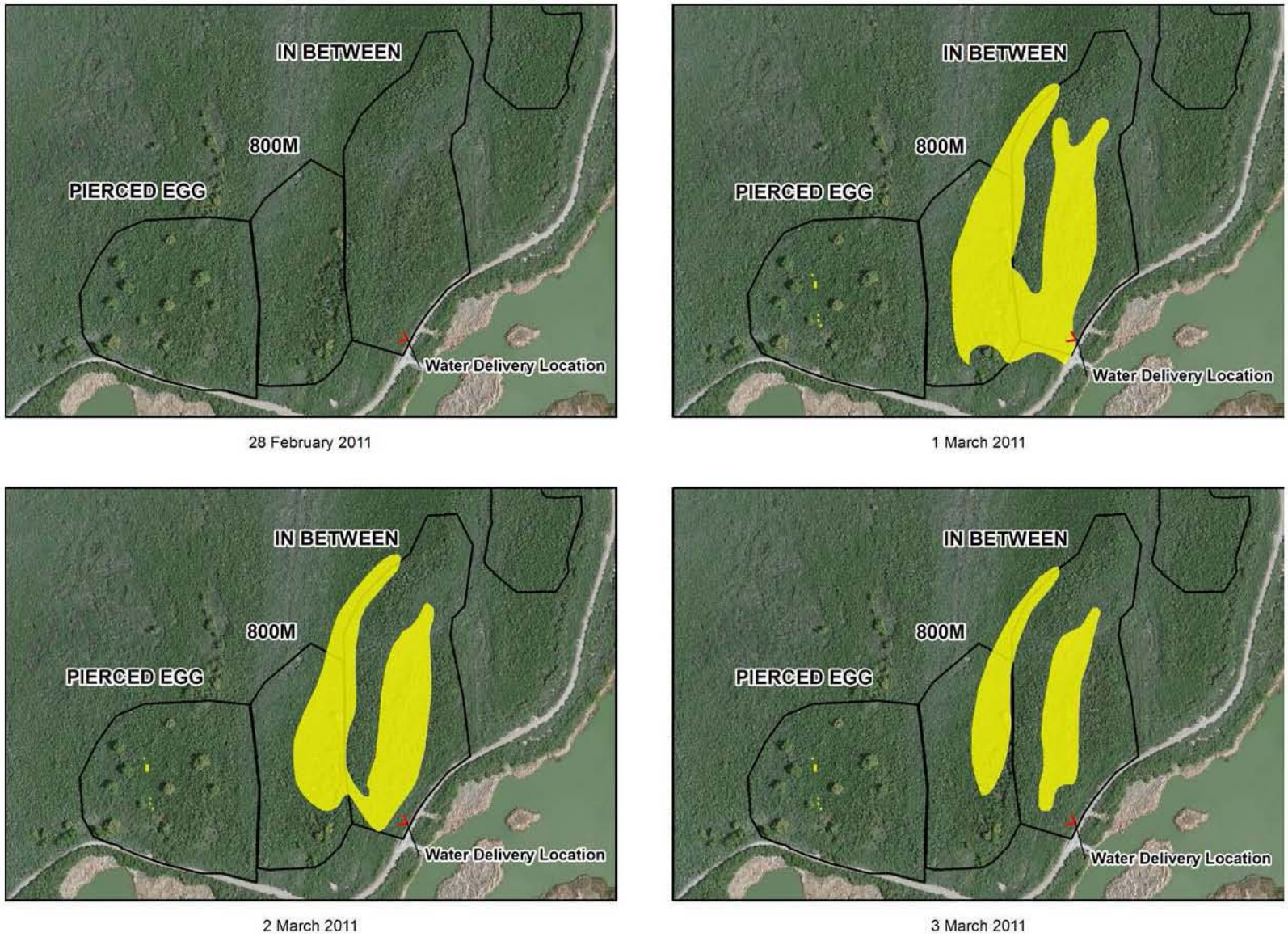


Figure 8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011.

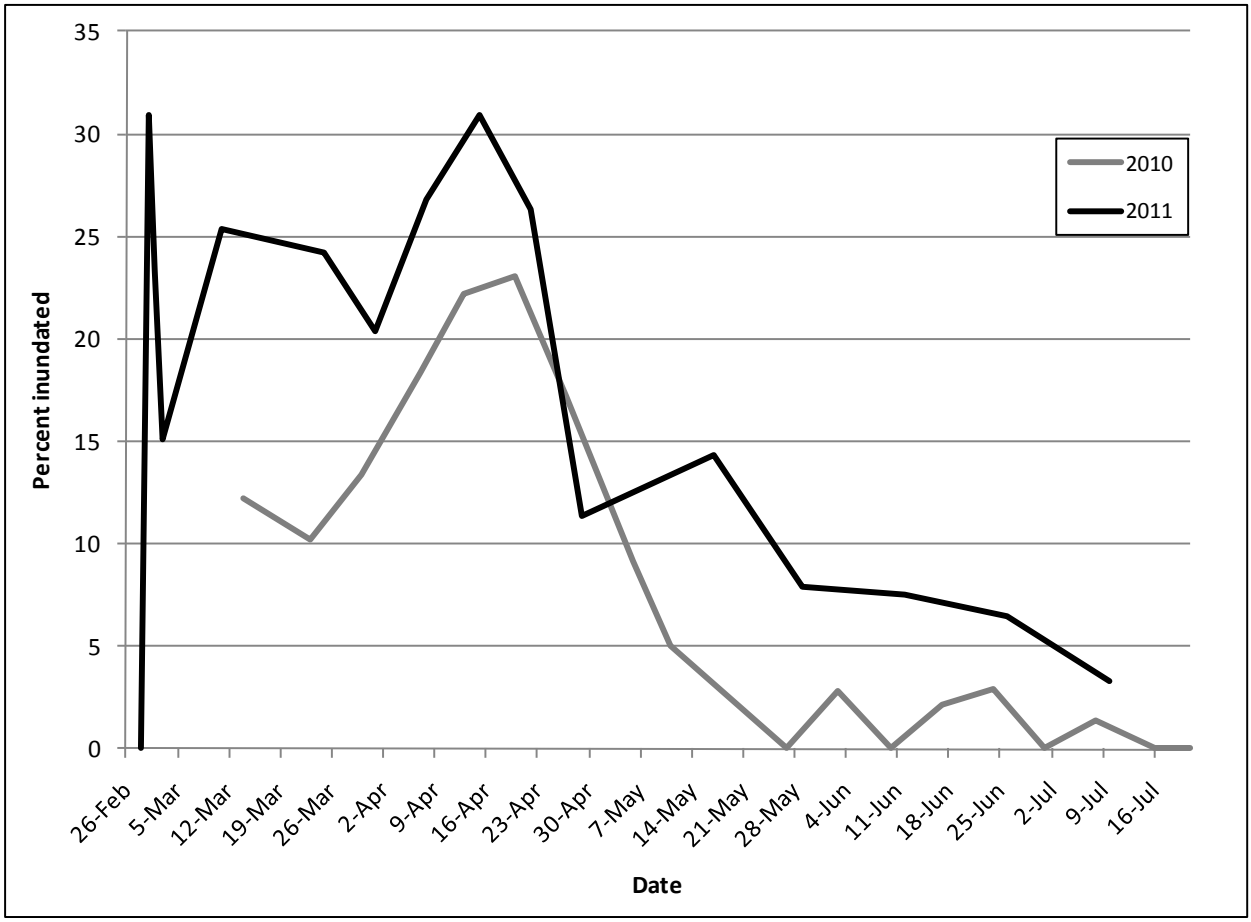


Figure 8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. Percentages are averaged over two-week periods for June and July 2011, because weekly visits alternated between the day before and the day after pumping.

(Tables 8.2 and 8.3). These same overall patterns were seen in 2011 (Tables 8.4 and 8.5). These data are shown graphically for easier comparison of data between years (Figures 8.9a–8.17a). Data are also shown as the difference between the flooded and non-flooded areas in both 2010 (the control year) and 2011 (Figures 8.9b–8.17b). If flooding had no effect, we would expect the differences between the flooded and non-flooded areas to be similar in both years.

Table 8.6 presents the significance test results (*P*-values) for the comparison of flooded versus non-flooded areas in 2010 and 2011. The first two columns show the comparison of each microclimate variable, overall across the season, in the flooded versus non-flooded areas in 2010 and 2011, respectively. Baseline data were collected in 2010, so significant *P*-values in this column indicate inherent differences between the flooded and non-flooded areas. A significant *P*-value in the column for a given year indicates a difference between flood groups, and corresponds to a significant gap between the solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. A significant *P*-value for a given variable in only one year but not both suggests an effect of flooding.

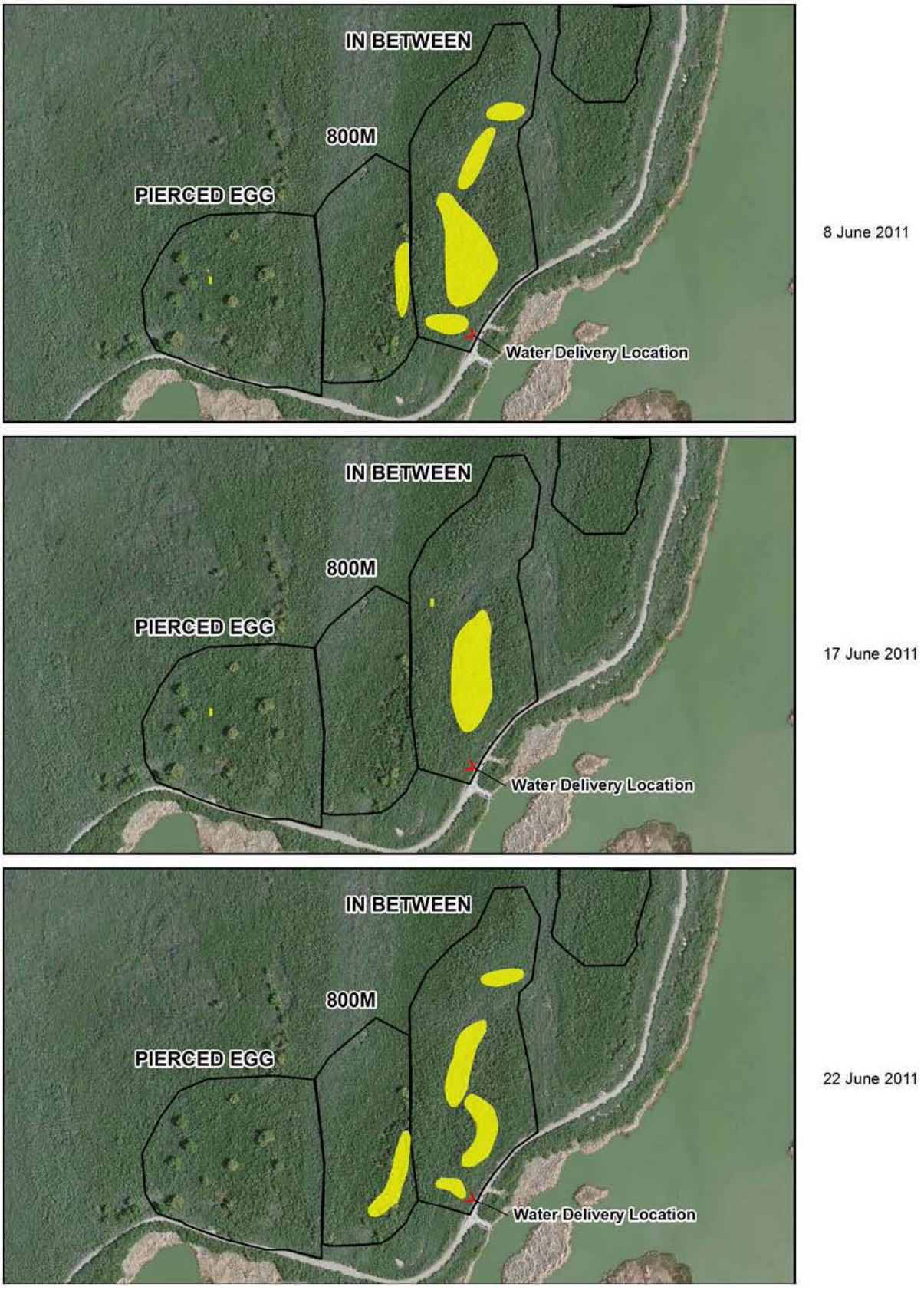


Figure 8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011.

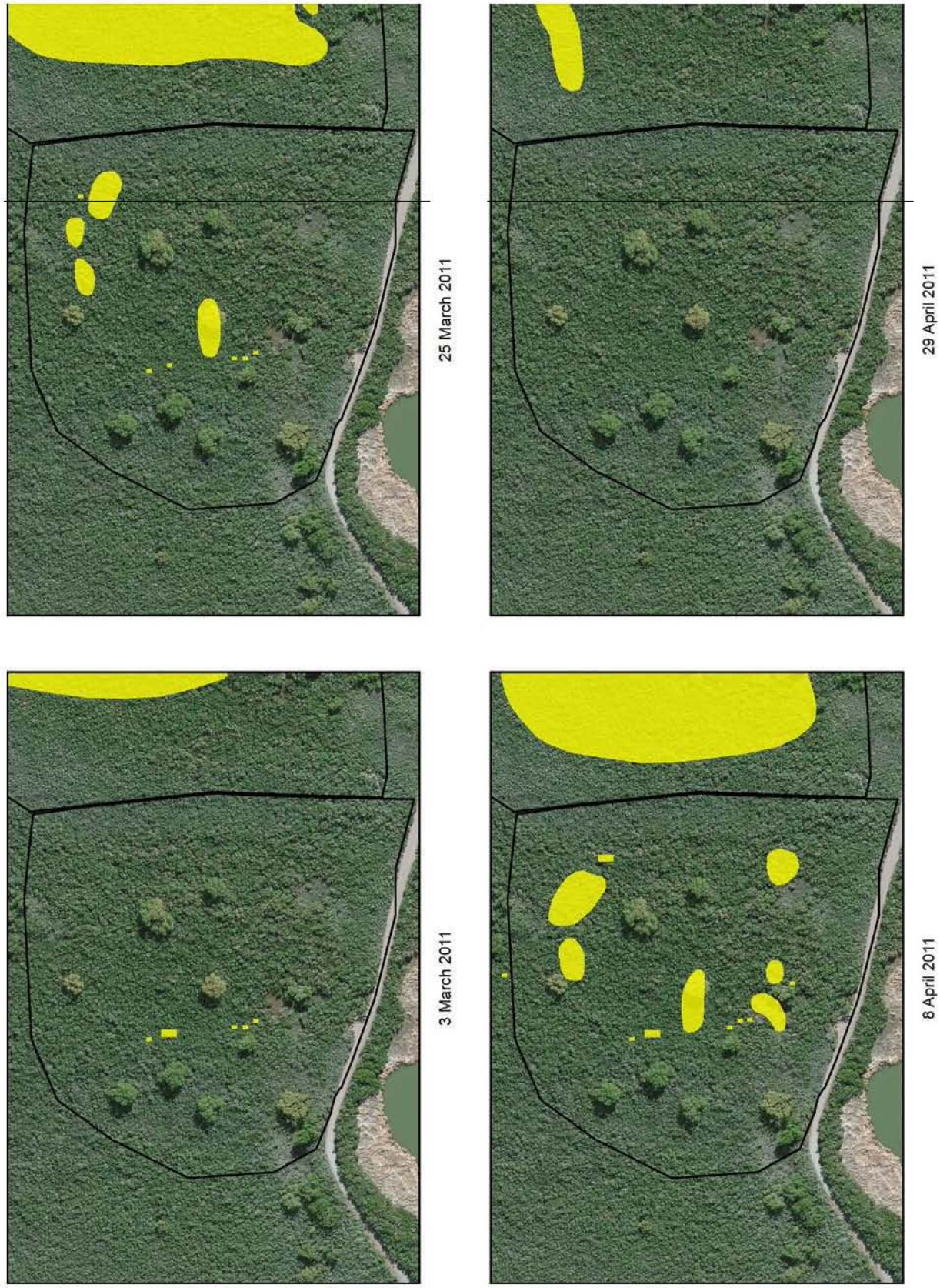


Figure 8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011.

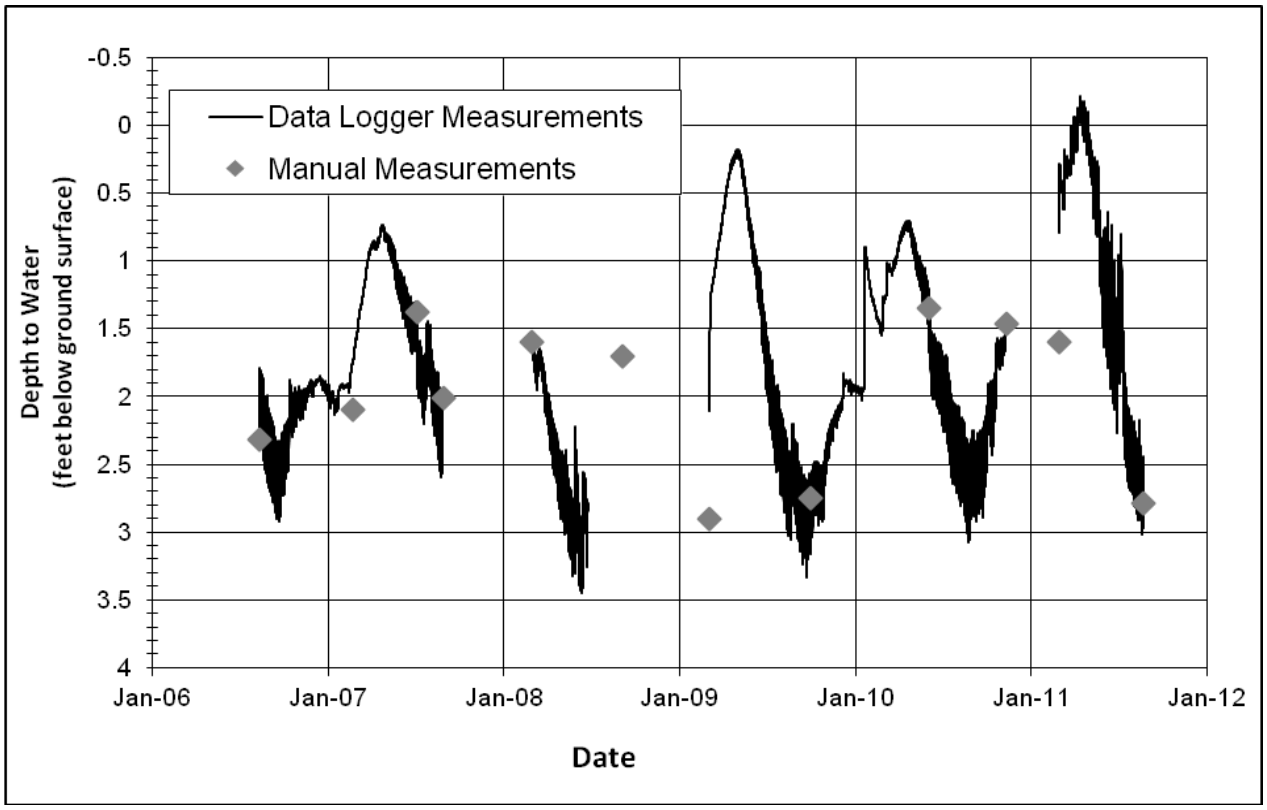


Figure 8.6. Topock Marsh hydrograph, 2006–2011.

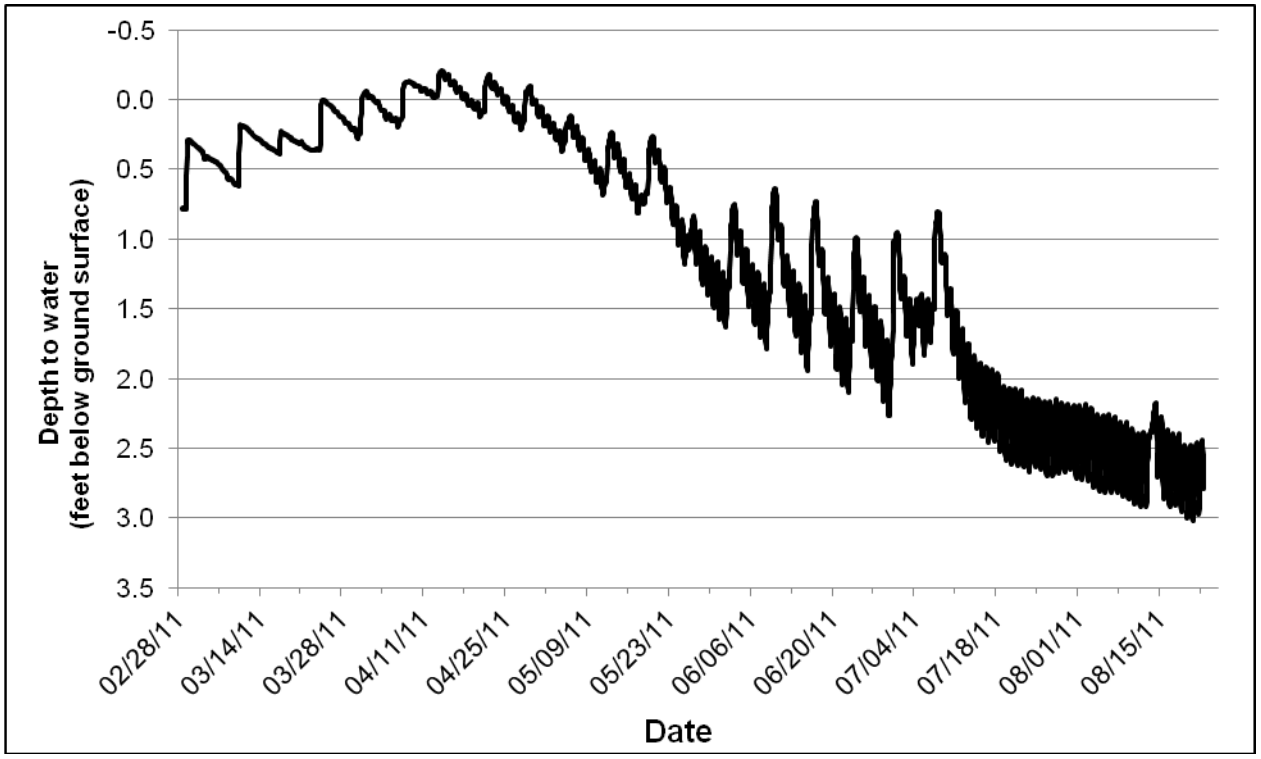


Figure 8.7. Topock Marsh hydrograph, February–July, 2011.

We also examined how each microclimate variable changed through the season. The third and fourth columns of Table 8.6 show *P*-values for the comparison of seasonal change in the flooded vs. non-flooded areas (i.e., the time*flood group interaction) in 2010 and 2011, respectively. Significant *P*-values in either column indicate that the microclimate variable changed through the season in the flooded area in a different way than in the non-flooded area in that year, and corresponds to non-parallel solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. Again, a significant *P*-value for a given variable in one year but not the other suggests an effect of flooding.

We also examined between-year differences for soil moisture variables within the non-flooded and flooded areas (columns 5 and 6, respectively, of Table 8.6). We did not include results for the between-year analysis for temperature and humidity variables because significant between-year differences could be the result of variation in climate between years, and any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates an overall between-year difference within the flood group and corresponds to a significant gap between the gray (2010) and black (2011) lines for that flood group in Figures 8.9a–8.12a.

Finally, we compared change through the season for soil moisture variables in 2010 versus 2011 (i.e., the time*year interaction) within the non-flooded and flooded areas (columns 7 and 8, respectively, of Table 8.6). Again, we did not include the results of this analysis for temperature and humidity variables because any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates that, within the given flood group, the variable changed through time in 2010 in a different way than it changed through time in 2011. This corresponds to non-parallel gray (2010) and black (2011) lines for the flood group in Figures 8.9a–8.12a.

None of the measures of soil moisture and presence of surface water differed overall between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1). In 2011, three measures of surface water (distance to surface water, percentage of the area within 20 m that was flooded, and percentage of the area within 50 m that was flooded) differed between the flooded and non-flooded area (Table 8.6, column 2), with all three variables indicating wetter overall conditions in the flooded area (Figures 8.10–8.12). Soil moisture and both measures of the percentage of the area inundated showed a significant interaction between flood group and time in 2011 (Table 8.6, column 4); soil moisture declined more rapidly in the flooded versus the non-flooded area as the extent of the flooding decreased through the season (Figure 8.9), and the measures of the percentage inundated decreased throughout the season in the flooded area while they remained constant (at zero) through the season in the non-flooded area (Figures 8.11 and 8.12). The non-flooded area differed significantly between years in soil moisture, distance to water, and percentage of the area within 50 m that was inundated (Table 8.6, column 5); all measures reflected the overall lower marsh levels and resulting drier conditions in 2011. The flooded area differed between years in all measures of surface water (Table 8.6, column 5), with all variables indicating wetter conditions in 2011. Overall soil moisture in the flooded area did not differ significantly between years (Table 8.6, column 6) but did show a significant interaction between year and time (Table 8.6, column 8); soil moisture was higher in 2011 than in 2010 early in the season but had dropped to a lower level in 2011 than in 2010 by early June, again illustrating the overall dry conditions in 2011 (Figure 8.9).

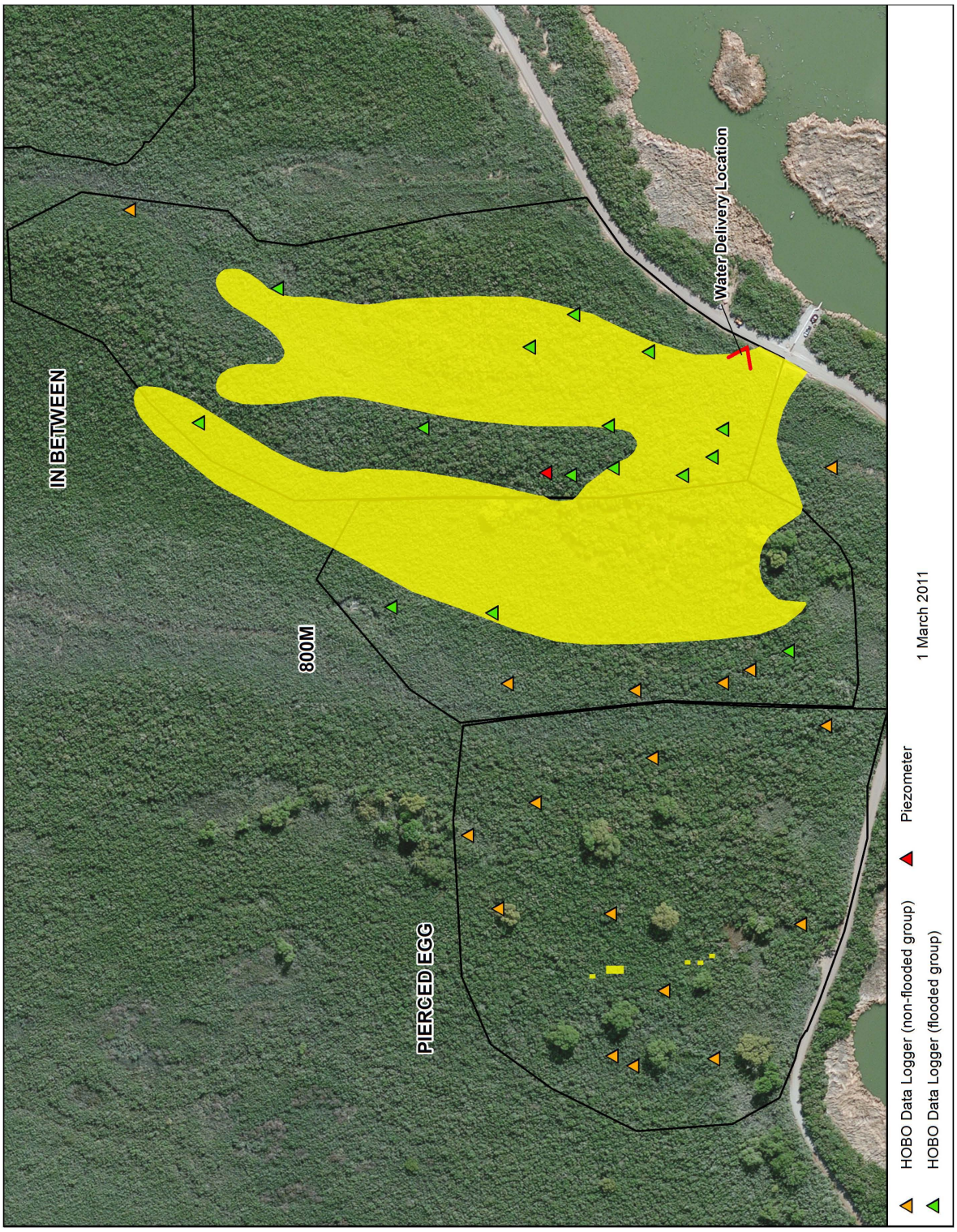


Figure 8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011.

Table 8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	911.4 (14.0)	897.9 (13.4)	881.2 (14.0)	878.6 (10.8)	863.2 (9.8)	836.8 (12.1)	867.3 (16.3)
Mean distance to nearest standing water	31.0 (6.2)	31.9 (6.1)	62.5 (8.7)	68.5 (8.1)	101.6 (10.6)	98.4 (10.8)	110.3 (17.9)
% of area within 20 m that was inundated	10.7 (6.3)	10.0 (5.0)	1.9 (1.9)	1.9 (1.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	18.7 (5.6)	12.4 (3.8)	1.8 (1.0)	2.0 (1.1)	0.0 (0.0)	0.3 (0.3)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	35.3 (0.3)	36.2 (0.4)	38.4 (0.3)	38.5 (0.3)	41.9 (0.3)	43.1 (0.3)	43.4 (0.4)
Mean minimum nocturnal temperature (°C)	5.0 (0.2)	8.5 (0.3)	8.4 (0.2)	9.9 (0.2)	18.0 (0.2)	13.8 (0.2)	18.3 (0.2)
Mean daily temperature range (°C)	30.3 (0.3)	27.7 (0.4)	30.0 (0.3)	28.6(0.4)	23.9 (0.3)	29.4 (0.3)	25.1 (0.4)
Humidity							
Mean diurnal vapor pressure (Pa)	597.4 (9.3)	818.4 (13.4)	798.1 (14.1)	976.4 (16.2)	1588.5 (23.5)	1649.4 (28.5)	2279.7 (36.0)
Mean nocturnal vapor pressure (Pa)	652.2 (8.7)	888.1 (11.9)	890.9 (11.2)	1022.4 (12.4)	1537.7 (17.5)	1423.7 (16.8)	1929.9 (22.3)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

Table 8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	908.1 (13.7)	908.0 (12.9)	892.7 (13.8)	838.4 (20.6)	853.9 (11.8)	834.3 (19.8)	804.5 (17.9)
Mean distance to nearest standing water	44.9 (9.7)	42.8 (9.3)	54.0 (10.2)	60.6 (17.1)	102.8 (11.9)	115.0 (13.4)	192.0 (23.3)
% of area within 20 m that was inundated	8.0 (6.7)	6.2 (4.4)	5.3 (4.6)	6.4 (5.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	13.5 (4.8)	15.5 (4.8)	10.1 (4.1)	6.7 (4.4)	4.1 (3.0)	0.0 (0.0)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	32.2 (0.3)	33.7 (0.4)	35.7 (0.3)	36.3 (0.4)	39.8 (0.4)	40.9 (0.4)	40.9 (0.4)
Mean minimum nocturnal temperature (°C)	6.0 (0.2)	9.4 (0.3)	9.1 (0.2)	10.6 (0.2)	18.7 (0.2)	14.5 (0.2)	18.9 (0.2)
Mean daily temperature range (°C)	26.2 (0.4)	24.3 (0.5)	26.6 (0.4)	25.7 (0.4)	21.1 (0.4)	26.5 (0.4)	22.0 (0.5)
Humidity							
Mean diurnal vapor pressure (Pa)	611.7 (10.1)	834.7 (14.5)	813.2 (15.4)	998.5 (17.9)	1595.6 (24.6)	1612.9 (26.8)	2209.8 (35.8)
Mean nocturnal vapor pressure (Pa)	676.5 (9.5)	913.3 (12.7)	906.3 (11.5)	1043.2 (13.0)	1535.3 (18.6)	1418.7 (16.8)	1921.6 (23.7)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

AR064257

Table 8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 17)							
Mean soil moisture (mV)	883.8 (14.4)	904.1 (13.3)	878.4 (22.7)	835.4 (16.8)	811.4 (19.0)	819.4 (12.1)	817.4 (11.4)
Mean distance to nearest standing water	N/A	N/A	122.0 (61.1)	138.9 (21.6)	149.4 (19.4)	120.4 (16.3)	115.6 (13.9)
% of area within 20 m that was inundated	3.6 (10.9)	N/A	0.0 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (40.0)	1.7 (1.7)
% of area within 50 m that was inundated	3.6 (3.6)	N/A	1.9 (1.4)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.1 (0.1)
Temperature (n = 16)							
Mean maximum diurnal temperature (°C)	34.8 (0.5)	38.2 (0.3)	38.7 (0.3)	36.6 (0.3)	40.3 (0.3)	43.5 (0.2)	41.3 (0.3)
Mean minimum nocturnal temperature (°C)	6.8 (0.3)	11.0 (0.2)	9.3 (0.3)	11.6 (0.2)	12.5 (0.2)	18.0 (0.2)	20.0 (0.2)
Mean daily temperature range (°C)	28.1 (0.5)	27.2 (0.4)	29.4 (0.4)	25.0 (0.4)	27.8 (0.3)	25.5 (0.3)	21.3 (0.5)
Humidity (n = 16)							
Mean diurnal vapor pressure (Pa)	666.5 (14.2)	761.1 (13.8)	858.8 (15.9)	1066.2 (14.9)	1229.4 (24.5)	1598.9 (20.7)	2467.8 (43.7)
Mean nocturnal vapor pressure (Pa)	666.3 (12.5)	817.0 (13.8)	922.1 (13.6)	1033 (10.4)	1178.1 (19.1)	1436.8 (12.9)	2215.1 (32.2)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

Table 8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 15)							
Mean soil moisture (mV)	955.6 (12.1)	944.3 (14.7)	893.7 (17.8)	867.8 (17.8)	779.1 (28.5)	768.8 (23.4)	809.6 (24.0)
Mean distance to nearest standing water	N/A	N/A	12.0 (4.7)	48.5 (23.6)	84.7 (20.5)	73.0 (18.7)	98.11 (20.0)
% of area within 20 m that was inundated	57.7 (10.9)	N/A	39.6 (10.0)	18.3 (8.1)	18.0 (8.3)	17.5 (6.4)	5.8 (3.2)
% of area within 50 m that was inundated	54.6 (10.5)	N/A	36.1 (7.7)	23.4 (8.3)	20.1 (9.7)	26.3 (8.7)	11.7 (4.9)
Temperature (n = 14)							
Mean maximum diurnal temperature (°C)	31.8 (0.5)	34.8 (0.3)	36.0 (0.4)	34.5 (0.4)	38.5 (0.3)	42.1 (0.3)	40.5 (0.4)
Mean minimum nocturnal temperature (°C)	8.1 (0.3)	12.1 (0.3)	10.3 (0.3)	12.3 (0.2)	13.2 (0.2)	18.9 (0.2)	20.6 (0.2)
Mean daily temperature range (°C)	23.7 (0.5)	22.7 (0.4)	25.6 (0.5)	22.2 (0.4)	25.2 (0.4)	23.2 (0.5)	19.9 (0.5)
Humidity (n = 13)							
Mean diurnal vapor pressure (Pa)	732.4(16.5)	843.4 (16.5)	917.4 (18.5)	1110.9 (16.2)	1250.5 (25.1)	1631.8 (21.3)	2501.8 (49.7)
Mean nocturnal vapor pressure (Pa)	773.6 (14.4)	926.0 (17.1)	1031.2 (16.0)	1112.5 (12.8)	1255.2 (21.5)	1516.9 (16.6)	2251.2 (35.6)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

AR064258

All measures of temperature (mean daily maximum, mean daily minimum, mean temperature range) tended toward being different (*P*-values between 0.04 and 0.07) between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1), with the flooded area having lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range than the non-flooded area (Figures 8.13–8.15). This pattern persisted in 2011 (Table 8.6, column 2; Figures 8.13–8.15). The change in temperature variables through the season was similar in the flooded and non-flooded areas in 2010 (Table 8.6, column 3) but not in 2011 (Table 8.6, column 4). In 2011, the flooded area began the season with lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range when compared to the non-flooded area; these differences diminished steadily as the season progressed (Figures 8.13–8.15).

Diurnal and nocturnal vapor pressure did not differ significantly between flooded and non-flooded areas under baseline conditions in 2010 (Table 8.6, column 1). In 2011, both measures of humidity were higher in the flooded versus non-flooded area (Figures 8.16 and 8.17), but this difference was significant only for nocturnal vapor pressure (Table 8.6, column 2). The difference in nocturnal vapor pressure between flooded and non-flooded areas decreased through the season in 2011 (Table 8.6, column 4; Figure 8.17).

Comparison between day before and day after flood events – A comparison of temperature and humidity variables the day before and the day after each flood event in 2011 showed that, overall, flood events appeared to affect all temperature and humidity variables, and the effect was not constant through the season for any variable except mean diurnal vapor pressure (Table 8.7). The effect of flooding is graphed (Figures 8.18-8.22) to aid in interpretation of flooding effects. In each figure there are three graphs. The first graph shows the difference in the given microclimate variable between the day before and the day after each flood event for the flooded and non-flooded areas. The fluctuation in the non-flooded area between the day before and day after each flood events indicates the baseline change in general weather conditions; deviation in the flooded area from this baseline change suggests an effect of flooding. This deviation (the difference between the non-flooded and flooded areas) is depicted in the second graph in each figure. The third graph in each figure plots this deviation against baseline weather conditions to show whether the direction and magnitude of any effects of flooding varied based on underlying weather conditions.

Overall, the flooded area had a lower maximum diurnal temperature in relation to the non-flooded area on the day after a flood event than on the day before a flood event (Table 8.7, Figures 8.18a and 8.18b). The effect of flooding on the maximum diurnal temperature was related to the maximum temperature recorded on the day after a flood event in the non-flooded area (Figure 8.18c); flooding had the greatest effect of lowering the maximum temperature on hot days but raised the maximum temperature on relatively cool days. Overall, minimum nocturnal temperature on the day after a flood event was higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.19a and 8.19b). The effect of flooding on minimum nocturnal temperature did not appear to be related to minimum nocturnal temperature (Figure 8.19c). Overall, the daily temperature range on the day after a flood event was smaller in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.20a and 8.20b). This effect was strongly related to the maximum temperature on the day after a flood event, with flooding having the greatest effect of reducing the daily temperature range on hot days (Figure 8.20c).

Both diurnal and nocturnal vapor pressure on the day after a flood event were higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.21a, 8.21b, 8.22a, and 8.22b). Diurnal vapor pressure was affected the most strongly in the middle of the season (Figure 8.21b), but this effect was not related to overall vapor pressure (Figure 8.21c). The effect on nocturnal vapor pressure was weakly, inversely related to ambient vapor pressure.

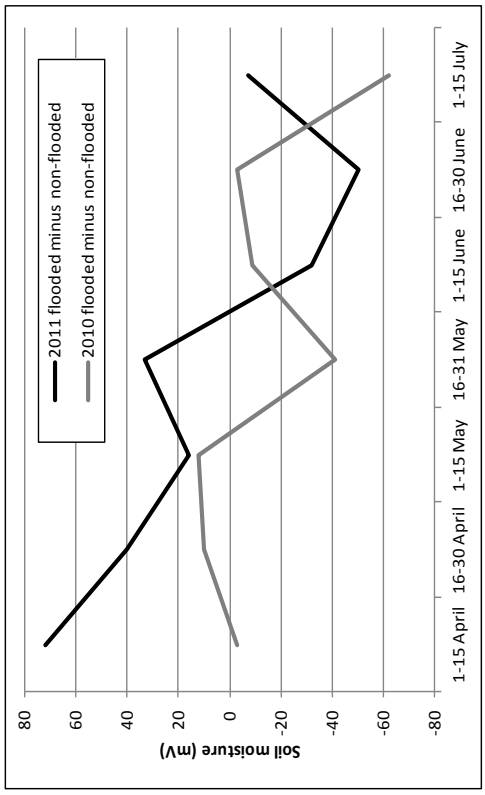


Figure 8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

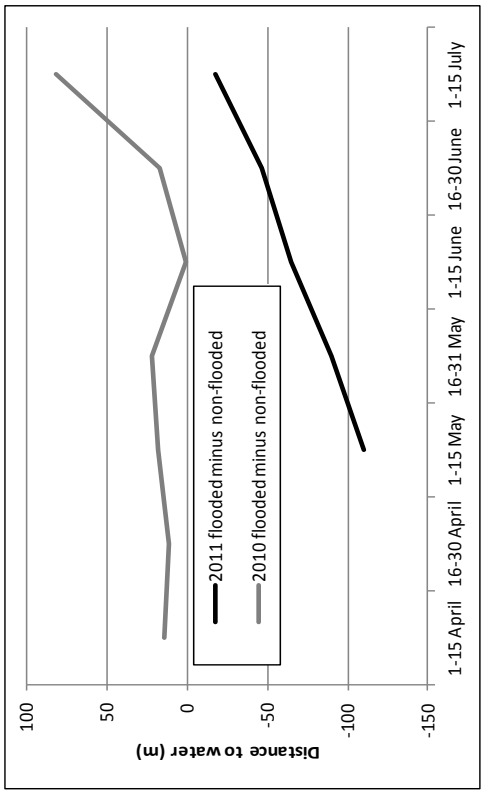


Figure 8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

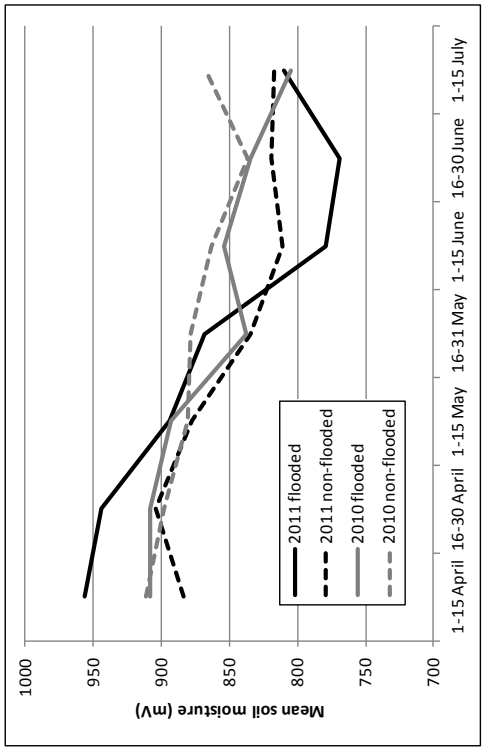


Figure 8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

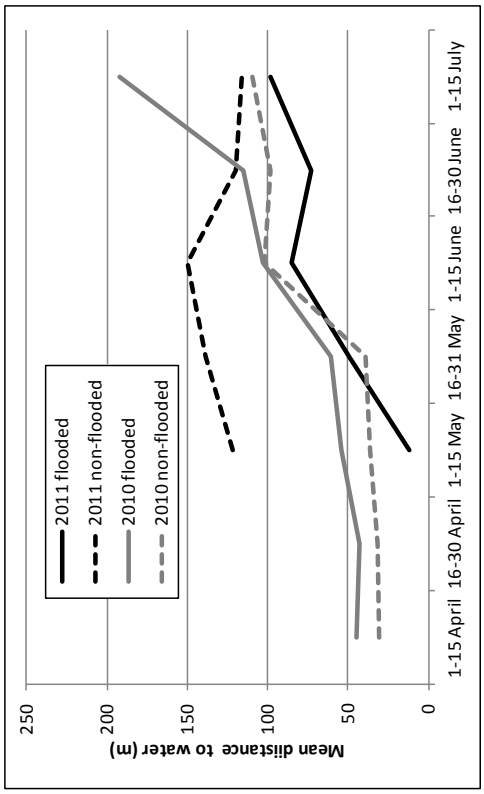


Figure 8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

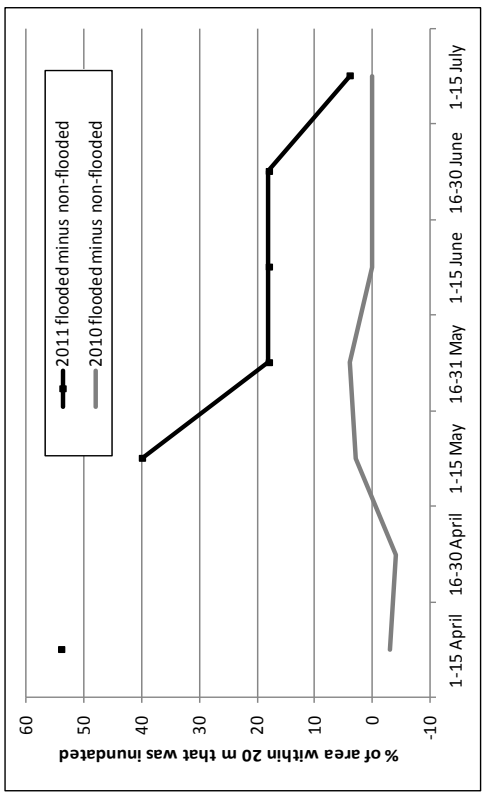


Figure 8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011.

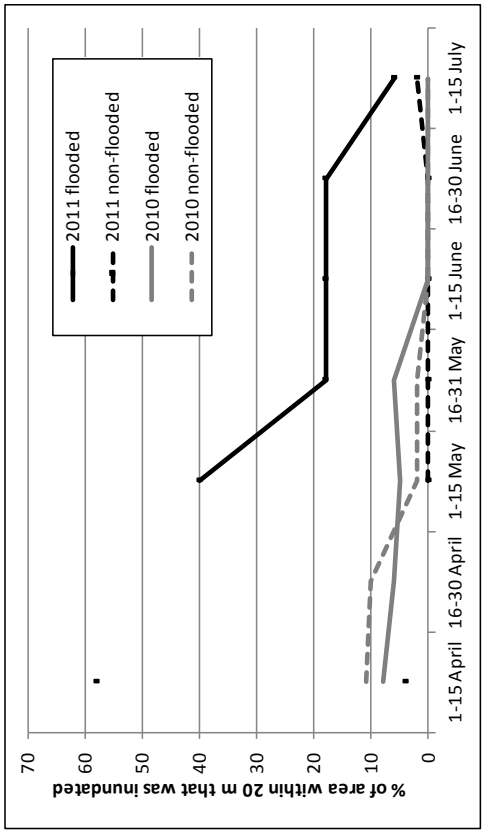


Figure 8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

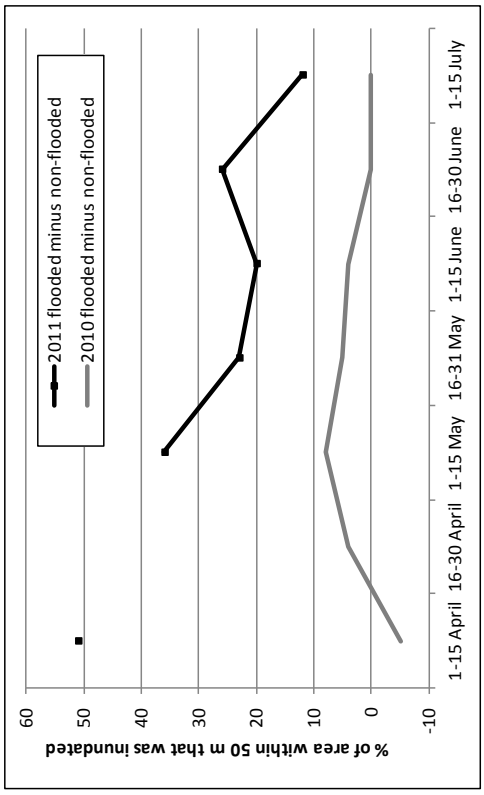


Figure 8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011.

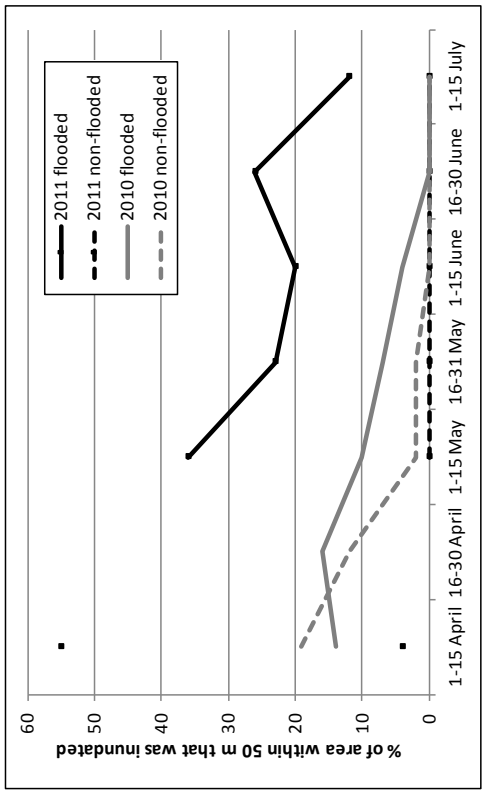


Figure 8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

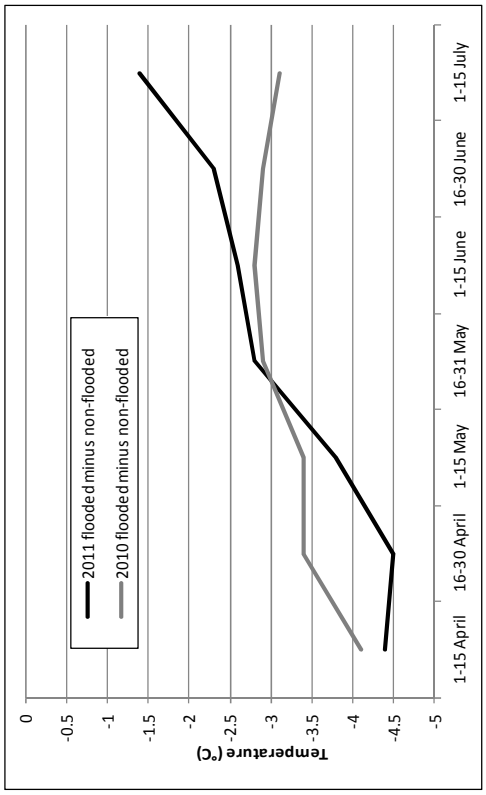


Figure 8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

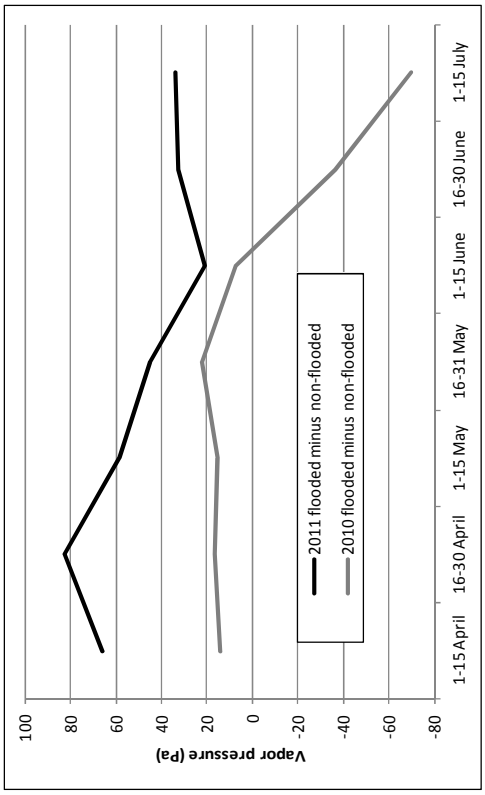


Figure 8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

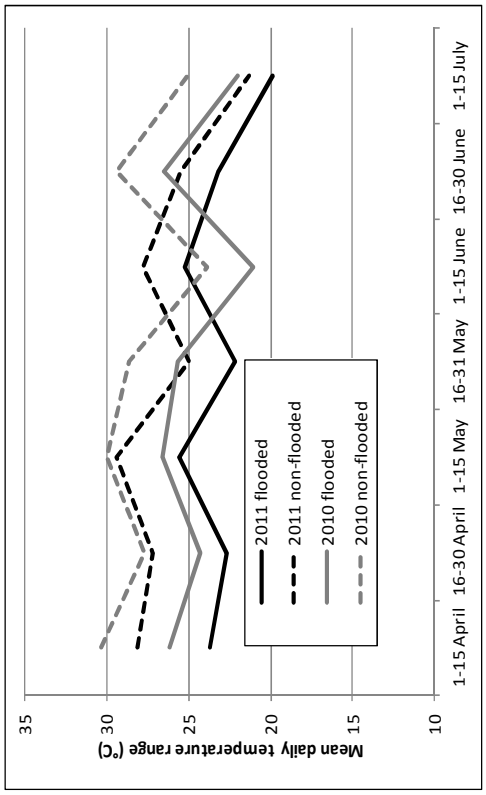


Figure 8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

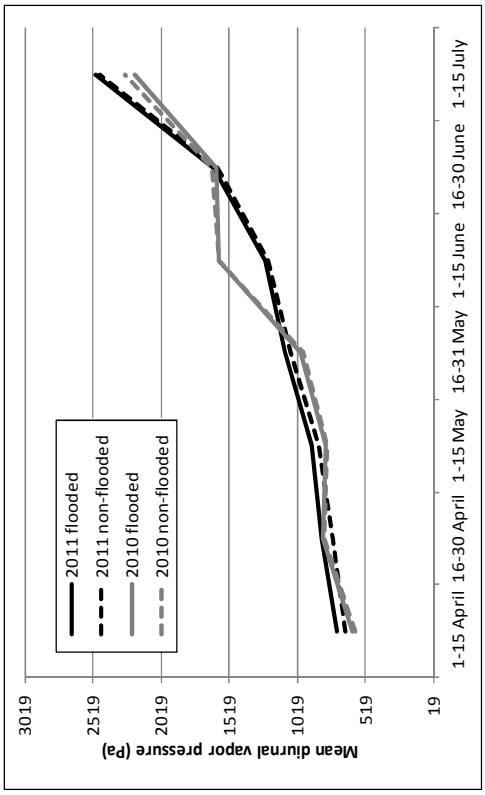


Figure 8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

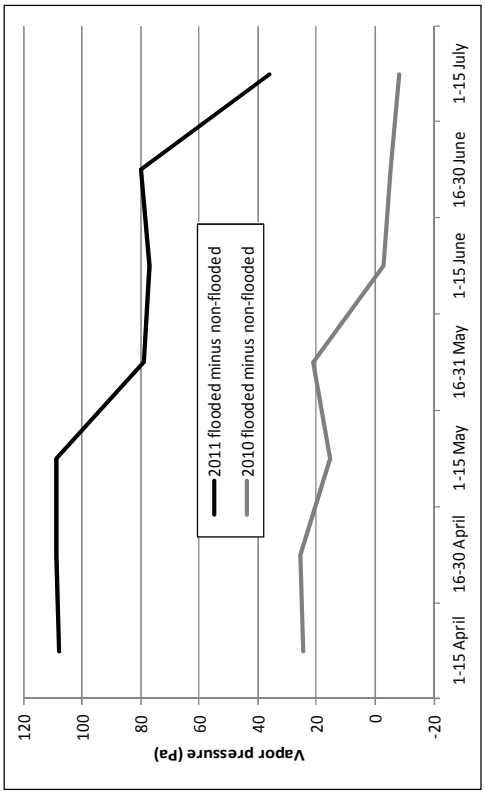


Figure 8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

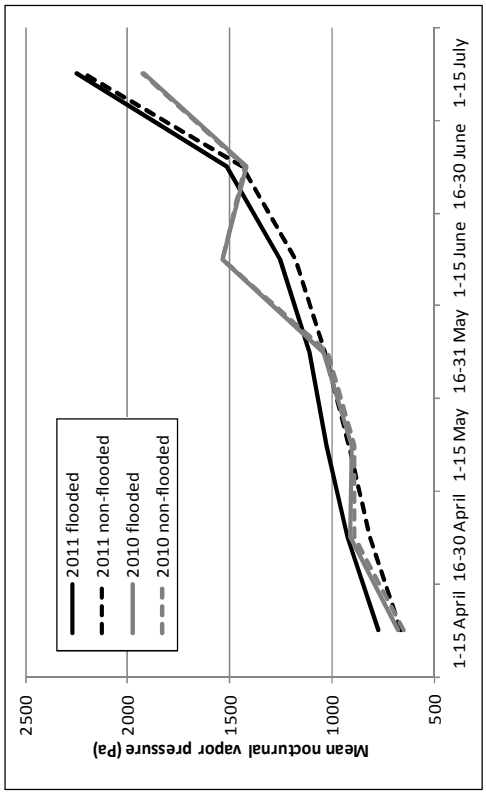


Figure 8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Table 8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011.

	Flooded vs. non-flooded areas overall, within the year (between flood group differences)		Change over the season for flooded vs. non-flooded areas, by year (interaction between flood group and time)		2010 vs. 2011 overall, within flood group (between-year differences)		Change over the season for 2010 vs. 2011, by flood group (interaction between year group and time)	
Parameter	**2010**	**2011**	**2010**	**2011**	**Non-flooded**	**Flooded**	**Non-flooded**	**Flooded**
Soil Moisture								
Mean soil moisture (mV)	0.329	0.563	0.014	<0.001	<0.001	0.884	0.131	0.009
Mean distance to nearest standing water	0.124	0.009	<0.001	0.173	<0.001	<0.001	0.066	0.023
% of area within 20 m that was inundated	0.997	<0.001	0.750	<0.001	0.208	<0.001	0.718	0.010
% of area within 50 m that was inundated	0.497	<0.001	0.147	0.001	0.026	<0.001	0.004	0.407
Temperature								
Mean maximum diurnal temperature (°C)	0.067	0.071	0.954	0.009	--	--	--	--
Mean minimum nocturnal temperature (°C)	0.069	0.044	0.088	<0.001	--	--	--	--
Mean daily temperature range (°C)	0.041	0.047	0.802	0.001	--	--	--	--
Humidity								
Mean diurnal vapor pressure (Pa)	0.943	0.349	0.618	0.845	--	--	--	--
Mean nocturnal vapor pressure (Pa)	0.751	0.011	0.170	0.012	--	--	--	--

* Data restricted from April 1 through July 15 for both years. For 2011, distance-to-water measures do not include April and percent inundated measures do not include April 16-30.

AR064265

Table 8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011*

	Maximum diurnal temperature		Minimum nocturnal temperature		Daily temperature range		Mean diurnal vapor pressure		Mean nocturnal vapor pressure	
Day of flooding	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded
31 March	9.3	8.6	5.8	6.3	3.5	2.3	113.2	190.7	155.2	275.4
7 April	-18.9	-15.5	-1.5	-3.6	-17.4	-11.9	-194.4	-191.8	-443.1	-495.4
13 April	-5.5	-5.0	2.6	2.6	-8.0	-7.6	-263.6	-338.0	-263.7	-292.1
21 April	0.1	-0.9	-3.6	-2.9	3.6	2.0	-193.7	-154.0	-41.8	-21.3
28 April	2.4	1.9	11.1	9.1	-8.7	-7.2	201.0	239.3	-152.9	-264.2
5 May	3.0	2.0	4.5	4.3	-1.3	-2.3	261.9	323.6	260.4	249.5
12 May	5.5	5.0	2.8	4.0	2.7	1.0	95.5	149.7	93.4	175.2
19 May	11.9	11.1	-0.4	0.4	12.2	10.7	-269.0	-170.6	26.8	83.3
26 May	0.6	0.7	4.7	4.7	-4.1	-3.9	57.7	132.3	-38.9	50.1
2 June	4.8	3.6	-3.4	-2.5	8.2	6.1	-150.2	-40.7	93.0	158.1
9 June	3.0	3.0	1.3	2.4	1.8	0.5	196.3	220.0	96.7	157.7
16 June	-3.9	-4.4	3.5	4.4	-7.3	-8.7	-328.5	-223.9	-90.9	-61.9
23 June	-0.8	-1.7	4.8	5.5	-5.6	-7.2	-84.3	-85.4	-7.2	55.6
30 June	0.2	-0.7	-11.4	-11.3	11.6	10.6	522.0	587.7	402.6	565.5
7 July	11.0	8.0	0.7	1.5	10.3	6.5	-190.4	-136.2	-212.0	-178.1
Mean (SE)	1.5 (0.6)	1.0 (0.6)	1.4 (0.4)	1.7 (0.4)	0.1 (0.7)	-0.6 (0.6)	-15.1 (22.3)	33.5 (23.9)	-8.2 (18.3)	30.5 (24.0)
P-values, flooded vs. non-flooded areas, overall	0.034		0.031		0.008		0.011		0.007	
P-values, change over the season for flooded vs. non-flooded areas (interaction between flood group and time)	0.003		<0.001		<0.001		0.542		<0.001	

* Differences are the day after flooding minus the day before flooding.

AR064266

Figure 8.18a. Difference between the day before and day after (day after minus day before) each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.18b. Difference between flood groups (non-flooded minus flooded) in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011.

Figure 8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.19a. Difference between the day before and day after (day after minus day before) each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.19b. Difference between flood groups (non-flooded minus flooded) in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011.

Figure 8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.20a. Difference between the day before and day after (day after minus day before) each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.20b. Difference between flood groups (non-flooded minus flooded) in difference in daily temperature range before and after each flood event, Topock Marsh, 2011.

Figure 8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.21a. Difference between the day before and day after (day after minus day before) each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.21b. Difference between flood groups (non-flooded minus flooded) in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011.

Figure 8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

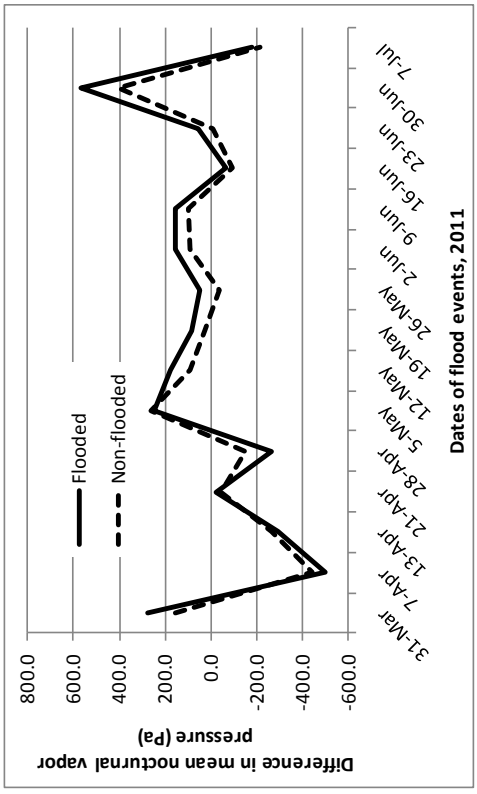


Figure 8.22a. Difference between the day before and day after (day after minus day before) each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

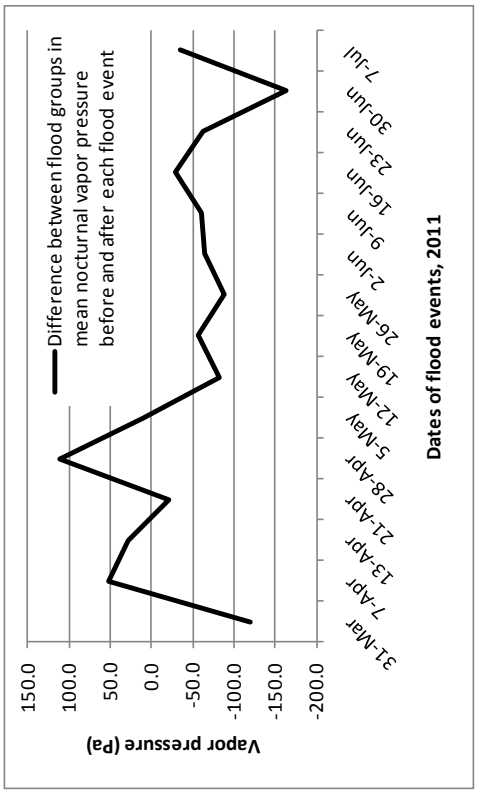


Figure 8.22b. Difference between flood groups (non-flooded minus flooded) in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011.

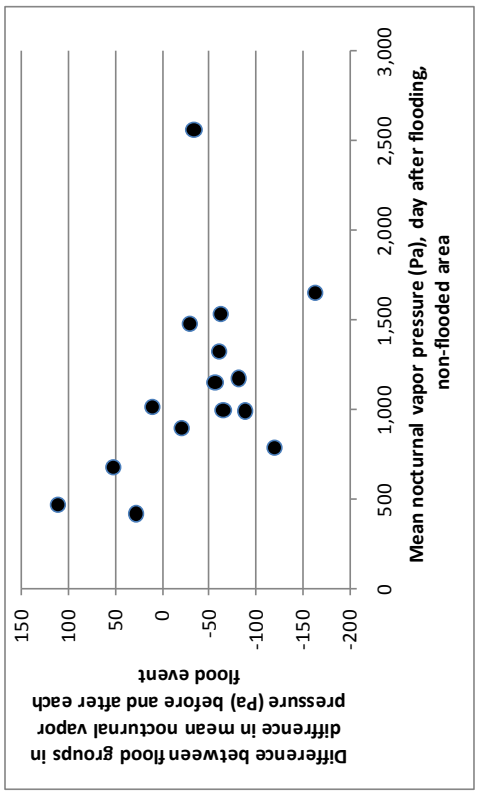


Figure 8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Vegetation

We collected vegetation data at all 15 flooded and 17 non-flooded locations. Vegetation characteristics in 2010 and 2011 are summarized in Table 8.8, and vertical foliage profiles are shown in Figures 8.23–8.26. Vegetation characteristics are typical of those documented in dense, tamarisk stands at Topock Marsh in previous years (McLeod et al. 2008a), with dense canopy closure and a small percentage of native vegetation.

Vegetation characteristics differed between years in both flooded and non-flooded areas in percent canopy closure, percent woody ground cover, and the amount of live vegetation in all height categories (Table 8.8, *P*-values in "Year" column). Percent canopy closure and percent woody ground cover was higher in 2011 than in 2010, while the number of hits of live vegetation recorded in all height categories was lower in 2011. Woody ground cover was the only variable that showed an interaction between year and flood group, meaning that the change in woody ground cover was different in the flooded area versus the non-flooded area (right-most column of Table 8.8). Woody ground cover increased more dramatically in the non-flooded area than in the flooded area.

Table 8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011*

Parameter	2010		2011		*P*-value	
	Flooded	Non-flooded	Flooded	Non-flooded	Year	Year*flood group
Average canopy height (m)	6.3 (0.3)	5.9 (0.3)	6.2 (0.2)	5.9 (0.3)	0.725	0.904
	4.2–7.4	3.4–8.3	4.0–7.0	3.5–8.5		
% total canopy closure	89.5 (1.5)	88.7 (2)	94.3 (1)	90.7 (1.4)	0.007	0.260
	78.6–97.9	63–97.4	85.9–100	77.6–97.4		
% woody ground cover	23.7 (5.4)	13.2 (3.6)	45.8 (8.9)	77.1 (5.3)	<0.001	<0.001
	2.5–66.3	1–52.8	5.0–100.0	17.5–100		
Live vertical foliage (hits) below average nest height	2.6 (0.7)	3.0 (0.6)	1.4 (0.3)	2.1 (0.5)	0.018	0.718
	0.3–12.1	0.0–7.4	0.0–3.3	0.0–6.7		
Live vertical foliage (hits) at average nest height	2.6 (0.4)	2.7 (0.4)	1.6 (0.3)	2.0 (0.2)	<0.001	0.335
	0.1–5	0.8–6	0.2–3.8	0.3–3.9		
Live vertical foliage (hits) above average nest height	9.7 (0.7)	7.0 (1.1)	6.0 (0.6)	4.2 (0.7)	<0.001	0.433
	4.7–13.8	0.9–18.4	2.8–10.1	0.2–9.7		
Dead vertical foliage (hits) below average nest height	8.2 (0.7)	9.3 (0.5)	8.1 (0.7)	9.0 (0.6)	0.762	0.858
	2.4–13.1	5.1–13.4	4.8–13.4	5.1–14.2		
Dead vertical foliage (hits) at average nest height	1.9 (0.3)	2.0 (0.3)	2.2 (0.2)	1.9 (0.3)	0.460	0.241
	0.3–5.0	0.1–4.2	0.9–4.0	0.1–4.2		
Dead vertical foliage (hits) above average nest height	1.3 (0.4)	1.0 (0.2)	1.4 (0.3)	1.3 (0.2)	0.358	0.613
	0.0–3.9	0.0–2.9	0.0–3.2	0.0–4.1		
Percent native	0.0 (0.0)	5.3 (3.1)	0.0 (0.0)	7.5 (5)	0.680	0.680
	0.0–0.0	0.0–48.7	0.0–0.0	0.0–78.5		

* Data are presented as mean, standard error, and range. *P*-values for year indicate differences between years for both flooded and non-flooded locations combined. *P*-values for year*flooded indicate whether flooded areas changed between years differently than did non-flooded areas.

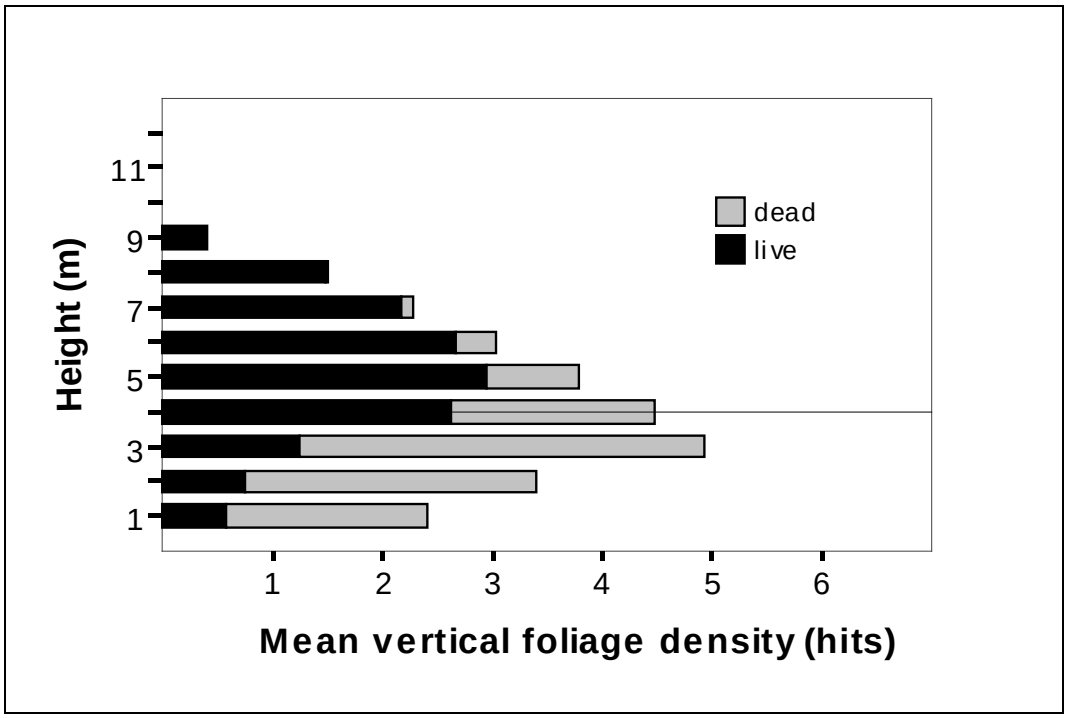


Figure 8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

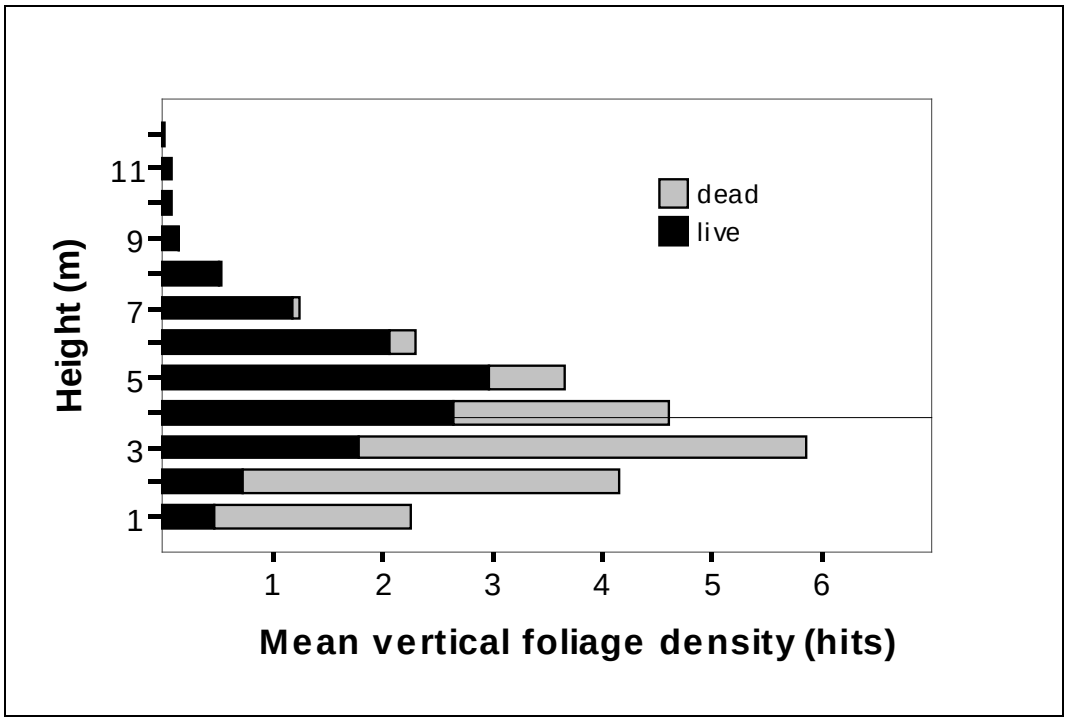


Figure 8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

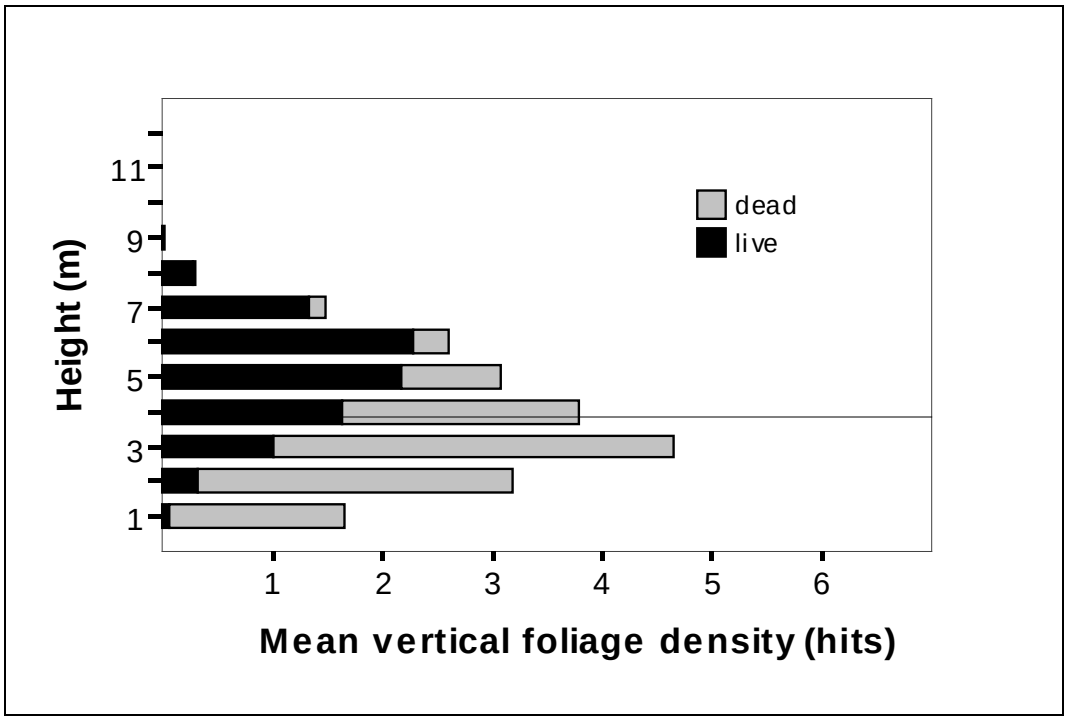


Figure 8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

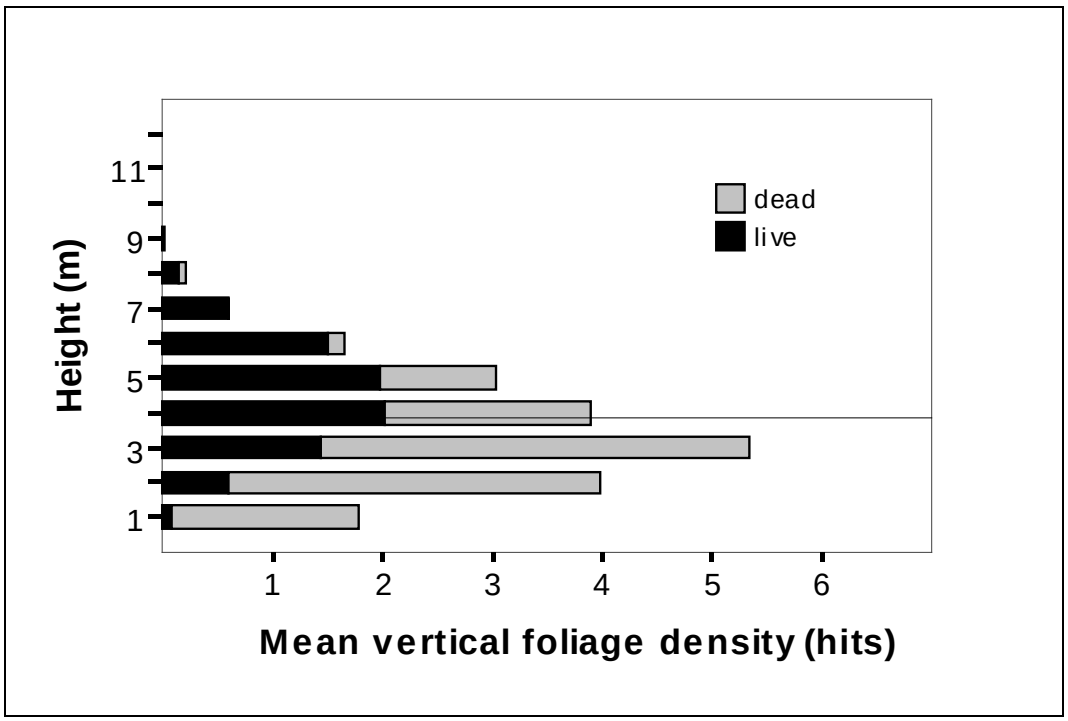


Figure 8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

DISCUSSION

Water delivery had the expected effect of increasing the extent and duration of surface water present within the target area in 2011 in comparison with the previous year, despite the overall lower level of Topock Marsh in 2011. Surface water from a given pumping event covered a larger extent and declined more slowly when the underlying water table was high, indicating that pumping was more effective in creating the surface water conditions favored by flycatchers when coupled with a high underlying water table.

In the area affected by flooding, water delivery had the expected effect of raising soil moisture, decreasing distance to water from the sample points, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also appeared to increase humidity within the flooded area; both diurnal and nocturnal vapor pressure were higher in the flooded area than in the non-flooded area in 2011 but not in 2010. In addition to the overall effect on humidity, flooding also had short-term effects on humidity as shown by the analysis of conditions on the day before versus the day after each flood event. On average, flood events produced higher diurnal and nocturnal vapor pressure in the flooded area in comparison to the non-flooded area.

The effect of water delivery on temperature was not as clear. The analysis comparing the flooded and non-flooded areas throughout the year did not show a statistically significant overall effect of flooding on any of the temperature variables, but there was an interaction between flood group and time in 2011, showing that all temperature variables changed through the year in the flooded area in a different way than they changed in the non-flooded area. In 2011, the difference between the flooded and non-flooded areas in all temperature variables declined as the season progressed. An analysis of temperature variables on the day before versus the day after each flood event showed that, on average, flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area. Thus, flood events did affect temperature, but these effects did not seem to persist across two-week periods. The interaction between flood group and time in 2011 suggests that the effect on temperature from a given flood event persisted for shorter periods of time as the season progressed.

Areas occupied by flycatchers typically have higher soil moisture, higher humidity, lower maximum temperatures, and smaller daily temperature ranges than unoccupied areas (McLeod et al. 2008a); thus, water delivery appeared to change the microclimate conditions within the flooded area in ways that would favor flycatcher occupancy.

The between-year changes in several of the vegetation variables appear somewhat contradictory, with canopy closure increasing between 2010 and 2011 but the amount of live vertical foliage decreasing between 2010 and 2011 in all height categories. It is difficult to distinguish between true changes in the vegetation and observer variation. The between-year differences were recorded in both flooded and non-flooded areas, indicating that flooding had no effect on changes in canopy closure or density of live vegetation. Woody ground cover increased between 2010 and 2011 in both flooded and non-flooded areas but increased much more dramatically in non-flooded areas. The overall increase in the percentage of woody ground cover could be strongly influenced by observer variation, but the significant interaction between year and flooded category suggests that the presence of surface water had an effect on the amount of woody cover, with flooding resulting in less woody cover. In general, water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy.

Water delivery resulted in the flooded area of In Between and 800M being the only portion of the sites surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season (see Chapter 2). Five flycatcher territories were recorded in Topock Marsh in 2011 (see Chapters

2 and 3); one of these territories was within the flooded portion of 800M and consisted of an unpaired male flycatcher. This flycatcher was detected at the territory in 800M through the end of June and then was detected for a few days in early July at another site approximately 1.5 km away. In 2010, the area that was affected by flooding in 2011 contained two resident, unpaired male flycatchers; in 2009, this same area contained one resident, unpaired male flycatcher. Water delivery thus did not result in increased flycatcher occupancy in the target area.

The number of flycatchers at Topock Marsh has been declining since 2004 (see Chapter 2), and few flycatcher young have been produced locally in recent years (see Chapter 4). Thus, there may be few adult flycatchers in the local population, and the lack of response by flycatchers to water delivery may be indicative of there being few adults available to establish territories. In addition, low water levels in 2011 throughout areas of Topock Marsh that have been historically occupied by flycatchers likely reduced the overall suitability of the area for flycatchers. Although supplemental water delivery appeared to produce conditions that would be favorable to flycatcher occupancy, the confounding factors of dry conditions elsewhere in Topock Marsh and a low population may have limited the ability of flycatchers to colonize the area.

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

This page intentionally left blank.

Chapter 9

MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS

For ease of reference this chapter summarizes all study design and management recommendations discussed in previous chapters.

BROADCAST SURVEYS

Pahranagat MAPS and Pahranagat South were affected prior to the start of the 2010 survey season by a fire that removed the understory and damaged the overstory trees. We did not survey these sites in 2011 but recommend revisiting them in another 2–3 years to determine whether the understory has recovered to the point where it might support breeding flycatchers. We do not recommend surveying these sites in 2012.

Littlefield Poles was affected in December 2010 by a flood that heavily scoured much of the surrounding area. Hydrology, stand density, and vegetation height were all negatively impacted by the flood. We recommend revisiting this site at the beginning of future breeding seasons to determine whether the vegetation and hydrology have recovered to the point where breeding flycatchers might be supported.

Bunker Marsh North was surveyed at the start of 2011, but surveys were discontinued in mid-June due to lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

Mormon Mesa North and Hedgerow at Mormon Mesa have been completely dry for the last several years, and neither of these sites has supported breeding flycatchers since 2005. We visited each site once at the beginning of the 2011 season to determine whether the hydrology of the sites was altered by heavy flooding on the Virgin River in December 2010. Both sites were dry during the initial visit and surveys were discontinued. We recommend discontinuing surveys at these sites until another flood event occurs that has the potential to alter the hydrology within the site. Virgin River #1 South consists of two disjunct areas. The southern section had dry soils throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion of the site if no surface water is present. Virgin River #2 received extensive sedimentation ranging in depth from 15 to 60 cm as a result of the December 2010 flood. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in the southern portion of the site.

We revisited Tractor in Topock Marsh at the beginning of the 2011 season. Vegetation structure at the site is not suitable for supporting breeding flycatchers, and we do not recommend future visits to this site.

At Bill Williams River NWR, we revisited New River for the first time since it was initially evaluated in 2008. In 2008, the vegetation appeared too young and sparse to support willow flycatchers. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years. Wispy Willow, a small area of new coyote willow growth downstream of Site #1, currently lacks the size to resemble occupied flycatcher habitat along the LCR, but the site should be reassessed in future years.

Ground reconnaissance of Laguna revealed that, overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat. Surface water was present only in one small area. Soils in most of the site were complete dry. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

COWBIRD CONTROL

The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 29%, well below the average of 44% across all study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

In 2010 and 2011, we addled cowbird eggs in easily accessible flycatcher nests, and this appeared to reduce the hatch rate of the cowbird eggs and did not cause desertion of any nests by the flycatchers. Although sample sizes were small, results also suggested that the number of flycatcher nestlings fledged per nest might be higher as a result of cowbird egg addling and cowbird nestling removal. We recommend this program be continued in the future.

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

In previous years we correlated piezometer groundwater levels and soil moisture measurements and found no strong linear relationship (McLeod and Koronkiewicz 2009). Sites with high soil moisture values tended to show a weak, negative relationship between depth to groundwater and soil moisture, while sites with low soil moisture showed no relationship between depth to groundwater and soil moisture. This suggests that at sites where soil moisture is low, surface soil moisture content is not strongly influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

LITERATURE CITED

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. The University of Arizona Press, Tucson. 302 pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241–257.

Busch, J.D., M.P. Miller, E.H. Paxton, M.K. Sogge, and P. Keim. 2000. Genetic variation in the endangered Southwestern Willow Flycatcher. Auk 117:586–595.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher breeding site and territory summary – 2005. USGS Southwest Biological Science Center report to the U.S. Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern willow flycatcher final survey and monitoring report. Arizona Game and Fish Department, Research Technical Guidance Bulletin #10, Phoenix.

Finch, D.M., and J.F. Kelly. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197–203 *in* Finch, D.M., J.C. Whitney, J.F. Kelly and S.R. Loftin (eds.). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings, RMRS-P-7.

Flett, M.A., and S.D. Sanders. 1987. Ecology of a Sierra Nevada population of Willow Flycatchers. Western Birds 18:37–42.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

Graber, A.E., and T.J. Koronkiewicz. 2009a. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2008. Final 2008 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 66 pp.

Graber, A.E., and T.J. Koronkiewicz. 2009b. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2009. Final 2009 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 25 pp.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern willow flycatcher 2006 survey and nest monitoring report. Nongame and Endangered Wildlife Program. Technical report 249. Arizona Game and Fish Department, Phoenix.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and willow flycatchers: a summary of their science and policy connections. Geomorphology 47:169–188.

Hanski, I.A., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pages 5–26 *in* Hanski, I.A. and Gilpin, M.E. (eds.). Metapopulation biology: Ecology, genetics, and evolution. Academic Press, San Diego, California.

Harris, J.H. 1991. Effects of Brown-headed Cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13–26.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds 18:27–36.

Hill, G.E. 1988. Age, plumage brightness, territory quality, and reproductive success in the Black-headed Grosbeak. Condor 90:379–388.

Holmes, R.T., P.P. Marra, and T.W. Sherry. 1996. Habitat-specific demography of breeding Black-throated Blue Warblers (*Dendroica caerulescens*): Implications for population dynamics. Journal of Animal Ecology 65:183–195.

Howell, N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Howlett, J.S., and B.J. Stutchbury. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover. Auk 113:1–9.

James, F.C., and H.H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

Johnson, K., P. Mahlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered Southwestern Willow Flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44:226–231.

Johnson, M.J., and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Kenwood, K.E., and E.H. Paxton. 2001. Survivorship and movements of Southwestern Willow Flycatchers in Arizona – 2001. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 44 pp.

Koronkiewicz, T.J., S.N. Cardinal, M.K. Sogge, and E.H. Paxton. 2002. Survivorship and movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2002. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. USGS Southwest Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. 43 pp.

Koronkiewicz, T.J., M.A. McLeod, B.T. Brown, and S.W. Carothers. 2006a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 176 pp.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper III, and E.H. Paxton. 2006b. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. Condor 108:558–570.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, California.

Lowther, P.E. 1993. Brown-headed Cowbird (*Molothrus ater*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 47. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* Sogge, M.K., B.E. Kus, S.J. Sferra and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M., and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, ecology, and conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bulletin 73(3):255–261.

Mayfield, H. 1975. Suggestions for calculating nest success. Wilson Bulletin 87(4):456–466.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 1 – 1996. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada,, [and] the U.S. Fish and Wildlife Service, Carlsbad, California by the San Bernardino County Museum, Redlands, California. 42 pp.

McKernan, R.L., and G. Braden. 1998. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 2 – 1997. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, [and] the U.S. Fish and Wildlife Service, Carlsbad, California, by the San Bernardino County Museum, Redlands, California. 64 pp.

McKernan, R.L., and G. Braden. 1999. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 3 – 1998. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 pp.

McKernan, R.L., and G. Braden. 2001a. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the Lower Colorado River: Year 4 – 1999. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 83 pp.

McKernan, R.L., and G. Braden. 2001b. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 5 – 2000. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 86 pp.

McKernan, R.L., and G. Braden. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 6 – 2001. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, by San Bernardino County Museum, Redlands, California. 58 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 153 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 165 pp.

McLeod, M.A., and A.R. Pellegrini. 2011. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2010. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 166 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 194 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 206 pp.

McLeod, M.A., T.J. Koronkiewicz, S.R. Nichols, B.T. Brown, and S.W. Carothers. 2008b. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2007. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 182 pp.

Moore, D., and D. Ahlers. 2008. 2007 Southwestern Willow Flycatcher study results: selected sites along the Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. Report prepared by Bureau of Reclamation, Technical Service Center, Denver, Colorado. 64 pp.

Munzer, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. Arizona Game and Fish Department, Phoenix, Arizona.

National Weather Service. 2011. Online: http://aa.usno.navy.mil/data/docs/RS_OneYear.html.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 Summary Report. USGS Colorado Plateau Research Station / Northern Arizona University report. 63 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in Central Arizona – a 10-year synthesis report. USGS Open-File Report 2007-1381.

Paxton, E.H., M.K. Sogge, T.J. Koronkiewicz, M.A. McLeod, and T.C. Theimer. 2010. Geographic variation in the plumage coloration of willow flycatchers *Empidonax traillii*. Journal of Avian Biology 41:128–138.

Periman, R.D., and J.F. Kelly. 2000. The dynamic environmental history of Southwest Willow Flycatcher habitat: A survey of changing riparian conditions through time. Pages 25–42 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson. 212 pp.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. General Technical Report PSW-GTR-144. U.S. Forest Service Pacific Southwest Research Station, Albany, California. 41 pp.

Ridgely, R.S., and G. Tudor. 1994. The birds of South America; Volume II: the Suboscine passerines. University of Texas Press, Austin.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in Illinois. Pages 408–418. *In* J.M. Hagan III and D.W. Johnston (eds.). Ecology and Conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Rosenberg, K.V., R. C. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson.

Rotenberry, J.T. 1985. The role of habitat in avian community composition: Physiognomy or floristics? Oecologia 67:213–217.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix.

SAS Institute Inc. 2009. SAS OnlineDoc®, Version 9.2. Cary, North Carolina.

Sedgwick, J.A. 2000. Willow flycatcher (*Empidonax traillii*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 533. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Sedgwick, J.A., and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to willow flycatchers. Pages 167–181 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.).Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Sedgwick, J.A., and F.L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. The Condor 94:720–733.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbits. 1997. A Southwestern Willow Flycatcher natural history summary and survey protocol. National Park Service Technical Report USGS/NAUCPRS/NRTR-97/12.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. Western Birds 32:167–172.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher. U.S. Geological Survey Techniques and Methods 2A-10. 38 pp.

Stiles, F.G., and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, New York.

Sumner, M.E. 2000. Handbook of soil science. CRC Press, Boca Raton, Florida.

U.S. Bureau of Reclamation (Reclamation). 1999. Long-term restoration program for the historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat along the lower Colorado River. Report submitted by USBR Lower Colorado Region to Lower Colorado Multi-Species Conservation Program. Boulder City, Nevada. 70 pp.

U.S. Bureau of Reclamation (Reclamation). 2000. Biological Assessment for proposed Interim Surplus Criteria, Secretarial Implementation Agreements for California Water Plan components and conservation measures on the Lower Colorado River (Lake Mead to the Southerly International Boundary). Prepared by U.S. Bureau of Reclamation, Lower Colorado Region. 80 pp.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. Federal Register 60:10694–10715.

U.S. Fish and Wildlife Service (USFWS). 2000. Southwestern willow flycatcher protocol revision 2000. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2001. Biological opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures on the Lower Colorado River, Lake Mead to the Southerly International Boundary, Arizona, California, and Nevada. Final Biological Opinion, U.S. Fish and Wildlife Service, Phoenix, Arizona. 90 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax trailli extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup, August 2002.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. San Diego Natural History Museum report to U.S. Bureau of Reclamation, Phoenix, Arizona.

White, G.S., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 (supplement):S120–139.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to Brown-headed Cowbird parasitism. M.S. Thesis, California State University, Chico. 25 pp.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Pages 182–190 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.). Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Whitfield, M.J., M.K. Sogge, S.J. Sferra, and B.E. Kus. 2003. Ecology and behavior —Introduction. Pages 53–55 *in* Sogge, M.K., B.E. Kus, S.J. Sferra, and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Wiens, J.A. 1989a. The ecology of bird communities. Volume 1: Foundations and patterns. Cambridge University Press, New York.

Wiens, J.A. 1989b. The ecology of bird communities. Volume 2: Processes and variations. Cambridge University Press, New York.

Woodward, H.D., and S.H. Stoleson. 2002. Brown-headed Cowbird attacks on Southwestern Willow Flycatcher nestlings. The Southwestern Naturalist 47(4):626–628.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

Younker, G.L., and C.W. Andersen. 1986. Mapping methods and vegetation changes along the lower Colorado River between Davis Dam and the border with Mexico. Report submitted to Bureau of Reclamation, Lower Colorado Region, in fulfillment of Contract No. 6-CS-30-03800. 22 pp.

Acknowledgements

This project was made possible by the support of many persons, agencies, private landowners, and our dedicated staff and field crew. Work was conducted under the auspices of Federal Fish and Wildlife Threatened and Endangered Species Permit TE028605-4 and Master Banding Permit #23258. Funding was provided by the U.S. Bureau of Reclamation, Boulder City, Nevada (Contract No. GS-10F-0209L) and the Nevada Department of Wildlife, Reno, Nevada. Chris Dodge from Reclamation provided background information and guidance.

Many thanks to the following national wildlife refuges and personnel for all their assistance: Kevin DesRoberts, Chivia Horton, Laurie Simons, and Jim Doctor at Pahranagat NWR; Linda Miller, Jack Allen, Dr. Kathleen Blair, Dick Gilbert, and Stan Culling at the Lake Havasu NWR Complex; and Mike Oldham, Elaine Johnson, Brenda Zaun, Bill Seese, Joe Barnett, and Steven Rimer at the SW Arizona NWR Complex. Thanks to Keith Day and Rob Dobbs with the Utah Division of Wildlife Resources for their support in St. George. Also, we would like to thank Cris Tomlinson, Christy Klinger, and Tim Wood with Nevada Department of Wildlife for their support at Key Pittman Wildlife Management Area, River Ranch, Warm Springs Natural Area, and Overton Wildlife Management Area. Thanks to Dave Syzdek with Southern Nevada Water Authority for logistical support and site tours at Warm Springs Natural Area.

Thanks to the following agencies and personnel for assistance with obtaining permits: Greg Beatty, Erin McCarthy, Daniel Marquez, Melissa Castiano, Vanessa Martinez, Leilani Takano, and Corey Kallstrom with the U.S. Fish and Wildlife Service; Florence L. Soehnlein and Danny Bystrak with the Federal Bird Banding Laboratory; Melissa Swain with the Arizona Game and Fish Department; Gloria Shaw with Lake Mead National Recreation Area; Randi Logsdon, and Esther Burkett with the California Department of Fish and Game; Cris Tomlinson and Julie Meadows with the Nevada Department of Wildlife; Suzanne McMullin with the Utah Division of Wildlife Resources; Tom Denniston with the Bureau of Land Management, St. George; and Bill Dowdle with the Arizona State Lands Department. Robert Bunker, Bill Evans, and Gary Hafen granted access to their properties.

Thanks to Johnny, Mike, and Kathy at Monte Vista Marine for assisting with boating logistics. Mike Rose assisted with ATV logistics.

This project would not be a success without our dedicated staff and field personnel. Many, many thanks to Jessica Maggio and Kimberly Proa who went beyond their administrative duties and coordinated housing, permitting, payroll, vehicles, computers, safety, and telecommunications and handled all manner of crises with cheerful aplomb. A very special thanks to Glenn Dunno for his GIS talents. Thanks also to Shara Monik, Lisa Jackson, and Rose Burgess for administrative and accounting support. And sincere thanks to the 2011 field personnel for hard work, dedication, and sweat.

Appendix A

FIELD DATA FORMS

Willow Flycatcher (WIFL) Survey and Detection Form (revised April 2010)

Site Name_____ State_____ County _____
USGS Quad Name _____ Elevation _____ (meters)
Creek, River, Wetland, or Lake Name_____
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? Yes___ No____

Survey Coordinates: Start: E_____ N_____ UTM Datum_____(See instructions)
Stop: E_____ N_____ UTM Zone _____
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

***** Fill in additional site information on back of this page *****

Survey # / Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N / If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Overall Site Summary Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total Survey Hrs_____		Total Adult Residents	Total Pairs	Total Territories	Total Nests	Were any Willow Flycatchers color-banded? Yes___ No ___ If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual _____ Date Report Completed_____ _____
US Fish and Wildlife Service Permit #_____State Wildlife Agency Permit #_____

Submit form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual _____ Phone # _____
Affiliation _____ E-mail _____
Site Name _____ Date Report Completed _____
Was this site surveyed in a previous year? Yes___ No ___ Unknown ____
Did you verify that this site name is consistent with that used in previous years? Yes ____ No _____ Not Applicable ___
If site name is different, what name(s) was used in the past? _____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes ____ No ____ If no, summarize below.

Management Authority for Survey Area: Federal____ Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) _____

Length of area surveyed: _____ (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

_____ Native broadleaf plants (entirely or almost entirely, > 90% native)

_____ Mixed native and exotic plants (mostly native, 50 - 90% native)

_____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

_____ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific names.
_____

Average height of canopy (Do not include a range): _____ (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections; 2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests; 3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.
_____
_____
_____
_____
_____
_____

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (10–25 July)]

General Info

Study Area: _____ **Survey Site:** _____ **Date:** _____

Observer(s): _____ **early**_____ **mid**_____ **late** _____ **other**_____

Vegetation

Vegetation at site: >90% native 50–90% native 50–90% exotic >90% exotic

Canopy closure: <25% 25–50% 50–70% 70–90% >90%

Overstory height (m): _____ **Dominant overstory species:** TASP SAGO SAEX POFR Other _____

Understory height (m): _____ **Dominant understory species**: TASP SAGO SAEX PLSE Other _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

Hydrology

% of site inundated: _____

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc):

_____

Average depth of surface water:
toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils (do not include inundated areas in percentage!): _____

% of site with damp soils (do not include inundated or saturated areas): _____

If not inundated or saturated, distance (m) to standing water or saturated soil:_____

How was distance determined? Visually estimated in field Measured in field using GPS
Measured from aerial photograph Other _____

Describe type of nearest surface water: _____

Narrative and Pictorial Description

Does this description cover the entire site? Y N **If not, which portion is described?**_____
_____

On the reverse, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats:

_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____

STUDY AREA: _____ **SITE**: _____ **BANDER**: _____ **DATE**: _____ **TIME**: _____ **TERR/NEST #**: _____
UTM NAD___ **Zone**___ _____ **E** _____ **N** **NBN:** ____ of ____
NOTES:_____

FEDERAL BAND #	COLOR COMBO		STATUS	SEX	AGE	FECAL SAMPLE? (Y or N)	GENETIC SAMPLE? (Y or N)	# PHOTOS TAKEN
	L	R						

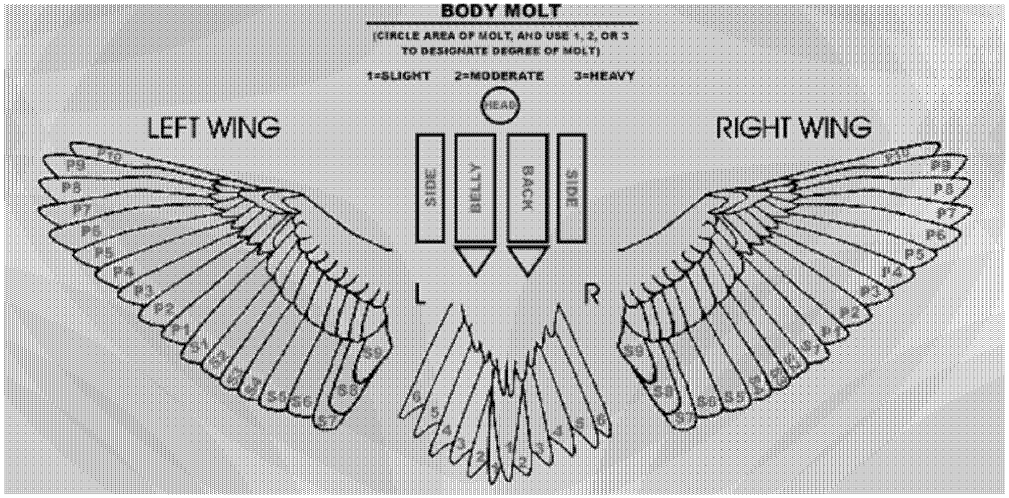
STATUS: NCP = new cap passive, NCT = new cap target, RCP = recap passive, RCT = recap target, NBN = nestling banded
SEX: U = unknown, F = female, M = male
AGE: AHY = after hatch year; SY = second year; L = nestling banded in nest; HY = hatch year/young of the year

Adults								
CP	BP	WING CHORD (mm)	TAIL ~~(mm)~~	CULMEN LENGTH (mm)	CULMEN WIDTH (mm)	FAT	RETAINED FEATHERS? Y or N, if Y use diagram, detail in notes	ACTIVE MOLT?

Nestlings	
Developmental Age (days)	MASS (g)

CP: 0 = non-breeding, S = partial breeding, M = full breeding
BP: 0 = none, 1 = smooth, 2 = vascularized and filled with fluid, 3 = wrinkled, 4 = molting
FAT: 0 = no fat; 1 = trace of fat in furculum, deeply concave, scattered patches, less than 5 percent filled; 2 = thin layer of fat in furculum, less than a third filled, trace of thin layer of fat in abdomen; 3 = furculum is ½ filled or more; small patches, not covering some areas, on abdomen; 4 = furculum more than 2/3 filled, level with clavicles, slightly mounded on abdomen

If a genetic sample or metric was not taken, explain why in notes



Date:_____ Page ____ of _____

				COLOR COMBO							
OBS	STUDY AREA	TERR	NEST	LEFT LEG	RIGHT LEG	CONF LEVL	CAP?	# WIFLS	SEX	NBN (__of__)	OBSERVATIONS AND COMMENTS: discuss observations & activities. **If you assign gender, explain!**
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =

Willow Flycatcher Territory/Nest Record Form

Year _____ Study Area_____ Survey Site_____ Territory/Nest no._____

Territory/Nest Location:
NAD:_____ Zone:_____

Territory UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest Height:_____ m (approx)

Nest Substrate:_____(e.g., TASP=tamarisk, SAGO=Goodding willow, SAEX = coyote willow, etc.)

Distance to standing water or saturated soil:

When nest found: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____

Depth of surface water at nest (circle how wet you got when nest was found):
dry damp muddy toes (<5cm) ankles (5-15 cm) calves (15-40 cm)
knees (40-60 cm) thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

At hatch: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____

At fledge/fail: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	BD (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No.	Presumed	Confirmed	
			Eggs
			Nestlings
			Fledglings

Cowbird

Trans dates	BD (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledglings

Outcome (Record code & describe):_____:_____

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **PA**= parasitized, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **AD**= failure, entire clutch addled/infertile; **OT**= failure due to other, or unknown, causes.

Mayfield Success

(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S**= successful; **D**= depredated; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other than predation; **A**= abandoned with host egg(s) or young; **Z**= abandoned, no (zero) eggs laid.

Willow Flycatcher Territory/Nest Record Form (continued)

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Date	Time In	Time Out	Obs	Mon Type	Stage	Adult pres.	# WE	# CE	# WN	# CN	#WF	Age Yng	Comments

LCR SWFL – Vegetation Datasheet

Observers: _____

Study area	Survey site	Plot type	ID#	UTM: E N	Acc. m	Date
Canopy height	Direct measurement m	Using clinometer Top % - Bottom % × Dist m	**Ground cover** Obs:	N E S W	**Canopy closure** Obs:	N S

Species	TASP single	TASP multi	TASP skipped	SAEX single	SAEX multi	SAEX skipped	SAGO single	SAGO multi	SAGO skipped	SNAG single	SNAG multi	SNAG skipped
Stem Count By cm dbh category: <1												
1–2.5												
2.6–5.5												
5.6–8												
8.1–10.5												
10.5–15												
Measured Trees >15 cm dbh												

Species	OTSP1 single	OTSP1 multi	OTSP1 skipped	OTSP2 single	OTSP2 multi	OTSP2 skipped	OTSP3 single	OTSP3 multi	OTSP3 skipped
Stem Count By cm dbh category: <1									
1–2.5									
2.6–5.5									
5.6–8									
8.1–10.5									
10.5–15									
Measured Trees >15 cm dbh									

Other species (write out full name)

OTSP1_____

OTSP2 _____

OTSP3_____

If stem splits below ankle height, measure and tally each stem in "single" column. If, at ankle height or above, stem splits into multiple branches, measure and tally the biggest stem in "multi" column and record how many stems you did not measure in the "skipped" column (in the size category of the stem you measured).

If stem is not at least breast height, do not count

Vertical Foliage Sampling

CENTER PLOT Observer: _____							
Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1*:	OTSP2*:	OTSP3*:
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10-cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
Use same OTSP (1,2,3) as listed on main record.

Notes:

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 1m Observer: _____ EAST 1m Observer: _____

Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 1m Observer: _____								WEST 1m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*__Use same OTSP (1,2,3) as listed on main record.__

SIDE 2

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 5m Observer: _____ EAST 5m Observer: _____

Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 5m Observer: _____								WEST 5m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 2

SWFL Microclimate at Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year) – (Territory #)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Date territory first occupied: _____ **Date territory vacated** _____

New Location ID (if this logger was already in the field) _____–_____–_____

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____

Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Habitat Monitoring Sites

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Survey site) – (Number)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **Accuracy**: _____ m

T/RH Downloads

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

Location ID codes: Study area codes – Topock Marsh = TM, Topock Gorge = TG, Ehrenberg = EH, Cibola = CI, Imperial = IM, Mittry = MI, Yuma = YU. Survey site codes – In Between = IB, Blankenship = BK, Havasu NE = HV, Ehrenberg = EH, Three Fingers Lake = TF, Cibola Lake = CL, Walker Lake = WL, Paradise = PV, Hoge Ranch = HR, Rattlesnake = RS, Clear Lake = LK, Ferguson Lake = FL, Ferguson Wash = FW, Great Blue Heron = GB, Mittry West = MW, Gila Confluence North = GC

Microclimate at Hydro Monitoring Sites – Topock

Study Area _TOPO___ Survey Site _____ LOCATION ID: TM –HM–_____
(Location ID)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

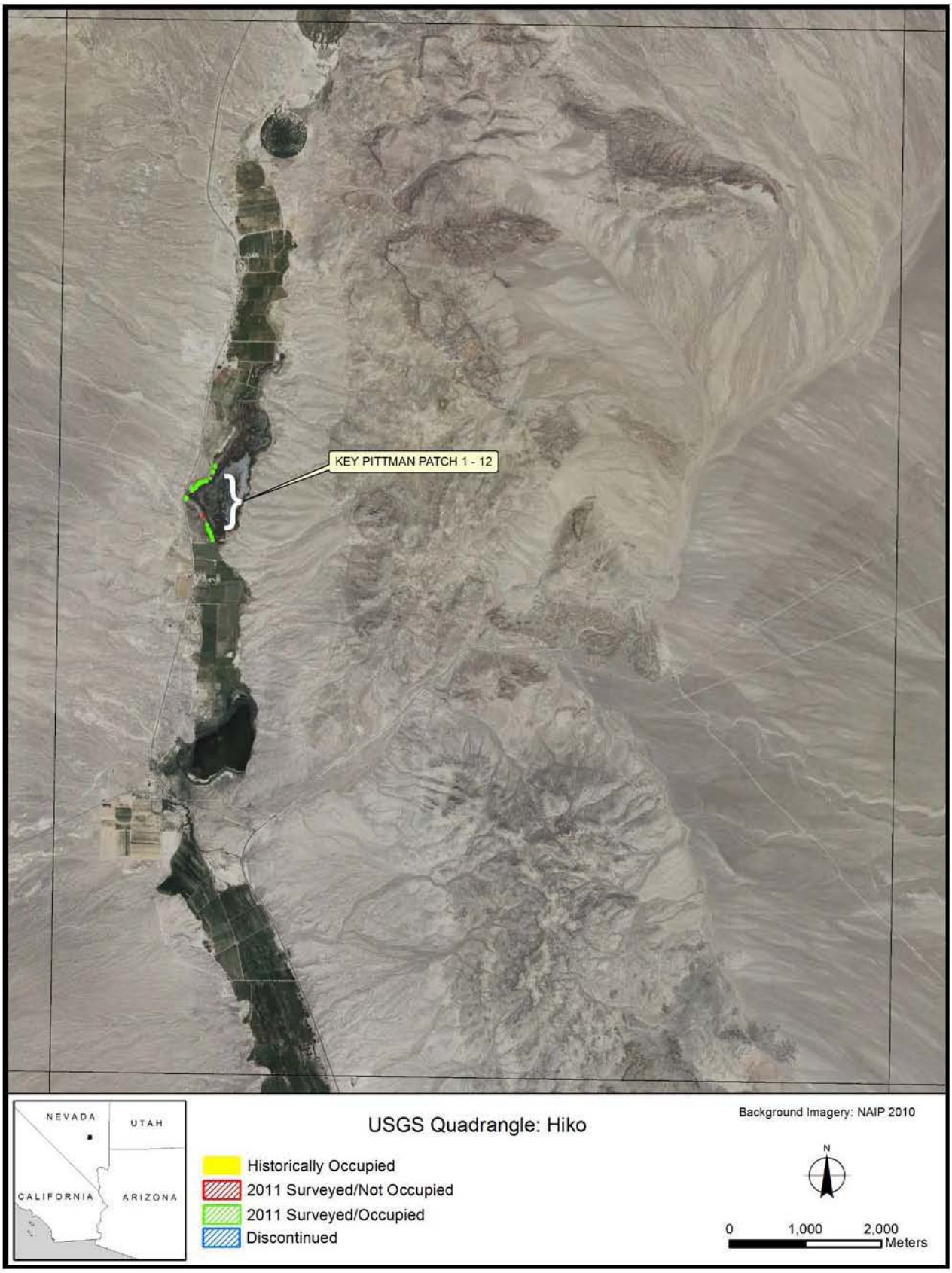
Soil moisture data collected on the following dates (enter SM data directly into database):

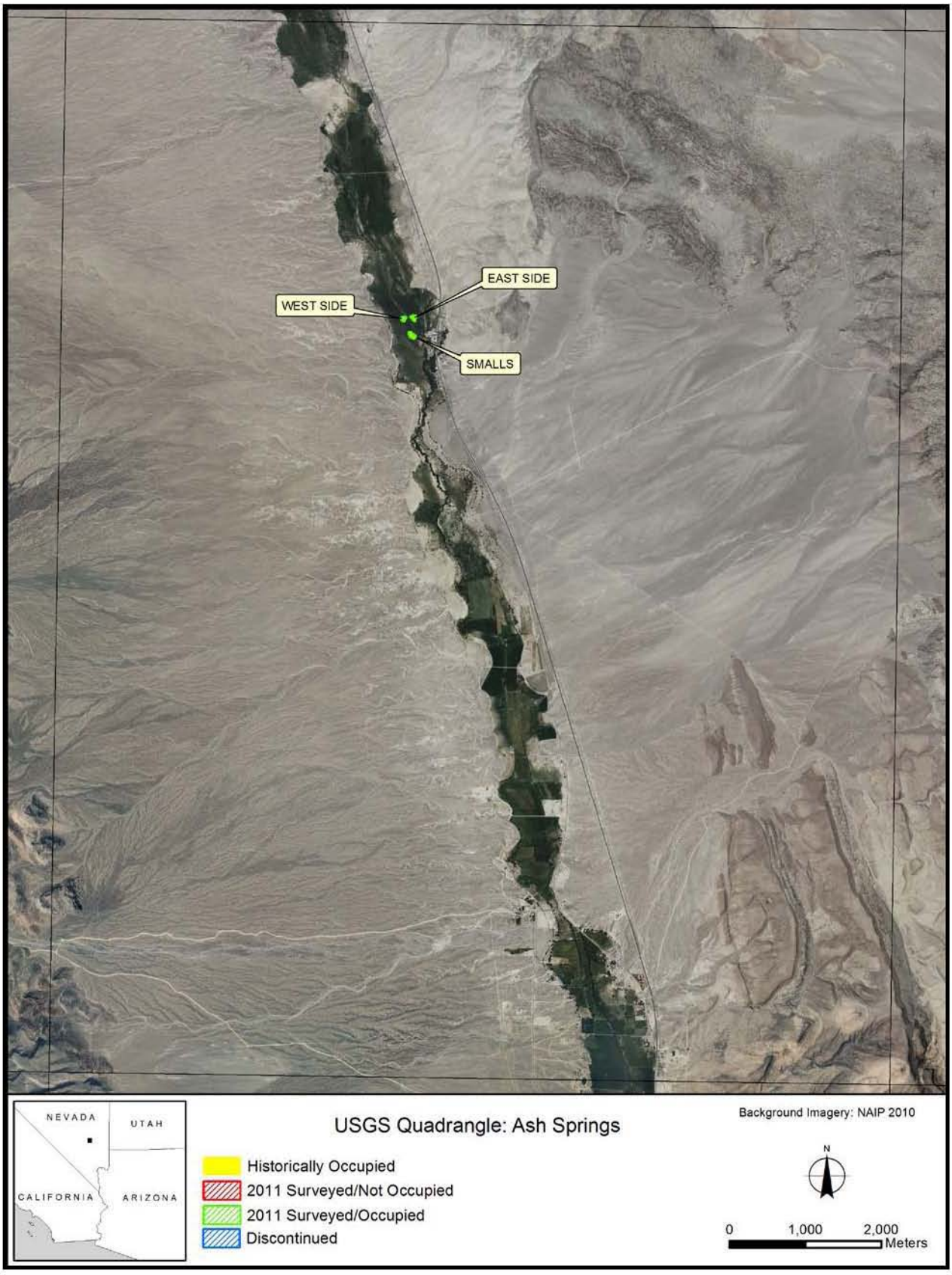
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____

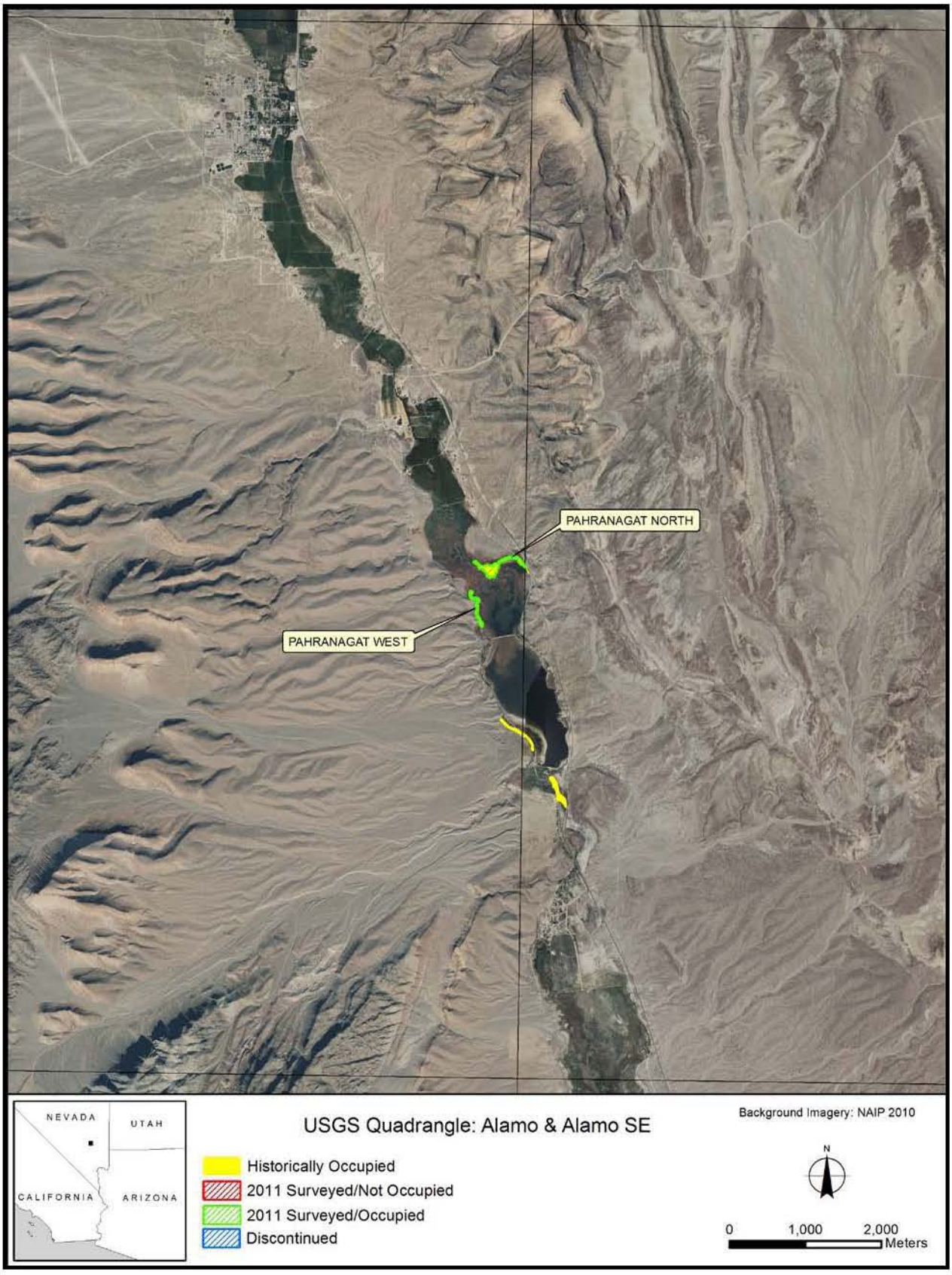
Appendix B

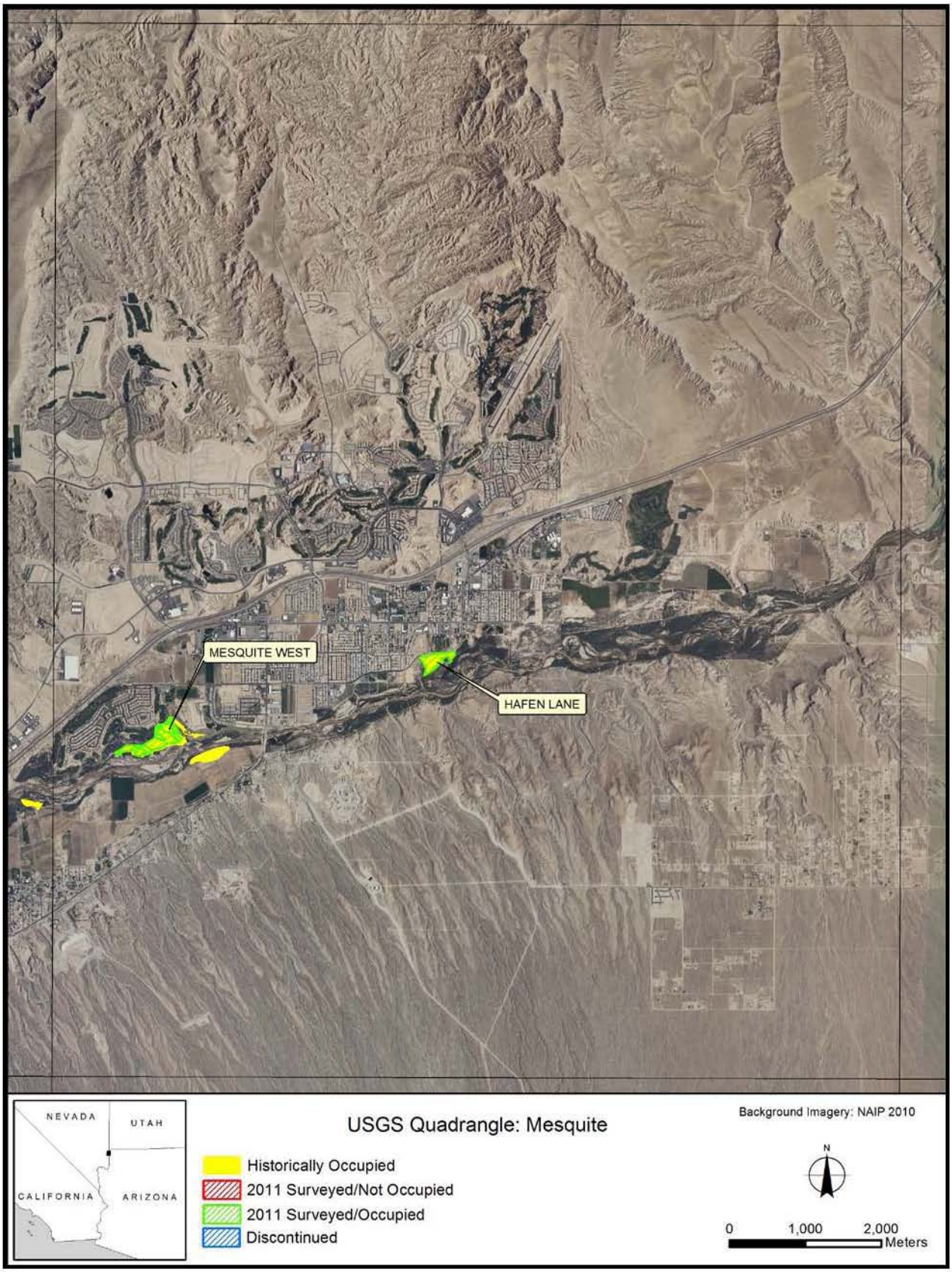
ORTHOPHOTOS SHOWING STUDY SITES

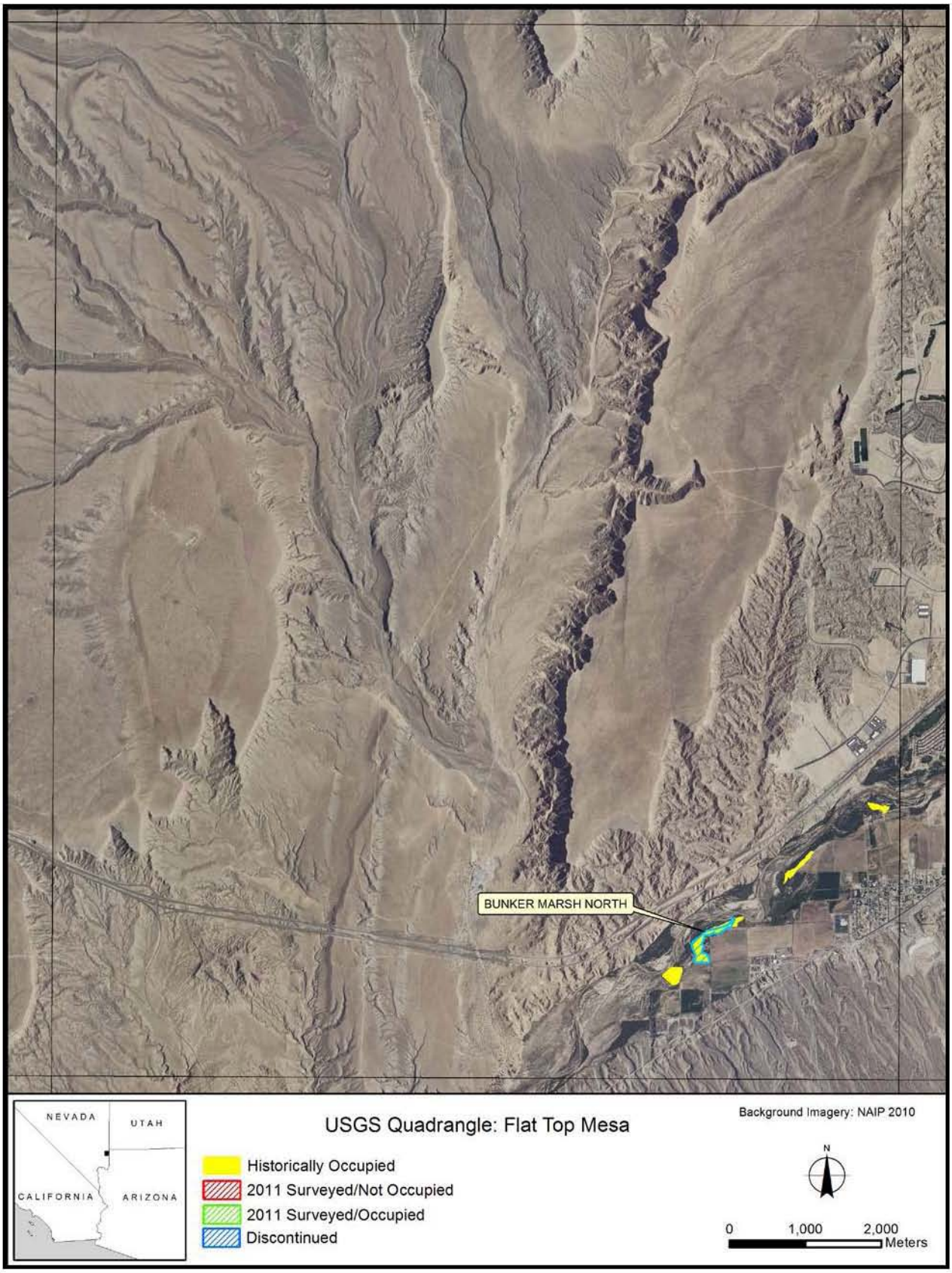

NEVADA
UTAH
CALIFORNIA
ARIZONA
MEXICO
KEY PITTMAN
RIVER RANCH
PAHRANAGAT NWR
WARM SPRINGS
MESQUITE
MORMON MESA
MUDDY RIVER
TOPOCK MARSH
BILL WILLIAMS RIVER NWR
PVER
CIBOLA
IMPERIAL
MITTRY LAKE
YUMA
St. George
Las Vegas
Kingman
Flagstaff
Quartzsite
Phoenix
Palm Springs
Yuma
Lake Mead
Lake Mohave
Lake Havasu
Salton Sea
Pahranagat Wash
Virgin River
Colorado River
Bill Williams River
Verde River
Gila River
Lower Colorado River Southwestern
Willow Flycatcher Study 2011
NDOW Study Area
Reclamation Study Area
City/Town
Highway
River
0 25 50 Mi
0 50 100 Km
1:3,300,000
N

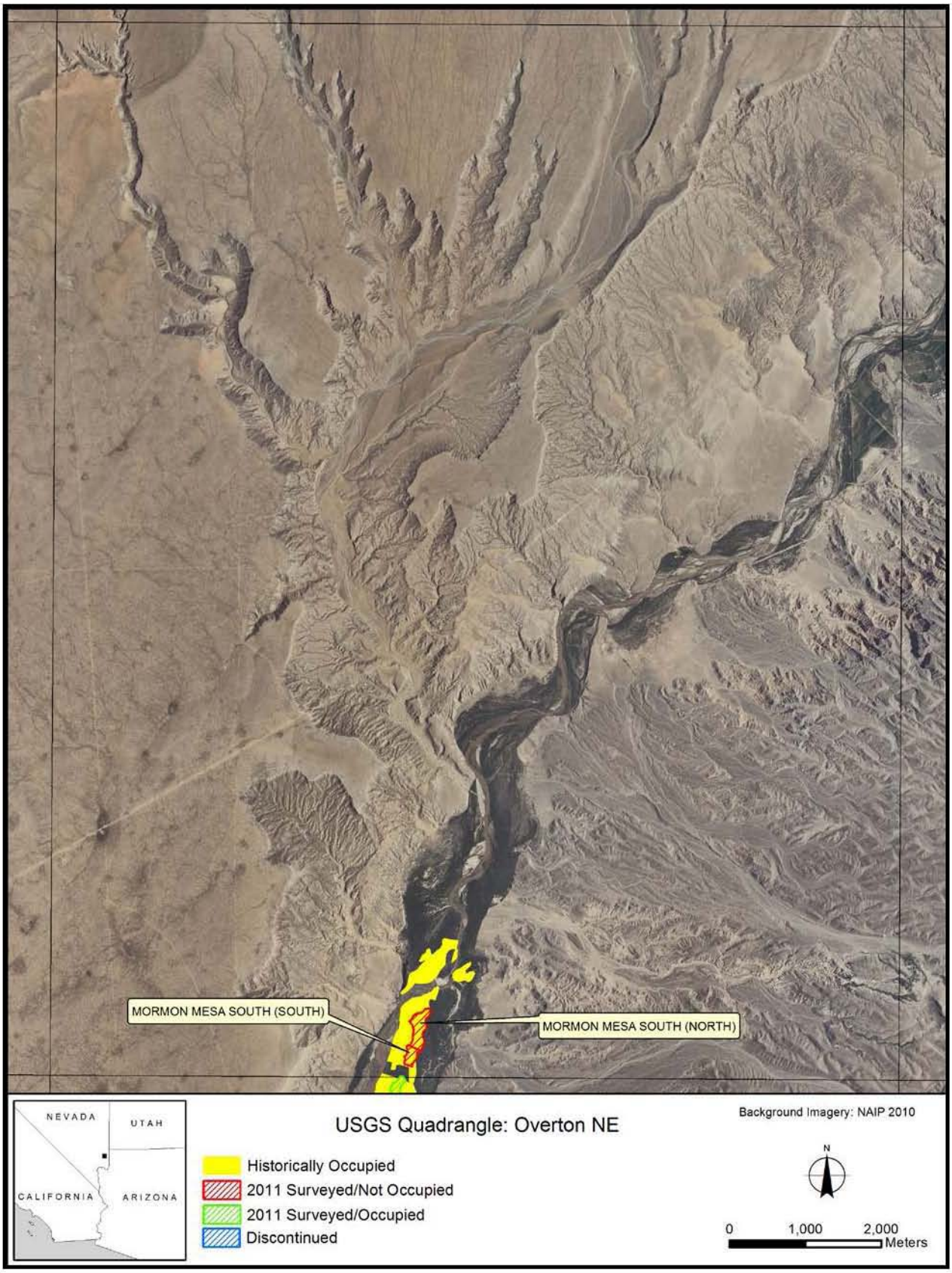

KEY PITTMAN PATCH 1 - 12
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Hiko
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

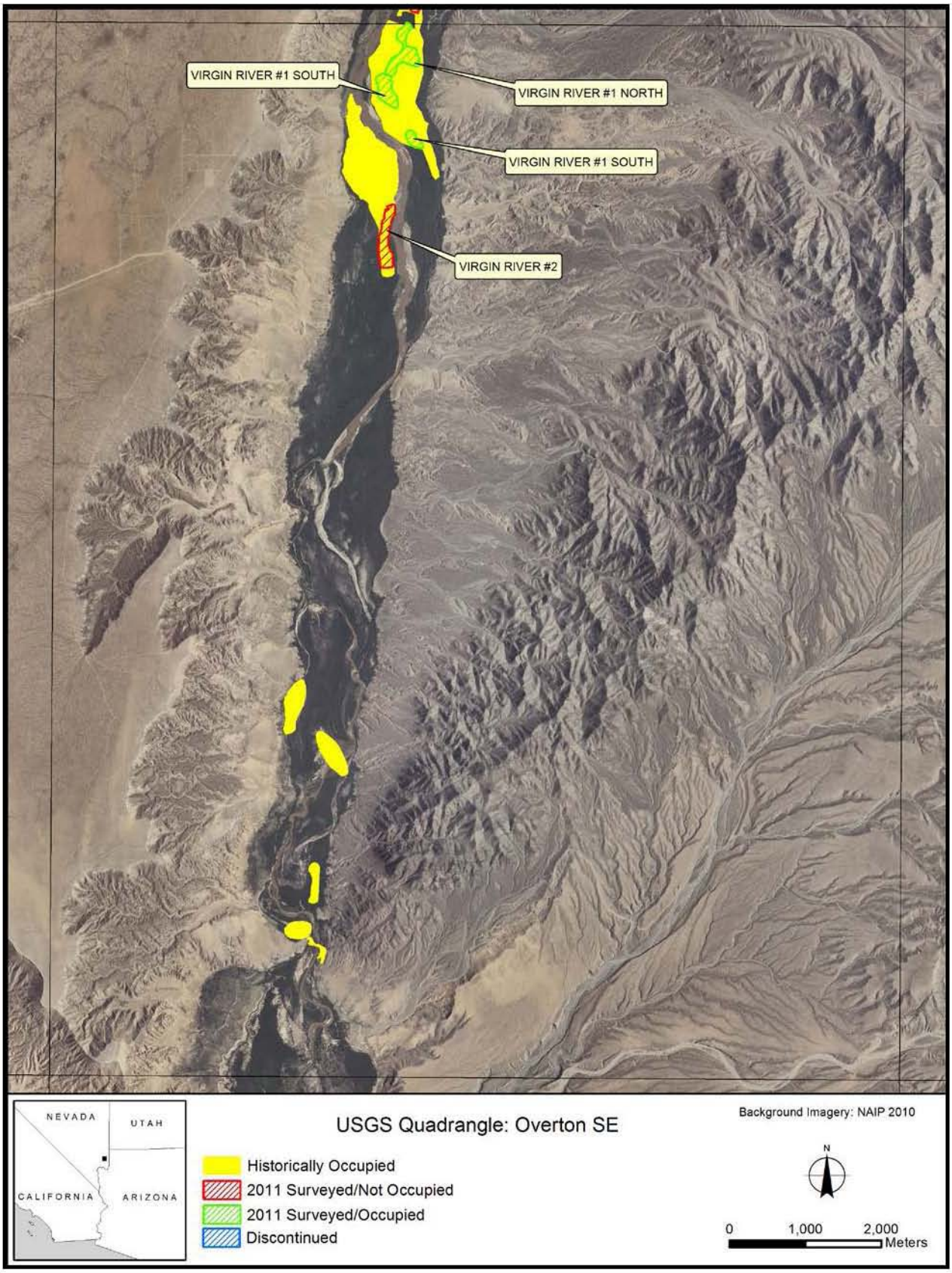

EAST SIDE
WEST SIDE
SMALLS
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Ash Springs
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

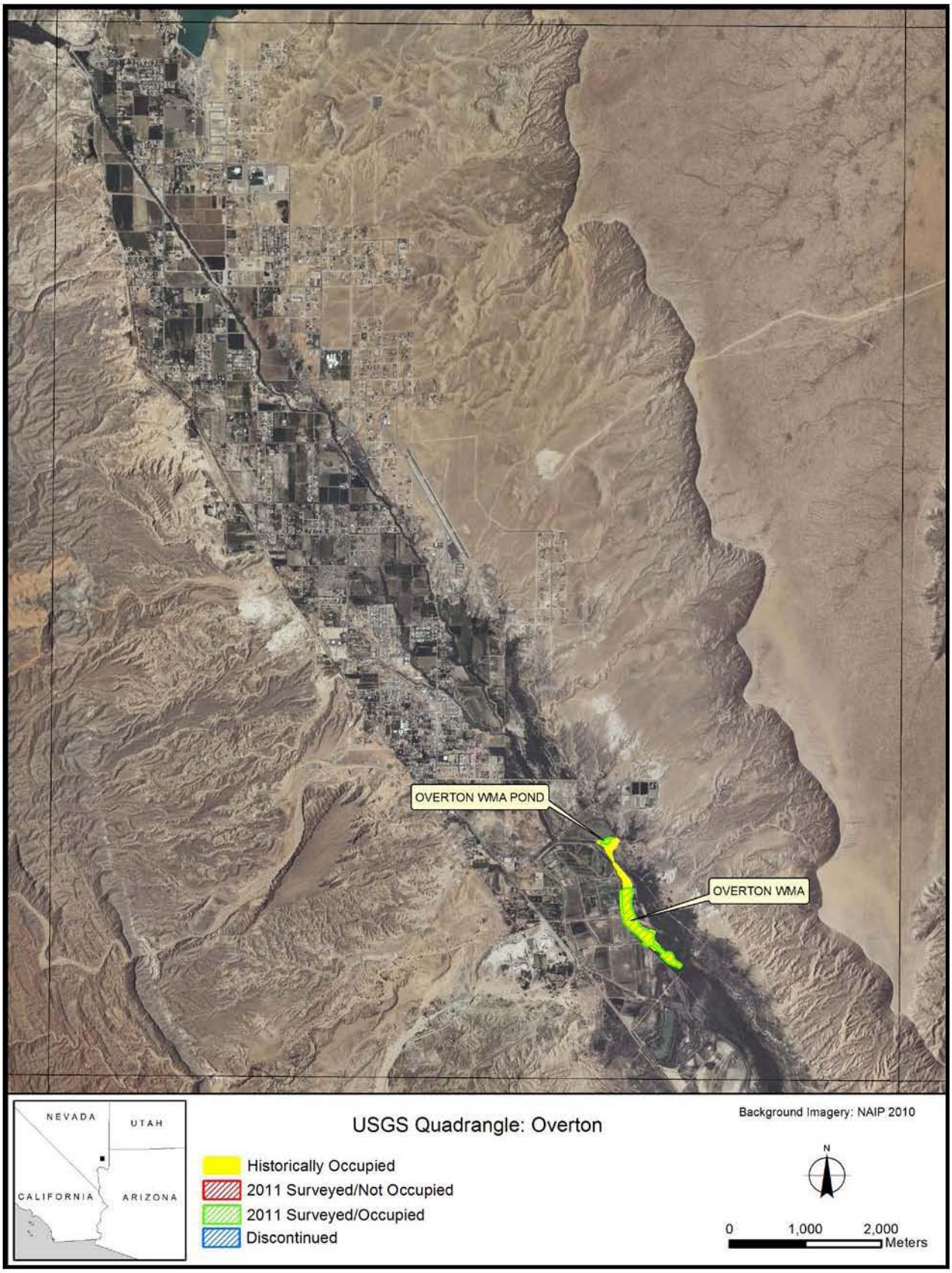

PAHRANAGAT NORTH
PAHRANAGAT WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Alamo & Alamo SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

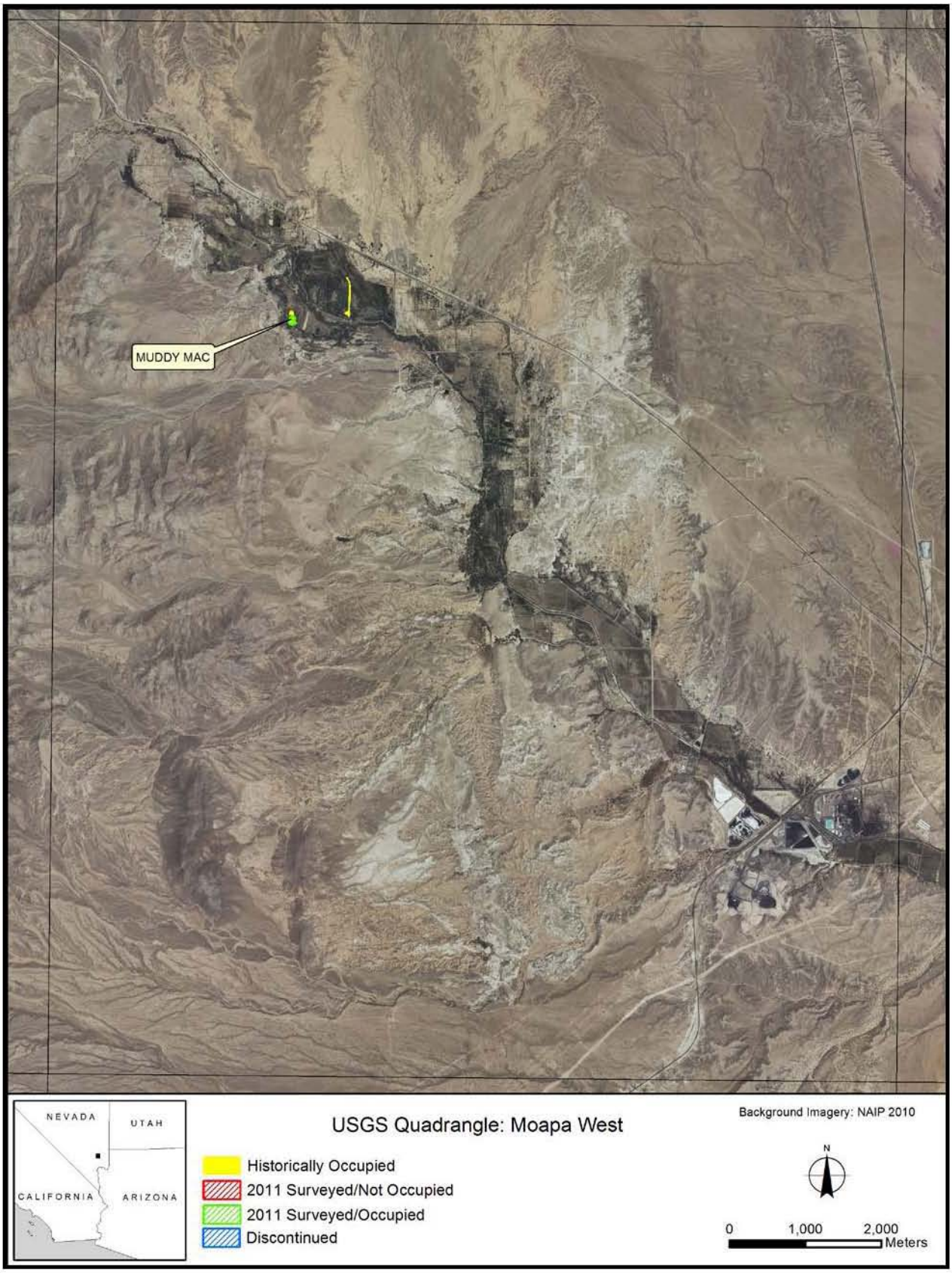

MESQUITE WEST
HAFEN LANE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Mesquite
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

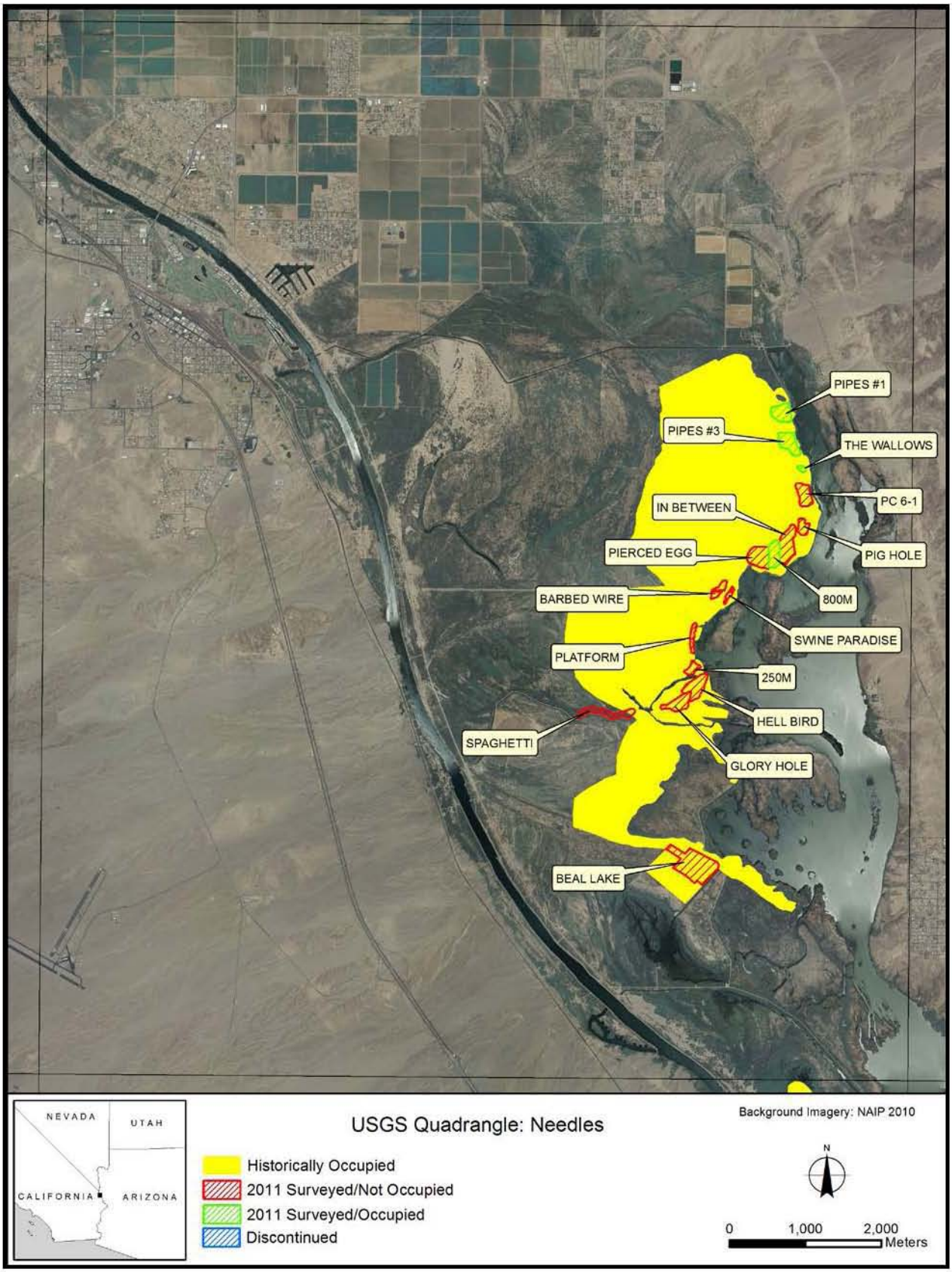

BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Flat Top Mesa
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

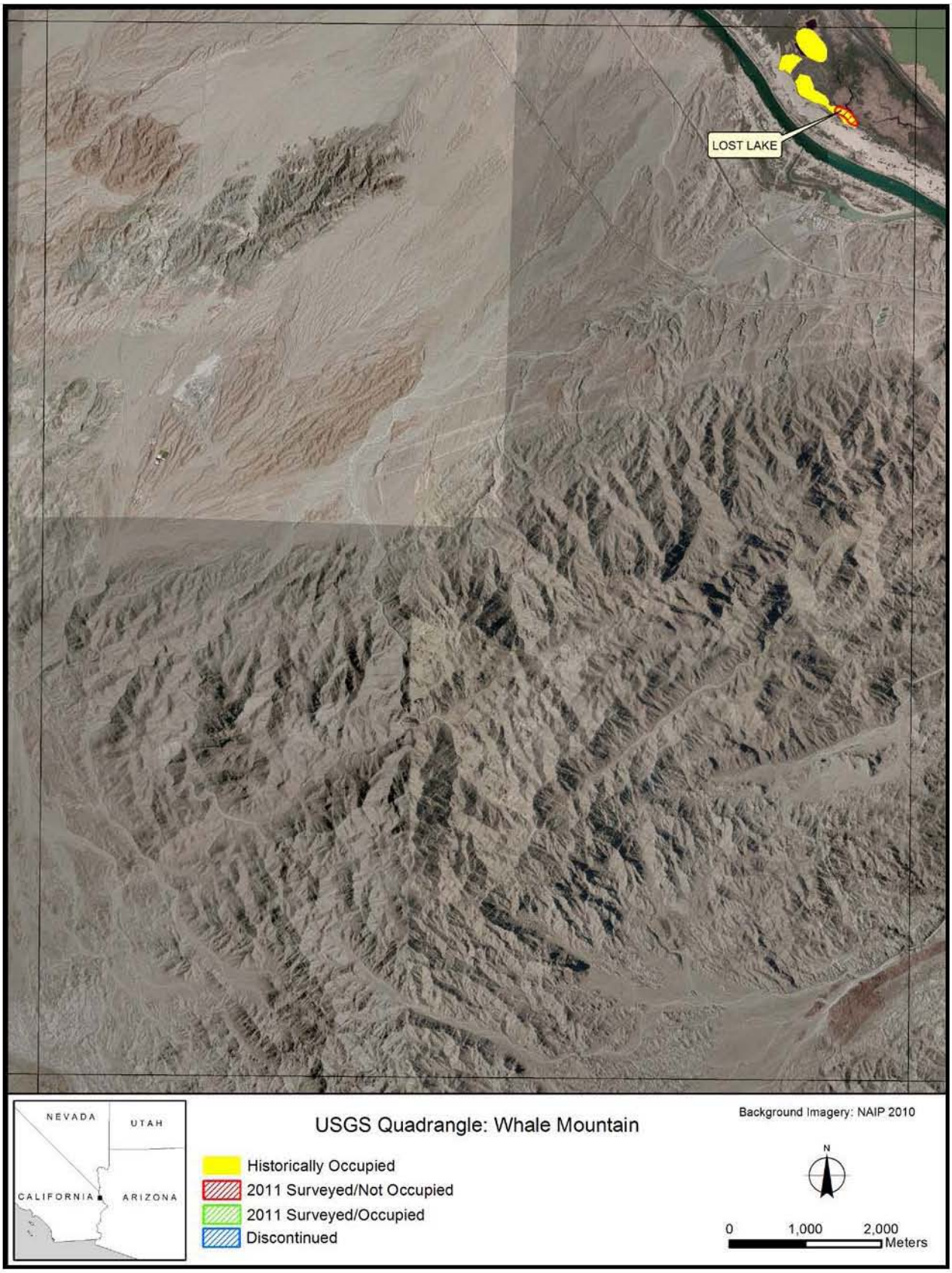

MORMON MESA SOUTH (SOUTH)
MORMON MESA SOUTH (NORTH)
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

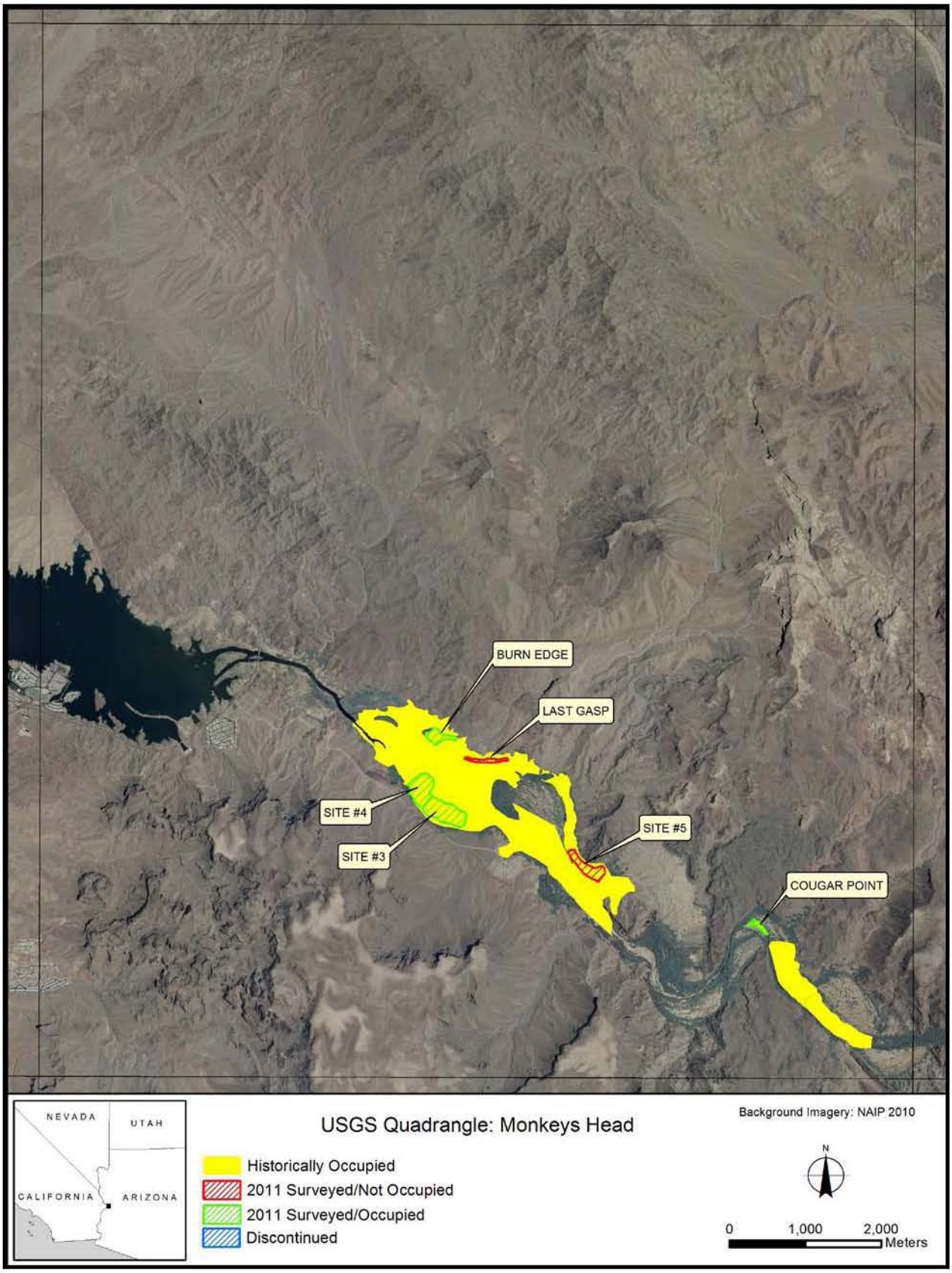

VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

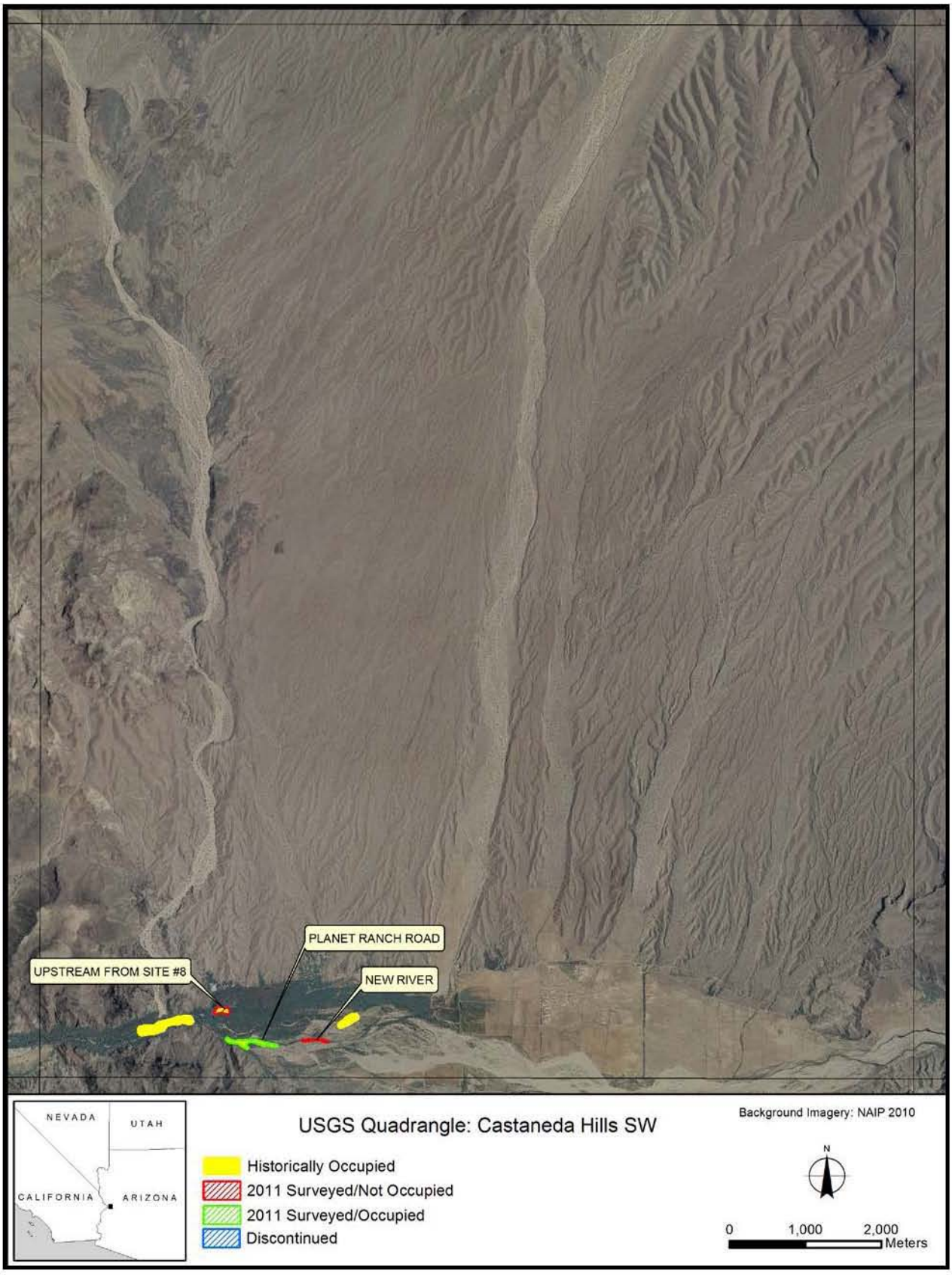

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

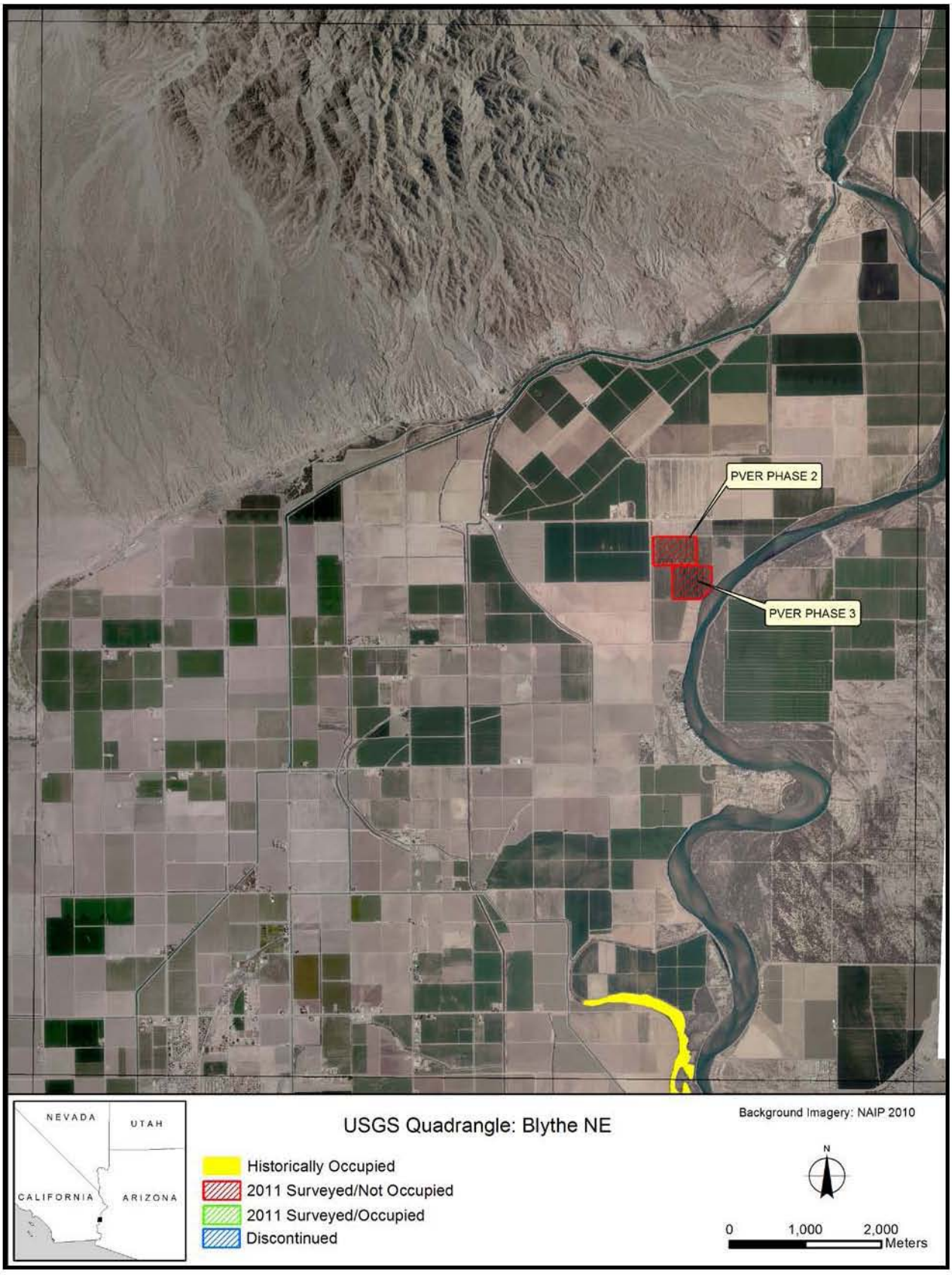

MUDDY MAC
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Moapa West
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

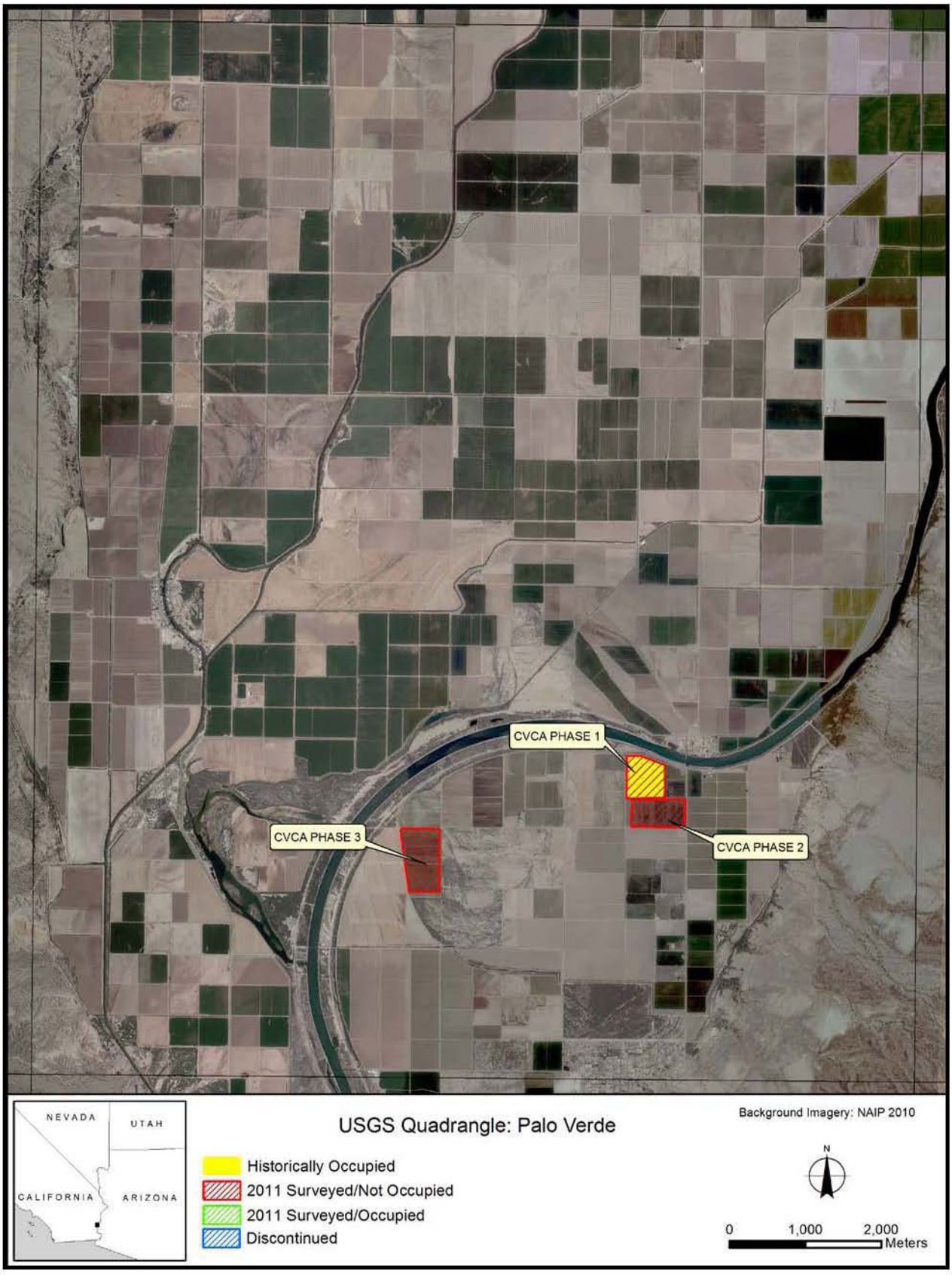

PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
IN BETWEEN
PIG HOLE
PIERCED EGG
800M
BARBED WIRE
SWINE PARADISE
PLATFORM
250M
HELL BIRD
SPAGHETTI
GLORY HOLE
BEAL LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

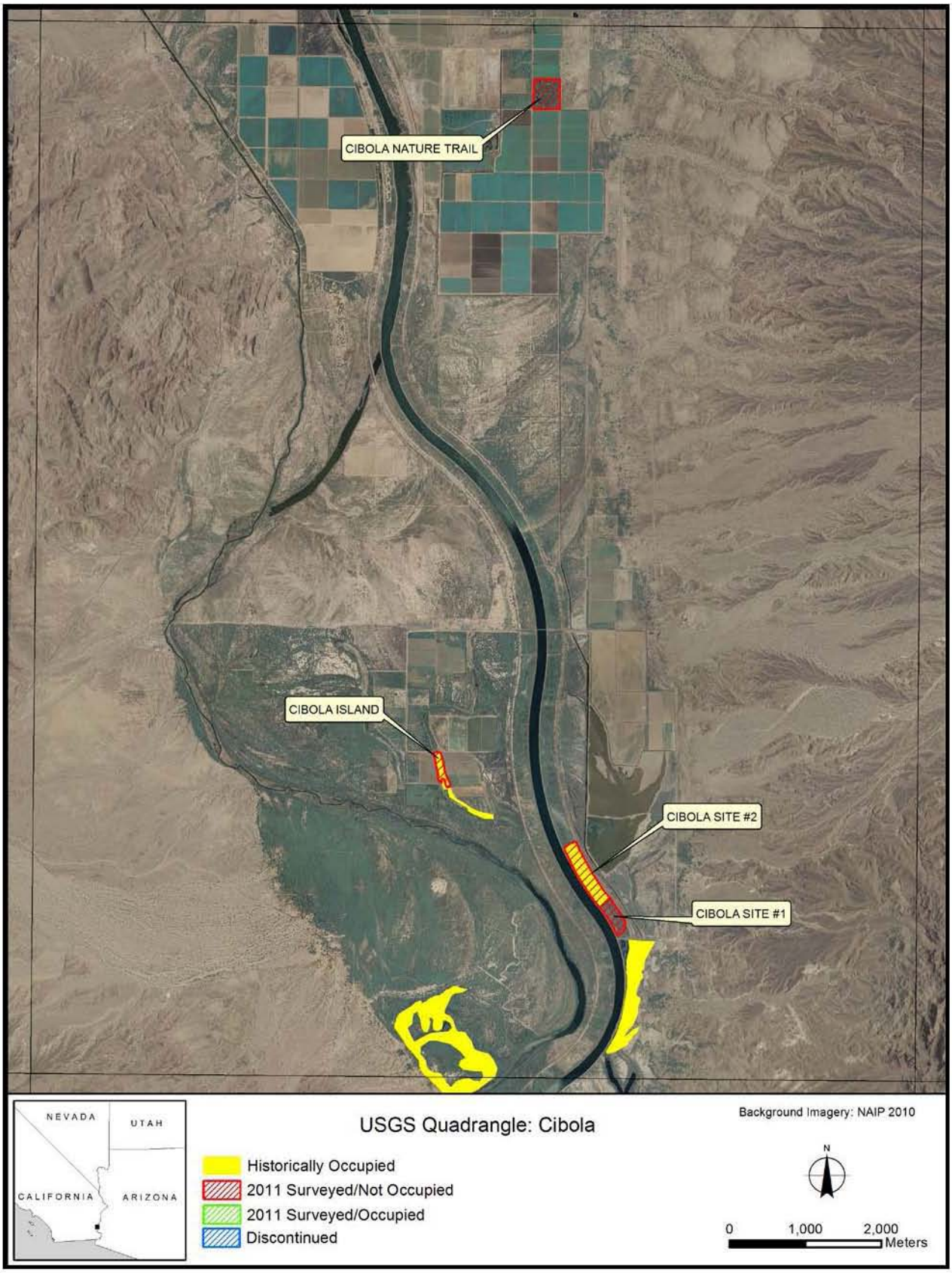

LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

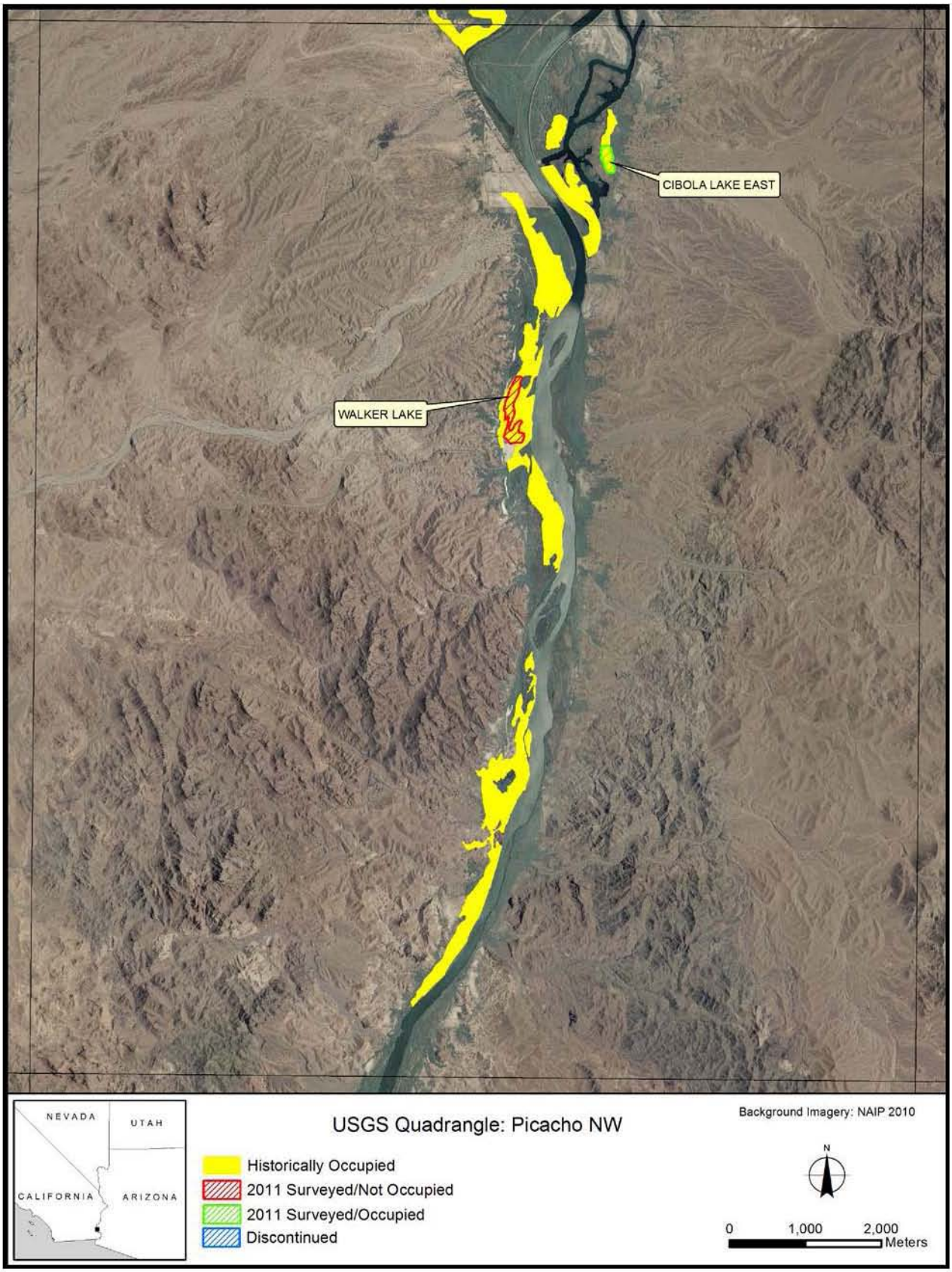

BURN EDGE
LAST GASP
SITE #4
SITE #3
SITE #5
COUGAR POINT
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

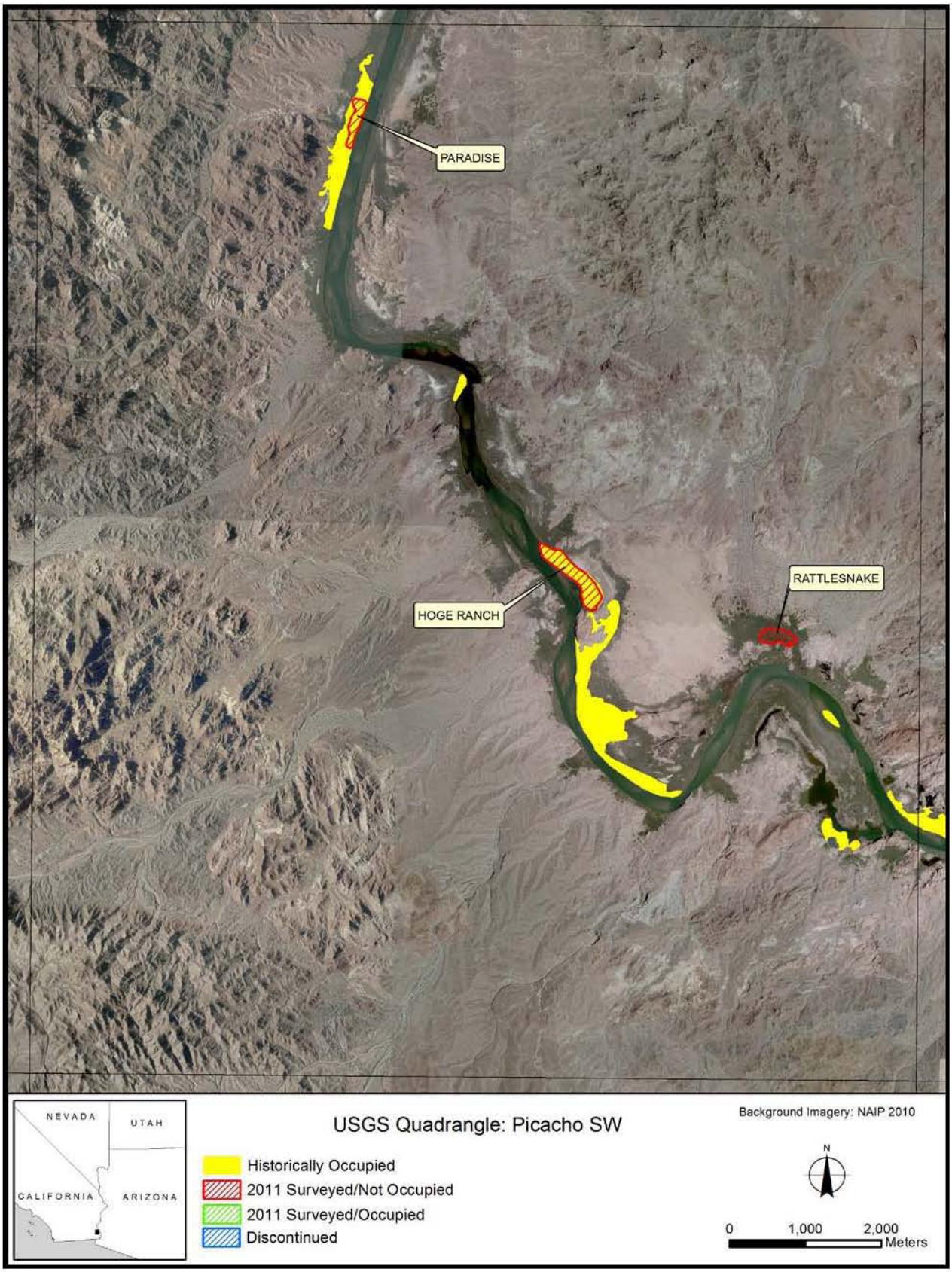

PLANET RANCH ROAD
UPSTREAM FROM SITE #8
NEW RIVER
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


PVER PHASE 2
PVER PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

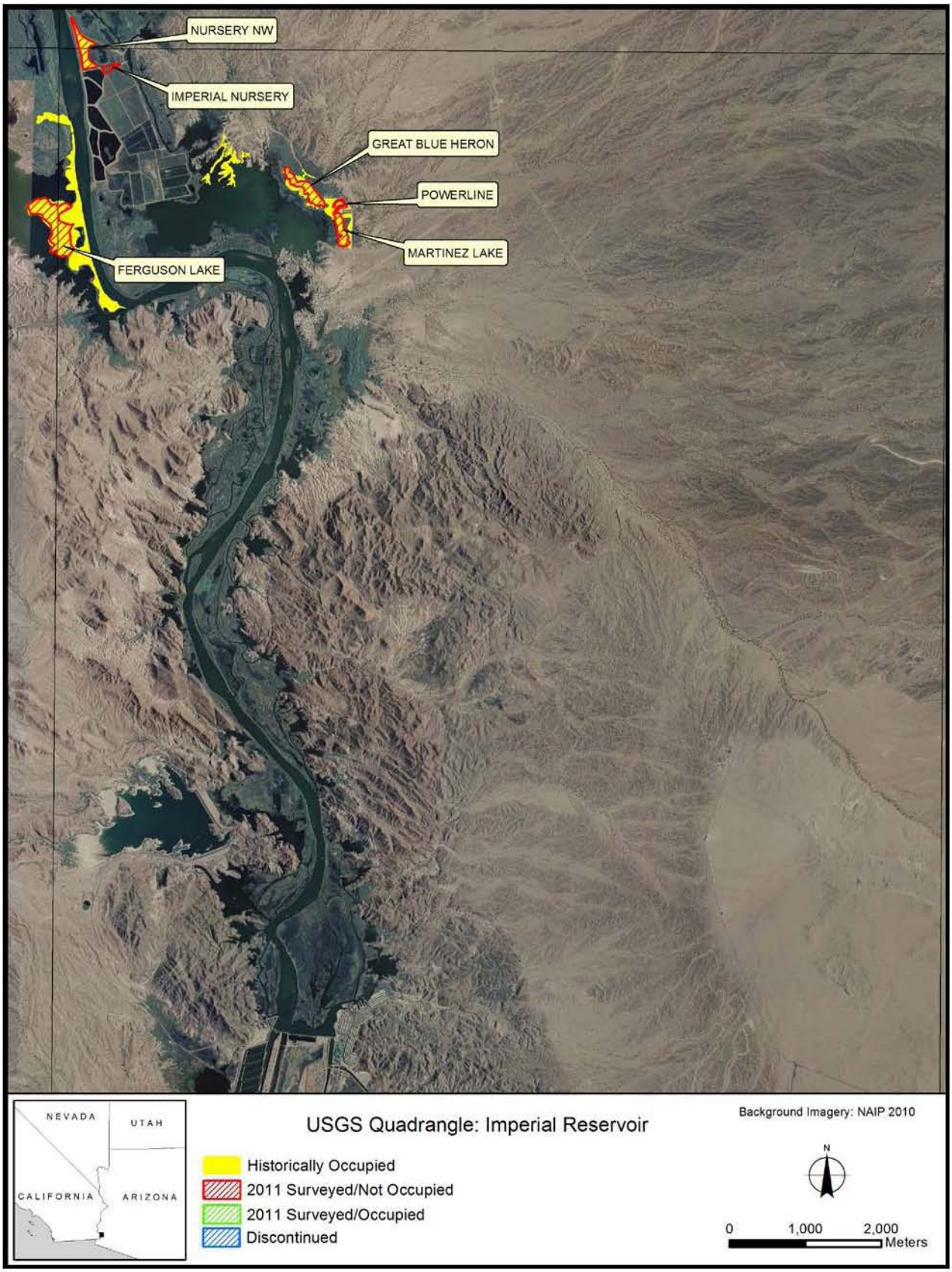

CVCA PHASE 1
CVCA PHASE 2
CVCA PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

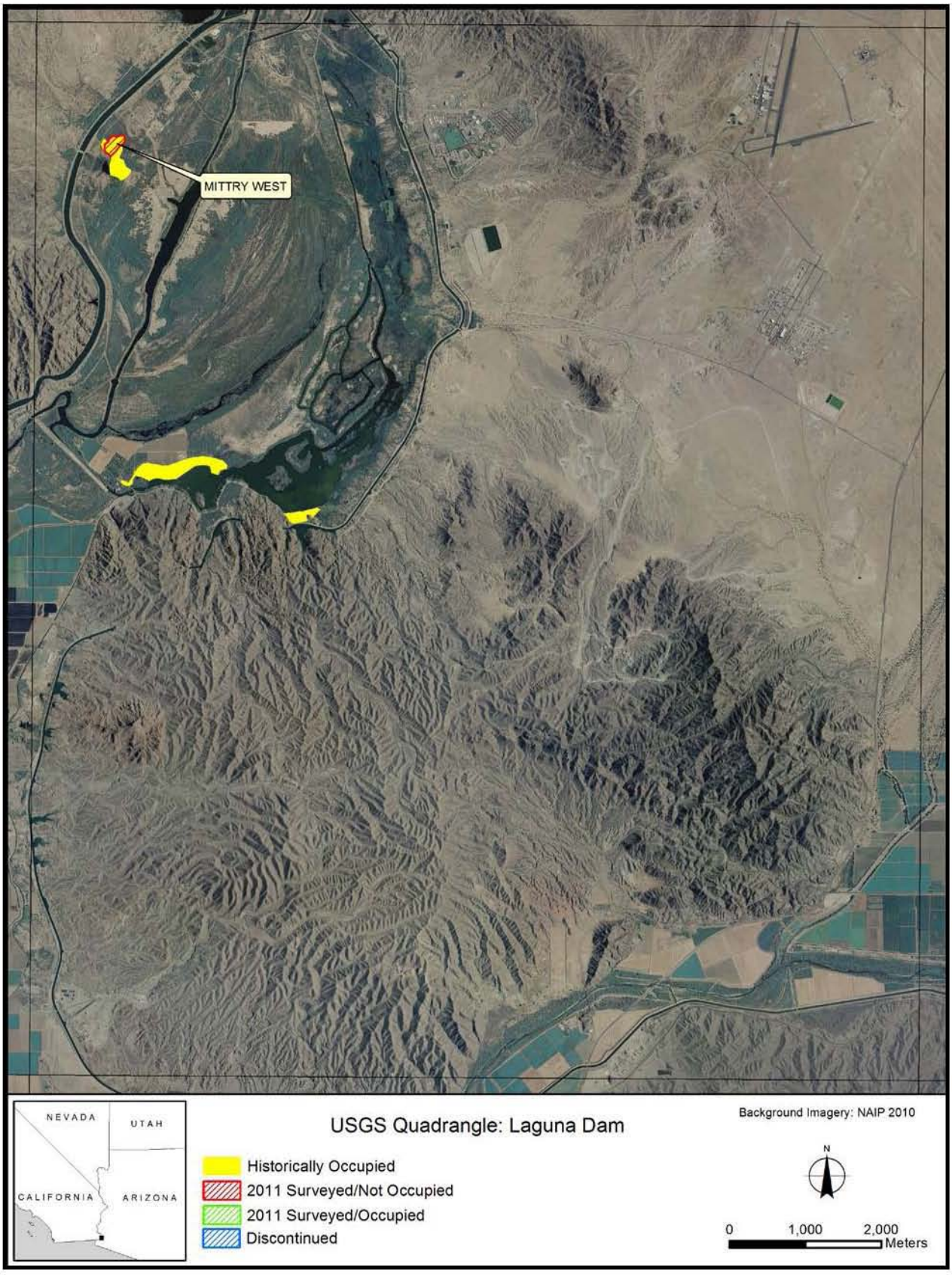

CIBOLA NATURE TRAIL
CIBOLA ISLAND
CIBOLA SITE #2
CIBOLA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

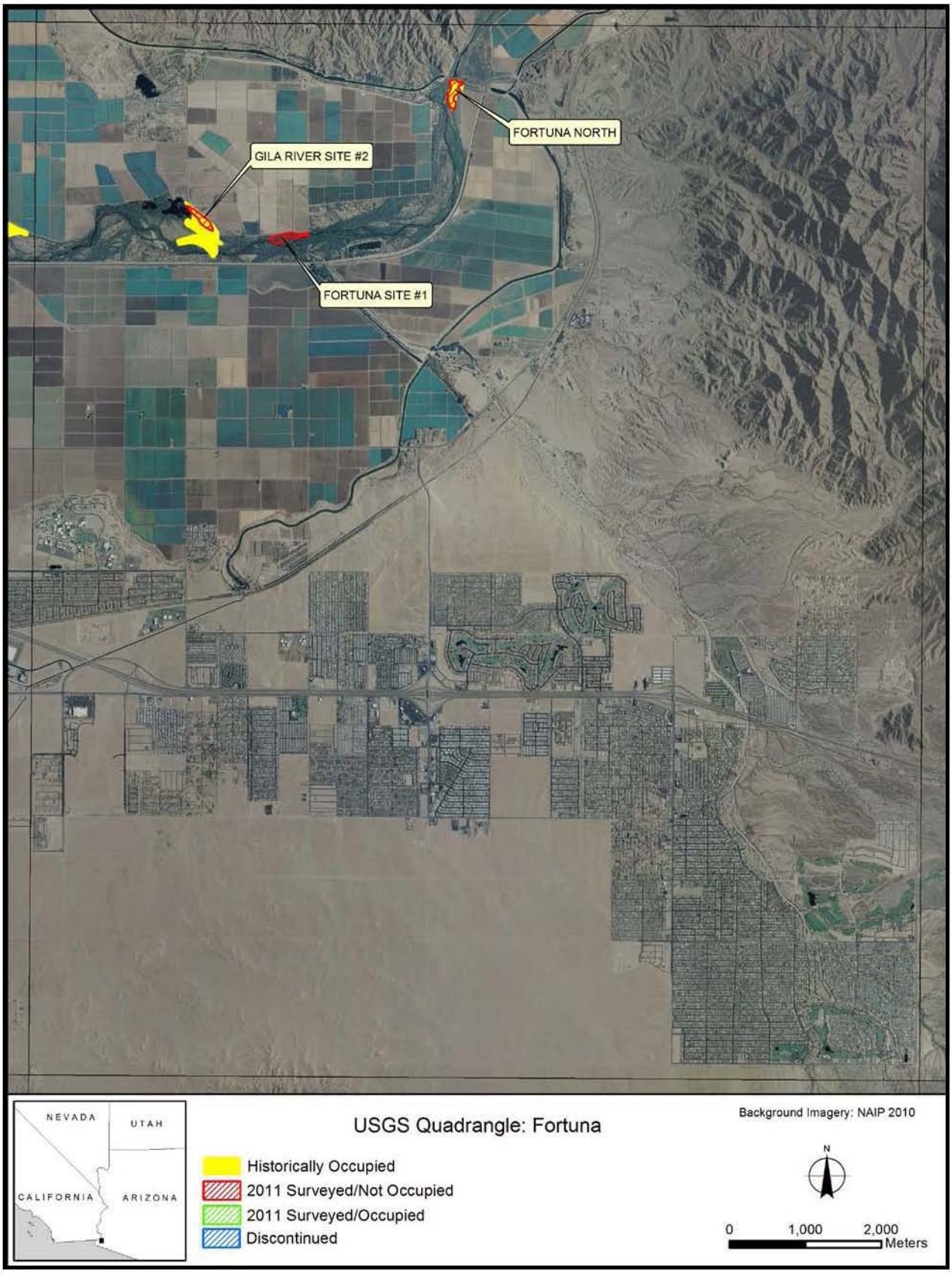

CIBOLA LAKE EAST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


PARADISE
HOGE RANCH
RATTLESNAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MILEMARKER 65
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


NURSERY NW
IMPERIAL NURSERY
GREAT BLUE HERON
POWERLINE
MARTINEZ LAKE
FERGUSON LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MITTRY WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


FORTUNA NORTH
GILA RIVER SITE #2
FORTUNA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Fortuna
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

Appendix C

SOUTHWESTERN WILLOW FLYCATCHER SURVEY RESULTS, 2011

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011*

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Pahranagat Valley	KEPI[5]	NV	Patch 0	0.04	0	---	2[6]	1	1	1	0	0
		NV	Patch 1	0.1	0	---	2	1	1	1	0	0
		NV	Patch 2	0.1	0	---	2	1	1	2	0	0
		NV	Patch 3	0.1	0	---	1	1	0	0	1	0
		NV	Patch 4	0.1	0	---	2	1	1	1	3[7]	0
		NV	Patch 4.5	0.02	5	0.3	0	0	0	0	0	0
		NV	Patch 5	0.1	0	---	2	1	1	2	0	0
		NV	Patch 6	0.2	0	---	5[8]	3	3	3	0	0
		NV	Patch 7	0.1	0	---	2	1	1	2	0	0
		NV	Patch 8	0.1	0	---	2	1	1	2	0	0
		NV	Patch 9	0.3	0	---	4	2	2	3	0	0
		NV	Patch 10	0.1	0	---	3[8]	2	2	4	0	0
		NV	Patch 10.5	0.02	0	---	0	0	0	0	2[9]	0
		NV	Patch 11	0.1	0	---	4	2	2	6	1	0
		NV	Patch 12	0.1	0	---	3[8]	2	2	6	2	0
		NV	Fence[10]	---	0	---	0	0	0	0	0	1
Pahranagat Valley	RIRA[11]	NV	East Side	0.4	1	0.8	2[7]	1	1	3	0	0
		NV	West Side	0.3	1	---	3[6,9,12]	2	1	1	2	0
		NV	Smalls	0.5	1	---	1	1	1	0	0	0
Pahranagat Valley	PAHR	NV	North	4.6	4	1.5	14[13,14]	10	6	7	5[12]	2
		NV	West	1.5	5	3.1	0	0	0	0	1[14]	0
Virgin River	MESQ	NV	Hafen Lane	6.1	5	16.2	3[15]	1	1	1	0	0
		NV	West	10.4	5	7.4	11[16,17]	7	6	8	0	0
		NV	Bunker Marsh North[18]	7.1	2	3.7	0	0	0	0	0	0
Virgin River	MOME[19]	NV	Mormon Mesa South (North)	8.4	4	9.3	0	0	0	0	0	0
		NV	Mormon Mesa South (South)	3.4	3	4.8	0	0	0	0	0	0
		NV	Virgin River #1 (North)	11.4	4	12.9	4	2	2	1	1	0
		NV	Virgin River #1 (South)	11.1	3	5.5	19[20]	12	11	19	2[16]	0
		NV	Virgin River #2	11.2	5	16.8	0	0	0	0	0	0

AR064336

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Muddy River	MUDD	NV	Overton WMA Pond	0.7	5	2.5	0	0	0	0	1	0
		NV	Overton WMA	14.9	6	18.0	13[15,20]	8	5	6	2	0
Muddy River	WMSP	NV	Muddy Mac[21]	0.7	0	---	2	1	1	1	0	3
Colorado River	TOPO	AZ	Pipes #1	5.2	5	8.5	1	1	0	0	0	0
		AZ	Pipes #3	5.7	5	4.6	2	1	1	1	1	0
		AZ	The Wallows	0.7	5	2.1	1	1	0	0	0	2
		AZ	PC6-1	4.8	5	8.0	0	0	0	0	0	1
		AZ	Pig Hole	2.4	5	5.1	0	0	0	0	0	0
		AZ	In Between	7.7	5	9.9	0	0	0	0	0	1
		AZ	800M	4.7	5	4.7	1	1	0	0	1	1
		AZ	Pierced Egg	6.7	5	8.5	0	0	0	0	0	4
		AZ	Swine Paradise	0.9	5	4.0	0	0	0	0	0	1
		AZ	Barbed Wire	2.1	5	4.0	0	0	0	0	0	0
		AZ	Platform	1.9	5	4.6	1	1	0	0	0	0
		AZ	250M	1.9	5	3.3	0	0	0	0	0	0
		AZ	Hell Bird	6.3	5	6.0	0	0	0	0	0	10
		AZ	Glory Hole	5.0	5	8.3	0	0	0	0	0	0
		AZ	Spaghetti	5.4	5	3.4	0	0	0	0	0	2
		AZ	Beal Lake	18.0	5	10.6	0	0	0	0	0	1
		AZ	Lost Lake	3.3	5	3.4	0	0	0	0	0	1
		AZ	Dock[10]	---	0	---	0	0	0	0	0	3
Bill Williams River	BIWI	AZ	Wispy Willow[18]	0.5	3	2.8	0	0	0	0	0	1
		AZ	Burn Edge	4.1	5	6.3	0	0	0	0	0	1
		AZ	Site #4	9.9	5	16.8	0	0	0	0	3	0
		AZ	Site #3	13.0	5	19.6	2	1	1	2	0	1
		AZ	Last Gasp	2.1	5	4.6	0	0	0	0	0	0
		AZ	Site #5	6.8	5	8.9	0	0	0	0	0	2
		AZ	Cougar Point[22]	1.3	0	---	2	1	1	1	0	0
		AZ	Upstream from Site #8	1.5	5	5.1	0	0	0	0	0	0

AR064337

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Bill Williams River	BIWI	AZ	Planet Ranch Road	3.3	5	12.0	3	2	2	3	0	2
		AZ	New River	0.6	5	3.9	0	0	0	0	0	0
Colorado River	PVER	CA	PVER Phase 2	21.4	6	16.5	0	0	0	0	0	11
		CA	PVER Phase 3	21.4	6	14.5	0	0	0	0	0	4
Colorado River	CIBO	AZ	CVCA Phase 1	26.2	6	16.0	0	0	0	0	0	12
		AZ	CVCA Phase 2	25.5	6	16.0	0	0	0	0	0	11
		AZ	CVCA Phase 3	38.4	5	14.0	0	0	0	0	0	18
		AZ	Cibola Nature Trail	13.7	5	6.0	0	0	0	0	0	1
		AZ	Cibola Island	4.2	3	2.3	0	0	0	0	0	0
		AZ	Cibola Site #2	16.4	5	6.2	0	0	0	0	0	5
		AZ	Cibola Site #1	7.7	5	4.1	0	0	0	0	0	0
		AZ	Cibola Lake #2 (East)	4.5	5	5.0	0	0	0	0	0	2
		CA	Walker Lake	11.4	3	4.9	0	0	0	0	0	1
Colorado River	IMPE	CA	Paradise	7.8	3	3.3	0	0	0	0	0	3
		AZ	Hoge Ranch	20.7	5	5.9	0	0	0	0	0	14
		AZ	Rattlesnake	7.6	5	6.4	0	0	0	0	0	5
		CA	Milemarker 65	10.0	2	0.9	0	0	0	0	0	1
		AZ	Nursery NW	7.0	5	6.9	0	0	0	0	0	6
		CA	Ferguson Lake	21.1	3	7.0	0	0	0	0	0	2
		AZ	Great Blue Heron	7.1	5	15.9	0	0	0	0	0	21
		AZ	Powerline	1.0	5	4.2	0	0	0	0	0	3
		AZ	Martinez Lake	4.6	5	8.8	0	0	0	0	0	2

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Colorado River	MITT	CA	Mittry West	4.4	3	4.3	0	0	0	0	0	3
Colorado River	YUMA	AZ	Gila River Site #2	2.9	4	5.3	0	0	0	0	0	7
		AZ	Fortuna Site #1	3.2	4	6.1	0	0	0	0	0	15
		AZ	Fortuna North	3.8	4	9.5	0	0	0	0	0	7

* This table includes only sites where regular surveys were scheduled and does not include sites where habitat reconnaissance and opportunistic surveys were conducted.

[1] Study areas consist of 1-18 survey sites that are grouped geographically. Alpha codes are as follows: KEPI = Key Pittman Wildlife Management Area, RIRA = River Ranch, PAHR = Pahranagat National Wildlife Refuge (NWR), MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, WMSP = Warm Springs Natural Area, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] Survey site is equivalent to the Arizona Department of Game and Fish site definition.

[3] Total number of individuals recorded that could not be classified as resident or migrant because of brief appearance after 15 June.

[4] Total number of individuals who could not be classified as resident or migrant because of brief appearance before 15 June.

[5] Only the one unoccupied site was surveyed.

[6] This female moved from River Ranch West Side after an unsuccessful nesting attempt to Key Pittman Patch 0 where she tried a second nesting attempt of unknown fate.

[7] This adult, detected on 27 July in Key Pittman Patch 4, held a territory at River Ranch East Side until 25 July.

[8] One male was polygynous with two females.

[9] This individual, detected on 24 July in Key Pittman Patch 10.5, held a territory at River Ranch West Side until 1 July.

[10] Not an official survey site. Incidental detections recorded.

[11] Due to flycatcher occupancy, sites were surveyed only once. Survey time represents total survey time at all sites combined.

[12] This individual, detected 17–19 June at Pahranagat North, moved to River Ranch West Side where he held a territory from 23 June to 13 July.

[13] One male was polygynous with three females.

[14] One female moved from Pahranagat North and was detected on 21 July with a group of three fledglings.

[15] One male held a territory at Overton WMA until 17 July and then displaced the male at Hafen Lane.

[16] One male held a territory at Mesquite West and was then recaptured on 24 July at Virgin River #1 South.

[17] Two males polygynous with two females.

[18] Surveys discontinued because of poor quality habitat.

[19] Unusually high water levels within the Virgin River prevented technicians from completing all five surveys.

[20] One male bred at Overton WMA until 17 July, then moved to Virgin River #1 South and bred. His female at Virgin River #1 South mated consecutively with two males.

[21] No surveys conducted; site was occupied the entire season.

[22] Site not formally surveyed; not a formal site until an unrelated field crew reported a flycatcher in the area. When SWCA visited the territory, the male was no longer present (though had been noted by the other crew earlier in the season) and only the female remained, attending the nest.

AR064339

Appendix D

DETECTIONS OF SPECIAL CONCERN SPECIES, 2011

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
PAHR	North	0	0	0	0	0	0	0	0	0	1	1	0
	West	0	0	0	0	0	0	0	0	0	10	0	1
MESQ	Hafen Lane	0	0	0	2	0	0	0	0	1	41	2	20
	West	0	0	0	0	0	0	0	0	0	49	0	22
	Bunker Marsh North	0	0	0	0	0	0	0	0	0	3	0	1
MOME	Mormon Mesa South	0	0	0	0	0	0	0	0	18	78	0	98
	Virgin River #1	0	0	0	0	0	0	0	0	2	27	2	37
	Virgin River #2	0	0	0	0	0	0	0	0	12	48	4	54
MUDD	Overton WMA	0	0	0	9	0	0	0	0	0	63	0	64
	Overton WMA Pond	0	0	0	0	0	0	0	0	1	17	2	16
TOPO	Pipes #1	0	0	0	0	0	0	0	0	0	1	1	42
	Pipes #3	0	0	0	0	0	0	4	0	0	11	5	41
	The Wallows	0	0	0	0	0	0	3	0	0	9	2	17
	PC6-1	0	0	0	0	0	0	1	0	1	9	3	60
	Pig Hole	0	0	0	0	0	0	0	0	0	3	0	27
	In Between	0	0	0	0	0	0	0	0	0	4	3	39
	800M	0	0	0	0	0	0	0	0	0	1	3	20
	Pierced Egg	0	0	0	0	0	0	5	0	0	19	5	55
	Swine Paradise	0	0	0	0	0	0	1	0	0	14	4	13
	Barbed Wire	0	0	0	0	0	0	1	0	0	5	6	26
	Platform	0	0	0	0	0	0	1	0	0	6	1	26
	250M	0	0	0	0	0	0	2	0	0	6	1	15
	Spaghetti	0	0	0	0	0	0	1	0	0	2	2	19
	Hell Bird	0	0	0	0	0	0	9	0	0	7	4	23
	Glory Hole	0	0	0	0	0	0	6	0	1	9	2	40

AR064342

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
TOPO	Beal Lake	0	0	0	3	0	0	1	0	40	22	10	57
	Lost Lake	0	0	2	0	0	0	0	0	0	5	2	8
BIWI	Wispy Willow	0	1	1	0	0	0	1	0	5	0	2	11
	Site #1[3]	0	0	2	0	0	0	1	0	1	0	1	3
	Site #2[3]	0	0	0	0	0	0	0	0	0	0	1	4
	Burn Edge	0	0	0	0	0	0	2	0	7	8	1	55
	Site #11[3]	0	0	0	0	0	0	2	0	1	0	0	5
	Site #4	0	0	0	0	0	0	22	0	11	32	11	97
	Site #3	0	0	0	3	1	0	4	0	11	51	8	119
	Last Gasp	0	0	0	0	0	0	6	0	1	5	1	70
	Site #5	0	0	0	1	0	0	7	0	13	16	6	81
	Mineral Wash[3]	0	0	0	0	0	0	0	0	8	5	0	9
	Beaver Pond[3]	0	0	0	0	0	0	3	0	8	14	1	35
	Upstream from Site #8	0	0	0	1	0	0	3	0	2	9	0	32
	Planet Ranch Road	1	0	0	3	0	0	6	0	14	22	5	44
	New River	2	0	0	2	0	0	0	0	9	2	1	22
PVER	PVER Phase 2	0	0	0	3	0	0	0	0	3	12	0	2
	PVER Phase 3	0	0	0	3	0	0	0	0	0	5	2	4
CIBO	CVCA Phase 1	0	0	0	5	0	0	1	0	0	10	6	7
	CVCA Phase 2	0	0	0	4	0	0	0	0	0	7	0	4
	CVCA Phase 3	0	0	0	0	0	0	0	0	0	1	4	4
	Cibola Nature Trail	0	0	0	0	0	0	0	0	1	17	1	13
	Cibola Island	0	0	0	3	0	0	0	0	0	0	0	4
	Cibola Site #2	0	1	0	0	0	0	0	0	0	0	0	14
	Cibola Site #1	0	0	3	0	0	0	3	0	0	1	1	10
	Cibola Lake #2 (East)	0	0	0	0	0	0	0	0	0	0	0	14

AR064343

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
CIBO	Walker Lake	0	0	0	0	0	0	4	0	0	0	0	8
IMPE	Paradise	0	0	0	0	0	0	4	0	0	0	0	6
	Hoge Ranch	0	0	3	0	0	0	2	0	0	0	0	13
	Rattlesnake	0	0	0	0	0	0	6	0	0	0	1	30
	Milemarker 65	0	0	1	0	0	0	0	0	0	1	0	4
	Nursery Northwest	7	0	2	0	0	0	1	0	1	3	0	22
	Ferguson Lake	0	0	9	0	0	0	2	0	0	0	0	19
	Great Blue Heron	0	0	0	0	0	0	13	0	1	16	2	67
	Powerline	0	1	1	0	0	0	5	0	0	1	1	15
	Martinez Lake	1	0	1	0	0	0	1	0	2	5	0	24
MITT	Mittry West	0	0	0	0	0	0	4	0	1	0	0	8
YUMA	Gila River Site #2	0	0	0	0	0	0	0	0	0	0	0	0
	Fortuna Site #1	0	0	0	0	0	0	0	0	0	1	1	9
	Fortuna North	0	0	0	0	0	0	0	0	0	1	0	14

[1] PAHR = Pahranagat NWR; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; TOPO = Topock Marsh; BIWI = Bill Williams River NWR; PVER = Palo Verde Ecological Reserve; CIBO = Cibola; IMPE = Imperial; MITT = Mittry Lake; YUMA = Yuma.

[2] BLRA = Black Rail, CLRA = Clapper Rail, LEBI = Least Bittern, YBCU = Yellow Billed Cuckoo, ELOW = Elf Owl, GIFL = Gilded Flicker, GIWO = Gila Woodpecker, VEFL = Vermilion Flycatcher, BEVI = Bell's Vireo, YWAR = Yellow Warbler, SUTA = Summer Tanager, YBCH = Yellow-breasted Chat.

[3] Site surveyed only once as part of an opportunistic effort.

Appendix E

ALL WILLOW FLYCATCHERS COLOR-BANDED AND/OR RESIGHTED, 2003–2011

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011*

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1490-89889	M	J							R		D	D	D	D			
1590-97338	M	A	P				P	P	P	P							
1710-20312	M	J							R		T						
1710-20638	M	A		G	M	M	M	M	M	M	M						
2090-42022	F	J		M					Q								
2110-78841	F	J						T	T	T	T						
2110-78842	M	A						Q	Q	Q							
2110-78855	M	J						T	T								
2110-78861	M	J						T	M[4]	Q							
2110-78863	M	J						T	T	T							
2140-66502	M	J						Q	Q								
2140-66503	F	J						Q		Q							
2140-66517	F	A						Q	Q	Q	D						
2140-66518	M	A						Q	Q								
2140-66561	M	A						P			P	P	P	P			
2140-66564	F	J						P	P								
2140-66566	M	J						P			P						
2140-66568	M	A						P	P		P	P	P	P			
2140-66606	M	J		M		Q	Q		Q								
2140-66621	F	A				P	P	P	P	P							
2140-66627	F	A				P	P	P		P							
2140-66690	F	J					P								S		
2140-66693	M	J					M	Q	Q								
2140-66696	F	J					Q		Q								
2140-66697	M	J					Q			P	P	P	P	P	P		
2140-66709	M	A						Q	Q	Q		Q[5]	M	M	M	M	M
2140-66728	M	J					T			T							
2140-66743	M	J			T					T							
2140-66775	M	J				T	M		Q	Q	Q						
2190-76604	M	A					P		P	P	P	P					
2320-31401	M	A							B								
2320-31402	M	A							B								
2320-31403	M	A							Y								
2320-31404	F	A							B								
2320-31405	F	A							B								
2320-31406	U	J							B								
2320-31407	F	J							B	T							
2320-31408	U	J							B								
2320-31409	U	J							B								
2320-31410	U	J							B								
2320-31411	U	J							B								
2320-31412	M	A							B	B							
2320-31413	U	A							Q								
2320-31414	M	A								T	T						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31415	F	A								T							
2320-31416	U	J								T							
2320-31417	U	J								T							
2320-31418	M	A								T	T						
2320-31419	U	J								T							
2320-31420	U	J								T							
2320-31421	U	J								T							
2320-31422	U	J								T							
2320-31423	U	A								T							
2320-31424	M	J								T	T						
2320-31425	U	J								T							
2320-31426	F	A							M								
2320-31427	M	A							M								
2320-31428	M	J							Q	M	Q[6]		M	M			
2320-31429	U	J							Q								
2320-31430	U	J							P								
2320-31431	U	J							Q								
2320-31432	U	J							P								
2320-31433	U	J							Q								
2320-31434	U	J							Q								
2320-31435	U	J							P								
2320-31436	U	J							P								
2320-31437	U	J							P								
2320-31438	M	J							Q	Q							
2320-31439	U	J							Q								
2320-31440	F	J							Q	M							
2320-31441	U	J							M								
2320-31443	U	J							Q								
2320-31444	F	A							Q	Q	Q	Q			M		
2320-31445	F	A							Q	Q	Q	Q	Q	Q	Q	Q	
2320-31446	U	J								P							
2320-31447	U	J								P							
2320-31448	U	J								P							
2320-31449	U	J								P							
2320-31450	U	J								P							
2320-31451	M	A							P	P	P	P					
2320-31452	M	A							P								
2320-31453	M	A							P	P							
2320-31454	M	A							P	P							
2320-31455	M	A							P								
2320-31456	U	J							P								
2320-31457	M	J							P	K							
2320-31458	M	J							P		P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31459	M	J							P	P							
2320-31460	U	J							P								
2320-31461	U	J							P								
2320-31462	U	J							P								
2320-31463	F	J							P			K	K			K	
2320-31464	U	J							P								
2320-31465	U	J							P								
2320-31466	F	A							P								
2320-31467	M	J							P		P	P					
2320-31468	M	J							P		P	P		K			
2320-31469	U	J							P								
2320-31470	U	J							P								
2320-31471	M	J							Q	Q			M		M		
2320-31472	U	J							Q								
2320-31473	M	J							Q	Q							
2320-31474	U	J							Q								
2320-31475	M	J							P	L							
2320-31476	F	A							Q								
2320-31477	U	J							Q								
2320-31479	F	A							Q	Q							
2320-31480	F	J							Q	Q							
2320-31481	U	J							P								
2320-31482	U	J							P								
2320-31483	U	J								Q							
2320-31484	M	J								P	P			K	K		
2320-31485	F	A								M		M	M	M			
2320-31486	F	J							Q	L	Q	M	M	M			
2320-31487	U	J							Q								
2320-31488	U	J							Q								
2320-31489	U	A								M							
2320-31490	M	A								L	L[7]	Q	Q	Q	Q		
2320-31491	M	A								Q							
2320-31493	M	A								D							
2320-31494	U	A								Q							
2320-31495	M	A								T							
2320-31496	U	J								M							
2320-31497	U	J								M							
2320-31498	F	J								M		G[8]	Q	Q	Q	Q	
2320-31499	M	A								Q							
2320-31500	U	J								Q							
2320-31501	M	A							B								
2320-31502	F	A							T	T							
2320-31503	U	A								I							

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31504	U	A								I							
2320-31505	M	A								T							
2320-31506	U	J								T							
2320-31507	U	J								T							
2320-31508	U	J								T							
2320-31510	U	J								T							
2320-31511	U	J								T							
2320-31512	U	J								T							
2320-31513	U	J								T							
2320-31514	U	J								T							
2320-31515	F	A								T	T	T					
2320-31516	F	A								G							
2320-31517	M	A								G	M	M			M		
2320-31518	U	J								T							
2320-31519	U	J								T							
2320-31520	U	J								T							
2320-31521	F	A								T	T						
2320-31522	U	J											Q				
2320-31523	U	J											M				
2320-31524	U	J											P				
2320-31525	U	J											P				
2320-31526	F	A							T	T	T						
2320-31527	F	A							T								
2320-31528	M	A							T								
2320-31529	U	J							T								
2320-31530	U	J							T								
2320-31531	U	J							T								
2320-31532	U	J							T								
2320-31533	U	J							T								
2320-31534	U	J							T								
2320-31535	U	J							T								
2320-31536	U	J							T								
2320-31537	U	J							T								
2320-31538	M	A								T							
2320-31539	M	A								B							
2320-31540	F	A								T							
2320-31541	M	A								T	T						
2320-31542	U	J								T							
2320-31543	U	J								T							
2320-31544	U	J								T							
2320-31545	U	J											P				
2320-31546	U	J											P				
2320-31547	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31548	U	J											P				
2320-31549	U	J											P				
2320-31550	U	J											P				
2320-31551	M	A								Q							
2320-31552	M	A								M							
2320-31553	M	A								M		M					
2320-31554	U	J								T							
2320-31555	U	J								T							
2320-31556	U	J								T							
2320-31557	U	J								T							
2320-31558	U	J								T							
2320-31559	M	A								T	T	T	T				
2320-31560	M	A								T	T	T	T	T			
2320-31561	U	J								T							
2320-31562	M	J								T		T		T	T	T	
2320-31563	U	J								T							
2320-31564	U	J								T							
2320-31565	F	A								T	T						
2320-31566	U	J										T					
2320-31567	M	A								T	T						
2320-31568	F	A								P							
2320-31569	U	J								P							
2320-31570	U	J								P							
2320-31571	U	J								P							
2320-31572	M	A								M							
2320-31573	F	A								Q	Q	Q	Q	Q			
2320-31574	U	J									P						
2320-31575	U	J										Q					
2320-31576	M	A							T	T							
2320-31577	F	A							T	T	T						
2320-31578	U	A							Y								
2320-31579	U	A							Y								
2320-31580	U	A							Y								
2320-31581	U	J							T								
2320-31582	U	J							T								
2320-31583	U	J							T								
2320-31584	F	A							T	T	T	T					
2320-31585	U	J							T								
2320-31586	U	J							T								
2320-31587	U	J							T								
2320-31588	U	J							T								
2320-31589	M	A								P	P	P	P				
2320-31590	M	A								P	P	P	P	P			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31591	M	A								P	P	P	P				
2320-31593	M	A								P	P	P					
2320-31594	M	A								P							
2320-31595	M	A								P	P	P	P	P	P	P	P
2320-31596	M	A								P							
2320-31598	M	A								T							
2320-31599	U	A								I							
2320-31600	U	A								I							
2320-31601	U	J								P							
2320-31602	U	J								P							
2320-31603	U	J								P							
2320-31604	M	J								P		K	K				
2320-31605	U	J								P							
2320-31606	U	J								P							
2320-31607	U	J								P							
2320-31608	U	J								P							
2320-31609	U	J								P							
2320-31610	U	J								P							
2320-31611	U	J								Q							
2320-31612	U	J								Q							
2320-31616	F	J								Q		D					
2320-31617	U	J								Q							
2320-31618	F	J								Q	M	M	M				
2320-31619	U	J								M							
2320-31620	U	J								M							
2320-31621	F	A								M							
2320-31622	M	A								Q							
2320-31623	U	J								M							
2320-31624	U	J								M							
2320-31625	F	A								M							
2320-31627	M	A								Q							
2320-31628	U	A								M							
2320-31629	U	J								M							
2320-31630	U	J								Q							
2320-31631	F	J								Q		D	D				
2320-31632	F	A								Q		M	M	M[9]		M	M
2320-31633	U	J								Q							
2320-31634	U	J								Q							
2320-31635	M	A								K							
2320-31636	U	J								K							
2320-31637	F	J								K	P						
2320-31638	U	J								K							
2320-31639	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31640	U	J											Q				
2320-31641	U	J											Q				
2320-31642	U	J											Q				
2320-31643	U	J											P				
2320-31644	U	J											M				
2320-31645	U	J											M				
2320-31646	U	J											P				
2320-31647	U	J														M	
2320-31648	U	J														M	
2320-31649	U	J											P				
2320-31650	F	J										T	T				
2320-31651	M	A								M							
2320-31652	M	A								M	Q	Q					
2320-31653	M	A								M	M	M	M				
2320-31654	M	A								Q							
2320-31655	F	A								Q	Q	Q					
2320-31656	F	A								P	P	P					
2320-31657	F	A								P	P	P	P	P	P		
2320-31658	F	A								P							
2320-31659	M	J								Q		D	D	D		D	
2320-31660	F	J								Q			M	S	S	S	
2320-31661	F	A								P	P	P	P	P			
2320-31662	F	A								P							
2320-31663	F	A								P	P	P	P	P			
2320-31664	F	A								P							
2320-31665	U	J								P							
2320-31666	U	J								P							
2320-31667	U	J								P							
2320-31668	F	A								P							
2320-31669	F	A								P							
2320-31670	U	J											Q				
2320-31671	U	J										M					
2320-31672	U	J											P				
2320-31673	U	J										T					
2320-31674	M	J										P		K	K	K	
2320-31675	U	J									T						
2320-31676	U	J									T						
2320-31677	U	J										T					
2320-31678	U	J										P					
2320-31679	U	J											P				
2320-31680	U	J									T						
2320-31681	U	J									T						
2320-31682	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31683	M	J									P		K				
2320-31684	U	J									P						
2320-31685	U	J									P						
2320-31686	M	J									P	P					
2320-31687	U	J									P						
2320-31688	M	J									Q	Q	Q	Q	Q	Q	Q
2320-31689	U	J									Q						
2320-31690	U	J									Q						
2320-31691	U	J									Q						
2320-31692	M	J									P	K					
2320-31693	U	J									P						
2320-31694	M	J									P		K	K			
2320-31695	F	J									P	P					
2320-31696	U	J									Q						
2320-31697	U	J									P						
2320-31698	F	J									P		P	P	P		
2320-31699	U	J									P						
2320-31700	U	J									P						
2360-59701	F	J									Q	Q					
2360-59702	M	J									Q	D	M				
2360-59703	U	J									Q						
2360-59704	U	J									M						
2360-59705	U	J									M						
2360-59706	U	J									K						
2360-59707	F	J									P	P					
2360-59708	F	J									P	P					
2360-59709	U	J									P						
2360-59710	U	J									P						
2360-59711	M	J									K			P	P	P	
2360-59712	M	J									K			P		P	P
2360-59713	U	J									K						
2360-59714	U	J									Q						
2360-59715	U	J									Q						
2360-59716	U	J									Q						
2360-59717	M	A								Q							
2360-59718	U	J									P						
2360-59719	U	J									T						
2360-59720	U	J									T						
2360-59721	U	J								P							
2360-59722	U	J									T						
2360-59723	U	J								P							
2360-59724	F	J								P		P					
2360-59725	U	J									B						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59727	M	J									B		B				
2360-59728	U	J									B						
2360-59729	U	J									T						
2360-59730	U	J									T						
2360-59731	U	J									T						
2360-59732	U	J									T						
2360-59733	U	J									T						
2360-59734	U	J									T						
2360-59735	U	J										P					
2360-59736	U	J										P					
2360-59737	U	J										D					
2360-59738	U	J										D					
2360-59739	U	J										Q					
2360-59740	U	J									P						
2360-59741	U	J									Q						
2360-59742	U	J									Q						
2360-59743	F	J											P	K			
2360-59744	U	J										T					
2360-59745	U	J										P					
2360-59746	U	J								G							
2360-59747	U	J										D					
2360-59748	U	J										D					
2360-59749	M	J										D	D[10]	M			
2360-59750	F	J										M	Q				
2360-59751	M	J										M	Q	Q	Q		
2360-59752	M	J										Q		Q	M		
2360-59753	U	J										Q					
2360-59754	M	J										Q	Q	Q	Q	P	P
2360-59755	U	J										Q					
2360-59756	U	J										P					
2360-59757	U	J								K							
2360-59758	U	J										P					
2360-59759	U	J										P					
2360-59760	U	J								L							
2360-59761	U	J								L							
2360-59762	U	J								Q							
2360-59763	U	J								Q							
2360-59764	U	J											P				
2360-59765	U	J											P				
2360-59766	U	J								Q							
2360-59767	U	J								K							
2360-59768	U	J										T					
2360-59769	U	J										M					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59770	U	J								K							
2360-59771	U	J								G							
2360-59772	F	A								K							
2360-59773	U	J											Q				
2360-59775	U	J											Q				
2360-59776	U	J											Q				
2360-59777	F	J											Q				M
2360-59778	U	J											Q				
2360-59779	U	J											K				
2360-59780	U	J											K				
2360-59781	U	J											K				
2360-59782	F	J											K			M	
2360-59785	U	J									D						
2360-59786	U	J									D						
2360-59787	U	J									D						
2360-59788	F	J									D	D	M	M	M	M	M
2360-59789	U	J										Q					
2360-59790	U	J										Q					
2360-59791	U	J										P					
2360-59792	U	J										P					
2360-59793	U	J										P					
2360-59794	U	J										P					
2360-59795	U	J										P					
2360-59796	U	J										P					
2360-59797	M	J										P	P				
2360-59798	U	J										P					
2360-59799	M	J										M	D	M		M	
2360-59800	U	J								G							
2370-39901	U	A								P							
2370-39902	U	J								P							
2370-39904	U	J								P							
2370-39911	M	A									P						
2370-39912	M	A									Q		Q				
2370-39913	M	A									G						
2370-39914	U	J									P						
2370-39915	M	A									P	P	P	P[11]	P	P	
2370-39916	M	A										T	T	T			
2370-39917	U	A										Y					
2370-39918	U	A										Y					
2370-39919	U	A										Y					
2370-39920	U	A										Y					
2370-39921	U	A										Y					
2370-39922	U	A										Y					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39923	U	A										Y					
2370-39924	U	A										Y					
2370-39925	U	A										Y					
2370-39926	U	A										Y					
2370-39927	U	A										Y					
2370-39928	U	A										Y					
2370-39929	M	A										G	G				
2370-39930	M	J													M	Q	D[12]
2370-39932	F	A									B	B	B				
2370-39933	U	A									Y						
2370-39934	U	A									Y						
2370-39935	U	A									Y						
2370-39937	M	A										Q	Q	Q			
2370-39938	M	A										M	M	M	M	M	M
2370-39939	F	A										Q	Q				
2370-39940	M	A										M	M	M	Q		
2370-39941	M	J										Q	L[13]				
2370-39942	U	J										D					
2370-39943	U	J										D					
2370-39944	U	J										D					
2370-39945	U	J										P					
2370-39946	M	J										P	P				
2370-39947	U	J										P					
2370-39948	F	A										M					
2370-39949	U	J										Q					
2370-39950	U	J										Q					
2370-39951	M	A									P	P	P	P			
2370-39953	M	A									P	P	P	P			
2370-39954	M	A									Q	Q	Q	Q			
2370-39956	F	A									D	D	D			M	M
2370-39957	F	A									Q	Q					
2370-39958	F	A									P						
2370-39959	M	A									P		A				
2370-39960	M	A									K						
2370-39961	M	A									P						
2370-39962	F	A									P						
2370-39964	F	A									P	P	P				
2370-39965	U	A									D						
2370-39966	M	J									D		M				
2370-39967	M	A										M	D[14]	Q	Q		
2370-39968	M	A															D
2370-39969	F	A													B		
2370-39970	U	J															M

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39971	U	A									P						
2370-39972	U	A									I						
2370-39973	U	A									Y						
2370-39974	U	A									I						
2370-39975	M	A									D	M					
2370-39976	M	A									D						
2370-39977	U	J									P						
2370-39978	F	A									P						
2370-39979	U	J									P						
2370-39980	M	J									P	K	K	K	K		
2370-39981	U	J									P						
2370-39982	U	A										Y					
2370-39983	U	A										Y					
2370-39984	U	A										Y					
2370-39985	U	A										Y					
2370-39986	M	A										G					
2370-39987	M	A										G					
2370-39988	M	A										G	M	M	M	M	
2370-39989	M	A										G					
2370-39990	F	A										G					
2370-39992	M	A										T					
2370-39993	U	A										Y					
2370-39994	U	A										Y					
2370-39995	U	A										Y					
2370-39996	U	A										Y					
2370-39997	U	A										Y					
2370-39998	U	A										Y					
2370-39999	M	A														Q	
2370-40000	M	A														D	D
2370-40001	U	J														P	
2370-40002	U	J														P	
2370-40003	M	A										T					
2370-40004	F	A										B			B		
2370-40005	U	J														S	
2370-40007	U	J														S	
2370-40008	U	J														D	
2370-40009	U	J														D	
2370-40010	U	J														D	K
2370-40011	F	A														Q	
2370-40012	M	A									Q	Q	Q				
2370-40013	M	A									P	P					
2370-40014	F	A									P	P	P				
2370-40016	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40017	M	A									M	M					
2370-40019	U	J									P						
2370-40020	U	J									P						
2370-40021	M	A									P	P					
2370-40022	M	A														K	
2370-40023	U	J													M		
2370-40024	M	J													K	K	K
2370-40025	U	J													K		
2370-40026	U	J													P		
2370-40027	F	J													P	E	K
2370-40029	M	J													M		D
2370-40030	U	J													M		
2370-40031	M	J													K	K	K
2370-40032	M	A									B						
2370-40033	U	A									Y						
2370-40034	U	A									Y						
2370-40035	U	A									Y						
2370-40036	M	A										G[15]					
2370-40037	F	A										G	M		M	M	M
2370-40038	M	A										G					
2370-40039	U	A										Y					
2370-40040	U	A										Y					
2370-40041	U	A										Y					
2370-40042	U	A										Y					
2370-40043	U	A										Y					
2370-40044	U	A										Y					
2370-40045	U	A										Y					
2370-40046	M	A										G	G[16]	M	M	M	M
2370-40047	F	A										P	P	P	P	P	P
2370-40048	U	J													T		
2370-40049	U	J													T		
2370-40050	U	J													T		
2370-40051	U	J														K	
2370-40052	M	A									B	B	B	B			
2370-40053	M	A									B						
2370-40054	M	A									B						
2370-40055	F	A									T						
2370-40056	M	A									T						
2370-40057	M	A										D					
2370-40058	M	A										M	B				
2370-40059	F	A										D	D	D			
2370-40060	M	A										P		P	P	P	P
2370-40061	F	A										P					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40062	F	A										P	P				
2370-40063	U	J										Q					
2370-40064	U	J										P					
2370-40065	U	J										Q					
2370-40066	F	A										Q	Q	Q	Q		
2370-40067	U	J										Q					
2370-40068	U	J										Q					
2370-40069	U	J										M					
2370-40070	U	J										M					
2370-40071	U	J										P					
2370-40072	U	J													M		
2370-40073	F	A													P	P	
2370-40074	U	J													P		
2370-40075	U	J													P		
2370-40076	U	J													P		
2370-40078	U	J															K
2370-40079	U	J															K
2370-40080	U	J										Q					
2370-40081	M	A										K					
2370-40082	F	A										K					
2370-40083	U	J										Q					
2370-40084	U	J										Q					
2370-40085	U	J											Q				
2370-40086	U	J											Q	M	M		
2370-40087	F	A											Q	Q	Q	Q	Q
2370-40088	M	A														D	D
2370-40089	U	J														M	
2370-40090	U	J														M	
2370-40091	F	J														M	D
2370-40093	U	J														M	
2370-40096	U	J												K			
2370-40097	M	J												K		K	K
2370-40098	U	J												K			
2370-40099	U	J													S		
2370-40100	U	J										K					
2370-40101	U	J										K					
2370-40102	U	J										K					
2370-40103	U	J										Q					
2370-40104	U	J										Q					
2370-40105	U	J										Q					
2370-40106	U	J										Q					
2370-40107	U	J										Q					
2370-40108	U	J										Q					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40110	U	J											T				
2370-40111	U	J											T				
2370-40112	M	J											T			T	
2370-40113	U	J											B				
2370-40114	M	J											T		T		
2370-40115	U	J											T				
2370-40116	U	J											T				
2370-40117	U	J											T				
2370-40118	U	J											T				
2370-40119	U	J											T				
2370-40120	U	J											T				
2370-40121	U	J											T				
2370-40122	U	J											T				
2370-40123	U	J											T				
2370-40124	M	J											T		M		
2370-40125	U	J											T				
2370-40126	M	A											G				
2370-40127	M	A											G				
2370-40129	M	A											G				
2370-40130	F	A													B		
2370-40132	F	A											T				
2370-40133	F	A											B				
2370-40134	U	A											B				
2370-40135	F	A											B				
2370-40136	F	A											T				
2370-40137	M	A											B				
2370-40138	M	A											T				
2370-40139	M	A											T	T			
2370-40140	F	A													P		
2370-40141	M	A													K	K	K
2370-40142	U	J													M		
2370-40143	U	J													Q		
2370-40144	M	J													M	T	
2370-40145	U	J													M		
2370-40146	U	J													S		
2370-40147	F	J												S	D		
2370-40148	F	J												S	S	S	S
2370-40149	U	J												S			
2370-40150	U	J													M		
2370-40151	F	J													M	M	
2370-40152	U	J													M		
2370-40153	U	J													S		
2370-40154	U	J													S		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40155	M	A													L		
2370-40156	M	A													B		
2370-40157	M	A											P		P	P	
2370-40158	M	J											B		T		
2370-40159	U	J											B				
2370-40160	F	A											G				
2370-40161	M	A											M	M	M		
2370-40162	U	J													B		
2370-40163	U	J													B		
2370-40164	U	J											Q				
2370-40165	M	A													B		
2370-40166	U	A											P				
2370-40167	U	J											P				
2370-40168	F	A											P	P	P		
2370-40169	U	J											M				
2370-40170	F	A											Q	Q			
2370-40171	F	A											D				
2370-40173	M	A											M	M	M	M	
2370-40174	U	J													M		
2370-40175	M	J													M	Q	Q
2370-40176	M	A													M		
2370-40177	U	J														T	
2370-40179	U	J														K	
2370-40180	M	A													B		
2370-40181	M	A													T		
2370-40182	U	J													B		
2370-40183	F	A											M				
2370-40184	M	A											D				
2370-40185	M	A											P				
2370-40186	M	A											D				
2370-40187	M	A											K				
2370-40188	U	J											Q				
2370-40190	M	J											P				K
2370-40191	F	A											M	M	M		
2370-40192	F	A											D			B	
2370-40193	F	A											Q	Q	Q	D	
2370-40194	F	A											P	P	P	P	
2370-40195	F	A											P	P	P		
2370-40197	M	A											M	Q	Q	M	M
2370-40199	U	J											P				
2390-92348	F	J		T						T							
2390-92350	M	A				M	Q		Q	Q							
2390-92365	M	J				D			Q	Q	Q						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2390-92410	M	A					Q		Q								
2390-92420	M	J					Q	Q	Q								
2390-92421	M	J					Q	Q	Q	Q	M	M					
2390-92427	F	J					M		Q								
2390-92433	M	J					Q		Q	Q							
2390-92434	M	J					Q	Q		Q	Q	Q	Q	Q	Q	M	M
2390-92451	F	J			M	M		Q		Q							
2390-92470	F	J					Q			Q							
2390-92475	M	J					M	Q	Q	Q	Q	Q	Q	Q			
2430-61006	U	A											Y				
2430-61007	U	A											Y				
2430-61008	U	A											Y				
2430-61009	U	A											Y				
2430-61010	U	A											Y				
2430-61011	U	A											Y				
2430-61012	U	A											Y				
2430-61013	U	A											Y				
2430-61014	U	A											Y				
2430-61015	U	A											Y				
2430-61016	U	A											Y				
2430-61017	U	A											Y				
2430-61018	U	A											Y				
2430-61019	U	A											Y				
2430-61020	U	A											Y				
2430-61021	U	A											Y				
2430-61023	U	A											Y				
2430-61024	U	A											Y				
2430-61025	U	A											Y				
2430-61026	U	A											Y				
2430-61027	U	A											Y				
2430-61028	U	A											Y				
2430-61029	U	A											Y				
2430-61030	U	A											Y				
2430-61031	U	A											Y				
2430-61032	U	A											Y				
2430-61033	U	A											Y				
2430-61034	U	A											Y				
2430-61035	U	A											Y				
2430-61036	U	A											Y				
2430-61037	U	A											Y				
2430-61038	U	A											Y				
2430-61039	U	A											Y				
2430-61040	U	A											Y				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61041	U	A											Y				
2430-61042	U	A											Y				
2430-61043	U	A											Y				
2430-61044	U	A											Y				
2430-61045	U	A											Y				
2430-61046	U	A											Y				
2430-61047	U	A											Y				
2430-61048	U	A											Y				
2430-61049	U	A											Y				
2430-61050	U	A											Y				
2430-61051	U	A											Y				
2430-61052	U	A											Y				
2430-61053	U	A											Y				
2430-61054	U	A											Y				
2430-61055	U	A											Y				
2430-61056	U	A											Y				
2430-61058	U	A											Y				
2430-61059	U	A											Y				
2430-61060	U	A											Y				
2430-61061	U	A											Y				
2430-61062	U	A											Y				
2430-61063	U	A											Y				
2430-61064	U	A											Y				
2430-61065	U	A											Y				
2430-61067	U	A											Y				
2430-61068	U	A											Y				
2430-61069	U	A											Y				
2430-61070	U	A											Y				
2430-61071	U	A											Y				
2430-61072	M	A												G			T
2430-61073	M	A												B			
2430-61074	U	J												B			
2430-61075	U	J												B			
2430-61076	U	J												B			
2430-61077	U	J												M			
2430-61078	U	J												Q			
2430-61079	F	A												M			
2430-61080	M	A												P	P	P	P
2430-61081	U	J												M			
2430-61082	U	J												Q			
2430-61083	M	A												P	P	P	P
2430-61084	M	J												Q		D	
2430-61085	M	A													D	D	D

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61086	U	J													M		
2430-61087	F	A													P	P	P
2430-61088	M	A														N	D
2430-61089	U	J														M	
2430-61090	U	J														M	
2430-61091	U	J														S	
2430-61092	F	A														S	
2430-61093	M	A														S	S
2430-61094	U	J														D	
2430-61095	M	A														M	
2430-61096	F	A														L	
2430-61097	U	J														P	
2430-61098	M	J														P	E[17]
2430-61099	U	J														K	E[18]
2430-61100	F	A														K	K
2430-61101	U	J												K			
2430-61102	U	J												K			
2430-61103	M	A												D			
2430-61104	M	A												M			
2430-61105	M	A												Q			
2430-61106	M	J												P		M	M
2430-61107	U	J												P			
2430-61108	U	J												P			
2430-61109	F	A												K			
2430-61110	U	J												K			
2430-61111	U	J												P			
2430-61112	U	J												P			
2430-61113	U	J												P			
2430-61114	M	J												P		K	K
2430-61115	U	J												P			
2430-61116	F	A												M	M		
2430-61117	U	J												P			
2430-61118	M	J												P	M	M	K
2430-61119	U	J												P			
2430-61120	F	J												P	P	P	P
2430-61121	U	J												Q			
2430-61122	U	J												P			
2430-61123	F	J												P		P	
2430-61124	F	J												P		K	
2430-61125	M	A												K			
2430-61126	U	J												S			
2430-61127	M	A												P	P		
2430-61128	U	J												M			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61129	U	J												Q			
2430-61130	U	J												Q			
2430-61131	U	J												M			
2430-61132	U	J												M			
2430-61133	U	J												M			
2430-61134	M	A												T		N	N
2430-61135	M	A												T	T	T	
2430-61136	M	A												B	B	B	B
2430-61137	F	A												B	B	B	B
2430-61138	F	A												B			
2430-61139	F	A												T			
2430-61140	U	J												B			
2430-61141	U	J												B			
2430-61142	U	J												B			
2430-61143	U	J												T			
2430-61144	U	J												T			
2430-61145	U	J												T			
2430-61151	U	J														K	
2430-61152	U	J														P	
2430-61153	F	A													M		
2430-61154	F	J													Q	S	S
2430-61155	U	J													Q		
2430-61156	U	J													K		
2430-61157	U	J													K		
2430-61158	M	A													K	K	K
2430-61159	M	J													M		K
2430-61160	U	J													M		
2430-61161	U	J													D		
2430-61162	M	A													S		
2430-61163	F	A														K	
2430-61165	M	J												Q	Q	M	
2430-61167	M	A												M	M	M	M
2430-61168	U	J												M			
2430-61169	U	J												M			
2430-61170	U	J												M			
2430-61171	U	J												M			
2430-61172	F	J												M	M		
2430-61173	U	J												M	M		
2430-61174	F	J												M		Q	
2430-61175	U	J												Q			
2430-61176	M	J												Q		P	P
2430-61177	U	J												Q			
2430-61178	M	A												K			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61179	M	A												K	P	P	P
2430-61180	M	A												K		K	K
2430-61181	F	A												K	K		
2430-61182	M	A												K			
2430-61183	M	A												K			
2430-61184	U	J												Q			
2430-61185	F	J												Q	M		
2430-61186	U	J												Q			
2430-61187	M	J												Q	L	L	
2430-61188	U	J												Q			
2430-61189	M	J												Q		M	
2430-61190	U	J												Q			
2430-61191	M	J												M	D		
2430-61192	U	J												M			
2430-61193	U	J												M			
2430-61194	U	J												Q	Q		
2430-61195	U	J												Q			
2430-61196	U	J												Q			
2430-61197	M	J												P		K	K
2430-61198	U	J												P	Q		
2430-61199	U	J												P			
2430-61200	U	J												P			
2430-61202	U	J												M			
2430-61203	U	J												M			
2430-61204	U	J												M			
2430-61205	U	J												M			
2430-61206	M	J												M		M	
2430-61207	F	J												M	D	D	
2430-61208	U	J												D			
2430-61209	M	A												V	D		
2430-61210	U	A												K			
2430-61211	U	J												S			
2430-61212	U	J												M			
2430-61213	U	J														K	
2430-61214	M	A															K
2430-61215	U	J															P
2430-61216	U	J															Q
2430-61217	U	J															Q
2430-61218	U	J															P
2430-61219	U	J															M
2430-61220	U	J															P
2430-61221	U	J														P	
2430-61223	U	J												D			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61224	U	J												D			
2430-61225	U	J												D			
2430-61226	U	J														P	
2430-61227	U	J														P	
2430-61228	U	J														K	
2430-61229	U	J														K	
2430-61230	F	A														S	S
2430-61231	U	J														S	
2430-61232	U	J														L	
2430-61233	U	J														L	
2430-61234	F	A														Q	Q
2430-61235	U	J														Q	
2430-61236	U	J														K	
2430-61237	U	J															B
2430-61271	U	J													P		
2430-61276	U	J														Q	
2430-61277	U	J													P		
2430-61278	M	J													P		
2430-61279	F	J													P	K	K
2430-61280	U	J														M	
2430-61285	U	J													M		
2540-58101	U	J														K	
2540-58102	U	J														K	
2540-58103	U	J														K	
2540-58104	M	J														K	
2540-58105	U	J														Q	
2540-58106	U	J														Q	
2540-58107	M	J														Q	
2540-58108	U	A															T
2540-58109	M	A															P[19]
2540-58110	F	A															P
2540-58111	F	A															P
2540-58112	U	J															Q
2540-58113	U	J															M
2540-58114	U	J															P
2540-58115	U	J															B
2540-58116	U	J														B	
2540-58117	U	J														B	
2540-58118	U	J														K	
2540-58119	U	J														K	
2540-58120	F	A															B
2540-58132	M	A													S	S	S
2540-58141	U	J													M		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58142	U	J													M		
2540-58143	M	A													D		
2540-58144	U	J													K		
2540-58145	U	J													K		
2540-58146	M	A													B		
2540-58147	U	J														B	
2540-58148	U	J														Q	
2540-58149	U	J														Q	
2540-58150	U	J														Q	
2540-58151	U	J														Q	
2540-58152	F	A															Q
2540-58154	M	J													M	T	D[20]
2540-58155	U	J													M		
2540-58156	F	A														K	K
2540-58157	U	J														K	E
2540-58158	M	J														K	K
2540-58159	F	J														K	K
2540-58160	U	J														S	
2540-58161	U	J														L	
2540-58162	U	J														K	
2540-58163	U	J														K	
2540-58164	U	J														K	
2540-58165	F	J														K	K
2540-58166	U	J														K	
2540-58172	M	A															Q
2540-58173	U	J															M
2540-58174	U	J															M
2540-58175	F	A															K
2540-58176	M	A															Q
2540-58177	F	A															K
2540-58178	U	J															K
2540-58179	U	J															K
2540-58180	U	J															K
2540-58182	U	J															K
2540-58183	U	J															K
2540-58184	F	A															M
2540-58185	U	J													P		
2540-58186	M	A													S		
2540-58187	F	A													P		K
2540-58188	U	J													P		
2540-58189	F	A													P		
2540-58190	U	J														T	
2540-58191	U	J														P	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58192	M	A														Q	Q[21]
2540-58193	F	A														N	N
2540-58194	U	J														D	
2540-58195	U	J														P	
2540-58196	U	J														P	
2540-58197	U	J														P	
2540-58198	U	J														P	
2540-58199	U	J														K	
2540-58200	U	J														K	
2540-58201	U	J														K	P
2540-58202	M	A														K	
2540-58203	F	A														K	K
2540-58204	F	A														K	
2540-58205	U	J														K	
2540-58206	U	J														P	
2540-58207	U	J														P	
2540-58208	U	J														P	
2540-58209	F	A														P	
2540-58211	U	J															K
2540-58212	U	J															K
2540-58213	U	J															M
2540-58214	U	J															K
2540-58216	U	J													M		
2540-58217	M	A													S	S	
2540-58218	U	J													S		
2540-58219	U	J													Q		
2540-58220	M	A														B	B
2540-58221	M	A														B	
2540-58222	U	J														K	
2540-58223	M	A														K	K
2540-58224	F	J														K	K
2540-58225	U	J														K	
2540-58226	F	A														K	
2540-58227	M	A														T	
2540-58228	M	A														T	T
2540-58229	M	A														B	
2540-58230	F	A														B	B
2540-58231	F	A														T	M
2540-58232	U	J														T	
2540-58233	F	A														N	
2540-58235	U	J														N	
2540-58236	U	J														N	
2540-58237	U	J														K	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58238	F	J														K	E[22]
2540-58239	U	J														K	
2540-58240	F	J														K	E
2540-58241	F	A														K	K
2540-58242	U	J														K	
2540-58243	U	J														K	
2540-58244	U	J														K	
2540-58245	M	A															P
2540-58246	M	A															E
2540-58247	U	J															K
2540-58274	U	J															N
2540-58275	U	J															N
2540-58276	U	J															K
2540-58277	U	J															K
2540-58278	U	L															D
2540-58279	U	J															D
2540-58280	U	J															K
2540-58282	U	J															K
2540-58283	U	J															K
2540-58284	U	J															P
2540-58285	U	J															P
2540-58286	U	J															P
2540-58287	M	A															S
2540-58288	U	J														P	
2540-58289	F	A														K	
2540-58290	U	J														K	
2540-58291	U	J														K	
2540-58292	U	J														K	
2540-58293	F	A														P	P
2540-58294	U	J														P	
2540-58295	U	J														P	
2540-58296	U	J														P	
2540-58297	F	A															K
2540-58298	U	J															K
2540-58299	U	J															K
2540-58378	U	J															K
2540-58385	U	J															S
2540-58386	F	A															K
2540-58387	M	A															K
2590-53101	U	J															P
2590-53102	U	J															P
2590-53103	U	J															P
2590-53104	U	J															P

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2590-53105	F	A															D
2590-53106	U	J															M
2590-53107	U	J															M
2590-53108	F	A															D
2590-53109	U	J															P
2590-53110	F	A															K
2590-53111	U	J															K
2590-53112	U	J															K
2590-53113	U	J															K
2590-53114	U	J															K
2590-53115	U	J															M
2590-53116	U	J															M
2590-53117	U	J															M
2590-53118	U	J															K
2590-53119	U	J															M
2590-53121	F	A															K
2590-53122	U	J															K
2590-53123	U	J															K
2590-53124	M	A															K
2590-53125	U	J															K
2590-53126	U	J															D
2590-53127	U	J															K
2590-53141	U	J															M
2590-53142	U	J															M
2590-53143	U	J															N
2590-53144	U	J															K
2590-53145	M	A															S
2590-53147	U	J															D
2590-53148	U	A															K
2590-53149	U	J															K
2590-53150	U	J															M
2590-53151	U	J															M
2590-53152	U	J															Q
2590-53154	U	J															Q
2590-53162	M	A															T
2590-53163	F	A															B
2590-53164	U	J															B
2590-53171	F	A															E
2590-53172	U	J															K
2590-53173	F	A															K
2590-53182	U	J															B

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3500-68963	U	J								T							
3500-68968	U	J								P							
3500-68969	U	J								P							
3500-68972	F	J								P	P	P					

* Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA.

[1] K = Key Pittman, E = River Ranch, P = Pahranagat NWR, W = Meadow Valley Wash, L = Littlefield, Q = Mesquite, M = Mormon Mesa, D = Muddy River, N = Warm Springs, G = Grand Canyon, T = Topock Marsh, B = Bill Williams River NWR, I = Imperial, Y = Yuma, S = St. George, V = Las Vegas Wash, R = Roosevelt Lake, A = Ash Meadows. Study area indicated is the study area where the individual was first detected during the given season. Within-season movements are indicated with individual footnotes.

[2] M = male, F = female, U = unknown.

[3] A = adult, J = juvenile.

[4] Within-season movement from Mormon Mesa to Mesquite.

[5] Within-season movement from Mesquite to Mormon Mesa.

[6] Within-season movement from Mesquite to Mormon Mesa.

[7] Within-season movement from Littlefield to Mesquite.

[8] Within-season movement from Grand Canyon to Mesquite.

[9] Within-season movement from Mormon Mesa to Muddy River.

[10] Within-season movement from Muddy River to Mormon Mesa.

[11] Within-season movement from Pahranagat to Key Pittman.

[12] Within-season movement from Muddy River to Mesquite.

[13] Within-season movement from Littlefield to Mesquite.

[14] Within-season movement from Muddy River to Mesquite.

[15] Within-season movement from Grand Canyon to Mesquite.

[16] Within-season movement from Grand Canyon to Mormon Mesa.

[17] Within-season movement from River Ranch to Key Pittman.

[18] Within-season movement from River Ranch to Key Pittman.

[19] Within-season movement from Pahranagat to River Ranch.

[20] Within-season movement from Muddy River to Mormon Mesa. Likely also within-season movement from Topock to Muddy River in 2010.

[21] Within-season movement from Mesquite to Mormon Mesa.

[22] Within-season movement from River Ranch to Key Pittman.

Appendix F

CONTRIBUTING PERSONNEL

Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Banding Lead
Wendy Langeberg, Ph.D.	Statistician
Glenn A. Dunno, M.A.	GIS Specialist
DeAnne Rietz, M.S.	Hydrologist
Jessica Maggio	Project Administrator/Formatting Specialist
Kimberly Proa	Administrative Assistant/Data Entry
Dorothy A. House, M.A.	Technical Editor
Anne Pellegrini	Project Coordinator
Sarah Nichols	Assistant Project Coordinator
Danielle Ethier	Field Coordinator
Iwona Kuczyńska	Field Coordinator
Katie Barnes	Bander/Nest Monitor
Ashley Daniels	Bander/Nest Monitor
Jill Peiffer	Bander/Nest Monitor
Josh Sayers	Bander/Nest Monitor
Ryan Davis	Surveyor/Nest Monitor
Greg Joder	Surveyor/Nest Monitor
Alex McDonnell	Surveyor/Nest Monitor
Zach Mobley	Surveyor/Nest Monitor
Amber Swicegood	Surveyor/Nest Monitor
Tim Schreckengost	Surveyor
Jesse Vooz	Surveyor

Lower Colorado River Multi-Species Conservation Program

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2011 Annual Report

Prepared by Mary Anne McLeod and Anne Pellegrini,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2012

RECOMMENDED CITATION:

McLeod, M.A., and A.R. Pellegrini. 2012. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2011. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 167 pp.

CONTENTS

Executive Summary xi

1. INTRODUCTION 1
PROJECT HISTORY 1
RELATED STUDIES 2
SPECIES INTRODUCTION 2
PURPOSE AND DESCRIPTION OF STUDY 4

2. PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS 7
INTRODUCTION 7
Special Concern Species 7
METHODS 9
Site Selection 9
Additional Site Evaluation 12
Broadcast Surveys 12
Site Description 12
RESULTS 13
Reclamation Study Areas 13
Pahranagat National Wildlife Refuge, Nevada 18
Littlefield, Arizona 20
Mesquite, Nevada 20
Mormon Mesa, Nevada 21
Muddy River, Nevada 23
Topock Marsh, Arizona 24
Bill Williams River National Wildlife Refuge, Arizona 29
Palo Verde Ecological Reserve, California 32
Cibola, Arizona and California 33
Imperial, Arizona and California 35
Mittry Lake, California 38
Yuma, Arizona 38
NDOW Study Areas 39
Key Pittman Wildlife Management Area, Nevada 40
River Ranch 41
Warm Springs Natural Area 42
DISCUSSION 43

3. COLOR-BANDING AND RESIGHTING 45
INTRODUCTION 45
METHODS 45
Color-Banding 45
Resighting 46
RESULTS 47
Reclamation Study Areas 47
Site-by-Site Color-Banding and Resighting 47
NDOW Study Areas 58
Site-by-Site Color-Banding and Resighting 58

Non-Monitoring Sites 64
Adult Between-Year Return and Dispersal 64
Juvenile Between-Year Return and Dispersal 65
Within-Year, Between-Study Area Movements 66
DISCUSSION 67
Color-Banding Effort 67
Adult and Juvenile Between-Year Dispersal 67
Within-year, Between Study Area Movement 69
Adult and Juvenile Survivorship 69

4. NEST MONITORING 71
INTRODUCTION 71
METHODS 71
RESULTS 73
Reclamation Study Areas 73
Nest Monitoring 73
Nest Failure 74
Brood Parasitism 74
Cowbird Egg Addling 75
Mayfield Nest Success and Nest Productivity 77
NDOW Study Areas 78
Nest Monitoring 78
Nest Failure 79
Brood Parasitism 79
Cowbird Egg Addling 80
Mayfield Nest Success and Productivity 80
DISCUSSION 81
Reclamation Study Areas 81
Number of Breeding Flycatchers 81
Nest Success 82
Nest Failure 82
Brood Parasitism 83
Cowbird Egg Addling 84
NDOW Study Areas 84

5. VEGETATION AND HABITAT CHARACTERISTICS 87
INTRODUCTION 87
METHODS 87
Data Analyses 88
RESULTS 89
DISCUSSION 92

6. MICROCLIMATE 93
INTRODUCTION 93
METHODS 93
Temperature and Humidity Measurements 93
Soil Moisture Measurements 94
Statistical Analyses 95

RESULTS 95
DISCUSSION 107

7. HABITAT MONITORING: PARKER TO IMPERIAL DAMS 109
INTRODUCTION 109
METHODS 110
Temperature/Humidity Loggers 110
Soil Moisture Measurements 112
Vegetation Measurements 112
Groundwater Measurements 112
Statistical Analyses 112
Microclimate 112
Vegetation 113
RESULTS 113
Temperature/Humidity Logger Maintenance 113
Microclimate 113
2011 Microclimate Descriptive Statistics 113
Between-year Comparisons of Microclimate Characteristics 114
Vegetation Measurements 114
Between-year Comparisons of Vegetation Characteristics 114
DISCUSSION 121
Microclimate 121
Between-year Comparisons of Microclimate Characteristics 121
Vegetation 121
Groundwater Levels 123
Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements 123

8. SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 125
INTRODUCTION 125
METHODS 125
Water Delivery 125
Surface Water Mapping 126
Groundwater Measurements 126
Data Collection 127
Data Validation 127
Microclimate 127
Vegetation 128
Data Analyses 128
Microclimate 128
Vegetation 128
RESULTS 129
Water Delivery 129
Surface Water Mapping 129
Groundwater Monitoring 130
Microclimate 130
Vegetation 153
DISCUSSION 156

9. MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS 159
BROADCAST SURVEYS 159
COWBIRD CONTROL 160
HABITAT MONITORING: PARKER TO IMPERIAL DAMS 160
SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 160

10. LITERATURE CITED 161

Appendices

A. Field Data Forms
B. Orthophotos Showing Study Sites
C. Southwestern Willow Flycatcher Survey Results, 2011
D. Detections of Special Concern Species, 2011
E. All Willow Flycatchers Color-Banded and/or Resighted, 2003–2011
F. Contributing Personnel

Figures

1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*).. 3
2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2011..... 8
5.1. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2011. 91
5.2. Vertical foliage density at occupied willow flycatcher territories in cottonwood/willow habitat type, 2011..... 92
6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 98
6.2. Distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 99
6.3. Percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011..... 100
6.4. Percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011..... 101
6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 102
6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 103
6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 104
6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 105
6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 106
7.1. Locations of test and control sites, habitat monitoring study, 2005–2011..... 111
7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011..... 118
7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120

7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011. 122
8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011. 126
8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011. 131
8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. 132
8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011. 133
8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011. 134
8.6. Topock Marsh hydrograph, 2006–2011. 135
8.7. Topock Marsh hydrograph, February–July, 2011. 135
8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011. 137

8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011 141
8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 142
8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011. 142
8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 142
8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011. 142
8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 144
8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 144
8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 144
8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 144
8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 145
8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 145
8.18a. Difference between the day before and day after each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011. 148
8.18b. Difference between flood groups in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011. 148
8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 148
8.19a. Difference between the day before and day after each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011. 149

8.19b. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011. 149
8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 149
8.20a. Difference between the day before and day after each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011. 150
8.20b. Difference between flood groups in difference in daily temperature range before and after each flood event, Topock Marsh, 2011. 150
8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 150
8.21a. Difference between the day before and day after each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011. 151
8.21b. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011. 151
8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011. 151
8.22a. Difference between the day before and day after each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011. 152
8.22b. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011. 152
8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011. 152
8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010.. 154
8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010.. 154
8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. 155
8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011.. 155

Tables

2.1. Proposed Survey Schedule for Selected Sites 9
2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011 13
2.3. Detections of Willow Flycatchers Recorded after 15 June 2011 at Sites Where Breeding or Residency Was Not Confirmed 15
2.4. Yellow-billed Cuckoo Detections at Reclamation Study Areas, 2011 16
2.5. Yuma Clapper Rail Detections at Reclamation Study Areas, 2011 16
2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas,
2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011 39
3.1. Willow Flycatchers Detected at Reclamation Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season 49
3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 50
3.3. Willow Flycatchers Detected at NDOW Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season 59
3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 60
3.5. Banded Willow Flycatchers, Non-Monitoring Sites, 2011 64
3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011 64
3.7. Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2011 65
3.8. Juvenile Flycatchers Banded as Hatch Year Birds in 2007, 2009, or 2010 and Identified for the First Time in 2011 66
3.9. Adult Willow Flycatcher Within-Year Movements for All Individuals Identified at Two Different Study Areas in 2011 67
4.1. Summary of Willow Flycatcher Nest Monitoring Results at Reclamation Study Areas, 2011 73
4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Reclamation Study Areas from 1996 to 2011 74
4.3. Summary of Causes of Willow Flycatcher Nest Failure at Reclamation Study Areas, 2011 75
4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds, 2011 75
4.5. Brown-headed Cowbird Annual Hatch Rate in Willow Flycatcher Nests at Reclamation Study Areas from 2003 to 2011 76
4.6. Willow Flycatcher Nesting Success for Parasitized Nests at Reclamation Study Areas from 2003 to 2011 76
4.7. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Reclamation Study Areas, 2011 77
4.8. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Reclamation Study Areas, 2011 78
4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011 78
4.10. Summary of Causes of Willow Flycatcher Nest Failure at NDOW Study Areas, 2011 79
4.11. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds in Key Pittman, River Ranch, and Warm Springs Study Areas, 2011 80
4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011 80

4.13. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at NDOW Study Areas, 2011 81
5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2011 90
5.2. Proportion of Stems Omitted from Stem Counts 91
6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory, 2011 96
6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Willow, 2011 97
7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011 115
7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011 115
7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011 117
7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011 119
7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011 119
8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011 129
8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010 138
8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010 138
8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011 139
8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011 139
8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011 146
8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011 147
8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011 153

EXECUTIVE SUMMARY

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*), listed as federally endangered in 1995, breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico. Historical breeding records and museum collections indicate a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region. Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Willow flycatcher studies have been conducted along the Virgin and lower Colorado Rivers and tributaries annually since 1996, in compliance with requirements set forth by the U.S. Fish and Wildlife Service (USFWS) regarding U.S. Bureau of Reclamation (Reclamation) routine operations and maintenance along the lower Colorado River. Biological Assessments and the resulting Biological Opinions on operations and maintenance were prepared as steps to developing a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). The LCR MSCP was signed in April 2005, and implementation of the program began in October 2005. The LCR MSCP calls for continued surveys and monitoring of willow flycatchers along the lower Colorado River. SWCA Environmental Consultants (SWCA) was contracted by Reclamation to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the Virgin and lower Colorado River regions in 2011.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet of California apportionment water for 75 years. The point of diversion, previously located below Parker Dam, would change to a point above Parker Dam. These changes in water regulation could cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less and have the potential to modify riparian habitats below Parker Dam. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams. In 2004, Reclamation biologists initiated studies of the microclimate within potentially affected areas. In 2005, these studies were continued and expanded by SWCA to address how the hydrological changes might affect riparian habitats along the Parker to Imperial reach.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. Water delivery commenced 1 March 2011 and continued into July. Baseline conditions of vegetation, microclimate, and hydrology in the target area were documented in 2009 and 2010, and these studies were continued in 2011 to document conditions during the water delivery period.

SWCA was retained by Nevada Department of Wildlife (NDOW) in 2011 to complete flycatcher surveys, site descriptions, nest monitoring and color-banding at Key Pittman Wildlife Management Area, River Ranch, and Warm Springs Natural Area. We also completed surveys for Yellow-billed Cuckoos at these study areas.

Approximately 100 sites are included in the Reclamation study of flycatchers along the Virgin and lower Colorado Rivers, but a portion of the sites are surveyed biennially rather than annually. In 2011, we completed presence/absence surveys, following a 5-survey protocol, and site descriptions at a subset of the 100 sites. At study areas where territorial flycatchers were detected in 2011, we searched for nests in all areas occupied by territorial flycatchers; monitored willow flycatcher nests to document nest fate, brood parasitism, and causes of nest failure; and color-banded and resighted as many willow flycatchers as possible to determine the breeding status of territorial flycatchers and document movement and recruitment. We also measured characteristics of vegetation and microclimate in occupied territories at one study area.

We used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 59 Reclamation sites, ranging in size from <1 to 38 ha, along the Virgin and lower Colorado Rivers and tributaries from Pahranagat National Wildlife Refuge (NWR), Nevada, south to Yuma, Arizona between 15 May and 24 July 2011. We detected willow flycatchers on at least one occasion at 47 of these sites. Breeding or resident flycatchers were detected at 13 sites within the Pahranagat NWR, Mesquite, Mormon Mesa, and Muddy River, Nevada; and Topock Marsh and Bill Williams River NWR, Arizona, study areas. South of Bill Williams, 154 willow flycatcher detections were recorded between 15 May and 20 June; no flycatcher detections were recorded at any of these sites after 20 June. Monitoring results suggest these flycatchers were not resident, breeding individuals and were most likely spring migrants.

We completed broadcast surveys for flycatchers at 3 sites and monitored an additional 17 sites within the three NDOW study areas and detected breeding flycatchers within 15 sites. We also completed surveys for Yellow-billed Cuckoos at these study areas. No cuckoos were detected during surveys or incidentally.

We used targeted mist-net and passive netting techniques to capture and uniquely color-band adult and fledgling willow flycatchers at all sites where resident willow flycatchers were detected. Nestlings were banded between 8 and 10 days of age. We banded each willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and one pin-striped, aluminum band on the other. We used binoculars to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combinations on their legs.

At Reclamation study areas, we color-banded 15 new adult flycatchers and recaptured 11 individuals detected in previous years as adults. An additional 31 adults were identified to individual via resighting, while 3 individuals were resighted but did not have their color combinations confirmed. We detected two individuals identified as returning nestlings by the presence of a single federal band, with one (50%) identified to individual via recapture. Two additional returning nestlings with full combinations were recaptured. Thirty adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 30 adults. We banded 40 nestlings from 17 nests. Of the 40 nestlings banded, 5 were known or suspected to have died before fledging. We banded flycatchers opportunistically at St. George, Utah, capturing and color-banding two new adults and one nestling.

At NDOW study areas, we color-banded 13 new adult flycatchers and recaptured 3 individuals detected in previous years as adults. An additional 25 adults were identified to individual via resighting, while 2 individuals were resighted but did not have their color combinations confirmed. We recaptured one individual identified as a returning nestling by the presence of a single federal band. Three additional adults were captured with a full color combination and identified as returning nestlings from 2009 or 2010. Five adult flycatchers remained unbanded, and banding status was undetermined for one adult. We banded 34 nestlings from 13 nests. Of the 34 nestlings banded, 3 were suspected to have died before fledging.

Of the 96 resident, adult willow flycatchers identified to individual at monitored study areas in 2010, 55 (57%) were identified in 2011; 5 (9%) were detected at a different study area from where they were last detected in 2010. We detected seven within-year, between-study area movements in 2011.

Of the 51 juveniles banded and not known or suspected to have died at Reclamation study areas in 2010, 2 (4%) were identified in 2011. An additional 36 juveniles were banded at NDOW study areas and not known or suspected to have died in 2010; nine (25%) were identified in 2011. Sixteen individuals originally banded as nestlings in previous years were identified for the first time in 2011. Of the 16 returning nestlings identified in 2011, 12 (75%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2011 was 12.8 km.

We recorded 50 territories at all Reclamation study areas. Of these, 36 (72%) consisted of paired flycatchers and 14 (28%) consisted of unpaired individuals. Eight breeding males were polygynous, two pairing with three females and six pairing with two females. One female mated consecutively with two different males. One male moved and established a second territory within the same study area. We recorded 24 territories at NDOW study areas. Of these, 21 (88%) consisted of breeding individuals, 1 (4%) consisted of paired individuals with no documented breeding activity, and 2 (8%) consisted of unpaired males. Three males were polygynous; each mated with two females.

At Reclamation study areas, we documented 49 willow flycatcher nesting attempts, 43 of which contained eggs and were used in calculating nest success and productivity. Eighteen (42%) nests were successful and fledged young; and 25 (58%) failed. Mayfield survival probability ranged from 0.198 to 1.000, and was 0.467 for all sites combined (except Topock Marsh where Mayfield nest success could not be calculated due to a lack of data). Depredation was the major cause of nest failure, accounting for 52% of all failed nests and 65% of nests that failed after flycatcher eggs were laid.

We documented 38 flycatcher nesting attempts at NDOW study areas; 36 of these were known to contain flycatcher eggs and were used in calculating nest success and productivity. Of nests known to contain flycatcher eggs, fourteen (39%) were successful and fledged young, and 22 (61%) failed. Depredation accounted for the majority (59%) of all nest failures. Mayfield survival probability was 0.447 at Key Pittman and could not be calculated at River Ranch or Warm Springs due to lack of data.

At Reclamation study areas, 7 of 37 nests (19%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds. Brood parasitism at Reclamation study areas ranged from 0 to 60% and was highest at Muddy River. At NDOW study areas, 4 of 34 nests (12%) with flycatcher eggs and known contents were brood parasitized. Brood parasitism was 11% at Key Pittman, 75% at River Ranch, and 0% at Warm Springs. We addled cowbird eggs via vigorous shaking at all easily accessible flycatcher nests. Egg addling appeared to reduce the hatch rate of cowbird eggs, though small sample size precluded rigorous comparisons. Nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized. This is not necessarily due to the success or failure of the addling program as parasitized nests often failed for other reasons (e.g., depredation or failure of flycatcher eggs to hatch).

At Bill Williams River NWR, we gathered data on microclimate characteristics at one location each for two of the territorial male flycatchers we identified; both males obtained mates and had nesting attempts. We also gathered data on vegetation characteristics at these two territories, plus an additional two territories; one of the additional territories was occupied by a nesting pair and the other by an unpaired male. We delineated the following habitat types: 1) Goodding willow with tamarisk understory, and 2) cottonwood/willow. Both of these vegetation types fall within the definition of cottonwood-willow habitat (cottonwoods and willows constituting at least 10% of total trees) as used in the LCR MSCP. We present results for each of our delineated habitat types as well as for the cottonwood-willow vegetation types used in the LCR MSCP. Sample sizes in 2011 are too small to provide an accurate

representation of the range and variance in vegetation and microclimate characteristics in each habitat type.

Both vegetation types (Goodding willow with tamarisk understory and cottonwood/willow) exhibited moist or inundated soil conditions at some point in the breeding season. Daily maximum temperatures spanned a range of ~5°C among habitat types, while daily minimum temperatures spanned <3°C. Vapor pressure increased through the end of July for both habitat types and was higher in Gooding willow with tamarisk understory than in cottonwood/willow.

In 2005, we selected 11 sites between Parker and Imperial Dams for inclusion in the habitat monitoring study addressing how changes in water transfer actions might affect riparian habitat. We also selected two control sites above Parker Dam and two below Imperial Dam. At each site we installed 3–5 temperature/humidity data loggers. Soil moisture measurements were collected at each data logger location in 2011 during each flycatcher survey at the site and when logger data were downloaded. Vegetation measurements were also collected at each data logger location after surveys were completed.

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 and cooler conditions in 2009 than in the other years. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional, rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station. Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

We noted between-year differences at the habitat monitoring sites for several vegetation variables, but none of the variables exhibited a unidirectional change across time. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years. Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred.

Supplemental water delivery to support habitat enhancement commenced at Topock Marsh in 2011, periodically flooding portions of In Between and 800M. The flooded area at those two sites was the only area surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season. Water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy. Water delivery had the expected effect of raising soil moisture, decreasing distance to water, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also increased humidity within the flooded area. Flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area, but these effects did not seem to persist across two-week periods. Areas occupied by flycatchers typically have higher soil moisture, higher humidity, and more moderate temperatures than unoccupied areas; thus, water delivery appeared to change the conditions within the flooded area in ways that would favor flycatcher occupancy. Water delivery was the most effective at creating conditions favored by flycatchers when the underlying water table was high. Despite the presence of favorable conditions, flycatcher occupancy in the target area did not increase in 2011, possibly because dry conditions elsewhere in Topock Marsh and a low flycatcher population may have limited the ability of flycatchers to colonize the area.

Chapter 1

INTRODUCTION

PROJECT HISTORY

In 1995, the U.S. Bureau of Reclamation (Reclamation), other federal, state, and tribal agencies, and environmental and recreational interests agreed to form a partnership to develop and implement a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). As a step to developing the LCR MSCP, Reclamation prepared a Biological Assessment (BA) in August 1996, evaluating the effects of dam operations and maintenance activities on threatened, endangered, and sensitive (TES) species. These species included the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), which was listed by the U.S. Fish and Wildlife Service (USFWS) as endangered in 1995 (60 FR 10694–10715). In response to the BA, the USFWS issued a Biological Opinion (BO) in April 1997 outlining several terms and conditions Reclamation must implement in order not to jeopardize the species. Among these terms and conditions was the requirement to survey and monitor occupied and potential habitat for Southwestern Willow Flycatchers along the LCR for a period of five years. The studies were intended to determine the number of willow flycatcher territories, status of breeding pairs, flycatcher nest success, the biotic and abiotic characteristics of occupied willow flycatcher sites, and Brown-headed Cowbird (*Molothrus ater*) brood parasitism rates. In 2002, Reclamation reinitiated consultation with USFWS on the effects of continued dam operations and maintenance on TES species along the LCR. The USFWS responded with a BO in April 2002 requiring continued Southwestern Willow Flycatcher studies along the LCR through April 2005. The BO also required implementation of a study to evaluate the effectiveness of Brown-headed Cowbird trapping for conservation of the flycatcher.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet for 75 years. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams.

The LCR MSCP is a 50-year program that seeks to protect 26 TES species and their habitats along the LCR while maintaining river regulation and water management required by law. The LCR MSCP was approved in April 2005 with the signing of a Record of Decision by the Secretary of the Department of the Interior, and implementation of the program began in October 2005. Documentation for the LCR MSCP includes a Habitat Conservation Plan (HCP), BA/BO, and an Environmental Impact Statement. The HCP specifies monitoring and research measures that call for surveys and research to better define habitat requirements for the Southwestern Willow Flycatcher and studies to determine the effects of cowbird nest parasitism on flycatcher reproduction.

Reclamation initiated willow flycatcher studies along the LCR in 1996, in anticipation of the requirements outlined in the BOs that were part of LCR MSCP development. These studies have been conducted annually since 1996. From 1997 to 2010,[1] breeding populations of Southwestern Willow Flycatchers were documented at eight study areas along the Virgin and lower Colorado Rivers and tributaries: (1) Pahranagat National Wildlife Refuge (NWR), Nevada; (2) Beaver Dam Wash at Littlefield, Arizona; (3) Mesquite and (4) Mormon Mesa on the Virgin River, Nevada; (5) Overton

[1] Studies in 1996 did not include any sites in Nevada.

Wildlife Management Area (WMA) along the Muddy River, Nevada; (6) Grand Canyon, Arizona; (7) Topock Marsh on the Colorado River, Havasu NWR, Arizona; and (8) Bill Williams River NWR (Bill Williams), Arizona (McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; Braden and McKernan unpubl. data). From 1997 to 2010, willow flycatchers, including one banded migrant Southwestern Willow Flycatcher (Koronkiewicz et al. 2006a), were detected during the breeding season at several sites along the Colorado River south of the Bill Williams River to the Mexico border, but no nesting activity was confirmed.

In compliance with the consultation on Interim Surplus Criteria and Secretarial Implementation Agreements, Reclamation biologists deployed temperature/humidity data loggers in 2004 at a subset of sites currently monitored for Southwestern Willow Flycatcher along the Colorado River in California and Arizona. These studies were expanded in 2005 to include annual monitoring of groundwater levels, vegetation, and soil moisture in addition to temperature and humidity.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh in 2004–2008, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. The selected area at Topock had seen the greatest decline in numbers of resident flycatchers but had not experienced any dramatic changes in vegetation. Water delivery was anticipated to commence in 2010, and monitoring of vegetation, microclimate, and hydrologic condition in the target area was initiated in 2009 to obtain baseline conditions in the target area. Water delivery was delayed until 2011, so additional monitoring of baseline conditions occurred in 2010.

RELATED STUDIES

Prior to 2010, Nevada Department of Wildlife (NDOW) completed nest monitoring at Key Pittman WMA, and SWCA Environmental Consultants (SWCA) banded flycatcher nestlings and adults opportunistically in cooperation with the monitoring efforts. In 2010, NDOW retained SWCA to conduct surveys, site descriptions, nest monitoring, and banding at flycatcher breeding areas at Key Pittman WMA and Warm Springs Natural Area. This work was expanded in 2011 to include River Ranch in the Pahranagat Valley. SWCA also completed surveys for Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) at Key Pittman and River Ranch. Results of surveys, site descriptions, nest monitoring, and banding efforts at Key Pittman, River Ranch, and Warm Springs are presented in Chapters 2, 3, and 4.

Utah Division of Wildlife Resources monitored breeding flycatchers in St. George, Utah. SWCA banded adults and nestlings opportunistically in St. George in cooperation with the monitoring efforts. Banding results from St. George are presented in a separate table in Chapter 3.

SPECIES INTRODUCTION

The Southwestern Willow Flycatcher is one of four subspecies of willow flycatcher currently recognized (Unitt 1987), although Browning (1993) posits a fifth subspecies (*E. t. campestris*) occurring in the central portions of the United States (Figure 1.1). The Southwestern Willow Flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987).

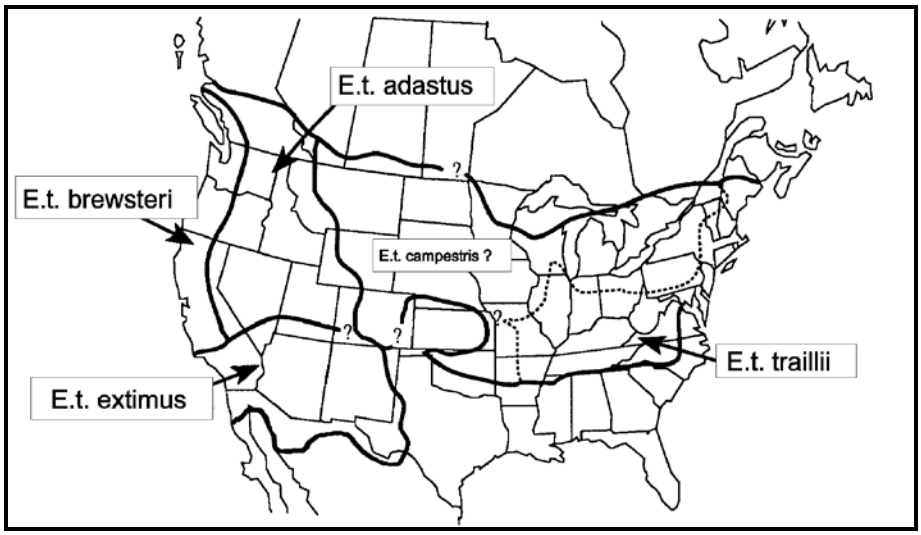


Figure 1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*). Adapted from Unitt (1987), Browning (1993), and Sogge et al. (1997).

In the Southwest, most willow flycatcher breeding territories are found within small breeding sites containing five or fewer territories (Durst et al. 2006). One of the last long-distance Neotropical migrants to arrive in North America in spring, Southwestern Willow Flycatchers have a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in August (Sogge et al. 1997). All four subspecies of willow flycatchers spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995, Unitt 1997), with wintering ground habitat similar to the breeding grounds (Lynn et al. 2003). Willow flycatchers have been recorded on the wintering grounds from central Mexico to southern Central America as early as mid-August (Stiles and Skutch 1989, Howell and Webb 1995), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz et al. 2006b).

Historical breeding records and museum collections indicate that a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the LCR region (Unitt 1987). However, no nests have been located south of the Bill Williams River, Arizona, in over 65 years (Unitt 1987), though northbound and southbound migrant willow flycatchers use the riparian corridor (Phillips et al. 1964; Brown et al. 1987; McKernan and Braden 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; this document). Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (USFWS 1995, Marshall and Stoleson 2000). Because of low population numbers range-wide, identifying and conserving willow flycatcher breeding sites is thought to be crucial to the recovery of the species (USFWS 2002).

Tamarisk beetles (*Diorhabda* spp.) may pose an additional threat to Southwestern Willow Flycatchers. Tamarisk beetles defoliate tamarisk (*Tamarix* spp.) plants during flycatcher breeding season, likely exposing flycatcher nests to adverse microclimate conditions and increased risk of depredation and parasitism. Tamarisk beetles were released in St. George, Utah, in 2006, and widespread defoliation was first observed in St. George in 2008. The area of defoliation on the Virgin River has expanded downstream annually since then, encompassing Littlefield, Arizona, in 2009; the Highway 170 bridge

downstream of Bunkerville, Nevada, in 2010; and the entire stretch of the Virgin River to Lake Mead by the end of the breeding season in 2011.

PURPOSE AND DESCRIPTION OF STUDY

The purpose of the 2011 study is to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the lower Colorado and Virgin River region. Lower Grand Canyon was not visited in 2009–2011 because the declining level of Lake Mead dramatically reduced the amount of potential flycatcher habitat, and the formation of rapids at Pearce Ferry and Iceberg Canyon made access difficult and dangerous. This project encompasses four types of studies: (1) presence/absence surveys, including site descriptions, at preselected sites along the lower Colorado River and portions of major tributaries; (2) intensive studies at all study areas where breeding flycatchers are located to assess Southwestern Willow Flycatcher demographics and ecology, habitat selection, and the effects of Brown-headed Cowbird brood parasitism; (3) monitoring of microclimate, vegetation, and groundwater conditions of currently occupied[2] Southwestern Willow Flycatcher habitat between Parker and Imperial Dams; and (4) monitoring microclimate, vegetation, and surface hydrology in a selected portion of flycatcher habitat within Topock Marsh to document the effects of habitat enhancement efforts. SWCA's contract specifies the following field tasks:

Presence/absence Surveys. At approximately 100 sites along the LCR, conduct presence/absence surveys, following a 5-survey protocol (per USFWS 2000).

Site Descriptions. Provide a general site description for each site, including major types of vegetation and hydrological conditions, at least three times during the survey period.

Nest Monitoring. Search for nests in all areas occupied by territorial flycatchers, and monitor all nests to determine nest fate, brood parasitism, and causes of nest failure.

Banding. Band as many adult and juvenile flycatchers as possible at sites with territorial flycatchers.

Vegetation, Soils, and Microclimate. Collect vegetation, soil, and microclimate data at the within-territory level at breeding locations in order to quantify conditions at flycatcher territories for replication at restoration areas.

Habitat Monitoring. At 15 previously identified sites, monitor vegetation, microclimate, and groundwater conditions to determine how these may be affected by water transfer actions at Parker Dam.

Surface Hydrology, Vegetation, and Microclimate Monitoring. Within a selected portion of Topock Marsh, monitor surface hydrology, microclimate, and vegetation conditions.

Each distinct aspect of the 2011 study is addressed in a separate chapter in this report, as follows:

Chapter 2 – Presence/absence Surveys and Site Descriptions. This chapter presents the methodology and results for presence/absence surveys and gives a general site description for each survey site.

[2] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year, 1996–2011.

Chapter 3 – Color-banding and Resighting. Details of banding activities and resighting of previously banded flycatchers are presented in this chapter. Also included are discussions of within- and between-year movement of individual flycatchers.

Chapter 4 – Nest Monitoring. This chapter summarizes nesting attempts, nest fates, and productivity for all Southwestern Willow Flycatcher nesting activity.

Chapter 5 – Vegetation and Habitat Characteristics. Vegetation sampling methods are described, and vegetation characteristics are summarized for territories in different habitat types.

Chapter 6 – Microclimate. The methodology of monitoring temperature, humidity, and soil moisture is described, and microclimate characteristics are summarized for flycatcher territories in different habitat types.

Chapter 7 – Habitat Monitoring: Parker to Imperial Dams. The methodology and results of monitoring microclimate, vegetation, and groundwater conditions at occupied sites between Parker and Imperial Dams are presented.

Chapter 8 – Surface Hydrology, Microclimate, and Vegetation Monitoring: Topock Marsh. This chapter describes sampling methods and compares baseline conditions documented in 2009 and 2010 to those documented in 2011 in an area targeted for habitat enhancement.

Chapter 9 – Management and Study Design Recommendations. Recommendations from all previous report chapters are summarized for ease of reference.

This page intentionally left blank.

Chapter 2

PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS

INTRODUCTION

Broadcasts of recorded conspecific vocalizations are useful in eliciting responses from nearby willow flycatchers, and multiple broadcast surveys conducted throughout the breeding season are the standard technique for determining the presence or absence of *E. t. extimus* (Sogge et al. 2010). According to Sogge et al. (2010) and USFWS (2002), willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* probably belong to the southwestern subspecies. However, because northbound individuals of all western subspecies of the willow flycatcher migrate through areas where *E. t. extimus* are actively nesting, and southbound migrants occur where *E. t. extimus* are still breeding (Sogge et al. 2010, USFWS 2002), field confirmation of the southwestern subspecies is problematic.[1] For example, the northwestern *E. t. brewsteri*, far more numerous than *E. t. extimus*, has been documented migrating north in southern California as late as 20 June (Garrett and Dunn 1981 as cited in Unitt 1987), and Phillips et al. (1964 as cited in Unitt 1987) documented *E. t. brewsteri* collected in southern Arizona on 23 June. An understanding of willow flycatcher migration ecology in combination with multiple broadcast surveys conducted throughout the breeding season is therefore needed to assess the presence and residency of Southwestern Willow Flycatchers.

Migration routes used by *E. t. extimus* are not well documented, though more is known of northbound migration in spring than the southbound migration in fall because flycatchers are more vocal in spring and can therefore be distinguished from other *Empidonax* species. During northbound migration, all subspecies of willow flycatchers use riparian habitats similar to breeding habitat along major river drainages in the Southwest such as the Rio Grande (Finch and Kelly 1999), Colorado River (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson unpubl. data). Although migrating willow flycatchers may favor young, native willow habitats (Yong and Finch 1997), migrants are also found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, even though not used for breeding, are likely important for both reproduction and survival. For most long-distance Neotropical migrant passerines, migration stopover habitats are needed to replenish energy reserves to continue northbound or southbound migration.

In 2011, as part of our contract with Reclamation, we completed multiple broadcast surveys at sites in 11 study areas[2] (hereafter Reclamation study areas) along the LCR and its tributaries to detect both migrant and resident willow flycatchers (Figure 2.1). We also completed surveys in three additional study areas (Key Pittman, River Ranch, and Warm Springs; hereafter NDOW study areas) as part of our contract with NDOW.

Special Concern Species

The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is listed as federally endangered by the USFWS, and the Yellow-billed Cuckoo is a candidate for federal listing. Both species occur along the LCR and its tributaries and are of concern to managing agencies. Nine additional avian species [California Black Rail (*Laterallus jamaicensis coturniculus*), Least Bittern (*Ixobrychus exilis*), Elf Owl (*Micrathene whitneyi*),

[1] Throughout this document, the terms "flycatcher" and "willow flycatcher" refer to *E. t. extimus* when individuals are confirmed as residents. For individuals for which residency is undetermined, subspecies is unknown.

[2] Study areas consist of 1–18 survey sites that are grouped geographically (see Table 2.2).



Figure 2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2011. (Note, study area labels represent the approximate center of multiple sites within that region; see Table 2.2)

Gila Woodpecker (*Melanerpes uropygialis*), Gilded Flicker (*Colaptes auratus chrysoides*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Arizona Bell's Vireo (*Vireo bellii arizonae*), Sonoran Yellow Warbler (*Setophaga petechia sonorana*), and Summer Tanager (*Piranga rubra*)] are considered to be special-concern species under the LCR MSCP. The Yellow-breasted Chat (*Icteria virens*) is also considered a special concern species in California. We did not survey specifically for these species at the 11 Reclamation study areas but recorded all incidental detections. We recorded all incidental detections of special concern species at all three NDOW study areas and completed surveys for Yellow-billed Cuckoos at Key Pittman and River Ranch.

METHODS

Site Selection

Survey sites were selected based on locations surveyed during previous years of willow flycatcher studies on the LCR (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011) and reconnaissance on foot prior to the start of the 2011 survey period. Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (>50%) and standing water or saturated soil under or adjacent to the vegetation were considered the most suitable habitats for flycatchers. Early successional stands of young riparian vegetation >3 m in height in proximity to surface water or saturated soil were also considered potentially suitable flycatcher habitat. Riparian vegetation contiguous with suitable habitat was often included as part of survey areas. Reclamation biologist Chris Dodge guided and approved site selection at the 11 Reclamation study areas. For sites surveyed in previous years, we retained original site names.

In 2008 we implemented a biennial survey schedule at selected sites in study areas where resident flycatchers had not been documented in the previous 10 years of surveys. Sites were selected for biennial surveys based on the absence of damp or wet soils within the site and/or the relative absence of dense vegetation that might provide suitable nesting habitat for flycatchers. After the 2008 survey season, we revised the survey schedule based on conditions observed in the field and added several sites at Bill Williams to the biennial schedule. These sites were ones at which no resident flycatchers had been detected since 2003. The proposed schedule at the beginning of the 2011 survey season is given in Table 2.1 and may be further revised based on conditions observed during 2011.

Table 2.1. Proposed Survey Schedule for Selected Sites

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
TOGO[2]	Pulpit Rock	Tiny. Wet soil adjacent to river; upland edge dry.			X
	Picture Rock	Wet soil adjacent to river; interior dry.			X
	Blankenship Bend North	Stand of willow adjacent to marsh.	X		
	Blankenship Bend South	Mosaic of cattail, bulrush, willow. Areas with water under vegetation.	X		
	Havasu NE	Mature vegetation; interior of site is completely dry, no water beneath the vegetation.		X	

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
BIWI	Site #1	Mixed-native vegetation; dry soils and stands of dense arrowweed in the center of the site; coyote willow and surface water along the site edge, bordering an arm of Lake Havasu.		X	
	Site #2	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Site #11	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Black Rail	Mixed-native vegetation; generally sparse understory; narrow strip of dense vegetation.		X	
	Mineral Wash	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Beaver Pond	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Site #8	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within the river channel.		X	
PVER	PVER Phase 2	Restoration area.	X		
	PVER Phase 3	Restoration area.	X		
EHRE	Ehrenberg	Emergent cottonwood and Goodding willow; understory primarily arrowweed and *Baccharis* sp.; formerly contained a dense stand of coyote willow but these willows have all died.		X	
CIBO	CVCA Phase 1	Restoration area.	X		
	CVCA Phase 2	Restoration area.	X		
	CVCA Phase 3	Restoration area.	X		
	Cibola Nature Trail	Generally dry and sparse. Restoration area; habitat improvements taking place, may improve.	X		
	Cibola Island	Narrow, linear site; patches of dense Goodding willow adjacent to marsh.	X		
	Cibola Site 2	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Cibola Site 1	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Three Fingers Lake	Vegetation short, very dry and hot in interior.		X	
	Cibola Lake #1 (North)	Patchy vegetation, hot and dry in interior.		X	
	Cibola Lake #2 (East)	Patchy vegetation, hot and dry in interior.			X
	Cibola Lake #3 (West)	Patchy vegetation, hot and dry in interior.		X	
	Walker Lake	Tamarisk with emergent willows; water under vegetation along lake edge.	X		
IMPE	Paradise	Some big willows with tamarisk understory, sometimes has water in marshes.	X		
	Hoge Ranch	Mosaic of tamarisk, willow, and marshes. Sometimes wet.	X		
	Adobe Lake	Perched above river, very dry; dense tamarisk with many dead branches in understory.		X	
	Rattlesnake	Dense willows, wet soils.	X		

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
IMPE	Milemarker 65	Very narrow strip (<50m) of tamarisk adjacent to bulrush marsh. Understory of *Phragmites* creates extremely dense vegetation within 3 m of ground.			X
	Clear Lake/The Alley	Mature tamarisk, very dense understory. Very dry except immediately next to backwater channel.		X	
	Nursery NW	Dense tamarisk interspersed with marsh areas.	X		
	Imperial Nursery	Plantation. No understory.		X	
	Ferguson Lake	Mix of willow and tamarisk with water under vegetation on west side of site. East side dry and scrubby.	X		
	Ferguson Wash	Mature tamarisk with emergent willow. Very dry in interior of site. Borders backwater channel and Ferguson Lake. Moist soils only along channel edge.		X	
	Great Blue Heron	Goodding willow overstory, tamarisk understory; moist soils in parts of the site.	X		
	Powerline	Very small. Stringer of trees around cattail marsh that sometimes contains water. Sparse canopy.			X
	Martinez Lake	Scattered willows, tamarisk and arrowweed understory, sparse canopy closure.			X
MITT	Mittry West	Willow overstory, tamarisk understory, 80% canopy closure; sometimes wet.	X		
	Mittry South	Monotypic tamarisk, lots of deadfall. Interior dry. Adjacent to lake.		X	
YUMA	Gila Confluence North	Patchy. A few small stands of mature willows around cattail marshes. Marshes sometimes contain water. Half of site burned in 2006. Overall canopy closure 50%.		X	
	Gila River Site #2	Cottonwood/willow overstory, tamarisk and arrowweed understory; dry soils in interior; canopy closure 50%.			X
	Fortuna Site #1	Narrow (30m) strip of cottonwood/willow. Patchy understory of tamarisk and arrowweed on periphery, no understory within cottonwood/willow. Interior dry.			X
	Fortuna North	Mature tamarisk, 80% canopy closure. Interior very dry. Adjacent to Gila River.			X

[1] TOGO = Topock Gorge, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, EHRE = Ehrenberg, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] No surveys were completed in Topock Gorge in 2011 because effort was redirected to hydrology monitoring at Topock Marsh (see Chapter 8).

We provided field personnel with high-resolution aerial photographs of all selected survey sites. The photographs were overlain with a UTM grid (NAD 83) and an outline of the proposed survey area. The boundaries of all survey sites were refined to include potential flycatcher habitat actually present. New boundaries were delineated on the aerial photographs based on UTM coordinates obtained in the field. All UTM coordinates were obtained using a Garmin Rino 110 GPS unit and were in NAD 83 to comply with Federal Geographic Data Committee standards.

Additional Site Evaluation

During the survey season, we conducted on-the-ground habitat reconnaissance and evaluation to locate additional potentially suitable willow flycatcher habitat and to reevaluate areas we had visited in previous years and had noted as having the potential to become suitable habitat. Field personnel were provided high-resolution aerial photographs overlain with a UTM grid to aide with navigation and the identification of potentially suitable flycatcher habitat. We focused habitat reconnaissance and evaluation in areas that contained or were adjacent to standing water or saturated soils, and that had vegetation characteristics similar to that of flycatcher breeding sites (i.e., dense vegetation within 2–4 m of the ground and high canopy closure). Broadcast surveys were conducted opportunistically during ground reconnaissance. Field personnel formulated qualitative site descriptions of all evaluated areas.

Broadcast Surveys

To elicit responses from nearby willow flycatchers, we broadcast conspecific vocalizations previously recorded throughout the Southwest from 1996 to 1998. All flycatcher surveys were conducted according to methods described in Sogge et al. (2010), and we followed a 5-survey protocol, as recommended by the U.S. Fish and Wildlife Service (USFWS 2000). We completed at least one survey between 15 and 31 May, at least one survey between 1 and 15 June, and three additional surveys between 16 June and 25 July. Surveys were separated by a minimum of five days whenever logistically possible. Field personnel surveyed within the habitat wherever possible, using a Sansa® ClipMP3 player coupled to a Radio Shack 277-1008C mini amplified speaker. Surveyors stopped every 30–40 m and broadcast willow flycatcher primary song (*fitz-bew*) and calls (*breets*). Field personnel watched for flycatchers and listened for vocal responses for approximately one to two minutes before proceeding to the next survey station. Wherever territorial flycatchers were detected, we discontinued broadcast surveys within a radius of 50 m of territories and commenced territory and nest monitoring, which involves more frequent visits (see Chapter 4). If an unidentified *Empidonax* flycatcher was observed but did not respond with song to the initial broadcast, we broadcast other conspecific vocalizations including *creets/breets*, *wee-oos*, *whitts*, *churr/kitters*, and a set of interaction calls given by a mated pair of flycatchers (per Lynn et al. 2003). These calls are frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify willow flycatchers. To produce a spatial representation of all survey areas, field personnel recorded survey start and stop UTM coordinates as well as the UTM coordinates of intermediate survey points. Observers recorded start and stop times and the location(s) and behavior of all willow flycatchers detected (see survey form, Appendix A). Field personnel also recorded the presence of Brown-headed Cowbirds (hereafter cowbirds) and livestock, as requested by the Arizona Game and Fish Department. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity (see Chapter 4), while livestock may substantially alter the vegetation in an area (USFWS 2002).

Site Description

Because vegetation structure and hydrology within riparian habitats are seasonally dynamic, field personnel completed site description forms (Appendix A) for each survey site at least three times throughout the survey season: early season (mid-May), mid-season (mid-June), and late season (mid-July). Vegetation composition (native vs. exotic) at survey sites followed the definitions of Sogge et al. (2010) and the Southwestern Willow Flycatcher Range-wide Database. Vegetation composition was defined as (1) native: >90% of the vegetation at a site was native; (2) exotic: >90% of the vegetation at a site was exotic/introduced; (3) mixed-native: 50 to 90% of the vegetation at a site was native; or (4) mixed-exotic: 50 to 90% of the vegetation at a site was exotic/introduced. Information from site

description forms was used in conjunction with habitat photographs and comments in field notebooks and on survey forms to formulate qualitative site descriptions.

RESULTS

Reclamation Study Areas

Field personnel spent 469.6 observer-hours conducting willow flycatcher broadcast surveys at 59 sites along the Virgin and lower Colorado Rivers and tributaries.[3] Willow flycatcher survey and monitoring results are summarized in Table 2.2 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2011 are shown on orthophotos in Appendix B, along with historically occupied habitat.[4] We did not complete surveys at sites in Topock Gorge because effort was redirected toward hydrology monitoring within Topock (see Chapter 8). Each site that was not occupied by territorial flycatchers was formally surveyed three to six times. A summary of willow flycatcher survey effort and survey site occupancy status is presented in Appendix C. Field personnel spent an additional 24.3 observer-hours completing habitat reconnaissance and evaluation and opportunistic surveys. The results of reconnaissance for each study area are presented below following the results for the regularly surveyed sites. Because subspecies identification of willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* is problematic (Sogge et al. 2010, USFWS 2002), flycatcher detections after 15 June at sites where breeding or residency was not confirmed are summarized in Table 2.3. Yellow-billed Cuckoo and Yuma Clapper Rail detections are listed in Tables 2.4 and 2.5, respectively, and overall numbers of detections of all special concern species are listed in Appendix D. Hydrologic characteristics of each site are summarized in Table 2.6.

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011*

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
PAHR	North	4.6	14 (15 May–16 Aug), 2 (18 May), 1 (17–19 Jun), 2 (12 Jul), 1 (13 Jul), 1 (4 Aug)
	West	1.5	1 (21 Jul)[6]
MESQ	Hafen Lane	6.1	2 (30 Jun–23 Jul), 1 (21–23 Jul)
	West	10.4	11 (17 May–17 Aug)
	Bunker Marsh North	7.1	ND[7]
MOME	Mormon Mesa South	11.8	ND
	Virgin River #1	22.5	23 (14 May–17 Aug), 1 (26 Jun), 1 (10–14 Jul), 1 (24 Jul)
	Virgin River #2	11.2	ND
MUDD	Overton WMA Pond	0.7	1 (2–5 Jul)
	Overton WMA	14.9	13 (14 May–7 Aug), 1 (6 Jul), 1 (2–3 Aug)

[3] We started the survey season with 57 sites scheduled for surveys in 2011. Two sites were added after reconnaissance revealed potential flycatcher habitat. We discontinued surveys at one site because of poor habitat quality.

[4] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June.

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4]
TOPO	Pipes #1	5.2	1 (23 Jun–1 Jul)
	Pipes #3	5.7	2 (23–27 Jun), 1 (6–8 Jul)[8]
	The Wallows	0.7	1 (1–5 Jun), 1 (9–13 Jun), 1 (25 Jun–9 Jul)[9]
	PC6-1	4.8	1 (1 Jun)
	Pig Hole	2.4	ND
	In Between	7.7	1 (21 May)
	800M	4.7	1 (7 May–28 Jun)[8], 1 (5–7 Jun), 1 (18 Jun)
	Pierced Egg	6.7	1 (24 May), 2 (29 May), 1 (3 Jun)
	Swine Paradise	0.9	1 (9 Jun)
	Barbed Wire	2.1	ND
	Platform	1.9	1 (16 May–10 Jun)[9]
	250M	1.9	ND
	Hell Bird	6.3	2 (16 May), 4 (29 May), 2 (4 Jun), 2 (8 Jun)
	Glory Hole	5.0	ND
	Spaghetti	5.4	2 (30 May)
	Beal Lake	18.0	1 (7 Jun)
	Lost Lake	3.3	1 (26 May)
	Dock[10]		3 (29 May)
BIWI	Wispy Willow[11]	0.5	1 (27 May)
	Burn Edge	4.1	1 (30 Jun)
	Site #4	9.9	1 (16 Jun), 1 (20–26 Jun), 1 (20 Jun–5 Jul)
	Site #3	13.0	2 (13 May–1 Aug), 1 (27 May)
	Last Gasp	2.1	ND
	Site #5	6.8	1 (21 May), 1 (29 May)
	Cougar Point[12]	1.3	2 (10–16 Jul)[13]
	Upstream from Site #8	1.5	ND
	Planet Ranch Road	3.3	3 (15 May–30 Jul), 1 (1 Jun), 1 (1–6 Jun)
	New River	0.6	ND
PVER	PVER Phase 2	21.4	3 (16 May), 6 (26 May), 2 (9 Jun)
	PVER Phase 3	21.4	1 (16 May), 3 (26 May)
CIBO	CVCA Phase 1	26.2	6 (23 May), 3 (31 May), 3 (8 Jun)
	CVCA Phase 2	25.5	11 (23 May)
	CVCA Phase 3	38.4	16 (24 May), 2 (1 Jun)
	Cibola Nature Trail	13.7	1 (1 Jun)
	Cibola Island	4.2	ND
	Cibola Site #2	16.4	3 (25 May), 2 (14 Jun)
	Cibola Site #1	7.7	ND
	Cibola Lake #2 (East)	4.5	1 (25 May), 1 (20 Jun)
	Walker Lake	11.4	1 (15 Jun)

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
IMPE	Paradise	7.8	3 (18 May)
	Hoge Ranch	20.7	8 (21 May), 6 (2 Jun)
	Rattlesnake	7.6	3 (21 May), 2 (2 Jun)
	Milemarker 65	10.0	1 (18 May)
	Nursery NW	7.0	4 (22 May), 2 (5 Jun)
	Ferguson Lake	21.1	2 (19 May)
	Great Blue Heron	7.1	3 (17 May), 9 (20 May), 4 (3 Jun), 5 (5 Jun)
	Powerline	1.0	2 (17 May), 1 (3 Jun)
	Martinez Lake	4.6	2 (3 Jun)
MITT	Mittry West	4.4	3 (17 May)
YUMA	Gila River Site #2	2.9	7 (4 Jun)
	Fortuna Site #1	3.2	15 (4 Jun)
	Fortuna North	3.8	6 (4 Jun), 1 (5 Jun)

* This table includes only sites where regular surveys were scheduled or where flycatcher were detected and does not include sites where habitat reconnaissance or opportunistic surveys were conducted and no flycatchers were detected.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Flycatchers in territories that were occupied throughout the breeding season are shown as being present throughout the season. Flycatchers detected on a single occasion or for a short period of time are listed separately.

[5] We detected several within-season movements between study areas in 2011. For details on movements see Table 3.9.

[6] Detection was of a banded family group (one adult with fledges) from Pahranagat North.

[7] Surveys discontinued because of poor quality habitat.

[8] This individual detected 7 May–28 Jun in 800M and 6–8 Jul in Pipes #3.

[9] This individual detected 16 May–10 Jun in Platform and 25 Jun–9 Jul in The Wallows.

[10] Not an official survey site. Incidental detections recorded.

[11] Site surveyed at beginning of season for reconnaissance. Not added to formal survey list due to unsuitable habitat.

[12] Site discovered with breeding flycatchers toward end of survey season.

[13] A singing male was reported at this territory by personnel from an unrelated field crew prior to 10 Jul; only the female was detected during nest monitoring visits 10–16 Jul.

Table 2.3. Detections of Willow Flycatchers Recorded after 15 June 2011 at Sites Where Breeding or Residency Was Not Confirmed

Study Area[1]	Site	Date	Comments
MUDD	Overton WMA Pond	2 Jul	Singing spontaneously (*fitz-bew*)
BIWI	Burn Edge	30 Jun	Occasional unsolicited vocalizations (*fitz-bew* and *wheeo*)
CIBO	Cibola Lake #2 (East)	20 Jun	Brief primary song (*fitz-bew*)

[1] MUDD = Muddy River, BIWI = Bill Williams River NWR, CIBO = Cibola.

Table 2.4. Yellow-billed Cuckoo Detections at Reclamation Study Areas, 2011

Study Area[1]	Site	Date	Behavioral Observations
MESQ	Hafen Lane	23 Jun	One individual detected
	West	19–22 Jul	Repeated detections of one or two individuals
MUDD	Overton WMA	14 Jul	One individual heard
TOPO	Beal Lake	29 Jun	One individual detected
		13 Jul	Two individuals detected
BIWI	Site #3	30 Jun	One individual heard
		16 Jul	Two individuals heard (*coo* and *kowlp*)
	Site #5	10 Jul	One individual detected
	Planet Ranch Road	2–17 Jul	Repeated detections of one or two cuckoos
	New River	7 Jul	One individual detected
		17 Jul	One individual detected
PVER	Phase 2	13 Jun	One individual seen and heard (*kuk* and *kowlp*)
		12 Jul	Two or three individuals heard (*kuk* and *coo*)
	Phase 3	12 Jul	One individual heard
CIBO	CVCA Phase 1	17 Jun	One individual detected
		13 Jul	Two individuals heard
	CVCA Phase 2	17 Jun	One individual heard (*coo*)
		13 Jul	Three or four individuals detected
	CVCA Phase 3	8 Jun	One individual seen
	Cibola Island	7 Jul	Two individuals heard (*kuk* and *coo*), one silent cuckoo seen

[1] MESQ = Mesquite, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve; CIBO = Cibola.

Table 2.5. Yuma Clapper Rail Detections at Reclamation Study Areas, 2011

Study Area[1]	Site	Date(s)	Behavioral Observations
BIWI	Wispy Willow	13 Jun	One individual heard
CIBO	Cibola Site #2	28 Jun	One individual heard
IMPE	Powerline	5 Jul	One individual heard

[1] BIWI = Bill Williams River NWR, CIBO = Cibola, IMPE = Imperial.

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011*

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PAHR	North[4]	8/--/2	15/--/5	4/--/1	0/--/0
	West[4]	0/0/0	0/0/0	0/0/0	2/5/15
MESQ	Hafen Lane[4]	0/0/0	0/0/0	0/0/0	1/1/1
	West[4]	2/--/0	15/--/0	15/--/0	0/--/0
	Bunker Marsh North[4]	5/--/--	15/--/--	0/--/--	0/--/--

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
MOME	Mormon Mesa North	0/--/--	0/--/--	0/--/--	40/--/--
	Hedgerow	0/--/--	0/--/--	0/--/--	300/--/--
	Mormon Mesa South[4]	--/0/0	--/0/0	--/0/0	--/0/0
	Virgin River #1	--/10/10	--/10/20	--/5/8	--/--/0
	Virgin River #2	0/0/0	0/0/0	0/0/0	20/20/20
MUDD	Overton WMA Pond	2/--/2	40/--/10	0/--/0	0/--/0
	Overton WMA	--/--/10	--/--/30	--/--/8	--/0/0
TOPO	Pipes #1	0/0/0	0/0/0	0/0/0	40/40/40
	Pipes #3	0/0/0	0/0/0	0/0/0	40/40/40
	The Wallows	0/0/0	0/0/0	1/0/0	0/80/80
	PC6-1	0/0/0	0/0/0	0/0/0	40/40/40
	Pig Hole	0/0/0	0/0/0	0/0/0	120/120/120
	In Between	25/15/20	30/40/10	30/10/5	0/0/0
	800M	0/0/0	0/0/0	0/10/0	70/0/70
	Pierced Egg	1[5]/1[5]/0	10/3/0	0/0/0	0/0/30
	Swine Paradise[6]	0/0/0	0/0/0	0/0/0	40/40/40
	Barbed Wire	0/2/0	0/10/0	0/0/0	150/0/150
	Platform[6]	0/0/0	0/0/0	0/0/0	20/20/20
	250M[6]	0/0/0	0/0/0	0/0/0	0/0/0
	Hell Bird[6]	0/0/0	0/0/0	0/0/0	0/0/0
	Glory Hole	0/0/0	0/0/0	0/0/0	70/70/70
	Spaghetti	--/--/--	--/--/--	--/--/--	0/0/0
	Beal Lake[7]	0/0/45	0/0/3	0/0/0	20/20/0
	Lost Lake[6]	0/0/0	0/0/0	0/0/0	20/20/20
BIWI	Burn Edge	20/1/<1	10/10/40	30/1/0	0/0/0
	Site #4[4]	5/1/1	10/>100/>100	0/2/0	0/0/0
	Site #3	4/0/0	10/0/0	2/5/0	0/0/250
	Last Gasp	10/1/0	30/3/0	5/0/0	0/0/>1000
	Site #5	10/5/5	30/100/100	3/0/0	0/0/0
	Cougar Point[8]	--/--/70	--/--/10	--/--/25	--/--/0
	Upstream from Site #8[6]	10/10/10	10/10/10	5/5/5	0/0/0
	Planet Ranch Road	50/40/50	40/60/50	30/10/3	0/0/0
	New River	15/15/15	10/10/10	5/10/--	0/0/0

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PVER	PVER Phase 2[7]	0/10/0	0/3/0	0/5/0	300/0/5
	PVER Phase 3[7]	0/25/30	0/10/10	0/40/10	10/0/0
CIBO	CVCA Phase 1[7]	20/0/15	10/0/10	40/0/5	0/10/0
	CVCA Phase 2[7]	0/0/0	0/0/0	0/0/5	5/5/0
CIBO	CVCA Phase 3[7]	0/75/0	0/10/0	0/15/0	10/0/5
	Cibola Nature Trail[7]	0/0/0	0/0/0	0/0/0	12/15/15
	Cibola Island	--/0/0	--/0/0	--/0/0	--/--/5
	Cibola Site #2	0/10/10	0/10/--	--/5/5	100/0/0
	Cibola Site #1	30/15/30	10/10/--	--/10/3	0/0/0
	Cibola Lake #2 (East)[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Walker Lake[4]	--/20/5	--/3/3	--/--/5	--/0/0
IMPE	Paradise[4]	40/--/0	25/--/0	--/--/3	0/0/0
	Hoge Ranch[4]	--/5/5	--/25/20	--/3/3	0/0/0
	Rattlesnake[6]	0/10/0	0/10/0	30/10/0	0/0/5
	Milemarker 65[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Nursery NW[6]	30/50/15	30/30/10	10/10/10	0/0/0
	Ferguson Lake[4]	5/--/25	25/--/25	5/--/5	0/0/0
	Great Blue Heron[6]	0/0/--	0/0/--	0/0/--	100/100/--
	Powerline[6]	10/20/--	10/25/--	40/10/--	0/0/--
	Martinez Lake	0/10/--	0/10/--	25/8/--	0/0/--
MITT	Mittry West	90/5/--	40/5/--	5/25/--	0/0/--
YUMA	Gila River Site #2[4]	--/0/0	--/0/0	--/0/0	--/5/5
	Fortuna Site #1[4]	--/0/0	--/0/0	--/5/0	--/0/0
	Fortuna North[4]	--/10/10	--/10/15	--/5/5	--/0/0

* Values are given for each site as recorded in mid-May, mid-June, and mid-July.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] -- = Hydrologic information not recorded.

[3] Percent of site with saturated soil does not include inundated areas.

[4] Site bordered by a river, lake, or pond.

[5] Saturated soil or water was present only in pig wallows.

[6] Site borders marsh.

[7] Site is irrigated as part of restoration efforts; amount of standing water highly variable throughout survey season.

[8] Site not visited until July; not formally surveyed.

Pahranagat National Wildlife Refuge, Nevada

Pahranagat National Wildlife Refuge consists of a series of lakes and marshes in Pahranagat Valley approximately 150 km north of Las Vegas, Nevada. Patches of primarily native vegetation exist at the inflow and outflow of Upper Pahranagat Lake and along the lakeshore. Prior to the 2008 survey season, the majority of the riparian vegetation along the north side of the upper lake (Pahranagat North) was

inundated annually with up to 1 m of water, with the highest water levels occurring in May. Major structural problems with the dam that impounds the upper lake resulted in the upper lake being drained in early 2008, and the riparian vegetation at the north end of the lake was not flooded during the 2008 or 2009 breeding seasons. The dam was repaired prior to the 2010 breeding season, and lake levels in 2010 and 2011 were higher than they had been in the two previous years but not as high as they had been prior to 2008.

PAHRANAGAT NORTH

Area: 4.6 ha Elevation: 1,026 m

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*; hereafter cottonwood) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lakebed. Canopy height within the patch is around 20 m, and canopy closure is approximately 80%. Many of the large trees in the northeastern section of the site are dead or dying. Additional scattered cottonwood trees have fallen throughout the site creating multiple small clearings. Standing water and saturated soils were present within the southern portion of the site in May, and the site slowly dried out during the survey season, with no water or saturated soils present by the middle of July except in an inflow channel that runs along the northern side of the site and drains into the lakebed at the southeastern corner of the site.

We detected 10 breeding willow flycatchers, as well as 4 resident, unpaired males and 7 individuals for which residency could not be determined. The site lies immediately adjacent to a cattle pasture, and a lack of fencing coupled with low lake levels allowed cattle to periodically access to the site for a portion of the breeding season. We surveyed the unoccupied east arm of the site four times, totaling 1.5 observer-hours.

PAHRANAGAT WEST

Area: 1.5 ha Elevation: 1,026 m

This native site consists of a stringer of cottonwood, one to three trees wide and 20 m in height, on the western edge of Upper Pahranagat Lake. The site has no significant understory vegetation, and canopy closure varies from <50 to 80%. The eastern edge of the site is vegetated with bulrush, which extends into the lakebed to the east. The western edge of the site is vegetated in yerba mansa (*Anemopsis californica*) extending into dry, upland desert. During the survey season, the interior of the site was dry, but surface water was present adjacent to the site in the lakebed.

We detected one adult and one hatch year willow flycatcher on 21 July and two additional hatch year willow flycatchers on 21–25 July; all individuals were known or suspected to have come from Pahranagat North. We surveyed the site five times, totaling 3.1 observer-hours. No cowbirds were detected, and there was no sign of livestock use.

GROUND RECONNAISSANCE RESULTS

Pahranagat South

The majority of this site was affected by a fire prior to the start of the 2010 survey season. The fire removed all understory vegetation and charred the trunks and lower branches of the overstory trees. The site now consists of a stringer of cottonwood, 20 m tall, along a human-made channel that carries the outflow from Upper Pahranagat Lake. The understory contains Indian hemp (*Apocynum cannabinum*) and some small patches of coyote willow (*Salix exigua*) 3 m in height. Canopy closure within the cottonwood stringer is approximately 50%. The channel held water during the site visit in May; surrounding soils were dry. While suitable understory components are now present, they are not currently of sufficient size

to resemble typical occupied willow flycatcher habitat. We recommend reassessing this site in future years. We surveyed the site once, totaling 0.25 observer-hours. No willow flycatchers were detected.

Littlefield, Arizona

In recent years, our survey and monitoring activities focused on Beaver Dam Wash near the Highway 91 Bridge. In December 2010, a flood scoured much of the area, and we evaluated the site (Littlefield Poles) at the beginning of the season for suitability.

GROUND RECONNAISSANCE RESULTS

Littlefield Poles

The site consists of primarily native vegetation and is located on Beaver Dam Wash, immediately upstream of the Highway 91 Bridge. Overall changes to the site as a result of the flood in December 2010 include a reduction in vegetation density and height and a significant change in hydrology. Vegetation along the northern edge of the site consists of a scattered overstory of cottonwood averaging 25 m in height. The previously documented lower strata vegetation of tamarisk and Russian olive (*Elaeagnus angustifolia*) in the cottonwood area are significantly reduced or absent. The southern portion of the site consists of stands of coyote willow and young Goodding willow and cottonwood approximately 5 m in height. These stands have thinned significantly, and canopy closure is now 30 to 50% overall. Extensive sedimentation of the site has also reduced canopy height. No surface water was present in May or June, and the nearest water was Beaver Dam Wash, which was restricted to a channel roughly 80 m from the site. We surveyed the site twice, totaling 1.0 observer-hours. No willow flycatchers were detected. Because of the lack of surface water within the site and the reduction in vegetation density, this site does not currently resemble typical occupied flycatcher breeding habitat. We recommend reassessing the site at the beginning of future breeding seasons.

Mesquite, Nevada

The Mesquite study area is in the floodplain of the Virgin River near Mesquite and Bunkerville, Nevada.

HAFEN LANE

Area: 6.1 ha Elevation: 475 m

This mixed-exotic site lies within the floodplain of the Virgin River in Mesquite, Nevada, between Hafen Lane and the active river channel. Two drainage ditches that pass underneath Hafen Lane flow into the site; the eastern inflow supports a dense stand of cottonwood and Goodding willow, 10 m in height, with some coyote willow 5 m in height in the understory. The western inflow supports a stringer of coyote willow 4–6 m in height and scattered Goodding willow 15–18 m in height, with 70% canopy closure. The coyote willow in the western stringer is of varying health and density. Between the stringers, the site is vegetated by 6-m-tall tamarisk with 90% canopy closure. No water was documented within the site, but damp soils were noted on all visits within the drainage ditches. Tamarisk beetles and heavily defoliated tamarisk were noted at the site in mid-June.

We detected three breeding flycatchers, one of which was a male from Muddy River that displaced the resident male. Portions of the site not known to be occupied were surveyed five times for a total of 16.2 observer-hours. Cowbirds were detected on all surveys, and no sign of livestock use was observed.

MESQUITE WEST

Area: 10.4 ha Elevation: 470 m

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Golf courses and housing developments border the site to the north, and the Virgin River borders the site to the south. This large site is primarily a mosaic of cattail (*Typha* spp.) and bulrush (*Schoenoplectus californicus*) marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The coyote willows are generally 5–6 m in height, and canopy closure varies from 50 to >90%. The eastern portion of the site is primarily coyote willow, while the western portion contains a mix of willow and tamarisk. Hydrology at the site is influenced by irrigation runoff from adjacent golf courses and agriculture. The site was regularly inundated through early June. Thereafter, a change in the access point of water into the site diverted all water straight into the Virgin River, bypassing the site altogether. Tamarisk beetles and defoliated tamarisk were noted within the site in mid- to late June.

We detected 10 breeding willow flycatchers and 1 resident, unpaired male. Areas of Mesquite West not known to be occupied by flycatchers were surveyed five times, totaling 7.4 observer-hours. Cowbirds were detected on all surveys. Some signs of cattle were observed early in the season in the eastern portion of the site near the river.

BUNKER MARSH NORTH

Area: 7.1 ha Elevation: 456 m

This mixed-exotic site lies within the floodplain of the Virgin River near Bunkerville, Nevada, approximately 4 km downstream of Mesquite West. The site is between agricultural fields to the southeast and the Virgin River to the northwest. The site is primarily 5–7-m-tall tamarisk, with scattered Goodding willow primarily in the southern portion of the site. Some Goodding willows are also present along the western and northern ends of the site. Canopy closure ranges from 25 to 80%. Surface water was noted within the site in May in a small stream in the northern portion of the site and a small puddle in the center of the site, but no water was noted in mid-June. Dry marshes were present adjacent to the site. Tamarisk beetle larvae but no defoliation were observed in mid-May, and extensive defoliation was observed by mid-June. Surveys at this site were discontinued in mid-June because of the lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

We detected no willow flycatchers. The site was visited twice, for a total of 3.7 observer-hours. Cowbirds were detected on both surveys, and signs of cattle were observed within the site.

Mormon Mesa, Nevada

For approximately 15 km upstream of its confluence with the Muddy River, the Virgin River flows through a 1-km-wide floodplain with a mosaic of habitats, including cattail marshes and tamarisk and willow forest. Much of the area is typically seasonally inundated from snowmelt in the spring and monsoon rains in mid and late summer, and the entire study area experienced severe flooding over the 2004–2005 winter. All the areas surveyed at Mormon Mesa are at least 10 km upstream of the Muddy River confluence. In December 2010, the study area experienced another severe flood. Part of the river shifted its course, and river levels remained elevated (in the 75th percentile) throughout the breeding season, limiting access to portions of the study area during May and early June. Tamarisk beetles and heavy defoliation were noted throughout the study area by mid-July.

MORMON MESA SOUTH

North half: Area: 8.4 ha Elevation: 385 m

South half: Area: 3.4 ha Elevation: 385 m

This mixed-exotic site was split into two contiguous areas to facilitate tracking of survey activity. The site has scattered Goodding willow up to 20 m, but more typically 12–15 m, in height and a patchy understory of tamarisk 3–6 m in height. Dead cattail and arrowweed (*Pluchea sericea*) are present in the understory in this area. Canopy closure is widely variable, ranging from >80% in tamarisk thickets to <50% in openings. There was no surface water within the site, but damp soils were noted in the center of the northern half of the site in May and June. The presence of dead cattails and deadfall suggests that this site was formerly considerably wetter, and portions of the site still have the structure to provide potential flycatcher habitat with wetter soil conditions.

No willow flycatchers were detected. Due to elevated river levels, we surveyed the northern half four times and the southern half three times, totaling 9.3 and 4.8 observer-hours, respectively. Cowbirds were detected on all surveys in the northern half and none of the surveys in the southern half. Signs of cattle were noted within the site on all occasions.

VIRGIN RIVER #1

North half: Area: 11.4 ha Elevation: 380 m

South half: Area: 11.1 ha Elevation: 380 m

Virgin River #1 was also divided into two areas, Virgin River #1 North and Virgin River #1 South, to facilitate streamlining of field logistics. Virgin River #1 North is primarily tamarisk 4–6 m in height, with areas of emergent Goodding willow in the central and southwestern portions of the site. Canopy closure throughout the site is 70–90%. Some surface water was present in June in channels running north to south through the center of the site and in the southwestern corner of the site. By July only a few spots of saturated soil remained in these areas.

We detected four breeding willow flycatchers in the southwestern corner of Virgin River #1 North. We also detected one additional flycatcher for which residency and breeding status could not be determined. Areas of this site not known to be occupied by flycatchers were surveyed four times, totaling 12.9 observer-hours. Cowbirds were detected on all surveys and cattle were observed in the site on multiple occasions.

Virgin River #1 South consists of two disjunct sections; the northern section is immediately south of Virgin River #1 North, while the southern portion is approximately 700 m SSE of Virgin River #1 North. The northern section is primarily tamarisk 4–6 m in height with patches of coyote willow 6 m in height and scattered Goodding willow 8–12 m in height. Canopy closure varies from >90% in areas of dense willow and tamarisk to 25% in marshy openings. The northern section contained standing water throughout the survey season. The southern section consists of tamarisk 6–7 m in height, with a cluster of emergent Goodding willow and dead coyote willow. Canopy closure is 70–90%. Soils in the southern section were dry throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion if soils are dry.

We detected 18 breeding willow flycatchers and one unpaired, resident male in the northern section of Virgin River #1 South. We detected two additional willow flycatchers for which residency and breeding status could not be confirmed. Areas of the site not known to be occupied by willow flycatchers were surveyed three times, totaling 5.5 observer-hours. Cowbirds were observed on two surveys, and signs of cattle were observed.

VIRGIN RIVER #2

Area: 11.2 ha Elevation: 380 m

This site received extensive sedimentation from the flood in December 2010. The depth of new sediment ranged from 15 to 60 cm and was most extensive in the southern portion of the site. The site consists of mixed-exotic vegetation with tamarisk 4–6 m in height with a cluster of emergent Goodding willow at the northern end of the site and scattered, emergent Goodding willow at the southern end of the site. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in this portion of the site. Overall canopy closure is 70–90%. The site contained no surface water during the breeding season, though a small area at the very northern end of the site contained damp soil in May and June. The Virgin River, on the eastern edge of the site, had surface water throughout the season.

No willow flycatchers were detected. We surveyed the site five times, totaling 16.8 observer-hours. Cowbirds were observed on all surveys, and cattle sign were observed at the site.

GROUND RECONNAISSANCE RESULTS

Mormon Mesa North

We discontinued surveys after the initial visit at this site in 2010 due to dry conditions and a lack of flycatcher detections since 2005. In December 2010, the study area experienced significant flooding, with the potential to alter the hydrology within the site. We reassessed the site at the beginning of 2011. This site consists of mixed-exotic vegetation, primarily tamarisk 3–5 m in height with areas of emergent Goodding willow up to 12 m in height and patches of coyote willow. Canopy closure varies from 70% in the taller tamarisk to around 50% in the shorter tamarisk. The western edge of the site has a 100 x 50-m patch of Goodding willow, 8 m in height, with up to 75% canopy closure and dead cattails in the understory. Soils were completely dry within the site during a visit in early June, and the nearest water was in the river channel approximately 40 m away. We did not formally survey the site in 2011, though no flycatchers were detected during the site visit. We recommend discontinuing surveys at this site until another flood event occurs that has the potential to alter the hydrology within the site.

Hedgerow

We discontinued surveys after the initial visit at this site in 2010 because of completely dry conditions and a lack of flycatcher detections since surveys began in 2005. In December 2010, the entire study area experienced a significant flood that had the potential to change the hydrology within the site. We reassessed the site at the beginning of 2011. The site is east of Mormon Mesa North, on the eastern side of the Virgin River. It consists of mixed-exotic vegetation with a continuous understory of tamarisk 4–5 m in height and scattered emergent Goodding willow up to 12 m in height. Many of the willows have dead branches. The site is surrounded by tamarisk and arrowweed 2–3 m in height. Canopy closure in the tamarisk varies from about 50% on the edges of the site up to 80% in the denser areas. Soils within the site were completely dry during a visit in May. We did not formally survey the site in 2011, but no flycatchers were detected during the May site visit. We recommend discontinuing surveys at this site until another flood event occurs that has the potential to alter hydrologic conditions.

Muddy River, Nevada

The Muddy River study area is along the Muddy River in the Overton Wildlife Management Area (WMA) near Overton, Nevada.

OVERTON WMA POND

Area: 0.7 ha Elevation: 378 m

This site consists of a patch of mixed-native vegetation approximately 150 m long and 75 m wide at the north end of Overton WMA just south of Honeybee Reservoir. The dominant vegetation consists of 12-m-tall Goodding willow with a sparse 5-m-tall tamarisk understory. Cattail and sedges (*Carex* sp.) are also present on the edges of the site. Arrowweed is present in scattered, dense patches within and along the edges of the site. Canopy closure is variable, ranging up to 90%. A small stream channel runs through the site, and it held surface water throughout the season.

We detected one willow flycatcher for which residency could not be determined. We surveyed the site five times for a total of 2.5 observer-hours. Cowbirds were detected on two visits, and no sign of livestock use was observed.

OVERTON WMA

Area: 14.9 ha Elevation: 378 m

This site consists of a 150-m-wide strip of riparian vegetation spanning both sides of the Muddy River. The site is bordered to the southwest by open agricultural fields and to the northeast by sparser areas of riparian vegetation. The site flooded heavily during the 2004–2005 winter, but vegetation at the site was relatively unchanged. The northern portion of the site is dominated by very dense tamarisk up to 7 m in height with canopy closure of 70–90%. The southern portion of the site consists primarily of a stand of Goodding willow 10–15 m in height with an understory of tamarisk and cattail. Canopy closure in this area is up to 90%. Flowing water was present in the channels of the Muddy River throughout the survey season. Soils in the northern portion of the site outside of the river channel were dry throughout the season. Soils in the southern portion were saturated early in the season and dry at the end of the season in areas adjacent to the channels. Beavers have felled swaths of Goodding willow in the southern portion of the site, resulting in gaps in the canopy. Approximately 0.3 ha of the southern portion of the site was bulldozed in 2005 as part of Overton WMA efforts to repair flood damage to their water control system. Two stretches of the channel of the Muddy River within the site were dredged with heavy equipment over the 2007–2008 winter, resulting in a cleared swath 10–15 m wide on the western bank of the river.

We located 10 breeding willow flycatchers and three unpaired, resident males. We also detected two flycatchers for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed six times, totaling 18.0 observer-hours. We observed no signs of livestock but detected cowbirds on all surveys.

Topock Marsh, Arizona

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow. Seasonally wet, low-lying areas are interspersed throughout the riparian area. Water levels within Topock Marsh were unusually low in 2011 because the intake valve at the upstream end of the marsh was closed for construction purposes. Feral pigs are present throughout the Topock study area, and evidence of pigs was observed in most survey sites.

PIPES #1

Area: 5.2 ha Elevation: 140 m

This exotic site is bordered to the east by the refuge road and consists primarily of monotypic tamarisk 6–9 m in height. Arrowweed occurs in dense patches within 50 m of the refuge road. The tamarisk is densest within 100 m of the refuge road and becomes more open toward the western edge of the site. The northern edge of the site has the tallest canopy, and there is relatively little deadfall in this area compared to the rest of the site. The central and southern portions of the site have many dead stems and clusters of fallen trees. Canopy closure is 70–90%. The site contained no standing water during the survey season.

We detected one unpaired, resident willow flycatcher from 23 June to 1 July. We surveyed the site five times, totaling 8.5 observer-hours. Cowbirds were detected on all surveys.

PIPES #3

Area: 5.7 ha Elevation: 140 m

This site is bordered to the east by the refuge road. Arrowweed occurs in dense patches within 50 m of the road. Most of the site is vegetated by tamarisk 5–7 m in height. The southeastern portion of the site has a few emergent Goodding willow up to 15 m in height and open areas with marsh vegetation. Canopy closure generally exceeds 70%. The site contained no standing water during the survey season.

We detected two breeding flycatchers and one individual that moved to Pipes #3 after holding a territory in 800M. Portions of Pipes #3 not known to be occupied by flycatchers were surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all surveys.

THE WALLOWS

Area: 0.7 ha Elevation: 140 m

The Wallows is primarily vegetated by tamarisk 5–6 m in height with emergent Goodding willow on the western side of the site. The northwestern edge of the site borders an open cattail marsh. The eastern side is dry and grades from 2-m-tall arrowweed along the refuge road to tamarisk up to 8 m in height in the center of the site. Overall canopy closure ranges from 50% in the marshy area to 90% in the tamarisk. Approximately 1% of the site had saturated soil in mid-May, but the site was entirely dry by mid-June.

We detected one resident, unpaired male that moved to The Wallows from Platform. We also detected two individuals for which residency could not be confirmed. Portions of the site not known to be occupied were surveyed five times, totaling 2.1 hours. Cowbirds were detected on three surveys.

PC6-1

Area: 4.8 ha Elevation: 140 m

PC6-1 is a mixed-exotic site consisting primarily of tamarisk 6–7 m in height, with a few patches of arrowweed and cattails present in the understory. A scattered overstory of Goodding willow approximately 10–15 m in height is present in the southwestern corner of the site. Arrowweed 1–2 m in height is present under the willow. A portion of the site within approximately 50 m of the refuge road contains thick stands of arrowweed. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the refuge road is approximately 50%. The site was completely dry throughout the survey season.

We detected one willow flycatcher across the road from PC6-1 on 1 June. The site was surveyed five times, totaling 8.1 observer-hours. Cowbirds were detected on all surveys.

PIG HOLE

Area: 2.4 ha Elevation: 140 m

Pig Hole consists of monotypic tamarisk 6–7 m in height, with canopy closure ranging from 70 to 90%. Tamarisk along the northern edge has many wispy branches and smaller diameter stems than the rest of the site. A few dense patches of arrowweed are present on the eastern edge. No standing water or saturated soil was observed within the site during the survey season.

No willow flycatchers were detected. The site was surveyed five times, totaling 5.1 observer-hours. Cowbirds were detected on all surveys.

IN BETWEEN

Area: 7.7 ha Elevation: 140 m

In Between consists of monotypic tamarisk 6–8 m in height. The lowest 3 m of the stand generally lacks foliage, resulting in a relatively open understory. Canopy closure is 70–90%, and the western edge of the site borders a marsh. In Between was affected by water delivery in 2011 (see Chapter 8) and contained varying amounts of surface water through the middle of July.

We detected one flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 9.9 observer-hours. Cowbirds were observed on four surveys.

800M

Area: 4.7 ha Elevation: 140 m

800M adjoins the western edge of In Between, and the eastern half of the site consists of a cattail and bulrush marsh with clumps of tamarisk 5–7 m in height and scattered, emergent Goodding willow. The remainder of the site is vegetated by tamarisk 4–7 m in height. Canopy closure in the tamarisk is generally >90%, while canopy closure in the marsh is around 50%. 800M was affected by water delivery in 2011 (see Chapter 8) and contained varying amounts of surface water and saturated soil in the marsh through early July.

We located one resident, unpaired male flycatcher and two additional individuals for which residency could not be confirmed. Portions of the site not known to be occupied were surveyed five times, totaling 4.7 observer-hours. Cowbirds were observed on all surveys.

PIERCED EGG

Area: 6.7 ha Elevation: 140 m

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height, with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to have a more open understory and contain patches of cattail and bulrush. Overall canopy closure is approximately 80%. The only water or saturated soil within the site was in deep pig wallows.

We detected four flycatchers for which residency could not be confirmed. We surveyed the site five times for a total of 8.5 observer-hours. Cowbirds were observed on all surveys.

SWINE PARADISE

Area: 0.9 ha Elevation: 140 m

Vegetation at this mixed-exotic site consists of tamarisk 6–8 m in height and scattered, emergent Goodding willow up to 15 m in height, with patches of coyote willow. Overall canopy closure is approximately 80%. The northern tip of the site was bulldozed prior to the survey season for a new water conveyance channel. The site was dry throughout the survey season.

We detected one willow flycatcher for which residency could not be determined. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds were detected on three visits.

BARBED WIRE

Area: 2.1 ha Elevation: 140 m

One large, emergent Goodding willow occurs at the site; otherwise, the site is vegetated by tamarisk 6–10 m in height and of varying density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy openings than the southwestern portion of the site. A 40-m-wide strip was bulldozed through the center of the site east to west for a new water conveyance channel prior to the start of the survey season. Canopy closure outside the bulldozed area is approximately 70–90%. The only standing water or saturated soil observed in the site was within the new channel.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds were detected on four visits.

PLATFORM

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road to the west and open bulrush and cattail marsh to the east. Vegetation at the site consists of tamarisk 8 m in height with a few emergent Goodding willow. A narrow line of 5-m-tall coyote willow approximately 5 m wide runs along the eastern edge of portions of the site. Overall canopy closure is approximately 90%. Soils within the site were very dry throughout the survey season.

We detected one resident, unpaired male willow flycatcher. Portions of the site not known to be occupied were surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all visits.

250M

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is dominated by mesquite trees (*Prosopis* sp.) with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and a few emergent Goodding willows approximately 12 m in height. Canopy closure within the site ranges from 70 to 90%. The site was completely dry throughout the survey season.

No willow flycatchers were detected. The site was surveyed five times, totaling 3.3 observer-hours. Cowbirds were detected on three surveys.

HELL BIRD AND GLORY HOLE

Hell Bird: Area: 6.3 ha Elevation: 140 m
Glory Hole: Area: 5.0 ha Elevation: 140 m

These contiguous mixed-exotic sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure are highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6–8 m in height and Goodding willow 15 m in height. Screwbean mesquite (*Prosopis pubescens*) is also scattered throughout the sites. Canopy closure ranges from 50 to 90%. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush. Areas vegetated by cattail and bulrush are interspersed throughout the survey sites. Extremely low water levels in Topock Marsh resulted in increased accessibility in 2011, and Hell Bird was expanded approximately 100 m to the northeast to encompass areas of coyote willow. Both sites were completely dry throughout the survey season.

We detected 10 flycatchers in Hell Bird for which residency could not be confirmed. No flycatchers were detected in Glory Hole. Hell Bird and Glory Hole were surveyed five times each, totaling 6.0 and 8.3 observer-hours, respectively. Cowbirds were detected during four surveys in each site.

SPAGHETTI

Area: 5.4 ha Elevation: 140 m

Spaghetti is a long, narrow site, generally no more than 30 m wide, running along the Farm Ditch to the west of Glory Hole. The site is vegetated by patches of dense coyote willow up to 7 m in height, scattered Goodding willow up to 12 m in height, and mesquite approximately 8 m in height, with tamarisk interspersed throughout the site. Canopy closure in the coyote willow patches is approximately 80%. Deep water in the ditch made the site inaccessible on foot throughout the survey season, and hydrologic conditions within the site were not assessed.

We detected two willow flycatchers for which residency could not be confirmed. We surveyed this site five times, totaling 3.4 observer-hours. Cowbirds were detected on two visits.

BEAL LAKE

Area: 18.0 ha Elevation: 140 m

This mixed-native restoration site consists of a mosaic of cottonwood, Goodding willow, coyote willow, mesquite, and arrowweed, with some tamarisk scattered throughout the site. Canopy height is highly variable and averages approximately 3–4 m over most of the site and up to 10 m in the cottonwood stands; canopy closure is sparse and averages 35%, reaching 85% in the cottonwood stands. The amount of standing water and saturated soil is highly variable because the site is flood irrigated. Sandy soil at the site allows the water to drain rapidly after irrigation.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed this site five times, totaling 10.6 observer-hours. Cowbirds were detected on all surveys.

LOST LAKE

Area: 3.3 ha Elevation: 140 m

This site consists of a narrow (<100-m-wide) strip of riparian vegetation separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. The northern edge of the site consists of an overstory of planted cottonwoods 10–15 m in height, with an

understory of tamarisk 5 m in height, on the edge of a cattail marsh. South of the cottonwoods, the site is primarily tamarisk, 5–8 m in height, with small openings vegetated by arrowweed. Overall canopy closure is approximately 80%. Surface water or saturated soil was present in the marsh on the northern edge of the site throughout the season, but the interior of the site was dry.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 3.4 observer-hours. Cowbirds were detected on four visits.

GROUND RECONNAISSANCE RESULTS

Tractor

This mixed-native site is approximately 1 km north of the inlet ditch at the northern end of Topock Marsh and consists of a 300-m-long stringer of cottonwood 15 m in height with an understory of *Baccharis* sp., mesquite, and 4-m-tall tamarisk bordering a 15-m-wide cattail marsh. The site is bordered by hayfields to the north and south, a dry concrete channel to the west, and a road and a slough to the east. The site was dry during our visit on 26 May except for one small puddle at the far western end of the site, and surveys were discontinued. We visited the site once, totaling 0.3 observer hours. No willow flycatchers or cowbirds were detected. We do not recommend future visits to this site.

Bill Williams River National Wildlife Refuge, Arizona

The Bill Williams River NWR contains the last expanse of native cottonwood-willow forest in the LCR region. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream. We did not observe evidence of livestock use at any of the Bill Williams sites.

BURN EDGE

Area: 4.1 ha Elevation: 140 m

Burn Edge is near the northern edge of the Bill Williams riparian corridor, on the eastern edge of an area that burned in 2006. A cattail marsh with Goodding willow and cottonwood 15 m in height runs east-west through the center of the site. This portion of the site also has clumps of tamarisk up to 6 m in height. Canopy closure in the marshy area varies from around 60% at the eastern end to 25% at the western end. The area on either side of the marsh consists of tamarisk 6 m in height with up to 90% canopy closure. An area of the marsh approximately 100 m long was inundated or saturated in May, but only a small puddle remained at the western end of the marsh in June and July.

On 30 June, we detected one willow flycatcher for which residency could not be confirmed. The site was surveyed five times, totaling 6.3 observer-hours. Cowbirds were detected on four visits.

BILL WILLIAMS SITE #4 AND SITE #3

Site #4: Area: 9.9 ha Elevation: 140 m

Site #3: Area: 13.0 ha Elevation: 140 m

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow 15–20 m in height and patches of monotypic tamarisk up to 8 m in height. Patches of coyote willow are also present. Canopy closure is variable and overall is approximately 50%. Stands of cattails and marshy areas occupy approximately 10% of Site #3.

The understory in some areas is very open, and the ground in these areas is covered with herbaceous vegetation. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Mosquito Flats had a network of small, flowing streams with some open marshes in May. By mid-June, the streams and marshes were muddy but contained no standing water, and the only surface water remaining was in a deep, backwater channel on the western side of Site #4.

We detected one resident, unpaired flycatcher and two flycatchers for which residency could not be confirmed in Site #4. Two breeding flycatchers and one individual for which residency could not be confirmed were detected in Site #3. Portions of the sites not known to be occupied by flycatchers were visited five times, totaling 16.8 observer-hours at Site #4 and 19.6 observer-hours at Site #3. Cowbirds were detected on all surveys of Mosquito Flats.

LAST GASP

Area: 2.1 ha Elevation: 140 m

Last Gasp is a narrow, mixed-native site along a channel on the northern edge of the Bill Williams riparian area, approximately 250 m east of Burn Edge. Vegetation within the site consists of a broken overstory of cottonwood and Goodding willow 15–20 m in height and a tamarisk understory 5–7 m in height. Canopy closure varies from 50% in the channel to 80–90% in the surrounding tamarisk. Surface water was present in ponds and puddles within the channel in May. One small puddle remained in mid-June, and the site was completely dry in July.

No willow flycatchers were detected at Last Gasp. We surveyed the site five times, totaling 4.6 observer-hours. Cowbirds were detected on all visits.

BILL WILLIAMS SITE #5

Area: 6.8 ha Elevation: 143 m

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the northeast by steep cliffs and to the west by a dry river channel. Vegetation in the site is mixed-native, with Goodding willow and cottonwood 15–20 m in height in the overstory. The understory consists of tamarisk 7 m in height as well as some young Goodding willow and cottonwood. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure in the site is variable, ranging from 25% in open areas to 70–90% in the denser vegetation. Standing water was present throughout the survey season along the northeastern edge of the site in the form of a small stream with deep beaver ponds. Soils in the majority of the site were dry.

We detected one willow flycatcher on 21 May and one individual on 29 May; residency could not be determined for these individuals. We surveyed the site five times, totaling 8.9 observer-hours. Cowbirds were detected on all surveys.

COUGAR POINT

Area: 1.3 ha Elevation: 157 m

This site was visited in early July after personnel from an unrelated field crew reported hearing a willow flycatcher singing. The site consists of dense, young, even-age stands of Goodding willow and cottonwood approximately 6 m in height along a channel of the Bill Williams River. Seep willow (*Baccharis salicifolia*) is present in the understory but appears to be dying back as it becomes shaded by the taller cottonwoods and willows. Cattail marshes are present within and around the site. Canopy

closure within the woody vegetation exceeds 80%. Surface water was present within the marshes and the woody vegetation when the site was visited in July and August.

We detected one nesting female flycatcher, but the male was not detected during nest monitoring visits. No formal surveys were completed.

UPSTREAM FROM SITE #8

Area: 1.5 ha Elevation: 170 m

Vegetation in the majority of the site consists of an overstory of cottonwood and Goodding willow up to 15 m in height and an understory of tamarisk. The western third and southern edge of the site are vegetated by Goodding willow and cottonwood up to 10 m in height. The eastern third is dominated by dry tamarisk 4–6 m in height with scattered, emergent Goodding willow and cottonwoods. The northern edge of the site borders a cattail marsh. Canopy cover is variable and ranges from 50 to 80%. The western portion of the site contained surface water throughout the breeding season.

We detected no willow flycatchers. We surveyed the site five times, totaling 5.1 observer-hours. Cowbirds were detected on two visits.

PLANET RANCH ROAD

Area: 3.3 ha Elevation: 170 m

This mixed-native site follows the Bill Williams River at the southern edge of the riparian area. The vegetation immediately adjacent to the river is dominated by Goodding willow and cottonwood up to 15 m in height. Both riverbanks are steep, and vegetation on top of the banks more than a few meters from the water is dominated by arrowweed and tamarisk 4–5 m in height. Canopy closure within the site is highly variable, ranging from <50% on the dry banks to 90% within dense willow and cottonwood stands. The river had surface water throughout the survey season and was impounded in multiple locations by beaver dams.

We detected three breeding willow flycatchers and two individuals for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 12.0 observer-hours. We detected cowbirds on four surveys.

NEW RIVER

Area: 0.6 ha Elevation: 180 m

We first visited this site in 2008, at which time the vegetation appeared too young and sparse to support willow flycatchers, and determined that the site should be reevaluated in future years. The site consists of narrow stringers of cottonwood and Goodding willow along both sides of a channel of the Bill Williams River. Some patches of vegetation reach 8 m in height, but average height is approximately 5 m. Vegetation closest to the water is typically 3–4 m in height with 90% canopy closure, while the cottonwoods and willows on the periphery of the site reach 8 m in height but only 25% canopy closure. Soils within and around the site are very sandy. The western portion of the site contained surface water within the river channel throughout the survey season. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.9 observer-hours. Cowbirds were detected on one survey.

GROUND RECONNAISSANCE AND OPPORTUNISTIC SURVEY RESULTS

Wispy Willow

This site is approximately 200 m downstream of Site #1 along the north bank of the Bill Williams River. The site consists of a patch of coyote willow approximately 60 x 30 m in size. Canopy height is 4–5 m, and stem diameter is generally ~ 3 cm. Canopy closure is 70–90%. Water from the channel extended under the willows during the site visit in May. The vegetation is not currently of sufficient size to resemble typical occupied willow flycatcher habitat along the LCR, but the site should be evaluated in future years. We surveyed the site three times, totaling 2.8 observer-hours. We detected one flycatcher on 27 May between Wispy Willow and Site #1.

Site #1, Site #2, and Site #11

These sites are scheduled for biennial surveys in 2012. We completed one opportunistic survey on 13 June at each site, as the field schedule allowed. All three sites are at the mouth of the Bill Williams River, along an arm of Lake Havasu that follows the river channel, and are vegetated by Goodding willow and cottonwood up to 20 m in height and an understory of tamarisk. Canopy closure is approximately 70%. No flycatchers were detected, but cowbirds were detected at all three sites. The survey totaled 1.8 observer-hours for the three sites combined.

Mineral Wash and Beaver Pond

These sites are scheduled for biennial surveys in 2012. We completed one opportunistic survey on 12 June at each site, as the field schedule allowed. Mineral Wash and Beaver Pond are adjacent sites, approximately 3 km upstream of Site #5, and follow channels of the Bill Williams River. Both sites contain mixed-native vegetation consisting of an overstory of Goodding willow and cottonwood up to 18 m in height and an understory of tamarisk averaging 5 m in height. Each site contained surface water within at least one river channel at the time of the survey. We detected no willow flycatchers but did detect cowbirds at both sites. The survey of Mineral Wash and Beaver Pond totaled 2.3 and 5.5 observer-hours, respectively.

Palo Verde Ecological Reserve, California

PVER PHASE 2

Area: 21.4 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of cottonwood, Goodding willow, and coyote willow, which reach heights of 10, 8, and 5 m, respectively. Height and density of the vegetation varies within and between cells of the site. Canopy closure is highly variable, ranging from <25 to 85%. The entire site has a ground covering of alfalfa (*Medicado sativa*). The site is flood irrigated and contained surface water in a portion of the site during one visit in June.

We detected three willow flycatchers on 16 May, six on 26 May, and two on 9 June. One of the flycatchers detected on 9 June was determined to be color-banded. The combination could not be confirmed with 100% confidence, but it was likely an individual originally banded in southern Nevada. We could not relocate the banded individual on subsequent visits to the site. We surveyed the site six times, totaling 16.5 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was recorded.

PVER PHASE 3

Area: 21.4 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow that reach heights of approximately 10, 5, and 4 m, respectively. Height and density of the vegetation varies within and between the cells of the site. Canopy closure is highly variable, ranging from 50 to 80%. The entire site has a ground covering of alfalfa. The site is flood irrigated and contained surface water in approximately one quarter of the site on visits in June and July.

We detected one willow flycatcher on 16 May and three on 26 May. We surveyed the site six times, totaling 14.5 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock was recorded.

Cibola, Arizona and California

CVCA PHASE 1

Area: 26.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. Each cell generally contains a single species and age class. The tallest cottonwoods and willows are around 12 m in height, and canopy closure in the densest areas is 85–90%. Coyote willow reaches 3–6 m in height. The site is flood irrigated and contained standing water in approximately 20% of the site during visits in May and July. The Colorado River is about 100 m from the northern edge of the site; the southern edge is adjacent to CVCA Phase 2; and the remaining two sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected six willow flycatchers on 23 May, three on 31 May, and three on 8 June. The site was surveyed six times, totaling 16.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA PHASE 2

Area: 25.5 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods and Goodding willow reach approximately 12 m, and canopy closure reaches 95% in the densest areas. Coyote willow reaches 3–6 m in height. The site is flood irrigated but did not contain standing water during any of our site description visits. The northern edge of the site is adjacent to CVCA Phase 1, and the remaining sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected 11 willow flycatchers on 23 May. The site was surveyed six times totaling 16.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA PHASE 3

Area: 38.4 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods reach approximately 10 m in height,

Goodding willows reach 7 m, and coyote willows reach 4 m. Canopy closure varies from 20 to 80%. The site is flood irrigated and contained surface water during a visit in June. The irrigation canal adjacent to the site held water during a visit in July. The site is surrounded by agricultural fields.

We detected 16 willow flycatchers on 24 May and 2 on 1 June. The site was surveyed five times, totaling 14.0 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

CIBOLA NATURE TRAIL

Area: 13.7 ha Elevation: 70 m

This habitat creation site consists of a mosaic of cottonwood, Goodding willow, and mesquite. Approximately half the site consists of scattered screwbean and honey mesquite (*Prosopis glandulosa*) up to 5 m in height with a thick understory of Emory baccharis (*Baccharis emoryii*). The northern half of the site contains an extensive stand of Goodding willow 8 m in height. The northern edge of the willow stand has canopy closure <25%, and many of the willow are dead. The southern half of the willow stand has canopy closure around 70%. The southwestern corner of the site has a small stand of cottonwoods, and stringers of cottonwoods up to 18 m in height occur throughout the site. The site is flood irrigated but did not contain surface water during any of our site description visits.

We detected one willow flycatcher on 1 June. The site was surveyed five times, totaling 6.0 observer-hours. Large numbers of cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA ISLAND

Area: 4.2 ha Elevation: 70 m

This mixed-native site is approximately 9.5 km southwest of Cibola Nature Trail. Dirt roads border the site to the north, east, and west. Open farm fields lie to the east and west, with irrigation channels alongside the roads. An irrigation canal empties into the northern end of the site, creating an open, marshy area down the center of the site. Between this marshy area and the western road, vegetation consists of an overstory of Goodding willow 10–12 m in height with an understory of tamarisk 5–7 m in height. Canopy closure within the willows is 80%. The eastern edge of the marsh is lined with a narrow strip of tamarisk 5–6 m in height with a few emergent Goodding willows on the marsh edge. Between the tamarisk strip and the eastern road, vegetation consists of honey mesquite and bushy arrowweed. The marsh was dry in mid-June and mid-July but had some surface water in early July. The irrigation canal running along the northern border of the site held water in mid-July. This site burned in a fire that started at the end of August.

No willow flycatchers were detected. The site was surveyed three times, totaling 2.3 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA SITE #2 AND CIBOLA SITE #1

Cibola Site #2: Area: 16.4 ha Elevation: 65 m

Cibola Site #1: Area: 7.7 ha Elevation: 65 m

These adjacent, mixed-exotic sites consist of a 200-m-wide strip of riparian vegetation between the channelized Colorado River to the west and a levee road to the east. Woody vegetation consists of a mix of tamarisk and arrowweed, 3–4 m in height, which is dry and scrubby on the eastern edge of the sites and becomes denser toward cattail marshes on the western edge of the sites. Emergent Goodding willow and

cottonwood are scattered along the eastern edge of the marshes. Overall canopy closure is less than 50%. The marshes contained surface water throughout the survey season.

We detected three willow flycatchers at Cibola Site #2 on 25 May and two on 14 June. No willow flycatchers were detected at Cibola Site #1. We surveyed each site five times, totaling 6.2 and 4.1 observer-hours for Cibola Site #2 and Cibola Site #1, respectively. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA LAKE EAST

Area: 4.5 ha Elevation: 64 m

This site borders the marsh on the eastern edge of Cibola Lake. Vegetation within the site consists primarily of tamarisk. Within 30 m of the marsh edge, tamarisk reaches 6–7 m in height and 90% canopy closure. As distance from the marsh increases, the height and density of the tamarisk decreases, and the tamarisk becomes mixed with arrowweed. Soil within the site was dry throughout the survey season.

We detected one willow flycatcher on 25 May and one on 20 June. The site was surveyed five times, totaling 5.0 observer-hours. Cowbirds were detected on four visits, and burros were heard on the periphery of the site.

WALKER LAKE

Area: 11.4 ha Elevation: 64 m

This mixed-exotic site is located along the northeastern edge of Walker Lake. The majority of the site consists of very dense tamarisk approximately 5 m in height with 90% canopy closure. The southeastern end of the site contains scattered emergent Goodding willow up to 20 m in height, as well as a couple of emergent cottonwoods. This portion of the site also contains a small opening with dead cattails and a small patch of half-dead coyote willow. Walker Lake contained standing water and saturated soil throughout the survey season, and the interior of the southern end of the site also contained surface water in both June and July.

We detected one willow flycatcher on 15 June. The site was visited three times, totaling 4.9 observer-hours. Cowbirds were detected on two surveys, and no evidence of livestock use was observed.

Imperial, Arizona and California

PARADISE

Area: 7.8 ha Elevation: 62 m

The center of this mixed-native site consists of stringers of cottonwood and Goodding willow 15–20 m in height. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. The cottonwoods and willows are separated from the Colorado River by a 50-m-wide strip of dense tamarisk. A marsh borders the western side of the southern third of the site. This marsh had been vegetated by cattails in previous years but now consists primarily of common reed (*Phragmites australis*). Canopy closure within the site is variable. Standing water was present within the marsh in May.

We detected three willow flycatchers on 18 May. The site was surveyed three times, totaling 3.3 observer-hours. Cowbirds were detected on every visit, and no evidence of livestock was noted.

HOGE RANCH

Area: 20.7 ha Elevation: 61 m

This mixed-exotic site borders the Colorado River and is dominated by tamarisk 4–6 m in height, with a few emergent cottonwood and Goodding willow (15 to 18 m in height) at the southern end of the site near the old ranch. Linear marshes with cattail, bulrush, and common reed occupy less than 20% of the interior of the site, and there are a few patches of coyote willow. Canopy closure is variable and reaches 70–90% in areas of dense, woody vegetation. The marshes in the interior of the site were inundated in June and July.

We detected eight willow flycatchers on 21 May and six on 2 June. The site was surveyed five times, totaling 5.9 observer-hours. Cowbirds were detected on every visit, and burros were heard near the site.

RATTLESNAKE

Area: 7.6 ha Elevation: 60 m

This mixed-exotic site is a patchwork of tamarisk 7 m in height with emergent Goodding willow up to 15 m in height and strips of dense coyote willow 6–8 m in height. Dense deadfall and debris within the coyote willows reduce the suitability of the area for willow flycatchers. Canopy closure is 70–90%. Extensive cattail marshes separate this site from the Colorado River. Standing water was present in the interior of the site in June.

We detected three willow flycatchers on 21 May and two on 2 June. The site was surveyed five times, totaling 6.4 observer-hours. Cowbirds were detected on all surveys, and burros were heard at the site.

MILEMARKER 65

Area: 10.0 ha Elevation: 58 m

The site is a narrow strip of mixed-exotic vegetation between the Colorado River and a backwater marsh. Vegetation at the site consists primarily of dense tamarisk 6 m in height. Dense common reed, approximately 3 m in height, also occurs throughout the site and together with the tamarisk creates almost complete canopy closure. Because of the impenetrable vegetation at the site, we surveyed it from the river, and hydrologic conditions in the interior of the site during the surveys are unknown.

We detected one willow flycatcher on 18 May. We surveyed the site twice for a total of 0.9 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

NURSERY NW

Area: 7.0 ha Elevation: 58 m

This mixed-exotic site lies between the Colorado River and a cattail marsh. The dominant vegetation is tamarisk approximately 5 m in height with an understory of common reed. Mesquite trees are scattered along the western edge of the site. The eastern edge of the site, adjacent to the cattail marsh, has a stand of Goodding willow 9 m in height. Overall canopy closure is around 70%, and the densest portions of the site have canopy closure >90%. Surface water was present in marsh and the eastern edge of the site throughout the survey season.

We detected four willow flycatchers on 22 May and two on 5 June. The site was surveyed five times, totaling 6.9 observer-hours. Cowbirds were detected on four visits, and there was no evidence of livestock use.

FERGUSON LAKE

Area: 21.1 ha Elevation: 57 m

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with scattered, emergent Goodding willow 10 m in height along the western edge of the site bordering Ferguson Lake. Tamarisk 5–6 m in height is the dominant understory species, and it forms a continuous canopy in portions of the site. The site also contains patches of arrowweed with scattered screwbean mesquite and little canopy cover. The western edge of the site up to 50 m from the lakeshore had standing water in June and July.

We detected two willow flycatchers on 19 May. The site was surveyed three times, totaling 7.4 observer-hours. Cowbirds were detected on all visits, and no signs of livestock use were observed.

GREAT BLUE HERON

Area: 7.1 ha Elevation: 58 m

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willow forms an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. Portions of the site contain thickets of willow deadfall. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. Soils within the site were dry throughout the survey season.

We detected three willow flycatchers on 17 May, nine on 20 May, four on 3 June, and five on 5 June. The site was surveyed five times, totaling 15.9 observer-hours. Cowbirds were detected on all visits, and burros were detected on the periphery of the site.

POWERLINE

Area: 1.0 ha Elevation: 58 m

This mixed-native site consists of a strip of Goodding willow and cottonwood along the border of a cattail marsh. Overstory height is approximately 12 m and canopy closure is approximately 50%. Tamarisk and arrowweed are present in the understory, and honey mesquite is mixed with the tamarisk on the upland edge of the site. Surface water was present in the marsh and in the southern portion of the site in May and June.

We detected two willow flycatchers on 17 May and one on 3 June. We surveyed the site five times, totaling 4.2 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were noted within the site.

MARTINEZ LAKE

Area: 4.6 ha Elevation: 58 m

This mixed-native site borders the eastern shore of Martinez Lake. The eastern edge of the site, adjacent to the upland, is dominated by arrowweed with scattered Goodding willow, cottonwood, and tamarisk. Goodding willow <10 m in height and cottonwood up to 15 m in height are more prevalent on the western edge of the site, adjacent to cattails and common reed along the lakeshore. Canopy closure is highly variable. The western edge of the site contained saturated soil in May and surface water in June.

We detected two willow flycatchers on 3 June. We surveyed the site five times, totaling 8.8 observer-hours. Cowbirds were detected on all visits, and burros were heard on the periphery of the site.

Mittry Lake, California

MITTRY WEST

Area: 4.4 ha Elevation: 48 m

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Deadfall is common throughout the site, and canopy closure varies from 30 to 70%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. A clump of coyote willow 6 m in height and 50 m in diameter is present in the northeastern corner of the site. Surface water was extensive in the site in May with a few puddles remaining in June.

We detected three willow flycatchers on 17 May. The site was visited three times, totaling 4.3 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

GROUND RECONNAISSANCE RESULTS

Laguna

Laguna encompasses 449 ha between Imperial and Laguna Dams, on the east side of the Laguna dredge discharge area. This area will be included in future riparian restoration efforts, and we evaluated the existing habitat to determine whether it is suitable for willow flycatchers. Vegetation at the site consists primarily of tamarisk < 4 m in height, arrowweed, and quail bush (*Atriplex lentiformis*). A small cattail marsh is present on the eastern edge of the site; surrounding vegetation consists of tamarisk, arrowweed, and a few 5-m-tall Goodding willow. A patch of Goodding willow 7 m in height with an understory of common reed and tamarisk is present along an old backwater channel in the north-central part of the site, but soils in this area were completely dry during the site visit on 6 June. Overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat, and surface water was present only in one small area. Soils in most of the site were complete dry. We visited the site once, for a total of 8.0 observer-hours. No willow flycatchers were detected. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

Yuma, Arizona

GILA RIVER SITE #2

Area: 2.9 ha Elevation: 45 m

The center of this mixed-native site consists of an overstory of cottonwood up to 15 m in height and Goodding willow approximately 8 m in height, with an understory of arrowweed. Canopy closure in the center of the site is approximately 50%, and there is deadfall in the understory. The remainder of the site is vegetated by tamarisk 4 m in height and arrowweed, with canopy closure <50%. The site is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. There was no standing water within the vegetation during the survey season, but the northwestern edge of the site borders a marsh, which held water throughout the season.

We detected seven willow flycatchers on 4 June. The site was surveyed four times, totaling 5.3 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

FORTUNA SITE #1

Area: 3.2 ha Elevation: 45 m

This mixed-native site consists of a narrow strip of cottonwood and Goodding willow up to 15 m in height with 50–70% canopy closure. Tamarisk and arrowweed form a patchy understory on the periphery of the site. Within the densest cottonwood/willow areas, there is little understory but many downed branches. The site is bordered to the north by agricultural fields and to the south by a cattail marsh and the Gila River. The interior of the site was dry in June and July, but the adjoining marsh contained surface water.

We detected 15 willow flycatchers on 4 June. We surveyed the site four times, totaling 6.1 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

FORTUNA NORTH

Area: 3.8 ha Elevation: 46 m

This site is vegetated primarily by mature tamarisk approximately 7 m in height. Goodding willow and mesquite, also 7 m in height, are scattered throughout the site but make up less than 10% of the vegetation. Canopy closure is approximately 80% in the densest areas. The Gila River runs along the western edge and through the northwestern corner of the site. No surface water was noted within the woody vegetation during the survey season, but the river contained water.

We detected six willow flycatchers on 4 June and one on 5 June. We surveyed the site four times, totaling 9.5 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

NDOW Study Areas

Field personnel spent 1.0 observer-hour completing broadcast surveys for willow flycatchers at 3 of 19 sites at Key Pittman WMA, River Ranch, and Warm Springs Natural Area. The remaining 17 sites were occupied by resident flycatchers from the beginning of the season and were monitored but not surveyed. Willow flycatcher survey and monitoring results are summarized in Table 2.7 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2011 are shown on orthophotos in Appendix B.

In addition to willow flycatcher surveys, field personnel spent 9.0 observer-hours completing broadcast surveys for Yellow-billed Cuckoo at both Key Pittman and River Ranch. The results of cuckoo surveys are summarized below.

Table 2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
KEPI	Patch 0	0.04	2 (6 Jun–8 Aug)
	Patch 1	0.1	2 (29 May–4 Aug)
	Patch 2	0.1	2 (18 May–8 Aug)
	Patch 3	0.1	1 (16 May–27 Jul)[6], 1 (31 Jul)
	Patch 4	0.1	2 (25 May–31 Jul), 3 (27 Jul)[6,7]
	Patch 4.5	0.02	ND

Table 2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
KEPI	Patch 5	0.1	2 (21 May–11 Aug)
	Patch 6	0.2	2 (16 May–6 Jul), 3 (18 Jun–31 Jul), 1 (12 Jul)[8]
	Patch 7	0.1	2 (16 May–11 Aug)
	Patch 8	0.1	2 (1 Jun–4 Aug)
	Patch 9	0.3	2 (16 May–31 Jul), 2 (18 Jun–2 Aug)
	Patch 10	0.1	3 (16 May–8 Aug)
	Patch 10.5	0.02	1 (26 Jun)[9], 1 (24 Jul)[7]
	Patch 11	0.1	4 (6 Jun – 11 Aug), 1 (30 Jun)[8]
	Patch 12	0.1	3 (21 May–14 Aug), 1 (30 Jun), 2 (27 Jul)[9]
	Fence[10]		1 (29 May)
RIRA	West Side	0.3	2 (15 Jun–3 Jul), 1 (23 Jun–13 Jul), 1 (19 Jun), 1 (23–27 Jul)
	East Side	0.4	2 (15 Jun–27 Jul)
	Smalls	0.5	1 (15 Jun–16 Jul), 1 (27–29 Jun)
WMSP	Muddy Mac	0.7	2 (15 May–28 Jul), 3 (26 May)

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Flycatchers in territories that were occupied throughout the breeding season are shown as being present throughout the season. Flycatchers detected on a single occasion or for a short period of time are listed separately.

[5] We detected several within-season movements between study areas in 2011. See Table 3.9 for details.

[6] One individual detected 16 May–27 Jul in Patch 3 and recaptured 27 Jul in Patch 4.

[7] One individual detected 26 Jun in Patch 10.5 and recaptured 27 Jul in Patch 4

[8] This individual detected 30 Jun in Patch 11 and12 Jul in Patch 6.

[9] One individual recaptured 26 Jun in Patch 10.5 and 27 Jul in Patch 12.

[10] Not an official survey site. Incidental detections recorded.

Key Pittman Wildlife Management Area, Nevada

PATCHES 0–12

Area: 1.4 ha Elevation: 1,169 m

This study area is divided into 15 small stands of coyote willow. These stands form a strip of habitat between bulrush marsh on the edge of Nesbitt Lake to the east and dry upland scrub dominated by saltbush and grasses to the west. Most of the stands are independent of each other, but four stands (Patches 6–9) have grown together, forming a larger contiguous stand. Each stand is characterized by very dense, large-diameter stems of coyote willow. Some areas have fallen or leaning stems with wispy growth in the lower 2 m, making traversing those areas difficult. Canopy height ranges from 4 to 8 m with the taller stems occurring in the center of each site, giving each stand a rounded look. Canopy closure is 70–90%. Surface water was present along the eastern edge in May and June, though no more than 10% of the area within the sites was inundated, with an additional 5% saturated. Soils were damp in July with no saturated soil or standing water.

We located 33 breeding willow flycatchers across 13 of the 15 sites. We detected one resident, unpaired male and an additional seven individuals for which we could not determine residency. An additional individual of undetermined residency was detected on a fence adjacent to the sites. Only the unoccupied site, Patch 4.5, was surveyed, totaling 0.3 observer-hours. Cowbirds were detected during one survey but were noted throughout the season during nest monitoring activities. Signs of cattle were present in the dry upland scrub, but the sites have been fenced off to prevent damage. Deer were present within the sites, but do not appear to heavily impact the vegetation structure.

YELLOW-BILLED CUCKOO SURVEYS

We completed four surveys for Yellow-billed Cuckoo at Key Pittman, totaling 6.5 observer-hours. The first survey included Patches 0–4.5 as well as the cottonwood stand at the southern end of Nesbitt Lake. The final three surveys covered the cottonwood stand and Patches 0–12. No Yellow-billed Cuckoos were detected.

River Ranch

River Ranch is in the Pahranagat Valley, approximately 12 km south of Key Pittman, and consists of several isolated patches of vegetation. Each patch is surrounded on all sides by grazed, irrigated cattle pasture, and the perimeter of each site has a distinct browse line at 1.5 m in height.

WEST SIDE

Area: 0.3 ha Elevation: 1,100 m

This site is composed primarily of dense, large-diameter coyote willow 7 m in height. Shorter coyote willow approximately 4 m in height is present around the perimeter, giving the site a rounded look. A gap 3 to 5 m wide runs diagonally through the site from the northwestern to the southeastern corner. Some Russian olive is scattered along the perimeter of this gap. There is little to no understory, except where willows are regenerating and in the gap, where grasses and other herbaceous plants dominate. Canopy closure is 90% throughout most of the site, except in the gap where it varies from 0 to 30%. Areas of deadfall up to 1 m deep are scattered throughout the site, making travel difficult in places. Water levels fluctuated throughout the season depending on irrigation activity. Maximum water extent included flowing, 10-cm-deep water covering approximately 50% of the site, saturated soils covering an additional 30%, and 20% with damp soils. Minimum water extent included damp soils throughout the site. Water tended to pool in a ditch approximately 1 m wide and 0.2 m deep surrounding the site.

We detected two breeding flycatchers and one male for which breeding status could not be confirmed. We also detected an additional two individuals for which residency could not be determined. Due to flycatcher occupancy, this site was surveyed only once, totaling 0.4 observer-hours. No cowbirds were detected during the survey, but they were noted intermittently throughout the breeding season in low numbers. Signs of cattle were present in and surrounding the site, but the cattle do not appear to use the interior of the site extensively.

EAST SIDE

Area: 0.4 ha Elevation: 1,100 m

This site is composed primarily of dense, large-diameter coyote willow 6 to 7 m in height. Tree height is shorter at the perimeter, giving the site a rounded appearance. Russian olive and velvet ash (*Fraxinus velutina*) occur in low numbers. There are numerous piles of deadfall scattered throughout the site. Little to no understory is present, except where the willow is able to regenerate and also in some small clearings

where herbaceous vegetation dominates. Canopy closure is primarily 70–80%, except in a few scattered clearings where it ranges from 0 to 25%. Water levels fluctuated throughout the season depending on irrigation activity. Maximum water extent included damp to almost saturated soils throughout and a ditch of water 1 m wide and 0.2 m deep surrounding the site. Minimum water extent included dry soils throughout the site.

We detected two breeding flycatchers. Due to flycatcher occupancy, no formal surveys were conducted. Brown-headed cowbirds were noted intermittently throughout the breeding season in low numbers. Signs of cattle were present throughout and surrounding the site, with cattle trails throughout the interior of the site.

SMALLS

Area: 0.5 ha Elevation: 1,100 m

This site is composed primarily of coyote willow 5 m tall. There is little understory except sparse, regenerating willow in the densely vegetated areas. A large gap in the vegetation, totaling approximately 25% of the site, dominates the northern half of the site. This gap is ringed by a stand of shorter coyote willow approximately 4 m in height and 4 m wide on the western, northern, and eastern sides. Canopy closure averages 80-85% in the vegetated areas. Deadfall is scattered throughout the site but typically does not occur in piles as it does in West Side and East Side. Water levels were variable throughout the season depending on irrigation activity. Maximum water extent included a pool of water at the northern end of the site and saturated soils throughout the remainder of the site. Minimum water extent included completely dry soils throughout the site.

We detected one male for which breeding status could not be confirmed and an additional individual for which we could not determine residency. Due to flycatcher occupancy, this site was surveyed only once, totaling 0.4 observer-hours. No cowbirds were detected during the survey, though they were noted at other times during the breeding season. Signs of heavy cattle use were present throughout the site.

YELLOW-BILLED CUCKOO SURVEYS

We completed three surveys for Yellow-billed Cuckoo at River Ranch, totaling 2.5 observer-hours. All suitable habitat was covered in each survey. No Yellow-billed Cuckoos were detected.

Warm Springs Natural Area

On 1 July 2010, a wildfire burned at least part of all the survey sites at Warm Springs. At the beginning of the breeding season of 2011, ground reconnaissance was conducted at all sites to assess the extent of the damage and suitability of habitat for flycatchers. The degree of damage varied from site to site and ranged from almost complete consumption of all vegetation to consumption of the understory with overstory structure intact but the canopy reduced by 80–90%. Regeneration of woody vegetation was noted at all sites, but vegetation was generally sparse and less than 2 m in height. One site was partially damaged in the fire with the remainder largely undamaged. Due to the degree of fire damage, surveys were discontinued at all sites except for the one partially damaged site.

MUDDY MAC

Area: 0.7 ha Elevation: 548 m

This native site is near the head of Apcar Stream. The northern portion of the site was heavily damaged in the 2010 fire, with the overstory being completely killed. Dense basal regeneration of velvet ash is occurring, but live vegetation is only 2 m in height. The southern half of the site is characterized by a

very dense velvet ash stand 8–9 m in height with no understory and ≥80% canopy closure. The extreme southern end of this site was also damaged in the 2010 fire with most of the trees consumed and only grass growing under the snags. Surface water was present throughout the survey season in the form of a flowing stream near the southern edge of the site. Soils were saturated in May with some standing water, but by June interior soils were completely dry.

We detected two breeding flycatchers and three individuals for which residency could not be determined. Due to flycatcher occupancy, this site was not formally surveyed. A cowbird was detected during one nest monitoring visit. No evidence of livestock was observed.

YELLOW-BILLED CUCKOO SURVEYS

No Yellow-billed Cuckoo surveys were conducted at Warm Springs in 2011 due to lack of suitable habitat.

DISCUSSION

The six Reclamation study areas occupied in 2011 by breeding flycatchers (Pahranagat NWR, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams River NWR) consistently held resident and breeding flycatchers in previous years (McKernan and Braden 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; details of residency and breeding in 2011 are presented in Chapters 3 and 4 of this document). In 2009 and 2010, breeding flycatchers were recorded along Beaver Dam Wash at Littlefield (Littlefield Poles) for the first time since 2004. Vegetation at Littlefield Poles was scoured during floods in December 2010, and the hydrology was altered so that no surface water was present at the site during visits in May and June. Surveys were discontinued at the site after the visit in June because of these changes. No flycatchers were recorded at the site in 2011.

A single pair of breeding flycatchers was detected at a new site in 2011. Along the Bill Williams River, breeding flycatchers were detected at Cougar Point, which had not previously been surveyed. The site consists of young, even-aged vegetation that likely only recently reached sufficient size to be suitable flycatcher breeding habitat.

Hydrologic conditions at Mesquite West in May and early June 2011 were similar to those observed in all prior years except 2009. In 2009, the site was largely dry, and premature leaf abscission was observed as early as May. In 2011, the site was wet through the beginning of the breeding season In mid-June, earthwork at the inflow to the site diverted water along the edge of the site and into the Virgin River. Although the site became dry, the canopy remained largely intact with only a minor amount of leaf abscission detected in August. Despite the presence of wet conditions in early 2011, the number of resident flycatchers (11) detected at Mesquite West in 2011 was lower than the numbers detected in previous years (25, 25, 24, 20, and 16 in 2006 through 2010, respectively). The decline in flycatcher numbers between 2009 and 2010 was likely influenced by poor nest success and poor habitat conditions in 2009 (McLeod and Pellegrini 2011). Reasons for the continued decline remain undetermined, but habitat suitability in the western portion of Mesquite West, which was not occupied in 2011, may be influenced by the defoliation of tamarisk.

Marsh elevations at Topock were lower than in any year since 2005. The number of resident adults detected at Topock continued to decline, with 5 resident adults detected in 2011, versus 36, 29, 18, 20, 14, and 11 detected in each year in 2005 through 2010, respectively. Changes over the years in the timing and magnitude of fluctuations in marsh levels may have contributed to the decline in the Topock flycatcher population (see Chapter 8). We continued our efforts to locate all potentially suitable willow

flycatcher habitat at Topock Marsh. We revisited two sites that were visited briefly in 2010; one site was surveyed regularly, and visits to the other site were discontinued because of lack of suitable habitat.

Tamarisk beetles were present at both Mesquite and Mormon Mesa in 2011. Extensive defoliation was noted in the vicinity of the Mesquite sites in June, but the areas currently occupied by willow flycatchers are primarily native, and defoliation did not have any noticeable effect on breeding. Defoliation was noted in the Mormon Mesa study area at all sites starting in July, with extensive defoliation noted by late July. Roughly half of the nests in Mormon Mesa are located in primarily native stands. The remaining nests are located in either mixed stands with a primarily native canopy, or in primarily non-native vegetation. Defoliation from tamarisk beetle activity therefore potentially affected only some of the nest stands at Mormon Mesa. In addition, the majority of flycatcher nesting attempts had either fledged or failed by the time defoliation became widespread, and there was no evidence that flycatcher nesting was affected by defoliation. Defoliation will presumably occur earlier in the year in 2012 at the Mormon Mesa sites now that tamarisk beetles are established in the area and thus may have greater effects on flycatcher nesting next year. Tamarisk beetles were noted as far downstream on the Virgin River as Lake Mead by the end of August, and defoliation was also observed on the Muddy River as far downstream as Overton and as far upstream as Warm Springs. The Muddy River study area may be affected by tamarisk beetles in 2012.

Although 154 flycatcher detections were recorded at sites surveyed south of the Bill Williams, monitoring results and behavioral observations (lack of territorial, aggressive behaviors exhibited toward conspecific broadcasts) at these sites suggest these flycatchers were not resident or breeding individuals but migrants. These results are consistent with those recorded in 2003–2010 (McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Banding studies in the Yuma area completed in 2003–2007 also suggested that willow flycatchers detected in mid-June were migrants (McLeod et al. 2008a). Migrant willow flycatchers along the lower Colorado River could belong to one of several subspecies (*E. t. extimus*, *E. t. adastus*, or *E. t. brewsteri*), and unless an individual is banded, it is impossible to determine in the field whether a migrant is *E. t. extimus* or one of the other two subspecies. A model based on plumage color variation predicted that approximately half of 96 willow flycatchers captured in the Yuma area in mid-June in 2004–2007 were *E. t. extimus* (Paxton et al. 2010), indicating that the southwestern subspecies does use the lower Colorado River as a migration corridor. In addition, two flycatchers banded at breeding sites monitored as part of the lower Colorado River study have been detected at sites south of the Bill Williams. Both individuals were detected for only one day and did not exhibit territorial behavior, suggesting they were migrants. The first individual was detected along the Gila River in Yuma in May 2005. It was identified by the presence of a single anodized federal band as having been banded as a nestling at one of the Reclamation study areas in either 2003 or 2004. In June 2011, a fully banded flycatcher was detected in PVER 2, one of the Reclamation habitat creation sites along the LCR. While the identity of the individual could not be confirmed by repeated observations, it was very likely banded in southern Nevada. This is the first confirmed sighting of a Southwestern Willow Flycatcher in one of the habitat creation sites south of the Bill Williams. Although the bird was likely a migrant, this detection demonstrates the importance of the habitat creation sites as stopover habitat for migrating Southwestern Willow Flycatchers. Flycatchers from breeding areas along the lower Colorado River and its tributaries may also provide a potential source population for the colonization of habitat creation sites (see Discussion in Chapter 3).

Chapter 3

COLOR-BANDING AND RESIGHTING

INTRODUCTION

Long-term monitoring of willow flycatchers of known identity, sex, and age is the only effective way to determine demographic life history parameters such as annual survivorship of adults and young, site fidelity, seasonal and between-year movements, and population structure. Thus, as an integral part of our studies, we captured and uniquely color-banded as many willow flycatchers as possible, allowing field personnel to resight individuals throughout the breeding season, as well as in subsequent years. Resighting consisted of using binoculars to determine the identity of a color-banded flycatcher by observing, from a distance, the unique color combination on its legs. This allowed field personnel to detect and monitor individuals without recapturing each bird. This was our ninth consecutive year of color-banding studies and builds upon color-banding initiated at these sites in 1997 (McKernan and Braden 1998).

METHODS

Color-Banding

From early May through mid-August, we captured, uniquely color-banded, and subsequently monitored adult and nestling willow flycatchers at all study areas where resident willow flycatchers were detected. The color-banding effort also included Key Pittman Wildlife Management Area, River Ranch, and Warm Springs Natural Area in Nevada (in cooperation with Nevada Department of Wildlife) and opportunistic banding in St. George, Utah (in cooperation with Utah Division of Wildlife Resources).

Adult flycatchers were captured with mist-nets, which provide the most effective technique for live-capture of adult songbirds (Ralph et al. 1993). We used a targeted capture technique (per Sogge et al. 2001), whereby a variety of conspecific vocalizations were broadcast from a CD player and remote speakers to lure territorial flycatchers into the nets. In addition, we used "passive netting," whereby several mist-nets were erected and periodically checked, with no broadcast of conspecific vocalizations. We banded each adult willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and a colored metal band on the other. We coordinated all color combinations with the Federal Bird Banding Laboratory and all other Southwestern Willow Flycatcher banding projects to minimize duplication of color combinations. For each color-banded bird recaptured, we visually inspected the legs and noted any evidence of irritation or injury that may be related to the presence of leg bands.

Nestlings were banded at 8 to 10 days of age, when they were large enough to retain the leg bands, yet young enough that they would not prematurely fledge from the nest (Whitfield 1990, Paxton et al. 1997). Nestlings were banded only when the location of the nest was such that nest access and removal/replacement of the nestlings would not endanger the nest, nest plant, or nestlings. Nestlings were also banded with a single, numbered federal band on one leg and a metal color-band on the other leg. Prior to 2008, we banded each nestling only with a single federal band, identifying it as a returning nestling in the event it returned in a subsequent year.

For each captured adult willow flycatcher, we recorded morphological measurements, including culmen, tail, wing, fat level, and molt onto standardized data forms (Appendix A). Sex was determined based on the presence of a cloacal protuberance in males or brood patch and/or egg(s) in the oviduct for females. Captured flycatchers lacking breeding characteristics and not observed engaging in male advertising song (see below) were sexed as unknown. Flycatchers with retained primary, secondary, and/or primary covert feathers (multiple aged remiges) were aged as second year adults, and those without (uniformly aged remiges) were aged as after second year (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). Individuals in juvenile plumage (unworn flight feathers and body plumage with broad, buff-colored wing bars and fleshy gape) were aged as hatch year.

Resighting

We determined the identity of a color-banded flycatcher by observing with binoculars, from a distance, the unique color combination on its legs. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed. Field personnel typically spent the early part of each morning color-banding, and directed their efforts to resighting as daylight increased and flycatchers became more difficult to capture. All banding, monitoring, and survey field personnel coordinated resighting efforts and recorded observations of color-banded and unbanded flycatchers onto standardized data forms (Appendix A). For resighted flycatchers (i.e., ones for which at least one leg was seen clearly enough to determine the presence or absence of a band), we recorded color-band combinations, territory number, site, standardized confidence levels of the resight, and behavioral observations. Willow flycatchers for which detections spanned one week or longer were considered resident at a site, regardless of the portion of the breeding season in which the bird was observed or whether a possible mate was observed. Flycatchers observed engaging in breeding behaviors (e.g., carrying nest material) were also considered resident regardless of the period of time over which they were observed. Flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male, and flycatchers observed carrying nest material or constructing or incubating a nest were sexed as female. Flycatchers not observed engaging in one of these diagnostic activities were sexed as unknown.

Inactive territories were visited at least three times (each visit four days apart) before territory visits stopped. All territories were assigned a unique alphanumeric code and were plotted onto high-resolution aerial photographs, thus producing a spatial representation of the flycatcher population at each study location. If multiple females were paired with a single male, each female received a unique territory number. Flycatchers were determined to be unpaired if none of the following breeding behaviors were observed: presence of another unchallenged flycatcher in the immediate vicinity, counter calling (*whitts*) with a nearby flycatcher, interaction twitter calls (*churr/kitters*) with a nearby flycatcher, a flycatcher in the immediate vicinity carrying nesting material, a flycatcher in the immediate vicinity carrying food or fecal sac, or adult flycatchers feeding young (per Sogge et al. 1997).

Unbanded flycatchers could not be identified to individual, but an unbanded flycatcher detected in a given location on multiple, consecutive visits was assumed to be the same individual. If an unbanded flycatcher or a flycatcher whose legs were not observed was detected at a given location on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered to be different individuals in the absence of behavioral observations indicating the flycatcher was actively defending a territory or was a member of a breeding pair.

RESULTS

Reclamation Study Areas

Color-Banding and Resighting – Field personnel color-banded 15 new adult flycatchers and recaptured 11 individuals previously captured as adults. An additional 31 adults were identified to individual via resighting, while 3 individuals were resighted but did not have their color combinations confirmed. Of the 31 adults that were resighted and identified, one was identified for the first time since it was banded as a nestling. We identified two additional individuals as returning nestlings by the presence of a single federal band, with one (50%) identified to individual via recapture. We recaptured two additional returning nestlings with full color combinations. Thirty adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 30 adults. Overall, 52% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.1). We banded 40 nestlings from 17 nests. Of the 40 nestlings banded, 5 were known or suspected to have died before fledging. We resighted an additional 10 unbanded fledglings from six nests; one fledgling was captured and banded. For details on all banded flycatchers detected at the study areas from 2003 to 2011, see Appendix E.

Site-by-Site Color-Banding and Resighting

Pahranagat – We detected 14 resident, adult willow flycatchers from 10 territories at Pahranagat. In addition to resident adults, we detected seven individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Of the 10 territories recorded at Pahranagat, 6 consisted of breeding pairs, and 4 consisted of unpaired males. Of the breeding individuals, one male was polygynous with three females. One resident female moved from her territory in Pahranagat North and was resighted at Pahranagat West along with three banded fledges.

Field personnel captured and color-banded four new adults and recaptured three flycatchers previously captured as adults. We resighted and identified an additional 10 adults. Three adults remained unbanded. Of the resighted adults, one was originally banded as a nestling in 2010 (see Table 3.8 for juvenile dispersal data). The color combination could not be determined for one adult. We banded 11 nestlings from four nests. We resighted seven unbanded fledglings from three additional nests; one fledgling was captured and banded.

Mesquite – We detected 14 resident, adult willow flycatchers from eight territories at Mesquite. Of the eight territories recorded at Mesquite, seven consisted of paired individuals and one consisted of an unpaired male (Table 3.2). Of the breeding individuals, two males were each polygynous with two females. The male at one territory was displaced by another male that moved from Muddy River (Table 3.9).

Field personnel captured and color-banded three new adults and confirmed the identities of an additional six adults via resighting. Three adults remained unbanded, and band status could not be determined for two adults. We banded five nestlings from two nests.

Mormon Mesa – We detected 23 resident, adult willow flycatchers from 14 territories at Mormon Mesa. In addition to resident adults, we detected three individuals for which residency could not be confirmed (Table 3.2). Of the 14 territories recorded at Mormon Mesa, 13 consisted of breeding individuals and 1 consisted of an unpaired male. One breeding male moved from Muddy River, and one male for which residency could not be confirmed moved from Mesquite West (Table 3.9). One female mated

consecutively with two males and four males were polygynous, one with three females and three with two females.

Field personnel captured and color-banded one new adult and recaptured five flycatchers previously captured as adults. We resighted and identified nine additional adults. We captured one returning nestling originally banded as a juvenile in 2007 (see Table 3.8) and resighted one returning nestling with a single federal band that we were unable to recapture. Eight adults remained unbanded, and band combination could not be confirmed for one adult. We banded 16 nestlings, two of which were suspected to have died before fledging, from seven nests and resighted three unbanded fledglings from three nests.

Muddy River – We detected 13 resident, adult willow flycatchers from eight territories at Muddy River. In addition to resident adults, we detected three individuals for which residency could not be confirmed. Of the eight territories recorded, five consisted of breeding pairs and three consisted of unpaired males (Table 3.2). One breeding male moved to Mormon Mesa and one unpaired male moved to Mesquite (Table 3.9).

Field personnel captured and color-banded three new adults and recaptured two flycatchers previously captured as adults. We recaptured two returning nestlings; one was originally banded in 2009 and the other in 2010 (see Table 3.8). We resighted and identified four other adults. Four adults remained unbanded, and band status could not be confirmed for one adult. We banded four nestlings from two nests; three of these nestlings died before fledging.

Topock – We detected five resident, adult willow flycatchers from five territories at Topock. In addition to resident adults, we detected 28 individuals for which residency could not be confirmed (Table 3.2). Of the five territories recorded at Topock, one consisted of a breeding pair and four consisted of unpaired males. One of the unpaired males established a territory at Platform and then moved to The Wallows and established a second territory.

Field personnel captured and color-banded two new adults and recaptured one flycatcher originally captured as an adult. We resighted and identified one other banded adult. Nine adults remained unbanded, and the band status of 19 individuals could not be determined. The color combination of one banded adult could not be confirmed.

Bill Williams – We detected eight resident willow flycatchers from five territories at Bill Williams. In addition to resident adults, we detected nine individuals for which residency could not be determined (Table 3.2). Of the five territories recorded at Bill Williams, four consisted of breeding individuals and one consisted of an unpaired male. One male was polygynous with two females. At one breeding territory, personnel from an unrelated field crew reported a singing male, but only the female was detected during nest monitoring visits.

Field personnel captured and color-banded two new adults. We resighted and identified four returning banded adults. Three adults remained unbanded, and band status could not be determined for eight adults. We banded four nestlings from two nests.

Table 3.1. Willow Flycatchers Detected at Reclamation Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Detected in Previous Year(s) as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Pahranagat	North	21	4	3	0	10	0	3	0	1	11(4)	1	86
	West	1[1]	0	0	0	1[1]	0	0	0	0	0	3[2]	100
	Study Area Total	**21**	**4**	**3**	**0**	**10**	**0**	**3**	**0**	**1**	**11(4)**	**1**	**86**
Mesquite	Hafen Lane	3	2	0	0	1[3]	0	0	0	0	0	0	100
	West	11	1	0	0	5[4]	0	3	2	0	5(2)	0	55
	Study Area Total	**14**	**3**	**0**	**0**	**6**	**0**	**3**	**2**	**0**	**5(2)**	**0**	**64**
Mormon Mesa	Virgin River #1 (North)	5	0	0	0	1	0	3	0	1	0	0	40
	Virgin River #1 (South)	21	1	5[4]	1	8[5]	1[6]	5	0	0	16(7)[7]	0	76
	Study Area Total	**26**	**1**	**5**	**1**	**9**	**1**	**8**	**0**	**1**	**16(7)**	**0**	**69**
Muddy River	Overton Pond	1	0	0	0	0	0	1	0	0	0	0	0
	Overton WMA	15	3	2[3,5]	2	4	0	3	1	0	4(2)[8]	0	73
	Study Area Total	**16**	**3**	**2**	**2**	**4**	**0**	**4**	**1**	**0**	**4(2)**	**0**	**69**
Topock	Pipes #1	1	0	0	0	0	0	0	0	1	0	0	100
	Pipes #3	3	1	0	0	1[9]	0	0	1	0	0	0	67
	The Wallows	3	0	0	0	1[10]	0	2	0	0	0	0	33
	PC6-1	1	0	0	0	0	0	1	0	0	0	0	0
	In Between	1	0	0	0	0	0	0	1	0	0	0	0
	800M	3	0	1[9]	0	0	0	1	1	0	0	0	33
	Pierced Egg	4	0	0	0	0	0	0	4	0	0	0	0
	Swine Paradise	1	0	0	0	0	0	1	0	0	0	0	0
	Platform	1	0	0	0	1[10]	0	0	0	0	0	0	100
	Hell Bird	10	1	0	0	0	0	2	7	0	0	0	10
	Spaghetti	2	0	0	0	0	0	0	2	0	0	0	0
	Beal Lake	1	0	0	0	0	0	0	1	0	0	0	0
	Lost Lake	1	0	0	0	0	0	1	0	0	0	0	0
	Dock[11]	3	0	0	0	0	0	1	2	0	0	0	0
	Study Area Total	**33**	**2**	**1**	**0**	**1**	**0**	**9**	**19**	**1**	**0**	**0**	**15**
Bill Williams	Wispy Willow	1	0	0	0	0	0	0	1	0	0	0	0
	Burn Edge	1	0	0	0	0	0	0	1	0	0	0	0
	Site #4	3	0	0	0	0	0	2	1	0	0	0	0
	Site #3	3	0	0	0	2	0	0	1	0	1(1)	0	67
	Site #5	2	0	0	0	0	0	0	2	0	0	0	0
	Cougar Point	2	1	0	0	0	0	0	1	0	0	0	50
	Planet Ranch Rd	5	1	0	0	2	0	1	1	0	3(1)	0	60
	Study Area Total	**17**	**2**	**0**	**0**	**4**	**0**	**3**	**8**	**0**	**4(2)**	**0**	**35**
Total		**124**	**15**	**11**	**3**	**31**	**1**	**30**	**30**	**3**	**40(17)**	**1**	**52**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.2.

[1] One individual moved from North to West and is tallied only once in the total.

[2] Three HY individuals moved from North to West. These individuals were resighted, not captured, at West and are not tallied in the total.

[3] One individual moved from Muddy River Overton WMA to Mesquite Hafen Lane and is tallied only once in the total.

[4] One individual moved from Mesquite West to Mormon Mesa Virgin River #1 South and is tallied only once in the total.

[5] One individual moved from Muddy River Overton WMA to Mormon Mesa Virgin River #1 South and is tallied only once in the total.

[6] Returning nestling.

[7] Two nestlings suspected to have died before fledging.

[8] Three nestlings died before fledging.

[9] One individual moved from 800M to Pipes #3 and is tallied only once in the total.

[10] One individual moved from Platform to The Wallows and is tallied only once in the total.

[11] Not a formal survey site. Flycatchers detected en route.

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	26-Jun-09	2430-61087	OB(M):XX	N/A	A4Y	F	12	R 12 Jul
	North	24-Jun-08	2430-61176	DK(M):XX	N/A	4Y	M	12	R 19 Jun
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	26-Jun-11	2540-58111	TQ:RYR(M)	N/A	AHY	F	13	N
	North	19-Jul-08	2430-61080	YY(M):XX	N/A	5Y	M	13	RS
	North	8-Jul-11	2590-53104	XX:GVG(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53102	XX:RV(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53103	XX:BRB(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53101	XX:DOD(M)	N/A	L	U	13	N
	North	24-Jun-11	2540-58110	RKR(M):TQ	N/A	AHY	F	23,F84	N; detected 21 Jul at F84 in PAHR West
	North	25-Jun-08	2430-61179	XX:KB(M)	N/A	A5Y	M	23,43,128	RS
	North	2-Jul-11	2430-61215	WBW(M):XX	N/A	L	U	23	N
	North	2-Jul-11	2430-61218	XX:OYO(M)	N/A	L	U	23,F81	N; detected 21–25 Jul at F81 in PAHR West
	North	1-Jul-08	2430-61120	XX:KO(M)	N/A	4Y	F	31	R 12 Jul
	North	21-Jun-06	2370-40060	YG(M):PU	N/A	A7Y	M	31	RS
	North	20-Jul-11	2590-53109	XX:WKW(M)	N/A	HY	U	31	N
	North	N/A	N/A	UB:UB	N/A	HY	U	31	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	31	RS
	North	1-Jul-06	2370-40047	PU:DD(M)	N/A	A7Y	F	43	RS
	North	3-Jul-11	2430-61220	RGR(M):XX	N/A	L	U	43	N
	North	3-Jul-11	2540-58114	YDY(M):TQ	N/A	L	U	43	N
	North	18-Jul-10	2540-58293	BO(M):TQ	N/A	3Y	F	128	RS
	North	6-Jul-11	2540-58286	TQ:DYD(M)	N/A	L	U	128	N

AR064449

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	6-Jul-11	2540-58284	GW(M):TQ	N/A	L	U	128	N
	North	6-Jul-11	2540-58285	TQ:YG(M)	N/A	L	U	128	N
	North	24-Jul-08	2430-61083	XX:YR(M)	N/A	5Y	M	T21	RS; detected 18 May–28 Jul
	North	7-Jul-06	2360-59754	OR(M):EE	N/A	6Y	M	T41	RS; detected 28 May–9 Jun
	North	18-May-04	2320-31595	WKW(M):EE	N/A	A9Y	M	T48	RS; detected 24 May–1 Aug
	North	6-Jul-05	2360-59712	EE:GKG(M)	N/A	7Y	M	T64	RS; detected 28 May–19 Jul
	North	13-Jun-11	2540-58245	TQ:KYK(M)	N/A	SY	M	F73	N; detected 13 Jun
	North	N/A	N/A	UB:UB	N/A	AHY	U	F76	RS; detected 18 May
	North	21-Jul-10	2540-58201	TQ:BO(M)	N/A	SY	U	F77	RS; detected 12 Jul
	North	INA	INA	banded	N/A	AHY	M	F78	RS; detected 4 Aug
	North	N/A	N/A	UB:UB	N/A	AHY	M	F79	RS; detected 18 May
	West	INA	INA	banded	N/A	HY	U	F80	RS; detected 21–25 Jul, probably from 128
	West	N/A	N/A	UB:UB	N/A	HY	U	F82	RS; detected 21 Jul, probably from PAHR North
	North	N/A	N/A	UB:UB	N/A	AHY	U	F83	RS; detected 12 Jul
	North	17-Jun-11	2540-58109	WK(M):TQ	N/A	SY	M	F120	N; detected 17–19 Jun, detected 23 Jun–13 Jul at T109 in RIRA West Side
MESQ	West	N/A	N/A	UB:UB	N/A	AHY	F	30	RS
	West	15-Jul-05	2320-31688	EE:BG(M)	N/A	7Y	M	30	RS
	West	13-Aug-11	2590-53152	XX:OKO(M)	N/A	L	U	30	N
	West	13-Aug-11	2590-53154	XX:GRG(M)	N/A	L	U	30	N
	Hafen Lane	22-Jul-11	2540-58152	TQ:KWK(M)	N/A	AHY	F	32	N
	Hafen Lane	30-Jun-11	2540-58176	TQ:WG(M)	N/A	SY	M	32	N; detected 30 Jun–17 Jul
	Hafen Lane	19-Jun-09	2370-39930	PU:GO(M)	N/A	3Y	M	32	RS; detected 21–23 Jul, detected 17 May–17 Jul at T22 in MUDD Overton WMA
	West	INA	INA	undetermined	N/A	AHY	F	40	
	West	6-Jun-10	2540-58192	TQ:BG(M)	N/A	A3Y	M	40, 103	RS; captured 24 Jul at F20 in MOME Virgin River #1 South

AR064450

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	26-Jul-07	2370-40087	PU:BZ(M)	N/A	A6Y	F	72	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	72	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	80	RS
	West	16-Jun-09	2370-40175	PU:OKO(M)	N/A	3Y	M	80, 127	RS
	West	21-Jul-10	2430-61234	XX:WGW(M)	N/A	A3Y	F	103	RS
	West	1-Jul-11	2430-61216	OKO(M):XX	N/A	L	U	103	N
	West	1-Jul-11	2430-61217	XX:YVY(M)	N/A	L	U	103	N
	West	1-Jul-11	2540-58112	WW(M):TQ	N/A	L	U	103	N
	West	INA	INA	undetermined	N/A	AHY	F	127	
	West	14-Jun-11	2540-58172	TQ:VV(M)	N/A	AHY	M	T102	N
MOME	Virgin River #1 South	6-Aug-05	2360-59788	BO(M):EE	N/A	7Y	F	1	RS
	Virgin River #1 South	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A11Y	M	1, 91	RS
	Virgin River #1 South	15-Jun-11	2540-58174	TQ:WK(M)	N/A	L	U	1	N
	Virgin River #1 South	15-Jun-11	2540-58173	TQ:VW(M)	N/A	L	U	1	N, R 12 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	1	RS
	Virgin River #1 South	25-Jun-07	2360-59777	EE:YKY(M)	EE:UB	5Y	F	2	R 19 Jul
	Virgin River #1 South	4-Jul-01	none[9]	UB:GY(M)	UB:XX	11Y	M	2, 7, 90	R 20 Jun and 19 Jul
	Virgin River #1 South	22-Jul-11	2590-53116	YDY(M):XX	N/A	L	U	2	N
	Virgin River #1 South	22-Jul-11	2590-56115	RKR(M):XX	N/A	L	U	2	N
	Virgin River #1 South	22-Jul-11	2590-53117	YGY(M):XX	N/A	L	U	2	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	5	RS
	Virgin River #1 South	3-Jun-07	2370-40197	OG(M):PU	N/A	A6Y	M	5, 50	RS
	Virgin River #1 South	INA	INA	PU:UB	N/A	AHY	F	7	RS
	Virgin River #1 North	INA	INA	banded	N/A	AHY	F	19	RS
	Virgin River #1 North	19-Jun-08	none[10]	UB:KW(M)	XX:KW(M)	A5Y	M	19	RS
	Virgin River #1 South	29-Jun-10	2540-58231	TQ:GR(M)	N/A	3Y	F	50	RS
	Virgin River #1 South	2-Jul-11	2590-53141	RK(M):XX	N/A	L	U	50	N; suspected to have died

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	2-Jul-11	2590-53142	XX:BWB(M)	N/A	L	U	50	N; suspected to have died
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	65	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	M	65	RS
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	F	66	RS
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	M	66	RS
	Virgin River #1 South	2-Jun-06	2370-40037	PU:DR(M)	N/A	A7Y	F	70	R 19 Jul
	Virgin River #1 South	14-Jun-06	2370-40046	PU:DK(M)	N/A	7Y	M	70, 104	RS
	Virgin River #1 South	19-Jul-11	2370-39970	PU:RWR(M)	N/A	L	U	70	N
	Virgin River #1 South	19-Jul-11	2540-58213	KWK(M):TQ	N/A	L	U	70	N
	Virgin River #1 South	9-Jun-05	2370-39956	PU:YWY(M)	PU:ZZ(M)	8Y	F	90	R 24 and 25 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	90	RS
	Virgin River #1 South	16-Jul-04	2320-31632	RZ(M):EE	N/A	9Y	F	91	RS; mated consecutively with 2 males
	Virgin River #1 South	31-Jul-09	2540-58154	DO(M):TQ	N/A	3Y	M	91	RS; breeding through 17 Jul at 18 in MUDD Overton WMA
	Virgin River #1 South	3-Jul-11	2540-58113	WY(M):TQ	N/A	L	U	91	N
	Virgin River #1 South	3-Jul-11	2430-61219	BVB(M):XX	N/A	L	U	91	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	91	RS
	Virgin River #1 South	12-Aug-11	2590-53119	GWG(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Aug-11	2590-53151	GDG(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Aug-11	2590-53150	KVK(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Jul-11	2540-58184	YGY(M):TQ	N/A	SY	F	92	N 12 Jul
	Virgin River #1 South	30-Jun-08	2430-61106	XX:KV(M)	N/A	4Y	M	92	R 2 and 12 Jul
	Virgin River #1 South	12-Jul-11	2590-53106	XX:OGO(M)	N/A	L	U	92	N
	Virgin River #1 South	12-Jul-11	2590-53107	XX:VKV(M)	N/A	L	U	92	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	104	RS
	Virgin River #1 South	8-Jun-06	2370-39938	KG(M):PU	N/A	7Y	M	T51	RS; detected 19 May–18 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	U	F8	RS; detected 26 Jun

AR064452

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	6-Jun-10	2540-58192	TQ:BG(M)	N/A	A3Y	M	F20	R 24 Jul; breeding through 19 Jul at 40 and 103 in MESQ West
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	M	F199	RS; detected 10–14 Jul
MUDD	Overton WMA	14-Jul-11	2590-53108	XX:YOY(M)	N/A	SY	F	3	N
	Overton WMA	25-Jul-09	2370-40029	KOK(M):PU	N/A	3Y	M	3	R 11Jul
	Overton WMA	18-Jul-11	2590-53126	XX:GOG(M)	N/A	L	U	3	N
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	4	RS
	Overton WMA	21-Jun-10	2370-40088	PU:VG(M)	N/A	3Y	M	4	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	11	RS
	Overton WMA	21-May-09	2430-61085	BV(M):XX	N/A	4Y	M	11	RS
	Overton WMA	11-Jul-11	2590-53105	XX:KGK(M)	N/A	SY	F	18	N
	Overton WMA	31-Jul-09	2540-58154	DO(M):TQ[11]	N/A	3Y	M	18	R 11 Jul; breeding 2–17 Aug at 91 in MOME Virgin River #1 South
	Overton WMA	22-Jun-10	2370-40091	PU:DRD(M)	N/A	SY	F	101	R 18 Jul
	Overton WMA	18-Jul-11	2370-39968	VG(M):PU	N/A	SY	M	101	N
	Overton WMA	20-Jul-11	2590-53147	YKY(M):XX	N/A	L	U	101	N; died before fledging
	Overton WMA	20-Jul-11	2540-58279	TQ:WW(M)	N/A	L	U	101	N; died before fledging
	Overton WMA	20-Jul-11	2540-58278	RR(M):TQ	N/A	L	U	101	N; died before fledging
	Overton WMA	8-Jun-10	2430-61088	XX:BKB(M)	N/A	A3Y	M	T10	RS; detected 14 May–13 Jul
	Overton WMA	19-Jun-09	2370-39930	PU:GO(M)	N/A	3Y	M	T22	R 25 Jun; detected 17 May–17 Jul, detected 21–23 Jul at 32 in MESQ Hafen Lane
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	T42	RS; detected 19 May–29 Jun
	Overton WMA	25-Jun-10	2370-40000	PU:WW(M)	N/A	3Y	M	F5	RS; detected 2–3 Aug
	Overton WMA	INA	INA	undetermined	N/A	AHY	U	F9	Detected 6 Jul
	Overton Pond	N/A	N/A	UB:UB	N/A	AHY	M	F111	RS; detected 2–5 Jul

AR064453

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pipes #3	INA	INA	undetermined	N/A	AHY	F	8	
	Pipes #3	27-Jun-11	2590-53162	XX:GD(M)	N/A	SY	M	8	N
	800M	12-Jun-08	2430-61072	XX:RK(M)	N/A	5Y	M	T1, F9	R 8 May; detected 7 May–28 Jun, detected 6–8 Jul at F9 in Pipes #3
	Platform	20-Jun-10	2540-58228	TQ:KO(M)	N/A	3Y	M	T3, T18, F72	RS; detected 16 May–10 June, detected 9–15 June at F72 north of Platform; detected 25 Jun–9 Jul at T18 in The Wallows
	Pipes #1	INA	INA	banded	N/A	AHY	M	T7	RS; detected 23 Jun–1 Jul
	800M	INA	INA	undetermined	N/A	AHY	U	F2	Detected 5–7 Jun
	In Between	INA	INA	undetermined	N/A	AHY	U	F4	Detected 21 May
	800M	N/A	N/A	UB:UB	N/A	AHY	U	F5	Detected 18 Jun
	PC6-1	N/A	N/A	UB:UB	N/A	AHY	U	F6	RS: detected 1 Jun
	Lost Lake	N/A	N/A	UB:UB	N/A	AHY	U	F11	RS: detected 26 May
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	F22	Detected 7 Jun
	Hell Bird	16-May-11	2540-58108	TQ:GK(M)	N/A	AHY	U	F42	N; detected 16 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	M	F43	Detected 16 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F44	Detected 29 May
	Dock	INA	INA	undetermined	N/A	AHY	U	F45	Detected 28 May
	Dock	N/A	N/A	UB:UB	N/A	AHY	U	F46	RS; detected 28 May
	Dock	INA	INA	undetermined	N/A	AHY	U	F47	Detected 28 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F48	Detected 29 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F49	Detected 29 May
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	M	F50	RS; detected 29 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F51	Detected 29 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F52	Detected 29 May
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	U	F53	RS: detected 4 Jun
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F54	Detected 4 Jun

AR064454

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F55	Detected 8 Jun
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F56	Detected 8 Jun
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F57	Detected 3 Jun
	Spaghetti	INA	INA	undetermined	N/A	AHY	U	F70	Detected 30 May
	Swine Paradise	N/A	N/A	UB:UB	N/A	AHY	M	F71	RS; detected 9 Jun
	Spaghetti	INA	INA	undetermined	N/A	AHY	U	F73	Detected 30 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F100	Detected 24 May
	The Wallows	N/A	N/A	UB:UB	N/A	AHY	U	F101	RS; detected 1–5 Jun
	The Wallows	N/A	N/A	UB:UB	N/A	AHY	M	F102	RS; detected 9–13 Jun
BIWI	Site #3	6-Jun-08	2430-61137	XX:BR(M)	N/A	5Y	F	2	RS
	Site #3	6-Jun-08	2430-61136	XX:BG(M)	N/A	5Y	M	2	RS
	Site #3	14-Jul-11	2590-53164	RV(M):XX	N/A	L	U	2	N
	Cougar Point	14-Jul-11	2540-58120	TQ:YKY(M)	N/A	AHY	F	33	N
	Cougar Point	INA	INA	undetermined	N/A	AHY	M	33	Detected by an unrelated field crew; not detected during nest monitoring
	Planet Ranch Road	10-Jul-10	2540-58230	YD(M):TQ	N/A	3Y	F	41	RS
	Planet Ranch Road	12-Jun-10	2540-58220	TQ:DY(M)	N/A	A3Y	M	41, 103	RS
	Planet Ranch Road	2-Jul-11	2590-53163	XX:KVK(M)	N/A	SY	F	103	N
	Planet Ranch Road	17-Jul-11	2590-53182	XX:RBR(M)	N/A	L	U	103	N
	Planet Ranch Road	17-Jul-11	2430-61237	XX:VRV(M)	N/A	L	U	103	N
	Planet Ranch Road	17-Jul-11	2540-58115	TQ:WKW(M)	N/A	L	U	103	N
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	T17	RS; detected 20 Jun–5 Jul
	Planet Ranch Road	INA	INA	undetermined	N/A	AHY	U	F12	Detected 1 Jun
	Planet Ranch Road	N/A	N/A	UB:UB	N/A	AHY	U	F13	RS; detected 1–6 Jun
	Site #4	INA	INA	undetermined	N/A	AHY	U	F15	Detected 16 Jun
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	F16	RS; detected 20–26 Jun
	Site #5	INA	INA	undetermined	N/A	AHY	U	F21	Detected 21 May

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
BIWI	Site #5	INA	INA	undetermined	N/A	AHY	U	F22	Detected 29 May
	Wispy Willow	INA	INA	undetermined	N/A	AHY	U	F31	Detected 27 May
	Burn Edge	INA	INA	undetermined	N/A	AHY	M	F32	Detected 30 Jun
	Site #3	INA	INA	undetermined	N/A	AHY	U	F44	Detected 27 May

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2011.

[5] **Age in 2011**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Original federal band number 2390-92434.

[10] Original federal band number 2430-61167. Individual resighted at the beginning of the season with XX:KW(M) with an injured left leg but subsequently lost the left foot and federal band.

[11] Further review of data suggests this individual likely present at MUDD 9 Jul–3 Aug 2010 and erroneously reported (McLeod and Pellegrini 2011) as DR(M):TQ.

AR064456

NDOW Study Areas

Color-Banding and Resighting – Field personnel color-banded 13 new adult flycatchers and recaptured 3 individuals previously captured as adults. An additional 25 adults were identified to individual via resighting, while 2 individuals were resighted but did not have color combinations confirmed. We recaptured one individual identified as a returning nestling by the presence of a single federal band from 2007. Three additional adults were captured with full color combinations and identified as returning nestlings from 2009 or 2010 (Table 3.8). Five adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for one adult. Overall, 89% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.3). We banded 34 nestlings from 13 nests. Of the 34 nestlings banded, 3 were suspected to have died before fledging. For details on all banded flycatchers detected at the study areas from 2003 to 2011, see Appendix E.

Site-by-Site Color-Banding and Resighting

Key Pittman Wildlife Management Area – We detected 34 resident willow flycatchers from 19 territories at Key Pittman Wildlife Management Area. In addition to resident adults, we detected eight individuals for which residency and/or breeding status could not be determined (Table 3.4). Of the 19 territories at Key Pittman, 18 consisted of breeding individuals and 1 consisted of an unpaired male. Three males were each polygynous with two females.

Field personnel captured and color-banded 11 new adults and recaptured five flycatchers previously seen as adults (Table 3.4). We resighted and identified 20 additional adults; 5 of these individuals were detected for the first time since they were banded as nestlings in 2010 (see Table 3.8). We captured two returning nestlings originally banded as juveniles in 2007 and 2009. Two adults remained unbanded, and color combinations could not be confirmed for two adults. We banded 31 nestlings from 12 nests; we suspect three of these nestlings from two nests died before fledging. We resighted four unbanded fledglings from three additional nests.

River Ranch – We detected seven resident willow flycatchers from four territories at River Ranch. In addition to resident adults, we detected two individuals for whom residency and/or breeding status could not be determined (Table 3.4). Of the four territories at River Ranch, two consisted of breeding individuals, one consisted of a pair with no documented breeding activity, and one consisted of an unpaired male.

Field personnel captured and color-banded two new adult flycatchers. We resighted and identified six additional adults, five of which were banded as nestlings in 2010 (Table 3.8). One adult remained unbanded.

Warm Springs Natural Area – We detected two resident willow flycatchers from one territory at Warm Springs Natural Area. In addition to resident adults, we detected three individuals for whom residency and/or breeding status could not be determined (Table 3.4). The single territory at Warm Springs consisted of breeding individuals.

Field personnel did not capture or recapture any adult flycatchers. We resighted and identified two adults. Two adults remained unbanded, and the presence of bands could not be confirmed for one adult. We banded three nestlings from one nest.

Table 3.3. Willow Flycatchers Detected at NDOW Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Detected in Previous Year(s) as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Key Pittman WMA	Patch 0	2	0	0	0	2[1]	0	0	0	0	1(1)[2]	0	100
	Patch 1	2	1	0	0	1	0	0	0	0	3(1)	0	100
	Patch 2	2	0	0	0	2	0	0	0	0	2(1)	0	100
	Patch 3	2	0	0	0	1[3]	0	0	0	1	0	0	100
	Patch 4	5	1	1[3]	2[4,5]	0	0	1	0	0	2(1)	0	67
	Patch 5	2	0	1	0	0	0	1	0	0	0	0	50
	Patch 6	6	2	0	0	4[6]	0	0	0	0	5(2)[8]	0	100
	Patch 7	2	1	0	1	0	0	0	0	0	4(1)	0	100
	Patch 8	2	0	0	0	2	0	0	0	0	0	0	100
	Patch 9	4	1	0	0	3	0	0	0	0	4(1)	0	100
	Patch 10	3	1	1	0	1	0	0	0	0	5(2)	0	100
	Patch 10.5	2	0	0	1[7]	1[5]	0	0	0	0	0	0	100
	Patch 11	5	1	0	0	4[6]	0	0	0	0	3(1)	0	100
	Patch 12	6	3	0	1[7]	1	0	0	0	1	2(1)	0	100
	Fence[9]	1	0	0	0	1	0	0	0	0	0	0	100
	Study Area Total	**42**	**11**	**3**	**4**	**20**	**0**	**2**	**0**	**2**	**31(12)**	**0**	**95**
River Ranch	East Side	2	0	0	0	2[4]	0	0	0	0	0	0	100
	West Side	5	0	0	0	4[1,5]	0	1	0	0	0	0	80
	Smalls	2	2	0	0	0	0	0	0	0	0	0	100
	Study Area Total	**9**	**2**	**0**	**0**	**6**	**0**	**1**	**0**	**0**	**0**	**0**	**89**
Warm Springs Natural Area	Muddy Mac	5	0	0	0	2	0	2	1	0	3(1)	0	40
	Study Area Total	**5**	**0**	**0**	**0**	**2**	**0**	**2**	**1**	**0**	**3(1)**	**0**	**40**
Total		**53**	**13**	**3**	**4**	**25**	**0**	**5**	**1**	**2**	**34(13)**	**0**	**89**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.4.

[1] One individual moved from River Ranch West Side to Key Pittman WMA Patch 0 and is tallied only once in the total.

[2] Nestling suspected to have died in nest.

[3] One individual resighted in Key Pittman Patch 3 was recaptured in Patch 4, and is tallied only once in the total.

[4] One individual moved from River Ranch East Side to Key Pittman WMA Patch 4 and is only tallied once in the total.

[5] One individual moved from River Ranch West Side to Key Pittman WMA Patch 10.5 and is only tallied once in the total. This individual was resighted in Patch 10.5 and later recaptured in Patch 4, and is tallied only once in the total.

[6] One individual was detected in Patch 11 and Patch 6 and is tallied only once in the total.

[7] One individual recaptured in Patch 10.5 and Patch 12 and is tallied only once in the total.

[8] Two nestlings suspected to have died before fledging in one nest.

[9] Not a formal survey area. Individual detected in passing between Patches 5 and 6 on fence-line that runs along highway.

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 10	6-Jul-11	2540-58177	TQ:KRK(M)	N/A	AHY	F	15	N
	Patch 10	16-Jul-09	2430-61158	RB(M):XX	N/A	A4Y	M	15,93	R 28 Jun and 6 Jul
	Patch 10	16-Jul-11	2370-40078	YV(M):PU	N/A	L	U	15	N
	Patch 10	16-Jul-11	2590-53144	XX:GDG(M)	N/A	L	U	15	N
	Patch 7	21-Jul-11	2590-53110	OW(M):XX	N/A	AHY	F	16	N
	Patch 7	14-Jul-07	2370-40190	RY(M):PU	UB:PU	5Y	M	16	R 21 Jul
	Patch 7	21-Jul-11	2590-53111	VD(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53112	BKB(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53113	BYB(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53114	KOK(M):XX	N/A	L	U	16	N
	Patch 6	25-Jul-10	2540-58241	TQ:BY(M)	N/A	A3Y	F	17	RS
	Patch 6	18-Jun-11	2430-61214	DV(M):XX	N/A	SY	M	17	N
	Patch 12	28-Jun-11	2540-58175	TQ:WO(M)	N/A	AHY	F	44	N
	Patch 12	27-Jul-11	2540-58387	GWG(M):TQ	N/A	AHY	M	44,107	N
	Patch 12	N/A	N/A	UB:UB	N/A	HY	U	44	RS
	Patch 11	27-Jul-11	2540-58386	OGO(M):TQ	N/A	AHY	F	45	N
	Patch 11	3-Aug-08	2370-40097	PU:GY(M)	N/A	4Y	M	45	RS
	Patch 11	28-Jul-11	2590-53118	RDR(M):XX	N/A	L	U	45	N
	Patch 11	28-Jul-11	2590-53149	YRY(M):XX	N/A	L	U	45	N
	Patch 11	28-Jul-11	2540-58280	OD(M):TQ	N/A	L	U	45	N
	Patch 8	28-Jul-10	2540-58165	DB(M):TQ	N/A	SY	F	46	RS
	Patch 8	1-Jul-08	2430-61118	XX:KK(M)	N/A	4Y	M	46	RS
	Patch 5	N/A	N/A	UB:UB	N/A	AHY	F	47	RS
	Patch 5	16-Jul-09	2370-40031	OGO(M):PU	N/A	3Y	M	47	R 28 Jun
	Patch 5	N/A	N/A	UB:UB	N/A	HY	U	47	RS
	Patch 5	N/A	N/A	UB:UB	N/A	HY	U	47	RS
	Patch 1	14-Jul-11	2590-53173	YBY(M):XX	N/A	SY	F	49	N

AR064459

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 1	29-Jul-09	2370-40140	PU:YK(M)	N/A	4Y	M	49	RS
	Patch 1	17-Jul-11	2540-58211	TQ:OW(M)	N/A	L	U	49	N
	Patch 1	17-Jul-11	2540-58212	YWY(M):TQ	N/A	L	U	49	N
	Patch 1	17-Jul-11	2590-53125	VBV(M):XX	N/A	L	U	49	N
	Patch 0	30-Jun-10	2540-58238	TQ:GOG(M)	N/A	SY	F	57	RS; breeding 23–27 Jun at RIRA West Side then moved to KEPI
	Patch 0	8-Jul-10	2540-58158	RB(M):TQ	N/A	SY	M	57	RS
	Patch 0	2-Aug-11	2540-58298	TQ:RO(M)	N/A	L	U	57	N; suspected to have died in nest
	Patch 2	8-Jul-10	2540-58159	KB(M):TQ	N/A	SY	F	61	RS
	Patch 2	2-Jul-09	2370-40024	PU:BV(M)	N/A	3Y	M	61	RS
	Patch 2	1-Aug-11	2540-58214	TQ:YRY(M)	N/A	L	U	61	N
	Patch 2	1-Aug-11	2590-53127	WGW(M):XX	N/A	L	U	61	N
	Patch 9	8-Jul-10	2540-58156	BG(M):TQ	N/A	A3Y	F	62	RS
	Patch 9	1-Jul-08	2430-61114	WR(M):XX	N/A	4Y	M	62	RS
	Patch 9	7-Jul-11	2540-58182	GR(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58183	KK(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58282	KV(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58283	KW(M):TQ	N/A	L	U	62	N
	Patch 10	21-Jul-10	2430-61100	XX:YKY(M)	N/A	3Y	F	93	RS
	Patch 10	16-Jul-11	2370-40079	PU:KRK(M)	N/A	L	U	93	N
	Patch 10	16-Jul-11	2540-58276	VW(M):TQ	N/A	L	U	93	N
	Patch 10	16-Jul-11	2540-58277	TQ:YY(M)	N/A	L	U	93	N
	Patch 4	27-Jul-11	2540-58297	RYR(M):TQ	N/A	AHY	F	100	N
	Patch 4	N/A	N/A	UB:UB	N/A	AHY	M	100	RS
	Patch 4	10-Jul-11	2540-58247	OKO(M):TQ	N/A	L	U	100	N
	Patch 4	10-Jul-11	2590-53172	XX:VYV(M)	N/A	L	U	100	N; R 27 Jul
	Patch 11	28-Jul-10	2540-58203	TQ:WD(M)	N/A	3Y	F	106	RS

AR064460

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 11	10-Jul-10	2540-58223	YV(M):TQ	N/A	3Y	M	106	RS
	Patch 11	N/A	N/A	UB:UB	N/A	HY	U	106	RS
	Patch 12	10-Jul-10	2540-58224	TQ:RD(M)	N/A	SY	F	107	RS
	Patch 12	8-Aug-11	2540-58378	WD(M):TQ	N/A	L	U	107	N
	Patch 12	8-Aug-11	2540-58299	TQ:YO(M)	N/A	L	U	107	N
	Patch 6	14-Jul-09	2430-61279	XX:DW(M)	N/A	3Y	F	121	RS
	Patch 6	17-Jul-11	2590-53124	XX:VGV(M)	N/A	AHY	M	121,122	N
	Patch 6	16-Jul-11	2590-53122	XX:KWK(M)	N/A	L	U	121	N; suspected to have died in nest
	Patch 6	16-Jul-11	2590-53123	BRB(M):XX	N/A	L	U	121	N; suspected to have died in nest
	Patch 6	20-Jul-09	2540-58187	TQ:RB(M)	N/A	A4Y	F	122	RS[9]
	Patch 6	7-Jul-11	2540-58180	TQ:WY(M)	N/A	L	U	122	N
	Patch 6	7-Jul-11	2540-58178	BD(M):TQ	N/A	L	U	122	N
	Patch 6	7-Jul-11	2540-58179	GK(M):TQ	N/A	L	U	122	N
	Patch 9	5-Jul-11	2590-53121	XX:WRW(M)	N/A	AHY	F	123	N
	Patch 9	26-Jun-08	2430-61180	RD(M):XX	N/A	5Y	M	123	RS
	Patch 3	3-Jul-08	2430-61197	XX:VY(M)	N/A	4Y	M	T14	RS; detected 16 May–27 Jul; R 27 Jul in Patch 4
	Patch 4	13-Jul-10	2430-61099	XX:WOW(M)	N/A	SY	U	F18	R 27 Jul; not detected post capture; breeding 15 Jun–25 Jul at RIRA East Side
	Fence	6-Jul-09	2370-40027	YY(M):PU	N/A	3Y	U	F19	RS; detected 29 May on fence between Patches 5 and 6
	Patch 11	29-Jun-10	2370-40010	KRK(M):PU	N/A	AHY	U	F20	RS; detected 30 Jun, detected 12 Jul in Patch 6
	Patch 3	INA	INA	banded	N/A	AHY	U	F21	RS; detected 31 Jul
	Patch 12	27-Jul-11	2590-53148	RYR(M):TQ	N/A	AHY	U	F22	N; detected 27 Jul
	Patch 12	INA	INA	banded	N/A	AHY	U	F23	RS; detected 30 Jun
	Patch 10.5	23-Jun-09	2430-61159	OK(M):XX	N/A	3Y	M	F75	R 26 Jun, also 27 Jul in Patch 12; otherwise not detected
	Patch 10.5	12-Jul-09	2430-61098	XX:WDW(M)	N/A	SY	M	F112	RS; detected 24 Jul; R 27 Jul in Patch 4; breeding 23 Jun–1 Jul at RIRA West Side

AR064461

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
RIRA	West Side	30-Jun-10	2540-58238	TQ:GOG(M)	N/A	SY	F	95	RS; detected 23–27 Jun; moved to KEPI Patch 0
	West Side	12-Jul-10	2430-61098	XX:WDW(M)	N/A	SY	M	95	RS; detected 24–27 July at KEPI
	Smalls	27-Jun-11	2590-53171	XX:ORO(M)	N/A	SY	F	108	N; detected 27–29 Jun
	Smalls	27-Jun-11	2540-58246	BR(M):TQ	N/A	SY	M	108	N; detected 15 Jun–16 Jul
	East Side	30-Jun-10	2540-58240	KYK(M):TQ	N/A	SY	F	110	RS
	East Side	13-Jul-10	2430-61099	XX:WOW(M)	N/A	SY	U	110	RS; detected 15 Jun–25 Jul; detected 27 Jul at KEPI Patch 4
	West Side	17-Jun-11	2540-58109	WK(M):TQ	N/A	SY	M	T109	RS; detected 23 Jun–13 Jul; detected 17–19 Jun at PAHR North
	West Side	8-Jul-10	2540-58157	OY(M):TQ	N/A	SY	U	F111	RS; detected 23–27 Jul
	West Side	N/A	N/A	UB:UB	N/A	AHY	M	F112	RS; detected 19 Jun
WMSP	Muddy Mac	8-Jun-10	2540-58193	TQ:DB(M)	N/A	A3Y	F	71	RS
	Muddy Mac	20-May-08	2540-58234[10]	KD(M):TQ	N/A	A5Y	M	71	RS
	Muddy Mac	13-Jul-11	2590-53143	XX:RV(M)	N/A	L	U	71	N
	Muddy Mac	13-Jul-11	2540-58275	TQ:YD(M)	N/A	L	U	71	N
	Muddy Mac	13-Jul-11	2540-58274	VG(M):TQ	N/A	L	U	71	N
	Muddy Mac	INA	INA	undetermined	N/A	AHY	M	F54	Detected 26 May
	Muddy Mac	N/A	N/A	UB:UB	N/A	AHY	M	F55	RS; detected 26 May
	Muddy Mac	N/A	N/A	UB:UB	N/A	AHY	U	F56	RS; detected 26 May

[1] KEPI = Key Pittman WMA; RIRA = River Ranch; WMSP = Warm Springs Natural Area.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2011.

[5] **Age in 2011**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Further review of data suggests this individual likely present at KEPI during the 2010 breeding season, but this cannot be confirmed.

[10] Original federal band number 2430-61134.

AR064462

Non-Monitoring Sites

This study area was monitored by another agency, and here we report only banded flycatchers that were captured or resighted. Unbanded individuals or those with unknown band status are not included.

St. George – Field personnel captured and color-banded two new adults and recaptured one individual previously captured as an adult (Table 3.5). We banded one nestling. Personnel from Utah Division of Wildlife Resources resighted and identified an additional four adult flycatchers. Two more banded adults were resighted, but their identities could not be confirmed.

Table 3.5. Banded Willow Flycatchers, Non-Monitoring Sites, 2011

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Age[3]	Sex[4]	Observation Status[5]
STGE	Snipe Pond	28-Jun-09	2430-61154	RO(M):XX	3Y	F	R 20 Jul
	Snipe Pond	20-Jul-11	2590-53145	XX:RWR(M)	AHY	M	N
	Snipe Pond	20-Jul-11	2540-58385	TQ:KGK(M)	L	U	N
	Snipe Pond	20-Jul-11	2590-53287	OO(M):TQ	AHY	M	N
	Riverside East	27-Jul-08	2370-40148	PU:KR(M)	4Y	F	RS
	Riverside East	22-Jun-09	2540-58132	TQ:OD(M)	A4Y	M	RS
	Riverside Marsh	9-Jul-10	2430-61230	XX:GWG(M)	A3Y	F	RS
	Riverside Marsh	29-Jun-10	2430-61093	XX:VBV(M)	A3Y	M	RS
	Riverside Marsh	INA	INA	banded	AHY	F	RS
	Riverside Marsh	INA	INA	banded	AHY	M	RS

[1] STGE = St. George.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, TQ = turquoise federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2011:** L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[4] **Sex codes**: M = male, F = female, U = unknown.

[5] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

Adult Between-Year Return and Dispersal

In 2010 we individually identified 96 adult, resident willow flycatchers at all monitored study areas, of which 55 (57%) were detected in 2011 (Table 3.6). Of the returning resident adults, five (9%) were detected at a different study area than where they were last detected in 2010 (Table 3.7). One adult flycatcher that was detected in 2010 at a site monitored by NDOW was detected at a different study area in 2011. Two additional flycatchers that were last detected in 2008 or 2009 exhibited between-year movement in 2011. The median dispersal distance for all returning adult flycatchers exhibiting between-year movements in 2011 was 86.8 km (min = 11.9 km, max = 203.1 km).

Table 3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011

Study Area	# Identified in 2010	# of 2010 Birds Detected in 2011	% Return	% Return to Same Study Area
Key Pittman	21	13	62	100
Pahranagat	19	12	63	100
Littlefield	2	0	0	--

Table 3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011 (Continued)

Study Area	# Identified in 2010	# of 2010 Birds Detected in 2011	% Return	% Return to Same Study Area
Mesquite	11	6	55	83
Mormon Mesa	19	12	63	92
Muddy River	6	3	50	100
Warm Springs	3	2	67	50
Topock	8	3	38	33
Bill Williams	7	4	57	100
Total	**96**	**55**	**57**	**91**

Table 3.7. Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2011

Study Area/Site/Year Detected[1]	Study Area/Site Detected 2011[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
GRCA/Iceberg Canyon/2008	TOPO/800M	153.6	2430-61072	XX:RK(M)	M
PAHR/North/2009	KEPI/Patch 6	30.1	2540-58187	TQ:RB(M)[4]	F
MOME/Virgin River #1 South/2010	KEPI/Patch 8	132.7	2430-61118	XX:KK(M)	M
RIRA/West Side/2010	KEPI/Patch 5	11.9	2370-40027	YY(M):PU	F
TOPO/Glory Hole/2010	MOME/Virgin River #1 South	203.1	2540-58231	TQ:GR(M)	F
MESQ/West/2010	MUDD/Overton WMA	40.9	2370-39930	PU:GO(M)	M
WMSP/Muddy Mac/2010	MUDD/Overton WMA	35.4	2430-61088	XX:BKB(M)	M
TOPO/800M/2010	MUDD/Overton WMA	189.3	2540-58154	DO(M):TQ[5]	M

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, WMSP = Warm Springs Natural Area, MUDD = Muddy River, TOPO = Topock Marsh.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male.

[4] Further review of data suggests this individual likely present at KEPI during the 2010 breeding season, but this cannot be confirmed.

[5] Further review of data suggests this individual moved from TOPO to MUDD during the 2010 breeding season but this cannot be confirmed.

Juvenile Between-Year Return and Dispersal

In 2010, we banded 52 nestlings at the Reclamation study areas. One of these nestlings was known to have died before fledging. Of the remaining 51 juveniles, 2 (4%) were identified in 2011. Two individuals originally banded as nestlings in 2007 and two individuals originally banded as nestlings in 2009 were identified for the first time in 2011 (Table 3.8). In 2010, we banded an additional 41 nestlings at the NDOW study areas. Five of these nestlings were known to have died before fledging. Of the remaining 36 juveniles, 9 (25%) were identified in 2011 (Table 3.8). No additional nestlings banded in prior years at NDOW sites were identified. Of the 16 returning nestlings identified in 2010, 12 (75%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2011 was 12.8 km (min = 0.03 km, max = 138.0 km).

One additional returning nestling from 2003–2007 was resighted in 2011 at Mormon Mesa, but the identity of this individual was undetermined because we were unable to recapture it.

Table 3.8. Juvenile Flycatchers Banded as Hatch Year Birds in 2007, 2009, or 2010 and Identified for the First Time in 2011

Study Area/ Site Banded[1]	Year Hatched	Study Area/Site Detected 2011[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/North	2007	KEPI/Patch 7	30.1	2370-40190	RY(M):PU	M
MESQ/West	2007	MOME/Virgin River #1 South	27.4	2360-59777	EE:YKY(M)	F
MOME/Virgin River #1 South	2009	KEPI/Patch 10.5	132.8	2430-61159	OK(M):XX	M
MOME/Virgin River #1 South	2009	MUDD/Overton WMA	13.6	2370-40029	KOK(M):PU	M
KEPI/Patch 10.5	2010	PAHR/North	30.1	2540-58201	TQ:BO(M)	U
KEPI/Patch 9	2010	KEPI/Patch 12	0.3	2540-58224	TQ:RD(M)	F
KEPI/Patch 9	2010	RIRA/East Side	12.0	2430-61099	XX:WOW(M)	U
KEPI/Patch 8	2010	KEPI/Patch 8	0.03	2540-58165	DB(M):TQ	F
KEPI/Patch 7	2010	RIRA/West Side	11.9	2540-58238	TQ:GOG(M)	F
KEPI/Patch 7	2010	RIRA/East Side	11.9	2540-58240	KYK(M):TQ	F
KEPI/Patch 6	2010	KEPI/Patch 2	0.6	2540-58159	KB(M):TQ	F
KEPI/Patch 6	2010	KEPI/Patch 0	0.7	2540-58158	RB(M):TQ	M
KEPI/Patch 6	2010	RIRA/West Side	11.9	2540-58157	OY(M):TQ	U
PAHR/North	2010	RIRA/West Side	18.2	2430-61098	XX:WDW(M)	M
MOME/Virgin River #1 South	2010	MUDD/Overton WMA	13.6	2370-40091	PU:DRD(M)	F
MUDD/Overton WMA	2010	KEPI/Patch 6	138.0	2370-40010	KRK(M):PU	U

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, G = green, B = light blue, D = dark blue, W = white, Y = yellow, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

Within-Year, Between-Study Area Movements

We detected seven within-year, between-study area movements in 2011 (Table 3.9). Three individuals moved from River Ranch to Key Pittman WMA. One male held a territory in River Ranch West Side (23 June – 1 July), was detected on 24 July at Key Pittman Patch 10.5, and recaptured passively on 27 July in Patch 4. The female from the same territory in River Ranch West Side moved after a failed nesting attempt (23 – 27 June) to Key Pittman Patch 0 where she had another nesting attempt of unknown fate (8 July – 4 August). Another individual, likely a male, was present in River Ranch East Side (15 June – 25 July) and was recaptured passively at Key Pittman Patch 4 on 27 July. A male at Pahranagat North was detected 17 – 19 June and moved to River Ranch West Side where he held a territory from 23 June to 13 July. One male held a territory at Mesquite West (17 May – 19 July) and was recaptured passively on 24 July in Mormon Mesa Virgin River #1 South. Two males moved from Muddy River Overton WMA after holding territories. One male held his territory from 17 May to 17 July and was then detected at Mesquite Hafen Lane from 21 to 23 July. The other male held his territory from 17 June to 17 July and then moved to Mormon Mesa Virgin River #1 South where he was detected from 2 to 17 August.

Table 3.9. Adult Willow Flycatcher Within-Year Movements for All Individuals Identified at Two Different Study Areas in 2011

Start Study Area/Site[1]	End Study Area/Site[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
RIRA/West Side	KEPI/Patch 4	11.4	2430-61098	XX:WDW(M)	M
RIRA/East Side	KEPI/Patch 4	11.4	2430-61099	XX:WOW(M)	U
RIRA/West Side	KEPI/Patch 0	11.2	2540-58238	TQ:GOG(M)	F
PAHR/North	RIRA/West Side	18.2	2540-58109	WK(M):TQ	M
MESQ/West	MOME/Virgin River #1 South	27.2	2540-58192	TQ:BG(M)	M
MUDD/Overton WMA	MESQ/Hafen Lane	43.9	2370-39930	PU:GO(M)	M
MUDD/Overton WMA	MOME/Virgin River #1 South	13.5	2540-58154	DO(M):TQ	M

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

DISCUSSION

Color-Banding Effort

Overall, 52% of the adult flycatchers detected at the monitoring sites during 2011 were banded by the end of the breeding season. This compares to 55, 57, 75, 70, 73, 69, 67 and 66% in 2003–2010, respectively. Unbanded willow flycatchers with an undetermined residency status are included in calculating these percentages; therefore, in most cases, these numbers under-represent the actual proportion of resident banded flycatchers at a given site. Differences between study areas in the percentage of banded individuals are related to vegetation density and overall structure, which affect our ability to erect mist-nets in the habitat, and the percentage of adults that are residents. Topock Marsh typically has the lowest percentage of color-banded flycatchers because dense vegetation limits the number and size of possible net locations and because, particularly in recent years, the number of resident adults is low in comparison to the total number of flycatchers detected.

Prior to 2008, we banded all nestlings with a single anodized federal band, identifying the bird as a returning nestling in the event it was sighted in a subsequent year. The individual would then have to be recaptured to determine its individual identity and to apply a unique color combination so the bird could be individually identified via resighting. The rationale for banding nestlings with a single anodized band was that the majority of nestlings do not return in subsequent years, resulting in the loss of a large number of unique color combinations. To eliminate the need to recapture returning nestlings, in 2008–2011 we applied unique color combinations to all nestlings. The use of full color combinations on nestlings in 2008–2010 has greatly reduced the number of adults with single federal bands, with only three detected across all study areas in 2011. Banding nestlings with full color combinations also allows us to record juvenile dispersal movements that might otherwise go undetected.

Adult and Juvenile Between-Year Dispersal

Resident adults detected at Topock have historically shown very high site fidelity. Until 2010, when we documented between-year movement of an adult male from Topock to Warm Springs, no between-year movements of resident Topock adults to another study area had been detected. In 2011, two additional between-year movements of resident Topock adults to other study areas were documented. One was a

breeding female identified in Mormon Mesa who had last been identified in 2010 as a breeding female in Topock. The other was a breeding male from Muddy River who was last documented in 2010 as a resident, unpaired male in Topock. These two movements provide further evidence that individuals who do not return to Topock after being documented in a given year may be moving to other locations. When an individual is not identified in a given year, there is no way to distinguish between going undetected, mortality, or emigration from the study area. Documenting emigration allows for an estimation of emigration rates, thereby improving the accuracy of survival estimates. It is possible that there have been movements of resident, unbanded Topock adults to other monitored study areas, but there would be no way to detect these movements. Furthermore, the movement of the female to Mormon Mesa may also be indicative of the poor habitat conditions present in Topock in 2011. Females who breed successfully in a given year typically demonstrate high site fidelity the following year. This female successfully fledged two nestlings in 2010 and was not detected in Topock in 2011.

Adult and juvenile dispersal data for the 2011 field season show overall high site fidelity exhibited by adult flycatchers and lower natal site fidelity exhibited by juveniles, with juveniles dispersing among study areas. These dispersal data are consistent with the patterns observed in the LCR region from 1998 to 2011, over which period 90% of adult returns were to the same study area, while only 48% of all juvenile returns were to the natal study area (McKernan and Braden unpubl. data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). These dispersal data are also consistent with range-wide data (Paxton et al. 2007), with adult flycatchers exhibiting high site fidelity to breeding areas. Juvenile dispersal within the Virgin/lower Colorado River population(s) is largely limited to this region, and while reciprocal juvenile movements among geographically isolated flycatcher populations of the greater Southwest do occur, they are rare. Only three instances of willow flycatcher immigration from sites outside the Virgin/lower Colorado River region have been recorded since 1997 (McKernan and Braden unpubl. data, McLeod et al. 2008a), with two males originally banded as nestlings in 2003 at Roosevelt Lake recaptured in 2005 at Muddy River and Topock, and one male banded as a nestling in 1999 at Roosevelt Lake recaptured in 2002 in Grand Canyon. Although movements of this magnitude are infrequent, other instances of dispersal distances greater than 140 km have been reported for the Southwestern Willow Flycatcher (Paxton et al. 2007) and have been noted within the Virgin/lower Colorado River population (McLeod et al. 2008a, McLeod and Koronkiewicz 2010, McLeod and Pellegrini 2011). Banding studies at Roosevelt Lake and along the San Pedro River were discontinued after 2005, so immigration of juveniles produced in those areas after 2005 would have gone undetected.

The observed dispersal patterns fit well with the tenets of contemporary metapopulation theory (Hanski and Simberloff 1997), suggesting the Virgin/lower Colorado River population may be a panmictic sub-population of a greater metapopulation. Occasional juvenile dispersal between sub-populations is likely an important population variable in terms of gene flow, with movements contributing to an understanding of the observed patterns of high genetic diversity within and low genetic isolation among Southwestern Willow Flycatcher populations (Busch et al. 2000). Dispersal by juveniles or adults is required for the colonization of new breeding sites, and long-distance movements will be required if newly established Reclamation habitat creation sites are to be colonized. The closest known breeding sites are at Bill Williams River NWR and Topock Marsh, approximately 75–150 km from the PVER and CVCA habitat creation sites (see Chapter 2). The habitat creation sites could also be colonized by individuals from more distant breeding areas, such as those along the Virgin River. Although such long-distance movements are relatively infrequent, two adult movements between the lower Colorado and the Virgin River were documented in 2011, and multiple instances of adult and juvenile dispersal between the Virgin River and Topock Marsh and Bill Williams River NWR have been documented in recent years (McLeod et al. 2008b; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Physical connectivity of riparian habitats within the greater landscape is crucial in enabling these long-distance movements. Without adequate stop-over habitats and foraging areas, flycatchers attempting long-distance movements are more likely to be exposed to adverse environmental conditions.

Within-year, Between Study Area Movement

Within-year, between study area movements typically occur at low rates in any given year. In 2003–2010, we detected between zero and four (median = 1.5) movements per year. In 2011, we documented the largest number of individuals (seven) moving between study areas within a given year. The increase in the number of documented movements may have been affected by the addition in 2011 of River Ranch to the monitored study areas. Movements to and from River Ranch accounted for four (57%) of the seven movements. One additional within-year movement, which would otherwise likely have gone undetected, was detected via passive netting. Thus, the detection of an unusually high number of within-year movements in 2011 is not necessarily indicative of there being more movements, but rather that we were better able to detect them.

The movement of three of the seven resident or paired adults at River Ranch to another study area is suggestive of poor habitat quality at River Ranch. In addition, eight of the nine individuals detected at River Ranch were known to be second-year individuals (age of the ninth individual was unknown). A high proportion of second-year birds could also be indicative of poor habitat quality. This pattern is seen in multiple species where the best habitat is typically occupied by older individuals, who may be more competitive or arrive sooner on the breeding grounds, leaving habitat of lesser quality for younger birds (Hill 1988, Holmes et al. 1996). Higher proportions of second-year birds also tend to be seen in young, newly developed habitat, such as that seen in the lower Grand Canyon in 2006–2008, possibly as a result of dispersal and colonization (McLeod et al. 2007, McLeod et al. 2008b, McLeod and Koronkiewicz 2009). However, the habitat at River Ranch has been established for several years (C. Tomlinson, NDOW, pers. comm.), and the high proportion of second-year birds is more likely due to habitat quality than stand age.

Adult and Juvenile Survivorship

Annual survivorship is defined as the number of individuals that survive from one year to the next, and accurate estimates depend on year-to-year detection of uniquely marked birds. Fifty-seven percent of the adult, resident willow flycatchers identified in 2010 were detected again in 2011, while of the 87 juveniles banded in 2010, only 11 (13%) were identified in 2011. Thus, minimum estimated adult and juvenile survival from 2010 to 2011 at all monitored sites was 57 and 13%, respectively. These simple annual percent survivorship calculations assume that all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. To provide more robust estimates of annual survival, demographic data acquired from 2003 to 2012 will be combined with data collected during 1997–2002. Survival and detection probabilities will be estimated using program MARK (White and Burnham 1999) and presented in a summary report in 2012.

This page intentionally left blank.

Chapter 4

NEST MONITORING

INTRODUCTION

Documentation of nest success and productivity is critical to understanding local population status and demographic patterns of the Southwestern Willow Flycatcher. In 2011, at all sites where willow flycatcher breeding activity was suspected, we conducted intensive nest searches and nest monitoring. Specific objectives of nest monitoring included identifying breeding individuals (see Chapter 3, Color-banding and Resighting), calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Nest monitoring results from 2011 were compared with those at the study areas from 1996 to 2010 (Braden and McKernan unpubl. data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Although aspects of willow flycatcher breeding ecology can vary widely across its broad geographical and elevational ranges throughout the Southwest (Whitfield et al. 2003), we compared monitoring results with range-wide data to identify specific variables that may contribute to the characterization of flycatcher breeding ecology throughout the lower Colorado and Virgin River riparian systems.

METHODS

Upon locating territorial willow flycatchers, regardless of whether a possible mate was observed, we conducted intensive nest searches following the methods of Rourke et al. (1999). Nest monitoring followed a modification of the methods described by Rourke et al. (1999) and the Breeding Biology Research and Monitoring Database (BBIRD) protocol by Martin et al. (1997).

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites. Nests were monitored every two to four days after nest building was complete and incubation was confirmed. Nests at NDOW study areas were monitored less frequently (every four days or more) because of budgetary restrictions. During incubation and after hatching, nest contents were observed directly using a telescoping mirror pole to determine nest contents and transition dates. Nest monitoring during nest building and egg laying stages was limited to reduce the chance of abandonment during these periods. To reduce the risk of depredation (Martin et al. 1997), brood parasitism by the Brown-headed Cowbird, and premature fledging of young (Rourke et al. 1999), we observed nests from a distance with binoculars once the number and age of nestlings were confirmed. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

Per instructions from Reclamation biologists, we considered a willow flycatcher nest successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted based on the number of fledglings actually observed. This method of determining success differs from that recommended by some nest monitoring protocols (e.g., Martin et al. 1997, Rourke et al. 1999), which consider a nest as successful if chicks are observed in the nest within two days of the estimated fledge date. The method we follow produces a conservative estimate of both nest success rate and number of fledges.

We considered a nest to have failed if (1) the nest was abandoned prior to egg laying (abandoned); (2) the nest was deserted with flycatcher eggs or young remaining (deserted); (3) the nest was found empty or destroyed more than two days prior to the estimated fledge date (depredated); (4) nestlings died in the nest despite being tended by the adults(nestlings died in nest); or (5) the entire clutch was incubated for an excess of 20 days (infertile/addled). For nests containing flycatcher eggs, parasitism was considered the cause of nest failure if (1) cowbird young outlived any flycatcher eggs or young, or (2) the nest was parasitized during egg laying and the disappearance of flycatcher eggs coincided with the appearance of cowbird eggs.

During each nest check, we recorded date and time of the visit, observer initials, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and number and behavior of adults and/or fledges present onto standardized data forms (Appendix A) that included the nest or territory number and UTM coordinates. We calculated flycatcher nest success using both apparent nesting success (number of successful nests/total number of nests containing at least one flycatcher egg) and the Mayfield method (Mayfield 1961, 1975), which calculates daily nest survival to account for nests that failed before they were found. We assumed one egg was laid per day, and incubation was considered to start the day the last egg was laid (per Martin et al. 1997). The nestling period was considered to start the day the first egg hatched and end the day the first nestling fledged. If exact transition dates or dates of depredation events were unknown, we estimated the transition date as halfway between observations. For nests where fate was unknown, we used the last known date of activity to determine the number of observation days. To calculate Mayfield survival probabilities (MSP), we used the average length of each nest stage (2.14, 12.85, and 13.76 days for laying, incubation, and nestling stages, respectively) as observed in this study in 2003–2011 for nests where transition dates were known. Nest productivity was calculated as the number of young fledged per nesting attempt that produced at least one flycatcher egg. Fecundity was calculated as number of young produced per female over the breeding season. Parasitism rates were calculated as the percentage of nests with known contents that included at least one flycatcher egg and one cowbird egg.

In 2011, we attempted to addle cowbird eggs in easily accessible flycatcher nests at all study areas except Pahranagat. If the nest was accessible without a ladder, the cowbird egg was addled as soon as it was discovered. If a ladder was required, the cowbird egg was addled on the next regularly scheduled nest visit. Cowbird eggs were addled only if we could obtain a direct view of the nest contents from a secure location, either on the ground on or a ladder. We carefully removed the cowbird egg from the nest and placed it in a padded film canister. We then shook the canister vigorously for about one minute, incorporating sharp, jerky movements. The egg was then returned to the nest. The cowbird egg was not permanently removed from the nest so as not to mimic a partial depredation event, which might result in nest desertion. If a nest was found with a cowbird nestling already in the nest, or if a shaken cowbird egg still hatched, we removed the cowbird nestling from the nest.

All field personnel practiced egg addling with several button quail (*Coturnix chinensis*) eggs at the start of field season to determine how vigorously they could shake an egg without breaking it. Button quail eggs are slightly larger than cowbird eggs (19 x 25 mm vs. 16 x 21 mm) but provide a reasonable and easily available substitute. Shaken eggs were carefully opened to determine whether any damage to the internal structure of the egg was apparent. Field personnel varied in their ability to shake an egg to the point of causing internal damage without breaking the shell.

RESULTS

Reclamation Study Areas

Nest Monitoring

We documented 49 willow flycatcher nesting attempts at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams; 43 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Eighteen (42%) nests were successful and fledged young, and 23 (53%) failed. The fate of two nests (5%) was unknown. Nest success ranged from 0% at Topock Marsh to 100% at Pahranagat (Table 4.1). For a comparison of apparent nest success at all monitoring sites from 1997 to 2011, see Table 4.2.

Thirty-five nesting females, of which all but three were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was documented for which no nesting attempt could be confirmed. Of the 35 nesting females, 23 had one nesting attempt, 10 had two nesting attempts, and 2 had three nesting attempts. Of the 12 females with multiple nesting attempts, 9 renested after failed nests and 3 renested after a successful nest.

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Reclamation Study Areas, 2011

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate	Parasitized Nests[4]
PAHR	North	6	7	7	7 (100)	0	0	0
	Total	*6*	*7*	*7*	*7 (100)*	*0*	*0*	*0*
MESQ	Hafen Lane	1	1	1	0	1 (100)	0	1 (100)
	West	6	8	6	2 (33)	4 (67)	0	1 (20)
	Total	*7*	*9*	*7*	*2 (29)*	*5 (71)*	*0*	*2 (33)*
MOME	Virgin River #1 North	2	1	1	0	1 (100)	0	0
	Virgin River #1 South	11	19	17	7 (41)	9 (53)	1 (6)	1 (7)
	Total	*13*	*20*	*18*	*7 (39)*	*10 (55)*	*1 (6)*	*1 (7)*
MUDD	Overton WMA	5	6	5	0	4 (80)	1 (20)	3 (60)
	Total	*5*	*6*	*5*	*0*	*4 (80)*	*1 (20)*	*3 (60)*
TOPO	Pipes #3	1	1	1	0	1	0	0
	Total	*1*	*1*	*1*	*0*	*1 (100)*	*0*	*0*
BIWI	Site #3	1	2	2	1 (50)	1 (50)	0	0
	Cougar Point	1	1	1	0	1 (100)	0	1 (100)
	Planet Ranch Rd	2	3	2	1 (50)	1 (50)	0	0
	Total	*4*	*6*	*5*	*2 (40)*	*3 (60)*	*0*	*1 (20)*
Overall Total		**36**	**49**	**43**	**18 (42)**	**23 (53)**	**2 (5)**	**7 (19)**

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Table 4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Reclamation Study Areas from 1996 to 2011*

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
1996	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nc[5]	Nc[5]	Nm[3]
1997	Nm[3]	Nd[4]	67 (3)	42 (12)	Nc[5]	Nc[5]	Nc[5]	Nd[4]
1998	47 (19)	Nd[4]	0 (7)	70 (10)	Nm[3]	Nc[5]	53 (15)	Nd[4]
1999	60 (15)	Nm[3]	Nd[4]	45 (11)	Nm[3]	Nc[5]	38 (16)	100 (1)
2000	63 (16)	Nd[4]	50 (8)	38 (13)	100 (1)	Nc[5]	36 (11)	100 (1)
2001	50 (18)	Nd[4]	53 (17)	54 (13)	Nc[5]	Nc[5]	36 (14)	50 (4)
2002	33 (12)	Nd[4]	59 (17)	0 (9)	Nd[4]	Nd[4]	50 (6)	78 (9)
2003	91 (11)	Nd[4]	44 (18)	0 (10)	Nd[4]	Nd[4]	78 (9)	100 (2)
2004	76 (17)	50 (2)	24 (17)	50 (6)	Nd[4]	Bc[6]	45 (38)	Nd[4]
2005	58 (19)	Nd[4]	42 (12)	17 (6)	38 (8)	Nd[4]	24 (34)	100 (2)
2006	60 (15)	Nd[4]	55 (20)	50 (8)	44 (9)	0 (3)	23 (17)[7]	20 (5)
2007	67 (12)	Nd[4]	57 (14)	27 (11)	0 (6)	0 (1)	75 (8)	25 (8)
2008	80 (10)	Nd[4]	82 (11)	62 (13)	25 (8)	Nd[4]	13 (8)[8]	40 (5)[8]
2009	47 (17)[8]	0 (1)	21 (14)[8]	53 (17)	0 (8)	Nm[3]	50 (2)	33 (6)
2010	59 (17)	50 (2)	31 (13)	42 (12)	100 (3)	Nm[3]	50 (2)	18 (11)
2011	100 (7)	Nd[4]	29 (7)	39 (18)[8]	0 (5)[8]	Nm[3]	0 (1)	40 (5)

* Data from 1997 to 2002 are from Braden and McKernan (unpubl. data); these numbers have been verified with the raw data and may differ from those presented in earlier annual reports. Data from 2003 to 2007 are from McLeod et al. 2008a; data from 2008 are in McLeod and Koronkiewicz 2009; data from 2009 are in McLeod and Koronkiewicz 2010; data from 2010 are in McLeod and Pellegrini 2011, and data from 2011 are in this document. Total number of nests containing at least one flycatcher egg is indicated in parentheses.

[1] Study area includes the Hafen Lane, Mesquite East, Mesquite West, and Bunker Farm sites.

[2] Study area includes the Virgin River Delta at Lake Mead.

[3] Nm = study area not monitored.

[4] Nd = study area surveyed, no breeding documented.

[5] Nc = breeding confirmed, nest success not calculated.

[6] Bc = breeding confirmed, undetermined if nestlings from a single nest fledged.

[7] An additional three nests (18%) were suspected to have fledged but fledglings were not visually confirmed.

[8] Fate of one nest was unknown.

Nest Failure

Depredation was the major cause of nest failure, accounting for 52% (15 of 29) of all failed nests (Table 4.3) and 65% (15 of 23) of nests that failed after flycatcher eggs were laid. Six nesting attempts (21% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, three nests (10%) were deserted, and three nests (10%) were incubated in excess of 20 days. Two nests (7%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism).

Brood Parasitism

Seven of 37[1] nests (19%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.4). For nests containing flycatcher eggs, parasitism caused nest failure at two nests. In one case, the parasitism event coincided with the disappearance of all flycatcher eggs; in the other, the nest contained one cowbird nestling when it was found. No parasitized nests were known to

[1] Table 4.1 shows a total of 43 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, six nests whose contents could not be determined were excluded from calculations (e.g., nests that were too high to check contents to determine presence/absence of cowbird eggs or nesting attempts that were discovered late in the nesting cycle).

fledge a flycatcher, but the fate of one nest was unknown. Of the remaining four parasitized nests that contained flycatcher eggs, two were depredated and two contained addled flycatcher eggs. Brood parasitism ranged from 0 to 60% and was highest at Muddy River (see Table 4.1). In 2011, nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized (one-sided Fisher's exact test, $P = 0.038$).

Table 4.3. Summary of Causes of Willow Flycatcher Nest Failure at Reclamation Study Areas, 2011*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled
PAHR	7	0	0	0	0	0	0
MESQ	9	7	2 (29)	0	4 (57)	0	1 (14)
MOME	20	12	2 (17)	3 (25)[2]	6 (50)	0	1 (8)
MUDD	6	5	1 (20)	0	2 (40)	1 (20)	1 (20)
TOPO	1	1	0	0	1 (100)	0	0
BIWI	6	4	1 (25)	0	2 (50)	1 (25)	0
Total	**49**	**29**	**6 (21)**	**3 (10)**	**15 (52)**	**2 (7)**	**3 (10)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] One nest deserted after partial depredation, one deserted after 18 days incubation, one deserted during incubation with one flycatcher egg.

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds, 2011*

Study Area[1]	Nest ID Code	Outcome[2]
MESQ	32A	Incubated >20 days. CE was addled and never hatched
	72B	Depredated during incubation
MOME	90A	Depredated during incubation
MUDD	3A	Fate unknown. One 14-day-old WN seen on nest rim, but fledging not confirmed. CE was addled and never hatched
	11A	3 WE disappeared and CE appeared 17 days into incubation
	18A	Incubated >20 days. CE was addled and never hatched
BIWI	33A	Nest found with one CN and no flycatcher nestlings or WE

* All nesting attempts are included.

[1] MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg, CE = cowbird egg, WN = willow flycatcher nestling, CN = cowbird nestling.

Cowbird Egg Addling

We attempted to addle cowbird eggs at three of the seven parasitized nests. Two of the remaining four nests were too high to reach; both these nests were depredated during incubation. One nest was found with a cowbird nestling and no other nest contents; the nestling was removed. At the seventh nest, the parasitism event caused nest failure. All three parasitized nests where we attempted to addle cowbird eggs were incubated long enough for any viable cowbird eggs to hatch, though none did (Table 4.5). The 2011 hatch rate of 0% is markedly lower than annual hatch rates of un-addled eggs in 2003–2009 (min = 60; max = 89; median = 75).

In 2011, only one of three parasitized nests that were incubated full-term hatched flycatcher nestlings (Table 4.6); the other two nests were incubated in excess of 20 days without any flycatcher eggs hatching. The fate of the parasitized nest that hatched a flycatcher nestling was unknown; we detected a 14-day-old flycatcher nestling on the nest rim but were unable to confirm that the nestling fledged. Success rates of parasitized nests that hatched at least one flycatcher nestling in 2003–2009 ranged from 44 to 100%. In parasitized nests that hatched flycatchers, the number of nestlings that survived to at least eight days old in 2011 (1.0/nest) was comparable to the numbers seen in 2003–2009 (min = 0.6; max = 1.5; median = 1.3).

Table 4.5. Brown-headed Cowbird Annual Hatch Rate in Willow Flycatcher Nests at Reclamation Study Areas from 2003 to 2011

Year	# Nests[1]	# CE	# CN	Hatch Rate
2003	4	4	3	75
2004	9	9	8	89
2005	9	9	7	78
2006	2	3	2	67
2007	6	8	6	75
2008	5	5	3	60
2009	8	8	5	63
2010[2]	4	4	1	25
2011[2]	3	3	0	0

[1] Total number of nests in which the cowbird egg hatched or was incubated full term (>10 days) are included.

[2] All cowbird eggs were addled at least once.

Table 4.6. Willow Flycatcher Nesting Success for Parasitized Nests at Reclamation Study Areas from 2003 to 2011

Year	# Nests[1]	# Nests with Flycatcher Nestlings[2]	# Nests with Flycatcher Fledges[3]	# Flycatcher Nestlings of Banding Age[4]	# Flycatcher Fledges[5]
2003	3	2 (67)	2 (100)	2 (1.0)	2 (1.0)
2004	10	9 (90)	4 (44)	5 (0.6)	5 (0.6)
2005	10	10 (100)	5 (50)	8 (0.8)	6 (0.6)
2006	4	4 (100)	2 (50)	6 (1.5)	3 (0.8)
2007	5	2 (40)	2 (100)	3 (1.5)	3 (1.5)
2008	5	4 (80)	3 (75)	5 (1.3)	3 (0.8)
2009	6	4 (67)	2 (50)	6 (1.5)	4 (1.0)
2010[6]	4	4 (100)	3 (75)	7 (1.8)	5 (1.3)
2011[6]	3	1 (33)[7]	--[8]	1 (1.0)	--

[1] Total number of parasitized nests in which flycatcher eggs hatched or were incubated long enough to hatch (>14 days).

[2] Total number of parasitized nests that hatched flycatcher nestlings. Percentage of total nests is indicated in parentheses.

[3] Total number of parasitized nests that produced flycatcher fledges. Percentage of nests with nestlings is indicated in parentheses.

[4] Total number of nestlings that reached at least banding age (8 days). Number of nestlings per nest with nestlings is indicated in parentheses.

[5] Total number of nestlings that fledged. Number of nestlings per parasitized nest with nestlings is indicated in parentheses.

[6] All cowbird eggs were addled in these nests.

[7] The eggs in the other two nests failed to hatch; both were incubated at least 20 days.

[8] The flycatcher nestling was last seen in the nest on day 14. It is unclear whether it successfully fledged.

Mayfield Nest Success and Nest Productivity

Mayfield survival probability (MSP) ranged from 0.198 at Mesquite to 1.000 at Pahranagat and was 0.467 for all sites combined (Table 4.7). At all sites, 40 nestlings were confirmed to have fledged from 41 nests of known outcome (mean number of fledglings/nest = 0.98, SE = 0.19). Fecundity across study areas ranged from 0.00 to 2.83 young per female and averaged 1.18 (SE = 0.25) (Table 4.8).

Table 4.7. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Reclamation Study Areas, 2011*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Pahranagat	1	0/15	1.000	1.000
	2	0/77.5	1.000	1.000
	3	0/98	1.000	1.000
	MSP all stages = 1.000			
Mesquite	1	1/10	0.900	0.798
	2	2/63.5	0.969	0.663
	3	2/29	0.931	0.374
	MSP all stages = 0.198			
Mormon Mesa	1	0/22	1.000	1.000
	2	10/154.5	0.935	0.423
	3	0/98.5	1.000	1.000
	MSP all stages = 0.423			
Muddy River	1	0/10	1.000	1.000
	2	3/70	0.957	0.570
	3	1/24.5	0.959	0.564
	MSP all stages = 0.321			
Topock	1	0/0		
	2	1/1	0.000	0.000
	3	0/0		
	MSP all stages = N/A[2]			
Bill Williams	1	0/6	1.000	1.000
	2	2/42.5	0.953	0.538
	3	0/28.5	1.000	1.000
	MSP all stages = 0.538			
Total	**1**	**1/63**	**0.984**	**0.966**
	2	**18/409**	**0.956**	**0.561**
	3	**3/278.5**	**0.989**	**0.862**
	MSP all stages = 0.467			

* Mayfield survival probability was calculated using 2.14-day egg laying, 12.85-day incubation, and 13.76-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

[2] MSP cannot be calculated for all stages because of lack of data.

Table 4.8. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Reclamation Study Areas, 2011*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Pahranagat	17	7	2.43 (0.30)	6	2.83 (0.31)
Mesquite	3	7	0.43 (0.30)	7	0.43 (0.30)
Mormon Mesa	16	16	0.94 (0.30)	12	1.33 (0.48)
Muddy River	0	4	0.00 (0.00)	4	0.00 (0.00)
Topock	0	1	0.00	1	0.00
Bill Williams	4	5	0.80 (0.58)	4	1.00 (0.71)
Total	**40**	**41**	**0.98 (0.19)**	**34**	**1.18 (0.25)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females for which nest outcome was known.

NDOW Study Areas

Nest Monitoring

We documented 38 willow flycatcher nesting attempts at Key Pittman, River Ranch, and Warm Springs; 36 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Fourteen (39%) nests were successful and fledged young, and 20 (56%) failed. Fate was unknown at two (5%) nests. Nest success was 42% at Key Pittman, 0% at River Ranch, and 100% at Warm Springs (Table 4.9).

Twenty-one nesting females, all of which were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was documented for which no nesting attempt was found. Of the 21 nesting females, 9 had one nesting attempt, 7 had two nesting attempts, and 5 had three nesting attempts. All 12 females with multiple nesting attempts renested after failed nests.

Table 4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
KEPI	Patch 0	1	1	1	0	0	1 (100)	0
	Patch 1	1	1	1	1 (100)	0	0	0
	Patch 2	1	2	2	1 (50)	1 (50)	0	0
	Patch 4	1	1	1	1 (100)	0	0	0
	Patch 5	1	2	2	1 (50)	1 (50)	0	0
	Patch 6	3	3	3	1 (33)	1 (33)	1 (33)	0
	Patch 7	1	2	2	1 (50)	1 (50)	0	0
	Patch 8	1	2	2	0	2 (100)	0	1 (50)
	Patch 9	2	3	3	1 (33)	2 (67)	0	0
	Patch 10	2	4	4	2 (50)	2 (50)	0	0
	Patch 11	2	6	5	2 (40)	3 (60)	0	0
	Patch 12	2	6	5	2 (40)	3 (60)	0	0
	Total	*18*	*33*	*31*	*13 (42)*	*16 (52)*	*2 (6)*	*1 (11)*

Table 4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
RIRA	East Side	1	3	3	0	3(100)	0	3 (100)
	West Side	1	1	1	0	1(100)	0	0
	Smalls	1	0	--	--	--	--	--
	Total	*3*	*4*	*4*	*0*	*4 (100)*	*0*	*3 (75)*
WMSP	Muddy Mac	1	1	1	1 (100)	0	0	0
	Total	*1*	*1*	*1*	*1 (100)*	*0*	*0*	*0*
Overall Total		**22**	**38**	**36**	**14 (39)**	**20 (56)**	**2 (5)**	**4 (12)**

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Nest Failure

Depredation was the major cause of nest failure, accounting for 59% (13 of 22) of all failed nests (Table 4.10) and 65% (13 of 20) of nests that failed after flycatcher eggs were laid. Two nesting attempts (9% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, and four nests (18%) were deserted. One nest (5%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism), and all nestlings died in two nests (9%) that were still being tended by adult flycatchers.

Table 4.10. Summary of Causes of Willow Flycatcher Nest Failure at NDOW Study Areas, 2011*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled	Nestling(s) died in nest
KEPI	33	18	2 (11)	3 (17)[2]	11 (61)	0	0	2 (11)
RIRA	4	4	0	1 (25)	2 (50)	1 (25)	0	0
WMSP	1	0	0	0	0	0	0	0
Total	**38**	**22**	**2 (9)**	**4 (18)**	**13 (59)**	**1 (5)**	**0**	**2 (9)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] All nests deserted during incubation; structure of one nest damaged, possibly from a depredation attempt.

Brood Parasitism

Four of 34[2] nests (12%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.11). All four nests failed. In one case, the parasitism event coincided with the disappearance of any flycatcher eggs. In another, the parasitism event coincided with the disappearance of two of three flycatcher eggs, and the remaining flycatcher egg disappeared a few days later. The female

[2] Table 4.9 shows 36 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, two nests whose contents could not be determined were excluded from calculations (e.g., nesting attempts that were discovered late in the nesting cycle).

flycatcher continued to incubate the cowbird egg, which had been addled. One nest was deserted with two flycatcher eggs and a cowbird egg. In the remaining nest, the cowbird nestling was removed but the flycatcher nestling developed very slowly and eventually died in the nest. Brood parasitism was 11% at Key Pittman, 75% at River Ranch, and 0% at Warm Springs (see Table 4.9).

Table 4.11. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds in Key Pittman, River Ranch, and Warm Springs Study Areas, 2011*

Study Area[1]	Nest ID Code	Outcome[2]
KEPI	46B	CN removed shortly after hatching. WN developed very slowly and eventually died in the nest.
RIRA	110A	WE disappeared when CE appeared.
	110B	Nest deserted with two WE and one CE.
	110C	Two of three WE disappeared when CE appeared. Last WE disappeared a few days later.

* All nesting attempts are included.

[1] KEPI = Key Pittman WMA, RIRA = River Ranch.

[2] WE = willow flycatcher egg, CE = cowbird egg, WN = willow flycatcher nestling, CN = cowbird nestling.

Cowbird Egg Addling

Three nests at River Ranch were parasitized; one nest was too high to reach but was deserted during incubation, and the parasitism event caused failure at another nest. We addled the cowbird egg at the third nest at River Ranch. Partial depredation of this nest resulted in the loss of the remaining flycatcher egg; the female flycatcher continued to incubate the cowbird egg, which never hatched. We removed one cowbird nestling from a nest at Key Pittman that was found late in incubation. This nest also failed, with a lone flycatcher nestling developing very slowly and eventually dying in the nest.

Mayfield Nest Success and Productivity

Mayfield survival probability (MSP) was 0.447 at Key Pittman. MSP could not be calculated across all nest stages at River Ranch and Warm Springs because of lack of data for some stages. MSP was 0.375 for all three sites combined (Table 4.12). At all sites, 33 nestlings were confirmed to have fledged from 34 nests of known outcome (mean number of fledglings/nest = 0.97, SE = 0.22). Fecundity across study areas ranged from 0 to 3.0 young per female and averaged 1.65 (SE = 0.28) (Table 4.13).

Table 4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Key Pittman	1	1/42	0.976	0.950
	2	12/277	0.957	0.566
	3	3/224	0.987	0.831
	MSP all stages = 0.447			
River Ranch	1	2/5	0.600	0.335
	2	2/13.5	0.852	0.127
	3	0/0		
	MSP all stages = N/A[2]			

Table 4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011* (Continued)

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Warm Springs	1	0/0		
	2	0/13	1.000	1.000
	3	1/14	1.000	1.000
	MSP all stages = N/A[2]			
Total	**1**	**3/47**	**0.936**	**0.868**
	2	**14/303.5**	**0.954**	**0.545**
	3	**4/238**	**0.983**	**0.792**
	MSP all stages = 0.375			

* Mayfield survival probability was calculated using 2.14-day egg laying, 12.85-day incubation, and 13.76-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

[2] MSP cannot be calculated for all stages because of lack of data.

Table 4.13. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at NDOW Study Areas, 2011*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Key Pittman	30	29	1.03 (0.24)	16	1.88 (0.29)
River Ranch	0	4	0.00 (0.00)	3	0.00 (0.00)
Warm Springs	3	1	3.00	1	3.00
Total	**33**	**34**	**0.97 (0.22)**	**20**	**1.65 (0.28)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females.

DISCUSSION

Reclamation Study Areas

Number of Breeding Flycatchers

In 2011, willow flycatcher nesting was documented at six Reclamation study areas (Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams). No flycatchers were documented at Littlefield, which held breeding flycatchers in 2009 and 2010 but was scoured by floods in December 2010. Given that southwestern riparian ecosystems experience dynamic change and are not ecologically static (Periman and Kelly 2000), willow flycatcher occupancy and nesting are likely to be affected by changes in habitat suitability, with breeding flycatchers detected at a given site in one year and not in another. The number of flycatcher pairs recorded at Mormon Mesa, Muddy River, and Bill Williams was comparable to that recorded over the last several years. Mesquite had seven pairs in both 2011 and 2010, which was a drop from the number of pairs recorded in the previous four years (range 11–15). The main breeding site at Mesquite was dry in 2009 and nesting success was poor that year (McLeod and Koronkiewicz 2010). Flycatchers appeared to respond to the poor conditions by returning to other breeding sites in 2010 rather than returning to Mesquite (McLeod and Pellegrini 2011), and the number of breeding flycatchers at Mesquite was consequently reduced. It is unclear why the number of breeding pairs at Mesquite remained low in 2011 despite wet conditions at Mesquite West (see Chapter 2) at the beginning of the breeding season. It is possible that habitat suitability in the western portion of

Mesquite West, which is a mix of tamarisk and coyote willow and was unoccupied in 2011, has been reduced by tamarisk beetle defoliation.

Pahranagat had six breeding pairs in 2011, the lowest number recorded since 2003 (range 8–15 pairs). Monitoring in future years will help determine whether this is a temporary decline at Pahranagat or whether the amount of suitable habitat could be decreasing because of the reduced amount of surface water at the site in 2008–2011(see Chapter 2). There is evidence that the spatial distribution of nests within the main breeding site at Pahranagat has shifted over the years, moving away from the interior of the site, which was formerly inundated, and toward the periphery of the site, which is still in close proximity to surface water (NAU, unpubl. data).

Topock Marsh had five resident flycatchers, consisting of three unpaired males and one pair, the lowest number of resident individuals recorded since monitoring began in 1998. The number of resident flycatchers at Topock has been declining steadily since 2004. Water levels were exceptionally low in 2011 (see Chapter 2), which may have contributed to the continuing decline.

Nest Success

Nest success alone is an incomplete measure of the production of young. Successful nests produce from one to four young, and variations in nest productivity are not reflected in nest success rates. In addition, although every failed nest attempt lowers percent nest success and MSP, success of a subsequent nesting attempt may result in the same number of young produced as if the initial nesting attempt had been successful. Thus, nest productivity (young produced per nesting attempt) and fecundity (young produced per female) in conjunction with nest success provide additional information on the success of a given breeding season. Nest success at Pahranagat (100%) was, as it has been every year since 2003, higher than the average for all study areas. Productivity (2.43 young per nest) and fecundity (2.83 young per female) at Pahranagat in 2011 were also the highest recorded at any Reclamation study area, demonstrating that Pahranagat continues to be a highly productive site for willow flycatchers.

Percent nest success was essentially unchanged at Mesquite compared to 2010, but fecundity in 2011 (0.43) was less than half that of 2010 (1.00), and only three fledglings were produced. Fecundity was also low in 2009 (0.25). The main breeding site at Mesquite was dry during much of the breeding season in 2009 and after mid-June 2011, and dry conditions may be related to poor flycatcher reproduction (Moore and Ahlers 2008). Percent nest success, productivity, and fecundity at Mormon Mesa were all similar to what they had been in 2010. Muddy River, Topock, and Bill Williams continued to exhibit annual fluctuations in reproductive metrics, but sample sizes are too low to attribute much significance to the rates observed in 2011. Nest success results again illustrate that the demographic patterns of passerine populations often vary year to year, and sometimes to a very large degree (Wiens 1989a). The variable patterns of nest success observed at the study areas over many years demonstrate the need for long-term data.

Nest Failure

As in 2003–2010, depredation was the major cause of willow flycatcher nest failure, accounting for 52% of all failed nests in 2011. These results are consistent with those reported at the Reclamation study areas from 1998 to 2002 (Braden and McKernan unpubl. data) and at sites across Arizona from 1996 to 2008 (Graber et al. 2007, Ellis et al. 2008, Graber and Koronkiewicz 2009a), which indicate depredation as accounting for the majority of all willow flycatcher nest failures. Factors influencing the increases and decreases in nest depredation at the monitored study areas are inherently complex and at this time remain undetermined. For open-cup nesting passerines, nest depredation rates can vary year to year, and sometimes substantially, with depredation of eggs and young ultimately linked to landscape

characteristics and fluctuations in predator densities, abundance, and richness (Wiens 1989b, Robinson 1992, Howlett and Stutchbury 1996).

In 2008, Northern Arizona University (NAU) initiated a nest camera study in cooperation with SWCA on open-cup nesting passerines at selected study areas along the lower Colorado River and tributaries. The study used video and still cameras on real and artificial nests to identify depredation rates and nest predators. The study continued in 2009 and 2010, with video cameras deployed at flycatcher nests and still cameras at artificial nests. Marks on clay eggs indicated that most depredation events at Mesquite were from birds, while at Pahranagat both birds and rodents depredated artificial nests (NAU unpubl. data). Both Brown-headed Cowbirds and Yellow-breasted Chats were identified by still cameras as depredating artificial nests. Cowbirds were also documented on video depredating flycatcher nests at Mesquite in both 2009 and 2010. A variety of avian predators were documented depredating flycatcher nests at Pahranagat. The study was continued in 2011, with video cameras deployed at real flycatcher nests at Pahranagat, but all flycatcher nests were successful and no depredation events were documented. Results of this study suggest that avian species may be important predators on flycatcher nests at Reclamation study areas. Ellis et al. (2008) also identified Cooper's Hawks (*Accipiter cooperii*) and Yellow-breasted Chats depredating flycatcher nests at sites in Arizona.

Brood Parasitism

Brood parasitism by Brown-headed Cowbirds across all Reclamation study areas ranged from 0 to 60% and averaged 19% (see Table 4.1). These results are consistent with those reported at the study areas from 1998 to 2010 (Braden and McKernan unpubl. Data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011), but these parasitism rates are higher than those reported at other monitored sites across Arizona in 1996–2006, which were less than 10% at most sites in most years (Graber et al. 2007, Ellis et al. 2008).

We observed multiple occasions in which the disappearance of flycatcher eggs coincided with the parasitism event. In this case, cowbirds were suspected of ejecting the eggs. Female Brown-headed Cowbirds are known to physically attack willow flycatcher nestlings (Woodward and Stoleson 2002), remove single eggs, and occasionally destroy entire broods after laying is complete or after hatching (Lowther 1993 as cited in Woodward and Stoleson 2002). In addition, cowbirds were photographed removing eggs from artificial nests during the 2008–2010 camera study, and cowbirds were documented on video depredating flycatcher nests during both the incubation and nestling phases. Therefore, it is likely that other depredation events on eggs and nestlings are attributable to cowbirds.

Parasitism does not invariably cause nest failure, but the success rate (18%) for parasitized nests at all study areas in 2003–2011 was less than half that of unparasitized nests (49%). Similar results were recorded for willow flycatchers in Oregon, with parasitism resulting in a 50% decrease in success rates compared to unparasitized nests (Sedgwick and Iko 1999) and at other sites in Arizona, where in 1996–2005, 20% of parasitized nests fledged flycatcher young vs. 57% of unparasitized nests (Ellis et al. 2008). Parasitized nests that did succeed in fledging flycatcher young at all study areas in 2003–2011 produced on average fewer young (1.3 young/nest) than did unparasitized nests (2.2 young/nest; $F_{1,249} = 21.24$, $P < 0.001$). Cowbirds may eject flycatcher eggs during the parasitism event, thus reducing clutch size, and cowbird young also cause interspecific nestling competition, as evidenced by the presence of severely underdeveloped nestlings in some parasitized nests. For all nests monitored from 2003 to 2011, 44% of nests that fledged a cowbird also fledged flycatcher young. This is a higher rate of success than that observed in Southwestern Willow Flycatchers at Kern River, California (9%; Whitfield and Sogge 1999), but comparable to that observed at other Arizona sites (40%; Ellis et al. 2008).

Female flycatchers may desert their nests after parasitism events and thus expend energy renesting and laying additional eggs. Given that adult flycatchers exhibit high site fidelity to breeding areas (Braden and McKernan unpubl. data, McLeod et al. 2008a, McLeod and Koronkiewicz 2009, this document) and renest most often after failed nests (Sedgwick 2000), females returning to sites with high brood parasitism may have reduced lifetime fecundity because they are expending energy on multiple failed nesting attempts over many years. An analysis of lifetime fecundity of females will be included in the summary report in 2012. In addition, willow flycatchers that fledge late in the season have been shown to have a lower survival rate than those that fledge early in the season (Paxton et al. 2007, McLeod et al. 2008a), suggesting additional hidden effects of parasitism and subsequent renesting on flycatcher demography.

Cowbird trapping and removal studies were initiated at Pahranagat, Mesquite, and Topock Marsh in 2003 and continued through 2007. Results of these studies showed that cowbird trapping appeared to lower parasitism rates in comparison to the pre-trapping period of 1998–2002 only at Pahranagat, with no parasitism detected during trapping years (McLeod et al. 2008a). No cowbird trapping was completed in 2008–2011, but even in the absence of cowbird trapping, no parasitism events were detected at Pahranagat in 2008, 2009, or 2011. One parasitism event was noted in 2010, and the nest was abandoned before flycatcher eggs were laid. This nest was located on the very edge of the site, adjacent to open, upland habitat, possibly increasing parasitism probability. These observations suggest that cowbird trapping may have lingering effects beyond the years in which trapping is completed.

We speculated that trapping might have affected the parasitism rate at Pahranagat but not the other study areas because Pahranagat consists of relatively small, isolated patches of riparian habitat rather than existing in a large, contiguous riparian corridor. The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 26%, well below the average of 46% across all other study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

Cowbird Egg Addling

We addled cowbird eggs and removed cowbird nestlings in all study areas except Pahranagat in 2011. Pahranagat was not included because it is still part of the 5-year post-cowbird-trapping experiment. Though sample size is small, addling cowbird eggs seemed to reduce the hatch rate of cowbird eggs. Furthermore, none of the females deserted their nests after we addled cowbird eggs. One female in a non-Reclamation study area from whose nest a cowbird nestling was removed also continued to raise the remaining flycatcher nestling. While flycatcher hatch rates and productivity were not improved by the program in 2011, this is not necessarily due to the program itself so much as low parasitism rates and high rates of nest failure due to addling where parasitism did occur. We recommend this program be continued in the future. Field personnel should also continue to practice egg addling at the beginning of the season with button quail eggs to maximize the effectiveness of shaking eggs in preventing hatching.

NDOW Study Areas

At Warm Springs, a fire during the breeding season of 2010 affected all sites and reduced the availability of suitable habitat (see Chapter 2), and the number of breeding pairs declined correspondingly from three to one in 2010 and 2011, respectively. Many measures of nesting (number of breeding pairs, Mayfield nest success, and rate of brood parasitism) were similar at Key Pittman between 2010 and 2011.

Productivity and fecundity were lower in 2011 (1.03 and 1.88, respectively) than in 2010 (1.23 and 2.03, respectively), but there was no statistically significant difference in either fecundity or productivity between years.

Cowbird parasitism was high (75%) at River Ranch, and none of the four nests at this site was successful. Low nest success is further indication of poor habitat quality at River Ranch (see Chapter 3 for a discussion of within-year movement and the presence of second-year individuals at River Ranch).

Video cameras were deployed on flycatcher nests in both 2010 and 2011 at Key Pittman. Two depredation events were recorded on video in 2011 (NAU unpubl. data), one by a kingsnake (*Lampropeltis getulus*) and the other by a Sharp-shinned Hawk (*Accipiter striatus*). Field personnel also witnessed a depredation event by a short-tailed weasel (*Mustela frenata*).

This page intentionally left blank.

Chapter 5

VEGETATION AND HABITAT CHARACTERISTICS

INTRODUCTION

Our objective for vegetation sampling is to provide a quantitative summary of the floristic and structural conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if they resemble occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the vegetation consists primarily of very large and widely spaces trees, and these characteristics are unique to the site and not likely to be replicated in restoration areas. In 2011, we completed vegetation sampling within occupied territories only at Bill Williams because of the relatively low sample size of vegetation plots obtained at this study area over previous years. Sampling at all other study areas was discontinued because of adequate sample sizes from previous years. A combined analysis of all years of vegetation data will be presented in a summary report in 2012.

METHODS

We described and measured vegetation and habitat features following a modification of the methods of James and Shugart (1970). Vegetation characteristics were measured within a 5-m-radius circle. To avoid disrupting flycatcher breeding activities, we measured vegetation late in the summer when the nest, territory, and adjacent flycatcher territories were inactive.

In 2008, we measured vegetation and habitat characteristics at one plot for each resident (i.e., detected for at least one week) male flycatcher we identified, regardless of whether or not he obtained a mate. Plot center locations were determined as soon as territories were identified. We estimated the center of the male's activity by observing his use of singing perches and selecting a location that was approximately equidistant from the perches at the perimeter of his use area. We then proceeded in a randomly selected compass direction for a randomly selected distance between 0 and 20 m. We used additional random numbers to select the exact location in which to hang a temperature/humidity data logger (see Chapter 6) and used that location as plot center. This process resulted in the random selection of a point that was still within the male's territory. The sampling points were marked in the field with flagging that remained in place over the winter.

In 2009, we identified the territory center for each resident male as described above. If an existing sampling point from 2008 was within 20 m of the territory center identified in 2009, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. All sampling points that were assigned to active territories in 2009 were marked with flagging that remained in the field over the winter. We repeated this point selection procedure for territories that were active in 2010 and 2011, assigning a sampling point that was used in the previous year if one was within 20 m of the current territory and selecting a new sampling point if no existing point were available. Sampling points that were identified in 2010 but were not within 20 m of a territory center in 2011 were resampled in 2011.

At each plot, we laid out four 5-m-long ropes from plot center, one in each of the four cardinal directions. Each rope was marked at 1 m and 5 m from the center of the plot. At plot center and at 1 m and 5 m from

the center of the plot in each cardinal direction, we measured vertical foliage density using a 7.5-m-tall survey rod. Working our way up the rod, we recorded the presence of vegetation, by species, within a 10-cm radius of the rod in 0.1-m intervals (presence of the species within the 0.1-m interval equaled one "hit" on the rod), and summed all hits in 1-m intervals. Presence of dead vegetation (snags) was recorded in the same manner, but not identified to species. If canopy vegetation continued above 8.0 m, we estimated the number of hits as zero, greater than five, or less than five hits per 1-m interval until the canopy vegetation stopped (modified from Rotenberry 1985).

We measured total canopy closure using a Model-A spherical densiometer at 1 m north and south of the center of each plot and averaged these measurements to obtain a single canopy closure value for each plot. We measured average canopy height within each plot by selecting a representative tree and using a survey rod or a clinometer and measuring tape to measure the height of the selected tree. We estimated percent woody ground cover, alive and dead, within 0.5 m of the ground using a Daubenmire-type frame with the lower edge of the frame centered at 1 m north, south, east, and west of plot center. These percentages were averaged to obtain a single measure of percent woody ground cover for each plot.

We tallied the number of live stems for each species within 5 m of the center of the plot. Stems were tallied if they were at least 1.4-m tall and >2.5 cm in diameter at 10 cm above the ground. Stems were tallied by the following diameter at breast height (dbh) categories: <1 cm, 1–2.5 cm, 2.6–5.5 cm, 5.6–8 cm, 8.1–10.5 cm, and 10.6–15 cm. Any stems >15 cm dbh were measured and the exact dbh was recorded. Dead stems were also tallied in these categories, but not identified to species. We marked each stem with a piece of chalk after it was tallied to facilitate accurate stem counts.

During vegetation sampling in 2003–2007, if a stem branched above 10 cm but below 1.4 m above the ground, only the largest stem was tallied. In habitats (e.g., tamarisk) where stems frequently branch in this height interval, this method of counting stems may underestimate the density of stems that form an important part of the habitat structure. Therefore, in 2008–2011 we tallied stems as we had in previous years and then for each stem that branched between 10 cm and 1.4 m from the ground, we tallied the number of additional stems that were at least 2.5 cm in diameter at 10 cm above the point where it branched from the main stem.

Additional information recorded at each plot included the date when the measurements were taken, observer initials, and UTM coordinates for each plot center.

Data Analyses

We used high-resolution aerial photography and field knowledge of each study area to delineate clusters of territories that occur within habitat patches of similar floristics and canopy height. Vegetation characteristics were then summarized for each habitat type. For each habitat type, we give the corresponding vegetation classification as defined in Younker and Andersen (1986) and used in the LCR MSCP. We also pooled data across habitat types that fell under a single vegetation classification and present summary statistics for each vegetation classification. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

Stem counts were grouped into the following size categories for analysis: ≤2.5 cm dbh, 2.6–8 cm dbh, and >8 cm dbh. For each size category, stem counts are reported separately for live and dead stems; the sum of these is the equivalent of the stem counts per size category that were reported in the 2003–2007 summary report (McLeod et al. 2008a). Vertical foliage density measurements above 8.0 m that were recorded as < or >5 hits per meter were converted to 2.5 and 7.5 hits, respectively, to allow analyses of these data as continuous rather than categorical. Vertical foliage density was calculated for each meter interval as the mean of the number of hits recorded within the interval at the nine locations in the plot.

In 2003–2007, we had measured vertical foliage density only at plot center and 1 m from plot center in each cardinal direction, and foliage density measures per meter interval were presented as the sum of the hits recorded at the five locations in the plot. Thus, vertical foliage data presented in reports from 2003 to 2007 should be divided by 5 to be comparable to data presented here. In the five-year summary report (McLeod et al. 2008a), vertical foliage data were grouped into three categories of above, at, and below the nest. We used average nest height as measured in 2003–2011 in each vegetation type to demarcate vertical foliage categories in 2011. As with stem counts, vertical foliage data are reported separately for live and dead vegetation.

Percent native vegetation was calculated as the average of the percent basal area that was native and the percent native vertical foliage hits. To obtain basal area, we multiplied the number of stems tallied in each size class by the average basal area of a stem in that class, given an even distribution of stems within each size class. For data collected in 2003–2007 (reported in McLeod et al. 2008a), we did not use vertical foliage data to calculate percent native because all vertical foliage data were collected within 1 m of plot center and represented only a small portion of the plot. We included vertical foliage data in the percent native calculations in 2008–2011 to account for the influence of stems that were too small to be tallied or were rooted outside the 5-m-radius circle but overhung the plot.

RESULTS

We measured vegetation at Bill Williams at four occupied territories and four territories that were occupied in 2010 but not in 2011. The eight territories are located in five survey sites at Bill Williams: Site #3, Site #4, Burn Edge, Planet Ranch Road, and Cougar Point. Of the four occupied territories, three had nesting flycatchers and one was occupied by an unpaired male. Small sample sizes preclude any comparison between territories occupied by nesting pairs versus those occupied by unpaired males; data collected in 2011 will be combined with data collected in previous years for this comparison, which will be presented in a five-year summary report in 2012. Data from territories that were occupied in 2010 but not in 2011 are not included in the 2011 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. This analysis would also be presented in the summary report.

We delineated the following habitat types: 1) Goodding willow with tamarisk understory, and 2) cottonwood/willow. Goodding willow with tamarisk understory occurred in Site #3, Site #4, and Burn Edge, while cottonwood/willow was present at Planet Ranch Road and Cougar Point. Average nest height recorded in 2003–2011 and used to assign vertical foliage strata for each vegetation category were 4.2 m for Goodding willow with tamarisk understory and 2.5 m for cottonwood/willow.

Although the vegetation types delineated in this report differ from one another in vertical structure and floristic composition, all fall within the definition of cottonwood-willow habitat (cottonwoods and willows constituting at least 10% of total trees) as described in Younker and Anderson (1986) and used in the LCR MSCP. The cottonwood/willow habitat type as delineated in this report falls under the definition of cottonwood-willow Type III (no understory, with the canopy layer from 4.5–6.0 m), while Goodding willow with tamarisk understory as delineated in this report falls under the definition of cottonwood-willow Type I (three definitive layers of vegetation with the majority of the vegetation volume at 6.0 m or more).

Vegetation characteristics of each habitat type are summarized in Table 5.1. Habitat characteristics varied between and within habitat types.

Table 5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2011*

Parameter	SAGO with TASP understory (C-W Type I) (n=2)	POFR and SAGO (C-W Type III) (n=2)
Average canopy height (m)	6.3 (0.5)	7.4 (0.7)
	5.8–6.8	6.7–8.0
% total canopy closure	90.9 (3.9)	97.4 (1.6)
	87.0–94.8	95.8–99.0
% woody ground cover	33.9 (21.4)	37.1 (31.6)
	12.5–55.3	5.5–68.8
# live stems ≤2.5 cm dbh per ha	1846 (1210)	1210 (1210)
	637–3056	0–2419
# live stems 2.6–8 cm dbh per ha	3183 (764)	9486 (446)
	2419–3947	9040–9931
# live stems >8 cm dbh per ha	573 (318)	1210 (64)
	255–891	1146–1273
# dead stems ≤2.5 cm dbh per ha	446 (191)	1337 (955)
	255–891	382–2292
# dead stems 2.6–8 cm dbh per ha	827 (191)	764 (255)
	637–1019	509–1019
# dead stems >8 cm dbh per ha	64 (64)	0 (0)
	0–127	0–0
Percent native	1.7 (1.2)	99.1 (0.6)
	0.4–2.9	98.8–100.0
Live vertical foliage (hits) below average nest height	6.3 (0.4)	1.9 (1.1)
	5.9–6.7	0.8–3.0
Live vertical foliage (hits) at average nest height	2.7 (0.0)	3.9 (1.9)
	2.7–2.7	2.0–5.8
Live vertical foliage (hits) above average nest height	2.2 (0.8)	13.7 (2.4)
	1.4–3.0	11.2–16.1
Dead vertical foliage (hits) below average nest height	12.7 (1.8)	3.4 (2.7)
	10.9–14.4	0.8–6.1
Dead vertical foliage (hits) at average nest height	0.6 (0.4)	1.8 (1.7)
	0.1–1.0	0.1–3.6
Dead vertical foliage (hits) above average nest height	0.2 (0.2)	1.0 (1.0)
	0–0.4	0–2

* Data are presented as mean, standard error, and range. Stem counts include only the largest stem of any cluster that branched above 10 cm above the ground. SAGO = Goodding willow, TASP = tamarisk, POFR = cottonwood, C-W = cottonwood-willow.

The proportion of stems omitted from stem counts by counting only the largest stem of a cluster that branched between 10 cm and 1.4 m above the ground varied both by size and species of the main stem (Table 5.2). Larger stems typically had more branches that were omitted.

Vertical foliage profiles for each habitat type are shown in Figures 5.1–5.2. Average nest height in each habitat type, as recorded in 2003–2011, is also shown on each graph. In both habitat types, the proportion of dead vegetation in the vertical profile was highest immediately above the ground and declined with increasing height. The densest live foliage occurred 3–5 m above the ground, at or above average nest height.

Table 5.2. Proportion of Stems Omitted from Stem Counts

Size category[1]	Species			
	Tamarisk	Coyote willow	Goodding willow	Dead stems
≤2.5 cm dbh	0.12	--	0.0	0.05
2.6–8 cm dbh	0.67	--	0.0	0.52
>8 cm dbh	1.46	--	0.0	2.0

[1] Size category indicates the size of the main stem that was tallied. All stems that were omitted from the stem count are equal to or smaller than the size of the main stem.

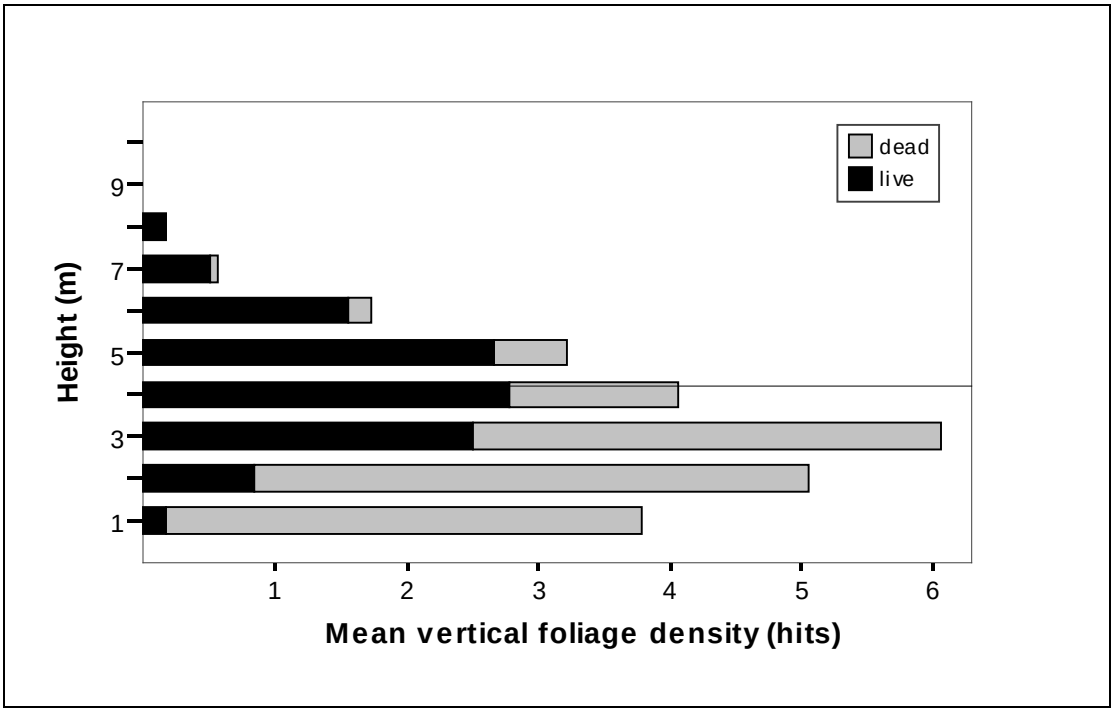


Figure 5.1. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2011. Horizontal line shows average nest height in this habitat type in 2003–2011. This habitat type is also cottonwood-willow Type I.

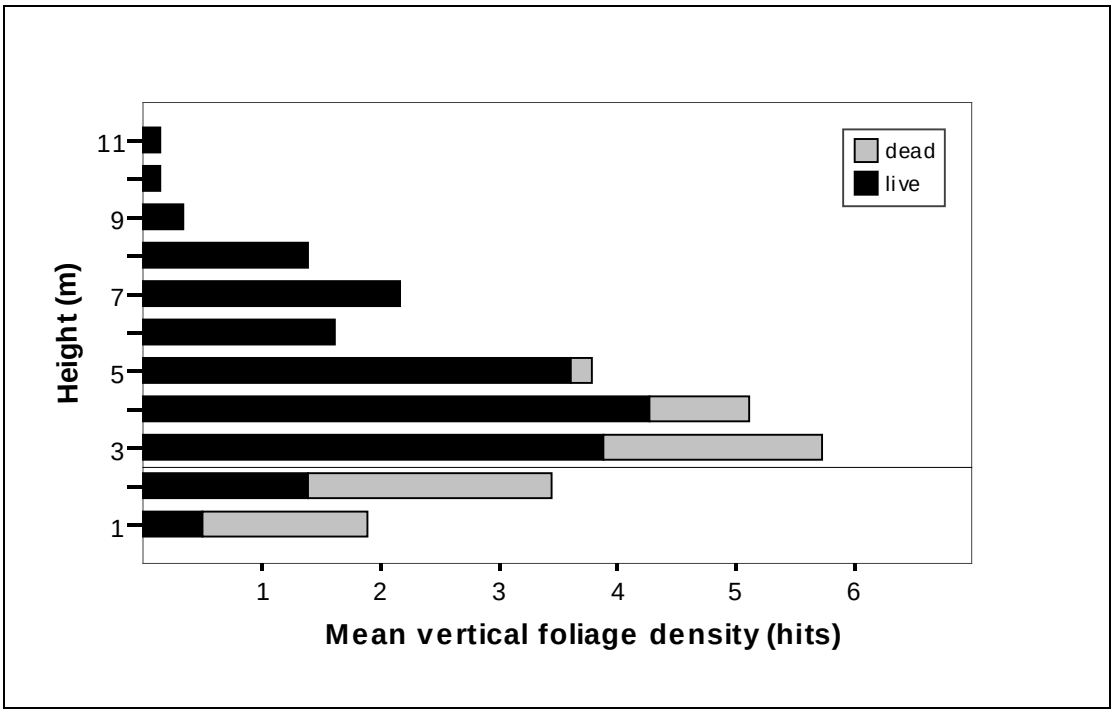


Figure 5.2. Vertical foliage density at occupied willow flycatcher territories in cottonwood/willow habitat type, 2011. Horizontal line shows average nest height in this habitat type in 2010–2011. This habitat type is also cottonwood-willow Type III.

DISCUSSION

The purpose of vegetation measurements of occupied habitat is to provide quantitative guidelines for restoration efforts. The limited data collected in 2011 preclude any meaningful summary of habitat characteristics and any comparison between vegetation types. In a summary report to be completed in 2012, data from 2011 will be combined with other data collected within active territories in prior years to provide a more comprehensive description of each habitat type.

Chapter 6

MICROCLIMATE

INTRODUCTION

Our objective for microclimate sampling is to provide a quantitative summary of microclimate conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if the microclimate resembles that in occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the study area is approximately 650 m higher in elevation and experiences a cooler climate than the LCR MSCP planning area. In 2011, we collected microclimate data only at Bill Williams; adequate sample sizes had been achieved at all other study areas in previous years.

METHODS

Temperature and Humidity Measurements

Measurements of temperature and humidity were recorded automatically every 15 minutes using a HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) that combines a thermometer (degrees Celsius), humidity monitor, and digital data logger. We camouflaged all HOBO units by placing them in an inverted small, plastic container coated with spray adhesive and local vegetation. The opening at the bottom was covered with shadecloth, allowing free air circulation around the unit.

In 2010, we collected microclimate measurements at one location for each resident male flycatcher we identified, regardless of the length of time the male was resident and whether or not he obtained a mate. One HOBO unit was placed within each active flycatcher territory. We estimated the center of the male's territory (see Chapter 5) and then determined the location of the HOBO unit by means of the following instructions and the use of random number sequences:

1) The compass direction to walk from the territory center, given in degrees from north, was determined from a random number sequence.

2) The distance (between 0 and 20 m) to walk in the designated direction was determined from a random number sequence. Once that distance was traveled, the closest woody tree or shrub was selected for data logger placement.

3) The HOBO unit was placed at a randomly selected height within the range of flycatcher nest heights documented at that study area in 2003–2007 (McLeod et al. 2008a). The distribution of random numbers followed the distribution of nest heights. If the chosen tree or shrub was of insufficient height to accept the height from the random number sequence, then field personnel placed the HOBO unit at the first height in the sequence that was less than the height of the tree or shrub. If no nests had been previously recorded at that study area, field personnel used the height sequences from the nearest study area with known nests.

4) The distance (0–2 m) at which the HOBO was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If the tree or shrub was of insufficient radius to accept the distance from the random number sequence, then field personnel placed the unit at the first number in the sequence that was less than the radius of the tree or shrub.

5) The compass direction, given in degrees from north, at which the unit was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If there was no branch in this compass direction that would support the data logger at the height and distance specified in (3) and (4), field personnel proceeded clockwise around the tree or shrub until a suitable branch was located.

If, as presented in (3) and (4), a number from a subsequent random number sequence (sequence meaning a row in the random number table) was used because the number in the initial sequence was too high, then both sequences were considered used and no longer available for future use. If these directions took field personnel outside of the riparian zone or to a site without trees or shrubs, they returned to the territory center and used the next sequence of random numbers.

The HOBO logger locations representing active territories in 2010 at Bill Williams were marked in the field with flagging, which remained in place over the 2010–2011 winter. HOBO loggers were redeployed in these same locations in early May 2011. During the breeding season of 2011, we identified the territory center for each resident male. If an existing sampling point was within 20 m of the territory center identified in 2010, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. Sampling points that were identified in 2010 but were not within 20 m of a territory center in 2011 were resampled in 2011. Data from these points are not included in the 2011 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. All HOBO units were removed from the field at the end of the breeding season.

Soil Moisture Measurements

A ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively) was used to gather soil moisture data. The soil moisture readings (nine per site) were recorded directly beneath the HOBO logger (plot center) and at 1.0 and 2.0 m from plot center in each cardinal direction. Soil moisture readings were collected when the HOBO logger was deployed and at two-week intervals throughout the breeding season until the HOBO logger was removed at the end of the season. Soil moisture was recorded both as voltage (mV) and as volumetric water content (%).[1] Soil type on the HH2 was set to mineral soil. For any soil moisture measurement point that was underwater, we recorded the depth of standing water and assigned a value of 994 mV, which is equivalent to 50% volumetric water content, or fully saturated soil. All mV values greater than 994 were also reassigned as 994 mV, because this reading represents fully saturated soil and because the mV to percent relationship becomes excessively nonlinear for mV readings above this point. Each time we collected soil moisture data, we also recorded the distance to the nearest standing water or saturated soil (as measured by visual estimate, GPS, or aerial photo) and recorded the approximate percentage, as estimated in the field by visual observation in combination with aerial photo, of the site within 20 and 50 m of the data logger that contained inundated or saturated soil.

A soil sample was collected from beneath each HOBO location that was new in 2011. Samples were approximately the size of a medium apple, collected from the surface down to and including a depth of 5 cm, and placed in a heavy zip-lock plastic bag labeled with the site designation. These samples will contribute to an ongoing analysis of soil texture, which strongly influences capillary action and therefore

[1] The soil moisture logger measures the dielectric constant of moist soil via a direct current voltage, which is converted to volumetric soil moisture with conversion tables. For very high (above ~1000 mV) or low (below ~90 mV) voltage readings, the HH2 reports volumetric soil moisture as "above" or "below" the table, respectively. To enable the use of all data, we analyzed and report only the mV readings. Both mV and percentage were recorded in the field to facilitate data proofing. Voltage is related to soil moisture as follows: $1.07 + 6.4V - 6.4V^2 + 4.7V^3 = 1.6 + 8.4\theta$, where θ = volumetric soil moisture.

overall soil moisture (Sumner 2000). Results of the soil texture analysis will be presented in the 2012 summary report.

Statistical Analyses

Soil moisture data were entered into a database as they were collected during the field season. We downloaded data from the HOBO data loggers into databases at the end of the field season. We merged all data to create one dataset for further analysis. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Distance to nearest standing water or saturated soil
- % of the area within 20 m of plot center that was inundated or saturated
- % of the area within 50 m of plot center that was inundated or saturated
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[2]
- Mean nocturnal vapor pressure

Soil moisture variables were summarized per visit, and temperature/humidity variables were summarized on a daily basis. We determined diurnal and nocturnal periods by using the actual daily sunrise and sunset times reported for the region by the National Weather Service (2011). We selected the above measures of temperature and humidity for analysis because they were the most highly correlated with other variables or were the most useful in distinguishing use areas from non-use locations (McLeod et al. 2008a). Territories were grouped according to habitat type (see Chapter 5), and microclimate variables were averaged for each habitat type over the following two-week periods to show how microclimate conditions changed throughout the breeding season: 16–31 May, 1–15 June, 15–30 June, 1–15 July, and 16–31 July. Data were also summarized by vegetation classification (see Chapter 5).

Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009). Data are presented as mean (standard error) unless otherwise noted.

RESULTS

We collected microclimate data at two active territories that contained nesting pairs and four territories that were occupied in 2010 but not in 2011. Data from territories that were occupied in 2010 but not in 2011 are not included in the 2011 data presented below but may be used in future analyses to identify any changes in microclimate that may lead to territory abandonment. This analysis would be presented in a five-year summary report in 2012. One active territory was in Goodding willow with tamarisk understory, which falls under the cottonwood-willow Type I vegetation classification, and the other territory was in cottonwood/willow, which falls under cottonwood-willow Type III (see Chapter 5). Microclimate variables are summarized by two-week periods for each vegetation type in Tables 6.1 and 6.2. These same variables are plotted in Figures 6.1–6.9 to facilitate comparisons between vegetation types.

[2] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

Table 6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory, 2011*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture (n=1)[1]						
Mean soil moisture (mV)	894.7	831.7	750.7	758.0	752.8	731.3
Mean distance to nearest standing water	15.0	15.0	15.0	375.0	393.0	470.0
% of area within 20 m that was inundated	25.0	20.0	5.0	0.0	0.0	0.0
% of area within 50 m that was inundated	30.0	35.0	15.0	0.0	0.0	0.0
Temperature (n=1)[2]						
Mean maximum diurnal temperature (°C)	35.3 (0.8)	37.9 (0.6)	39.7 (0.3)	41.6 (0.7)	39.2 (0.5)	N/A
Mean minimum nocturnal temperature (°C)	11.8 (0.7)	12.3 (0.5)	16.5 (0.6)	19.7 (0.9)	20.6 (0.8)	N/A
Mean daily temperature range (°C)	23.4 (1.0)	25.6 (0.7)	23.2 (0.5)	21.9 (0.9)	18.7 (0.9)	N/A
Humidity (n=1)[2]						
Mean diurnal vapor pressure (Pa)	1309.5 (67.2)	1726.9 (118.4)	2249.5 (113.7)	2991.2 (126.2)	3063.0 (84.2)	N/A
Mean nocturnal vapor pressure (Pa)	1037.0 (48.0)	1308.9 (52.3)	1562.9 (72.3)	2297.7 (116.8)	2339.8 (94.6)	N/A

* Data are presented as mean (standard error). This habitat type is also cottonwood-willow Type I.
[1] Sample size indicates the number of data logger locations. No standard error is reported for periods in which soil moisture variables were measured only once.
[2] Sample size indicates the number of data logger locations. Mean and standard error are reported for daily readings within each time period.

Table 6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Willow, 2011*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture (n=1)[1]						
Mean soil moisture (mV)	951.3	986.7 (0.1)	921.0	957.0	965.3	904.9
Mean distance to nearest standing water	1.0	1.3 (0.3)	0.0	1.0	1.0	1.0
% of area within 20 m that was inundated	55.0	60.0 (20.0)	40.0	85.0	50.0	60.0
% of area within 50 m that was inundated	70.0	50.0 (10.0)	65.0	45.0	60.0	50.0
Temperature (n=1)[2]						
Mean maximum diurnal temperature (°C)	29.9 (0.8)	32.6 (0.6)	35.2 (0.5)	35.0 (0.5)	35.3 (0.7)	N/A
Mean minimum nocturnal temperature (°C)	14.5 (1.0)	13.6 (0.7)	19.1 (0.8)	21.0 (1.0)	22.4 (0.8)	N/A
Mean daily temperature range (°C)	15.4 (1.3)	19.0 (0.9)	16.1 (0.6)	13.9 (1.1)	13.0 (0.9)	N/A
Humidity (n=1)[2]						
Mean diurnal vapor pressure (Pa)	1112.0 (43.0)	1269.8 (64.8)	1516.9 (50.4)	2312.6 (164.7)	2245.6 (114.6)	N/A
Mean nocturnal vapor pressure (Pa)	806.2 (25.2)	904.9 (42.3)	1114.3 (47.0)	1937.9 (147.3)	1873.1 (111.8)	N/A

* Data are presented as mean (standard error). This habitat type is also cottonwood-willow Type III.
[1] Sample size indicates the number of data logger locations. Mean and standard error are reported for time periods in which soil moisture variables were measured twice. No standard error is reported for periods in which soil moisture variables were measured only once.
[2] Sample size indicates the number of data logger locations. Mean and standard error are reported for daily readings within each time period.

AR064496

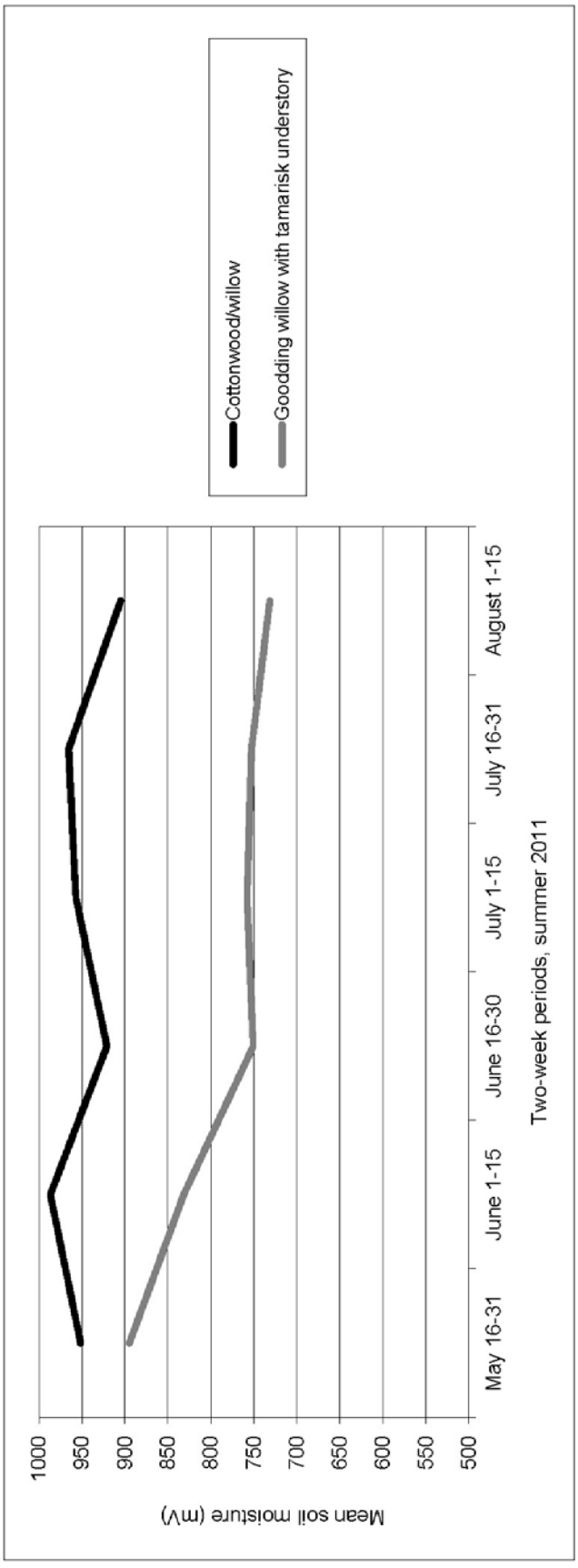


Figure 6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory.

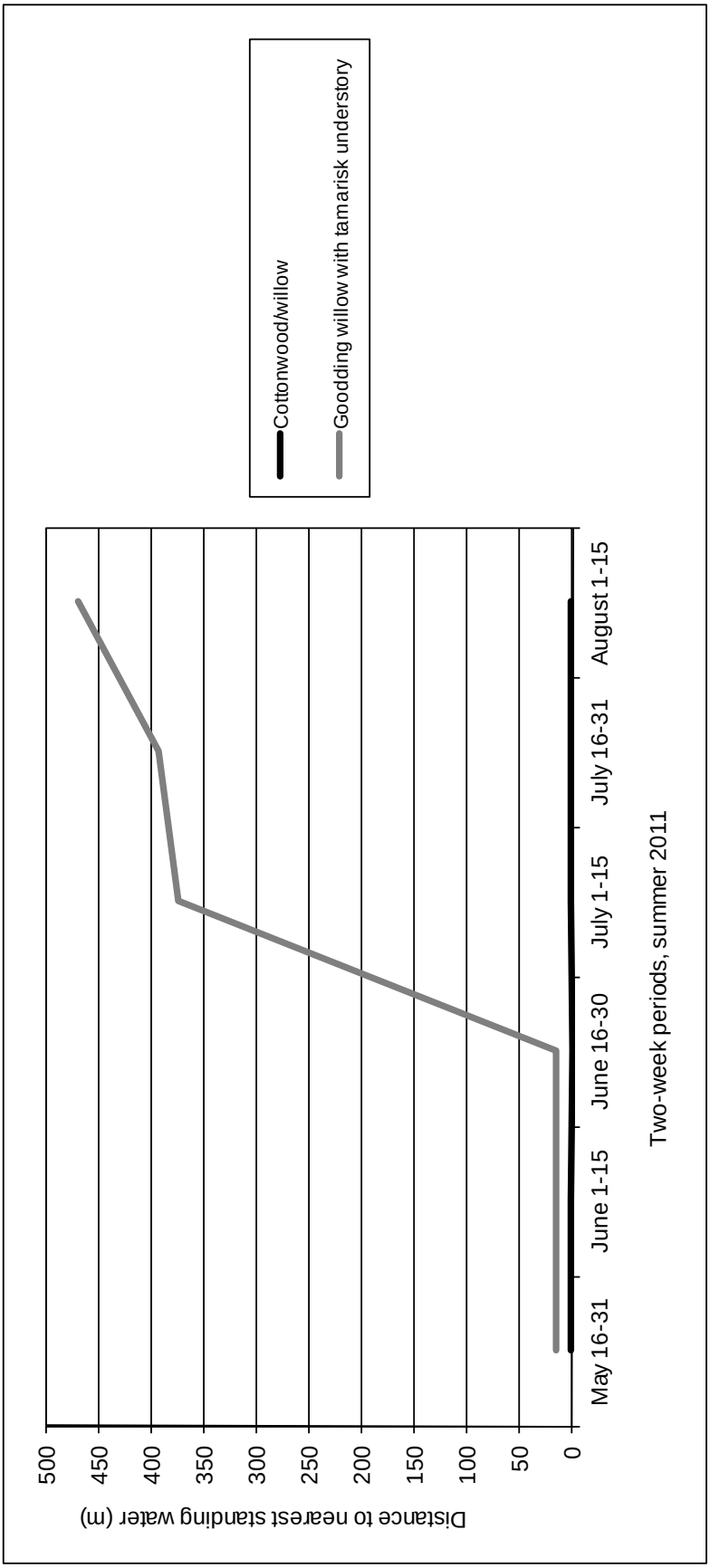


Figure 6.2. Distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which distance to water was measured more than once in a given two-week period.

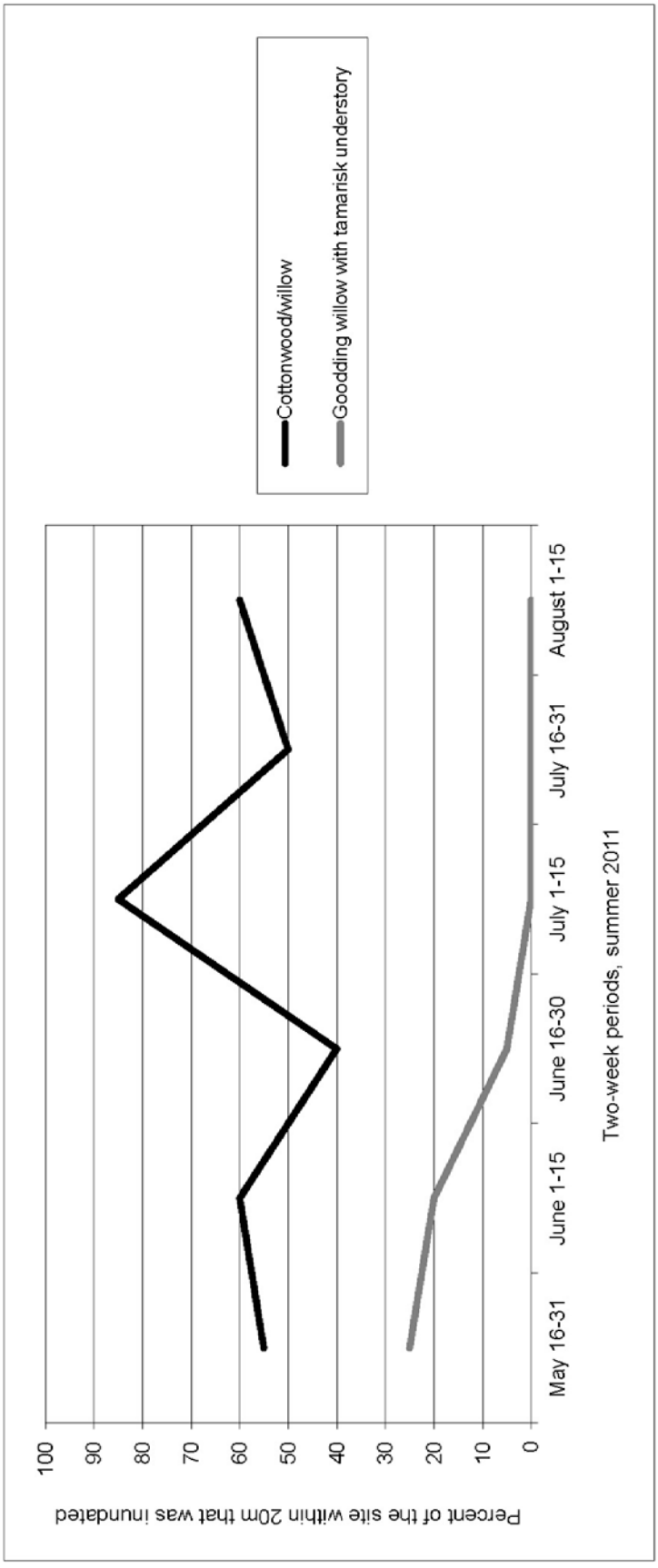


Figure 6.3. Percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which percent inundated was measured more than once in a given two-week period.

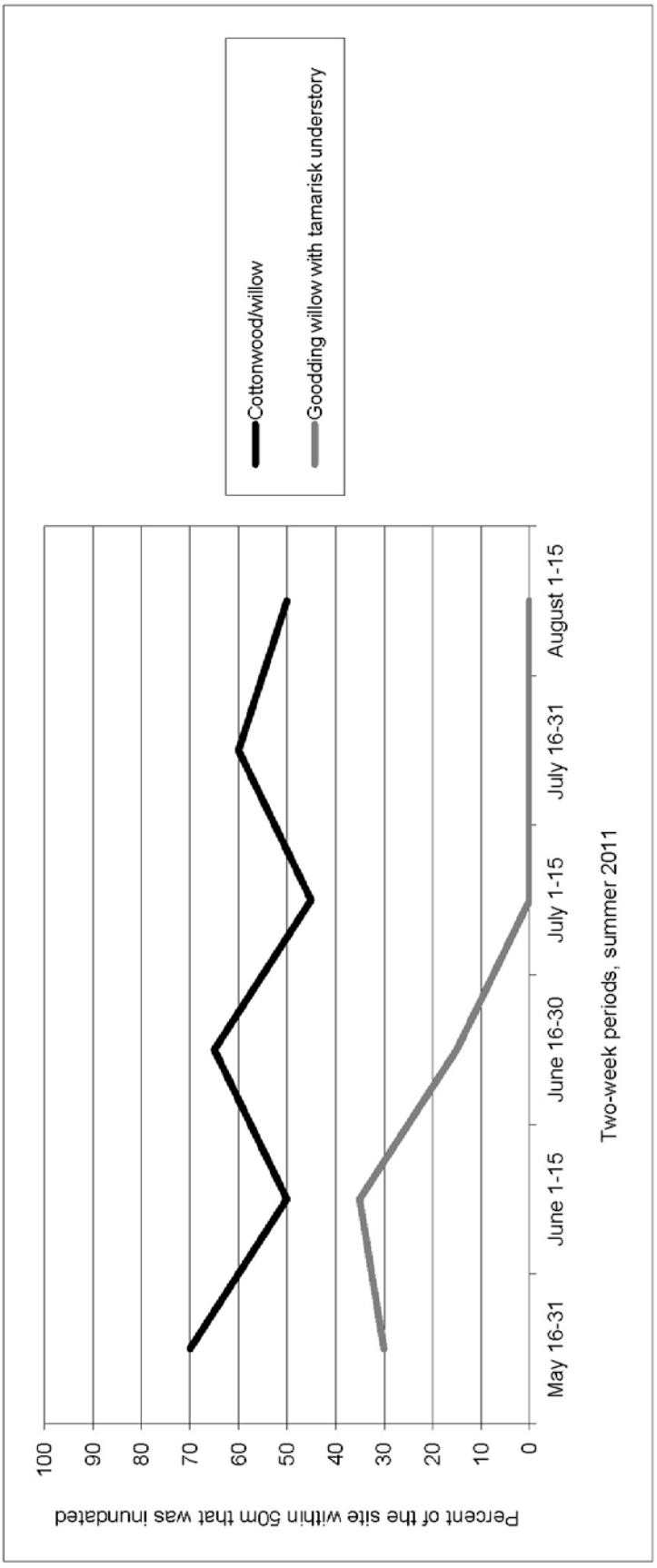


Figure 6.4. Percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which percent inundated was measured more than once in a given two-week period.

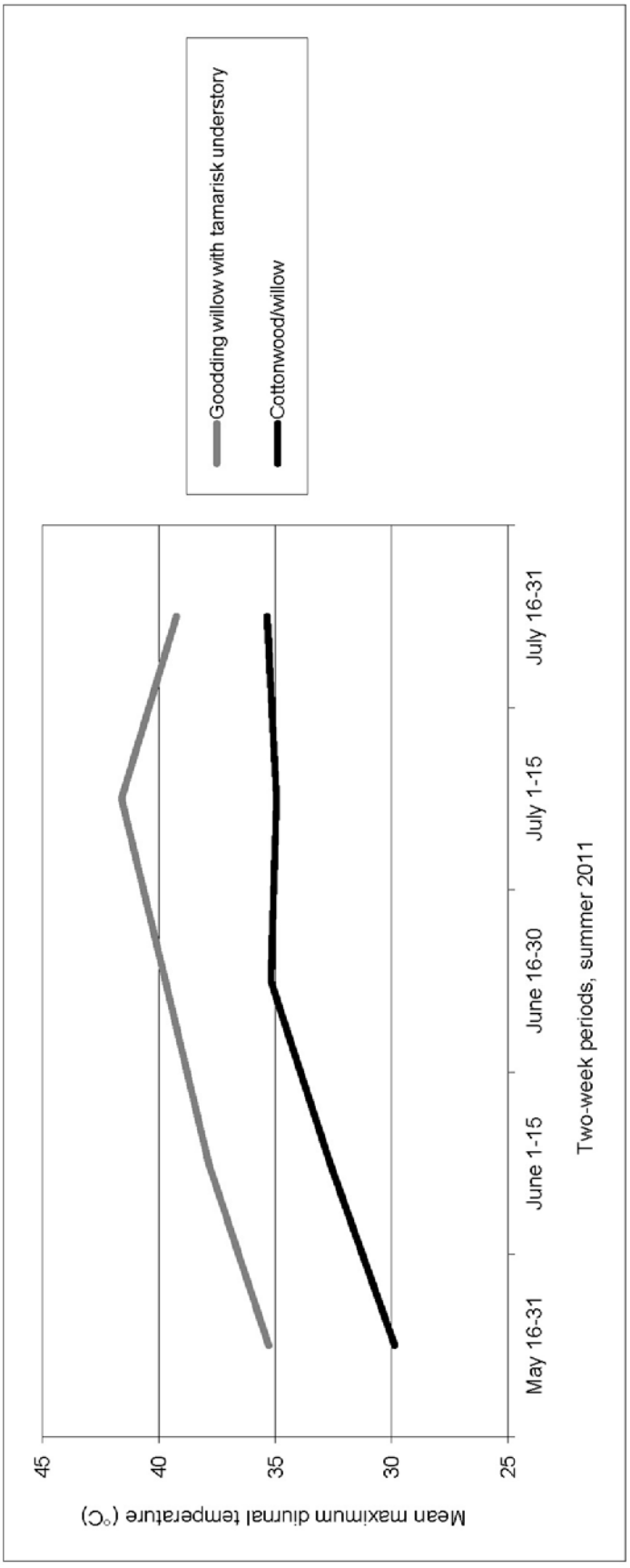


Figure 6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

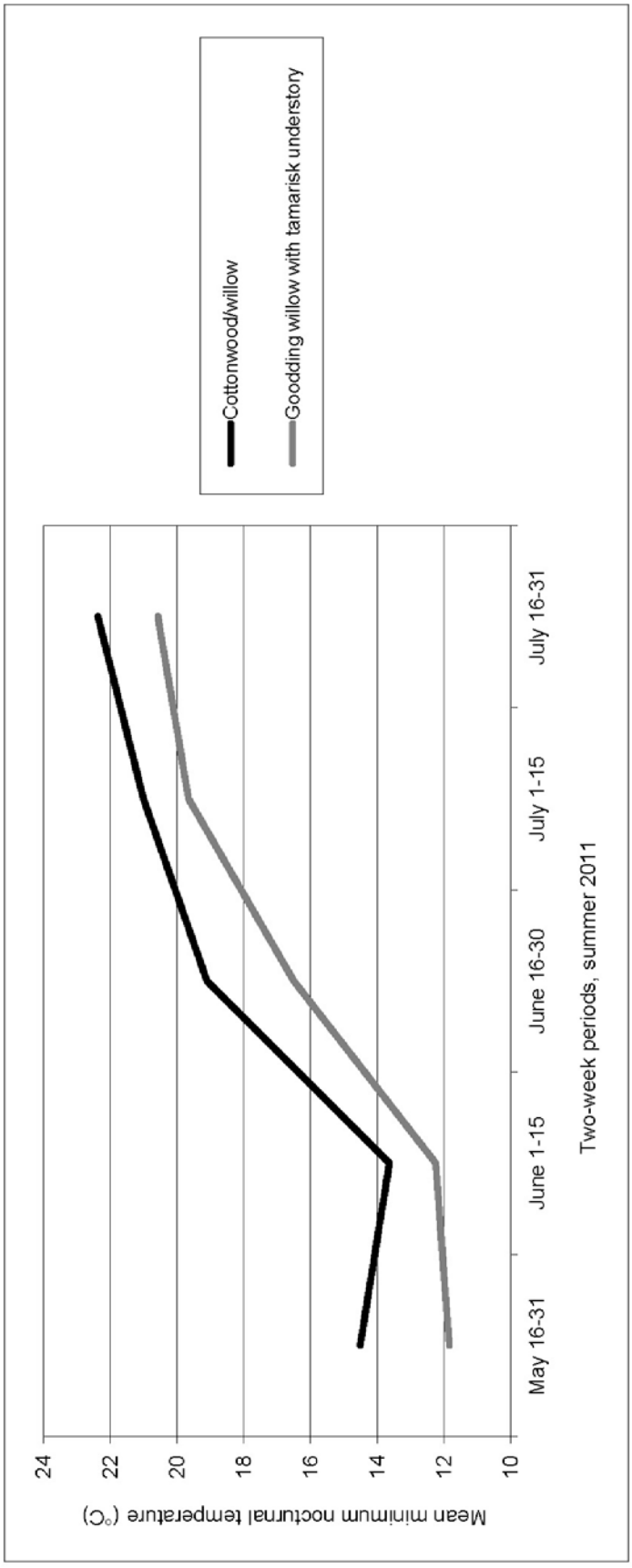


Figure 6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

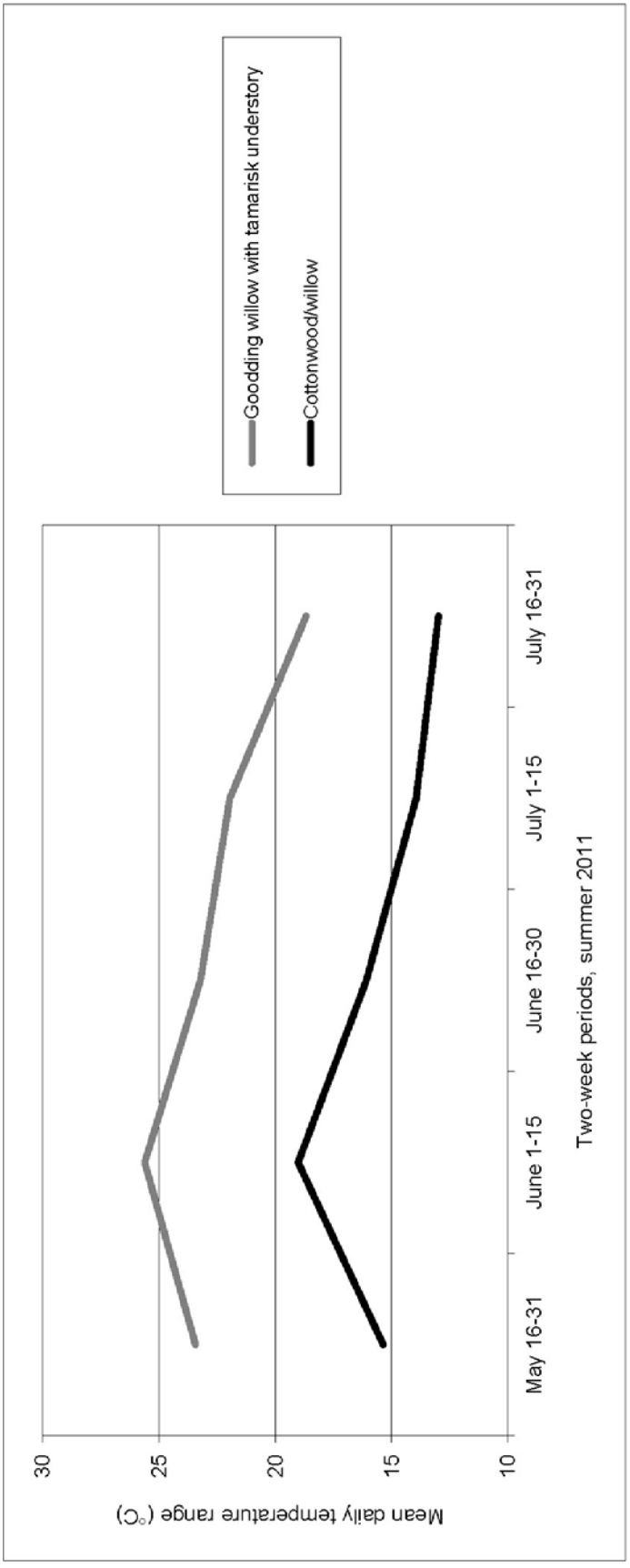


Figure 6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

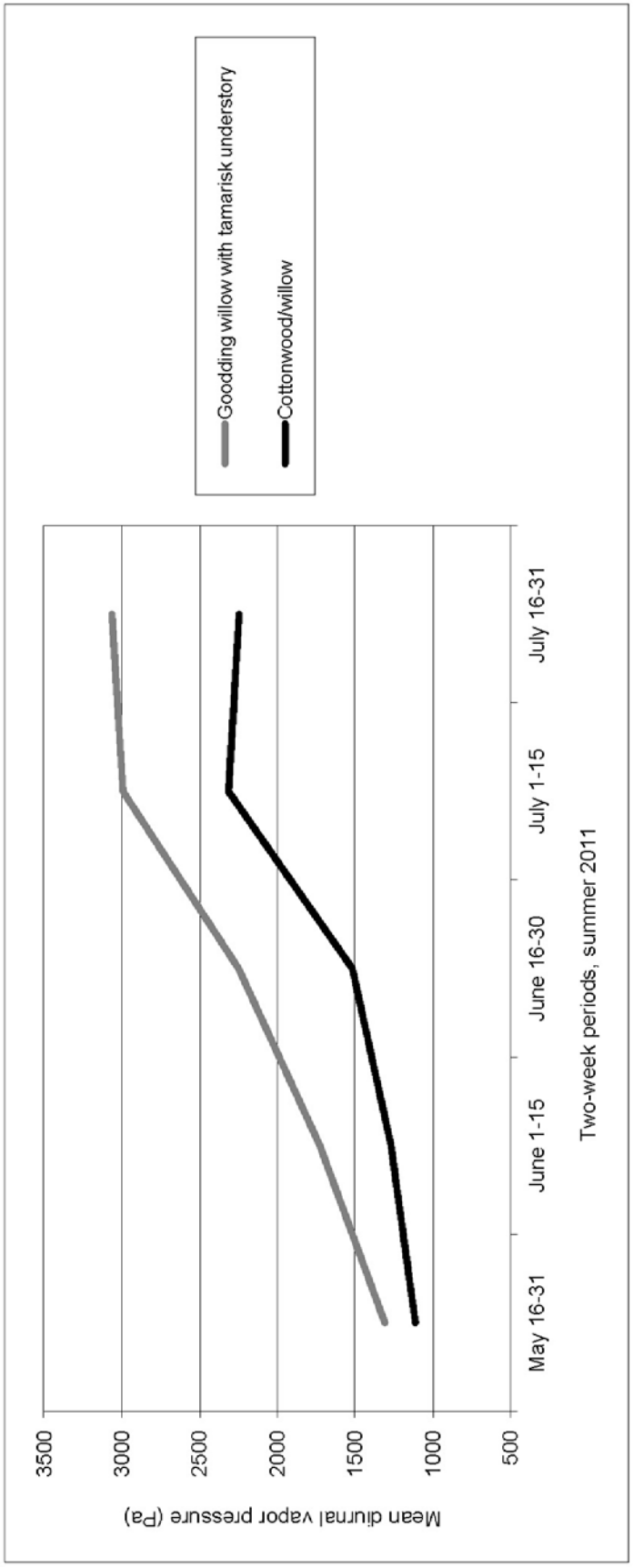


Figure 6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

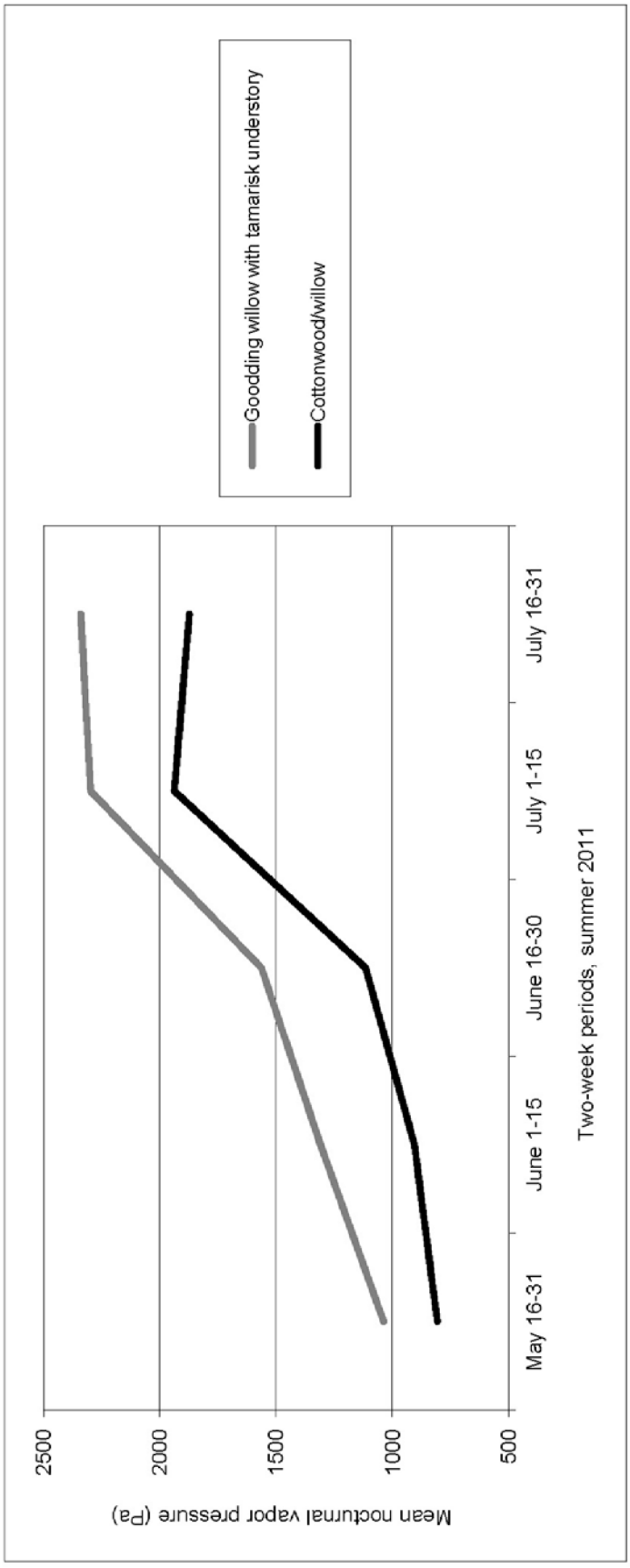


Figure 6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

Both vegetation types exhibited moist soil conditions at some point during the breeding season. Goodding willow with tamarisk understory had high soil moisture content at the beginning of the breeding season and standing water within the territory through late June. The inundated percentage of the surrounding area declined steadily through May and June, and distance to surface water was over 300 m in July and August. Cottonwood/willow had consistently high soil moisture, and the inundated percentage of the surrounding area was at least 50% throughout the breeding season.

Mean daily maximum temperatures spanned a range of ~5°C among habitat types. Daily minimum temperatures showed a smaller range of <3°C. The daily temperature range in cottonwood/willow was consistently smaller than in Goodding willow with tamarisk understory. Vapor pressure increased through the end of July for both habitat types and was higher in Goodding willow with tamarisk understory than in cottonwood/willow.

DISCUSSION

The limited data collected in 2011 preclude any meaningful comparison between habitat types and any summary of overall microclimate characteristics in flycatcher territories. Data collected in 2011 will be added to data collected in prior years for a combined analysis to be presented in the summary report in 2012.

This page intentionally left blank.

Chapter 7

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

INTRODUCTION

Southwestern Willow Flycatcher nests and breeding territories are typically located near rivers, streams, and open water (Sogge and Marshall 2000) or over wet soil (Flett and Sanders 1987, Harris et al. 1987, Harris 1991). Nest substrate plants are often rooted in or overhang standing water. Although the association between breeding flycatchers and open water or wet soil is widely recognized by managers and scientists alike, the exact nature of the association is poorly quantified. Water may be a direct environmental cue for flycatcher nesting behavior or it may be the ultimate cause of proximate factors such as vegetation composition and structure, prey base, and microclimate.

Anthropogenic or natural modifications to surface water resources (i.e., fluvial hydrology and geomorphology) can modify existing and potential flycatcher breeding habitat and therefore have the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). For example, nine flycatcher territories at San Marcial on the middle Rio Grande in New Mexico exhibited a near absence of nesting attempts in 1996 when a combination of drought, upstream dam operations, and upstream withdrawals for irrigation removed all surface water (Johnson et al. 1999). This was in contrast to previous (1994, 1995) and subsequent (1997) years when active nests were documented at the site, with the river flowing in those years. A nearby control site that contained water exhibited multiple nesting attempts during all four years, leading Johnson et al. (1999) to suggest that the presence of water was a fundamental requirement for nesting. A similar pattern was observed along the Gila River in Arizona when decreased streamflow from 2002 to 2004 coincided with the number of flycatcher territories declining by nearly half each year (Munzer et al. 2005). Since 2004, flows within the Gila River have been greater and more consistent, and correspond with a continuing increase in flycatcher territories (14 to 97) from 2004 to 2009 (Graber and Koronkiewicz 2009b).

Flow characteristics of the lower Colorado River have been modified by numerous dams and irrigation withdrawals (Rosenberg et al. 1991). The river reach between Parker Dam and Imperial Dam is regulated by releases from Parker Dam, which has been in operation since 1939. Existing riparian habitat in the Parker to Imperial reach has likely adjusted to historical water release patterns from Parker Dam and appears to be in a stable or declining condition (LCR MSCP 2004). Implementation of the Secretarial Implementation Agreements/California 4.4 Plan (hereafter SIAs) by Reclamation would change the point of diversion for up to 400,000 acre-feet of California apportionment water for up to 75 years (USFWS 2001). The point of diversion, previously located below Parker Dam at Imperial Dam, would change to a point above Parker Dam, resulting in lower water levels in the river between Parker and Imperial. The change in point of diversion was scheduled to begin in 2002.

River flow changes related to the change in point of diversion have the potential to further modify riparian habitats below Parker Dam, habitats that are presently considered potentially suitable for willow flycatcher (USFWS 2001:47). Reclamation (2000) estimated that implementation of the SIAs will cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less. As a result, 372 acres (151 ha) of occupied[1] Southwestern Willow Flycatcher habitat could lose their moist soils. This loss could influence plant species composition (loss of cottonwood and willow) and structure (loss of vegetation volume) over an undetermined length of time. In addition, Reclamation estimated that 5,404 acres (2,187 ha) of

[1] As per the USFWS, occupied Southwestern Willow Flycatcher habitat is defined as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year since surveys began in 1996.

potential flycatcher habitat could be influenced by the drop in groundwater level. These changes may affect the distribution, abundance, occupancy, and prey base of Southwestern Willow Flycatchers in the Parker to Imperial reach.

In 2004, Reclamation completed a pilot year of habitat monitoring by deploying temperature/humidity data loggers at several sites in the Parker to Imperial reach. Reclamation then initiated a more comprehensive, long-term study in 2005 for the purpose of addressing how the above hydrological changes might affect riparian habitats along the Parker to Imperial reach. The objective is to monitor 151 ha (372 acres) of occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams for 10–15 years to determine how microclimate, vegetation, and groundwater conditions might be affected by the SIAs water transfer actions. Monitoring did not commence until after diversions started; therefore, antecedent conditions are unknown and monitoring analyses focus on detecting change through time rather than comparing current conditions to a baseline. An additional objective was to compare microclimate characteristics of sites in the Parker to Imperial reach with those at flycatcher breeding areas. This analysis was completed in previous years and is not repeated here. This chapter reports the results of habitat monitoring to date.

METHODS

In 2005, we selected a subset of sites that are currently surveyed for the presence of willow flycatchers for inclusion in the habitat monitoring study. We chose 11 sites distributed along the Parker to Imperial reach that are reasonably accessible, and where we believed groundwater levels were influenced primarily by river levels and not by outside sources such as irrigation return flows. Chosen sites equated to at least 75.3 ha (186 acres) on the California side of the lower Colorado River and at least 75.3 ha (186 acres) on the Arizona side. We also chose four control sites, two above Parker Dam and two below Imperial Dam, to distinguish any changes in microclimate, groundwater, or vegetation caused by water transfer actions from those caused by fluctuations in climate or rainfall. The 11 test sites are Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron, and the four control sites are Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North (Figure 7.1). We monitored these same 15 sites from 2005 to 2011. In August of 2006, we initiated habitat monitoring within a consistently occupied breeding site at Topock Marsh to obtain groundwater levels and patterns with which we can compare results obtained at the habitat monitoring sites. The analysis comparing Topock to the 15 habitat monitoring sites was completed in previous years and is not repeated here.

Temperature/Humidity Loggers

In 2005, we deployed HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) temperature/humidity data loggers at several locations within each site selected for habitat monitoring. All loggers collected data at 15-minute intervals and were placed in inverted plastic containers and camouflaged as described in Chapter 6. All 60 logger locations selected in 2005 were retained in 2006. Two additional data loggers were installed in the Topock Marsh monitoring site in August 2006. A portion of Gila Confluence North, one of the control sites below Imperial Dam, burned in December 2006. As a result of the fire, all vegetation at one HOBO location at the site was killed, and vegetation at another HOBO location was dramatically reduced. These two HOBOs were replaced in May 2007 with HOBOs at new locations within unburned portions of the site.

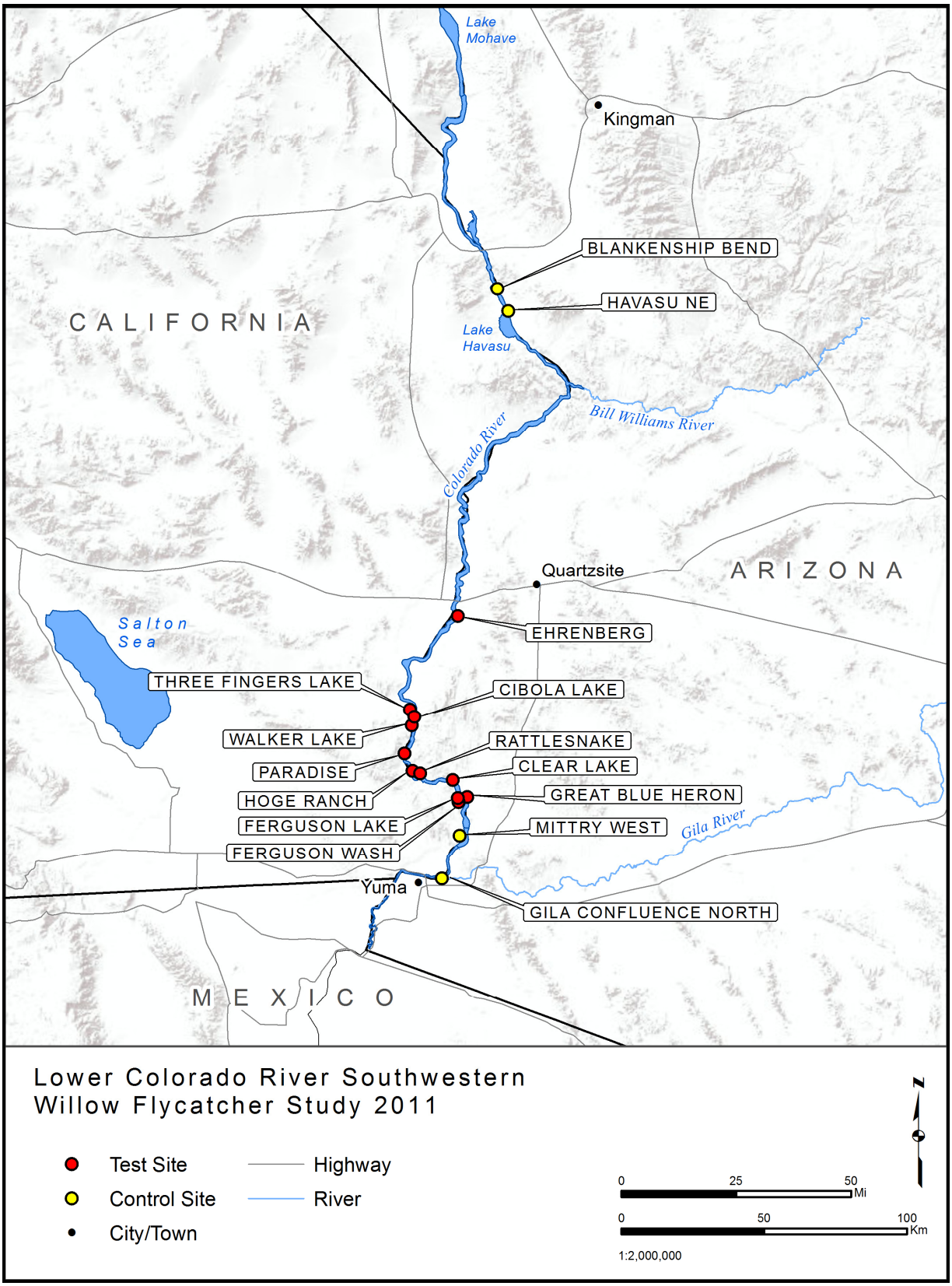


Figure 7.1. Locations of test and control sites, habitat monitoring study, 2005–2011.

HOBO loggers have been downloaded two or three times per year since installation. At each download, we examined the data to determine if there are any problems with data logger function. Data loggers were replaced whenever a potential problem with the sensors was detected. Battery level was also checked at each download, and the battery was replaced if needed.

Soil Moisture Measurements

Soil moisture beneath each HOBO logger was measured and recorded using a hand-held ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively). Soil moisture measurements were collected during each presence/absence survey between 15 May and 25 July and when HOBO data were downloaded. Soil moisture measurements, percent of the area containing inundated or saturated soil, and distance to water were recorded as described in Chapter 6.

Vegetation Measurements

We completed vegetation measurements, following the methods described in Chapter 5, at each HOBO location after flycatcher surveys were completed in late July. All HOBO loggers were also downloaded at this time. Vegetation measurements were completed at the same locations as in 2005–2010 with the exception of Gila Confluence North, where vegetation measurements were collected at the two new HOBO locations established in 2007.

Groundwater Measurements

Piezometers were installed in May–August 2005 near each of the 15 sites selected for habitat monitoring. Analyses of groundwater data in previous years showed that releases from Parker Dam can be used to predict the groundwater level beneath the habitat polygons (e.g., McLeod et al. 2007, McLeod and Koronkiewicz 2009); consequently, these piezometers were removed in 2010. Analyses of the piezometer data are not repeated here. One additional piezometer was installed at Topock Marsh within occupied flycatcher habitat in 2006; see Chapter 8 for information regarding this piezometer.

Statistical Analyses

Microclimate

The following values were calculated for all 15 habitat monitoring sites:

- Mean soil moisture from plot center to 2.0 m from plot center
- Mean maximum diurnal temperature
- Mean minimum nocturnal temperature
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure
- Mean nocturnal vapor pressure

The diurnal and nocturnal periods were determined from the daily sunrise and sunset times reported for the region by the National Weather Service (2011).

We assigned all plots as a control site (above Parker Dam or below Imperial Dam) or as a test site (between Parker and Imperial). We analyzed between-year differences in humidity and soil moisture values within these two groups using linear mixed models and analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models. These analyses were restricted to 1 June–1 August. Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

We analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models for canopy height, canopy closure, percent woody ground cover, three categories of stem sizes for both live and dead stems, the percentage of each stem size category that consisted of live stems, and the percentage of the basal area within the plot that consisted of native vegetation. In prior years we used repeated measures ANOVA for these analyses; however, repeated measures ANOVA excludes cases with missing values whereas linear mixed models allow for the inclusion of all data. We also used repeated measures linear mixed models to examine foliage density for live and dead vegetation summed over all height intervals. These analyses and all descriptive statistics were produced using SPSS® Version 16.0 (SPSS Inc.) software. We excluded vertical foliage density measurements at 5 m from plot center from the analysis so as to have comparable data across years.

RESULTS

Temperature/Humidity Logger Maintenance

All HOBO loggers were downloaded at the beginning and end of the 2011 field season. Four loggers had fallen to the ground over the winter because of sun damage to the logger housing. Five loggers that were in place over the winter had bad humidity sensors but useable temperature data, and one logger failed to collect data. Of the HOBO loggers in place May–August 2011, three failed to collect data, four had faulty humidity data, and four fell to the ground. Data from fallen loggers were not used in the analysis.

Microclimate

2011 Microclimate Descriptive Statistics

Soil moisture, temperature, and vapor pressure parameters from the 15 study sites monitored in 2011 exhibited substantial variation among sites (Table 7.1). Soil moisture varied from a low of 140.9 mV at Ferguson Wash to a high of 939.4 at Mittry West.

Mean maximum diurnal temperatures ranged from a low of 37.4^{o}C at Rattlesnake to a high of 48.2^{o}C at Cibola Lake. Mean minimum nocturnal temperatures ranged from a low of 15.1^{o}C at Gila Confluence North to a high of 20.0^{o}C at Three Fingers Lake. Mean daily temperature range varied from 19.5^{o}C at Ferguson Lake to 28.9^{o}C at Paradise.

Mean diurnal vapor pressure was lowest at Blankenship Bend (1106.6 Pa) and highest at Three Fingers Lake (1953.5 Pa). Mean nocturnal vapor pressure was lowest at Ferguson Wash (1080.9 Pa) and highest at Three Fingers Lake (1849.7 Pa).

Between-year Comparisons of Microclimate Characteristics

All microclimate characteristics varied significantly over time at test sites (Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron; Table 7.2). At control sites (Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North), mean minimum nocturnal temperature varied significantly over time, along with measures of soil moisture and humidity. Neither test nor control sites showed a unidirectional change in any of the microclimate measures in 2005–2011 (Figures 7.2–7.7), although both measures of humidity showed a generally decreasing trend at both test and control sites since 2006. The changes over time differed between test and control sites for soil moisture, mean diurnal vapor pressure, and mean nocturnal vapor pressure (right-most column of Table 7.2).

Soil moisture fluctuated among years at both test and control sites, but the patterns did not mirror one another (Figure 7.2). Between 2005 and 2006, soil moisture decreased more dramatically at control sites than at test sites, while between 2007 and 2008, soil moisture decreased at control sites but rose at test sites. Between 2009 and 2010, soil moisture decreased at test sites but rose at control sites. Diurnal vapor pressure rose more sharply at test sites than at control sites between 2005 and 2006 and then fell more sharply at test sites than at control sites between 2006 and 2007 (Figure 7.6), and nocturnal vapor pressure also showed larger fluctuations at test sites than at control sites.

Vegetation Measurements

Vegetation characteristics varied widely both between and within the selected habitat monitoring sites (Table 7.3). Average canopy height ranged from 3.3 m (Three Fingers Lake) to 9.8 m (Ehrenberg), and average canopy closure ranged from 66.9% (Ehrenberg) to 98.6% (Clear Lake). Measures of other habitat characteristics were similarly variable. Vertical foliage profiles for each site are shown in Figure 7.8. Sites typically exhibited the densest foliage within 3–5 m of the ground, and the majority of vegetation within 2–3 m of the ground typically consisted of dead branches.

Between-year Comparisons of Vegetation Characteristics

Many vegetation variables varied between years within the test and control groups (Table 7.4), but none of the variables exhibited change in a consistent direction over time (Figures 7.9–7.24). There was a significant interaction between year and location (meaning that the change between years among test sites was significantly different from the change at control sites) for woody ground cover ($P = 0.004$), number of live stems ≤2.5 cm dbh ($P = 0.043$), number of dead stems ≤ 2.5 cm dbh ($P = 0.040$), percent of live stems ≤2.5 cm dbh ($P = 0.022$), and dead vertical foliage hits ($P = 0.003$). Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years. Overall, the number of live stems ≤2.5 cm dbh decreased through time at both test and control plots (Figure 7.12), while the number of dead stems ≤ 2.5 cm dbh decreased only at control plots (Figure 7.15), though there was considerable annual fluctuation for both variables. The percentage of live stems increased at control plots but decreased at test plots (Figure 7.18). The amount of dead vertical foliage hits increased through time at both test and control plots, but increased more rapidly at test plots (Figure 7.23).

Table 7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011*

Descriptive Statistics	Blankenship Bend	Havasu NE	Ehrenberg	Three Fingers Lake	Cibola Lake	Walker Lake	Paradise	Hoge Ranch	Rattlesnake	Clear Lake	Ferguson Lake	Ferguson Wash	Great Blue Heron	Mittry West	Gila Confluence North
Soil Moisture															
Mean soil moisture (mV)	850.2 (89.7)	267.4 (74.5)	641.3 (106.7)	425. (61.3)	494.6 (114.5)	900.7 (28.6)	707.0 (50.7)	829.5 (21.5)	735.1 (44.4)	424.7 (157.2)	925.7 (15.0)	140.9 (5.5)	876.0 (9.6)	939.4 (10.8)	399.3 (104.2)
Temperature															
Mean maximum diurnal temperature (°C)	42.4 (0.3)	44.9 (0.5)	45.6 (0.4)	46.4 (0.6)	48.2 (0.3)	44.1 (0.3)	45.7 (0.4)	45.1 (0.4)	37.4 (0.2)	40.1 (0.3)	38.9 (0.3)	40.0 (0.3)	39.7 (0.3)	42.2 (0.3)	42.9 (0.4)
Mean minimum nocturnal temperature (°C)	17.2 (0.3)	18.6 (0.3)	18.2 (0.4)	20.0 (0.6)	19.9 (0.3)	16.7 (0.3)	16.8 (0.3)	17.0 (0.3)	16.2 (0.3)	18.4 (0.3)	19.4 (0.2)	19.1 (0.3)	16.3 (0.3)	17.8 (0.3)	15.1 (0.4)
Mean daily temperature range (°C)	25.2 (0.4)	26.4 (0.6)	27.4 (0.5)	26.4 (1.0)	28.3 (0.4)	27.4 (0.4)	28.9 (0.5)	28.2 (0.4)	21.2 (0.3)	21.7 (0.4)	19.5 (0.3)	20.9 (0.3)	23.5 (0.3)	25.4 (0.4)	27.8 (0.4)
Humidity															
Mean diurnal vapor pressure (Pa)	1106.6 (33.8)	1342.7 (38.2)	1133.4 (42.1)	1953.5 (92.7)	1216.0 (44.5)	1139.2 (29.8)	1336.9 (43.3)	1318.2 (33.1)	1670.7 (42.8)	1334.5 (38.9)	1359.7 (30.1)	1244.9 (30.1)	1306.1 (38.3)	1297.5 (34.1)	1269.0 (34.6)
Mean nocturnal vapor pressure (Pa)	1185.3 (32.8)	1215.5 (34.0)	1197.1 (40.0)	1849.7 (81.7)	1321.3 (38.3)	1154.9 (26.0)	1332.9 (34.8)	1316.2 (30.4)	1620.5 (37.8)	1239.3 (32.3)	1378.6 (27.3)	1080.9 (26.3)	1292.7 (33.6)	1235.8 (28.9)	1236.4 (31.8)

* Data are presented as mean (standard error).

Table 7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011*

Parameter	Test (n=45)								Control (n=15)								P-value for difference between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Soil Moisture																	
Mean soil moisture (mV)	645.7 (44.8)	634.4 (48.6)	662.9 (44.8)	705.8 (42.7)	699.2 (35.7)	651.4 (20.8)	636.2 (46.5)	<0.001	694.4 (89.8)	582.9 (98.1)	635.3 (98.4)	607.5 (90.7)	591.7 (90.6)	687.5 (36.3)	631.3 (96.4)	<0.001	<0.001
Temperature																	
Mean maximum diurnal temperature (°C)	44.9 (0.1)	46.1 (0.1)	45.2 (0.1)	46.5 (0.1)	43.8 (0.1)	45.0 (0.1)	44.0 (0.1)	<0.001	45.6 (0.2)	48.0 (0.2)	46.4 (0.2)	45.7 (0.2)	44.2 (0.2)	46.2 (0.2)	45.1 (0.2)	0.065	0.245
Mean minimum nocturnal temperature (°C)	20.7 (0.1)	22.7 (0.1)	20.4 (0.1)	20.7 (0.1)	21.2 (0.1)	20.4 (0.1)	20.1 (0.1)	<0.001	20.2 (0.2)	22.1 (0.2)	20.3 (0.2)	20.8 (0.2)	21.2 (0.1)	20.9 (0.2)	19.5 (0.2)	<0.001	0.423
Mean daily temperature range (°C)	24.2 (0.2)	23.5 (0.2)	24.8 (0.2)	25.8 (0.2)	22.6 (0.2)	24.6 (0.2)	23.9 (0.2)	<0.001	25.4 (0.2)	26.0 (0.3)	26.1 (0.3)	24.9 (0.3)	23.0 (0.2)	25.3 (0.3)	25.6 (0.3)	0.345	0.138
Humidity																	
Mean diurnal vapor pressure (Pa)	1797.2 (13.0)	2028.4 (13.5)	1737.9 (16.6)	1770.4 (12.8)	1758.9 (13.4)	1588.3 (12.6)	1556.0 (14.8)	<0.001	1726.3 (20.4)	1863.9 (21.9)	1696.9 (21.7)	1692.3 (20.5)	1701.1 (18.9)	1582.8 (17.3)	1493.4 (23.0)	<0.001	0.010
Mean nocturnal vapor pressure (Pa)	1686.3 (11.2)	1860.4 (10.5)	1852.7 (14.0)	1679.8 (10.2)	1618.0 (10.5)	1484.0 (10.3)	1507.7 (13.0)	<0.001	1638.2 (17.6)	1703.4 (18.7)	1559.9 (20.7)	1582.9 (18.4)	1583.2 (17.0)	1479.8 (15.8)	1431.0 (20.9)	<0.001	0.002

*Data are presented as means (standard error). The analysis was restricted to 1 June–1 August each year.

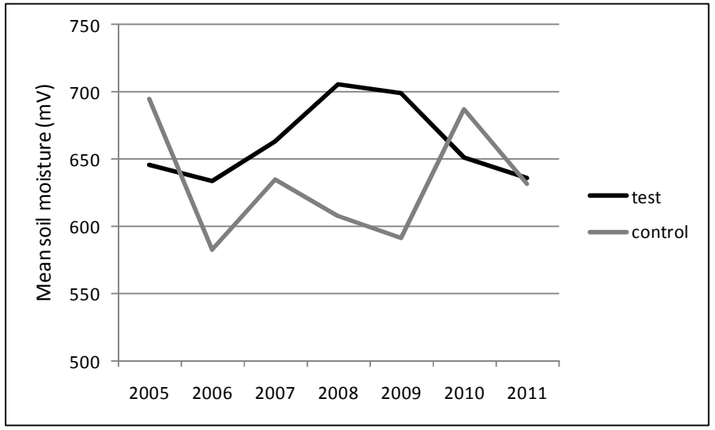


Figure 7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

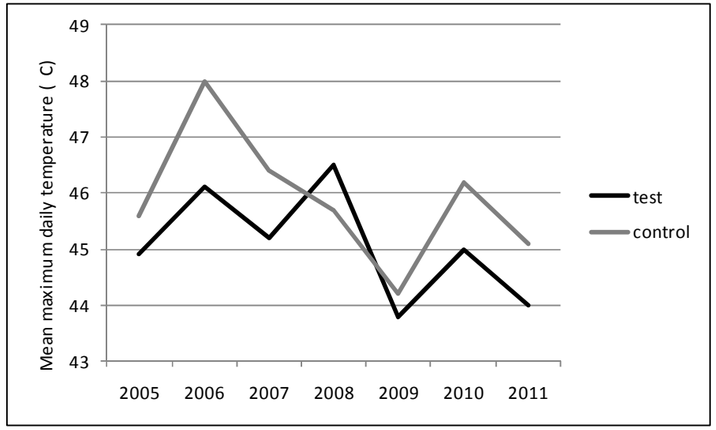


Figure 7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

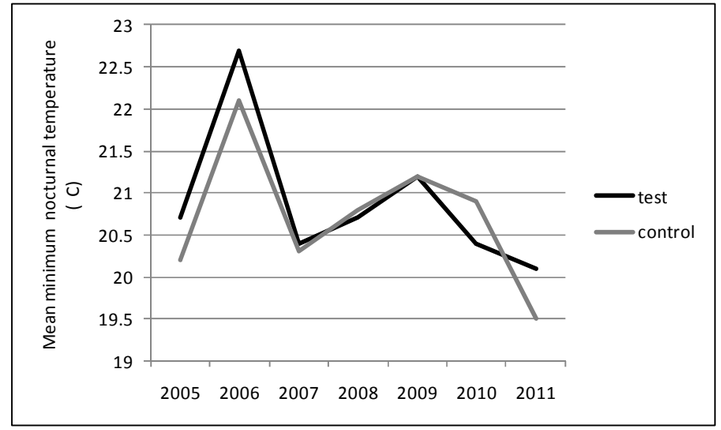


Figure 7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

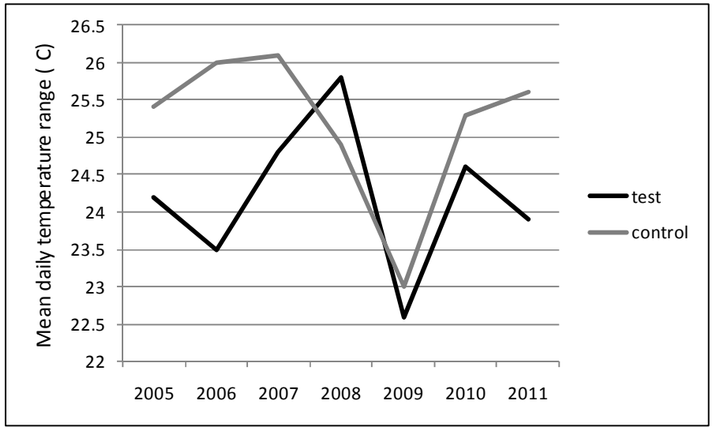


Figure 7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

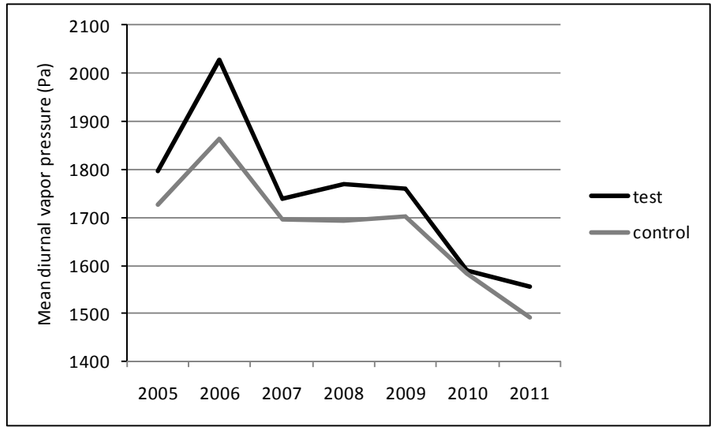


Figure 7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

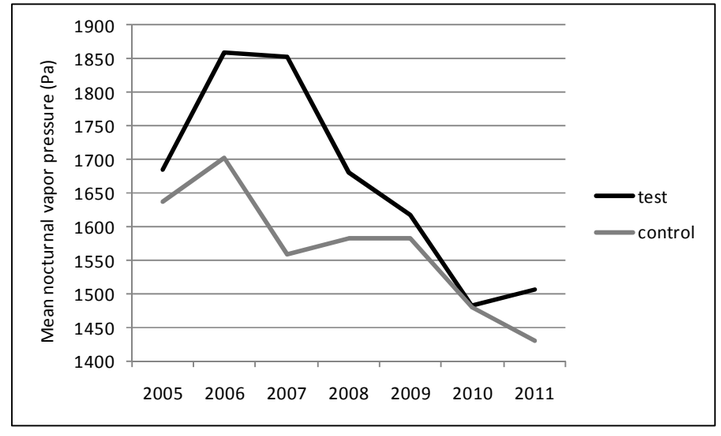


Figure 7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

Table 7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011*

Parameter	Blankenship Bend (n=4)	Havasu NE (n=4)	Ehrenberg (n=4)	Three Fingers Lake (n=5)	Cibola Lake (n=5)	Walker Lake (n=3)	Paradise (n=4)	Hoge Ranch (n=4)	Rattlesnake (n=4)	Clear Lake (n=3)	Ferguson Lake (n=5)	Ferguson Wash (n=4)	Great Blue Heron (n=4)	Mittry West (n=4)	Gila Confluence North (n=3)
Average canopy height (m)	6.2 (1.1)	3.9 (0.7)	9.8 (2.9)	3.3 (0.3)	3.9 (0.4)	7.2 (1.8)	7.8 (3.0)	4.6 (0.6)	8.1 (1.1)	7.1 (0.1)	5.2 (0.3)	5.9 (0.4)	7.7 (1.3)	7.5 (2.2)	7.4 (2.0)
	4.2–9.0	3.0–6.0	2.1–15.8	2.7–4.3	2.2–4.5	5.3–10.7	4.1–16.7	3.6–6.1	6.5–11.4	7.0–7.2	4.5–5.9	4.7–6.6	5.6–10.9	3.6–13.1	4.8–11.3
% total canopy closure	81.9 (9.6)	88 (6.6)	66.9 (14.5)	82.9 (6)	78.8 (14.5)	93.1 (3.3)	95.1 (2.3)	90.0 (3.5)	98.3 (0.7)	98.6 (1.7)	96.8 (1.6)	96.4 (1.7)	96.2 (1)	88.7 (6.4)	86.3 (6.7)
	53.1–92.2	69.3–97.4	41.1–95.8	59.4–92.7	20.8–96.9	87–98.4	89.6–99.5	82.3–98.4	96.4–100.0	95.3–100.5	92.2–100.0	92.7–99.5	93.2–97.9	69.8–97.4	75.5–98.4
% woody ground cover	76.3 (13.7)	44.7 (13.8)	38.9 (12.1)	13.9 (4.5)	34 (7.5)	79.7 (11.9)	90.9 (7.9)	60.1 (17.8)	65.1 (6.0)	51.6 (12.2)	47.2 (15.8)	35.4 (8.8)	39.8 (8.4)	41.7 (8.2)	55.4 (3.4)
	43.8–99.0	6.3–70.0	9.3–58.8	3.5–30.0	7.5–53.8	57.0–97.0	67.5–100.0	26.3–92.0	51.3–78.8	30.0–72.3	3.5–92.5	21.3–61.3	14.8–50.8	27.5–65.0	48.8–60.0
# live stems ≤2.5 cm dbh per ha	509 (360)	64 (64)	446 (331)	2266 (646)	229 (117)	212 (153)	350 (223)	796 (210)	509 (260)	255 (255)	1171 (415)	286 (210)	223 (109)	1910 (1069)	1188 (112)
	0–1528	0–255	0–1401	382–3820	0–509	0–509	127–1019	382–1273	0–1019	0–764	382–2419	0–891	0–509	0–3947	1019–1401
# live stems 2.6–8 cm dbh per ha	1432 (439)	509 (289)	668 (318)	5628 (1696)	3132 (816)	2080 (552)	3247 (2368)	2674 (597)	2324 (1216)	849 (612)	5195 (1045)	1910 (260)	3629 (1349)	3310 (909)	2928 (1083)
	255–2165	0–1273	0–1528	1783–11968	891–5984	1146–3056	382–10313	1655–3947	0–5475	0–2037	2165–8403	1401–2419	1783–7639	1401–5730	1273–4966
# live stems >8 cm dbh per ha	318 (82)	764 (172)	159 (61)	229 (199)	255 (90)	340 (278)	573 (489)	350 (109)	1337 (433)	1188 (363)	586 (154)	1114 (204)	1050 (141)	637 (356)	1316 (331)
	127–509	255–1019	0–255	0–1019	0–509	0–891	0–2037	127–637	127–2165	764–1910	127–1019	764–1528	637–1273	0–1655	764–1910
# dead stems ≤2.5 cm dbh per ha	95 (61)	0 (0)	159 (159)	331 (154)	76 (31)	0 (0)	191 (152)	64 (37)	255 (116)	0 (0)	306 (204)	127 (127)	127 (90)	1464 (667)	679 (405)
	0–255	0–0	0–637	0–764	0–127	0–0	0–637	0–127	0–509	0–0	0–1019	0–509	0–382	127–3183	0–1401
# dead stems 2.6–8 cm dbh per ha	859 (445)	32 (32)	700 (391)	942 (154)	840 (532)	127 (127)	509 (429)	2260 (1656)	796 (427)	170 (170)	764 (401)	541 (390)	541 (223)	318 (198)	1019 (515)
	0–2037	0–127	0–1655	509–1401	0–2928	0–382	0–1783	0–7130	0–1655	0–509	127–2292	0–1655	0–1019	0–891	0–1655
# dead stems >8 cm dbh per ha	95 (61)	64 (64)	0 (0)	0 (0)	25 (25)	0 (0)	0 (0)	0 (0)	127 (127)	297 (297)	0 (0)	64 (37)	159 (61)	64 (64)	42 (42)
	0–255	0–255	0–0	0–0	0–127	0–0	0–0	0–0	0–509	0–891	0–0	0–127	0–255	0–255	0–127
Percent basal area native	31.7 (19.5)	32.8 (23.6)	96.1 (2.4)	0.5 (0.5)	1.6 (1.3)	29.3 (29.3)	18.7 (18.3)	31.2 (19.2)	39.5 (21.4)	0.0 (0.0)	2.0 (1.9)	22.7 (13.7)	36.1 (15.7)	53.4 (22.4)	100.0 (0.0)
	0–80.0	0–100.0	89.1–99.5	0.0–2.3	0.0–6.8	0.0–87.9	0.0–73.5	0.0–85.1	0.0–100.0	0.0–0.0	0.0–9.6	0.0–55.1	0.0–76.4	0.0–91.4	100.0–100.0

* Data presented are means, (standard error), and range.

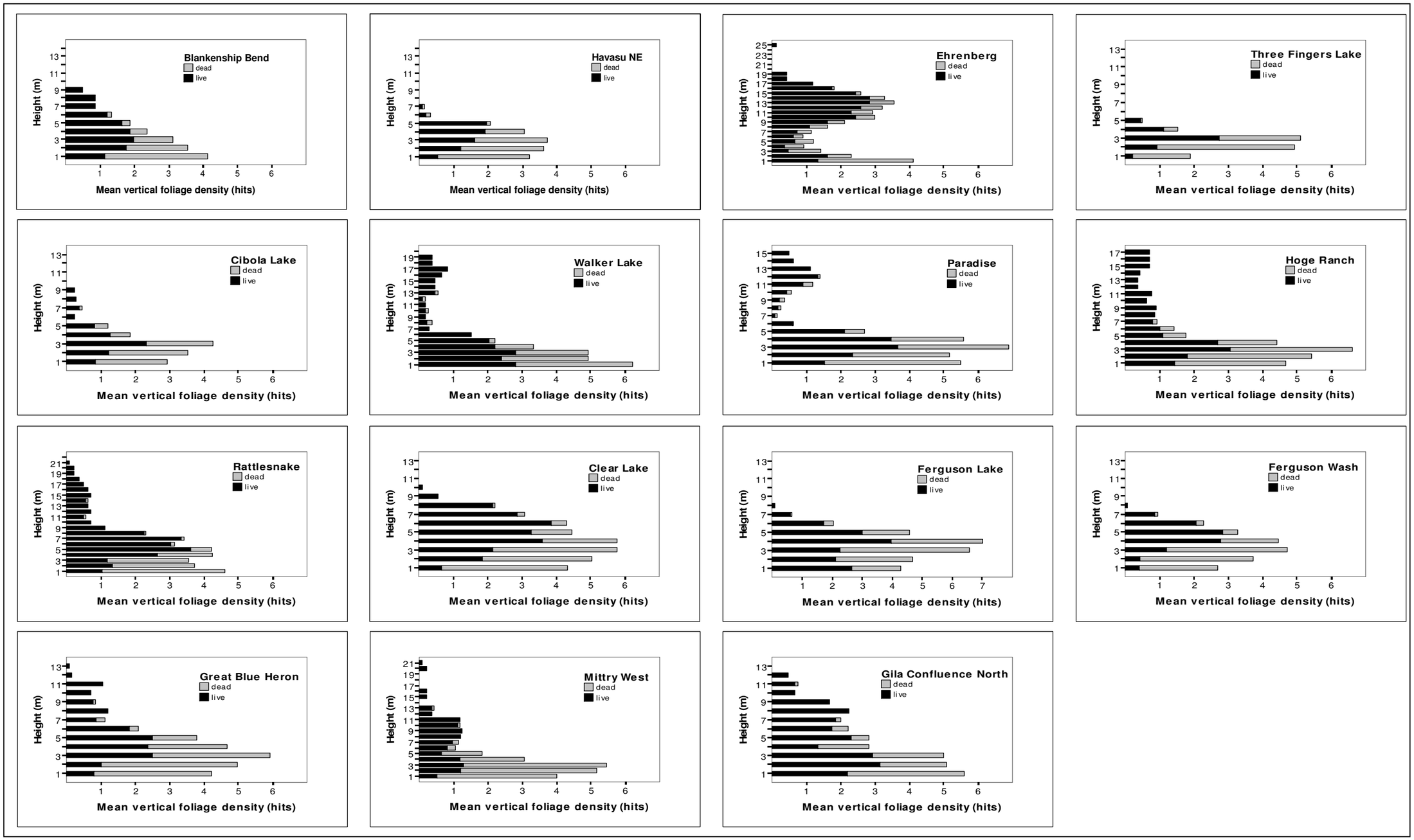


Figure 7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011.

Table 7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011

Parameter	Test (n=45)								Control (n=15)								P-value for difference in means between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Average canopy height (m)	6.6	7.0	5.8	6.7	7.1	6.5	6.2	0.055	6.6	7.0	6.8	7.7	7.0	6.9	6.2	0.004	0.493
% total canopy closure	84.7	78.3	87.9	88.1	86.7	85.3	89.7	<0.001	80.8	76.9	85.7	85.5	82.5	80.5	86.2	0.008	0.963
% woody ground cover	31.1	27.3	30.0	41.6	23.5	35.6	48.7	<0.001	24.4	46.7	40.2	53.0	31.4	38.0	54.5	<0.001	0.004
# live stems ≤2.5 cm dbh per ha	1932	2272	2515	1358	2530	1316	671	<0.001	985	2574	1842	883	1210	1010	900	<0.001	0.043
# live stems 2.6–8 cm dbh per ha	3107	2722	3143	3899	2314	3271	3030	<0.001	1655	2310	1918	2139	1401	1859	1986	0.002	0.517
# live stems >8 cm dbh per ha	481	430	654	671	597	637	628	0.025	603	646	730	730	546	586	722	0.048	0.587
# dead stems ≤2.5 cm dbh per ha	340	1282	1259	1084	1949	1075	161	<0.001	1214	1492	1367	1384	1455	552	552	<0.001	0.040
# dead stems 2.6–8 cm dbh per ha	1234	821	925	1879	1081	1310	778	0.015	1061	437	747	1392	609	475	526	<0.001	0.790
# dead stems >8 cm dbh per ha	48	59	96	108	91	110	54	0.096	59	82	127	59	118	85	68	0.892	0.866
% live stems ≤2.5 cm dbh	81.7	66.1	66.3	61.0	52.4	57.2	75.2	<0.001	51.9	63.2	55.7	41.4	41.8	70.3	65.8	0.082	0.022
% live stems 2.6–8 cm dbh	72.8	74.6	77.1	68.3	66.1	69.1	77.8	0.033	70.8	79.2	70.2	58.6	64.6	79.5	76.0	<0.001	0.139
% live stems >8 cm dbh	92.8	84.6	87.7	91.8	89.0	88.4	96.0	N/A[1]	90.8	89.1	89.4	89.9	81.9	84.5	86.0	N/A[1]	0.540
Percent basal area native	27.2	20.3	28.9	23.8	21.6	22.1	24.1	0.195	42.7	52.8	59.9	46.9	45.0	57.9	51.4	0.274	0.090
Total live foliage hits	17.4	17.7	11.3	17.0	19.3	17.1	17.8	<0.001	18.1	15.5	16.5	18.4	17.5	16.9	14.3	0.335	0.375
Total dead foliage hits	9.3	10.0	5.1	10.8	9.1	14.1	10.5	<0.001	8.4	6.6	6.1	11.0	6.3	8.5	9.2	0.042	0.003
Percent live foliage hits	62.7	62.0	65.8	58.7	63.8	56.1	59.3	0.006	69.1	70.0	69.6	64.8	72.9	67.6	58.7	0.065	0.281

[1] Model failed to converge; no P-value.

Table 7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Difference (2001–present)	% Change (2001–present)
January	6,820	5,599	6,478	6,327	5,536	4,166	5,842	5,945	4,850	6,177	3,794	5,983	384	6.9%
February	9,123	8,505	8,978	6,881	7,129	4,888	7,798	8,491	8,232	7,137	5,960	6,470	-2,035	-23.9%
March	11,594	10,524	11,334	12,360	11,523	9,699	9,752	11,122	12,180	11,973	10,879	10,881	357	3.4%
April	14,613	14,090	13,610	13,803	12,824	11,356	11,985	12,618	14,293	13,184	11,259	12,594	-1,496	-10.6%
May	14,174	14,068	12,826	11,990	12,252	11,428	11,998	11,718	11,339	10,533	10,765	10,798	-3,270	-23.2%
June	13,803	14,733	13,713	12,778	12,741	12,444	12,383	12,116	11,957	9,992	10,931	11,394	-3,339	-22.7%
July	14,210	14,974	14,439	13,100	12,331	13,842	11,688	12,180	12,226	10,645	12,098	11,438	-3,536	-23.6%
August	11,441	12,047	12,118	10,803	11,420	10,316	10,141	10,317	10,720	9,459	10,508	8,951	-3,096	-25.7%
September	11,233	10,837	10,429	11,159	9,566	9,048	7,334	9,195	9,072	8,492	9,803	7,637	-3,200	-29.5%
October	9,362	8,852	8,765	9,761	7,405	6,967	7,424	7,204	7,568	7,241	7,562	7,111	-1,741	-19.7%
November	7,437	7,357	7,049	6,153	5,163	6,335	6,094	5,420	6,369	6,136	6,435		-922	-12.5%
December	6,706	5,970	5,615	5,737	4,129	4,841	5,507	4,079	3,829	4,872	4,315		-1,655	-27.7%

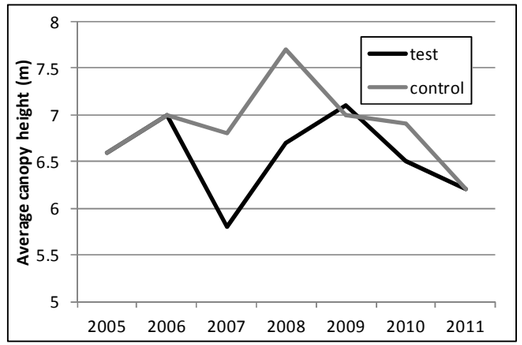


Figure 7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

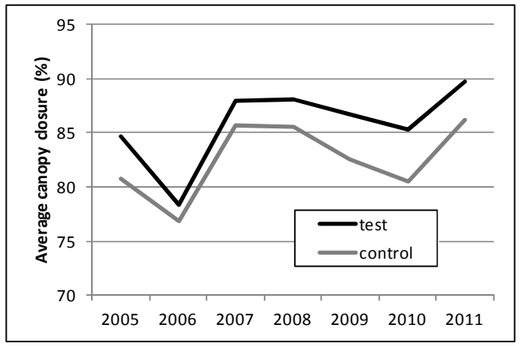


Figure 7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

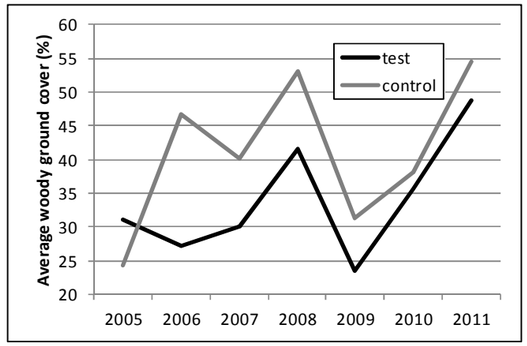


Figure 7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

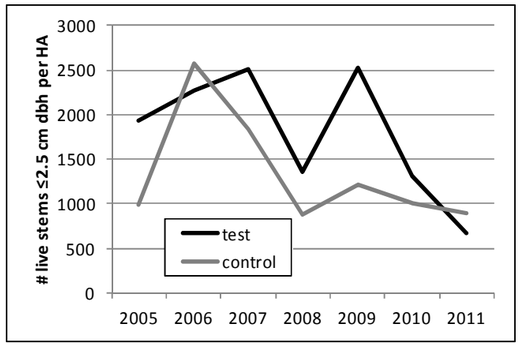


Figure 7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

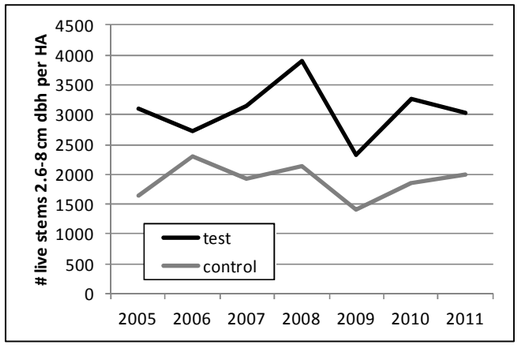


Figure 7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

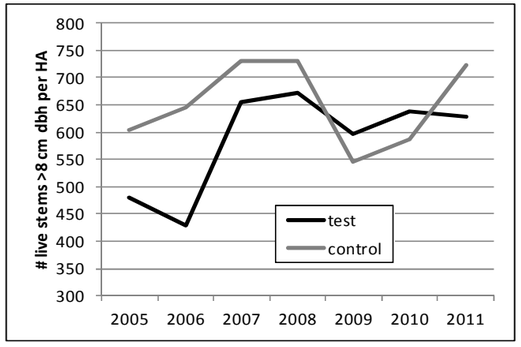


Figure 7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

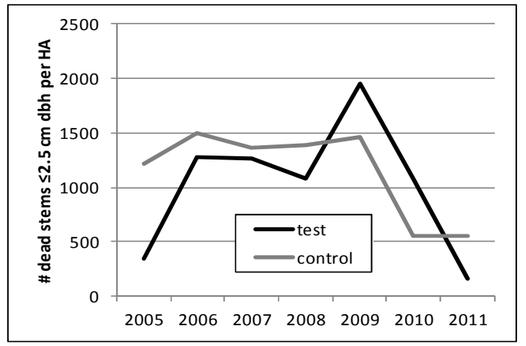


Figure 7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

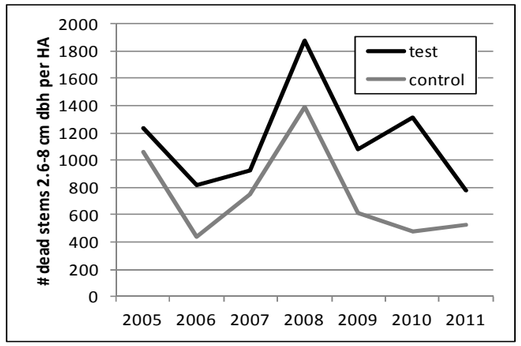


Figure 7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

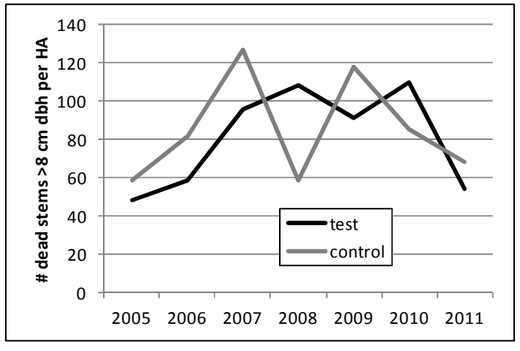


Figure 7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

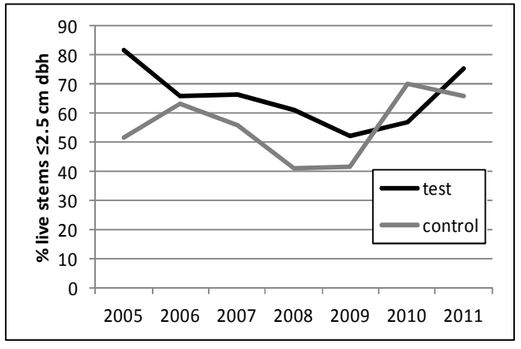


Figure 7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

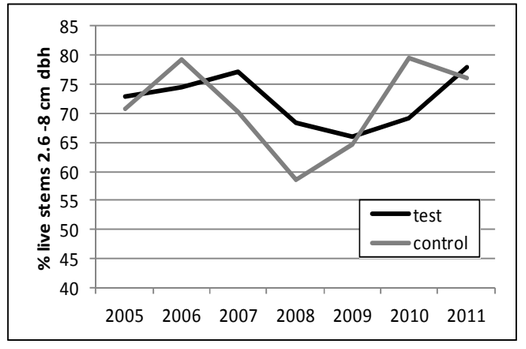


Figure 7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

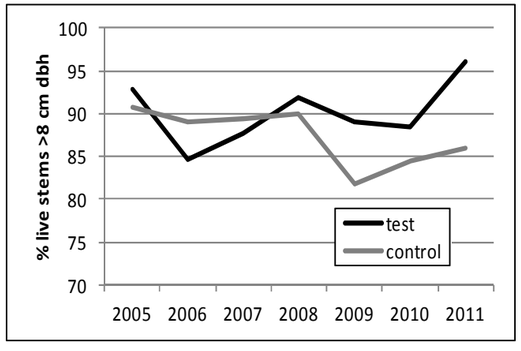


Figure 7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

DISCUSSION

Microclimate

Between-year Comparisons of Microclimate Characteristics

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 than in the other years and cooler conditions in 2009. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. However, the role of river flows in influencing soil moisture is unclear, given that no strong relationship was found between piezometer levels and soil moisture (McLeod and Koronkiewicz 2009). Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station (Coop ID 46118; Figure 7.25). Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

Vegetation

Between-year differences across all sites were noted for many variables, but none showed unidirectional trends over time, suggesting there has been no overall, detectable change in vegetation. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years.

Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality (but see discussion of stem counts, below).

The pooling of all sites into a test vs. control analysis may obscure changes in vegetation at specific sites. For example, one vegetation plot at Ehrenberg contained a significant coyote willow component (98% of the total basal area) in 2005. The willow gradually died over the next several years until no live willow remained in 2009. Most of the vegetation along the LCR, including at the sites selected for habitat monitoring, consists primarily of tamarisk, which is less sensitive than willow to changes in water availability. Measurable changes in overall vegetation as a response to reduced groundwater levels may take several years to develop in tamarisk, or the tamarisk may change very little if at all.

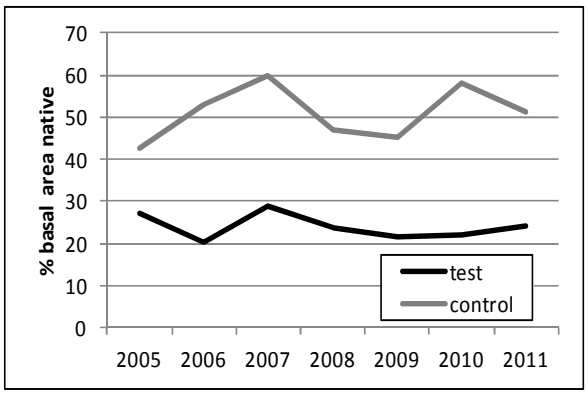


Figure 7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

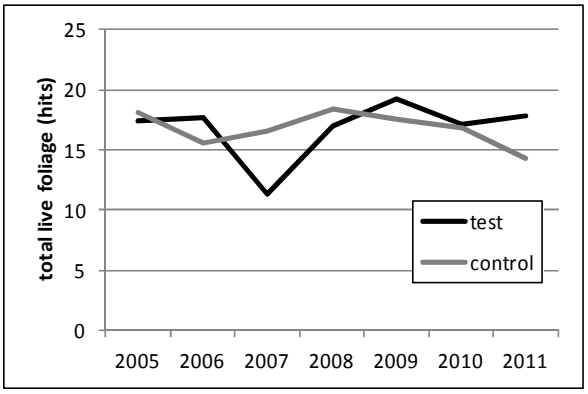


Figure 7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

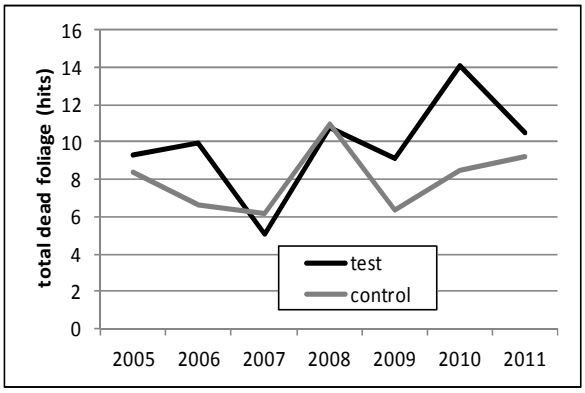


Figure 7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

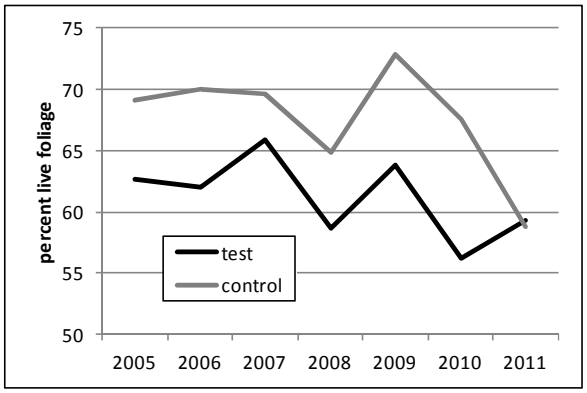


Figure 7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

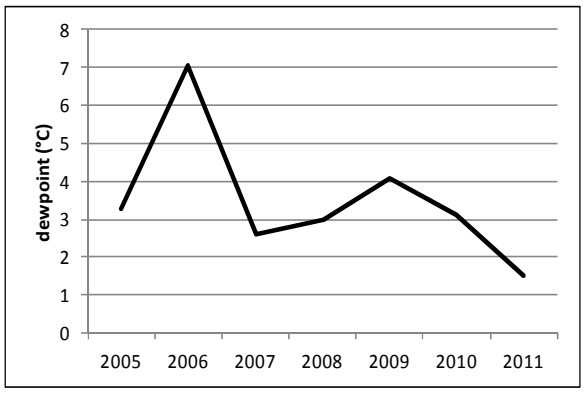


Figure 7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Repeatability of stem counts depends on having a plot of fixed size. Each plot is divided into quadrants, with a rope having the 5-m distance (the edge of the plot) clearly marked extended in each cardinal direction from plot center. It can be nearly impossible to extend the rope flat or straight, introducing variability into the size of the plot. Even more problematic than this, however, is the inability of the observers, in very dense vegetation, to see the cardinal ropes from the center of the quadrant or to see the center of the plot from the edge to be able to envision an arc connecting the ends of two adjacent cardinal ropes and delineating the edge of the circular plot. Observers vary widely in their ability to estimate distance, and when reference points are not visible, it is very difficult to determine whether a stem near the edge of the plot falls within the plot or not. In 2009, we explicitly instructed observers to use a measuring tape to determine the distance from plot center for any stem for which inclusion in or exclusion from the plot seemed questionable.

This method should help reduce difficulties in producing repeatable stem counts but still depends on observers being able to tell when they are near the edge of the plot and taking the extra time to measure distance if the inclusion of a stem is in question. Another factor that inhibits accurate stem counts in dense vegetation is the difficulty in keeping track of which stems have been counted already and which have not. In 2009, we began using chalk to mark stems that had already been counted to try to minimize omission or double-counting of stems.

Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred as the result of decreasing flows from 2001 to 2005 (see Table 7.5). Other methods, such as analysis of satellite imagery, would have to be used to detect any changes in vegetation that might have occurred prior to 2005.

Groundwater Levels

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

In previous years we correlated piezometer ground water levels and soil moisture measurements and found no strong linear relationship. The strongest relationships were found at sites that had the highest soil moisture values. This suggests that at sites where soil moisture is low, surface soil moisture content is not influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

This page intentionally left blank.

Chapter 8

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

INTRODUCTION

Monitoring of Southwestern Willow Flycatcher populations at Topock Marsh began in 1997, and data on number of flycatcher pairs and nest success are available for 1998–2011. The breeding population at Topock declined from a high of 29 pairs in 2004 to fewer than 10 pairs in 2007 and 2008. This decline prompted concern from USFWS about the flycatcher population at Topock, which was presumed to be the likely source population for any flycatchers that would colonize restoration areas on the lower Colorado River. USFWS and Reclamation initiated discussions after the breeding season of 2008 to identify habitat enhancement measures that could be implemented at Topock Marsh in an attempt to raise the number and productivity of flycatchers.

The affinity of breeding Southwestern Willow Flycatchers with standing water and saturated soil is noted consistently in the literature (e.g., Johnson et al. 1999, Munzer et al. 2005, McLeod et al. 2008a, Graber and Koronkiewicz 2009b), and flycatcher nests along the Middle Rio Grande that were above inundated or saturated soil all season produced more young per successful nest than nests that were above dry soil all season (Moore and Ahlers 2008). An examination of water levels within Topock Marsh from 1997 to the present shows that after 2004, water levels peaked at lower levels, high water levels were of shorter duration, and over-winter lows were lower than was the case prior to 2004 (Figure 8.1). Because of the influence of surface water on flycatcher occupancy and productivity, USFWS and Reclamation developed a plan to pump water into a portion of the flycatcher habitat at Topock Marsh.

Two adjacent areas within Topock, known as In Between and 800M, were selected in 2008 as the location for habitat enhancement via supplemental water delivery. The number of breeding flycatcher pairs in these areas declined steadily from 10 in 2004 to 0 in 2008, but the vegetation in the area had not changed markedly during that time (McLeod and Koronkiewicz 2010). The addition of surface water and saturated soil to this area might make it more attractive to flycatchers and increase nest success and productivity of any flycatchers that nest in the area. In addition, widespread inundation could make portions of In Between, 800M, and the surrounding area that typically had been dry during surveys since 2003 and not occupied by flycatchers more suitable for flycatcher occupancy.

Supplemental water delivery commenced in March 2011. We monitored hydrological, microclimate, and vegetation conditions at In Between, 800M, and the adjacent area of Pierced Egg in 2009 and 2010 to assess baseline habitat conditions. We completed the same monitoring in 2011 during water delivery.

METHODS

Water Delivery

Over the winter of 2010–2011, the water delivery system was installed. The system consisted of a Crisafulli trailer pump, modified to be hydraulically driven and capable of moving approximately 41.6 m^3 (11,000 gallons) of water per minute, along with a 0.61 m (24 inch) diameter pipe carrying the water into the target area (In Between, 800M, and Pierced Egg) from the open water of Topock Marsh.

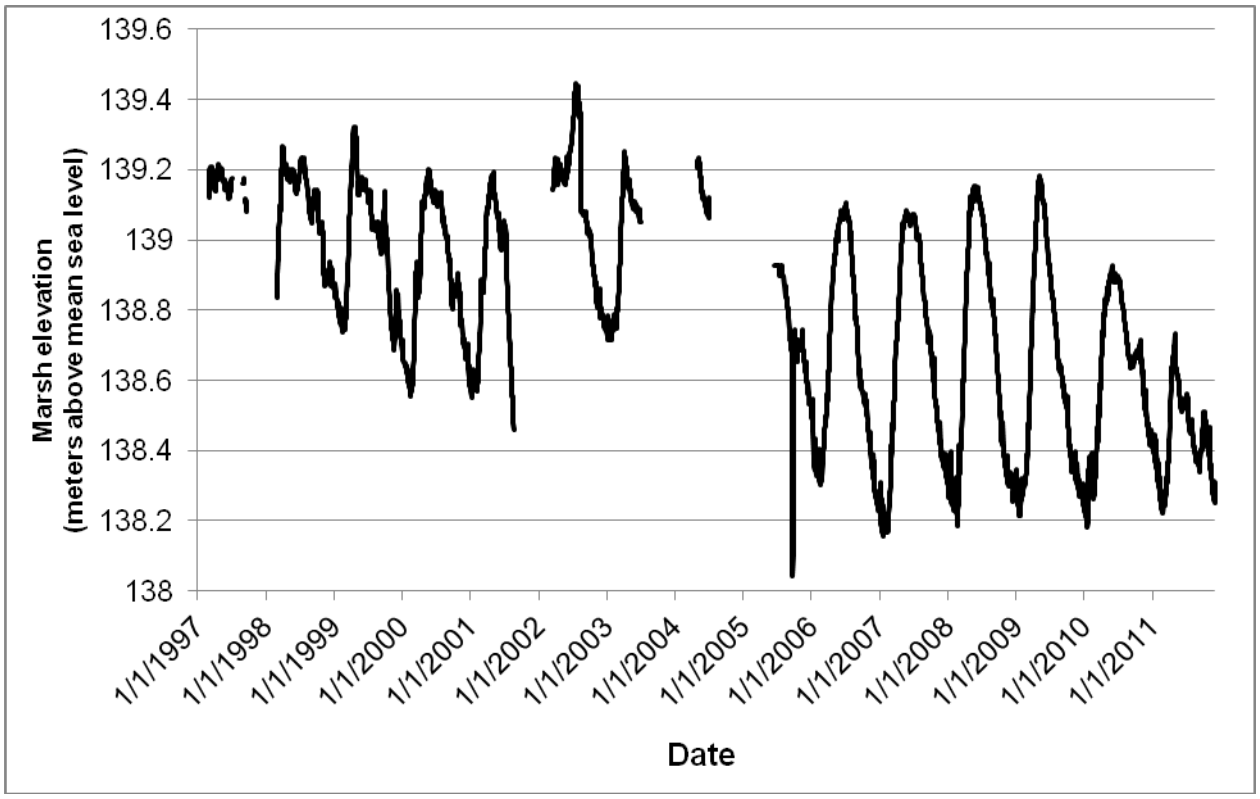


Figure 8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011.

Surface Water Mapping

We mapped surface water at weekly intervals between 14 March and 21 July 2010. In 2011, we mapped water within the target area immediately prior to the initiation of water delivery on 1 March and for three days following the initial pumping. This provided baseline data on water levels, the maximum extent of water, and the longevity of water within the target area. We continued visiting In Between, 800M, and Pierced Egg at approximately weekly intervals through mid-July. During each visit, we traversed trails throughout each site and used GPS and aerial photographs to map the extent and depth of surface water within the sites. At the conclusion of each visit, we compiled our GPS points and field notes to prepare a hardcopy map of the sites, with areas of surface water and saturated soils delineated on the map and indexed to a key detailing the nature (e.g., pig wallow, open marsh, flooded forest) and depth of each wet area. All hardcopy maps were digitized after the field season using ArcGIS. From the digitized shapefiles, we calculated the percentage of the target area that contained surface water at each visit.

Groundwater Measurements

A 0.02 m (¾-inch) diameter shallow well, or piezometer, equipped with a pressure transducer and data logger was installed in 2006 in In Between at Topock Marsh as part of habitat monitoring between Parker and Imperial Dams (see Chapter 7). This piezometer is within the target area of water delivery and thus was left in place when the other piezometers used in the study were removed. This piezometer is described in McLeod et al. (2007) and has been downloaded approximately three times per year since installation. At each download we checked the battery level and function of the data logger. Batteries were replaced as necessary and data were examined to ascertain potential equipment malfunction.

Data Collection

A pressure transducer/data logger equipped with a vented cable collected data hourly at the piezometer. These devices measure and record pressure of the water column present in the well, and these pressure measurements are then converted into water levels (in distance below top of casing). With vented cables and data transfer ports there is no need to correct measurements for atmospheric pressure changes, and the data can be downloaded at the wellhead without disturbing the pressure transducer in the well.

During the initial installation of the pressure transducer, as well as at each data download thereafter, water level was manually measured in the piezometer using an electric water level sounder (Solinst-brand). This known water level was then used to program the pressure transducer with a baseline measurement from which all other automatically recorded water levels were calculated.

Data Validation

We have identified several potential sources of error in the water levels recorded by piezometers. We developed a rigorous protocol to validate each data download, determine if any errors exist with the data, and correct the raw data if possible. Specific sources of error are identified below.

Install Drift. Because piezometers are constructed such that the pressure transducer is almost the same diameter as the inside of the piezometer, removing and inserting the pressure transducers to change batteries can change the water levels in the piezometer temporarily but drastically.

Operational Drift. In rare cases, the accuracy of the data loggers can change in the time period between downloads.

Improper Setup. After downloading data, the data logger is reset for the next round of measurements. Conducting the startup procedure improperly can lead to errors; fortunately, most of these setup errors can be corrected. Common errors include mistakenly setting the type of reference used (i.e., recording water level elevation instead of depth), not resetting the starting water level reference value to the water level value measured manually in the field, and not restarting the data logger but continuing with the previous setup.

At each download, we compared the water level recorded by the piezometer with the manual measurement. We also checked the data logger parameters to determine whether the data logger was initialized properly. If a discrepancy >0.09 m (0.3 feet) existed between the data logger and the manual measurement, and this discrepancy could not be accounted for and corrected by examining the setup parameters and applying an appropriate correction factor, the data were not used for analysis.

Microclimate

In 2009, the In Between, 800M, and Pierced Egg polygons were stratified into use (occupied by flycatchers) and non-use (unoccupied by flycatchers) areas, as observed in 2003–2008. Use areas tend to be wetter than non-use areas and thus are presumably low-lying and more likely to be affected by water delivery into the habitat. We excluded the cattail marsh in the center of the 800M polygon from either the use or non-use areas. We superimposed a 25- x 25-m grid on a GIS software shapefile of the use and non-use areas, numbered the grid blocks, and selected blocks using a random number generator. We used the centroid of the selected block as the sample point and located each point in the field by navigating to the given coordinates using a Rino 110 GPS unit. We determined the exact location of each sample point by means of random number sequences as described in Chapter 6. All sample points used in 2009 were marked in the field with flagging that remained in place over the 2009–2010 and 2010–2011 winters,

allowing for relocation at the beginning of each subsequent season. We relocated each sample point in 2011 and redeployed a data logger in the same location. We used HOBO H8 Pro data loggers (see Chapter 6) to record temperature and humidity at each sample point at 15-minute intervals. Each logger remained in place until the end of the flycatcher breeding season. We collected soil moisture readings, as described in Chapter 6, below each data logger at bi-weekly intervals.

Vegetation

In late July of each year 2009–2011, at the end of the flycatcher breeding season, we collected vegetation measurements at each HOBO logger location. Vegetation plots were centered on the logger, and we collected the vegetation measurements described in Chapter 5, with the exception of stem counts. Given the relatively short time span between the implementation of water delivery and the subsequent vegetation measurements, any responses in vegetation are more likely to be apparent in canopy closure and vertical foliage density than in stem counts.

Data Analyses

We had originally stratified the sample points into use and non-use areas on the assumption that the use areas were more likely to be inundated during water delivery. The water that was pumped into the target area did not reach all the use areas; therefore, we reclassified the points into flooded and non-flooded areas (also referred to as flood groups) according to whether the point was within 20 m (i.e., within a distance that would be encompassed by a flycatcher territory [Sedgwick and Knopf 1992]) of the maximum extent of water recorded immediately post water delivery in 2011. We compared data collected during 2011 to those collected in 2010. We did not include data from 2009 in the comparison because temperature and humidity data collected at the Needles, California weather station (Coop ID 46118) indicated that weather conditions in 2011 were overall more similar to those in 2010 than in 2009, and similar weather data between years may facilitate interpretation of between-year comparisons.

Microclimate

Microclimate data were summarized as described in Chapter 6. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures analysis using a linear mixed model to compare the seasonal changes in flooded versus non-flooded areas in 2010 and 2011. We also used a repeated measures analysis using a linear mixed model to compare temperature and humidity variables the day after a flood event to those recorded the day before the flood event in flooded versus non-flooded areas in 2011. All analyses were completed using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

Vertical foliage data were summarized as described in Chapter 5. Percent native vegetation was calculated as the percent of the foliage hits that consisted of native vegetation. We used the average nest height (3.78 m) recorded at In Between, 800M, and Pierced Egg from 2003 to 2008 to delineate the below, at, and above nest height categories. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures linear mixed model to compare the conditions measured in each flood group in 2011 versus those measured at those same points in 2010. We also used this model to detect any year*flood group interactions, which indicate that the between-year change detected for a given variable in the flooded area differed from the change detected in the non-flooded areas. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

RESULTS

Water Delivery

Water delivery was initiated on 1 March and continued through 7 July. The pump was operated once a week for several hours (Table 8.1), and the hours of operation and flowmeter readings were recorded in a log book.

Table 8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011

Date of Pumping	Hours Operated	Total Pump Output (millions of gallons)	Total Pump Output (cubic meters)	Date(s) of Water Mapping
1 Mar	4.7	3.10	11735	27–28 Feb, 1–3 Mar
10 Mar	5.9	3.89	14725	11 Mar
17 Mar	3.3	2.18	8252	18 Mar
24 Mar	4.8	3.17	12000	25 Mar
31 Mar	5.3	3.50	13249	1 Apr
7 Apr	4.5	2.97	11243	8 Apr
13 Apr	4.3	2.84	10751	15 Apr
21 Apr	4.3	2.84	10751	22 Apr
28 Apr	4.5	2.97	11243	29 Apr
5 May	5.6	3.70	10221	---
12 May	4.0	2.64	9994	14 May
19 May	4.1	2.71	10258	20 May
26 May	1.8	1.19	4505	24 and 29 May
2 Jun	3.5	2.31	8744	3 Jun
9 Jun[1]	4.2	2.77	10493	8 Jun
16 Jun[1]	4.2	2.77	10493	17 Jun
23 Jun	4.0	2.64	9994	22 Jun
30 Jun	4.5	2.97	11243	1 Jul
7 Jul	4.0	2.64	9994	6 and 15 Jul

[1] No data recorded, hours and pump output estimated from flowmeter reading on 23 Jun.

Surface Water Mapping

Immediately prior to the start of water delivery on 1 March, surface water was limited to pig wallows in Pierced Egg (Figure 8.2, map from 28 February). Surface water covered portions of In Between and 800M immediately after pumping on 1 March (Figure 8.2, map from 1 March). There was a noticeable decrease in water extent over the following two days (Figure 8.2, maps from 2 and 3 March; and Figure 8.3), but we determined that weekly pumping would be sufficient to maintain elevated water levels within the target area. From March to late May, all weekly visits occurred on the day immediately following water delivery. Starting in late May, we alternated our weekly visits to fall on the day before water delivery and the day after water delivery so we could document minimum and maximum extent of water (Table 8.1). During this latter part of the season, the extent of the inundated and saturated area in In

Between and 800M remained relatively constant throughout each week following pumping (Figure 8.4). In general, water delivery maintained water levels above those of 2010 (Figure 8.3), despite the markedly lower water levels within Topock Marsh in 2011 compared to 2010 (see Chapter 2).

We noted an increase in surface water within Pierced Egg starting in March and peaking by mid-April; by the end of April, Pierced Egg was completely dry (Figure 8.5). Surface water from the pumping did not flow into Pierced Egg, and the fluctuation of water levels in Pierced Egg was likely the result of a rise in local groundwater levels, which typically peak in April (see Groundwater Monitoring, below) and could also have been influenced by water delivery. The peak in groundwater levels is reflected in the overall percentage of In Between, 800M, and Pierced Egg that was inundated or saturated, which also peaked in mid-April and fell rapidly by early May (Figure 8.3). Water delivery appeared to result in a greater extent of surface water early in the season when overall groundwater levels throughout the area were relatively high. Later in the season, when overall groundwater levels had dropped, surface water was generally restricted to In Between, with portions of 800M sometimes having saturated soil.

Groundwater Monitoring

The piezometer at Topock Marsh shows that local groundwater levels typically peak each year in April (Figure 8.6). Daily cycles are apparent in the hydrograph across all years, showing low water levels during the afternoon hours when vegetation water demands and evapotranspiration are greatest and high water levels in early morning hours. The magnitude of the daily cycle is greatest during the summer months when vegetation demands are greatest and lowest during the winter months when cooler daily temperatures and dormant vegetation result in lower water demands.

Weekly trends in groundwater levels were apparent in March–July 2011 (Figure 8.7) and paralleled the pumping schedule, with groundwater rising on the day of pumping and falling through the week until the next pumping. When groundwater levels were at relatively high levels in March and April, each pumping session increased the groundwater level at the piezometer approximately 0.08 m (0.25 feet) and then the water level fell linearly through the week until the next pumping session. As water levels dropped in May and June, the effect of each pumping session on the water level at the piezometer increased; each pumping session increased the water level by up to 0.23 m (0.75 feet), and water levels fell more rapidly immediately following pumping than they did later in the week. The groundwater level recorded by the piezometer peaked at the highest level recorded in any year since 2006, showing that water delivery raised the local groundwater table within the target area despite the overall lower water table in the marsh (see Chapter 2).

Microclimate

In 2010, we deployed 15 HOBO loggers in the flooded area and 17 loggers in the non-flooded area between 14 and 29 March (Figure 8.8). All loggers functioned correctly in 2010. In 2011, we deployed HOBO loggers in these same locations between 27 February and 11 March. In 2011, two loggers, one in the flooded area and one in the non-flooded area, failed to launch and collected no data; one logger in the flooded area had a faulty humidity sensor, and humidity data from this logger were excluded from the analysis. Data analyses were restricted to the period between 1 April and 15 July to encompass the dates when all loggers were deployed in both years. In 2010, soil conditions became progressively drier throughout the season for both the flooded and non-flooded areas, while temperatures rose throughout the season and vapor pressure values showed the typical rise seen in July with the onset of summer monsoons

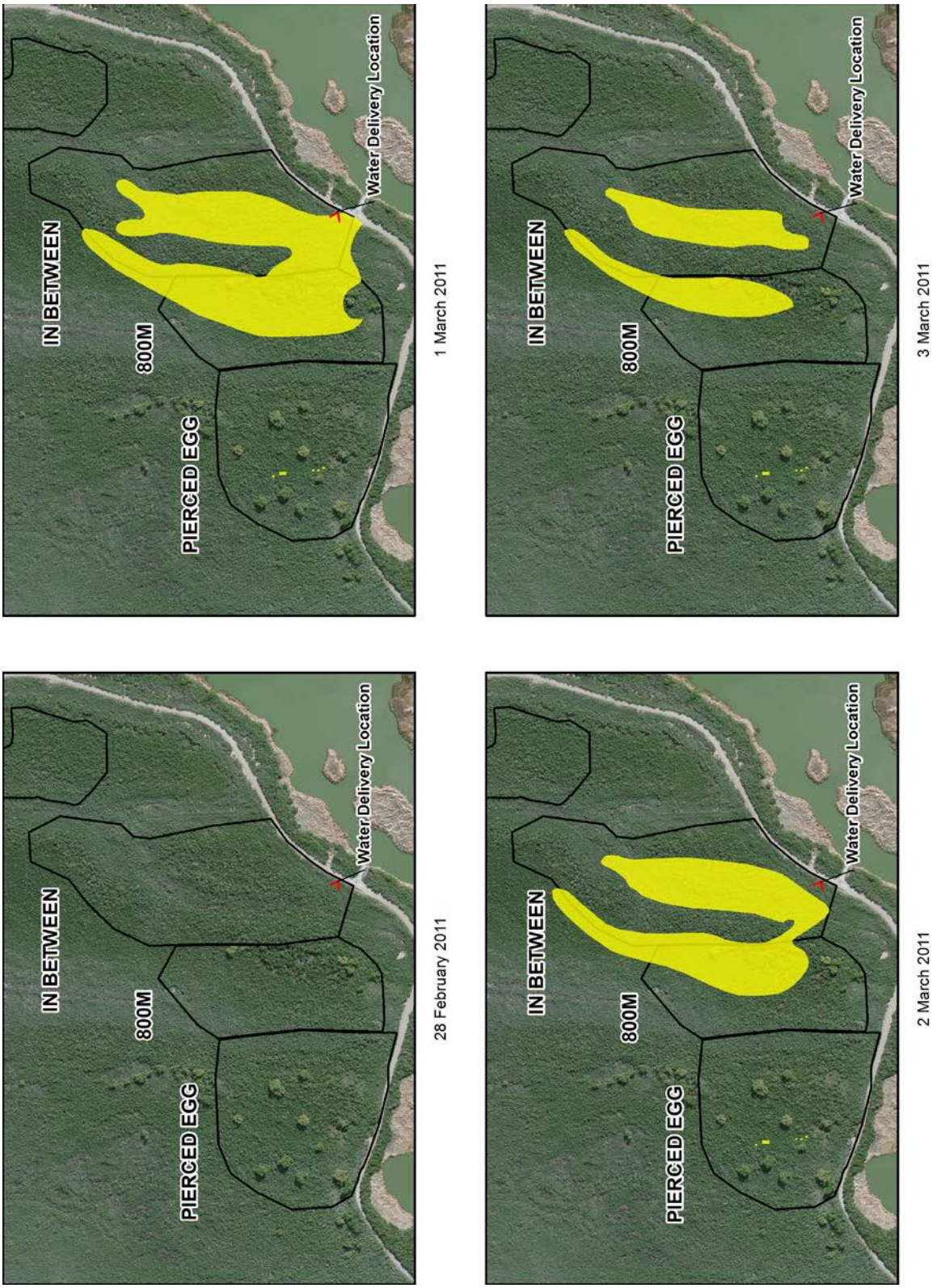


Figure 8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011.

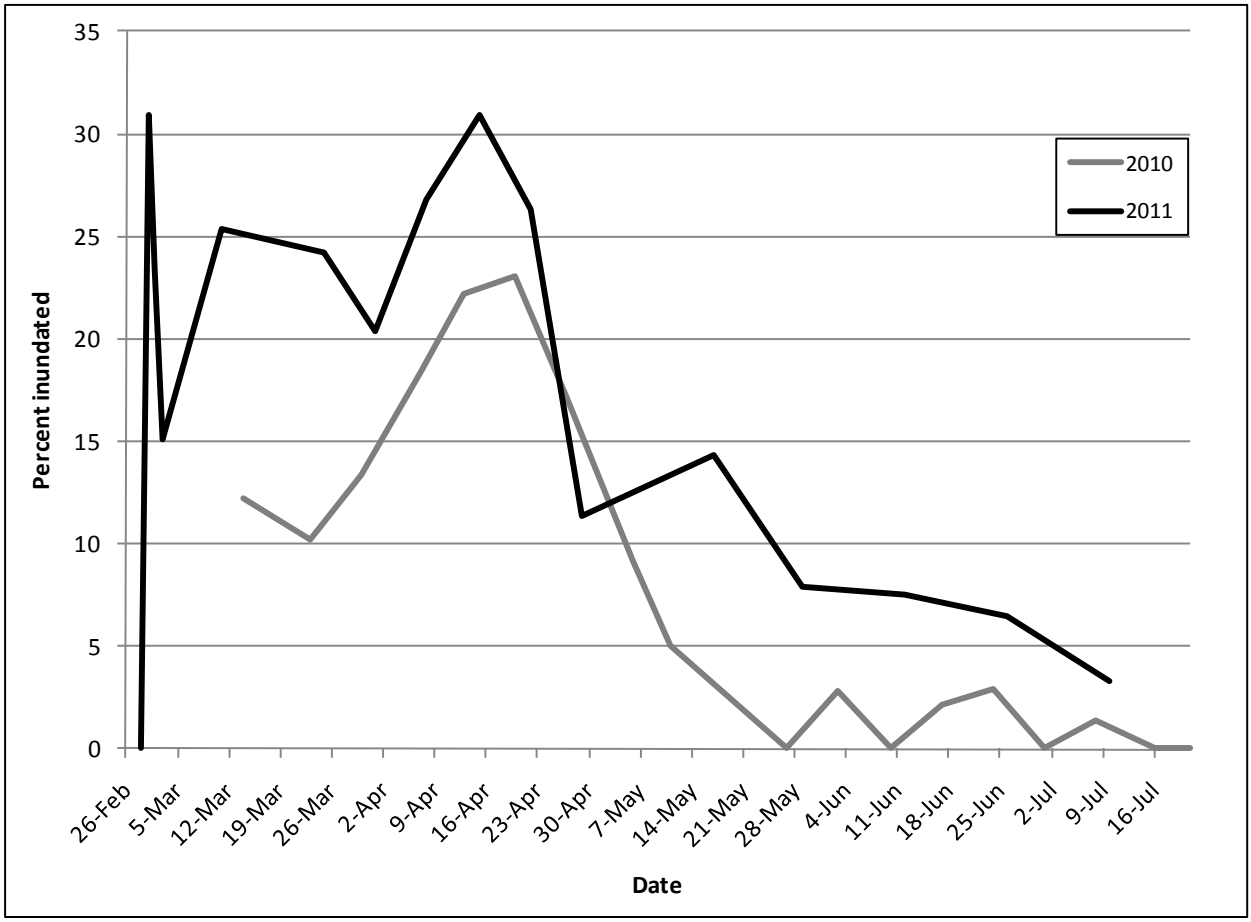


Figure 8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. Percentages are averaged over two-week periods for June and July 2011, because weekly visits alternated between the day before and the day after pumping.

(Tables 8.2 and 8.3). These same overall patterns were seen in 2011 (Tables 8.4 and 8.5). These data are shown graphically for easier comparison of data between years (Figures 8.9a–8.17a). Data are also shown as the difference between the flooded and non-flooded areas in both 2010 (the control year) and 2011 (Figures 8.9b–8.17b). If flooding had no effect, we would expect the differences between the flooded and non-flooded areas to be similar in both years.

Table 8.6 presents the significance test results (*P*-values) for the comparison of flooded versus non-flooded areas in 2010 and 2011. The first two columns show the comparison of each microclimate variable, overall across the season, in the flooded versus non-flooded areas in 2010 and 2011, respectively. Baseline data were collected in 2010, so significant *P*-values in this column indicate inherent differences between the flooded and non-flooded areas. A significant *P*-value in the column for a given year indicates a difference between flood groups, and corresponds to a significant gap between the solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. A significant *P*-value for a given variable in only one year but not both suggests an effect of flooding.

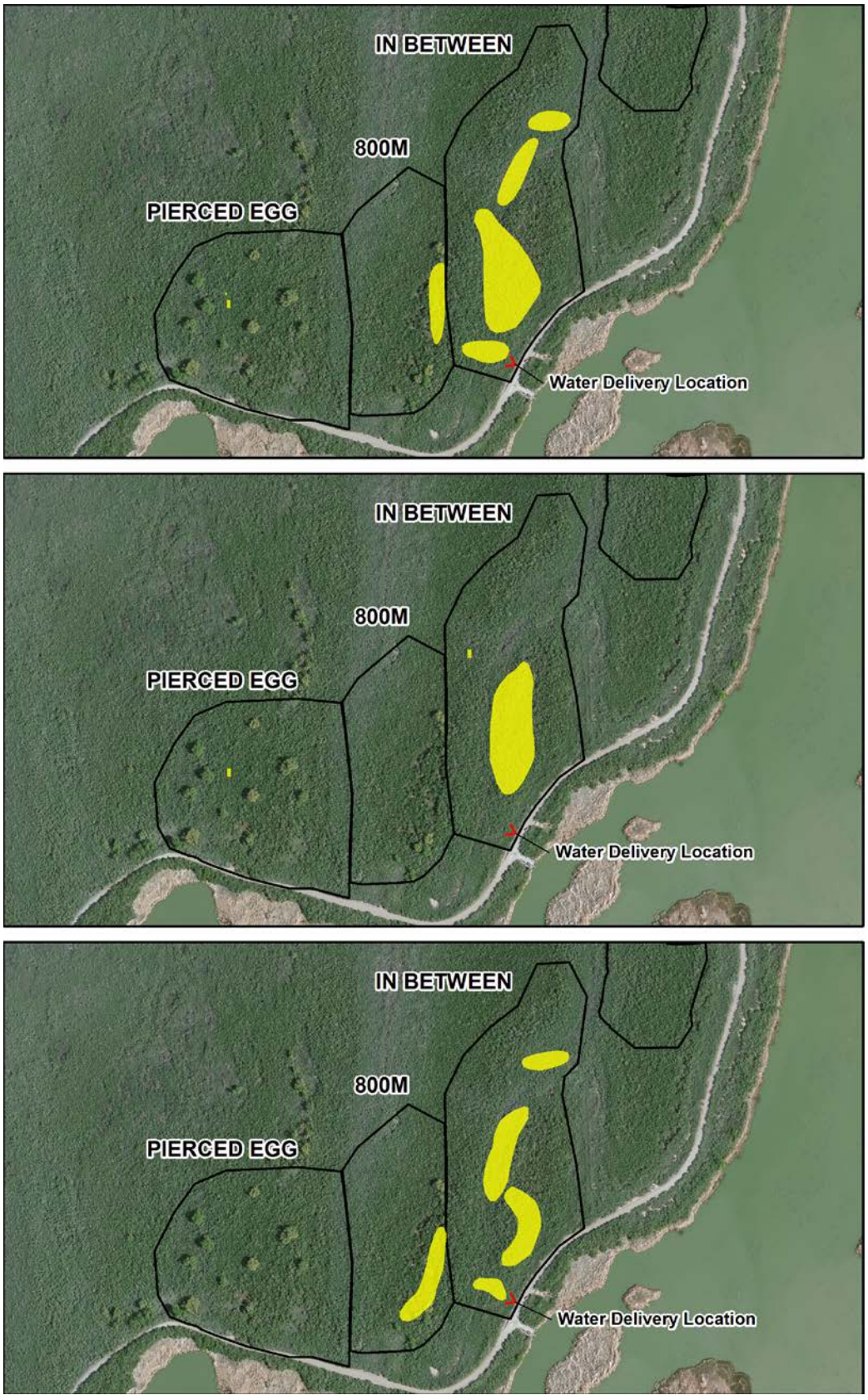


Figure 8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011.

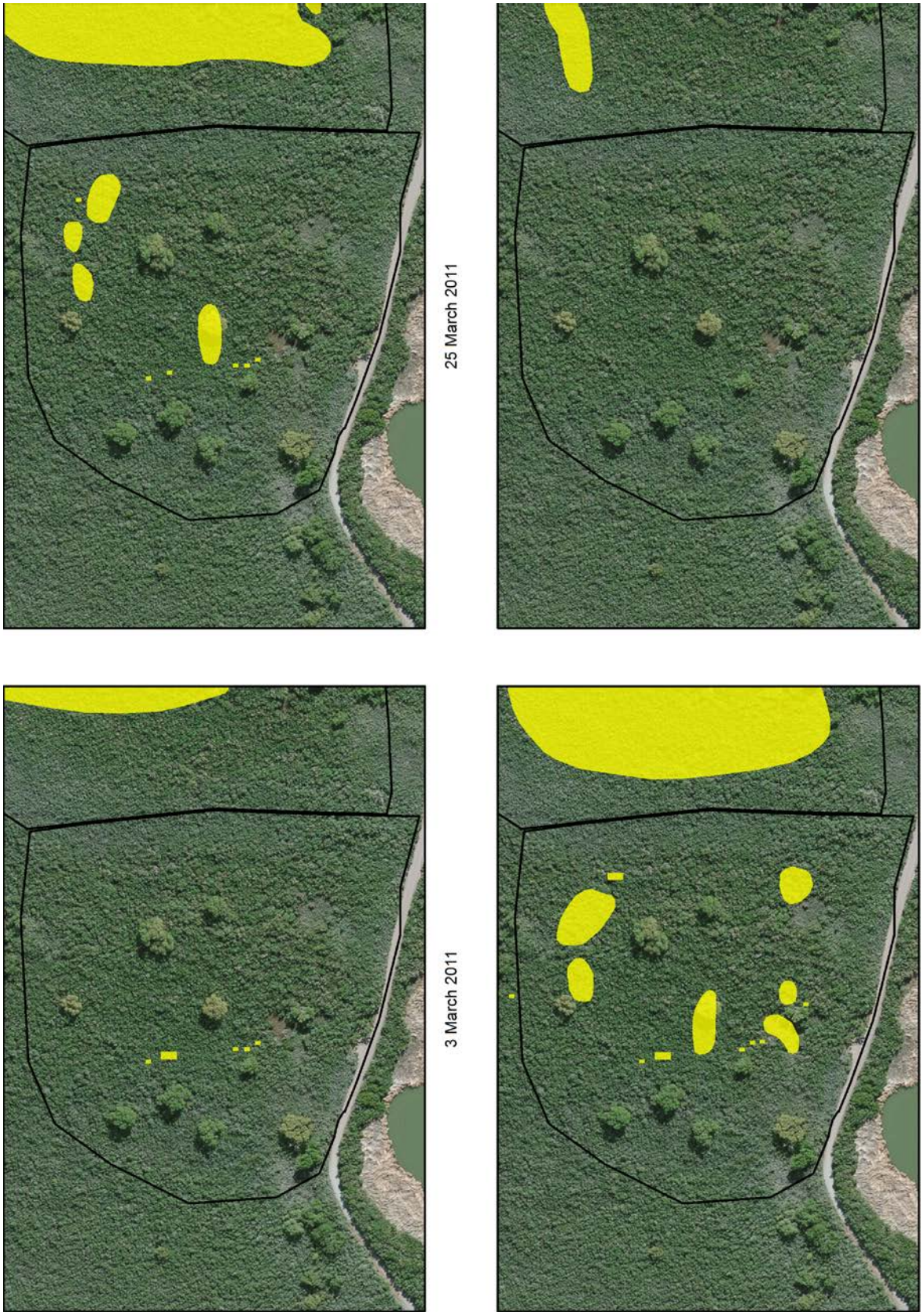


Figure 8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011.

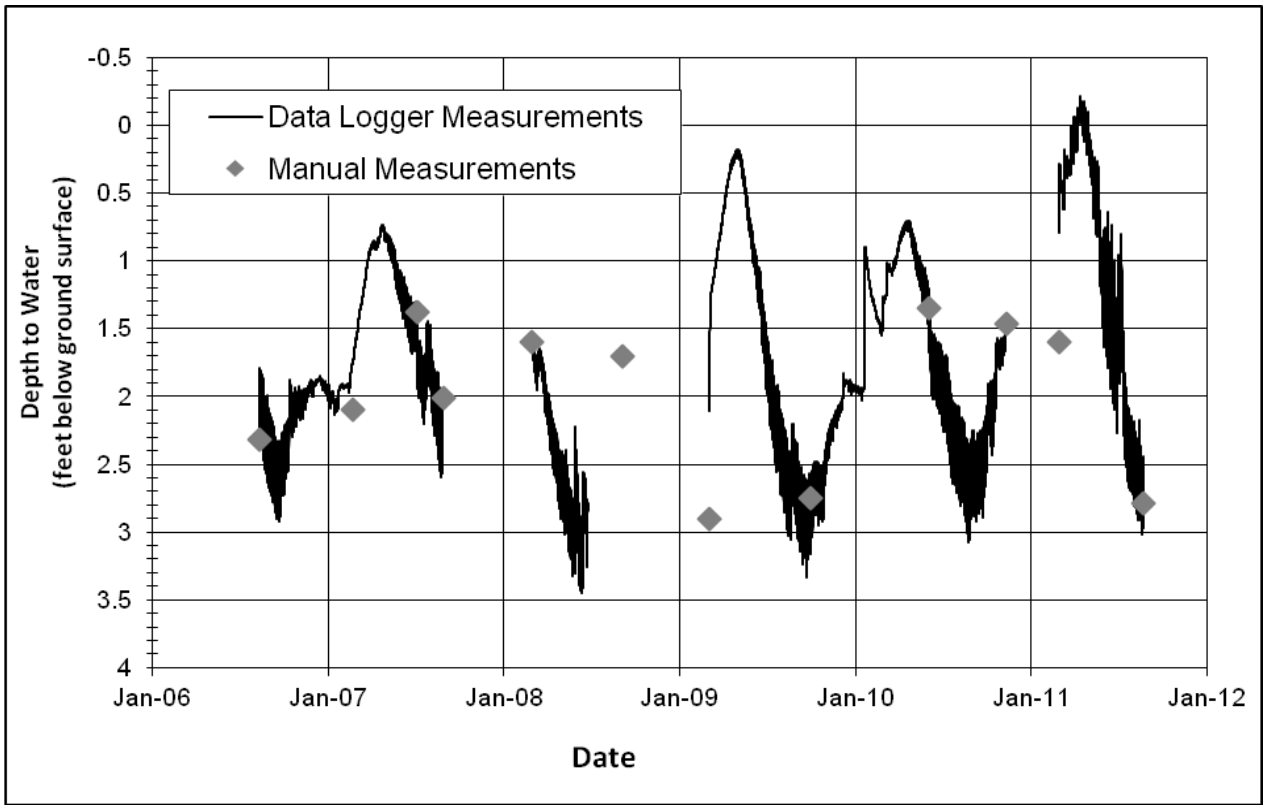


Figure 8.6. Topock Marsh hydrograph, 2006–2011.

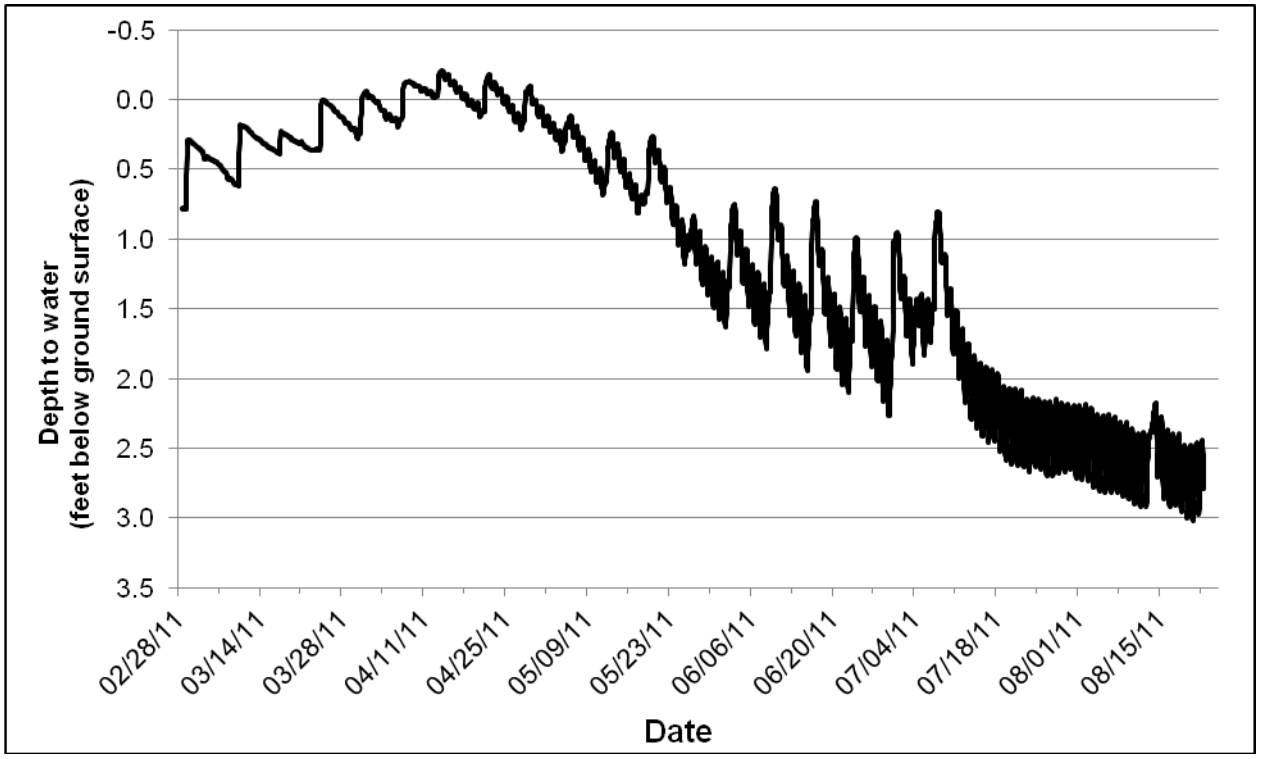


Figure 8.7. Topock Marsh hydrograph, February–July, 2011.

We also examined how each microclimate variable changed through the season. The third and fourth columns of Table 8.6 show *P*-values for the comparison of seasonal change in the flooded vs. non-flooded areas (i.e., the time*flood group interaction) in 2010 and 2011, respectively. Significant *P*-values in either column indicate that the microclimate variable changed through the season in the flooded area in a different way than in the non-flooded area in that year, and corresponds to non-parallel solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. Again, a significant *P*-value for a given variable in one year but not the other suggests an effect of flooding.

We also examined between-year differences for soil moisture variables within the non-flooded and flooded areas (columns 5 and 6, respectively, of Table 8.6). We did not include results for the between-year analysis for temperature and humidity variables because significant between-year differences could be the result of variation in climate between years, and any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates an overall between-year difference within the flood group and corresponds to a significant gap between the gray (2010) and black (2011) lines for that flood group in Figures 8.9a–8.12a.

Finally, we compared change through the season for soil moisture variables in 2010 versus 2011 (i.e., the time*year interaction) within the non-flooded and flooded areas (columns 7 and 8, respectively, of Table 8.6). Again, we did not include the results of this analysis for temperature and humidity variables because any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates that, within the given flood group, the variable changed through time in 2010 in a different way than it changed through time in 2011. This corresponds to non-parallel gray (2010) and black (2011) lines for the flood group in Figures 8.9a–8.12a.

None of the measures of soil moisture and presence of surface water differed overall between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1). In 2011, three measures of surface water (distance to surface water, percentage of the area within 20 m that was flooded, and percentage of the area within 50 m that was flooded) differed between the flooded and non-flooded area (Table 8.6, column 2), with all three variables indicating wetter overall conditions in the flooded area (Figures 8.10–8.12). Soil moisture and both measures of the percentage of the area inundated showed a significant interaction between flood group and time in 2011 (Table 8.6, column 4); soil moisture declined more rapidly in the flooded versus the non-flooded area as the extent of the flooding decreased through the season (Figure 8.9), and the measures of the percentage inundated decreased throughout the season in the flooded area while they remained constant (at zero) through the season in the non-flooded area (Figures 8.11 and 8.12). The non-flooded area differed significantly between years in soil moisture, distance to water, and percentage of the area within 50 m that was inundated (Table 8.6, column 5); all measures reflected the overall lower marsh levels and resulting drier conditions in 2011. The flooded area differed between years in all measures of surface water (Table 8.6, column 5), with all variables indicating wetter conditions in 2011. Overall soil moisture in the flooded area did not differ significantly between years (Table 8.6, column 6) but did show a significant interaction between year and time (Table 8.6, column 8); soil moisture was higher in 2011 than in 2010 early in the season but had dropped to a lower level in 2011 than in 2010 by early June, again illustrating the overall dry conditions in 2011 (Figure 8.9).

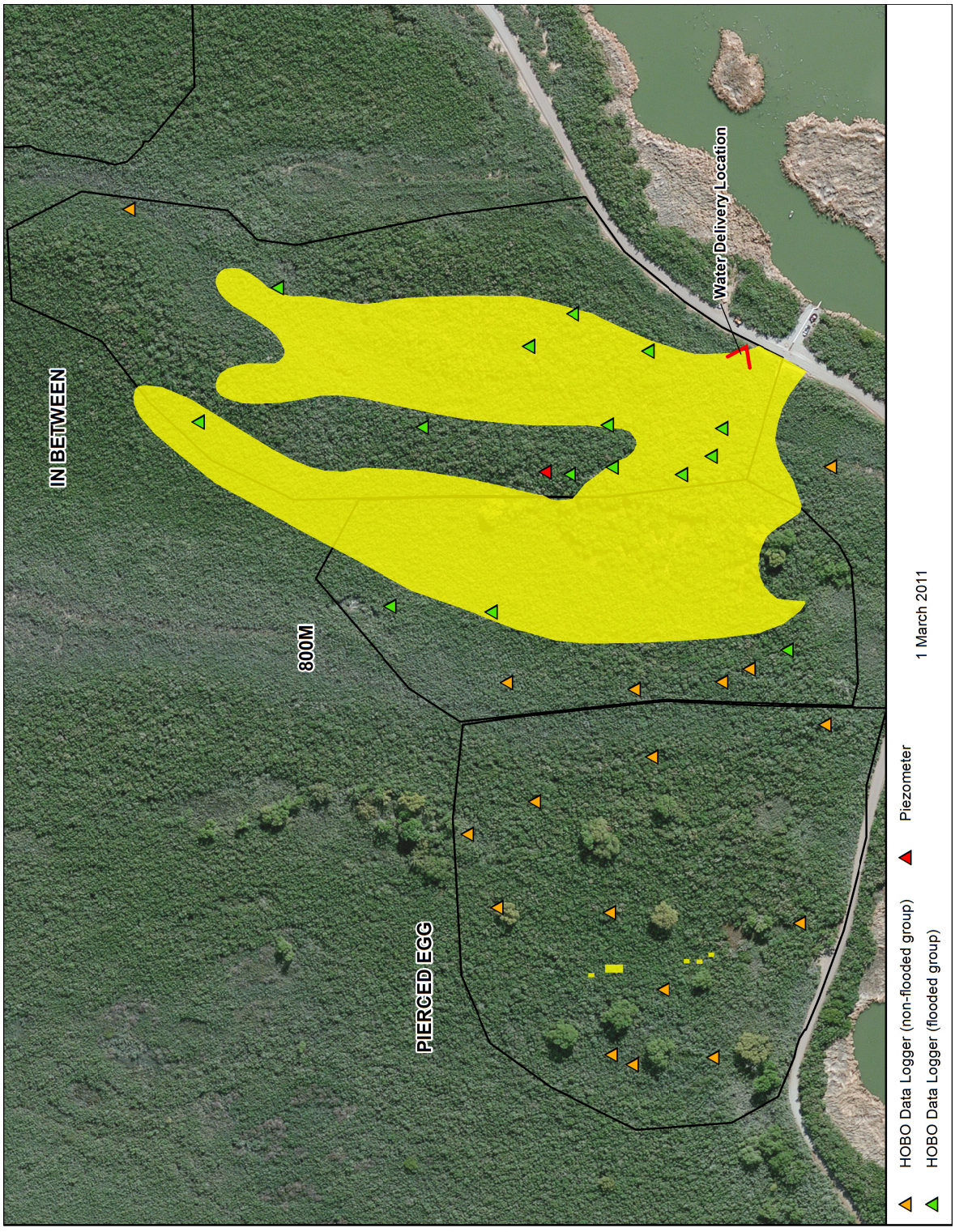


Figure 8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011.

Table 8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	911.4 (14.0)	897.9 (13.4)	881.2 (14.0)	878.6 (10.8)	863.2 (9.8)	836.8 (12.1)	867.3 (16.3)
Mean distance to nearest standing water	31.0 (6.2)	31.9 (6.1)	62.5 (8.7)	68.5 (8.1)	101.6 (10.6)	98.4 (10.8)	110.3 (17.9)
% of area within 20 m that was inundated	10.7 (6.3)	10.0 (5.0)	1.9 (1.9)	1.9 (1.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	18.7 (5.6)	12.4 (3.8)	1.8 (1.0)	2.0 (1.1)	0.0 (0.0)	0.3 (0.3)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	35.3 (0.3)	36.2 (0.4)	38.4 (0.3)	38.5 (0.3)	41.9 (0.3)	43.1 (0.3)	43.4 (0.4)
Mean minimum nocturnal temperature (°C)	5.0 (0.2)	8.5 (0.3)	8.4 (0.2)	9.9 (0.2)	18.0 (0.2)	13.8 (0.2)	18.3 (0.2)
Mean daily temperature range (°C)	30.3 (0.3)	27.7 (0.4)	30.0 (0.3)	28.6(0.4)	23.9 (0.3)	29.4 (0.3)	25.1 (0.4)
Humidity							
Mean diurnal vapor pressure (Pa)	597.4 (9.3)	818.4 (13.4)	798.1 (14.1)	976.4 (16.2)	1588.5 (23.5)	1649.4 (28.5)	2279.7 (36.0)
Mean nocturnal vapor pressure (Pa)	652.2 (8.7)	888.1 (11.9)	890.9 (11.2)	1022.4 (12.4)	1537.7 (17.5)	1423.7 (16.8)	1929.9 (22.3)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

Table 8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	908.1 (13.7)	908.0 (12.9)	892.7 (13.8)	838.4 (20.6)	853.9 (11.8)	834.3 (19.8)	804.5 (17.9)
Mean distance to nearest standing water	44.9 (9.7)	42.8 (9.3)	54.0 (10.2)	60.6 (17.1)	102.8 (11.9)	115.0 (13.4)	192.0 (23.3)
% of area within 20 m that was inundated	8.0 (6.7)	6.2 (4.4)	5.3 (4.6)	6.4 (5.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	13.5 (4.8)	15.5 (4.8)	10.1 (4.1)	6.7 (4.4)	4.1 (3.0)	0.0 (0.0)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	32.2 (0.3)	33.7 (0.4)	35.7 (0.3)	36.3 (0.4)	39.8 (0.4)	40.9 (0.4)	40.9 (0.4)
Mean minimum nocturnal temperature (°C)	6.0 (0.2)	9.4 (0.3)	9.1 (0.2)	10.6 (0.2)	18.7 (0.2)	14.5 (0.2)	18.9 (0.2)
Mean daily temperature range (°C)	26.2 (0.4)	24.3 (0.5)	26.6 (0.4)	25.7 (0.4)	21.1 (0.4)	26.5 (0.4)	22.0 (0.5)
Humidity							
Mean diurnal vapor pressure (Pa)	611.7 (10.1)	834.7 (14.5)	813.2 (15.4)	998.5 (17.9)	1595.6 (24.6)	1612.9 (26.8)	2209.8 (35.8)
Mean nocturnal vapor pressure (Pa)	676.5 (9.5)	913.3 (12.7)	906.3 (11.5)	1043.2 (13.0)	1535.3 (18.6)	1418.7 (16.8)	1921.6 (23.7)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

AR064537

Table 8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 17)							
Mean soil moisture (mV)	883.8 (14.4)	904.1 (13.3)	878.4 (22.7)	835.4 (16.8)	811.4 (19.0)	819.4 (12.1)	817.4 (11.4)
Mean distance to nearest standing water	N/A	N/A	122.0 (61.1)	138.9 (21.6)	149.4 (19.4)	120.4 (16.3)	115.6 (13.9)
% of area within 20 m that was inundated	3.6 (10.9)	N/A	0.0 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (40.0)	1.7 (1.7)
% of area within 50 m that was inundated	3.6 (3.6)	N/A	1.9 (1.4)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.1 (0.1)
Temperature (n = 16)							
Mean maximum diurnal temperature (°C)	34.8 (0.5)	38.2 (0.3)	38.7 (0.3)	36.6 (0.3)	40.3 (0.3)	43.5 (0.2)	41.3 (0.3)
Mean minimum nocturnal temperature (°C)	6.8 (0.3)	11.0 (0.2)	9.3 (0.3)	11.6 (0.2)	12.5 (0.2)	18.0 (0.2)	20.0 (0.2)
Mean daily temperature range (°C)	28.1 (0.5)	27.2 (0.4)	29.4 (0.4)	25.0 (0.4)	27.8 (0.3)	25.5 (0.3)	21.3 (0.5)
Humidity (n = 16)							
Mean diurnal vapor pressure (Pa)	666.5 (14.2)	761.1 (13.8)	858.8 (15.9)	1066.2 (14.9)	1229.4 (24.5)	1598.9 (20.7)	2467.8 (43.7)
Mean nocturnal vapor pressure (Pa)	666.3 (12.5)	817.0 (13.8)	922.1 (13.6)	1033 (10.4)	1178.1 (19.1)	1436.8 (12.9)	2215.1 (32.2)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

Table 8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 15)							
Mean soil moisture (mV)	955.6 (12.1)	944.3 (14.7)	893.7 (17.8)	867.8 (17.8)	779.1 (28.5)	768.8 (23.4)	809.6 (24.0)
Mean distance to nearest standing water	N/A	N/A	12.0 (4.7)	48.5 (23.6)	84.7 (20.5)	73.0 (18.7)	98.11 (20.0)
% of area within 20 m that was inundated	57.7 (10.9)	N/A	39.6 (10.0)	18.3 (8.1)	18.0 (8.3)	17.5 (6.4)	5.8 (3.2)
% of area within 50 m that was inundated	54.6 (10.5)	N/A	36.1 (7.7)	23.4 (8.3)	20.1 (9.7)	26.3 (8.7)	11.7 (4.9)
Temperature (n = 14)							
Mean maximum diurnal temperature (°C)	31.8 (0.5)	34.8 (0.3)	36.0 (0.4)	34.5 (0.4)	38.5 (0.3)	42.1 (0.3)	40.5 (0.4)
Mean minimum nocturnal temperature (°C)	8.1 (0.3)	12.1 (0.3)	10.3 (0.3)	12.3 (0.2)	13.2 (0.2)	18.9 (0.2)	20.6 (0.2)
Mean daily temperature range (°C)	23.7 (0.5)	22.7 (0.4)	25.6 (0.5)	22.2 (0.4)	25.2 (0.4)	23.2 (0.5)	19.9 (0.5)
Humidity (n = 13)							
Mean diurnal vapor pressure (Pa)	732.4(16.5)	843.4 (16.5)	917.4 (18.5)	1110.9 (16.2)	1250.5 (25.1)	1631.8 (21.3)	2501.8 (49.7)
Mean nocturnal vapor pressure (Pa)	773.6 (14.4)	926.0 (17.1)	1031.2 (16.0)	1112.5 (12.8)	1255.2 (21.5)	1516.9 (16.6)	2251.2 (35.6)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

AR064538

All measures of temperature (mean daily maximum, mean daily minimum, mean temperature range) tended toward being different (*P*-values between 0.04 and 0.07) between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1), with the flooded area having lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range than the non-flooded area (Figures 8.13–8.15). This pattern persisted in 2011 (Table 8.6, column 2; Figures 8.13–8.15). The change in temperature variables through the season was similar in the flooded and non-flooded areas in 2010 (Table 8.6, column 3) but not in 2011 (Table 8.6, column 4). In 2011, the flooded area began the season with lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range when compared to the non-flooded area; these differences diminished steadily as the season progressed (Figures 8.13–8.15).

Diurnal and nocturnal vapor pressure did not differ significantly between flooded and non-flooded areas under baseline conditions in 2010 (Table 8.6, column 1). In 2011, both measures of humidity were higher in the flooded versus non-flooded area (Figures 8.16 and 8.17), but this difference was significant only for nocturnal vapor pressure (Table 8.6, column 2). The difference in nocturnal vapor pressure between flooded and non-flooded areas decreased through the season in 2011 (Table 8.6, column 4; Figure 8.17).

Comparison between day before and day after flood events – A comparison of temperature and humidity variables the day before and the day after each flood event in 2011 showed that, overall, flood events appeared to affect all temperature and humidity variables, and the effect was not constant through the season for any variable except mean diurnal vapor pressure (Table 8.7). The effect of flooding is graphed (Figures 8.18-8.22) to aid in interpretation of flooding effects. In each figure there are three graphs. The first graph shows the difference in the given microclimate variable between the day before and the day after each flood event for the flooded and non-flooded areas. The fluctuation in the non-flooded area between the day before and day after each flood events indicates the baseline change in general weather conditions; deviation in the flooded area from this baseline change suggests an effect of flooding. This deviation (the difference between the non-flooded and flooded areas) is depicted in the second graph in each figure. The third graph in each figure plots this deviation against baseline weather conditions to show whether the direction and magnitude of any effects of flooding varied based on underlying weather conditions.

Overall, the flooded area had a lower maximum diurnal temperature in relation to the non-flooded area on the day after a flood event than on the day before a flood event (Table 8.7, Figures 8.18a and 8.18b). The effect of flooding on the maximum diurnal temperature was related to the maximum temperature recorded on the day after a flood event in the non-flooded area (Figure 8.18c); flooding had the greatest effect of lowering the maximum temperature on hot days but raised the maximum temperature on relatively cool days. Overall, minimum nocturnal temperature on the day after a flood event was higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.19a and 8.19b). The effect of flooding on minimum nocturnal temperature did not appear to be related to minimum nocturnal temperature (Figure 8.19c). Overall, the daily temperature range on the day after a flood event was smaller in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.20a and 8.20b). This effect was strongly related to the maximum temperature on the day after a flood event, with flooding having the greatest effect of reducing the daily temperature range on hot days (Figure 8.20c).

Both diurnal and nocturnal vapor pressure on the day after a flood event were higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.21a, 8.21b, 8.22a, and 8.22b). Diurnal vapor pressure was affected the most strongly in the middle of the season (Figure 8.21b), but this effect was not related to overall vapor pressure (Figure 8.21c). The effect on nocturnal vapor pressure was weakly, inversely related to ambient vapor pressure.

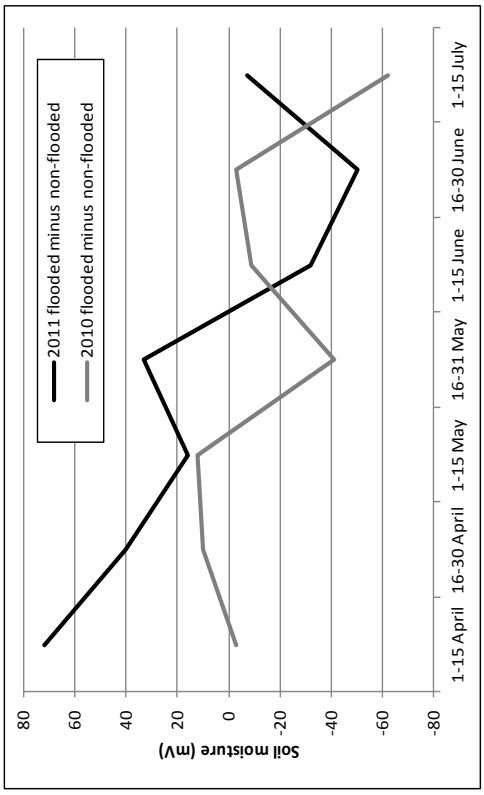


Figure 8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

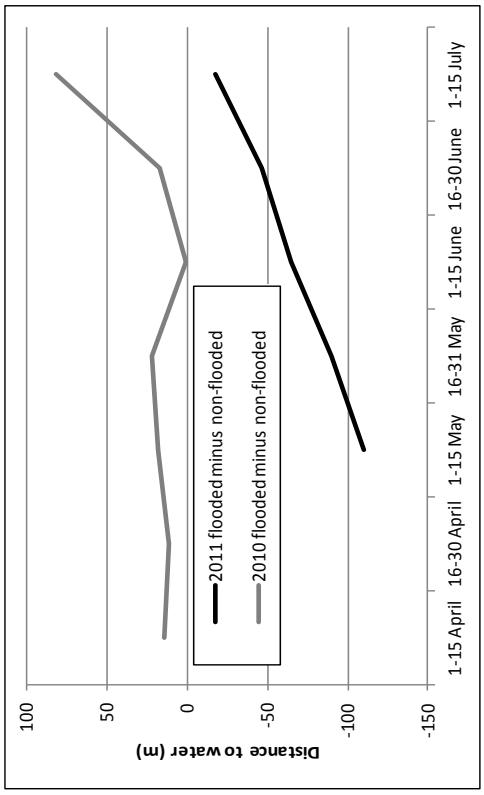


Figure 8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

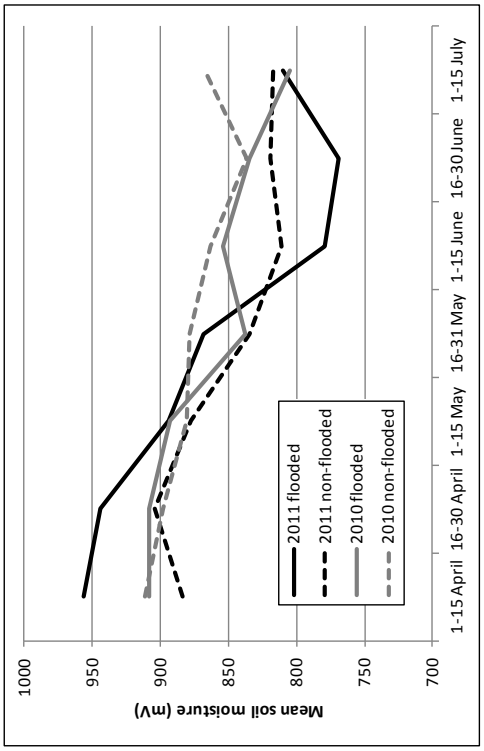


Figure 8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

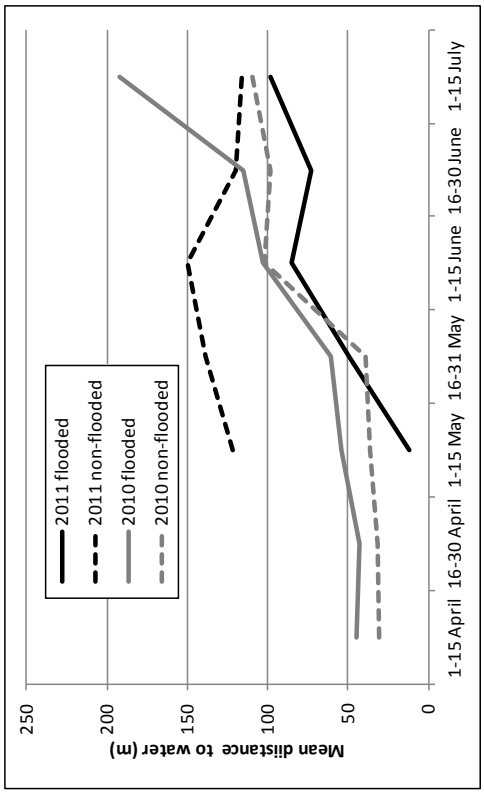


Figure 8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

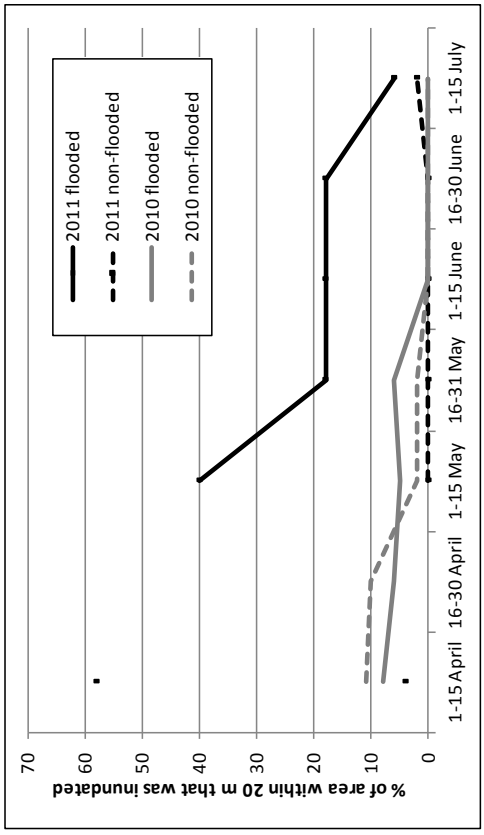


Figure 8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

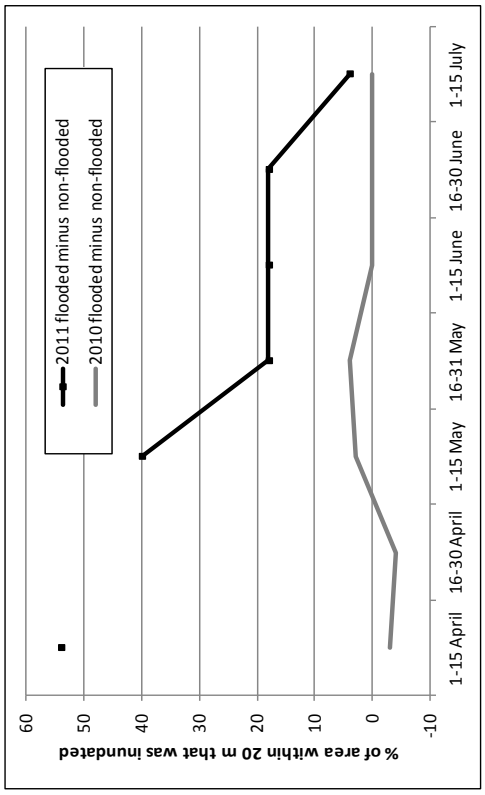


Figure 8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011.

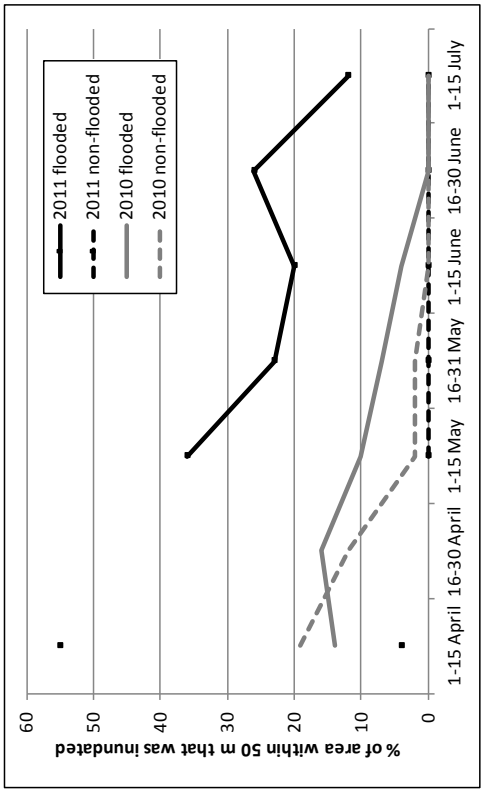


Figure 8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

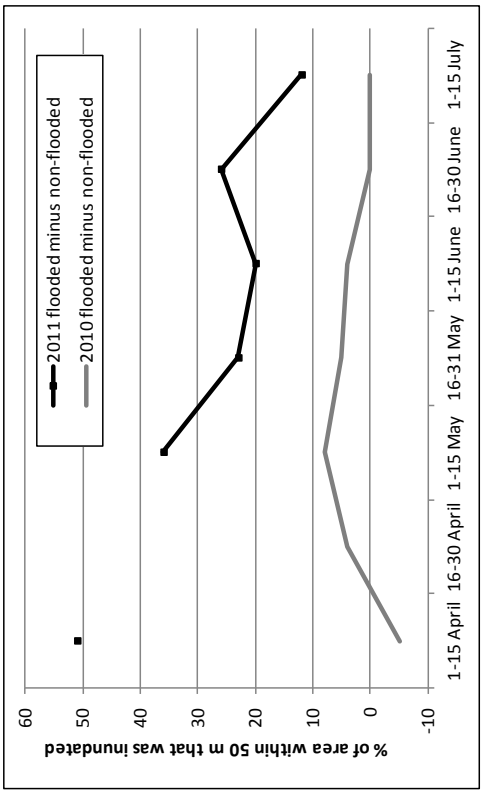


Figure 8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011.

Figure 8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Figure 8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

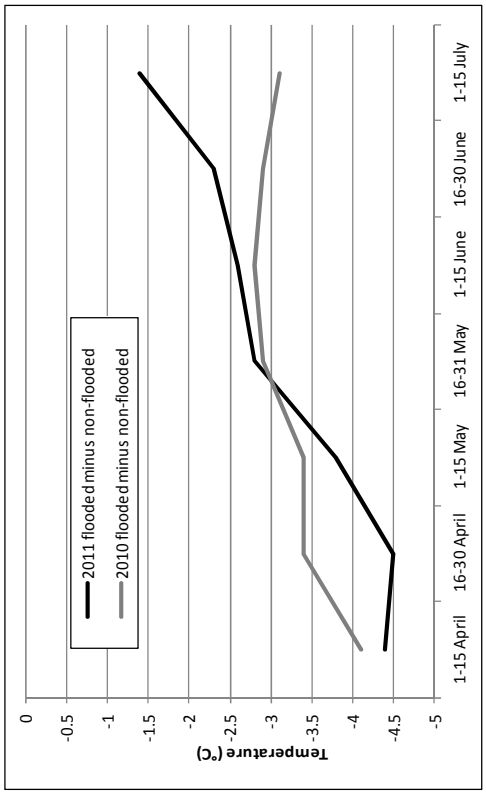


Figure 8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

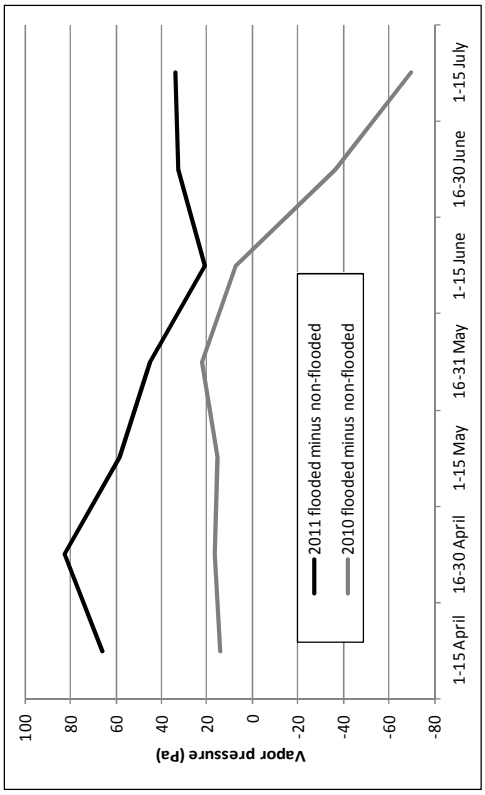


Figure 8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

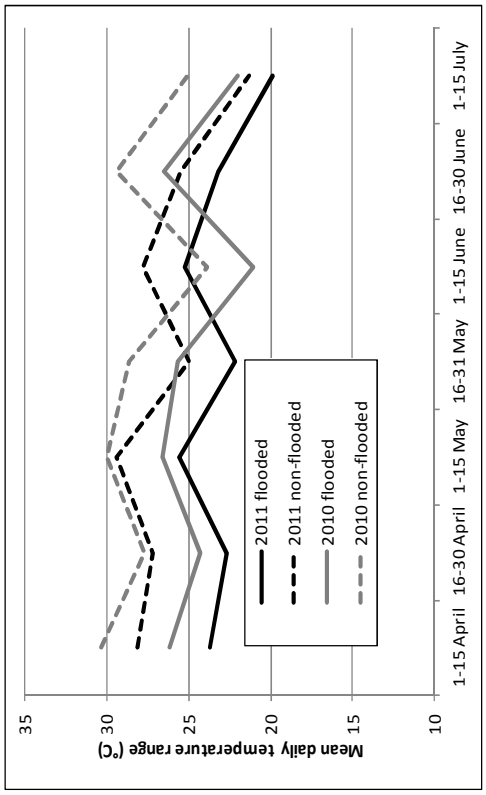


Figure 8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

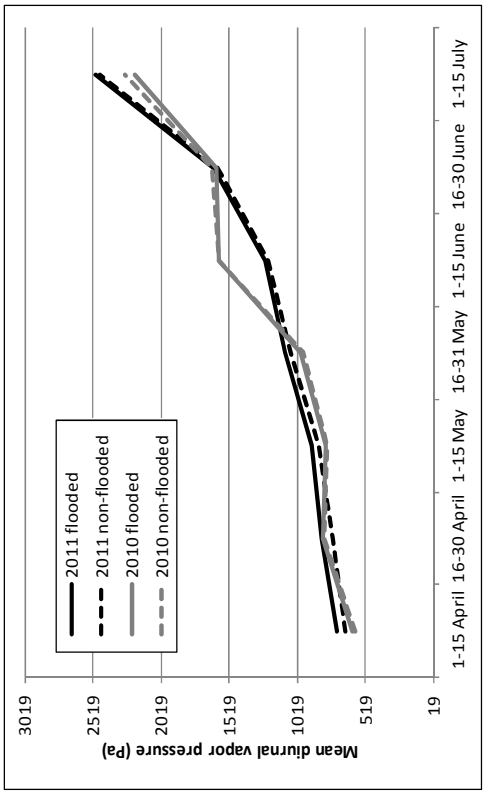


Figure 8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

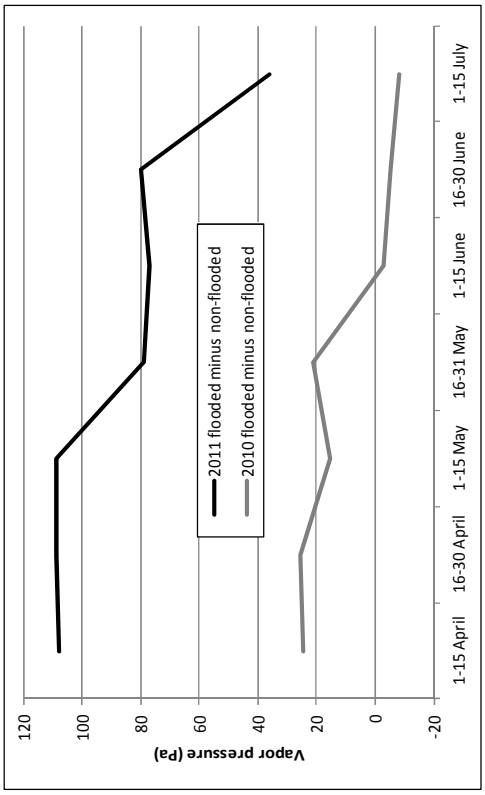


Figure 8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

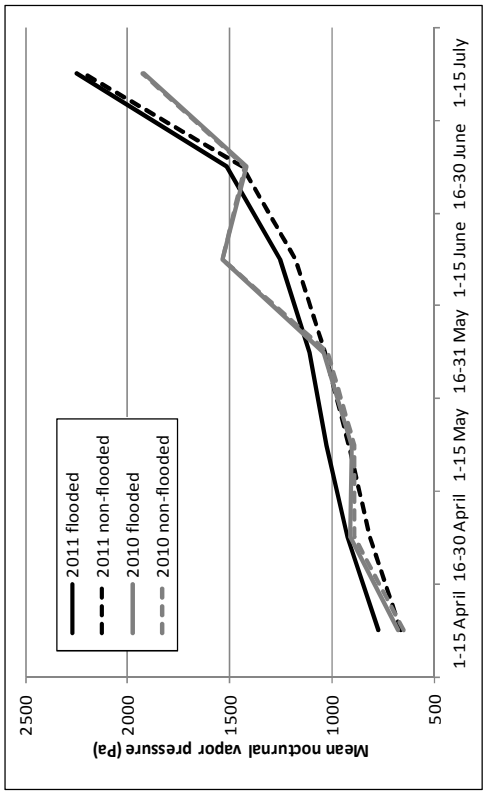


Figure 8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Table 8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011.

	Flooded vs. non-flooded areas overall, within the year (between flood group differences)		Change over the season for flooded vs. non-flooded areas, by year (interaction between flood group and time)		2010 vs. 2011 overall, within flood group (between-year differences)		Change over the season for 2010 vs. 2011, by flood group (interaction between year group and time)	
Parameter	**2010**	**2011**	**2010**	**2011**	**Non-flooded**	**Flooded**	**Non-flooded**	**Flooded**
Soil Moisture								
Mean soil moisture (mV)	0.329	0.563	0.014	<0.001	<0.001	0.884	0.131	0.009
Mean distance to nearest standing water	0.124	0.009	<0.001	0.173	<0.001	<0.001	0.066	0.023
% of area within 20 m that was inundated	0.997	<0.001	0.750	<0.001	0.208	<0.001	0.718	0.010
% of area within 50 m that was inundated	0.497	<0.001	0.147	0.001	0.026	<0.001	0.004	0.407
Temperature								
Mean maximum diurnal temperature (°C)	0.067	0.071	0.954	0.009	--	--	--	--
Mean minimum nocturnal temperature (°C)	0.069	0.044	0.088	<0.001	--	--	--	--
Mean daily temperature range (°C)	0.041	0.047	0.802	0.001	--	--	--	--
Humidity								
Mean diurnal vapor pressure (Pa)	0.943	0.349	0.618	0.845	--	--	--	--
Mean nocturnal vapor pressure (Pa)	0.751	0.011	0.170	0.012	--	--	--	--

* Data restricted from April 1 through July 15 for both years. For 2011, distance-to-water measures do not include April and percent inundated measures do not include April 16-30.

AR064545

Table 8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011*

	Maximum diurnal temperature		Minimum nocturnal temperature		Daily temperature range		Mean diurnal vapor pressure		Mean nocturnal vapor pressure	
Day of flooding	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded
31 March	9.3	8.6	5.8	6.3	3.5	2.3	113.2	190.7	155.2	275.4
7 April	-18.9	-15.5	-1.5	-3.6	-17.4	-11.9	-194.4	-191.8	-443.1	-495.4
13 April	-5.5	-5.0	2.6	2.6	-8.0	-7.6	-263.6	-338.0	-263.7	-292.1
21 April	0.1	-0.9	-3.6	-2.9	3.6	2.0	-193.7	-154.0	-41.8	-21.3
28 April	2.4	1.9	11.1	9.1	-8.7	-7.2	201.0	239.3	-152.9	-264.2
5 May	3.0	2.0	4.5	4.3	-1.3	-2.3	261.9	323.6	260.4	249.5
12 May	5.5	5.0	2.8	4.0	2.7	1.0	95.5	149.7	93.4	175.2
19 May	11.9	11.1	-0.4	0.4	12.2	10.7	-269.0	-170.6	26.8	83.3
26 May	0.6	0.7	4.7	4.7	-4.1	-3.9	57.7	132.3	-38.9	50.1
2 June	4.8	3.6	-3.4	-2.5	8.2	6.1	-150.2	-40.7	93.0	158.1
9 June	3.0	3.0	1.3	2.4	1.8	0.5	196.3	220.0	96.7	157.7
16 June	-3.9	-4.4	3.5	4.4	-7.3	-8.7	-328.5	-223.9	-90.9	-61.9
23 June	-0.8	-1.7	4.8	5.5	-5.6	-7.2	-84.3	-85.4	-7.2	55.6
30 June	0.2	-0.7	-11.4	-11.3	11.6	10.6	522.0	587.7	402.6	565.5
7 July	11.0	8.0	0.7	1.5	10.3	6.5	-190.4	-136.2	-212.0	-178.1
Mean (SE)	1.5 (0.6)	1.0 (0.6)	1.4 (0.4)	1.7 (0.4)	0.1 (0.7)	-0.6 (0.6)	-15.1 (22.3)	33.5 (23.9)	-8.2 (18.3)	30.5 (24.0)
P-values, flooded vs. non-flooded areas, overall	0.034		0.031		0.008		0.011		0.007	
P-values, change over the season for flooded vs. non-flooded areas (interaction between flood group and time)	0.003		<0.001		<0.001		0.542		<0.001	

* Differences are the day after flooding minus the day before flooding.

Figure 8.18a. Difference between the day before and day after (day after minus day before) each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.18b. Difference between flood groups (non-flooded minus flooded) in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011.

Figure 8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.19a. Difference between the day before and day after (day after minus day before) each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.19b. Difference between flood groups (non-flooded minus flooded) in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011.

Figure 8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.20a. Difference between the day before and day after (day after minus day before) each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.20b. Difference between flood groups (non-flooded minus flooded) in difference in daily temperature range before and after each flood event, Topock Marsh, 2011.

Figure 8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.21a. Difference between the day before and day after (day after minus day before) each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.21b. Difference between flood groups (non-flooded minus flooded) in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011.

Figure 8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

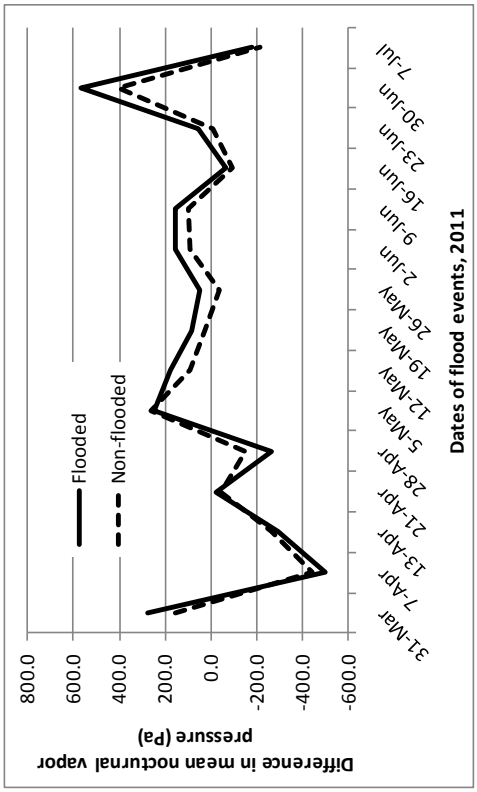


Figure 8.22a. Difference between the day before and day after (day after minus day before) each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

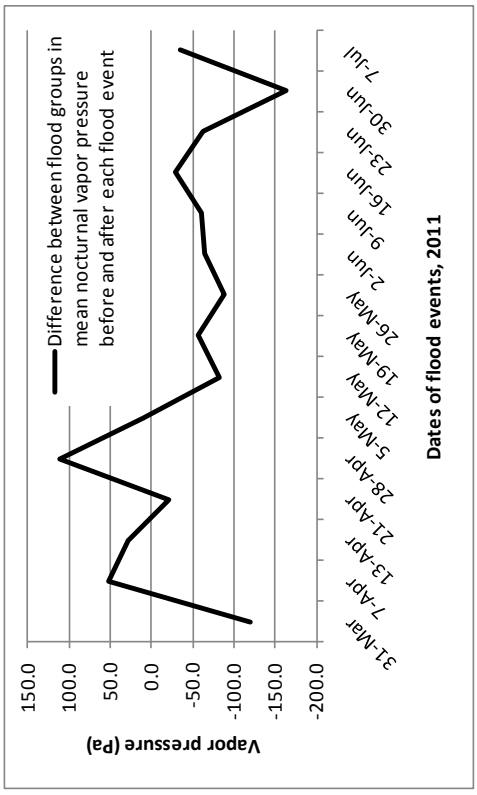


Figure 8.22b. Difference between flood groups (non-flooded minus flooded) in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011.

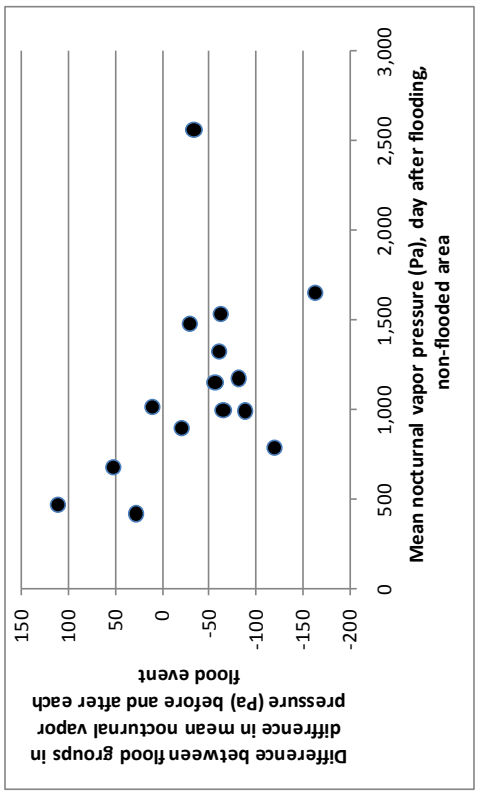


Figure 8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Vegetation

We collected vegetation data at all 15 flooded and 17 non-flooded locations. Vegetation characteristics in 2010 and 2011 are summarized in Table 8.8, and vertical foliage profiles are shown in Figures 8.23–8.26. Vegetation characteristics are typical of those documented in dense, tamarisk stands at Topock Marsh in previous years (McLeod et al. 2008a), with dense canopy closure and a small percentage of native vegetation.

Vegetation characteristics differed between years in both flooded and non-flooded areas in percent canopy closure, percent woody ground cover, and the amount of live vegetation in all height categories (Table 8.8, *P*-values in "Year" column). Percent canopy closure and percent woody ground cover was higher in 2011 than in 2010, while the number of hits of live vegetation recorded in all height categories was lower in 2011. Woody ground cover was the only variable that showed an interaction between year and flood group, meaning that the change in woody ground cover was different in the flooded area versus the non-flooded area (right-most column of Table 8.8). Woody ground cover increased more dramatically in the non-flooded area than in the flooded area.

Table 8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011*

Parameter	2010		2011		*P*-value	
	Flooded	Non-flooded	Flooded	Non-flooded	Year	Year*flood group
Average canopy height (m)	6.3 (0.3)	5.9 (0.3)	6.2 (0.2)	5.9 (0.3)	0.725	0.904
	4.2–7.4	3.4–8.3	4.0–7.0	3.5–8.5		
% total canopy closure	89.5 (1.5)	88.7 (2)	94.3 (1)	90.7 (1.4)	0.007	0.260
	78.6–97.9	63–97.4	85.9–100	77.6–97.4		
% woody ground cover	23.7 (5.4)	13.2 (3.6)	45.8 (8.9)	77.1 (5.3)	<0.001	<0.001
	2.5–66.3	1–52.8	5.0–100.0	17.5–100		
Live vertical foliage (hits) below average nest height	2.6 (0.7)	3.0 (0.6)	1.4 (0.3)	2.1 (0.5)	0.018	0.718
	0.3–12.1	0.0–7.4	0.0–3.3	0.0–6.7		
Live vertical foliage (hits) at average nest height	2.6 (0.4)	2.7 (0.4)	1.6 (0.3)	2.0 (0.2)	<0.001	0.335
	0.1–5	0.8–6	0.2–3.8	0.3–3.9		
Live vertical foliage (hits) above average nest height	9.7 (0.7)	7.0 (1.1)	6.0 (0.6)	4.2 (0.7)	<0.001	0.433
	4.7–13.8	0.9–18.4	2.8–10.1	0.2–9.7		
Dead vertical foliage (hits) below average nest height	8.2 (0.7)	9.3 (0.5)	8.1 (0.7)	9.0 (0.6)	0.762	0.858
	2.4–13.1	5.1–13.4	4.8–13.4	5.1–14.2		
Dead vertical foliage (hits) at average nest height	1.9 (0.3)	2.0 (0.3)	2.2 (0.2)	1.9 (0.3)	0.460	0.241
	0.3–5.0	0.1–4.2	0.9–4.0	0.1–4.2		
Dead vertical foliage (hits) above average nest height	1.3 (0.4)	1.0 (0.2)	1.4 (0.3)	1.3 (0.2)	0.358	0.613
	0.0–3.9	0.0–2.9	0.0–3.2	0.0–4.1		
Percent native	0.0 (0.0)	5.3 (3.1)	0.0 (0.0)	7.5 (5)	0.680	0.680
	0.0–0.0	0.0–48.7	0.0–0.0	0.0–78.5		

* Data are presented as mean, standard error, and range. *P*-values for year indicate differences between years for both flooded and non-flooded locations combined. *P*-values for year*flooded indicate whether flooded areas changed between years differently than did non-flooded areas.

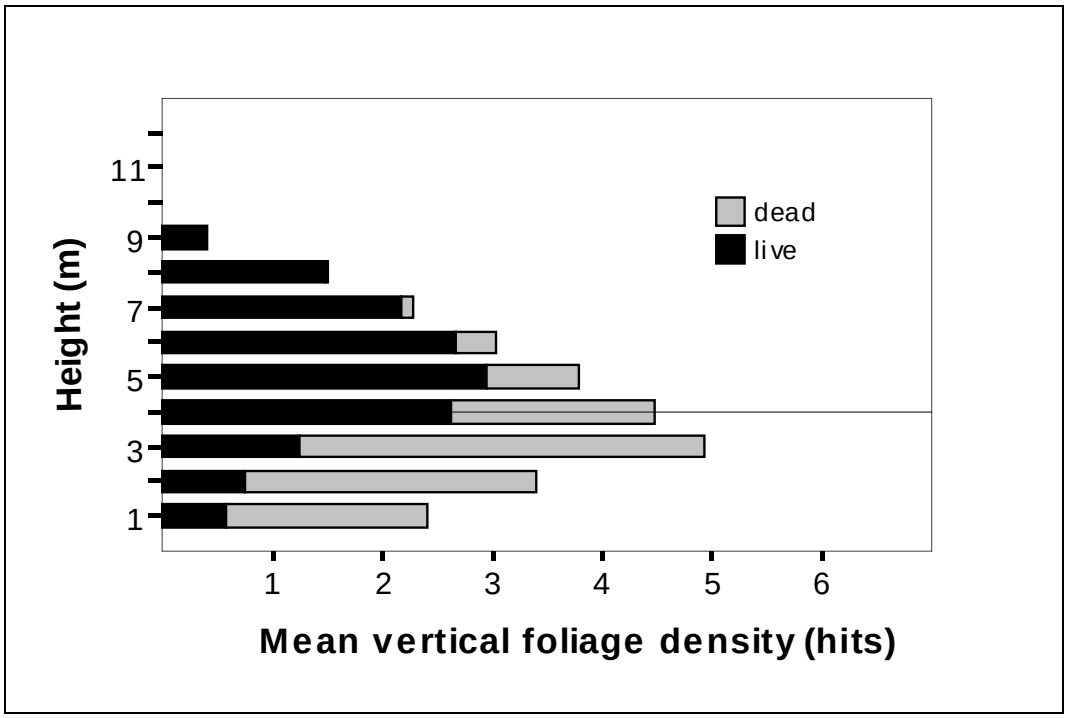


Figure 8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

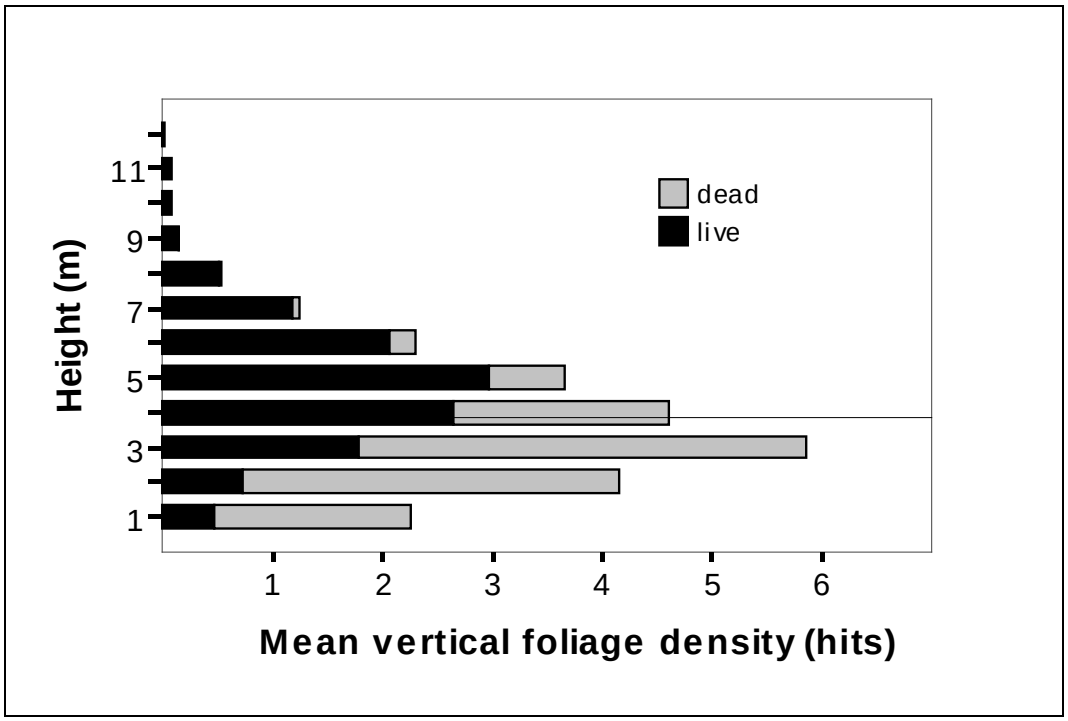


Figure 8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

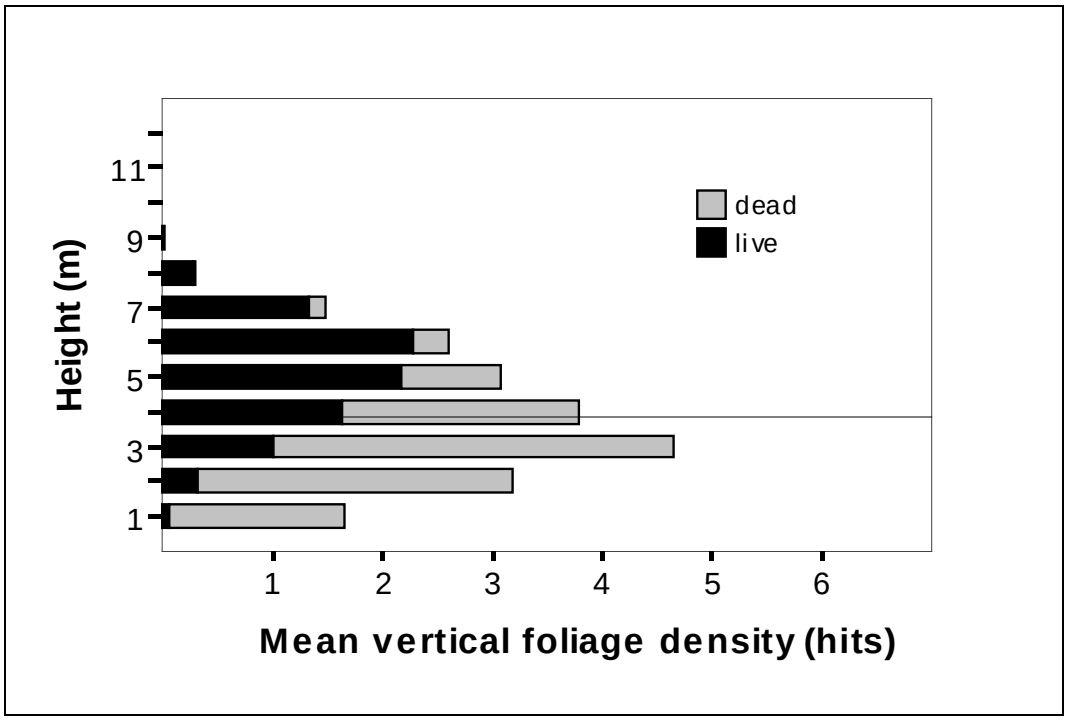


Figure 8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

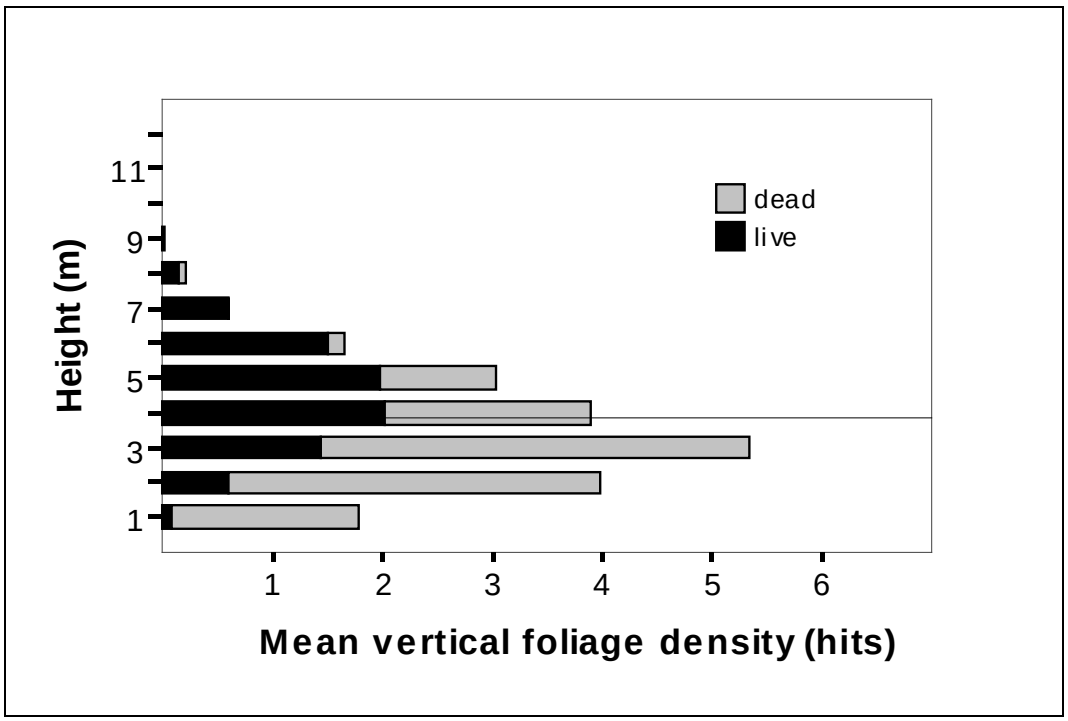


Figure 8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

DISCUSSION

Water delivery had the expected effect of increasing the extent and duration of surface water present within the target area in 2011 in comparison with the previous year, despite the overall lower level of Topock Marsh in 2011. Surface water from a given pumping event covered a larger extent and declined more slowly when the underlying water table was high, indicating that pumping was more effective in creating the surface water conditions favored by flycatchers when coupled with a high underlying water table.

In the area affected by flooding, water delivery had the expected effect of raising soil moisture, decreasing distance to water from the sample points, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also appeared to increase humidity within the flooded area; both diurnal and nocturnal vapor pressure were higher in the flooded area than in the non-flooded area in 2011 but not in 2010. In addition to the overall effect on humidity, flooding also had short-term effects on humidity as shown by the analysis of conditions on the day before versus the day after each flood event. On average, flood events produced higher diurnal and nocturnal vapor pressure in the flooded area in comparison to the non-flooded area.

The effect of water delivery on temperature was not as clear. The analysis comparing the flooded and non-flooded areas throughout the year did not show a statistically significant overall effect of flooding on any of the temperature variables, but there was an interaction between flood group and time in 2011, showing that all temperature variables changed through the year in the flooded area in a different way than they changed in the non-flooded area. In 2011, the difference between the flooded and non-flooded areas in all temperature variables declined as the season progressed. An analysis of temperature variables on the day before versus the day after each flood event showed that, on average, flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area. Thus, flood events did affect temperature, but these effects did not seem to persist across two-week periods. The interaction between flood group and time in 2011 suggests that the effect on temperature from a given flood event persisted for shorter periods of time as the season progressed.

Areas occupied by flycatchers typically have higher soil moisture, higher humidity, lower maximum temperatures, and smaller daily temperature ranges than unoccupied areas (McLeod et al. 2008a); thus, water delivery appeared to change the microclimate conditions within the flooded area in ways that would favor flycatcher occupancy.

The between-year changes in several of the vegetation variables appear somewhat contradictory, with canopy closure increasing between 2010 and 2011 but the amount of live vertical foliage decreasing between 2010 and 2011 in all height categories. It is difficult to distinguish between true changes in the vegetation and observer variation. The between-year differences were recorded in both flooded and non-flooded areas, indicating that flooding had no effect on changes in canopy closure or density of live vegetation. Woody ground cover increased between 2010 and 2011 in both flooded and non-flooded areas but increased much more dramatically in non-flooded areas. The overall increase in the percentage of woody ground cover could be strongly influenced by observer variation, but the significant interaction between year and flooded category suggests that the presence of surface water had an effect on the amount of woody cover, with flooding resulting in less woody cover. In general, water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy.

Water delivery resulted in the flooded area of In Between and 800M being the only portion of the sites surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season (see Chapter 2). Five flycatcher territories were recorded in Topock Marsh in 2011 (see Chapters

2 and 3); one of these territories was within the flooded portion of 800M and consisted of an unpaired male flycatcher. This flycatcher was detected at the territory in 800M through the end of June and then was detected for a few days in early July at another site approximately 1.5 km away. In 2010, the area that was affected by flooding in 2011 contained two resident, unpaired male flycatchers; in 2009, this same area contained one resident, unpaired male flycatcher. Water delivery thus did not result in increased flycatcher occupancy in the target area.

The number of flycatchers at Topock Marsh has been declining since 2004 (see Chapter 2), and few flycatcher young have been produced locally in recent years (see Chapter 4). Thus, there may be few adult flycatchers in the local population, and the lack of response by flycatchers to water delivery may be indicative of there being few adults available to establish territories. In addition, low water levels in 2011 throughout areas of Topock Marsh that have been historically occupied by flycatchers likely reduced the overall suitability of the area for flycatchers. Although supplemental water delivery appeared to produce conditions that would be favorable to flycatcher occupancy, the confounding factors of dry conditions elsewhere in Topock Marsh and a low population may have limited the ability of flycatchers to colonize the area.

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

This page intentionally left blank.

Chapter 9

MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS

For ease of reference this chapter summarizes all study design and management recommendations discussed in previous chapters.

BROADCAST SURVEYS

Pahranagat MAPS and Pahranagat South were affected prior to the start of the 2010 survey season by a fire that removed the understory and damaged the overstory trees. We did not survey these sites in 2011 but recommend revisiting them in another 2–3 years to determine whether the understory has recovered to the point where it might support breeding flycatchers. We do not recommend surveying these sites in 2012.

Littlefield Poles was affected in December 2010 by a flood that heavily scoured much of the surrounding area. Hydrology, stand density, and vegetation height were all negatively impacted by the flood. We recommend revisiting this site at the beginning of future breeding seasons to determine whether the vegetation and hydrology have recovered to the point where breeding flycatchers might be supported.

Bunker Marsh North was surveyed at the start of 2011, but surveys were discontinued in mid-June due to lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

Mormon Mesa North and Hedgerow at Mormon Mesa have been completely dry for the last several years, and neither of these sites has supported breeding flycatchers since 2005. We visited each site once at the beginning of the 2011 season to determine whether the hydrology of the sites was altered by heavy flooding on the Virgin River in December 2010. Both sites were dry during the initial visit and surveys were discontinued. We recommend discontinuing surveys at these sites until another flood event occurs that has the potential to alter the hydrology within the site. Virgin River #1 South consists of two disjunct areas. The southern section had dry soils throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion of the site if no surface water is present. Virgin River #2 received extensive sedimentation ranging in depth from 15 to 60 cm as a result of the December 2010 flood. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in the southern portion of the site.

We revisited Tractor in Topock Marsh at the beginning of the 2011 season. Vegetation structure at the site is not suitable for supporting breeding flycatchers, and we do not recommend future visits to this site.

At Bill Williams River NWR, we revisited New River for the first time since it was initially evaluated in 2008. In 2008, the vegetation appeared too young and sparse to support willow flycatchers. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years. Wispy Willow, a small area of new coyote willow growth downstream of Site #1, currently lacks the size to resemble occupied flycatcher habitat along the LCR, but the site should be reassessed in future years.

Ground reconnaissance of Laguna revealed that, overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat. Surface water was present only in one small area. Soils in most of the site were complete dry. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

COWBIRD CONTROL

The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 29%, well below the average of 44% across all study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

In 2010 and 2011, we addled cowbird eggs in easily accessible flycatcher nests, and this appeared to reduce the hatch rate of the cowbird eggs and did not cause desertion of any nests by the flycatchers. Although sample sizes were small, results also suggested that the number of flycatcher nestlings fledged per nest might be higher as a result of cowbird egg addling and cowbird nestling removal. We recommend this program be continued in the future.

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

In previous years we correlated piezometer groundwater levels and soil moisture measurements and found no strong linear relationship (McLeod and Koronkiewicz 2009). Sites with high soil moisture values tended to show a weak, negative relationship between depth to groundwater and soil moisture, while sites with low soil moisture showed no relationship between depth to groundwater and soil moisture. This suggests that at sites where soil moisture is low, surface soil moisture content is not strongly influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

LITERATURE CITED

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. The University of Arizona Press, Tucson. 302 pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241–257.

Busch, J.D., M.P. Miller, E.H. Paxton, M.K. Sogge, and P. Keim. 2000. Genetic variation in the endangered Southwestern Willow Flycatcher. Auk 117:586–595.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher breeding site and territory summary – 2005. USGS Southwest Biological Science Center report to the U.S. Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern willow flycatcher final survey and monitoring report. Arizona Game and Fish Department, Research Technical Guidance Bulletin #10, Phoenix.

Finch, D.M., and J.F. Kelly. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197–203 *in* Finch, D.M., J.C. Whitney, J.F. Kelly and S.R. Loftin (eds.). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings, RMRS-P-7.

Flett, M.A., and S.D. Sanders. 1987. Ecology of a Sierra Nevada population of Willow Flycatchers. Western Birds 18:37–42.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

Graber, A.E., and T.J. Koronkiewicz. 2009a. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2008. Final 2008 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 66 pp.

Graber, A.E., and T.J. Koronkiewicz. 2009b. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2009. Final 2009 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 25 pp.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern willow flycatcher 2006 survey and nest monitoring report. Nongame and Endangered Wildlife Program. Technical report 249. Arizona Game and Fish Department, Phoenix.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and willow flycatchers: a summary of their science and policy connections. Geomorphology 47:169–188.

Hanski, I.A., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pages 5–26 *in* Hanski, I.A. and Gilpin, M.E. (eds.). Metapopulation biology: Ecology, genetics, and evolution. Academic Press, San Diego, California.

Harris, J.H. 1991. Effects of Brown-headed Cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13–26.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds 18:27–36.

Hill, G.E. 1988. Age, plumage brightness, territory quality, and reproductive success in the Black-headed Grosbeak. Condor 90:379–388.

Holmes, R.T., P.P. Marra, and T.W. Sherry. 1996. Habitat-specific demography of breeding Black-throated Blue Warblers (*Dendroica caerulescens*): Implications for population dynamics. Journal of Animal Ecology 65:183–195.

Howell, N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Howlett, J.S., and B.J. Stutchbury. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover. Auk 113:1–9.

James, F.C., and H.H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

Johnson, K., P. Mahlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered Southwestern Willow Flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44:226–231.

Johnson, M.J., and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Kenwood, K.E., and E.H. Paxton. 2001. Survivorship and movements of Southwestern Willow Flycatchers in Arizona – 2001. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 44 pp.

Koronkiewicz, T.J., S.N. Cardinal, M.K. Sogge, and E.H. Paxton. 2002. Survivorship and movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2002. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. USGS Southwest Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. 43 pp.

Koronkiewicz, T.J., M.A. McLeod, B.T. Brown, and S.W. Carothers. 2006a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 176 pp.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper III, and E.H. Paxton. 2006b. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. Condor 108:558–570.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, California.

Lowther, P.E. 1993. Brown-headed Cowbird (*Molothrus ater*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 47. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* Sogge, M.K., B.E. Kus, S.J. Sferra and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M., and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, ecology, and conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bulletin 73(3):255–261.

Mayfield, H. 1975. Suggestions for calculating nest success. Wilson Bulletin 87(4):456–466.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 1 – 1996. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada,, [and] the U.S. Fish and Wildlife Service, Carlsbad, California by the San Bernardino County Museum, Redlands, California. 42 pp.

McKernan, R.L., and G. Braden. 1998. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 2 – 1997. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, [and] the U.S. Fish and Wildlife Service, Carlsbad, California, by the San Bernardino County Museum, Redlands, California. 64 pp.

McKernan, R.L., and G. Braden. 1999. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 3 – 1998. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 pp.

McKernan, R.L., and G. Braden. 2001a. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the Lower Colorado River: Year 4 – 1999. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 83 pp.

McKernan, R.L., and G. Braden. 2001b. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 5 – 2000. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 86 pp.

McKernan, R.L., and G. Braden. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 6 – 2001. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, by San Bernardino County Museum, Redlands, California. 58 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 153 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 165 pp.

McLeod, M.A., and A.R. Pellegrini. 2011. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2010. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 166 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 194 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 206 pp.

McLeod, M.A., T.J. Koronkiewicz, S.R. Nichols, B.T. Brown, and S.W. Carothers. 2008b. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2007. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 182 pp.

Moore, D., and D. Ahlers. 2008. 2007 Southwestern Willow Flycatcher study results: selected sites along the Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. Report prepared by Bureau of Reclamation, Technical Service Center, Denver, Colorado. 64 pp.

Munzer, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. Arizona Game and Fish Department, Phoenix, Arizona.

National Weather Service. 2011. Online: http://aa.usno.navy.mil/data/docs/RS_OneYear.html.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 Summary Report. USGS Colorado Plateau Research Station / Northern Arizona University report. 63 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in Central Arizona – a 10-year synthesis report. USGS Open-File Report 2007-1381.

Paxton, E.H., M.K. Sogge, T.J. Koronkiewicz, M.A. McLeod, and T.C. Theimer. 2010. Geographic variation in the plumage coloration of willow flycatchers *Empidonax traillii*. Journal of Avian Biology 41:128–138.

Periman, R.D., and J.F. Kelly. 2000. The dynamic environmental history of Southwest Willow Flycatcher habitat: A survey of changing riparian conditions through time. Pages 25–42 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson. 212 pp.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. General Technical Report PSW-GTR-144. U.S. Forest Service Pacific Southwest Research Station, Albany, California. 41 pp.

Ridgely, R.S., and G. Tudor. 1994. The birds of South America; Volume II: the Suboscine passerines. University of Texas Press, Austin.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in Illinois. Pages 408–418. *In* J.M. Hagan III and D.W. Johnston (eds.). Ecology and Conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Rosenberg, K.V., R. C. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson.

Rotenberry, J.T. 1985. The role of habitat in avian community composition: Physiognomy or floristics? Oecologia 67:213–217.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix.

SAS Institute Inc. 2009. SAS OnlineDoc®, Version 9.2. Cary, North Carolina.

Sedgwick, J.A. 2000. Willow flycatcher (*Empidonax traillii*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 533. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Sedgwick, J.A., and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to willow flycatchers. Pages 167–181 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.).Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Sedgwick, J.A., and F.L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. The Condor 94:720–733.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbits. 1997. A Southwestern Willow Flycatcher natural history summary and survey protocol. National Park Service Technical Report USGS/NAUCPRS/NRTR-97/12.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. Western Birds 32:167–172.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher. U.S. Geological Survey Techniques and Methods 2A-10. 38 pp.

Stiles, F.G., and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, New York.

Sumner, M.E. 2000. Handbook of soil science. CRC Press, Boca Raton, Florida.

U.S. Bureau of Reclamation (Reclamation). 1999. Long-term restoration program for the historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat along the lower Colorado River. Report submitted by USBR Lower Colorado Region to Lower Colorado Multi-Species Conservation Program. Boulder City, Nevada. 70 pp.

U.S. Bureau of Reclamation (Reclamation). 2000. Biological Assessment for proposed Interim Surplus Criteria, Secretarial Implementation Agreements for California Water Plan components and conservation measures on the Lower Colorado River (Lake Mead to the Southerly International Boundary). Prepared by U.S. Bureau of Reclamation, Lower Colorado Region. 80 pp.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. Federal Register 60:10694–10715.

U.S. Fish and Wildlife Service (USFWS). 2000. Southwestern willow flycatcher protocol revision 2000. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2001. Biological opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures on the Lower Colorado River, Lake Mead to the Southerly International Boundary, Arizona, California, and Nevada. Final Biological Opinion, U.S. Fish and Wildlife Service, Phoenix, Arizona. 90 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax trailli extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup, August 2002.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. San Diego Natural History Museum report to U.S. Bureau of Reclamation, Phoenix, Arizona.

White, G.S., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 (supplement):S120–139.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to Brown-headed Cowbird parasitism. M.S. Thesis, California State University, Chico. 25 pp.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Pages 182–190 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.). Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Whitfield, M.J., M.K. Sogge, S.J. Sferra, and B.E. Kus. 2003. Ecology and behavior —Introduction. Pages 53–55 *in* Sogge, M.K., B.E. Kus, S.J. Sferra, and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Wiens, J.A. 1989a. The ecology of bird communities. Volume 1: Foundations and patterns. Cambridge University Press, New York.

Wiens, J.A. 1989b. The ecology of bird communities. Volume 2: Processes and variations. Cambridge University Press, New York.

Woodward, H.D., and S.H. Stoleson. 2002. Brown-headed Cowbird attacks on Southwestern Willow Flycatcher nestlings. The Southwestern Naturalist 47(4):626–628.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

Younker, G.L., and C.W. Andersen. 1986. Mapping methods and vegetation changes along the lower Colorado River between Davis Dam and the border with Mexico. Report submitted to Bureau of Reclamation, Lower Colorado Region, in fulfillment of Contract No. 6-CS-30-03800. 22 pp.

Acknowledgements

This project was made possible by the support of many persons, agencies, private landowners, and our dedicated staff and field crew. Work was conducted under the auspices of Federal Fish and Wildlife Threatened and Endangered Species Permit TE028605-4 and Master Banding Permit #23258. Funding was provided by the U.S. Bureau of Reclamation, Boulder City, Nevada (Contract No. GS-10F-0209L) and the Nevada Department of Wildlife, Reno, Nevada. Chris Dodge from Reclamation provided background information and guidance.

Many thanks to the following national wildlife refuges and personnel for all their assistance: Kevin DesRoberts, Chivia Horton, Laurie Simons, and Jim Doctor at Pahranagat NWR; Linda Miller, Jack Allen, Dr. Kathleen Blair, Dick Gilbert, and Stan Culling at the Lake Havasu NWR Complex; and Mike Oldham, Elaine Johnson, Brenda Zaun, Bill Seese, Joe Barnett, and Steven Rimer at the SW Arizona NWR Complex. Thanks to Keith Day and Rob Dobbs with the Utah Division of Wildlife Resources for their support in St. George. Also, we would like to thank Cris Tomlinson, Christy Klinger, and Tim Wood with Nevada Department of Wildlife for their support at Key Pittman Wildlife Management Area, River Ranch, Warm Springs Natural Area, and Overton Wildlife Management Area. Thanks to Dave Syzdek with Southern Nevada Water Authority for logistical support and site tours at Warm Springs Natural Area.

Thanks to the following agencies and personnel for assistance with obtaining permits: Greg Beatty, Erin McCarthy, Daniel Marquez, Melissa Castiano, Vanessa Martinez, Leilani Takano, and Corey Kallstrom with the U.S. Fish and Wildlife Service; Florence L. Soehnlein and Danny Bystrak with the Federal Bird Banding Laboratory; Melissa Swain with the Arizona Game and Fish Department; Gloria Shaw with Lake Mead National Recreation Area; Randi Logsdon, and Esther Burkett with the California Department of Fish and Game; Cris Tomlinson and Julie Meadows with the Nevada Department of Wildlife; Suzanne McMullin with the Utah Division of Wildlife Resources; Tom Denniston with the Bureau of Land Management, St. George; and Bill Dowdle with the Arizona State Lands Department. Robert Bunker, Bill Evans, and Gary Hafen granted access to their properties.

Thanks to Johnny, Mike, and Kathy at Monte Vista Marine for assisting with boating logistics. Mike Rose assisted with ATV logistics.

This project would not be a success without our dedicated staff and field personnel. Many, many thanks to Jessica Maggio and Kimberly Proa who went beyond their administrative duties and coordinated housing, permitting, payroll, vehicles, computers, safety, and telecommunications and handled all manner of crises with cheerful aplomb. A very special thanks to Glenn Dunno for his GIS talents. Thanks also to Shara Monik, Lisa Jackson, and Rose Burgess for administrative and accounting support. And sincere thanks to the 2011 field personnel for hard work, dedication, and sweat.

Appendix A

FIELD DATA FORMS

Willow Flycatcher (WIFL) Survey and Detection Form (revised April 2010)

Site Name_____ State_____ County _____
USGS Quad Name _____ Elevation _____ (meters)
Creek, River, Wetland, or Lake Name_____
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? Yes___ No____

Survey Coordinates: Start: E_____ N_____ UTM Datum_____(See instructions)
Stop: E_____ N_____ UTM Zone _____
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

***** Fill in additional site information on back of this page *****

Survey # / Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N / If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Overall Site Summary Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total Survey Hrs _____		Total Adult Residents	Total Pairs	Total Territories	Total Nests	Were any Willow Flycatchers color-banded? Yes___ No ___ If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual _____ Date Report Completed_____ _____
US Fish and Wildlife Service Permit #_____State Wildlife Agency Permit #_____

Submit form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual _____ Phone # _____
Affiliation _____ E-mail _____
Site Name _____ Date Report Completed _____
Was this site surveyed in a previous year? Yes___ No ___ Unknown ____
Did you verify that this site name is consistent with that used in previous years? Yes ____ No _____ Not Applicable ___
If site name is different, what name(s) was used in the past?_____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes ____ No ____ If no, summarize below.

Management Authority for Survey Area: Federal____ Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) _____

Length of area surveyed: _____ (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

_____ Native broadleaf plants (entirely or almost entirely, > 90% native)

_____ Mixed native and exotic plants (mostly native, 50 - 90% native)

_____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

_____ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific names.
_____

Average height of canopy (Do not include a range): _____ (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections; 2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests; 3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.
_____
_____
_____
_____
_____
_____

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (10–25 July)]

General Info

Study Area: _____ **Survey Site:** _____ **Date:** _____

Observer(s): _____ **early**_____ **mid**_____ **late** _____ **other**_____

Vegetation

Vegetation at site: >90% native 50–90% native 50–90% exotic >90% exotic

Canopy closure: <25% 25–50% 50–70% 70–90% >90%

Overstory height (m): _____ **Dominant overstory species:** TASP SAGO SAEX POFR Other _____

Understory height (m): _____ **Dominant understory species**: TASP SAGO SAEX PLSE Other _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

Hydrology

% of site inundated: _____

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc):

_____

Average depth of surface water:
toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils (do not include inundated areas in percentage!): _____

% of site with damp soils (do not include inundated or saturated areas): _____

If not inundated or saturated, distance (m) to standing water or saturated soil:_____

How was distance determined? Visually estimated in field Measured in field using GPS
Measured from aerial photograph Other _____

Describe type of nearest surface water: _____

Narrative and Pictorial Description

Does this description cover the entire site? Y N **If not, which portion is described?**_____

_____

On the reverse, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats:

_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____

STUDY AREA: _____ **SITE**: _____ **BANDER**: _____ **DATE**: _____ **TIME**: _____ **TERR/NEST #**: _____

UTM NAD___ **Zone**___ _____ **E** _____ **N** **NBN:** ____ of ____

NOTES:_____

FEDERAL BAND #	COLOR COMBO		STATUS	SEX	AGE	FECAL SAMPLE? (Y or N)	GENETIC SAMPLE? (Y or N)	# PHOTOS TAKEN
	L	R						

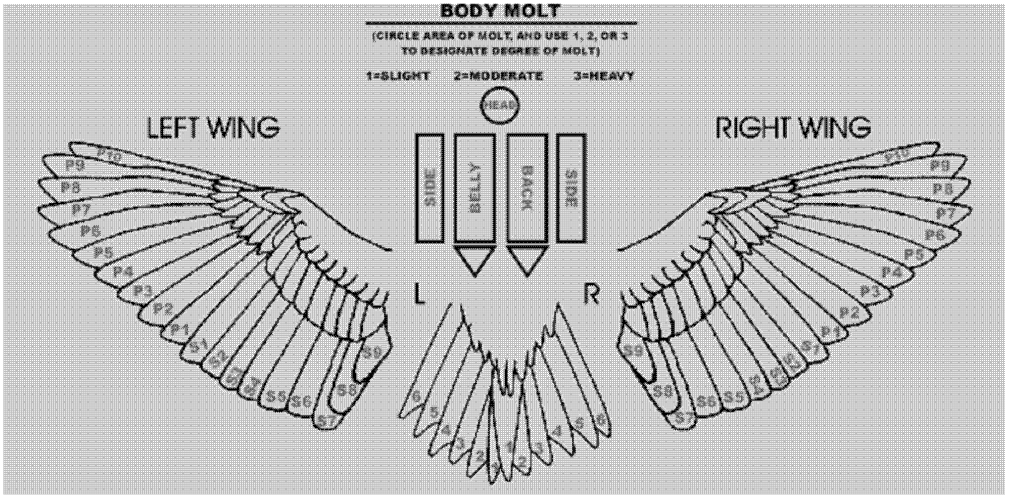
STATUS: NCP = new cap passive, NCT = new cap target, RCP = recap passive, RCT = recap target, NBN = nestling banded
SEX: U = unknown, F = female, M = male
AGE: AHY = after hatch year; SY = second year; L = nestling banded in nest; HY = hatch year/young of the year

Adults								
CP	BP	WING CHORD	TAIL ~~(mm)~~	CULMEN LENGTH	CULMEN WIDTH	FAT	RETAINED FEATHERS?	ACTIVE MOLT?
		(mm)		(mm)	(mm)		Y or N, if Y use diagram, detail in notes	

Nestlings	
Developmental Age (days)	MASS (g)

CP: 0 = non-breeding, S = partial breeding, M = full breeding
BP: 0 = none, 1 = smooth, 2 = vascularized and filled with fluid, 3 = wrinkled, 4 = molting
FAT: 0 = no fat; 1 = trace of fat in furculum, deeply concave, scattered patches, less than 5 percent filled; 2 = thin layer of fat in furculum, less than a third filled, trace of thin layer of fat in abdomen; 3 = furculum is ½ filled or more; small patches, not covering some areas, on abdomen; 4 = furculum more than 2/3 filled, level with clavicles, slightly mounded on abdomen

If a genetic sample or metric was not taken, explain why in notes



Date:_____ Page ___ of ___

OBS	STUDY AREA	TERR	NEST	COLOR COMBO LEFT LEG	COLOR COMBO RIGHT LEG	CONF LEVL	CAP?	# WIFLS	SEX	NBN (_ of _)	OBSERVATIONS AND COMMENTS: discuss observations & activities. **If you assign gender, explain!**
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =

Willow Flycatcher Territory/Nest Record Form

Year _____ Study Area_____ Survey Site_____ Territory/Nest no._____

Territory/Nest Location:
NAD:_____ Zone:_____

Territory UTMs:

Easting:_____

Northing:_____

GPS Accuracy: _____m

Nest UTMs:

Easting:_____

Northing:_____

GPS Accuracy: _____m

Nest Height:_____ m (approx)

Nest Substrate:_____(e.g., TASP=tamarisk, SAGO–Goodding willow, SAEX – coyote willow, etc.)

Distance to standing water or saturated soil:

When nest found: _____(m) Date _____ How determined? _____

UTME_____ UTMN_____ Accuracy _____

Depth of surface water at nest (circle how wet you got when nest was found):

dry damp muddy toes (<5cm) ankles (5-15 cm) calves (15-40 cm)

knees (40-60 cm) thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

At hatch: _____(m) Date _____ How determined? _____

UTME_____ UTMN_____ Accuracy _____

At fledge/fail: _____(m) Date _____ How determined? _____

UTME_____ UTMN_____ Accuracy _____

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	B D (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No.	Presumed	Confirmed	
			Eggs
			Nestlings
			Fledglings

Cowbird

Trans dates	B D (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledgling s

Outcome (Record code & describe)**:**_____**:**_____

_____

_____

_____

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **PA**= parasitized, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **AD**= failure, entire clutch addled/infertile; **OT**= failure due to other, or unknown, causes.

Mayfield Success

(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S**= successful; **D**= depredated; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other than predation; **A**= abandoned with host egg(s) or young; **Z**= abandoned, no (zero) eggs laid.

Willow Flycatcher Territory/Nest Record Form (continued)

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Date	Time In	Time Out	Obs	Mon Type	Stage	Adult pres.	# WE	# CE	# WN	# CN	#WF	Age Yng	Comments

LCR SWFL – Vegetation Datasheet Observers: _____

Study area	Survey site	Plot type	ID#	UTM: E N	Acc. m	Date

Canopy height	Direct measurement m	Using clinometer Top % - Bottom % × Dist m	Ground cover Obs.	N	E	S	W	Canopy closure Obs:	N	S

Species		TASP single	TASP multi	TASP skipped	SAEX single	SAEX multi	SAEX skipped	SAGO single	SAGO multi	SAGO skipped	SNAG single	SNAG multi	SNAG skipped
Stem Count By cm dbh category	<1												
	1–2.5												
	2.6–5.5												
	5.6–8												
	8.1–10.5												
	10.5–15												
	Measured Trees >15 cm dbh												

Species		OTSP1 single	OTSP1 multi	OTSP1 skipped	OTSP2 single	OTSP2 multi	OTSP2 skipped	OTSP3 single	OTSP3 multi	OTSP3 skipped
Stem Count By cm dbh category	<1									
	1–2.5									
	2.6–5.5									
	5.6–8									
	8.1–10.5									
	10.5–15									
	Measured Trees >15 cm dbh									

Other species (write out full name)

OTSP1_____

OTSP2 _____

OTSP3_____

If stem splits below ankle height, measure and tally each stem in "single" column. If, at ankle height or above, stem splits into multiple branches, measure and tally the biggest stem in "multi" column and record how many stems you did not measure in the "skipped" column (in the size category of the stem you measured).

If stem is not at least breast height, do not count

Vertical Foliage Sampling

CENTER PLOT Observer: _____							
Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1*:	OTSP2*:	OTSP3*:
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10-cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
Use same OTSP (1,2,3) as listed on main record.

Notes:

Vertical Foliage Sampling

Study Area:			Survey Site:			Plot type:			ID#			Date:		
NORTH 1m Observer: _____									EAST 1m Observer: _____					
Height (m)	Hits/Species							Height (m)	Hits/Species					
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same **OTSP (1,2,3)** as listed on main record.

SIDE 1

Vertical Foliage Sampling

SOUTH 1m Observer: _____								WEST 1m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1 _____	OTSP2 _____	OTSP3 _____		TASP	SAGO	SAEX	SNAG	OTSP1 _____	OTSP2 _____	OTSP3 _____
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 5m Observer: _____								EAST 5m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 5m Observer: _____								WEST 5m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

SWFL Microclimate at Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year) – (Territory #)

UTM coordinates: E 0_ _ _ _ _ _ _ N _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Date territory first occupied: _____ **Date territory vacated** _____

New Location ID (if this logger was already in the field) _____–_____–_____

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Habitat Monitoring Sites

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Survey site) – (Number)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **Accuracy**: _____ m

T/RH Downloads

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

Location ID codes: Study area codes – Topock Marsh = TM, Topock Gorge = TG, Ehrenberg = EH, Cibola = CI, Imperial = IM, Mittry = MI, Yuma = YU. Survey site codes – In Between = IB, Blankenship = BK, Havasu NE = HV, Ehrenberg = EH, Three Fingers Lake = TF, Cibola Lake = CL, Walker Lake = WL, Paradise = PV, Hoge Ranch = HR, Rattlesnake = RS, Clear Lake = LK, Ferguson Lake = FL, Ferguson Wash = FW, Great Blue Heron = GB, Mittry West = MW, Gila Confluence North = GC

Microclimate at Hydro Monitoring Sites – Topock

Study Area _TOPO___ Survey Site _____ LOCATION ID: TM –HM–_____
(Location ID)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

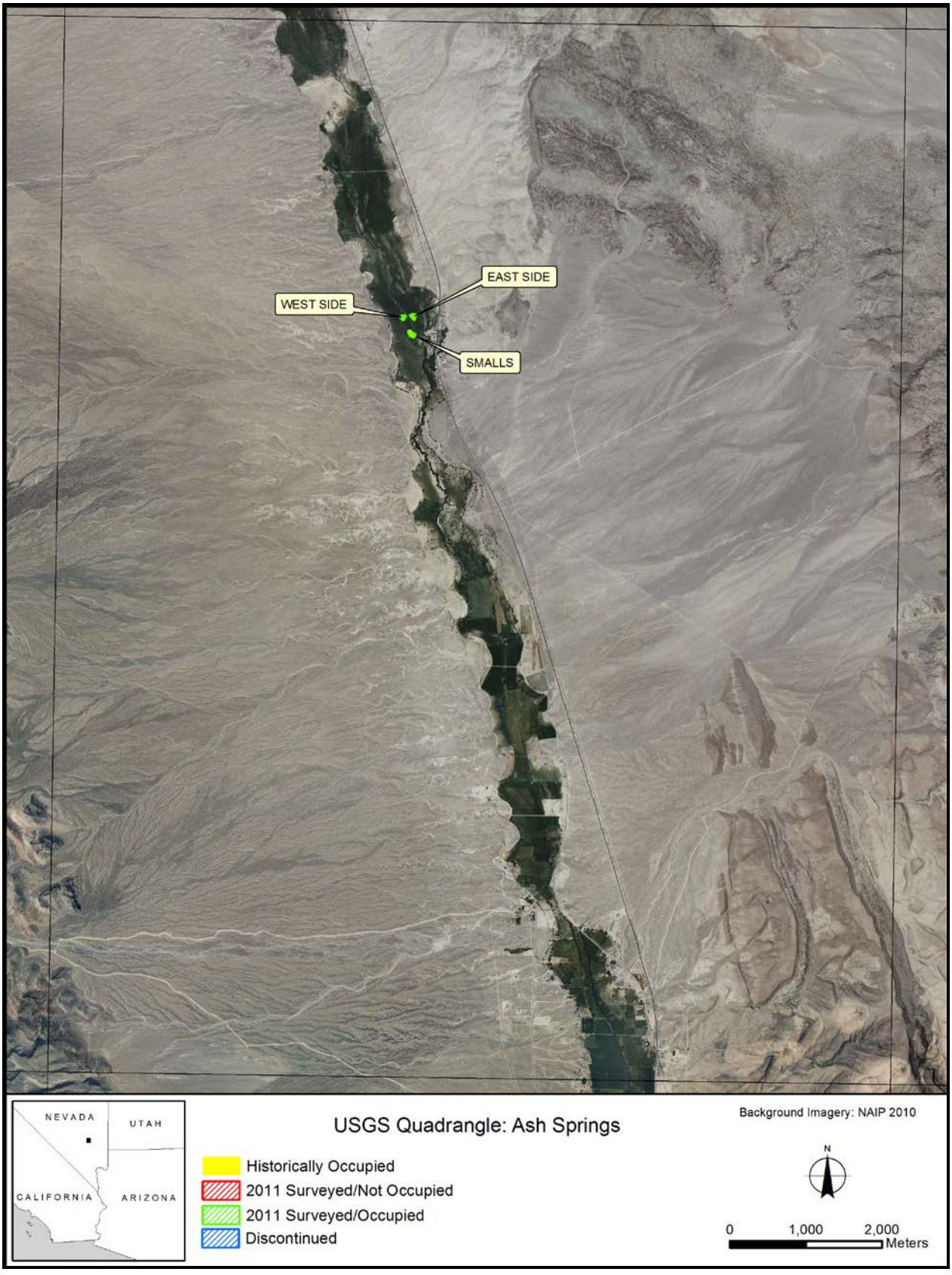
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

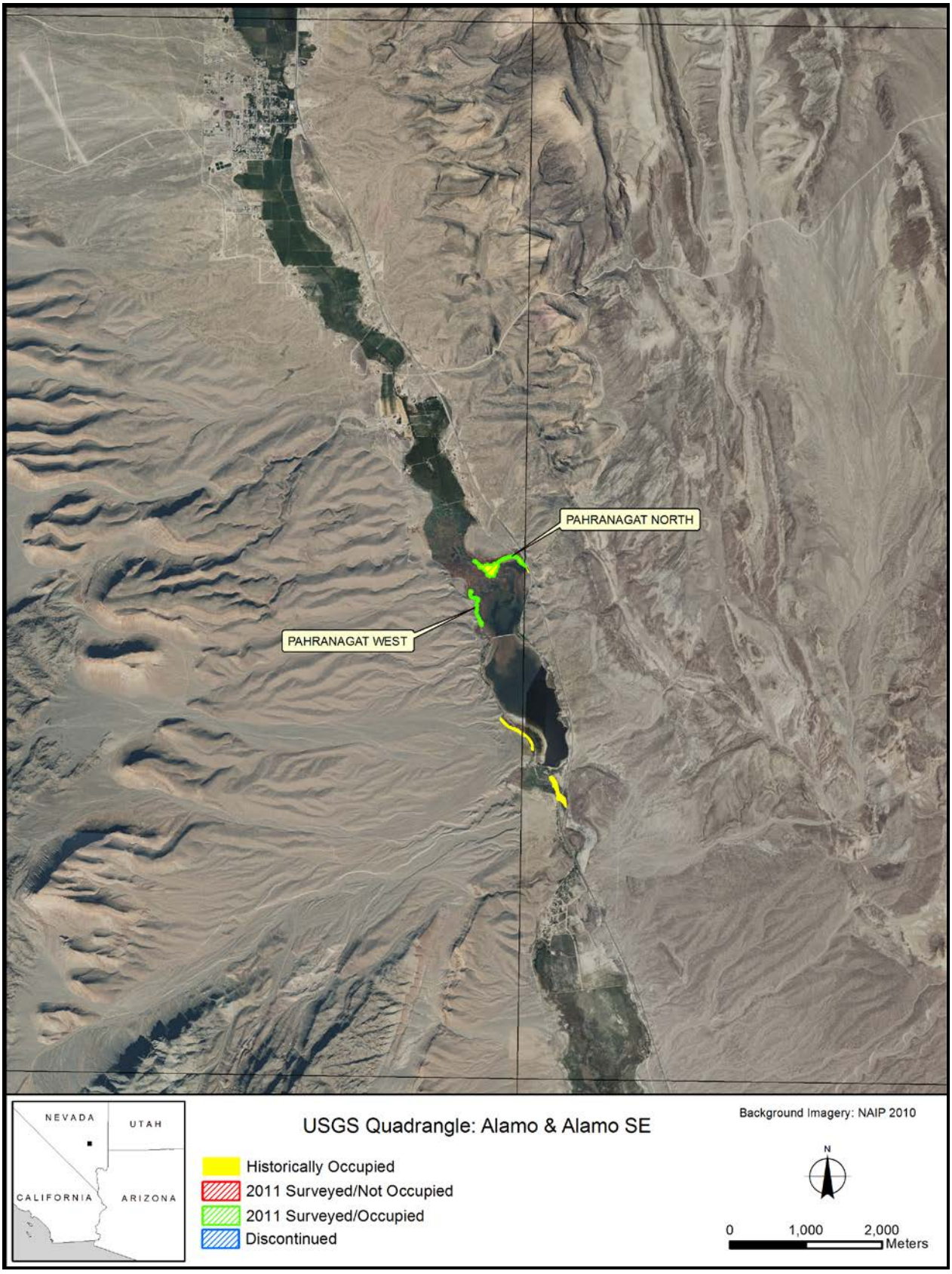
Appendix B

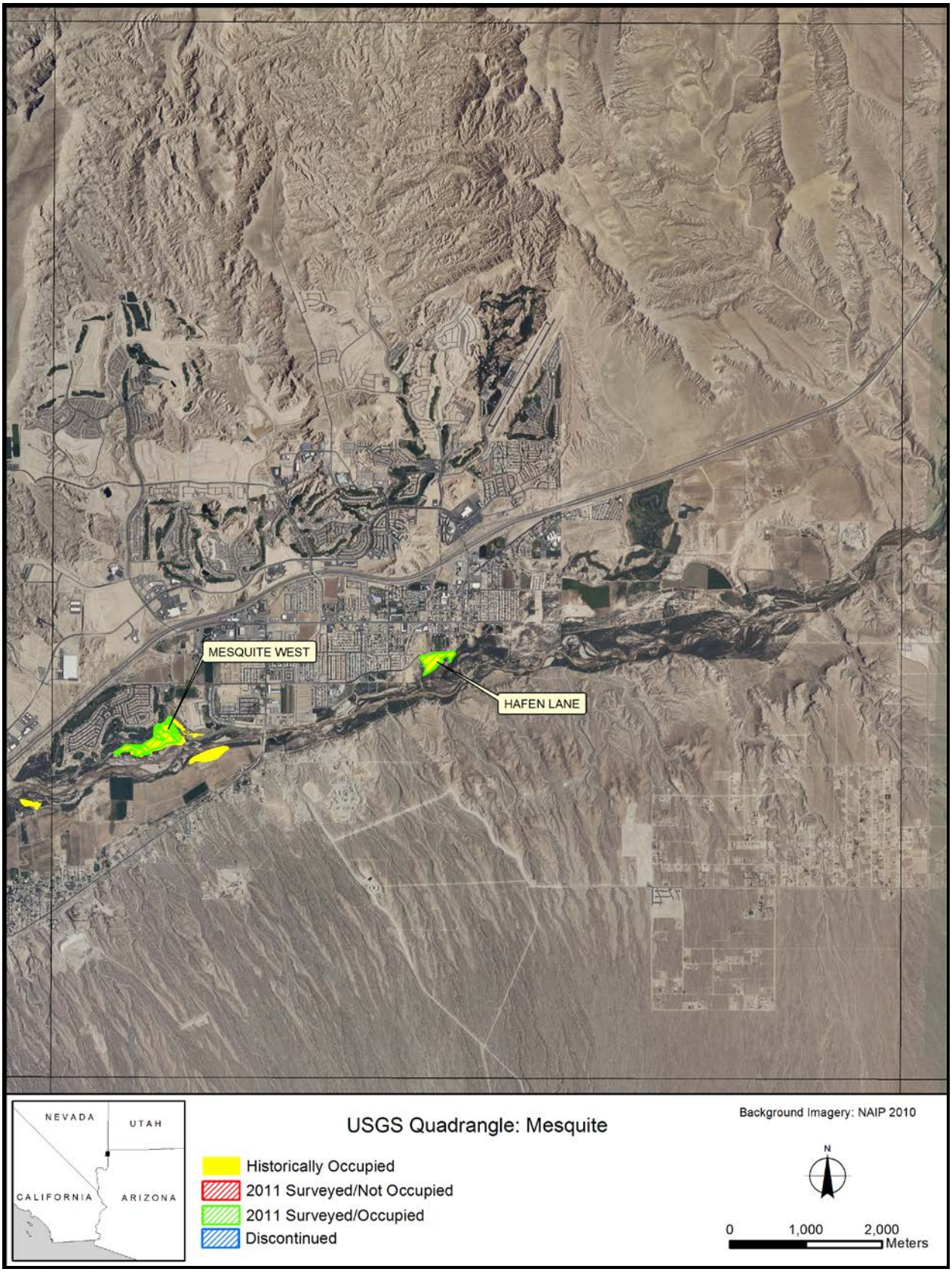
ORTHOPHOTOS SHOWING STUDY SITES

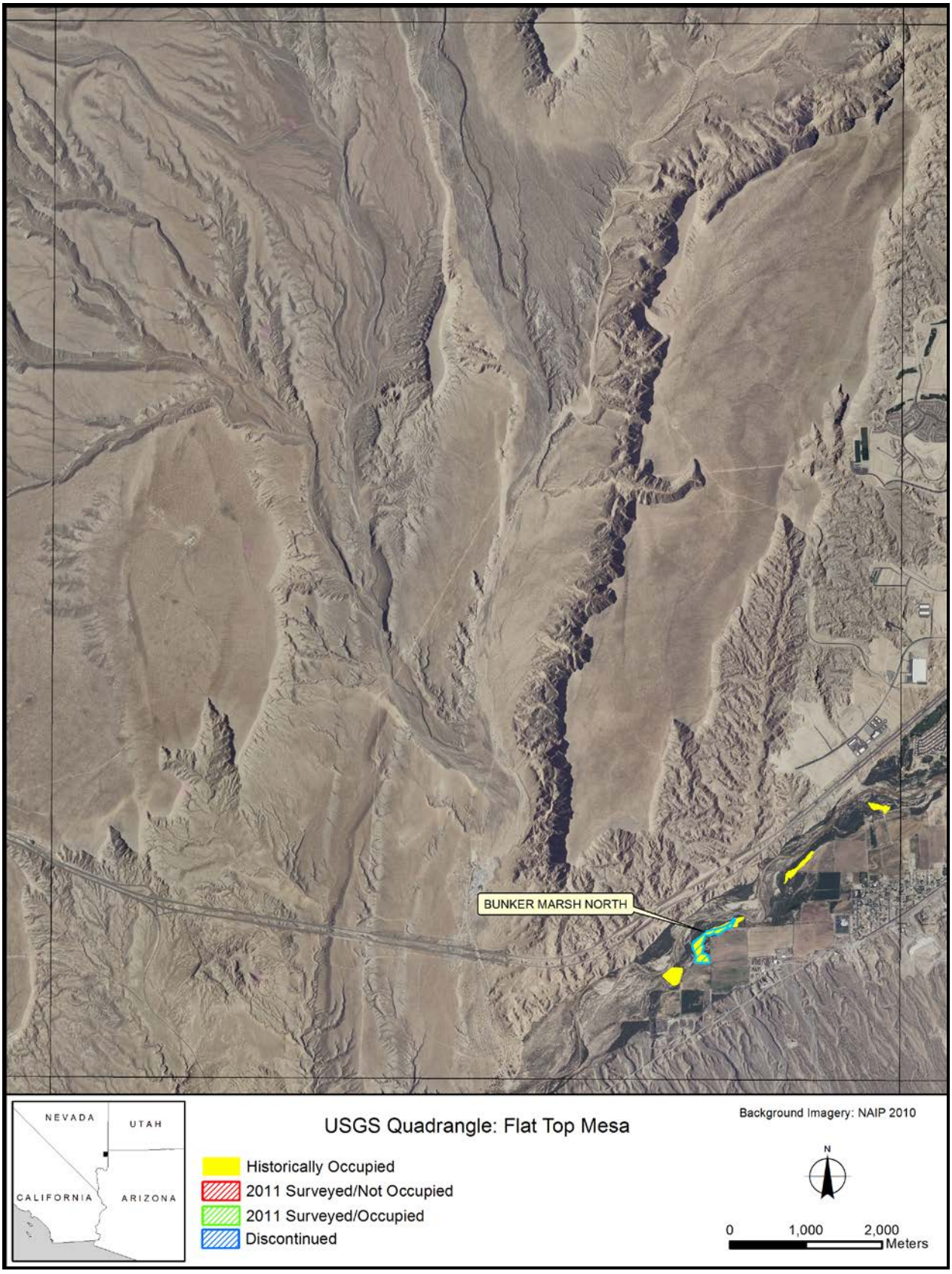

NEVADA
UTAH
CALIFORNIA
ARIZONA
MEXICO
KEY PITTMAN
RIVER RANCH
PAHRANAGAT NWR
WARM SPRINGS
MESQUITE
MORMON MESA
MUDDY RIVER
TOPOCK MARSH
BILL WILLIAMS RIVER NWR
PVER
CIBOLA
IMPERIAL
MITTRY LAKE
YUMA
St. George
Las Vegas
Kingman
Flagstaff
Quartzsite
Phoenix
Palm Springs
Yuma
Lake Mead
Lake Mohave
Lake Havasu
Salton Sea
Pahranagat Wash
Virgin River
Colorado River
Bill Williams River
Verde River
Gila River
Lower Colorado River Southwestern
Willow Flycatcher Study 2011
NDOW Study Area
Reclamation Study Area
City/Town
Highway
River
0 25 50 Mi
0 50 100 Km
1:3,300,000
N

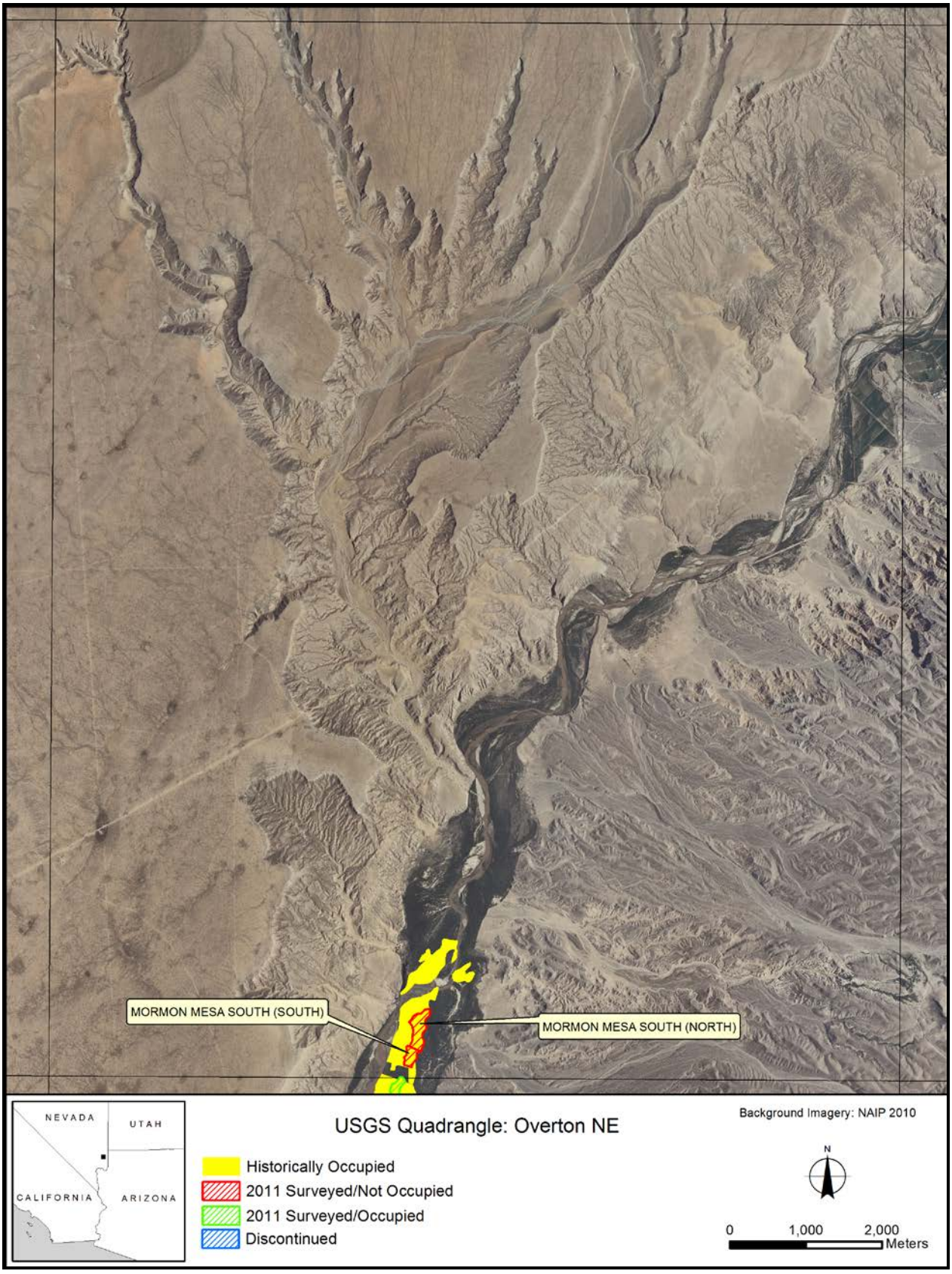

KEY PITTMAN PATCH 1 - 12
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Hiko
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

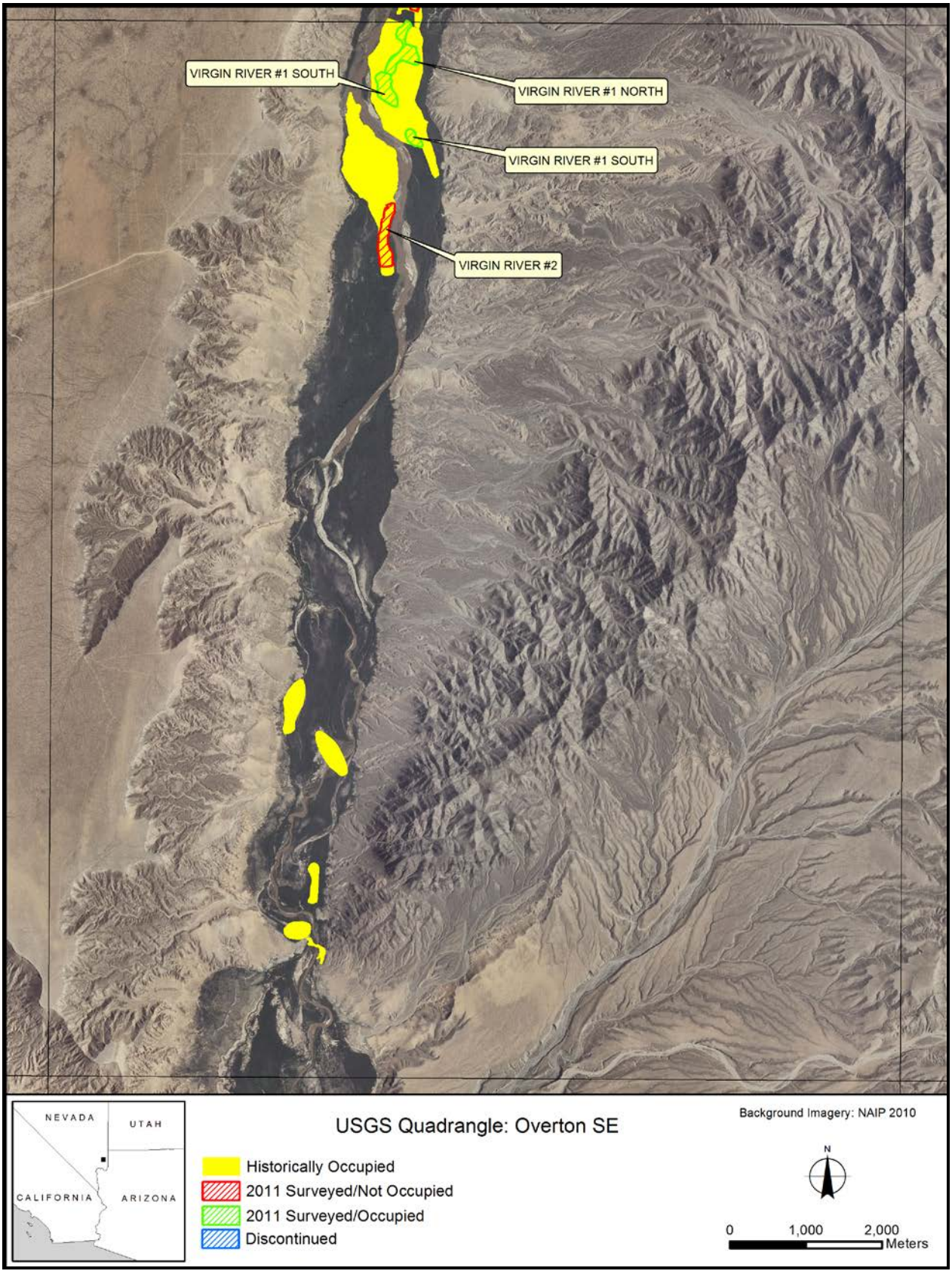

EAST SIDE
WEST SIDE
SMALLS
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Ash Springs
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

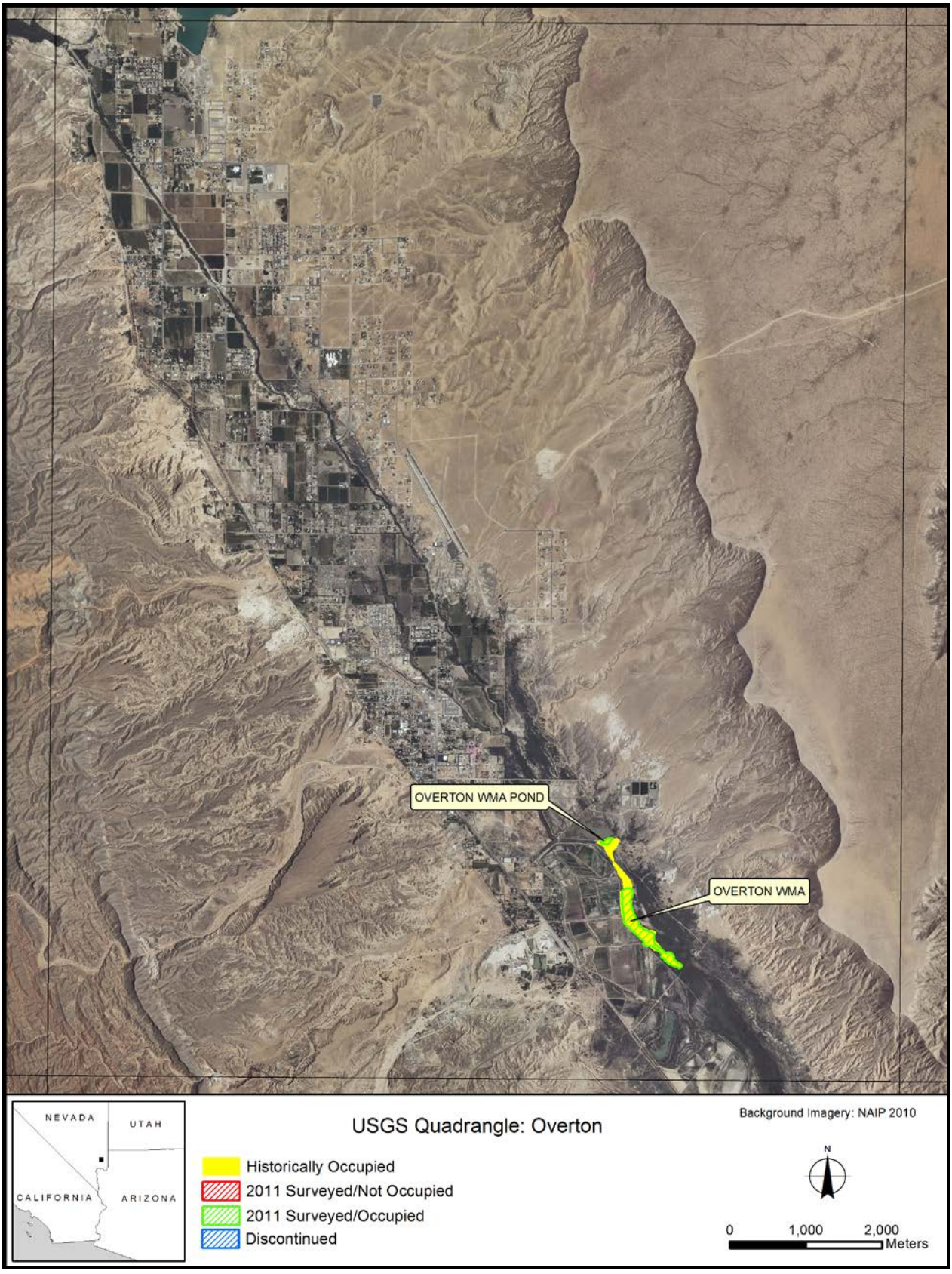

PAHRANAGAT NORTH
PAHRANAGAT WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Alamo & Alamo SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

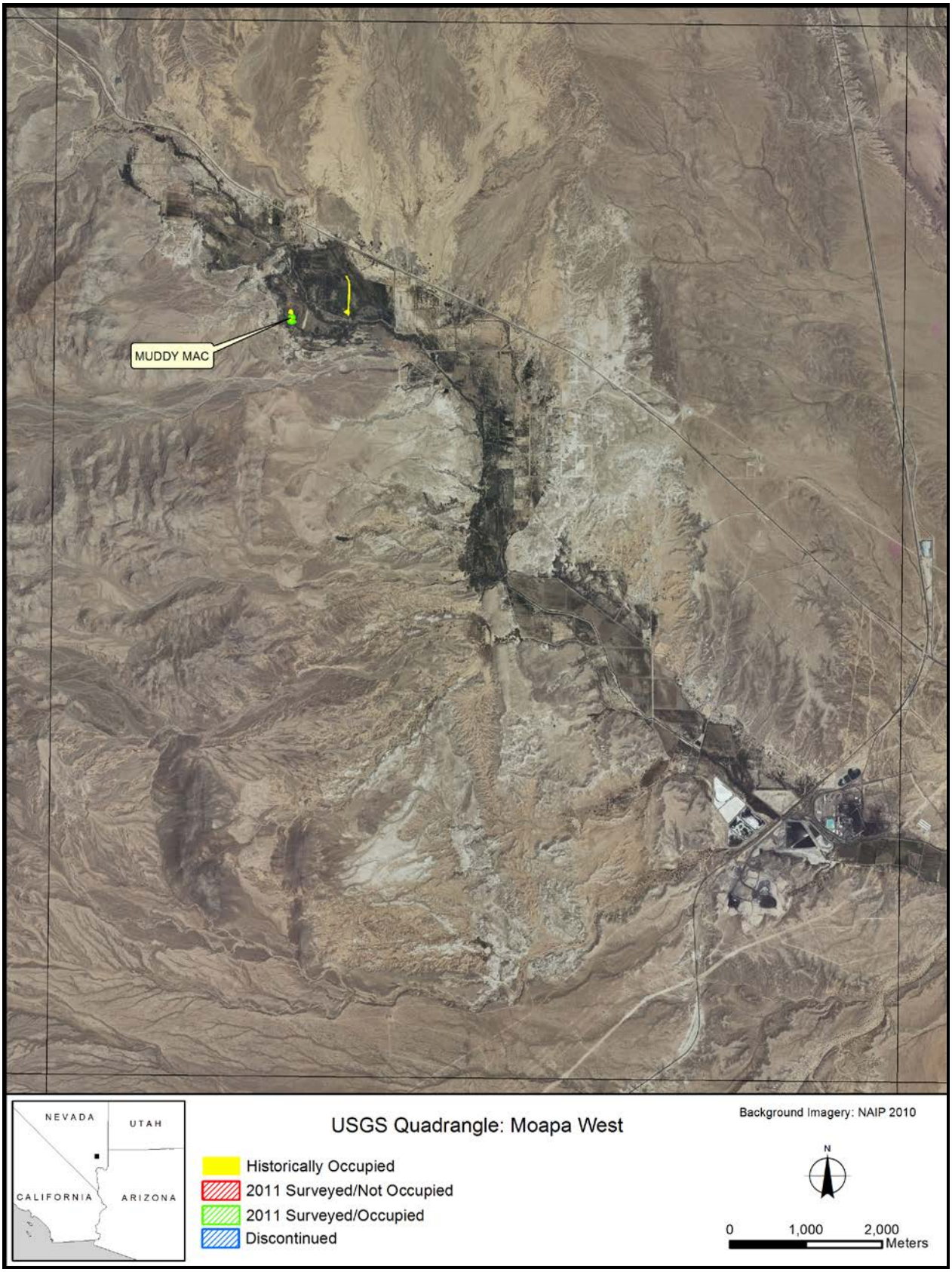

MESQUITE WEST
HAFEN LANE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Mesquite
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

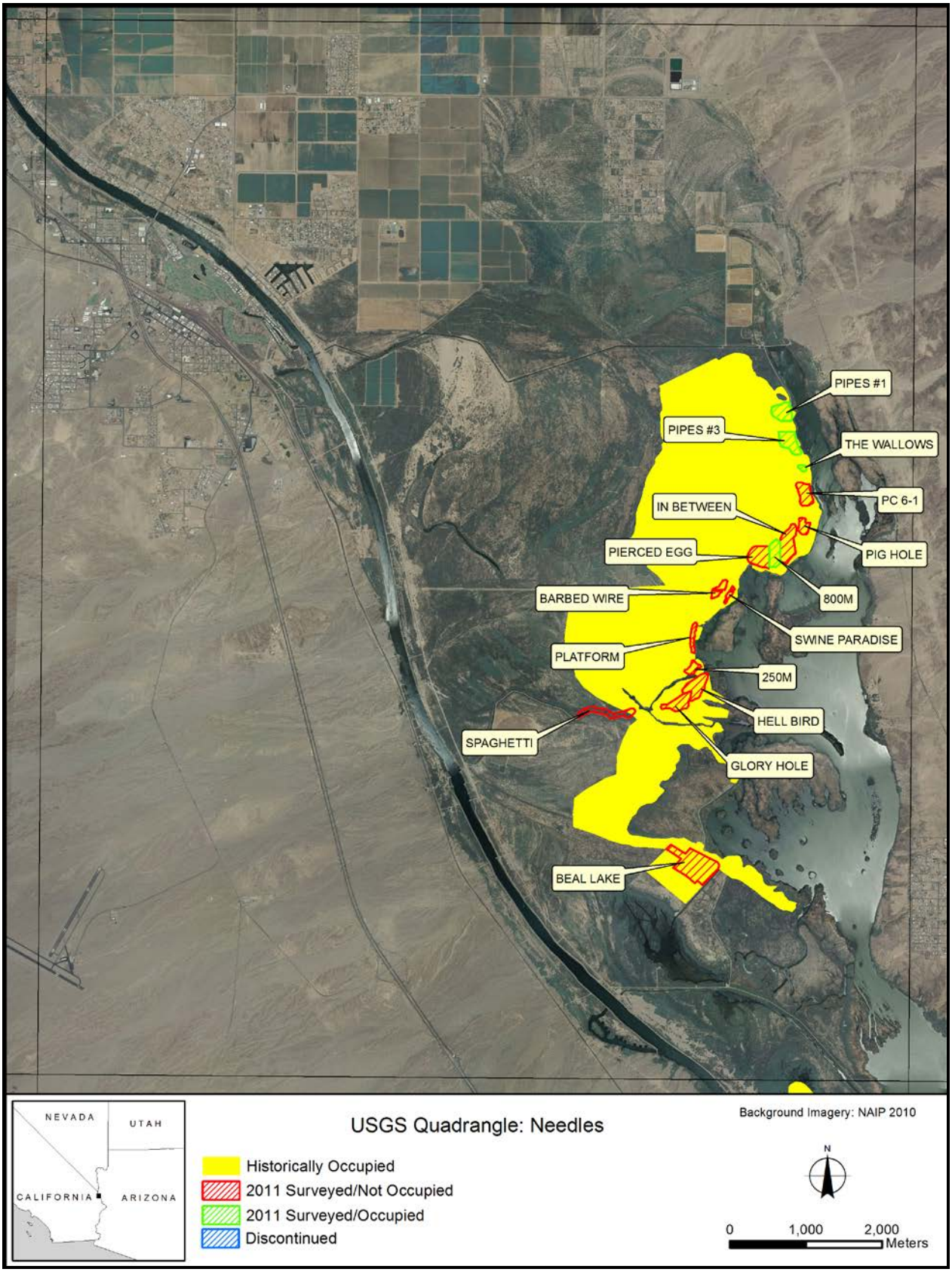

BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Flat Top Mesa
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MORMON MESA SOUTH (SOUTH)
MORMON MESA SOUTH (NORTH)
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

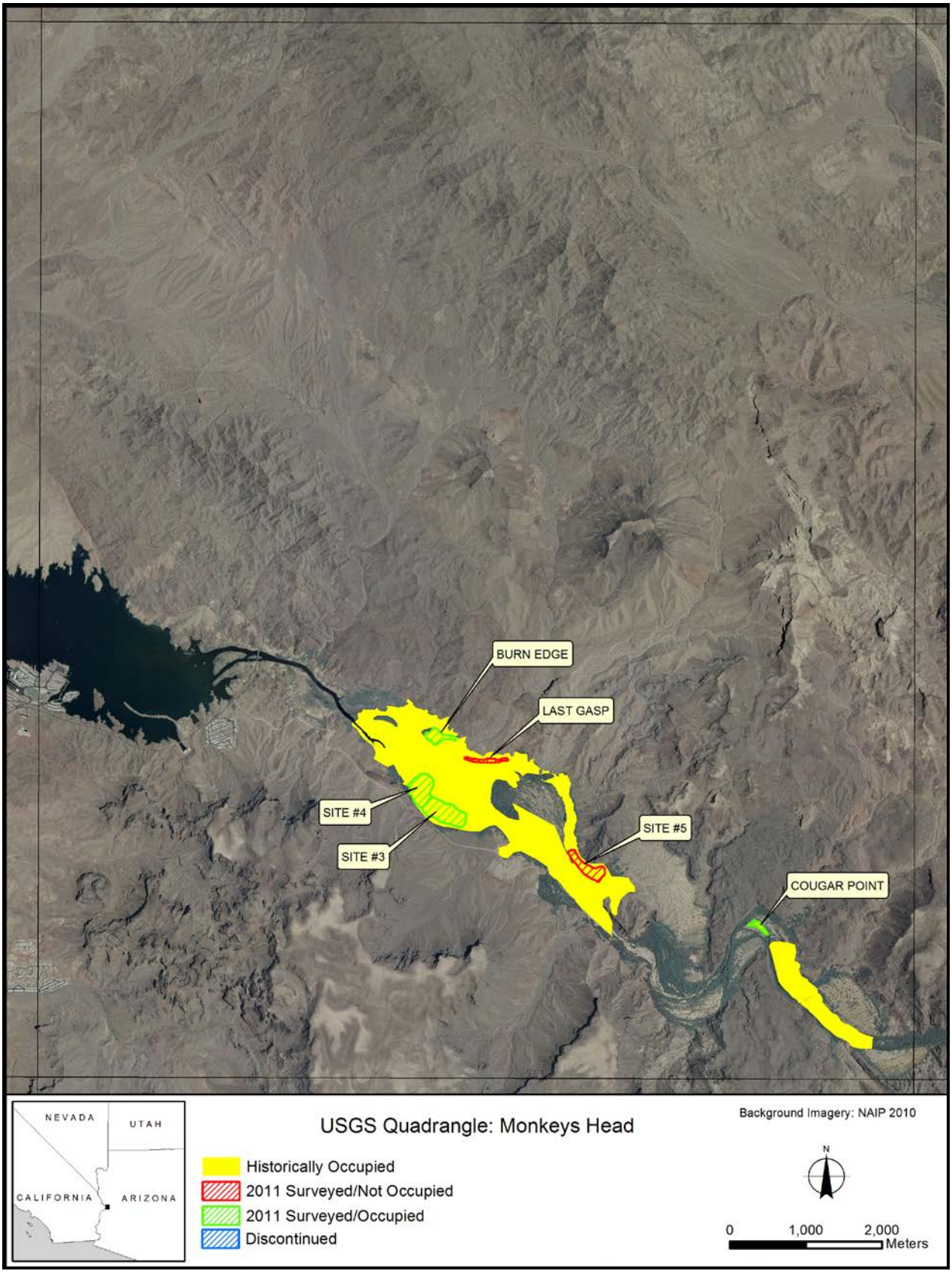

VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

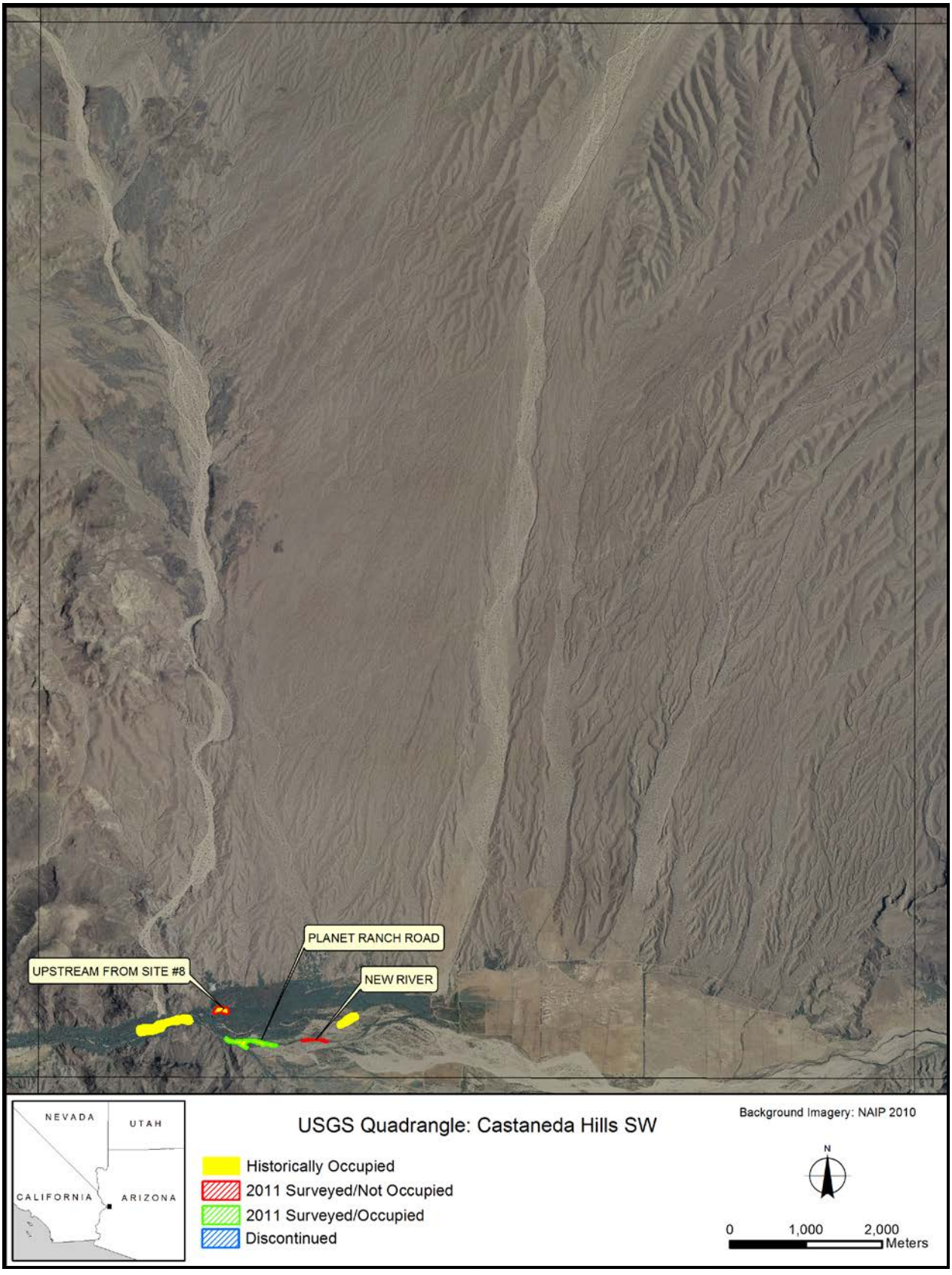

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

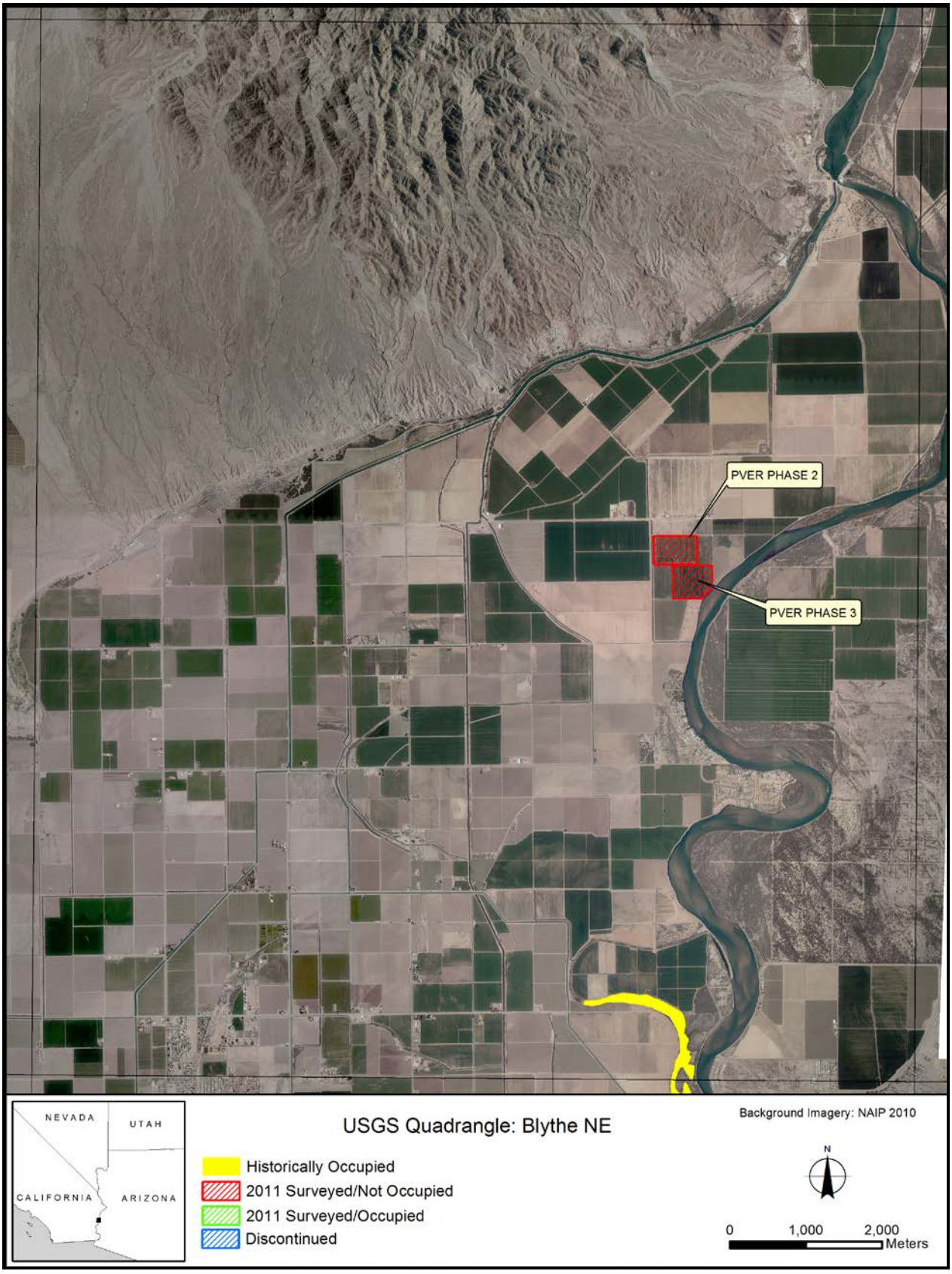

MUDDY MAC
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Moapa West
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

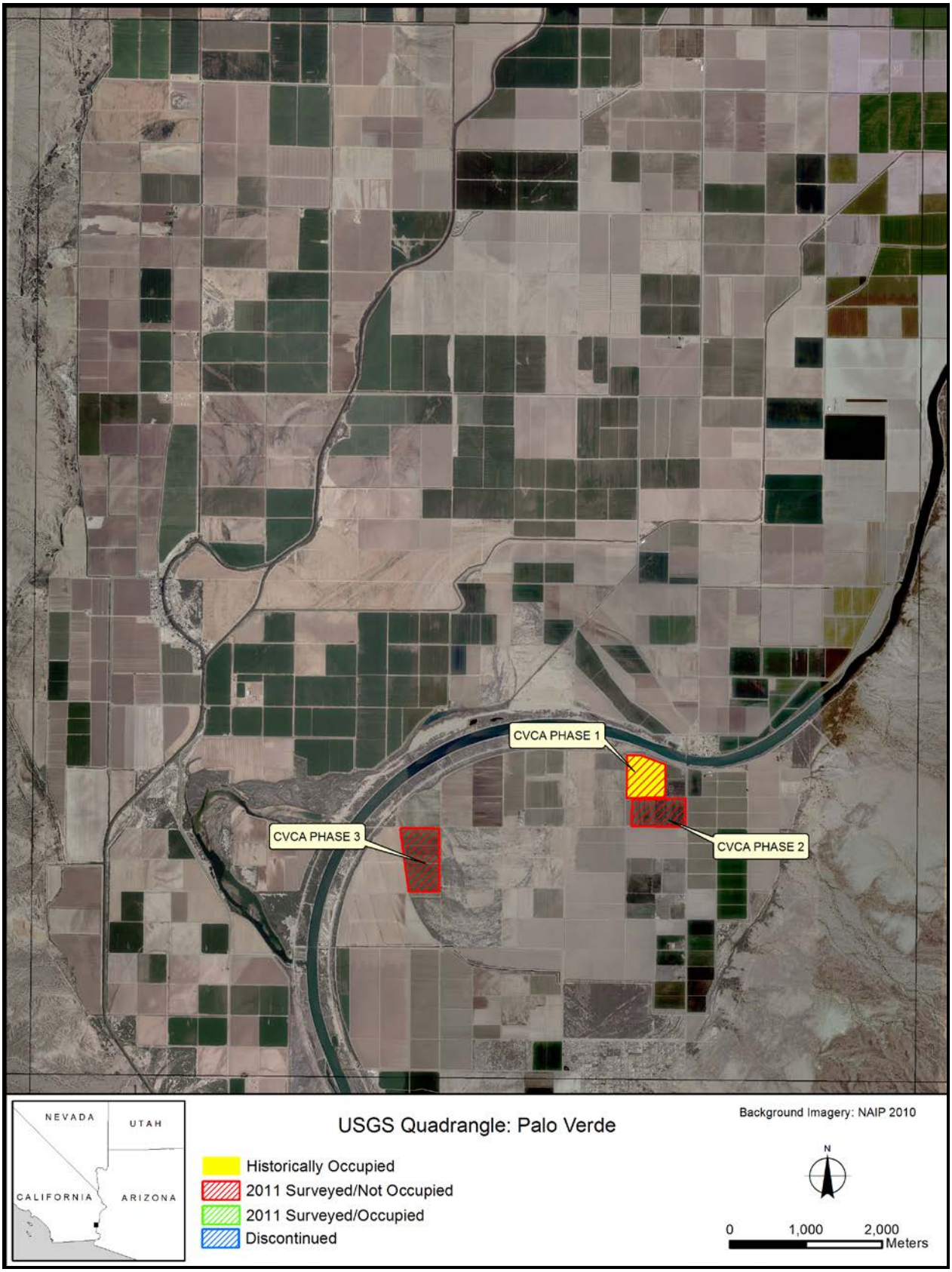

PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
IN BETWEEN
PIG HOLE
PIERCED EGG
800M
BARBED WIRE
SWINE PARADISE
PLATFORM
250M
HELL BIRD
SPAGHETTI
GLORY HOLE
BEAL LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

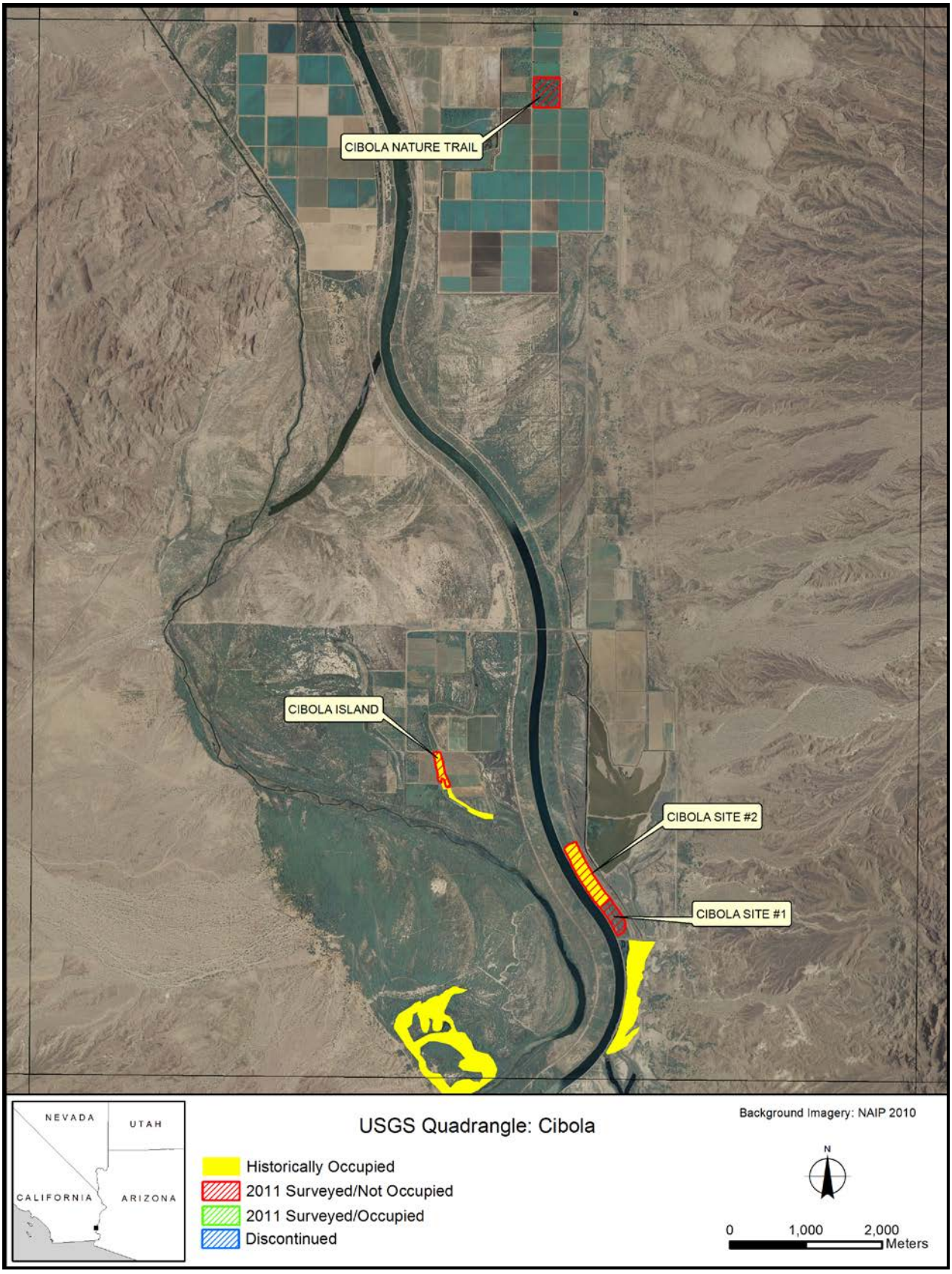

LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

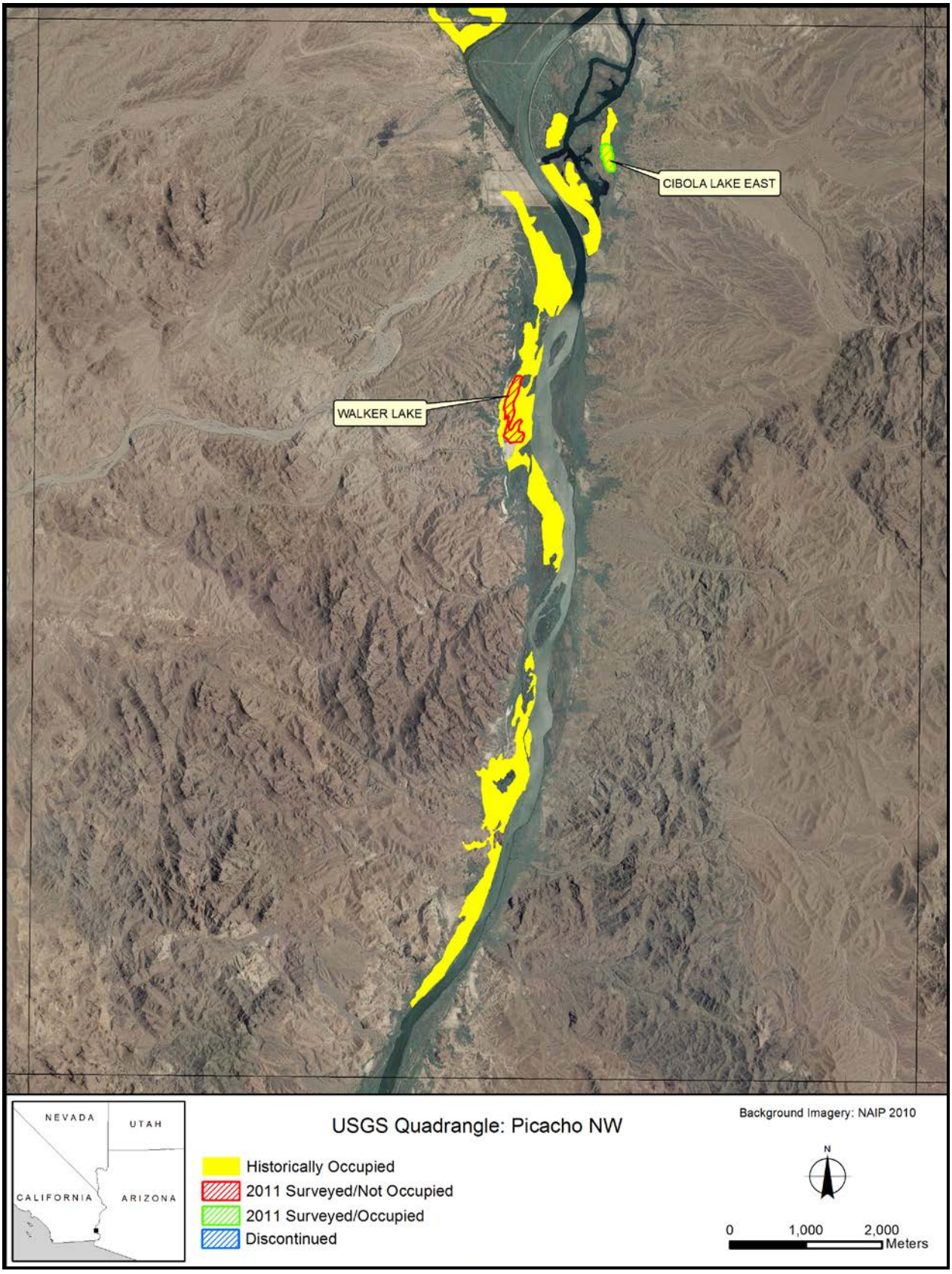

BURN EDGE
LAST GASP
SITE #4
SITE #3
SITE #5
COUGAR POINT
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

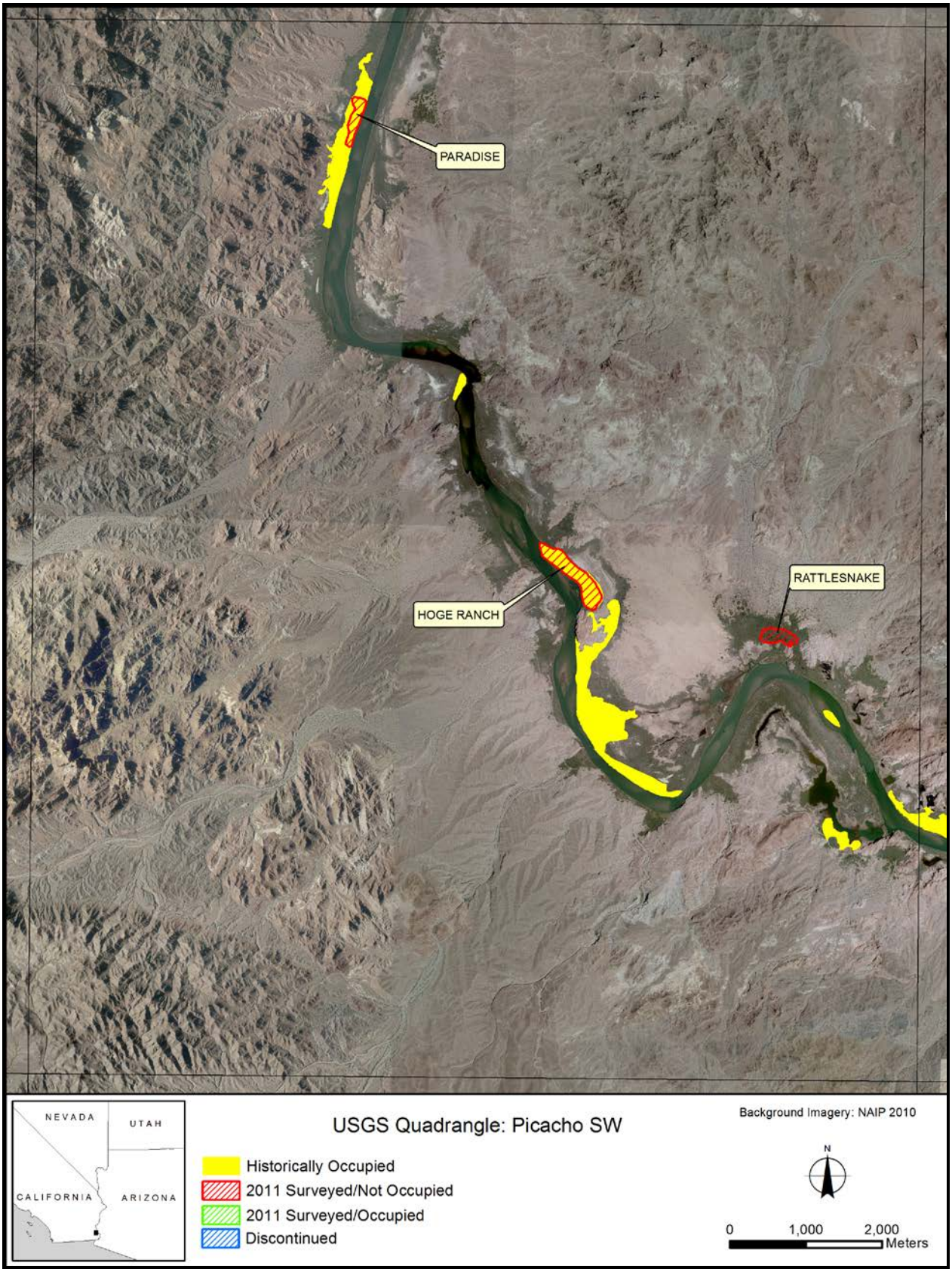

PLANET RANCH ROAD
UPSTREAM FROM SITE #8
NEW RIVER
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

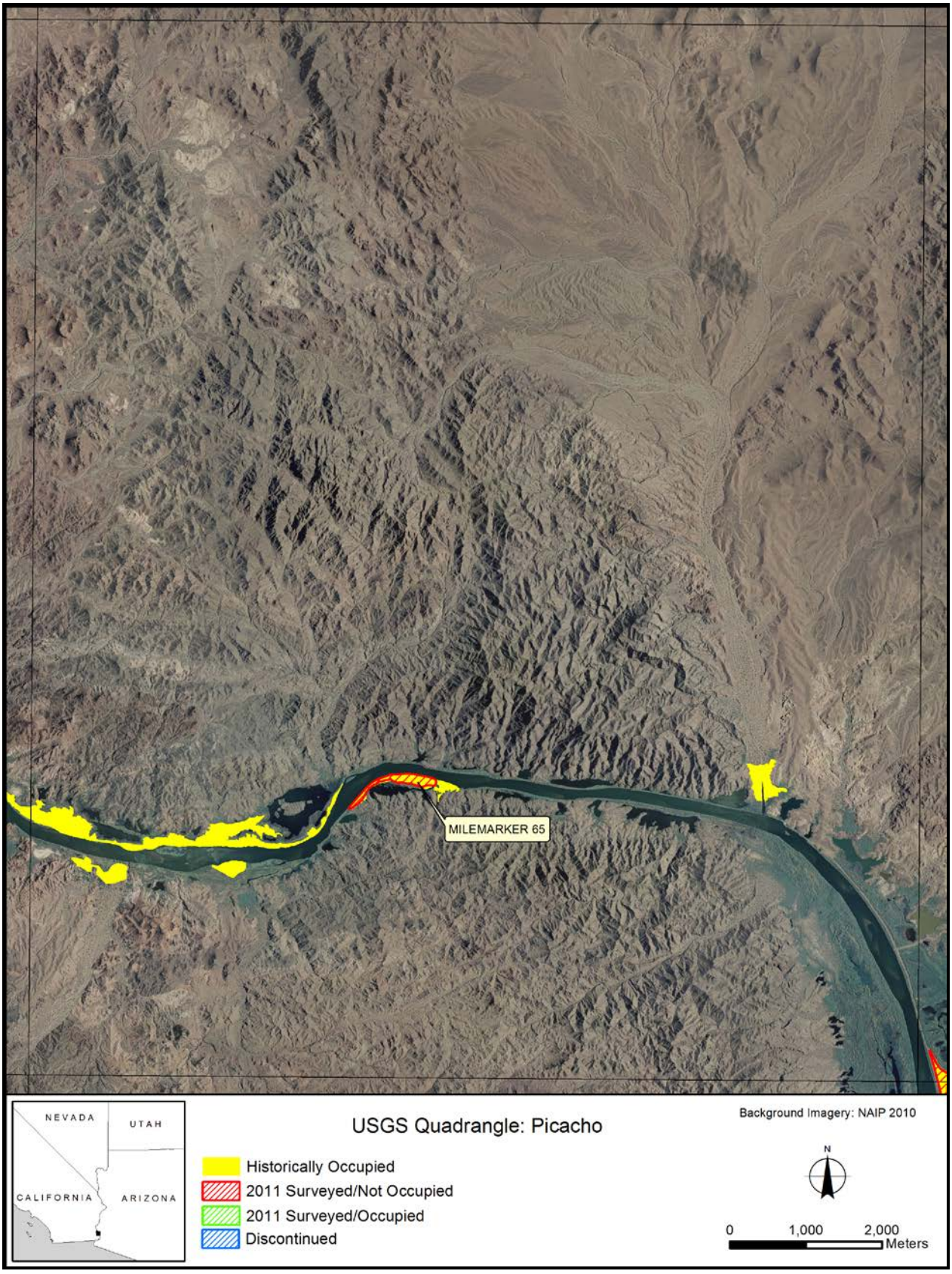

PVER PHASE 2
PVER PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

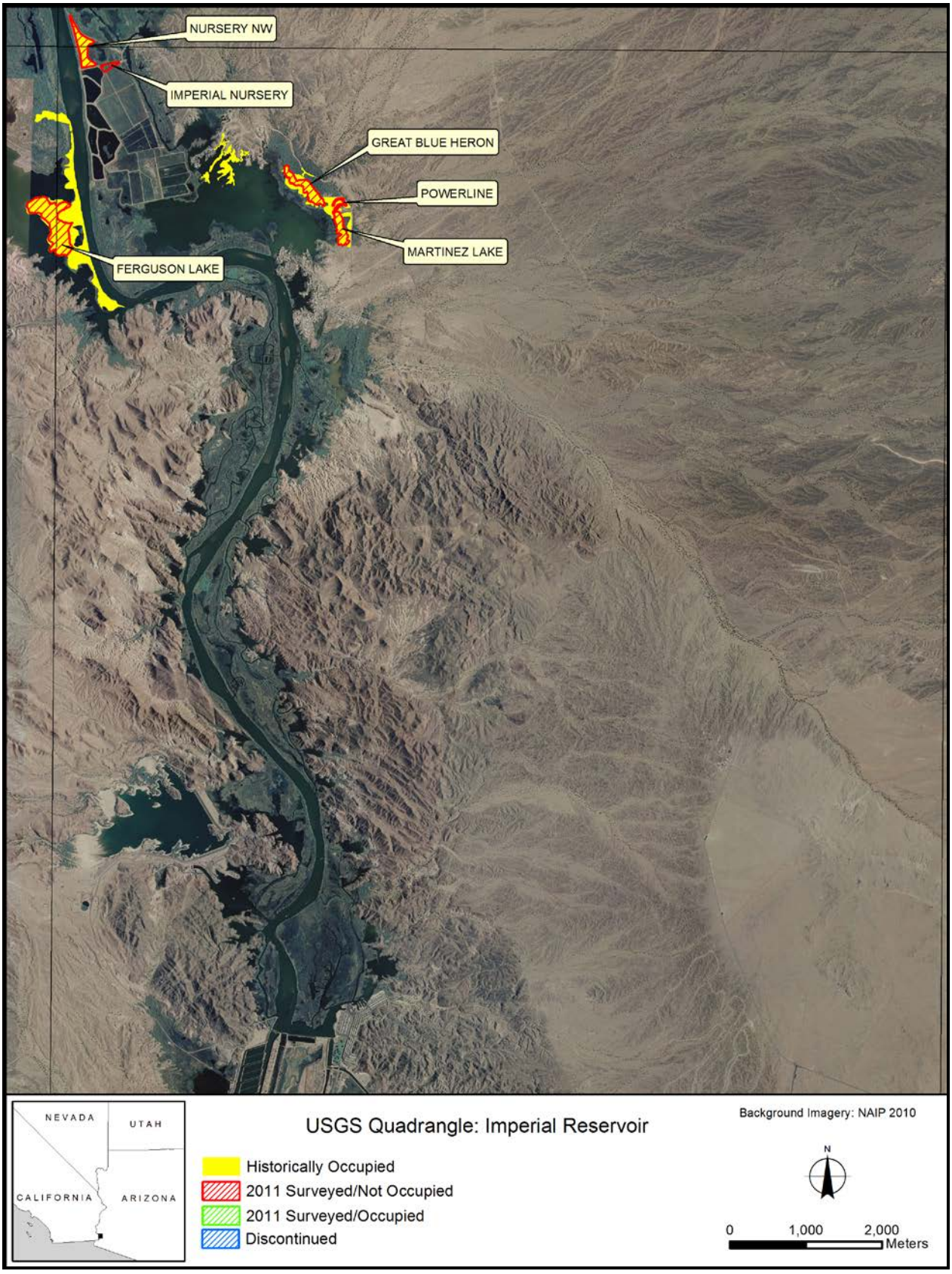

CVCA PHASE 1
CVCA PHASE 2
CVCA PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

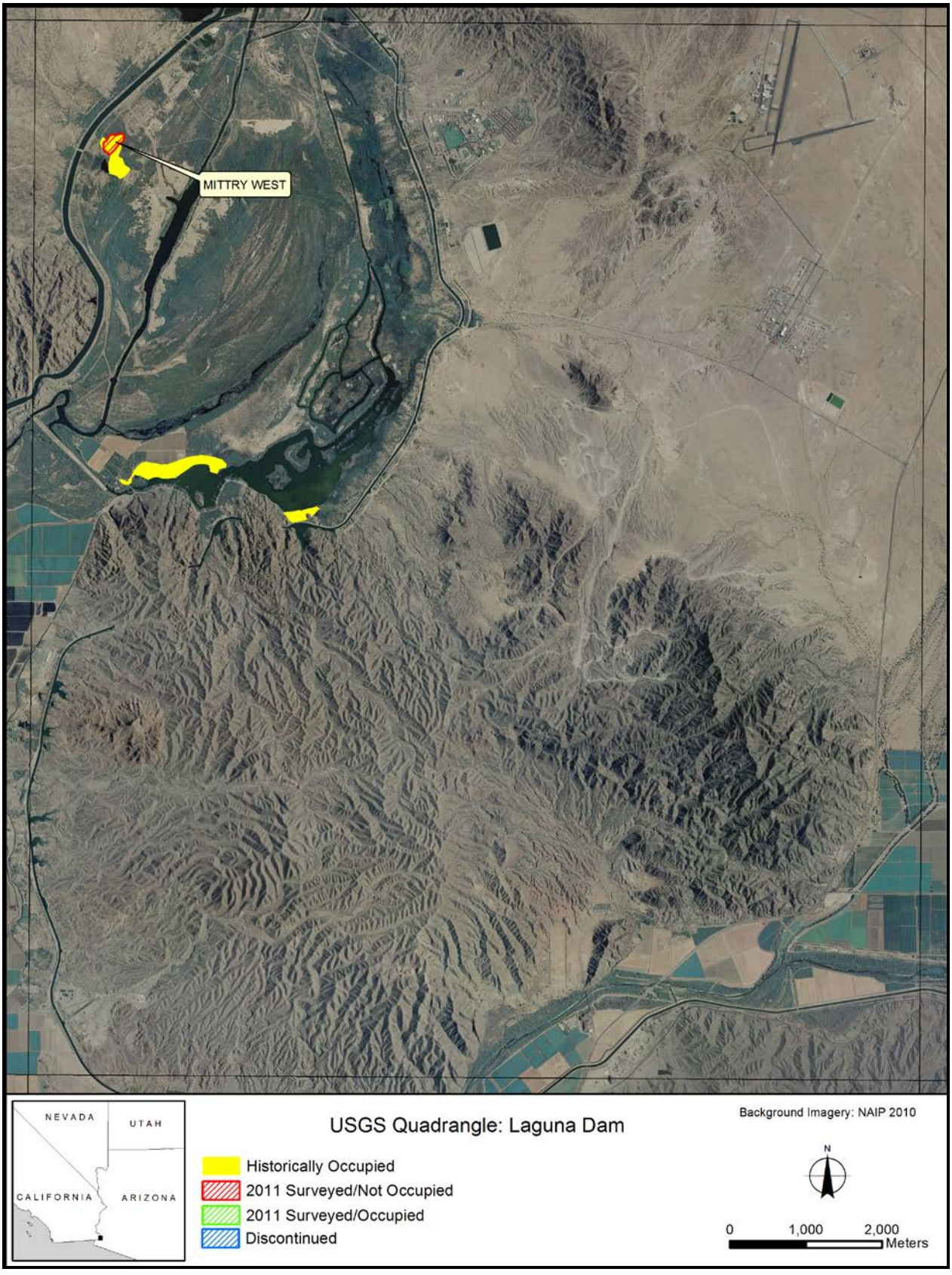

CIBOLA NATURE TRAIL
CIBOLA ISLAND
CIBOLA SITE #2
CIBOLA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

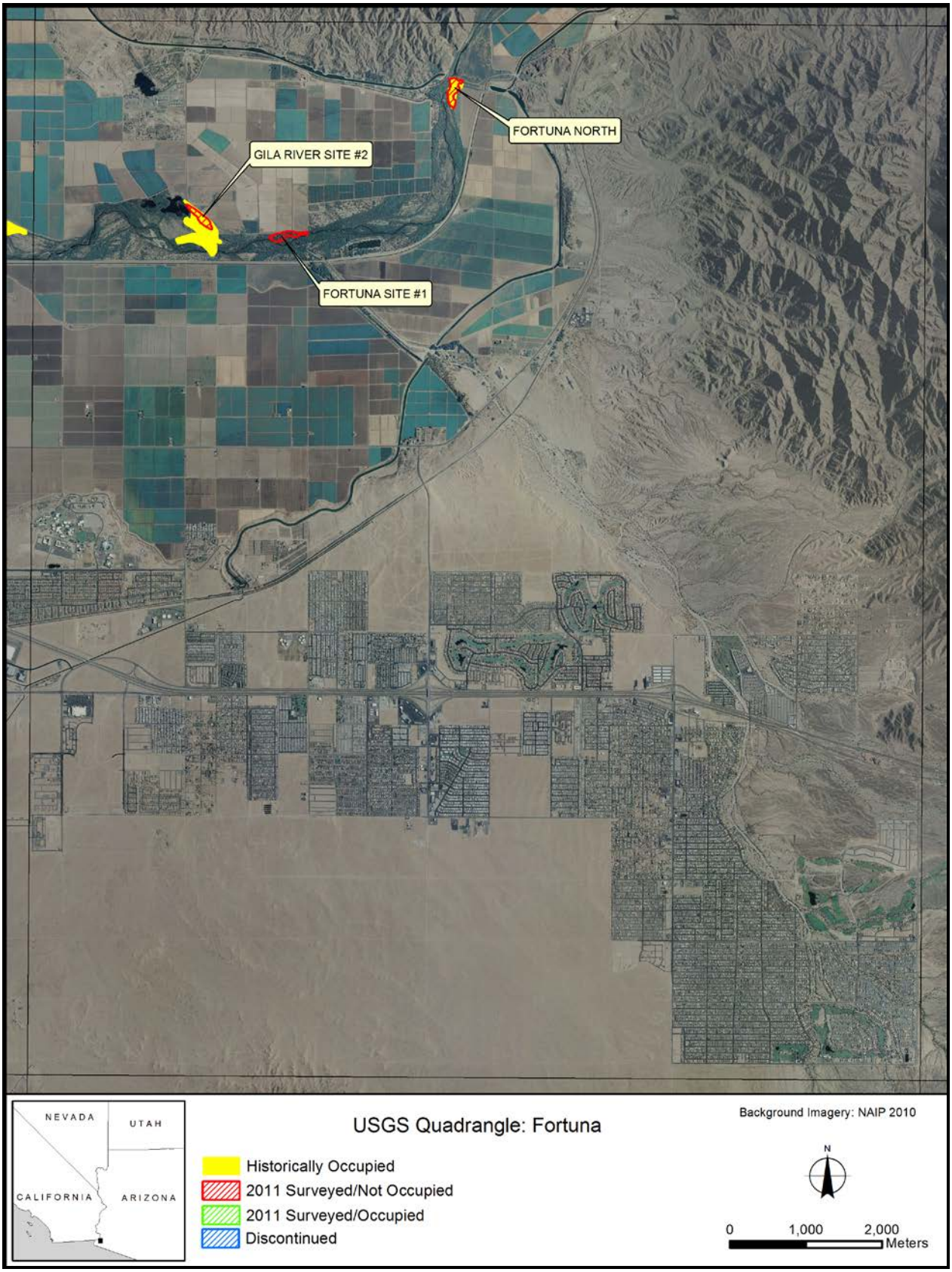

CIBOLA LAKE EAST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


PARADISE
HOGE RANCH
RATTLESNAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MILEMARKER 65
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


NURSERY NW
IMPERIAL NURSERY
GREAT BLUE HERON
POWERLINE
MARTINEZ LAKE
FERGUSON LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MITTRY WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


FORTUNA NORTH
GILA RIVER SITE #2
FORTUNA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Fortuna
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

Appendix C

SOUTHWESTERN WILLOW FLYCATCHER SURVEY RESULTS, 2011

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011*

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Pahranagat Valley	KEPI[5]	NV	Patch 0	0.04	0	---	2[6]	1	1	1	0	0
		NV	Patch 1	0.1	0	---	2	1	1	1	0	0
		NV	Patch 2	0.1	0	---	2	1	1	2	0	0
		NV	Patch 3	0.1	0	---	1	1	0	0	1	0
		NV	Patch 4	0.1	0	---	2	1	1	1	3[7]	0
		NV	Patch 4.5	0.02	5	0.3	0	0	0	0	0	0
		NV	Patch 5	0.1	0	---	2	1	1	2	0	0
		NV	Patch 6	0.2	0	---	5[8]	3	3	3	0	0
		NV	Patch 7	0.1	0	---	2	1	1	2	0	0
		NV	Patch 8	0.1	0	---	2	1	1	2	0	0
		NV	Patch 9	0.3	0	---	4	2	2	3	0	0
		NV	Patch 10	0.1	0	---	3[8]	2	2	4	0	0
		NV	Patch 10.5	0.02	0	---	0	0	0	0	2[9]	0
		NV	Patch 11	0.1	0	---	4	2	2	6	1	0
		NV	Patch 12	0.1	0	---	3[8]	2	2	6	2	0
		NV	Fence[10]	---	0	---	0	0	0	0	0	1
Pahranagat Valley	RIRA[11]	NV	East Side	0.4	1	0.8	2[7]	1	1	3	0	0
		NV	West Side	0.3	1	---	3[6,9,12]	2	1	1	2	0
		NV	Smalls	0.5	1	---	1	1	1	0	0	0
Pahranagat Valley	PAHR	NV	North	4.6	4	1.5	14[13,14]	10	6	7	5[12]	2
		NV	West	1.5	5	3.1	0	0	0	0	1[14]	0
Virgin River	MESQ	NV	Hafen Lane	6.1	5	16.2	3[15]	1	1	1	0	0
		NV	West	10.4	5	7.4	11[16,17]	7	6	8	0	0
		NV	Bunker Marsh North[18]	7.1	2	3.7	0	0	0	0	0	0
Virgin River	MOME[19]	NV	Mormon Mesa South (North)	8.4	4	9.3	0	0	0	0	0	0
		NV	Mormon Mesa South (South)	3.4	3	4.8	0	0	0	0	0	0
		NV	Virgin River #1 (North)	11.4	4	12.9	4	2	2	1	1	0
		NV	Virgin River #1 (South)	11.1	3	5.5	19[20]	12	11	19	2[16]	0
		NV	Virgin River #2	11.2	5	16.8	0	0	0	0	0	0

AR064616

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Muddy River	MUDD	NV	Overton WMA Pond	0.7	5	2.5	0	0	0	0	1	0
		NV	Overton WMA	14.9	6	18.0	13[15,20]	8	5	6	2	0
Muddy River	WMSP	NV	Muddy Mac[21]	0.7	0	---	2	1	1	1	0	3
Colorado River	TOPO	AZ	Pipes #1	5.2	5	8.5	1	1	0	0	0	0
		AZ	Pipes #3	5.7	5	4.6	2	1	1	1	1	0
		AZ	The Wallows	0.7	5	2.1	1	1	0	0	0	2
		AZ	PC6-1	4.8	5	8.0	0	0	0	0	0	1
		AZ	Pig Hole	2.4	5	5.1	0	0	0	0	0	0
		AZ	In Between	7.7	5	9.9	0	0	0	0	0	1
		AZ	800M	4.7	5	4.7	1	1	0	0	1	1
		AZ	Pierced Egg	6.7	5	8.5	0	0	0	0	0	4
		AZ	Swine Paradise	0.9	5	4.0	0	0	0	0	0	1
		AZ	Barbed Wire	2.1	5	4.0	0	0	0	0	0	0
		AZ	Platform	1.9	5	4.6	1	1	0	0	0	0
		AZ	250M	1.9	5	3.3	0	0	0	0	0	0
		AZ	Hell Bird	6.3	5	6.0	0	0	0	0	0	10
		AZ	Glory Hole	5.0	5	8.3	0	0	0	0	0	0
		AZ	Spaghetti	5.4	5	3.4	0	0	0	0	0	2
		AZ	Beal Lake	18.0	5	10.6	0	0	0	0	0	1
		AZ	Lost Lake	3.3	5	3.4	0	0	0	0	0	1
		AZ	Dock[10]	---	0	---	0	0	0	0	0	3
Bill Williams River	BIWI	AZ	Wispy Willow[18]	0.5	3	2.8	0	0	0	0	0	1
		AZ	Burn Edge	4.1	5	6.3	0	0	0	0	0	1
		AZ	Site #4	9.9	5	16.8	0	0	0	0	3	0
		AZ	Site #3	13.0	5	19.6	2	1	1	2	0	1
		AZ	Last Gasp	2.1	5	4.6	0	0	0	0	0	0
		AZ	Site #5	6.8	5	8.9	0	0	0	0	0	2
		AZ	Cougar Point[22]	1.3	0	---	2	1	1	1	0	0
		AZ	Upstream from Site #8	1.5	5	5.1	0	0	0	0	0	0

AR064617

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Bill Williams River	BIWI	AZ	Planet Ranch Road	3.3	5	12.0	3	2	2	3	0	2
		AZ	New River	0.6	5	3.9	0	0	0	0	0	0
Colorado River	PVER	CA	PVER Phase 2	21.4	6	16.5	0	0	0	0	0	11
		CA	PVER Phase 3	21.4	6	14.5	0	0	0	0	0	4
Colorado River	CIBO	AZ	CVCA Phase 1	26.2	6	16.0	0	0	0	0	0	12
		AZ	CVCA Phase 2	25.5	6	16.0	0	0	0	0	0	11
		AZ	CVCA Phase 3	38.4	5	14.0	0	0	0	0	0	18
		AZ	Cibola Nature Trail	13.7	5	6.0	0	0	0	0	0	1
		AZ	Cibola Island	4.2	3	2.3	0	0	0	0	0	0
		AZ	Cibola Site #2	16.4	5	6.2	0	0	0	0	0	5
		AZ	Cibola Site #1	7.7	5	4.1	0	0	0	0	0	0
		AZ	Cibola Lake #2 (East)	4.5	5	5.0	0	0	0	0	0	2
		CA	Walker Lake	11.4	3	4.9	0	0	0	0	0	1
Colorado River	IMPE	CA	Paradise	7.8	3	3.3	0	0	0	0	0	3
		AZ	Hoge Ranch	20.7	5	5.9	0	0	0	0	0	14
		AZ	Rattlesnake	7.6	5	6.4	0	0	0	0	0	5
		CA	Milemarker 65	10.0	2	0.9	0	0	0	0	0	1
		AZ	Nursery NW	7.0	5	6.9	0	0	0	0	0	6
		CA	Ferguson Lake	21.1	3	7.0	0	0	0	0	0	2
		AZ	Great Blue Heron	7.1	5	15.9	0	0	0	0	0	21
		AZ	Powerline	1.0	5	4.2	0	0	0	0	0	3
		AZ	Martinez Lake	4.6	5	8.8	0	0	0	0	0	2

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Colorado River	MITT	CA	Mittry West	4.4	3	4.3	0	0	0	0	0	3
Colorado River	YUMA	AZ	Gila River Site #2	2.9	4	5.3	0	0	0	0	0	7
		AZ	Fortuna Site #1	3.2	4	6.1	0	0	0	0	0	15
		AZ	Fortuna North	3.8	4	9.5	0	0	0	0	0	7

* This table includes only sites where regular surveys were scheduled and does not include sites where habitat reconnaissance and opportunistic surveys were conducted.

[1] Study areas consist of 1-18 survey sites that are grouped geographically. Alpha codes are as follows: KEPI = Key Pittman Wildlife Management Area, RIRA = River Ranch, PAHR = Pahranagat National Wildlife Refuge (NWR), MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, WMSP = Warm Springs Natural Area, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] Survey site is equivalent to the Arizona Department of Game and Fish site definition.

[3] Total number of individuals recorded that could not be classified as resident or migrant because of brief appearance after 15 June.

[4] Total number of individuals who could not be classified as resident or migrant because of brief appearance before 15 June.

[5] Only the one unoccupied site was surveyed.

[6] This female moved from River Ranch West Side after an unsuccessful nesting attempt to Key Pittman Patch 0 where she tried a second nesting attempt of unknown fate.

[7] This adult, detected on 27 July in Key Pittman Patch 4, held a territory at River Ranch East Side until 25 July.

[8] One male was polygynous with two females.

[9] This individual, detected on 24 July in Key Pittman Patch 10.5, held a territory at River Ranch West Side until 1 July.

[10] Not an official survey site. Incidental detections recorded.

[11] Due to flycatcher occupancy, sites were surveyed only once. Survey time represents total survey time at all sites combined.

[12] This individual, detected 17–19 June at Pahranagat North, moved to River Ranch West Side where he held a territory from 23 June to 13 July.

[13] One male was polygynous with three females.

[14] One female moved from Pahranagat North and was detected on 21 July with a group of three fledglings.

[15] One male held a territory at Overton WMA until 17 July and then displaced the male at Hafen Lane.

[16] One male held a territory at Mesquite West and was then recaptured on 24 July at Virgin River #1 South.

[17] Two males polygynous with two females.

[18] Surveys discontinued because of poor quality habitat.

[19] Unusually high water levels within the Virgin River prevented technicians from completing all five surveys.

[20] One male bred at Overton WMA until 17 July, then moved to Virgin River #1 South and bred. His female at Virgin River #1 South mated consecutively with two males.

[21] No surveys conducted; site was occupied the entire season.

[22] Site not formally surveyed; not a formal site until an unrelated field crew reported a flycatcher in the area. When SWCA visited the territory, the male was no longer present (though had been noted by the other crew earlier in the season) and only the female remained, attending the nest.

AR064619

Appendix D

DETECTIONS OF SPECIAL CONCERN SPECIES, 2011

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
PAHR	North	0	0	0	0	0	0	0	0	0	1	1	0
	West	0	0	0	0	0	0	0	0	0	10	0	1
MESQ	Hafen Lane	0	0	0	2	0	0	0	0	1	41	2	20
	West	0	0	0	0	0	0	0	0	0	49	0	22
	Bunker Marsh North	0	0	0	0	0	0	0	0	0	3	0	1
MOME	Mormon Mesa South	0	0	0	0	0	0	0	0	18	78	0	98
	Virgin River #1	0	0	0	0	0	0	0	0	2	27	2	37
	Virgin River #2	0	0	0	0	0	0	0	0	12	48	4	54
MUDD	Overton WMA	0	0	0	9	0	0	0	0	0	63	0	64
	Overton WMA Pond	0	0	0	0	0	0	0	0	1	17	2	16
TOPO	Pipes #1	0	0	0	0	0	0	0	0	0	1	1	42
	Pipes #3	0	0	0	0	0	0	4	0	0	11	5	41
	The Wallows	0	0	0	0	0	0	3	0	0	9	2	17
	PC6-1	0	0	0	0	0	0	1	0	1	9	3	60
	Pig Hole	0	0	0	0	0	0	0	0	0	3	0	27
	In Between	0	0	0	0	0	0	0	0	0	4	3	39
	800M	0	0	0	0	0	0	0	0	0	1	3	20
	Pierced Egg	0	0	0	0	0	0	5	0	0	19	5	55
	Swine Paradise	0	0	0	0	0	0	1	0	0	14	4	13
	Barbed Wire	0	0	0	0	0	0	1	0	0	5	6	26
	Platform	0	0	0	0	0	0	1	0	0	6	1	26
	250M	0	0	0	0	0	0	2	0	0	6	1	15
	Spaghetti	0	0	0	0	0	0	1	0	0	2	2	19
	Hell Bird	0	0	0	0	0	0	9	0	0	7	4	23
	Glory Hole	0	0	0	0	0	0	6	0	1	9	2	40

AR064622

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
TOPO	Beal Lake	0	0	0	3	0	0	1	0	40	22	10	57
	Lost Lake	0	0	2	0	0	0	0	0	0	5	2	8
BIWI	Wispy Willow	0	1	1	0	0	0	1	0	5	0	2	11
	Site #1[3]	0	0	2	0	0	0	1	0	1	0	1	3
	Site #2[3]	0	0	0	0	0	0	0	0	0	0	1	4
	Burn Edge	0	0	0	0	0	0	2	0	7	8	1	55
	Site #11[3]	0	0	0	0	0	0	2	0	1	0	0	5
	Site #4	0	0	0	0	0	0	22	0	11	32	11	97
	Site #3	0	0	0	3	1	0	4	0	11	51	8	119
	Last Gasp	0	0	0	0	0	0	6	0	1	5	1	70
	Site #5	0	0	0	1	0	0	7	0	13	16	6	81
	Mineral Wash[3]	0	0	0	0	0	0	0	0	8	5	0	9
	Beaver Pond[3]	0	0	0	0	0	0	3	0	8	14	1	35
	Upstream from Site #8	0	0	0	1	0	0	3	0	2	9	0	32
	Planet Ranch Road	1	0	0	3	0	0	6	0	14	22	5	44
	New River	2	0	0	2	0	0	0	0	9	2	1	22
PVER	PVER Phase 2	0	0	0	3	0	0	0	0	3	12	0	2
	PVER Phase 3	0	0	0	3	0	0	0	0	0	5	2	4
CIBO	CVCA Phase 1	0	0	0	5	0	0	1	0	0	10	6	7
	CVCA Phase 2	0	0	0	4	0	0	0	0	0	7	0	4
	CVCA Phase 3	0	0	0	0	0	0	0	0	0	1	4	4
	Cibola Nature Trail	0	0	0	0	0	0	0	0	1	17	1	13
	Cibola Island	0	0	0	3	0	0	0	0	0	0	0	4
	Cibola Site #2	0	1	0	0	0	0	0	0	0	0	0	14
	Cibola Site #1	0	0	3	0	0	0	3	0	0	1	1	10
	Cibola Lake #2 (East)	0	0	0	0	0	0	0	0	0	0	0	14

AR064623

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
CIBO	Walker Lake	0	0	0	0	0	0	4	0	0	0	0	8
IMPE	Paradise	0	0	0	0	0	0	4	0	0	0	0	6
	Hoge Ranch	0	0	3	0	0	0	2	0	0	0	0	13
	Rattlesnake	0	0	0	0	0	0	6	0	0	0	1	30
	Milemarker 65	0	0	1	0	0	0	0	0	0	1	0	4
	Nursery Northwest	7	0	2	0	0	0	1	0	1	3	0	22
	Ferguson Lake	0	0	9	0	0	0	2	0	0	0	0	19
	Great Blue Heron	0	0	0	0	0	0	13	0	1	16	2	67
	Powerline	0	1	1	0	0	0	5	0	0	1	1	15
	Martinez Lake	1	0	1	0	0	0	1	0	2	5	0	24
MITT	Mittry West	0	0	0	0	0	0	4	0	1	0	0	8
YUMA	Gila River Site #2	0	0	0	0	0	0	0	0	0	0	0	0
	Fortuna Site #1	0	0	0	0	0	0	0	0	0	1	1	9
	Fortuna North	0	0	0	0	0	0	0	0	0	1	0	14

[1] PAHR = Pahranagat NWR; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; TOPO = Topock Marsh; BIWI = Bill Williams River NWR; PVER = Palo Verde Ecological Reserve; CIBO = Cibola; IMPE = Imperial; MITT = Mittry Lake; YUMA = Yuma.

[2] BLRA = Black Rail, CLRA = Clapper Rail, LEBI = Least Bittern, YBCU = Yellow Billed Cuckoo, ELOW = Elf Owl, GIFL = Gilded Flicker, GIWO = Gila Woodpecker, VEFL = Vermilion Flycatcher, BEVI = Bell's Vireo, YWAR = Yellow Warbler, SUTA = Summer Tanager, YBCH = Yellow-breasted Chat.

[3] Site surveyed only once as part of an opportunistic effort.

Appendix E

ALL WILLOW FLYCATCHERS COLOR-BANDED AND/OR RESIGHTED, 2003–2011

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011*

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1490-89889	M	J							R		D	D	D	D			
1590-97338	M	A	P				P	P	P	P							
1710-20312	M	J							R		T						
1710-20638	M	A		G	M	M	M	M	M	M	M						
2090-42022	F	J		M					Q								
2110-78841	F	J						T	T	T	T						
2110-78842	M	A						Q	Q	Q							
2110-78855	M	J						T	T								
2110-78861	M	J						T	M[4]	Q							
2110-78863	M	J						T	T	T							
2140-66502	M	J						Q	Q								
2140-66503	F	J						Q		Q							
2140-66517	F	A						Q	Q	Q	D						
2140-66518	M	A						Q	Q								
2140-66561	M	A						P			P	P	P	P			
2140-66564	F	J						P	P								
2140-66566	M	J						P			P						
2140-66568	M	A						P	P		P	P	P	P			
2140-66606	M	J		M		Q	Q		Q								
2140-66621	F	A				P	P	P	P	P							
2140-66627	F	A				P	P	P		P							
2140-66690	F	J					P								S		
2140-66693	M	J					M	Q	Q								
2140-66696	F	J					Q		Q								
2140-66697	M	J					Q			P	P	P	P	P	P		
2140-66709	M	A						Q	Q	Q		Q[5]	M	M	M	M	M
2140-66728	M	J					T			T							
2140-66743	M	J			T					T							
2140-66775	M	J				T	M		Q	Q	Q						
2190-76604	M	A					P		P	P	P	P					
2320-31401	M	A							B								
2320-31402	M	A							B								
2320-31403	M	A							Y								
2320-31404	F	A							B								
2320-31405	F	A							B								
2320-31406	U	J							B								
2320-31407	F	J							B	T							
2320-31408	U	J							B								
2320-31409	U	J							B								
2320-31410	U	J							B								
2320-31411	U	J							B								
2320-31412	M	A							B	B							
2320-31413	U	A							Q								
2320-31414	M	A								T	T						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31415	F	A								T							
2320-31416	U	J								T							
2320-31417	U	J								T							
2320-31418	M	A								T	T						
2320-31419	U	J								T							
2320-31420	U	J								T							
2320-31421	U	J								T							
2320-31422	U	J								T							
2320-31423	U	A								T							
2320-31424	M	J								T	T						
2320-31425	U	J								T							
2320-31426	F	A							M								
2320-31427	M	A							M								
2320-31428	M	J							Q	M	Q[6]		M	M			
2320-31429	U	J							Q								
2320-31430	U	J							P								
2320-31431	U	J							Q								
2320-31432	U	J							P								
2320-31433	U	J							Q								
2320-31434	U	J							Q								
2320-31435	U	J							P								
2320-31436	U	J							P								
2320-31437	U	J							P								
2320-31438	M	J							Q	Q							
2320-31439	U	J							Q								
2320-31440	F	J							Q	M							
2320-31441	U	J							M								
2320-31443	U	J							Q								
2320-31444	F	A							Q	Q	Q	Q			M		
2320-31445	F	A							Q	Q	Q	Q	Q	Q	Q	Q	
2320-31446	U	J								P							
2320-31447	U	J								P							
2320-31448	U	J								P							
2320-31449	U	J								P							
2320-31450	U	J								P							
2320-31451	M	A							P	P	P	P					
2320-31452	M	A							P								
2320-31453	M	A							P	P							
2320-31454	M	A							P	P							
2320-31455	M	A							P								
2320-31456	U	J							P								
2320-31457	M	J							P	K							
2320-31458	M	J							P		P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31459	M	J							P	P							
2320-31460	U	J							P								
2320-31461	U	J							P								
2320-31462	U	J							P								
2320-31463	F	J							P			K	K			K	
2320-31464	U	J							P								
2320-31465	U	J							P								
2320-31466	F	A							P								
2320-31467	M	J							P		P	P					
2320-31468	M	J							P		P	P		K			
2320-31469	U	J							P								
2320-31470	U	J							P								
2320-31471	M	J							Q	Q			M		M		
2320-31472	U	J							Q								
2320-31473	M	J							Q	Q							
2320-31474	U	J							Q								
2320-31475	M	J							P	L							
2320-31476	F	A							Q								
2320-31477	U	J							Q								
2320-31479	F	A							Q	Q							
2320-31480	F	J							Q	Q							
2320-31481	U	J							P								
2320-31482	U	J							P								
2320-31483	U	J								Q							
2320-31484	M	J								P	P			K	K		
2320-31485	F	A								M		M	M	M			
2320-31486	F	J							Q	L	Q	M	M	M			
2320-31487	U	J							Q								
2320-31488	U	J							Q								
2320-31489	U	A								M							
2320-31490	M	A								L	L[7]	Q	Q	Q	Q		
2320-31491	M	A								Q							
2320-31493	M	A								D							
2320-31494	U	A								Q							
2320-31495	M	A								T							
2320-31496	U	J								M							
2320-31497	U	J								M							
2320-31498	F	J								M		G[8]	Q	Q	Q	Q	
2320-31499	M	A								Q							
2320-31500	U	J								Q							
2320-31501	M	A							B								
2320-31502	F	A							T	T							
2320-31503	U	A								I							

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31504	U	A								I							
2320-31505	M	A								T							
2320-31506	U	J								T							
2320-31507	U	J								T							
2320-31508	U	J								T							
2320-31510	U	J								T							
2320-31511	U	J								T							
2320-31512	U	J								T							
2320-31513	U	J								T							
2320-31514	U	J								T							
2320-31515	F	A								T	T	T					
2320-31516	F	A								G							
2320-31517	M	A								G	M	M			M		
2320-31518	U	J								T							
2320-31519	U	J								T							
2320-31520	U	J								T							
2320-31521	F	A								T	T						
2320-31522	U	J											Q				
2320-31523	U	J											M				
2320-31524	U	J											P				
2320-31525	U	J											P				
2320-31526	F	A							T	T	T						
2320-31527	F	A							T								
2320-31528	M	A							T								
2320-31529	U	J							T								
2320-31530	U	J							T								
2320-31531	U	J							T								
2320-31532	U	J							T								
2320-31533	U	J							T								
2320-31534	U	J							T								
2320-31535	U	J							T								
2320-31536	U	J							T								
2320-31537	U	J							T								
2320-31538	M	A								T							
2320-31539	M	A								B							
2320-31540	F	A								T							
2320-31541	M	A								T	T						
2320-31542	U	J								T							
2320-31543	U	J								T							
2320-31544	U	J								T							
2320-31545	U	J											P				
2320-31546	U	J											P				
2320-31547	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31548	U	J											P				
2320-31549	U	J											P				
2320-31550	U	J											P				
2320-31551	M	A								Q							
2320-31552	M	A								M							
2320-31553	M	A								M		M					
2320-31554	U	J								T							
2320-31555	U	J								T							
2320-31556	U	J								T							
2320-31557	U	J								T							
2320-31558	U	J								T							
2320-31559	M	A								T	T	T	T				
2320-31560	M	A								T	T	T	T	T			
2320-31561	U	J								T							
2320-31562	M	J								T		T		T	T	T	
2320-31563	U	J								T							
2320-31564	U	J								T							
2320-31565	F	A								T	T						
2320-31566	U	J										T					
2320-31567	M	A								T	T						
2320-31568	F	A								P							
2320-31569	U	J								P							
2320-31570	U	J								P							
2320-31571	U	J								P							
2320-31572	M	A								M							
2320-31573	F	A								Q	Q	Q	Q	Q			
2320-31574	U	J									P						
2320-31575	U	J										Q					
2320-31576	M	A							T	T							
2320-31577	F	A							T	T	T						
2320-31578	U	A							Y								
2320-31579	U	A							Y								
2320-31580	U	A							Y								
2320-31581	U	J							T								
2320-31582	U	J							T								
2320-31583	U	J							T								
2320-31584	F	A							T	T	T	T					
2320-31585	U	J							T								
2320-31586	U	J							T								
2320-31587	U	J							T								
2320-31588	U	J							T								
2320-31589	M	A								P	P	P	P				
2320-31590	M	A								P	P	P	P	P			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31591	M	A								P	P	P	P				
2320-31593	M	A								P	P	P					
2320-31594	M	A								P							
2320-31595	M	A								P	P	P	P	P	P	P	P
2320-31596	M	A								P							
2320-31598	M	A								T							
2320-31599	U	A								I							
2320-31600	U	A								I							
2320-31601	U	J								P							
2320-31602	U	J								P							
2320-31603	U	J								P							
2320-31604	M	J								P		K	K				
2320-31605	U	J								P							
2320-31606	U	J								P							
2320-31607	U	J								P							
2320-31608	U	J								P							
2320-31609	U	J								P							
2320-31610	U	J								P							
2320-31611	U	J								Q							
2320-31612	U	J								Q							
2320-31616	F	J								Q		D					
2320-31617	U	J								Q							
2320-31618	F	J								Q	M	M	M				
2320-31619	U	J								M							
2320-31620	U	J								M							
2320-31621	F	A								M							
2320-31622	M	A								Q							
2320-31623	U	J								M							
2320-31624	U	J								M							
2320-31625	F	A								M							
2320-31627	M	A								Q							
2320-31628	U	A								M							
2320-31629	U	J								M							
2320-31630	U	J								Q							
2320-31631	F	J								Q		D	D				
2320-31632	F	A								Q		M	M	M[9]		M	M
2320-31633	U	J								Q							
2320-31634	U	J								Q							
2320-31635	M	A								K							
2320-31636	U	J								K							
2320-31637	F	J								K	P						
2320-31638	U	J								K							
2320-31639	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31640	U	J											Q				
2320-31641	U	J											Q				
2320-31642	U	J											Q				
2320-31643	U	J											P				
2320-31644	U	J											M				
2320-31645	U	J											M				
2320-31646	U	J											P				
2320-31647	U	J														M	
2320-31648	U	J														M	
2320-31649	U	J											P				
2320-31650	F	J										T	T				
2320-31651	M	A								M							
2320-31652	M	A								M	Q	Q					
2320-31653	M	A								M	M	M	M				
2320-31654	M	A								Q							
2320-31655	F	A								Q	Q	Q					
2320-31656	F	A								P	P	P					
2320-31657	F	A								P	P	P	P	P	P		
2320-31658	F	A								P							
2320-31659	M	J								Q		D	D	D		D	
2320-31660	F	J								Q			M	S	S	S	
2320-31661	F	A								P	P	P	P	P			
2320-31662	F	A								P							
2320-31663	F	A								P	P	P	P	P			
2320-31664	F	A								P							
2320-31665	U	J								P							
2320-31666	U	J								P							
2320-31667	U	J								P							
2320-31668	F	A								P							
2320-31669	F	A								P							
2320-31670	U	J											Q				
2320-31671	U	J										M					
2320-31672	U	J											P				
2320-31673	U	J										T					
2320-31674	M	J										P		K	K	K	
2320-31675	U	J									T						
2320-31676	U	J									T						
2320-31677	U	J										T					
2320-31678	U	J										P					
2320-31679	U	J											P				
2320-31680	U	J									T						
2320-31681	U	J									T						
2320-31682	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31683	M	J									P		K				
2320-31684	U	J									P						
2320-31685	U	J									P						
2320-31686	M	J									P	P					
2320-31687	U	J									P						
2320-31688	M	J									Q	Q	Q	Q	Q	Q	Q
2320-31689	U	J									Q						
2320-31690	U	J									Q						
2320-31691	U	J									Q						
2320-31692	M	J									P	K					
2320-31693	U	J									P						
2320-31694	M	J									P		K	K			
2320-31695	F	J									P	P					
2320-31696	U	J									Q						
2320-31697	U	J									P						
2320-31698	F	J									P		P	P	P		
2320-31699	U	J									P						
2320-31700	U	J									P						
2360-59701	F	J									Q	Q					
2360-59702	M	J									Q	D	M				
2360-59703	U	J									Q						
2360-59704	U	J									M						
2360-59705	U	J									M						
2360-59706	U	J									K						
2360-59707	F	J									P	P					
2360-59708	F	J									P	P					
2360-59709	U	J									P						
2360-59710	U	J									P						
2360-59711	M	J									K			P	P	P	
2360-59712	M	J									K			P		P	P
2360-59713	U	J									K						
2360-59714	U	J									Q						
2360-59715	U	J									Q						
2360-59716	U	J									Q						
2360-59717	M	A								Q							
2360-59718	U	J									P						
2360-59719	U	J									T						
2360-59720	U	J									T						
2360-59721	U	J								P							
2360-59722	U	J									T						
2360-59723	U	J								P							
2360-59724	F	J								P		P					
2360-59725	U	J									B						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59727	M	J									B		B				
2360-59728	U	J									B						
2360-59729	U	J									T						
2360-59730	U	J									T						
2360-59731	U	J									T						
2360-59732	U	J									T						
2360-59733	U	J									T						
2360-59734	U	J									T						
2360-59735	U	J										P					
2360-59736	U	J										P					
2360-59737	U	J										D					
2360-59738	U	J										D					
2360-59739	U	J										Q					
2360-59740	U	J									P						
2360-59741	U	J									Q						
2360-59742	U	J									Q						
2360-59743	F	J											P	K			
2360-59744	U	J										T					
2360-59745	U	J										P					
2360-59746	U	J								G							
2360-59747	U	J										D					
2360-59748	U	J										D					
2360-59749	M	J										D	D[10]	M			
2360-59750	F	J										M	Q				
2360-59751	M	J										M	Q	Q	Q		
2360-59752	M	J										Q		Q	M		
2360-59753	U	J										Q					
2360-59754	M	J										Q	Q	Q	Q	P	P
2360-59755	U	J										Q					
2360-59756	U	J										P					
2360-59757	U	J								K							
2360-59758	U	J										P					
2360-59759	U	J										P					
2360-59760	U	J								L							
2360-59761	U	J								L							
2360-59762	U	J								Q							
2360-59763	U	J								Q							
2360-59764	U	J											P				
2360-59765	U	J											P				
2360-59766	U	J								Q							
2360-59767	U	J								K							
2360-59768	U	J										T					
2360-59769	U	J										M					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59770	U	J								K							
2360-59771	U	J								G							
2360-59772	F	A								K							
2360-59773	U	J											Q				
2360-59775	U	J											Q				
2360-59776	U	J											Q				
2360-59777	F	J											Q				M
2360-59778	U	J											Q				
2360-59779	U	J											K				
2360-59780	U	J											K				
2360-59781	U	J											K				
2360-59782	F	J											K			M	
2360-59785	U	J									D						
2360-59786	U	J									D						
2360-59787	U	J									D						
2360-59788	F	J									D	D	M	M	M	M	M
2360-59789	U	J										Q					
2360-59790	U	J										Q					
2360-59791	U	J										P					
2360-59792	U	J										P					
2360-59793	U	J										P					
2360-59794	U	J										P					
2360-59795	U	J										P					
2360-59796	U	J										P					
2360-59797	M	J										P	P				
2360-59798	U	J										P					
2360-59799	M	J										M	D	M		M	
2360-59800	U	J								G							
2370-39901	U	A								P							
2370-39902	U	J								P							
2370-39904	U	J								P							
2370-39911	M	A									P						
2370-39912	M	A									Q		Q				
2370-39913	M	A									G						
2370-39914	U	J									P						
2370-39915	M	A									P	P	P	P[11]	P	P	
2370-39916	M	A										T	T	T			
2370-39917	U	A										Y					
2370-39918	U	A										Y					
2370-39919	U	A										Y					
2370-39920	U	A										Y					
2370-39921	U	A										Y					
2370-39922	U	A										Y					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39923	U	A										Y					
2370-39924	U	A										Y					
2370-39925	U	A										Y					
2370-39926	U	A										Y					
2370-39927	U	A										Y					
2370-39928	U	A										Y					
2370-39929	M	A										G	G				
2370-39930	M	J													M	Q	D[12]
2370-39932	F	A									B	B	B				
2370-39933	U	A									Y						
2370-39934	U	A									Y						
2370-39935	U	A									Y						
2370-39937	M	A										Q	Q	Q			
2370-39938	M	A										M	M	M	M	M	M
2370-39939	F	A										Q	Q				
2370-39940	M	A										M	M	M	Q		
2370-39941	M	J										Q	L[13]				
2370-39942	U	J										D					
2370-39943	U	J										D					
2370-39944	U	J										D					
2370-39945	U	J										P					
2370-39946	M	J										P	P				
2370-39947	U	J										P					
2370-39948	F	A										M					
2370-39949	U	J										Q					
2370-39950	U	J										Q					
2370-39951	M	A									P	P	P	P			
2370-39953	M	A									P	P	P	P			
2370-39954	M	A									Q	Q	Q	Q			
2370-39956	F	A									D	D	D			M	M
2370-39957	F	A									Q	Q					
2370-39958	F	A									P						
2370-39959	M	A									P		A				
2370-39960	M	A									K						
2370-39961	M	A									P						
2370-39962	F	A									P						
2370-39964	F	A									P	P	P				
2370-39965	U	A									D						
2370-39966	M	J									D		M				
2370-39967	M	A										M	D[14]	Q	Q		
2370-39968	M	A															D
2370-39969	F	A													B		
2370-39970	U	J															M

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39971	U	A									P						
2370-39972	U	A									I						
2370-39973	U	A									Y						
2370-39974	U	A									I						
2370-39975	M	A									D	M					
2370-39976	M	A									D						
2370-39977	U	J									P						
2370-39978	F	A									P						
2370-39979	U	J									P						
2370-39980	M	J									P	K	K	K	K		
2370-39981	U	J									P						
2370-39982	U	A										Y					
2370-39983	U	A										Y					
2370-39984	U	A										Y					
2370-39985	U	A										Y					
2370-39986	M	A										G					
2370-39987	M	A										G					
2370-39988	M	A										G	M	M	M	M	
2370-39989	M	A										G					
2370-39990	F	A										G					
2370-39992	M	A										T					
2370-39993	U	A										Y					
2370-39994	U	A										Y					
2370-39995	U	A										Y					
2370-39996	U	A										Y					
2370-39997	U	A										Y					
2370-39998	U	A										Y					
2370-39999	M	A														Q	
2370-40000	M	A														D	D
2370-40001	U	J														P	
2370-40002	U	J														P	
2370-40003	M	A										T					
2370-40004	F	A										B			B		
2370-40005	U	J														S	
2370-40007	U	J														S	
2370-40008	U	J														D	
2370-40009	U	J														D	
2370-40010	U	J														D	K
2370-40011	F	A														Q	
2370-40012	M	A									Q	Q	Q				
2370-40013	M	A									P	P					
2370-40014	F	A									P	P	P				
2370-40016	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40017	M	A									M	M					
2370-40019	U	J									P						
2370-40020	U	J									P						
2370-40021	M	A									P	P					
2370-40022	M	A														K	
2370-40023	U	J													M		
2370-40024	M	J													K	K	K
2370-40025	U	J													K		
2370-40026	U	J													P		
2370-40027	F	J													P	E	K
2370-40029	M	J													M		D
2370-40030	U	J													M		
2370-40031	M	J													K	K	K
2370-40032	M	A									B						
2370-40033	U	A									Y						
2370-40034	U	A									Y						
2370-40035	U	A									Y						
2370-40036	M	A										G[15]					
2370-40037	F	A										G	M		M	M	M
2370-40038	M	A										G					
2370-40039	U	A										Y					
2370-40040	U	A										Y					
2370-40041	U	A										Y					
2370-40042	U	A										Y					
2370-40043	U	A										Y					
2370-40044	U	A										Y					
2370-40045	U	A										Y					
2370-40046	M	A										G	G[16]	M	M	M	M
2370-40047	F	A										P	P	P	P	P	P
2370-40048	U	J													T		
2370-40049	U	J													T		
2370-40050	U	J													T		
2370-40051	U	J														K	
2370-40052	M	A									B	B	B	B			
2370-40053	M	A									B						
2370-40054	M	A									B						
2370-40055	F	A									T						
2370-40056	M	A									T						
2370-40057	M	A										D					
2370-40058	M	A										M	B				
2370-40059	F	A										D	D	D			
2370-40060	M	A										P		P	P	P	P
2370-40061	F	A										P					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40062	F	A										P	P				
2370-40063	U	J										Q					
2370-40064	U	J										P					
2370-40065	U	J										Q					
2370-40066	F	A										Q	Q	Q	Q		
2370-40067	U	J										Q					
2370-40068	U	J										Q					
2370-40069	U	J										M					
2370-40070	U	J										M					
2370-40071	U	J										P					
2370-40072	U	J													M		
2370-40073	F	A													P	P	
2370-40074	U	J													P		
2370-40075	U	J													P		
2370-40076	U	J													P		
2370-40078	U	J															K
2370-40079	U	J															K
2370-40080	U	J										Q					
2370-40081	M	A										K					
2370-40082	F	A										K					
2370-40083	U	J										Q					
2370-40084	U	J										Q					
2370-40085	U	J											Q				
2370-40086	U	J											Q	M	M		
2370-40087	F	A											Q	Q	Q	Q	Q
2370-40088	M	A														D	D
2370-40089	U	J														M	
2370-40090	U	J														M	
2370-40091	F	J														M	D
2370-40093	U	J														M	
2370-40096	U	J												K			
2370-40097	M	J												K		K	K
2370-40098	U	J												K			
2370-40099	U	J													S		
2370-40100	U	J										K					
2370-40101	U	J										K					
2370-40102	U	J										K					
2370-40103	U	J										Q					
2370-40104	U	J										Q					
2370-40105	U	J										Q					
2370-40106	U	J										Q					
2370-40107	U	J										Q					
2370-40108	U	J										Q					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40110	U	J											T				
2370-40111	U	J											T				
2370-40112	M	J											T			T	
2370-40113	U	J											B				
2370-40114	M	J											T		T		
2370-40115	U	J											T				
2370-40116	U	J											T				
2370-40117	U	J											T				
2370-40118	U	J											T				
2370-40119	U	J											T				
2370-40120	U	J											T				
2370-40121	U	J											T				
2370-40122	U	J											T				
2370-40123	U	J											T				
2370-40124	M	J											T		M		
2370-40125	U	J											T				
2370-40126	M	A											G				
2370-40127	M	A											G				
2370-40129	M	A											G				
2370-40130	F	A													B		
2370-40132	F	A											T				
2370-40133	F	A											B				
2370-40134	U	A											B				
2370-40135	F	A											B				
2370-40136	F	A											T				
2370-40137	M	A											B				
2370-40138	M	A											T				
2370-40139	M	A											T	T			
2370-40140	F	A													P		
2370-40141	M	A													K	K	K
2370-40142	U	J													M		
2370-40143	U	J													Q		
2370-40144	M	J													M	T	
2370-40145	U	J													M		
2370-40146	U	J													S		
2370-40147	F	J												S	D		
2370-40148	F	J												S	S	S	S
2370-40149	U	J												S			
2370-40150	U	J													M		
2370-40151	F	J													M	M	
2370-40152	U	J													M		
2370-40153	U	J													S		
2370-40154	U	J													S		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40155	M	A													L		
2370-40156	M	A													B		
2370-40157	M	A											P		P	P	
2370-40158	M	J											B		T		
2370-40159	U	J											B				
2370-40160	F	A											G				
2370-40161	M	A											M	M	M		
2370-40162	U	J													B		
2370-40163	U	J													B		
2370-40164	U	J											Q				
2370-40165	M	A													B		
2370-40166	U	A											P				
2370-40167	U	J											P				
2370-40168	F	A											P	P	P		
2370-40169	U	J											M				
2370-40170	F	A											Q	Q			
2370-40171	F	A											D				
2370-40173	M	A											M	M	M	M	
2370-40174	U	J													M		
2370-40175	M	J													M	Q	Q
2370-40176	M	A													M		
2370-40177	U	J														T	
2370-40179	U	J														K	
2370-40180	M	A													B		
2370-40181	M	A													T		
2370-40182	U	J													B		
2370-40183	F	A											M				
2370-40184	M	A											D				
2370-40185	M	A											P				
2370-40186	M	A											D				
2370-40187	M	A											K				
2370-40188	U	J											Q				
2370-40190	M	J											P				K
2370-40191	F	A											M	M	M		
2370-40192	F	A											D			B	
2370-40193	F	A											Q	Q	Q	D	
2370-40194	F	A											P	P	P	P	
2370-40195	F	A											P	P	P		
2370-40197	M	A											M	Q	Q	M	M
2370-40199	U	J											P				
2390-92348	F	J		T						T							
2390-92350	M	A				M	Q		Q	Q							
2390-92365	M	J				D			Q	Q	Q						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2390-92410	M	A					Q		Q								
2390-92420	M	J					Q	Q	Q								
2390-92421	M	J					Q	Q	Q	Q	M	M					
2390-92427	F	J					M		Q								
2390-92433	M	J					Q		Q	Q							
2390-92434	M	J					Q	Q		Q	Q	Q	Q	Q	Q	M	M
2390-92451	F	J			M	M		Q		Q							
2390-92470	F	J					Q			Q							
2390-92475	M	J					M	Q	Q	Q	Q	Q	Q	Q			
2430-61006	U	A											Y				
2430-61007	U	A											Y				
2430-61008	U	A											Y				
2430-61009	U	A											Y				
2430-61010	U	A											Y				
2430-61011	U	A											Y				
2430-61012	U	A											Y				
2430-61013	U	A											Y				
2430-61014	U	A											Y				
2430-61015	U	A											Y				
2430-61016	U	A											Y				
2430-61017	U	A											Y				
2430-61018	U	A											Y				
2430-61019	U	A											Y				
2430-61020	U	A											Y				
2430-61021	U	A											Y				
2430-61023	U	A											Y				
2430-61024	U	A											Y				
2430-61025	U	A											Y				
2430-61026	U	A											Y				
2430-61027	U	A											Y				
2430-61028	U	A											Y				
2430-61029	U	A											Y				
2430-61030	U	A											Y				
2430-61031	U	A											Y				
2430-61032	U	A											Y				
2430-61033	U	A											Y				
2430-61034	U	A											Y				
2430-61035	U	A											Y				
2430-61036	U	A											Y				
2430-61037	U	A											Y				
2430-61038	U	A											Y				
2430-61039	U	A											Y				
2430-61040	U	A											Y				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61041	U	A											Y				
2430-61042	U	A											Y				
2430-61043	U	A											Y				
2430-61044	U	A											Y				
2430-61045	U	A											Y				
2430-61046	U	A											Y				
2430-61047	U	A											Y				
2430-61048	U	A											Y				
2430-61049	U	A											Y				
2430-61050	U	A											Y				
2430-61051	U	A											Y				
2430-61052	U	A											Y				
2430-61053	U	A											Y				
2430-61054	U	A											Y				
2430-61055	U	A											Y				
2430-61056	U	A											Y				
2430-61058	U	A											Y				
2430-61059	U	A											Y				
2430-61060	U	A											Y				
2430-61061	U	A											Y				
2430-61062	U	A											Y				
2430-61063	U	A											Y				
2430-61064	U	A											Y				
2430-61065	U	A											Y				
2430-61067	U	A											Y				
2430-61068	U	A											Y				
2430-61069	U	A											Y				
2430-61070	U	A											Y				
2430-61071	U	A											Y				
2430-61072	M	A												G			T
2430-61073	M	A												B			
2430-61074	U	J												B			
2430-61075	U	J												B			
2430-61076	U	J												B			
2430-61077	U	J												M			
2430-61078	U	J												Q			
2430-61079	F	A												M			
2430-61080	M	A												P	P	P	P
2430-61081	U	J												M			
2430-61082	U	J												Q			
2430-61083	M	A												P	P	P	P
2430-61084	M	J												Q		D	
2430-61085	M	A													D	D	D

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61086	U	J													M		
2430-61087	F	A													P	P	P
2430-61088	M	A														N	D
2430-61089	U	J														M	
2430-61090	U	J														M	
2430-61091	U	J														S	
2430-61092	F	A														S	
2430-61093	M	A														S	S
2430-61094	U	J														D	
2430-61095	M	A														M	
2430-61096	F	A														L	
2430-61097	U	J														P	
2430-61098	M	J														P	E[17]
2430-61099	U	J														K	E[18]
2430-61100	F	A														K	K
2430-61101	U	J												K			
2430-61102	U	J												K			
2430-61103	M	A												D			
2430-61104	M	A												M			
2430-61105	M	A												Q			
2430-61106	M	J												P		M	M
2430-61107	U	J												P			
2430-61108	U	J												P			
2430-61109	F	A												K			
2430-61110	U	J												K			
2430-61111	U	J												P			
2430-61112	U	J												P			
2430-61113	U	J												P			
2430-61114	M	J												P		K	K
2430-61115	U	J												P			
2430-61116	F	A												M	M		
2430-61117	U	J												P			
2430-61118	M	J												P	M	M	K
2430-61119	U	J												P			
2430-61120	F	J												P	P	P	P
2430-61121	U	J												Q			
2430-61122	U	J												P			
2430-61123	F	J												P		P	
2430-61124	F	J												P		K	
2430-61125	M	A												K			
2430-61126	U	J												S			
2430-61127	M	A												P	P		
2430-61128	U	J												M			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61129	U	J												Q			
2430-61130	U	J												Q			
2430-61131	U	J												M			
2430-61132	U	J												M			
2430-61133	U	J												M			
2430-61134	M	A												T		N	N
2430-61135	M	A												T	T	T	
2430-61136	M	A												B	B	B	B
2430-61137	F	A												B	B	B	B
2430-61138	F	A												B			
2430-61139	F	A												T			
2430-61140	U	J												B			
2430-61141	U	J												B			
2430-61142	U	J												B			
2430-61143	U	J												T			
2430-61144	U	J												T			
2430-61145	U	J												T			
2430-61151	U	J														K	
2430-61152	U	J														P	
2430-61153	F	A													M		
2430-61154	F	J													Q	S	S
2430-61155	U	J													Q		
2430-61156	U	J													K		
2430-61157	U	J													K		
2430-61158	M	A													K	K	K
2430-61159	M	J													M		K
2430-61160	U	J													M		
2430-61161	U	J													D		
2430-61162	M	A													S		
2430-61163	F	A														K	
2430-61165	M	J												Q	Q	M	
2430-61167	M	A												M	M	M	M
2430-61168	U	J												M			
2430-61169	U	J												M			
2430-61170	U	J												M			
2430-61171	U	J												M			
2430-61172	F	J												M	M		
2430-61173	U	J												M	M		
2430-61174	F	J												M		Q	
2430-61175	U	J												Q			
2430-61176	M	J												Q		P	P
2430-61177	U	J												Q			
2430-61178	M	A												K			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61179	M	A												K	P	P	P
2430-61180	M	A												K		K	K
2430-61181	F	A												K	K		
2430-61182	M	A												K			
2430-61183	M	A												K			
2430-61184	U	J												Q			
2430-61185	F	J												Q	M		
2430-61186	U	J												Q			
2430-61187	M	J												Q	L	L	
2430-61188	U	J												Q			
2430-61189	M	J												Q		M	
2430-61190	U	J												Q			
2430-61191	M	J												M	D		
2430-61192	U	J												M			
2430-61193	U	J												M			
2430-61194	U	J												Q	Q		
2430-61195	U	J												Q			
2430-61196	U	J												Q			
2430-61197	M	J												P		K	K
2430-61198	U	J												P	Q		
2430-61199	U	J												P			
2430-61200	U	J												P			
2430-61202	U	J												M			
2430-61203	U	J												M			
2430-61204	U	J												M			
2430-61205	U	J												M			
2430-61206	M	J												M		M	
2430-61207	F	J												M	D	D	
2430-61208	U	J												D			
2430-61209	M	A												V	D		
2430-61210	U	A												K			
2430-61211	U	J												S			
2430-61212	U	J												M			
2430-61213	U	J														K	
2430-61214	M	A															K
2430-61215	U	J															P
2430-61216	U	J															Q
2430-61217	U	J															Q
2430-61218	U	J															P
2430-61219	U	J															M
2430-61220	U	J															P
2430-61221	U	J														P	
2430-61223	U	J												D			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61224	U	J												D			
2430-61225	U	J												D			
2430-61226	U	J														P	
2430-61227	U	J														P	
2430-61228	U	J														K	
2430-61229	U	J														K	
2430-61230	F	A														S	S
2430-61231	U	J														S	
2430-61232	U	J														L	
2430-61233	U	J														L	
2430-61234	F	A														Q	Q
2430-61235	U	J														Q	
2430-61236	U	J														K	
2430-61237	U	J															B
2430-61271	U	J													P		
2430-61276	U	J														Q	
2430-61277	U	J													P		
2430-61278	M	J													P		
2430-61279	F	J													P	K	K
2430-61280	U	J														M	
2430-61285	U	J													M		
2540-58101	U	J														K	
2540-58102	U	J														K	
2540-58103	U	J														K	
2540-58104	M	J														K	
2540-58105	U	J														Q	
2540-58106	U	J														Q	
2540-58107	M	J														Q	
2540-58108	U	A															T
2540-58109	M	A															P[19]
2540-58110	F	A															P
2540-58111	F	A															P
2540-58112	U	J															Q
2540-58113	U	J															M
2540-58114	U	J															P
2540-58115	U	J															B
2540-58116	U	J														B	
2540-58117	U	J														B	
2540-58118	U	J														K	
2540-58119	U	J														K	
2540-58120	F	A															B
2540-58132	M	A													S	S	S
2540-58141	U	J													M		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58142	U	J													M		
2540-58143	M	A													D		
2540-58144	U	J													K		
2540-58145	U	J													K		
2540-58146	M	A													B		
2540-58147	U	J														B	
2540-58148	U	J														Q	
2540-58149	U	J														Q	
2540-58150	U	J														Q	
2540-58151	U	J														Q	
2540-58152	F	A															Q
2540-58154	M	J													M	T	D[20]
2540-58155	U	J													M		
2540-58156	F	A														K	K
2540-58157	U	J														K	E
2540-58158	M	J														K	K
2540-58159	F	J														K	K
2540-58160	U	J														S	
2540-58161	U	J														L	
2540-58162	U	J														K	
2540-58163	U	J														K	
2540-58164	U	J														K	
2540-58165	F	J														K	K
2540-58166	U	J														K	
2540-58172	M	A															Q
2540-58173	U	J															M
2540-58174	U	J															M
2540-58175	F	A															K
2540-58176	M	A															Q
2540-58177	F	A															K
2540-58178	U	J															K
2540-58179	U	J															K
2540-58180	U	J															K
2540-58182	U	J															K
2540-58183	U	J															K
2540-58184	F	A															M
2540-58185	U	J													P		
2540-58186	M	A													S		
2540-58187	F	A													P		K
2540-58188	U	J													P		
2540-58189	F	A													P		
2540-58190	U	J														T	
2540-58191	U	J														P	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58192	M	A														Q	Q[21]
2540-58193	F	A														N	N
2540-58194	U	J														D	
2540-58195	U	J														P	
2540-58196	U	J														P	
2540-58197	U	J														P	
2540-58198	U	J														P	
2540-58199	U	J														K	
2540-58200	U	J														K	
2540-58201	U	J														K	P
2540-58202	M	A														K	
2540-58203	F	A														K	K
2540-58204	F	A														K	
2540-58205	U	J														K	
2540-58206	U	J														P	
2540-58207	U	J														P	
2540-58208	U	J														P	
2540-58209	F	A														P	
2540-58211	U	J															K
2540-58212	U	J															K
2540-58213	U	J															M
2540-58214	U	J															K
2540-58216	U	J													M		
2540-58217	M	A													S	S	
2540-58218	U	J													S		
2540-58219	U	J													Q		
2540-58220	M	A														B	B
2540-58221	M	A														B	
2540-58222	U	J														K	
2540-58223	M	A														K	K
2540-58224	F	J														K	K
2540-58225	U	J														K	
2540-58226	F	A														K	
2540-58227	M	A														T	
2540-58228	M	A														T	T
2540-58229	M	A														B	
2540-58230	F	A														B	B
2540-58231	F	A														T	M
2540-58232	U	J														T	
2540-58233	F	A														N	
2540-58235	U	J														N	
2540-58236	U	J														N	
2540-58237	U	J														K	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58238	F	J														K	E[22]
2540-58239	U	J														K	
2540-58240	F	J														K	E
2540-58241	F	A														K	K
2540-58242	U	J														K	
2540-58243	U	J														K	
2540-58244	U	J														K	
2540-58245	M	A															P
2540-58246	M	A															E
2540-58247	U	J															K
2540-58274	U	J															N
2540-58275	U	J															N
2540-58276	U	J															K
2540-58277	U	J															K
2540-58278	U	L															D
2540-58279	U	J															D
2540-58280	U	J															K
2540-58282	U	J															K
2540-58283	U	J															K
2540-58284	U	J															P
2540-58285	U	J															P
2540-58286	U	J															P
2540-58287	M	A															S
2540-58288	U	J														P	
2540-58289	F	A														K	
2540-58290	U	J														K	
2540-58291	U	J														K	
2540-58292	U	J														K	
2540-58293	F	A														P	P
2540-58294	U	J														P	
2540-58295	U	J														P	
2540-58296	U	J														P	
2540-58297	F	A															K
2540-58298	U	J															K
2540-58299	U	J															K
2540-58378	U	J															K
2540-58385	U	J															S
2540-58386	F	A															K
2540-58387	M	A															K
2590-53101	U	J															P
2590-53102	U	J															P
2590-53103	U	J															P
2590-53104	U	J															P

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2590-53105	F	A															D
2590-53106	U	J															M
2590-53107	U	J															M
2590-53108	F	A															D
2590-53109	U	J															P
2590-53110	F	A															K
2590-53111	U	J															K
2590-53112	U	J															K
2590-53113	U	J															K
2590-53114	U	J															K
2590-53115	U	J															M
2590-53116	U	J															M
2590-53117	U	J															M
2590-53118	U	J															K
2590-53119	U	J															M
2590-53121	F	A															K
2590-53122	U	J															K
2590-53123	U	J															K
2590-53124	M	A															K
2590-53125	U	J															K
2590-53126	U	J															D
2590-53127	U	J															K
2590-53141	U	J															M
2590-53142	U	J															M
2590-53143	U	J															N
2590-53144	U	J															K
2590-53145	M	A															S
2590-53147	U	J															D
2590-53148	U	A															K
2590-53149	U	J															K
2590-53150	U	J															M
2590-53151	U	J															M
2590-53152	U	J															Q
2590-53154	U	J															Q
2590-53162	M	A															T
2590-53163	F	A															B
2590-53164	U	J															B
2590-53171	F	A															E
2590-53172	U	J															K
2590-53173	F	A															K
2590-53182	U	J															B

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3500-68963	U	J								T							
3500-68968	U	J								P							
3500-68969	U	J								P							
3500-68972	F	J								P	P	P					

* Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA.

[1] K = Key Pittman, E = River Ranch, P = Pahranagat NWR, W = Meadow Valley Wash, L = Littlefield, Q = Mesquite, M = Mormon Mesa, D = Muddy River, N = Warm Springs, G = Grand Canyon, T = Topock Marsh, B = Bill Williams River NWR, I = Imperial, Y = Yuma, S = St. George, V = Las Vegas Wash, R = Roosevelt Lake, A = Ash Meadows. Study area indicated is the study area where the individual was first detected during the given season. Within-season movements are indicated with individual footnotes.

[2] M = male, F = female, U = unknown.

[3] A = adult, J = juvenile.

[4] Within-season movement from Mormon Mesa to Mesquite.

[5] Within-season movement from Mesquite to Mormon Mesa.

[6] Within-season movement from Mesquite to Mormon Mesa.

[7] Within-season movement from Littlefield to Mesquite.

[8] Within-season movement from Grand Canyon to Mesquite.

[9] Within-season movement from Mormon Mesa to Muddy River.

[10] Within-season movement from Muddy River to Mormon Mesa.

[11] Within-season movement from Pahranagat to Key Pittman.

[12] Within-season movement from Muddy River to Mesquite.

[13] Within-season movement from Littlefield to Mesquite.

[14] Within-season movement from Muddy River to Mesquite.

[15] Within-season movement from Grand Canyon to Mesquite.

[16] Within-season movement from Grand Canyon to Mormon Mesa.

[17] Within-season movement from River Ranch to Key Pittman.

[18] Within-season movement from River Ranch to Key Pittman.

[19] Within-season movement from Pahranagat to River Ranch.

[20] Within-season movement from Muddy River to Mormon Mesa. Likely also within-season movement from Topock to Muddy River in 2010.

[21] Within-season movement from Mesquite to Mormon Mesa.

[22] Within-season movement from River Ranch to Key Pittman.

Appendix F

CONTRIBUTING PERSONNEL

Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Banding Lead
Wendy Langeberg, Ph.D.	Statistician
Glenn A. Dunno, M.A.	GIS Specialist
DeAnne Rietz, M.S.	Hydrologist
Jessica Maggio	Project Administrator/Formatting Specialist
Kimberly Proa	Administrative Assistant/Data Entry
Dorothy A. House, M.A.	Technical Editor
Anne Pellegrini	Project Coordinator
Sarah Nichols	Assistant Project Coordinator
Danielle Ethier	Field Coordinator
Iwona Kuczyńska	Field Coordinator
Katie Barnes	Bander/Nest Monitor
Ashley Daniels	Bander/Nest Monitor
Jill Peiffer	Bander/Nest Monitor
Josh Sayers	Bander/Nest Monitor
Ryan Davis	Surveyor/Nest Monitor
Greg Joder	Surveyor/Nest Monitor
Alex McDonnell	Surveyor/Nest Monitor
Zach Mobley	Surveyor/Nest Monitor
Amber Swicegood	Surveyor/Nest Monitor
Tim Schreckengost	Surveyor
Jesse Vooz	Surveyor

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy

Lower Colorado River Multi-Species Conservation Program

Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2011 Annual Report

Prepared by Mary Anne McLeod and Anne Pellegrini,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2012

RECOMMENDED CITATION:

McLeod, M.A., and A.R. Pellegrini. 2012. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2011. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 167 pp.

CONTENTS

Executive Summary xi

1. INTRODUCTION 1
PROJECT HISTORY 1
RELATED STUDIES 2
SPECIES INTRODUCTION 2
PURPOSE AND DESCRIPTION OF STUDY 4

2. PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS 7
INTRODUCTION 7
Special Concern Species 7
METHODS 9
Site Selection 9
Additional Site Evaluation 12
Broadcast Surveys 12
Site Description 12
RESULTS 13
Reclamation Study Areas 13
Pahranagat National Wildlife Refuge, Nevada 18
Littlefield, Arizona 20
Mesquite, Nevada 20
Mormon Mesa, Nevada 21
Muddy River, Nevada 23
Topock Marsh, Arizona 24
Bill Williams River National Wildlife Refuge, Arizona 29
Palo Verde Ecological Reserve, California 32
Cibola, Arizona and California 33
Imperial, Arizona and California 35
Mittry Lake, California 38
Yuma, Arizona 38
NDOW Study Areas 39
Key Pittman Wildlife Management Area, Nevada 40
River Ranch 41
Warm Springs Natural Area 42
DISCUSSION 43

3. COLOR-BANDING AND RESIGHTING 45
INTRODUCTION 45
METHODS 45
Color-Banding 45
Resighting 46
RESULTS 47
Reclamation Study Areas 47
Site-by-Site Color-Banding and Resighting 47
NDOW Study Areas 58
Site-by-Site Color-Banding and Resighting 58

Non-Monitoring Sites 64
Adult Between-Year Return and Dispersal 64
Juvenile Between-Year Return and Dispersal 65
Within-Year, Between-Study Area Movements 66
DISCUSSION 67
Color-Banding Effort 67
Adult and Juvenile Between-Year Dispersal 67
Within-year, Between Study Area Movement 69
Adult and Juvenile Survivorship 69

4. NEST MONITORING 71
INTRODUCTION 71
METHODS 71
RESULTS 73
Reclamation Study Areas 73
Nest Monitoring 73
Nest Failure 74
Brood Parasitism 74
Cowbird Egg Addling 75
Mayfield Nest Success and Nest Productivity 77
NDOW Study Areas 78
Nest Monitoring 78
Nest Failure 79
Brood Parasitism 79
Cowbird Egg Addling 80
Mayfield Nest Success and Productivity 80
DISCUSSION 81
Reclamation Study Areas 81
Number of Breeding Flycatchers 81
Nest Success 82
Nest Failure 82
Brood Parasitism 83
Cowbird Egg Addling 84
NDOW Study Areas 84

5. VEGETATION AND HABITAT CHARACTERISTICS 87
INTRODUCTION 87
METHODS 87
Data Analyses 88
RESULTS 89
DISCUSSION 92

6. MICROCLIMATE 93
INTRODUCTION 93
METHODS 93
Temperature and Humidity Measurements 93
Soil Moisture Measurements 94
Statistical Analyses 95

RESULTS 95
DISCUSSION 107

7. HABITAT MONITORING: PARKER TO IMPERIAL DAMS 109
INTRODUCTION 109
METHODS 110
Temperature/Humidity Loggers 110
Soil Moisture Measurements 112
Vegetation Measurements 112
Groundwater Measurements 112
Statistical Analyses 112
Microclimate 112
Vegetation 113
RESULTS 113
Temperature/Humidity Logger Maintenance 113
Microclimate 113
2011 Microclimate Descriptive Statistics 113
Between-year Comparisons of Microclimate Characteristics 114
Vegetation Measurements 114
Between-year Comparisons of Vegetation Characteristics 114
DISCUSSION 121
Microclimate 121
Between-year Comparisons of Microclimate Characteristics 121
Vegetation 121
Groundwater Levels 123
Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements 123

8. SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 125
INTRODUCTION 125
METHODS 125
Water Delivery 125
Surface Water Mapping 126
Groundwater Measurements 126
Data Collection 127
Data Validation 127
Microclimate 127
Vegetation 128
Data Analyses 128
Microclimate 128
Vegetation 128
RESULTS 129
Water Delivery 129
Surface Water Mapping 129
Groundwater Monitoring 130
Microclimate 130
Vegetation 153
DISCUSSION 156

9. MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS 159
BROADCAST SURVEYS 159
COWBIRD CONTROL 160
HABITAT MONITORING: PARKER TO IMPERIAL DAMS 160
SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH 160

10. LITERATURE CITED 161

Appendices

A. Field Data Forms
B. Orthophotos Showing Study Sites
C. Southwestern Willow Flycatcher Survey Results, 2011
D. Detections of Special Concern Species, 2011
E. All Willow Flycatchers Color-Banded and/or Resighted, 2003–2011
F. Contributing Personnel

Figures

1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*).. 3
2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2011..... 8
5.1. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2011. 91
5.2. Vertical foliage density at occupied willow flycatcher territories in cottonwood/willow habitat type, 2011..... 92
6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 98
6.2. Distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 99
6.3. Percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011..... 100
6.4. Percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011..... 101
6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 102
6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 103
6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 104
6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 105
6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. 106
7.1. Locations of test and control sites, habitat monitoring study, 2005–2011..... 111
7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 116
7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011..... 116
7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011..... 118
7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120

7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 120
7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011. 122
7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011. 122
8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011. 126
8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011. 131
8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. 132
8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011. 133
8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011. 134
8.6. Topock Marsh hydrograph, 2006–2011. 135
8.7. Topock Marsh hydrograph, February–July, 2011. 135
8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011. 137

8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011 141
8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 141
8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 142
8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011. 142
8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 142
8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011. 142
8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 143
8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 144
8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 144
8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 144
8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 144
8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011. 145
8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011 145
8.18a. Difference between the day before and day after each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011. 148
8.18b. Difference between flood groups in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011. 148
8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 148
8.19a. Difference between the day before and day after each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011. 149

8.19b. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011. 149
8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 149
8.20a. Difference between the day before and day after each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011. 150
8.20b. Difference between flood groups in difference in daily temperature range before and after each flood event, Topock Marsh, 2011. 150
8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011. 150
8.21a. Difference between the day before and day after each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011. 151
8.21b. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011. 151
8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011. 151
8.22a. Difference between the day before and day after each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011. 152
8.22b. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011. 152
8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011. 152
8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010.. 154
8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010.. 154
8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. 155
8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011.. 155

Tables

2.1. Proposed Survey Schedule for Selected Sites 9
2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011 13
2.3. Detections of Willow Flycatchers Recorded after 15 June 2011 at Sites Where Breeding or Residency Was Not Confirmed 15
2.4. Yellow-billed Cuckoo Detections at Reclamation Study Areas, 2011 16
2.5. Yuma Clapper Rail Detections at Reclamation Study Areas, 2011 16
2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas,
2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011 39
3.1. Willow Flycatchers Detected at Reclamation Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season 49
3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 50
3.3. Willow Flycatchers Detected at NDOW Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season 59
3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 60
3.5. Banded Willow Flycatchers, Non-Monitoring Sites, 2011 64
3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011 64
3.7. Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2011 65
3.8. Juvenile Flycatchers Banded as Hatch Year Birds in 2007, 2009, or 2010 and Identified for the First Time in 2011 66
3.9. Adult Willow Flycatcher Within-Year Movements for All Individuals Identified at Two Different Study Areas in 2011 67
4.1. Summary of Willow Flycatcher Nest Monitoring Results at Reclamation Study Areas, 2011 73
4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Reclamation Study Areas from 1996 to 2011 74
4.3. Summary of Causes of Willow Flycatcher Nest Failure at Reclamation Study Areas, 2011 75
4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds, 2011 75
4.5. Brown-headed Cowbird Annual Hatch Rate in Willow Flycatcher Nests at Reclamation Study Areas from 2003 to 2011 76
4.6. Willow Flycatcher Nesting Success for Parasitized Nests at Reclamation Study Areas from 2003 to 2011 76
4.7. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Reclamation Study Areas, 2011 77
4.8. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Reclamation Study Areas, 2011 78
4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011 78
4.10. Summary of Causes of Willow Flycatcher Nest Failure at NDOW Study Areas, 2011 79
4.11. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds in Key Pittman, River Ranch, and Warm Springs Study Areas, 2011 80
4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011 80

4.13. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at NDOW Study Areas, 2011 81
5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2011 90
5.2. Proportion of Stems Omitted from Stem Counts 91
6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory, 2011 96
6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Willow, 2011 97
7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011 115
7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011 115
7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011 117
7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011 119
7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011 119
8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011 129
8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010 138
8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010 138
8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011 139
8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011 139
8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011 146
8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011 147
8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011 153

EXECUTIVE SUMMARY

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*), listed as federally endangered in 1995, breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico. Historical breeding records and museum collections indicate a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the lower Colorado River region. Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Willow flycatcher studies have been conducted along the Virgin and lower Colorado Rivers and tributaries annually since 1996, in compliance with requirements set forth by the U.S. Fish and Wildlife Service (USFWS) regarding U.S. Bureau of Reclamation (Reclamation) routine operations and maintenance along the lower Colorado River. Biological Assessments and the resulting Biological Opinions on operations and maintenance were prepared as steps to developing a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). The LCR MSCP was signed in April 2005, and implementation of the program began in October 2005. The LCR MSCP calls for continued surveys and monitoring of willow flycatchers along the lower Colorado River. SWCA Environmental Consultants (SWCA) was contracted by Reclamation to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the Virgin and lower Colorado River regions in 2011.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet of California apportionment water for 75 years. The point of diversion, previously located below Parker Dam, would change to a point above Parker Dam. These changes in water regulation could cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less and have the potential to modify riparian habitats below Parker Dam. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams. In 2004, Reclamation biologists initiated studies of the microclimate within potentially affected areas. In 2005, these studies were continued and expanded by SWCA to address how the hydrological changes might affect riparian habitats along the Parker to Imperial reach.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. Water delivery commenced 1 March 2011 and continued into July. Baseline conditions of vegetation, microclimate, and hydrology in the target area were documented in 2009 and 2010, and these studies were continued in 2011 to document conditions during the water delivery period.

SWCA was retained by Nevada Department of Wildlife (NDOW) in 2011 to complete flycatcher surveys, site descriptions, nest monitoring and color-banding at Key Pittman Wildlife Management Area, River Ranch, and Warm Springs Natural Area. We also completed surveys for Yellow-billed Cuckoos at these study areas.

Approximately 100 sites are included in the Reclamation study of flycatchers along the Virgin and lower Colorado Rivers, but a portion of the sites are surveyed biennially rather than annually. In 2011, we completed presence/absence surveys, following a 5-survey protocol, and site descriptions at a subset of the 100 sites. At study areas where territorial flycatchers were detected in 2011, we searched for nests in all areas occupied by territorial flycatchers; monitored willow flycatcher nests to document nest fate, brood parasitism, and causes of nest failure; and color-banded and resighted as many willow flycatchers as possible to determine the breeding status of territorial flycatchers and document movement and recruitment. We also measured characteristics of vegetation and microclimate in occupied territories at one study area.

We used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 59 Reclamation sites, ranging in size from <1 to 38 ha, along the Virgin and lower Colorado Rivers and tributaries from Pahranagat National Wildlife Refuge (NWR), Nevada, south to Yuma, Arizona between 15 May and 24 July 2011. We detected willow flycatchers on at least one occasion at 47 of these sites. Breeding or resident flycatchers were detected at 13 sites within the Pahranagat NWR, Mesquite, Mormon Mesa, and Muddy River, Nevada; and Topock Marsh and Bill Williams River NWR, Arizona, study areas. South of Bill Williams, 154 willow flycatcher detections were recorded between 15 May and 20 June; no flycatcher detections were recorded at any of these sites after 20 June. Monitoring results suggest these flycatchers were not resident, breeding individuals and were most likely spring migrants.

We completed broadcast surveys for flycatchers at 3 sites and monitored an additional 17 sites within the three NDOW study areas and detected breeding flycatchers within 15 sites. We also completed surveys for Yellow-billed Cuckoos at these study areas. No cuckoos were detected during surveys or incidentally.

We used targeted mist-net and passive netting techniques to capture and uniquely color-band adult and fledgling willow flycatchers at all sites where resident willow flycatchers were detected. Nestlings were banded between 8 and 10 days of age. We banded each willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and one pin-striped, aluminum band on the other. We used binoculars to determine the identity of previously color-banded flycatchers by observing, from a distance, the unique color combinations on their legs.

At Reclamation study areas, we color-banded 15 new adult flycatchers and recaptured 11 individuals detected in previous years as adults. An additional 31 adults were identified to individual via resighting, while 3 individuals were resighted but did not have their color combinations confirmed. We detected two individuals identified as returning nestlings by the presence of a single federal band, with one (50%) identified to individual via recapture. Two additional returning nestlings with full combinations were recaptured. Thirty adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 30 adults. We banded 40 nestlings from 17 nests. Of the 40 nestlings banded, 5 were known or suspected to have died before fledging. We banded flycatchers opportunistically at St. George, Utah, capturing and color-banding two new adults and one nestling.

At NDOW study areas, we color-banded 13 new adult flycatchers and recaptured 3 individuals detected in previous years as adults. An additional 25 adults were identified to individual via resighting, while 2 individuals were resighted but did not have their color combinations confirmed. We recaptured one individual identified as a returning nestling by the presence of a single federal band. Three additional adults were captured with a full color combination and identified as returning nestlings from 2009 or 2010. Five adult flycatchers remained unbanded, and banding status was undetermined for one adult. We banded 34 nestlings from 13 nests. Of the 34 nestlings banded, 3 were suspected to have died before fledging.

Of the 96 resident, adult willow flycatchers identified to individual at monitored study areas in 2010, 55 (57%) were identified in 2011; 5 (9%) were detected at a different study area from where they were last detected in 2010. We detected seven within-year, between-study area movements in 2011.

Of the 51 juveniles banded and not known or suspected to have died at Reclamation study areas in 2010, 2 (4%) were identified in 2011. An additional 36 juveniles were banded at NDOW study areas and not known or suspected to have died in 2010; nine (25%) were identified in 2011. Sixteen individuals originally banded as nestlings in previous years were identified for the first time in 2011. Of the 16 returning nestlings identified in 2011, 12 (75%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2011 was 12.8 km.

We recorded 50 territories at all Reclamation study areas. Of these, 36 (72%) consisted of paired flycatchers and 14 (28%) consisted of unpaired individuals. Eight breeding males were polygynous, two pairing with three females and six pairing with two females. One female mated consecutively with two different males. One male moved and established a second territory within the same study area. We recorded 24 territories at NDOW study areas. Of these, 21 (88%) consisted of breeding individuals, 1 (4%) consisted of paired individuals with no documented breeding activity, and 2 (8%) consisted of unpaired males. Three males were polygynous; each mated with two females.

At Reclamation study areas, we documented 49 willow flycatcher nesting attempts, 43 of which contained eggs and were used in calculating nest success and productivity. Eighteen (42%) nests were successful and fledged young; and 25 (58%) failed. Mayfield survival probability ranged from 0.198 to 1.000, and was 0.467 for all sites combined (except Topock Marsh where Mayfield nest success could not be calculated due to a lack of data). Depredation was the major cause of nest failure, accounting for 52% of all failed nests and 65% of nests that failed after flycatcher eggs were laid.

We documented 38 flycatcher nesting attempts at NDOW study areas; 36 of these were known to contain flycatcher eggs and were used in calculating nest success and productivity. Of nests known to contain flycatcher eggs, fourteen (39%) were successful and fledged young, and 22 (61%) failed. Depredation accounted for the majority (59%) of all nest failures. Mayfield survival probability was 0.447 at Key Pittman and could not be calculated at River Ranch or Warm Springs due to lack of data.

At Reclamation study areas, 7 of 37 nests (19%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds. Brood parasitism at Reclamation study areas ranged from 0 to 60% and was highest at Muddy River. At NDOW study areas, 4 of 34 nests (12%) with flycatcher eggs and known contents were brood parasitized. Brood parasitism was 11% at Key Pittman, 75% at River Ranch, and 0% at Warm Springs. We addled cowbird eggs via vigorous shaking at all easily accessible flycatcher nests. Egg addling appeared to reduce the hatch rate of cowbird eggs, though small sample size precluded rigorous comparisons. Nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized. This is not necessarily due to the success or failure of the addling program as parasitized nests often failed for other reasons (e.g., depredation or failure of flycatcher eggs to hatch).

At Bill Williams River NWR, we gathered data on microclimate characteristics at one location each for two of the territorial male flycatchers we identified; both males obtained mates and had nesting attempts. We also gathered data on vegetation characteristics at these two territories, plus an additional two territories; one of the additional territories was occupied by a nesting pair and the other by an unpaired male. We delineated the following habitat types: 1) Goodding willow with tamarisk understory, and 2) cottonwood/willow. Both of these vegetation types fall within the definition of cottonwood-willow habitat (cottonwoods and willows constituting at least 10% of total trees) as used in the LCR MSCP. We present results for each of our delineated habitat types as well as for the cottonwood-willow vegetation types used in the LCR MSCP. Sample sizes in 2011 are too small to provide an accurate

representation of the range and variance in vegetation and microclimate characteristics in each habitat type.

Both vegetation types (Goodding willow with tamarisk understory and cottonwood/willow) exhibited moist or inundated soil conditions at some point in the breeding season. Daily maximum temperatures spanned a range of ~5°C among habitat types, while daily minimum temperatures spanned <3°C. Vapor pressure increased through the end of July for both habitat types and was higher in Gooding willow with tamarisk understory than in cottonwood/willow.

In 2005, we selected 11 sites between Parker and Imperial Dams for inclusion in the habitat monitoring study addressing how changes in water transfer actions might affect riparian habitat. We also selected two control sites above Parker Dam and two below Imperial Dam. At each site we installed 3–5 temperature/humidity data loggers. Soil moisture measurements were collected at each data logger location in 2011 during each flycatcher survey at the site and when logger data were downloaded. Vegetation measurements were also collected at each data logger location after surveys were completed.

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 and cooler conditions in 2009 than in the other years. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional, rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station. Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

We noted between-year differences at the habitat monitoring sites for several vegetation variables, but none of the variables exhibited a unidirectional change across time. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years. Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred.

Supplemental water delivery to support habitat enhancement commenced at Topock Marsh in 2011, periodically flooding portions of In Between and 800M. The flooded area at those two sites was the only area surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season. Water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy. Water delivery had the expected effect of raising soil moisture, decreasing distance to water, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also increased humidity within the flooded area. Flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area, but these effects did not seem to persist across two-week periods. Areas occupied by flycatchers typically have higher soil moisture, higher humidity, and more moderate temperatures than unoccupied areas; thus, water delivery appeared to change the conditions within the flooded area in ways that would favor flycatcher occupancy. Water delivery was the most effective at creating conditions favored by flycatchers when the underlying water table was high. Despite the presence of favorable conditions, flycatcher occupancy in the target area did not increase in 2011, possibly because dry conditions elsewhere in Topock Marsh and a low flycatcher population may have limited the ability of flycatchers to colonize the area.

Chapter 1

INTRODUCTION

PROJECT HISTORY

In 1995, the U.S. Bureau of Reclamation (Reclamation), other federal, state, and tribal agencies, and environmental and recreational interests agreed to form a partnership to develop and implement a Multi-Species Conservation Program (MSCP) for long-term endangered species compliance and management in the historical floodplain of the lower Colorado River (LCR). As a step to developing the LCR MSCP, Reclamation prepared a Biological Assessment (BA) in August 1996, evaluating the effects of dam operations and maintenance activities on threatened, endangered, and sensitive (TES) species. These species included the Southwestern Willow Flycatcher (*Empidonax traillii extimus*), which was listed by the U.S. Fish and Wildlife Service (USFWS) as endangered in 1995 (60 FR 10694–10715). In response to the BA, the USFWS issued a Biological Opinion (BO) in April 1997 outlining several terms and conditions Reclamation must implement in order not to jeopardize the species. Among these terms and conditions was the requirement to survey and monitor occupied and potential habitat for Southwestern Willow Flycatchers along the LCR for a period of five years. The studies were intended to determine the number of willow flycatcher territories, status of breeding pairs, flycatcher nest success, the biotic and abiotic characteristics of occupied willow flycatcher sites, and Brown-headed Cowbird (*Molothrus ater*) brood parasitism rates. In 2002, Reclamation reinitiated consultation with USFWS on the effects of continued dam operations and maintenance on TES species along the LCR. The USFWS responded with a BO in April 2002 requiring continued Southwestern Willow Flycatcher studies along the LCR through April 2005. The BO also required implementation of a study to evaluate the effectiveness of Brown-headed Cowbird trapping for conservation of the flycatcher.

Reclamation and USFWS completed a separate consultation on the potential effects to threatened and endangered species from implementation of surplus guidelines through 2016 and an annual change in the point of diversion for up to 400,000 acre-feet for 75 years. A Biological Opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures was issued in January 2001 and required monitoring of 150.5 ha of existing, occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams.

The LCR MSCP is a 50-year program that seeks to protect 26 TES species and their habitats along the LCR while maintaining river regulation and water management required by law. The LCR MSCP was approved in April 2005 with the signing of a Record of Decision by the Secretary of the Department of the Interior, and implementation of the program began in October 2005. Documentation for the LCR MSCP includes a Habitat Conservation Plan (HCP), BA/BO, and an Environmental Impact Statement. The HCP specifies monitoring and research measures that call for surveys and research to better define habitat requirements for the Southwestern Willow Flycatcher and studies to determine the effects of cowbird nest parasitism on flycatcher reproduction.

Reclamation initiated willow flycatcher studies along the LCR in 1996, in anticipation of the requirements outlined in the BOs that were part of LCR MSCP development. These studies have been conducted annually since 1996. From 1997 to 2010,[1] breeding populations of Southwestern Willow Flycatchers were documented at eight study areas along the Virgin and lower Colorado Rivers and tributaries: (1) Pahranagat National Wildlife Refuge (NWR), Nevada; (2) Beaver Dam Wash at Littlefield, Arizona; (3) Mesquite and (4) Mormon Mesa on the Virgin River, Nevada; (5) Overton

[1] Studies in 1996 did not include any sites in Nevada.

Wildlife Management Area (WMA) along the Muddy River, Nevada; (6) Grand Canyon, Arizona; (7) Topock Marsh on the Colorado River, Havasu NWR, Arizona; and (8) Bill Williams River NWR (Bill Williams), Arizona (McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; Braden and McKernan unpubl. data). From 1997 to 2010, willow flycatchers, including one banded migrant Southwestern Willow Flycatcher (Koronkiewicz et al. 2006a), were detected during the breeding season at several sites along the Colorado River south of the Bill Williams River to the Mexico border, but no nesting activity was confirmed.

In compliance with the consultation on Interim Surplus Criteria and Secretarial Implementation Agreements, Reclamation biologists deployed temperature/humidity data loggers in 2004 at a subset of sites currently monitored for Southwestern Willow Flycatcher along the Colorado River in California and Arizona. These studies were expanded in 2005 to include annual monitoring of groundwater levels, vegetation, and soil moisture in addition to temperature and humidity.

Following the breeding season of 2008, USFWS and Reclamation initiated discussions regarding the declining number of willow flycatcher territories at Topock Marsh in 2004–2008, the importance of the flycatcher population in the Topock area to flycatcher conservation along the LCR, and possible measures to enhance flycatcher habitat at Topock. A plan was developed to pump water into a portion of the flycatcher breeding habitat at Topock beginning in February or March and continuing into the flycatcher breeding season. The selected area at Topock had seen the greatest decline in numbers of resident flycatchers but had not experienced any dramatic changes in vegetation. Water delivery was anticipated to commence in 2010, and monitoring of vegetation, microclimate, and hydrologic condition in the target area was initiated in 2009 to obtain baseline conditions in the target area. Water delivery was delayed until 2011, so additional monitoring of baseline conditions occurred in 2010.

RELATED STUDIES

Prior to 2010, Nevada Department of Wildlife (NDOW) completed nest monitoring at Key Pittman WMA, and SWCA Environmental Consultants (SWCA) banded flycatcher nestlings and adults opportunistically in cooperation with the monitoring efforts. In 2010, NDOW retained SWCA to conduct surveys, site descriptions, nest monitoring, and banding at flycatcher breeding areas at Key Pittman WMA and Warm Springs Natural Area. This work was expanded in 2011 to include River Ranch in the Pahranagat Valley. SWCA also completed surveys for Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) at Key Pittman and River Ranch. Results of surveys, site descriptions, nest monitoring, and banding efforts at Key Pittman, River Ranch, and Warm Springs are presented in Chapters 2, 3, and 4.

Utah Division of Wildlife Resources monitored breeding flycatchers in St. George, Utah. SWCA banded adults and nestlings opportunistically in St. George in cooperation with the monitoring efforts. Banding results from St. George are presented in a separate table in Chapter 3.

SPECIES INTRODUCTION

The Southwestern Willow Flycatcher is one of four subspecies of willow flycatcher currently recognized (Unitt 1987), although Browning (1993) posits a fifth subspecies (*E. t. campestris*) occurring in the central portions of the United States (Figure 1.1). The Southwestern Willow Flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987).

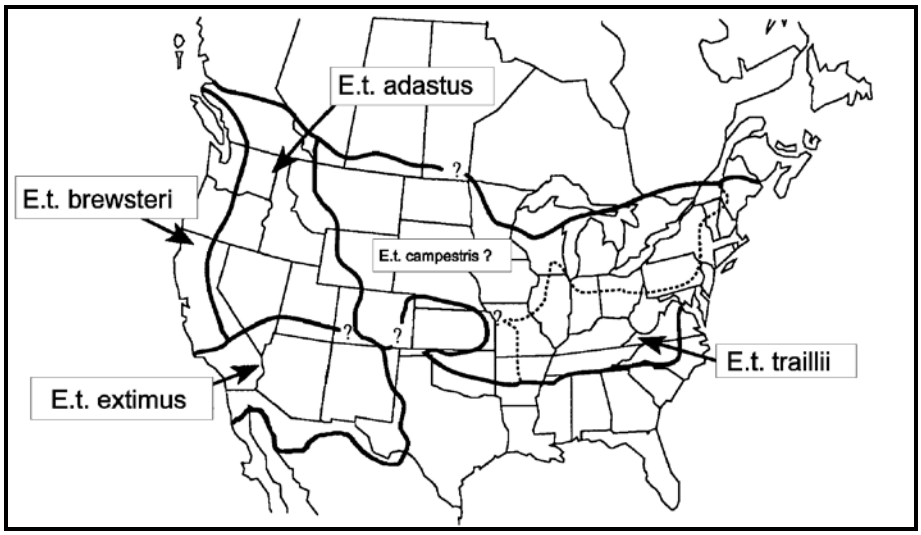


Figure 1.1. Breeding range distribution of the subspecies of the willow flycatcher (*Empidonax traillii*). Adapted from Unitt (1987), Browning (1993), and Sogge et al. (1997).

In the Southwest, most willow flycatcher breeding territories are found within small breeding sites containing five or fewer territories (Durst et al. 2006). One of the last long-distance Neotropical migrants to arrive in North America in spring, Southwestern Willow Flycatchers have a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in August (Sogge et al. 1997). All four subspecies of willow flycatchers spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995, Unitt 1997), with wintering ground habitat similar to the breeding grounds (Lynn et al. 2003). Willow flycatchers have been recorded on the wintering grounds from central Mexico to southern Central America as early as mid-August (Stiles and Skutch 1989, Howell and Webb 1995), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz et al. 2006b).

Historical breeding records and museum collections indicate that a sizable population of Southwestern Willow Flycatchers may have existed along the extreme southern stretches of the LCR region (Unitt 1987). However, no nests have been located south of the Bill Williams River, Arizona, in over 65 years (Unitt 1987), though northbound and southbound migrant willow flycatchers use the riparian corridor (Phillips et al. 1964; Brown et al. 1987; McKernan and Braden 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; this document). Factors contributing to the decline of flycatchers on the breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by nonnative plants; and brood parasitism by Brown-headed Cowbirds (USFWS 1995, Marshall and Stoleson 2000). Because of low population numbers range-wide, identifying and conserving willow flycatcher breeding sites is thought to be crucial to the recovery of the species (USFWS 2002).

Tamarisk beetles (*Diorhabda* spp.) may pose an additional threat to Southwestern Willow Flycatchers. Tamarisk beetles defoliate tamarisk (*Tamarix* spp.) plants during flycatcher breeding season, likely exposing flycatcher nests to adverse microclimate conditions and increased risk of depredation and parasitism. Tamarisk beetles were released in St. George, Utah, in 2006, and widespread defoliation was first observed in St. George in 2008. The area of defoliation on the Virgin River has expanded downstream annually since then, encompassing Littlefield, Arizona, in 2009; the Highway 170 bridge

downstream of Bunkerville, Nevada, in 2010; and the entire stretch of the Virgin River to Lake Mead by the end of the breeding season in 2011.

PURPOSE AND DESCRIPTION OF STUDY

The purpose of the 2011 study is to continue surveys, monitoring, and demographic and ecological studies of the Southwestern Willow Flycatcher in suitable and/or historical riparian and wetland habitats throughout the lower Colorado and Virgin River region. Lower Grand Canyon was not visited in 2009–2011 because the declining level of Lake Mead dramatically reduced the amount of potential flycatcher habitat, and the formation of rapids at Pearce Ferry and Iceberg Canyon made access difficult and dangerous. This project encompasses four types of studies: (1) presence/absence surveys, including site descriptions, at preselected sites along the lower Colorado River and portions of major tributaries; (2) intensive studies at all study areas where breeding flycatchers are located to assess Southwestern Willow Flycatcher demographics and ecology, habitat selection, and the effects of Brown-headed Cowbird brood parasitism; (3) monitoring of microclimate, vegetation, and groundwater conditions of currently occupied[2] Southwestern Willow Flycatcher habitat between Parker and Imperial Dams; and (4) monitoring microclimate, vegetation, and surface hydrology in a selected portion of flycatcher habitat within Topock Marsh to document the effects of habitat enhancement efforts. SWCA's contract specifies the following field tasks:

Presence/absence Surveys. At approximately 100 sites along the LCR, conduct presence/absence surveys, following a 5-survey protocol (per USFWS 2000).

Site Descriptions. Provide a general site description for each site, including major types of vegetation and hydrological conditions, at least three times during the survey period.

Nest Monitoring. Search for nests in all areas occupied by territorial flycatchers, and monitor all nests to determine nest fate, brood parasitism, and causes of nest failure.

Banding. Band as many adult and juvenile flycatchers as possible at sites with territorial flycatchers.

Vegetation, Soils, and Microclimate. Collect vegetation, soil, and microclimate data at the within-territory level at breeding locations in order to quantify conditions at flycatcher territories for replication at restoration areas.

Habitat Monitoring. At 15 previously identified sites, monitor vegetation, microclimate, and groundwater conditions to determine how these may be affected by water transfer actions at Parker Dam.

Surface Hydrology, Vegetation, and Microclimate Monitoring. Within a selected portion of Topock Marsh, monitor surface hydrology, microclimate, and vegetation conditions.

Each distinct aspect of the 2011 study is addressed in a separate chapter in this report, as follows:

Chapter 2 – Presence/absence Surveys and Site Descriptions. This chapter presents the methodology and results for presence/absence surveys and gives a general site description for each survey site.

[2] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year, 1996–2011.

Chapter 3 – Color-banding and Resighting. Details of banding activities and resighting of previously banded flycatchers are presented in this chapter. Also included are discussions of within- and between-year movement of individual flycatchers.

Chapter 4 – Nest Monitoring. This chapter summarizes nesting attempts, nest fates, and productivity for all Southwestern Willow Flycatcher nesting activity.

Chapter 5 – Vegetation and Habitat Characteristics. Vegetation sampling methods are described, and vegetation characteristics are summarized for territories in different habitat types.

Chapter 6 – Microclimate. The methodology of monitoring temperature, humidity, and soil moisture is described, and microclimate characteristics are summarized for flycatcher territories in different habitat types.

Chapter 7 – Habitat Monitoring: Parker to Imperial Dams. The methodology and results of monitoring microclimate, vegetation, and groundwater conditions at occupied sites between Parker and Imperial Dams are presented.

Chapter 8 – Surface Hydrology, Microclimate, and Vegetation Monitoring: Topock Marsh. This chapter describes sampling methods and compares baseline conditions documented in 2009 and 2010 to those documented in 2011 in an area targeted for habitat enhancement.

Chapter 9 – Management and Study Design Recommendations. Recommendations from all previous report chapters are summarized for ease of reference.

This page intentionally left blank.

Chapter 2

PRESENCE/ABSENCE SURVEYS AND SITE DESCRIPTIONS

INTRODUCTION

Broadcasts of recorded conspecific vocalizations are useful in eliciting responses from nearby willow flycatchers, and multiple broadcast surveys conducted throughout the breeding season are the standard technique for determining the presence or absence of *E. t. extimus* (Sogge et al. 2010). According to Sogge et al. (2010) and USFWS (2002), willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* probably belong to the southwestern subspecies. However, because northbound individuals of all western subspecies of the willow flycatcher migrate through areas where *E. t. extimus* are actively nesting, and southbound migrants occur where *E. t. extimus* are still breeding (Sogge et al. 2010, USFWS 2002), field confirmation of the southwestern subspecies is problematic.[1] For example, the northwestern *E. t. brewsteri*, far more numerous than *E. t. extimus*, has been documented migrating north in southern California as late as 20 June (Garrett and Dunn 1981 as cited in Unitt 1987), and Phillips et al. (1964 as cited in Unitt 1987) documented *E. t. brewsteri* collected in southern Arizona on 23 June. An understanding of willow flycatcher migration ecology in combination with multiple broadcast surveys conducted throughout the breeding season is therefore needed to assess the presence and residency of Southwestern Willow Flycatchers.

Migration routes used by *E. t. extimus* are not well documented, though more is known of northbound migration in spring than the southbound migration in fall because flycatchers are more vocal in spring and can therefore be distinguished from other *Empidonax* species. During northbound migration, all subspecies of willow flycatchers use riparian habitats similar to breeding habitat along major river drainages in the Southwest such as the Rio Grande (Finch and Kelly 1999), Colorado River (McKernan and Braden 1999), San Juan River (Johnson and Sogge 1997), and the Green River (M. Johnson unpubl. data). Although migrating willow flycatchers may favor young, native willow habitats (Yong and Finch 1997), migrants are also found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, even though not used for breeding, are likely important for both reproduction and survival. For most long-distance Neotropical migrant passerines, migration stopover habitats are needed to replenish energy reserves to continue northbound or southbound migration.

In 2011, as part of our contract with Reclamation, we completed multiple broadcast surveys at sites in 11 study areas[2] (hereafter Reclamation study areas) along the LCR and its tributaries to detect both migrant and resident willow flycatchers (Figure 2.1). We also completed surveys in three additional study areas (Key Pittman, River Ranch, and Warm Springs; hereafter NDOW study areas) as part of our contract with NDOW.

Special Concern Species

The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is listed as federally endangered by the USFWS, and the Yellow-billed Cuckoo is a candidate for federal listing. Both species occur along the LCR and its tributaries and are of concern to managing agencies. Nine additional avian species [California Black Rail (*Laterallus jamaicensis coturniculus*), Least Bittern (*Ixobrychus exilis*), Elf Owl (*Micrathene whitneyi*),

[1] Throughout this document, the terms "flycatcher" and "willow flycatcher" refer to *E. t. extimus* when individuals are confirmed as residents. For individuals for which residency is undetermined, subspecies is unknown.

[2] Study areas consist of 1–18 survey sites that are grouped geographically (see Table 2.2).



Figure 2.1. Locations of Southwestern Willow Flycatcher study areas along the lower Colorado River and tributaries, 2011. (Note, study area labels represent the approximate center of multiple sites within that region; see Table 2.2)

Gila Woodpecker (*Melanerpes uropygialis*), Gilded Flicker (*Colaptes auratus chrysoides*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Arizona Bell's Vireo (*Vireo bellii arizonae*), Sonoran Yellow Warbler (*Setophaga petechia sonorana*), and Summer Tanager (*Piranga rubra*)] are considered to be special-concern species under the LCR MSCP. The Yellow-breasted Chat (*Icteria virens*) is also considered a special concern species in California. We did not survey specifically for these species at the 11 Reclamation study areas but recorded all incidental detections. We recorded all incidental detections of special concern species at all three NDOW study areas and completed surveys for Yellow-billed Cuckoos at Key Pittman and River Ranch.

METHODS

Site Selection

Survey sites were selected based on locations surveyed during previous years of willow flycatcher studies on the LCR (McKernan 1997; McKernan and Braden 1998, 1999, 2001a, 2001b, 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011) and reconnaissance on foot prior to the start of the 2011 survey period. Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (>50%) and standing water or saturated soil under or adjacent to the vegetation were considered the most suitable habitats for flycatchers. Early successional stands of young riparian vegetation >3 m in height in proximity to surface water or saturated soil were also considered potentially suitable flycatcher habitat. Riparian vegetation contiguous with suitable habitat was often included as part of survey areas. Reclamation biologist Chris Dodge guided and approved site selection at the 11 Reclamation study areas. For sites surveyed in previous years, we retained original site names.

In 2008 we implemented a biennial survey schedule at selected sites in study areas where resident flycatchers had not been documented in the previous 10 years of surveys. Sites were selected for biennial surveys based on the absence of damp or wet soils within the site and/or the relative absence of dense vegetation that might provide suitable nesting habitat for flycatchers. After the 2008 survey season, we revised the survey schedule based on conditions observed in the field and added several sites at Bill Williams to the biennial schedule. These sites were ones at which no resident flycatchers had been detected since 2003. The proposed schedule at the beginning of the 2011 survey season is given in Table 2.1 and may be further revised based on conditions observed during 2011.

Table 2.1. Proposed Survey Schedule for Selected Sites

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
TOGO[2]	Pulpit Rock	Tiny. Wet soil adjacent to river; upland edge dry.			X
	Picture Rock	Wet soil adjacent to river; interior dry.			X
	Blankenship Bend North	Stand of willow adjacent to marsh.	X		
	Blankenship Bend South	Mosaic of cattail, bulrush, willow. Areas with water under vegetation.	X		
	Havasu NE	Mature vegetation; interior of site is completely dry, no water beneath the vegetation.		X	

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
BIWI	Site #1	Mixed-native vegetation; dry soils and stands of dense arrowweed in the center of the site; coyote willow and surface water along the site edge, bordering an arm of Lake Havasu.		X	
	Site #2	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Site #11	Mature mixed-native vegetation; dry soils and extensive deadfall within the site; bordered by an arm of Lake Havasu.		X	
	Black Rail	Mixed-native vegetation; generally sparse understory; narrow strip of dense vegetation.		X	
	Mineral Wash	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Beaver Pond	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within river channels.		X	
	Site #8	Mixed-native vegetation; sparse canopy closure; dry soil underneath the vegetation; water only within the river channel.		X	
PVER	PVER Phase 2	Restoration area.	X		
	PVER Phase 3	Restoration area.	X		
EHRE	Ehrenberg	Emergent cottonwood and Goodding willow; understory primarily arrowweed and *Baccharis* sp.; formerly contained a dense stand of coyote willow but these willows have all died.		X	
CIBO	CVCA Phase 1	Restoration area.	X		
	CVCA Phase 2	Restoration area.	X		
	CVCA Phase 3	Restoration area.	X		
	Cibola Nature Trail	Generally dry and sparse. Restoration area; habitat improvements taking place, may improve.	X		
	Cibola Island	Narrow, linear site; patches of dense Goodding willow adjacent to marsh.	X		
	Cibola Site 2	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Cibola Site 1	No dense canopy. Mostly tamarisk with some emergent willow. Cattail marshes in parts of the site, but dry soil under the tamarisk.			X
	Three Fingers Lake	Vegetation short, very dry and hot in interior.		X	
	Cibola Lake #1 (North)	Patchy vegetation, hot and dry in interior.		X	
	Cibola Lake #2 (East)	Patchy vegetation, hot and dry in interior.			X
	Cibola Lake #3 (West)	Patchy vegetation, hot and dry in interior.		X	
	Walker Lake	Tamarisk with emergent willows; water under vegetation along lake edge.	X		
IMPE	Paradise	Some big willows with tamarisk understory, sometimes has water in marshes.	X		
	Hoge Ranch	Mosaic of tamarisk, willow, and marshes. Sometimes wet.	X		
	Adobe Lake	Perched above river, very dry; dense tamarisk with many dead branches in understory.		X	
	Rattlesnake	Dense willows, wet soils.	X		

Table 2.1. Proposed Survey Schedule for Selected Sites (Continued)

Study Area[1]	Site	Habitat Comments	Proposed Survey Schedule		
			Annual	2008, 2010, 2012	2009, 2011
IMPE	Milemarker 65	Very narrow strip (<50m) of tamarisk adjacent to bulrush marsh. Understory of *Phragmites* creates extremely dense vegetation within 3 m of ground.			X
	Clear Lake/The Alley	Mature tamarisk, very dense understory. Very dry except immediately next to backwater channel.		X	
	Nursery NW	Dense tamarisk interspersed with marsh areas.	X		
	Imperial Nursery	Plantation. No understory.		X	
	Ferguson Lake	Mix of willow and tamarisk with water under vegetation on west side of site. East side dry and scrubby.	X		
	Ferguson Wash	Mature tamarisk with emergent willow. Very dry in interior of site. Borders backwater channel and Ferguson Lake. Moist soils only along channel edge.		X	
	Great Blue Heron	Goodding willow overstory, tamarisk understory; moist soils in parts of the site.	X		
	Powerline	Very small. Stringer of trees around cattail marsh that sometimes contains water. Sparse canopy.			X
	Martinez Lake	Scattered willows, tamarisk and arrowweed understory, sparse canopy closure.			X
MITT	Mittry West	Willow overstory, tamarisk understory, 80% canopy closure; sometimes wet.	X		
	Mittry South	Monotypic tamarisk, lots of deadfall. Interior dry. Adjacent to lake.		X	
YUMA	Gila Confluence North	Patchy. A few small stands of mature willows around cattail marshes. Marshes sometimes contain water. Half of site burned in 2006. Overall canopy closure 50%.		X	
	Gila River Site #2	Cottonwood/willow overstory, tamarisk and arrowweed understory; dry soils in interior; canopy closure 50%.			X
	Fortuna Site #1	Narrow (30m) strip of cottonwood/willow. Patchy understory of tamarisk and arrowweed on periphery, no understory within cottonwood/willow. Interior dry.			X
	Fortuna North	Mature tamarisk, 80% canopy closure. Interior very dry. Adjacent to Gila River.			X

[1] TOGO = Topock Gorge, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, EHRE = Ehrenberg, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] No surveys were completed in Topock Gorge in 2011 because effort was redirected to hydrology monitoring at Topock Marsh (see Chapter 8).

We provided field personnel with high-resolution aerial photographs of all selected survey sites. The photographs were overlain with a UTM grid (NAD 83) and an outline of the proposed survey area. The boundaries of all survey sites were refined to include potential flycatcher habitat actually present. New boundaries were delineated on the aerial photographs based on UTM coordinates obtained in the field. All UTM coordinates were obtained using a Garmin Rino 110 GPS unit and were in NAD 83 to comply with Federal Geographic Data Committee standards.

Additional Site Evaluation

During the survey season, we conducted on-the-ground habitat reconnaissance and evaluation to locate additional potentially suitable willow flycatcher habitat and to reevaluate areas we had visited in previous years and had noted as having the potential to become suitable habitat. Field personnel were provided high-resolution aerial photographs overlain with a UTM grid to aide with navigation and the identification of potentially suitable flycatcher habitat. We focused habitat reconnaissance and evaluation in areas that contained or were adjacent to standing water or saturated soils, and that had vegetation characteristics similar to that of flycatcher breeding sites (i.e., dense vegetation within 2–4 m of the ground and high canopy closure). Broadcast surveys were conducted opportunistically during ground reconnaissance. Field personnel formulated qualitative site descriptions of all evaluated areas.

Broadcast Surveys

To elicit responses from nearby willow flycatchers, we broadcast conspecific vocalizations previously recorded throughout the Southwest from 1996 to 1998. All flycatcher surveys were conducted according to methods described in Sogge et al. (2010), and we followed a 5-survey protocol, as recommended by the U.S. Fish and Wildlife Service (USFWS 2000). We completed at least one survey between 15 and 31 May, at least one survey between 1 and 15 June, and three additional surveys between 16 June and 25 July. Surveys were separated by a minimum of five days whenever logistically possible. Field personnel surveyed within the habitat wherever possible, using a Sansa® ClipMP3 player coupled to a Radio Shack 277-1008C mini amplified speaker. Surveyors stopped every 30–40 m and broadcast willow flycatcher primary song (*fitz-bew*) and calls (*breets*). Field personnel watched for flycatchers and listened for vocal responses for approximately one to two minutes before proceeding to the next survey station. Wherever territorial flycatchers were detected, we discontinued broadcast surveys within a radius of 50 m of territories and commenced territory and nest monitoring, which involves more frequent visits (see Chapter 4). If an unidentified *Empidonax* flycatcher was observed but did not respond with song to the initial broadcast, we broadcast other conspecific vocalizations including *creets/breets*, *wee-oos*, *whitts*, *churr/kitters*, and a set of interaction calls given by a mated pair of flycatchers (per Lynn et al. 2003). These calls are frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify willow flycatchers. To produce a spatial representation of all survey areas, field personnel recorded survey start and stop UTM coordinates as well as the UTM coordinates of intermediate survey points. Observers recorded start and stop times and the location(s) and behavior of all willow flycatchers detected (see survey form, Appendix A). Field personnel also recorded the presence of Brown-headed Cowbirds (hereafter cowbirds) and livestock, as requested by the Arizona Game and Fish Department. Cowbirds may affect flycatcher populations by decreasing flycatcher productivity (see Chapter 4), while livestock may substantially alter the vegetation in an area (USFWS 2002).

Site Description

Because vegetation structure and hydrology within riparian habitats are seasonally dynamic, field personnel completed site description forms (Appendix A) for each survey site at least three times throughout the survey season: early season (mid-May), mid-season (mid-June), and late season (mid-July). Vegetation composition (native vs. exotic) at survey sites followed the definitions of Sogge et al. (2010) and the Southwestern Willow Flycatcher Range-wide Database. Vegetation composition was defined as (1) native: >90% of the vegetation at a site was native; (2) exotic: >90% of the vegetation at a site was exotic/introduced; (3) mixed-native: 50 to 90% of the vegetation at a site was native; or (4) mixed-exotic: 50 to 90% of the vegetation at a site was exotic/introduced. Information from site

description forms was used in conjunction with habitat photographs and comments in field notebooks and on survey forms to formulate qualitative site descriptions.

RESULTS

Reclamation Study Areas

Field personnel spent 469.6 observer-hours conducting willow flycatcher broadcast surveys at 59 sites along the Virgin and lower Colorado Rivers and tributaries.[3] Willow flycatcher survey and monitoring results are summarized in Table 2.2 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2011 are shown on orthophotos in Appendix B, along with historically occupied habitat.[4] We did not complete surveys at sites in Topock Gorge because effort was redirected toward hydrology monitoring within Topock (see Chapter 8). Each site that was not occupied by territorial flycatchers was formally surveyed three to six times. A summary of willow flycatcher survey effort and survey site occupancy status is presented in Appendix C. Field personnel spent an additional 24.3 observer-hours completing habitat reconnaissance and evaluation and opportunistic surveys. The results of reconnaissance for each study area are presented below following the results for the regularly surveyed sites. Because subspecies identification of willow flycatchers detected between approximately 15 June and 20 July in the breeding range of *E. t. extimus* is problematic (Sogge et al. 2010, USFWS 2002), flycatcher detections after 15 June at sites where breeding or residency was not confirmed are summarized in Table 2.3. Yellow-billed Cuckoo and Yuma Clapper Rail detections are listed in Tables 2.4 and 2.5, respectively, and overall numbers of detections of all special concern species are listed in Appendix D. Hydrologic characteristics of each site are summarized in Table 2.6.

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011*

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
PAHR	North	4.6	14 (15 May–16 Aug), 2 (18 May), 1 (17–19 Jun), 2 (12 Jul), 1 (13 Jul), 1 (4 Aug)
	West	1.5	1 (21 Jul)[6]
MESQ	Hafen Lane	6.1	2 (30 Jun–23 Jul), 1 (21–23 Jul)
	West	10.4	11 (17 May–17 Aug)
	Bunker Marsh North	7.1	ND[7]
MOME	Mormon Mesa South	11.8	ND
	Virgin River #1	22.5	23 (14 May–17 Aug), 1 (26 Jun), 1 (10–14 Jul), 1 (24 Jul)
	Virgin River #2	11.2	ND
MUDD	Overton WMA Pond	0.7	1 (2–5 Jul)
	Overton WMA	14.9	13 (14 May–7 Aug), 1 (6 Jul), 1 (2–3 Aug)

[3] We started the survey season with 57 sites scheduled for surveys in 2011. Two sites were added after reconnaissance revealed potential flycatcher habitat. We discontinued surveys at one site because of poor habitat quality.

[4] As per Reclamation (1999), we defined occupied Southwestern Willow Flycatcher habitat as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June.

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4]
TOPO	Pipes #1	5.2	1 (23 Jun–1 Jul)
	Pipes #3	5.7	2 (23–27 Jun), 1 (6–8 Jul)[8]
	The Wallows	0.7	1 (1–5 Jun), 1 (9–13 Jun), 1 (25 Jun–9 Jul)[9]
	PC6-1	4.8	1 (1 Jun)
	Pig Hole	2.4	ND
	In Between	7.7	1 (21 May)
	800M	4.7	1 (7 May–28 Jun)[8], 1 (5–7 Jun), 1 (18 Jun)
	Pierced Egg	6.7	1 (24 May), 2 (29 May), 1 (3 Jun)
	Swine Paradise	0.9	1 (9 Jun)
	Barbed Wire	2.1	ND
	Platform	1.9	1 (16 May–10 Jun)[9]
	250M	1.9	ND
	Hell Bird	6.3	2 (16 May), 4 (29 May), 2 (4 Jun), 2 (8 Jun)
	Glory Hole	5.0	ND
	Spaghetti	5.4	2 (30 May)
	Beal Lake	18.0	1 (7 Jun)
	Lost Lake	3.3	1 (26 May)
	Dock[10]		3 (29 May)
BIWI	Wispy Willow[11]	0.5	1 (27 May)
	Burn Edge	4.1	1 (30 Jun)
	Site #4	9.9	1 (16 Jun), 1 (20–26 Jun), 1 (20 Jun–5 Jul)
	Site #3	13.0	2 (13 May–1 Aug), 1 (27 May)
	Last Gasp	2.1	ND
	Site #5	6.8	1 (21 May), 1 (29 May)
	Cougar Point[12]	1.3	2 (10–16 Jul)[13]
	Upstream from Site #8	1.5	ND
	Planet Ranch Road	3.3	3 (15 May–30 Jul), 1 (1 Jun), 1 (1–6 Jun)
	New River	0.6	ND
PVER	PVER Phase 2	21.4	3 (16 May), 6 (26 May), 2 (9 Jun)
	PVER Phase 3	21.4	1 (16 May), 3 (26 May)
CIBO	CVCA Phase 1	26.2	6 (23 May), 3 (31 May), 3 (8 Jun)
	CVCA Phase 2	25.5	11 (23 May)
	CVCA Phase 3	38.4	16 (24 May), 2 (1 Jun)
	Cibola Nature Trail	13.7	1 (1 Jun)
	Cibola Island	4.2	ND
	Cibola Site #2	16.4	3 (25 May), 2 (14 Jun)
	Cibola Site #1	7.7	ND
	Cibola Lake #2 (East)	4.5	1 (25 May), 1 (20 Jun)
	Walker Lake	11.4	1 (15 Jun)

Table 2.2. Adult Willow Flycatcher Detections at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3]
IMPE	Paradise	7.8	3 (18 May)
	Hoge Ranch	20.7	8 (21 May), 6 (2 Jun)
	Rattlesnake	7.6	3 (21 May), 2 (2 Jun)
	Milemarker 65	10.0	1 (18 May)
	Nursery NW	7.0	4 (22 May), 2 (5 Jun)
	Ferguson Lake	21.1	2 (19 May)
	Great Blue Heron	7.1	3 (17 May), 9 (20 May), 4 (3 Jun), 5 (5 Jun)
	Powerline	1.0	2 (17 May), 1 (3 Jun)
	Martinez Lake	4.6	2 (3 Jun)
MITT	Mittry West	4.4	3 (17 May)
YUMA	Gila River Site #2	2.9	7 (4 Jun)
	Fortuna Site #1	3.2	15 (4 Jun)
	Fortuna North	3.8	6 (4 Jun), 1 (5 Jun)

* This table includes only sites where regular surveys were scheduled or where flycatcher were detected and does not include sites where habitat reconnaissance or opportunistic surveys were conducted and no flycatchers were detected.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Flycatchers in territories that were occupied throughout the breeding season are shown as being present throughout the season. Flycatchers detected on a single occasion or for a short period of time are listed separately.

[5] We detected several within-season movements between study areas in 2011. For details on movements see Table 3.9.

[6] Detection was of a banded family group (one adult with fledges) from Pahranagat North.

[7] Surveys discontinued because of poor quality habitat.

[8] This individual detected 7 May–28 Jun in 800M and 6–8 Jul in Pipes #3.

[9] This individual detected 16 May–10 Jun in Platform and 25 Jun–9 Jul in The Wallows.

[10] Not an official survey site. Incidental detections recorded.

[11] Site surveyed at beginning of season for reconnaissance. Not added to formal survey list due to unsuitable habitat.

[12] Site discovered with breeding flycatchers toward end of survey season.

[13] A singing male was reported at this territory by personnel from an unrelated field crew prior to 10 Jul; only the female was detected during nest monitoring visits 10–16 Jul.

Table 2.3. Detections of Willow Flycatchers Recorded after 15 June 2011 at Sites Where Breeding or Residency Was Not Confirmed

Study Area[1]	Site	Date	Comments
MUDD	Overton WMA Pond	2 Jul	Singing spontaneously (*fitz-bew*)
BIWI	Burn Edge	30 Jun	Occasional unsolicited vocalizations (*fitz-bew* and *wheeo*)
CIBO	Cibola Lake #2 (East)	20 Jun	Brief primary song (*fitz-bew*)

[1] MUDD = Muddy River, BIWI = Bill Williams River NWR, CIBO = Cibola.

Table 2.4. Yellow-billed Cuckoo Detections at Reclamation Study Areas, 2011

Study Area[1]	Site	Date	Behavioral Observations
MESQ	Hafen Lane	23 Jun	One individual detected
	West	19–22 Jul	Repeated detections of one or two individuals
MUDD	Overton WMA	14 Jul	One individual heard
TOPO	Beal Lake	29 Jun	One individual detected
		13 Jul	Two individuals detected
BIWI	Site #3	30 Jun	One individual heard
		16 Jul	Two individuals heard (*coo* and *kowlp*)
	Site #5	10 Jul	One individual detected
	Planet Ranch Road	2–17 Jul	Repeated detections of one or two cuckoos
	New River	7 Jul	One individual detected
		17 Jul	One individual detected
PVER	Phase 2	13 Jun	One individual seen and heard (*kuk* and *kowlp*)
		12 Jul	Two or three individuals heard (*kuk* and *coo*)
	Phase 3	12 Jul	One individual heard
CIBO	CVCA Phase 1	17 Jun	One individual detected
		13 Jul	Two individuals heard
	CVCA Phase 2	17 Jun	One individual heard (*coo*)
		13 Jul	Three or four individuals detected
	CVCA Phase 3	8 Jun	One individual seen
	Cibola Island	7 Jul	Two individuals heard (*kuk* and *coo*), one silent cuckoo seen

[1] MESQ = Mesquite, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve; CIBO = Cibola.

Table 2.5. Yuma Clapper Rail Detections at Reclamation Study Areas, 2011

Study Area[1]	Site	Date(s)	Behavioral Observations
BIWI	Wispy Willow	13 Jun	One individual heard
CIBO	Cibola Site #2	28 Jun	One individual heard
IMPE	Powerline	5 Jul	One individual heard

[1] BIWI = Bill Williams River NWR, CIBO = Cibola, IMPE = Imperial.

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011*

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PAHR	North[4]	8/--/2	15/--/5	4/--/1	0/--/0
	West[4]	0/0/0	0/0/0	0/0/0	2/5/15
MESQ	Hafen Lane[4]	0/0/0	0/0/0	0/0/0	1/1/1
	West[4]	2/--/0	15/--/0	15/--/0	0/--/0
	Bunker Marsh North[4]	5/--/--	15/--/--	0/--/--	0/--/--

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
MOME	Mormon Mesa North	0/--/--	0/--/--	0/--/--	40/--/--
	Hedgerow	0/--/--	0/--/--	0/--/--	300/--/--
	Mormon Mesa South[4]	--/0/0	--/0/0	--/0/0	--/0/0
	Virgin River #1	--/10/10	--/10/20	--/5/8	--/--/0
	Virgin River #2	0/0/0	0/0/0	0/0/0	20/20/20
MUDD	Overton WMA Pond	2/--/2	40/--/10	0/--/0	0/--/0
	Overton WMA	--/--/10	--/--/30	--/--/8	--/0/0
TOPO	Pipes #1	0/0/0	0/0/0	0/0/0	40/40/40
	Pipes #3	0/0/0	0/0/0	0/0/0	40/40/40
	The Wallows	0/0/0	0/0/0	1/0/0	0/80/80
	PC6-1	0/0/0	0/0/0	0/0/0	40/40/40
	Pig Hole	0/0/0	0/0/0	0/0/0	120/120/120
	In Between	25/15/20	30/40/10	30/10/5	0/0/0
	800M	0/0/0	0/0/0	0/10/0	70/0/70
	Pierced Egg	1[5]/1[5]/0	10/3/0	0/0/0	0/0/30
	Swine Paradise[6]	0/0/0	0/0/0	0/0/0	40/40/40
	Barbed Wire	0/2/0	0/10/0	0/0/0	150/0/150
	Platform[6]	0/0/0	0/0/0	0/0/0	20/20/20
	250M[6]	0/0/0	0/0/0	0/0/0	0/0/0
	Hell Bird[6]	0/0/0	0/0/0	0/0/0	0/0/0
	Glory Hole	0/0/0	0/0/0	0/0/0	70/70/70
	Spaghetti	--/--/--	--/--/--	--/--/--	0/0/0
	Beal Lake[7]	0/0/45	0/0/3	0/0/0	20/20/0
	Lost Lake[6]	0/0/0	0/0/0	0/0/0	20/20/20
BIWI	Burn Edge	20/1/<1	10/10/40	30/1/0	0/0/0
	Site #4[4]	5/1/1	10/>100/>100	0/2/0	0/0/0
	Site #3	4/0/0	10/0/0	2/5/0	0/0/250
	Last Gasp	10/1/0	30/3/0	5/0/0	0/0/>1000
	Site #5	10/5/5	30/100/100	3/0/0	0/0/0
	Cougar Point[8]	--/--/70	--/--/10	--/--/25	--/--/0
	Upstream from Site #8[6]	10/10/10	10/10/10	5/5/5	0/0/0
	Planet Ranch Road	50/40/50	40/60/50	30/10/3	0/0/0
	New River	15/15/15	10/10/10	5/10/--	0/0/0

Table 2.6. Summary of Hydrologic Conditions at Each Survey Site at Reclamation Study Areas, 2011* (Continued)

Study Area[1]	Survey Site	% Site Inundated[2]	Depth (cm) of Surface Water[2]	% Site with Saturated Soil[2,3]	Distance (m) to Surface Water or Saturated Soil[2]
PVER	PVER Phase 2[7]	0/10/0	0/3/0	0/5/0	300/0/5
	PVER Phase 3[7]	0/25/30	0/10/10	0/40/10	10/0/0
CIBO	CVCA Phase 1[7]	20/0/15	10/0/10	40/0/5	0/10/0
	CVCA Phase 2[7]	0/0/0	0/0/0	0/0/5	5/5/0
CIBO	CVCA Phase 3[7]	0/75/0	0/10/0	0/15/0	10/0/5
	Cibola Nature Trail[7]	0/0/0	0/0/0	0/0/0	12/15/15
	Cibola Island	--/0/0	--/0/0	--/0/0	--/--/5
	Cibola Site #2	0/10/10	0/10/--	--/5/5	100/0/0
	Cibola Site #1	30/15/30	10/10/--	--/10/3	0/0/0
	Cibola Lake #2 (East)[4]	0/0/0	0/0/0	0/0/0	0/0/0
	Walker Lake[4]	--/20/5	--/3/3	--/--/5	--/0/0
IMPE	Paradise[4]	40/--/0	25/--/0	--/--/3	0/0/0
	Hoge Ranch[4]	--/5/5	--/25/20	--/3/3	0/0/0
	Rattlesnake[6]	0/10/0	0/10/0	30/10/0	0/0/5
	Milemarker 65[4]	--/--/--	--/--/--	--/--/--	0/0/0
	Nursery NW[6]	30/50/15	30/30/10	10/10/10	0/0/0
	Ferguson Lake[4]	5/--/25	25/--/25	5/--/5	0/0/0
	Great Blue Heron[6]	0/0/--	0/0/--	0/0/--	100/100/--
	Powerline[6]	10/20/--	10/25/--	40/10/--	0/0/--
	Martinez Lake	0/10/--	0/10/--	25/8/--	0/0/--
MITT	Mittry West	90/5/--	40/5/--	5/25/--	0/0/--
YUMA	Gila River Site #2[4]	--/0/0	--/0/0	--/0/0	--/5/5
	Fortuna Site #1[4]	--/0/0	--/0/0	--/5/0	--/0/0
	Fortuna North[4]	--/10/10	--/10/15	--/5/5	--/0/0

* Values are given for each site as recorded in mid-May, mid-June, and mid-July.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] -- = Hydrologic information not recorded.

[3] Percent of site with saturated soil does not include inundated areas.

[4] Site bordered by a river, lake, or pond.

[5] Saturated soil or water was present only in pig wallows.

[6] Site borders marsh.

[7] Site is irrigated as part of restoration efforts; amount of standing water highly variable throughout survey season.

[8] Site not visited until July; not formally surveyed.

Pahranagat National Wildlife Refuge, Nevada

Pahranagat National Wildlife Refuge consists of a series of lakes and marshes in Pahranagat Valley approximately 150 km north of Las Vegas, Nevada. Patches of primarily native vegetation exist at the inflow and outflow of Upper Pahranagat Lake and along the lakeshore. Prior to the 2008 survey season, the majority of the riparian vegetation along the north side of the upper lake (Pahranagat North) was

inundated annually with up to 1 m of water, with the highest water levels occurring in May. Major structural problems with the dam that impounds the upper lake resulted in the upper lake being drained in early 2008, and the riparian vegetation at the north end of the lake was not flooded during the 2008 or 2009 breeding seasons. The dam was repaired prior to the 2010 breeding season, and lake levels in 2010 and 2011 were higher than they had been in the two previous years but not as high as they had been prior to 2008.

PAHRANAGAT NORTH

Area: 4.6 ha Elevation: 1,026 m

Pahranagat North is a stand of large-diameter Goodding willow (*Salix gooddingii*) at the inflow of Upper Pahranagat Lake. Fremont cottonwood (*Populus fremontii*; hereafter cottonwood) lines the northern, upland edge of the site and extends in narrow stringers around the edge of the lakebed. Canopy height within the patch is around 20 m, and canopy closure is approximately 80%. Many of the large trees in the northeastern section of the site are dead or dying. Additional scattered cottonwood trees have fallen throughout the site creating multiple small clearings. Standing water and saturated soils were present within the southern portion of the site in May, and the site slowly dried out during the survey season, with no water or saturated soils present by the middle of July except in an inflow channel that runs along the northern side of the site and drains into the lakebed at the southeastern corner of the site.

We detected 10 breeding willow flycatchers, as well as 4 resident, unpaired males and 7 individuals for which residency could not be determined. The site lies immediately adjacent to a cattle pasture, and a lack of fencing coupled with low lake levels allowed cattle to periodically access to the site for a portion of the breeding season. We surveyed the unoccupied east arm of the site four times, totaling 1.5 observer-hours.

PAHRANAGAT WEST

Area: 1.5 ha Elevation: 1,026 m

This native site consists of a stringer of cottonwood, one to three trees wide and 20 m in height, on the western edge of Upper Pahranagat Lake. The site has no significant understory vegetation, and canopy closure varies from <50 to 80%. The eastern edge of the site is vegetated with bulrush, which extends into the lakebed to the east. The western edge of the site is vegetated in yerba mansa (*Anemopsis californica*) extending into dry, upland desert. During the survey season, the interior of the site was dry, but surface water was present adjacent to the site in the lakebed.

We detected one adult and one hatch year willow flycatcher on 21 July and two additional hatch year willow flycatchers on 21–25 July; all individuals were known or suspected to have come from Pahranagat North. We surveyed the site five times, totaling 3.1 observer-hours. No cowbirds were detected, and there was no sign of livestock use.

GROUND RECONNAISSANCE RESULTS

Pahranagat South

The majority of this site was affected by a fire prior to the start of the 2010 survey season. The fire removed all understory vegetation and charred the trunks and lower branches of the overstory trees. The site now consists of a stringer of cottonwood, 20 m tall, along a human-made channel that carries the outflow from Upper Pahranagat Lake. The understory contains Indian hemp (*Apocynum cannabinum*) and some small patches of coyote willow (*Salix exigua*) 3 m in height. Canopy closure within the cottonwood stringer is approximately 50%. The channel held water during the site visit in May; surrounding soils were dry. While suitable understory components are now present, they are not currently of sufficient size

to resemble typical occupied willow flycatcher habitat. We recommend reassessing this site in future years. We surveyed the site once, totaling 0.25 observer-hours. No willow flycatchers were detected.

Littlefield, Arizona

In recent years, our survey and monitoring activities focused on Beaver Dam Wash near the Highway 91 Bridge. In December 2010, a flood scoured much of the area, and we evaluated the site (Littlefield Poles) at the beginning of the season for suitability.

GROUND RECONNAISSANCE RESULTS

Littlefield Poles

The site consists of primarily native vegetation and is located on Beaver Dam Wash, immediately upstream of the Highway 91 Bridge. Overall changes to the site as a result of the flood in December 2010 include a reduction in vegetation density and height and a significant change in hydrology. Vegetation along the northern edge of the site consists of a scattered overstory of cottonwood averaging 25 m in height. The previously documented lower strata vegetation of tamarisk and Russian olive (*Elaeagnus angustifolia*) in the cottonwood area are significantly reduced or absent. The southern portion of the site consists of stands of coyote willow and young Goodding willow and cottonwood approximately 5 m in height. These stands have thinned significantly, and canopy closure is now 30 to 50% overall. Extensive sedimentation of the site has also reduced canopy height. No surface water was present in May or June, and the nearest water was Beaver Dam Wash, which was restricted to a channel roughly 80 m from the site. We surveyed the site twice, totaling 1.0 observer-hours. No willow flycatchers were detected. Because of the lack of surface water within the site and the reduction in vegetation density, this site does not currently resemble typical occupied flycatcher breeding habitat. We recommend reassessing the site at the beginning of future breeding seasons.

Mesquite, Nevada

The Mesquite study area is in the floodplain of the Virgin River near Mesquite and Bunkerville, Nevada.

HAFEN LANE

Area: 6.1 ha Elevation: 475 m

This mixed-exotic site lies within the floodplain of the Virgin River in Mesquite, Nevada, between Hafen Lane and the active river channel. Two drainage ditches that pass underneath Hafen Lane flow into the site; the eastern inflow supports a dense stand of cottonwood and Goodding willow, 10 m in height, with some coyote willow 5 m in height in the understory. The western inflow supports a stringer of coyote willow 4–6 m in height and scattered Goodding willow 15–18 m in height, with 70% canopy closure. The coyote willow in the western stringer is of varying health and density. Between the stringers, the site is vegetated by 6-m-tall tamarisk with 90% canopy closure. No water was documented within the site, but damp soils were noted on all visits within the drainage ditches. Tamarisk beetles and heavily defoliated tamarisk were noted at the site in mid-June.

We detected three breeding flycatchers, one of which was a male from Muddy River that displaced the resident male. Portions of the site not known to be occupied were surveyed five times for a total of 16.2 observer-hours. Cowbirds were detected on all surveys, and no sign of livestock use was observed.

MESQUITE WEST

Area: 10.4 ha Elevation: 470 m

This mixed-native site lies within the floodplain of the Virgin River in Mesquite, Nevada. Golf courses and housing developments border the site to the north, and the Virgin River borders the site to the south. This large site is primarily a mosaic of cattail (*Typha* spp.) and bulrush (*Schoenoplectus californicus*) marshes separated by narrow (40–50 m) strips of dense coyote willow with interspersed tamarisk. The coyote willows are generally 5–6 m in height, and canopy closure varies from 50 to >90%. The eastern portion of the site is primarily coyote willow, while the western portion contains a mix of willow and tamarisk. Hydrology at the site is influenced by irrigation runoff from adjacent golf courses and agriculture. The site was regularly inundated through early June. Thereafter, a change in the access point of water into the site diverted all water straight into the Virgin River, bypassing the site altogether. Tamarisk beetles and defoliated tamarisk were noted within the site in mid- to late June.

We detected 10 breeding willow flycatchers and 1 resident, unpaired male. Areas of Mesquite West not known to be occupied by flycatchers were surveyed five times, totaling 7.4 observer-hours. Cowbirds were detected on all surveys. Some signs of cattle were observed early in the season in the eastern portion of the site near the river.

BUNKER MARSH NORTH

Area: 7.1 ha Elevation: 456 m

This mixed-exotic site lies within the floodplain of the Virgin River near Bunkerville, Nevada, approximately 4 km downstream of Mesquite West. The site is between agricultural fields to the southeast and the Virgin River to the northwest. The site is primarily 5–7-m-tall tamarisk, with scattered Goodding willow primarily in the southern portion of the site. Some Goodding willows are also present along the western and northern ends of the site. Canopy closure ranges from 25 to 80%. Surface water was noted within the site in May in a small stream in the northern portion of the site and a small puddle in the center of the site, but no water was noted in mid-June. Dry marshes were present adjacent to the site. Tamarisk beetle larvae but no defoliation were observed in mid-May, and extensive defoliation was observed by mid-June. Surveys at this site were discontinued in mid-June because of the lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

We detected no willow flycatchers. The site was visited twice, for a total of 3.7 observer-hours. Cowbirds were detected on both surveys, and signs of cattle were observed within the site.

Mormon Mesa, Nevada

For approximately 15 km upstream of its confluence with the Muddy River, the Virgin River flows through a 1-km-wide floodplain with a mosaic of habitats, including cattail marshes and tamarisk and willow forest. Much of the area is typically seasonally inundated from snowmelt in the spring and monsoon rains in mid and late summer, and the entire study area experienced severe flooding over the 2004–2005 winter. All the areas surveyed at Mormon Mesa are at least 10 km upstream of the Muddy River confluence. In December 2010, the study area experienced another severe flood. Part of the river shifted its course, and river levels remained elevated (in the 75th percentile) throughout the breeding season, limiting access to portions of the study area during May and early June. Tamarisk beetles and heavy defoliation were noted throughout the study area by mid-July.

MORMON MESA SOUTH

North half: Area: 8.4 ha Elevation: 385 m

South half: Area: 3.4 ha Elevation: 385 m

This mixed-exotic site was split into two contiguous areas to facilitate tracking of survey activity. The site has scattered Goodding willow up to 20 m, but more typically 12–15 m, in height and a patchy understory of tamarisk 3–6 m in height. Dead cattail and arrowweed (*Pluchea sericea*) are present in the understory in this area. Canopy closure is widely variable, ranging from >80% in tamarisk thickets to <50% in openings. There was no surface water within the site, but damp soils were noted in the center of the northern half of the site in May and June. The presence of dead cattails and deadfall suggests that this site was formerly considerably wetter, and portions of the site still have the structure to provide potential flycatcher habitat with wetter soil conditions.

No willow flycatchers were detected. Due to elevated river levels, we surveyed the northern half four times and the southern half three times, totaling 9.3 and 4.8 observer-hours, respectively. Cowbirds were detected on all surveys in the northern half and none of the surveys in the southern half. Signs of cattle were noted within the site on all occasions.

VIRGIN RIVER #1

North half: Area: 11.4 ha Elevation: 380 m

South half: Area: 11.1 ha Elevation: 380 m

Virgin River #1 was also divided into two areas, Virgin River #1 North and Virgin River #1 South, to facilitate streamlining of field logistics. Virgin River #1 North is primarily tamarisk 4–6 m in height, with areas of emergent Goodding willow in the central and southwestern portions of the site. Canopy closure throughout the site is 70–90%. Some surface water was present in June in channels running north to south through the center of the site and in the southwestern corner of the site. By July only a few spots of saturated soil remained in these areas.

We detected four breeding willow flycatchers in the southwestern corner of Virgin River #1 North. We also detected one additional flycatcher for which residency and breeding status could not be determined. Areas of this site not known to be occupied by flycatchers were surveyed four times, totaling 12.9 observer-hours. Cowbirds were detected on all surveys and cattle were observed in the site on multiple occasions.

Virgin River #1 South consists of two disjunct sections; the northern section is immediately south of Virgin River #1 North, while the southern portion is approximately 700 m SSE of Virgin River #1 North. The northern section is primarily tamarisk 4–6 m in height with patches of coyote willow 6 m in height and scattered Goodding willow 8–12 m in height. Canopy closure varies from >90% in areas of dense willow and tamarisk to 25% in marshy openings. The northern section contained standing water throughout the survey season. The southern section consists of tamarisk 6–7 m in height, with a cluster of emergent Goodding willow and dead coyote willow. Canopy closure is 70–90%. Soils in the southern section were dry throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion if soils are dry.

We detected 18 breeding willow flycatchers and one unpaired, resident male in the northern section of Virgin River #1 South. We detected two additional willow flycatchers for which residency and breeding status could not be confirmed. Areas of the site not known to be occupied by willow flycatchers were surveyed three times, totaling 5.5 observer-hours. Cowbirds were observed on two surveys, and signs of cattle were observed.

VIRGIN RIVER #2

Area: 11.2 ha Elevation: 380 m

This site received extensive sedimentation from the flood in December 2010. The depth of new sediment ranged from 15 to 60 cm and was most extensive in the southern portion of the site. The site consists of mixed-exotic vegetation with tamarisk 4–6 m in height with a cluster of emergent Goodding willow at the northern end of the site and scattered, emergent Goodding willow at the southern end of the site. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in this portion of the site. Overall canopy closure is 70–90%. The site contained no surface water during the breeding season, though a small area at the very northern end of the site contained damp soil in May and June. The Virgin River, on the eastern edge of the site, had surface water throughout the season.

No willow flycatchers were detected. We surveyed the site five times, totaling 16.8 observer-hours. Cowbirds were observed on all surveys, and cattle sign were observed at the site.

GROUND RECONNAISSANCE RESULTS

Mormon Mesa North

We discontinued surveys after the initial visit at this site in 2010 due to dry conditions and a lack of flycatcher detections since 2005. In December 2010, the study area experienced significant flooding, with the potential to alter the hydrology within the site. We reassessed the site at the beginning of 2011. This site consists of mixed-exotic vegetation, primarily tamarisk 3–5 m in height with areas of emergent Goodding willow up to 12 m in height and patches of coyote willow. Canopy closure varies from 70% in the taller tamarisk to around 50% in the shorter tamarisk. The western edge of the site has a 100 x 50-m patch of Goodding willow, 8 m in height, with up to 75% canopy closure and dead cattails in the understory. Soils were completely dry within the site during a visit in early June, and the nearest water was in the river channel approximately 40 m away. We did not formally survey the site in 2011, though no flycatchers were detected during the site visit. We recommend discontinuing surveys at this site until another flood event occurs that has the potential to alter the hydrology within the site.

Hedgerow

We discontinued surveys after the initial visit at this site in 2010 because of completely dry conditions and a lack of flycatcher detections since surveys began in 2005. In December 2010, the entire study area experienced a significant flood that had the potential to change the hydrology within the site. We reassessed the site at the beginning of 2011. The site is east of Mormon Mesa North, on the eastern side of the Virgin River. It consists of mixed-exotic vegetation with a continuous understory of tamarisk 4–5 m in height and scattered emergent Goodding willow up to 12 m in height. Many of the willows have dead branches. The site is surrounded by tamarisk and arrowweed 2–3 m in height. Canopy closure in the tamarisk varies from about 50% on the edges of the site up to 80% in the denser areas. Soils within the site were completely dry during a visit in May. We did not formally survey the site in 2011, but no flycatchers were detected during the May site visit. We recommend discontinuing surveys at this site until another flood event occurs that has the potential to alter hydrologic conditions.

Muddy River, Nevada

The Muddy River study area is along the Muddy River in the Overton Wildlife Management Area (WMA) near Overton, Nevada.

OVERTON WMA POND

Area: 0.7 ha Elevation: 378 m

This site consists of a patch of mixed-native vegetation approximately 150 m long and 75 m wide at the north end of Overton WMA just south of Honeybee Reservoir. The dominant vegetation consists of 12-m-tall Goodding willow with a sparse 5-m-tall tamarisk understory. Cattail and sedges (*Carex* sp.) are also present on the edges of the site. Arrowweed is present in scattered, dense patches within and along the edges of the site. Canopy closure is variable, ranging up to 90%. A small stream channel runs through the site, and it held surface water throughout the season.

We detected one willow flycatcher for which residency could not be determined. We surveyed the site five times for a total of 2.5 observer-hours. Cowbirds were detected on two visits, and no sign of livestock use was observed.

OVERTON WMA

Area: 14.9 ha Elevation: 378 m

This site consists of a 150-m-wide strip of riparian vegetation spanning both sides of the Muddy River. The site is bordered to the southwest by open agricultural fields and to the northeast by sparser areas of riparian vegetation. The site flooded heavily during the 2004–2005 winter, but vegetation at the site was relatively unchanged. The northern portion of the site is dominated by very dense tamarisk up to 7 m in height with canopy closure of 70–90%. The southern portion of the site consists primarily of a stand of Goodding willow 10–15 m in height with an understory of tamarisk and cattail. Canopy closure in this area is up to 90%. Flowing water was present in the channels of the Muddy River throughout the survey season. Soils in the northern portion of the site outside of the river channel were dry throughout the season. Soils in the southern portion were saturated early in the season and dry at the end of the season in areas adjacent to the channels. Beavers have felled swaths of Goodding willow in the southern portion of the site, resulting in gaps in the canopy. Approximately 0.3 ha of the southern portion of the site was bulldozed in 2005 as part of Overton WMA efforts to repair flood damage to their water control system. Two stretches of the channel of the Muddy River within the site were dredged with heavy equipment over the 2007–2008 winter, resulting in a cleared swath 10–15 m wide on the western bank of the river.

We located 10 breeding willow flycatchers and three unpaired, resident males. We also detected two flycatchers for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed six times, totaling 18.0 observer-hours. We observed no signs of livestock but detected cowbirds on all surveys.

Topock Marsh, Arizona

Topock Marsh lies within Havasu NWR and encompasses over 3,000 ha of open water, cattail and bulrush marsh, and riparian vegetation. A large expanse (over 2,000 ha) of riparian vegetation occupies the Colorado River floodplain between the Colorado River on the western edge of the floodplain and the open water of Topock Marsh on the eastern edge of the floodplain. The vegetation is primarily monotypic tamarisk with isolated patches of tall Goodding willow. Seasonally wet, low-lying areas are interspersed throughout the riparian area. Water levels within Topock Marsh were unusually low in 2011 because the intake valve at the upstream end of the marsh was closed for construction purposes. Feral pigs are present throughout the Topock study area, and evidence of pigs was observed in most survey sites.

PIPES #1

Area: 5.2 ha Elevation: 140 m

This exotic site is bordered to the east by the refuge road and consists primarily of monotypic tamarisk 6–9 m in height. Arrowweed occurs in dense patches within 50 m of the refuge road. The tamarisk is densest within 100 m of the refuge road and becomes more open toward the western edge of the site. The northern edge of the site has the tallest canopy, and there is relatively little deadfall in this area compared to the rest of the site. The central and southern portions of the site have many dead stems and clusters of fallen trees. Canopy closure is 70–90%. The site contained no standing water during the survey season.

We detected one unpaired, resident willow flycatcher from 23 June to 1 July. We surveyed the site five times, totaling 8.5 observer-hours. Cowbirds were detected on all surveys.

PIPES #3

Area: 5.7 ha Elevation: 140 m

This site is bordered to the east by the refuge road. Arrowweed occurs in dense patches within 50 m of the road. Most of the site is vegetated by tamarisk 5–7 m in height. The southeastern portion of the site has a few emergent Goodding willow up to 15 m in height and open areas with marsh vegetation. Canopy closure generally exceeds 70%. The site contained no standing water during the survey season.

We detected two breeding flycatchers and one individual that moved to Pipes #3 after holding a territory in 800M. Portions of Pipes #3 not known to be occupied by flycatchers were surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all surveys.

THE WALLOWS

Area: 0.7 ha Elevation: 140 m

The Wallows is primarily vegetated by tamarisk 5–6 m in height with emergent Goodding willow on the western side of the site. The northwestern edge of the site borders an open cattail marsh. The eastern side is dry and grades from 2-m-tall arrowweed along the refuge road to tamarisk up to 8 m in height in the center of the site. Overall canopy closure ranges from 50% in the marshy area to 90% in the tamarisk. Approximately 1% of the site had saturated soil in mid-May, but the site was entirely dry by mid-June.

We detected one resident, unpaired male that moved to The Wallows from Platform. We also detected two individuals for which residency could not be confirmed. Portions of the site not known to be occupied were surveyed five times, totaling 2.1 hours. Cowbirds were detected on three surveys.

PC6-1

Area: 4.8 ha Elevation: 140 m

PC6-1 is a mixed-exotic site consisting primarily of tamarisk 6–7 m in height, with a few patches of arrowweed and cattails present in the understory. A scattered overstory of Goodding willow approximately 10–15 m in height is present in the southwestern corner of the site. Arrowweed 1–2 m in height is present under the willow. A portion of the site within approximately 50 m of the refuge road contains thick stands of arrowweed. Canopy closure in the interior of the site is approximately 90%, while canopy closure on the periphery of the site near the refuge road is approximately 50%. The site was completely dry throughout the survey season.

We detected one willow flycatcher across the road from PC6-1 on 1 June. The site was surveyed five times, totaling 8.1 observer-hours. Cowbirds were detected on all surveys.

PIG HOLE

Area: 2.4 ha Elevation: 140 m

Pig Hole consists of monotypic tamarisk 6–7 m in height, with canopy closure ranging from 70 to 90%. Tamarisk along the northern edge has many wispy branches and smaller diameter stems than the rest of the site. A few dense patches of arrowweed are present on the eastern edge. No standing water or saturated soil was observed within the site during the survey season.

No willow flycatchers were detected. The site was surveyed five times, totaling 5.1 observer-hours. Cowbirds were detected on all surveys.

IN BETWEEN

Area: 7.7 ha Elevation: 140 m

In Between consists of monotypic tamarisk 6–8 m in height. The lowest 3 m of the stand generally lacks foliage, resulting in a relatively open understory. Canopy closure is 70–90%, and the western edge of the site borders a marsh. In Between was affected by water delivery in 2011 (see Chapter 8) and contained varying amounts of surface water through the middle of July.

We detected one flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 9.9 observer-hours. Cowbirds were observed on four surveys.

800M

Area: 4.7 ha Elevation: 140 m

800M adjoins the western edge of In Between, and the eastern half of the site consists of a cattail and bulrush marsh with clumps of tamarisk 5–7 m in height and scattered, emergent Goodding willow. The remainder of the site is vegetated by tamarisk 4–7 m in height. Canopy closure in the tamarisk is generally >90%, while canopy closure in the marsh is around 50%. 800M was affected by water delivery in 2011 (see Chapter 8) and contained varying amounts of surface water and saturated soil in the marsh through early July.

We located one resident, unpaired male flycatcher and two additional individuals for which residency could not be confirmed. Portions of the site not known to be occupied were surveyed five times, totaling 4.7 observer-hours. Cowbirds were observed on all surveys.

PIERCED EGG

Area: 6.7 ha Elevation: 140 m

This mixed-exotic site borders the western edge of 800M and consists of dense tamarisk 7 m in height, with a scattered overstory of Goodding willow 15 m in height. Areas with willows tend to have a more open understory and contain patches of cattail and bulrush. Overall canopy closure is approximately 80%. The only water or saturated soil within the site was in deep pig wallows.

We detected four flycatchers for which residency could not be confirmed. We surveyed the site five times for a total of 8.5 observer-hours. Cowbirds were observed on all surveys.

SWINE PARADISE

Area: 0.9 ha Elevation: 140 m

Vegetation at this mixed-exotic site consists of tamarisk 6–8 m in height and scattered, emergent Goodding willow up to 15 m in height, with patches of coyote willow. Overall canopy closure is approximately 80%. The northern tip of the site was bulldozed prior to the survey season for a new water conveyance channel. The site was dry throughout the survey season.

We detected one willow flycatcher for which residency could not be determined. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds were detected on three visits.

BARBED WIRE

Area: 2.1 ha Elevation: 140 m

One large, emergent Goodding willow occurs at the site; otherwise, the site is vegetated by tamarisk 6–10 m in height and of varying density. The northeastern portion of the site contains taller stems, less dead wood in the understory, and fewer large canopy openings than the southwestern portion of the site. A 40-m-wide strip was bulldozed through the center of the site east to west for a new water conveyance channel prior to the start of the survey season. Canopy closure outside the bulldozed area is approximately 70–90%. The only standing water or saturated soil observed in the site was within the new channel.

No willow flycatchers were detected. We surveyed the site five times, totaling 4.0 observer-hours. Cowbirds were detected on four visits.

PLATFORM

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road to the west and open bulrush and cattail marsh to the east. Vegetation at the site consists of tamarisk 8 m in height with a few emergent Goodding willow. A narrow line of 5-m-tall coyote willow approximately 5 m wide runs along the eastern edge of portions of the site. Overall canopy closure is approximately 90%. Soils within the site were very dry throughout the survey season.

We detected one resident, unpaired male willow flycatcher. Portions of the site not known to be occupied were surveyed five times, totaling 4.6 observer-hours. Cowbirds were detected on all visits.

250M

Area: 1.9 ha Elevation: 140 m

This site lies between the main refuge road and the open marsh. Vegetation composition and structure varies with distance from the marsh. Closest to the refuge road the site is dominated by mesquite trees (*Prosopis* sp.) with an understory of arrowweed. The center of the site is dominated by tamarisk approximately 7 m in height. Closest to the marsh, the site contains patches of coyote willow and a few emergent Goodding willows approximately 12 m in height. Canopy closure within the site ranges from 70 to 90%. The site was completely dry throughout the survey season.

No willow flycatchers were detected. The site was surveyed five times, totaling 3.3 observer-hours. Cowbirds were detected on three surveys.

HELL BIRD AND GLORY HOLE

Hell Bird: Area: 6.3 ha Elevation: 140 m
Glory Hole: Area: 5.0 ha Elevation: 140 m

These contiguous mixed-exotic sites are located on an island separated from the main riparian area by a narrow, deep channel. Vegetation composition and structure are highly variable, with the survey areas vegetated primarily by a mosaic of tamarisk 6–8 m in height and Goodding willow 15 m in height. Screwbean mesquite (*Prosopis pubescens*) is also scattered throughout the sites. Canopy closure ranges from 50 to 90%. The survey areas are bordered on the west by a sand dune and on other sides by dense bulrush. Areas vegetated by cattail and bulrush are interspersed throughout the survey sites. Extremely low water levels in Topock Marsh resulted in increased accessibility in 2011, and Hell Bird was expanded approximately 100 m to the northeast to encompass areas of coyote willow. Both sites were completely dry throughout the survey season.

We detected 10 flycatchers in Hell Bird for which residency could not be confirmed. No flycatchers were detected in Glory Hole. Hell Bird and Glory Hole were surveyed five times each, totaling 6.0 and 8.3 observer-hours, respectively. Cowbirds were detected during four surveys in each site.

SPAGHETTI

Area: 5.4 ha Elevation: 140 m

Spaghetti is a long, narrow site, generally no more than 30 m wide, running along the Farm Ditch to the west of Glory Hole. The site is vegetated by patches of dense coyote willow up to 7 m in height, scattered Goodding willow up to 12 m in height, and mesquite approximately 8 m in height, with tamarisk interspersed throughout the site. Canopy closure in the coyote willow patches is approximately 80%. Deep water in the ditch made the site inaccessible on foot throughout the survey season, and hydrologic conditions within the site were not assessed.

We detected two willow flycatchers for which residency could not be confirmed. We surveyed this site five times, totaling 3.4 observer-hours. Cowbirds were detected on two visits.

BEAL LAKE

Area: 18.0 ha Elevation: 140 m

This mixed-native restoration site consists of a mosaic of cottonwood, Goodding willow, coyote willow, mesquite, and arrowweed, with some tamarisk scattered throughout the site. Canopy height is highly variable and averages approximately 3–4 m over most of the site and up to 10 m in the cottonwood stands; canopy closure is sparse and averages 35%, reaching 85% in the cottonwood stands. The amount of standing water and saturated soil is highly variable because the site is flood irrigated. Sandy soil at the site allows the water to drain rapidly after irrigation.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed this site five times, totaling 10.6 observer-hours. Cowbirds were detected on all surveys.

LOST LAKE

Area: 3.3 ha Elevation: 140 m

This site consists of a narrow (<100-m-wide) strip of riparian vegetation separated from the Colorado River to the southwest by a low ridge of barren sand dunes and bordered to the northeast by marshy areas. The northern edge of the site consists of an overstory of planted cottonwoods 10–15 m in height, with an

understory of tamarisk 5 m in height, on the edge of a cattail marsh. South of the cottonwoods, the site is primarily tamarisk, 5–8 m in height, with small openings vegetated by arrowweed. Overall canopy closure is approximately 80%. Surface water or saturated soil was present in the marsh on the northern edge of the site throughout the season, but the interior of the site was dry.

We detected one willow flycatcher for which residency could not be confirmed. We surveyed the site five times, totaling 3.4 observer-hours. Cowbirds were detected on four visits.

GROUND RECONNAISSANCE RESULTS

Tractor

This mixed-native site is approximately 1 km north of the inlet ditch at the northern end of Topock Marsh and consists of a 300-m-long stringer of cottonwood 15 m in height with an understory of *Baccharis* sp., mesquite, and 4-m-tall tamarisk bordering a 15-m-wide cattail marsh. The site is bordered by hayfields to the north and south, a dry concrete channel to the west, and a road and a slough to the east. The site was dry during our visit on 26 May except for one small puddle at the far western end of the site, and surveys were discontinued. We visited the site once, totaling 0.3 observer hours. No willow flycatchers or cowbirds were detected. We do not recommend future visits to this site.

Bill Williams River National Wildlife Refuge, Arizona

The Bill Williams River NWR contains the last expanse of native cottonwood-willow forest in the LCR region. The refuge encompasses over 2,500 ha along the Bill Williams River upstream from its mouth at Lake Havasu and contains a mixture of native forest, stands of monotypic tamarisk, beaver ponds, and cattail marsh. Survey sites within Bill Williams are listed below from west to east, moving progressively farther upstream. We did not observe evidence of livestock use at any of the Bill Williams sites.

BURN EDGE

Area: 4.1 ha Elevation: 140 m

Burn Edge is near the northern edge of the Bill Williams riparian corridor, on the eastern edge of an area that burned in 2006. A cattail marsh with Goodding willow and cottonwood 15 m in height runs east-west through the center of the site. This portion of the site also has clumps of tamarisk up to 6 m in height. Canopy closure in the marshy area varies from around 60% at the eastern end to 25% at the western end. The area on either side of the marsh consists of tamarisk 6 m in height with up to 90% canopy closure. An area of the marsh approximately 100 m long was inundated or saturated in May, but only a small puddle remained at the western end of the marsh in June and July.

On 30 June, we detected one willow flycatcher for which residency could not be confirmed. The site was surveyed five times, totaling 6.3 observer-hours. Cowbirds were detected on four visits.

BILL WILLIAMS SITE #4 AND SITE #3

Site #4: Area: 9.9 ha Elevation: 140 m

Site #3: Area: 13.0 ha Elevation: 140 m

These two sites are contiguous and together are known as Mosquito Flats. Vegetation is mixed-native, with an overstory of Goodding willow 15–20 m in height and patches of monotypic tamarisk up to 8 m in height. Patches of coyote willow are also present. Canopy closure is variable and overall is approximately 50%. Stands of cattails and marshy areas occupy approximately 10% of Site #3.

The understory in some areas is very open, and the ground in these areas is covered with herbaceous vegetation. Many large willows and cottonwoods have fallen over the past several years, leaving large gaps in the canopy and creating patches of thick, dead, fallen woody vegetation. Mosquito Flats had a network of small, flowing streams with some open marshes in May. By mid-June, the streams and marshes were muddy but contained no standing water, and the only surface water remaining was in a deep, backwater channel on the western side of Site #4.

We detected one resident, unpaired flycatcher and two flycatchers for which residency could not be confirmed in Site #4. Two breeding flycatchers and one individual for which residency could not be confirmed were detected in Site #3. Portions of the sites not known to be occupied by flycatchers were visited five times, totaling 16.8 observer-hours at Site #4 and 19.6 observer-hours at Site #3. Cowbirds were detected on all surveys of Mosquito Flats.

LAST GASP

Area: 2.1 ha Elevation: 140 m

Last Gasp is a narrow, mixed-native site along a channel on the northern edge of the Bill Williams riparian area, approximately 250 m east of Burn Edge. Vegetation within the site consists of a broken overstory of cottonwood and Goodding willow 15–20 m in height and a tamarisk understory 5–7 m in height. Canopy closure varies from 50% in the channel to 80–90% in the surrounding tamarisk. Surface water was present in ponds and puddles within the channel in May. One small puddle remained in mid-June, and the site was completely dry in July.

No willow flycatchers were detected at Last Gasp. We surveyed the site five times, totaling 4.6 observer-hours. Cowbirds were detected on all visits.

BILL WILLIAMS SITE #5

Area: 6.8 ha Elevation: 143 m

Site #5 is located on the eastern edge of the Bill Williams River floodplain and is bordered to the northeast by steep cliffs and to the west by a dry river channel. Vegetation in the site is mixed-native, with Goodding willow and cottonwood 15–20 m in height in the overstory. The understory consists of tamarisk 7 m in height as well as some young Goodding willow and cottonwood. Ground cover in portions of the site consists of thick, dead, fallen woody vegetation. Canopy closure in the site is variable, ranging from 25% in open areas to 70–90% in the denser vegetation. Standing water was present throughout the survey season along the northeastern edge of the site in the form of a small stream with deep beaver ponds. Soils in the majority of the site were dry.

We detected one willow flycatcher on 21 May and one individual on 29 May; residency could not be determined for these individuals. We surveyed the site five times, totaling 8.9 observer-hours. Cowbirds were detected on all surveys.

COUGAR POINT

Area: 1.3 ha Elevation: 157 m

This site was visited in early July after personnel from an unrelated field crew reported hearing a willow flycatcher singing. The site consists of dense, young, even-age stands of Goodding willow and cottonwood approximately 6 m in height along a channel of the Bill Williams River. Seep willow (*Baccharis salicifolia*) is present in the understory but appears to be dying back as it becomes shaded by the taller cottonwoods and willows. Cattail marshes are present within and around the site. Canopy

closure within the woody vegetation exceeds 80%. Surface water was present within the marshes and the woody vegetation when the site was visited in July and August.

We detected one nesting female flycatcher, but the male was not detected during nest monitoring visits. No formal surveys were completed.

UPSTREAM FROM SITE #8

Area: 1.5 ha Elevation: 170 m

Vegetation in the majority of the site consists of an overstory of cottonwood and Goodding willow up to 15 m in height and an understory of tamarisk. The western third and southern edge of the site are vegetated by Goodding willow and cottonwood up to 10 m in height. The eastern third is dominated by dry tamarisk 4–6 m in height with scattered, emergent Goodding willow and cottonwoods. The northern edge of the site borders a cattail marsh. Canopy cover is variable and ranges from 50 to 80%. The western portion of the site contained surface water throughout the breeding season.

We detected no willow flycatchers. We surveyed the site five times, totaling 5.1 observer-hours. Cowbirds were detected on two visits.

PLANET RANCH ROAD

Area: 3.3 ha Elevation: 170 m

This mixed-native site follows the Bill Williams River at the southern edge of the riparian area. The vegetation immediately adjacent to the river is dominated by Goodding willow and cottonwood up to 15 m in height. Both riverbanks are steep, and vegetation on top of the banks more than a few meters from the water is dominated by arrowweed and tamarisk 4–5 m in height. Canopy closure within the site is highly variable, ranging from <50% on the dry banks to 90% within dense willow and cottonwood stands. The river had surface water throughout the survey season and was impounded in multiple locations by beaver dams.

We detected three breeding willow flycatchers and two individuals for which residency could not be confirmed. Portions of the site not known to be occupied by flycatchers were surveyed five times, totaling 12.0 observer-hours. We detected cowbirds on four surveys.

NEW RIVER

Area: 0.6 ha Elevation: 180 m

We first visited this site in 2008, at which time the vegetation appeared too young and sparse to support willow flycatchers, and determined that the site should be reevaluated in future years. The site consists of narrow stringers of cottonwood and Goodding willow along both sides of a channel of the Bill Williams River. Some patches of vegetation reach 8 m in height, but average height is approximately 5 m. Vegetation closest to the water is typically 3–4 m in height with 90% canopy closure, while the cottonwoods and willows on the periphery of the site reach 8 m in height but only 25% canopy closure. Soils within and around the site are very sandy. The western portion of the site contained surface water within the river channel throughout the survey season. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years.

No willow flycatchers were detected. We surveyed the site five times, totaling 3.9 observer-hours. Cowbirds were detected on one survey.

GROUND RECONNAISSANCE AND OPPORTUNISTIC SURVEY RESULTS

Wispy Willow

This site is approximately 200 m downstream of Site #1 along the north bank of the Bill Williams River. The site consists of a patch of coyote willow approximately 60 x 30 m in size. Canopy height is 4–5 m, and stem diameter is generally ~ 3 cm. Canopy closure is 70–90%. Water from the channel extended under the willows during the site visit in May. The vegetation is not currently of sufficient size to resemble typical occupied willow flycatcher habitat along the LCR, but the site should be evaluated in future years. We surveyed the site three times, totaling 2.8 observer-hours. We detected one flycatcher on 27 May between Wispy Willow and Site #1.

Site #1, Site #2, and Site #11

These sites are scheduled for biennial surveys in 2012. We completed one opportunistic survey on 13 June at each site, as the field schedule allowed. All three sites are at the mouth of the Bill Williams River, along an arm of Lake Havasu that follows the river channel, and are vegetated by Goodding willow and cottonwood up to 20 m in height and an understory of tamarisk. Canopy closure is approximately 70%. No flycatchers were detected, but cowbirds were detected at all three sites. The survey totaled 1.8 observer-hours for the three sites combined.

Mineral Wash and Beaver Pond

These sites are scheduled for biennial surveys in 2012. We completed one opportunistic survey on 12 June at each site, as the field schedule allowed. Mineral Wash and Beaver Pond are adjacent sites, approximately 3 km upstream of Site #5, and follow channels of the Bill Williams River. Both sites contain mixed-native vegetation consisting of an overstory of Goodding willow and cottonwood up to 18 m in height and an understory of tamarisk averaging 5 m in height. Each site contained surface water within at least one river channel at the time of the survey. We detected no willow flycatchers but did detect cowbirds at both sites. The survey of Mineral Wash and Beaver Pond totaled 2.3 and 5.5 observer-hours, respectively.

Palo Verde Ecological Reserve, California

PVER PHASE 2

Area: 21.4 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of cottonwood, Goodding willow, and coyote willow, which reach heights of 10, 8, and 5 m, respectively. Height and density of the vegetation varies within and between cells of the site. Canopy closure is highly variable, ranging from <25 to 85%. The entire site has a ground covering of alfalfa (*Medicado sativa*). The site is flood irrigated and contained surface water in a portion of the site during one visit in June.

We detected three willow flycatchers on 16 May, six on 26 May, and two on 9 June. One of the flycatchers detected on 9 June was determined to be color-banded. The combination could not be confirmed with 100% confidence, but it was likely an individual originally banded in southern Nevada. We could not relocate the banded individual on subsequent visits to the site. We surveyed the site six times, totaling 16.5 observer-hours. Large numbers of cowbirds were detected on all visits, and no evidence of livestock use was recorded.

PVER PHASE 3

Area: 21.4 ha Elevation: 85 m

This habitat creation site is vegetated with a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow that reach heights of approximately 10, 5, and 4 m, respectively. Height and density of the vegetation varies within and between the cells of the site. Canopy closure is highly variable, ranging from 50 to 80%. The entire site has a ground covering of alfalfa. The site is flood irrigated and contained surface water in approximately one quarter of the site on visits in June and July.

We detected one willow flycatcher on 16 May and three on 26 May. We surveyed the site six times, totaling 14.5 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock was recorded.

Cibola, Arizona and California

CVCA PHASE 1

Area: 26.2 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. Each cell generally contains a single species and age class. The tallest cottonwoods and willows are around 12 m in height, and canopy closure in the densest areas is 85–90%. Coyote willow reaches 3–6 m in height. The site is flood irrigated and contained standing water in approximately 20% of the site during visits in May and July. The Colorado River is about 100 m from the northern edge of the site; the southern edge is adjacent to CVCA Phase 2; and the remaining two sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected six willow flycatchers on 23 May, three on 31 May, and three on 8 June. The site was surveyed six times, totaling 16.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA PHASE 2

Area: 25.5 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods and Goodding willow reach approximately 12 m, and canopy closure reaches 95% in the densest areas. Coyote willow reaches 3–6 m in height. The site is flood irrigated but did not contain standing water during any of our site description visits. The northern edge of the site is adjacent to CVCA Phase 1, and the remaining sides are surrounded by agriculture. The irrigation canal adjacent to the site held surface water throughout the season.

We detected 11 willow flycatchers on 23 May. The site was surveyed six times totaling 16.0 observer-hours. Large flocks of cowbirds were detected on all visits, and no evidence of livestock use was observed.

CVCA PHASE 3

Area: 38.4 ha Elevation: 73 m

This habitat creation area consists of a mosaic of rectangular cells of cottonwood, Goodding willow, and coyote willow of varying size and density. The tallest cottonwoods reach approximately 10 m in height,

Goodding willows reach 7 m, and coyote willows reach 4 m. Canopy closure varies from 20 to 80%. The site is flood irrigated and contained surface water during a visit in June. The irrigation canal adjacent to the site held water during a visit in July. The site is surrounded by agricultural fields.

We detected 16 willow flycatchers on 24 May and 2 on 1 June. The site was surveyed five times, totaling 14.0 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

CIBOLA NATURE TRAIL

Area: 13.7 ha Elevation: 70 m

This habitat creation site consists of a mosaic of cottonwood, Goodding willow, and mesquite. Approximately half the site consists of scattered screwbean and honey mesquite (*Prosopis glandulosa*) up to 5 m in height with a thick understory of Emory baccharis (*Baccharis emoryii*). The northern half of the site contains an extensive stand of Goodding willow 8 m in height. The northern edge of the willow stand has canopy closure <25%, and many of the willow are dead. The southern half of the willow stand has canopy closure around 70%. The southwestern corner of the site has a small stand of cottonwoods, and stringers of cottonwoods up to 18 m in height occur throughout the site. The site is flood irrigated but did not contain surface water during any of our site description visits.

We detected one willow flycatcher on 1 June. The site was surveyed five times, totaling 6.0 observer-hours. Large numbers of cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA ISLAND

Area: 4.2 ha Elevation: 70 m

This mixed-native site is approximately 9.5 km southwest of Cibola Nature Trail. Dirt roads border the site to the north, east, and west. Open farm fields lie to the east and west, with irrigation channels alongside the roads. An irrigation canal empties into the northern end of the site, creating an open, marshy area down the center of the site. Between this marshy area and the western road, vegetation consists of an overstory of Goodding willow 10–12 m in height with an understory of tamarisk 5–7 m in height. Canopy closure within the willows is 80%. The eastern edge of the marsh is lined with a narrow strip of tamarisk 5–6 m in height with a few emergent Goodding willows on the marsh edge. Between the tamarisk strip and the eastern road, vegetation consists of honey mesquite and bushy arrowweed. The marsh was dry in mid-June and mid-July but had some surface water in early July. The irrigation canal running along the northern border of the site held water in mid-July. This site burned in a fire that started at the end of August.

No willow flycatchers were detected. The site was surveyed three times, totaling 2.3 observer-hours. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA SITE #2 AND CIBOLA SITE #1

Cibola Site #2: Area: 16.4 ha Elevation: 65 m

Cibola Site #1: Area: 7.7 ha Elevation: 65 m

These adjacent, mixed-exotic sites consist of a 200-m-wide strip of riparian vegetation between the channelized Colorado River to the west and a levee road to the east. Woody vegetation consists of a mix of tamarisk and arrowweed, 3–4 m in height, which is dry and scrubby on the eastern edge of the sites and becomes denser toward cattail marshes on the western edge of the sites. Emergent Goodding willow and

cottonwood are scattered along the eastern edge of the marshes. Overall canopy closure is less than 50%. The marshes contained surface water throughout the survey season.

We detected three willow flycatchers at Cibola Site #2 on 25 May and two on 14 June. No willow flycatchers were detected at Cibola Site #1. We surveyed each site five times, totaling 6.2 and 4.1 observer-hours for Cibola Site #2 and Cibola Site #1, respectively. Cowbirds were detected on all surveys, and no evidence of livestock use was observed.

CIBOLA LAKE EAST

Area: 4.5 ha Elevation: 64 m

This site borders the marsh on the eastern edge of Cibola Lake. Vegetation within the site consists primarily of tamarisk. Within 30 m of the marsh edge, tamarisk reaches 6–7 m in height and 90% canopy closure. As distance from the marsh increases, the height and density of the tamarisk decreases, and the tamarisk becomes mixed with arrowweed. Soil within the site was dry throughout the survey season.

We detected one willow flycatcher on 25 May and one on 20 June. The site was surveyed five times, totaling 5.0 observer-hours. Cowbirds were detected on four visits, and burros were heard on the periphery of the site.

WALKER LAKE

Area: 11.4 ha Elevation: 64 m

This mixed-exotic site is located along the northeastern edge of Walker Lake. The majority of the site consists of very dense tamarisk approximately 5 m in height with 90% canopy closure. The southeastern end of the site contains scattered emergent Goodding willow up to 20 m in height, as well as a couple of emergent cottonwoods. This portion of the site also contains a small opening with dead cattails and a small patch of half-dead coyote willow. Walker Lake contained standing water and saturated soil throughout the survey season, and the interior of the southern end of the site also contained surface water in both June and July.

We detected one willow flycatcher on 15 June. The site was visited three times, totaling 4.9 observer-hours. Cowbirds were detected on two surveys, and no evidence of livestock use was observed.

Imperial, Arizona and California

PARADISE

Area: 7.8 ha Elevation: 62 m

The center of this mixed-native site consists of stringers of cottonwood and Goodding willow 15–20 m in height. Tamarisk (5 m in height) and arrowweed (3 m in height) make up the understory. The cottonwoods and willows are separated from the Colorado River by a 50-m-wide strip of dense tamarisk. A marsh borders the western side of the southern third of the site. This marsh had been vegetated by cattails in previous years but now consists primarily of common reed (*Phragmites australis*). Canopy closure within the site is variable. Standing water was present within the marsh in May.

We detected three willow flycatchers on 18 May. The site was surveyed three times, totaling 3.3 observer-hours. Cowbirds were detected on every visit, and no evidence of livestock was noted.

HOGE RANCH

Area: 20.7 ha Elevation: 61 m

This mixed-exotic site borders the Colorado River and is dominated by tamarisk 4–6 m in height, with a few emergent cottonwood and Goodding willow (15 to 18 m in height) at the southern end of the site near the old ranch. Linear marshes with cattail, bulrush, and common reed occupy less than 20% of the interior of the site, and there are a few patches of coyote willow. Canopy closure is variable and reaches 70–90% in areas of dense, woody vegetation. The marshes in the interior of the site were inundated in June and July.

We detected eight willow flycatchers on 21 May and six on 2 June. The site was surveyed five times, totaling 5.9 observer-hours. Cowbirds were detected on every visit, and burros were heard near the site.

RATTLESNAKE

Area: 7.6 ha Elevation: 60 m

This mixed-exotic site is a patchwork of tamarisk 7 m in height with emergent Goodding willow up to 15 m in height and strips of dense coyote willow 6–8 m in height. Dense deadfall and debris within the coyote willows reduce the suitability of the area for willow flycatchers. Canopy closure is 70–90%. Extensive cattail marshes separate this site from the Colorado River. Standing water was present in the interior of the site in June.

We detected three willow flycatchers on 21 May and two on 2 June. The site was surveyed five times, totaling 6.4 observer-hours. Cowbirds were detected on all surveys, and burros were heard at the site.

MILEMARKER 65

Area: 10.0 ha Elevation: 58 m

The site is a narrow strip of mixed-exotic vegetation between the Colorado River and a backwater marsh. Vegetation at the site consists primarily of dense tamarisk 6 m in height. Dense common reed, approximately 3 m in height, also occurs throughout the site and together with the tamarisk creates almost complete canopy closure. Because of the impenetrable vegetation at the site, we surveyed it from the river, and hydrologic conditions in the interior of the site during the surveys are unknown.

We detected one willow flycatcher on 18 May. We surveyed the site twice for a total of 0.9 observer-hours. Cowbirds were detected on both visits, and no evidence of livestock use was observed.

NURSERY NW

Area: 7.0 ha Elevation: 58 m

This mixed-exotic site lies between the Colorado River and a cattail marsh. The dominant vegetation is tamarisk approximately 5 m in height with an understory of common reed. Mesquite trees are scattered along the western edge of the site. The eastern edge of the site, adjacent to the cattail marsh, has a stand of Goodding willow 9 m in height. Overall canopy closure is around 70%, and the densest portions of the site have canopy closure >90%. Surface water was present in marsh and the eastern edge of the site throughout the survey season.

We detected four willow flycatchers on 22 May and two on 5 June. The site was surveyed five times, totaling 6.9 observer-hours. Cowbirds were detected on four visits, and there was no evidence of livestock use.

FERGUSON LAKE

Area: 21.1 ha Elevation: 57 m

The Ferguson Lake site is on a strip of land between Ferguson Lake and the Colorado River. Vegetation is mixed-native, with scattered, emergent Goodding willow 10 m in height along the western edge of the site bordering Ferguson Lake. Tamarisk 5–6 m in height is the dominant understory species, and it forms a continuous canopy in portions of the site. The site also contains patches of arrowweed with scattered screwbean mesquite and little canopy cover. The western edge of the site up to 50 m from the lakeshore had standing water in June and July.

We detected two willow flycatchers on 19 May. The site was surveyed three times, totaling 7.4 observer-hours. Cowbirds were detected on all visits, and no signs of livestock use were observed.

GREAT BLUE HERON

Area: 7.1 ha Elevation: 58 m

This site, on the eastern shore of Martinez Lake, consists of mixed-exotic vegetation. Near the shore of Martinez Lake, Goodding willow forms an overstory 15 m in height, with an understory of tamarisk, common reed, and giant reed (*Arundo* sp.). Canopy closure in this area is 80%. Portions of the site contain thickets of willow deadfall. Farther from the lake, the site is vegetated by scattered arrowweed and tamarisk 6 m in height, with canopy closure <50%. Soils within the site were dry throughout the survey season.

We detected three willow flycatchers on 17 May, nine on 20 May, four on 3 June, and five on 5 June. The site was surveyed five times, totaling 15.9 observer-hours. Cowbirds were detected on all visits, and burros were detected on the periphery of the site.

POWERLINE

Area: 1.0 ha Elevation: 58 m

This mixed-native site consists of a strip of Goodding willow and cottonwood along the border of a cattail marsh. Overstory height is approximately 12 m and canopy closure is approximately 50%. Tamarisk and arrowweed are present in the understory, and honey mesquite is mixed with the tamarisk on the upland edge of the site. Surface water was present in the marsh and in the southern portion of the site in May and June.

We detected two willow flycatchers on 17 May and one on 3 June. We surveyed the site five times, totaling 4.2 observer-hours. Cowbirds were detected on all visits, and burro tracks and scat were noted within the site.

MARTINEZ LAKE

Area: 4.6 ha Elevation: 58 m

This mixed-native site borders the eastern shore of Martinez Lake. The eastern edge of the site, adjacent to the upland, is dominated by arrowweed with scattered Goodding willow, cottonwood, and tamarisk. Goodding willow <10 m in height and cottonwood up to 15 m in height are more prevalent on the western edge of the site, adjacent to cattails and common reed along the lakeshore. Canopy closure is highly variable. The western edge of the site contained saturated soil in May and surface water in June.

We detected two willow flycatchers on 3 June. We surveyed the site five times, totaling 8.8 observer-hours. Cowbirds were detected on all visits, and burros were heard on the periphery of the site.

Mittry Lake, California

MITTRY WEST

Area: 4.4 ha Elevation: 48 m

The center of this mixed-native site is dominated by Goodding willow 12 m in height with a dense understory of arrowweed and tamarisk. Deadfall is common throughout the site, and canopy closure varies from 30 to 70%. Honey and screwbean mesquite are scattered throughout the site but are more common near the periphery. A clump of coyote willow 6 m in height and 50 m in diameter is present in the northeastern corner of the site. Surface water was extensive in the site in May with a few puddles remaining in June.

We detected three willow flycatchers on 17 May. The site was visited three times, totaling 4.3 observer-hours. Cowbirds were detected during all surveys, and no evidence of livestock use was observed.

GROUND RECONNAISSANCE RESULTS

Laguna

Laguna encompasses 449 ha between Imperial and Laguna Dams, on the east side of the Laguna dredge discharge area. This area will be included in future riparian restoration efforts, and we evaluated the existing habitat to determine whether it is suitable for willow flycatchers. Vegetation at the site consists primarily of tamarisk < 4 m in height, arrowweed, and quail bush (*Atriplex lentiformis*). A small cattail marsh is present on the eastern edge of the site; surrounding vegetation consists of tamarisk, arrowweed, and a few 5-m-tall Goodding willow. A patch of Goodding willow 7 m in height with an understory of common reed and tamarisk is present along an old backwater channel in the north-central part of the site, but soils in this area were completely dry during the site visit on 6 June. Overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat, and surface water was present only in one small area. Soils in most of the site were complete dry. We visited the site once, for a total of 8.0 observer-hours. No willow flycatchers were detected. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

Yuma, Arizona

GILA RIVER SITE #2

Area: 2.9 ha Elevation: 45 m

The center of this mixed-native site consists of an overstory of cottonwood up to 15 m in height and Goodding willow approximately 8 m in height, with an understory of arrowweed. Canopy closure in the center of the site is approximately 50%, and there is deadfall in the understory. The remainder of the site is vegetated by tamarisk 4 m in height and arrowweed, with canopy closure <50%. The site is bordered to the north by agricultural fields and to the south by an open, sandy area vegetated by arrowweed. There was no standing water within the vegetation during the survey season, but the northwestern edge of the site borders a marsh, which held water throughout the season.

We detected seven willow flycatchers on 4 June. The site was surveyed four times, totaling 5.3 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

FORTUNA SITE #1

Area: 3.2 ha Elevation: 45 m

This mixed-native site consists of a narrow strip of cottonwood and Goodding willow up to 15 m in height with 50–70% canopy closure. Tamarisk and arrowweed form a patchy understory on the periphery of the site. Within the densest cottonwood/willow areas, there is little understory but many downed branches. The site is bordered to the north by agricultural fields and to the south by a cattail marsh and the Gila River. The interior of the site was dry in June and July, but the adjoining marsh contained surface water.

We detected 15 willow flycatchers on 4 June. We surveyed the site four times, totaling 6.1 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

FORTUNA NORTH

Area: 3.8 ha Elevation: 46 m

This site is vegetated primarily by mature tamarisk approximately 7 m in height. Goodding willow and mesquite, also 7 m in height, are scattered throughout the site but make up less than 10% of the vegetation. Canopy closure is approximately 80% in the densest areas. The Gila River runs along the western edge and through the northwestern corner of the site. No surface water was noted within the woody vegetation during the survey season, but the river contained water.

We detected six willow flycatchers on 4 June and one on 5 June. We surveyed the site four times, totaling 9.5 observer-hours. Cowbirds were detected on all visits, and no evidence of livestock use was observed.

NDOW Study Areas

Field personnel spent 1.0 observer-hour completing broadcast surveys for willow flycatchers at 3 of 19 sites at Key Pittman WMA, River Ranch, and Warm Springs Natural Area. The remaining 17 sites were occupied by resident flycatchers from the beginning of the season and were monitored but not surveyed. Willow flycatcher survey and monitoring results are summarized in Table 2.7 and are presented below along with site descriptions. Details of occupancy, pairing, color-banding, and breeding are presented in Chapters 3 and 4. The boundaries of survey sites and occupancy in 2011 are shown on orthophotos in Appendix B.

In addition to willow flycatcher surveys, field personnel spent 9.0 observer-hours completing broadcast surveys for Yellow-billed Cuckoo at both Key Pittman and River Ranch. The results of cuckoo surveys are summarized below.

Table 2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
KEPI	Patch 0	0.04	2 (6 Jun–8 Aug)
	Patch 1	0.1	2 (29 May–4 Aug)
	Patch 2	0.1	2 (18 May–8 Aug)
	Patch 3	0.1	1 (16 May–27 Jul)[6], 1 (31 Jul)
	Patch 4	0.1	2 (25 May–31 Jul), 3 (27 Jul)[6,7]
	Patch 4.5	0.02	ND

Table 2.7. Willow Flycatcher Detections at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Survey Site	Area (ha)	Number Detected (Date(s) of Detection)[2,3,4,5]
KEPI	Patch 5	0.1	2 (21 May–11 Aug)
	Patch 6	0.2	2 (16 May–6 Jul), 3 (18 Jun–31 Jul), 1 (12 Jul)[8]
	Patch 7	0.1	2 (16 May–11 Aug)
	Patch 8	0.1	2 (1 Jun–4 Aug)
	Patch 9	0.3	2 (16 May–31 Jul), 2 (18 Jun–2 Aug)
	Patch 10	0.1	3 (16 May–8 Aug)
	Patch 10.5	0.02	1 (26 Jun)[9], 1 (24 Jul)[7]
	Patch 11	0.1	4 (6 Jun – 11 Aug), 1 (30 Jun)[8]
	Patch 12	0.1	3 (21 May–14 Aug), 1 (30 Jun), 2 (27 Jul)[9]
	Fence[10]		1 (29 May)
RIRA	West Side	0.3	2 (15 Jun–3 Jul), 1 (23 Jun–13 Jul), 1 (19 Jun), 1 (23–27 Jul)
	East Side	0.4	2 (15 Jun–27 Jul)
	Smalls	0.5	1 (15 Jun–16 Jul), 1 (27–29 Jun)
WMSP	Muddy Mac	0.7	2 (15 May–28 Jul), 3 (26 May)

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] ND = No willow flycatchers were detected.

[3] See Chapter 3 for details on territories, residency, pairing, and color-banding; see Chapter 4 for details on nesting activity.

[4] Flycatchers in territories that were occupied throughout the breeding season are shown as being present throughout the season. Flycatchers detected on a single occasion or for a short period of time are listed separately.

[5] We detected several within-season movements between study areas in 2011. See Table 3.9 for details.

[6] One individual detected 16 May–27 Jul in Patch 3 and recaptured 27 Jul in Patch 4.

[7] One individual detected 26 Jun in Patch 10.5 and recaptured 27 Jul in Patch 4

[8] This individual detected 30 Jun in Patch 11 and12 Jul in Patch 6.

[9] One individual recaptured 26 Jun in Patch 10.5 and 27 Jul in Patch 12.

[10] Not an official survey site. Incidental detections recorded.

Key Pittman Wildlife Management Area, Nevada

PATCHES 0–12

Area: 1.4 ha Elevation: 1,169 m

This study area is divided into 15 small stands of coyote willow. These stands form a strip of habitat between bulrush marsh on the edge of Nesbitt Lake to the east and dry upland scrub dominated by saltbush and grasses to the west. Most of the stands are independent of each other, but four stands (Patches 6–9) have grown together, forming a larger contiguous stand. Each stand is characterized by very dense, large-diameter stems of coyote willow. Some areas have fallen or leaning stems with wispy growth in the lower 2 m, making traversing those areas difficult. Canopy height ranges from 4 to 8 m with the taller stems occurring in the center of each site, giving each stand a rounded look. Canopy closure is 70–90%. Surface water was present along the eastern edge in May and June, though no more than 10% of the area within the sites was inundated, with an additional 5% saturated. Soils were damp in July with no saturated soil or standing water.

We located 33 breeding willow flycatchers across 13 of the 15 sites. We detected one resident, unpaired male and an additional seven individuals for which we could not determine residency. An additional individual of undetermined residency was detected on a fence adjacent to the sites. Only the unoccupied site, Patch 4.5, was surveyed, totaling 0.3 observer-hours. Cowbirds were detected during one survey but were noted throughout the season during nest monitoring activities. Signs of cattle were present in the dry upland scrub, but the sites have been fenced off to prevent damage. Deer were present within the sites, but do not appear to heavily impact the vegetation structure.

YELLOW-BILLED CUCKOO SURVEYS

We completed four surveys for Yellow-billed Cuckoo at Key Pittman, totaling 6.5 observer-hours. The first survey included Patches 0–4.5 as well as the cottonwood stand at the southern end of Nesbitt Lake. The final three surveys covered the cottonwood stand and Patches 0–12. No Yellow-billed Cuckoos were detected.

River Ranch

River Ranch is in the Pahranagat Valley, approximately 12 km south of Key Pittman, and consists of several isolated patches of vegetation. Each patch is surrounded on all sides by grazed, irrigated cattle pasture, and the perimeter of each site has a distinct browse line at 1.5 m in height.

WEST SIDE

Area: 0.3 ha Elevation: 1,100 m

This site is composed primarily of dense, large-diameter coyote willow 7 m in height. Shorter coyote willow approximately 4 m in height is present around the perimeter, giving the site a rounded look. A gap 3 to 5 m wide runs diagonally through the site from the northwestern to the southeastern corner. Some Russian olive is scattered along the perimeter of this gap. There is little to no understory, except where willows are regenerating and in the gap, where grasses and other herbaceous plants dominate. Canopy closure is 90% throughout most of the site, except in the gap where it varies from 0 to 30%. Areas of deadfall up to 1 m deep are scattered throughout the site, making travel difficult in places. Water levels fluctuated throughout the season depending on irrigation activity. Maximum water extent included flowing, 10-cm-deep water covering approximately 50% of the site, saturated soils covering an additional 30%, and 20% with damp soils. Minimum water extent included damp soils throughout the site. Water tended to pool in a ditch approximately 1 m wide and 0.2 m deep surrounding the site.

We detected two breeding flycatchers and one male for which breeding status could not be confirmed. We also detected an additional two individuals for which residency could not be determined. Due to flycatcher occupancy, this site was surveyed only once, totaling 0.4 observer-hours. No cowbirds were detected during the survey, but they were noted intermittently throughout the breeding season in low numbers. Signs of cattle were present in and surrounding the site, but the cattle do not appear to use the interior of the site extensively.

EAST SIDE

Area: 0.4 ha Elevation: 1,100 m

This site is composed primarily of dense, large-diameter coyote willow 6 to 7 m in height. Tree height is shorter at the perimeter, giving the site a rounded appearance. Russian olive and velvet ash (*Fraxinus velutina*) occur in low numbers. There are numerous piles of deadfall scattered throughout the site. Little to no understory is present, except where the willow is able to regenerate and also in some small clearings

where herbaceous vegetation dominates. Canopy closure is primarily 70–80%, except in a few scattered clearings where it ranges from 0 to 25%. Water levels fluctuated throughout the season depending on irrigation activity. Maximum water extent included damp to almost saturated soils throughout and a ditch of water 1 m wide and 0.2 m deep surrounding the site. Minimum water extent included dry soils throughout the site.

We detected two breeding flycatchers. Due to flycatcher occupancy, no formal surveys were conducted. Brown-headed cowbirds were noted intermittently throughout the breeding season in low numbers. Signs of cattle were present throughout and surrounding the site, with cattle trails throughout the interior of the site.

SMALLS

Area: 0.5 ha Elevation: 1,100 m

This site is composed primarily of coyote willow 5 m tall. There is little understory except sparse, regenerating willow in the densely vegetated areas. A large gap in the vegetation, totaling approximately 25% of the site, dominates the northern half of the site. This gap is ringed by a stand of shorter coyote willow approximately 4 m in height and 4 m wide on the western, northern, and eastern sides. Canopy closure averages 80-85% in the vegetated areas. Deadfall is scattered throughout the site but typically does not occur in piles as it does in West Side and East Side. Water levels were variable throughout the season depending on irrigation activity. Maximum water extent included a pool of water at the northern end of the site and saturated soils throughout the remainder of the site. Minimum water extent included completely dry soils throughout the site.

We detected one male for which breeding status could not be confirmed and an additional individual for which we could not determine residency. Due to flycatcher occupancy, this site was surveyed only once, totaling 0.4 observer-hours. No cowbirds were detected during the survey, though they were noted at other times during the breeding season. Signs of heavy cattle use were present throughout the site.

YELLOW-BILLED CUCKOO SURVEYS

We completed three surveys for Yellow-billed Cuckoo at River Ranch, totaling 2.5 observer-hours. All suitable habitat was covered in each survey. No Yellow-billed Cuckoos were detected.

Warm Springs Natural Area

On 1 July 2010, a wildfire burned at least part of all the survey sites at Warm Springs. At the beginning of the breeding season of 2011, ground reconnaissance was conducted at all sites to assess the extent of the damage and suitability of habitat for flycatchers. The degree of damage varied from site to site and ranged from almost complete consumption of all vegetation to consumption of the understory with overstory structure intact but the canopy reduced by 80–90%. Regeneration of woody vegetation was noted at all sites, but vegetation was generally sparse and less than 2 m in height. One site was partially damaged in the fire with the remainder largely undamaged. Due to the degree of fire damage, surveys were discontinued at all sites except for the one partially damaged site.

MUDDY MAC

Area: 0.7 ha Elevation: 548 m

This native site is near the head of Apcar Stream. The northern portion of the site was heavily damaged in the 2010 fire, with the overstory being completely killed. Dense basal regeneration of velvet ash is occurring, but live vegetation is only 2 m in height. The southern half of the site is characterized by a

very dense velvet ash stand 8–9 m in height with no understory and ≥80% canopy closure. The extreme southern end of this site was also damaged in the 2010 fire with most of the trees consumed and only grass growing under the snags. Surface water was present throughout the survey season in the form of a flowing stream near the southern edge of the site. Soils were saturated in May with some standing water, but by June interior soils were completely dry.

We detected two breeding flycatchers and three individuals for which residency could not be determined. Due to flycatcher occupancy, this site was not formally surveyed. A cowbird was detected during one nest monitoring visit. No evidence of livestock was observed.

YELLOW-BILLED CUCKOO SURVEYS

No Yellow-billed Cuckoo surveys were conducted at Warm Springs in 2011 due to lack of suitable habitat.

DISCUSSION

The six Reclamation study areas occupied in 2011 by breeding flycatchers (Pahranagat NWR, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams River NWR) consistently held resident and breeding flycatchers in previous years (McKernan and Braden 2002; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011; details of residency and breeding in 2011 are presented in Chapters 3 and 4 of this document). In 2009 and 2010, breeding flycatchers were recorded along Beaver Dam Wash at Littlefield (Littlefield Poles) for the first time since 2004. Vegetation at Littlefield Poles was scoured during floods in December 2010, and the hydrology was altered so that no surface water was present at the site during visits in May and June. Surveys were discontinued at the site after the visit in June because of these changes. No flycatchers were recorded at the site in 2011.

A single pair of breeding flycatchers was detected at a new site in 2011. Along the Bill Williams River, breeding flycatchers were detected at Cougar Point, which had not previously been surveyed. The site consists of young, even-aged vegetation that likely only recently reached sufficient size to be suitable flycatcher breeding habitat.

Hydrologic conditions at Mesquite West in May and early June 2011 were similar to those observed in all prior years except 2009. In 2009, the site was largely dry, and premature leaf abscission was observed as early as May. In 2011, the site was wet through the beginning of the breeding season In mid-June, earthwork at the inflow to the site diverted water along the edge of the site and into the Virgin River. Although the site became dry, the canopy remained largely intact with only a minor amount of leaf abscission detected in August. Despite the presence of wet conditions in early 2011, the number of resident flycatchers (11) detected at Mesquite West in 2011 was lower than the numbers detected in previous years (25, 25, 24, 20, and 16 in 2006 through 2010, respectively). The decline in flycatcher numbers between 2009 and 2010 was likely influenced by poor nest success and poor habitat conditions in 2009 (McLeod and Pellegrini 2011). Reasons for the continued decline remain undetermined, but habitat suitability in the western portion of Mesquite West, which was not occupied in 2011, may be influenced by the defoliation of tamarisk.

Marsh elevations at Topock were lower than in any year since 2005. The number of resident adults detected at Topock continued to decline, with 5 resident adults detected in 2011, versus 36, 29, 18, 20, 14, and 11 detected in each year in 2005 through 2010, respectively. Changes over the years in the timing and magnitude of fluctuations in marsh levels may have contributed to the decline in the Topock flycatcher population (see Chapter 8). We continued our efforts to locate all potentially suitable willow

flycatcher habitat at Topock Marsh. We revisited two sites that were visited briefly in 2010; one site was surveyed regularly, and visits to the other site were discontinued because of lack of suitable habitat.

Tamarisk beetles were present at both Mesquite and Mormon Mesa in 2011. Extensive defoliation was noted in the vicinity of the Mesquite sites in June, but the areas currently occupied by willow flycatchers are primarily native, and defoliation did not have any noticeable effect on breeding. Defoliation was noted in the Mormon Mesa study area at all sites starting in July, with extensive defoliation noted by late July. Roughly half of the nests in Mormon Mesa are located in primarily native stands. The remaining nests are located in either mixed stands with a primarily native canopy, or in primarily non-native vegetation. Defoliation from tamarisk beetle activity therefore potentially affected only some of the nest stands at Mormon Mesa. In addition, the majority of flycatcher nesting attempts had either fledged or failed by the time defoliation became widespread, and there was no evidence that flycatcher nesting was affected by defoliation. Defoliation will presumably occur earlier in the year in 2012 at the Mormon Mesa sites now that tamarisk beetles are established in the area and thus may have greater effects on flycatcher nesting next year. Tamarisk beetles were noted as far downstream on the Virgin River as Lake Mead by the end of August, and defoliation was also observed on the Muddy River as far downstream as Overton and as far upstream as Warm Springs. The Muddy River study area may be affected by tamarisk beetles in 2012.

Although 154 flycatcher detections were recorded at sites surveyed south of the Bill Williams, monitoring results and behavioral observations (lack of territorial, aggressive behaviors exhibited toward conspecific broadcasts) at these sites suggest these flycatchers were not resident or breeding individuals but migrants. These results are consistent with those recorded in 2003–2010 (McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Banding studies in the Yuma area completed in 2003–2007 also suggested that willow flycatchers detected in mid-June were migrants (McLeod et al. 2008a). Migrant willow flycatchers along the lower Colorado River could belong to one of several subspecies (*E. t. extimus*, *E. t. adastus*, or *E. t. brewsteri*), and unless an individual is banded, it is impossible to determine in the field whether a migrant is *E. t. extimus* or one of the other two subspecies. A model based on plumage color variation predicted that approximately half of 96 willow flycatchers captured in the Yuma area in mid-June in 2004–2007 were *E. t. extimus* (Paxton et al. 2010), indicating that the southwestern subspecies does use the lower Colorado River as a migration corridor. In addition, two flycatchers banded at breeding sites monitored as part of the lower Colorado River study have been detected at sites south of the Bill Williams. Both individuals were detected for only one day and did not exhibit territorial behavior, suggesting they were migrants. The first individual was detected along the Gila River in Yuma in May 2005. It was identified by the presence of a single anodized federal band as having been banded as a nestling at one of the Reclamation study areas in either 2003 or 2004. In June 2011, a fully banded flycatcher was detected in PVER 2, one of the Reclamation habitat creation sites along the LCR. While the identity of the individual could not be confirmed by repeated observations, it was very likely banded in southern Nevada. This is the first confirmed sighting of a Southwestern Willow Flycatcher in one of the habitat creation sites south of the Bill Williams. Although the bird was likely a migrant, this detection demonstrates the importance of the habitat creation sites as stopover habitat for migrating Southwestern Willow Flycatchers. Flycatchers from breeding areas along the lower Colorado River and its tributaries may also provide a potential source population for the colonization of habitat creation sites (see Discussion in Chapter 3).

Chapter 3

COLOR-BANDING AND RESIGHTING

INTRODUCTION

Long-term monitoring of willow flycatchers of known identity, sex, and age is the only effective way to determine demographic life history parameters such as annual survivorship of adults and young, site fidelity, seasonal and between-year movements, and population structure. Thus, as an integral part of our studies, we captured and uniquely color-banded as many willow flycatchers as possible, allowing field personnel to resight individuals throughout the breeding season, as well as in subsequent years. Resighting consisted of using binoculars to determine the identity of a color-banded flycatcher by observing, from a distance, the unique color combination on its legs. This allowed field personnel to detect and monitor individuals without recapturing each bird. This was our ninth consecutive year of color-banding studies and builds upon color-banding initiated at these sites in 1997 (McKernan and Braden 1998).

METHODS

Color-Banding

From early May through mid-August, we captured, uniquely color-banded, and subsequently monitored adult and nestling willow flycatchers at all study areas where resident willow flycatchers were detected. The color-banding effort also included Key Pittman Wildlife Management Area, River Ranch, and Warm Springs Natural Area in Nevada (in cooperation with Nevada Department of Wildlife) and opportunistic banding in St. George, Utah (in cooperation with Utah Division of Wildlife Resources).

Adult flycatchers were captured with mist-nets, which provide the most effective technique for live-capture of adult songbirds (Ralph et al. 1993). We used a targeted capture technique (per Sogge et al. 2001), whereby a variety of conspecific vocalizations were broadcast from a CD player and remote speakers to lure territorial flycatchers into the nets. In addition, we used “passive netting,” whereby several mist-nets were erected and periodically checked, with no broadcast of conspecific vocalizations. We banded each adult willow flycatcher with a single, numbered U.S. federal aluminum band on one leg and a colored metal band on the other. We coordinated all color combinations with the Federal Bird Banding Laboratory and all other Southwestern Willow Flycatcher banding projects to minimize duplication of color combinations. For each color-banded bird recaptured, we visually inspected the legs and noted any evidence of irritation or injury that may be related to the presence of leg bands.

Nestlings were banded at 8 to 10 days of age, when they were large enough to retain the leg bands, yet young enough that they would not prematurely fledge from the nest (Whitfield 1990, Paxton et al. 1997). Nestlings were banded only when the location of the nest was such that nest access and removal/replacement of the nestlings would not endanger the nest, nest plant, or nestlings. Nestlings were also banded with a single, numbered federal band on one leg and a metal color-band on the other leg. Prior to 2008, we banded each nestling only with a single federal band, identifying it as a returning nestling in the event it returned in a subsequent year.

For each captured adult willow flycatcher, we recorded morphological measurements, including culmen, tail, wing, fat level, and molt onto standardized data forms (Appendix A). Sex was determined based on the presence of a cloacal protuberance in males or brood patch and/or egg(s) in the oviduct for females. Captured flycatchers lacking breeding characteristics and not observed engaging in male advertising song (see below) were sexed as unknown. Flycatchers with retained primary, secondary, and/or primary covert feathers (multiple aged remiges) were aged as second year adults, and those without (uniformly aged remiges) were aged as after second year (per Kenwood and Paxton 2001 and Koronkiewicz et al. 2002). Individuals in juvenile plumage (unworn flight feathers and body plumage with broad, buff-colored wing bars and fleshy gape) were aged as hatch year.

Resighting

We determined the identity of a color-banded flycatcher by observing with binoculars, from a distance, the unique color combination on its legs. Typically, territories and active nests were focal areas for resighting, but entire sites were surveyed. Field personnel typically spent the early part of each morning color-banding, and directed their efforts to resighting as daylight increased and flycatchers became more difficult to capture. All banding, monitoring, and survey field personnel coordinated resighting efforts and recorded observations of color-banded and unbanded flycatchers onto standardized data forms (Appendix A). For resighted flycatchers (i.e., ones for which at least one leg was seen clearly enough to determine the presence or absence of a band), we recorded color-band combinations, territory number, site, standardized confidence levels of the resight, and behavioral observations. Willow flycatchers for which detections spanned one week or longer were considered resident at a site, regardless of the portion of the breeding season in which the bird was observed or whether a possible mate was observed. Flycatchers observed engaging in breeding behaviors (e.g., carrying nest material) were also considered resident regardless of the period of time over which they were observed. Flycatchers observed engaging in lengthy, primary song from high perches (male advertising song) were sexed as male, and flycatchers observed carrying nest material or constructing or incubating a nest were sexed as female. Flycatchers not observed engaging in one of these diagnostic activities were sexed as unknown.

Inactive territories were visited at least three times (each visit four days apart) before territory visits stopped. All territories were assigned a unique alphanumeric code and were plotted onto high-resolution aerial photographs, thus producing a spatial representation of the flycatcher population at each study location. If multiple females were paired with a single male, each female received a unique territory number. Flycatchers were determined to be unpaired if none of the following breeding behaviors were observed: presence of another unchallenged flycatcher in the immediate vicinity, counter calling (*whitts*) with a nearby flycatcher, interaction twitter calls (*churr/kitters*) with a nearby flycatcher, a flycatcher in the immediate vicinity carrying nesting material, a flycatcher in the immediate vicinity carrying food or fecal sac, or adult flycatchers feeding young (per Sogge et al. 1997).

Unbanded flycatchers could not be identified to individual, but an unbanded flycatcher detected in a given location on multiple, consecutive visits was assumed to be the same individual. If an unbanded flycatcher or a flycatcher whose legs were not observed was detected at a given location on multiple visits but one or more intervening visits failed to detect a flycatcher, the detections were considered to be different individuals in the absence of behavioral observations indicating the flycatcher was actively defending a territory or was a member of a breeding pair.

RESULTS

Reclamation Study Areas

Color-Banding and Resighting – Field personnel color-banded 15 new adult flycatchers and recaptured 11 individuals previously captured as adults. An additional 31 adults were identified to individual via resighting, while 3 individuals were resighted but did not have their color combinations confirmed. Of the 31 adults that were resighted and identified, one was identified for the first time since it was banded as a nestling. We identified two additional individuals as returning nestlings by the presence of a single federal band, with one (50%) identified to individual via recapture. We recaptured two additional returning nestlings with full color combinations. Thirty adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for 30 adults. Overall, 52% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.1). We banded 40 nestlings from 17 nests. Of the 40 nestlings banded, 5 were known or suspected to have died before fledging. We resighted an additional 10 unbanded fledglings from six nests; one fledgling was captured and banded. For details on all banded flycatchers detected at the study areas from 2003 to 2011, see Appendix E.

Site-by-Site Color-Banding and Resighting

Pahranagat – We detected 14 resident, adult willow flycatchers from 10 territories at Pahranagat. In addition to resident adults, we detected seven individuals for which residency and/or breeding status could not be confirmed (Table 3.2). Of the 10 territories recorded at Pahranagat, 6 consisted of breeding pairs, and 4 consisted of unpaired males. Of the breeding individuals, one male was polygynous with three females. One resident female moved from her territory in Pahranagat North and was resighted at Pahranagat West along with three banded fledges.

Field personnel captured and color-banded four new adults and recaptured three flycatchers previously captured as adults. We resighted and identified an additional 10 adults. Three adults remained unbanded. Of the resighted adults, one was originally banded as a nestling in 2010 (see Table 3.8 for juvenile dispersal data). The color combination could not be determined for one adult. We banded 11 nestlings from four nests. We resighted seven unbanded fledglings from three additional nests; one fledgling was captured and banded.

Mesquite – We detected 14 resident, adult willow flycatchers from eight territories at Mesquite. Of the eight territories recorded at Mesquite, seven consisted of paired individuals and one consisted of an unpaired male (Table 3.2). Of the breeding individuals, two males were each polygynous with two females. The male at one territory was displaced by another male that moved from Muddy River (Table 3.9).

Field personnel captured and color-banded three new adults and confirmed the identities of an additional six adults via resighting. Three adults remained unbanded, and band status could not be determined for two adults. We banded five nestlings from two nests.

Mormon Mesa – We detected 23 resident, adult willow flycatchers from 14 territories at Mormon Mesa. In addition to resident adults, we detected three individuals for which residency could not be confirmed (Table 3.2). Of the 14 territories recorded at Mormon Mesa, 13 consisted of breeding individuals and 1 consisted of an unpaired male. One breeding male moved from Muddy River, and one male for which residency could not be confirmed moved from Mesquite West (Table 3.9). One female mated

consecutively with two males and four males were polygynous, one with three females and three with two females.

Field personnel captured and color-banded one new adult and recaptured five flycatchers previously captured as adults. We resighted and identified nine additional adults. We captured one returning nestling originally banded as a juvenile in 2007 (see Table 3.8) and resighted one returning nestling with a single federal band that we were unable to recapture. Eight adults remained unbanded, and band combination could not be confirmed for one adult. We banded 16 nestlings, two of which were suspected to have died before fledging, from seven nests and resighted three unbanded fledglings from three nests.

Muddy River – We detected 13 resident, adult willow flycatchers from eight territories at Muddy River. In addition to resident adults, we detected three individuals for which residency could not be confirmed. Of the eight territories recorded, five consisted of breeding pairs and three consisted of unpaired males (Table 3.2). One breeding male moved to Mormon Mesa and one unpaired male moved to Mesquite (Table 3.9).

Field personnel captured and color-banded three new adults and recaptured two flycatchers previously captured as adults. We recaptured two returning nestlings; one was originally banded in 2009 and the other in 2010 (see Table 3.8). We resighted and identified four other adults. Four adults remained unbanded, and band status could not be confirmed for one adult. We banded four nestlings from two nests; three of these nestlings died before fledging.

Topock – We detected five resident, adult willow flycatchers from five territories at Topock. In addition to resident adults, we detected 28 individuals for which residency could not be confirmed (Table 3.2). Of the five territories recorded at Topock, one consisted of a breeding pair and four consisted of unpaired males. One of the unpaired males established a territory at Platform and then moved to The Wallows and established a second territory.

Field personnel captured and color-banded two new adults and recaptured one flycatcher originally captured as an adult. We resighted and identified one other banded adult. Nine adults remained unbanded, and the band status of 19 individuals could not be determined. The color combination of one banded adult could not be confirmed.

Bill Williams – We detected eight resident willow flycatchers from five territories at Bill Williams. In addition to resident adults, we detected nine individuals for which residency could not be determined (Table 3.2). Of the five territories recorded at Bill Williams, four consisted of breeding individuals and one consisted of an unpaired male. One male was polygynous with two females. At one breeding territory, personnel from an unrelated field crew reported a singing male, but only the female was detected during nest monitoring visits.

Field personnel captured and color-banded two new adults. We resighted and identified four returning banded adults. Three adults remained unbanded, and band status could not be determined for eight adults. We banded four nestlings from two nests.

Table 3.1. Willow Flycatchers Detected at Reclamation Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Detected in Previous Year(s) as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Pahranagat	North	21	4	3	0	10	0	3	0	1	11(4)	1	86
	West	1[1]	0	0	0	1[1]	0	0	0	0	0	3[2]	100
	Study Area Total	**21**	**4**	**3**	**0**	**10**	**0**	**3**	**0**	**1**	**11(4)**	**1**	**86**
Mesquite	Hafen Lane	3	2	0	0	1[3]	0	0	0	0	0	0	100
	West	11	1	0	0	5[4]	0	3	2	0	5(2)	0	55
	Study Area Total	**14**	**3**	**0**	**0**	**6**	**0**	**3**	**2**	**0**	**5(2)**	**0**	**64**
Mormon Mesa	Virgin River #1 (North)	5	0	0	0	1	0	3	0	1	0	0	40
	Virgin River #1 (South)	21	1	5[4]	1	8[5]	1[6]	5	0	0	16(7)[7]	0	76
	Study Area Total	**26**	**1**	**5**	**1**	**9**	**1**	**8**	**0**	**1**	**16(7)**	**0**	**69**
Muddy River	Overton Pond	1	0	0	0	0	0	1	0	0	0	0	0
	Overton WMA	15	3	2[3,5]	2	4	0	3	1	0	4(2)[8]	0	73
	Study Area Total	**16**	**3**	**2**	**2**	**4**	**0**	**4**	**1**	**0**	**4(2)**	**0**	**69**
Topock	Pipes #1	1	0	0	0	0	0	0	0	1	0	0	100
	Pipes #3	3	1	0	0	1[9]	0	0	1	0	0	0	67
	The Wallows	3	0	0	0	1[10]	0	2	0	0	0	0	33
	PC6-1	1	0	0	0	0	0	1	0	0	0	0	0
	In Between	1	0	0	0	0	0	0	1	0	0	0	0
	800M	3	0	1[9]	0	0	0	1	1	0	0	0	33
	Pierced Egg	4	0	0	0	0	0	0	4	0	0	0	0
	Swine Paradise	1	0	0	0	0	0	1	0	0	0	0	0
	Platform	1	0	0	0	1[10]	0	0	0	0	0	0	100
	Hell Bird	10	1	0	0	0	0	2	7	0	0	0	10
	Spaghetti	2	0	0	0	0	0	0	2	0	0	0	0
	Beal Lake	1	0	0	0	0	0	0	1	0	0	0	0
	Lost Lake	1	0	0	0	0	0	1	0	0	0	0	0
	Dock[11]	3	0	0	0	0	0	1	2	0	0	0	0
	Study Area Total	**33**	**2**	**1**	**0**	**1**	**0**	**9**	**19**	**1**	**0**	**0**	**15**
Bill Williams	Wispy Willow	1	0	0	0	0	0	0	1	0	0	0	0
	Burn Edge	1	0	0	0	0	0	0	1	0	0	0	0
	Site #4	3	0	0	0	0	0	2	1	0	0	0	0
	Site #3	3	0	0	0	2	0	0	1	0	1(1)	0	67
	Site #5	2	0	0	0	0	0	0	2	0	0	0	0
	Cougar Point	2	1	0	0	0	0	0	1	0	0	0	50
	Planet Ranch Rd	5	1	0	0	2	0	1	1	0	3(1)	0	60
	Study Area Total	**17**	**2**	**0**	**0**	**4**	**0**	**3**	**8**	**0**	**4(2)**	**0**	**35**
Total		**124**	**15**	**11**	**3**	**31**	**1**	**30**	**30**	**3**	**40(17)**	**1**	**52**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.2.

[1] One individual moved from North to West and is tallied only once in the total.

[2] Three HY individuals moved from North to West. These individuals were resighted, not captured, at West and are not tallied in the total.

[3] One individual moved from Muddy River Overton WMA to Mesquite Hafen Lane and is tallied only once in the total.

[4] One individual moved from Mesquite West to Mormon Mesa Virgin River #1 South and is tallied only once in the total.

[5] One individual moved from Muddy River Overton WMA to Mormon Mesa Virgin River #1 South and is tallied only once in the total.

[6] Returning nestling.

[7] Two nestlings suspected to have died before fledging.

[8] Three nestlings died before fledging.

[9] One individual moved from 800M to Pipes #3 and is tallied only once in the total.

[10] One individual moved from Platform to The Wallows and is tallied only once in the total.

[11] Not a formal survey site. Flycatchers detected en route.

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	26-Jun-09	2430-61087	OB(M):XX	N/A	A4Y	F	12	R 12 Jul
	North	24-Jun-08	2430-61176	DK(M):XX	N/A	4Y	M	12	R 19 Jun
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	12	RS
	North	26-Jun-11	2540-58111	TQ:RYR(M)	N/A	AHY	F	13	N
	North	19-Jul-08	2430-61080	YY(M):XX	N/A	5Y	M	13	RS
	North	8-Jul-11	2590-53104	XX:GVG(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53102	XX:RV(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53103	XX:BRB(M)	N/A	L	U	13	N
	North	8-Jul-11	2590-53101	XX:DOD(M)	N/A	L	U	13	N
	North	24-Jun-11	2540-58110	RKR(M):TQ	N/A	AHY	F	23,F84	N; detected 21 Jul at F84 in PAHR West
	North	25-Jun-08	2430-61179	XX:KB(M)	N/A	A5Y	M	23,43,128	RS
	North	2-Jul-11	2430-61215	WBW(M):XX	N/A	L	U	23	N
	North	2-Jul-11	2430-61218	XX:OYO(M)	N/A	L	U	23,F81	N; detected 21–25 Jul at F81 in PAHR West
	North	1-Jul-08	2430-61120	XX:KO(M)	N/A	4Y	F	31	R 12 Jul
	North	21-Jun-06	2370-40060	YG(M):PU	N/A	A7Y	M	31	RS
	North	20-Jul-11	2590-53109	XX:WKW(M)	N/A	HY	U	31	N
	North	N/A	N/A	UB:UB	N/A	HY	U	31	RS
	North	N/A	N/A	UB:UB	N/A	HY	U	31	RS
	North	1-Jul-06	2370-40047	PU:DD(M)	N/A	A7Y	F	43	RS
	North	3-Jul-11	2430-61220	RGR(M):XX	N/A	L	U	43	N
	North	3-Jul-11	2540-58114	YDY(M):TQ	N/A	L	U	43	N
	North	18-Jul-10	2540-58293	BO(M):TQ	N/A	3Y	F	128	RS
	North	6-Jul-11	2540-58286	TQ:DYD(M)	N/A	L	U	128	N

AR064731

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
PAHR	North	6-Jul-11	2540-58284	GW(M):TQ	N/A	L	U	128	N
	North	6-Jul-11	2540-58285	TQ:YG(M)	N/A	L	U	128	N
	North	24-Jul-08	2430-61083	XX:YR(M)	N/A	5Y	M	T21	RS; detected 18 May–28 Jul
	North	7-Jul-06	2360-59754	OR(M):EE	N/A	6Y	M	T41	RS; detected 28 May–9 Jun
	North	18-May-04	2320-31595	WKW(M):EE	N/A	A9Y	M	T48	RS; detected 24 May–1 Aug
	North	6-Jul-05	2360-59712	EE:GKG(M)	N/A	7Y	M	T64	RS; detected 28 May–19 Jul
	North	13-Jun-11	2540-58245	TQ:KYK(M)	N/A	SY	M	F73	N; detected 13 Jun
	North	N/A	N/A	UB:UB	N/A	AHY	U	F76	RS; detected 18 May
	North	21-Jul-10	2540-58201	TQ:BO(M)	N/A	SY	U	F77	RS; detected 12 Jul
	North	INA	INA	banded	N/A	AHY	M	F78	RS; detected 4 Aug
	North	N/A	N/A	UB:UB	N/A	AHY	M	F79	RS; detected 18 May
	West	INA	INA	banded	N/A	HY	U	F80	RS; detected 21–25 Jul, probably from 128
	West	N/A	N/A	UB:UB	N/A	HY	U	F82	RS; detected 21 Jul, probably from PAHR North
	North	N/A	N/A	UB:UB	N/A	AHY	U	F83	RS; detected 12 Jul
	North	17-Jun-11	2540-58109	WK(M):TQ	N/A	SY	M	F120	N; detected 17–19 Jun, detected 23 Jun–13 Jul at T109 in RIRA West Side
MESQ	West	N/A	N/A	UB:UB	N/A	AHY	F	30	RS
	West	15-Jul-05	2320-31688	EE:BG(M)	N/A	7Y	M	30	RS
	West	13-Aug-11	2590-53152	XX:OKO(M)	N/A	L	U	30	N
	West	13-Aug-11	2590-53154	XX:GRG(M)	N/A	L	U	30	N
	Hafen Lane	22-Jul-11	2540-58152	TQ:KWK(M)	N/A	AHY	F	32	N
	Hafen Lane	30-Jun-11	2540-58176	TQ:WG(M)	N/A	SY	M	32	N; detected 30 Jun–17 Jul
	Hafen Lane	19-Jun-09	2370-39930	PU:GO(M)	N/A	3Y	M	32	RS; detected 21–23 Jul, detected 17 May–17 Jul at T22 in MUDD Overton WMA
	West	INA	INA	undetermined	N/A	AHY	F	40	
	West	6-Jun-10	2540-58192	TQ:BG(M)	N/A	A3Y	M	40, 103	RS; captured 24 Jul at F20 in MOME Virgin River #1 South

AR064732

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MESQ	West	26-Jul-07	2370-40087	PU:BZ(M)	N/A	A6Y	F	72	RS
	West	N/A	N/A	UB:UB	N/A	AHY	M	72	RS
	West	N/A	N/A	UB:UB	N/A	AHY	F	80	RS
	West	16-Jun-09	2370-40175	PU:OKO(M)	N/A	3Y	M	80, 127	RS
	West	21-Jul-10	2430-61234	XX:WGW(M)	N/A	A3Y	F	103	RS
	West	1-Jul-11	2430-61216	OKO(M):XX	N/A	L	U	103	N
	West	1-Jul-11	2430-61217	XX:YVY(M)	N/A	L	U	103	N
	West	1-Jul-11	2540-58112	WW(M):TQ	N/A	L	U	103	N
	West	INA	INA	undetermined	N/A	AHY	F	127	
	West	14-Jun-11	2540-58172	TQ:VV(M)	N/A	AHY	M	T102	N
MOME	Virgin River #1 South	6-Aug-05	2360-59788	BO(M):EE	N/A	7Y	F	1	RS
	Virgin River #1 South	22-Jul-02	2140-66709	Bs:GW(M)	N/A	A11Y	M	1, 91	RS
	Virgin River #1 South	15-Jun-11	2540-58174	TQ:WK(M)	N/A	L	U	1	N
	Virgin River #1 South	15-Jun-11	2540-58173	TQ:VW(M)	N/A	L	U	1	N, R 12 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	1	RS
	Virgin River #1 South	25-Jun-07	2360-59777	EE:YKY(M)	EE:UB	5Y	F	2	R 19 Jul
	Virgin River #1 South	4-Jul-01	none[9]	UB:GY(M)	UB:XX	11Y	M	2, 7, 90	R 20 Jun and 19 Jul
	Virgin River #1 South	22-Jul-11	2590-53116	YDY(M):XX	N/A	L	U	2	N
	Virgin River #1 South	22-Jul-11	2590-56115	RKR(M):XX	N/A	L	U	2	N
	Virgin River #1 South	22-Jul-11	2590-53117	YGY(M):XX	N/A	L	U	2	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	5	RS
	Virgin River #1 South	3-Jun-07	2370-40197	OG(M):PU	N/A	A6Y	M	5, 50	RS
	Virgin River #1 South	INA	INA	PU:UB	N/A	AHY	F	7	RS
	Virgin River #1 North	INA	INA	banded	N/A	AHY	F	19	RS
	Virgin River #1 North	19-Jun-08	none[10]	UB:KW(M)	XX:KW(M)	A5Y	M	19	RS
	Virgin River #1 South	29-Jun-10	2540-58231	TQ:GR(M)	N/A	3Y	F	50	RS
	Virgin River #1 South	2-Jul-11	2590-53141	RK(M):XX	N/A	L	U	50	N; suspected to have died

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	2-Jul-11	2590-53142	XX:BWB(M)	N/A	L	U	50	N; suspected to have died
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	65	RS
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	M	65	RS
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	F	66	RS
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	M	66	RS
	Virgin River #1 South	2-Jun-06	2370-40037	PU:DR(M)	N/A	A7Y	F	70	R 19 Jul
	Virgin River #1 South	14-Jun-06	2370-40046	PU:DK(M)	N/A	7Y	M	70, 104	RS
	Virgin River #1 South	19-Jul-11	2370-39970	PU:RWR(M)	N/A	L	U	70	N
	Virgin River #1 South	19-Jul-11	2540-58213	KWK(M):TQ	N/A	L	U	70	N
	Virgin River #1 South	9-Jun-05	2370-39956	PU:YWY(M)	PU:ZZ(M)	8Y	F	90	R 24 and 25 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	90	RS
	Virgin River #1 South	16-Jul-04	2320-31632	RZ(M):EE	N/A	9Y	F	91	RS; mated consecutively with 2 males
	Virgin River #1 South	31-Jul-09	2540-58154	DO(M):TQ	N/A	3Y	M	91	RS; breeding through 17 Jul at 18 in MUDD Overton WMA
	Virgin River #1 South	3-Jul-11	2540-58113	WY(M):TQ	N/A	L	U	91	N
	Virgin River #1 South	3-Jul-11	2430-61219	BVB(M):XX	N/A	L	U	91	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	HY	U	91	RS
	Virgin River #1 South	12-Aug-11	2590-53119	GWG(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Aug-11	2590-53151	GDG(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Aug-11	2590-53150	KVK(M):XX	N/A	L	U	91	N
	Virgin River #1 South	12-Jul-11	2540-58184	YGY(M):TQ	N/A	SY	F	92	N 12 Jul
	Virgin River #1 South	30-Jun-08	2430-61106	XX:KV(M)	N/A	4Y	M	92	R 2 and 12 Jul
	Virgin River #1 South	12-Jul-11	2590-53106	XX:OGO(M)	N/A	L	U	92	N
	Virgin River #1 South	12-Jul-11	2590-53107	XX:VKV(M)	N/A	L	U	92	N
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	F	104	RS
	Virgin River #1 South	8-Jun-06	2370-39938	KG(M):PU	N/A	7Y	M	T51	RS; detected 19 May–18 Jul
	Virgin River #1 South	N/A	N/A	UB:UB	N/A	AHY	U	F8	RS; detected 26 Jun

AR064734

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
MOME	Virgin River #1 South	6-Jun-10	2540-58192	TQ:BG(M)	N/A	A3Y	M	F20	R 24 Jul; breeding through 19 Jul at 40 and 103 in MESQ West
	Virgin River #1 North	N/A	N/A	UB:UB	N/A	AHY	M	F199	RS; detected 10–14 Jul
MUDD	Overton WMA	14-Jul-11	2590-53108	XX:YOY(M)	N/A	SY	F	3	N
	Overton WMA	25-Jul-09	2370-40029	KOK(M):PU	N/A	3Y	M	3	R 11Jul
	Overton WMA	18-Jul-11	2590-53126	XX:GOG(M)	N/A	L	U	3	N
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	4	RS
	Overton WMA	21-Jun-10	2370-40088	PU:VG(M)	N/A	3Y	M	4	RS
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	F	11	RS
	Overton WMA	21-May-09	2430-61085	BV(M):XX	N/A	4Y	M	11	RS
	Overton WMA	11-Jul-11	2590-53105	XX:KGK(M)	N/A	SY	F	18	N
	Overton WMA	31-Jul-09	2540-58154	DO(M):TQ[11]	N/A	3Y	M	18	R 11 Jul; breeding 2–17 Aug at 91 in MOME Virgin River #1 South
	Overton WMA	22-Jun-10	2370-40091	PU:DRD(M)	N/A	SY	F	101	R 18 Jul
	Overton WMA	18-Jul-11	2370-39968	VG(M):PU	N/A	SY	M	101	N
	Overton WMA	20-Jul-11	2590-53147	YKY(M):XX	N/A	L	U	101	N; died before fledging
	Overton WMA	20-Jul-11	2540-58279	TQ:WW(M)	N/A	L	U	101	N; died before fledging
	Overton WMA	20-Jul-11	2540-58278	RR(M):TQ	N/A	L	U	101	N; died before fledging
	Overton WMA	8-Jun-10	2430-61088	XX:BKB(M)	N/A	A3Y	M	T10	RS; detected 14 May–13 Jul
	Overton WMA	19-Jun-09	2370-39930	PU:GO(M)	N/A	3Y	M	T22	R 25 Jun; detected 17 May–17 Jul, detected 21–23 Jul at 32 in MESQ Hafen Lane
	Overton WMA	N/A	N/A	UB:UB	N/A	AHY	M	T42	RS; detected 19 May–29 Jun
	Overton WMA	25-Jun-10	2370-40000	PU:WW(M)	N/A	3Y	M	F5	RS; detected 2–3 Aug
	Overton WMA	INA	INA	undetermined	N/A	AHY	U	F9	Detected 6 Jul
	Overton Pond	N/A	N/A	UB:UB	N/A	AHY	M	F111	RS; detected 2–5 Jul

AR064735

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Pipes #3	INA	INA	undetermined	N/A	AHY	F	8	
	Pipes #3	27-Jun-11	2590-53162	XX:GD(M)	N/A	SY	M	8	N
	800M	12-Jun-08	2430-61072	XX:RK(M)	N/A	5Y	M	T1, F9	R 8 May; detected 7 May–28 Jun, detected 6–8 Jul at F9 in Pipes #3
	Platform	20-Jun-10	2540-58228	TQ:KO(M)	N/A	3Y	M	T3, T18, F72	RS; detected 16 May–10 June, detected 9–15 June at F72 north of Platform; detected 25 Jun–9 Jul at T18 in The Wallows
	Pipes #1	INA	INA	banded	N/A	AHY	M	T7	RS; detected 23 Jun–1 Jul
	800M	INA	INA	undetermined	N/A	AHY	U	F2	Detected 5–7 Jun
	In Between	INA	INA	undetermined	N/A	AHY	U	F4	Detected 21 May
	800M	N/A	N/A	UB:UB	N/A	AHY	U	F5	Detected 18 Jun
	PC6-1	N/A	N/A	UB:UB	N/A	AHY	U	F6	RS: detected 1 Jun
	Lost Lake	N/A	N/A	UB:UB	N/A	AHY	U	F11	RS: detected 26 May
	Beal Lake	INA	INA	undetermined	N/A	AHY	U	F22	Detected 7 Jun
	Hell Bird	16-May-11	2540-58108	TQ:GK(M)	N/A	AHY	U	F42	N; detected 16 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	M	F43	Detected 16 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F44	Detected 29 May
	Dock	INA	INA	undetermined	N/A	AHY	U	F45	Detected 28 May
	Dock	N/A	N/A	UB:UB	N/A	AHY	U	F46	RS; detected 28 May
	Dock	INA	INA	undetermined	N/A	AHY	U	F47	Detected 28 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F48	Detected 29 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F49	Detected 29 May
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	M	F50	RS; detected 29 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F51	Detected 29 May
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F52	Detected 29 May
	Hell Bird	N/A	N/A	UB:UB	N/A	AHY	U	F53	RS: detected 4 Jun
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F54	Detected 4 Jun

AR064736

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
TOPO	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F55	Detected 8 Jun
	Hell Bird	INA	INA	undetermined	N/A	AHY	U	F56	Detected 8 Jun
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F57	Detected 3 Jun
	Spaghetti	INA	INA	undetermined	N/A	AHY	U	F70	Detected 30 May
	Swine Paradise	N/A	N/A	UB:UB	N/A	AHY	M	F71	RS; detected 9 Jun
	Spaghetti	INA	INA	undetermined	N/A	AHY	U	F73	Detected 30 May
	Pierced Egg	INA	INA	undetermined	N/A	AHY	U	F100	Detected 24 May
	The Wallows	N/A	N/A	UB:UB	N/A	AHY	U	F101	RS; detected 1–5 Jun
	The Wallows	N/A	N/A	UB:UB	N/A	AHY	M	F102	RS; detected 9–13 Jun
BIWI	Site #3	6-Jun-08	2430-61137	XX:BR(M)	N/A	5Y	F	2	RS
	Site #3	6-Jun-08	2430-61136	XX:BG(M)	N/A	5Y	M	2	RS
	Site #3	14-Jul-11	2590-53164	RV(M):XX	N/A	L	U	2	N
	Cougar Point	14-Jul-11	2540-58120	TQ:YKY(M)	N/A	AHY	F	33	N
	Cougar Point	INA	INA	undetermined	N/A	AHY	M	33	Detected by an unrelated field crew; not detected during nest monitoring
	Planet Ranch Road	10-Jul-10	2540-58230	YD(M):TQ	N/A	3Y	F	41	RS
	Planet Ranch Road	12-Jun-10	2540-58220	TQ:DY(M)	N/A	A3Y	M	41, 103	RS
	Planet Ranch Road	2-Jul-11	2590-53163	XX:KVK(M)	N/A	SY	F	103	N
	Planet Ranch Road	17-Jul-11	2590-53182	XX:RBR(M)	N/A	L	U	103	N
	Planet Ranch Road	17-Jul-11	2430-61237	XX:VRV(M)	N/A	L	U	103	N
	Planet Ranch Road	17-Jul-11	2540-58115	TQ:WKW(M)	N/A	L	U	103	N
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	T17	RS; detected 20 Jun–5 Jul
	Planet Ranch Road	INA	INA	undetermined	N/A	AHY	U	F12	Detected 1 Jun
	Planet Ranch Road	N/A	N/A	UB:UB	N/A	AHY	U	F13	RS; detected 1–6 Jun
	Site #4	INA	INA	undetermined	N/A	AHY	U	F15	Detected 16 Jun
	Site #4	N/A	N/A	UB:UB	N/A	AHY	M	F16	RS; detected 20–26 Jun
	Site #5	INA	INA	undetermined	N/A	AHY	U	F21	Detected 21 May

Table 3.2. Willow Flycatchers Detected at All Reclamation Study Areas with Resident Flycatchers, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[3]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
BIWI	Site #5	INA	INA	undetermined	N/A	AHY	U	F22	Detected 29 May
	Wispy Willow	INA	INA	undetermined	N/A	AHY	U	F31	Detected 27 May
	Burn Edge	INA	INA	undetermined	N/A	AHY	M	F32	Detected 30 Jun
	Site #3	INA	INA	undetermined	N/A	AHY	U	F44	Detected 27 May

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2011.

[5] **Age in 2011**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Original federal band number 2390-92434.

[10] Original federal band number 2430-61167. Individual resighted at the beginning of the season with XX:KW(M) with an injured left leg but subsequently lost the left foot and federal band.

[11] Further review of data suggests this individual likely present at MUDD 9 Jul–3 Aug 2010 and erroneously reported (McLeod and Pellegrini 2011) as DR(M):TQ.

AR064738

NDOW Study Areas

Color-Banding and Resighting – Field personnel color-banded 13 new adult flycatchers and recaptured 3 individuals previously captured as adults. An additional 25 adults were identified to individual via resighting, while 2 individuals were resighted but did not have color combinations confirmed. We recaptured one individual identified as a returning nestling by the presence of a single federal band from 2007. Three additional adults were captured with full color combinations and identified as returning nestlings from 2009 or 2010 (Table 3.8). Five adult flycatchers remained unbanded, and banding status was undetermined (i.e., we were unable to determine if these individuals were banded) for one adult. Overall, 89% of the adult flycatchers detected at the monitoring sites were known to be color-banded by the end of the breeding season (Table 3.3). We banded 34 nestlings from 13 nests. Of the 34 nestlings banded, 3 were suspected to have died before fledging. For details on all banded flycatchers detected at the study areas from 2003 to 2011, see Appendix E.

Site-by-Site Color-Banding and Resighting

Key Pittman Wildlife Management Area – We detected 34 resident willow flycatchers from 19 territories at Key Pittman Wildlife Management Area. In addition to resident adults, we detected eight individuals for which residency and/or breeding status could not be determined (Table 3.4). Of the 19 territories at Key Pittman, 18 consisted of breeding individuals and 1 consisted of an unpaired male. Three males were each polygynous with two females.

Field personnel captured and color-banded 11 new adults and recaptured five flycatchers previously seen as adults (Table 3.4). We resighted and identified 20 additional adults; 5 of these individuals were detected for the first time since they were banded as nestlings in 2010 (see Table 3.8). We captured two returning nestlings originally banded as juveniles in 2007 and 2009. Two adults remained unbanded, and color combinations could not be confirmed for two adults. We banded 31 nestlings from 12 nests; we suspect three of these nestlings from two nests died before fledging. We resighted four unbanded fledglings from three additional nests.

River Ranch – We detected seven resident willow flycatchers from four territories at River Ranch. In addition to resident adults, we detected two individuals for whom residency and/or breeding status could not be determined (Table 3.4). Of the four territories at River Ranch, two consisted of breeding individuals, one consisted of a pair with no documented breeding activity, and one consisted of an unpaired male.

Field personnel captured and color-banded two new adult flycatchers. We resighted and identified six additional adults, five of which were banded as nestlings in 2010 (Table 3.8). One adult remained unbanded.

Warm Springs Natural Area – We detected two resident willow flycatchers from one territory at Warm Springs Natural Area. In addition to resident adults, we detected three individuals for whom residency and/or breeding status could not be determined (Table 3.4). The single territory at Warm Springs consisted of breeding individuals.

Field personnel did not capture or recapture any adult flycatchers. We resighted and identified two adults. Two adults remained unbanded, and the presence of bands could not be confirmed for one adult. We banded three nestlings from one nest.

Table 3.3. Willow Flycatchers Detected at NDOW Study Areas Where Resident Flycatchers Were Observed during the 2011 Breeding Season*

Study Area	Site	Adults									Nestlings Banded (# nests)	Fledglings Captured	% of All Adults Banded
		Total Adults Detected	New Captured	Recaptured		Resighted							
				Detected in Previous Year(s) as Adults	Returning Nestlings	Color combination confirmed		Unbanded	Band Status Undetermined	Banded (color combinations unconfirmed)			
						Individual Identified	Individual Not Identified						
Key Pittman WMA	Patch 0	2	0	0	0	2[1]	0	0	0	0	1(1)[2]	0	100
	Patch 1	2	1	0	0	1	0	0	0	0	3(1)	0	100
	Patch 2	2	0	0	0	2	0	0	0	0	2(1)	0	100
	Patch 3	2	0	0	0	1[3]	0	0	0	1	0	0	100
	Patch 4	5	1	1[3]	2[4,5]	0	0	1	0	0	2(1)	0	67
	Patch 5	2	0	1	0	0	0	1	0	0	0	0	50
	Patch 6	6	2	0	0	4[6]	0	0	0	0	5(2)[8]	0	100
	Patch 7	2	1	0	1	0	0	0	0	0	4(1)	0	100
	Patch 8	2	0	0	0	2	0	0	0	0	0	0	100
	Patch 9	4	1	0	0	3	0	0	0	0	4(1)	0	100
	Patch 10	3	1	1	0	1	0	0	0	0	5(2)	0	100
	Patch 10.5	2	0	0	1[7]	1[5]	0	0	0	0	0	0	100
	Patch 11	5	1	0	0	4[6]	0	0	0	0	3(1)	0	100
	Patch 12	6	3	0	1[7]	1	0	0	0	1	2(1)	0	100
	Fence[9]	1	0	0	0	1	0	0	0	0	0	0	100
	Study Area Total	**42**	**11**	**3**	**4**	**20**	**0**	**2**	**0**	**2**	**31(12)**	**0**	**95**
River Ranch	East Side	2	0	0	0	2[4]	0	0	0	0	0	0	100
	West Side	5	0	0	0	4[1,5]	0	1	0	0	0	0	80
	Smalls	2	2	0	0	0	0	0	0	0	0	0	100
	Study Area Total	**9**	**2**	**0**	**0**	**6**	**0**	**1**	**0**	**0**	**0**	**0**	**89**
Warm Springs Natural Area	Muddy Mac	5	0	0	0	2	0	2	1	0	3(1)	0	40
	Study Area Total	**5**	**0**	**0**	**0**	**2**	**0**	**2**	**1**	**0**	**3(1)**	**0**	**40**
Total		**53**	**13**	**3**	**4**	**25**	**0**	**5**	**1**	**2**	**34(13)**	**0**	**89**

* Individuals are identified as new captures (previously unbanded), recaptures of previously banded birds, resightings of previously banded birds for which band combinations were confirmed, birds known to be unbanded, birds for which band status could not be determined, and resighting of previously banded birds for which band combinations were undetermined. Included are total numbers of adults detected and percent of all adults banded. For breeding and/or residency status of adults see Table 3.4.

[1] One individual moved from River Ranch West Side to Key Pittman WMA Patch 0 and is tallied only once in the total.

[2] Nestling suspected to have died in nest.

[3] One individual resighted in Key Pittman Patch 3 was recaptured in Patch 4, and is tallied only once in the total.

[4] One individual moved from River Ranch East Side to Key Pittman WMA Patch 4 and is only tallied once in the total.

[5] One individual moved from River Ranch West Side to Key Pittman WMA Patch 10.5 and is only tallied once in the total. This individual was resighted in Patch 10.5 and later recaptured in Patch 4, and is tallied only once in the total.

[6] One individual was detected in Patch 11 and Patch 6 and is tallied only once in the total.

[7] One individual recaptured in Patch 10.5 and Patch 12 and is tallied only once in the total.

[8] Two nestlings suspected to have died before fledging in one nest.

[9] Not a formal survey area. Individual detected in passing between Patches 5 and 6 on fence-line that runs along highway.

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 10	6-Jul-11	2540-58177	TQ:KRK(M)	N/A	AHY	F	15	N
	Patch 10	16-Jul-09	2430-61158	RB(M):XX	N/A	A4Y	M	15,93	R 28 Jun and 6 Jul
	Patch 10	16-Jul-11	2370-40078	YV(M):PU	N/A	L	U	15	N
	Patch 10	16-Jul-11	2590-53144	XX:GDG(M)	N/A	L	U	15	N
	Patch 7	21-Jul-11	2590-53110	OW(M):XX	N/A	AHY	F	16	N
	Patch 7	14-Jul-07	2370-40190	RY(M):PU	UB:PU	5Y	M	16	R 21 Jul
	Patch 7	21-Jul-11	2590-53111	VD(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53112	BKB(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53113	BYB(M):XX	N/A	L	U	16	N
	Patch 7	21-Jul-11	2590-53114	KOK(M):XX	N/A	L	U	16	N
	Patch 6	25-Jul-10	2540-58241	TQ:BY(M)	N/A	A3Y	F	17	RS
	Patch 6	18-Jun-11	2430-61214	DV(M):XX	N/A	SY	M	17	N
	Patch 12	28-Jun-11	2540-58175	TQ:WO(M)	N/A	AHY	F	44	N
	Patch 12	27-Jul-11	2540-58387	GWG(M):TQ	N/A	AHY	M	44,107	N
	Patch 12	N/A	N/A	UB:UB	N/A	HY	U	44	RS
	Patch 11	27-Jul-11	2540-58386	OGO(M):TQ	N/A	AHY	F	45	N
	Patch 11	3-Aug-08	2370-40097	PU:GY(M)	N/A	4Y	M	45	RS
	Patch 11	28-Jul-11	2590-53118	RDR(M):XX	N/A	L	U	45	N
	Patch 11	28-Jul-11	2590-53149	YRY(M):XX	N/A	L	U	45	N
	Patch 11	28-Jul-11	2540-58280	OD(M):TQ	N/A	L	U	45	N
	Patch 8	28-Jul-10	2540-58165	DB(M):TQ	N/A	SY	F	46	RS
	Patch 8	1-Jul-08	2430-61118	XX:KK(M)	N/A	4Y	M	46	RS
	Patch 5	N/A	N/A	UB:UB	N/A	AHY	F	47	RS
	Patch 5	16-Jul-09	2370-40031	OGO(M):PU	N/A	3Y	M	47	R 28 Jun
	Patch 5	N/A	N/A	UB:UB	N/A	HY	U	47	RS
	Patch 5	N/A	N/A	UB:UB	N/A	HY	U	47	RS
	Patch 1	14-Jul-11	2590-53173	YBY(M):XX	N/A	SY	F	49	N

AR064741

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 1	29-Jul-09	2370-40140	PU:YK(M)	N/A	4Y	M	49	RS
	Patch 1	17-Jul-11	2540-58211	TQ:OW(M)	N/A	L	U	49	N
	Patch 1	17-Jul-11	2540-58212	YWY(M):TQ	N/A	L	U	49	N
	Patch 1	17-Jul-11	2590-53125	VBV(M):XX	N/A	L	U	49	N
	Patch 0	30-Jun-10	2540-58238	TQ:GOG(M)	N/A	SY	F	57	RS; breeding 23–27 Jun at RIRA West Side then moved to KEPI
	Patch 0	8-Jul-10	2540-58158	RB(M):TQ	N/A	SY	M	57	RS
	Patch 0	2-Aug-11	2540-58298	TQ:RO(M)	N/A	L	U	57	N; suspected to have died in nest
	Patch 2	8-Jul-10	2540-58159	KB(M):TQ	N/A	SY	F	61	RS
	Patch 2	2-Jul-09	2370-40024	PU:BV(M)	N/A	3Y	M	61	RS
	Patch 2	1-Aug-11	2540-58214	TQ:YRY(M)	N/A	L	U	61	N
	Patch 2	1-Aug-11	2590-53127	WGW(M):XX	N/A	L	U	61	N
	Patch 9	8-Jul-10	2540-58156	BG(M):TQ	N/A	A3Y	F	62	RS
	Patch 9	1-Jul-08	2430-61114	WR(M):XX	N/A	4Y	M	62	RS
	Patch 9	7-Jul-11	2540-58182	GR(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58183	KK(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58282	KV(M):TQ	N/A	L	U	62	N
	Patch 9	7-Jul-11	2540-58283	KW(M):TQ	N/A	L	U	62	N
	Patch 10	21-Jul-10	2430-61100	XX:YKY(M)	N/A	3Y	F	93	RS
	Patch 10	16-Jul-11	2370-40079	PU:KRK(M)	N/A	L	U	93	N
	Patch 10	16-Jul-11	2540-58276	VW(M):TQ	N/A	L	U	93	N
	Patch 10	16-Jul-11	2540-58277	TQ:YY(M)	N/A	L	U	93	N
	Patch 4	27-Jul-11	2540-58297	RYR(M):TQ	N/A	AHY	F	100	N
	Patch 4	N/A	N/A	UB:UB	N/A	AHY	M	100	RS
	Patch 4	10-Jul-11	2540-58247	OKO(M):TQ	N/A	L	U	100	N
	Patch 4	10-Jul-11	2590-53172	XX:VYV(M)	N/A	L	U	100	N; R 27 Jul
	Patch 11	28-Jul-10	2540-58203	TQ:WD(M)	N/A	3Y	F	106	RS

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
KEPI	Patch 11	10-Jul-10	2540-58223	YV(M):TQ	N/A	3Y	M	106	RS
	Patch 11	N/A	N/A	UB:UB	N/A	HY	U	106	RS
	Patch 12	10-Jul-10	2540-58224	TQ:RD(M)	N/A	SY	F	107	RS
	Patch 12	8-Aug-11	2540-58378	WD(M):TQ	N/A	L	U	107	N
	Patch 12	8-Aug-11	2540-58299	TQ:YO(M)	N/A	L	U	107	N
	Patch 6	14-Jul-09	2430-61279	XX:DW(M)	N/A	3Y	F	121	RS
	Patch 6	17-Jul-11	2590-53124	XX:VGV(M)	N/A	AHY	M	121,122	N
	Patch 6	16-Jul-11	2590-53122	XX:KWK(M)	N/A	L	U	121	N; suspected to have died in nest
	Patch 6	16-Jul-11	2590-53123	BRB(M):XX	N/A	L	U	121	N; suspected to have died in nest
	Patch 6	20-Jul-09	2540-58187	TQ:RB(M)	N/A	A4Y	F	122	RS[9]
	Patch 6	7-Jul-11	2540-58180	TQ:WY(M)	N/A	L	U	122	N
	Patch 6	7-Jul-11	2540-58178	BD(M):TQ	N/A	L	U	122	N
	Patch 6	7-Jul-11	2540-58179	GK(M):TQ	N/A	L	U	122	N
	Patch 9	5-Jul-11	2590-53121	XX:WRW(M)	N/A	AHY	F	123	N
	Patch 9	26-Jun-08	2430-61180	RD(M):XX	N/A	5Y	M	123	RS
	Patch 3	3-Jul-08	2430-61197	XX:VY(M)	N/A	4Y	M	T14	RS; detected 16 May–27 Jul; R 27 Jul in Patch 4
	Patch 4	13-Jul-10	2430-61099	XX:WOW(M)	N/A	SY	U	F18	R 27 Jul; not detected post capture; breeding 15 Jun–25 Jul at RIRA East Side
	Fence	6-Jul-09	2370-40027	YY(M):PU	N/A	3Y	U	F19	RS; detected 29 May on fence between Patches 5 and 6
	Patch 11	29-Jun-10	2370-40010	KRK(M):PU	N/A	AHY	U	F20	RS; detected 30 Jun, detected 12 Jul in Patch 6
	Patch 3	INA	INA	banded	N/A	AHY	U	F21	RS; detected 31 Jul
	Patch 12	27-Jul-11	2590-53148	RYR(M):TQ	N/A	AHY	U	F22	N; detected 27 Jul
	Patch 12	INA	INA	banded	N/A	AHY	U	F23	RS; detected 30 Jun
	Patch 10.5	23-Jun-09	2430-61159	OK(M):XX	N/A	3Y	M	F75	R 26 Jun, also 27 Jul in Patch 12; otherwise not detected
	Patch 10.5	12-Jul-09	2430-61098	XX:WDW(M)	N/A	SY	M	F112	RS; detected 24 Jul; R 27 Jul in Patch 4; breeding 23 Jun–1 Jul at RIRA West Side

Table 3.4. Willow Flycatchers Detected at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Date Banded	Federal Band #[2]	Color Combination[2]	Old Color Combination[2,3,4]	Age[5]	Sex[6]	Territory or Location[7]	Observation Status[8]
RIRA	West Side	30-Jun-10	2540-58238	TQ:GOG(M)	N/A	SY	F	95	RS; detected 23–27 Jun; moved to KEPI Patch 0
	West Side	12-Jul-10	2430-61098	XX:WDW(M)	N/A	SY	M	95	RS; detected 24–27 July at KEPI
	Smalls	27-Jun-11	2590-53171	XX:ORO(M)	N/A	SY	F	108	N; detected 27–29 Jun
	Smalls	27-Jun-11	2540-58246	BR(M):TQ	N/A	SY	M	108	N; detected 15 Jun–16 Jul
	East Side	30-Jun-10	2540-58240	KYK(M):TQ	N/A	SY	F	110	RS
	East Side	13-Jul-10	2430-61099	XX:WOW(M)	N/A	SY	U	110	RS; detected 15 Jun–25 Jul; detected 27 Jul at KEPI Patch 4
	West Side	17-Jun-11	2540-58109	WK(M):TQ	N/A	SY	M	T109	RS; detected 23 Jun–13 Jul; detected 17–19 Jun at PAHR North
	West Side	8-Jul-10	2540-58157	OY(M):TQ	N/A	SY	U	F111	RS; detected 23–27 Jul
	West Side	N/A	N/A	UB:UB	N/A	AHY	M	F112	RS; detected 19 Jun
WMSP	Muddy Mac	8-Jun-10	2540-58193	TQ:DB(M)	N/A	A3Y	F	71	RS
	Muddy Mac	20-May-08	2540-58234[10]	KD(M):TQ	N/A	A5Y	M	71	RS
	Muddy Mac	13-Jul-11	2590-53143	XX:RV(M)	N/A	L	U	71	N
	Muddy Mac	13-Jul-11	2540-58275	TQ:YD(M)	N/A	L	U	71	N
	Muddy Mac	13-Jul-11	2540-58274	VG(M):TQ	N/A	L	U	71	N
	Muddy Mac	INA	INA	undetermined	N/A	AHY	M	F54	Detected 26 May
	Muddy Mac	N/A	N/A	UB:UB	N/A	AHY	M	F55	RS; detected 26 May
	Muddy Mac	N/A	N/A	UB:UB	N/A	AHY	U	F56	RS; detected 26 May

[1] KEPI = Key Pittman WMA; RIRA = River Ranch; WMSP = Warm Springs Natural Area.

[2] N/A = not applicable, INA = information not available.

[3] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, Bs = blue federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold, banded = bird was banded but combination could not be determined, undetermined = presence of bands could not be determined. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[4] Old combination included only if rebanded in 2011.

[5] **Age in 2011**: L = nestling, HY = hatch year, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[6] **Sex codes**: M = male, F = female, U = unknown.

[7] **Territory or Location code**: Number without an alpha code indicates a flycatcher pair, T = territorial individual detected for at least 7 days, F = individual detected for less than 7 days. Number indicates unique location.

[8] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

[9] Further review of data suggests this individual likely present at KEPI during the 2010 breeding season, but this cannot be confirmed.

[10] Original federal band number 2430-61134.

AR064744

Non-Monitoring Sites

This study area was monitored by another agency, and here we report only banded flycatchers that were captured or resighted. Unbanded individuals or those with unknown band status are not included.

St. George – Field personnel captured and color-banded two new adults and recaptured one individual previously captured as an adult (Table 3.5). We banded one nestling. Personnel from Utah Division of Wildlife Resources resighted and identified an additional four adult flycatchers. Two more banded adults were resighted, but their identities could not be confirmed.

Table 3.5. Banded Willow Flycatchers, Non-Monitoring Sites, 2011

Study Area[1]	Site	Date Banded	Federal Band #	Color Combination[2]	Age[3]	Sex[4]	Observation Status[5]
STGE	Snipe Pond	28-Jun-09	2430-61154	RO(M):XX	3Y	F	R 20 Jul
	Snipe Pond	20-Jul-11	2590-53145	XX:RWR(M)	AHY	M	N
	Snipe Pond	20-Jul-11	2540-58385	TQ:KGK(M)	L	U	N
	Snipe Pond	20-Jul-11	2590-53287	OO(M):TQ	AHY	M	N
	Riverside East	27-Jul-08	2370-40148	PU:KR(M)	4Y	F	RS
	Riverside East	22-Jun-09	2540-58132	TQ:OD(M)	A4Y	M	RS
	Riverside Marsh	9-Jul-10	2430-61230	XX:GWG(M)	A3Y	F	RS
	Riverside Marsh	29-Jun-10	2430-61093	XX:VBV(M)	A3Y	M	RS
	Riverside Marsh	INA	INA	banded	AHY	F	RS
	Riverside Marsh	INA	INA	banded	AHY	M	RS

[1] STGE = St. George.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, TQ = turquoise federal band, XX = standard silver federal band, (M) = metal pin striped band, UB = unbanded, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, V = violet, W = white, K = black, Z = gold. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Age in 2011:** L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, etc.

[4] **Sex codes**: M = male, F = female, U = unknown.

[5] **Observation status codes**: N = new capture, R = recapture followed by date recaptured, RS = resight.

Adult Between-Year Return and Dispersal

In 2010 we individually identified 96 adult, resident willow flycatchers at all monitored study areas, of which 55 (57%) were detected in 2011 (Table 3.6). Of the returning resident adults, five (9%) were detected at a different study area than where they were last detected in 2010 (Table 3.7). One adult flycatcher that was detected in 2010 at a site monitored by NDOW was detected at a different study area in 2011. Two additional flycatchers that were last detected in 2008 or 2009 exhibited between-year movement in 2011. The median dispersal distance for all returning adult flycatchers exhibiting between-year movements in 2011 was 86.8 km (min = 11.9 km, max = 203.1 km).

Table 3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011

Study Area	# Identified in 2010	# of 2010 Birds Detected in 2011	% Return	% Return to Same Study Area
Key Pittman	21	13	62	100
Pahranagat	19	12	63	100
Littlefield	2	0	0	--

Table 3.6. Resident Adult Willow Flycatcher Annual Return from 2010 to 2011 (Continued)

Study Area	# Identified in 2010	# of 2010 Birds Detected in 2011	% Return	% Return to Same Study Area
Mesquite	11	6	55	83
Mormon Mesa	19	12	63	92
Muddy River	6	3	50	100
Warm Springs	3	2	67	50
Topock	8	3	38	33
Bill Williams	7	4	57	100
Total	**96**	**55**	**57**	**91**

Table 3.7. Adult Willow Flycatcher Between-Year Movements for All Individuals Identified in a Previous Year and Recaptured or Resighted at a Different Study Area in 2011

Study Area/Site/Year Detected[1]	Study Area/Site Detected 2011[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
GRCA/Iceberg Canyon/2008	TOPO/800M	153.6	2430-61072	XX:RK(M)	M
PAHR/North/2009	KEPI/Patch 6	30.1	2540-58187	TQ:RB(M)[4]	F
MOME/Virgin River #1 South/2010	KEPI/Patch 8	132.7	2430-61118	XX:KK(M)	M
RIRA/West Side/2010	KEPI/Patch 5	11.9	2370-40027	YY(M):PU	F
TOPO/Glory Hole/2010	MOME/Virgin River #1 South	203.1	2540-58231	TQ:GR(M)	F
MESQ/West/2010	MUDD/Overton WMA	40.9	2370-39930	PU:GO(M)	M
WMSP/Muddy Mac/2010	MUDD/Overton WMA	35.4	2430-61088	XX:BKB(M)	M
TOPO/800M/2010	MUDD/Overton WMA	189.3	2540-58154	DO(M):TQ[5]	M

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, WMSP = Warm Springs Natural Area, MUDD = Muddy River, TOPO = Topock Marsh.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male.

[4] Further review of data suggests this individual likely present at KEPI during the 2010 breeding season, but this cannot be confirmed.

[5] Further review of data suggests this individual moved from TOPO to MUDD during the 2010 breeding season but this cannot be confirmed.

Juvenile Between-Year Return and Dispersal

In 2010, we banded 52 nestlings at the Reclamation study areas. One of these nestlings was known to have died before fledging. Of the remaining 51 juveniles, 2 (4%) were identified in 2011. Two individuals originally banded as nestlings in 2007 and two individuals originally banded as nestlings in 2009 were identified for the first time in 2011 (Table 3.8). In 2010, we banded an additional 41 nestlings at the NDOW study areas. Five of these nestlings were known to have died before fledging. Of the remaining 36 juveniles, 9 (25%) were identified in 2011 (Table 3.8). No additional nestlings banded in prior years at NDOW sites were identified. Of the 16 returning nestlings identified in 2010, 12 (75%) dispersed away from their natal study area. The median dispersal distance for all returning juvenile flycatchers in 2011 was 12.8 km (min = 0.03 km, max = 138.0 km).

One additional returning nestling from 2003–2007 was resighted in 2011 at Mormon Mesa, but the identity of this individual was undetermined because we were unable to recapture it.

Table 3.8. Juvenile Flycatchers Banded as Hatch Year Birds in 2007, 2009, or 2010 and Identified for the First Time in 2011

Study Area/ Site Banded[1]	Year Hatched	Study Area/Site Detected 2011[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
PAHR/North	2007	KEPI/Patch 7	30.1	2370-40190	RY(M):PU	M
MESQ/West	2007	MOME/Virgin River #1 South	27.4	2360-59777	EE:YKY(M)	F
MOME/Virgin River #1 South	2009	KEPI/Patch 10.5	132.8	2430-61159	OK(M):XX	M
MOME/Virgin River #1 South	2009	MUDD/Overton WMA	13.6	2370-40029	KOK(M):PU	M
KEPI/Patch 10.5	2010	PAHR/North	30.1	2540-58201	TQ:BO(M)	U
KEPI/Patch 9	2010	KEPI/Patch 12	0.3	2540-58224	TQ:RD(M)	F
KEPI/Patch 9	2010	RIRA/East Side	12.0	2430-61099	XX:WOW(M)	U
KEPI/Patch 8	2010	KEPI/Patch 8	0.03	2540-58165	DB(M):TQ	F
KEPI/Patch 7	2010	RIRA/West Side	11.9	2540-58238	TQ:GOG(M)	F
KEPI/Patch 7	2010	RIRA/East Side	11.9	2540-58240	KYK(M):TQ	F
KEPI/Patch 6	2010	KEPI/Patch 2	0.6	2540-58159	KB(M):TQ	F
KEPI/Patch 6	2010	KEPI/Patch 0	0.7	2540-58158	RB(M):TQ	M
KEPI/Patch 6	2010	RIRA/West Side	11.9	2540-58157	OY(M):TQ	U
PAHR/North	2010	RIRA/West Side	18.2	2430-61098	XX:WDW(M)	M
MOME/Virgin River #1 South	2010	MUDD/Overton WMA	13.6	2370-40091	PU:DRD(M)	F
MUDD/Overton WMA	2010	KEPI/Patch 6	138.0	2370-40010	KRK(M):PU	U

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.

[2] **Color-band codes**: EE = electric yellow federal band, PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, G = green, B = light blue, D = dark blue, W = white, Y = yellow, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

Within-Year, Between-Study Area Movements

We detected seven within-year, between-study area movements in 2011 (Table 3.9). Three individuals moved from River Ranch to Key Pittman WMA. One male held a territory in River Ranch West Side (23 June – 1 July), was detected on 24 July at Key Pittman Patch 10.5, and recaptured passively on 27 July in Patch 4. The female from the same territory in River Ranch West Side moved after a failed nesting attempt (23 – 27 June) to Key Pittman Patch 0 where she had another nesting attempt of unknown fate (8 July – 4 August). Another individual, likely a male, was present in River Ranch East Side (15 June – 25 July) and was recaptured passively at Key Pittman Patch 4 on 27 July. A male at Pahranagat North was detected 17 – 19 June and moved to River Ranch West Side where he held a territory from 23 June to 13 July. One male held a territory at Mesquite West (17 May – 19 July) and was recaptured passively on 24 July in Mormon Mesa Virgin River #1 South. Two males moved from Muddy River Overton WMA after holding territories. One male held his territory from 17 May to 17 July and was then detected at Mesquite Hafen Lane from 21 to 23 July. The other male held his territory from 17 June to 17 July and then moved to Mormon Mesa Virgin River #1 South where he was detected from 2 to 17 August.

Table 3.9. Adult Willow Flycatcher Within-Year Movements for All Individuals Identified at Two Different Study Areas in 2011

Start Study Area/Site[1]	End Study Area/Site[1]	Distance Moved (km)	Federal Band #	Color Combination[2]	Sex[3]
RIRA/West Side	KEPI/Patch 4	11.4	2430-61098	XX:WDW(M)	M
RIRA/East Side	KEPI/Patch 4	11.4	2430-61099	XX:WOW(M)	U
RIRA/West Side	KEPI/Patch 0	11.2	2540-58238	TQ:GOG(M)	F
PAHR/North	RIRA/West Side	18.2	2540-58109	WK(M):TQ	M
MESQ/West	MOME/Virgin River #1 South	27.2	2540-58192	TQ:BG(M)	M
MUDD/Overton WMA	MESQ/Hafen Lane	43.9	2370-39930	PU:GO(M)	M
MUDD/Overton WMA	MOME/Virgin River #1 South	13.5	2540-58154	DO(M):TQ	M

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River.

[2] **Color-band codes**: PU = pumpkin federal band, XX = standard silver federal band, TQ = turquoise federal band, (M) = metal pin striped band, R = red, O = orange, Y = yellow, G = green, D = dark blue, B = light blue, K = black. Color combinations are read as the bird's left leg and right leg, top to bottom; two letters designate every band; color-band designations for right and left legs are separated with a colon.

[3] **Sex codes**: F = female, M = male, U = unknown.

DISCUSSION

Color-Banding Effort

Overall, 52% of the adult flycatchers detected at the monitoring sites during 2011 were banded by the end of the breeding season. This compares to 55, 57, 75, 70, 73, 69, 67 and 66% in 2003–2010, respectively. Unbanded willow flycatchers with an undetermined residency status are included in calculating these percentages; therefore, in most cases, these numbers under-represent the actual proportion of resident banded flycatchers at a given site. Differences between study areas in the percentage of banded individuals are related to vegetation density and overall structure, which affect our ability to erect mist-nets in the habitat, and the percentage of adults that are residents. Topock Marsh typically has the lowest percentage of color-banded flycatchers because dense vegetation limits the number and size of possible net locations and because, particularly in recent years, the number of resident adults is low in comparison to the total number of flycatchers detected.

Prior to 2008, we banded all nestlings with a single anodized federal band, identifying the bird as a returning nestling in the event it was sighted in a subsequent year. The individual would then have to be recaptured to determine its individual identity and to apply a unique color combination so the bird could be individually identified via resighting. The rationale for banding nestlings with a single anodized band was that the majority of nestlings do not return in subsequent years, resulting in the loss of a large number of unique color combinations. To eliminate the need to recapture returning nestlings, in 2008–2011 we applied unique color combinations to all nestlings. The use of full color combinations on nestlings in 2008–2010 has greatly reduced the number of adults with single federal bands, with only three detected across all study areas in 2011. Banding nestlings with full color combinations also allows us to record juvenile dispersal movements that might otherwise go undetected.

Adult and Juvenile Between-Year Dispersal

Resident adults detected at Topock have historically shown very high site fidelity. Until 2010, when we documented between-year movement of an adult male from Topock to Warm Springs, no between-year movements of resident Topock adults to another study area had been detected. In 2011, two additional between-year movements of resident Topock adults to other study areas were documented. One was a

breeding female identified in Mormon Mesa who had last been identified in 2010 as a breeding female in Topock. The other was a breeding male from Muddy River who was last documented in 2010 as a resident, unpaired male in Topock. These two movements provide further evidence that individuals who do not return to Topock after being documented in a given year may be moving to other locations. When an individual is not identified in a given year, there is no way to distinguish between going undetected, mortality, or emigration from the study area. Documenting emigration allows for an estimation of emigration rates, thereby improving the accuracy of survival estimates. It is possible that there have been movements of resident, unbanded Topock adults to other monitored study areas, but there would be no way to detect these movements. Furthermore, the movement of the female to Mormon Mesa may also be indicative of the poor habitat conditions present in Topock in 2011. Females who breed successfully in a given year typically demonstrate high site fidelity the following year. This female successfully fledged two nestlings in 2010 and was not detected in Topock in 2011.

Adult and juvenile dispersal data for the 2011 field season show overall high site fidelity exhibited by adult flycatchers and lower natal site fidelity exhibited by juveniles, with juveniles dispersing among study areas. These dispersal data are consistent with the patterns observed in the LCR region from 1998 to 2011, over which period 90% of adult returns were to the same study area, while only 48% of all juvenile returns were to the natal study area (McKernan and Braden unpubl. data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). These dispersal data are also consistent with range-wide data (Paxton et al. 2007), with adult flycatchers exhibiting high site fidelity to breeding areas. Juvenile dispersal within the Virgin/lower Colorado River population(s) is largely limited to this region, and while reciprocal juvenile movements among geographically isolated flycatcher populations of the greater Southwest do occur, they are rare. Only three instances of willow flycatcher immigration from sites outside the Virgin/lower Colorado River region have been recorded since 1997 (McKernan and Braden unpubl. data, McLeod et al. 2008a), with two males originally banded as nestlings in 2003 at Roosevelt Lake recaptured in 2005 at Muddy River and Topock, and one male banded as a nestling in 1999 at Roosevelt Lake recaptured in 2002 in Grand Canyon. Although movements of this magnitude are infrequent, other instances of dispersal distances greater than 140 km have been reported for the Southwestern Willow Flycatcher (Paxton et al. 2007) and have been noted within the Virgin/lower Colorado River population (McLeod et al. 2008a, McLeod and Koronkiewicz 2010, McLeod and Pellegrini 2011). Banding studies at Roosevelt Lake and along the San Pedro River were discontinued after 2005, so immigration of juveniles produced in those areas after 2005 would have gone undetected.

The observed dispersal patterns fit well with the tenets of contemporary metapopulation theory (Hanski and Simberloff 1997), suggesting the Virgin/lower Colorado River population may be a panmictic sub-population of a greater metapopulation. Occasional juvenile dispersal between sub-populations is likely an important population variable in terms of gene flow, with movements contributing to an understanding of the observed patterns of high genetic diversity within and low genetic isolation among Southwestern Willow Flycatcher populations (Busch et al. 2000). Dispersal by juveniles or adults is required for the colonization of new breeding sites, and long-distance movements will be required if newly established Reclamation habitat creation sites are to be colonized. The closest known breeding sites are at Bill Williams River NWR and Topock Marsh, approximately 75–150 km from the PVER and CVCA habitat creation sites (see Chapter 2). The habitat creation sites could also be colonized by individuals from more distant breeding areas, such as those along the Virgin River. Although such long-distance movements are relatively infrequent, two adult movements between the lower Colorado and the Virgin River were documented in 2011, and multiple instances of adult and juvenile dispersal between the Virgin River and Topock Marsh and Bill Williams River NWR have been documented in recent years (McLeod et al. 2008b; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Physical connectivity of riparian habitats within the greater landscape is crucial in enabling these long-distance movements. Without adequate stop-over habitats and foraging areas, flycatchers attempting long-distance movements are more likely to be exposed to adverse environmental conditions.

Within-year, Between Study Area Movement

Within-year, between study area movements typically occur at low rates in any given year. In 2003–2010, we detected between zero and four (median = 1.5) movements per year. In 2011, we documented the largest number of individuals (seven) moving between study areas within a given year. The increase in the number of documented movements may have been affected by the addition in 2011 of River Ranch to the monitored study areas. Movements to and from River Ranch accounted for four (57%) of the seven movements. One additional within-year movement, which would otherwise likely have gone undetected, was detected via passive netting. Thus, the detection of an unusually high number of within-year movements in 2011 is not necessarily indicative of there being more movements, but rather that we were better able to detect them.

The movement of three of the seven resident or paired adults at River Ranch to another study area is suggestive of poor habitat quality at River Ranch. In addition, eight of the nine individuals detected at River Ranch were known to be second-year individuals (age of the ninth individual was unknown). A high proportion of second-year birds could also be indicative of poor habitat quality. This pattern is seen in multiple species where the best habitat is typically occupied by older individuals, who may be more competitive or arrive sooner on the breeding grounds, leaving habitat of lesser quality for younger birds (Hill 1988, Holmes et al. 1996). Higher proportions of second-year birds also tend to be seen in young, newly developed habitat, such as that seen in the lower Grand Canyon in 2006–2008, possibly as a result of dispersal and colonization (McLeod et al. 2007, McLeod et al. 2008b, McLeod and Koronkiewicz 2009). However, the habitat at River Ranch has been established for several years (C. Tomlinson, NDOW, pers. comm.), and the high proportion of second-year birds is more likely due to habitat quality than stand age.

Adult and Juvenile Survivorship

Annual survivorship is defined as the number of individuals that survive from one year to the next, and accurate estimates depend on year-to-year detection of uniquely marked birds. Fifty-seven percent of the adult, resident willow flycatchers identified in 2010 were detected again in 2011, while of the 87 juveniles banded in 2010, only 11 (13%) were identified in 2011. Thus, minimum estimated adult and juvenile survival from 2010 to 2011 at all monitored sites was 57 and 13%, respectively. These simple annual percent survivorship calculations assume that all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. To provide more robust estimates of annual survival, demographic data acquired from 2003 to 2012 will be combined with data collected during 1997–2002. Survival and detection probabilities will be estimated using program MARK (White and Burnham 1999) and presented in a summary report in 2012.

This page intentionally left blank.

Chapter 4

NEST MONITORING

INTRODUCTION

Documentation of nest success and productivity is critical to understanding local population status and demographic patterns of the Southwestern Willow Flycatcher. In 2011, at all sites where willow flycatcher breeding activity was suspected, we conducted intensive nest searches and nest monitoring. Specific objectives of nest monitoring included identifying breeding individuals (see Chapter 3, Color-banding and Resighting), calculating nest success and failure, documenting causes of nest failure (e.g., abandonment, desertion, depredation, and brood parasitism), and calculating nest productivity. Nest monitoring results from 2011 were compared with those at the study areas from 1996 to 2010 (Braden and McKernan unpubl. data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011). Although aspects of willow flycatcher breeding ecology can vary widely across its broad geographical and elevational ranges throughout the Southwest (Whitfield et al. 2003), we compared monitoring results with range-wide data to identify specific variables that may contribute to the characterization of flycatcher breeding ecology throughout the lower Colorado and Virgin River riparian systems.

METHODS

Upon locating territorial willow flycatchers, regardless of whether a possible mate was observed, we conducted intensive nest searches following the methods of Rourke et al. (1999). Nest monitoring followed a modification of the methods described by Rourke et al. (1999) and the Breeding Biology Research and Monitoring Database (BBIRD) protocol by Martin et al. (1997).

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites. Nests were monitored every two to four days after nest building was complete and incubation was confirmed. Nests at NDOW study areas were monitored less frequently (every four days or more) because of budgetary restrictions. During incubation and after hatching, nest contents were observed directly using a telescoping mirror pole to determine nest contents and transition dates. Nest monitoring during nest building and egg laying stages was limited to reduce the chance of abandonment during these periods. To reduce the risk of depredation (Martin et al. 1997), brood parasitism by the Brown-headed Cowbird, and premature fledging of young (Rourke et al. 1999), we observed nests from a distance with binoculars once the number and age of nestlings were confirmed. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

Per instructions from Reclamation biologists, we considered a willow flycatcher nest successful only if fledglings were observed near the nest or in surrounding areas. The number of young fledged from each nest was counted based on the number of fledglings actually observed. This method of determining success differs from that recommended by some nest monitoring protocols (e.g., Martin et al. 1997, Rourke et al. 1999), which consider a nest as successful if chicks are observed in the nest within two days of the estimated fledge date. The method we follow produces a conservative estimate of both nest success rate and number of fledges.

We considered a nest to have failed if (1) the nest was abandoned prior to egg laying (abandoned); (2) the nest was deserted with flycatcher eggs or young remaining (deserted); (3) the nest was found empty or destroyed more than two days prior to the estimated fledge date (depredated); (4) nestlings died in the nest despite being tended by the adults(nestlings died in nest); or (5) the entire clutch was incubated for an excess of 20 days (infertile/addled). For nests containing flycatcher eggs, parasitism was considered the cause of nest failure if (1) cowbird young outlived any flycatcher eggs or young, or (2) the nest was parasitized during egg laying and the disappearance of flycatcher eggs coincided with the appearance of cowbird eggs.

During each nest check, we recorded date and time of the visit, observer initials, monitoring method (observation via binoculars or mirror pole), nesting stage, nest contents, and number and behavior of adults and/or fledges present onto standardized data forms (Appendix A) that included the nest or territory number and UTM coordinates. We calculated flycatcher nest success using both apparent nesting success (number of successful nests/total number of nests containing at least one flycatcher egg) and the Mayfield method (Mayfield 1961, 1975), which calculates daily nest survival to account for nests that failed before they were found. We assumed one egg was laid per day, and incubation was considered to start the day the last egg was laid (per Martin et al. 1997). The nestling period was considered to start the day the first egg hatched and end the day the first nestling fledged. If exact transition dates or dates of depredation events were unknown, we estimated the transition date as halfway between observations. For nests where fate was unknown, we used the last known date of activity to determine the number of observation days. To calculate Mayfield survival probabilities (MSP), we used the average length of each nest stage (2.14, 12.85, and 13.76 days for laying, incubation, and nestling stages, respectively) as observed in this study in 2003–2011 for nests where transition dates were known. Nest productivity was calculated as the number of young fledged per nesting attempt that produced at least one flycatcher egg. Fecundity was calculated as number of young produced per female over the breeding season. Parasitism rates were calculated as the percentage of nests with known contents that included at least one flycatcher egg and one cowbird egg.

In 2011, we attempted to addle cowbird eggs in easily accessible flycatcher nests at all study areas except Pahranagat. If the nest was accessible without a ladder, the cowbird egg was addled as soon as it was discovered. If a ladder was required, the cowbird egg was addled on the next regularly scheduled nest visit. Cowbird eggs were addled only if we could obtain a direct view of the nest contents from a secure location, either on the ground on or a ladder. We carefully removed the cowbird egg from the nest and placed it in a padded film canister. We then shook the canister vigorously for about one minute, incorporating sharp, jerky movements. The egg was then returned to the nest. The cowbird egg was not permanently removed from the nest so as not to mimic a partial depredation event, which might result in nest desertion. If a nest was found with a cowbird nestling already in the nest, or if a shaken cowbird egg still hatched, we removed the cowbird nestling from the nest.

All field personnel practiced egg addling with several button quail (*Coturnix chinensis*) eggs at the start of field season to determine how vigorously they could shake an egg without breaking it. Button quail eggs are slightly larger than cowbird eggs (19 x 25 mm vs. 16 x 21 mm) but provide a reasonable and easily available substitute. Shaken eggs were carefully opened to determine whether any damage to the internal structure of the egg was apparent. Field personnel varied in their ability to shake an egg to the point of causing internal damage without breaking the shell.

RESULTS

Reclamation Study Areas

Nest Monitoring

We documented 49 willow flycatcher nesting attempts at Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams; 43 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Eighteen (42%) nests were successful and fledged young, and 23 (53%) failed. The fate of two nests (5%) was unknown. Nest success ranged from 0% at Topock Marsh to 100% at Pahranagat (Table 4.1). For a comparison of apparent nest success at all monitoring sites from 1997 to 2011, see Table 4.2.

Thirty-five nesting females, of which all but three were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was documented for which no nesting attempt could be confirmed. Of the 35 nesting females, 23 had one nesting attempt, 10 had two nesting attempts, and 2 had three nesting attempts. Of the 12 females with multiple nesting attempts, 9 renested after failed nests and 3 renested after a successful nest.

Table 4.1. Summary of Willow Flycatcher Nest Monitoring Results at Reclamation Study Areas, 2011

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate	Parasitized Nests[4]
PAHR	North	6	7	7	7 (100)	0	0	0
	Total	*6*	*7*	*7*	*7 (100)*	*0*	*0*	*0*
MESQ	Hafen Lane	1	1	1	0	1 (100)	0	1 (100)
	West	6	8	6	2 (33)	4 (67)	0	1 (20)
	Total	*7*	*9*	*7*	*2 (29)*	*5 (71)*	*0*	*2 (33)*
MOME	Virgin River #1 North	2	1	1	0	1 (100)	0	0
	Virgin River #1 South	11	19	17	7 (41)	9 (53)	1 (6)	1 (7)
	Total	*13*	*20*	*18*	*7 (39)*	*10 (55)*	*1 (6)*	*1 (7)*
MUDD	Overton WMA	5	6	5	0	4 (80)	1 (20)	3 (60)
	Total	*5*	*6*	*5*	*0*	*4 (80)*	*1 (20)*	*3 (60)*
TOPO	Pipes #3	1	1	1	0	1	0	0
	Total	*1*	*1*	*1*	*0*	*1 (100)*	*0*	*0*
BIWI	Site #3	1	2	2	1 (50)	1 (50)	0	0
	Cougar Point	1	1	1	0	1 (100)	0	1 (100)
	Planet Ranch Rd	2	3	2	1 (50)	1 (50)	0	0
	Total	*4*	*6*	*5*	*2 (40)*	*3 (60)*	*0*	*1 (20)*
Overall Total		**36**	**49**	**43**	**18 (42)**	**23 (53)**	**2 (5)**	**7 (19)**

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Table 4.2. Willow Flycatcher Percent Apparent Nest Success Recorded at Reclamation Study Areas from 1996 to 2011*

Year	Pahranagat	Littlefield	Mesquite[1]	Mormon Mesa[2]	Muddy River	Grand Canyon	Topock	Bill Williams
1996	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nm[3]	Nc[5]	Nc[5]	Nm[3]
1997	Nm[3]	Nd[4]	67 (3)	42 (12)	Nc[5]	Nc[5]	Nc[5]	Nd[4]
1998	47 (19)	Nd[4]	0 (7)	70 (10)	Nm[3]	Nc[5]	53 (15)	Nd[4]
1999	60 (15)	Nm[3]	Nd[4]	45 (11)	Nm[3]	Nc[5]	38 (16)	100 (1)
2000	63 (16)	Nd[4]	50 (8)	38 (13)	100 (1)	Nc[5]	36 (11)	100 (1)
2001	50 (18)	Nd[4]	53 (17)	54 (13)	Nc[5]	Nc[5]	36 (14)	50 (4)
2002	33 (12)	Nd[4]	59 (17)	0 (9)	Nd[4]	Nd[4]	50 (6)	78 (9)
2003	91 (11)	Nd[4]	44 (18)	0 (10)	Nd[4]	Nd[4]	78 (9)	100 (2)
2004	76 (17)	50 (2)	24 (17)	50 (6)	Nd[4]	Bc[6]	45 (38)	Nd[4]
2005	58 (19)	Nd[4]	42 (12)	17 (6)	38 (8)	Nd[4]	24 (34)	100 (2)
2006	60 (15)	Nd[4]	55 (20)	50 (8)	44 (9)	0 (3)	23 (17)[7]	20 (5)
2007	67 (12)	Nd[4]	57 (14)	27 (11)	0 (6)	0 (1)	75 (8)	25 (8)
2008	80 (10)	Nd[4]	82 (11)	62 (13)	25 (8)	Nd[4]	13 (8)[8]	40 (5)[8]
2009	47 (17)[8]	0 (1)	21 (14)[8]	53 (17)	0 (8)	Nm[3]	50 (2)	33 (6)
2010	59 (17)	50 (2)	31 (13)	42 (12)	100 (3)	Nm[3]	50 (2)	18 (11)
2011	100 (7)	Nd[4]	29 (7)	39 (18)[8]	0 (5)[8]	Nm[3]	0 (1)	40 (5)

* Data from 1997 to 2002 are from Braden and McKernan (unpubl. data); these numbers have been verified with the raw data and may differ from those presented in earlier annual reports. Data from 2003 to 2007 are from McLeod et al. 2008a; data from 2008 are in McLeod and Koronkiewicz 2009; data from 2009 are in McLeod and Koronkiewicz 2010; data from 2010 are in McLeod and Pellegrini 2011, and data from 2011 are in this document. Total number of nests containing at least one flycatcher egg is indicated in parentheses.

[1] Study area includes the Hafen Lane, Mesquite East, Mesquite West, and Bunker Farm sites.

[2] Study area includes the Virgin River Delta at Lake Mead.

[3] Nm = study area not monitored.

[4] Nd = study area surveyed, no breeding documented.

[5] Nc = breeding confirmed, nest success not calculated.

[6] Bc = breeding confirmed, undetermined if nestlings from a single nest fledged.

[7] An additional three nests (18%) were suspected to have fledged but fledglings were not visually confirmed.

[8] Fate of one nest was unknown.

Nest Failure

Depredation was the major cause of nest failure, accounting for 52% (15 of 29) of all failed nests (Table 4.3) and 65% (15 of 23) of nests that failed after flycatcher eggs were laid. Six nesting attempts (21% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, three nests (10%) were deserted, and three nests (10%) were incubated in excess of 20 days. Two nests (7%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism).

Brood Parasitism

Seven of 37[1] nests (19%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.4). For nests containing flycatcher eggs, parasitism caused nest failure at two nests. In one case, the parasitism event coincided with the disappearance of all flycatcher eggs; in the other, the nest contained one cowbird nestling when it was found. No parasitized nests were known to

[1] Table 4.1 shows a total of 43 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, six nests whose contents could not be determined were excluded from calculations (e.g., nests that were too high to check contents to determine presence/absence of cowbird eggs or nesting attempts that were discovered late in the nesting cycle).

fledge a flycatcher, but the fate of one nest was unknown. Of the remaining four parasitized nests that contained flycatcher eggs, two were depredated and two contained addled flycatcher eggs. Brood parasitism ranged from 0 to 60% and was highest at Muddy River (see Table 4.1). In 2011, nests that contained flycatcher eggs and were brood parasitized were less likely to fledge flycatcher young than nests that were not parasitized (one-sided Fisher's exact test, $P = 0.038$).

Table 4.3. Summary of Causes of Willow Flycatcher Nest Failure at Reclamation Study Areas, 2011*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled
PAHR	7	0	0	0	0	0	0
MESQ	9	7	2 (29)	0	4 (57)	0	1 (14)
MOME	20	12	2 (17)	3 (25)[2]	6 (50)	0	1 (8)
MUDD	6	5	1 (20)	0	2 (40)	1 (20)	1 (20)
TOPO	1	1	0	0	1 (100)	0	0
BIWI	6	4	1 (25)	0	2 (50)	1 (25)	0
Total	**49**	**29**	**6 (21)**	**3 (10)**	**15 (52)**	**2 (7)**	**3 (10)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] PAHR = Pahranagat NWR, MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, TOPO = Topock Marsh, BIWI = Bill Williams River NWR.

[2] One nest deserted after partial depredation, one deserted after 18 days incubation, one deserted during incubation with one flycatcher egg.

Table 4.4. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds, 2011*

Study Area[1]	Nest ID Code	Outcome[2]
MESQ	32A	Incubated >20 days. CE was addled and never hatched
	72B	Depredated during incubation
MOME	90A	Depredated during incubation
MUDD	3A	Fate unknown. One 14-day-old WN seen on nest rim, but fledging not confirmed. CE was addled and never hatched
	11A	3 WE disappeared and CE appeared 17 days into incubation
	18A	Incubated >20 days. CE was addled and never hatched
BIWI	33A	Nest found with one CN and no flycatcher nestlings or WE

* All nesting attempts are included.

[1] MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, BIWI = Bill Williams River NWR.

[2] WE = willow flycatcher egg, CE = cowbird egg, WN = willow flycatcher nestling, CN = cowbird nestling.

Cowbird Egg Addling

We attempted to addle cowbird eggs at three of the seven parasitized nests. Two of the remaining four nests were too high to reach; both these nests were depredated during incubation. One nest was found with a cowbird nestling and no other nest contents; the nestling was removed. At the seventh nest, the parasitism event caused nest failure. All three parasitized nests where we attempted to addle cowbird eggs were incubated long enough for any viable cowbird eggs to hatch, though none did (Table 4.5). The 2011 hatch rate of 0% is markedly lower than annual hatch rates of un-addled eggs in 2003–2009 (min = 60; max = 89; median = 75).

In 2011, only one of three parasitized nests that were incubated full-term hatched flycatcher nestlings (Table 4.6); the other two nests were incubated in excess of 20 days without any flycatcher eggs hatching. The fate of the parasitized nest that hatched a flycatcher nestling was unknown; we detected a 14-day-old flycatcher nestling on the nest rim but were unable to confirm that the nestling fledged. Success rates of parasitized nests that hatched at least one flycatcher nestling in 2003–2009 ranged from 44 to 100%. In parasitized nests that hatched flycatchers, the number of nestlings that survived to at least eight days old in 2011 (1.0/nest) was comparable to the numbers seen in 2003–2009 (min = 0.6; max = 1.5; median = 1.3).

Table 4.5. Brown-headed Cowbird Annual Hatch Rate in Willow Flycatcher Nests at Reclamation Study Areas from 2003 to 2011

Year	# Nests[1]	# CE	# CN	Hatch Rate
2003	4	4	3	75
2004	9	9	8	89
2005	9	9	7	78
2006	2	3	2	67
2007	6	8	6	75
2008	5	5	3	60
2009	8	8	5	63
2010[2]	4	4	1	25
2011[2]	3	3	0	0

[1] Total number of nests in which the cowbird egg hatched or was incubated full term (>10 days) are included.

[2] All cowbird eggs were addled at least once.

Table 4.6. Willow Flycatcher Nesting Success for Parasitized Nests at Reclamation Study Areas from 2003 to 2011

Year	# Nests[1]	# Nests with Flycatcher Nestlings[2]	# Nests with Flycatcher Fledges[3]	# Flycatcher Nestlings of Banding Age[4]	# Flycatcher Fledges[5]
2003	3	2 (67)	2 (100)	2 (1.0)	2 (1.0)
2004	10	9 (90)	4 (44)	5 (0.6)	5 (0.6)
2005	10	10 (100)	5 (50)	8 (0.8)	6 (0.6)
2006	4	4 (100)	2 (50)	6 (1.5)	3 (0.8)
2007	5	2 (40)	2 (100)	3 (1.5)	3 (1.5)
2008	5	4 (80)	3 (75)	5 (1.3)	3 (0.8)
2009	6	4 (67)	2 (50)	6 (1.5)	4 (1.0)
2010[6]	4	4 (100)	3 (75)	7 (1.8)	5 (1.3)
2011[6]	3	1 (33)[7]	--[8]	1 (1.0)	--

[1] Total number of parasitized nests in which flycatcher eggs hatched or were incubated long enough to hatch (>14 days).

[2] Total number of parasitized nests that hatched flycatcher nestlings. Percentage of total nests is indicated in parentheses.

[3] Total number of parasitized nests that produced flycatcher fledges. Percentage of nests with nestlings is indicated in parentheses.

[4] Total number of nestlings that reached at least banding age (8 days). Number of nestlings per nest with nestlings is indicated in parentheses.

[5] Total number of nestlings that fledged. Number of nestlings per parasitized nest with nestlings is indicated in parentheses.

[6] All cowbird eggs were addled in these nests.

[7] The eggs in the other two nests failed to hatch; both were incubated at least 20 days.

[8] The flycatcher nestling was last seen in the nest on day 14. It is unclear whether it successfully fledged.

Mayfield Nest Success and Nest Productivity

Mayfield survival probability (MSP) ranged from 0.198 at Mesquite to 1.000 at Pahranagat and was 0.467 for all sites combined (Table 4.7). At all sites, 40 nestlings were confirmed to have fledged from 41 nests of known outcome (mean number of fledglings/nest = 0.98, SE = 0.19). Fecundity across study areas ranged from 0.00 to 2.83 young per female and averaged 1.18 (SE = 0.25) (Table 4.8).

Table 4.7. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages at Reclamation Study Areas, 2011*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Pahranagat	1	0/15	1.000	1.000
	2	0/77.5	1.000	1.000
	3	0/98	1.000	1.000
	MSP all stages = 1.000			
Mesquite	1	1/10	0.900	0.798
	2	2/63.5	0.969	0.663
	3	2/29	0.931	0.374
	MSP all stages = 0.198			
Mormon Mesa	1	0/22	1.000	1.000
	2	10/154.5	0.935	0.423
	3	0/98.5	1.000	1.000
	MSP all stages = 0.423			
Muddy River	1	0/10	1.000	1.000
	2	3/70	0.957	0.570
	3	1/24.5	0.959	0.564
	MSP all stages = 0.321			
Topock	1	0/0		
	2	1/1	0.000	0.000
	3	0/0		
	MSP all stages = N/A[2]			
Bill Williams	1	0/6	1.000	1.000
	2	2/42.5	0.953	0.538
	3	0/28.5	1.000	1.000
	MSP all stages = 0.538			
Total	**1**	**1/63**	**0.984**	**0.966**
	2	**18/409**	**0.956**	**0.561**
	3	**3/278.5**	**0.989**	**0.862**
	MSP all stages = 0.467			

* Mayfield survival probability was calculated using 2.14-day egg laying, 12.85-day incubation, and 13.76-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

[2] MSP cannot be calculated for all stages because of lack of data.

Table 4.8. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at Reclamation Study Areas, 2011*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Pahranagat	17	7	2.43 (0.30)	6	2.83 (0.31)
Mesquite	3	7	0.43 (0.30)	7	0.43 (0.30)
Mormon Mesa	16	16	0.94 (0.30)	12	1.33 (0.48)
Muddy River	0	4	0.00 (0.00)	4	0.00 (0.00)
Topock	0	1	0.00	1	0.00
Bill Williams	4	5	0.80 (0.58)	4	1.00 (0.71)
Total	**40**	**41**	**0.98 (0.19)**	**34**	**1.18 (0.25)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females for which nest outcome was known.

NDOW Study Areas

Nest Monitoring

We documented 38 willow flycatcher nesting attempts at Key Pittman, River Ranch, and Warm Springs; 36 of these nests were known to contain flycatcher eggs and were used in calculating nest success and productivity. Fourteen (39%) nests were successful and fledged young, and 20 (56%) failed. Fate was unknown at two (5%) nests. Nest success was 42% at Key Pittman, 0% at River Ranch, and 100% at Warm Springs (Table 4.9).

Twenty-one nesting females, all of which were known to have produced at least one egg, were followed through all of their nesting attempts. One additional female was documented for which no nesting attempt was found. Of the 21 nesting females, 9 had one nesting attempt, 7 had two nesting attempts, and 5 had three nesting attempts. All 12 females with multiple nesting attempts renested after failed nests.

Table 4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
KEPI	Patch 0	1	1	1	0	0	1 (100)	0
	Patch 1	1	1	1	1 (100)	0	0	0
	Patch 2	1	2	2	1 (50)	1 (50)	0	0
	Patch 4	1	1	1	1 (100)	0	0	0
	Patch 5	1	2	2	1 (50)	1 (50)	0	0
	Patch 6	3	3	3	1 (33)	1 (33)	1 (33)	0
	Patch 7	1	2	2	1 (50)	1 (50)	0	0
	Patch 8	1	2	2	0	2 (100)	0	1 (50)
	Patch 9	2	3	3	1 (33)	2 (67)	0	0
	Patch 10	2	4	4	2 (50)	2 (50)	0	0
	Patch 11	2	6	5	2 (40)	3 (60)	0	0
	Patch 12	2	6	5	2 (40)	3 (60)	0	0
	Total	*18*	*33*	*31*	*13 (42)*	*16 (52)*	*2 (6)*	*1 (11)*

Table 4.9. Summary of Willow Flycatcher Nest Monitoring Results at NDOW Study Areas, 2011 (Continued)

Study Area[1]	Site	Pairs	Nests	Nests with 1+ WE[2]	Successful Nests[3]	Failed Nests[3]	Nests with Unknown Fate[3]	Parasitized Nests[4]
RIRA	East Side	1	3	3	0	3(100)	0	3 (100)
	West Side	1	1	1	0	1(100)	0	0
	Smalls	1	0	--	--	--	--	--
	Total	*3*	*4*	*4*	*0*	*4 (100)*	*0*	*3 (75)*
WMSP	Muddy Mac	1	1	1	1 (100)	0	0	0
	Total	*1*	*1*	*1*	*1 (100)*	*0*	*0*	*0*
Overall Total		**22**	**38**	**36**	**14 (39)**	**20 (56)**	**2 (5)**	**4 (12)**

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] WE = willow flycatcher egg.

[3] Only nests with at least one flycatcher egg were used in percentage calculations. Percentages are given in parentheses.

[4] Parasitized nests include all nests that contained at least one flycatcher egg and one cowbird egg, regardless of nest fate. Percentages include only nests with at least one flycatcher egg and for which contents could be determined.

Nest Failure

Depredation was the major cause of nest failure, accounting for 59% (13 of 22) of all failed nests (Table 4.10) and 65% (13 of 20) of nests that failed after flycatcher eggs were laid. Two nesting attempts (9% of all failed nests) were abandoned prior to willow flycatcher eggs being laid, and four nests (18%) were deserted. One nest (5%) failed because of Brown-headed Cowbird parasitism (see below for more details on parasitism), and all nestlings died in two nests (9%) that were still being tended by adult flycatchers.

Table 4.10. Summary of Causes of Willow Flycatcher Nest Failure at NDOW Study Areas, 2011*

Study Area[1]	Total # Nests	All Failed Nests	Abandoned	Deserted	Depredated	Parasitized	Addled	Nestling(s) died in nest
KEPI	33	18	2 (11)	3 (17)[2]	11 (61)	0	0	2 (11)
RIRA	4	4	0	1 (25)	2 (50)	1 (25)	0	0
WMSP	1	0	0	0	0	0	0	0
Total	**38**	**22**	**2 (9)**	**4 (18)**	**13 (59)**	**1 (5)**	**0**	**2 (9)**

* All nesting attempts (those with and without flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure.

[1] KEPI = Key Pittman WMA, RIRA = River Ranch, WMSP = Warm Springs Natural Area.

[2] All nests deserted during incubation; structure of one nest damaged, possibly from a depredation attempt.

Brood Parasitism

Four of 34[2] nests (12%) with flycatcher eggs and known contents were brood parasitized by Brown-headed Cowbirds (Table 4.11). All four nests failed. In one case, the parasitism event coincided with the disappearance of any flycatcher eggs. In another, the parasitism event coincided with the disappearance of two of three flycatcher eggs, and the remaining flycatcher egg disappeared a few days later. The female

[2] Table 4.9 shows 36 nests known to contain at least one flycatcher egg. When calculating brood parasitism rates, however, two nests whose contents could not be determined were excluded from calculations (e.g., nesting attempts that were discovered late in the nesting cycle).

flycatcher continued to incubate the cowbird egg, which had been addled. One nest was deserted with two flycatcher eggs and a cowbird egg. In the remaining nest, the cowbird nestling was removed but the flycatcher nestling developed very slowly and eventually died in the nest. Brood parasitism was 11% at Key Pittman, 75% at River Ranch, and 0% at Warm Springs (see Table 4.9).

Table 4.11. Fates of Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds in Key Pittman, River Ranch, and Warm Springs Study Areas, 2011*

Study Area[1]	Nest ID Code	Outcome[2]
KEPI	46B	CN removed shortly after hatching. WN developed very slowly and eventually died in the nest.
RIRA	110A	WE disappeared when CE appeared.
	110B	Nest deserted with two WE and one CE.
	110C	Two of three WE disappeared when CE appeared. Last WE disappeared a few days later.

* All nesting attempts are included.

[1] KEPI = Key Pittman WMA, RIRA = River Ranch.

[2] WE = willow flycatcher egg, CE = cowbird egg, WN = willow flycatcher nestling, CN = cowbird nestling.

Cowbird Egg Addling

Three nests at River Ranch were parasitized; one nest was too high to reach but was deserted during incubation, and the parasitism event caused failure at another nest. We addled the cowbird egg at the third nest at River Ranch. Partial depredation of this nest resulted in the loss of the remaining flycatcher egg; the female flycatcher continued to incubate the cowbird egg, which never hatched. We removed one cowbird nestling from a nest at Key Pittman that was found late in incubation. This nest also failed, with a lone flycatcher nestling developing very slowly and eventually dying in the nest.

Mayfield Nest Success and Productivity

Mayfield survival probability (MSP) was 0.447 at Key Pittman. MSP could not be calculated across all nest stages at River Ranch and Warm Springs because of lack of data for some stages. MSP was 0.375 for all three sites combined (Table 4.12). At all sites, 33 nestlings were confirmed to have fledged from 34 nests of known outcome (mean number of fledglings/nest = 0.97, SE = 0.22). Fecundity across study areas ranged from 0 to 3.0 young per female and averaged 1.65 (SE = 0.28) (Table 4.13).

Table 4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011*

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Key Pittman	1	1/42	0.976	0.950
	2	12/277	0.957	0.566
	3	3/224	0.987	0.831
	MSP all stages = 0.447			
River Ranch	1	2/5	0.600	0.335
	2	2/13.5	0.852	0.127
	3	0/0		
	MSP all stages = N/A[2]			

Table 4.12. Daily Survival Rates and Mayfield Survival Probabilities (MSP) for Willow Flycatcher Nest Stages NDOW Study Areas, 2011* (Continued)

Study Area	Nest Stage[1]	Nest Losses/ Observation Days	Daily Survival Rate	Mayfield Survival Probability
Warm Springs	1	0/0		
	2	0/13	1.000	1.000
	3	1/14	1.000	1.000
	MSP all stages = N/A[2]			
Total	**1**	**3/47**	**0.936**	**0.868**
	2	**14/303.5**	**0.954**	**0.545**
	3	**4/238**	**0.983**	**0.792**
	MSP all stages = 0.375			

* Mayfield survival probability was calculated using 2.14-day egg laying, 12.85-day incubation, and 13.76-day nestling stages.

[1] 1 = egg laying, 2 = incubation, 3 = nestling.

[2] MSP cannot be calculated for all stages because of lack of data.

Table 4.13. Willow Flycatcher Nest Productivity (Young Fledged per Nest) and Fecundity (Young Fledged per Female) at NDOW Study Areas, 2011*

Study Area	Young Fledged	# Nests	Productivity Mean (SE)	# Females	Fecundity Mean (SE)
Key Pittman	30	29	1.03 (0.24)	16	1.88 (0.29)
River Ranch	0	4	0.00 (0.00)	3	0.00 (0.00)
Warm Springs	3	1	3.00	1	3.00
Total	**33**	**34**	**0.97 (0.22)**	**20**	**1.65 (0.28)**

* Productivity calculations include nests that contained flycatcher eggs and had a known outcome. Fecundity calculations include all females.

DISCUSSION

Reclamation Study Areas

Number of Breeding Flycatchers

In 2011, willow flycatcher nesting was documented at six Reclamation study areas (Pahranagat, Mesquite, Mormon Mesa, Muddy River, Topock Marsh, and Bill Williams). No flycatchers were documented at Littlefield, which held breeding flycatchers in 2009 and 2010 but was scoured by floods in December 2010. Given that southwestern riparian ecosystems experience dynamic change and are not ecologically static (Periman and Kelly 2000), willow flycatcher occupancy and nesting are likely to be affected by changes in habitat suitability, with breeding flycatchers detected at a given site in one year and not in another. The number of flycatcher pairs recorded at Mormon Mesa, Muddy River, and Bill Williams was comparable to that recorded over the last several years. Mesquite had seven pairs in both 2011 and 2010, which was a drop from the number of pairs recorded in the previous four years (range 11–15). The main breeding site at Mesquite was dry in 2009 and nesting success was poor that year (McLeod and Koronkiewicz 2010). Flycatchers appeared to respond to the poor conditions by returning to other breeding sites in 2010 rather than returning to Mesquite (McLeod and Pellegrini 2011), and the number of breeding flycatchers at Mesquite was consequently reduced. It is unclear why the number of breeding pairs at Mesquite remained low in 2011 despite wet conditions at Mesquite West (see Chapter 2) at the beginning of the breeding season. It is possible that habitat suitability in the western portion of

Mesquite West, which is a mix of tamarisk and coyote willow and was unoccupied in 2011, has been reduced by tamarisk beetle defoliation.

Pahranagat had six breeding pairs in 2011, the lowest number recorded since 2003 (range 8–15 pairs). Monitoring in future years will help determine whether this is a temporary decline at Pahranagat or whether the amount of suitable habitat could be decreasing because of the reduced amount of surface water at the site in 2008–2011(see Chapter 2). There is evidence that the spatial distribution of nests within the main breeding site at Pahranagat has shifted over the years, moving away from the interior of the site, which was formerly inundated, and toward the periphery of the site, which is still in close proximity to surface water (NAU, unpubl. data).

Topock Marsh had five resident flycatchers, consisting of three unpaired males and one pair, the lowest number of resident individuals recorded since monitoring began in 1998. The number of resident flycatchers at Topock has been declining steadily since 2004. Water levels were exceptionally low in 2011 (see Chapter 2), which may have contributed to the continuing decline.

Nest Success

Nest success alone is an incomplete measure of the production of young. Successful nests produce from one to four young, and variations in nest productivity are not reflected in nest success rates. In addition, although every failed nest attempt lowers percent nest success and MSP, success of a subsequent nesting attempt may result in the same number of young produced as if the initial nesting attempt had been successful. Thus, nest productivity (young produced per nesting attempt) and fecundity (young produced per female) in conjunction with nest success provide additional information on the success of a given breeding season. Nest success at Pahranagat (100%) was, as it has been every year since 2003, higher than the average for all study areas. Productivity (2.43 young per nest) and fecundity (2.83 young per female) at Pahranagat in 2011 were also the highest recorded at any Reclamation study area, demonstrating that Pahranagat continues to be a highly productive site for willow flycatchers.

Percent nest success was essentially unchanged at Mesquite compared to 2010, but fecundity in 2011 (0.43) was less than half that of 2010 (1.00), and only three fledglings were produced. Fecundity was also low in 2009 (0.25). The main breeding site at Mesquite was dry during much of the breeding season in 2009 and after mid-June 2011, and dry conditions may be related to poor flycatcher reproduction (Moore and Ahlers 2008). Percent nest success, productivity, and fecundity at Mormon Mesa were all similar to what they had been in 2010. Muddy River, Topock, and Bill Williams continued to exhibit annual fluctuations in reproductive metrics, but sample sizes are too low to attribute much significance to the rates observed in 2011. Nest success results again illustrate that the demographic patterns of passerine populations often vary year to year, and sometimes to a very large degree (Wiens 1989a). The variable patterns of nest success observed at the study areas over many years demonstrate the need for long-term data.

Nest Failure

As in 2003–2010, depredation was the major cause of willow flycatcher nest failure, accounting for 52% of all failed nests in 2011. These results are consistent with those reported at the Reclamation study areas from 1998 to 2002 (Braden and McKernan unpubl. data) and at sites across Arizona from 1996 to 2008 (Graber et al. 2007, Ellis et al. 2008, Graber and Koronkiewicz 2009a), which indicate depredation as accounting for the majority of all willow flycatcher nest failures. Factors influencing the increases and decreases in nest depredation at the monitored study areas are inherently complex and at this time remain undetermined. For open-cup nesting passerines, nest depredation rates can vary year to year, and sometimes substantially, with depredation of eggs and young ultimately linked to landscape

characteristics and fluctuations in predator densities, abundance, and richness (Wiens 1989b, Robinson 1992, Howlett and Stutchbury 1996).

In 2008, Northern Arizona University (NAU) initiated a nest camera study in cooperation with SWCA on open-cup nesting passerines at selected study areas along the lower Colorado River and tributaries. The study used video and still cameras on real and artificial nests to identify depredation rates and nest predators. The study continued in 2009 and 2010, with video cameras deployed at flycatcher nests and still cameras at artificial nests. Marks on clay eggs indicated that most depredation events at Mesquite were from birds, while at Pahranagat both birds and rodents depredated artificial nests (NAU unpubl. data). Both Brown-headed Cowbirds and Yellow-breasted Chats were identified by still cameras as depredating artificial nests. Cowbirds were also documented on video depredating flycatcher nests at Mesquite in both 2009 and 2010. A variety of avian predators were documented depredating flycatcher nests at Pahranagat. The study was continued in 2011, with video cameras deployed at real flycatcher nests at Pahranagat, but all flycatcher nests were successful and no depredation events were documented. Results of this study suggest that avian species may be important predators on flycatcher nests at Reclamation study areas. Ellis et al. (2008) also identified Cooper's Hawks (*Accipiter cooperii*) and Yellow-breasted Chats depredating flycatcher nests at sites in Arizona.

Brood Parasitism

Brood parasitism by Brown-headed Cowbirds across all Reclamation study areas ranged from 0 to 60% and averaged 19% (see Table 4.1). These results are consistent with those reported at the study areas from 1998 to 2010 (Braden and McKernan unpubl. Data; McLeod et al. 2008a; McLeod and Koronkiewicz 2009, 2010; McLeod and Pellegrini 2011), but these parasitism rates are higher than those reported at other monitored sites across Arizona in 1996–2006, which were less than 10% at most sites in most years (Graber et al. 2007, Ellis et al. 2008).

We observed multiple occasions in which the disappearance of flycatcher eggs coincided with the parasitism event. In this case, cowbirds were suspected of ejecting the eggs. Female Brown-headed Cowbirds are known to physically attack willow flycatcher nestlings (Woodward and Stoleson 2002), remove single eggs, and occasionally destroy entire broods after laying is complete or after hatching (Lowther 1993 as cited in Woodward and Stoleson 2002). In addition, cowbirds were photographed removing eggs from artificial nests during the 2008–2010 camera study, and cowbirds were documented on video depredating flycatcher nests during both the incubation and nestling phases. Therefore, it is likely that other depredation events on eggs and nestlings are attributable to cowbirds.

Parasitism does not invariably cause nest failure, but the success rate (18%) for parasitized nests at all study areas in 2003–2011 was less than half that of unparasitized nests (49%). Similar results were recorded for willow flycatchers in Oregon, with parasitism resulting in a 50% decrease in success rates compared to unparasitized nests (Sedgwick and Iko 1999) and at other sites in Arizona, where in 1996–2005, 20% of parasitized nests fledged flycatcher young vs. 57% of unparasitized nests (Ellis et al. 2008). Parasitized nests that did succeed in fledging flycatcher young at all study areas in 2003–2011 produced on average fewer young (1.3 young/nest) than did unparasitized nests (2.2 young/nest; $F_{1,249} = 21.24$, $P < 0.001$). Cowbirds may eject flycatcher eggs during the parasitism event, thus reducing clutch size, and cowbird young also cause interspecific nestling competition, as evidenced by the presence of severely underdeveloped nestlings in some parasitized nests. For all nests monitored from 2003 to 2011, 44% of nests that fledged a cowbird also fledged flycatcher young. This is a higher rate of success than that observed in Southwestern Willow Flycatchers at Kern River, California (9%; Whitfield and Sogge 1999), but comparable to that observed at other Arizona sites (40%; Ellis et al. 2008).

Female flycatchers may desert their nests after parasitism events and thus expend energy renesting and laying additional eggs. Given that adult flycatchers exhibit high site fidelity to breeding areas (Braden and McKernan unpubl. data, McLeod et al. 2008a, McLeod and Koronkiewicz 2009, this document) and renest most often after failed nests (Sedgwick 2000), females returning to sites with high brood parasitism may have reduced lifetime fecundity because they are expending energy on multiple failed nesting attempts over many years. An analysis of lifetime fecundity of females will be included in the summary report in 2012. In addition, willow flycatchers that fledge late in the season have been shown to have a lower survival rate than those that fledge early in the season (Paxton et al. 2007, McLeod et al. 2008a), suggesting additional hidden effects of parasitism and subsequent renesting on flycatcher demography.

Cowbird trapping and removal studies were initiated at Pahranagat, Mesquite, and Topock Marsh in 2003 and continued through 2007. Results of these studies showed that cowbird trapping appeared to lower parasitism rates in comparison to the pre-trapping period of 1998–2002 only at Pahranagat, with no parasitism detected during trapping years (McLeod et al. 2008a). No cowbird trapping was completed in 2008–2011, but even in the absence of cowbird trapping, no parasitism events were detected at Pahranagat in 2008, 2009, or 2011. One parasitism event was noted in 2010, and the nest was abandoned before flycatcher eggs were laid. This nest was located on the very edge of the site, adjacent to open, upland habitat, possibly increasing parasitism probability. These observations suggest that cowbird trapping may have lingering effects beyond the years in which trapping is completed.

We speculated that trapping might have affected the parasitism rate at Pahranagat but not the other study areas because Pahranagat consists of relatively small, isolated patches of riparian habitat rather than existing in a large, contiguous riparian corridor. The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 26%, well below the average of 46% across all other study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

Cowbird Egg Addling

We addled cowbird eggs and removed cowbird nestlings in all study areas except Pahranagat in 2011. Pahranagat was not included because it is still part of the 5-year post-cowbird-trapping experiment. Though sample size is small, addling cowbird eggs seemed to reduce the hatch rate of cowbird eggs. Furthermore, none of the females deserted their nests after we addled cowbird eggs. One female in a non-Reclamation study area from whose nest a cowbird nestling was removed also continued to raise the remaining flycatcher nestling. While flycatcher hatch rates and productivity were not improved by the program in 2011, this is not necessarily due to the program itself so much as low parasitism rates and high rates of nest failure due to addling where parasitism did occur. We recommend this program be continued in the future. Field personnel should also continue to practice egg addling at the beginning of the season with button quail eggs to maximize the effectiveness of shaking eggs in preventing hatching.

NDOW Study Areas

At Warm Springs, a fire during the breeding season of 2010 affected all sites and reduced the availability of suitable habitat (see Chapter 2), and the number of breeding pairs declined correspondingly from three to one in 2010 and 2011, respectively. Many measures of nesting (number of breeding pairs, Mayfield nest success, and rate of brood parasitism) were similar at Key Pittman between 2010 and 2011.

Productivity and fecundity were lower in 2011 (1.03 and 1.88, respectively) than in 2010 (1.23 and 2.03, respectively), but there was no statistically significant difference in either fecundity or productivity between years.

Cowbird parasitism was high (75%) at River Ranch, and none of the four nests at this site was successful. Low nest success is further indication of poor habitat quality at River Ranch (see Chapter 3 for a discussion of within-year movement and the presence of second-year individuals at River Ranch).

Video cameras were deployed on flycatcher nests in both 2010 and 2011 at Key Pittman. Two depredation events were recorded on video in 2011 (NAU unpubl. data), one by a kingsnake (*Lampropeltis getulus*) and the other by a Sharp-shinned Hawk (*Accipiter striatus*). Field personnel also witnessed a depredation event by a short-tailed weasel (*Mustela frenata*).

This page intentionally left blank.

Chapter 5

VEGETATION AND HABITAT CHARACTERISTICS

INTRODUCTION

Our objective for vegetation sampling is to provide a quantitative summary of the floristic and structural conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if they resemble occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the vegetation consists primarily of very large and widely spaces trees, and these characteristics are unique to the site and not likely to be replicated in restoration areas. In 2011, we completed vegetation sampling within occupied territories only at Bill Williams because of the relatively low sample size of vegetation plots obtained at this study area over previous years. Sampling at all other study areas was discontinued because of adequate sample sizes from previous years. A combined analysis of all years of vegetation data will be presented in a summary report in 2012.

METHODS

We described and measured vegetation and habitat features following a modification of the methods of James and Shugart (1970). Vegetation characteristics were measured within a 5-m-radius circle. To avoid disrupting flycatcher breeding activities, we measured vegetation late in the summer when the nest, territory, and adjacent flycatcher territories were inactive.

In 2008, we measured vegetation and habitat characteristics at one plot for each resident (i.e., detected for at least one week) male flycatcher we identified, regardless of whether or not he obtained a mate. Plot center locations were determined as soon as territories were identified. We estimated the center of the male's activity by observing his use of singing perches and selecting a location that was approximately equidistant from the perches at the perimeter of his use area. We then proceeded in a randomly selected compass direction for a randomly selected distance between 0 and 20 m. We used additional random numbers to select the exact location in which to hang a temperature/humidity data logger (see Chapter 6) and used that location as plot center. This process resulted in the random selection of a point that was still within the male's territory. The sampling points were marked in the field with flagging that remained in place over the winter.

In 2009, we identified the territory center for each resident male as described above. If an existing sampling point from 2008 was within 20 m of the territory center identified in 2009, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. All sampling points that were assigned to active territories in 2009 were marked with flagging that remained in the field over the winter. We repeated this point selection procedure for territories that were active in 2010 and 2011, assigning a sampling point that was used in the previous year if one was within 20 m of the current territory and selecting a new sampling point if no existing point were available. Sampling points that were identified in 2010 but were not within 20 m of a territory center in 2011 were resampled in 2011.

At each plot, we laid out four 5-m-long ropes from plot center, one in each of the four cardinal directions. Each rope was marked at 1 m and 5 m from the center of the plot. At plot center and at 1 m and 5 m from

the center of the plot in each cardinal direction, we measured vertical foliage density using a 7.5-m-tall survey rod. Working our way up the rod, we recorded the presence of vegetation, by species, within a 10-cm radius of the rod in 0.1-m intervals (presence of the species within the 0.1-m interval equaled one "hit" on the rod), and summed all hits in 1-m intervals. Presence of dead vegetation (snags) was recorded in the same manner, but not identified to species. If canopy vegetation continued above 8.0 m, we estimated the number of hits as zero, greater than five, or less than five hits per 1-m interval until the canopy vegetation stopped (modified from Rotenberry 1985).

We measured total canopy closure using a Model-A spherical densiometer at 1 m north and south of the center of each plot and averaged these measurements to obtain a single canopy closure value for each plot. We measured average canopy height within each plot by selecting a representative tree and using a survey rod or a clinometer and measuring tape to measure the height of the selected tree. We estimated percent woody ground cover, alive and dead, within 0.5 m of the ground using a Daubenmire-type frame with the lower edge of the frame centered at 1 m north, south, east, and west of plot center. These percentages were averaged to obtain a single measure of percent woody ground cover for each plot.

We tallied the number of live stems for each species within 5 m of the center of the plot. Stems were tallied if they were at least 1.4-m tall and >2.5 cm in diameter at 10 cm above the ground. Stems were tallied by the following diameter at breast height (dbh) categories: <1 cm, 1–2.5 cm, 2.6–5.5 cm, 5.6–8 cm, 8.1–10.5 cm, and 10.6–15 cm. Any stems >15 cm dbh were measured and the exact dbh was recorded. Dead stems were also tallied in these categories, but not identified to species. We marked each stem with a piece of chalk after it was tallied to facilitate accurate stem counts.

During vegetation sampling in 2003–2007, if a stem branched above 10 cm but below 1.4 m above the ground, only the largest stem was tallied. In habitats (e.g., tamarisk) where stems frequently branch in this height interval, this method of counting stems may underestimate the density of stems that form an important part of the habitat structure. Therefore, in 2008–2011 we tallied stems as we had in previous years and then for each stem that branched between 10 cm and 1.4 m from the ground, we tallied the number of additional stems that were at least 2.5 cm in diameter at 10 cm above the point where it branched from the main stem.

Additional information recorded at each plot included the date when the measurements were taken, observer initials, and UTM coordinates for each plot center.

Data Analyses

We used high-resolution aerial photography and field knowledge of each study area to delineate clusters of territories that occur within habitat patches of similar floristics and canopy height. Vegetation characteristics were then summarized for each habitat type. For each habitat type, we give the corresponding vegetation classification as defined in Younker and Andersen (1986) and used in the LCR MSCP. We also pooled data across habitat types that fell under a single vegetation classification and present summary statistics for each vegetation classification. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

Stem counts were grouped into the following size categories for analysis: ≤2.5 cm dbh, 2.6–8 cm dbh, and >8 cm dbh. For each size category, stem counts are reported separately for live and dead stems; the sum of these is the equivalent of the stem counts per size category that were reported in the 2003–2007 summary report (McLeod et al. 2008a). Vertical foliage density measurements above 8.0 m that were recorded as < or >5 hits per meter were converted to 2.5 and 7.5 hits, respectively, to allow analyses of these data as continuous rather than categorical. Vertical foliage density was calculated for each meter interval as the mean of the number of hits recorded within the interval at the nine locations in the plot.

In 2003–2007, we had measured vertical foliage density only at plot center and 1 m from plot center in each cardinal direction, and foliage density measures per meter interval were presented as the sum of the hits recorded at the five locations in the plot. Thus, vertical foliage data presented in reports from 2003 to 2007 should be divided by 5 to be comparable to data presented here. In the five-year summary report (McLeod et al. 2008a), vertical foliage data were grouped into three categories of above, at, and below the nest. We used average nest height as measured in 2003–2011 in each vegetation type to demarcate vertical foliage categories in 2011. As with stem counts, vertical foliage data are reported separately for live and dead vegetation.

Percent native vegetation was calculated as the average of the percent basal area that was native and the percent native vertical foliage hits. To obtain basal area, we multiplied the number of stems tallied in each size class by the average basal area of a stem in that class, given an even distribution of stems within each size class. For data collected in 2003–2007 (reported in McLeod et al. 2008a), we did not use vertical foliage data to calculate percent native because all vertical foliage data were collected within 1 m of plot center and represented only a small portion of the plot. We included vertical foliage data in the percent native calculations in 2008–2011 to account for the influence of stems that were too small to be tallied or were rooted outside the 5-m-radius circle but overhung the plot.

RESULTS

We measured vegetation at Bill Williams at four occupied territories and four territories that were occupied in 2010 but not in 2011. The eight territories are located in five survey sites at Bill Williams: Site #3, Site #4, Burn Edge, Planet Ranch Road, and Cougar Point. Of the four occupied territories, three had nesting flycatchers and one was occupied by an unpaired male. Small sample sizes preclude any comparison between territories occupied by nesting pairs versus those occupied by unpaired males; data collected in 2011 will be combined with data collected in previous years for this comparison, which will be presented in a five-year summary report in 2012. Data from territories that were occupied in 2010 but not in 2011 are not included in the 2011 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. This analysis would also be presented in the summary report.

We delineated the following habitat types: 1) Goodding willow with tamarisk understory, and 2) cottonwood/willow. Goodding willow with tamarisk understory occurred in Site #3, Site #4, and Burn Edge, while cottonwood/willow was present at Planet Ranch Road and Cougar Point. Average nest height recorded in 2003–2011 and used to assign vertical foliage strata for each vegetation category were 4.2 m for Goodding willow with tamarisk understory and 2.5 m for cottonwood/willow.

Although the vegetation types delineated in this report differ from one another in vertical structure and floristic composition, all fall within the definition of cottonwood-willow habitat (cottonwoods and willows constituting at least 10% of total trees) as described in Younker and Anderson (1986) and used in the LCR MSCP. The cottonwood/willow habitat type as delineated in this report falls under the definition of cottonwood-willow Type III (no understory, with the canopy layer from 4.5–6.0 m), while Goodding willow with tamarisk understory as delineated in this report falls under the definition of cottonwood-willow Type I (three definitive layers of vegetation with the majority of the vegetation volume at 6.0 m or more).

Vegetation characteristics of each habitat type are summarized in Table 5.1. Habitat characteristics varied between and within habitat types.

Table 5.1. Summary of Vegetation Characteristics at Occupied Southwestern Willow Flycatcher Territories in Varying Habitat Types, Lower Colorado River and Tributaries, 2011*

Parameter	SAGO with TASP understory (C-W Type I) (n=2)	POFR and SAGO (C-W Type III) (n=2)
Average canopy height (m)	6.3 (0.5)	7.4 (0.7)
	5.8–6.8	6.7–8.0
% total canopy closure	90.9 (3.9)	97.4 (1.6)
	87.0–94.8	95.8–99.0
% woody ground cover	33.9 (21.4)	37.1 (31.6)
	12.5–55.3	5.5–68.8
# live stems ≤2.5 cm dbh per ha	1846 (1210)	1210 (1210)
	637–3056	0–2419
# live stems 2.6–8 cm dbh per ha	3183 (764)	9486 (446)
	2419–3947	9040–9931
# live stems >8 cm dbh per ha	573 (318)	1210 (64)
	255–891	1146–1273
# dead stems ≤2.5 cm dbh per ha	446 (191)	1337 (955)
	255–891	382–2292
# dead stems 2.6–8 cm dbh per ha	827 (191)	764 (255)
	637–1019	509–1019
# dead stems >8 cm dbh per ha	64 (64)	0 (0)
	0–127	0–0
Percent native	1.7 (1.2)	99.1 (0.6)
	0.4–2.9	98.8–100.0
Live vertical foliage (hits) below average nest height	6.3 (0.4)	1.9 (1.1)
	5.9–6.7	0.8–3.0
Live vertical foliage (hits) at average nest height	2.7 (0.0)	3.9 (1.9)
	2.7–2.7	2.0–5.8
Live vertical foliage (hits) above average nest height	2.2 (0.8)	13.7 (2.4)
	1.4–3.0	11.2–16.1
Dead vertical foliage (hits) below average nest height	12.7 (1.8)	3.4 (2.7)
	10.9–14.4	0.8–6.1
Dead vertical foliage (hits) at average nest height	0.6 (0.4)	1.8 (1.7)
	0.1–1.0	0.1–3.6
Dead vertical foliage (hits) above average nest height	0.2 (0.2)	1.0 (1.0)
	0–0.4	0–2

* Data are presented as mean, standard error, and range. Stem counts include only the largest stem of any cluster that branched above 10 cm above the ground. SAGO = Goodding willow, TASP = tamarisk, POFR = cottonwood, C-W = cottonwood-willow.

The proportion of stems omitted from stem counts by counting only the largest stem of a cluster that branched between 10 cm and 1.4 m above the ground varied both by size and species of the main stem (Table 5.2). Larger stems typically had more branches that were omitted.

Vertical foliage profiles for each habitat type are shown in Figures 5.1–5.2. Average nest height in each habitat type, as recorded in 2003–2011, is also shown on each graph. In both habitat types, the proportion of dead vegetation in the vertical profile was highest immediately above the ground and declined with increasing height. The densest live foliage occurred 3–5 m above the ground, at or above average nest height.

Table 5.2. Proportion of Stems Omitted from Stem Counts

Size category[1]	Species			
	Tamarisk	Coyote willow	Goodding willow	Dead stems
≤2.5 cm dbh	0.12	--	0.0	0.05
2.6–8 cm dbh	0.67	--	0.0	0.52
>8 cm dbh	1.46	--	0.0	2.0

[1] Size category indicates the size of the main stem that was tallied. All stems that were omitted from the stem count are equal to or smaller than the size of the main stem.

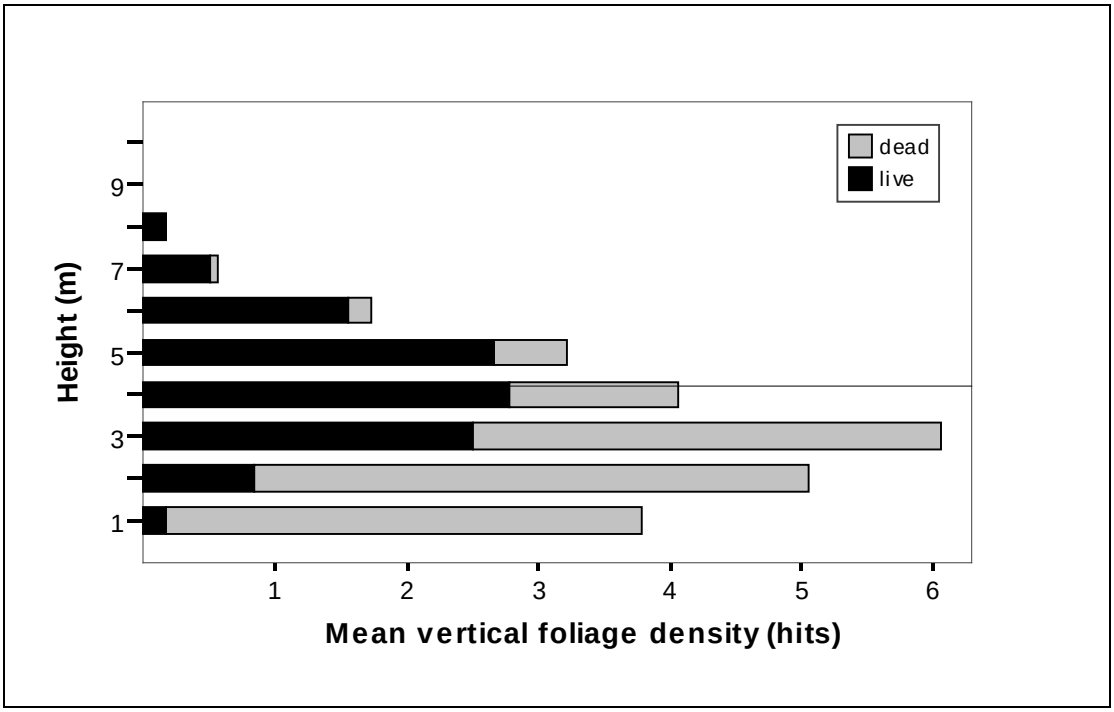


Figure 5.1. Vertical foliage density at occupied willow flycatcher territories in Goodding willow with tamarisk understory habitat type, 2011. Horizontal line shows average nest height in this habitat type in 2003–2011. This habitat type is also cottonwood-willow Type I.

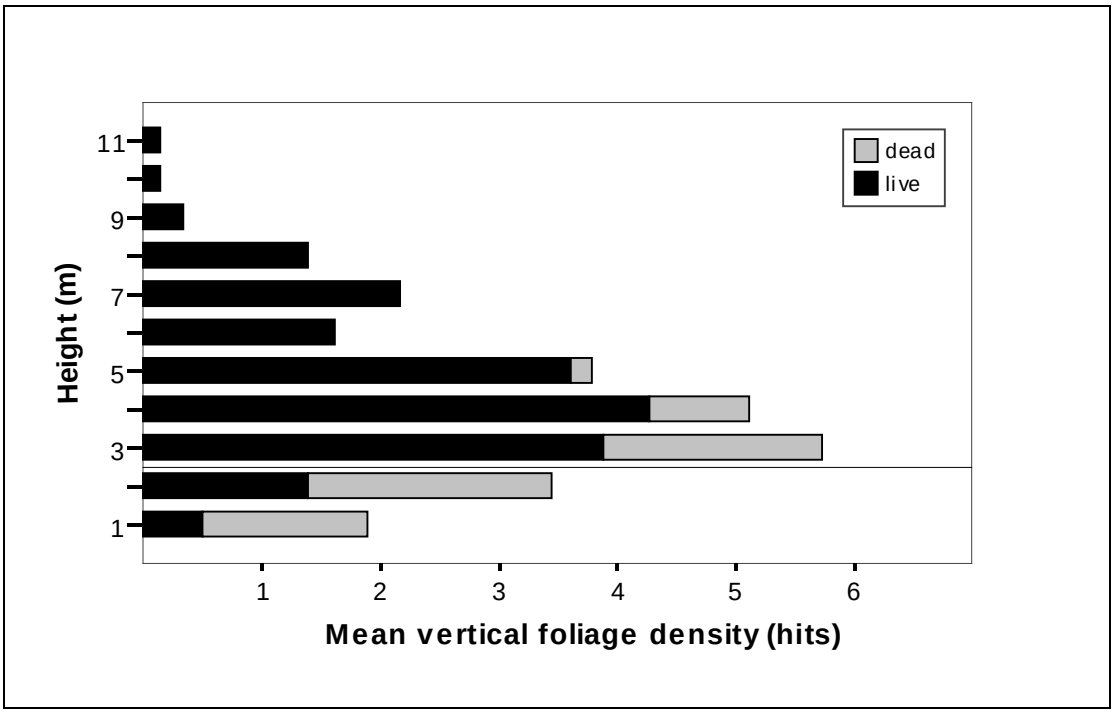


Figure 5.2. Vertical foliage density at occupied willow flycatcher territories in cottonwood/willow habitat type, 2011. Horizontal line shows average nest height in this habitat type in 2010–2011. This habitat type is also cottonwood-willow Type III.

DISCUSSION

The purpose of vegetation measurements of occupied habitat is to provide quantitative guidelines for restoration efforts. The limited data collected in 2011 preclude any meaningful summary of habitat characteristics and any comparison between vegetation types. In a summary report to be completed in 2012, data from 2011 will be combined with other data collected within active territories in prior years to provide a more comprehensive description of each habitat type.

Chapter 6

MICROCLIMATE

INTRODUCTION

Our objective for microclimate sampling is to provide a quantitative summary of microclimate conditions within occupied territories in various vegetation types. These descriptive summaries will provide guidance for managers working to restore and create riparian habitat to meet the obligations of the LCR MSCP and will provide a means to evaluate habitats to determine if the microclimate resembles that in occupied flycatcher territories. The Pahranagat study area was excluded from the characterization of occupied territories because the study area is approximately 650 m higher in elevation and experiences a cooler climate than the LCR MSCP planning area. In 2011, we collected microclimate data only at Bill Williams; adequate sample sizes had been achieved at all other study areas in previous years.

METHODS

Temperature and Humidity Measurements

Measurements of temperature and humidity were recorded automatically every 15 minutes using a HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) that combines a thermometer (degrees Celsius), humidity monitor, and digital data logger. We camouflaged all HOBO units by placing them in an inverted small, plastic container coated with spray adhesive and local vegetation. The opening at the bottom was covered with shadecloth, allowing free air circulation around the unit.

In 2010, we collected microclimate measurements at one location for each resident male flycatcher we identified, regardless of the length of time the male was resident and whether or not he obtained a mate. One HOBO unit was placed within each active flycatcher territory. We estimated the center of the male's territory (see Chapter 5) and then determined the location of the HOBO unit by means of the following instructions and the use of random number sequences:

1) The compass direction to walk from the territory center, given in degrees from north, was determined from a random number sequence.

2) The distance (between 0 and 20 m) to walk in the designated direction was determined from a random number sequence. Once that distance was traveled, the closest woody tree or shrub was selected for data logger placement.

3) The HOBO unit was placed at a randomly selected height within the range of flycatcher nest heights documented at that study area in 2003–2007 (McLeod et al. 2008a). The distribution of random numbers followed the distribution of nest heights. If the chosen tree or shrub was of insufficient height to accept the height from the random number sequence, then field personnel placed the HOBO unit at the first height in the sequence that was less than the height of the tree or shrub. If no nests had been previously recorded at that study area, field personnel used the height sequences from the nearest study area with known nests.

4) The distance (0–2 m) at which the HOBO was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If the tree or shrub was of insufficient radius to accept the distance from the random number sequence, then field personnel placed the unit at the first number in the sequence that was less than the radius of the tree or shrub.

5) The compass direction, given in degrees from north, at which the unit was placed from the bole of the tree or center of the shrub was determined from a random number sequence. If there was no branch in this compass direction that would support the data logger at the height and distance specified in (3) and (4), field personnel proceeded clockwise around the tree or shrub until a suitable branch was located.

If, as presented in (3) and (4), a number from a subsequent random number sequence (sequence meaning a row in the random number table) was used because the number in the initial sequence was too high, then both sequences were considered used and no longer available for future use. If these directions took field personnel outside of the riparian zone or to a site without trees or shrubs, they returned to the territory center and used the next sequence of random numbers.

The HOBO logger locations representing active territories in 2010 at Bill Williams were marked in the field with flagging, which remained in place over the 2010–2011 winter. HOBO loggers were redeployed in these same locations in early May 2011. During the breeding season of 2011, we identified the territory center for each resident male. If an existing sampling point was within 20 m of the territory center identified in 2010, we assigned that existing point to the current territory. If there was no existing point within 20 m of the territory center, we located a new sampling point as described above. Sampling points that were identified in 2010 but were not within 20 m of a territory center in 2011 were resampled in 2011. Data from these points are not included in the 2011 data presented below but may be used in future analyses to identify any changes in vegetation that may lead to territory abandonment. All HOBO units were removed from the field at the end of the breeding season.

Soil Moisture Measurements

A ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively) was used to gather soil moisture data. The soil moisture readings (nine per site) were recorded directly beneath the HOBO logger (plot center) and at 1.0 and 2.0 m from plot center in each cardinal direction. Soil moisture readings were collected when the HOBO logger was deployed and at two-week intervals throughout the breeding season until the HOBO logger was removed at the end of the season. Soil moisture was recorded both as voltage (mV) and as volumetric water content (%).[1] Soil type on the HH2 was set to mineral soil. For any soil moisture measurement point that was underwater, we recorded the depth of standing water and assigned a value of 994 mV, which is equivalent to 50% volumetric water content, or fully saturated soil. All mV values greater than 994 were also reassigned as 994 mV, because this reading represents fully saturated soil and because the mV to percent relationship becomes excessively nonlinear for mV readings above this point. Each time we collected soil moisture data, we also recorded the distance to the nearest standing water or saturated soil (as measured by visual estimate, GPS, or aerial photo) and recorded the approximate percentage, as estimated in the field by visual observation in combination with aerial photo, of the site within 20 and 50 m of the data logger that contained inundated or saturated soil.

A soil sample was collected from beneath each HOBO location that was new in 2011. Samples were approximately the size of a medium apple, collected from the surface down to and including a depth of 5 cm, and placed in a heavy zip-lock plastic bag labeled with the site designation. These samples will contribute to an ongoing analysis of soil texture, which strongly influences capillary action and therefore

[1] The soil moisture logger measures the dielectric constant of moist soil via a direct current voltage, which is converted to volumetric soil moisture with conversion tables. For very high (above ~1000 mV) or low (below ~90 mV) voltage readings, the HH2 reports volumetric soil moisture as "above" or "below" the table, respectively. To enable the use of all data, we analyzed and report only the mV readings. Both mV and percentage were recorded in the field to facilitate data proofing. Voltage is related to soil moisture as follows: $1.07 + 6.4V - 6.4V^2 + 4.7V^3 = 1.6 + 8.4\theta$, where θ = volumetric soil moisture.

overall soil moisture (Sumner 2000). Results of the soil texture analysis will be presented in the 2012 summary report.

Statistical Analyses

Soil moisture data were entered into a database as they were collected during the field season. We downloaded data from the HOBO data loggers into databases at the end of the field season. We merged all data to create one dataset for further analysis. We summarized the following variables for each HOBO location:

- Mean soil moisture from plot center to 2.0 m from plot center
- Distance to nearest standing water or saturated soil
- % of the area within 20 m of plot center that was inundated or saturated
- % of the area within 50 m of plot center that was inundated or saturated
- Maximum diurnal temperature
- Minimum nocturnal temperature
- Daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure[2]
- Mean nocturnal vapor pressure

Soil moisture variables were summarized per visit, and temperature/humidity variables were summarized on a daily basis. We determined diurnal and nocturnal periods by using the actual daily sunrise and sunset times reported for the region by the National Weather Service (2011). We selected the above measures of temperature and humidity for analysis because they were the most highly correlated with other variables or were the most useful in distinguishing use areas from non-use locations (McLeod et al. 2008a). Territories were grouped according to habitat type (see Chapter 5), and microclimate variables were averaged for each habitat type over the following two-week periods to show how microclimate conditions changed throughout the breeding season: 16–31 May, 1–15 June, 15–30 June, 1–15 July, and 16–31 July. Data were also summarized by vegetation classification (see Chapter 5).

Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009). Data are presented as mean (standard error) unless otherwise noted.

RESULTS

We collected microclimate data at two active territories that contained nesting pairs and four territories that were occupied in 2010 but not in 2011. Data from territories that were occupied in 2010 but not in 2011 are not included in the 2011 data presented below but may be used in future analyses to identify any changes in microclimate that may lead to territory abandonment. This analysis would be presented in a five-year summary report in 2012. One active territory was in Goodding willow with tamarisk understory, which falls under the cottonwood-willow Type I vegetation classification, and the other territory was in cottonwood/willow, which falls under cottonwood-willow Type III (see Chapter 5). Microclimate variables are summarized by two-week periods for each vegetation type in Tables 6.1 and 6.2. These same variables are plotted in Figures 6.1–6.9 to facilitate comparisons between vegetation types.

[2] Vapor pressure, unlike relative humidity, is not influenced by ambient temperature, and may be a more biologically meaningful measure of water content of the air (e.g., the relative vapor pressure inside and outside an egg determines whether the egg loses moisture). We calculated vapor pressure from the absolute humidity and temperature recorded by the HOBOs.

Table 6.1. Microclimate Measures in Southwestern Willow Flycatcher Territories in Goodding Willow with Tamarisk Understory, 2011*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture (n=1)[1]						
Mean soil moisture (mV)	894.7	831.7	750.7	758.0	752.8	731.3
Mean distance to nearest standing water	15.0	15.0	15.0	375.0	393.0	470.0
% of area within 20 m that was inundated	25.0	20.0	5.0	0.0	0.0	0.0
% of area within 50 m that was inundated	30.0	35.0	15.0	0.0	0.0	0.0
Temperature (n=1)[2]						
Mean maximum diurnal temperature (°C)	35.3 (0.8)	37.9 (0.6)	39.7 (0.3)	41.6 (0.7)	39.2 (0.5)	N/A
Mean minimum nocturnal temperature (°C)	11.8 (0.7)	12.3 (0.5)	16.5 (0.6)	19.7 (0.9)	20.6 (0.8)	N/A
Mean daily temperature range (°C)	23.4 (1.0)	25.6 (0.7)	23.2 (0.5)	21.9 (0.9)	18.7 (0.9)	N/A
Humidity (n=1)[2]						
Mean diurnal vapor pressure (Pa)	1309.5 (67.2)	1726.9 (118.4)	2249.5 (113.7)	2991.2 (126.2)	3063.0 (84.2)	N/A
Mean nocturnal vapor pressure (Pa)	1037.0 (48.0)	1308.9 (52.3)	1562.9 (72.3)	2297.7 (116.8)	2339.8 (94.6)	N/A

* Data are presented as mean (standard error). This habitat type is also cottonwood-willow Type I.
[1] Sample size indicates the number of data logger locations. No standard error is reported for periods in which soil moisture variables were measured only once.
[2] Sample size indicates the number of data logger locations. Mean and standard error are reported for daily readings within each time period.

AR064777

Table 6.2. Microclimate Measures in Southwestern Willow Flycatcher Territories in Cottonwood/Willow, 2011*

Microclimate measure	May 16–31	June 1–15	June 16–30	July 1–15	July 16–31	August 1–15
Soil Moisture (n=1)[1]						
Mean soil moisture (mV)	951.3	986.7 (0.1)	921.0	957.0	965.3	904.9
Mean distance to nearest standing water	1.0	1.3 (0.3)	0.0	1.0	1.0	1.0
% of area within 20 m that was inundated	55.0	60.0 (20.0)	40.0	85.0	50.0	60.0
% of area within 50 m that was inundated	70.0	50.0 (10.0)	65.0	45.0	60.0	50.0
Temperature (n=1)[2]						
Mean maximum diurnal temperature (°C)	29.9 (0.8)	32.6 (0.6)	35.2 (0.5)	35.0 (0.5)	35.3 (0.7)	N/A
Mean minimum nocturnal temperature (°C)	14.5 (1.0)	13.6 (0.7)	19.1 (0.8)	21.0 (1.0)	22.4 (0.8)	N/A
Mean daily temperature range (°C)	15.4 (1.3)	19.0 (0.9)	16.1 (0.6)	13.9 (1.1)	13.0 (0.9)	N/A
Humidity (n=1)[2]						
Mean diurnal vapor pressure (Pa)	1112.0 (43.0)	1269.8 (64.8)	1516.9 (50.4)	2312.6 (164.7)	2245.6 (114.6)	N/A
Mean nocturnal vapor pressure (Pa)	806.2 (25.2)	904.9 (42.3)	1114.3 (47.0)	1937.9 (147.3)	1873.1 (111.8)	N/A

* Data are presented as mean (standard error). This habitat type is also cottonwood-willow Type III.
[1] Sample size indicates the number of data logger locations. Mean and standard error are reported for time periods in which soil moisture variables were measured twice. No standard error is reported for periods in which soil moisture variables were measured only once.
[2] Sample size indicates the number of data logger locations. Mean and standard error are reported for daily readings within each time period.

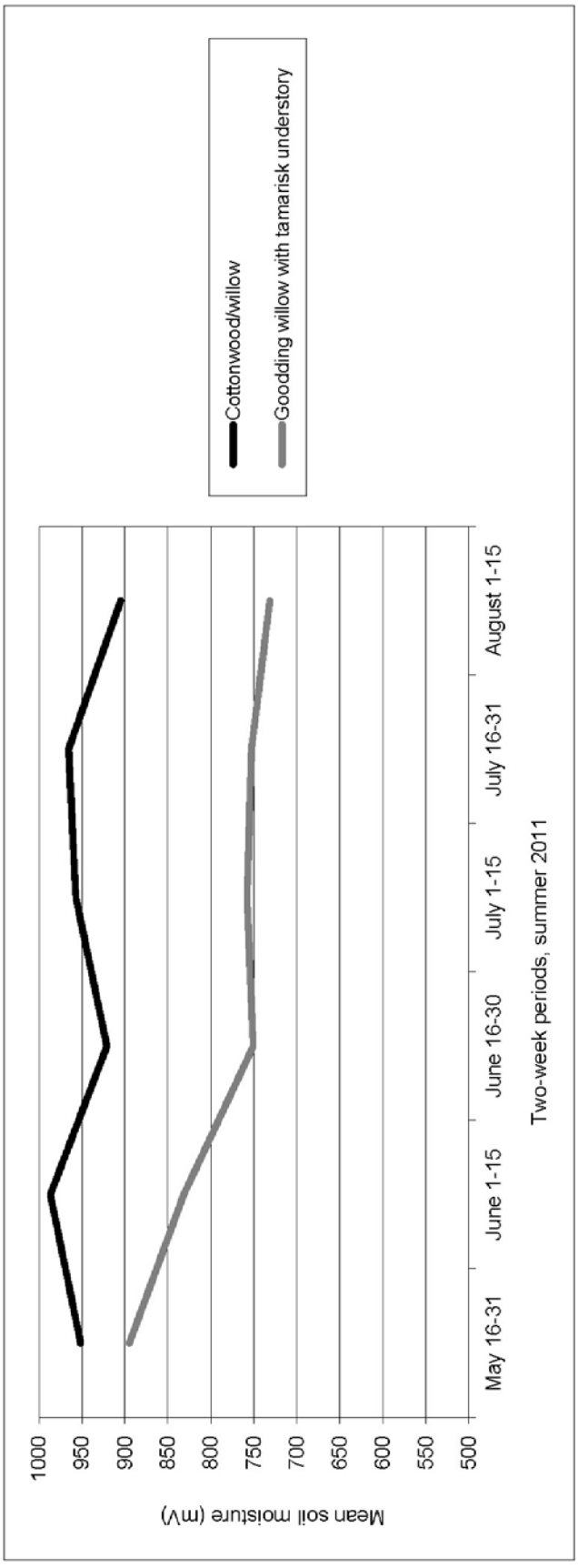


Figure 6.1. Mean soil moisture (mV) in Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory.

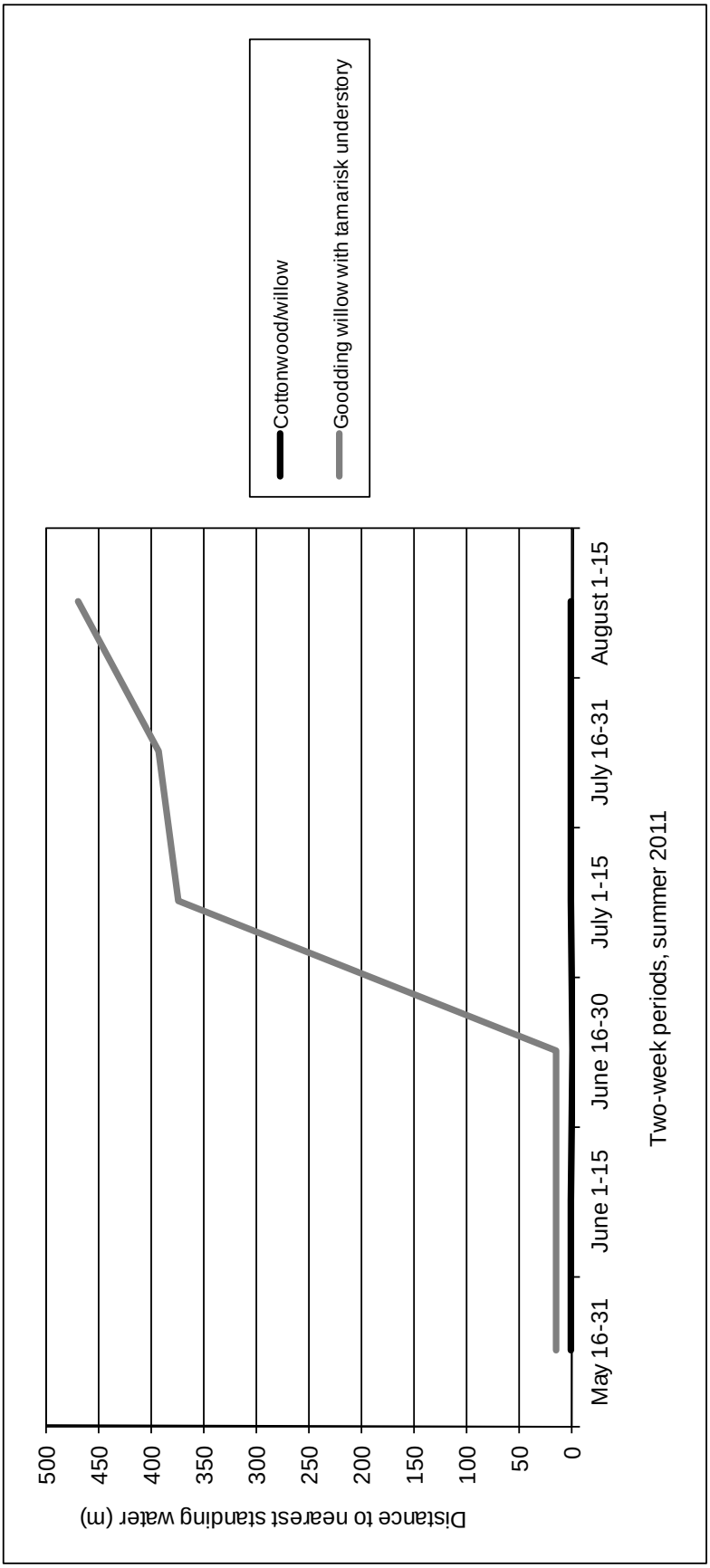


Figure 6.2. Distance (m) to standing water or saturated soil from Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which distance to water was measured more than once in a given two-week period.

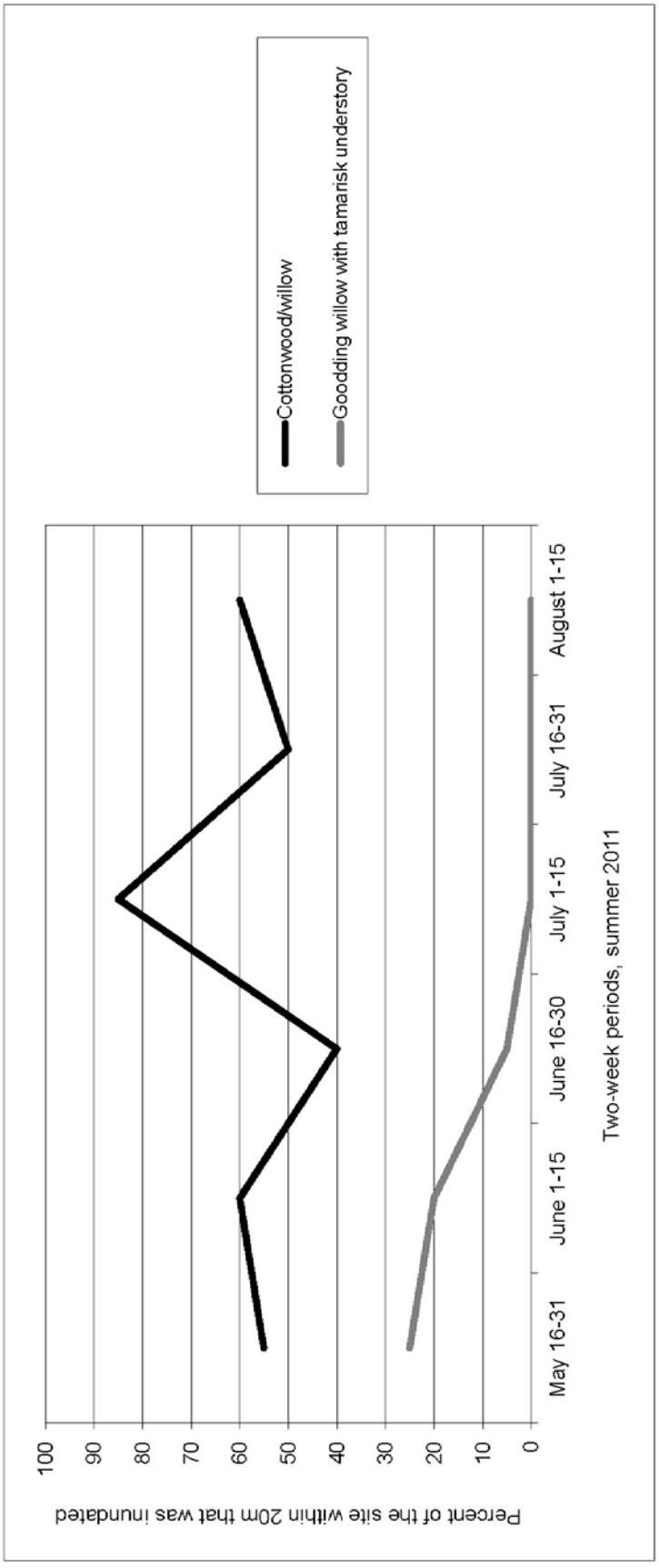


Figure 6.3. Percent of the area within 20 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which percent inundated was measured more than once in a given two-week period.

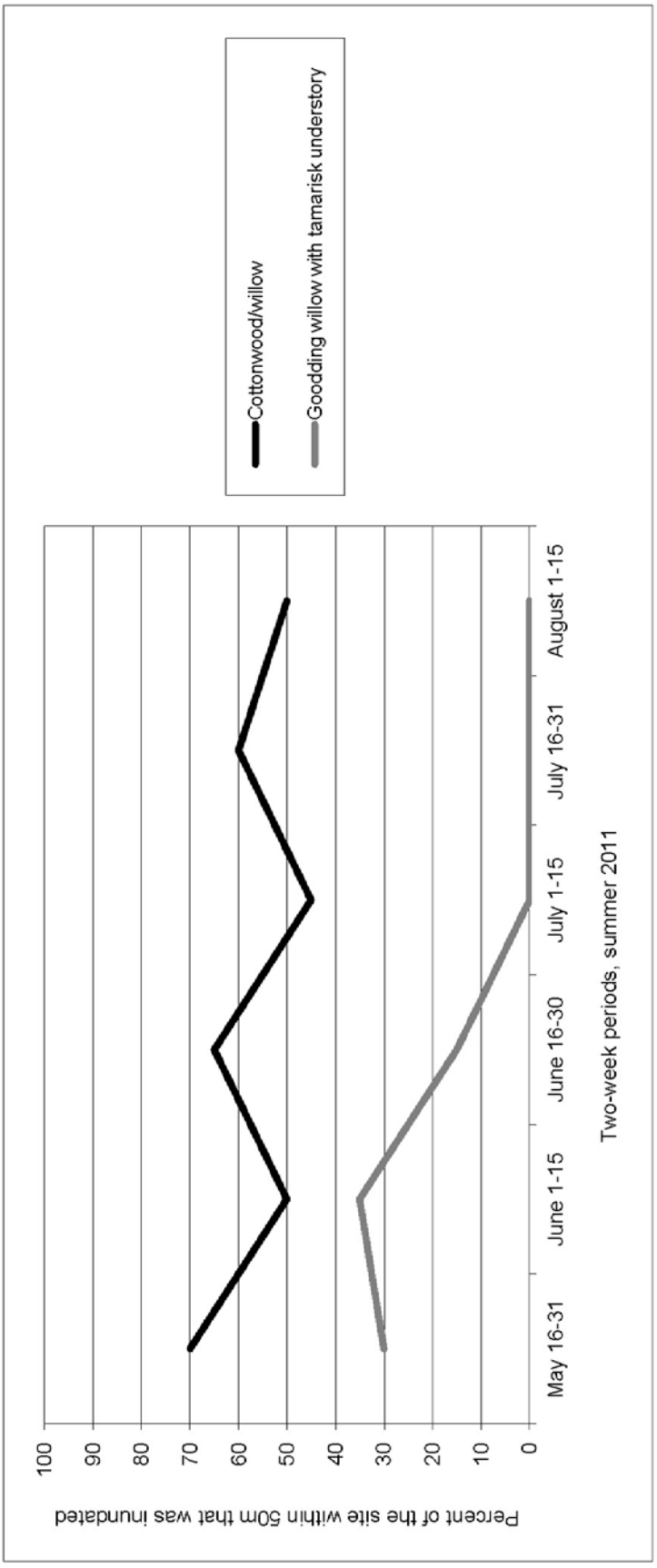


Figure 6.4. Percent of the area within 50 m of Southwestern Willow Flycatcher territories that contained standing water or saturated soil in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods. Each vegetation type contained a single flycatcher territory. Data are presented as means for instances in which percent inundated was measured more than once in a given two-week period.

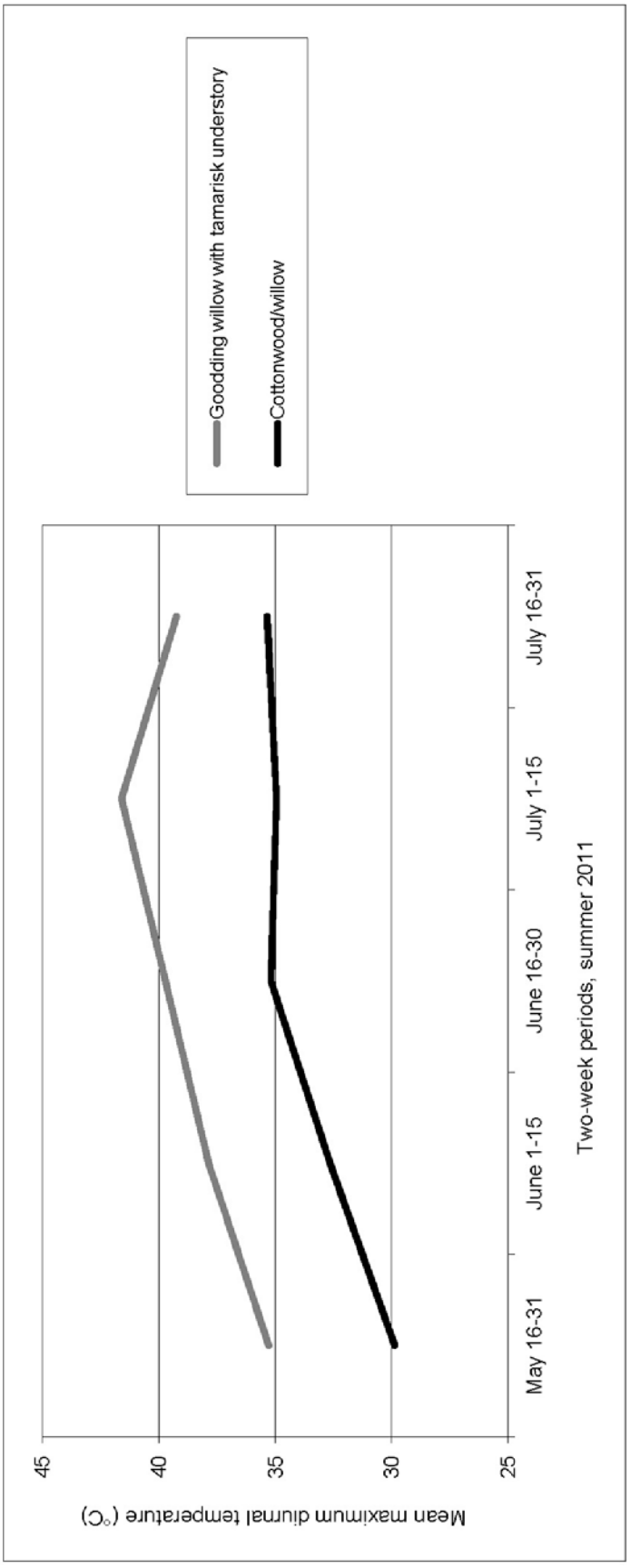


Figure 6.5. Mean maximum diurnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

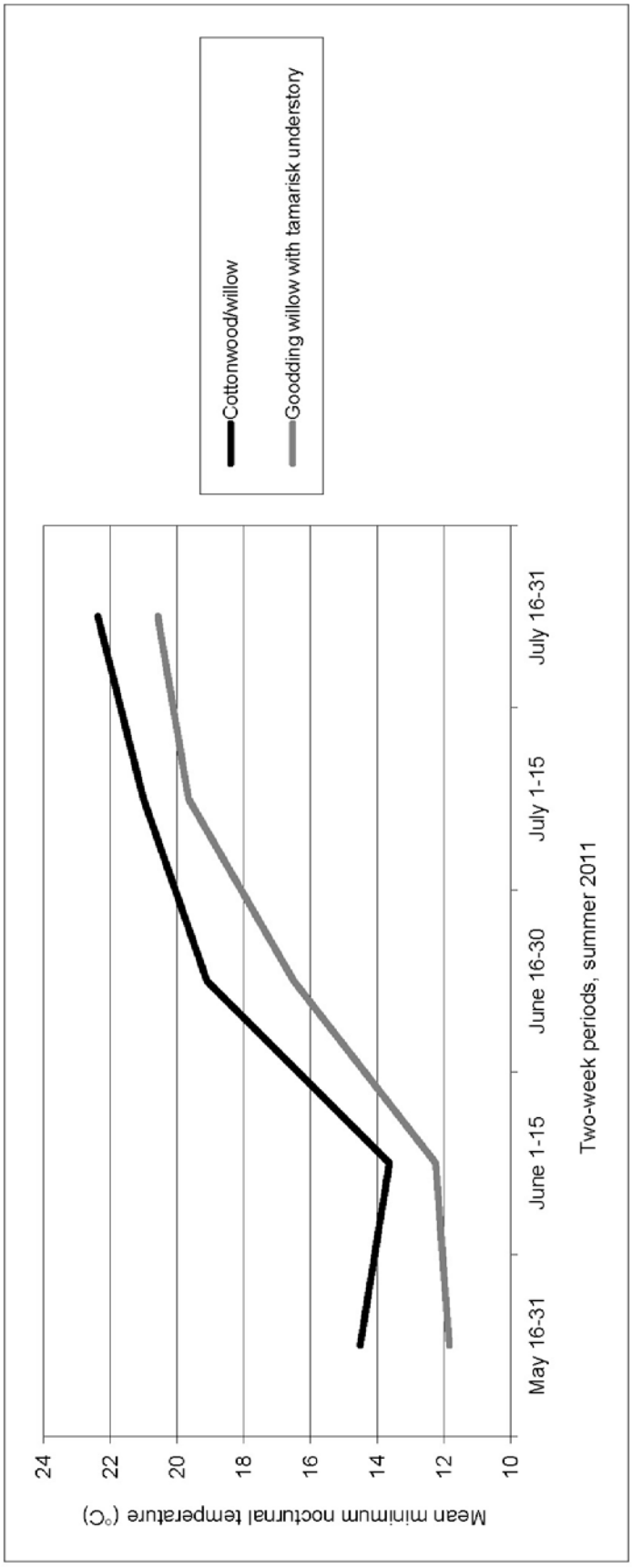


Figure 6.6. Mean minimum nocturnal temperature at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

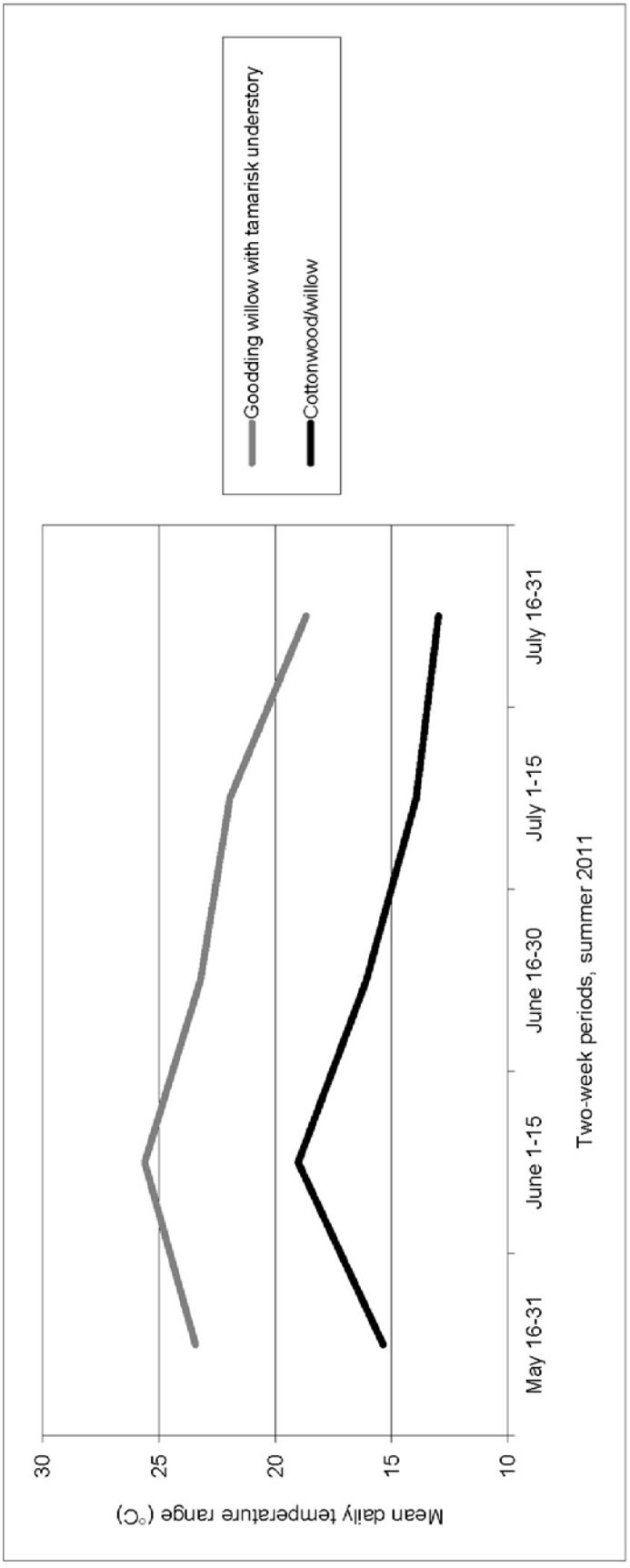


Figure 6.7. Mean daily temperature range at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

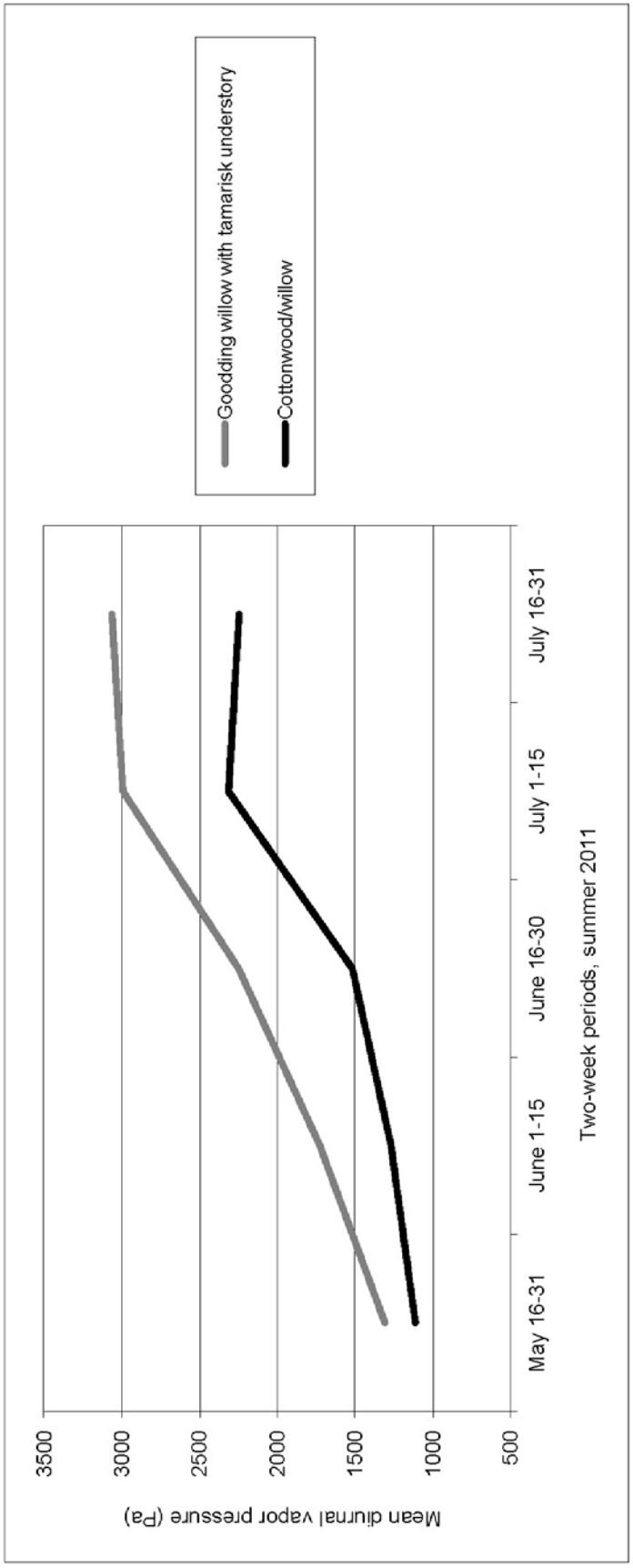


Figure 6.8. Mean diurnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

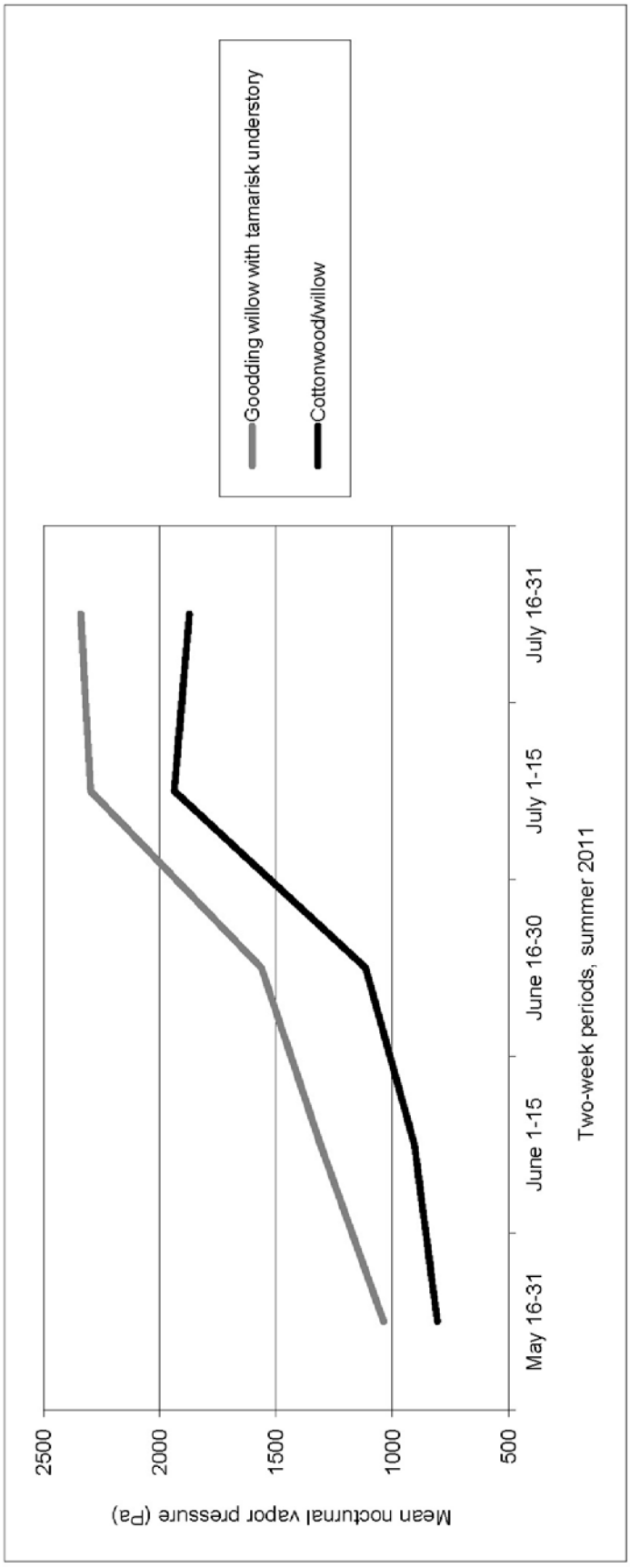


Figure 6.9. Mean nocturnal vapor pressure at Southwestern Willow Flycatcher territories in various vegetation types, lower Colorado River and tributaries, 2011. Cottonwood/willow = cottonwood-willow Type III, and Goodding willow with tamarisk understory = cottonwood-willow Type I. Data are summarized by two-week periods.

Both vegetation types exhibited moist soil conditions at some point during the breeding season. Goodding willow with tamarisk understory had high soil moisture content at the beginning of the breeding season and standing water within the territory through late June. The inundated percentage of the surrounding area declined steadily through May and June, and distance to surface water was over 300 m in July and August. Cottonwood/willow had consistently high soil moisture, and the inundated percentage of the surrounding area was at least 50% throughout the breeding season.

Mean daily maximum temperatures spanned a range of ~5°C among habitat types. Daily minimum temperatures showed a smaller range of <3°C. The daily temperature range in cottonwood/willow was consistently smaller than in Goodding willow with tamarisk understory. Vapor pressure increased through the end of July for both habitat types and was higher in Goodding willow with tamarisk understory than in cottonwood/willow.

DISCUSSION

The limited data collected in 2011 preclude any meaningful comparison between habitat types and any summary of overall microclimate characteristics in flycatcher territories. Data collected in 2011 will be added to data collected in prior years for a combined analysis to be presented in the summary report in 2012.

This page intentionally left blank.

Chapter 7

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

INTRODUCTION

Southwestern Willow Flycatcher nests and breeding territories are typically located near rivers, streams, and open water (Sogge and Marshall 2000) or over wet soil (Flett and Sanders 1987, Harris et al. 1987, Harris 1991). Nest substrate plants are often rooted in or overhang standing water. Although the association between breeding flycatchers and open water or wet soil is widely recognized by managers and scientists alike, the exact nature of the association is poorly quantified. Water may be a direct environmental cue for flycatcher nesting behavior or it may be the ultimate cause of proximate factors such as vegetation composition and structure, prey base, and microclimate.

Anthropogenic or natural modifications to surface water resources (i.e., fluvial hydrology and geomorphology) can modify existing and potential flycatcher breeding habitat and therefore have the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). For example, nine flycatcher territories at San Marcial on the middle Rio Grande in New Mexico exhibited a near absence of nesting attempts in 1996 when a combination of drought, upstream dam operations, and upstream withdrawals for irrigation removed all surface water (Johnson et al. 1999). This was in contrast to previous (1994, 1995) and subsequent (1997) years when active nests were documented at the site, with the river flowing in those years. A nearby control site that contained water exhibited multiple nesting attempts during all four years, leading Johnson et al. (1999) to suggest that the presence of water was a fundamental requirement for nesting. A similar pattern was observed along the Gila River in Arizona when decreased streamflow from 2002 to 2004 coincided with the number of flycatcher territories declining by nearly half each year (Munzer et al. 2005). Since 2004, flows within the Gila River have been greater and more consistent, and correspond with a continuing increase in flycatcher territories (14 to 97) from 2004 to 2009 (Graber and Koronkiewicz 2009b).

Flow characteristics of the lower Colorado River have been modified by numerous dams and irrigation withdrawals (Rosenberg et al. 1991). The river reach between Parker Dam and Imperial Dam is regulated by releases from Parker Dam, which has been in operation since 1939. Existing riparian habitat in the Parker to Imperial reach has likely adjusted to historical water release patterns from Parker Dam and appears to be in a stable or declining condition (LCR MSCP 2004). Implementation of the Secretarial Implementation Agreements/California 4.4 Plan (hereafter SIAs) by Reclamation would change the point of diversion for up to 400,000 acre-feet of California apportionment water for up to 75 years (USFWS 2001). The point of diversion, previously located below Parker Dam at Imperial Dam, would change to a point above Parker Dam, resulting in lower water levels in the river between Parker and Imperial. The change in point of diversion was scheduled to begin in 2002.

River flow changes related to the change in point of diversion have the potential to further modify riparian habitats below Parker Dam, habitats that are presently considered potentially suitable for willow flycatcher (USFWS 2001:47). Reclamation (2000) estimated that implementation of the SIAs will cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less. As a result, 372 acres (151 ha) of occupied[1] Southwestern Willow Flycatcher habitat could lose their moist soils. This loss could influence plant species composition (loss of cottonwood and willow) and structure (loss of vegetation volume) over an undetermined length of time. In addition, Reclamation estimated that 5,404 acres (2,187 ha) of

[1] As per the USFWS, occupied Southwestern Willow Flycatcher habitat is defined as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year since surveys began in 1996.

potential flycatcher habitat could be influenced by the drop in groundwater level. These changes may affect the distribution, abundance, occupancy, and prey base of Southwestern Willow Flycatchers in the Parker to Imperial reach.

In 2004, Reclamation completed a pilot year of habitat monitoring by deploying temperature/humidity data loggers at several sites in the Parker to Imperial reach. Reclamation then initiated a more comprehensive, long-term study in 2005 for the purpose of addressing how the above hydrological changes might affect riparian habitats along the Parker to Imperial reach. The objective is to monitor 151 ha (372 acres) of occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams for 10–15 years to determine how microclimate, vegetation, and groundwater conditions might be affected by the SIAs water transfer actions. Monitoring did not commence until after diversions started; therefore, antecedent conditions are unknown and monitoring analyses focus on detecting change through time rather than comparing current conditions to a baseline. An additional objective was to compare microclimate characteristics of sites in the Parker to Imperial reach with those at flycatcher breeding areas. This analysis was completed in previous years and is not repeated here. This chapter reports the results of habitat monitoring to date.

METHODS

In 2005, we selected a subset of sites that are currently surveyed for the presence of willow flycatchers for inclusion in the habitat monitoring study. We chose 11 sites distributed along the Parker to Imperial reach that are reasonably accessible, and where we believed groundwater levels were influenced primarily by river levels and not by outside sources such as irrigation return flows. Chosen sites equated to at least 75.3 ha (186 acres) on the California side of the lower Colorado River and at least 75.3 ha (186 acres) on the Arizona side. We also chose four control sites, two above Parker Dam and two below Imperial Dam, to distinguish any changes in microclimate, groundwater, or vegetation caused by water transfer actions from those caused by fluctuations in climate or rainfall. The 11 test sites are Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron, and the four control sites are Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North (Figure 7.1). We monitored these same 15 sites from 2005 to 2011. In August of 2006, we initiated habitat monitoring within a consistently occupied breeding site at Topock Marsh to obtain groundwater levels and patterns with which we can compare results obtained at the habitat monitoring sites. The analysis comparing Topock to the 15 habitat monitoring sites was completed in previous years and is not repeated here.

Temperature/Humidity Loggers

In 2005, we deployed HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) temperature/humidity data loggers at several locations within each site selected for habitat monitoring. All loggers collected data at 15-minute intervals and were placed in inverted plastic containers and camouflaged as described in Chapter 6. All 60 logger locations selected in 2005 were retained in 2006. Two additional data loggers were installed in the Topock Marsh monitoring site in August 2006. A portion of Gila Confluence North, one of the control sites below Imperial Dam, burned in December 2006. As a result of the fire, all vegetation at one HOBO location at the site was killed, and vegetation at another HOBO location was dramatically reduced. These two HOBOs were replaced in May 2007 with HOBOs at new locations within unburned portions of the site.

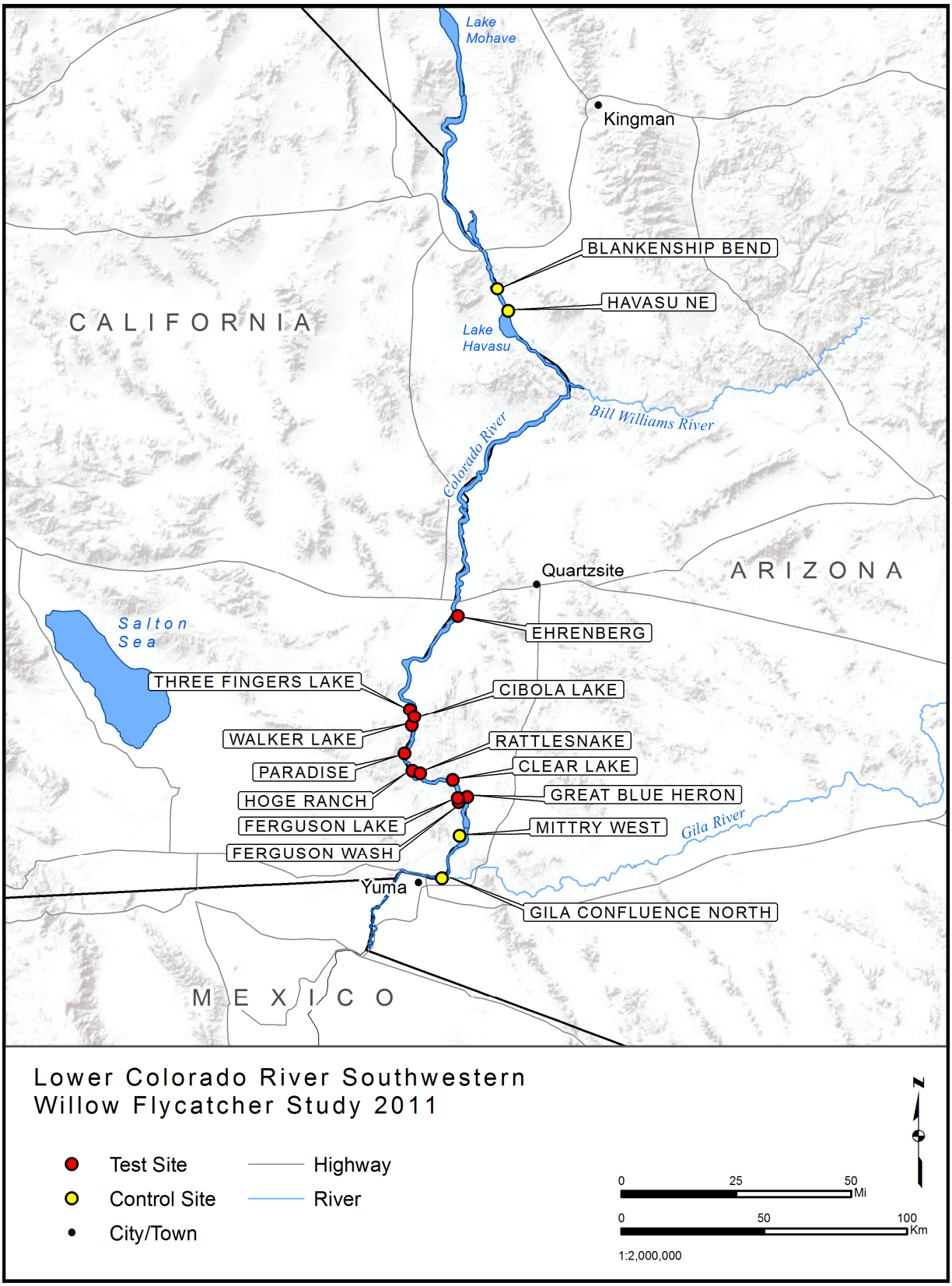


Figure 7.1. Locations of test and control sites, habitat monitoring study, 2005–2011.

HOBO loggers have been downloaded two or three times per year since installation. At each download, we examined the data to determine if there are any problems with data logger function. Data loggers were replaced whenever a potential problem with the sensors was detected. Battery level was also checked at each download, and the battery was replaced if needed.

Soil Moisture Measurements

Soil moisture beneath each HOBO logger was measured and recorded using a hand-held ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively). Soil moisture measurements were collected during each presence/absence survey between 15 May and 25 July and when HOBO data were downloaded. Soil moisture measurements, percent of the area containing inundated or saturated soil, and distance to water were recorded as described in Chapter 6.

Vegetation Measurements

We completed vegetation measurements, following the methods described in Chapter 5, at each HOBO location after flycatcher surveys were completed in late July. All HOBO loggers were also downloaded at this time. Vegetation measurements were completed at the same locations as in 2005–2010 with the exception of Gila Confluence North, where vegetation measurements were collected at the two new HOBO locations established in 2007.

Groundwater Measurements

Piezometers were installed in May–August 2005 near each of the 15 sites selected for habitat monitoring. Analyses of groundwater data in previous years showed that releases from Parker Dam can be used to predict the groundwater level beneath the habitat polygons (e.g., McLeod et al. 2007, McLeod and Koronkiewicz 2009); consequently, these piezometers were removed in 2010. Analyses of the piezometer data are not repeated here. One additional piezometer was installed at Topock Marsh within occupied flycatcher habitat in 2006; see Chapter 8 for information regarding this piezometer.

Statistical Analyses

Microclimate

The following values were calculated for all 15 habitat monitoring sites:

- Mean soil moisture from plot center to 2.0 m from plot center
- Mean maximum diurnal temperature
- Mean minimum nocturnal temperature
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure
- Mean nocturnal vapor pressure

The diurnal and nocturnal periods were determined from the daily sunrise and sunset times reported for the region by the National Weather Service (2011).

We assigned all plots as a control site (above Parker Dam or below Imperial Dam) or as a test site (between Parker and Imperial). We analyzed between-year differences in humidity and soil moisture values within these two groups using linear mixed models and analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models. These analyses were restricted to 1 June–1 August. Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

We analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models for canopy height, canopy closure, percent woody ground cover, three categories of stem sizes for both live and dead stems, the percentage of each stem size category that consisted of live stems, and the percentage of the basal area within the plot that consisted of native vegetation. In prior years we used repeated measures ANOVA for these analyses; however, repeated measures ANOVA excludes cases with missing values whereas linear mixed models allow for the inclusion of all data. We also used repeated measures linear mixed models to examine foliage density for live and dead vegetation summed over all height intervals. These analyses and all descriptive statistics were produced using SPSS® Version 16.0 (SPSS Inc.) software. We excluded vertical foliage density measurements at 5 m from plot center from the analysis so as to have comparable data across years.

RESULTS

Temperature/Humidity Logger Maintenance

All HOBO loggers were downloaded at the beginning and end of the 2011 field season. Four loggers had fallen to the ground over the winter because of sun damage to the logger housing. Five loggers that were in place over the winter had bad humidity sensors but useable temperature data, and one logger failed to collect data. Of the HOBO loggers in place May–August 2011, three failed to collect data, four had faulty humidity data, and four fell to the ground. Data from fallen loggers were not used in the analysis.

Microclimate

2011 Microclimate Descriptive Statistics

Soil moisture, temperature, and vapor pressure parameters from the 15 study sites monitored in 2011 exhibited substantial variation among sites (Table 7.1). Soil moisture varied from a low of 140.9 mV at Ferguson Wash to a high of 939.4 at Mittry West.

Mean maximum diurnal temperatures ranged from a low of 37.4^{o}C at Rattlesnake to a high of 48.2^{o}C at Cibola Lake. Mean minimum nocturnal temperatures ranged from a low of 15.1^{o}C at Gila Confluence North to a high of 20.0^{o}C at Three Fingers Lake. Mean daily temperature range varied from 19.5^{o}C at Ferguson Lake to 28.9^{o}C at Paradise.

Mean diurnal vapor pressure was lowest at Blankenship Bend (1106.6 Pa) and highest at Three Fingers Lake (1953.5 Pa). Mean nocturnal vapor pressure was lowest at Ferguson Wash (1080.9 Pa) and highest at Three Fingers Lake (1849.7 Pa).

Between-year Comparisons of Microclimate Characteristics

All microclimate characteristics varied significantly over time at test sites (Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron; Table 7.2). At control sites (Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North), mean minimum nocturnal temperature varied significantly over time, along with measures of soil moisture and humidity. Neither test nor control sites showed a unidirectional change in any of the microclimate measures in 2005–2011 (Figures 7.2–7.7), although both measures of humidity showed a generally decreasing trend at both test and control sites since 2006. The changes over time differed between test and control sites for soil moisture, mean diurnal vapor pressure, and mean nocturnal vapor pressure (right-most column of Table 7.2).

Soil moisture fluctuated among years at both test and control sites, but the patterns did not mirror one another (Figure 7.2). Between 2005 and 2006, soil moisture decreased more dramatically at control sites than at test sites, while between 2007 and 2008, soil moisture decreased at control sites but rose at test sites. Between 2009 and 2010, soil moisture decreased at test sites but rose at control sites. Diurnal vapor pressure rose more sharply at test sites than at control sites between 2005 and 2006 and then fell more sharply at test sites than at control sites between 2006 and 2007 (Figure 7.6), and nocturnal vapor pressure also showed larger fluctuations at test sites than at control sites.

Vegetation Measurements

Vegetation characteristics varied widely both between and within the selected habitat monitoring sites (Table 7.3). Average canopy height ranged from 3.3 m (Three Fingers Lake) to 9.8 m (Ehrenberg), and average canopy closure ranged from 66.9% (Ehrenberg) to 98.6% (Clear Lake). Measures of other habitat characteristics were similarly variable. Vertical foliage profiles for each site are shown in Figure 7.8. Sites typically exhibited the densest foliage within 3–5 m of the ground, and the majority of vegetation within 2–3 m of the ground typically consisted of dead branches.

Between-year Comparisons of Vegetation Characteristics

Many vegetation variables varied between years within the test and control groups (Table 7.4), but none of the variables exhibited change in a consistent direction over time (Figures 7.9–7.24). There was a significant interaction between year and location (meaning that the change between years among test sites was significantly different from the change at control sites) for woody ground cover ($P = 0.004$), number of live stems ≤2.5 cm dbh ($P = 0.043$), number of dead stems ≤ 2.5 cm dbh ($P = 0.040$), percent of live stems ≤2.5 cm dbh ($P = 0.022$), and dead vertical foliage hits ($P = 0.003$). Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years. Overall, the number of live stems ≤2.5 cm dbh decreased through time at both test and control plots (Figure 7.12), while the number of dead stems ≤ 2.5 cm dbh decreased only at control plots (Figure 7.15), though there was considerable annual fluctuation for both variables. The percentage of live stems increased at control plots but decreased at test plots (Figure 7.18). The amount of dead vertical foliage hits increased through time at both test and control plots, but increased more rapidly at test plots (Figure 7.23).

Table 7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011*

Descriptive Statistics	Blankenship Bend	Havasu NE	Ehrenberg	Three Fingers Lake	Cibola Lake	Walker Lake	Paradise	Hoge Ranch	Rattlesnake	Clear Lake	Ferguson Lake	Ferguson Wash	Great Blue Heron	Mittry West	Gila Confluence North
Soil Moisture															
Mean soil moisture (mV)	850.2 (89.7)	267.4 (74.5)	641.3 (106.7)	425. (61.3)	494.6 (114.5)	900.7 (28.6)	707.0 (50.7)	829.5 (21.5)	735.1 (44.4)	424.7 (157.2)	925.7 (15.0)	140.9 (5.5)	876.0 (9.6)	939.4 (10.8)	399.3 (104.2)
Temperature															
Mean maximum diurnal temperature (°C)	42.4 (0.3)	44.9 (0.5)	45.6 (0.4)	46.4 (0.6)	48.2 (0.3)	44.1 (0.3)	45.7 (0.4)	45.1 (0.4)	37.4 (0.2)	40.1 (0.3)	38.9 (0.3)	40.0 (0.3)	39.7 (0.3)	42.2 (0.3)	42.9 (0.4)
Mean minimum nocturnal temperature (°C)	17.2 (0.3)	18.6 (0.3)	18.2 (0.4)	20.0 (0.6)	19.9 (0.3)	16.7 (0.3)	16.8 (0.3)	17.0 (0.3)	16.2 (0.3)	18.4 (0.3)	19.4 (0.2)	19.1 (0.3)	16.3 (0.3)	17.8 (0.3)	15.1 (0.4)
Mean daily temperature range (°C)	25.2 (0.4)	26.4 (0.6)	27.4 (0.5)	26.4 (1.0)	28.3 (0.4)	27.4 (0.4)	28.9 (0.5)	28.2 (0.4)	21.2 (0.3)	21.7 (0.4)	19.5 (0.3)	20.9 (0.3)	23.5 (0.3)	25.4 (0.4)	27.8 (0.4)
Humidity															
Mean diurnal vapor pressure (Pa)	1106.6 (33.8)	1342.7 (38.2)	1133.4 (42.1)	1953.5 (92.7)	1216.0 (44.5)	1139.2 (29.8)	1336.9 (43.3)	1318.2 (33.1)	1670.7 (42.8)	1334.5 (38.9)	1359.7 (30.1)	1244.9 (30.1)	1306.1 (38.3)	1297.5 (34.1)	1269.0 (34.6)
Mean nocturnal vapor pressure (Pa)	1185.3 (32.8)	1215.5 (34.0)	1197.1 (40.0)	1849.7 (81.7)	1321.3 (38.3)	1154.9 (26.0)	1332.9 (34.8)	1316.2 (30.4)	1620.5 (37.8)	1239.3 (32.3)	1378.6 (27.3)	1080.9 (26.3)	1292.7 (33.6)	1235.8 (28.9)	1236.4 (31.8)

* Data are presented as mean (standard error).

Table 7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011*

Parameter	Test (n=45)								Control (n=15)								P-value for difference between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Soil Moisture																	
Mean soil moisture (mV)	645.7 (44.8)	634.4 (48.6)	662.9 (44.8)	705.8 (42.7)	699.2 (35.7)	651.4 (20.8)	636.2 (46.5)	<0.001	694.4 (89.8)	582.9 (98.1)	635.3 (98.4)	607.5 (90.7)	591.7 (90.6)	687.5 (36.3)	631.3 (96.4)	<0.001	<0.001
Temperature																	
Mean maximum diurnal temperature (°C)	44.9 (0.1)	46.1 (0.1)	45.2 (0.1)	46.5 (0.1)	43.8 (0.1)	45.0 (0.1)	44.0 (0.1)	<0.001	45.6 (0.2)	48.0 (0.2)	46.4 (0.2)	45.7 (0.2)	44.2 (0.2)	46.2 (0.2)	45.1 (0.2)	0.065	0.245
Mean minimum nocturnal temperature (°C)	20.7 (0.1)	22.7 (0.1)	20.4 (0.1)	20.7 (0.1)	21.2 (0.1)	20.4 (0.1)	20.1 (0.1)	<0.001	20.2 (0.2)	22.1 (0.2)	20.3 (0.2)	20.8 (0.2)	21.2 (0.1)	20.9 (0.2)	19.5 (0.2)	<0.001	0.423
Mean daily temperature range (°C)	24.2 (0.2)	23.5 (0.2)	24.8 (0.2)	25.8 (0.2)	22.6 (0.2)	24.6 (0.2)	23.9 (0.2)	<0.001	25.4 (0.2)	26.0 (0.3)	26.1 (0.3)	24.9 (0.3)	23.0 (0.2)	25.3 (0.3)	25.6 (0.3)	0.345	0.138
Humidity																	
Mean diurnal vapor pressure (Pa)	1797.2 (13.0)	2028.4 (13.5)	1737.9 (16.6)	1770.4 (12.8)	1758.9 (13.4)	1588.3 (12.6)	1556.0 (14.8)	<0.001	1726.3 (20.4)	1863.9 (21.9)	1696.9 (21.7)	1692.3 (20.5)	1701.1 (18.9)	1582.8 (17.3)	1493.4 (23.0)	<0.001	0.010
Mean nocturnal vapor pressure (Pa)	1686.3 (11.2)	1860.4 (10.5)	1852.7 (14.0)	1679.8 (10.2)	1618.0 (10.5)	1484.0 (10.3)	1507.7 (13.0)	<0.001	1638.2 (17.6)	1703.4 (18.7)	1559.9 (20.7)	1582.9 (18.4)	1583.2 (17.0)	1479.8 (15.8)	1431.0 (20.9)	<0.001	0.002

*Data are presented as means (standard error). The analysis was restricted to 1 June–1 August each year.

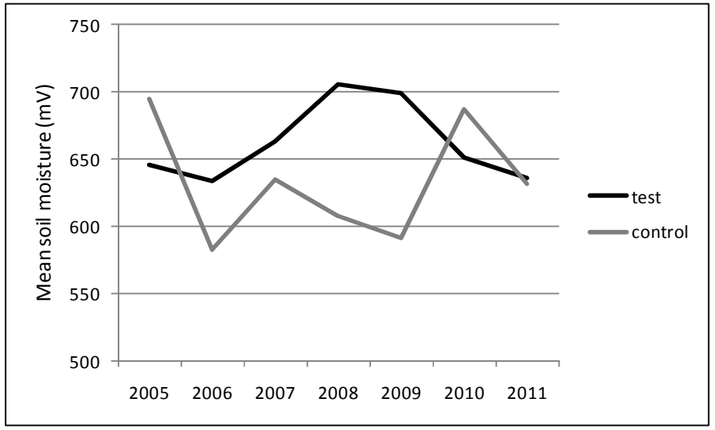


Figure 7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

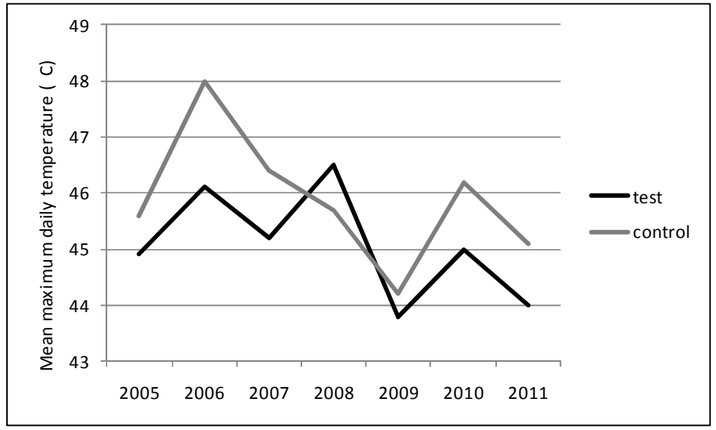


Figure 7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

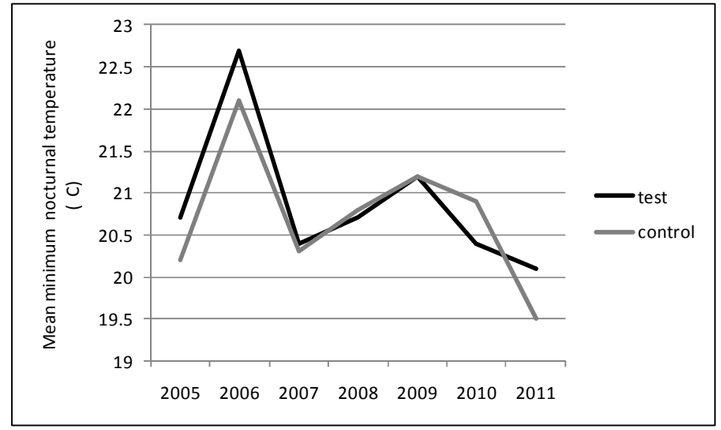


Figure 7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

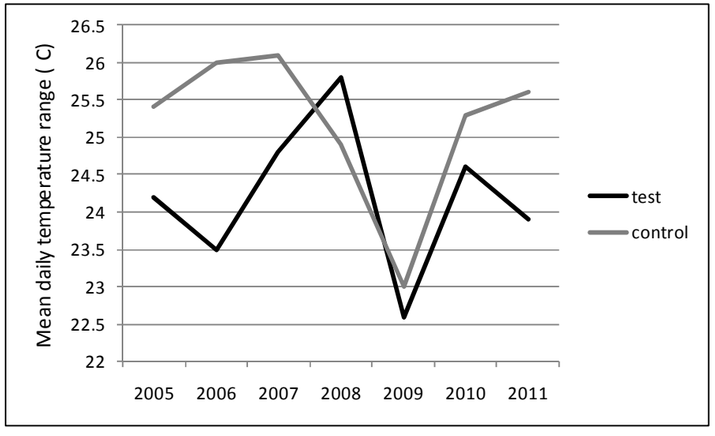


Figure 7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

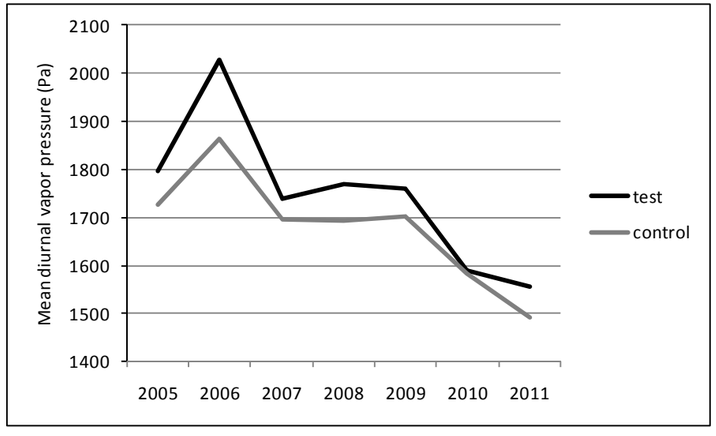


Figure 7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

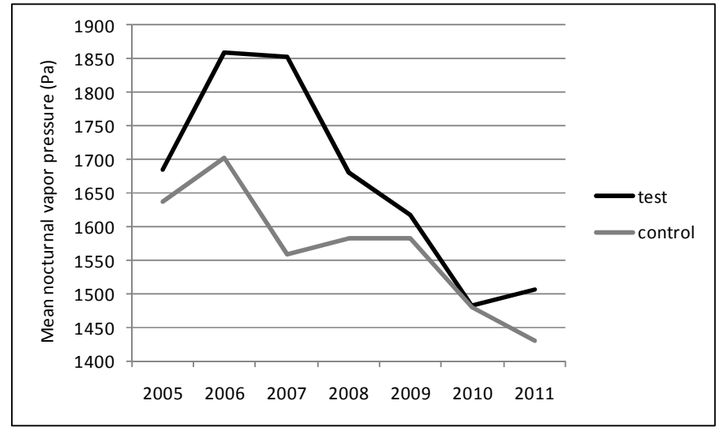


Figure 7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

Table 7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011*

Parameter	Blankenship Bend (n=4)	Havasu NE (n=4)	Ehrenberg (n=4)	Three Fingers Lake (n=5)	Cibola Lake (n=5)	Walker Lake (n=3)	Paradise (n=4)	Hoge Ranch (n=4)	Rattlesnake (n=4)	Clear Lake (n=3)	Ferguson Lake (n=5)	Ferguson Wash (n=4)	Great Blue Heron (n=4)	Mittry West (n=4)	Gila Confluence North (n=3)
Average canopy height (m)	6.2 (1.1)	3.9 (0.7)	9.8 (2.9)	3.3 (0.3)	3.9 (0.4)	7.2 (1.8)	7.8 (3.0)	4.6 (0.6)	8.1 (1.1)	7.1 (0.1)	5.2 (0.3)	5.9 (0.4)	7.7 (1.3)	7.5 (2.2)	7.4 (2.0)
	4.2–9.0	3.0–6.0	2.1–15.8	2.7–4.3	2.2–4.5	5.3–10.7	4.1–16.7	3.6–6.1	6.5–11.4	7.0–7.2	4.5–5.9	4.7–6.6	5.6–10.9	3.6–13.1	4.8–11.3
% total canopy closure	81.9 (9.6)	88 (6.6)	66.9 (14.5)	82.9 (6)	78.8 (14.5)	93.1 (3.3)	95.1 (2.3)	90.0 (3.5)	98.3 (0.7)	98.6 (1.7)	96.8 (1.6)	96.4 (1.7)	96.2 (1)	88.7 (6.4)	86.3 (6.7)
	53.1–92.2	69.3–97.4	41.1–95.8	59.4–92.7	20.8–96.9	87–98.4	89.6–99.5	82.3–98.4	96.4–100.0	95.3–100.5	92.2–100.0	92.7–99.5	93.2–97.9	69.8–97.4	75.5–98.4
% woody ground cover	76.3 (13.7)	44.7 (13.8)	38.9 (12.1)	13.9 (4.5)	34 (7.5)	79.7 (11.9)	90.9 (7.9)	60.1 (17.8)	65.1 (6.0)	51.6 (12.2)	47.2 (15.8)	35.4 (8.8)	39.8 (8.4)	41.7 (8.2)	55.4 (3.4)
	43.8–99.0	6.3–70.0	9.3–58.8	3.5–30.0	7.5–53.8	57.0–97.0	67.5–100.0	26.3–92.0	51.3–78.8	30.0–72.3	3.5–92.5	21.3–61.3	14.8–50.8	27.5–65.0	48.8–60.0
# live stems ≤2.5 cm dbh per ha	509 (360)	64 (64)	446 (331)	2266 (646)	229 (117)	212 (153)	350 (223)	796 (210)	509 (260)	255 (255)	1171 (415)	286 (210)	223 (109)	1910 (1069)	1188 (112)
	0–1528	0–255	0–1401	382–3820	0–509	0–509	127–1019	382–1273	0–1019	0–764	382–2419	0–891	0–509	0–3947	1019–1401
# live stems 2.6–8 cm dbh per ha	1432 (439)	509 (289)	668 (318)	5628 (1696)	3132 (816)	2080 (552)	3247 (2368)	2674 (597)	2324 (1216)	849 (612)	5195 (1045)	1910 (260)	3629 (1349)	3310 (909)	2928 (1083)
	255–2165	0–1273	0–1528	1783–11968	891–5984	1146–3056	382–10313	1655–3947	0–5475	0–2037	2165–8403	1401–2419	1783–7639	1401–5730	1273–4966
# live stems >8 cm dbh per ha	318 (82)	764 (172)	159 (61)	229 (199)	255 (90)	340 (278)	573 (489)	350 (109)	1337 (433)	1188 (363)	586 (154)	1114 (204)	1050 (141)	637 (356)	1316 (331)
	127–509	255–1019	0–255	0–1019	0–509	0–891	0–2037	127–637	127–2165	764–1910	127–1019	764–1528	637–1273	0–1655	764–1910
# dead stems ≤2.5 cm dbh per ha	95 (61)	0 (0)	159 (159)	331 (154)	76 (31)	0 (0)	191 (152)	64 (37)	255 (116)	0 (0)	306 (204)	127 (127)	127 (90)	1464 (667)	679 (405)
	0–255	0–0	0–637	0–764	0–127	0–0	0–637	0–127	0–509	0–0	0–1019	0–509	0–382	127–3183	0–1401
# dead stems 2.6–8 cm dbh per ha	859 (445)	32 (32)	700 (391)	942 (154)	840 (532)	127 (127)	509 (429)	2260 (1656)	796 (427)	170 (170)	764 (401)	541 (390)	541 (223)	318 (198)	1019 (515)
	0–2037	0–127	0–1655	509–1401	0–2928	0–382	0–1783	0–7130	0–1655	0–509	127–2292	0–1655	0–1019	0–891	0–1655
# dead stems >8 cm dbh per ha	95 (61)	64 (64)	0 (0)	0 (0)	25 (25)	0 (0)	0 (0)	0 (0)	127 (127)	297 (297)	0 (0)	64 (37)	159 (61)	64 (64)	42 (42)
	0–255	0–255	0–0	0–0	0–127	0–0	0–0	0–0	0–509	0–891	0–0	0–127	0–255	0–255	0–127
Percent basal area native	31.7 (19.5)	32.8 (23.6)	96.1 (2.4)	0.5 (0.5)	1.6 (1.3)	29.3 (29.3)	18.7 (18.3)	31.2 (19.2)	39.5 (21.4)	0.0 (0.0)	2.0 (1.9)	22.7 (13.7)	36.1 (15.7)	53.4 (22.4)	100.0 (0.0)
	0–80.0	0–100.0	89.1–99.5	0.0–2.3	0.0–6.8	0.0–87.9	0.0–73.5	0.0–85.1	0.0–100.0	0.0–0.0	0.0–9.6	0.0–55.1	0.0–76.4	0.0–91.4	100.0–100.0

* Data presented are means, (standard error), and range.

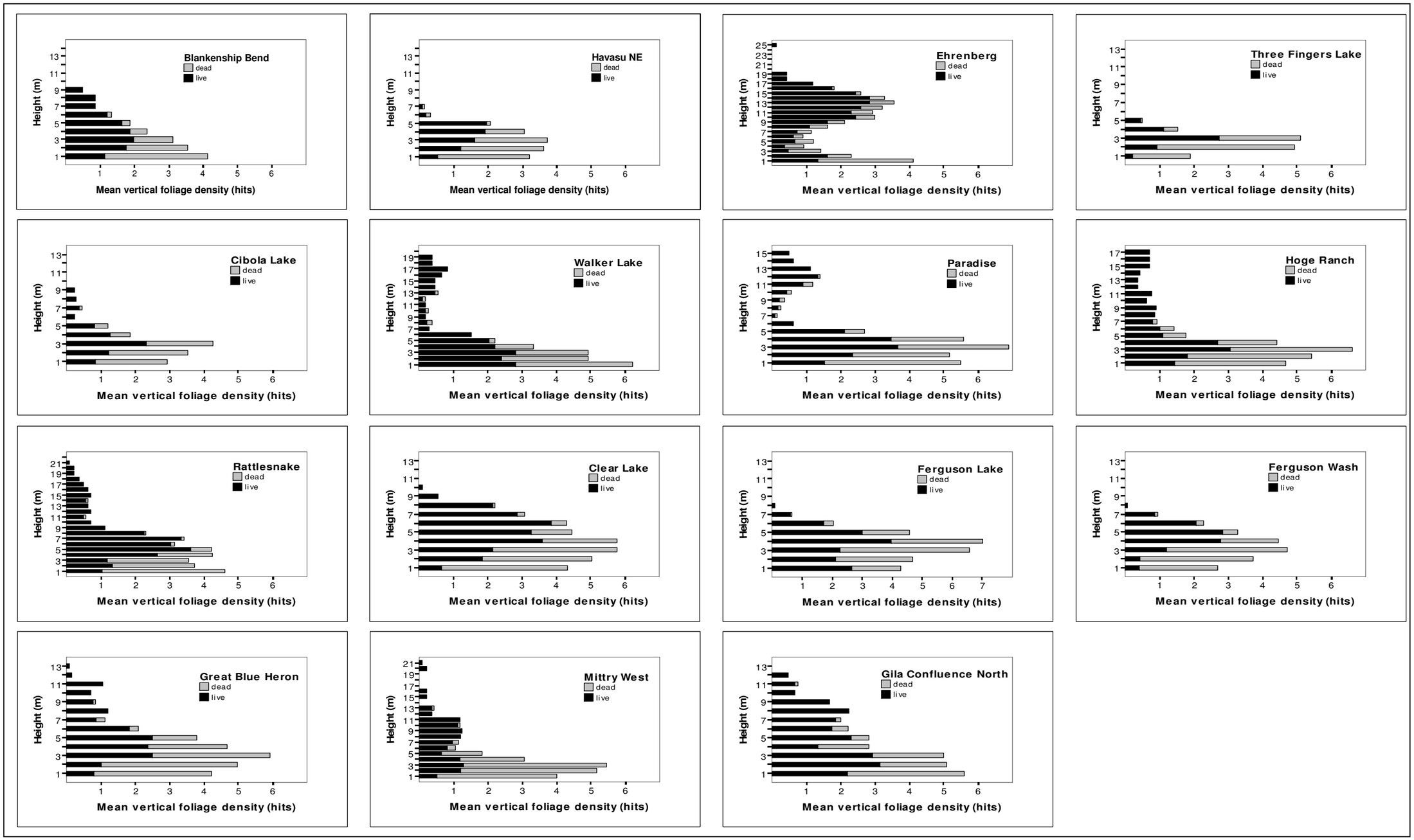


Figure 7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011.

Table 7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011

Parameter	Test (n=45)								Control (n=15)								P-value for difference in means between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Average canopy height (m)	6.6	7.0	5.8	6.7	7.1	6.5	6.2	0.055	6.6	7.0	6.8	7.7	7.0	6.9	6.2	0.004	0.493
% total canopy closure	84.7	78.3	87.9	88.1	86.7	85.3	89.7	<0.001	80.8	76.9	85.7	85.5	82.5	80.5	86.2	0.008	0.963
% woody ground cover	31.1	27.3	30.0	41.6	23.5	35.6	48.7	<0.001	24.4	46.7	40.2	53.0	31.4	38.0	54.5	<0.001	0.004
# live stems ≤2.5 cm dbh per ha	1932	2272	2515	1358	2530	1316	671	<0.001	985	2574	1842	883	1210	1010	900	<0.001	0.043
# live stems 2.6–8 cm dbh per ha	3107	2722	3143	3899	2314	3271	3030	<0.001	1655	2310	1918	2139	1401	1859	1986	0.002	0.517
# live stems >8 cm dbh per ha	481	430	654	671	597	637	628	0.025	603	646	730	730	546	586	722	0.048	0.587
# dead stems ≤2.5 cm dbh per ha	340	1282	1259	1084	1949	1075	161	<0.001	1214	1492	1367	1384	1455	552	552	<0.001	0.040
# dead stems 2.6–8 cm dbh per ha	1234	821	925	1879	1081	1310	778	0.015	1061	437	747	1392	609	475	526	<0.001	0.790
# dead stems >8 cm dbh per ha	48	59	96	108	91	110	54	0.096	59	82	127	59	118	85	68	0.892	0.866
% live stems ≤2.5 cm dbh	81.7	66.1	66.3	61.0	52.4	57.2	75.2	<0.001	51.9	63.2	55.7	41.4	41.8	70.3	65.8	0.082	0.022
% live stems 2.6–8 cm dbh	72.8	74.6	77.1	68.3	66.1	69.1	77.8	0.033	70.8	79.2	70.2	58.6	64.6	79.5	76.0	<0.001	0.139
% live stems >8 cm dbh	92.8	84.6	87.7	91.8	89.0	88.4	96.0	N/A[1]	90.8	89.1	89.4	89.9	81.9	84.5	86.0	N/A[1]	0.540
Percent basal area native	27.2	20.3	28.9	23.8	21.6	22.1	24.1	0.195	42.7	52.8	59.9	46.9	45.0	57.9	51.4	0.274	0.090
Total live foliage hits	17.4	17.7	11.3	17.0	19.3	17.1	17.8	<0.001	18.1	15.5	16.5	18.4	17.5	16.9	14.3	0.335	0.375
Total dead foliage hits	9.3	10.0	5.1	10.8	9.1	14.1	10.5	<0.001	8.4	6.6	6.1	11.0	6.3	8.5	9.2	0.042	0.003
Percent live foliage hits	62.7	62.0	65.8	58.7	63.8	56.1	59.3	0.006	69.1	70.0	69.6	64.8	72.9	67.6	58.7	0.065	0.281

[1] Model failed to converge; no P-value.

Table 7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Difference (2001–present)	% Change (2001–present)
January	6,820	5,599	6,478	6,327	5,536	4,166	5,842	5,945	4,850	6,177	3,794	5,983	384	6.9%
February	9,123	8,505	8,978	6,881	7,129	4,888	7,798	8,491	8,232	7,137	5,960	6,470	-2,035	-23.9%
March	11,594	10,524	11,334	12,360	11,523	9,699	9,752	11,122	12,180	11,973	10,879	10,881	357	3.4%
April	14,613	14,090	13,610	13,803	12,824	11,356	11,985	12,618	14,293	13,184	11,259	12,594	-1,496	-10.6%
May	14,174	14,068	12,826	11,990	12,252	11,428	11,998	11,718	11,339	10,533	10,765	10,798	-3,270	-23.2%
June	13,803	14,733	13,713	12,778	12,741	12,444	12,383	12,116	11,957	9,992	10,931	11,394	-3,339	-22.7%
July	14,210	14,974	14,439	13,100	12,331	13,842	11,688	12,180	12,226	10,645	12,098	11,438	-3,536	-23.6%
August	11,441	12,047	12,118	10,803	11,420	10,316	10,141	10,317	10,720	9,459	10,508	8,951	-3,096	-25.7%
September	11,233	10,837	10,429	11,159	9,566	9,048	7,334	9,195	9,072	8,492	9,803	7,637	-3,200	-29.5%
October	9,362	8,852	8,765	9,761	7,405	6,967	7,424	7,204	7,568	7,241	7,562	7,111	-1,741	-19.7%
November	7,437	7,357	7,049	6,153	5,163	6,335	6,094	5,420	6,369	6,136	6,435		-922	-12.5%
December	6,706	5,970	5,615	5,737	4,129	4,841	5,507	4,079	3,829	4,872	4,315		-1,655	-27.7%

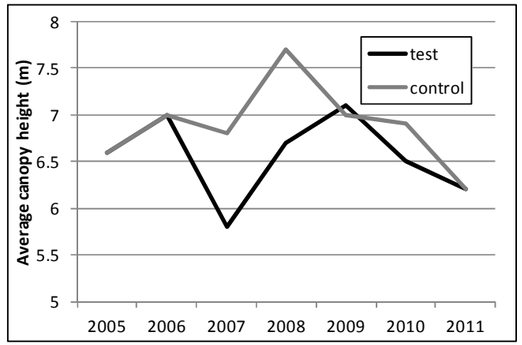


Figure 7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

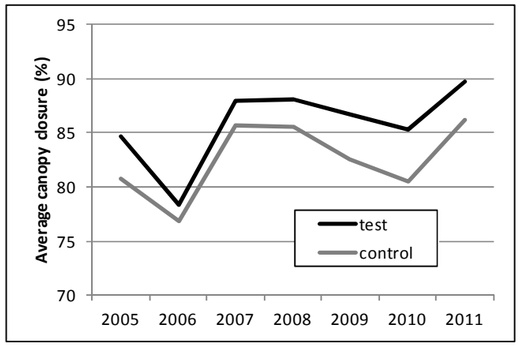


Figure 7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

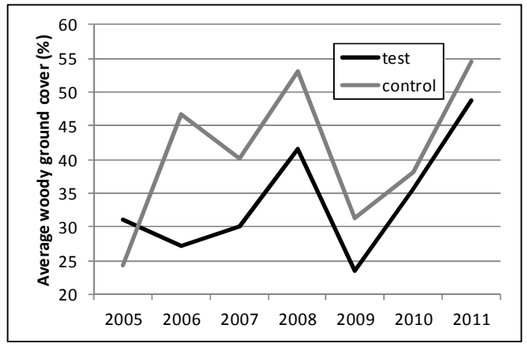


Figure 7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

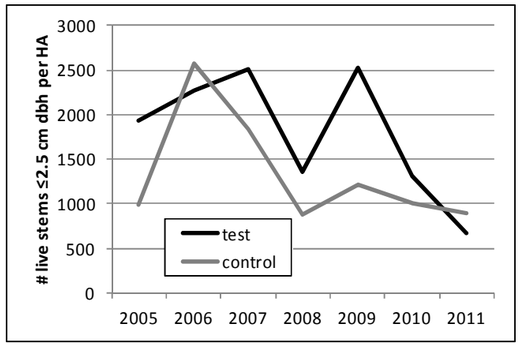


Figure 7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

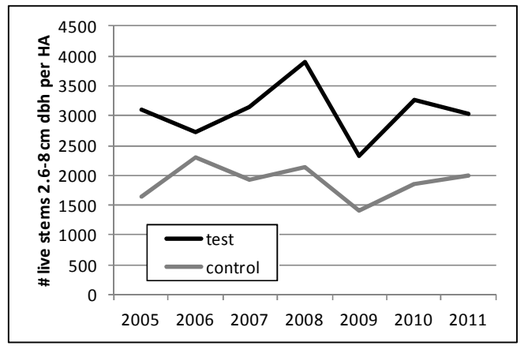


Figure 7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

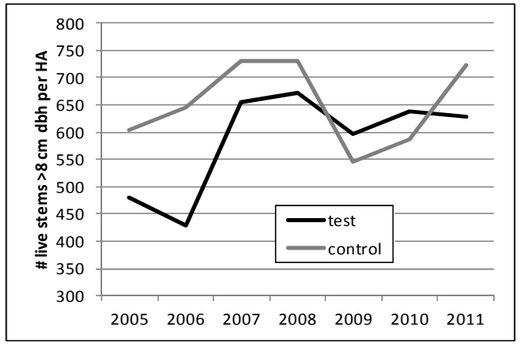


Figure 7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

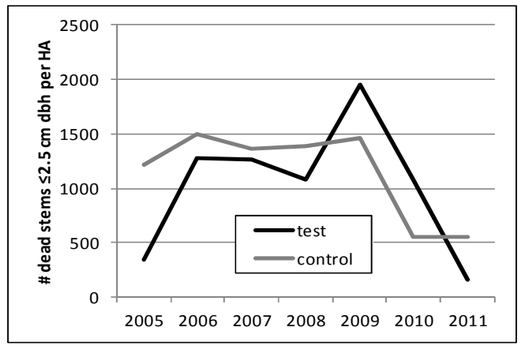


Figure 7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

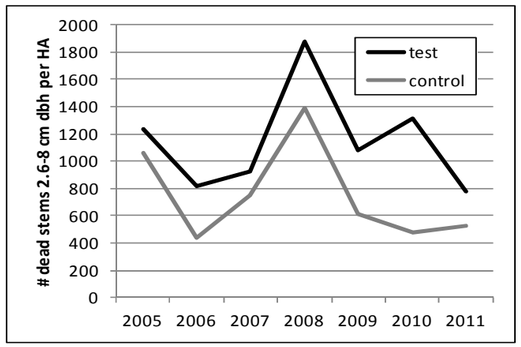


Figure 7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

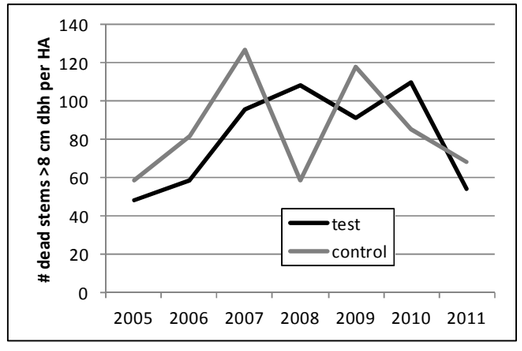


Figure 7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

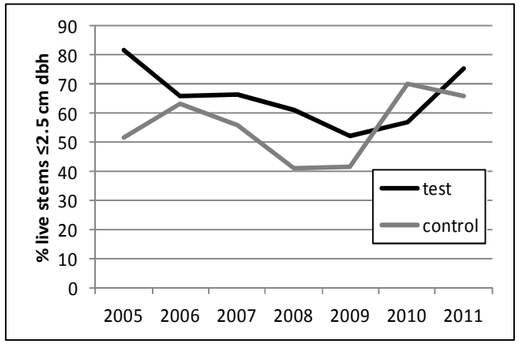


Figure 7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

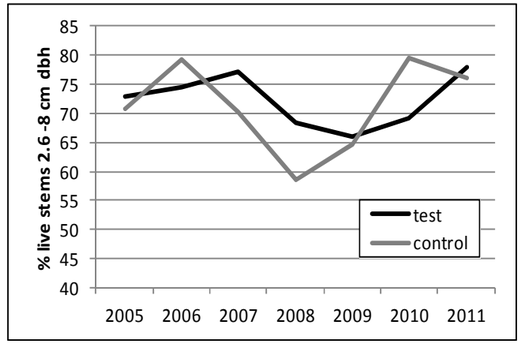


Figure 7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

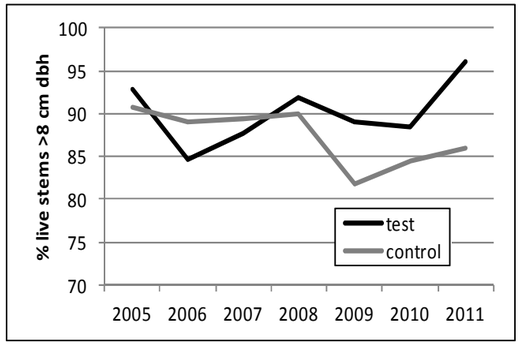


Figure 7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

DISCUSSION

Microclimate

Between-year Comparisons of Microclimate Characteristics

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 than in the other years and cooler conditions in 2009. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. However, the role of river flows in influencing soil moisture is unclear, given that no strong relationship was found between piezometer levels and soil moisture (McLeod and Koronkiewicz 2009). Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station (Coop ID 46118; Figure 7.25). Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

Vegetation

Between-year differences across all sites were noted for many variables, but none showed unidirectional trends over time, suggesting there has been no overall, detectable change in vegetation. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years.

Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality (but see discussion of stem counts, below).

The pooling of all sites into a test vs. control analysis may obscure changes in vegetation at specific sites. For example, one vegetation plot at Ehrenberg contained a significant coyote willow component (98% of the total basal area) in 2005. The willow gradually died over the next several years until no live willow remained in 2009. Most of the vegetation along the LCR, including at the sites selected for habitat monitoring, consists primarily of tamarisk, which is less sensitive than willow to changes in water availability. Measurable changes in overall vegetation as a response to reduced groundwater levels may take several years to develop in tamarisk, or the tamarisk may change very little if at all.

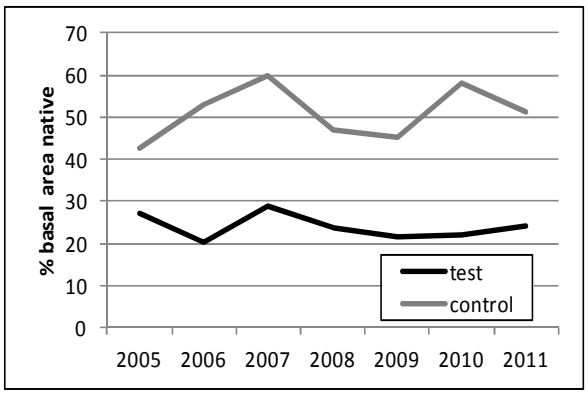


Figure 7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

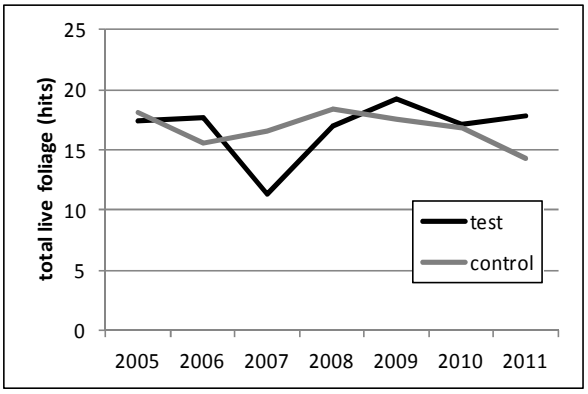


Figure 7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

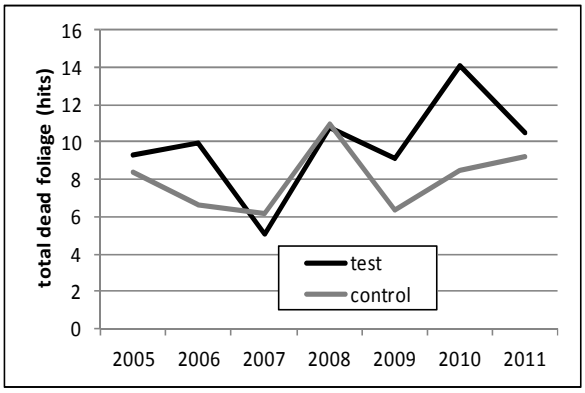


Figure 7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

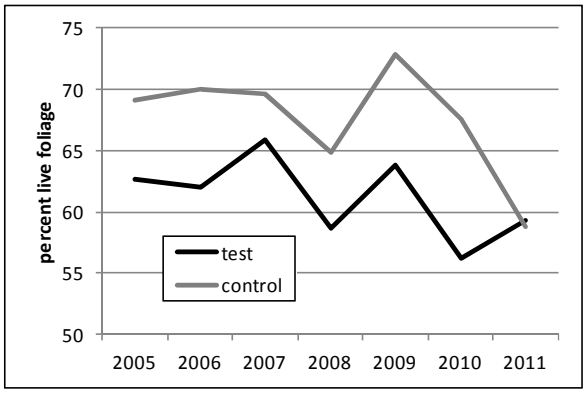


Figure 7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

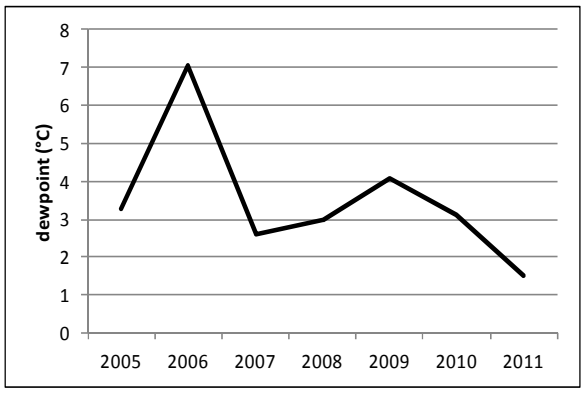


Figure 7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Repeatability of stem counts depends on having a plot of fixed size. Each plot is divided into quadrants, with a rope having the 5-m distance (the edge of the plot) clearly marked extended in each cardinal direction from plot center. It can be nearly impossible to extend the rope flat or straight, introducing variability into the size of the plot. Even more problematic than this, however, is the inability of the observers, in very dense vegetation, to see the cardinal ropes from the center of the quadrant or to see the center of the plot from the edge to be able to envision an arc connecting the ends of two adjacent cardinal ropes and delineating the edge of the circular plot. Observers vary widely in their ability to estimate distance, and when reference points are not visible, it is very difficult to determine whether a stem near the edge of the plot falls within the plot or not. In 2009, we explicitly instructed observers to use a measuring tape to determine the distance from plot center for any stem for which inclusion in or exclusion from the plot seemed questionable.

This method should help reduce difficulties in producing repeatable stem counts but still depends on observers being able to tell when they are near the edge of the plot and taking the extra time to measure distance if the inclusion of a stem is in question. Another factor that inhibits accurate stem counts in dense vegetation is the difficulty in keeping track of which stems have been counted already and which have not. In 2009, we began using chalk to mark stems that had already been counted to try to minimize omission or double-counting of stems.

Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred as the result of decreasing flows from 2001 to 2005 (see Table 7.5). Other methods, such as analysis of satellite imagery, would have to be used to detect any changes in vegetation that might have occurred prior to 2005.

Groundwater Levels

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

In previous years we correlated piezometer ground water levels and soil moisture measurements and found no strong linear relationship. The strongest relationships were found at sites that had the highest soil moisture values. This suggests that at sites where soil moisture is low, surface soil moisture content is not influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

This page intentionally left blank.

Chapter 8

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

INTRODUCTION

Monitoring of Southwestern Willow Flycatcher populations at Topock Marsh began in 1997, and data on number of flycatcher pairs and nest success are available for 1998–2011. The breeding population at Topock declined from a high of 29 pairs in 2004 to fewer than 10 pairs in 2007 and 2008. This decline prompted concern from USFWS about the flycatcher population at Topock, which was presumed to be the likely source population for any flycatchers that would colonize restoration areas on the lower Colorado River. USFWS and Reclamation initiated discussions after the breeding season of 2008 to identify habitat enhancement measures that could be implemented at Topock Marsh in an attempt to raise the number and productivity of flycatchers.

The affinity of breeding Southwestern Willow Flycatchers with standing water and saturated soil is noted consistently in the literature (e.g., Johnson et al. 1999, Munzer et al. 2005, McLeod et al. 2008a, Graber and Koronkiewicz 2009b), and flycatcher nests along the Middle Rio Grande that were above inundated or saturated soil all season produced more young per successful nest than nests that were above dry soil all season (Moore and Ahlers 2008). An examination of water levels within Topock Marsh from 1997 to the present shows that after 2004, water levels peaked at lower levels, high water levels were of shorter duration, and over-winter lows were lower than was the case prior to 2004 (Figure 8.1). Because of the influence of surface water on flycatcher occupancy and productivity, USFWS and Reclamation developed a plan to pump water into a portion of the flycatcher habitat at Topock Marsh.

Two adjacent areas within Topock, known as In Between and 800M, were selected in 2008 as the location for habitat enhancement via supplemental water delivery. The number of breeding flycatcher pairs in these areas declined steadily from 10 in 2004 to 0 in 2008, but the vegetation in the area had not changed markedly during that time (McLeod and Koronkiewicz 2010). The addition of surface water and saturated soil to this area might make it more attractive to flycatchers and increase nest success and productivity of any flycatchers that nest in the area. In addition, widespread inundation could make portions of In Between, 800M, and the surrounding area that typically had been dry during surveys since 2003 and not occupied by flycatchers more suitable for flycatcher occupancy.

Supplemental water delivery commenced in March 2011. We monitored hydrological, microclimate, and vegetation conditions at In Between, 800M, and the adjacent area of Pierced Egg in 2009 and 2010 to assess baseline habitat conditions. We completed the same monitoring in 2011 during water delivery.

METHODS

Water Delivery

Over the winter of 2010–2011, the water delivery system was installed. The system consisted of a Crisafulli trailer pump, modified to be hydraulically driven and capable of moving approximately 41.6 m^3 (11,000 gallons) of water per minute, along with a 0.61 m (24 inch) diameter pipe carrying the water into the target area (In Between, 800M, and Pierced Egg) from the open water of Topock Marsh.

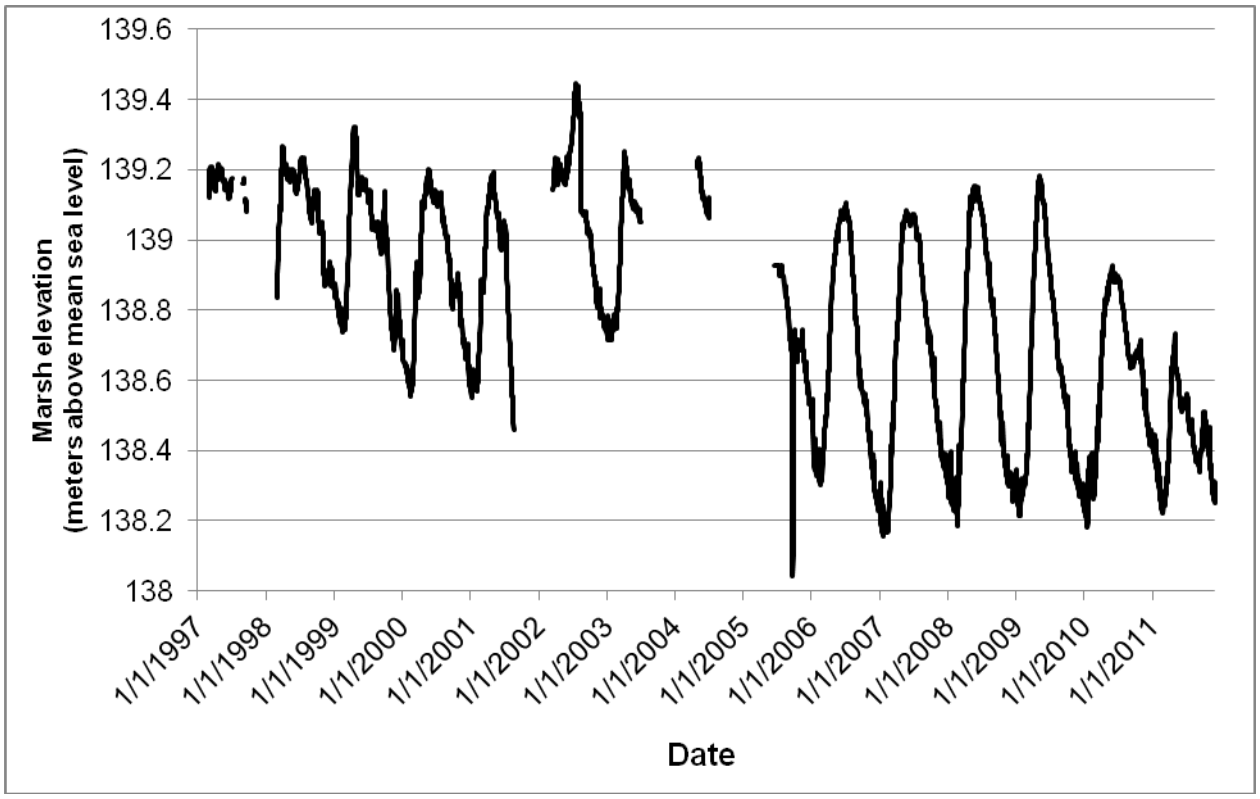


Figure 8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011.

Surface Water Mapping

We mapped surface water at weekly intervals between 14 March and 21 July 2010. In 2011, we mapped water within the target area immediately prior to the initiation of water delivery on 1 March and for three days following the initial pumping. This provided baseline data on water levels, the maximum extent of water, and the longevity of water within the target area. We continued visiting In Between, 800M, and Pierced Egg at approximately weekly intervals through mid-July. During each visit, we traversed trails throughout each site and used GPS and aerial photographs to map the extent and depth of surface water within the sites. At the conclusion of each visit, we compiled our GPS points and field notes to prepare a hardcopy map of the sites, with areas of surface water and saturated soils delineated on the map and indexed to a key detailing the nature (e.g., pig wallow, open marsh, flooded forest) and depth of each wet area. All hardcopy maps were digitized after the field season using ArcGIS. From the digitized shapefiles, we calculated the percentage of the target area that contained surface water at each visit.

Groundwater Measurements

A 0.02 m (¾-inch) diameter shallow well, or piezometer, equipped with a pressure transducer and data logger was installed in 2006 in In Between at Topock Marsh as part of habitat monitoring between Parker and Imperial Dams (see Chapter 7). This piezometer is within the target area of water delivery and thus was left in place when the other piezometers used in the study were removed. This piezometer is described in McLeod et al. (2007) and has been downloaded approximately three times per year since installation. At each download we checked the battery level and function of the data logger. Batteries were replaced as necessary and data were examined to ascertain potential equipment malfunction.

Data Collection

A pressure transducer/data logger equipped with a vented cable collected data hourly at the piezometer. These devices measure and record pressure of the water column present in the well, and these pressure measurements are then converted into water levels (in distance below top of casing). With vented cables and data transfer ports there is no need to correct measurements for atmospheric pressure changes, and the data can be downloaded at the wellhead without disturbing the pressure transducer in the well.

During the initial installation of the pressure transducer, as well as at each data download thereafter, water level was manually measured in the piezometer using an electric water level sounder (Solinst-brand). This known water level was then used to program the pressure transducer with a baseline measurement from which all other automatically recorded water levels were calculated.

Data Validation

We have identified several potential sources of error in the water levels recorded by piezometers. We developed a rigorous protocol to validate each data download, determine if any errors exist with the data, and correct the raw data if possible. Specific sources of error are identified below.

Install Drift. Because piezometers are constructed such that the pressure transducer is almost the same diameter as the inside of the piezometer, removing and inserting the pressure transducers to change batteries can change the water levels in the piezometer temporarily but drastically.

Operational Drift. In rare cases, the accuracy of the data loggers can change in the time period between downloads.

Improper Setup. After downloading data, the data logger is reset for the next round of measurements. Conducting the startup procedure improperly can lead to errors; fortunately, most of these setup errors can be corrected. Common errors include mistakenly setting the type of reference used (i.e., recording water level elevation instead of depth), not resetting the starting water level reference value to the water level value measured manually in the field, and not restarting the data logger but continuing with the previous setup.

At each download, we compared the water level recorded by the piezometer with the manual measurement. We also checked the data logger parameters to determine whether the data logger was initialized properly. If a discrepancy >0.09 m (0.3 feet) existed between the data logger and the manual measurement, and this discrepancy could not be accounted for and corrected by examining the setup parameters and applying an appropriate correction factor, the data were not used for analysis.

Microclimate

In 2009, the In Between, 800M, and Pierced Egg polygons were stratified into use (occupied by flycatchers) and non-use (unoccupied by flycatchers) areas, as observed in 2003–2008. Use areas tend to be wetter than non-use areas and thus are presumably low-lying and more likely to be affected by water delivery into the habitat. We excluded the cattail marsh in the center of the 800M polygon from either the use or non-use areas. We superimposed a 25- x 25-m grid on a GIS software shapefile of the use and non-use areas, numbered the grid blocks, and selected blocks using a random number generator. We used the centroid of the selected block as the sample point and located each point in the field by navigating to the given coordinates using a Rino 110 GPS unit. We determined the exact location of each sample point by means of random number sequences as described in Chapter 6. All sample points used in 2009 were marked in the field with flagging that remained in place over the 2009–2010 and 2010–2011 winters,

allowing for relocation at the beginning of each subsequent season. We relocated each sample point in 2011 and redeployed a data logger in the same location. We used HOBO H8 Pro data loggers (see Chapter 6) to record temperature and humidity at each sample point at 15-minute intervals. Each logger remained in place until the end of the flycatcher breeding season. We collected soil moisture readings, as described in Chapter 6, below each data logger at bi-weekly intervals.

Vegetation

In late July of each year 2009–2011, at the end of the flycatcher breeding season, we collected vegetation measurements at each HOBO logger location. Vegetation plots were centered on the logger, and we collected the vegetation measurements described in Chapter 5, with the exception of stem counts. Given the relatively short time span between the implementation of water delivery and the subsequent vegetation measurements, any responses in vegetation are more likely to be apparent in canopy closure and vertical foliage density than in stem counts.

Data Analyses

We had originally stratified the sample points into use and non-use areas on the assumption that the use areas were more likely to be inundated during water delivery. The water that was pumped into the target area did not reach all the use areas; therefore, we reclassified the points into flooded and non-flooded areas (also referred to as flood groups) according to whether the point was within 20 m (i.e., within a distance that would be encompassed by a flycatcher territory [Sedgwick and Knopf 1992]) of the maximum extent of water recorded immediately post water delivery in 2011. We compared data collected during 2011 to those collected in 2010. We did not include data from 2009 in the comparison because temperature and humidity data collected at the Needles, California weather station (Coop ID 46118) indicated that weather conditions in 2011 were overall more similar to those in 2010 than in 2009, and similar weather data between years may facilitate interpretation of between-year comparisons.

Microclimate

Microclimate data were summarized as described in Chapter 6. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures analysis using a linear mixed model to compare the seasonal changes in flooded versus non-flooded areas in 2010 and 2011. We also used a repeated measures analysis using a linear mixed model to compare temperature and humidity variables the day after a flood event to those recorded the day before the flood event in flooded versus non-flooded areas in 2011. All analyses were completed using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

Vertical foliage data were summarized as described in Chapter 5. Percent native vegetation was calculated as the percent of the foliage hits that consisted of native vegetation. We used the average nest height (3.78 m) recorded at In Between, 800M, and Pierced Egg from 2003 to 2008 to delineate the below, at, and above nest height categories. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures linear mixed model to compare the conditions measured in each flood group in 2011 versus those measured at those same points in 2010. We also used this model to detect any year*flood group interactions, which indicate that the between-year change detected for a given variable in the flooded area differed from the change detected in the non-flooded areas. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

RESULTS

Water Delivery

Water delivery was initiated on 1 March and continued through 7 July. The pump was operated once a week for several hours (Table 8.1), and the hours of operation and flowmeter readings were recorded in a log book.

Table 8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011

Date of Pumping	Hours Operated	Total Pump Output (millions of gallons)	Total Pump Output (cubic meters)	Date(s) of Water Mapping
1 Mar	4.7	3.10	11735	27–28 Feb, 1–3 Mar
10 Mar	5.9	3.89	14725	11 Mar
17 Mar	3.3	2.18	8252	18 Mar
24 Mar	4.8	3.17	12000	25 Mar
31 Mar	5.3	3.50	13249	1 Apr
7 Apr	4.5	2.97	11243	8 Apr
13 Apr	4.3	2.84	10751	15 Apr
21 Apr	4.3	2.84	10751	22 Apr
28 Apr	4.5	2.97	11243	29 Apr
5 May	5.6	3.70	10221	---
12 May	4.0	2.64	9994	14 May
19 May	4.1	2.71	10258	20 May
26 May	1.8	1.19	4505	24 and 29 May
2 Jun	3.5	2.31	8744	3 Jun
9 Jun[1]	4.2	2.77	10493	8 Jun
16 Jun[1]	4.2	2.77	10493	17 Jun
23 Jun	4.0	2.64	9994	22 Jun
30 Jun	4.5	2.97	11243	1 Jul
7 Jul	4.0	2.64	9994	6 and 15 Jul

[1] No data recorded, hours and pump output estimated from flowmeter reading on 23 Jun.

Surface Water Mapping

Immediately prior to the start of water delivery on 1 March, surface water was limited to pig wallows in Pierced Egg (Figure 8.2, map from 28 February). Surface water covered portions of In Between and 800M immediately after pumping on 1 March (Figure 8.2, map from 1 March). There was a noticeable decrease in water extent over the following two days (Figure 8.2, maps from 2 and 3 March; and Figure 8.3), but we determined that weekly pumping would be sufficient to maintain elevated water levels within the target area. From March to late May, all weekly visits occurred on the day immediately following water delivery. Starting in late May, we alternated our weekly visits to fall on the day before water delivery and the day after water delivery so we could document minimum and maximum extent of water (Table 8.1). During this latter part of the season, the extent of the inundated and saturated area in In

Between and 800M remained relatively constant throughout each week following pumping (Figure 8.4). In general, water delivery maintained water levels above those of 2010 (Figure 8.3), despite the markedly lower water levels within Topock Marsh in 2011 compared to 2010 (see Chapter 2).

We noted an increase in surface water within Pierced Egg starting in March and peaking by mid-April; by the end of April, Pierced Egg was completely dry (Figure 8.5). Surface water from the pumping did not flow into Pierced Egg, and the fluctuation of water levels in Pierced Egg was likely the result of a rise in local groundwater levels, which typically peak in April (see Groundwater Monitoring, below) and could also have been influenced by water delivery. The peak in groundwater levels is reflected in the overall percentage of In Between, 800M, and Pierced Egg that was inundated or saturated, which also peaked in mid-April and fell rapidly by early May (Figure 8.3). Water delivery appeared to result in a greater extent of surface water early in the season when overall groundwater levels throughout the area were relatively high. Later in the season, when overall groundwater levels had dropped, surface water was generally restricted to In Between, with portions of 800M sometimes having saturated soil.

Groundwater Monitoring

The piezometer at Topock Marsh shows that local groundwater levels typically peak each year in April (Figure 8.6). Daily cycles are apparent in the hydrograph across all years, showing low water levels during the afternoon hours when vegetation water demands and evapotranspiration are greatest and high water levels in early morning hours. The magnitude of the daily cycle is greatest during the summer months when vegetation demands are greatest and lowest during the winter months when cooler daily temperatures and dormant vegetation result in lower water demands.

Weekly trends in groundwater levels were apparent in March–July 2011 (Figure 8.7) and paralleled the pumping schedule, with groundwater rising on the day of pumping and falling through the week until the next pumping. When groundwater levels were at relatively high levels in March and April, each pumping session increased the groundwater level at the piezometer approximately 0.08 m (0.25 feet) and then the water level fell linearly through the week until the next pumping session. As water levels dropped in May and June, the effect of each pumping session on the water level at the piezometer increased; each pumping session increased the water level by up to 0.23 m (0.75 feet), and water levels fell more rapidly immediately following pumping than they did later in the week. The groundwater level recorded by the piezometer peaked at the highest level recorded in any year since 2006, showing that water delivery raised the local groundwater table within the target area despite the overall lower water table in the marsh (see Chapter 2).

Microclimate

In 2010, we deployed 15 HOBO loggers in the flooded area and 17 loggers in the non-flooded area between 14 and 29 March (Figure 8.8). All loggers functioned correctly in 2010. In 2011, we deployed HOBO loggers in these same locations between 27 February and 11 March. In 2011, two loggers, one in the flooded area and one in the non-flooded area, failed to launch and collected no data; one logger in the flooded area had a faulty humidity sensor, and humidity data from this logger were excluded from the analysis. Data analyses were restricted to the period between 1 April and 15 July to encompass the dates when all loggers were deployed in both years. In 2010, soil conditions became progressively drier throughout the season for both the flooded and non-flooded areas, while temperatures rose throughout the season and vapor pressure values showed the typical rise seen in July with the onset of summer monsoons

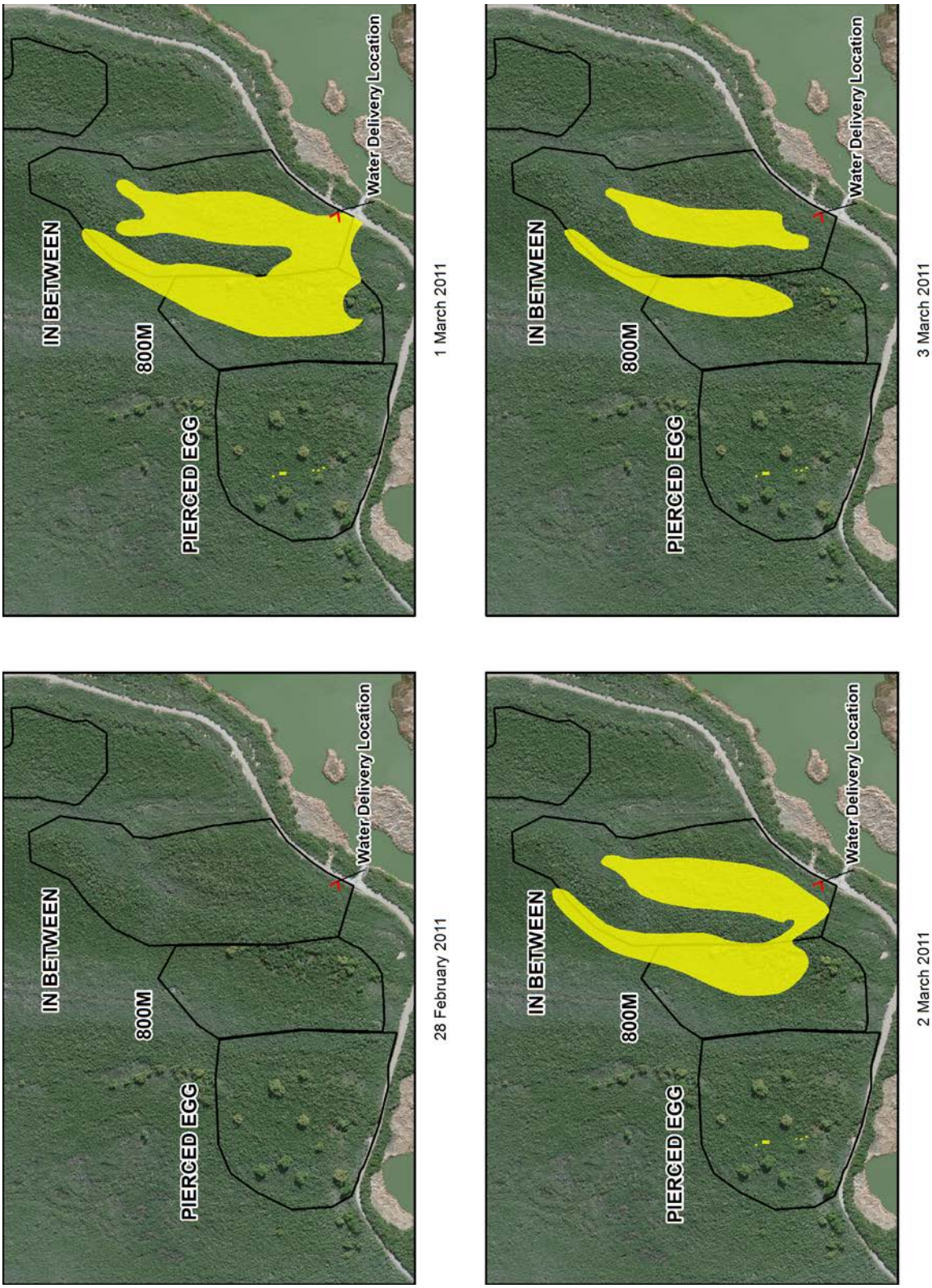


Figure 8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011.

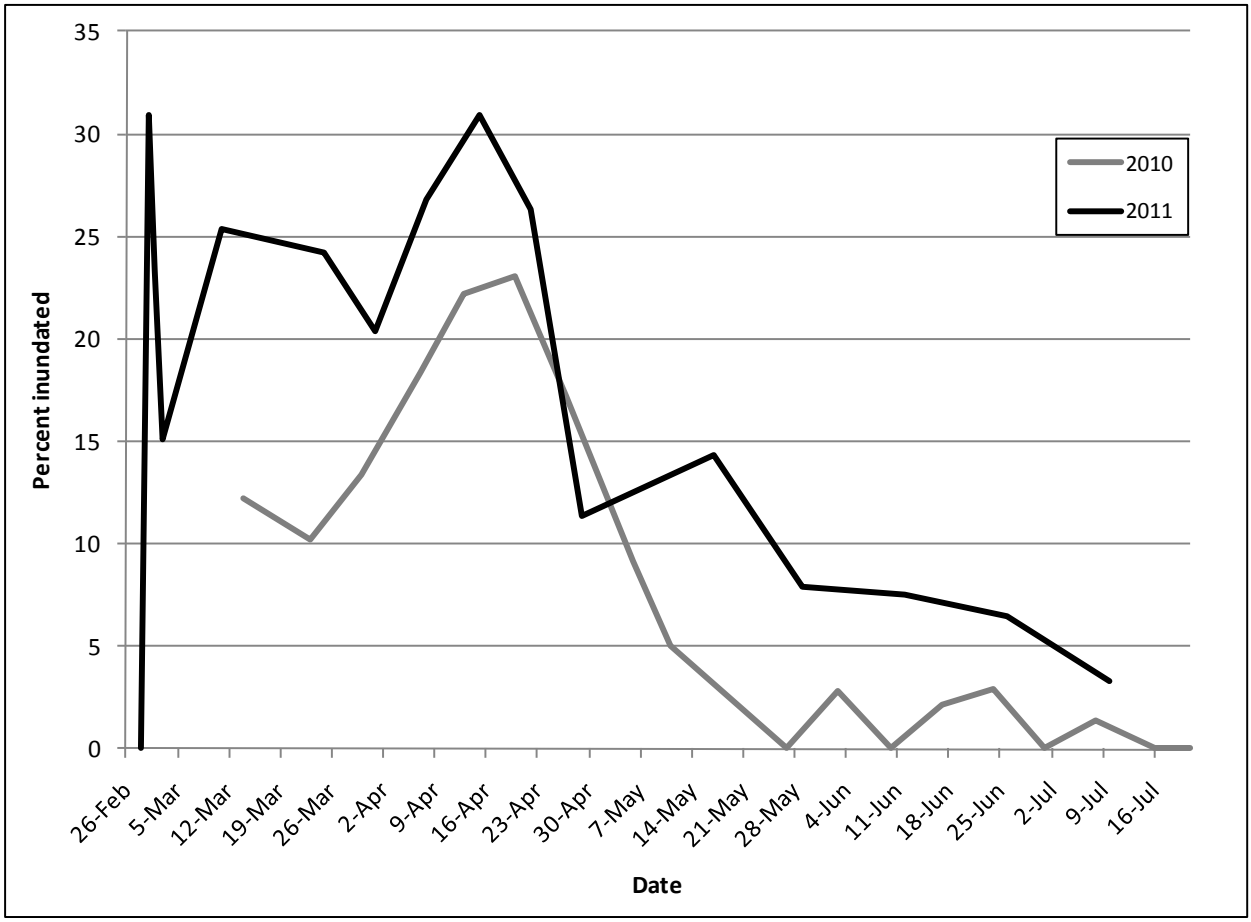


Figure 8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. Percentages are averaged over two-week periods for June and July 2011, because weekly visits alternated between the day before and the day after pumping.

(Tables 8.2 and 8.3). These same overall patterns were seen in 2011 (Tables 8.4 and 8.5). These data are shown graphically for easier comparison of data between years (Figures 8.9a–8.17a). Data are also shown as the difference between the flooded and non-flooded areas in both 2010 (the control year) and 2011 (Figures 8.9b–8.17b). If flooding had no effect, we would expect the differences between the flooded and non-flooded areas to be similar in both years.

Table 8.6 presents the significance test results (*P*-values) for the comparison of flooded versus non-flooded areas in 2010 and 2011. The first two columns show the comparison of each microclimate variable, overall across the season, in the flooded versus non-flooded areas in 2010 and 2011, respectively. Baseline data were collected in 2010, so significant *P*-values in this column indicate inherent differences between the flooded and non-flooded areas. A significant *P*-value in the column for a given year indicates a difference between flood groups, and corresponds to a significant gap between the solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. A significant *P*-value for a given variable in only one year but not both suggests an effect of flooding.

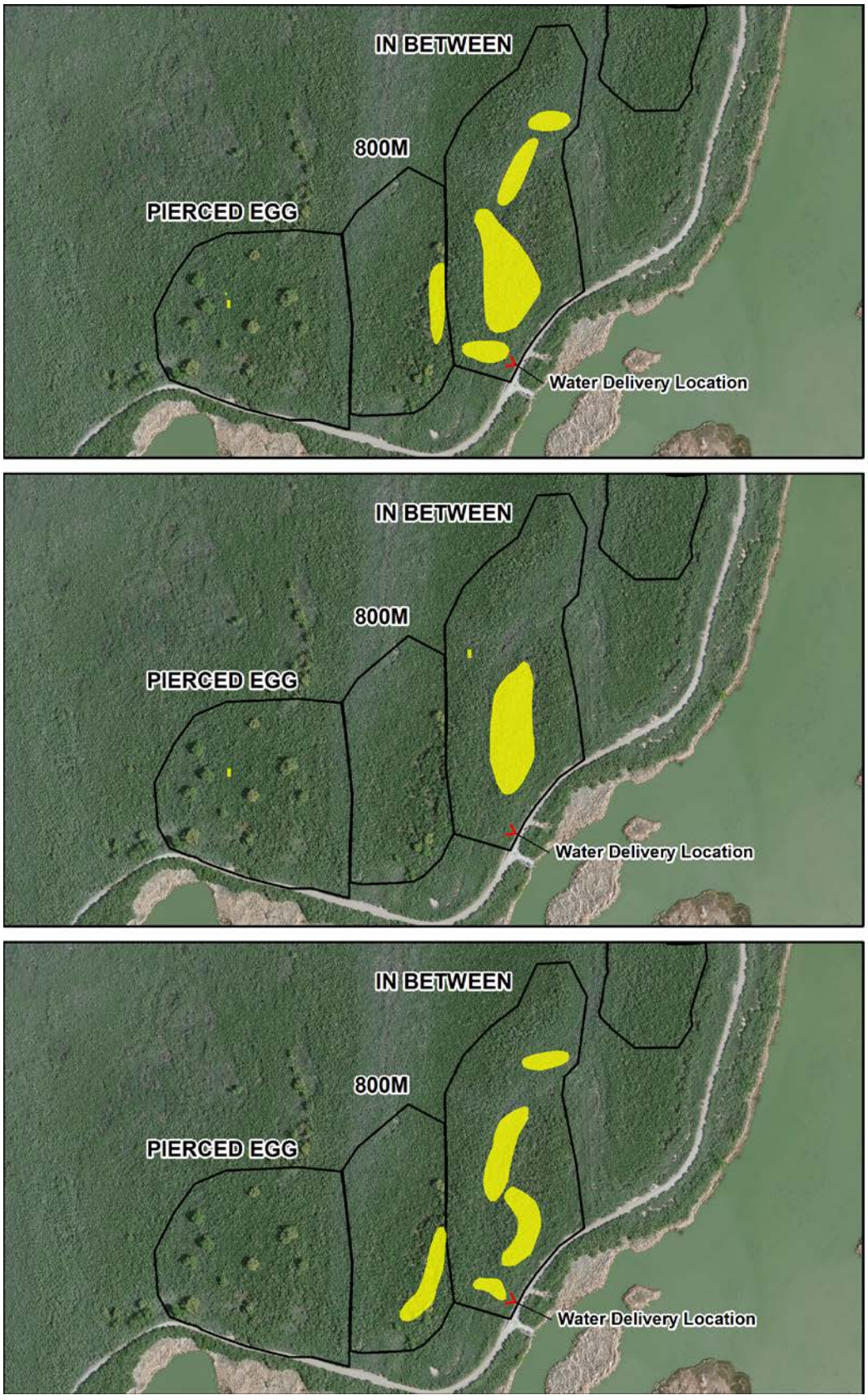


Figure 8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011.

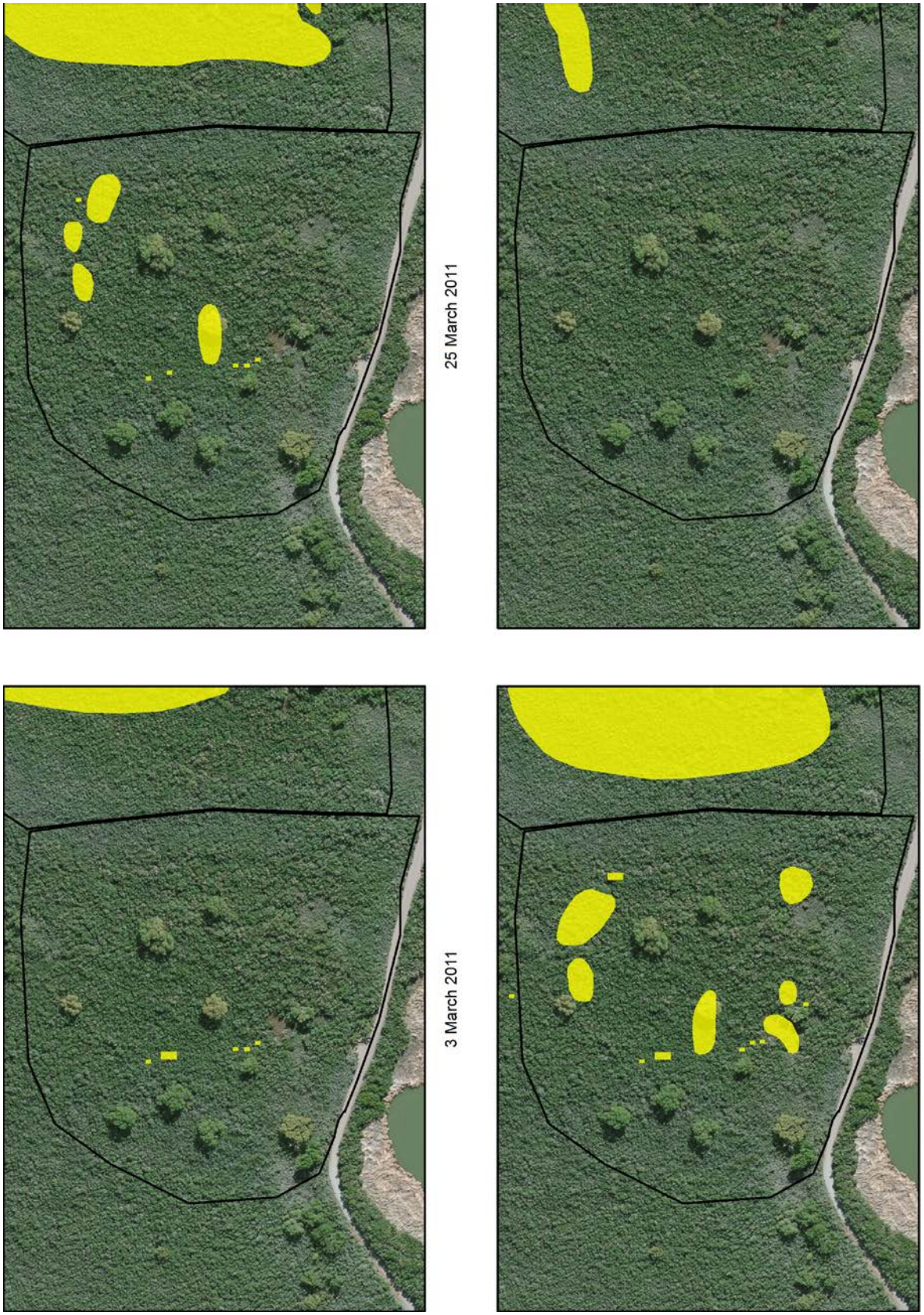


Figure 8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011.

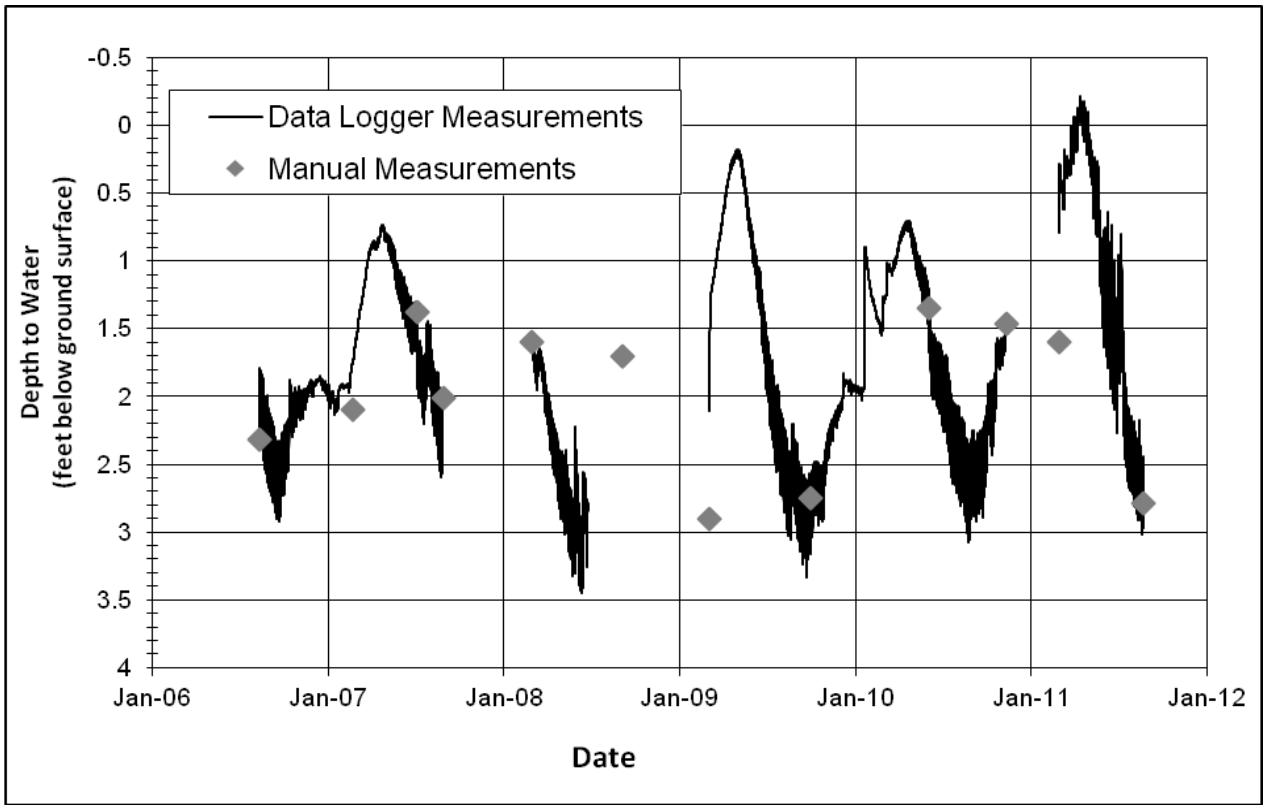


Figure 8.6. Topock Marsh hydrograph, 2006–2011.

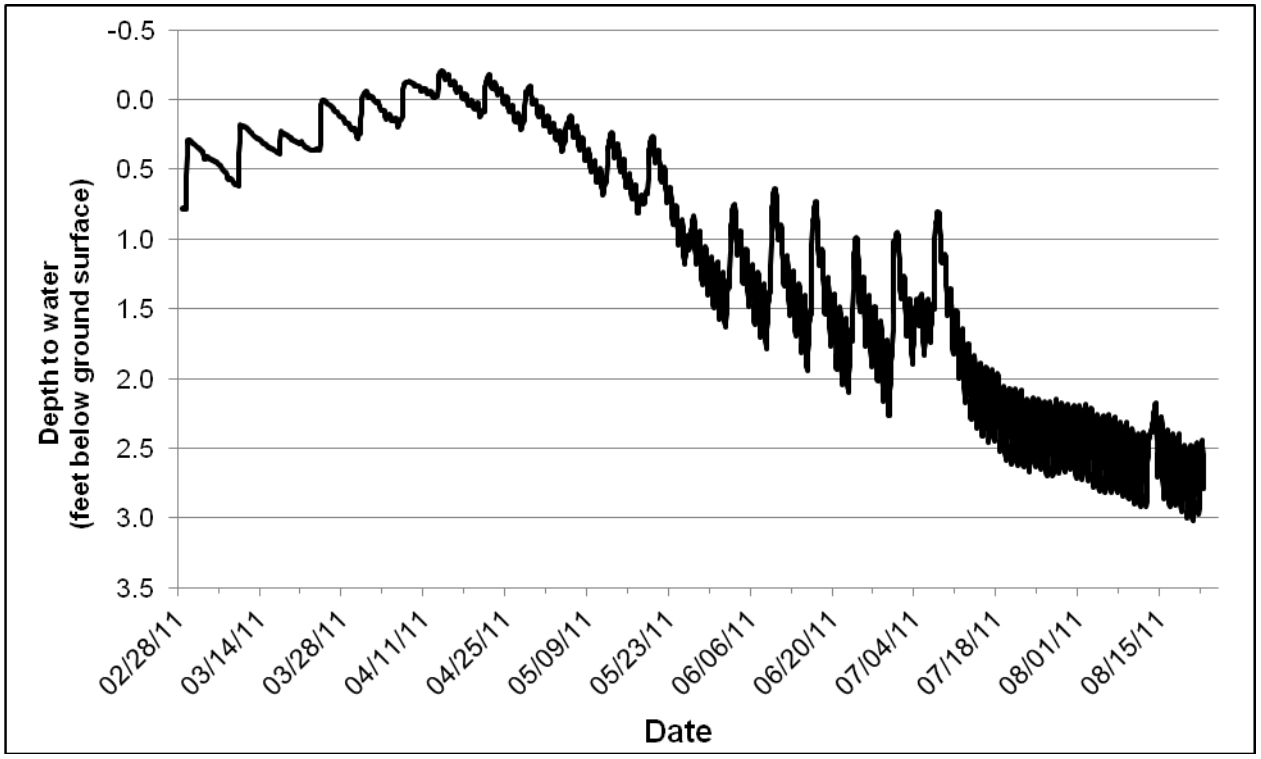


Figure 8.7. Topock Marsh hydrograph, February–July, 2011.

We also examined how each microclimate variable changed through the season. The third and fourth columns of Table 8.6 show *P*-values for the comparison of seasonal change in the flooded vs. non-flooded areas (i.e., the time*flood group interaction) in 2010 and 2011, respectively. Significant *P*-values in either column indicate that the microclimate variable changed through the season in the flooded area in a different way than in the non-flooded area in that year, and corresponds to non-parallel solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. Again, a significant *P*-value for a given variable in one year but not the other suggests an effect of flooding.

We also examined between-year differences for soil moisture variables within the non-flooded and flooded areas (columns 5 and 6, respectively, of Table 8.6). We did not include results for the between-year analysis for temperature and humidity variables because significant between-year differences could be the result of variation in climate between years, and any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates an overall between-year difference within the flood group and corresponds to a significant gap between the gray (2010) and black (2011) lines for that flood group in Figures 8.9a–8.12a.

Finally, we compared change through the season for soil moisture variables in 2010 versus 2011 (i.e., the time*year interaction) within the non-flooded and flooded areas (columns 7 and 8, respectively, of Table 8.6). Again, we did not include the results of this analysis for temperature and humidity variables because any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates that, within the given flood group, the variable changed through time in 2010 in a different way than it changed through time in 2011. This corresponds to non-parallel gray (2010) and black (2011) lines for the flood group in Figures 8.9a–8.12a.

None of the measures of soil moisture and presence of surface water differed overall between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1). In 2011, three measures of surface water (distance to surface water, percentage of the area within 20 m that was flooded, and percentage of the area within 50 m that was flooded) differed between the flooded and non-flooded area (Table 8.6, column 2), with all three variables indicating wetter overall conditions in the flooded area (Figures 8.10–8.12). Soil moisture and both measures of the percentage of the area inundated showed a significant interaction between flood group and time in 2011 (Table 8.6, column 4); soil moisture declined more rapidly in the flooded versus the non-flooded area as the extent of the flooding decreased through the season (Figure 8.9), and the measures of the percentage inundated decreased throughout the season in the flooded area while they remained constant (at zero) through the season in the non-flooded area (Figures 8.11 and 8.12). The non-flooded area differed significantly between years in soil moisture, distance to water, and percentage of the area within 50 m that was inundated (Table 8.6, column 5); all measures reflected the overall lower marsh levels and resulting drier conditions in 2011. The flooded area differed between years in all measures of surface water (Table 8.6, column 5), with all variables indicating wetter conditions in 2011. Overall soil moisture in the flooded area did not differ significantly between years (Table 8.6, column 6) but did show a significant interaction between year and time (Table 8.6, column 8); soil moisture was higher in 2011 than in 2010 early in the season but had dropped to a lower level in 2011 than in 2010 by early June, again illustrating the overall dry conditions in 2011 (Figure 8.9).

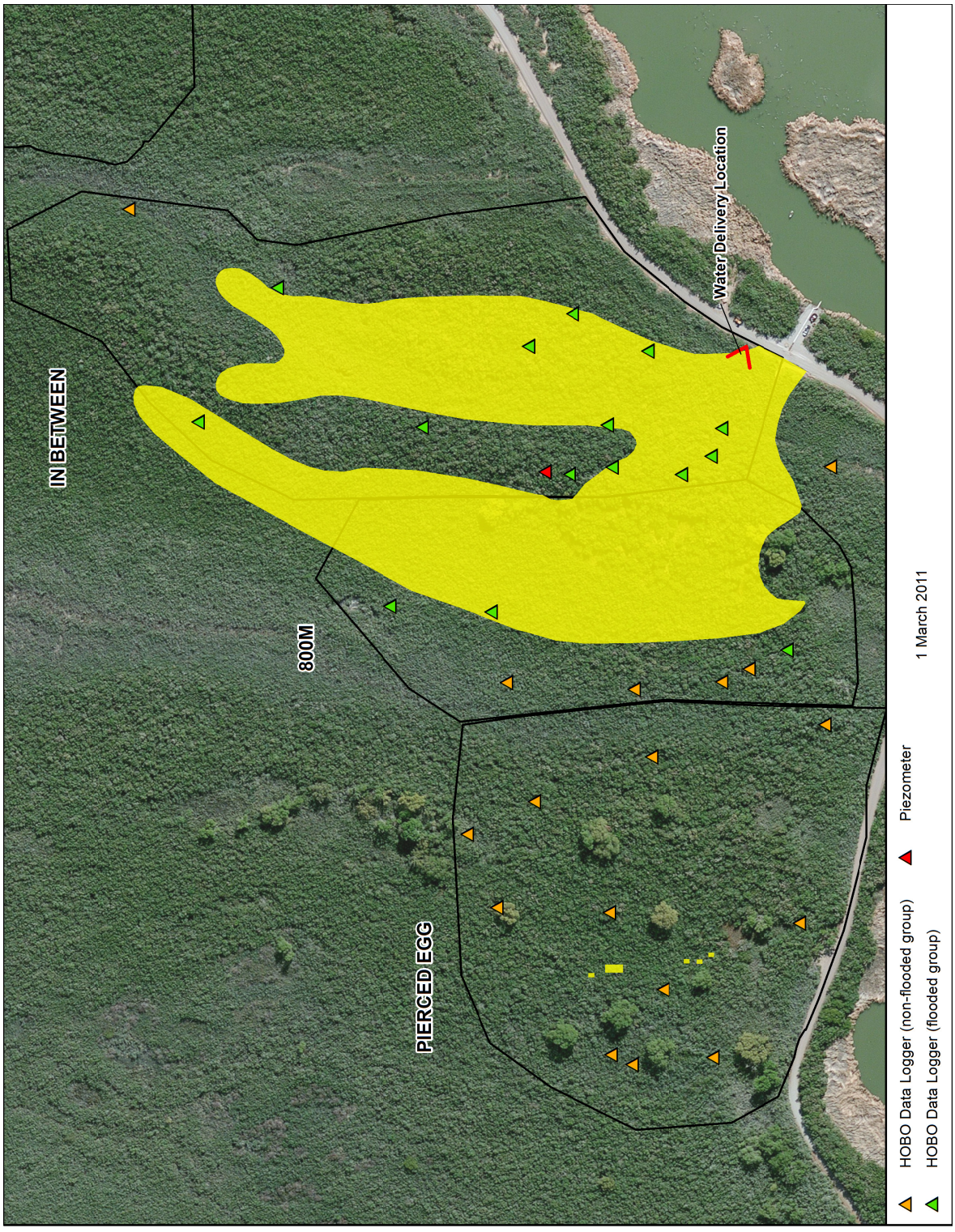


Figure 8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011.

Table 8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	911.4 (14.0)	897.9 (13.4)	881.2 (14.0)	878.6 (10.8)	863.2 (9.8)	836.8 (12.1)	867.3 (16.3)
Mean distance to nearest standing water	31.0 (6.2)	31.9 (6.1)	62.5 (8.7)	68.5 (8.1)	101.6 (10.6)	98.4 (10.8)	110.3 (17.9)
% of area within 20 m that was inundated	10.7 (6.3)	10.0 (5.0)	1.9 (1.9)	1.9 (1.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	18.7 (5.6)	12.4 (3.8)	1.8 (1.0)	2.0 (1.1)	0.0 (0.0)	0.3 (0.3)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	35.3 (0.3)	36.2 (0.4)	38.4 (0.3)	38.5 (0.3)	41.9 (0.3)	43.1 (0.3)	43.4 (0.4)
Mean minimum nocturnal temperature (°C)	5.0 (0.2)	8.5 (0.3)	8.4 (0.2)	9.9 (0.2)	18.0 (0.2)	13.8 (0.2)	18.3 (0.2)
Mean daily temperature range (°C)	30.3 (0.3)	27.7 (0.4)	30.0 (0.3)	28.6(0.4)	23.9 (0.3)	29.4 (0.3)	25.1 (0.4)
Humidity							
Mean diurnal vapor pressure (Pa)	597.4 (9.3)	818.4 (13.4)	798.1 (14.1)	976.4 (16.2)	1588.5 (23.5)	1649.4 (28.5)	2279.7 (36.0)
Mean nocturnal vapor pressure (Pa)	652.2 (8.7)	888.1 (11.9)	890.9 (11.2)	1022.4 (12.4)	1537.7 (17.5)	1423.7 (16.8)	1929.9 (22.3)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

Table 8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	908.1 (13.7)	908.0 (12.9)	892.7 (13.8)	838.4 (20.6)	853.9 (11.8)	834.3 (19.8)	804.5 (17.9)
Mean distance to nearest standing water	44.9 (9.7)	42.8 (9.3)	54.0 (10.2)	60.6 (17.1)	102.8 (11.9)	115.0 (13.4)	192.0 (23.3)
% of area within 20 m that was inundated	8.0 (6.7)	6.2 (4.4)	5.3 (4.6)	6.4 (5.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	13.5 (4.8)	15.5 (4.8)	10.1 (4.1)	6.7 (4.4)	4.1 (3.0)	0.0 (0.0)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	32.2 (0.3)	33.7 (0.4)	35.7 (0.3)	36.3 (0.4)	39.8 (0.4)	40.9 (0.4)	40.9 (0.4)
Mean minimum nocturnal temperature (°C)	6.0 (0.2)	9.4 (0.3)	9.1 (0.2)	10.6 (0.2)	18.7 (0.2)	14.5 (0.2)	18.9 (0.2)
Mean daily temperature range (°C)	26.2 (0.4)	24.3 (0.5)	26.6 (0.4)	25.7 (0.4)	21.1 (0.4)	26.5 (0.4)	22.0 (0.5)
Humidity							
Mean diurnal vapor pressure (Pa)	611.7 (10.1)	834.7 (14.5)	813.2 (15.4)	998.5 (17.9)	1595.6 (24.6)	1612.9 (26.8)	2209.8 (35.8)
Mean nocturnal vapor pressure (Pa)	676.5 (9.5)	913.3 (12.7)	906.3 (11.5)	1043.2 (13.0)	1535.3 (18.6)	1418.7 (16.8)	1921.6 (23.7)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

AR064819

Table 8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 17)							
Mean soil moisture (mV)	883.8 (14.4)	904.1 (13.3)	878.4 (22.7)	835.4 (16.8)	811.4 (19.0)	819.4 (12.1)	817.4 (11.4)
Mean distance to nearest standing water	N/A	N/A	122.0 (61.1)	138.9 (21.6)	149.4 (19.4)	120.4 (16.3)	115.6 (13.9)
% of area within 20 m that was inundated	3.6 (10.9)	N/A	0.0 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (40.0)	1.7 (1.7)
% of area within 50 m that was inundated	3.6 (3.6)	N/A	1.9 (1.4)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.1 (0.1)
Temperature (n = 16)							
Mean maximum diurnal temperature (°C)	34.8 (0.5)	38.2 (0.3)	38.7 (0.3)	36.6 (0.3)	40.3 (0.3)	43.5 (0.2)	41.3 (0.3)
Mean minimum nocturnal temperature (°C)	6.8 (0.3)	11.0 (0.2)	9.3 (0.3)	11.6 (0.2)	12.5 (0.2)	18.0 (0.2)	20.0 (0.2)
Mean daily temperature range (°C)	28.1 (0.5)	27.2 (0.4)	29.4 (0.4)	25.0 (0.4)	27.8 (0.3)	25.5 (0.3)	21.3 (0.5)
Humidity (n = 16)							
Mean diurnal vapor pressure (Pa)	666.5 (14.2)	761.1 (13.8)	858.8 (15.9)	1066.2 (14.9)	1229.4 (24.5)	1598.9 (20.7)	2467.8 (43.7)
Mean nocturnal vapor pressure (Pa)	666.3 (12.5)	817.0 (13.8)	922.1 (13.6)	1033 (10.4)	1178.1 (19.1)	1436.8 (12.9)	2215.1 (32.2)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

Table 8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 15)							
Mean soil moisture (mV)	955.6 (12.1)	944.3 (14.7)	893.7 (17.8)	867.8 (17.8)	779.1 (28.5)	768.8 (23.4)	809.6 (24.0)
Mean distance to nearest standing water	N/A	N/A	12.0 (4.7)	48.5 (23.6)	84.7 (20.5)	73.0 (18.7)	98.11 (20.0)
% of area within 20 m that was inundated	57.7 (10.9)	N/A	39.6 (10.0)	18.3 (8.1)	18.0 (8.3)	17.5 (6.4)	5.8 (3.2)
% of area within 50 m that was inundated	54.6 (10.5)	N/A	36.1 (7.7)	23.4 (8.3)	20.1 (9.7)	26.3 (8.7)	11.7 (4.9)
Temperature (n = 14)							
Mean maximum diurnal temperature (°C)	31.8 (0.5)	34.8 (0.3)	36.0 (0.4)	34.5 (0.4)	38.5 (0.3)	42.1 (0.3)	40.5 (0.4)
Mean minimum nocturnal temperature (°C)	8.1 (0.3)	12.1 (0.3)	10.3 (0.3)	12.3 (0.2)	13.2 (0.2)	18.9 (0.2)	20.6 (0.2)
Mean daily temperature range (°C)	23.7 (0.5)	22.7 (0.4)	25.6 (0.5)	22.2 (0.4)	25.2 (0.4)	23.2 (0.5)	19.9 (0.5)
Humidity (n = 13)							
Mean diurnal vapor pressure (Pa)	732.4(16.5)	843.4 (16.5)	917.4 (18.5)	1110.9 (16.2)	1250.5 (25.1)	1631.8 (21.3)	2501.8 (49.7)
Mean nocturnal vapor pressure (Pa)	773.6 (14.4)	926.0 (17.1)	1031.2 (16.0)	1112.5 (12.8)	1255.2 (21.5)	1516.9 (16.6)	2251.2 (35.6)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

All measures of temperature (mean daily maximum, mean daily minimum, mean temperature range) tended toward being different (*P*-values between 0.04 and 0.07) between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1), with the flooded area having lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range than the non-flooded area (Figures 8.13–8.15). This pattern persisted in 2011 (Table 8.6, column 2; Figures 8.13–8.15). The change in temperature variables through the season was similar in the flooded and non-flooded areas in 2010 (Table 8.6, column 3) but not in 2011 (Table 8.6, column 4). In 2011, the flooded area began the season with lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range when compared to the non-flooded area; these differences diminished steadily as the season progressed (Figures 8.13–8.15).

Diurnal and nocturnal vapor pressure did not differ significantly between flooded and non-flooded areas under baseline conditions in 2010 (Table 8.6, column 1). In 2011, both measures of humidity were higher in the flooded versus non-flooded area (Figures 8.16 and 8.17), but this difference was significant only for nocturnal vapor pressure (Table 8.6, column 2). The difference in nocturnal vapor pressure between flooded and non-flooded areas decreased through the season in 2011 (Table 8.6, column 4; Figure 8.17).

Comparison between day before and day after flood events – A comparison of temperature and humidity variables the day before and the day after each flood event in 2011 showed that, overall, flood events appeared to affect all temperature and humidity variables, and the effect was not constant through the season for any variable except mean diurnal vapor pressure (Table 8.7). The effect of flooding is graphed (Figures 8.18-8.22) to aid in interpretation of flooding effects. In each figure there are three graphs. The first graph shows the difference in the given microclimate variable between the day before and the day after each flood event for the flooded and non-flooded areas. The fluctuation in the non-flooded area between the day before and day after each flood events indicates the baseline change in general weather conditions; deviation in the flooded area from this baseline change suggests an effect of flooding. This deviation (the difference between the non-flooded and flooded areas) is depicted in the second graph in each figure. The third graph in each figure plots this deviation against baseline weather conditions to show whether the direction and magnitude of any effects of flooding varied based on underlying weather conditions.

Overall, the flooded area had a lower maximum diurnal temperature in relation to the non-flooded area on the day after a flood event than on the day before a flood event (Table 8.7, Figures 8.18a and 8.18b). The effect of flooding on the maximum diurnal temperature was related to the maximum temperature recorded on the day after a flood event in the non-flooded area (Figure 8.18c); flooding had the greatest effect of lowering the maximum temperature on hot days but raised the maximum temperature on relatively cool days. Overall, minimum nocturnal temperature on the day after a flood event was higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.19a and 8.19b). The effect of flooding on minimum nocturnal temperature did not appear to be related to minimum nocturnal temperature (Figure 8.19c). Overall, the daily temperature range on the day after a flood event was smaller in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.20a and 8.20b). This effect was strongly related to the maximum temperature on the day after a flood event, with flooding having the greatest effect of reducing the daily temperature range on hot days (Figure 8.20c).

Both diurnal and nocturnal vapor pressure on the day after a flood event were higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.21a, 8.21b, 8.22a, and 8.22b). Diurnal vapor pressure was affected the most strongly in the middle of the season (Figure 8.21b), but this effect was not related to overall vapor pressure (Figure 8.21c). The effect on nocturnal vapor pressure was weakly, inversely related to ambient vapor pressure.

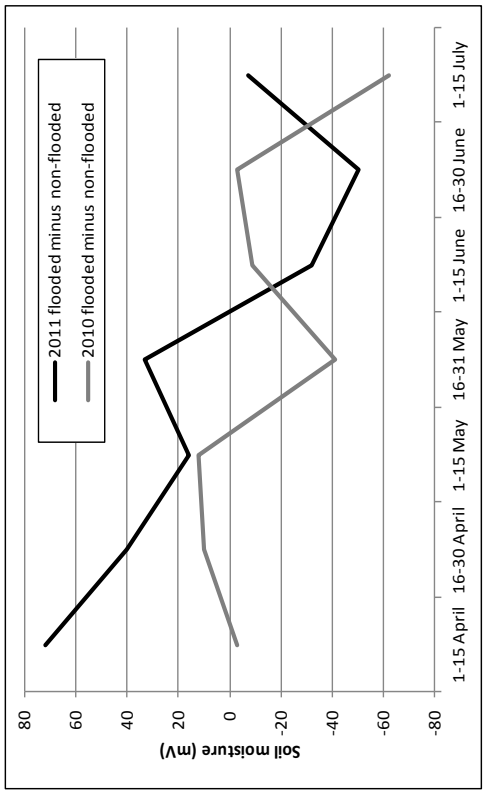


Figure 8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

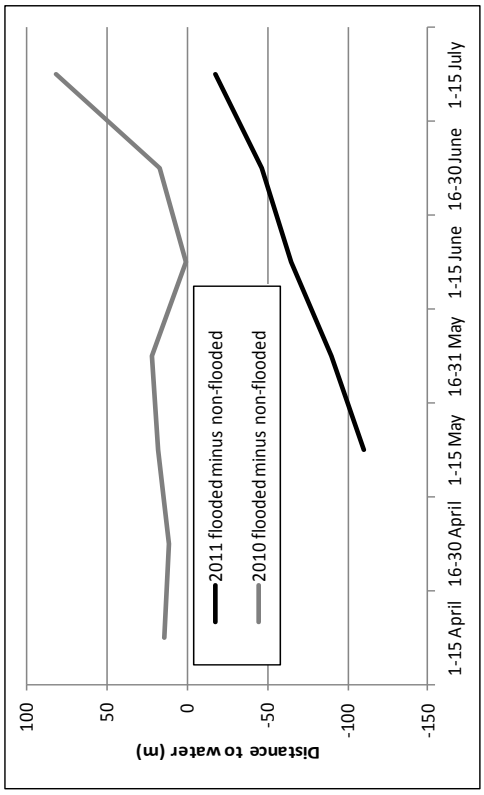


Figure 8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

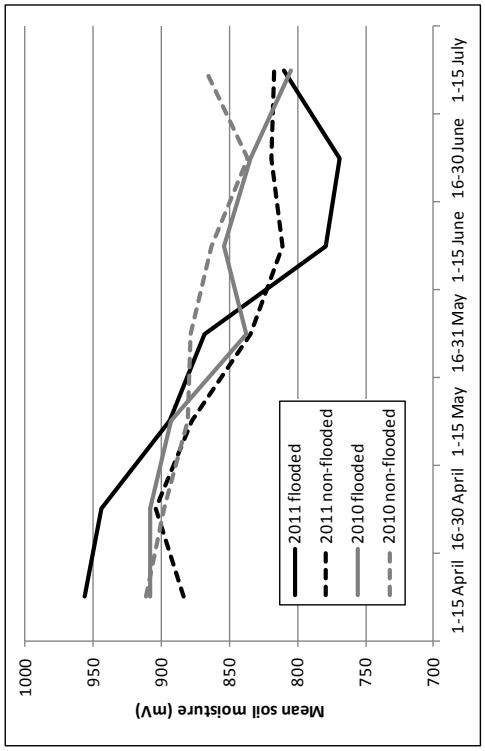


Figure 8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

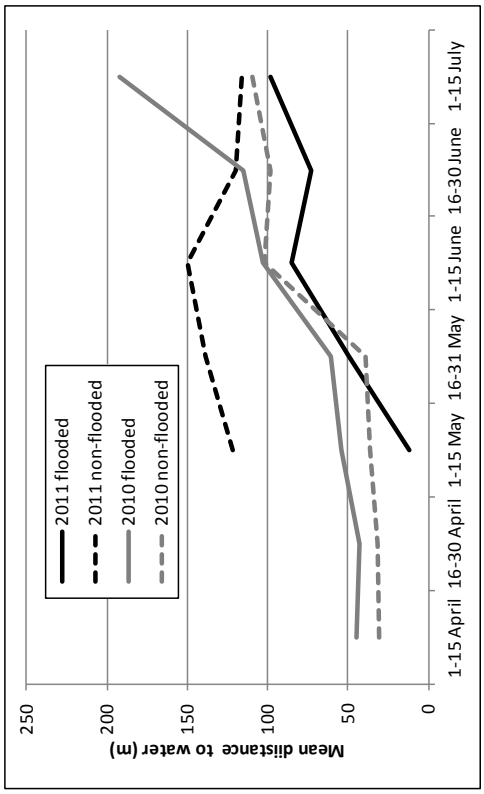


Figure 8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

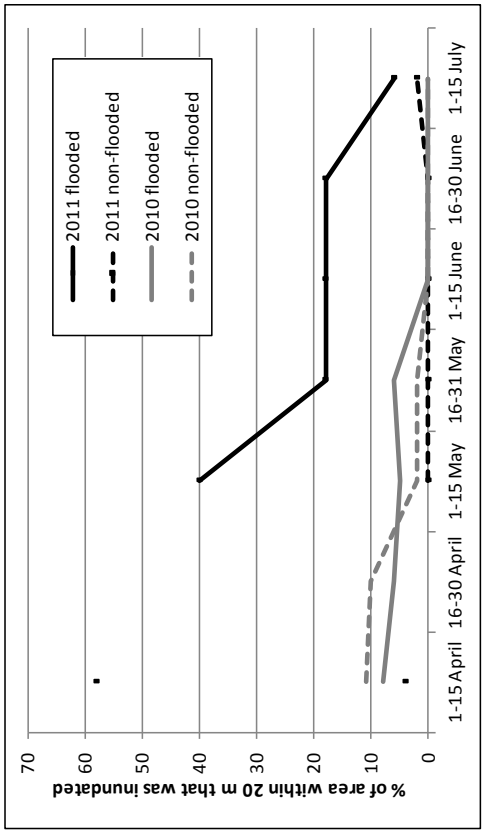


Figure 8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

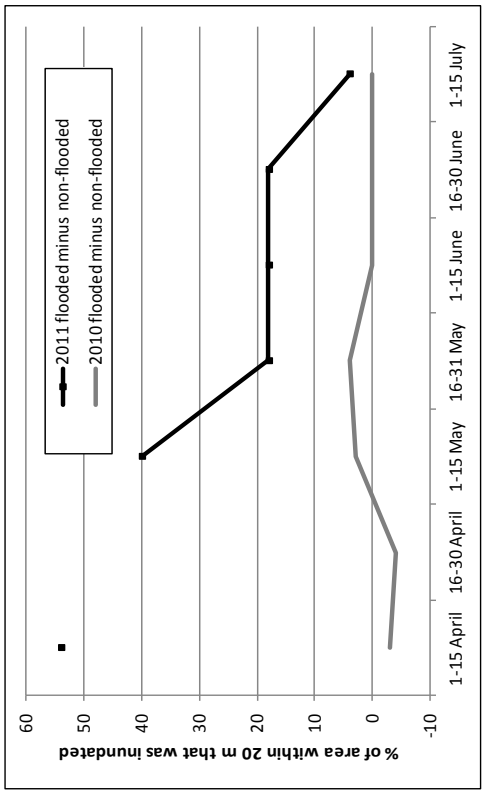


Figure 8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011.

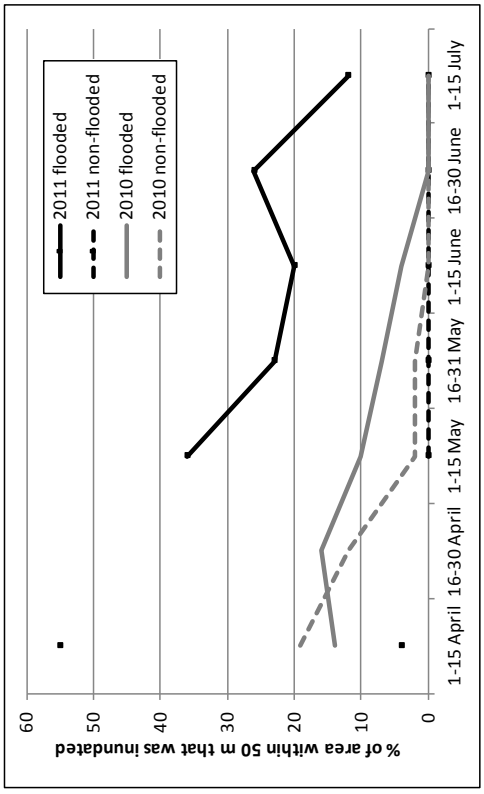


Figure 8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

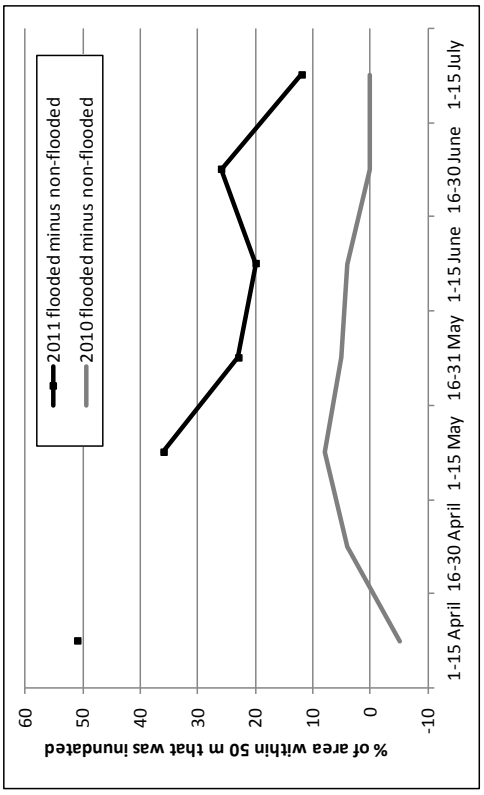


Figure 8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011.

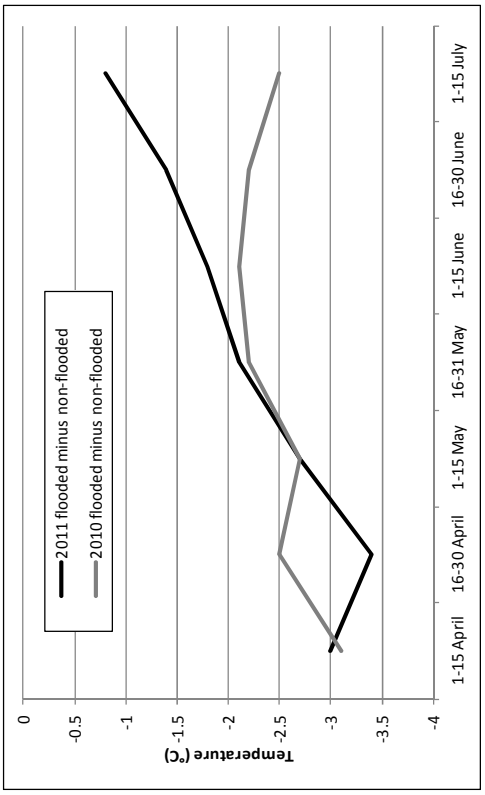


Figure 8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

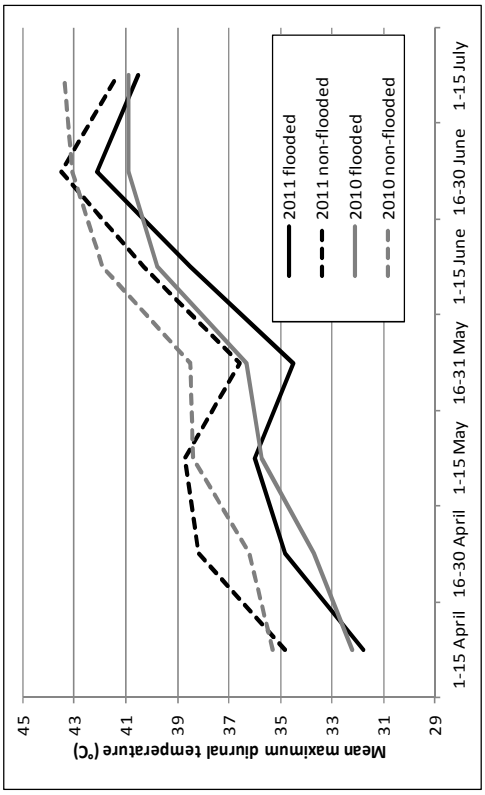


Figure 8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

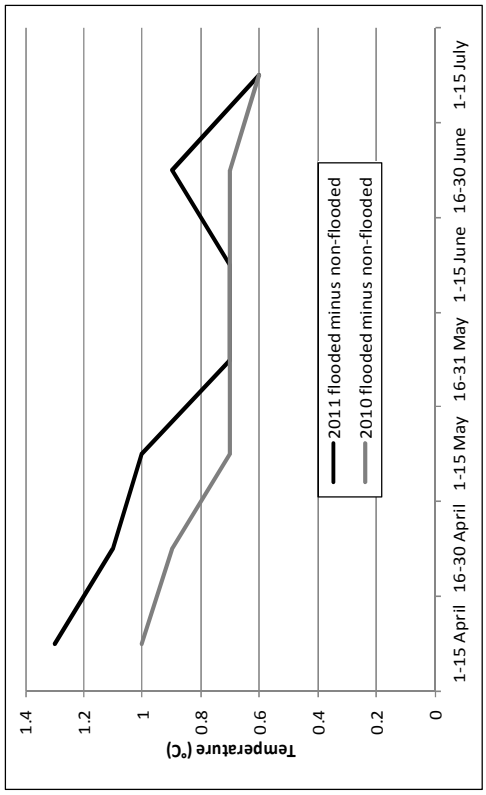


Figure 8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

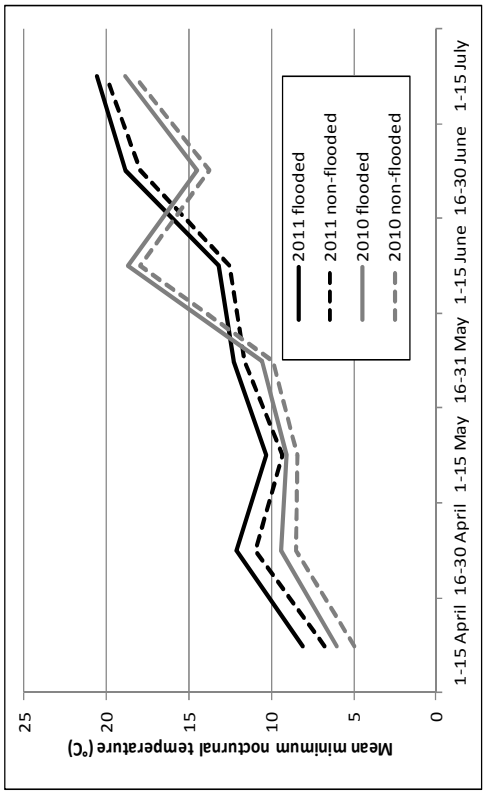


Figure 8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

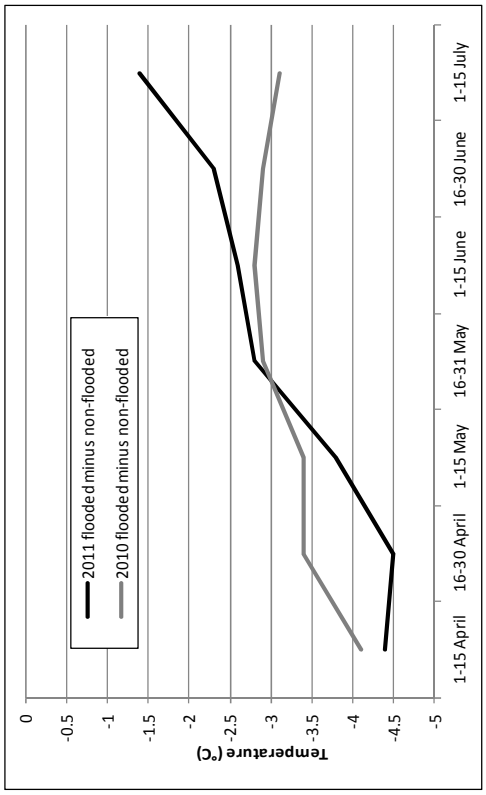


Figure 8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

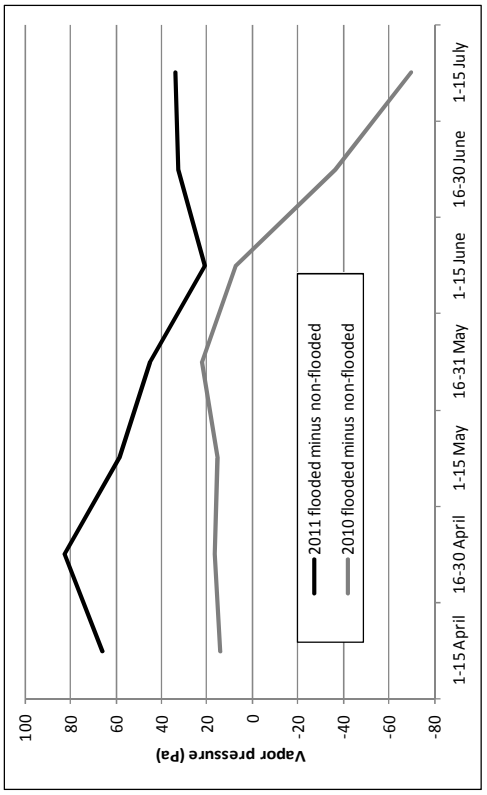


Figure 8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

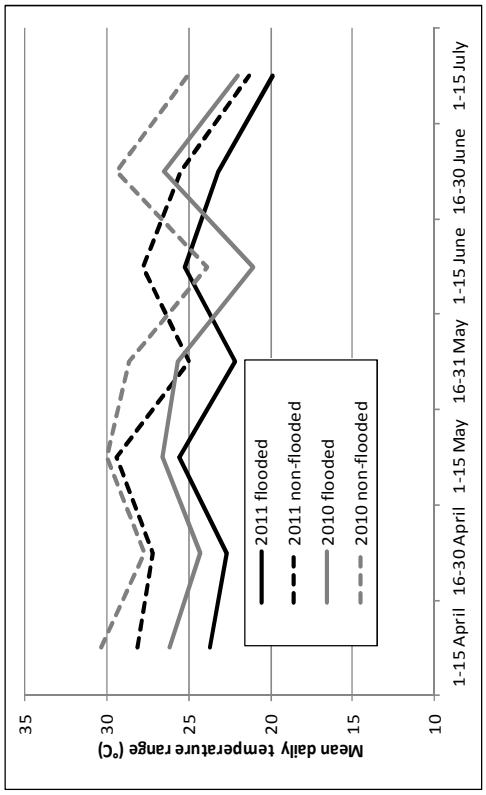


Figure 8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

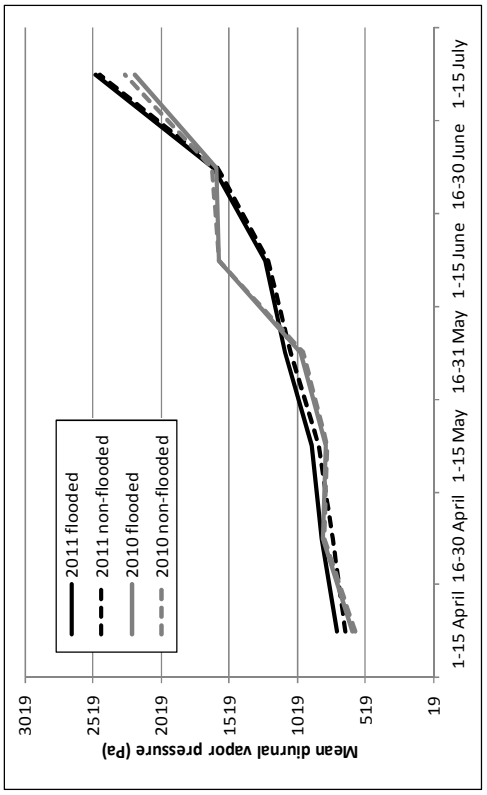


Figure 8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

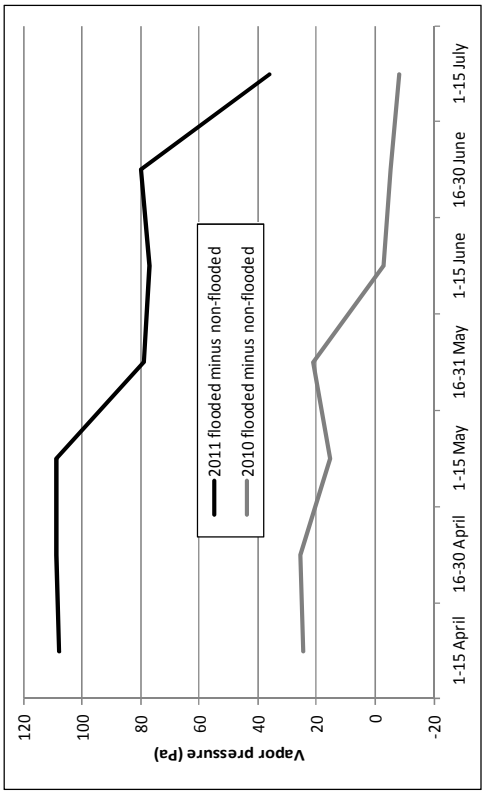


Figure 8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

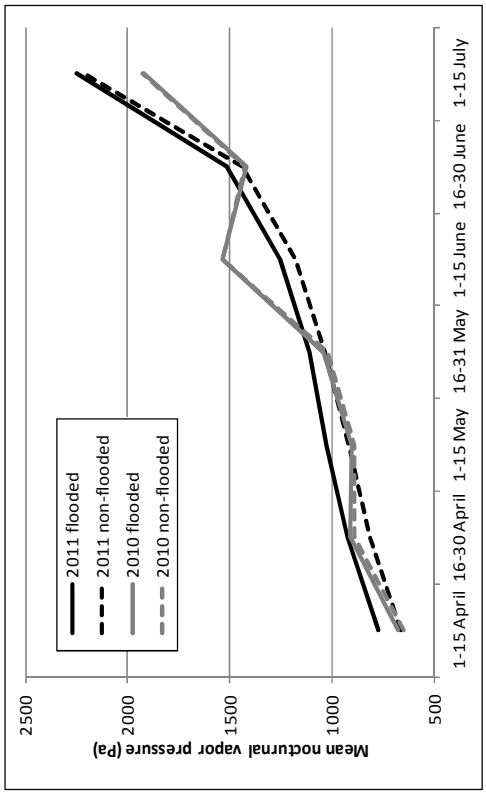


Figure 8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Table 8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011.

	Flooded vs. non-flooded areas overall, within the year (between flood group differences)		Change over the season for flooded vs. non-flooded areas, by year (interaction between flood group and time)		2010 vs. 2011 overall, within flood group (between-year differences)		Change over the season for 2010 vs. 2011, by flood group (interaction between year group and time)	
Parameter	**2010**	**2011**	**2010**	**2011**	**Non-flooded**	**Flooded**	**Non-flooded**	**Flooded**
Soil Moisture								
Mean soil moisture (mV)	0.329	0.563	0.014	<0.001	<0.001	0.884	0.131	0.009
Mean distance to nearest standing water	0.124	0.009	<0.001	0.173	<0.001	<0.001	0.066	0.023
% of area within 20 m that was inundated	0.997	<0.001	0.750	<0.001	0.208	<0.001	0.718	0.010
% of area within 50 m that was inundated	0.497	<0.001	0.147	0.001	0.026	<0.001	0.004	0.407
Temperature								
Mean maximum diurnal temperature (°C)	0.067	0.071	0.954	0.009	--	--	--	--
Mean minimum nocturnal temperature (°C)	0.069	0.044	0.088	<0.001	--	--	--	--
Mean daily temperature range (°C)	0.041	0.047	0.802	0.001	--	--	--	--
Humidity								
Mean diurnal vapor pressure (Pa)	0.943	0.349	0.618	0.845	--	--	--	--
Mean nocturnal vapor pressure (Pa)	0.751	0.011	0.170	0.012	--	--	--	--

* Data restricted from April 1 through July 15 for both years. For 2011, distance-to-water measures do not include April and percent inundated measures do not include April 16-30.

AR064827

Table 8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011*

	Maximum diurnal temperature		Minimum nocturnal temperature		Daily temperature range		Mean diurnal vapor pressure		Mean nocturnal vapor pressure	
Day of flooding	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded
31 March	9.3	8.6	5.8	6.3	3.5	2.3	113.2	190.7	155.2	275.4
7 April	-18.9	-15.5	-1.5	-3.6	-17.4	-11.9	-194.4	-191.8	-443.1	-495.4
13 April	-5.5	-5.0	2.6	2.6	-8.0	-7.6	-263.6	-338.0	-263.7	-292.1
21 April	0.1	-0.9	-3.6	-2.9	3.6	2.0	-193.7	-154.0	-41.8	-21.3
28 April	2.4	1.9	11.1	9.1	-8.7	-7.2	201.0	239.3	-152.9	-264.2
5 May	3.0	2.0	4.5	4.3	-1.3	-2.3	261.9	323.6	260.4	249.5
12 May	5.5	5.0	2.8	4.0	2.7	1.0	95.5	149.7	93.4	175.2
19 May	11.9	11.1	-0.4	0.4	12.2	10.7	-269.0	-170.6	26.8	83.3
26 May	0.6	0.7	4.7	4.7	-4.1	-3.9	57.7	132.3	-38.9	50.1
2 June	4.8	3.6	-3.4	-2.5	8.2	6.1	-150.2	-40.7	93.0	158.1
9 June	3.0	3.0	1.3	2.4	1.8	0.5	196.3	220.0	96.7	157.7
16 June	-3.9	-4.4	3.5	4.4	-7.3	-8.7	-328.5	-223.9	-90.9	-61.9
23 June	-0.8	-1.7	4.8	5.5	-5.6	-7.2	-84.3	-85.4	-7.2	55.6
30 June	0.2	-0.7	-11.4	-11.3	11.6	10.6	522.0	587.7	402.6	565.5
7 July	11.0	8.0	0.7	1.5	10.3	6.5	-190.4	-136.2	-212.0	-178.1
Mean (SE)	1.5 (0.6)	1.0 (0.6)	1.4 (0.4)	1.7 (0.4)	0.1 (0.7)	-0.6 (0.6)	-15.1 (22.3)	33.5 (23.9)	-8.2 (18.3)	30.5 (24.0)
P-values, flooded vs. non-flooded areas, overall	0.034		0.031		0.008		0.011		0.007	
P-values, change over the season for flooded vs. non-flooded areas (interaction between flood group and time)	0.003		<0.001		<0.001		0.542		<0.001	

* Differences are the day after flooding minus the day before flooding.

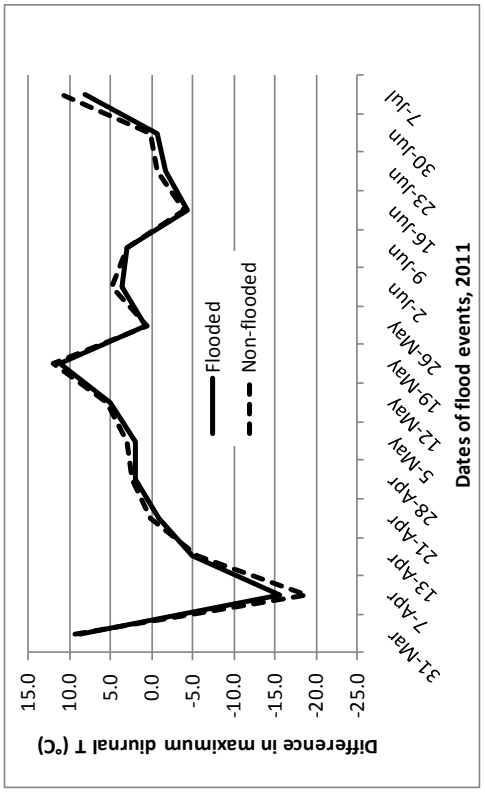


Figure 8.18a. Difference between the day before and day after (day after minus day before) each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

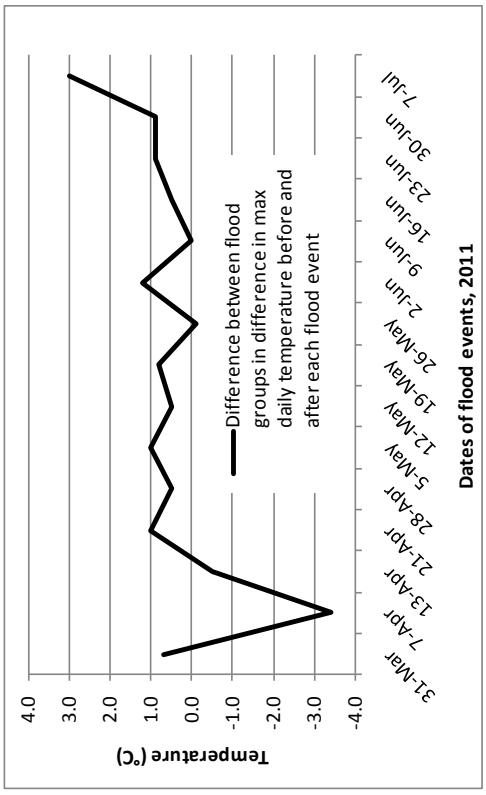


Figure 8.18b. Difference between flood groups (non-flooded minus flooded) in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011.

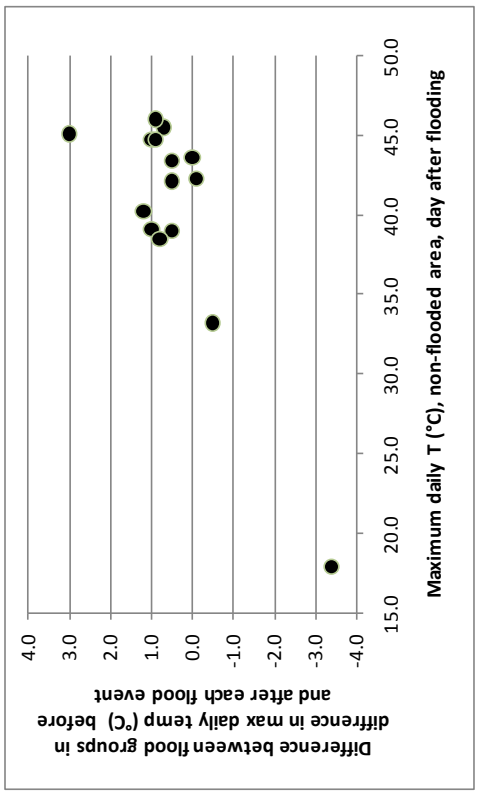


Figure 8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.19a. Difference between the day before and day after (day after minus day before) each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.19b. Difference between flood groups (non-flooded minus flooded) in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011.

Figure 8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.20a. Difference between the day before and day after (day after minus day before) each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.20b. Difference between flood groups (non-flooded minus flooded) in difference in daily temperature range before and after each flood event, Topock Marsh, 2011.

Figure 8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.21a. Difference between the day before and day after (day after minus day before) each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.21b. Difference between flood groups (non-flooded minus flooded) in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011.

Figure 8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Figure 8.22a. Difference between the day before and day after (day after minus day before) each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

Figure 8.22b. Difference between flood groups (non-flooded minus flooded) in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011.

Figure 8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Vegetation

We collected vegetation data at all 15 flooded and 17 non-flooded locations. Vegetation characteristics in 2010 and 2011 are summarized in Table 8.8, and vertical foliage profiles are shown in Figures 8.23–8.26. Vegetation characteristics are typical of those documented in dense, tamarisk stands at Topock Marsh in previous years (McLeod et al. 2008a), with dense canopy closure and a small percentage of native vegetation.

Vegetation characteristics differed between years in both flooded and non-flooded areas in percent canopy closure, percent woody ground cover, and the amount of live vegetation in all height categories (Table 8.8, *P*-values in "Year" column). Percent canopy closure and percent woody ground cover was higher in 2011 than in 2010, while the number of hits of live vegetation recorded in all height categories was lower in 2011. Woody ground cover was the only variable that showed an interaction between year and flood group, meaning that the change in woody ground cover was different in the flooded area versus the non-flooded area (right-most column of Table 8.8). Woody ground cover increased more dramatically in the non-flooded area than in the flooded area.

Table 8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011*

Parameter	2010		2011		*P*-value	
	Flooded	Non-flooded	Flooded	Non-flooded	Year	Year*flood group
Average canopy height (m)	6.3 (0.3)	5.9 (0.3)	6.2 (0.2)	5.9 (0.3)	0.725	0.904
	4.2–7.4	3.4–8.3	4.0–7.0	3.5–8.5		
% total canopy closure	89.5 (1.5)	88.7 (2)	94.3 (1)	90.7 (1.4)	0.007	0.260
	78.6–97.9	63–97.4	85.9–100	77.6–97.4		
% woody ground cover	23.7 (5.4)	13.2 (3.6)	45.8 (8.9)	77.1 (5.3)	<0.001	<0.001
	2.5–66.3	1–52.8	5.0–100.0	17.5–100		
Live vertical foliage (hits) below average nest height	2.6 (0.7)	3.0 (0.6)	1.4 (0.3)	2.1 (0.5)	0.018	0.718
	0.3–12.1	0.0–7.4	0.0–3.3	0.0–6.7		
Live vertical foliage (hits) at average nest height	2.6 (0.4)	2.7 (0.4)	1.6 (0.3)	2.0 (0.2)	<0.001	0.335
	0.1–5	0.8–6	0.2–3.8	0.3–3.9		
Live vertical foliage (hits) above average nest height	9.7 (0.7)	7.0 (1.1)	6.0 (0.6)	4.2 (0.7)	<0.001	0.433
	4.7–13.8	0.9–18.4	2.8–10.1	0.2–9.7		
Dead vertical foliage (hits) below average nest height	8.2 (0.7)	9.3 (0.5)	8.1 (0.7)	9.0 (0.6)	0.762	0.858
	2.4–13.1	5.1–13.4	4.8–13.4	5.1–14.2		
Dead vertical foliage (hits) at average nest height	1.9 (0.3)	2.0 (0.3)	2.2 (0.2)	1.9 (0.3)	0.460	0.241
	0.3–5.0	0.1–4.2	0.9–4.0	0.1–4.2		
Dead vertical foliage (hits) above average nest height	1.3 (0.4)	1.0 (0.2)	1.4 (0.3)	1.3 (0.2)	0.358	0.613
	0.0–3.9	0.0–2.9	0.0–3.2	0.0–4.1		
Percent native	0.0 (0.0)	5.3 (3.1)	0.0 (0.0)	7.5 (5)	0.680	0.680
	0.0–0.0	0.0–48.7	0.0–0.0	0.0–78.5		

* Data are presented as mean, standard error, and range. *P*-values for year indicate differences between years for both flooded and non-flooded locations combined. *P*-values for year*flooded indicate whether flooded areas changed between years differently than did non-flooded areas.

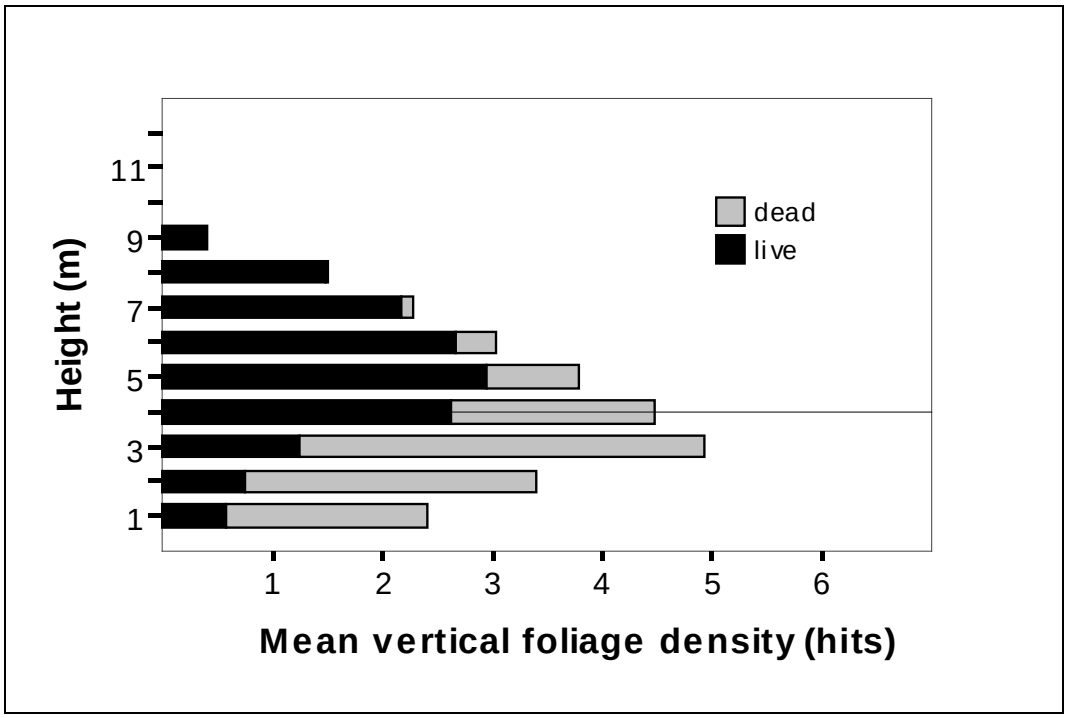


Figure 8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

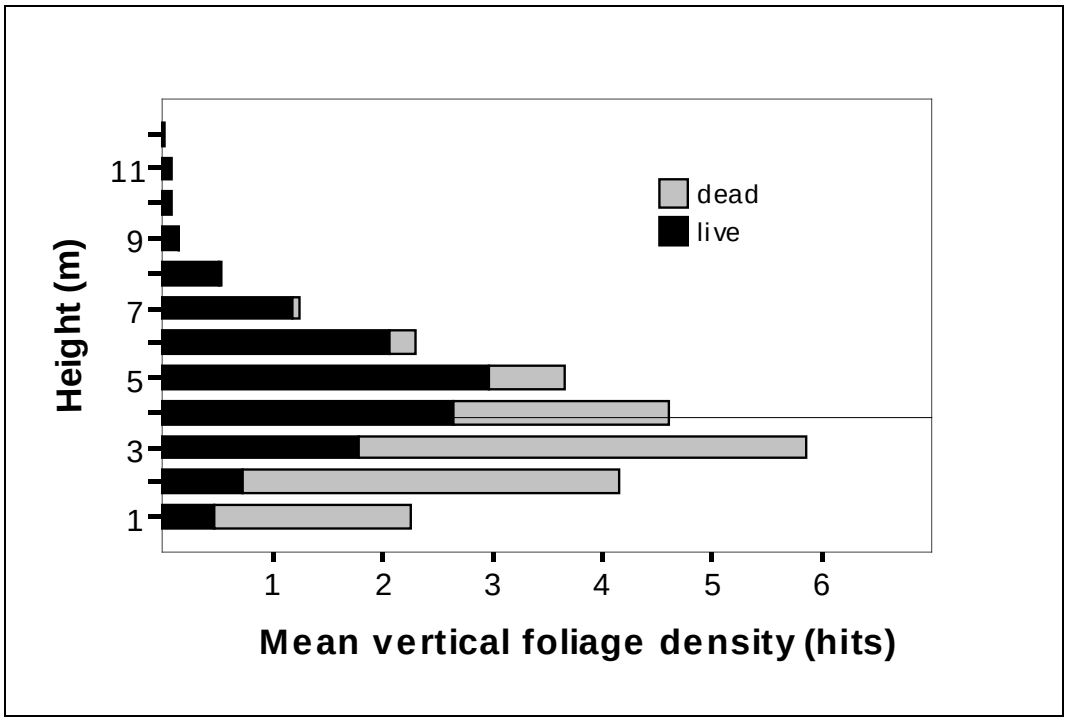


Figure 8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

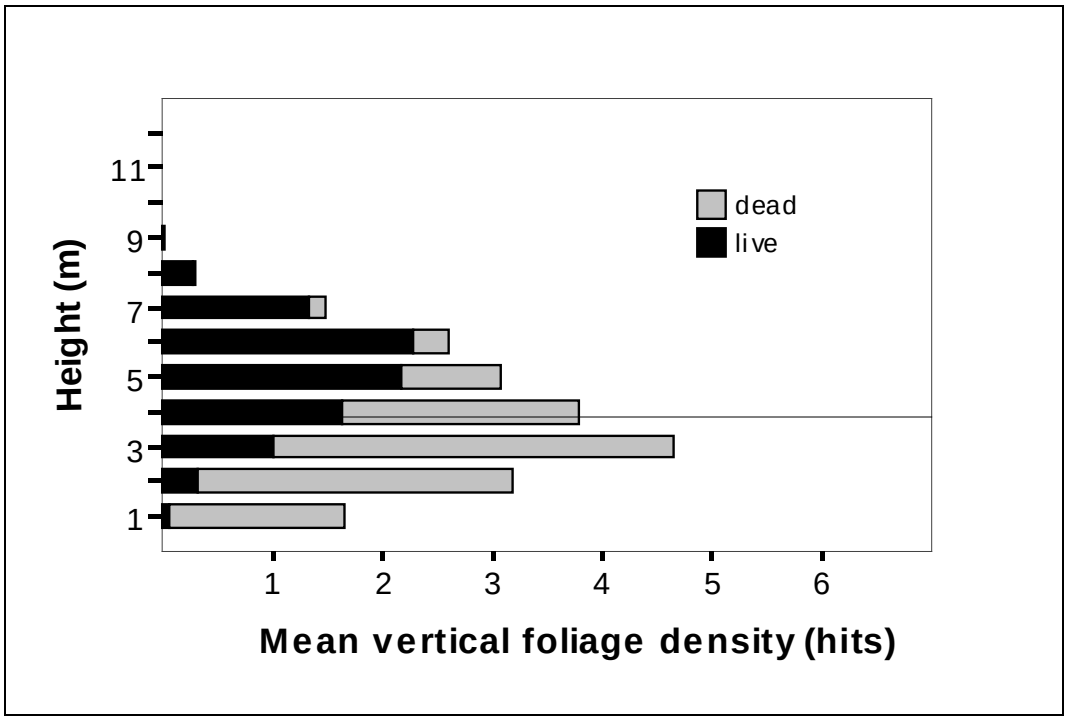


Figure 8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

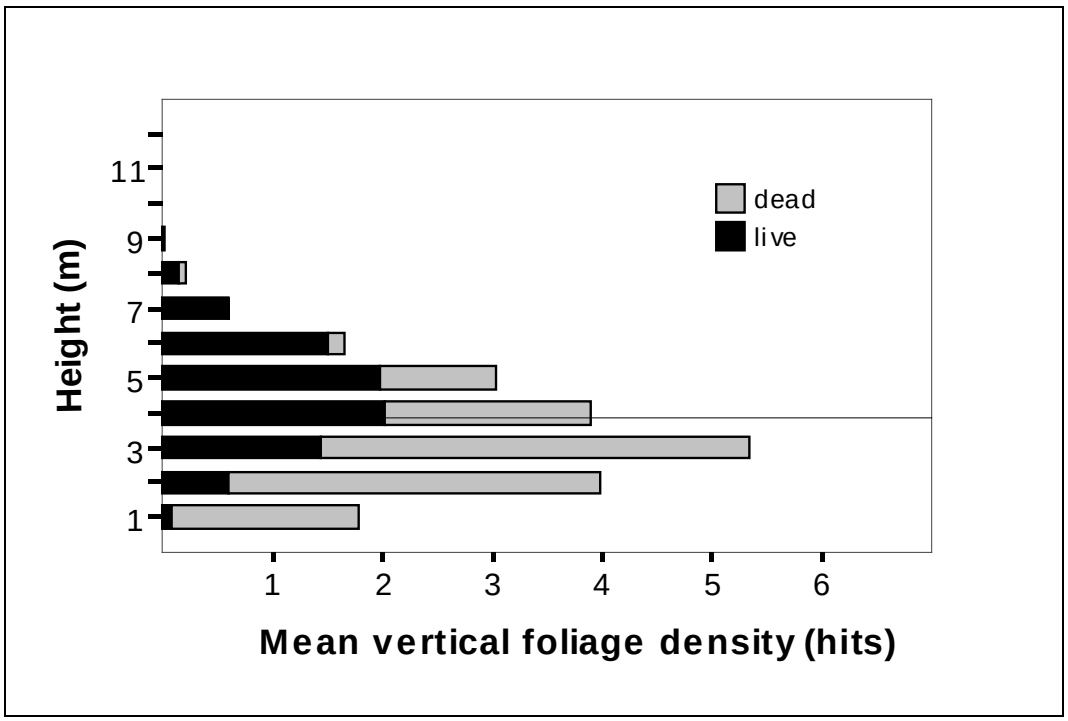


Figure 8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

DISCUSSION

Water delivery had the expected effect of increasing the extent and duration of surface water present within the target area in 2011 in comparison with the previous year, despite the overall lower level of Topock Marsh in 2011. Surface water from a given pumping event covered a larger extent and declined more slowly when the underlying water table was high, indicating that pumping was more effective in creating the surface water conditions favored by flycatchers when coupled with a high underlying water table.

In the area affected by flooding, water delivery had the expected effect of raising soil moisture, decreasing distance to water from the sample points, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also appeared to increase humidity within the flooded area; both diurnal and nocturnal vapor pressure were higher in the flooded area than in the non-flooded area in 2011 but not in 2010. In addition to the overall effect on humidity, flooding also had short-term effects on humidity as shown by the analysis of conditions on the day before versus the day after each flood event. On average, flood events produced higher diurnal and nocturnal vapor pressure in the flooded area in comparison to the non-flooded area.

The effect of water delivery on temperature was not as clear. The analysis comparing the flooded and non-flooded areas throughout the year did not show a statistically significant overall effect of flooding on any of the temperature variables, but there was an interaction between flood group and time in 2011, showing that all temperature variables changed through the year in the flooded area in a different way than they changed in the non-flooded area. In 2011, the difference between the flooded and non-flooded areas in all temperature variables declined as the season progressed. An analysis of temperature variables on the day before versus the day after each flood event showed that, on average, flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area. Thus, flood events did affect temperature, but these effects did not seem to persist across two-week periods. The interaction between flood group and time in 2011 suggests that the effect on temperature from a given flood event persisted for shorter periods of time as the season progressed.

Areas occupied by flycatchers typically have higher soil moisture, higher humidity, lower maximum temperatures, and smaller daily temperature ranges than unoccupied areas (McLeod et al. 2008a); thus, water delivery appeared to change the microclimate conditions within the flooded area in ways that would favor flycatcher occupancy.

The between-year changes in several of the vegetation variables appear somewhat contradictory, with canopy closure increasing between 2010 and 2011 but the amount of live vertical foliage decreasing between 2010 and 2011 in all height categories. It is difficult to distinguish between true changes in the vegetation and observer variation. The between-year differences were recorded in both flooded and non-flooded areas, indicating that flooding had no effect on changes in canopy closure or density of live vegetation. Woody ground cover increased between 2010 and 2011 in both flooded and non-flooded areas but increased much more dramatically in non-flooded areas. The overall increase in the percentage of woody ground cover could be strongly influenced by observer variation, but the significant interaction between year and flooded category suggests that the presence of surface water had an effect on the amount of woody cover, with flooding resulting in less woody cover. In general, water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy.

Water delivery resulted in the flooded area of In Between and 800M being the only portion of the sites surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season (see Chapter 2). Five flycatcher territories were recorded in Topock Marsh in 2011 (see Chapters

2 and 3); one of these territories was within the flooded portion of 800M and consisted of an unpaired male flycatcher. This flycatcher was detected at the territory in 800M through the end of June and then was detected for a few days in early July at another site approximately 1.5 km away. In 2010, the area that was affected by flooding in 2011 contained two resident, unpaired male flycatchers; in 2009, this same area contained one resident, unpaired male flycatcher. Water delivery thus did not result in increased flycatcher occupancy in the target area.

The number of flycatchers at Topock Marsh has been declining since 2004 (see Chapter 2), and few flycatcher young have been produced locally in recent years (see Chapter 4). Thus, there may be few adult flycatchers in the local population, and the lack of response by flycatchers to water delivery may be indicative of there being few adults available to establish territories. In addition, low water levels in 2011 throughout areas of Topock Marsh that have been historically occupied by flycatchers likely reduced the overall suitability of the area for flycatchers. Although supplemental water delivery appeared to produce conditions that would be favorable to flycatcher occupancy, the confounding factors of dry conditions elsewhere in Topock Marsh and a low population may have limited the ability of flycatchers to colonize the area.

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

This page intentionally left blank.

Chapter 9

MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS

For ease of reference this chapter summarizes all study design and management recommendations discussed in previous chapters.

BROADCAST SURVEYS

Pahranagat MAPS and Pahranagat South were affected prior to the start of the 2010 survey season by a fire that removed the understory and damaged the overstory trees. We did not survey these sites in 2011 but recommend revisiting them in another 2–3 years to determine whether the understory has recovered to the point where it might support breeding flycatchers. We do not recommend surveying these sites in 2012.

Littlefield Poles was affected in December 2010 by a flood that heavily scoured much of the surrounding area. Hydrology, stand density, and vegetation height were all negatively impacted by the flood. We recommend revisiting this site at the beginning of future breeding seasons to determine whether the vegetation and hydrology have recovered to the point where breeding flycatchers might be supported.

Bunker Marsh North was surveyed at the start of 2011, but surveys were discontinued in mid-June due to lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

Mormon Mesa North and Hedgerow at Mormon Mesa have been completely dry for the last several years, and neither of these sites has supported breeding flycatchers since 2005. We visited each site once at the beginning of the 2011 season to determine whether the hydrology of the sites was altered by heavy flooding on the Virgin River in December 2010. Both sites were dry during the initial visit and surveys were discontinued. We recommend discontinuing surveys at these sites until another flood event occurs that has the potential to alter the hydrology within the site. Virgin River #1 South consists of two disjunct areas. The southern section had dry soils throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion of the site if no surface water is present. Virgin River #2 received extensive sedimentation ranging in depth from 15 to 60 cm as a result of the December 2010 flood. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in the southern portion of the site.

We revisited Tractor in Topock Marsh at the beginning of the 2011 season. Vegetation structure at the site is not suitable for supporting breeding flycatchers, and we do not recommend future visits to this site.

At Bill Williams River NWR, we revisited New River for the first time since it was initially evaluated in 2008. In 2008, the vegetation appeared too young and sparse to support willow flycatchers. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years. Wispy Willow, a small area of new coyote willow growth downstream of Site #1, currently lacks the size to resemble occupied flycatcher habitat along the LCR, but the site should be reassessed in future years.

Ground reconnaissance of Laguna revealed that, overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat. Surface water was present only in one small area. Soils in most of the site were complete dry. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

COWBIRD CONTROL

The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 29%, well below the average of 44% across all study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

In 2010 and 2011, we addled cowbird eggs in easily accessible flycatcher nests, and this appeared to reduce the hatch rate of the cowbird eggs and did not cause desertion of any nests by the flycatchers. Although sample sizes were small, results also suggested that the number of flycatcher nestlings fledged per nest might be higher as a result of cowbird egg addling and cowbird nestling removal. We recommend this program be continued in the future.

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

In previous years we correlated piezometer groundwater levels and soil moisture measurements and found no strong linear relationship (McLeod and Koronkiewicz 2009). Sites with high soil moisture values tended to show a weak, negative relationship between depth to groundwater and soil moisture, while sites with low soil moisture showed no relationship between depth to groundwater and soil moisture. This suggests that at sites where soil moisture is low, surface soil moisture content is not strongly influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

LITERATURE CITED

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. The University of Arizona Press, Tucson. 302 pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241–257.

Busch, J.D., M.P. Miller, E.H. Paxton, M.K. Sogge, and P. Keim. 2000. Genetic variation in the endangered Southwestern Willow Flycatcher. Auk 117:586–595.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher breeding site and territory summary – 2005. USGS Southwest Biological Science Center report to the U.S. Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern willow flycatcher final survey and monitoring report. Arizona Game and Fish Department, Research Technical Guidance Bulletin #10, Phoenix.

Finch, D.M., and J.F. Kelly. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197–203 *in* Finch, D.M., J.C. Whitney, J.F. Kelly and S.R. Loftin (eds.). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings, RMRS-P-7.

Flett, M.A., and S.D. Sanders. 1987. Ecology of a Sierra Nevada population of Willow Flycatchers. Western Birds 18:37–42.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

Graber, A.E., and T.J. Koronkiewicz. 2009a. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2008. Final 2008 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 66 pp.

Graber, A.E., and T.J. Koronkiewicz. 2009b. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2009. Final 2009 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 25 pp.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern willow flycatcher 2006 survey and nest monitoring report. Nongame and Endangered Wildlife Program. Technical report 249. Arizona Game and Fish Department, Phoenix.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and willow flycatchers: a summary of their science and policy connections. Geomorphology 47:169–188.

Hanski, I.A., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pages 5–26 *in* Hanski, I.A. and Gilpin, M.E. (eds.). Metapopulation biology: Ecology, genetics, and evolution. Academic Press, San Diego, California.

Harris, J.H. 1991. Effects of Brown-headed Cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13–26.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds 18:27–36.

Hill, G.E. 1988. Age, plumage brightness, territory quality, and reproductive success in the Black-headed Grosbeak. Condor 90:379–388.

Holmes, R.T., P.P. Marra, and T.W. Sherry. 1996. Habitat-specific demography of breeding Black-throated Blue Warblers (*Dendroica caerulescens*): Implications for population dynamics. Journal of Animal Ecology 65:183–195.

Howell, N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Howlett, J.S., and B.J. Stutchbury. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover. Auk 113:1–9.

James, F.C., and H.H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

Johnson, K., P. Mahlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered Southwestern Willow Flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44:226–231.

Johnson, M.J., and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Kenwood, K.E., and E.H. Paxton. 2001. Survivorship and movements of Southwestern Willow Flycatchers in Arizona – 2001. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 44 pp.

Koronkiewicz, T.J., S.N. Cardinal, M.K. Sogge, and E.H. Paxton. 2002. Survivorship and movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2002. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. USGS Southwest Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. 43 pp.

Koronkiewicz, T.J., M.A. McLeod, B.T. Brown, and S.W. Carothers. 2006a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 176 pp.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper III, and E.H. Paxton. 2006b. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. Condor 108:558–570.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, California.

Lowther, P.E. 1993. Brown-headed Cowbird (*Molothrus ater*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 47. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* Sogge, M.K., B.E. Kus, S.J. Sferra and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M., and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, ecology, and conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bulletin 73(3):255–261.

Mayfield, H. 1975. Suggestions for calculating nest success. Wilson Bulletin 87(4):456–466.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 1 – 1996. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada,, [and] the U.S. Fish and Wildlife Service, Carlsbad, California by the San Bernardino County Museum, Redlands, California. 42 pp.

McKernan, R.L., and G. Braden. 1998. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 2 – 1997. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, [and] the U.S. Fish and Wildlife Service, Carlsbad, California, by the San Bernardino County Museum, Redlands, California. 64 pp.

McKernan, R.L., and G. Braden. 1999. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 3 – 1998. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 pp.

McKernan, R.L., and G. Braden. 2001a. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the Lower Colorado River: Year 4 – 1999. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 83 pp.

McKernan, R.L., and G. Braden. 2001b. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 5 – 2000. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 86 pp.

McKernan, R.L., and G. Braden. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 6 – 2001. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, by San Bernardino County Museum, Redlands, California. 58 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 153 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 165 pp.

McLeod, M.A., and A.R. Pellegrini. 2011. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2010. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 166 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 194 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 206 pp.

McLeod, M.A., T.J. Koronkiewicz, S.R. Nichols, B.T. Brown, and S.W. Carothers. 2008b. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2007. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 182 pp.

Moore, D., and D. Ahlers. 2008. 2007 Southwestern Willow Flycatcher study results: selected sites along the Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. Report prepared by Bureau of Reclamation, Technical Service Center, Denver, Colorado. 64 pp.

Munzer, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. Arizona Game and Fish Department, Phoenix, Arizona.

National Weather Service. 2011. Online: http://aa.usno.navy.mil/data/docs/RS_OneYear.html.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 Summary Report. USGS Colorado Plateau Research Station / Northern Arizona University report. 63 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in Central Arizona – a 10-year synthesis report. USGS Open-File Report 2007-1381.

Paxton, E.H., M.K. Sogge, T.J. Koronkiewicz, M.A. McLeod, and T.C. Theimer. 2010. Geographic variation in the plumage coloration of willow flycatchers *Empidonax traillii*. Journal of Avian Biology 41:128–138.

Periman, R.D., and J.F. Kelly. 2000. The dynamic environmental history of Southwest Willow Flycatcher habitat: A survey of changing riparian conditions through time. Pages 25–42 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson. 212 pp.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. General Technical Report PSW-GTR-144. U.S. Forest Service Pacific Southwest Research Station, Albany, California. 41 pp.

Ridgely, R.S., and G. Tudor. 1994. The birds of South America; Volume II: the Suboscine passerines. University of Texas Press, Austin.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in Illinois. Pages 408–418. *In* J.M. Hagan III and D.W. Johnston (eds.). Ecology and Conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Rosenberg, K.V., R. C. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson.

Rotenberry, J.T. 1985. The role of habitat in avian community composition: Physiognomy or floristics? Oecologia 67:213–217.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix.

SAS Institute Inc. 2009. SAS OnlineDoc®, Version 9.2. Cary, North Carolina.

Sedgwick, J.A. 2000. Willow flycatcher (*Empidonax traillii*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 533. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Sedgwick, J.A., and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to willow flycatchers. Pages 167–181 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.).Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Sedgwick, J.A., and F.L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. The Condor 94:720–733.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbits. 1997. A Southwestern Willow Flycatcher natural history summary and survey protocol. National Park Service Technical Report USGS/NAUCPRS/NRTR-97/12.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. Western Birds 32:167–172.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher. U.S. Geological Survey Techniques and Methods 2A-10. 38 pp.

Stiles, F.G., and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, New York.

Sumner, M.E. 2000. Handbook of soil science. CRC Press, Boca Raton, Florida.

U.S. Bureau of Reclamation (Reclamation). 1999. Long-term restoration program for the historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat along the lower Colorado River. Report submitted by USBR Lower Colorado Region to Lower Colorado Multi-Species Conservation Program. Boulder City, Nevada. 70 pp.

U.S. Bureau of Reclamation (Reclamation). 2000. Biological Assessment for proposed Interim Surplus Criteria, Secretarial Implementation Agreements for California Water Plan components and conservation measures on the Lower Colorado River (Lake Mead to the Southerly International Boundary). Prepared by U.S. Bureau of Reclamation, Lower Colorado Region. 80 pp.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. Federal Register 60:10694–10715.

U.S. Fish and Wildlife Service (USFWS). 2000. Southwestern willow flycatcher protocol revision 2000. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2001. Biological opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures on the Lower Colorado River, Lake Mead to the Southerly International Boundary, Arizona, California, and Nevada. Final Biological Opinion, U.S. Fish and Wildlife Service, Phoenix, Arizona. 90 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax trailli extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup, August 2002.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. San Diego Natural History Museum report to U.S. Bureau of Reclamation, Phoenix, Arizona.

White, G.S., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 (supplement):S120–139.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to Brown-headed Cowbird parasitism. M.S. Thesis, California State University, Chico. 25 pp.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Pages 182–190 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.). Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Whitfield, M.J., M.K. Sogge, S.J. Sferra, and B.E. Kus. 2003. Ecology and behavior —Introduction. Pages 53–55 *in* Sogge, M.K., B.E. Kus, S.J. Sferra, and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Wiens, J.A. 1989a. The ecology of bird communities. Volume 1: Foundations and patterns. Cambridge University Press, New York.

Wiens, J.A. 1989b. The ecology of bird communities. Volume 2: Processes and variations. Cambridge University Press, New York.

Woodward, H.D., and S.H. Stoleson. 2002. Brown-headed Cowbird attacks on Southwestern Willow Flycatcher nestlings. The Southwestern Naturalist 47(4):626–628.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

Younker, G.L., and C.W. Andersen. 1986. Mapping methods and vegetation changes along the lower Colorado River between Davis Dam and the border with Mexico. Report submitted to Bureau of Reclamation, Lower Colorado Region, in fulfillment of Contract No. 6-CS-30-03800. 22 pp.

Acknowledgements

This project was made possible by the support of many persons, agencies, private landowners, and our dedicated staff and field crew. Work was conducted under the auspices of Federal Fish and Wildlife Threatened and Endangered Species Permit TE028605-4 and Master Banding Permit #23258. Funding was provided by the U.S. Bureau of Reclamation, Boulder City, Nevada (Contract No. GS-10F-0209L) and the Nevada Department of Wildlife, Reno, Nevada. Chris Dodge from Reclamation provided background information and guidance.

Many thanks to the following national wildlife refuges and personnel for all their assistance: Kevin DesRoberts, Chivia Horton, Laurie Simons, and Jim Doctor at Pahranagat NWR; Linda Miller, Jack Allen, Dr. Kathleen Blair, Dick Gilbert, and Stan Culling at the Lake Havasu NWR Complex; and Mike Oldham, Elaine Johnson, Brenda Zaun, Bill Seese, Joe Barnett, and Steven Rimer at the SW Arizona NWR Complex. Thanks to Keith Day and Rob Dobbs with the Utah Division of Wildlife Resources for their support in St. George. Also, we would like to thank Cris Tomlinson, Christy Klinger, and Tim Wood with Nevada Department of Wildlife for their support at Key Pittman Wildlife Management Area, River Ranch, Warm Springs Natural Area, and Overton Wildlife Management Area. Thanks to Dave Syzdek with Southern Nevada Water Authority for logistical support and site tours at Warm Springs Natural Area.

Thanks to the following agencies and personnel for assistance with obtaining permits: Greg Beatty, Erin McCarthy, Daniel Marquez, Melissa Castiano, Vanessa Martinez, Leilani Takano, and Corey Kallstrom with the U.S. Fish and Wildlife Service; Florence L. Soehnlein and Danny Bystrak with the Federal Bird Banding Laboratory; Melissa Swain with the Arizona Game and Fish Department; Gloria Shaw with Lake Mead National Recreation Area; Randi Logsdon, and Esther Burkett with the California Department of Fish and Game; Cris Tomlinson and Julie Meadows with the Nevada Department of Wildlife; Suzanne McMullin with the Utah Division of Wildlife Resources; Tom Denniston with the Bureau of Land Management, St. George; and Bill Dowdle with the Arizona State Lands Department. Robert Bunker, Bill Evans, and Gary Hafen granted access to their properties.

Thanks to Johnny, Mike, and Kathy at Monte Vista Marine for assisting with boating logistics. Mike Rose assisted with ATV logistics.

This project would not be a success without our dedicated staff and field personnel. Many, many thanks to Jessica Maggio and Kimberly Proa who went beyond their administrative duties and coordinated housing, permitting, payroll, vehicles, computers, safety, and telecommunications and handled all manner of crises with cheerful aplomb. A very special thanks to Glenn Dunno for his GIS talents. Thanks also to Shara Monik, Lisa Jackson, and Rose Burgess for administrative and accounting support. And sincere thanks to the 2011 field personnel for hard work, dedication, and sweat.

Appendix A

FIELD DATA FORMS

Willow Flycatcher (WIFL) Survey and Detection Form (revised April 2010)

Site Name_____ State_____ County _____
USGS Quad Name _____ Elevation _____ (meters)
Creek, River, Wetland, or Lake Name_____
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? Yes___ No____

Survey Coordinates: Start: E_____ N_____ UTM Datum_____(See instructions)
Stop: E_____ N_____ UTM Zone _____
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

***** Fill in additional site information on back of this page *****

Survey # / Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N / If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Overall Site Summary Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total Survey Hrs _____		Total Adult Residents	Total Pairs	Total Territories	Total Nests	Were any Willow Flycatchers color-banded? Yes___ No ___ If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual _____ Date Report Completed_____ _____
US Fish and Wildlife Service Permit #_____State Wildlife Agency Permit #_____

Submit form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual _____ Phone # _____
Affiliation _____ E-mail _____
Site Name _____ Date Report Completed _____
Was this site surveyed in a previous year? Yes___ No ___ Unknown ____
Did you verify that this site name is consistent with that used in previous years? Yes ____ No _____ Not Applicable ___
If site name is different, what name(s) was used in the past?_____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes ____ No ____ If no, summarize below.

Management Authority for Survey Area: Federal____ Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) _____

Length of area surveyed: _____ (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

_____ Native broadleaf plants (entirely or almost entirely, > 90% native)

_____ Mixed native and exotic plants (mostly native, 50 - 90% native)

_____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

_____ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific names.
_____

Average height of canopy (Do not include a range): _____ (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections; 2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests; 3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.
_____
_____
_____
_____
_____
_____

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (10–25 July)]

General Info

Study Area: _____ **Survey Site:** _____ **Date:** _____

Observer(s): _____ **early**_____ **mid**_____ **late** _____ **other**_____

Vegetation

Vegetation at site: >90% native 50–90% native 50–90% exotic >90% exotic

Canopy closure: <25% 25–50% 50–70% 70–90% >90%

Overstory height (m): _____ **Dominant overstory species:** TASP SAGO SAEX POFR Other _____

Understory height (m): _____ **Dominant understory species**: TASP SAGO SAEX PLSE Other _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

Hydrology

% of site inundated: _____

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc):

_____

Average depth of surface water:
toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils (do not include inundated areas in percentage!): _____

% of site with damp soils (do not include inundated or saturated areas): _____

If not inundated or saturated, distance (m) to standing water or saturated soil:_____

How was distance determined? Visually estimated in field Measured in field using GPS
Measured from aerial photograph Other _____

Describe type of nearest surface water: _____

Narrative and Pictorial Description

Does this description cover the entire site? Y N **If not, which portion is described?**_____

_____

On the reverse, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats:

_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____

STUDY AREA: _____ **SITE**: _____ **BANDER**: _____ **DATE**: _____ **TIME**: _____ **TERR/NEST #**: _____

UTM NAD___ Zone___ _____ **E** _____ **N** **NBN:** ____ of ____

NOTES:_____

FEDERAL BAND #	COLOR COMBO		STATUS	SEX	AGE	FECAL SAMPLE? (Y or N)	GENETIC SAMPLE? (Y or N)	# PHOTOS TAKEN
	L	R						

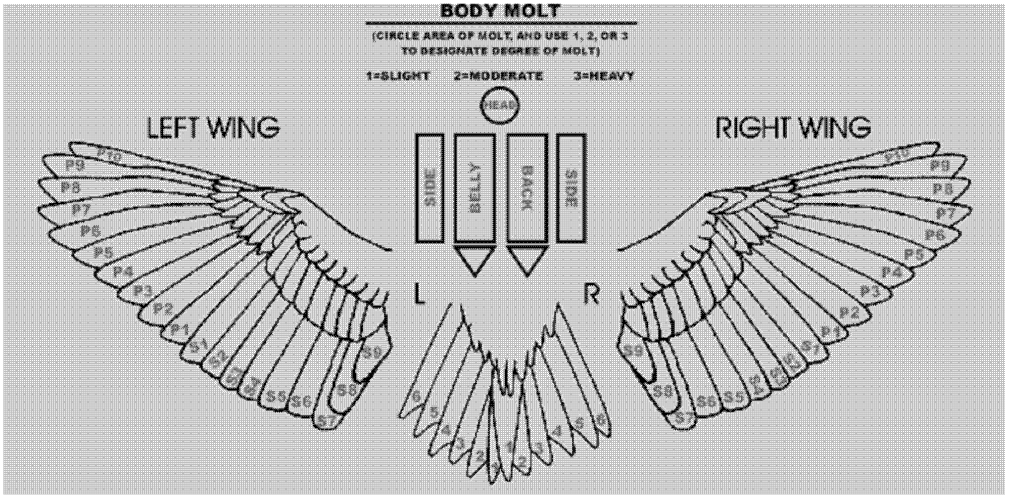
STATUS: NCP = new cap passive, NCT = new cap target, RCP = recap passive, RCT = recap target, NBN = nestling banded
SEX: U = unknown, F = female, M = male
AGE: AHY = after hatch year; SY = second year; L = nestling banded in nest; HY = hatch year/young of the year

Adults								
CP	BP	WING CHORD (mm)	TAIL ~~(mm)~~	CULMEN LENGTH (mm)	CULMEN WIDTH (mm)	FAT	RETAINED FEATHERS? Y or N, if Y use diagram, detail in notes	ACTIVE MOLT?

Nestlings	
Developmental Age (days)	MASS (g)

CP: 0 = non-breeding, S = partial breeding, M = full breeding
BP: 0 = none, 1 = smooth, 2 = vascularized and filled with fluid, 3 = wrinkled, 4 = molting
FAT: 0 = no fat; 1 = trace of fat in furculum, deeply concave, scattered patches, less than 5 percent filled; 2 = thin layer of fat in furculum, less than a third filled, trace of thin layer of fat in abdomen; 3 = furculum is ½ filled or more; small patches, not covering some areas, on abdomen; 4 = furculum more than 2/3 filled, level with clavicles, slightly mounded on abdomen

If a genetic sample or metric was not taken, explain why in notes



Date: _____ Page ___ of ___

OBS	STUDY AREA	TERR	NEST	COLOR COMBO LEFT LEG	COLOR COMBO RIGHT LEG	CONF LEVL	CAP?	# WIFLS	SEX	NBN (__of__)	OBSERVATIONS AND COMMENTS: discuss observations & activities. **If you assign gender, explain!**
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =
											Service Band Number =

Willow Flycatcher Territory/Nest Record Form

Year _____ Study Area_____ Survey Site_____ Territory/Nest no._____

Territory/Nest Location:
NAD:_____ Zone:_____

Territory UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest Height:_____ m (approx)

Nest Substrate:_____(e.g., TASP=tamarisk, SAGO–Goodding willow, SAEX – coyote willow, etc.)

Distance to standing water or saturated soil:
When nest found: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____
Depth of surface water at nest (circle how wet you got when nest was found):
dry damp muddy toes (<5cm) ankles (5-15 cm) calves (15-40 cm)
knees (40-60 cm) thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)
At hatch: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____
At fledge/fail: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	B D (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No.	Presumed	Confirmed	
			Eggs
			Nestlings
			Fledglings

Cowbird

Trans dates	B D (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledgling s

Outcome (Record code & describe)**:**_____**:**_____

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **PA**= parasitized, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **AD**= failure, entire clutch addled/infertile; **OT**= failure due to other, or unknown, causes.

Mayfield Success

(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S**= successful; **D**= depredated; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other than predation; **A**= abandoned with host egg(s) or young; **Z**= abandoned, no (zero) eggs laid.

Willow Flycatcher Territory/Nest Record Form (continued)

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Date	Time In	Time Out	Obs	Mon Type	Stage	Adult pres.	# WE	# CE	# WN	# CN	#WF	Age Yng	Comments

LCR SWFL – Vegetation Datasheet Observers: _____

Study area	Survey site	Plot type	ID#	UTM: E N	Acc. m	Date

Canopy height	Direct measurement m	Using clinometer Top % - Bottom % × Dist m	Ground cover Obs.	N	E	S	W	Canopy closure Obs:	N	S

Species		TASP single	TASP multi	TASP skipped	SAEX single	SAEX multi	SAEX skipped	SAGO single	SAGO multi	SAGO skipped	SNAG single	SNAG multi	SNAG skipped
Stem Count By cm dbh category	<1												
	1–2.5												
	2.6–5.5												
	5.6–8												
	8.1–10.5												
	10.5–15												
	Measured Trees >15 cm dbh												

Species		OTSP1 single	OTSP1 multi	OTSP1 skipped	OTSP2 single	OTSP2 multi	OTSP2 skipped	OTSP3 single	OTSP3 multi	OTSP3 skipped
Stem Count By cm dbh category	<1									
	1–2.5									
	2.6–5.5									
	5.6–8									
	8.1–10.5									
	10.5–15									
	Measured Trees >15 cm dbh									

Other species (write out full name)

OTSP1_____

OTSP2 _____

OTSP3_____

If stem splits below ankle height, measure and tally each stem in "single" column. If, at ankle height or above, stem splits into multiple branches, measure and tally the biggest stem in "multi" column and record how many stems you did not measure in the "skipped" column (in the size category of the stem you measured).

If stem is not at least breast height, do not count

Vertical Foliage Sampling

CENTER PLOT Observer: _____							
Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1*:	OTSP2*:	OTSP3*:
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10-cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
Use same OTSP (1,2,3) as listed on main record.

Notes:

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 1m Observer: _____								EAST 1m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 1m Observer: _____								WEST 1m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1 _____	OTSP2 _____	OTSP3 _____		TASP	SAGO	SAEX	SNAG	OTSP1 _____	OTSP2 _____	OTSP3 _____
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 5m Observer: _____								EAST 5m Observer: _____							
Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

SIDE 1

Vertical Foliage Sampling

SOUTH 5m Observer: _____ WEST 5m Observer: _____

Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

SWFL Microclimate at Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year) – (Territory #)

UTM coordinates: **E** 0__ __ __ __ __ __ **N** __ __ __ __ __ __ __ **GPS Accuracy**: _____ m

Date territory first occupied: _____ **Date territory vacated** _____

New Location ID (if this logger was already in the field) _____–_____–_____

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____

Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Habitat Monitoring Sites

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Survey site) – (Number)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **Accuracy**: _____ m

T/RH Downloads

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

Location ID codes: Study area codes – Topock Marsh = TM, Topock Gorge = TG, Ehrenberg = EH, Cibola = CI, Imperial = IM, Mittry = MI, Yuma = YU. Survey site codes – In Between = IB, Blankenship = BK, Havasu NE = HV, Ehrenberg = EH, Three Fingers Lake = TF, Cibola Lake = CL, Walker Lake = WL, Paradise = PV, Hoge Ranch = HR, Rattlesnake = RS, Clear Lake = LK, Ferguson Lake = FL, Ferguson Wash = FW, Great Blue Heron = GB, Mittry West = MW, Gila Confluence North = GC

Microclimate at Hydro Monitoring Sites – Topock

Study Area _TOPO___ Survey Site _____ LOCATION ID: TM –HM–_____
(Location ID)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

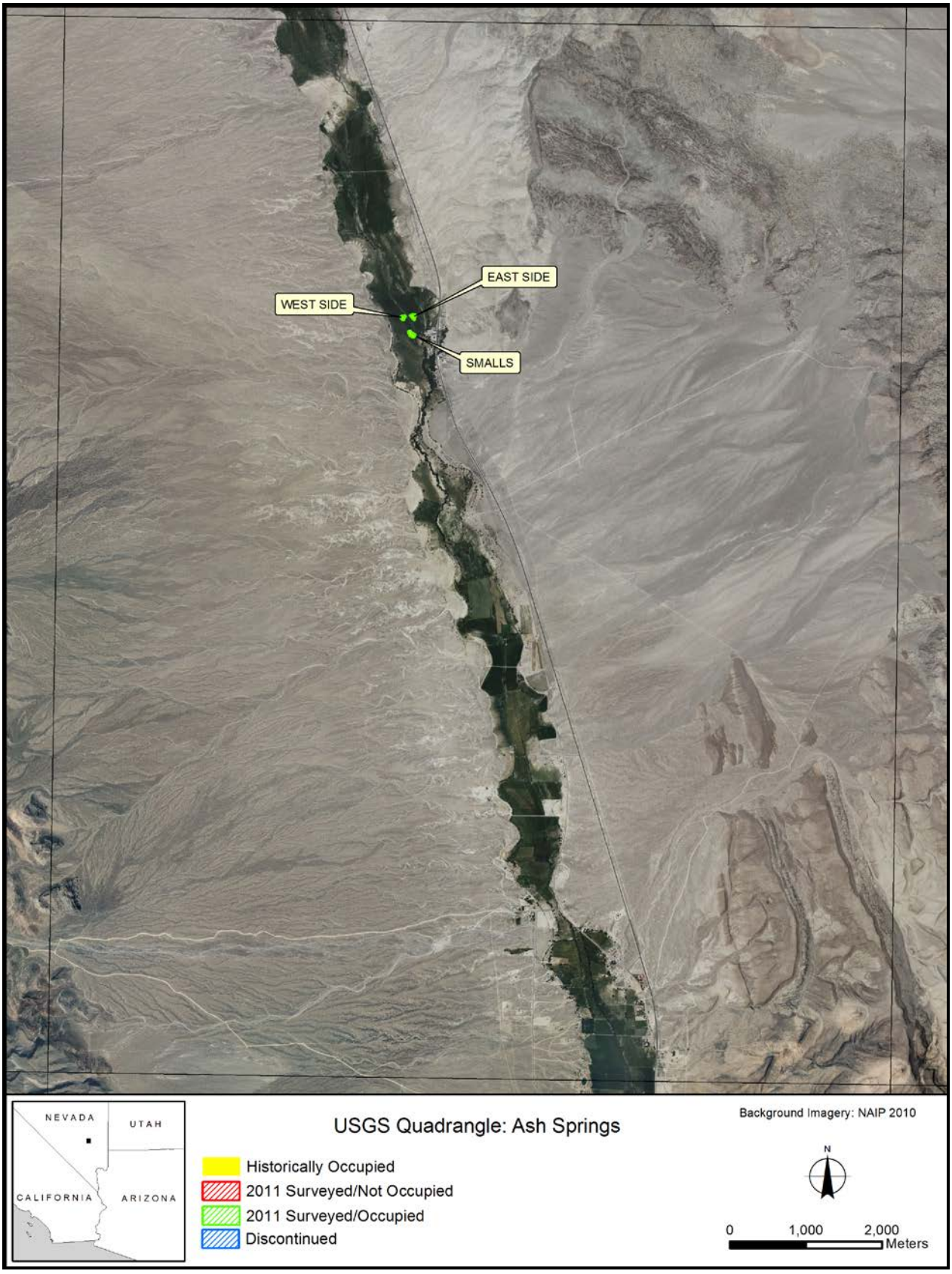
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____

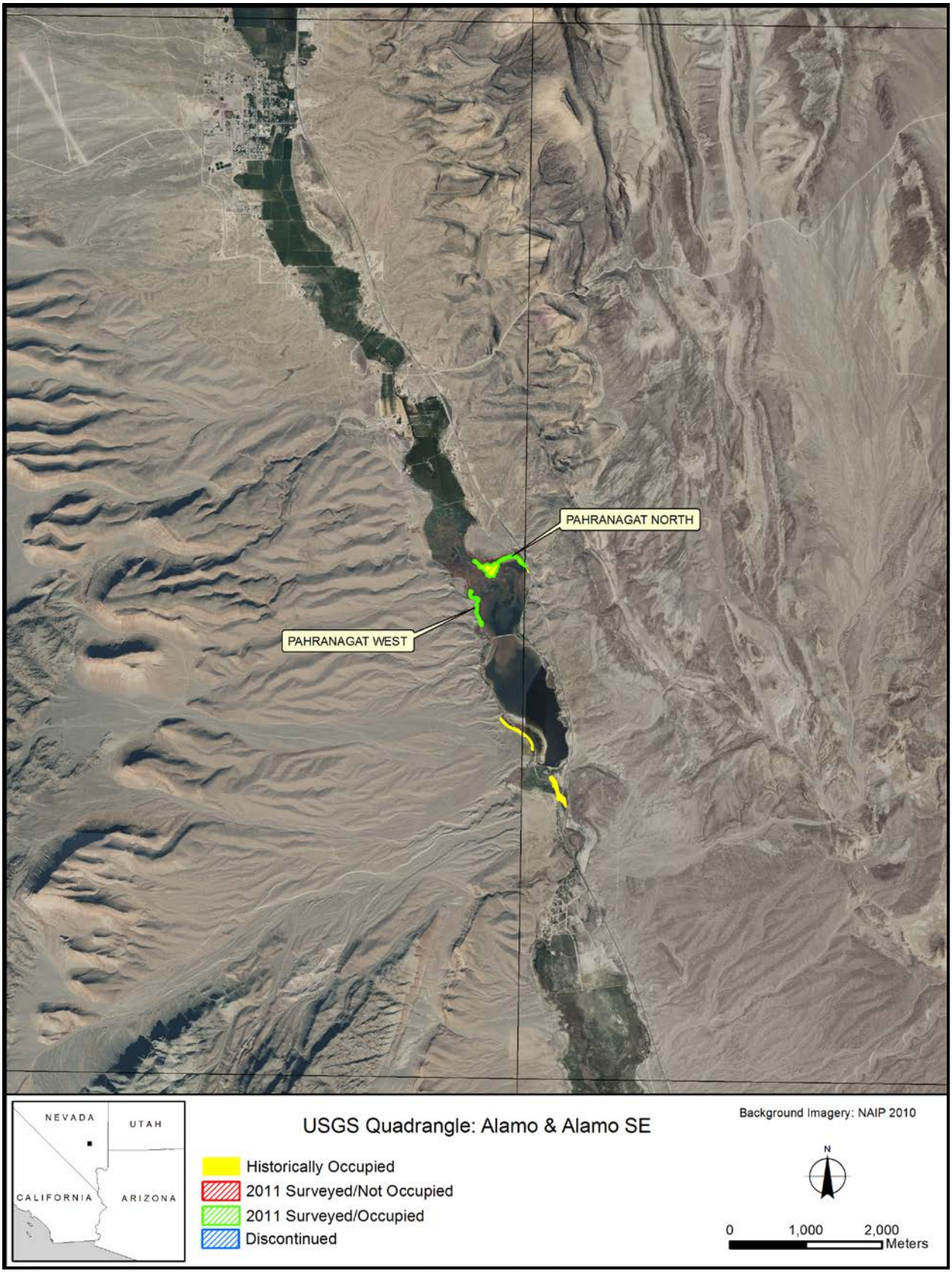
Appendix B

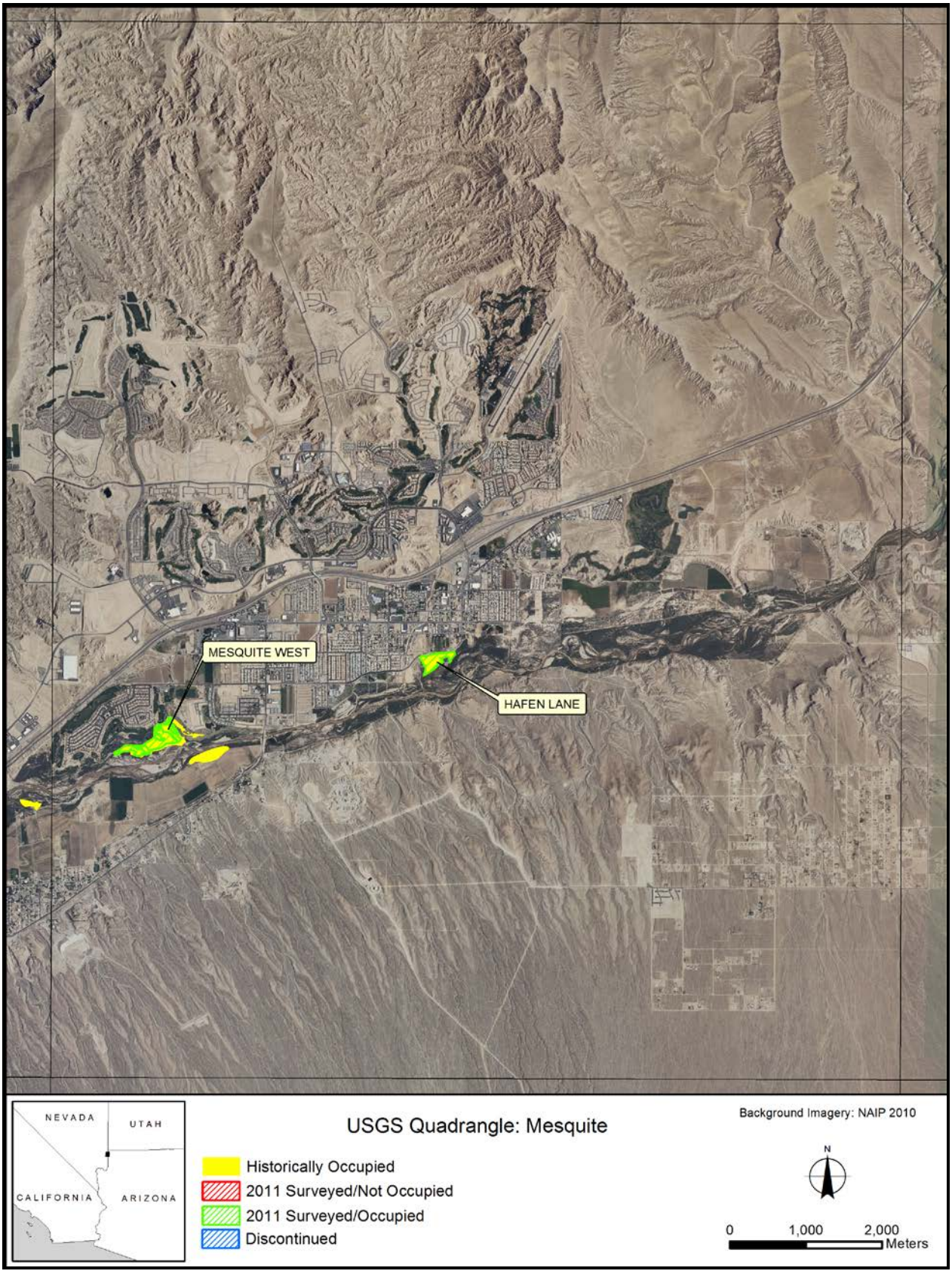
ORTHOPHOTOS SHOWING STUDY SITES

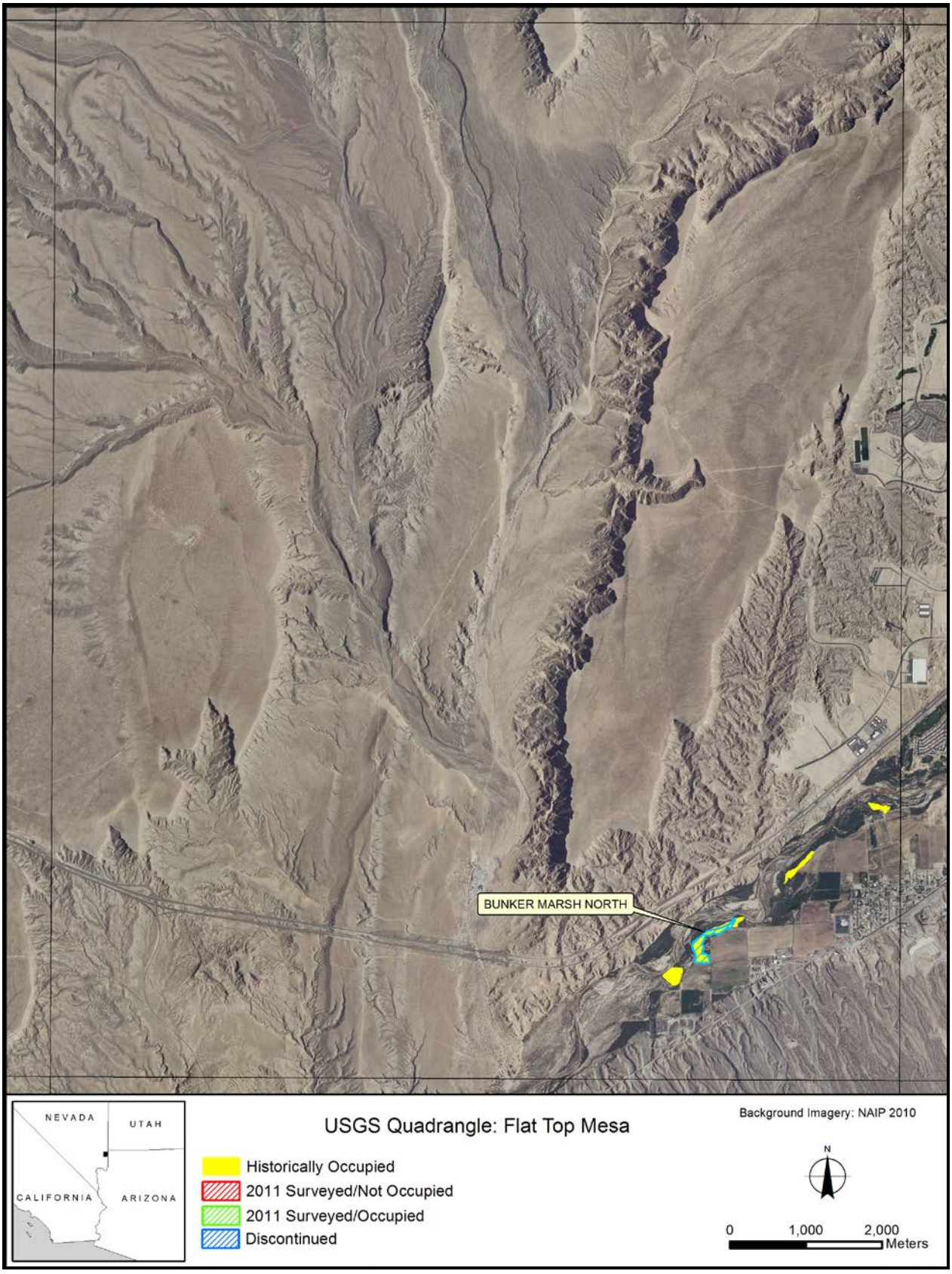

NEVADA
UTAH
CALIFORNIA
ARIZONA
MEXICO
KEY PITTMAN
RIVER RANCH
PAHRANAGAT NWR
WARM SPRINGS
MESQUITE
MORMON MESA
MUDDY RIVER
TOPOCK MARSH
BILL WILLIAMS RIVER NWR
PVER
CIBOLA
IMPERIAL
MITTRY LAKE
YUMA
St. George
Las Vegas
Kingman
Flagstaff
Quartzsite
Phoenix
Palm Springs
Yuma
Lake Mead
Lake Mohave
Lake Havasu
Salton Sea
Pahranagat Wash
Virgin River
Colorado River
Bill Williams River
Verde River
Gila River
Lower Colorado River Southwestern
Willow Flycatcher Study 2011
NDOW Study Area
Reclamation Study Area
City/Town
Highway
River
0 25 50 Mi
0 50 100 Km
1:3,300,000
N

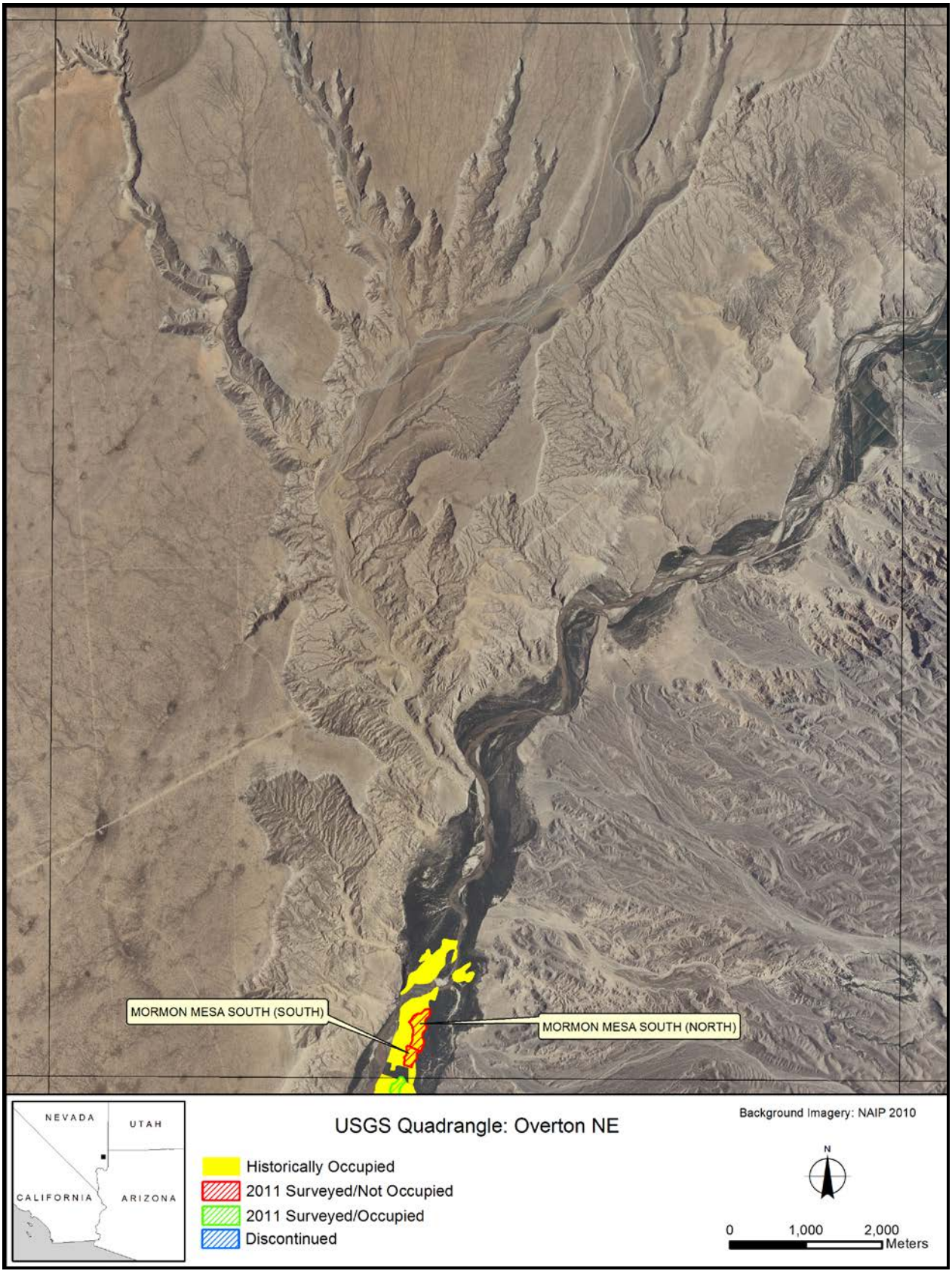

KEY PITTMAN PATCH 1 - 12
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Hiko
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

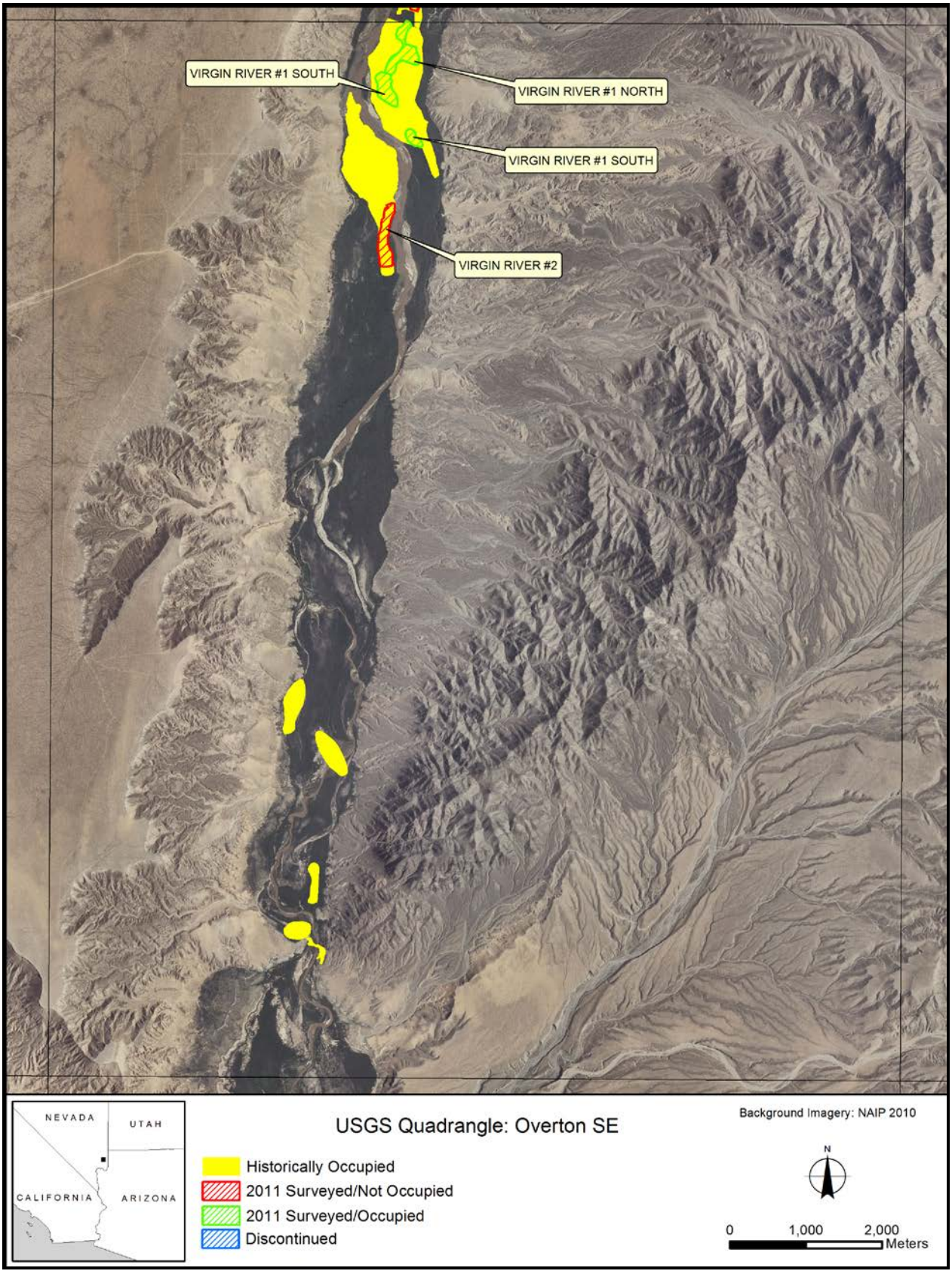

EAST SIDE
WEST SIDE
SMALLS
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Ash Springs
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

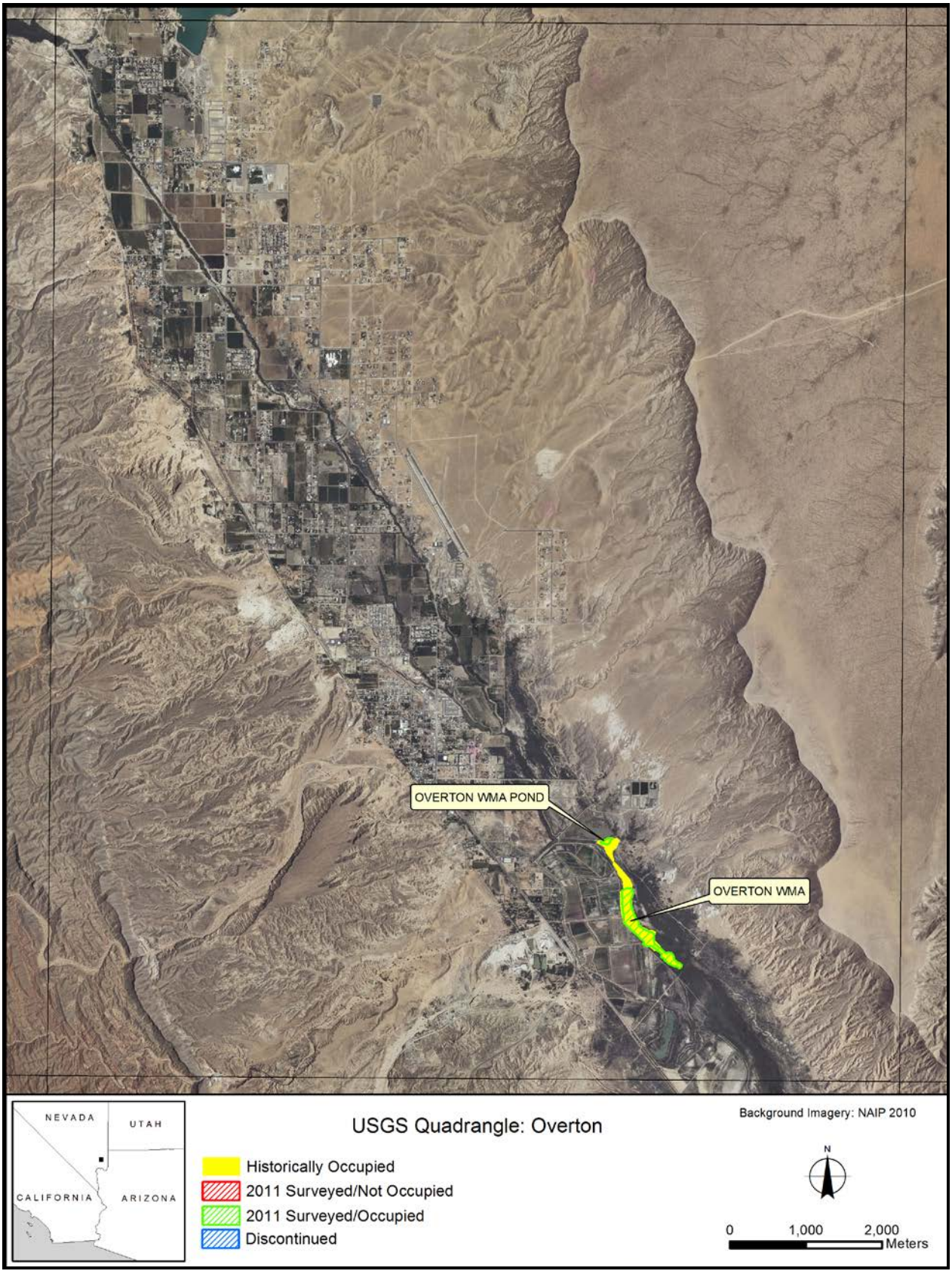

PAHRANAGAT NORTH
PAHRANAGAT WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Alamo & Alamo SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

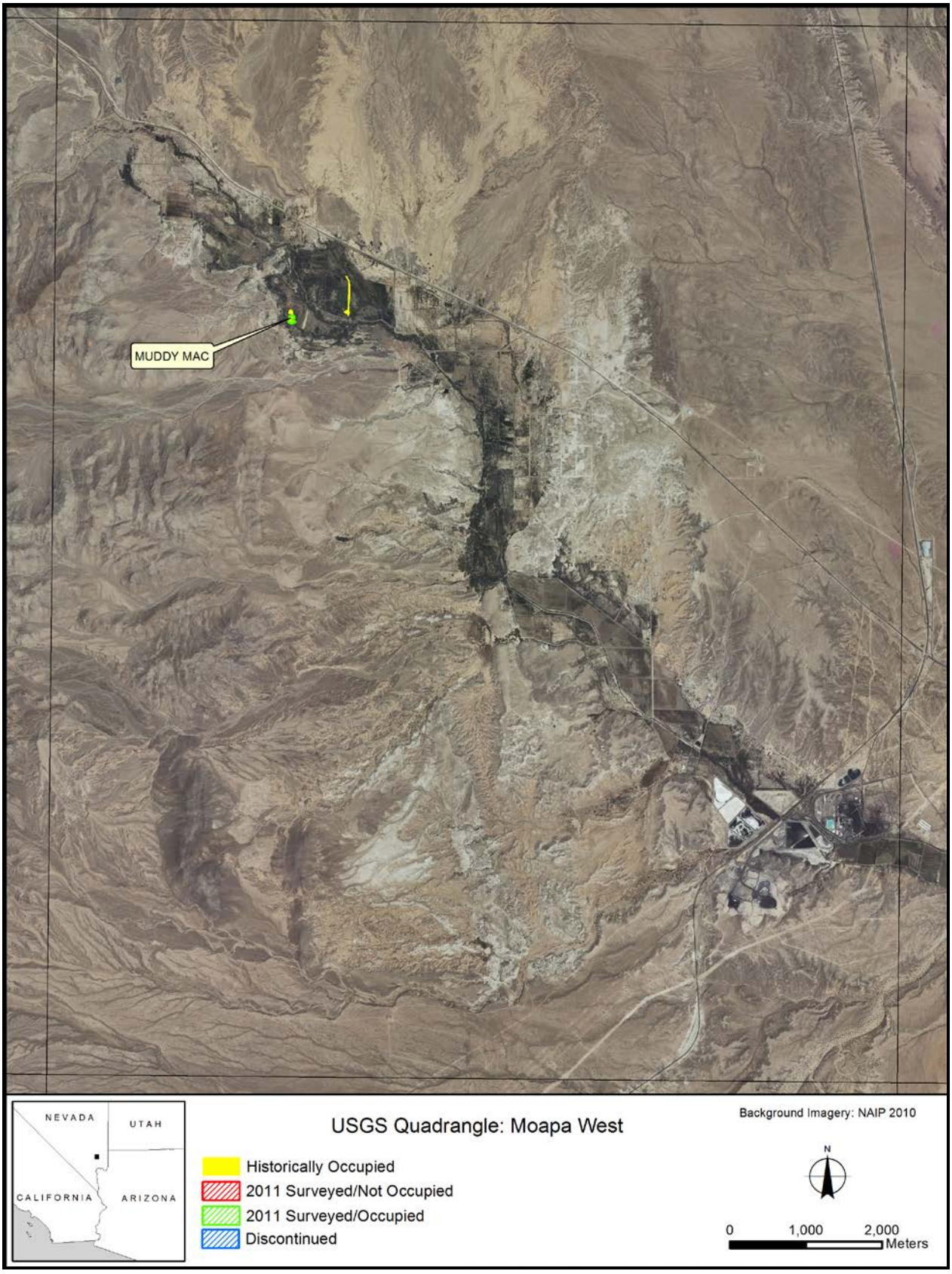

MESQUITE WEST
HAFEN LANE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Mesquite
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

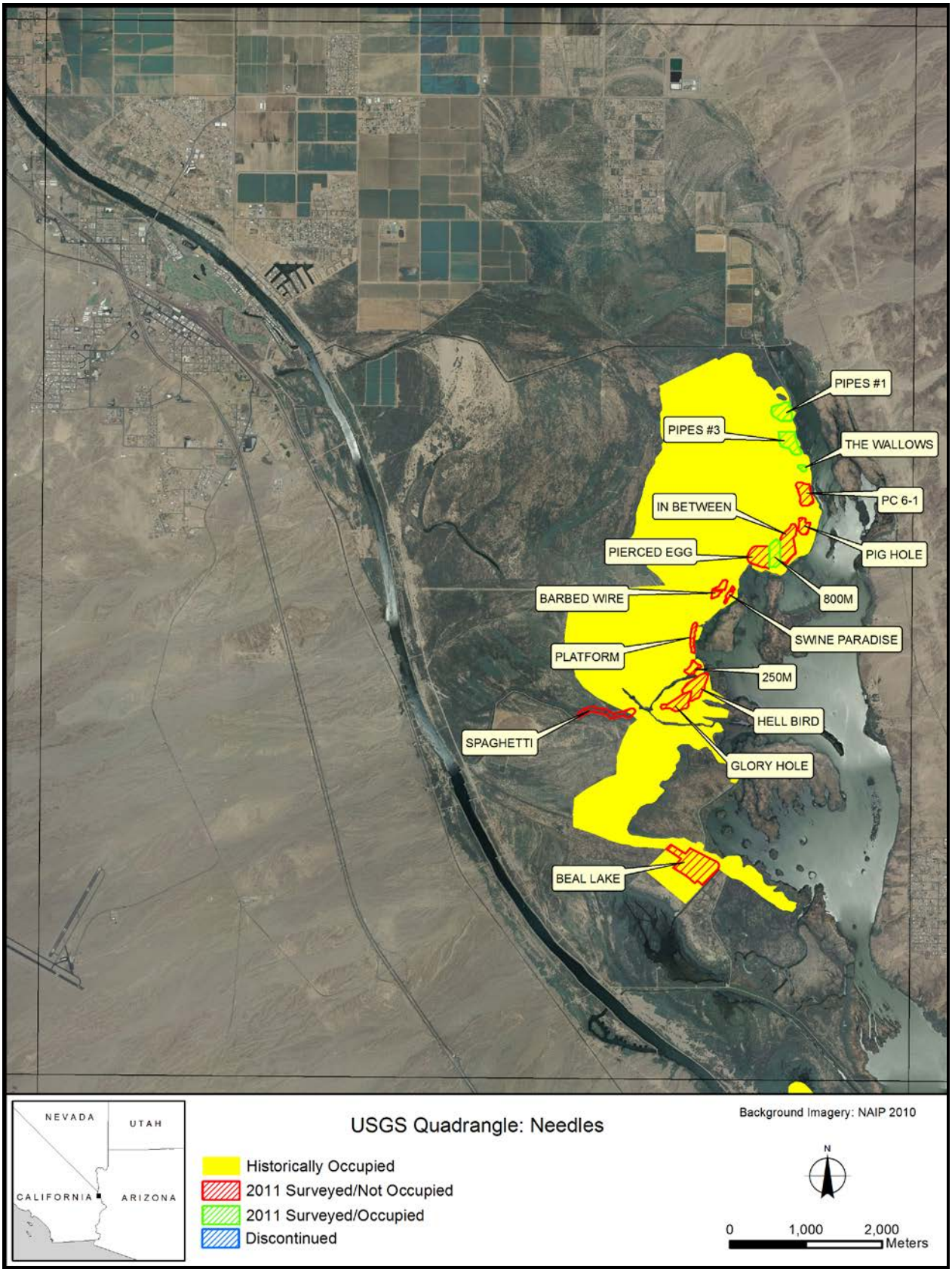

BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Flat Top Mesa
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MORMON MESA SOUTH (SOUTH)
MORMON MESA SOUTH (NORTH)
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

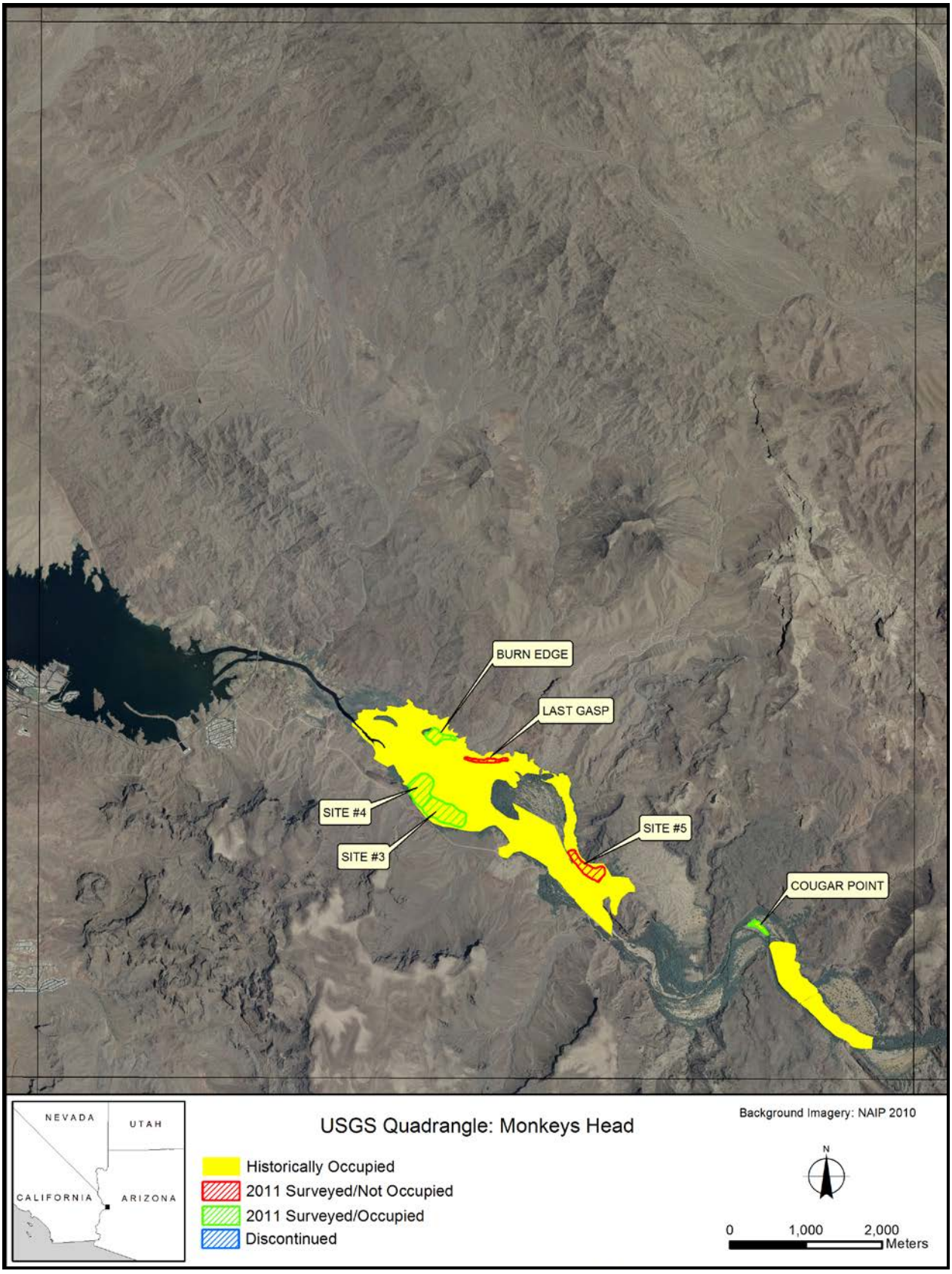

VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

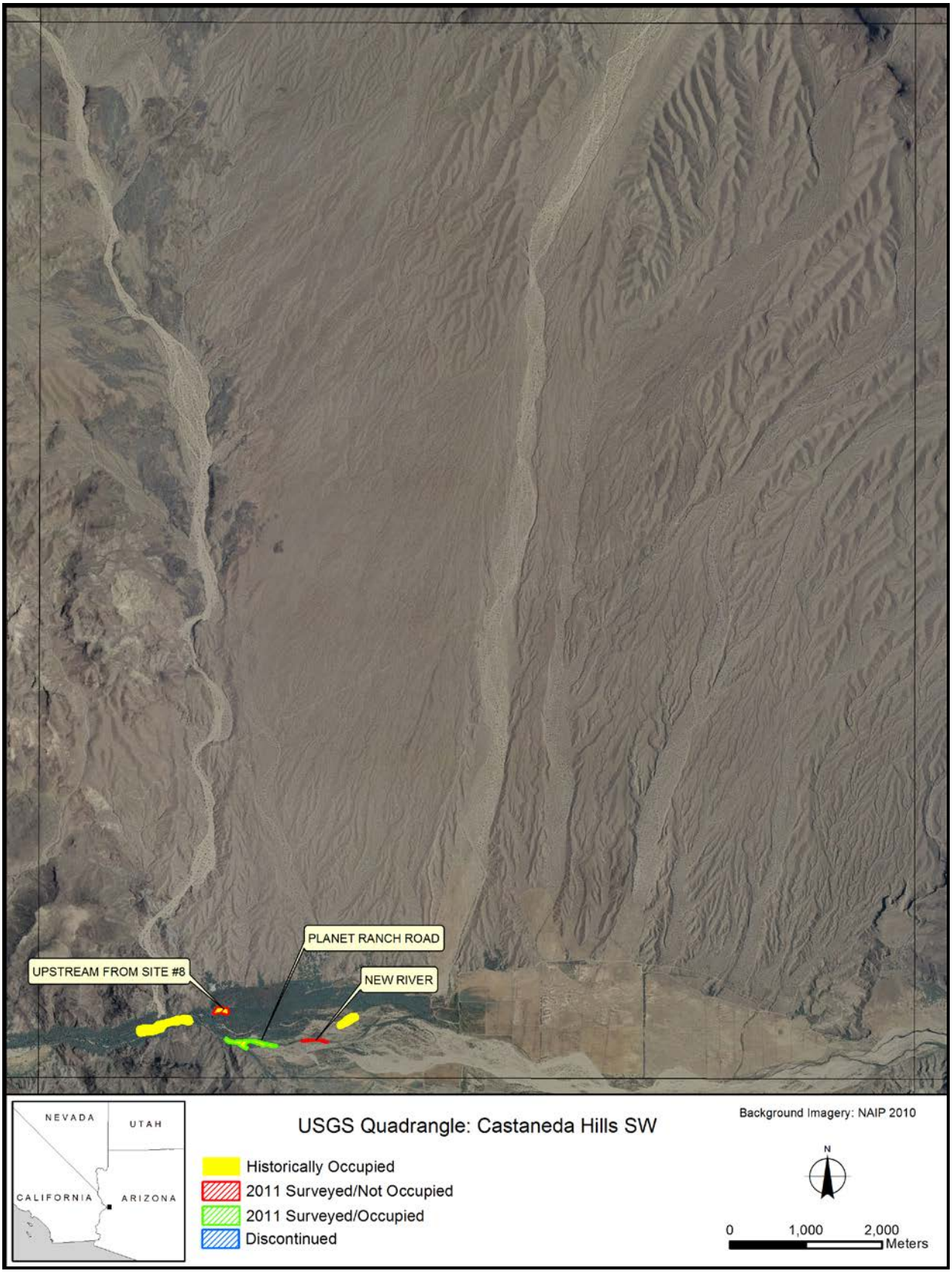

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

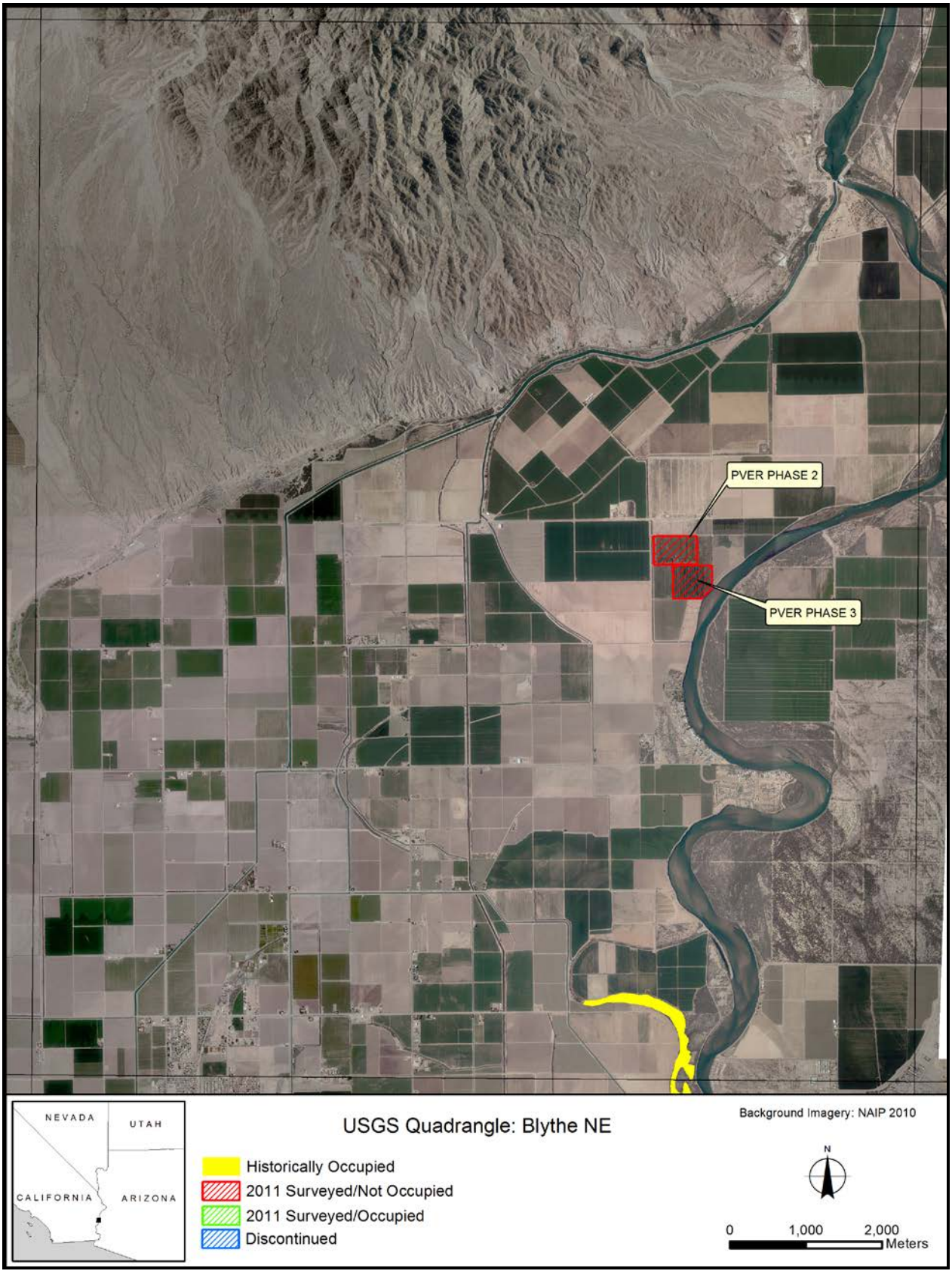

MUDDY MAC
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Moapa West
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

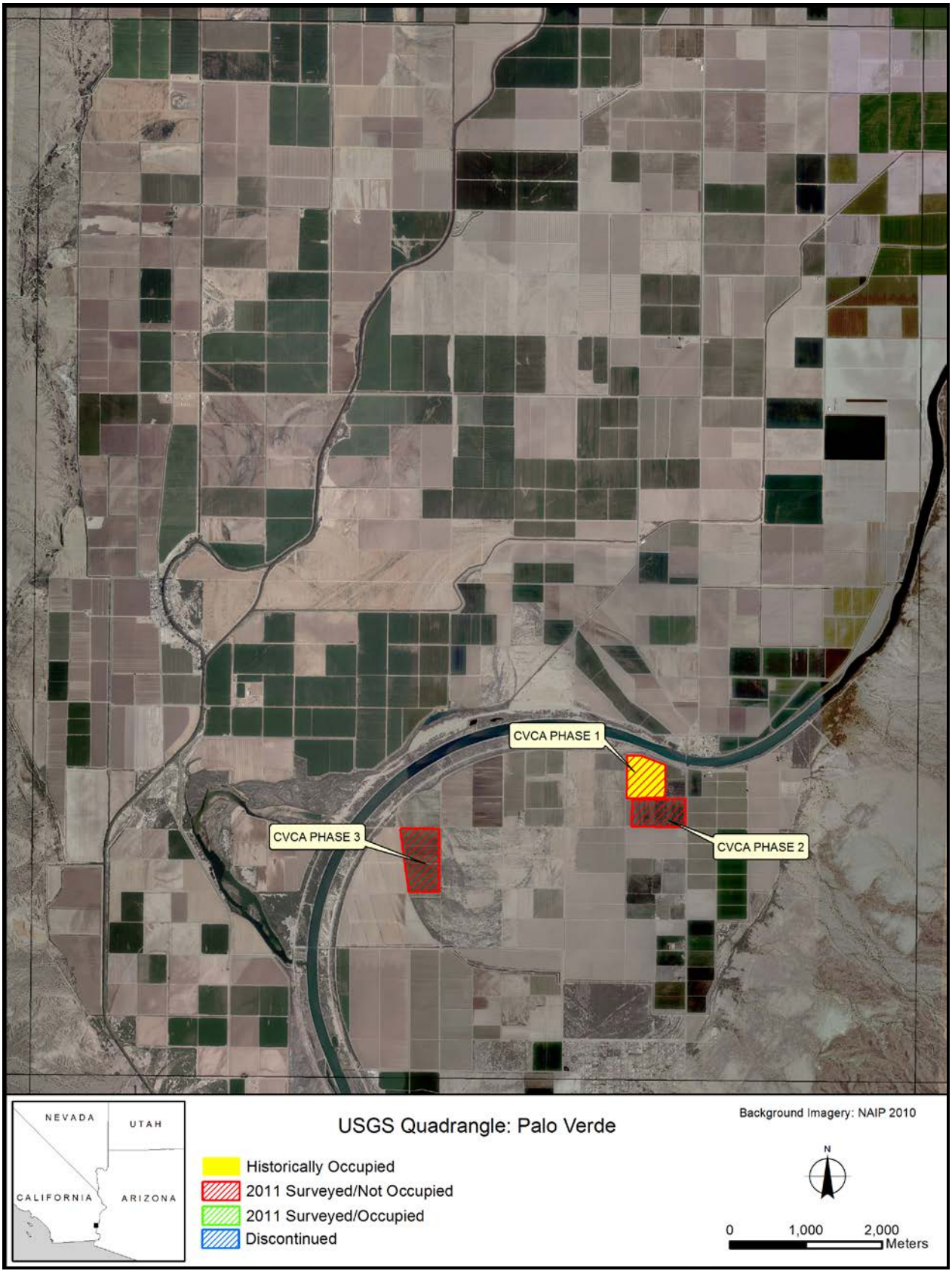

PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
IN BETWEEN
PIG HOLE
PIERCED EGG
800M
BARBED WIRE
SWINE PARADISE
PLATFORM
250M
HELL BIRD
SPAGHETTI
GLORY HOLE
BEAL LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

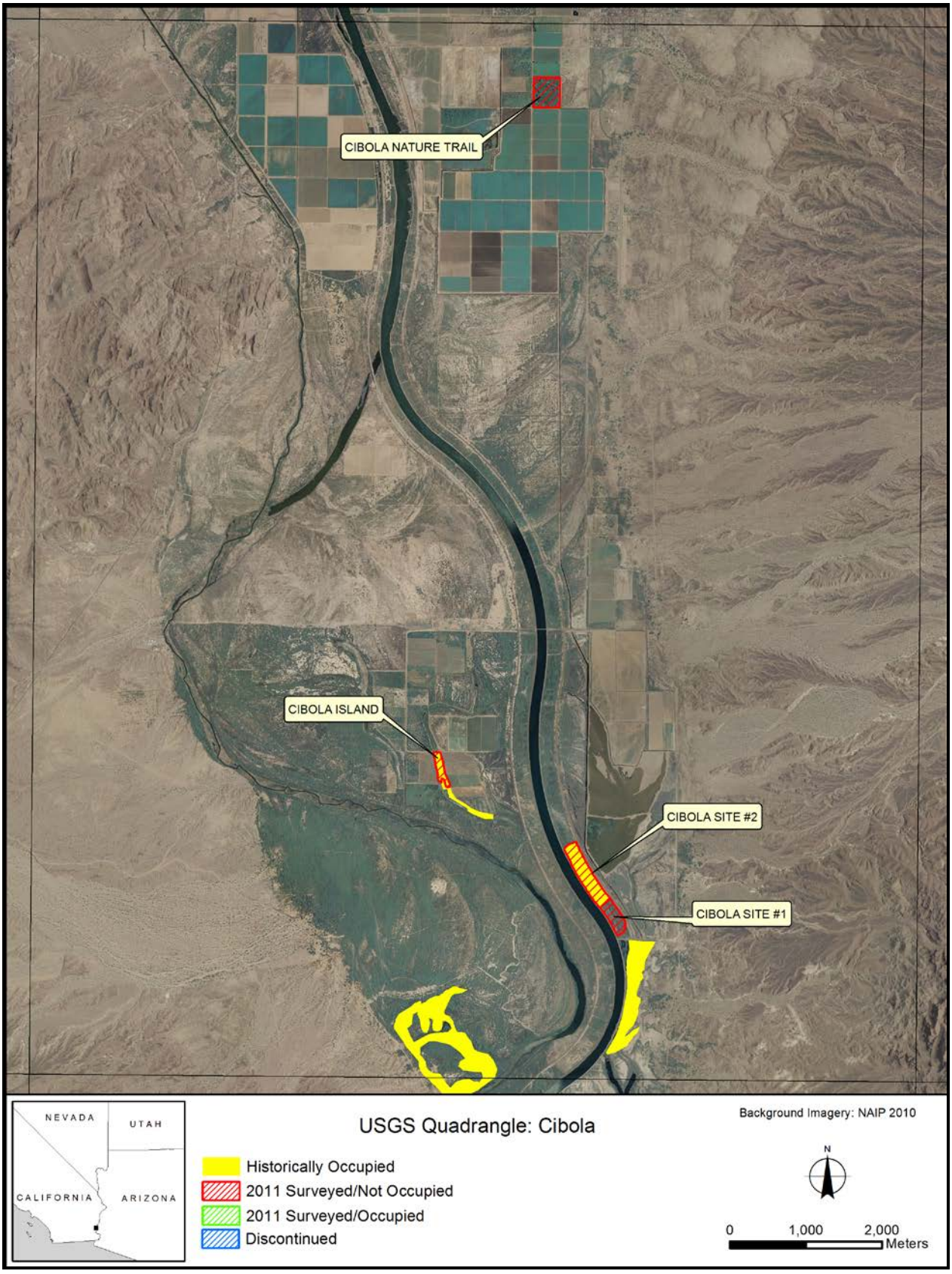

LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

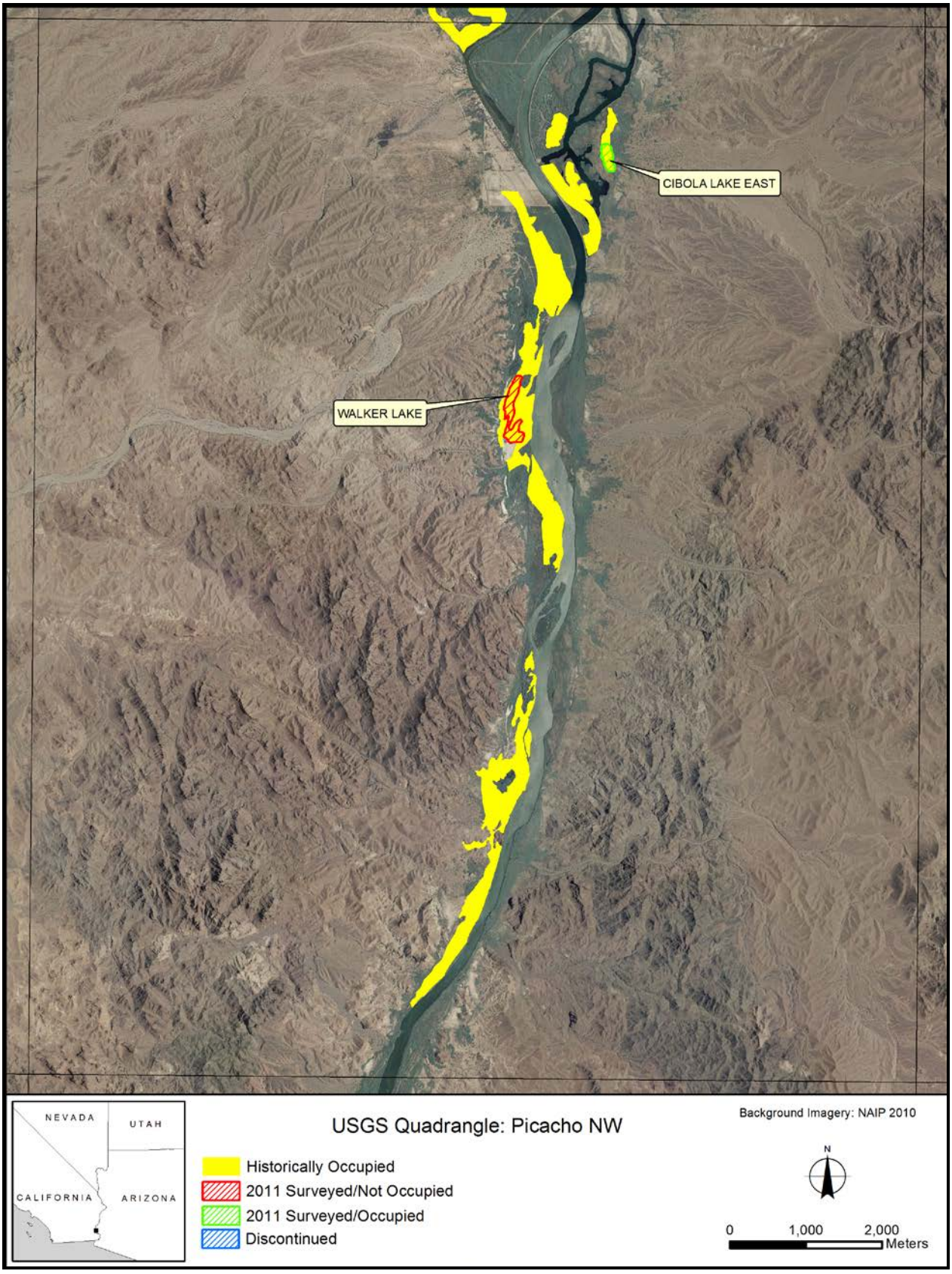

BURN EDGE
LAST GASP
SITE #4
SITE #3
SITE #5
COUGAR POINT
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

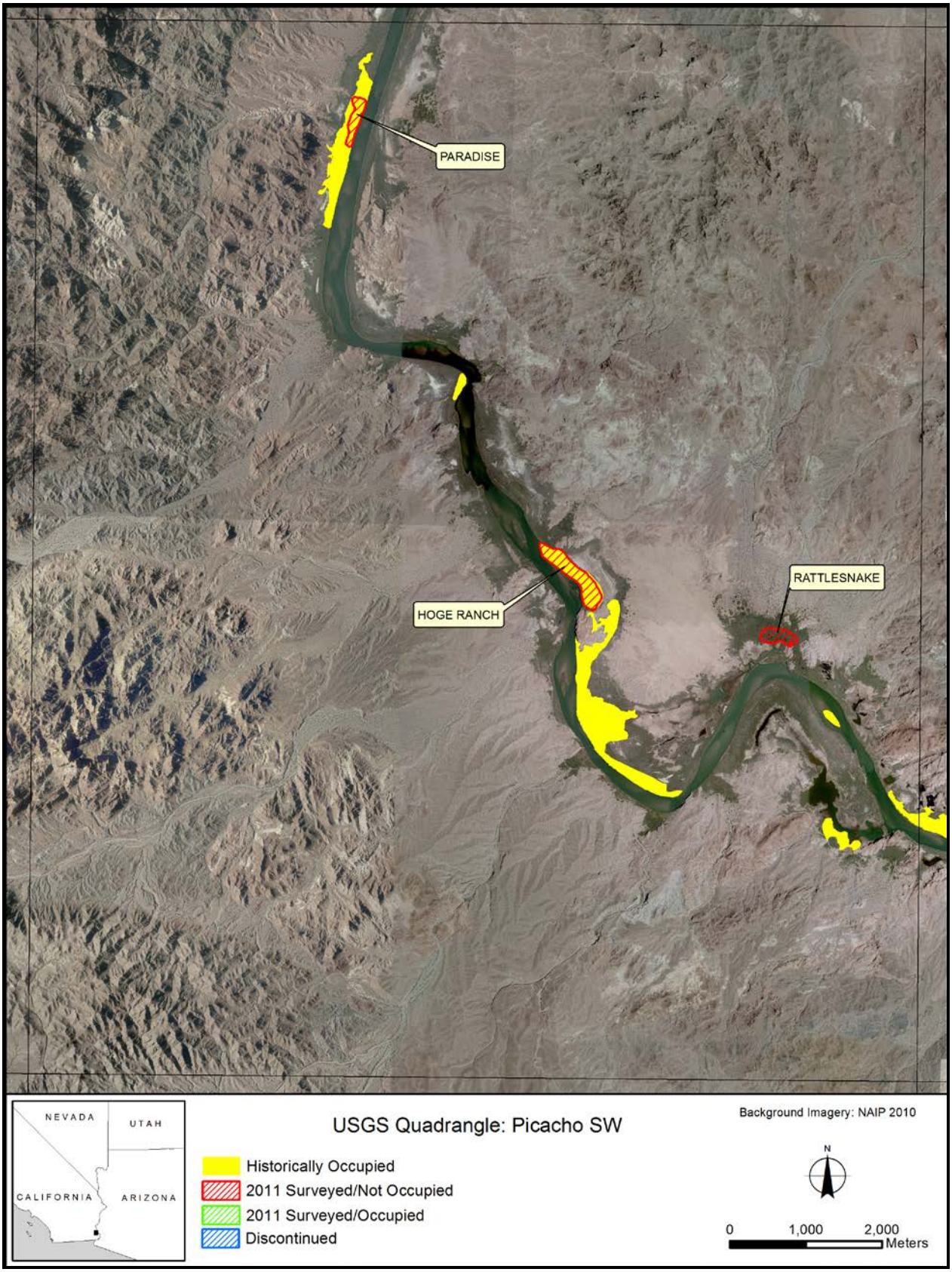

PLANET RANCH ROAD
UPSTREAM FROM SITE #8
NEW RIVER
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

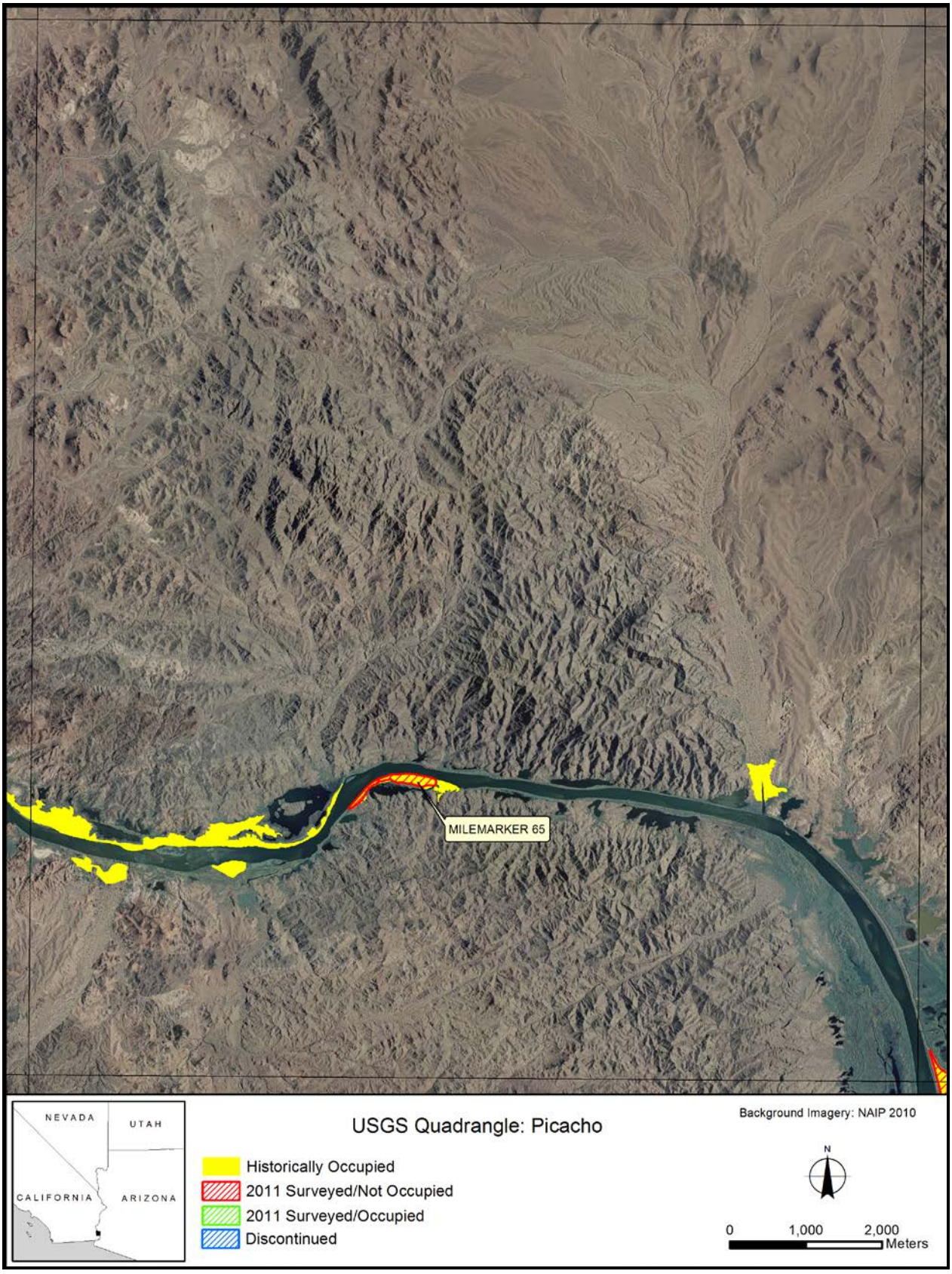

PVER PHASE 2
PVER PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

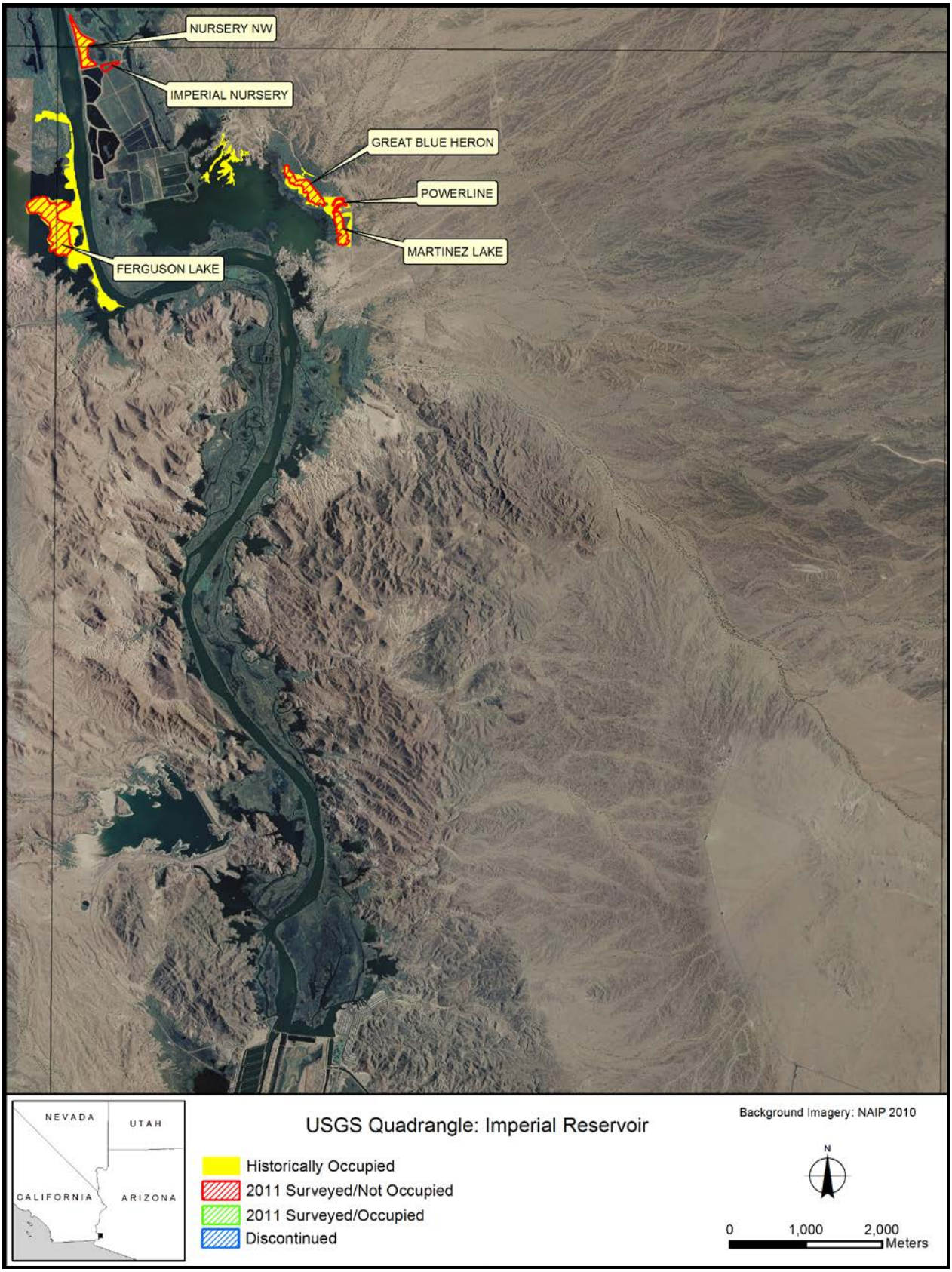

CVCA PHASE 1
CVCA PHASE 2
CVCA PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

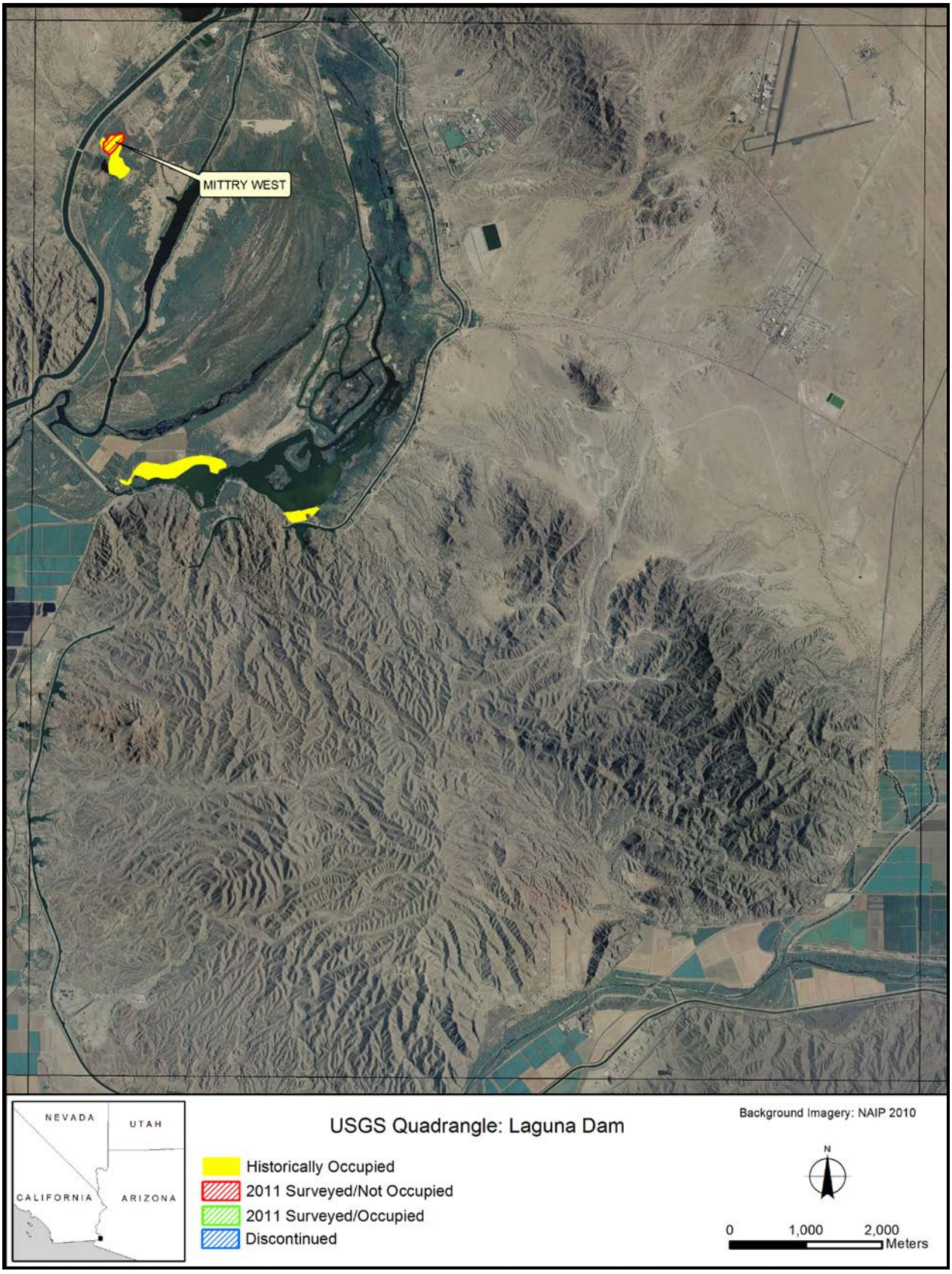

CIBOLA NATURE TRAIL
CIBOLA ISLAND
CIBOLA SITE #2
CIBOLA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

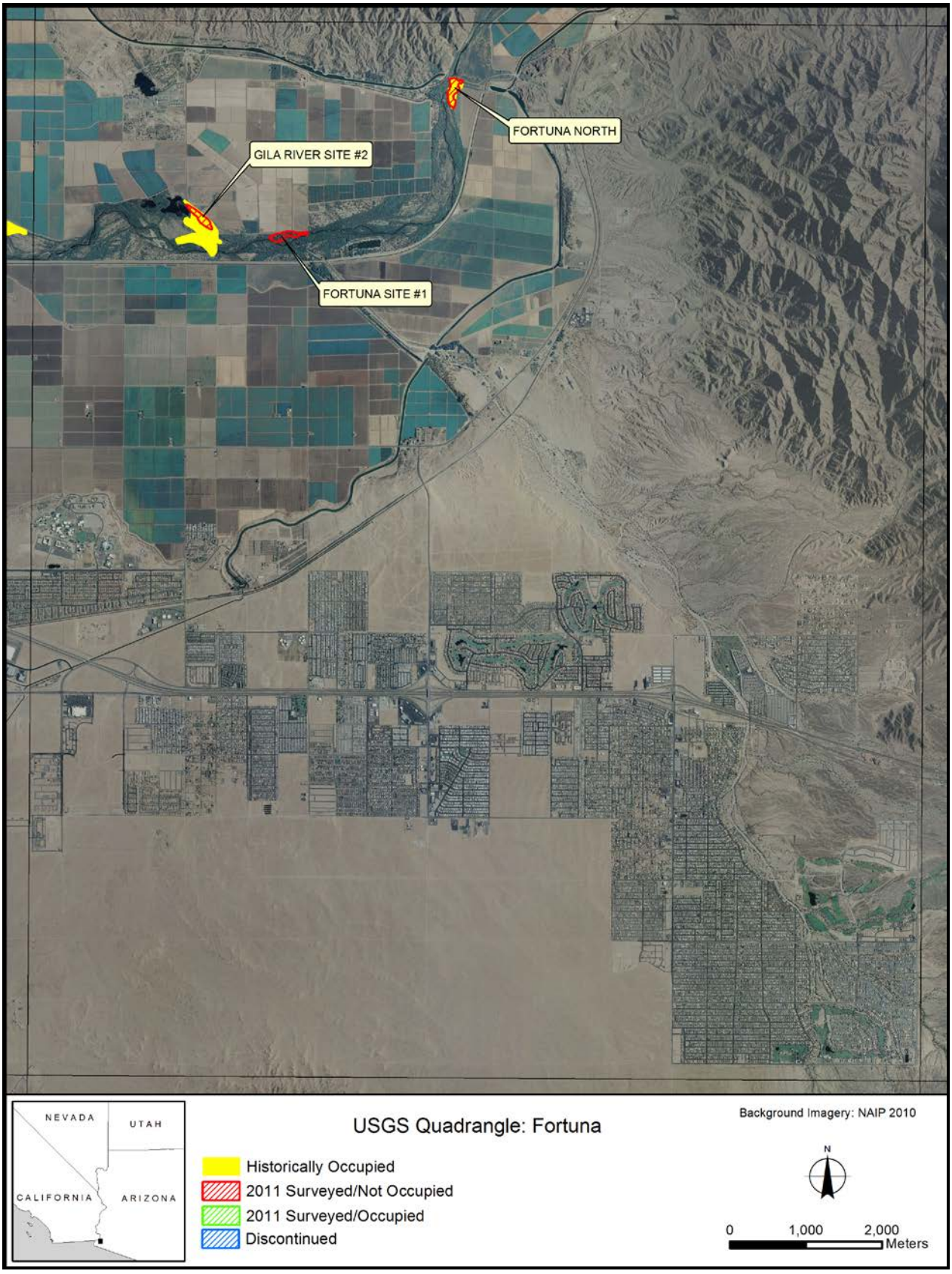

CIBOLA LAKE EAST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


PARADISE
HOGE RANCH
RATTLESNAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MILEMARKER 65
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


NURSERY NW
IMPERIAL NURSERY
GREAT BLUE HERON
POWERLINE
MARTINEZ LAKE
FERGUSON LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MITTRY WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


FORTUNA NORTH
GILA RIVER SITE #2
FORTUNA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Fortuna
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

Appendix C

SOUTHWESTERN WILLOW FLYCATCHER SURVEY RESULTS, 2011

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011*

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Pahranagat Valley	KEPI[5]	NV	Patch 0	0.04	0	---	2[6]	1	1	1	0	0
		NV	Patch 1	0.1	0	---	2	1	1	1	0	0
		NV	Patch 2	0.1	0	---	2	1	1	2	0	0
		NV	Patch 3	0.1	0	---	1	1	0	0	1	0
		NV	Patch 4	0.1	0	---	2	1	1	1	3[7]	0
		NV	Patch 4.5	0.02	5	0.3	0	0	0	0	0	0
		NV	Patch 5	0.1	0	---	2	1	1	2	0	0
		NV	Patch 6	0.2	0	---	5[8]	3	3	3	0	0
		NV	Patch 7	0.1	0	---	2	1	1	2	0	0
		NV	Patch 8	0.1	0	---	2	1	1	2	0	0
		NV	Patch 9	0.3	0	---	4	2	2	3	0	0
		NV	Patch 10	0.1	0	---	3[8]	2	2	4	0	0
		NV	Patch 10.5	0.02	0	---	0	0	0	0	2[9]	0
		NV	Patch 11	0.1	0	---	4	2	2	6	1	0
		NV	Patch 12	0.1	0	---	3[8]	2	2	6	2	0
		NV	Fence[10]	---	0	---	0	0	0	0	0	1
Pahranagat Valley	RIRA[11]	NV	East Side	0.4	1	0.8	2[7]	1	1	3	0	0
		NV	West Side	0.3	1	---	3[6,9,12]	2	1	1	2	0
		NV	Smalls	0.5	1	---	1	1	1	0	0	0
Pahranagat Valley	PAHR	NV	North	4.6	4	1.5	14[13,14]	10	6	7	5[12]	2
		NV	West	1.5	5	3.1	0	0	0	0	1[14]	0
Virgin River	MESQ	NV	Hafen Lane	6.1	5	16.2	3[15]	1	1	1	0	0
		NV	West	10.4	5	7.4	11[16,17]	7	6	8	0	0
		NV	Bunker Marsh North[18]	7.1	2	3.7	0	0	0	0	0	0
Virgin River	MOME[19]	NV	Mormon Mesa South (North)	8.4	4	9.3	0	0	0	0	0	0
		NV	Mormon Mesa South (South)	3.4	3	4.8	0	0	0	0	0	0
		NV	Virgin River #1 (North)	11.4	4	12.9	4	2	2	1	1	0
		NV	Virgin River #1 (South)	11.1	3	5.5	19[20]	12	11	19	2[16]	0
		NV	Virgin River #2	11.2	5	16.8	0	0	0	0	0	0

AR064898

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Muddy River	MUDD	NV	Overton WMA Pond	0.7	5	2.5	0	0	0	0	1	0
		NV	Overton WMA	14.9	6	18.0	13[15,20]	8	5	6	2	0
Muddy River	WMSP	NV	Muddy Mac[21]	0.7	0	---	2	1	1	1	0	3
Colorado River	TOPO	AZ	Pipes #1	5.2	5	8.5	1	1	0	0	0	0
		AZ	Pipes #3	5.7	5	4.6	2	1	1	1	1	0
		AZ	The Wallows	0.7	5	2.1	1	1	0	0	0	2
		AZ	PC6-1	4.8	5	8.0	0	0	0	0	0	1
		AZ	Pig Hole	2.4	5	5.1	0	0	0	0	0	0
		AZ	In Between	7.7	5	9.9	0	0	0	0	0	1
		AZ	800M	4.7	5	4.7	1	1	0	0	1	1
		AZ	Pierced Egg	6.7	5	8.5	0	0	0	0	0	4
		AZ	Swine Paradise	0.9	5	4.0	0	0	0	0	0	1
		AZ	Barbed Wire	2.1	5	4.0	0	0	0	0	0	0
		AZ	Platform	1.9	5	4.6	1	1	0	0	0	0
		AZ	250M	1.9	5	3.3	0	0	0	0	0	0
		AZ	Hell Bird	6.3	5	6.0	0	0	0	0	0	10
		AZ	Glory Hole	5.0	5	8.3	0	0	0	0	0	0
		AZ	Spaghetti	5.4	5	3.4	0	0	0	0	0	2
		AZ	Beal Lake	18.0	5	10.6	0	0	0	0	0	1
		AZ	Lost Lake	3.3	5	3.4	0	0	0	0	0	1
		AZ	Dock[10]	---	0	---	0	0	0	0	0	3
Bill Williams River	BIWI	AZ	Wispy Willow[18]	0.5	3	2.8	0	0	0	0	0	1
		AZ	Burn Edge	4.1	5	6.3	0	0	0	0	0	1
		AZ	Site #4	9.9	5	16.8	0	0	0	0	3	0
		AZ	Site #3	13.0	5	19.6	2	1	1	2	0	1
		AZ	Last Gasp	2.1	5	4.6	0	0	0	0	0	0
		AZ	Site #5	6.8	5	8.9	0	0	0	0	0	2
		AZ	Cougar Point[22]	1.3	0	---	2	1	1	1	0	0
		AZ	Upstream from Site #8	1.5	5	5.1	0	0	0	0	0	0

AR064899

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Bill Williams River	BIWI	AZ	Planet Ranch Road	3.3	5	12.0	3	2	2	3	0	2
		AZ	New River	0.6	5	3.9	0	0	0	0	0	0
Colorado River	PVER	CA	PVER Phase 2	21.4	6	16.5	0	0	0	0	0	11
		CA	PVER Phase 3	21.4	6	14.5	0	0	0	0	0	4
Colorado River	CIBO	AZ	CVCA Phase 1	26.2	6	16.0	0	0	0	0	0	12
		AZ	CVCA Phase 2	25.5	6	16.0	0	0	0	0	0	11
		AZ	CVCA Phase 3	38.4	5	14.0	0	0	0	0	0	18
		AZ	Cibola Nature Trail	13.7	5	6.0	0	0	0	0	0	1
		AZ	Cibola Island	4.2	3	2.3	0	0	0	0	0	0
		AZ	Cibola Site #2	16.4	5	6.2	0	0	0	0	0	5
		AZ	Cibola Site #1	7.7	5	4.1	0	0	0	0	0	0
		AZ	Cibola Lake #2 (East)	4.5	5	5.0	0	0	0	0	0	2
		CA	Walker Lake	11.4	3	4.9	0	0	0	0	0	1
Colorado River	IMPE	CA	Paradise	7.8	3	3.3	0	0	0	0	0	3
		AZ	Hoge Ranch	20.7	5	5.9	0	0	0	0	0	14
		AZ	Rattlesnake	7.6	5	6.4	0	0	0	0	0	5
		CA	Milemarker 65	10.0	2	0.9	0	0	0	0	0	1
		AZ	Nursery NW	7.0	5	6.9	0	0	0	0	0	6
		CA	Ferguson Lake	21.1	3	7.0	0	0	0	0	0	2
		AZ	Great Blue Heron	7.1	5	15.9	0	0	0	0	0	21
		AZ	Powerline	1.0	5	4.2	0	0	0	0	0	3
		AZ	Martinez Lake	4.6	5	8.8	0	0	0	0	0	2

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Colorado River	MITT	CA	Mittry West	4.4	3	4.3	0	0	0	0	0	3
Colorado River	YUMA	AZ	Gila River Site #2	2.9	4	5.3	0	0	0	0	0	7
		AZ	Fortuna Site #1	3.2	4	6.1	0	0	0	0	0	15
		AZ	Fortuna North	3.8	4	9.5	0	0	0	0	0	7

* This table includes only sites where regular surveys were scheduled and does not include sites where habitat reconnaissance and opportunistic surveys were conducted.

[1] Study areas consist of 1-18 survey sites that are grouped geographically. Alpha codes are as follows: KEPI = Key Pittman Wildlife Management Area, RIRA = River Ranch, PAHR = Pahranagat National Wildlife Refuge (NWR), MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, WMSP = Warm Springs Natural Area, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] Survey site is equivalent to the Arizona Department of Game and Fish site definition.

[3] Total number of individuals recorded that could not be classified as resident or migrant because of brief appearance after 15 June.

[4] Total number of individuals who could not be classified as resident or migrant because of brief appearance before 15 June.

[5] Only the one unoccupied site was surveyed.

[6] This female moved from River Ranch West Side after an unsuccessful nesting attempt to Key Pittman Patch 0 where she tried a second nesting attempt of unknown fate.

[7] This adult, detected on 27 July in Key Pittman Patch 4, held a territory at River Ranch East Side until 25 July.

[8] One male was polygynous with two females.

[9] This individual, detected on 24 July in Key Pittman Patch 10.5, held a territory at River Ranch West Side until 1 July.

[10] Not an official survey site. Incidental detections recorded.

[11] Due to flycatcher occupancy, sites were surveyed only once. Survey time represents total survey time at all sites combined.

[12] This individual, detected 17–19 June at Pahranagat North, moved to River Ranch West Side where he held a territory from 23 June to 13 July.

[13] One male was polygynous with three females.

[14] One female moved from Pahranagat North and was detected on 21 July with a group of three fledglings.

[15] One male held a territory at Overton WMA until 17 July and then displaced the male at Hafen Lane.

[16] One male held a territory at Mesquite West and was then recaptured on 24 July at Virgin River #1 South.

[17] Two males polygynous with two females.

[18] Surveys discontinued because of poor quality habitat.

[19] Unusually high water levels within the Virgin River prevented technicians from completing all five surveys.

[20] One male bred at Overton WMA until 17 July, then moved to Virgin River #1 South and bred. His female at Virgin River #1 South mated consecutively with two males.

[21] No surveys conducted; site was occupied the entire season.

[22] Site not formally surveyed; not a formal site until an unrelated field crew reported a flycatcher in the area. When SWCA visited the territory, the male was no longer present (though had been noted by the other crew earlier in the season) and only the female remained, attending the nest.

AR064901

Appendix D

DETECTIONS OF SPECIAL CONCERN SPECIES, 2011

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
PAHR	North	0	0	0	0	0	0	0	0	0	1	1	0
	West	0	0	0	0	0	0	0	0	0	10	0	1
MESQ	Hafen Lane	0	0	0	2	0	0	0	0	1	41	2	20
	West	0	0	0	0	0	0	0	0	0	49	0	22
	Bunker Marsh North	0	0	0	0	0	0	0	0	0	3	0	1
MOME	Mormon Mesa South	0	0	0	0	0	0	0	0	18	78	0	98
	Virgin River #1	0	0	0	0	0	0	0	0	2	27	2	37
	Virgin River #2	0	0	0	0	0	0	0	0	12	48	4	54
MUDD	Overton WMA	0	0	0	9	0	0	0	0	0	63	0	64
	Overton WMA Pond	0	0	0	0	0	0	0	0	1	17	2	16
TOPO	Pipes #1	0	0	0	0	0	0	0	0	0	1	1	42
	Pipes #3	0	0	0	0	0	0	4	0	0	11	5	41
	The Wallows	0	0	0	0	0	0	3	0	0	9	2	17
	PC6-1	0	0	0	0	0	0	1	0	1	9	3	60
	Pig Hole	0	0	0	0	0	0	0	0	0	3	0	27
	In Between	0	0	0	0	0	0	0	0	0	4	3	39
	800M	0	0	0	0	0	0	0	0	0	1	3	20
	Pierced Egg	0	0	0	0	0	0	5	0	0	19	5	55
	Swine Paradise	0	0	0	0	0	0	1	0	0	14	4	13
	Barbed Wire	0	0	0	0	0	0	1	0	0	5	6	26
	Platform	0	0	0	0	0	0	1	0	0	6	1	26
	250M	0	0	0	0	0	0	2	0	0	6	1	15
	Spaghetti	0	0	0	0	0	0	1	0	0	2	2	19
	Hell Bird	0	0	0	0	0	0	9	0	0	7	4	23
	Glory Hole	0	0	0	0	0	0	6	0	1	9	2	40

AR064904

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
TOPO	Beal Lake	0	0	0	3	0	0	1	0	40	22	10	57
	Lost Lake	0	0	2	0	0	0	0	0	0	5	2	8
BIWI	Wispy Willow	0	1	1	0	0	0	1	0	5	0	2	11
	Site #1[3]	0	0	2	0	0	0	1	0	1	0	1	3
	Site #2[3]	0	0	0	0	0	0	0	0	0	0	1	4
	Burn Edge	0	0	0	0	0	0	2	0	7	8	1	55
	Site #11[3]	0	0	0	0	0	0	2	0	1	0	0	5
	Site #4	0	0	0	0	0	0	22	0	11	32	11	97
	Site #3	0	0	0	3	1	0	4	0	11	51	8	119
	Last Gasp	0	0	0	0	0	0	6	0	1	5	1	70
	Site #5	0	0	0	1	0	0	7	0	13	16	6	81
	Mineral Wash[3]	0	0	0	0	0	0	0	0	8	5	0	9
	Beaver Pond[3]	0	0	0	0	0	0	3	0	8	14	1	35
	Upstream from Site #8	0	0	0	1	0	0	3	0	2	9	0	32
	Planet Ranch Road	1	0	0	3	0	0	6	0	14	22	5	44
	New River	2	0	0	2	0	0	0	0	9	2	1	22
PVER	PVER Phase 2	0	0	0	3	0	0	0	0	3	12	0	2
	PVER Phase 3	0	0	0	3	0	0	0	0	0	5	2	4
CIBO	CVCA Phase 1	0	0	0	5	0	0	1	0	0	10	6	7
	CVCA Phase 2	0	0	0	4	0	0	0	0	0	7	0	4
	CVCA Phase 3	0	0	0	0	0	0	0	0	0	1	4	4
	Cibola Nature Trail	0	0	0	0	0	0	0	0	1	17	1	13
	Cibola Island	0	0	0	3	0	0	0	0	0	0	0	4
	Cibola Site #2	0	1	0	0	0	0	0	0	0	0	0	14
	Cibola Site #1	0	0	3	0	0	0	3	0	0	1	1	10
	Cibola Lake #2 (East)	0	0	0	0	0	0	0	0	0	0	0	14

AR064905

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
CIBO	Walker Lake	0	0	0	0	0	0	4	0	0	0	0	8
IMPE	Paradise	0	0	0	0	0	0	4	0	0	0	0	6
	Hoge Ranch	0	0	3	0	0	0	2	0	0	0	0	13
	Rattlesnake	0	0	0	0	0	0	6	0	0	0	1	30
	Milemarker 65	0	0	1	0	0	0	0	0	0	1	0	4
	Nursery Northwest	7	0	2	0	0	0	1	0	1	3	0	22
	Ferguson Lake	0	0	9	0	0	0	2	0	0	0	0	19
	Great Blue Heron	0	0	0	0	0	0	13	0	1	16	2	67
	Powerline	0	1	1	0	0	0	5	0	0	1	1	15
	Martinez Lake	1	0	1	0	0	0	1	0	2	5	0	24
MITT	Mittry West	0	0	0	0	0	0	4	0	1	0	0	8
YUMA	Gila River Site #2	0	0	0	0	0	0	0	0	0	0	0	0
	Fortuna Site #1	0	0	0	0	0	0	0	0	0	1	1	9
	Fortuna North	0	0	0	0	0	0	0	0	0	1	0	14

[1] PAHR = Pahranagat NWR; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; TOPO = Topock Marsh; BIWI = Bill Williams River NWR; PVER = Palo Verde Ecological Reserve; CIBO = Cibola; IMPE = Imperial; MITT = Mittry Lake; YUMA = Yuma.

[2] BLRA = Black Rail, CLRA = Clapper Rail, LEBI = Least Bittern, YBCU = Yellow Billed Cuckoo, ELOW = Elf Owl, GIFL = Gilded Flicker, GIWO = Gila Woodpecker, VEFL = Vermilion Flycatcher, BEVI = Bell's Vireo, YWAR = Yellow Warbler, SUTA = Summer Tanager, YBCH = Yellow-breasted Chat.

[3] Site surveyed only once as part of an opportunistic effort.

Appendix E

ALL WILLOW FLYCATCHERS COLOR-BANDED AND/OR RESIGHTED, 2003–2011

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011*

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1490-89889	M	J							R		D	D	D	D			
1590-97338	M	A	P				P	P	P	P							
1710-20312	M	J							R		T						
1710-20638	M	A		G	M	M	M	M	M	M	M						
2090-42022	F	J		M					Q								
2110-78841	F	J						T	T	T	T						
2110-78842	M	A						Q	Q	Q							
2110-78855	M	J						T	T								
2110-78861	M	J						T	M[4]	Q							
2110-78863	M	J						T	T	T							
2140-66502	M	J						Q	Q								
2140-66503	F	J						Q		Q							
2140-66517	F	A						Q	Q	Q	D						
2140-66518	M	A						Q	Q								
2140-66561	M	A						P			P	P	P	P			
2140-66564	F	J						P	P								
2140-66566	M	J						P			P						
2140-66568	M	A						P	P		P	P	P	P			
2140-66606	M	J		M		Q	Q		Q								
2140-66621	F	A				P	P	P	P	P							
2140-66627	F	A				P	P	P		P							
2140-66690	F	J					P								S		
2140-66693	M	J					M	Q	Q								
2140-66696	F	J					Q		Q								
2140-66697	M	J					Q			P	P	P	P	P	P		
2140-66709	M	A						Q	Q	Q		Q[5]	M	M	M	M	M
2140-66728	M	J					T			T							
2140-66743	M	J			T					T							
2140-66775	M	J				T	M		Q	Q	Q						
2190-76604	M	A					P		P	P	P	P					
2320-31401	M	A							B								
2320-31402	M	A							B								
2320-31403	M	A							Y								
2320-31404	F	A							B								
2320-31405	F	A							B								
2320-31406	U	J							B								
2320-31407	F	J							B	T							
2320-31408	U	J							B								
2320-31409	U	J							B								
2320-31410	U	J							B								
2320-31411	U	J							B								
2320-31412	M	A							B	B							
2320-31413	U	A							Q								
2320-31414	M	A								T	T						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31415	F	A								T							
2320-31416	U	J								T							
2320-31417	U	J								T							
2320-31418	M	A								T	T						
2320-31419	U	J								T							
2320-31420	U	J								T							
2320-31421	U	J								T							
2320-31422	U	J								T							
2320-31423	U	A								T							
2320-31424	M	J								T	T						
2320-31425	U	J								T							
2320-31426	F	A							M								
2320-31427	M	A							M								
2320-31428	M	J							Q	M	Q[6]		M	M			
2320-31429	U	J							Q								
2320-31430	U	J							P								
2320-31431	U	J							Q								
2320-31432	U	J							P								
2320-31433	U	J							Q								
2320-31434	U	J							Q								
2320-31435	U	J							P								
2320-31436	U	J							P								
2320-31437	U	J							P								
2320-31438	M	J							Q	Q							
2320-31439	U	J							Q								
2320-31440	F	J							Q	M							
2320-31441	U	J							M								
2320-31443	U	J							Q								
2320-31444	F	A							Q	Q	Q	Q			M		
2320-31445	F	A							Q	Q	Q	Q	Q	Q	Q	Q	
2320-31446	U	J								P							
2320-31447	U	J								P							
2320-31448	U	J								P							
2320-31449	U	J								P							
2320-31450	U	J								P							
2320-31451	M	A							P	P	P	P					
2320-31452	M	A							P								
2320-31453	M	A							P	P							
2320-31454	M	A							P	P							
2320-31455	M	A							P								
2320-31456	U	J							P								
2320-31457	M	J							P	K							
2320-31458	M	J							P		P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31459	M	J							P	P							
2320-31460	U	J							P								
2320-31461	U	J							P								
2320-31462	U	J							P								
2320-31463	F	J							P			K	K			K	
2320-31464	U	J							P								
2320-31465	U	J							P								
2320-31466	F	A							P								
2320-31467	M	J							P		P	P					
2320-31468	M	J							P		P	P		K			
2320-31469	U	J							P								
2320-31470	U	J							P								
2320-31471	M	J							Q	Q			M		M		
2320-31472	U	J							Q								
2320-31473	M	J							Q	Q							
2320-31474	U	J							Q								
2320-31475	M	J							P	L							
2320-31476	F	A							Q								
2320-31477	U	J							Q								
2320-31479	F	A							Q	Q							
2320-31480	F	J							Q	Q							
2320-31481	U	J							P								
2320-31482	U	J							P								
2320-31483	U	J								Q							
2320-31484	M	J								P	P			K	K		
2320-31485	F	A								M		M	M	M			
2320-31486	F	J							Q	L	Q	M	M	M			
2320-31487	U	J							Q								
2320-31488	U	J							Q								
2320-31489	U	A								M							
2320-31490	M	A								L	L[7]	Q	Q	Q	Q		
2320-31491	M	A								Q							
2320-31493	M	A								D							
2320-31494	U	A								Q							
2320-31495	M	A								T							
2320-31496	U	J								M							
2320-31497	U	J								M							
2320-31498	F	J								M		G[8]	Q	Q	Q	Q	
2320-31499	M	A								Q							
2320-31500	U	J								Q							
2320-31501	M	A							B								
2320-31502	F	A							T	T							
2320-31503	U	A								I							

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31504	U	A								I							
2320-31505	M	A								T							
2320-31506	U	J								T							
2320-31507	U	J								T							
2320-31508	U	J								T							
2320-31510	U	J								T							
2320-31511	U	J								T							
2320-31512	U	J								T							
2320-31513	U	J								T							
2320-31514	U	J								T							
2320-31515	F	A								T	T	T					
2320-31516	F	A								G							
2320-31517	M	A								G	M	M			M		
2320-31518	U	J								T							
2320-31519	U	J								T							
2320-31520	U	J								T							
2320-31521	F	A								T	T						
2320-31522	U	J											Q				
2320-31523	U	J											M				
2320-31524	U	J											P				
2320-31525	U	J											P				
2320-31526	F	A							T	T	T						
2320-31527	F	A							T								
2320-31528	M	A							T								
2320-31529	U	J							T								
2320-31530	U	J							T								
2320-31531	U	J							T								
2320-31532	U	J							T								
2320-31533	U	J							T								
2320-31534	U	J							T								
2320-31535	U	J							T								
2320-31536	U	J							T								
2320-31537	U	J							T								
2320-31538	M	A								T							
2320-31539	M	A								B							
2320-31540	F	A								T							
2320-31541	M	A								T	T						
2320-31542	U	J								T							
2320-31543	U	J								T							
2320-31544	U	J								T							
2320-31545	U	J											P				
2320-31546	U	J											P				
2320-31547	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31548	U	J											P				
2320-31549	U	J											P				
2320-31550	U	J											P				
2320-31551	M	A								Q							
2320-31552	M	A								M							
2320-31553	M	A								M		M					
2320-31554	U	J								T							
2320-31555	U	J								T							
2320-31556	U	J								T							
2320-31557	U	J								T							
2320-31558	U	J								T							
2320-31559	M	A								T	T	T	T				
2320-31560	M	A								T	T	T	T	T			
2320-31561	U	J								T							
2320-31562	M	J								T		T		T	T	T	
2320-31563	U	J								T							
2320-31564	U	J								T							
2320-31565	F	A								T	T						
2320-31566	U	J										T					
2320-31567	M	A								T	T						
2320-31568	F	A								P							
2320-31569	U	J								P							
2320-31570	U	J								P							
2320-31571	U	J								P							
2320-31572	M	A								M							
2320-31573	F	A								Q	Q	Q	Q	Q			
2320-31574	U	J									P						
2320-31575	U	J										Q					
2320-31576	M	A							T	T							
2320-31577	F	A							T	T	T						
2320-31578	U	A							Y								
2320-31579	U	A							Y								
2320-31580	U	A							Y								
2320-31581	U	J							T								
2320-31582	U	J							T								
2320-31583	U	J							T								
2320-31584	F	A							T	T	T	T					
2320-31585	U	J							T								
2320-31586	U	J							T								
2320-31587	U	J							T								
2320-31588	U	J							T								
2320-31589	M	A								P	P	P	P				
2320-31590	M	A								P	P	P	P	P			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31591	M	A								P	P	P	P				
2320-31593	M	A								P	P	P					
2320-31594	M	A								P							
2320-31595	M	A								P	P	P	P	P	P	P	P
2320-31596	M	A								P							
2320-31598	M	A								T							
2320-31599	U	A								I							
2320-31600	U	A								I							
2320-31601	U	J								P							
2320-31602	U	J								P							
2320-31603	U	J								P							
2320-31604	M	J								P		K	K				
2320-31605	U	J								P							
2320-31606	U	J								P							
2320-31607	U	J								P							
2320-31608	U	J								P							
2320-31609	U	J								P							
2320-31610	U	J								P							
2320-31611	U	J								Q							
2320-31612	U	J								Q							
2320-31616	F	J								Q		D					
2320-31617	U	J								Q							
2320-31618	F	J								Q	M	M	M				
2320-31619	U	J								M							
2320-31620	U	J								M							
2320-31621	F	A								M							
2320-31622	M	A								Q							
2320-31623	U	J								M							
2320-31624	U	J								M							
2320-31625	F	A								M							
2320-31627	M	A								Q							
2320-31628	U	A								M							
2320-31629	U	J								M							
2320-31630	U	J								Q							
2320-31631	F	J								Q		D	D				
2320-31632	F	A								Q		M	M	M[9]		M	M
2320-31633	U	J								Q							
2320-31634	U	J								Q							
2320-31635	M	A								K							
2320-31636	U	J								K							
2320-31637	F	J								K	P						
2320-31638	U	J								K							
2320-31639	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31640	U	J											Q				
2320-31641	U	J											Q				
2320-31642	U	J											Q				
2320-31643	U	J											P				
2320-31644	U	J											M				
2320-31645	U	J											M				
2320-31646	U	J											P				
2320-31647	U	J														M	
2320-31648	U	J														M	
2320-31649	U	J											P				
2320-31650	F	J										T	T				
2320-31651	M	A								M							
2320-31652	M	A								M	Q	Q					
2320-31653	M	A								M	M	M	M				
2320-31654	M	A								Q							
2320-31655	F	A								Q	Q	Q					
2320-31656	F	A								P	P	P					
2320-31657	F	A								P	P	P	P	P	P		
2320-31658	F	A								P							
2320-31659	M	J								Q		D	D	D		D	
2320-31660	F	J								Q			M	S	S	S	
2320-31661	F	A								P	P	P	P	P			
2320-31662	F	A								P							
2320-31663	F	A								P	P	P	P	P			
2320-31664	F	A								P							
2320-31665	U	J								P							
2320-31666	U	J								P							
2320-31667	U	J								P							
2320-31668	F	A								P							
2320-31669	F	A								P							
2320-31670	U	J											Q				
2320-31671	U	J										M					
2320-31672	U	J											P				
2320-31673	U	J										T					
2320-31674	M	J										P		K	K	K	
2320-31675	U	J									T						
2320-31676	U	J									T						
2320-31677	U	J										T					
2320-31678	U	J										P					
2320-31679	U	J											P				
2320-31680	U	J									T						
2320-31681	U	J									T						
2320-31682	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31683	M	J									P		K				
2320-31684	U	J									P						
2320-31685	U	J									P						
2320-31686	M	J									P	P					
2320-31687	U	J									P						
2320-31688	M	J									Q	Q	Q	Q	Q	Q	Q
2320-31689	U	J									Q						
2320-31690	U	J									Q						
2320-31691	U	J									Q						
2320-31692	M	J									P	K					
2320-31693	U	J									P						
2320-31694	M	J									P		K	K			
2320-31695	F	J									P	P					
2320-31696	U	J									Q						
2320-31697	U	J									P						
2320-31698	F	J									P		P	P	P		
2320-31699	U	J									P						
2320-31700	U	J									P						
2360-59701	F	J									Q	Q					
2360-59702	M	J									Q	D	M				
2360-59703	U	J									Q						
2360-59704	U	J									M						
2360-59705	U	J									M						
2360-59706	U	J									K						
2360-59707	F	J									P	P					
2360-59708	F	J									P	P					
2360-59709	U	J									P						
2360-59710	U	J									P						
2360-59711	M	J									K			P	P	P	
2360-59712	M	J									K			P		P	P
2360-59713	U	J									K						
2360-59714	U	J									Q						
2360-59715	U	J									Q						
2360-59716	U	J									Q						
2360-59717	M	A								Q							
2360-59718	U	J									P						
2360-59719	U	J									T						
2360-59720	U	J									T						
2360-59721	U	J								P							
2360-59722	U	J									T						
2360-59723	U	J								P							
2360-59724	F	J								P		P					
2360-59725	U	J									B						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59727	M	J									B		B				
2360-59728	U	J									B						
2360-59729	U	J									T						
2360-59730	U	J									T						
2360-59731	U	J									T						
2360-59732	U	J									T						
2360-59733	U	J									T						
2360-59734	U	J									T						
2360-59735	U	J										P					
2360-59736	U	J										P					
2360-59737	U	J										D					
2360-59738	U	J										D					
2360-59739	U	J										Q					
2360-59740	U	J									P						
2360-59741	U	J									Q						
2360-59742	U	J									Q						
2360-59743	F	J											P	K			
2360-59744	U	J										T					
2360-59745	U	J										P					
2360-59746	U	J								G							
2360-59747	U	J										D					
2360-59748	U	J										D					
2360-59749	M	J										D	D[10]	M			
2360-59750	F	J										M	Q				
2360-59751	M	J										M	Q	Q	Q		
2360-59752	M	J										Q		Q	M		
2360-59753	U	J										Q					
2360-59754	M	J										Q	Q	Q	Q	P	P
2360-59755	U	J										Q					
2360-59756	U	J										P					
2360-59757	U	J								K							
2360-59758	U	J										P					
2360-59759	U	J										P					
2360-59760	U	J								L							
2360-59761	U	J								L							
2360-59762	U	J								Q							
2360-59763	U	J								Q							
2360-59764	U	J											P				
2360-59765	U	J											P				
2360-59766	U	J								Q							
2360-59767	U	J								K							
2360-59768	U	J										T					
2360-59769	U	J										M					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59770	U	J								K							
2360-59771	U	J								G							
2360-59772	F	A								K							
2360-59773	U	J											Q				
2360-59775	U	J											Q				
2360-59776	U	J											Q				
2360-59777	F	J											Q				M
2360-59778	U	J											Q				
2360-59779	U	J											K				
2360-59780	U	J											K				
2360-59781	U	J											K				
2360-59782	F	J											K			M	
2360-59785	U	J									D						
2360-59786	U	J									D						
2360-59787	U	J									D						
2360-59788	F	J									D	D	M	M	M	M	M
2360-59789	U	J										Q					
2360-59790	U	J										Q					
2360-59791	U	J										P					
2360-59792	U	J										P					
2360-59793	U	J										P					
2360-59794	U	J										P					
2360-59795	U	J										P					
2360-59796	U	J										P					
2360-59797	M	J										P	P				
2360-59798	U	J										P					
2360-59799	M	J										M	D	M		M	
2360-59800	U	J								G							
2370-39901	U	A								P							
2370-39902	U	J								P							
2370-39904	U	J								P							
2370-39911	M	A									P						
2370-39912	M	A									Q		Q				
2370-39913	M	A									G						
2370-39914	U	J									P						
2370-39915	M	A									P	P	P	P[11]	P	P	
2370-39916	M	A										T	T	T			
2370-39917	U	A										Y					
2370-39918	U	A										Y					
2370-39919	U	A										Y					
2370-39920	U	A										Y					
2370-39921	U	A										Y					
2370-39922	U	A										Y					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39923	U	A										Y					
2370-39924	U	A										Y					
2370-39925	U	A										Y					
2370-39926	U	A										Y					
2370-39927	U	A										Y					
2370-39928	U	A										Y					
2370-39929	M	A										G	G				
2370-39930	M	J													M	Q	D[12]
2370-39932	F	A									B	B	B				
2370-39933	U	A									Y						
2370-39934	U	A									Y						
2370-39935	U	A									Y						
2370-39937	M	A										Q	Q	Q			
2370-39938	M	A										M	M	M	M	M	M
2370-39939	F	A										Q	Q				
2370-39940	M	A										M	M	M	Q		
2370-39941	M	J										Q	L[13]				
2370-39942	U	J										D					
2370-39943	U	J										D					
2370-39944	U	J										D					
2370-39945	U	J										P					
2370-39946	M	J										P	P				
2370-39947	U	J										P					
2370-39948	F	A										M					
2370-39949	U	J										Q					
2370-39950	U	J										Q					
2370-39951	M	A									P	P	P	P			
2370-39953	M	A									P	P	P	P			
2370-39954	M	A									Q	Q	Q	Q			
2370-39956	F	A									D	D	D			M	M
2370-39957	F	A									Q	Q					
2370-39958	F	A									P						
2370-39959	M	A									P		A				
2370-39960	M	A									K						
2370-39961	M	A									P						
2370-39962	F	A									P						
2370-39964	F	A									P	P	P				
2370-39965	U	A									D						
2370-39966	M	J									D		M				
2370-39967	M	A										M	D[14]	Q	Q		
2370-39968	M	A															D
2370-39969	F	A													B		
2370-39970	U	J															M

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39971	U	A									P						
2370-39972	U	A									I						
2370-39973	U	A									Y						
2370-39974	U	A									I						
2370-39975	M	A									D	M					
2370-39976	M	A									D						
2370-39977	U	J									P						
2370-39978	F	A									P						
2370-39979	U	J									P						
2370-39980	M	J									P	K	K	K	K		
2370-39981	U	J									P						
2370-39982	U	A										Y					
2370-39983	U	A										Y					
2370-39984	U	A										Y					
2370-39985	U	A										Y					
2370-39986	M	A										G					
2370-39987	M	A										G					
2370-39988	M	A										G	M	M	M	M	
2370-39989	M	A										G					
2370-39990	F	A										G					
2370-39992	M	A										T					
2370-39993	U	A										Y					
2370-39994	U	A										Y					
2370-39995	U	A										Y					
2370-39996	U	A										Y					
2370-39997	U	A										Y					
2370-39998	U	A										Y					
2370-39999	M	A														Q	
2370-40000	M	A														D	D
2370-40001	U	J														P	
2370-40002	U	J														P	
2370-40003	M	A										T					
2370-40004	F	A										B			B		
2370-40005	U	J														S	
2370-40007	U	J														S	
2370-40008	U	J														D	
2370-40009	U	J														D	
2370-40010	U	J														D	K
2370-40011	F	A														Q	
2370-40012	M	A									Q	Q	Q				
2370-40013	M	A									P	P					
2370-40014	F	A									P	P	P				
2370-40016	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40017	M	A									M	M					
2370-40019	U	J									P						
2370-40020	U	J									P						
2370-40021	M	A									P	P					
2370-40022	M	A														K	
2370-40023	U	J													M		
2370-40024	M	J													K	K	K
2370-40025	U	J													K		
2370-40026	U	J													P		
2370-40027	F	J													P	E	K
2370-40029	M	J													M		D
2370-40030	U	J													M		
2370-40031	M	J													K	K	K
2370-40032	M	A									B						
2370-40033	U	A									Y						
2370-40034	U	A									Y						
2370-40035	U	A									Y						
2370-40036	M	A										G[15]					
2370-40037	F	A										G	M		M	M	M
2370-40038	M	A										G					
2370-40039	U	A										Y					
2370-40040	U	A										Y					
2370-40041	U	A										Y					
2370-40042	U	A										Y					
2370-40043	U	A										Y					
2370-40044	U	A										Y					
2370-40045	U	A										Y					
2370-40046	M	A										G	G[16]	M	M	M	M
2370-40047	F	A										P	P	P	P	P	P
2370-40048	U	J													T		
2370-40049	U	J													T		
2370-40050	U	J													T		
2370-40051	U	J														K	
2370-40052	M	A									B	B	B	B			
2370-40053	M	A									B						
2370-40054	M	A									B						
2370-40055	F	A									T						
2370-40056	M	A									T						
2370-40057	M	A										D					
2370-40058	M	A										M	B				
2370-40059	F	A										D	D	D			
2370-40060	M	A										P		P	P	P	P
2370-40061	F	A										P					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40062	F	A										P	P				
2370-40063	U	J										Q					
2370-40064	U	J										P					
2370-40065	U	J										Q					
2370-40066	F	A										Q	Q	Q	Q		
2370-40067	U	J										Q					
2370-40068	U	J										Q					
2370-40069	U	J										M					
2370-40070	U	J										M					
2370-40071	U	J										P					
2370-40072	U	J													M		
2370-40073	F	A													P	P	
2370-40074	U	J													P		
2370-40075	U	J													P		
2370-40076	U	J													P		
2370-40078	U	J															K
2370-40079	U	J															K
2370-40080	U	J										Q					
2370-40081	M	A										K					
2370-40082	F	A										K					
2370-40083	U	J										Q					
2370-40084	U	J										Q					
2370-40085	U	J											Q				
2370-40086	U	J											Q	M	M		
2370-40087	F	A											Q	Q	Q	Q	Q
2370-40088	M	A														D	D
2370-40089	U	J														M	
2370-40090	U	J														M	
2370-40091	F	J														M	D
2370-40093	U	J														M	
2370-40096	U	J												K			
2370-40097	M	J												K		K	K
2370-40098	U	J												K			
2370-40099	U	J													S		
2370-40100	U	J										K					
2370-40101	U	J										K					
2370-40102	U	J										K					
2370-40103	U	J										Q					
2370-40104	U	J										Q					
2370-40105	U	J										Q					
2370-40106	U	J										Q					
2370-40107	U	J										Q					
2370-40108	U	J										Q					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40110	U	J											T				
2370-40111	U	J											T				
2370-40112	M	J											T			T	
2370-40113	U	J											B				
2370-40114	M	J											T		T		
2370-40115	U	J											T				
2370-40116	U	J											T				
2370-40117	U	J											T				
2370-40118	U	J											T				
2370-40119	U	J											T				
2370-40120	U	J											T				
2370-40121	U	J											T				
2370-40122	U	J											T				
2370-40123	U	J											T				
2370-40124	M	J											T		M		
2370-40125	U	J											T				
2370-40126	M	A											G				
2370-40127	M	A											G				
2370-40129	M	A											G				
2370-40130	F	A													B		
2370-40132	F	A											T				
2370-40133	F	A											B				
2370-40134	U	A											B				
2370-40135	F	A											B				
2370-40136	F	A											T				
2370-40137	M	A											B				
2370-40138	M	A											T				
2370-40139	M	A											T	T			
2370-40140	F	A													P		
2370-40141	M	A													K	K	K
2370-40142	U	J													M		
2370-40143	U	J													Q		
2370-40144	M	J													M	T	
2370-40145	U	J													M		
2370-40146	U	J													S		
2370-40147	F	J												S	D		
2370-40148	F	J												S	S	S	S
2370-40149	U	J												S			
2370-40150	U	J													M		
2370-40151	F	J													M	M	
2370-40152	U	J													M		
2370-40153	U	J													S		
2370-40154	U	J													S		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40155	M	A													L		
2370-40156	M	A													B		
2370-40157	M	A											P		P	P	
2370-40158	M	J											B		T		
2370-40159	U	J											B				
2370-40160	F	A											G				
2370-40161	M	A											M	M	M		
2370-40162	U	J													B		
2370-40163	U	J													B		
2370-40164	U	J											Q				
2370-40165	M	A													B		
2370-40166	U	A											P				
2370-40167	U	J											P				
2370-40168	F	A											P	P	P		
2370-40169	U	J											M				
2370-40170	F	A											Q	Q			
2370-40171	F	A											D				
2370-40173	M	A											M	M	M	M	
2370-40174	U	J													M		
2370-40175	M	J													M	Q	Q
2370-40176	M	A													M		
2370-40177	U	J														T	
2370-40179	U	J														K	
2370-40180	M	A													B		
2370-40181	M	A													T		
2370-40182	U	J													B		
2370-40183	F	A											M				
2370-40184	M	A											D				
2370-40185	M	A											P				
2370-40186	M	A											D				
2370-40187	M	A											K				
2370-40188	U	J											Q				
2370-40190	M	J											P				K
2370-40191	F	A											M	M	M		
2370-40192	F	A											D			B	
2370-40193	F	A											Q	Q	Q	D	
2370-40194	F	A											P	P	P	P	
2370-40195	F	A											P	P	P		
2370-40197	M	A											M	Q	Q	M	M
2370-40199	U	J											P				
2390-92348	F	J		T						T							
2390-92350	M	A				M	Q		Q	Q							
2390-92365	M	J				D			Q	Q	Q						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2390-92410	M	A					Q		Q								
2390-92420	M	J					Q	Q	Q								
2390-92421	M	J					Q	Q	Q	Q	M	M					
2390-92427	F	J					M		Q								
2390-92433	M	J					Q		Q	Q							
2390-92434	M	J					Q	Q		Q	Q	Q	Q	Q	Q	M	M
2390-92451	F	J			M	M		Q		Q							
2390-92470	F	J					Q			Q							
2390-92475	M	J					M	Q	Q	Q	Q	Q	Q	Q			
2430-61006	U	A											Y				
2430-61007	U	A											Y				
2430-61008	U	A											Y				
2430-61009	U	A											Y				
2430-61010	U	A											Y				
2430-61011	U	A											Y				
2430-61012	U	A											Y				
2430-61013	U	A											Y				
2430-61014	U	A											Y				
2430-61015	U	A											Y				
2430-61016	U	A											Y				
2430-61017	U	A											Y				
2430-61018	U	A											Y				
2430-61019	U	A											Y				
2430-61020	U	A											Y				
2430-61021	U	A											Y				
2430-61023	U	A											Y				
2430-61024	U	A											Y				
2430-61025	U	A											Y				
2430-61026	U	A											Y				
2430-61027	U	A											Y				
2430-61028	U	A											Y				
2430-61029	U	A											Y				
2430-61030	U	A											Y				
2430-61031	U	A											Y				
2430-61032	U	A											Y				
2430-61033	U	A											Y				
2430-61034	U	A											Y				
2430-61035	U	A											Y				
2430-61036	U	A											Y				
2430-61037	U	A											Y				
2430-61038	U	A											Y				
2430-61039	U	A											Y				
2430-61040	U	A											Y				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61041	U	A											Y				
2430-61042	U	A											Y				
2430-61043	U	A											Y				
2430-61044	U	A											Y				
2430-61045	U	A											Y				
2430-61046	U	A											Y				
2430-61047	U	A											Y				
2430-61048	U	A											Y				
2430-61049	U	A											Y				
2430-61050	U	A											Y				
2430-61051	U	A											Y				
2430-61052	U	A											Y				
2430-61053	U	A											Y				
2430-61054	U	A											Y				
2430-61055	U	A											Y				
2430-61056	U	A											Y				
2430-61058	U	A											Y				
2430-61059	U	A											Y				
2430-61060	U	A											Y				
2430-61061	U	A											Y				
2430-61062	U	A											Y				
2430-61063	U	A											Y				
2430-61064	U	A											Y				
2430-61065	U	A											Y				
2430-61067	U	A											Y				
2430-61068	U	A											Y				
2430-61069	U	A											Y				
2430-61070	U	A											Y				
2430-61071	U	A											Y				
2430-61072	M	A												G			T
2430-61073	M	A												B			
2430-61074	U	J												B			
2430-61075	U	J												B			
2430-61076	U	J												B			
2430-61077	U	J												M			
2430-61078	U	J												Q			
2430-61079	F	A												M			
2430-61080	M	A												P	P	P	P
2430-61081	U	J												M			
2430-61082	U	J												Q			
2430-61083	M	A												P	P	P	P
2430-61084	M	J												Q		D	
2430-61085	M	A													D	D	D

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61086	U	J													M		
2430-61087	F	A													P	P	P
2430-61088	M	A														N	D
2430-61089	U	J														M	
2430-61090	U	J														M	
2430-61091	U	J														S	
2430-61092	F	A														S	
2430-61093	M	A														S	S
2430-61094	U	J														D	
2430-61095	M	A														M	
2430-61096	F	A														L	
2430-61097	U	J														P	
2430-61098	M	J														P	E[17]
2430-61099	U	J														K	E[18]
2430-61100	F	A														K	K
2430-61101	U	J												K			
2430-61102	U	J												K			
2430-61103	M	A												D			
2430-61104	M	A												M			
2430-61105	M	A												Q			
2430-61106	M	J												P		M	M
2430-61107	U	J												P			
2430-61108	U	J												P			
2430-61109	F	A												K			
2430-61110	U	J												K			
2430-61111	U	J												P			
2430-61112	U	J												P			
2430-61113	U	J												P			
2430-61114	M	J												P		K	K
2430-61115	U	J												P			
2430-61116	F	A												M	M		
2430-61117	U	J												P			
2430-61118	M	J												P	M	M	K
2430-61119	U	J												P			
2430-61120	F	J												P	P	P	P
2430-61121	U	J												Q			
2430-61122	U	J												P			
2430-61123	F	J												P		P	
2430-61124	F	J												P		K	
2430-61125	M	A												K			
2430-61126	U	J												S			
2430-61127	M	A												P	P		
2430-61128	U	J												M			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61129	U	J												Q			
2430-61130	U	J												Q			
2430-61131	U	J												M			
2430-61132	U	J												M			
2430-61133	U	J												M			
2430-61134	M	A												T		N	N
2430-61135	M	A												T	T	T	
2430-61136	M	A												B	B	B	B
2430-61137	F	A												B	B	B	B
2430-61138	F	A												B			
2430-61139	F	A												T			
2430-61140	U	J												B			
2430-61141	U	J												B			
2430-61142	U	J												B			
2430-61143	U	J												T			
2430-61144	U	J												T			
2430-61145	U	J												T			
2430-61151	U	J														K	
2430-61152	U	J														P	
2430-61153	F	A													M		
2430-61154	F	J													Q	S	S
2430-61155	U	J													Q		
2430-61156	U	J													K		
2430-61157	U	J													K		
2430-61158	M	A													K	K	K
2430-61159	M	J													M		K
2430-61160	U	J													M		
2430-61161	U	J													D		
2430-61162	M	A													S		
2430-61163	F	A														K	
2430-61165	M	J												Q	Q	M	
2430-61167	M	A												M	M	M	M
2430-61168	U	J												M			
2430-61169	U	J												M			
2430-61170	U	J												M			
2430-61171	U	J												M			
2430-61172	F	J												M	M		
2430-61173	U	J												M	M		
2430-61174	F	J												M		Q	
2430-61175	U	J												Q			
2430-61176	M	J												Q		P	P
2430-61177	U	J												Q			
2430-61178	M	A												K			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61179	M	A												K	P	P	P
2430-61180	M	A												K		K	K
2430-61181	F	A												K	K		
2430-61182	M	A												K			
2430-61183	M	A												K			
2430-61184	U	J												Q			
2430-61185	F	J												Q	M		
2430-61186	U	J												Q			
2430-61187	M	J												Q	L	L	
2430-61188	U	J												Q			
2430-61189	M	J												Q		M	
2430-61190	U	J												Q			
2430-61191	M	J												M	D		
2430-61192	U	J												M			
2430-61193	U	J												M			
2430-61194	U	J												Q	Q		
2430-61195	U	J												Q			
2430-61196	U	J												Q			
2430-61197	M	J												P		K	K
2430-61198	U	J												P	Q		
2430-61199	U	J												P			
2430-61200	U	J												P			
2430-61202	U	J												M			
2430-61203	U	J												M			
2430-61204	U	J												M			
2430-61205	U	J												M			
2430-61206	M	J												M		M	
2430-61207	F	J												M	D	D	
2430-61208	U	J												D			
2430-61209	M	A												V	D		
2430-61210	U	A												K			
2430-61211	U	J												S			
2430-61212	U	J												M			
2430-61213	U	J														K	
2430-61214	M	A															K
2430-61215	U	J															P
2430-61216	U	J															Q
2430-61217	U	J															Q
2430-61218	U	J															P
2430-61219	U	J															M
2430-61220	U	J															P
2430-61221	U	J														P	
2430-61223	U	J												D			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61224	U	J												D			
2430-61225	U	J												D			
2430-61226	U	J														P	
2430-61227	U	J														P	
2430-61228	U	J														K	
2430-61229	U	J														K	
2430-61230	F	A														S	S
2430-61231	U	J														S	
2430-61232	U	J														L	
2430-61233	U	J														L	
2430-61234	F	A														Q	Q
2430-61235	U	J														Q	
2430-61236	U	J														K	
2430-61237	U	J															B
2430-61271	U	J													P		
2430-61276	U	J														Q	
2430-61277	U	J													P		
2430-61278	M	J													P		
2430-61279	F	J													P	K	K
2430-61280	U	J														M	
2430-61285	U	J													M		
2540-58101	U	J														K	
2540-58102	U	J														K	
2540-58103	U	J														K	
2540-58104	M	J														K	
2540-58105	U	J														Q	
2540-58106	U	J														Q	
2540-58107	M	J														Q	
2540-58108	U	A															T
2540-58109	M	A															P[19]
2540-58110	F	A															P
2540-58111	F	A															P
2540-58112	U	J															Q
2540-58113	U	J															M
2540-58114	U	J															P
2540-58115	U	J															B
2540-58116	U	J														B	
2540-58117	U	J														B	
2540-58118	U	J														K	
2540-58119	U	J														K	
2540-58120	F	A															B
2540-58132	M	A													S	S	S
2540-58141	U	J													M		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58142	U	J													M		
2540-58143	M	A													D		
2540-58144	U	J													K		
2540-58145	U	J													K		
2540-58146	M	A													B		
2540-58147	U	J														B	
2540-58148	U	J														Q	
2540-58149	U	J														Q	
2540-58150	U	J														Q	
2540-58151	U	J														Q	
2540-58152	F	A															Q
2540-58154	M	J													M	T	D[20]
2540-58155	U	J													M		
2540-58156	F	A														K	K
2540-58157	U	J														K	E
2540-58158	M	J														K	K
2540-58159	F	J														K	K
2540-58160	U	J														S	
2540-58161	U	J														L	
2540-58162	U	J														K	
2540-58163	U	J														K	
2540-58164	U	J														K	
2540-58165	F	J														K	K
2540-58166	U	J														K	
2540-58172	M	A															Q
2540-58173	U	J															M
2540-58174	U	J															M
2540-58175	F	A															K
2540-58176	M	A															Q
2540-58177	F	A															K
2540-58178	U	J															K
2540-58179	U	J															K
2540-58180	U	J															K
2540-58182	U	J															K
2540-58183	U	J															K
2540-58184	F	A															M
2540-58185	U	J													P		
2540-58186	M	A													S		
2540-58187	F	A													P		K
2540-58188	U	J													P		
2540-58189	F	A													P		
2540-58190	U	J														T	
2540-58191	U	J														P	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58192	M	A														Q	Q[21]
2540-58193	F	A														N	N
2540-58194	U	J														D	
2540-58195	U	J														P	
2540-58196	U	J														P	
2540-58197	U	J														P	
2540-58198	U	J														P	
2540-58199	U	J														K	
2540-58200	U	J														K	
2540-58201	U	J														K	P
2540-58202	M	A														K	
2540-58203	F	A														K	K
2540-58204	F	A														K	
2540-58205	U	J														K	
2540-58206	U	J														P	
2540-58207	U	J														P	
2540-58208	U	J														P	
2540-58209	F	A														P	
2540-58211	U	J															K
2540-58212	U	J															K
2540-58213	U	J															M
2540-58214	U	J															K
2540-58216	U	J													M		
2540-58217	M	A													S	S	
2540-58218	U	J													S		
2540-58219	U	J													Q		
2540-58220	M	A														B	B
2540-58221	M	A														B	
2540-58222	U	J														K	
2540-58223	M	A														K	K
2540-58224	F	J														K	K
2540-58225	U	J														K	
2540-58226	F	A														K	
2540-58227	M	A														T	
2540-58228	M	A														T	T
2540-58229	M	A														B	
2540-58230	F	A														B	B
2540-58231	F	A														T	M
2540-58232	U	J														T	
2540-58233	F	A														N	
2540-58235	U	J														N	
2540-58236	U	J														N	
2540-58237	U	J														K	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58238	F	J														K	E[22]
2540-58239	U	J														K	
2540-58240	F	J														K	E
2540-58241	F	A														K	K
2540-58242	U	J														K	
2540-58243	U	J														K	
2540-58244	U	J														K	
2540-58245	M	A															P
2540-58246	M	A															E
2540-58247	U	J															K
2540-58274	U	J															N
2540-58275	U	J															N
2540-58276	U	J															K
2540-58277	U	J															K
2540-58278	U	L															D
2540-58279	U	J															D
2540-58280	U	J															K
2540-58282	U	J															K
2540-58283	U	J															K
2540-58284	U	J															P
2540-58285	U	J															P
2540-58286	U	J															P
2540-58287	M	A															S
2540-58288	U	J														P	
2540-58289	F	A														K	
2540-58290	U	J														K	
2540-58291	U	J														K	
2540-58292	U	J														K	
2540-58293	F	A														P	P
2540-58294	U	J														P	
2540-58295	U	J														P	
2540-58296	U	J														P	
2540-58297	F	A															K
2540-58298	U	J															K
2540-58299	U	J															K
2540-58378	U	J															K
2540-58385	U	J															S
2540-58386	F	A															K
2540-58387	M	A															K
2590-53101	U	J															P
2590-53102	U	J															P
2590-53103	U	J															P
2590-53104	U	J															P

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2590-53105	F	A															D
2590-53106	U	J															M
2590-53107	U	J															M
2590-53108	F	A															D
2590-53109	U	J															P
2590-53110	F	A															K
2590-53111	U	J															K
2590-53112	U	J															K
2590-53113	U	J															K
2590-53114	U	J															K
2590-53115	U	J															M
2590-53116	U	J															M
2590-53117	U	J															M
2590-53118	U	J															K
2590-53119	U	J															M
2590-53121	F	A															K
2590-53122	U	J															K
2590-53123	U	J															K
2590-53124	M	A															K
2590-53125	U	J															K
2590-53126	U	J															D
2590-53127	U	J															K
2590-53141	U	J															M
2590-53142	U	J															M
2590-53143	U	J															N
2590-53144	U	J															K
2590-53145	M	A															S
2590-53147	U	J															D
2590-53148	U	A															K
2590-53149	U	J															K
2590-53150	U	J															M
2590-53151	U	J															M
2590-53152	U	J															Q
2590-53154	U	J															Q
2590-53162	M	A															T
2590-53163	F	A															B
2590-53164	U	J															B
2590-53171	F	A															E
2590-53172	U	J															K
2590-53173	F	A															K
2590-53182	U	J															B

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3500-68963	U	J								T							
3500-68968	U	J								P							
3500-68969	U	J								P							
3500-68972	F	J								P	P	P					

* Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA.

[1] K = Key Pittman, E = River Ranch, P = Pahranagat NWR, W = Meadow Valley Wash, L = Littlefield, Q = Mesquite, M = Mormon Mesa, D = Muddy River, N = Warm Springs, G = Grand Canyon, T = Topock Marsh, B = Bill Williams River NWR, I = Imperial, Y = Yuma, S = St. George, V = Las Vegas Wash, R = Roosevelt Lake, A = Ash Meadows. Study area indicated is the study area where the individual was first detected during the given season. Within-season movements are indicated with individual footnotes.

[2] M = male, F = female, U = unknown.

[3] A = adult, J = juvenile.

[4] Within-season movement from Mormon Mesa to Mesquite.

[5] Within-season movement from Mesquite to Mormon Mesa.

[6] Within-season movement from Mesquite to Mormon Mesa.

[7] Within-season movement from Littlefield to Mesquite.

[8] Within-season movement from Grand Canyon to Mesquite.

[9] Within-season movement from Mormon Mesa to Muddy River.

[10] Within-season movement from Muddy River to Mormon Mesa.

[11] Within-season movement from Pahranagat to Key Pittman.

[12] Within-season movement from Muddy River to Mesquite.

[13] Within-season movement from Littlefield to Mesquite.

[14] Within-season movement from Muddy River to Mesquite.

[15] Within-season movement from Grand Canyon to Mesquite.

[16] Within-season movement from Grand Canyon to Mormon Mesa.

[17] Within-season movement from River Ranch to Key Pittman.

[18] Within-season movement from River Ranch to Key Pittman.

[19] Within-season movement from Pahranagat to River Ranch.

[20] Within-season movement from Muddy River to Mormon Mesa. Likely also within-season movement from Topock to Muddy River in 2010.

[21] Within-season movement from Mesquite to Mormon Mesa.

[22] Within-season movement from River Ranch to Key Pittman.

Appendix F

CONTRIBUTING PERSONNEL

Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Banding Lead
Wendy Langeberg, Ph.D.	Statistician
Glenn A. Dunno, M.A.	GIS Specialist
DeAnne Rietz, M.S.	Hydrologist
Jessica Maggio	Project Administrator/Formatting Specialist
Kimberly Proa	Administrative Assistant/Data Entry
Dorothy A. House, M.A.	Technical Editor
Anne Pellegrini	Project Coordinator
Sarah Nichols	Assistant Project Coordinator
Danielle Ethier	Field Coordinator
Iwona Kuczyńska	Field Coordinator
Katie Barnes	Bander/Nest Monitor
Ashley Daniels	Bander/Nest Monitor
Jill Peiffer	Bander/Nest Monitor
Josh Sayers	Bander/Nest Monitor
Ryan Davis	Surveyor/Nest Monitor
Greg Joder	Surveyor/Nest Monitor
Alex McDonnell	Surveyor/Nest Monitor
Zach Mobley	Surveyor/Nest Monitor
Amber Swicegood	Surveyor/Nest Monitor
Tim Schreckengost	Surveyor
Jesse Vooz	Surveyor

CD
Report 2 of 2
Internal Review
Only

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

2136

Flagstaff Office
114 North San Francisco Street, Suite 100
Flagstaff, AZ 86001
Tel 928.774.5500 Fax 928.779.2709
www.swca.com

29 February, 2012

Susie Tharratt, Recovery Permit Coordinator
Carlsbad U.S. Fish and Wildlife Service
6010 Hidden Valley Road
Carlsbad, CA 92011

Re: SW Willow Flycatcher Studies 2011
T&E Species Permit TE028605-4, Final Report Deliverables

Ms. Tharratt:

In fulfillment of SWCA Environmental Consultant's Federal Fish and Wildlife permit deliverable requirement with your department, please find enclosed on CDs the annual report titled *Southwestern Willow Flycatcher Surveys, Demography, and Ecology along the Lower Colorado River and Tributaries, 2011;* and the confidential annual report, *Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations along the Virgin and Lower Colorado River Regions, 2011.* These reports detail all of our Southwestern Willow Flycatcher studies conducted in southern Nevada and California in 2011 and are part of our final deliverable to U.S. Bureau of Reclamation. They are supplemental to our annual report delivered to your department in December 2011. Both reports are presented in a site-by-site format to facilitate locating information of interest.

If you or your department requires any additional information, please do not hesitate contacting me directly: (928) 774-5500 ext. 4201; tkoronkiewicz@swca.com.

Many thanks for your continuing support, sincerely,

Tom Koronkiewicz
Avian Ecologist

TJK
Enclosures

RECEIVED
USFWS
CFWO-CARLSBAD, CA
2012 MAR -2 AM 9:58

Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations Along the Virgin and Lower Colorado River Regions, 2011.



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2012

AR064943

LOWER COLORADO RIVER MULTI-SPECIES CONSERVATION PROGRAM
Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy

Lower Colorado River Multi-Species Conservation Program

Aerial Photographs of Southwestern Willow Flycatcher Nest and Territory Locations along the Virgin and Lower Colorado River Regions, 2011. Annual Report

Prepared by Mary Anne McLeod and Anne Pellegrini,
SWCA Environmental Consultants, Flagstaff, Arizona

Contract number GS-10F-0209L

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

February 2012

PREFACE

This document is one of the deliverables submitted to the U.S. Bureau of Reclamation under contract # GS-10F-0209L to complete Southwestern Willow Flycatcher (*Empidonax traillii extimus*) studies along the lower Colorado River and tributaries in 2011. The document comprises a list of all sites surveyed for willow flycatchers in 2011 and the UTM coordinates (Zone 11, NAD 83) of the centroid of each site (Table 1), along with a compilation of aerial photographs. These aerial photographs include the location, identity, and breeding status of each willow flycatcher detected at study areas where resident flycatchers were detected during 2011 (Figure 1). Sites that fall within a given map extent are also shown for reference, regardless of flycatcher presence within the site. For additional information regarding methodology and willow flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries in 2011 refer to:

> McLeod, M.A., and A.R. Pellegrini. 2012. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2011. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, NV by SWCA Environmental Consultants, Flagstaff, AZ. 167 pp.

This document is intended for use only by the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, the U.S. Geological Survey, Nevada Department of Wildlife, California Department of Fish and Game, and the Arizona Game and Fish Department. Specific locations of Southwestern Willow Flycatcher territories and nests may be considered by some agencies as sensitive information. Therefore, this document is not intended for general distribution. Please contact the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service for permission to copy and distribute this document.

Survey Site Selection

Willow flycatcher studies have been completed annually on the lower Colorado River and tributaries since 1996, and SWCA has been contracted for these studies each year since 2003. Sites surveyed in 2011 were selected based on sites surveyed in previous years, annual reconnaissance over the years by air and on the ground, and opportunistic flycatcher detections. Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (>50%) and standing water or saturated soil under or adjacent to the vegetation were considered the most suitable habitats for flycatchers. Early successional stands of young riparian vegetation >3 m in height in proximity to surface water or saturated soil were also considered potentially suitable flycatcher habitat. Site boundaries have been refined over the years based on conditions observed on the ground and include the full extent of known suitable and potential habitat. For sites surveyed in previous years, we retained original site names.

Color Leg Band Combination Codes

Color-band codes used on each aerial photograph follow the conventions presented below:

Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band and color-band designations for right and left legs are separated with a colon. **EE** = electric yellow federal band, **PU** = pumpkin federal band, **TQ** = turquoise federal band, **XX** = standard silver federal band, **Bs** = blue federal band, **R** = red, **D** = dark/navy blue, **B** = light blue, **K** = black, **V** = violet, **Z** = gold, **Y** = yellow, **G** = green, **W** = white, **O** = orange, **UB** = unbanded, **(M)** = metal pin striped band.

Nest and Willow Flycatcher Location Codes

Nest and willow flycatcher location codes on each aerial photograph follow the conventions presented below:

Blue	Unknown Status: the approximate use area center for individual willow flycatchers detected at the site for less than 7 days
Yellow	Nest Location: a willow flycatcher nest location
Red	Territory Center: the approximate territory center for a single, territorial willow flycatcher detected at the site for 7 or more days
Green	Pair/No Nest: the approximate territory center for a willow flycatcher pair for which no nesting was confirmed

All locations on the aerial photographs were based on UTM coordinates (Zone 11, NAD 83) obtained in the field in 2011 using a Garmin Rino 110 GPS unit.

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2011*

Study Area[1]	Survey Site	Area (ha)	UTM Coordinate of Site Centroid	Occupancy Status[2,3]
KEPI	Patch 0	0.04	656591E 4158848N	O, B
	Patch 1	0.1	656578E 4158893N	O, B
	Patch 2	0.1	656557E 4158946N	O, B
	Patch 3	0.1	656533E 4158980N	O, R
	Patch 4	0.1	656510E 4159046N	O, B
	Patch 4.5	0.02	656461E 4159156N	U, ND
	Patch 5	0.1	656224E 4159382N	O, B
	Patch 6	0.2	656308E 4159498N	O, B
	Patch 7	0.1	656344E 4159530N	O, B
	Patch 8	0.1	656360E 4159556N	O, B
	Patch 9	0.3	656404E 4159591N	O, B
	Patch 10	0.1	656481E 4159618N	O, B
	Patch 10.5	0.02	656530E 4159657N	O, B
	Patch 11	0.1	656565E 4159745N	O, B
	Patch 12	0.1	656592E 4159818N	O, B
RIRA	East Side	0.4	659403E 4147993N	O, B
	West Side	0.3	659268E 4147975N	O, B
	Smalls	0.5	659388E 4147759N	O, P
PAHR	North	4.6	665781E 4130976N	O, B
	West	1.5	665539E 4130426N	O, Un
MESQ	Hafen Lane	6.1	761533E 4076637N	O, B
	West	10.4	757880E 4075451N	O, B
	Bunker Marsh North	7.1	754073E 4072701N	D, ND
MOME	Mormon Mesa South (North half)	8.4	739573E 4057262N	U, ND
	Mormon Mesa South (South half)	3.4	739476E 4056901N	U, ND
	Virgin River #1 (North half)	11.4	739316E 4056227N	O, B
	Virgin River #1 (South half)	11.1	739213E 4055552N	O, B
	Virgin River #2	11.2	739172E 4053766N	U, ND
MUDD	Overton WMA Pond	0.7	731155E 4045638N	O, Un
	Overton WMA	14.9	731660E 4044514N	O, B
WMSP	Muddy Mac	0.7	704071E 4065648N	O, B
TOPO	Pipes #1	5.2	726906E 3856907N	O, R
	Pipes #3	5.7	727012E 3856517N	O, B
	The Wallows	0.7	727194E 3856182N	O, R
	PC6-1	4.8	727235E 3855838N	U, Un
	Pig Hole	2.4	727233E 3855415N	U, ND
	In Between	7.7	727036E 3855171N	U, Un
	800M	4.7	726867E 3855040N	O, R
	Pierced Egg	6.7	726668E 3855001N	U, Un

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	UTM Coordinate of Site Centroid	Occupancy Status[2,3]
TOPO	Swine Paradise	0.9	726285E 3854485N	U, Un
	Barbed Wire	2.1	726154E 3854553N	U, ND
	Platform	1.9	725829E 3853914N	U, Un
	250M	1.9	725838E 3853503N	U, ND
	Hell Bird	6.3	725891E 3853265N	U, Un
	Glory Hole	5.0	725671E 3853043N	U, ND
	Spaghetti	5.4	724726E 3852884N	U, Un
	Beal Lake	18.0	725946E 3850917N	U, Un
	Lost Lake	3.3	727971E 3846984N	U, Un
BIWI	Burn Edge	4.1	769876E 3798256N	O, Un
	Site #4	9.9	769684E 3797558N	O, R
	Site #3	13.0	769998E 3797260N	O, B
	Last Gasp	2.1	770525E 3797965N	U, ND
	Site #5	6.8	771903E 3796595N	U, Un
	Cougar Point	1.3	774179E 3795895N	O, B
	Upstream from Site #8	1.5	778658E 3794902N	U, ND
	Planet Ranch Road	3.3	779034E 3794487N	O, B
	New River	0.6	779900E 3794549N	U, ND
PVER	PVER Phase 2	21.4	728547E 3730261N	U, M
	PVER Phase 3	21.4	728776E 3729859N	U, M
CIBO	CVCA Phase 1	26.2	717274E 3699263N	U, M
	CVCA Phase 2	25.5	717469E 3698811N	U, M
	CVCA Phase 3	38.4	714371E 3698112N	U, M
	Cibola Nature Trail	13.7	716008E 3694360N	U, M
	Cibola Island	4.2	714894E 3685438N	U, ND
	Cibola Site #2	16.4	716845E 3684106N	U, M
	Cibola Site #1	7.7	717233E 3683564N	U, ND
	Cibola Lake #2 (East)	4.5	717146E 3679673N	O, M
	Walker Lake	11.4	716003E 3676276N	U, M
IMPE	Paradise	7.8	714120E 3666214N	U, M
	Hoge Ranch	20.7	717175E 3660307N	U, M
	Rattlesnake	7.6	719879E 3659586N	U, M
	Milemarker 65	10.0	726646E 3657774N	U, M
	Nursery NW	7.0	733900E 3654066N	U, M
	Ferguson Lake	21.1	733587E 3651733N	U, M
	Great Blue Heron	7.1	736876E 3652307N	U, M
	Powerline	1.0	737325E 3652100N	U, M
	Martinez Lake	4.6	737362E 3651773N	U, M

Table 1. Sites Surveyed and/or Monitored for Willow Flycatchers along the Lower Colorado River and Tributaries, 2011* (Continued)

Study Area[1]	Survey Site	Area (ha)	UTM Coordinate of Site Centroid	Occupancy Status[2]
MITT	Mittry West	4.4	734967E 3638617N	U, M
YUMA	Gila River Site #2	2.9	736484E 3623810N	U, M
	Fortuna Site #1	3.2	737603E 3623605N	U, M
	Fortuna North	3.8	739754E 3625575N	U, M

* As per Reclamation, we defined occupied sites as areas where willow flycatchers were detected after 15 June. Willow flycatchers for which detections spanned one week or longer were considered resident at a site, regardless of the portion of the breeding season in which the bird was observed or whether a possible mate was observed. For unidentified, non-resident willow flycatchers detected at study areas where flycatcher residency or breeding has been recorded, it is unknown if these individuals were migrants or non-territorial, local individuals. In study areas where no resident willow flycatchers have been detected since 2003, individuals detected on a single occasion are recorded as migrants.

[1] KEPI = Key Pittman Wildlife Management Area; RIRA = River Ranch; PAHR = Pahranagat National Wildlife Refuge (NWR); MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; WMSP = Warm Springs Natural Area; TOPO = Topock Marsh; BIWI = Bill Williams River NWR; PVER = Palo Verde Ecological Reserve; CIBO = Cibola; IMPE = Imperial; MITT = Mittry Lake; YUMA = Yuma.

[2] O = occupied; U = unoccupied; D = discontinued; B = breeding site; R = resident Southwestern Willow Flycatcher(s) recorded at site, no pairing/breeding behavior observed; P = paired willow flycatchers recorded at site, no nests located; M = migrant willow flycatcher(s) recorded at site, subspecies unknown; Un = residency status could not be determined; ND = no detection.

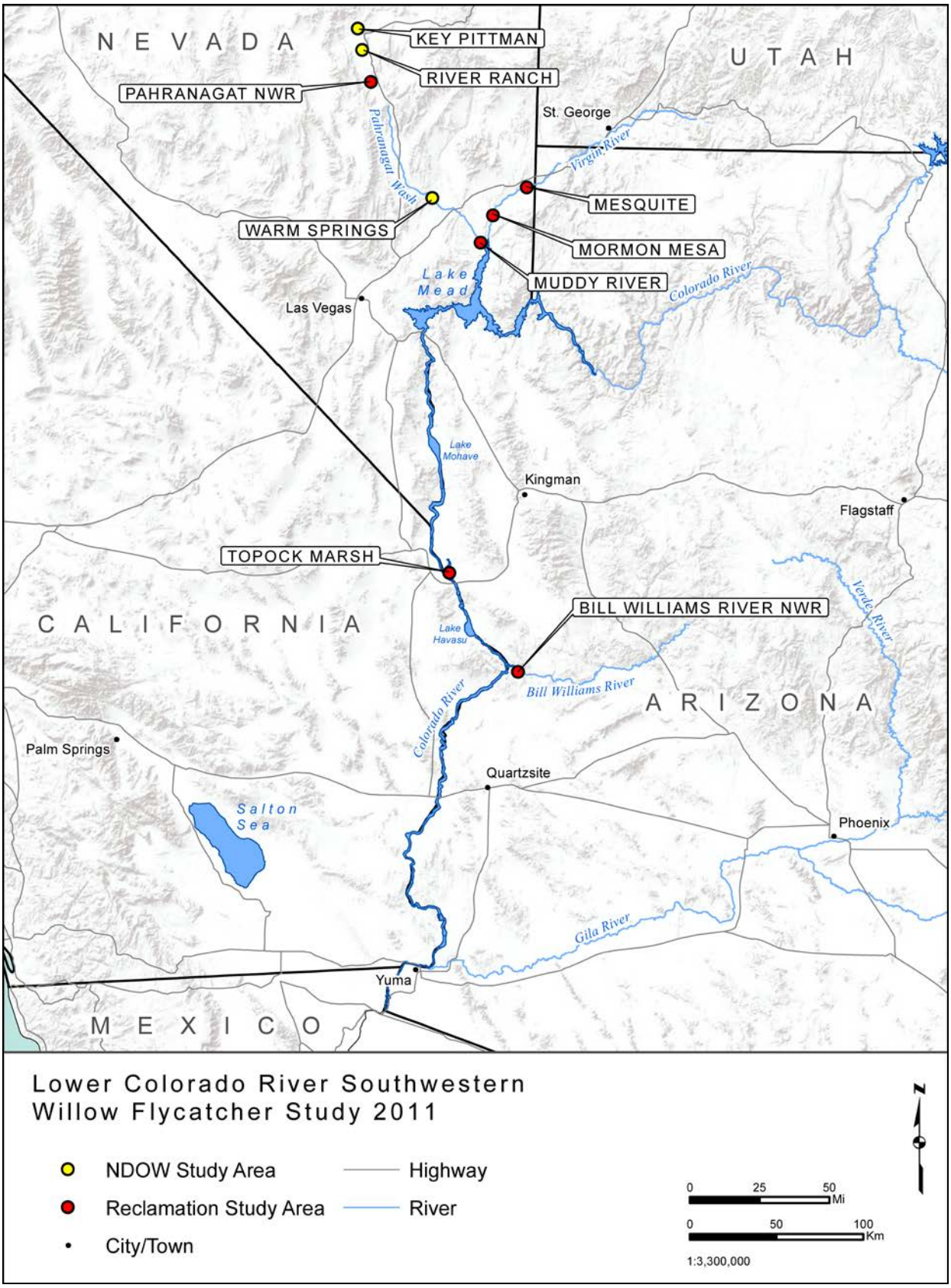
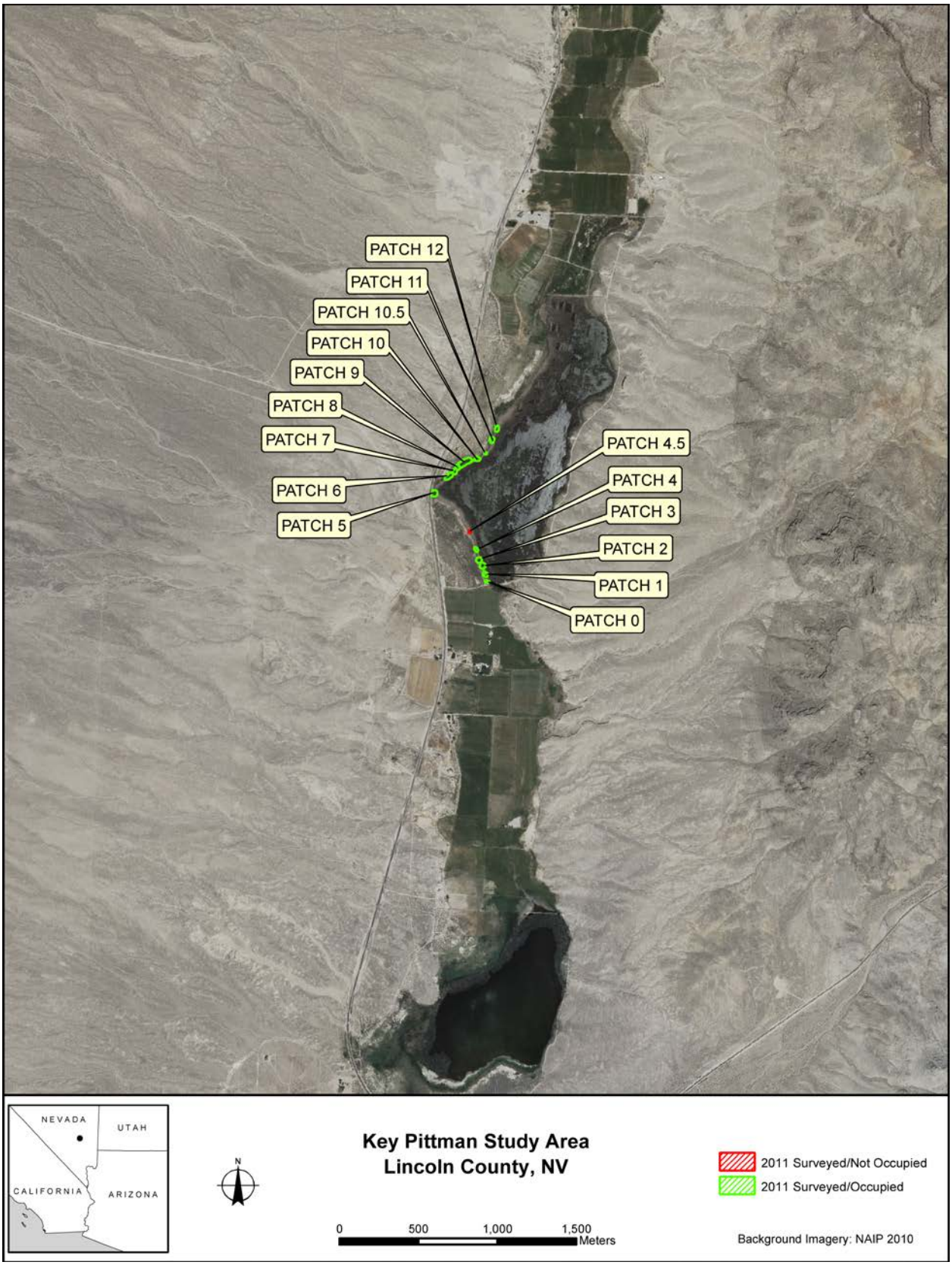
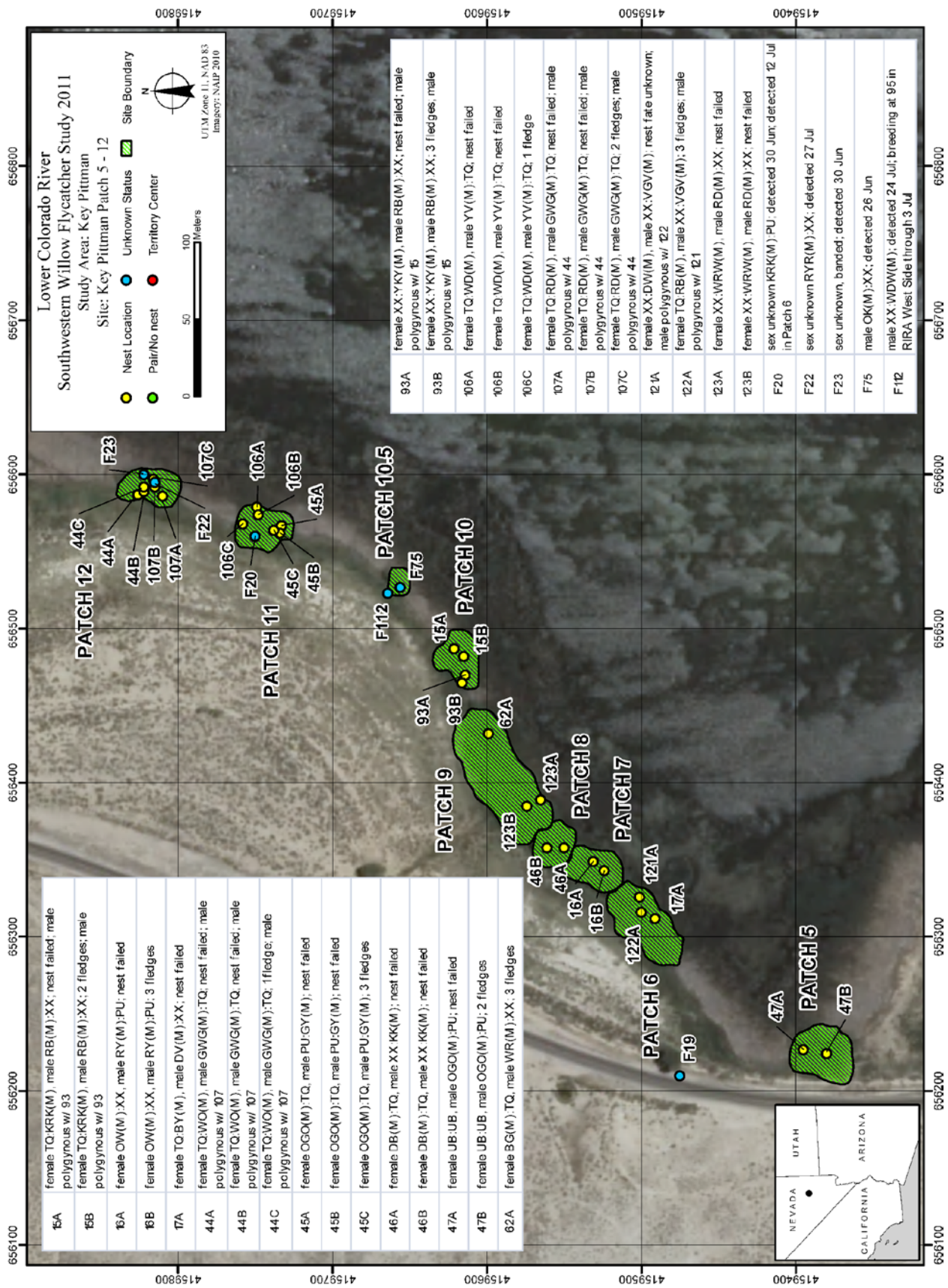
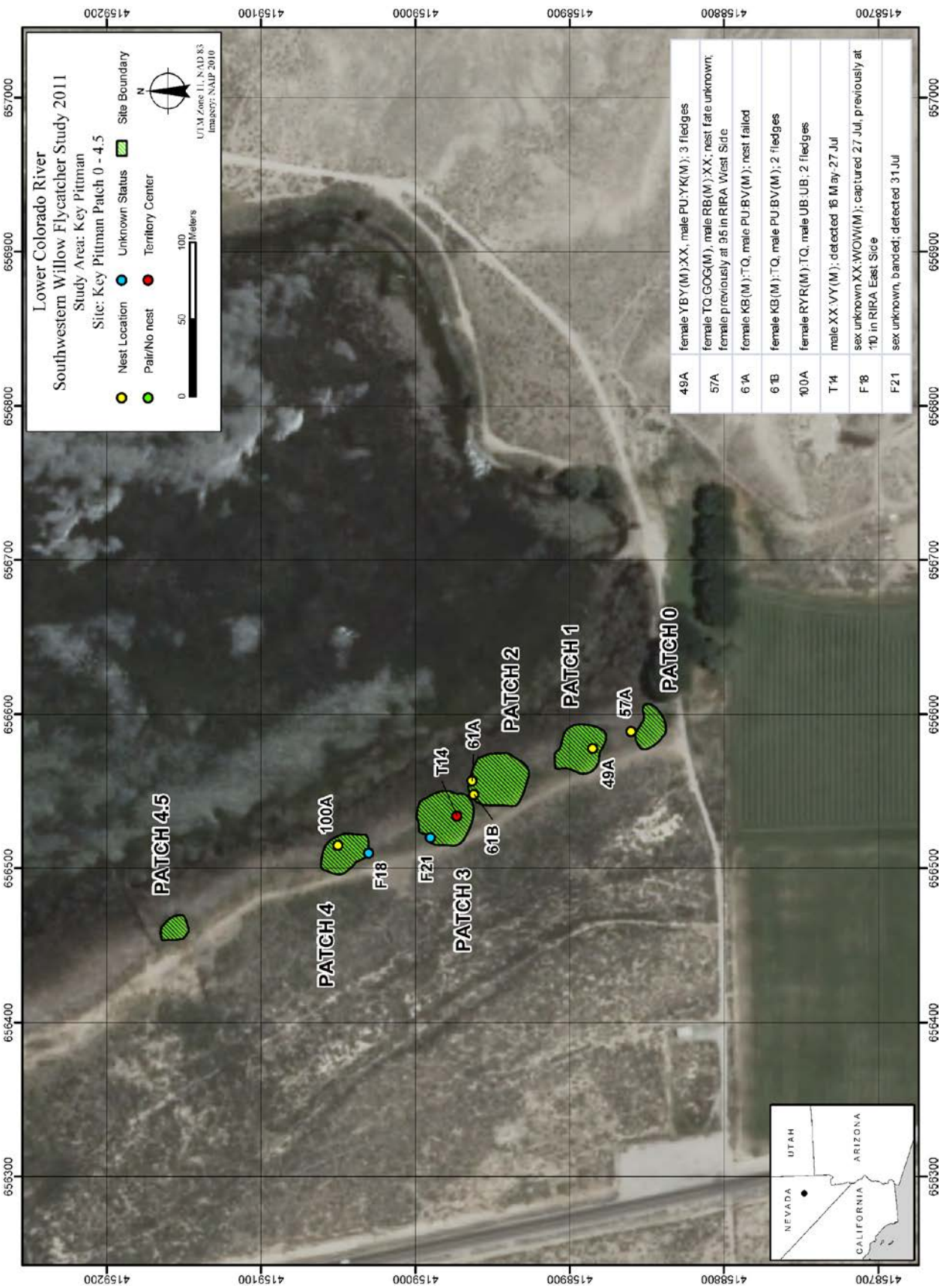
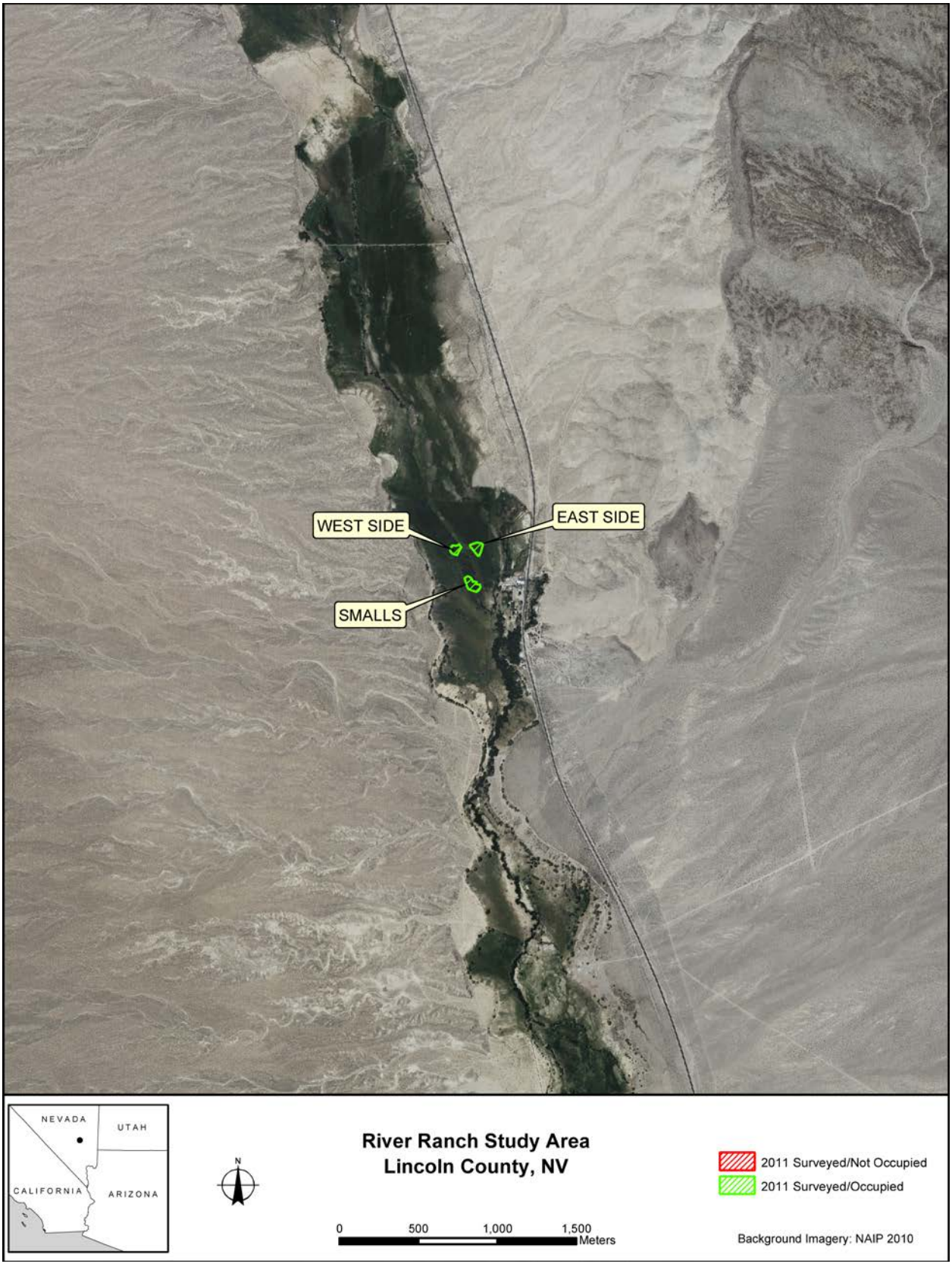


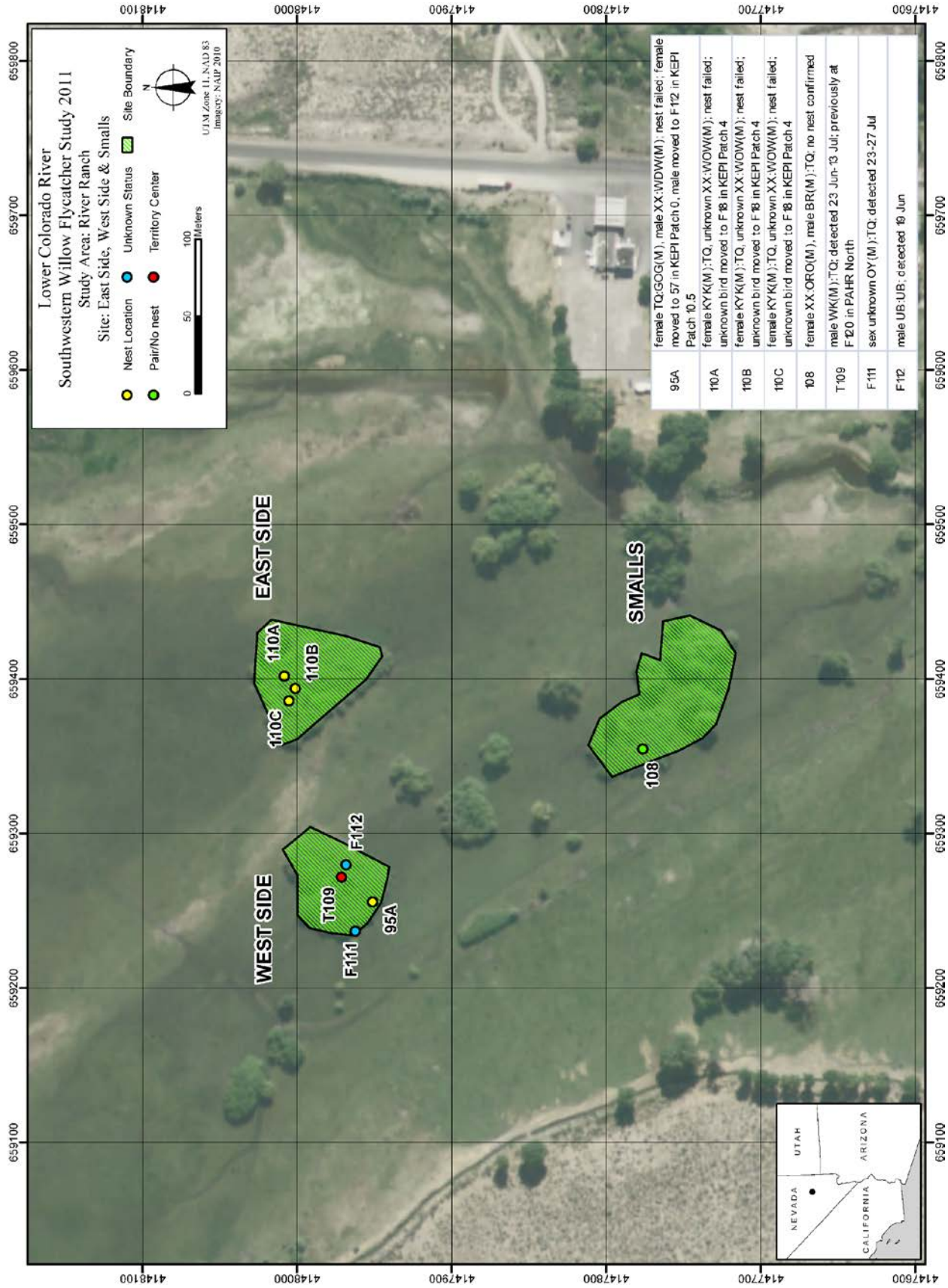
Figure 1. Locations of resident Southwestern Willow Flycatcher populations along the Virgin and lower Colorado Rivers, 2011.

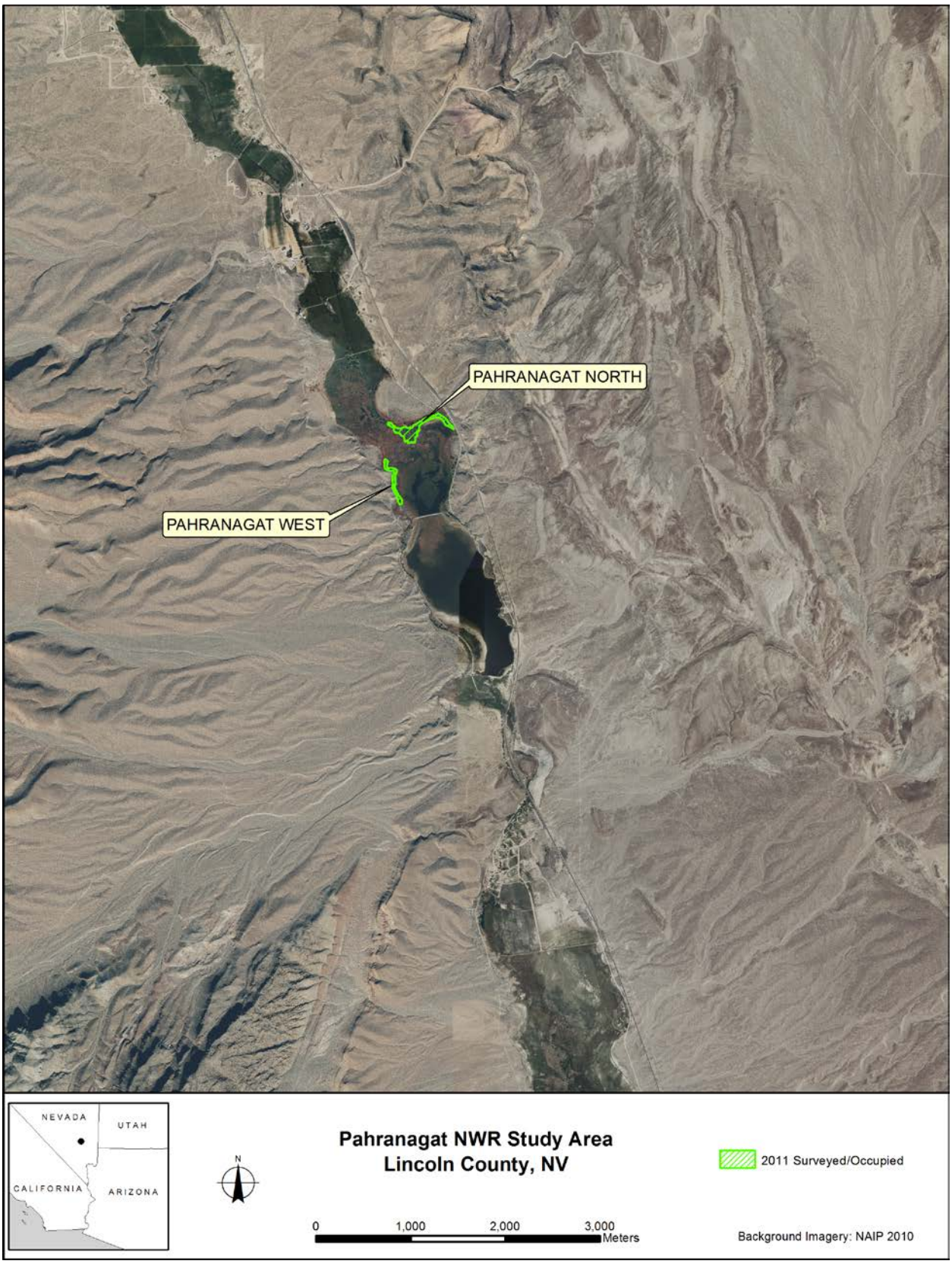

PATCH 12
PATCH 11
PATCH 10.5
PATCH 10
PATCH 9
PATCH 8
PATCH 7
PATCH 6
PATCH 5
PATCH 4.5
PATCH 4
PATCH 3
PATCH 2
PATCH 1
PATCH 0
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Key Pittman Study Area
Lincoln County, NV
0
500
1,000
1,500
Meters
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Background Imagery: NAIP 2010

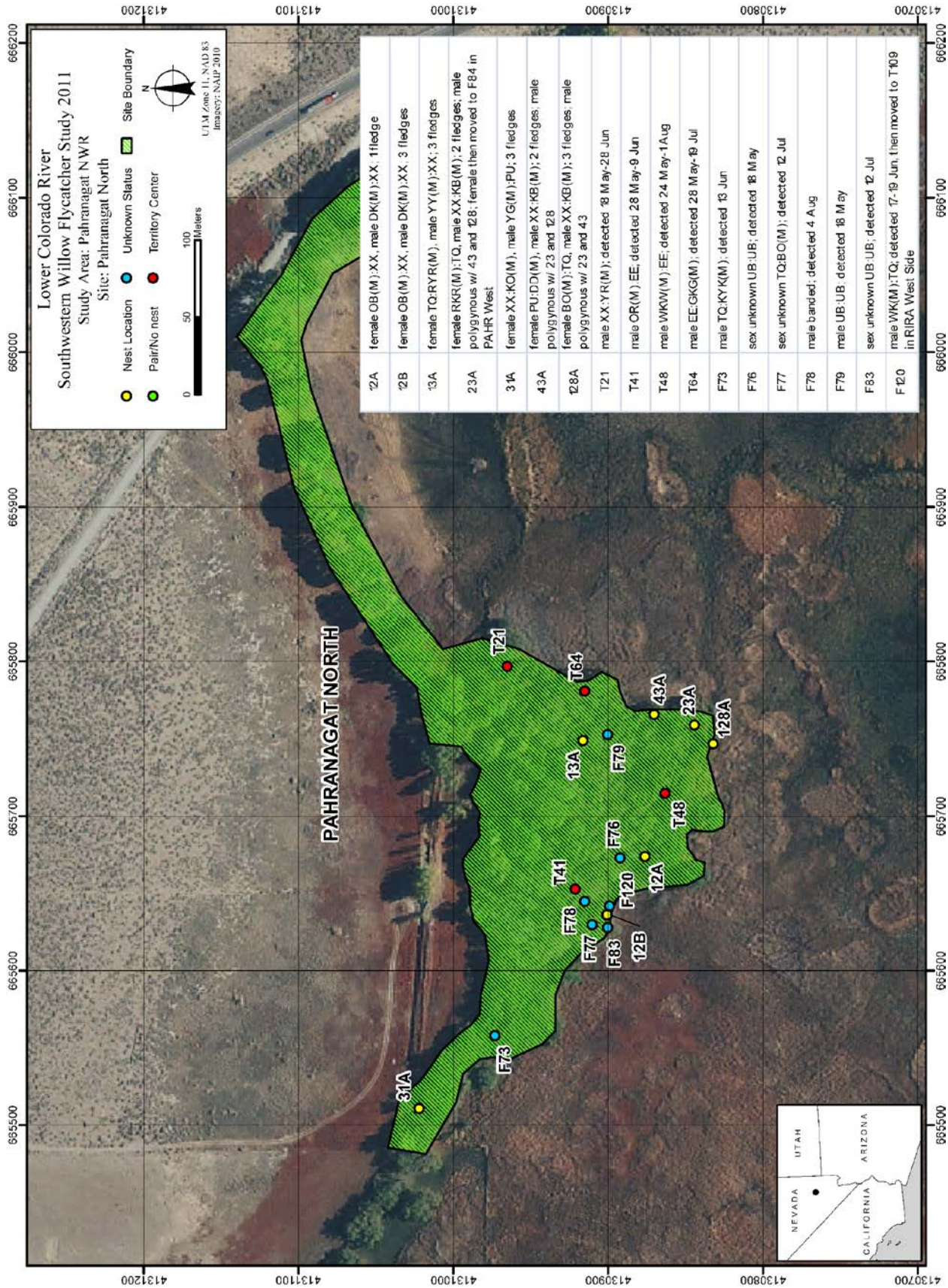

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Key Pittman
Site: Key Pittman Patch 5 - 12
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
PATCH 12
PATCH 11
PATCH 10.5
PATCH 10
PATCH 9
PATCH 8
PATCH 7
PATCH 6
PATCH 5
F23
44C
44A
44B
107B
107A
107C
F22
106C
F20
106A
106B
45A
45C
45B
F112
F75
15A
15B
93A
93B
62A
123A
123B
46B
46A
16A
16B
121A
122A
17A
F19
47A
47B
NEVADA
UTAH
ARIZONA
CALIFORNIA
15A female TQ:KRK(M), male RB(M):XX; nest failed; male polygynous w/ 93
15B female TQ:KRK(M), male RB(M):XX; 2 fledges; male polygynous w/ 93
16A female OW(M):XX, male RY(M):PU; nest failed
16B female OW(M):XX, male RY(M):PU; 3 fledges
17A female TQ:BY(M), male DV(M):XX; nest failed
44A female TQ:WO(M), male GWG(M):TQ; nest failed; male polygynous w/ 107
44B female TQ:WO(M), male GWG(M):TQ; nest failed; male polygynous w/ 107
44C female TQ:WO(M), male GWG(M):TQ; 1fledge; male polygynous w/ 107
45A female OGO(M):TQ, male PU:GY(M); nest failed
45B female OGO(M):TQ, male PU:GY(M); nest failed
45C female OGO(M):TQ, male PU:GY(M); 3 fledges
46A female DB(M):TQ, male XX:KK(M); nest failed
46B female DB(M):TQ, male XX:KK(M); nest failed
47A female UB:UB, male OGO(M):PU; nest failed
47B female UB:UB, male OGO(M):PU; 2 fledges
62A female BG(M):TQ, male WR(M):XX; 3 fledges
93A female XX:YKY(M), male RB(M):XX; nest failed; male polygynous w/ 15
93B female XX:YKY(M), male RB(M):XX; 3 fledges; male polygynous w/ 15
106A female TQ:WD(M), male YV(M):TQ; nest failed
106B female TQ:WD(M), male YV(M):TQ; nest failed
106C female TQ:WD(M), male YV(M):TQ; 1 fledge
107A female TQ:RD(M), male GWG(M):TQ; nest failed; male polygynous w/ 44
107B female TQ:RD(M), male GWG(M):TQ; nest failed; male polygynous w/ 44
107C female TQ:RD(M), male GWG(M):TQ; 2 fledges; male polygynous w/ 44
121A female XX:DW(M), male XX:VGV(M); nest fate unknown; male polygynous w/ 122
122A female TQ:RB(M), male XX:VGV(M); 3 fledges; male polygynous w/ 121
123A female XX:WRW(M), male RD(M):XX; nest failed
123B female XX:WRW(M), male RD(M):XX; nest failed
F20 sex unknown KRK(M):PU; detected 30 Jun; detected 12 Jul in Patch 6
F22 sex unknown RYR(M):XX; detected 27 Jul
F23 sex unknown, banded; detected 30 Jun
F75 male OK(M):XX; detected 26 Jun
F112 male XX:WDW(M); detected 24 Jul; breeding at 95 in RIRA West Side through 3 Jul

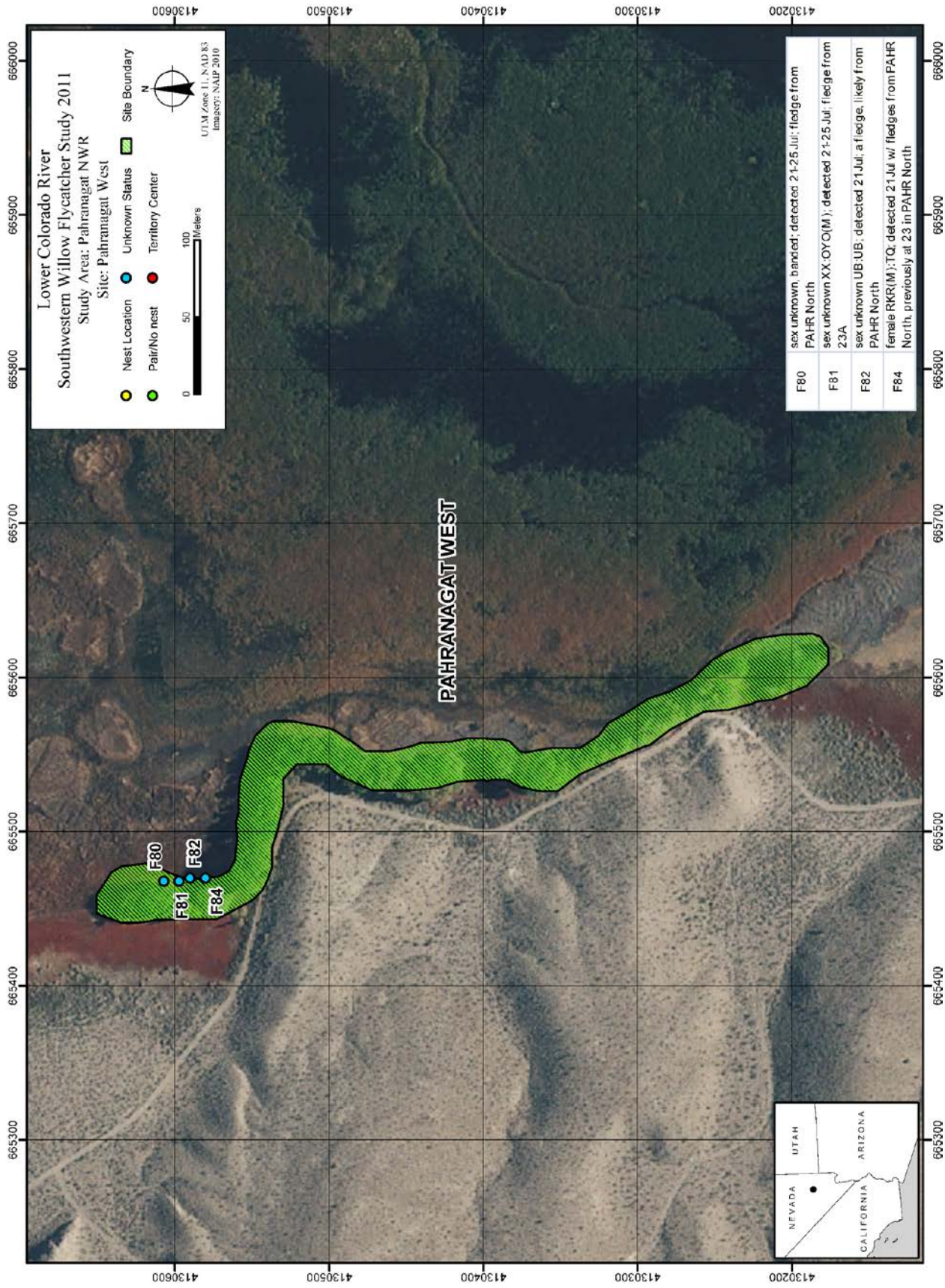

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Key Pittman
Site: Key Pittman Patch 0 - 4.5
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
49A female YBY(M):XX, male PU:YK(M); 3 fledges
57A female TQ:GOG(M), male RB(M):XX; nest fate unknown; female previously at 95 in RIRA West Side
61A female KB(M):TQ, male PU:BV(M); nest failed
61B female KB(M):TQ, male PU:BV(M); 2 fledges
100A female RYR(M):TQ, male UB:UB; 2 fledges
T14 male XX:VY(M); detected 16 May-27 Jul
F18 sex unknown XX:WOW(M); captured 27 Jul, previously at 110 in RIRA East Side
F21 sex unknown, banded; detected 31 Jul
PATCH 4.5
PATCH 4
PATCH 3
PATCH 2
PATCH 1
PATCH 0
100A
F18
F21
T14
61A
61B
49A
57A
NEVADA
UTAH
ARIZONA
CALIFORNIA
656300
656400
656500
656600
656700
656800
656900
657000
4158700
4158800
4158900
4159000
4159100
4159200


WEST SIDE
EAST SIDE
SMALLS
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
River Ranch Study Area
Lincoln County, NV
0
500
1,000
1,500
Meters
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Background Imagery: NAIP 2010

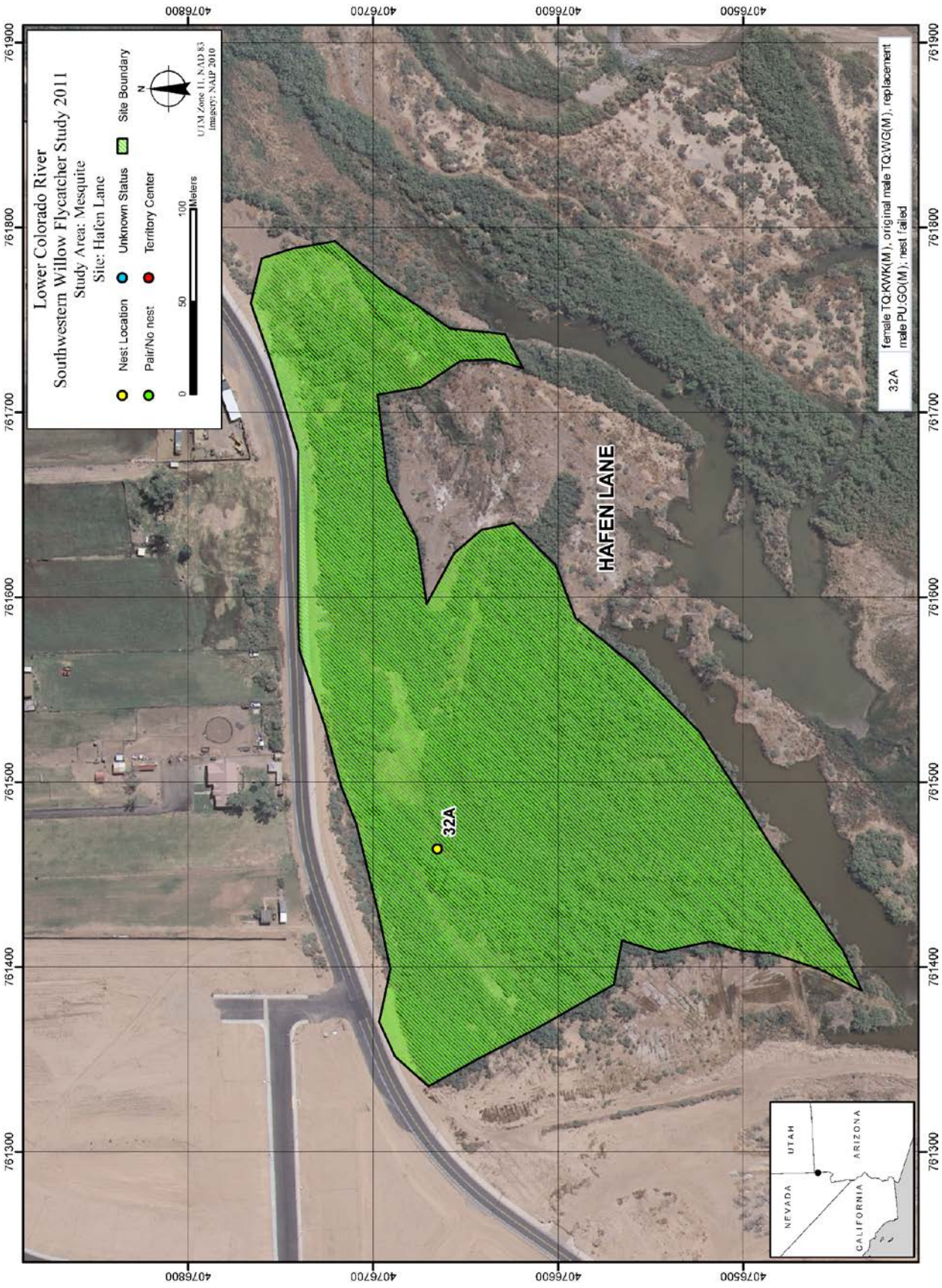

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: River Ranch
Site: East Side, West Side & Smalls
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
EAST SIDE
WEST SIDE
SMALLS
110A
110B
110C
F112
T109
95A
F111
108
95A female TQ:GOG(M), male XX:WDW(M); nest failed; female moved to 57 in KEPI Patch 0, male moved to F112 in KEPI Patch 10.5
110A female KYK(M):TQ, unknown XX:WOW(M); nest failed; unknown bird moved to F18 in KEPI Patch 4
110B female KYK(M):TQ, unknown XX:WOW(M); nest failed; unknown bird moved to F18 in KEPI Patch 4
110C female KYK(M):TQ, unknown XX:WOW(M); nest failed; unknown bird moved to F18 in KEPI Patch 4
108 female XX:ORO(M), male BR(M):TQ; no nest confirmed
T109 male WK(M):TQ; detected 23 Jun-13 Jul; previously at F120 in PAHR North
F111 sex unknown OY(M):TQ; detected 23-27 Jul
F112 male UB:UB; detected 19 Jun
UTAH
ARIZONA
NEVADA
CALIFORNIA

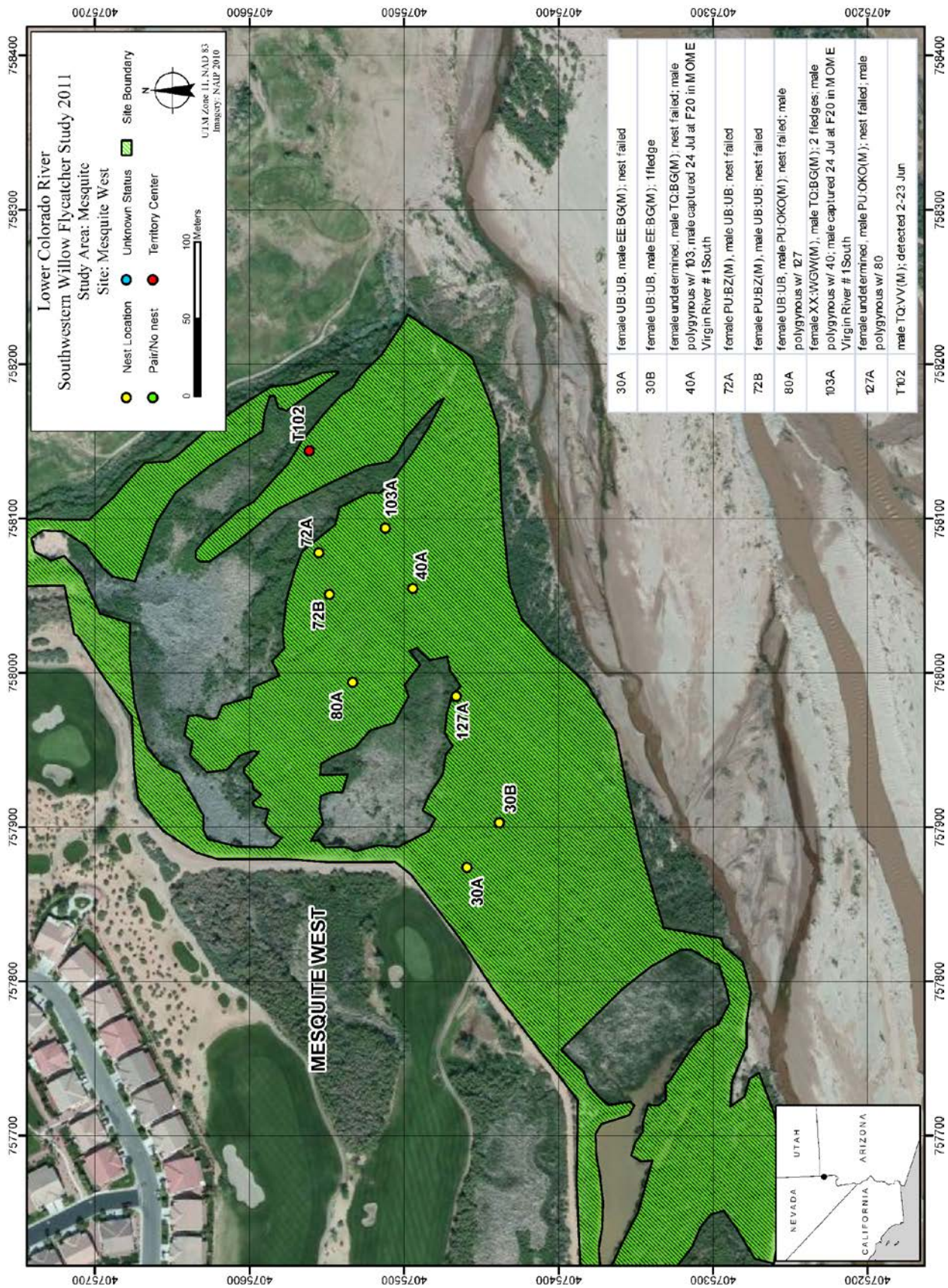

PAHRANAGAT NORTH
PAHRANAGAT WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Pahranagat NWR Study Area
Lincoln County, NV
2011 Surveyed/Occupied
0
1,000
2,000
3,000
Meters
Background Imagery: NAIP 2010

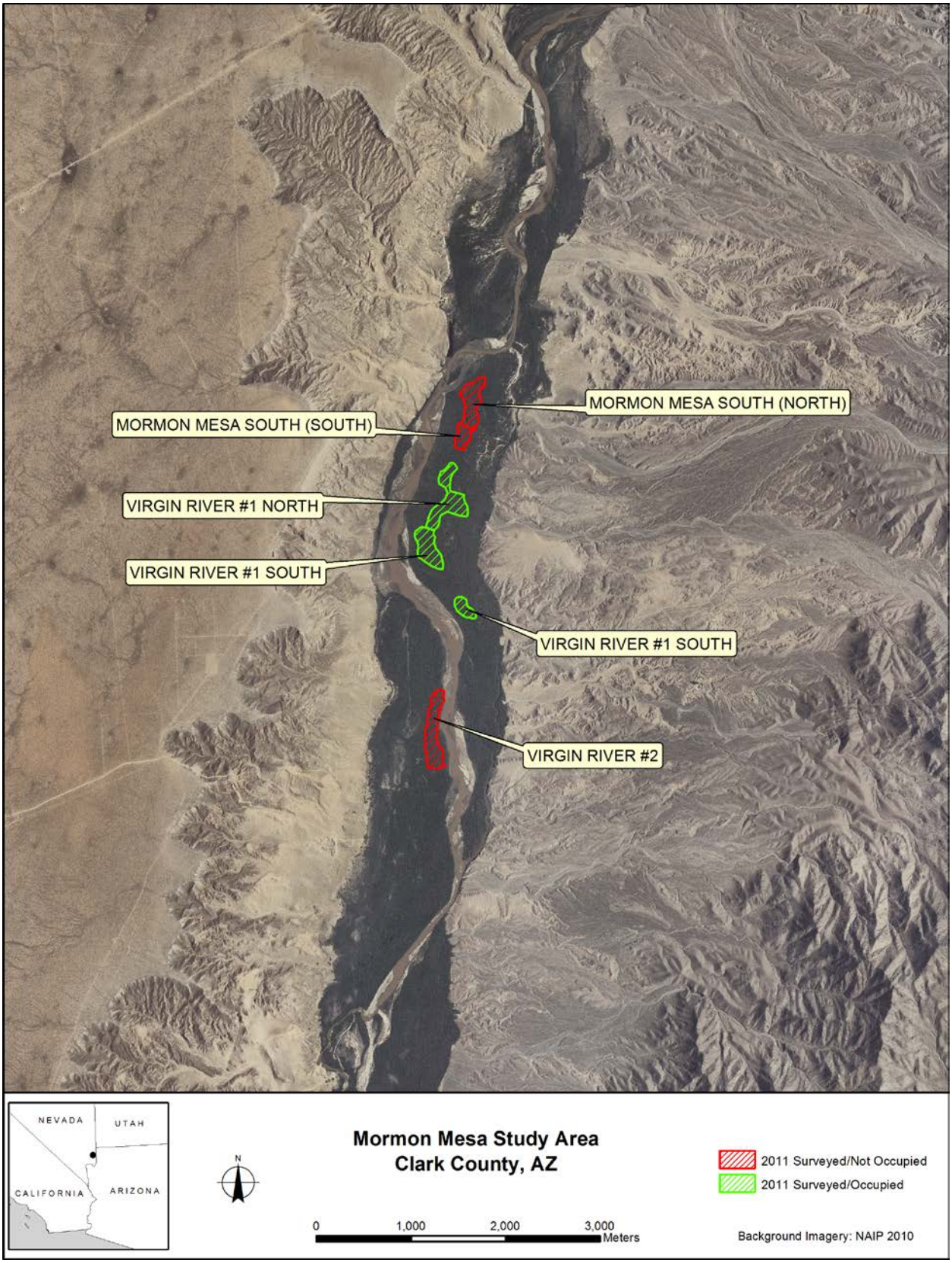

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Pahranagat NWR
Site: Pahranagat North
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
PAHRANAGAT NORTH
T21
T64
43A
23A
128A
13A
F79
T48
F76
T41
12A
F120
F78
F77
F83
12B
F73
31A
UTAH
ARIZONA
NEVADA
CALIFORNIA
12A female OB(M):XX, male DK(M):XX; 1fledge
12B female OB(M):XX, male DK(M):XX; 3 fledges
13A female TQ:RYR(M); male YY(M):XX; 3 fledges
23A female RKR(M):TQ, male XX:KB(M); 2 fledges; male polygynous w/ 43 and 128; female then moved to F84 in PAHR West
31A female XX:KO(M), male YG(M):PU; 3 fledges
43A female PU:DD(M), male XX:KB(M); 2 fledges; male polygynous w/ 23 and 128
128A female BO(M):TQ, male XX:KB(M); 3 fledges; male polygynous w/ 23 and 43
T21 male XX:YR(M); detected 18 May-28 Jun
T41 male OR(M) EE, detected 28 May-9 Jun
T48 male WK/W(M):EE; detected 24 May-1Aug
T64 male EE:GK/G(M); detected 28 May-19 Jul
F73 male TQ:KY/K(M); detected 13 Jun
F76 sex unknown UB:UB; detected 18 May
F77 sex unknown TQ:BO(M); detected 12 Jul
F78 male banded; detected 4 Aug
F79 male UB:UB detected 18 May
F83 sex unknown UB:UB; detected 12 Jul
F120 male WK(M):TQ; detected 17-19 Jun, then moved to T109 in RIRA West Side

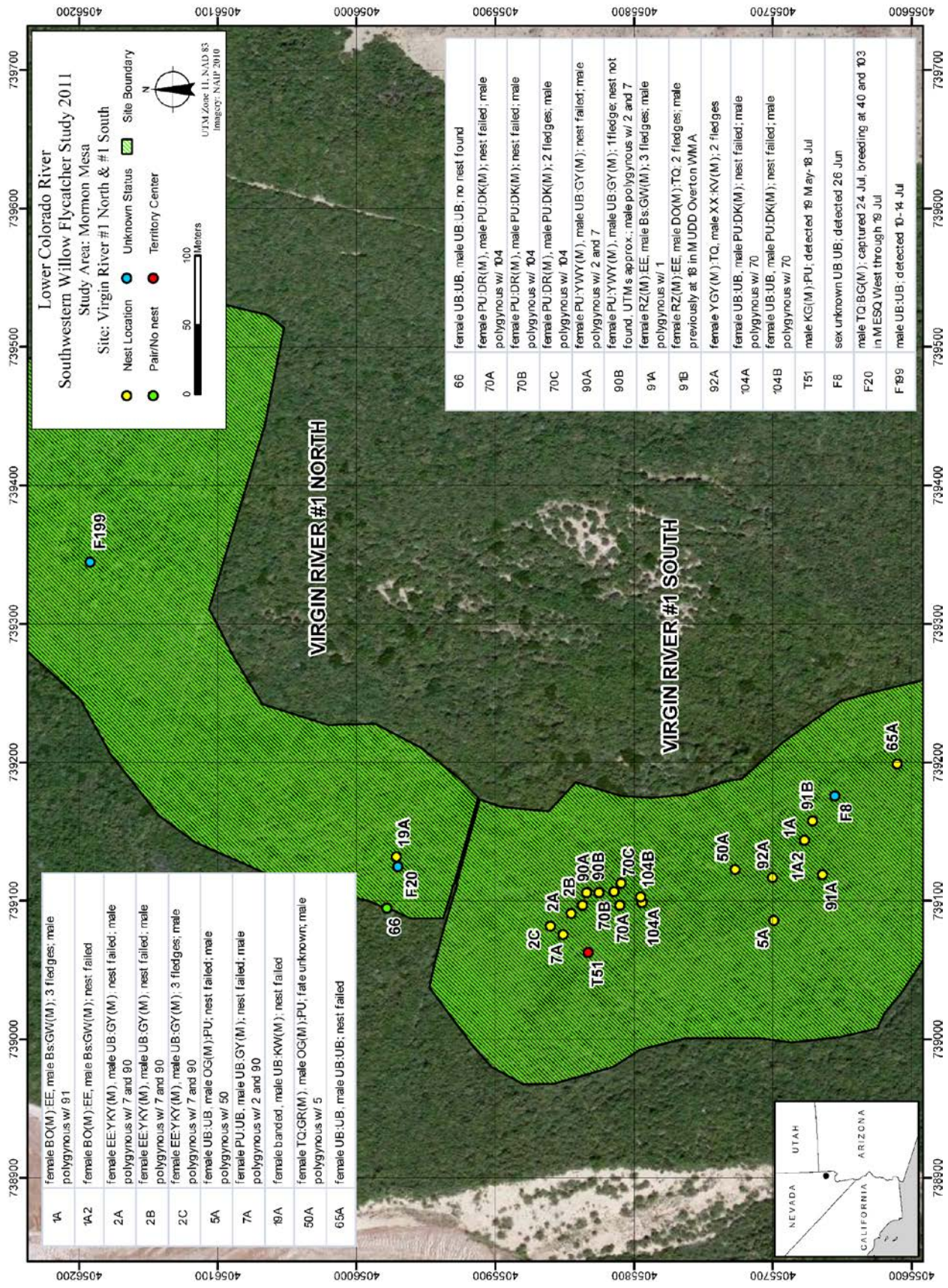

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Pahranagat NWR
Site: Pahranagat West
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F80
sex unknown, banded; detected 21-25 Jul; fledge from PAHR North
F81
sex unknown XX:OYO(M); detected 21-25 Jul; fledge from 23A
F82
sex unknown UB:UB; detected 21 Jul; a fledge, likely from PAHR North
F84
female RKR(M):TQ; detected 21 Jul w/ fledges from PAHR North, previously at 23 in PAHR North
PAHRANAGAT WEST
F80
F82
F81
F84
UTAH
ARIZONA
NEVADA
CALIFORNIA
665300
665400
665500
665600
665700
665800
665900
666000
413060
413050
413040
413030
413020

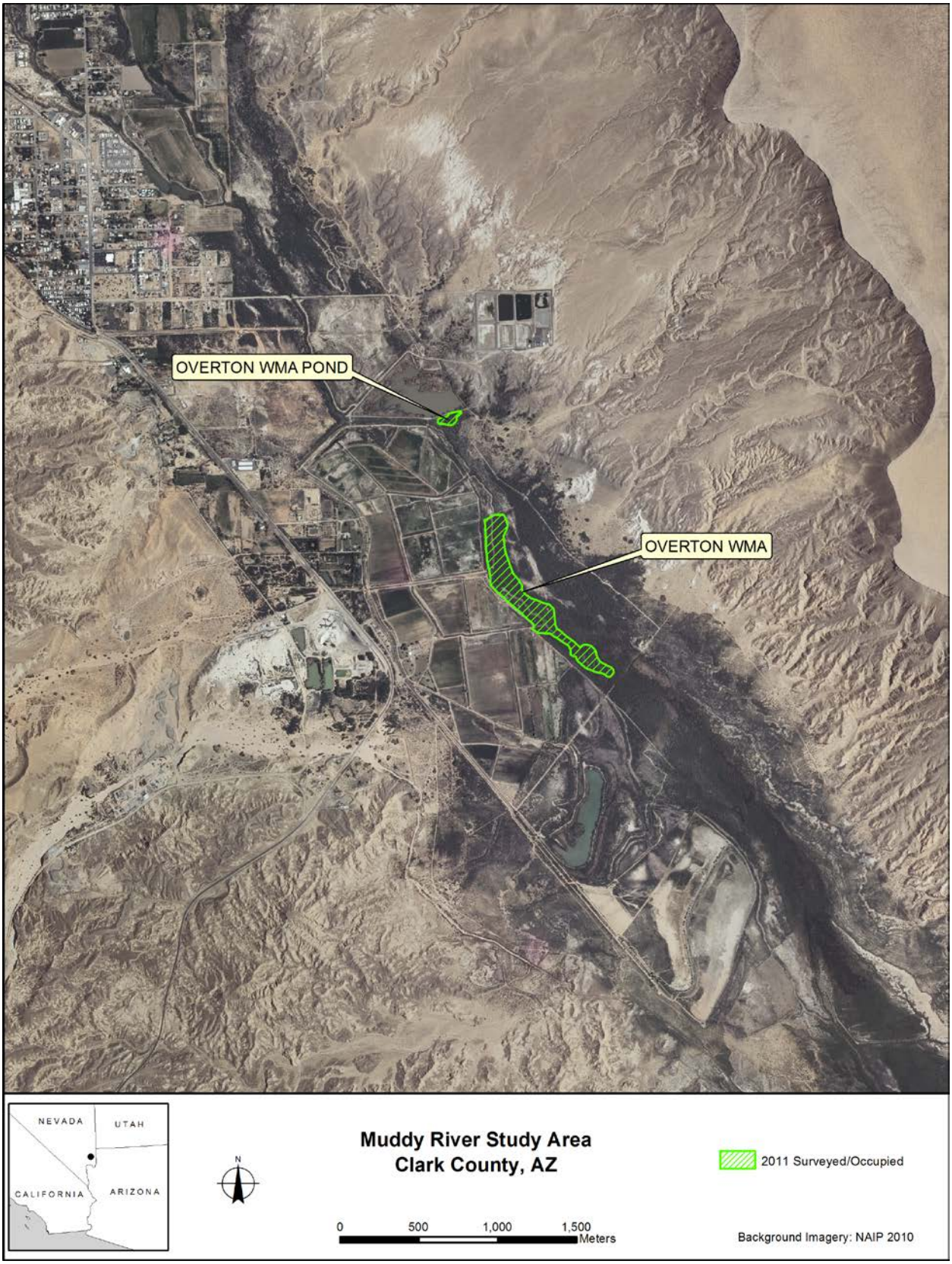

HAFEN LANE
MESQUITE WEST
BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Mesquite Study Area
Clark County, NV
0
1,000
2,000
3,000
Meters
2011 Surveyed/Occupied
2011 Discontinued
Background Imagery: NAIP 2010

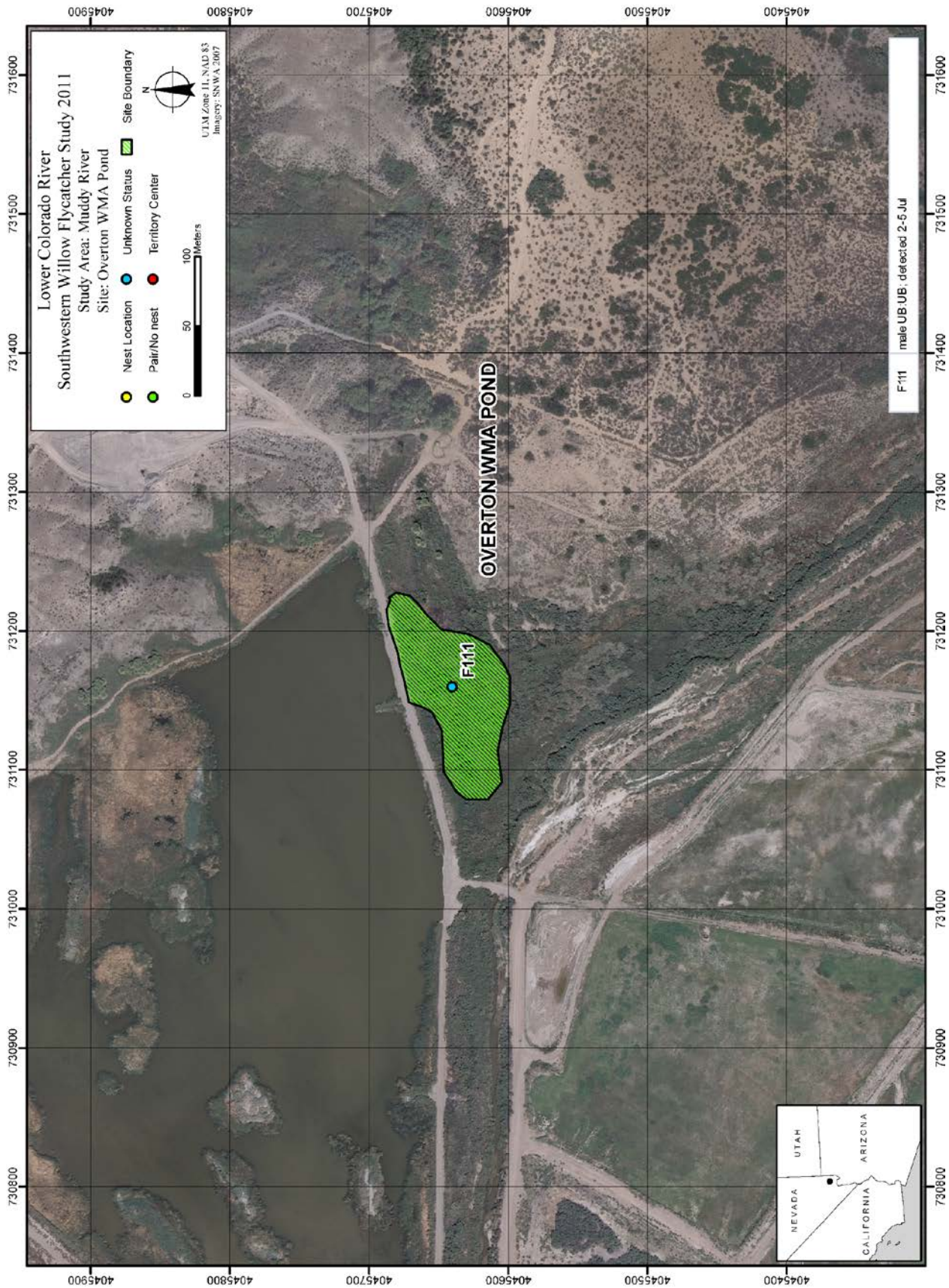

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Mesquite
Site: Hafen Lane
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
Meters
UTM Zone 11, NAD 83
Imagery: NAIP 2010
32A
female TQ:KWK(M), original male TQ:WG(M), replacement male PU:GO(M); nest failed
HAFEN LANE
32A
UTAH
ARIZONA
NEVADA
CALIFORNIA

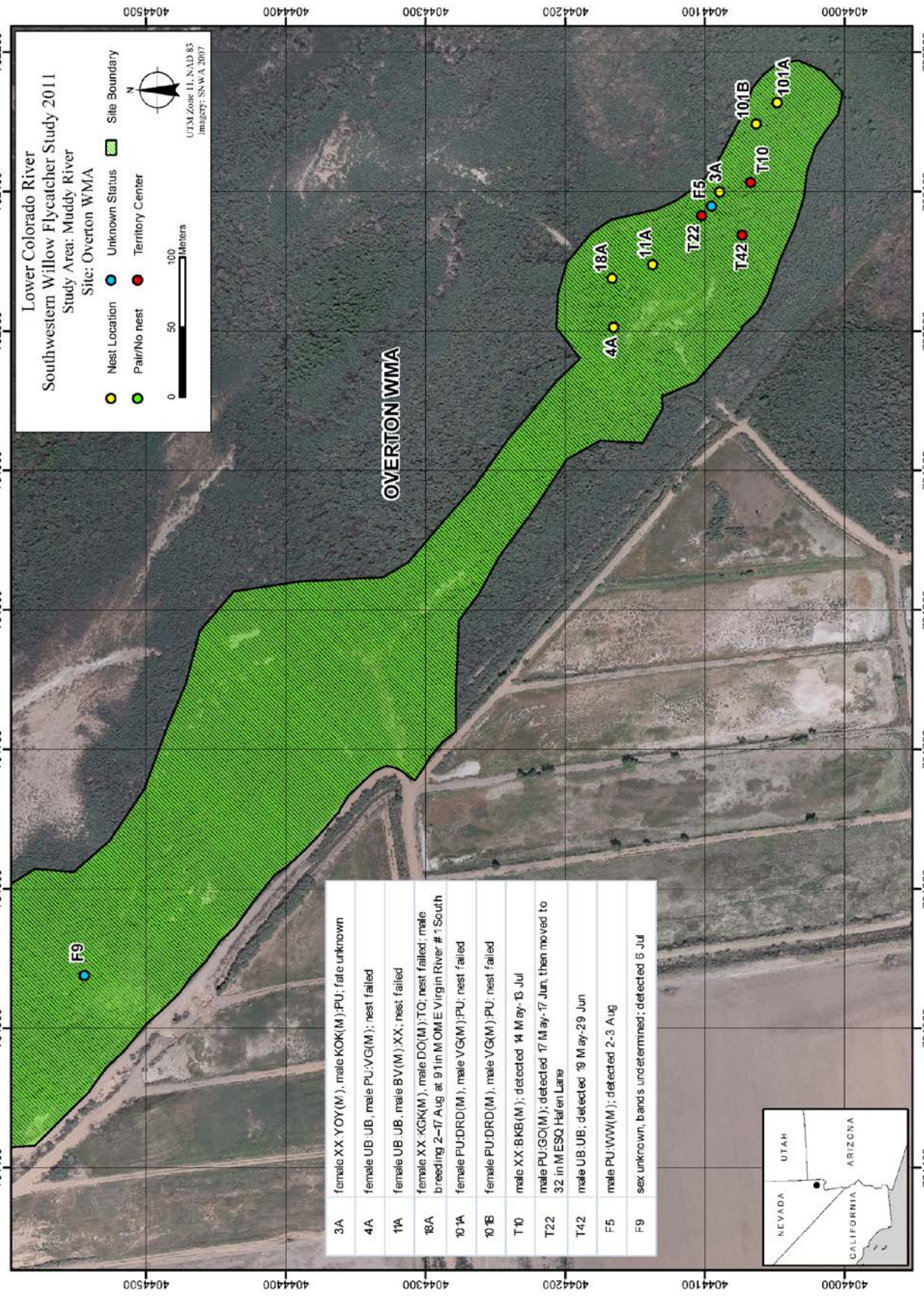

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Mesquite
Site: Mesquite West
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
30A female UB:UB, male EE:BG(M); nest failed
30B female UB:UB, male EE:BG(M); 1fledge
40A female undetermined, male TQ:BG(M); nest failed; male polygynous w/ 103, male captured 24 Jul at F20 in MOME Virgin River # 1South
72A female PU:BZ(M), male UB:UB; nest failed
72B female PU:BZ(M), male UB:UB; nest failed
80A female UB:UB, male PU:OKO(M); nest failed; male polygynous w/ 127
103A female XX:WGW(M), male TQ:BG(M); 2 fledges; male polygynous w/ 40; male captured 24 Jul at F20 in MOME Virgin River # 1South
127A female undetermined, male PU:OKO(M); nest failed; male polygynous w/ 80
T102 male TQ:VV(M); detected 2-23 Jun
T102
72A
103A
40A
72B
80A
127A
30B
30A
MESQUITE WEST
UTAH
NEVADA
ARIZONA
CALIFORNIA
407700
407600
407500
407400
407300
407200
758400
758300
758200
758100
758000
757900
757800
757700

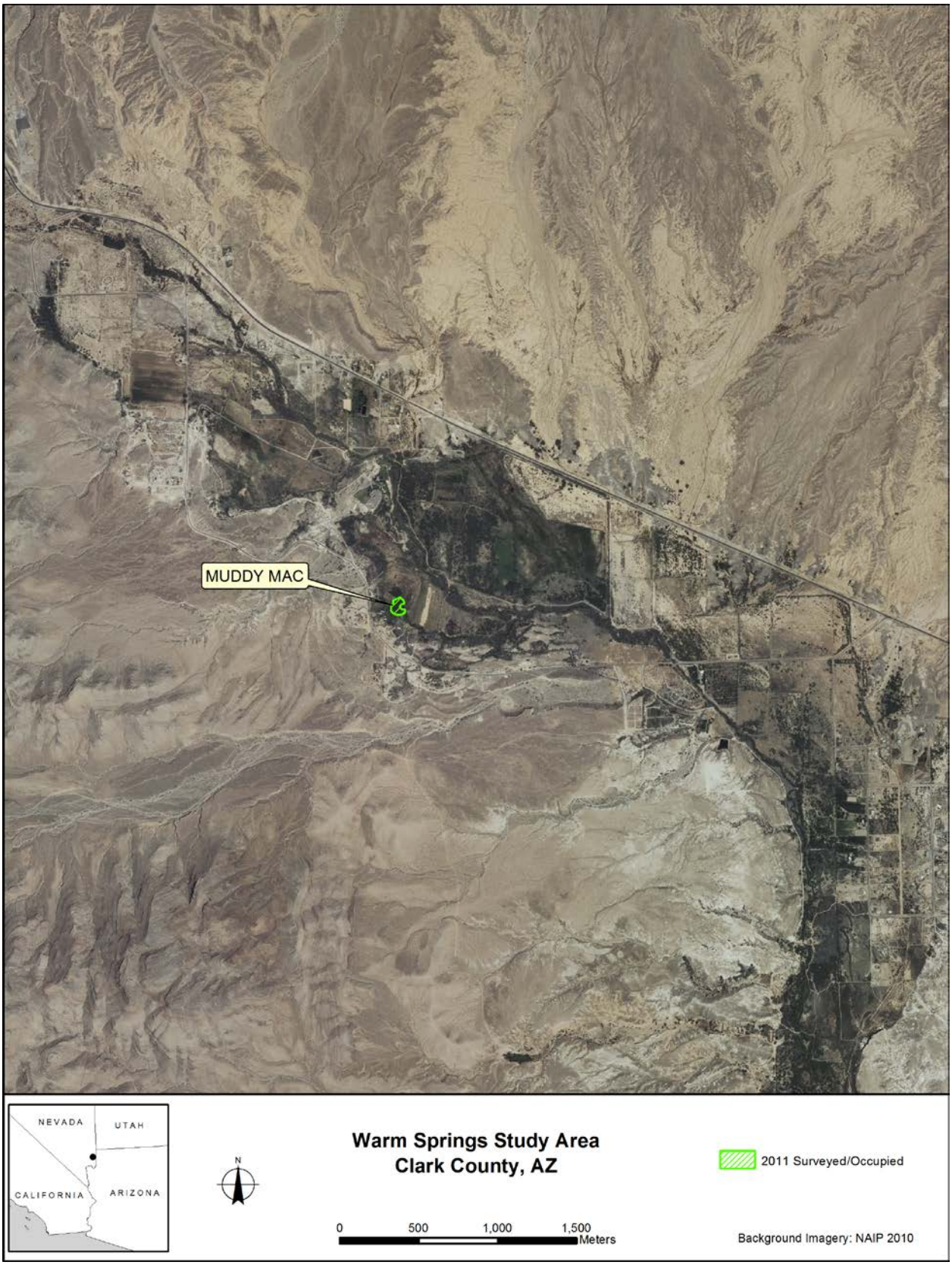

MORMON MESA SOUTH (NORTH)
MORMON MESA SOUTH (SOUTH)
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Mormon Mesa Study Area
Clark County, AZ
0
1,000
2,000
3,000
Meters
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Background Imagery: NAIP 2010

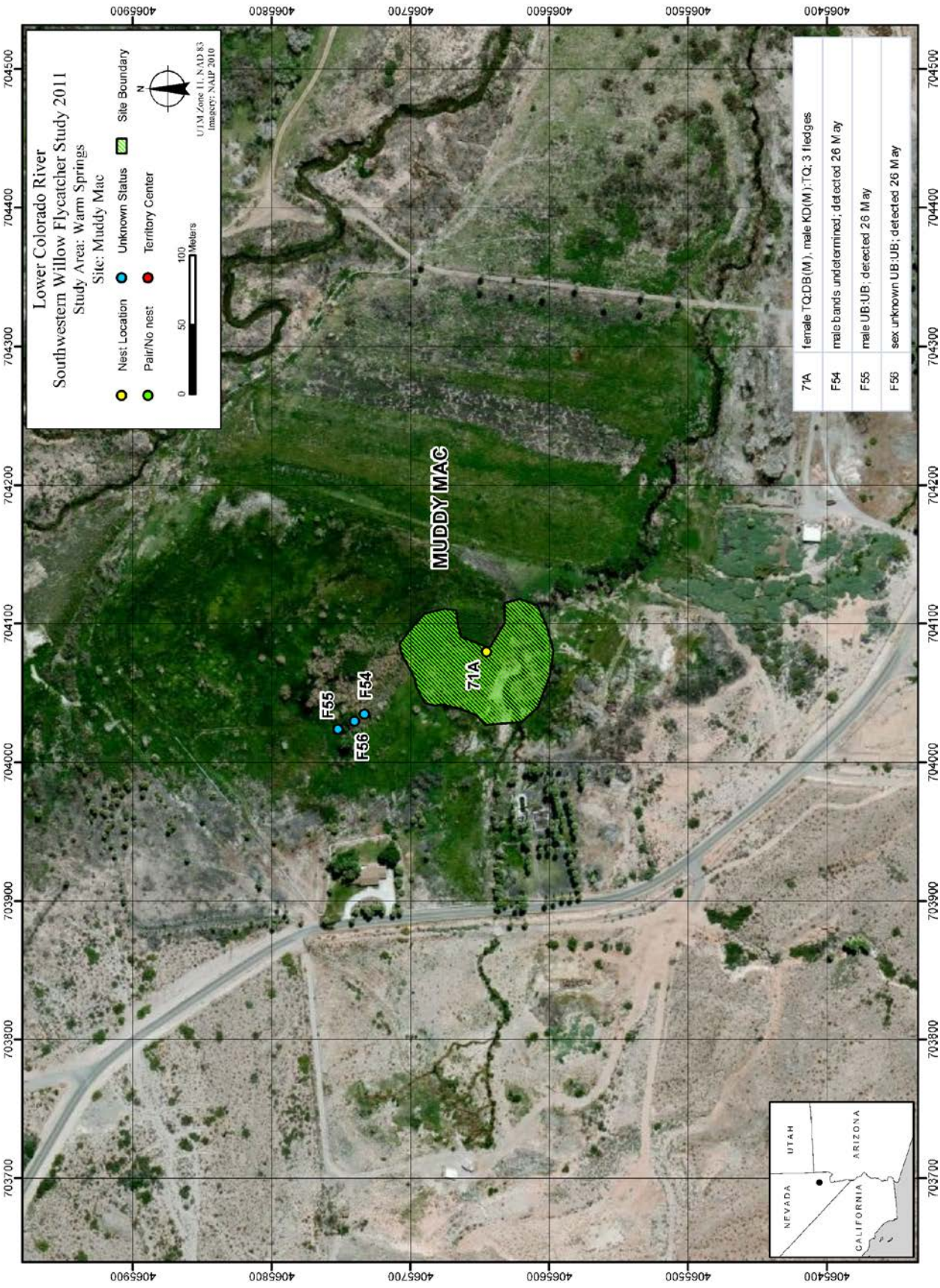

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Mormon Mesa
Site: Virgin River #1 North & #1 South
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
F199
F20
66
19A
2C
7A
2A
2B
90A
90B
T51
70B
70A
70C
104A
104B
5A
50A
92A
1A2
1A
91B
91A
F8
65A
NEVADA
UTAH
ARIZONA
CALIFORNIA
1A female BO(M):EE, male Bs:GW(M); 3 fledges; male polygynous w/ 91
1A2 female BO(M):EE, male Bs:GW(M); nest failed
2A female EE:YKY(M), male UB:GY(M); nest failed; male polygynous w/ 7 and 90
2B female EE:YKY(M), male UB:GY(M); nest failed; male polygynous w/ 7 and 90
2C female EE:YKY(M), male UB:GY(M); 3 fledges; male polygynous w/ 7 and 90
5A female UB:UB, male OG(M):PU; nest failed; male polygynous w/ 50
7A female PU:UB, male UB:GY(M); nest failed; male polygynous w/ 2 and 90
19A female banded, male UB:KW(M); nest failed
50A female TQ:GR(M), male OG(M):PU; fate unknown; male polygynous w/ 5
65A female UB:UB, male UB:UB; nest failed
66 female UB:UB, male UB:UB; no nest found
70A female PU:DR(M), male PU:DK(M); nest failed; male polygynous w/ 104
70B female PU:DR(M), male PU:DK(M); nest failed; male polygynous w/ 104
70C female PU:DR(M), male PU:DK(M); 2 fledges; male polygynous w/ 104
90A female PU:YWY(M), male UB:GY(M); nest failed; male polygynous w/ 2 and 7
90B female PU:YWY(M), male UB:GY(M); 1 fledge; nest not found, UTMs approx.; male polygynous w/ 2 and 7
91A female RZ(M):EE, male Bs:GW(M); 3 fledges; male polygynous w/ 1
91B female RZ(M):EE, male DO(M):TQ; 2 fledges; male previously at 18 in MUDD Overton WMA
92A female YGY(M):TQ, male XX:KV(M); 2 fledges
104A female UB:UB, male PU:DK(M); nest failed; male polygynous w/ 70
104B female UB:UB, male PU:DK(M); nest failed; male polygynous w/ 70
T51 male KG(M):PU; detected 19 May-18 Jul
F8 sex unknown UB UB; detected 26 Jun
F20 male TQ:BG(M); captured 24 Jul, breeding at 40 and 103 in MESQ West through 19 Jul
F199 male UB:UB; detected 10-14 Jul

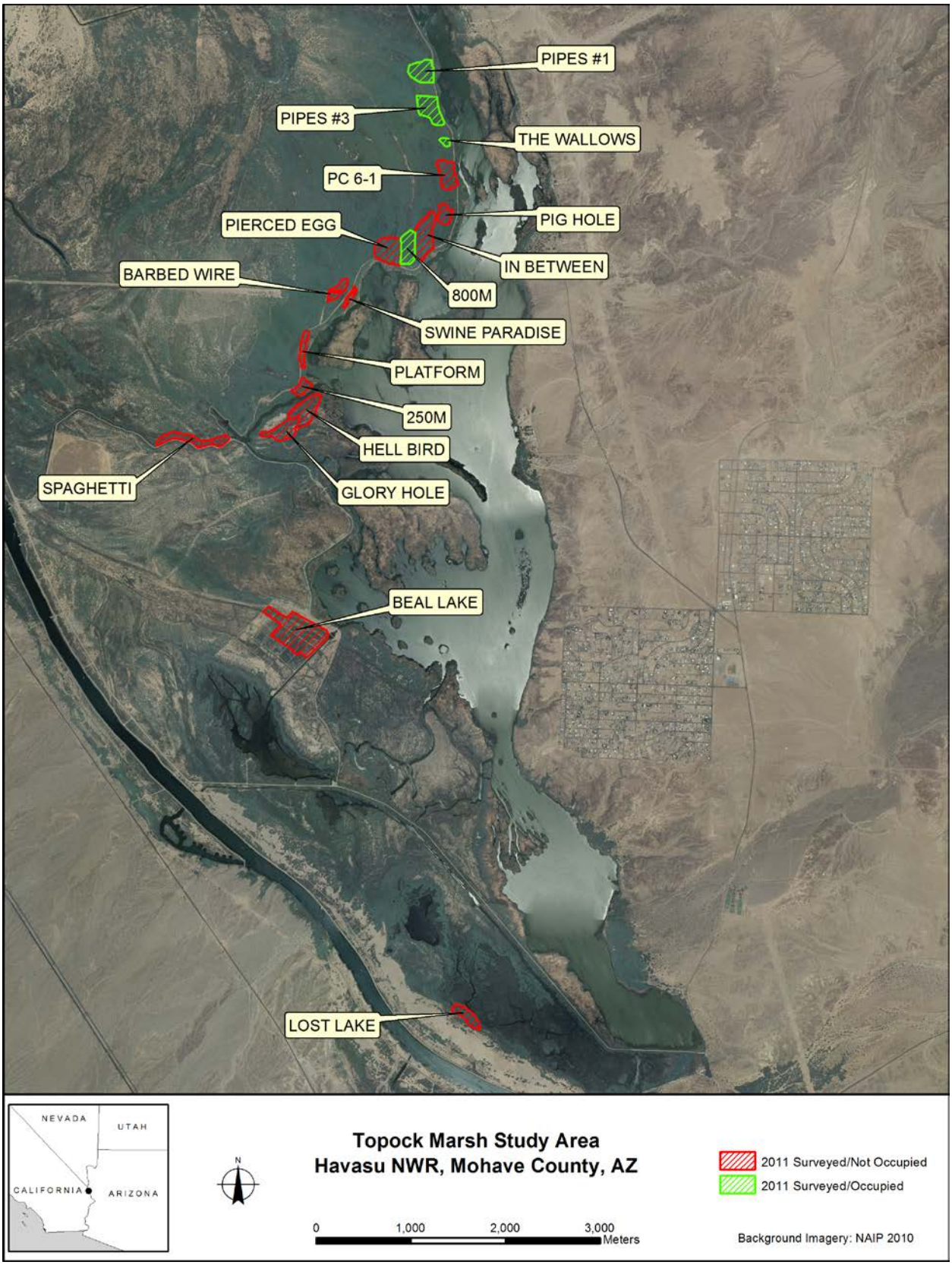

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Muddy River Study Area
Clark County, AZ
2011 Surveyed/Occupied
0
500
1,000
1,500
Meters
Background Imagery: NAIP 2010

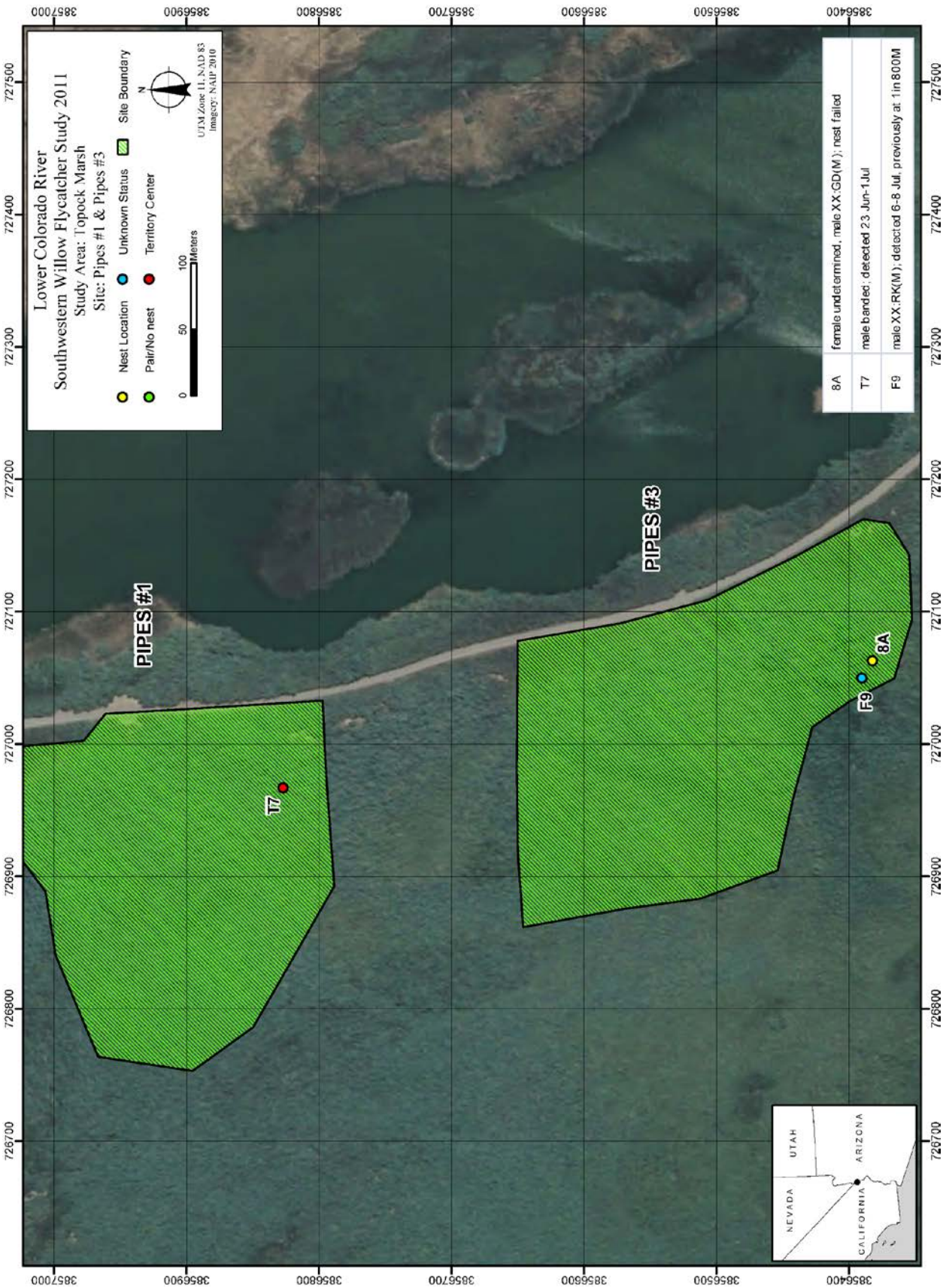

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Muddy River
Site: Overton WMA Pond
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: SNWA 2007
OVERTON WMA POND
F111
F111 male UB UB; detected 2-5 Jul
UTAH
ARIZONA
NEVADA
CALIFORNIA


Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Muddy River
Site: Overton WMA
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: SNWA 2007
OVERTON WMA
F9
4A
18A
11A
T22
F5
3A
T42
T10
101B
101A
NEVADA
UTAH
ARIZONA
CALIFORNIA
3A female XX:YOY(M), male KOK(M):PU; fate unknown
4A female UB:UB, male PU:VG(M); nest failed
11A female UB:UB, male BV(M):XX; nest failed
18A female XX:KGK(M), male DO(M):TQ; nest failed; male breeding 2–17 Aug at 91 in MOME Virgin River #1 South
101A female PU:DRD(M), male VG(M):PU; nest failed
101B female PU:DRD(M), male VG(M):PU; nest failed
T10 male XX:BKB(M); detected 14 May-13 Jul
T22 male PU:GO(M); detected 17 May-17 Jun, then moved to 32 in MESQ Hafen Lane
T42 male UB:UB; detected 19 May-29 Jun
F5 male PU:WW(M); detected 2-3 Aug
F9 sex unknown, bands undetermined; detected 6 Jul

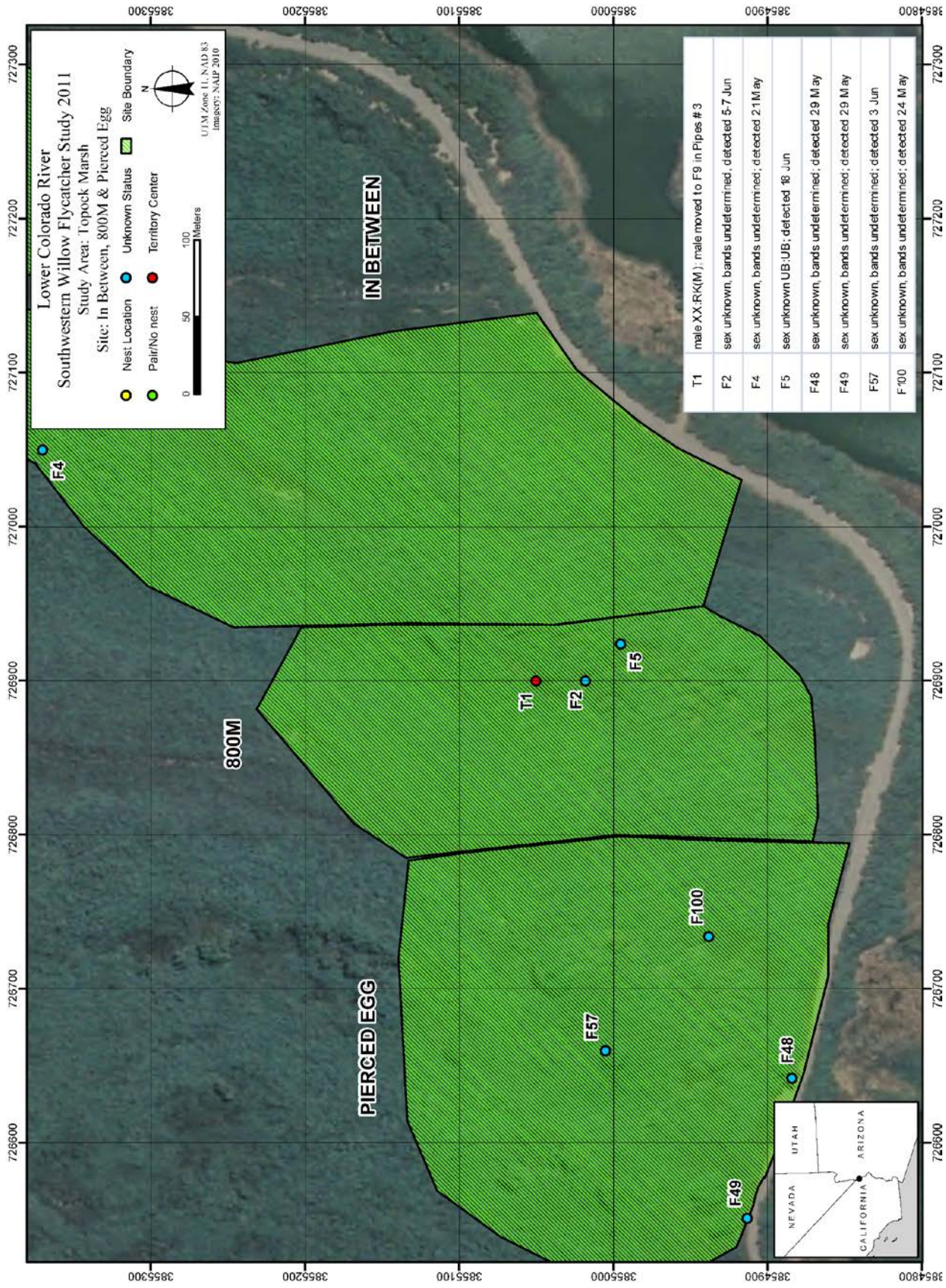

MUDDY MAC
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Warm Springs Study Area
Clark County, AZ
0
500
1,000
1,500
Meters
2011 Surveyed/Occupied
Background Imagery: NAIP 2010

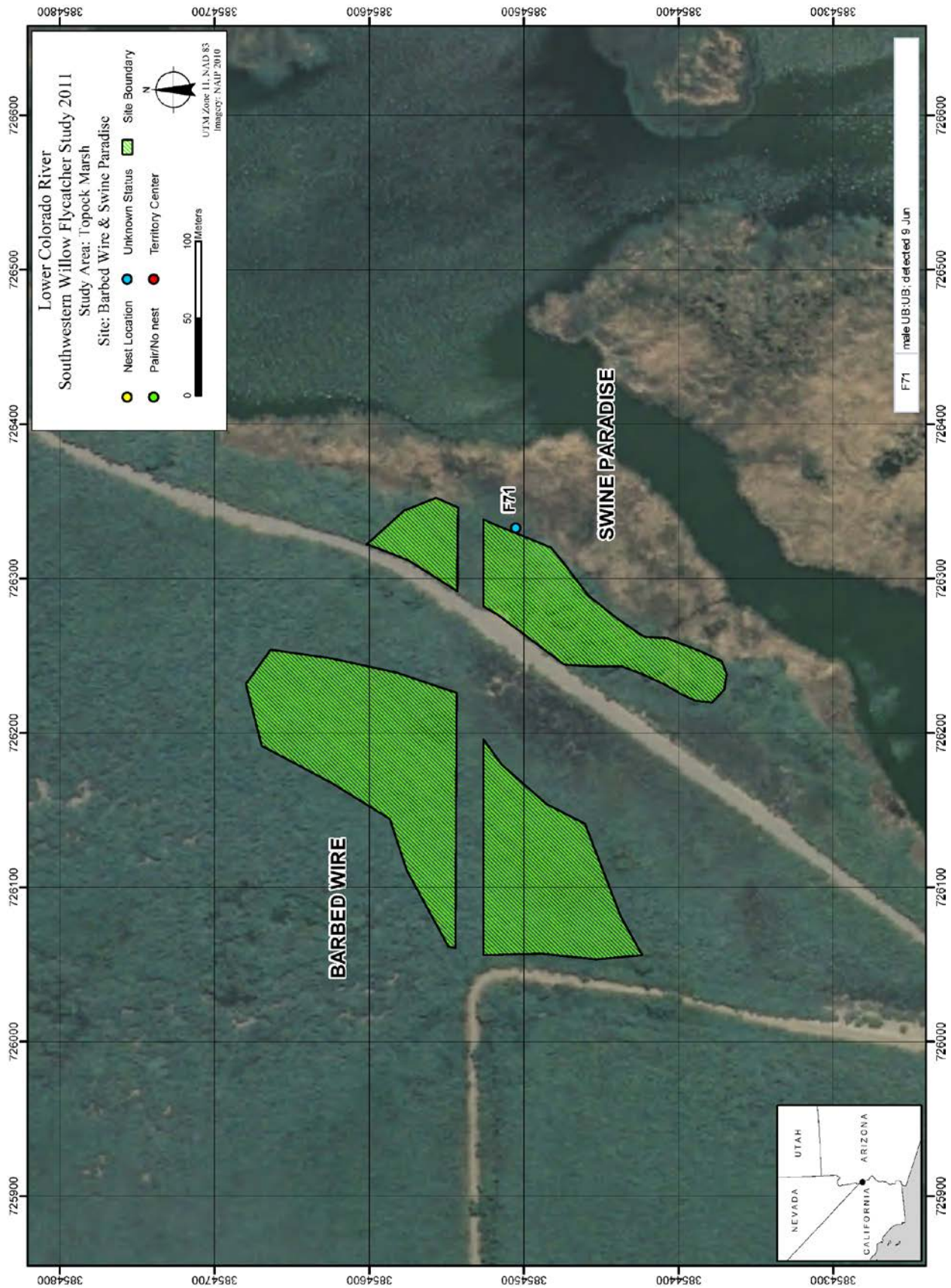

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Warm Springs
Site: Muddy Mac
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
UTM Zone 11, NAD 83
Imagery: NAIP 2010
N
71A female TQ:DB:(M), male KD(M):TQ; 3 fledges
F54 male bands undetermined; detected 26 May
F55 male UB:UB; detected 26 May
F56 sex unknown UB:UB; detected 26 May
MUDDY MAC
71A
F54
F55
F56
UTAH
ARIZONA
NEVADA
CALIFORNIA


PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
PIERCED EGG
PIG HOLE
IN BETWEEN
BARBED WIRE
800M
SWINE PARADISE
PLATFORM
250M
HELL BIRD
SPAGHETTI
GLORY HOLE
BEAL LAKE
LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Topock Marsh Study Area
Havasu NWR, Mohave County, AZ
0
1,000
2,000
3,000
Meters
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Background Imagery: NAIP 2010

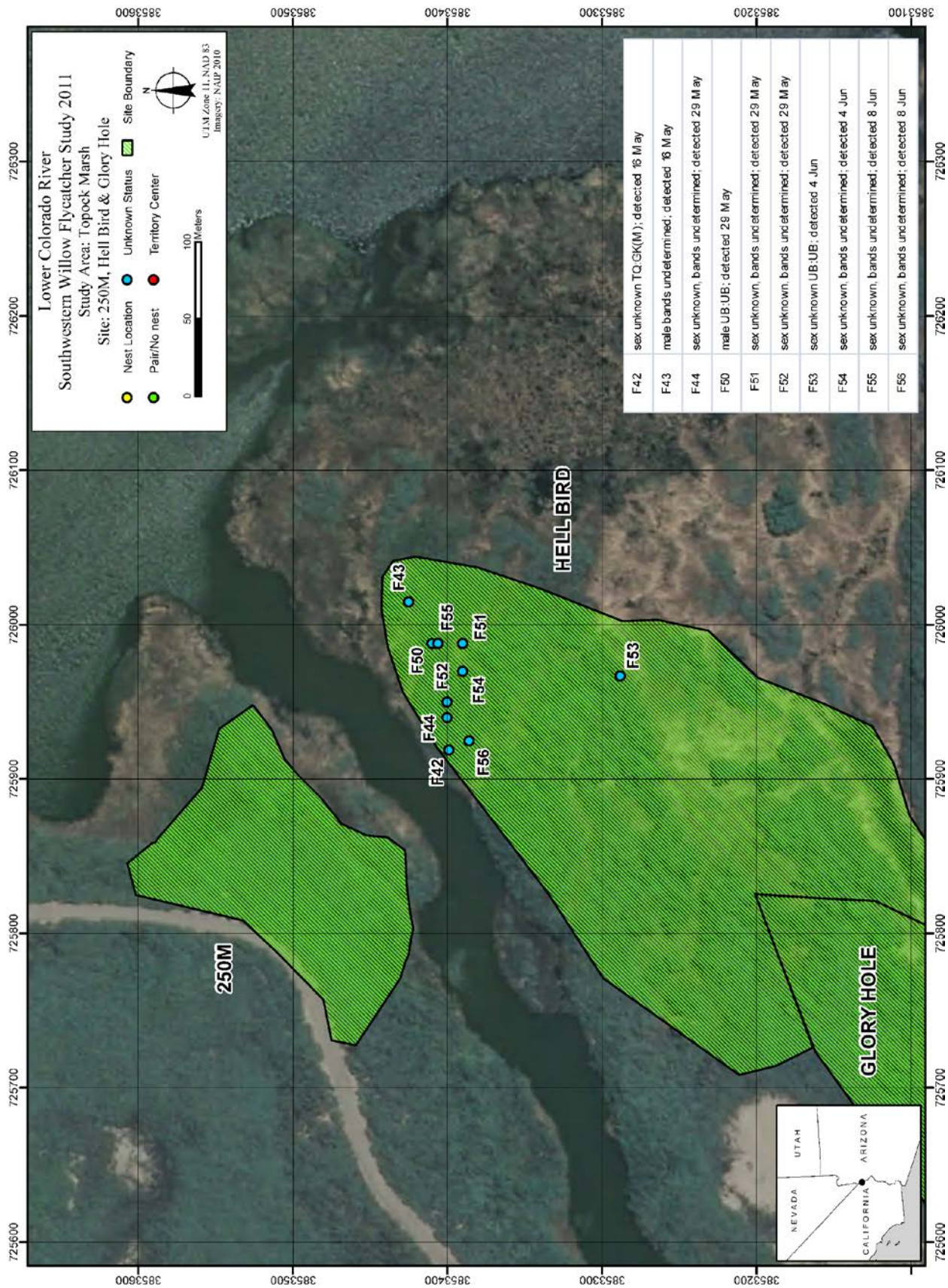

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: Pipes #1 & Pipes #3
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
8A female undetermined; male XX:GD(M); nest failed
T7 male banded; detected 23-Jun-1Jul
F9 male XX:RK(M); detected 6-8 Jul, previously at 1in 800M
PIPES #1
PIPES #3
T7
F9
8A
UTAH
ARIZONA
NEVADA
CALIFORNIA
3857000
3856900
3856800
3856700
3856600
3856500
3856400
727500
727400
727300
727200
727100
727000
726900
726800
726700

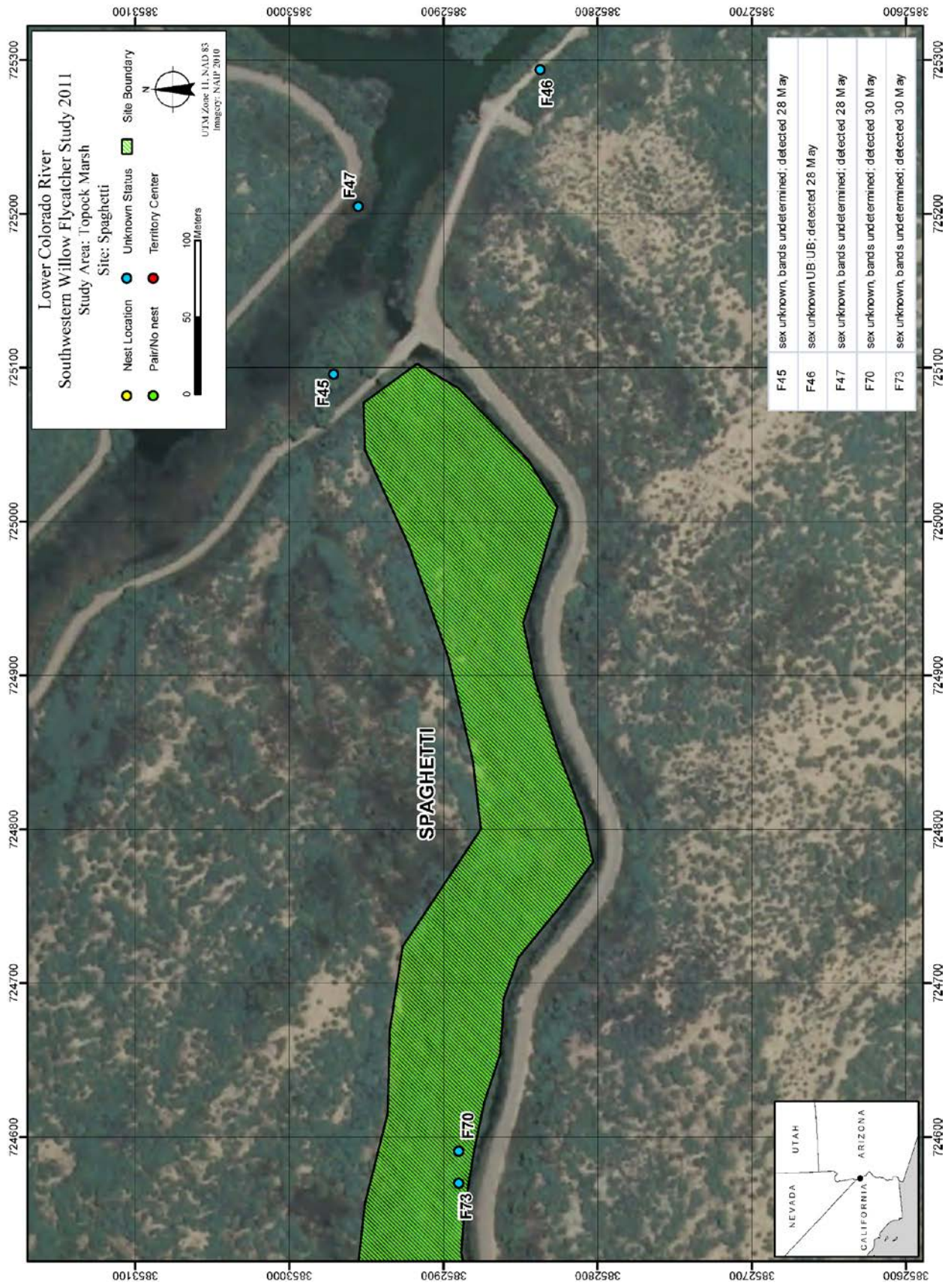

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: The Wallows & PC 6-1
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
T18 male TQ:KO(M); detected 25 Jun-9 Jul, previously at T3 and F72 in Platform
F6 sex unknown UB:UB; detected 1 Jun
F101 sex unknown UB:UB; detected 1-5 Jun
F102 male UB:UB; detected 9-13 Jun
THE WALLOWS
F102
T18
F101
F6
PC 6-1
UTAH
ARIZONA
NEVADA
CALIFORNIA
726900
727000
727100
727200
727300
727400
727500
727600
3856300
3856200
3856100
3856000
3855900
3855800

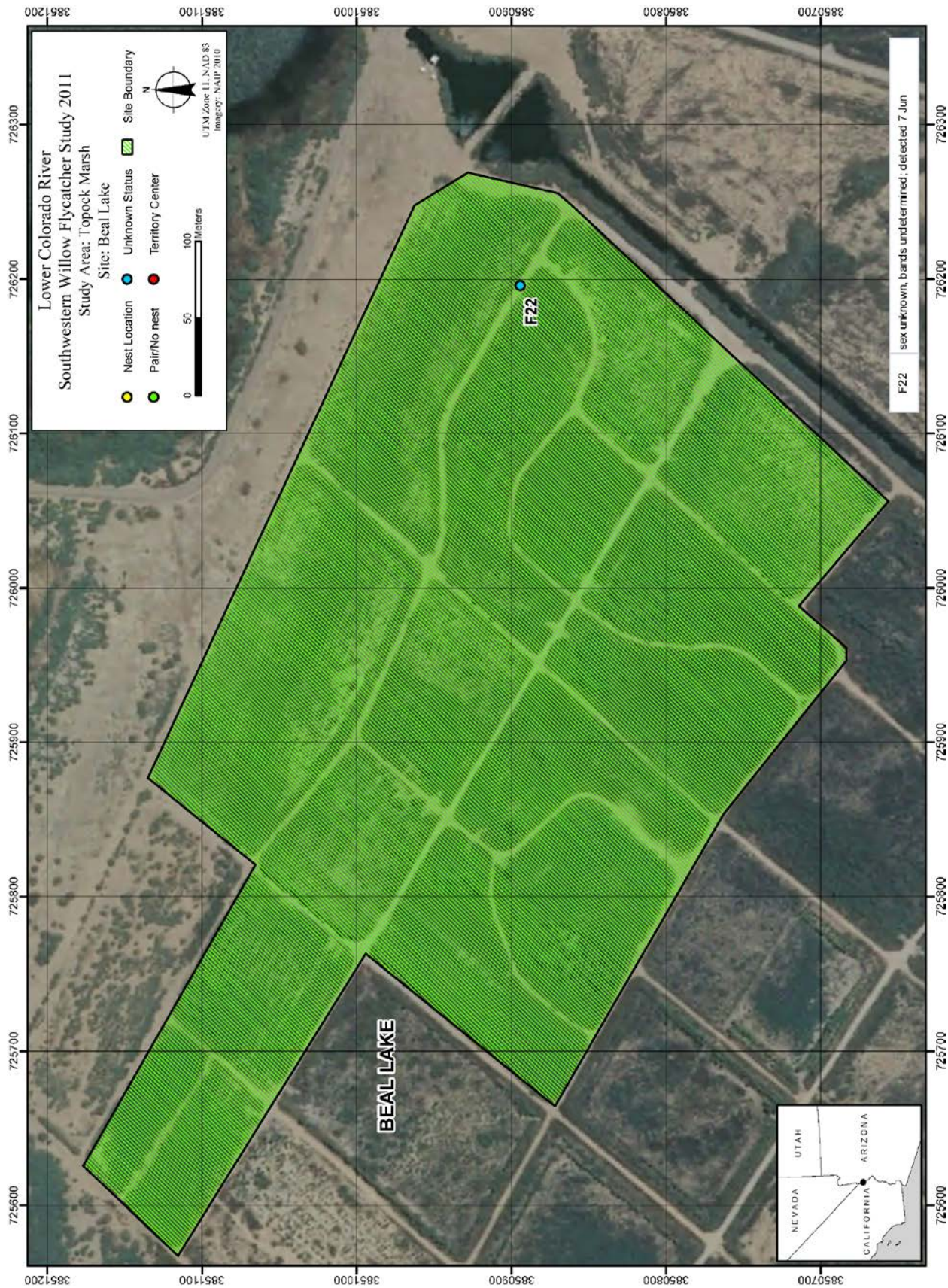

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: In Between, 800M & Pierced Egg
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
T1 male XX:RK(M); male moved to F9 in Pipes #3
F2 sex unknown, bands undetermined; detected 5-7 Jun
F4 sex unknown, bands undetermined; detected 21 May
F5 sex unknown UB:UB; detected 10 Jun
F48 sex unknown, bands undetermined; detected 29 May
F49 sex unknown, bands undetermined; detected 29 May
F57 sex unknown, bands undetermined; detected 3 Jun
F100 sex unknown, bands undetermined; detected 24 May
IN BETWEEN
800M
PIERCED EGG
F4
T1
F2
F5
F100
F57
F48
F49
UTAH
ARIZONA
NEVADA
CALIFORNIA
727300
727200
727100
727000
726900
726800
726700
726600
3854800
3854900
3855000
3855100
3855200
3855300

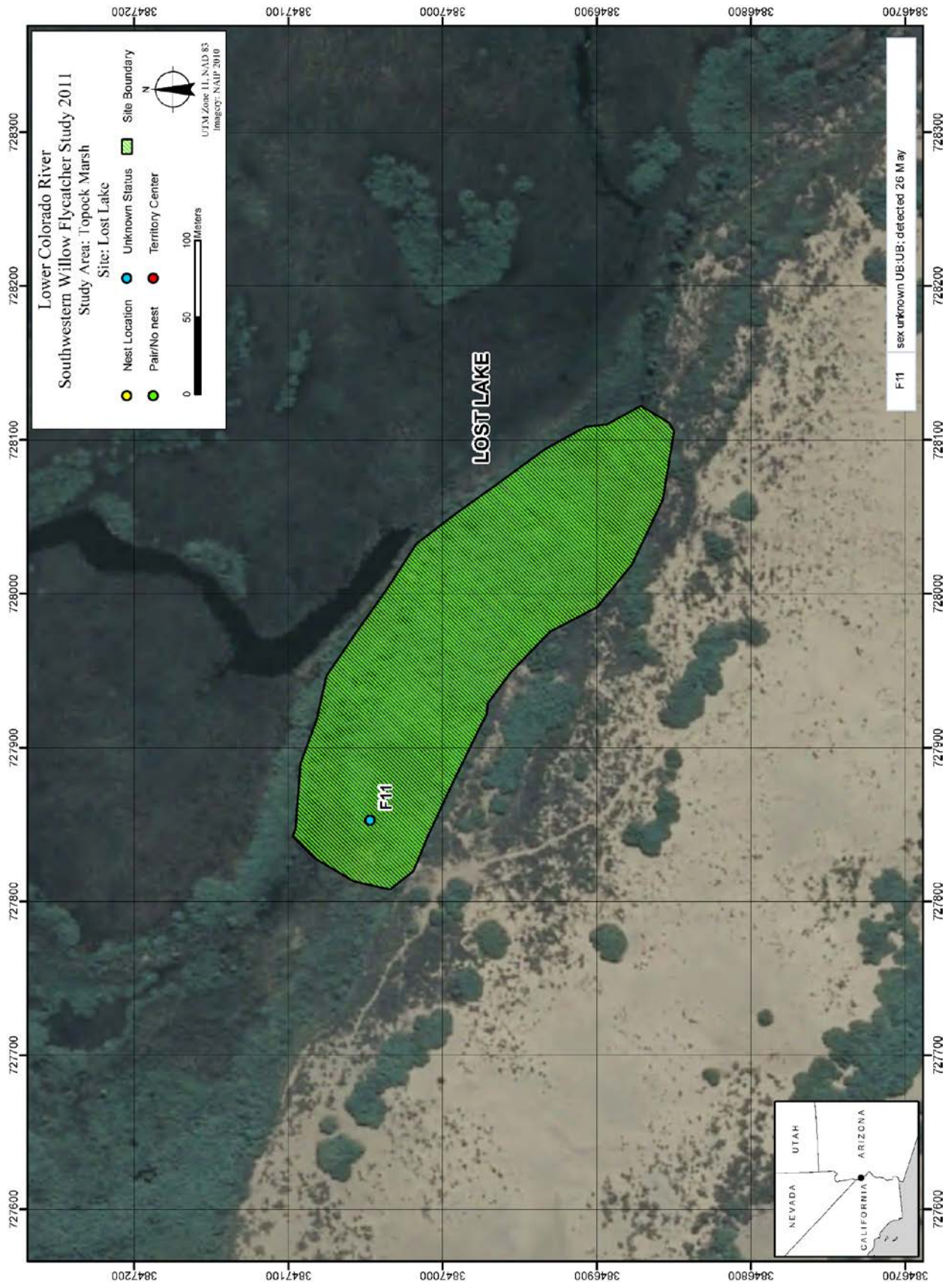

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: Barbed Wire & Swine Paradise
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F71
male UB:UB; detected 9 Jun
SWINE PARADISE
BARBED WIRE
UTAH
ARIZONA
NEVADA
CALIFORNIA
726600
726500
726400
726300
726200
726100
726000
725900
385480
385470
385460
385450
385440
385430

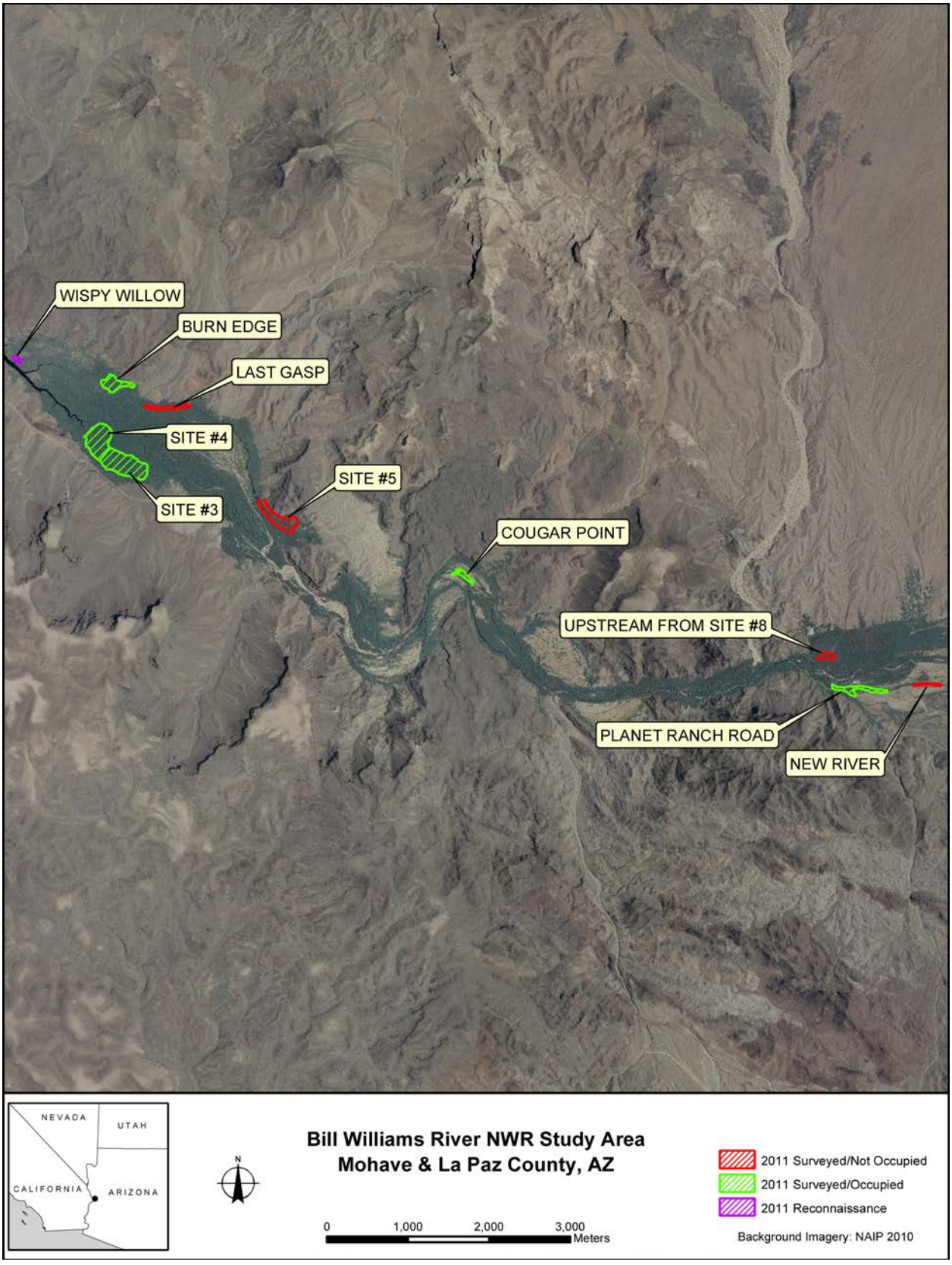

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: Platform
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
T3
male TQ:KO(M); detected 16 May- 9 Jun, then moved to F72 north of Platform, then to T18 in The Wallows
F72
male TQ:KO(M); detected 9- 15 Jun, previously at T3 in Platform, moved to T18 in The Wallows
PLATFORM
F72
T3
UTAH
ARIZONA
NEVADA
CALIFORNIA
726300
726200
726100
726000
725900
725800
725700
725600
385420
385410
385400
385390
385380
385370

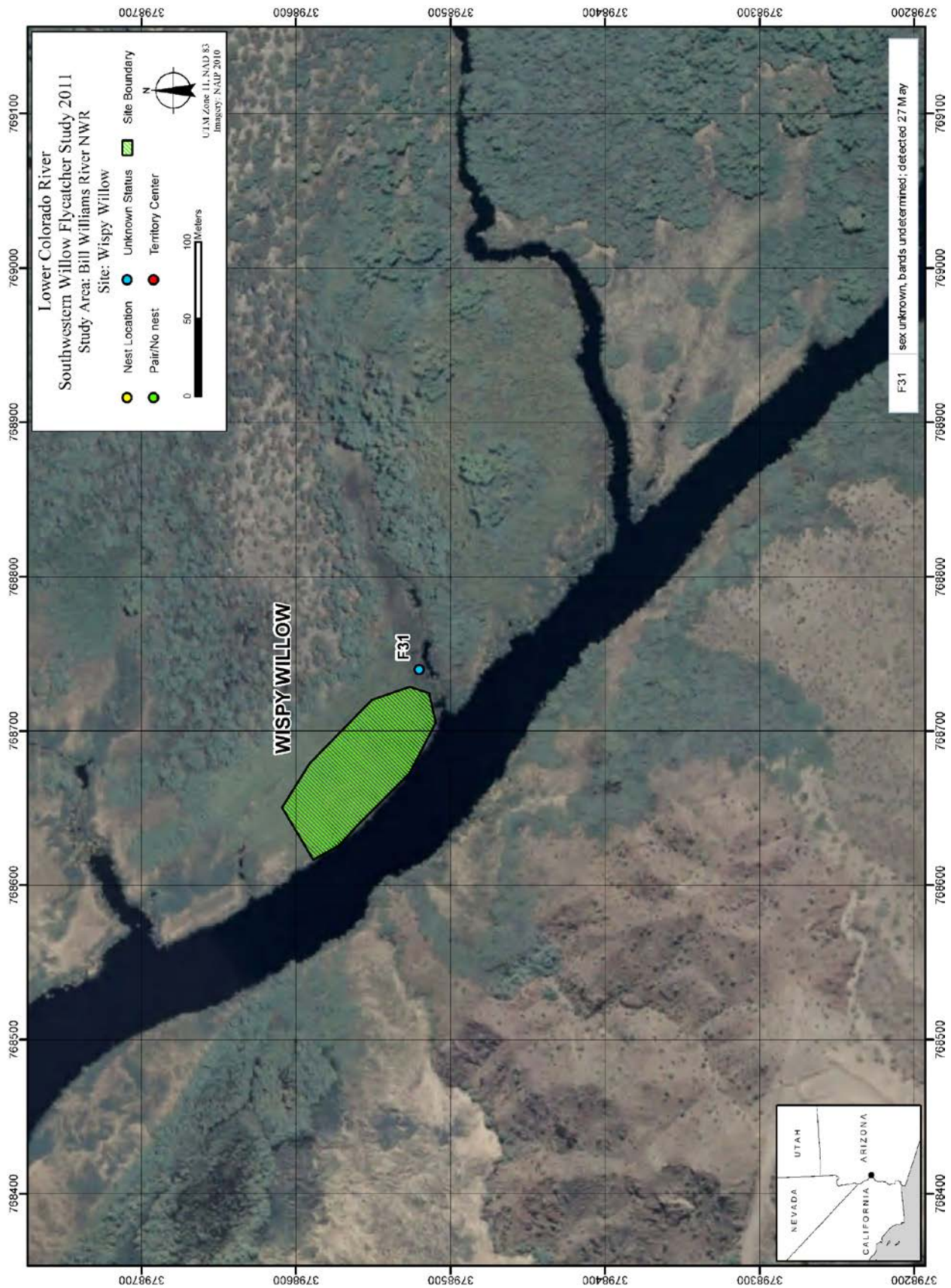

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: 250M, Hell Bird & Glory Hole
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F42 sex unknown TQ:GK(M); detected 16 May
F43 male bands undetermined; detected 16 May
F44 sex unknown, bands undetermined; detected 29 May
F50 male UB:UB; detected 28 May
F51 sex unknown, bands undetermined; detected 29 May
F52 sex unknown, bands undetermined; detected 29 May
F53 sex unknown UB:UB; detected 4 Jun
F54 sex unknown, bands undetermined; detected 4 Jun
F55 sex unknown, bands undetermined; detected 8 Jun
F56 sex unknown, bands undetermined; detected 8 Jun
HELL BIRD
250M
GLORY HOLE
F42
F43
F44
F50
F51
F52
F53
F54
F55
F56
UTAH
ARIZONA
NEVADA
CALIFORNIA
725600
725700
725800
725900
726000
726100
726200
726300
3853600
3853500
3853400
3853300
3853200
3853100

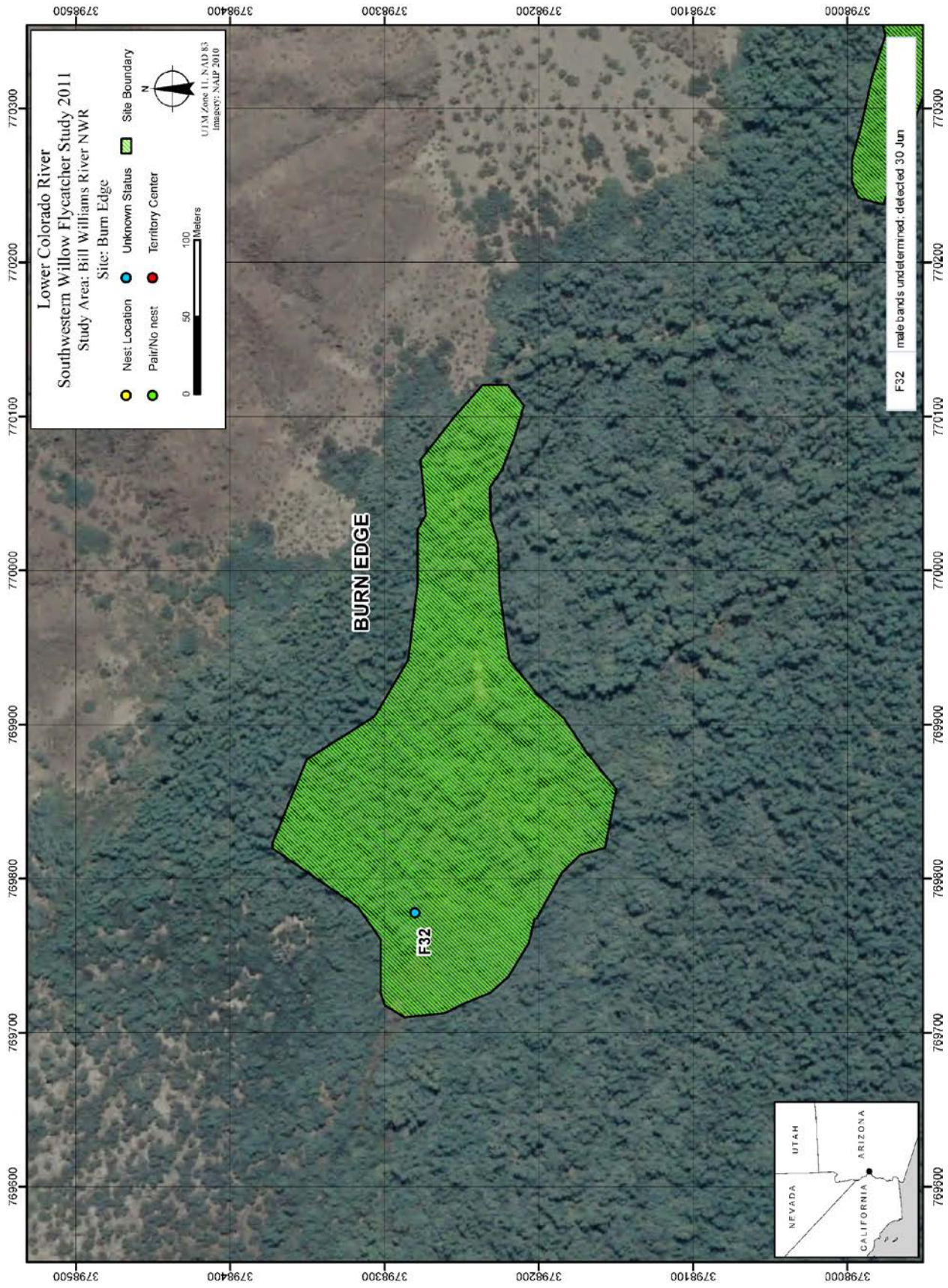

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: Spaghetti
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F45 sex unknown, bands undetermined; detected 28 May
F46 sex unknown UB UB; detected 28 May
F47 sex unknown, bands undetermined; detected 28 May
F70 sex unknown, bands undetermined; detected 30 May
F73 sex unknown, bands undetermined; detected 30 May
SPAGHETTI
F45
F46
F47
F70
F73
UTAH
ARIZONA
NEVADA
CALIFORNIA
725300
725200
725100
725000
724900
724800
724700
724600
3853100
3853000
3852900
3852800
3852700
3852600

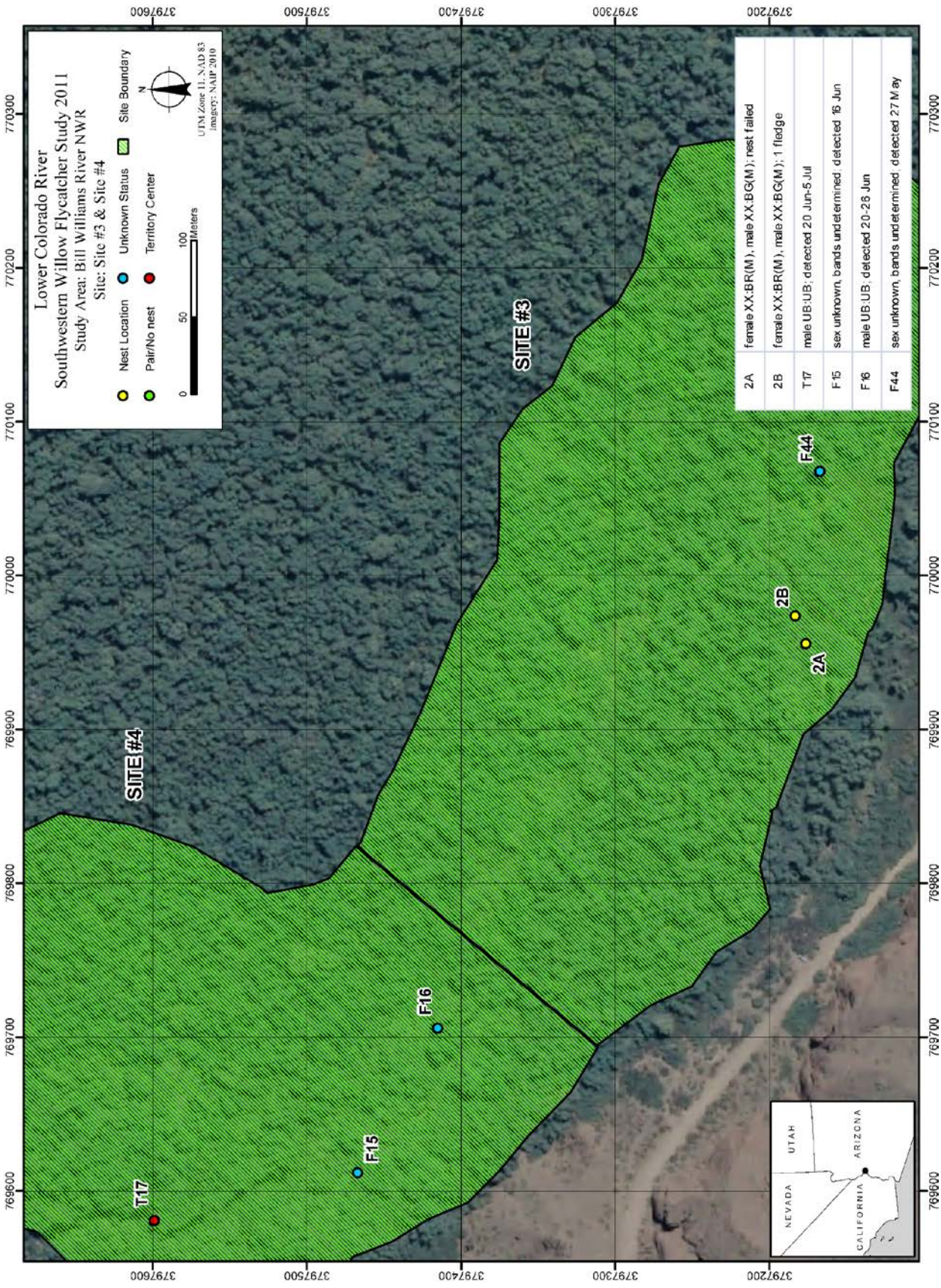

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: Beal Lake
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F22
sex unknown, bands undetermined; detected 7 Jun
BEAL LAKE
F22
UTAH
ARIZONA
NEVADA
CALIFORNIA
385700
385800
385900
386000
386100
386200
725600
725700
725800
725900
726000
726100
726200
726300

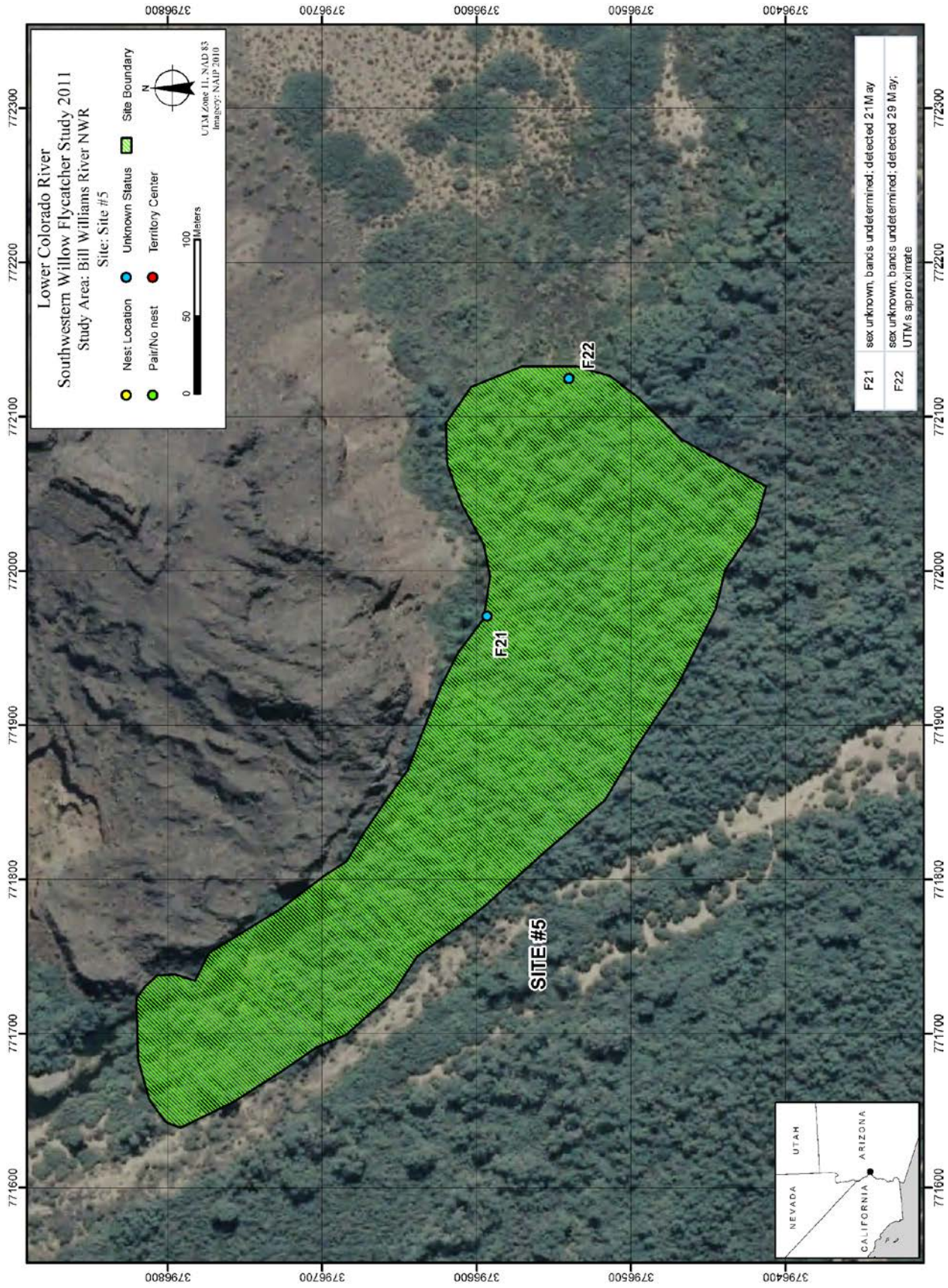

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Topock Marsh
Site: Lost Lake
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
LOST LAKE
F11
F11
sex unknown UB:UB; detected 26 May
UTAH
ARIZONA
NEVADA
CALIFORNIA
384720
384710
384700
384690
384680
384670
728300
728200
728100
728000
727900
727800
727700
727600

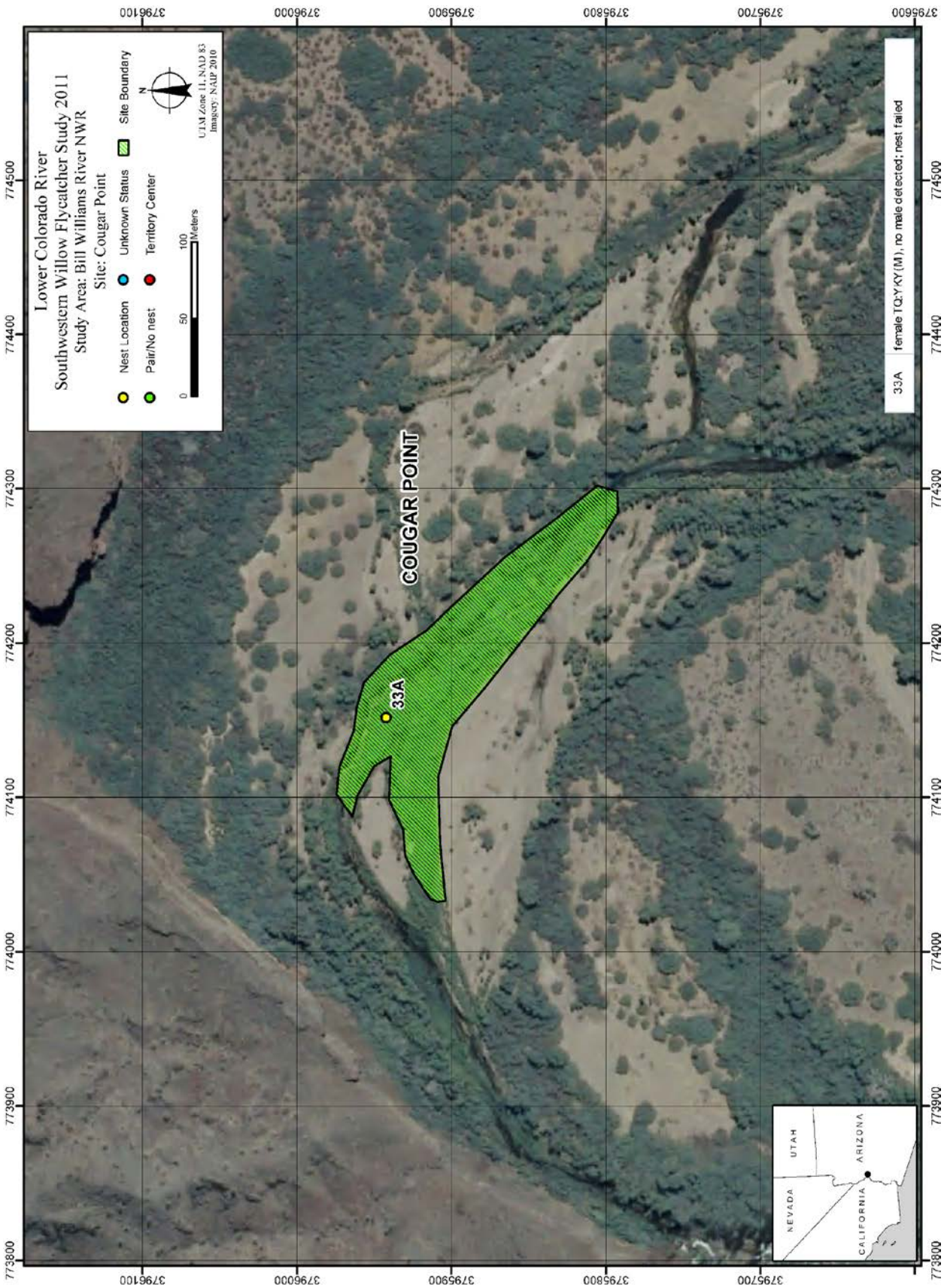

WISPY WILLOW
BURN EDGE
LAST GASP
SITE #4
SITE #5
SITE #3
COUGAR POINT
UPSTREAM FROM SITE #8
PLANET RANCH ROAD
NEW RIVER
NEVADA
UTAH
CALIFORNIA
ARIZONA
N
Bill Williams River NWR Study Area
Mohave & La Paz County, AZ
0
1,000
2,000
3,000
Meters
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
2011 Reconnaissance
Background Imagery: NAIP 2010

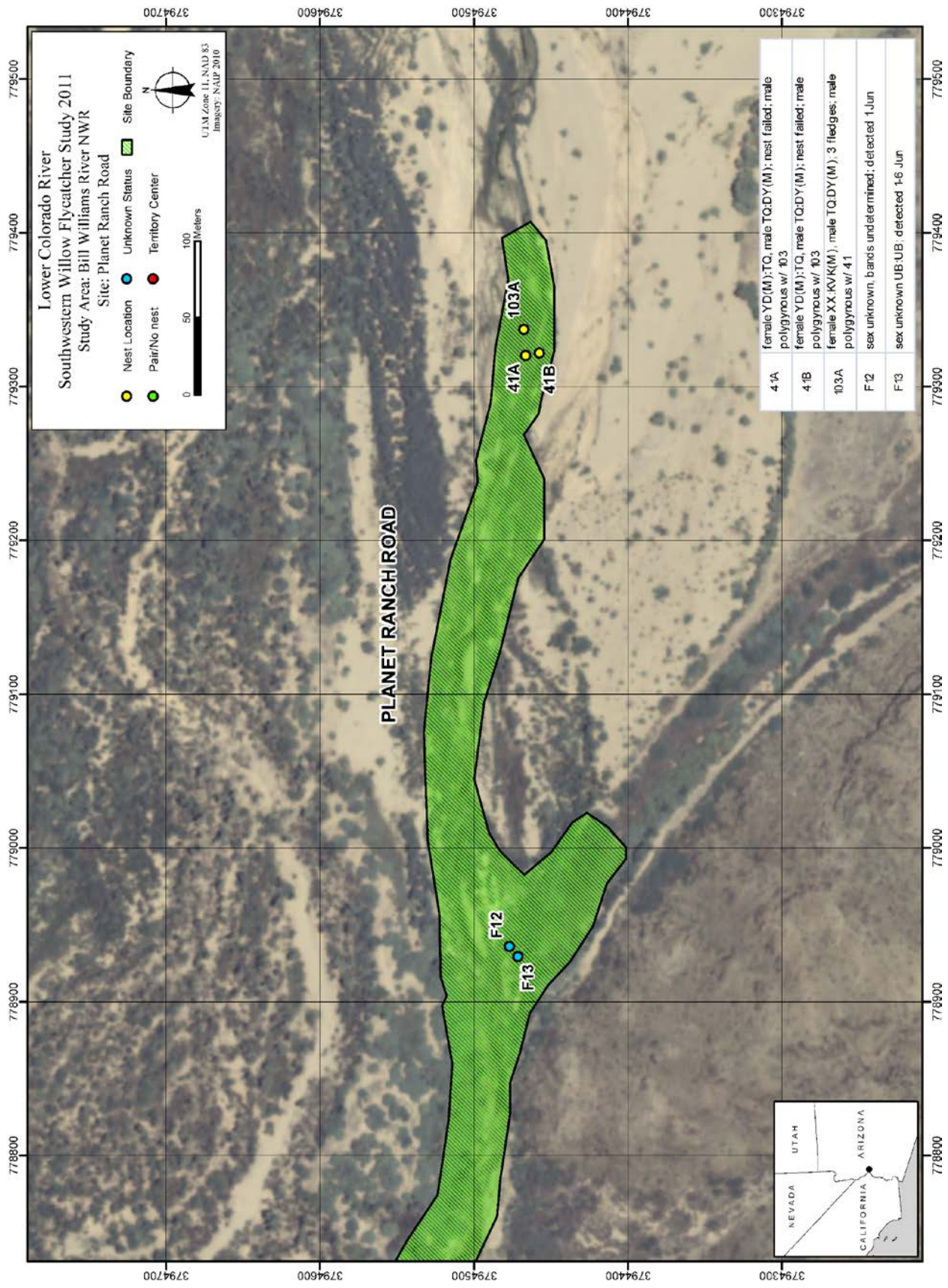

Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Bill Williams River NWR
Site: Wispy Willow
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F31
sex unknown, bands undetermined; detected 27 May
WISPY WILLOW
F31
UTAH
ARIZONA
NEVADA
CALIFORNIA
769100
769000
768900
768800
768700
768600
768500
768400
379870
379860
379850
379840
379830
379820


Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Bill Williams River NWR
Site: Burn Edge
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
BURN EDGE
F32
F32
male bands undetermined; detected 30 Jun
UTAH
ARIZONA
NEVADA
CALIFORNIA
3798500
3798400
3798300
3798200
3798100
3798000
770300
770200
770100
770000
769900
769800
769700
769600


Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Bill Williams River NWR
Site: Site #3 & Site #4
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
imagery: NAIP 2010
2A female XX:BR(M), male XX:BG(M); nest failed
2B female XX:BR(M), male XX:BG(M); 1 fledge
T17 male UB:UB; detected 20 Jun-5 Jul
F15 sex unknown, bands undetermined; detected 16 Jun
F16 male UB:UB; detected 20-26 Jun
F44 sex unknown, bands undetermined; detected 27 May
SITE #3
SITE #4
T17
F15
F16
2A
2B
F44
NEVADA
UTAH
ARIZONA
CALIFORNIA
769600
769700
769800
769900
770000
770100
770200
770300
3797600
3797500
3797400
3797300
3797200


Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Bill Williams River NWR
Site: Site #5
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
F21
sex unknown, bands undetermined; detected 21 May
F22
sex unknown, bands undetermined; detected 29 May; UTM's approximate
F21
F22
SITE #5
UTAH
ARIZONA
NEVADA
CALIFORNIA
772300
772200
772100
772000
771900
771800
771700
771600
3796800
3796700
3796600
3796500
3796400


Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Bill Williams River NWR
Site: Cougar Point
Nest Location
Pair/No nest
Unknown Status
Territory Center
Site Boundary
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
COUGAR POINT
33A
33A female TQ:YKY(M), no male detected; nest failed
UTAH
ARIZONA
NEVADA
CALIFORNIA


Lower Colorado River
Southwestern Willow Flycatcher Study 2011
Study Area: Bill Williams River NWR
Site: Planet Ranch Road
Nest Location
Unknown Status
Site Boundary
Pair/No nest
Territory Center
0
50
100
Meters
N
UTM Zone 11, NAD 83
Imagery: NAIP 2010
PLANET RANCH ROAD
103A
41A
41B
F12
F13
4 1A female YD(M):TQ, male TQ:DY(M); nest failed: male polygynous w/ 103
4 1B female YD(M):TQ, male TQ:DY(M); nest failed; male polygynous w/ 103
103A female XX:KVK(M), male TQ:DY(M); 3 fledges; male polygynous w/ 41
F12 sex unknown, bands undetermined; detected 1 Jun
F13 sex unknown UB:UB; detected 16 Jun
UTAH
ARIZONA
NEVADA
CALIFORNIA
3794700
3794600
3794500
3794400
3794300
779500
779400
779300
779200
779100
779000
778900
778800

Chapter 7

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

INTRODUCTION

Southwestern Willow Flycatcher nests and breeding territories are typically located near rivers, streams, and open water (Sogge and Marshall 2000) or over wet soil (Flett and Sanders 1987, Harris et al. 1987, Harris 1991). Nest substrate plants are often rooted in or overhang standing water. Although the association between breeding flycatchers and open water or wet soil is widely recognized by managers and scientists alike, the exact nature of the association is poorly quantified. Water may be a direct environmental cue for flycatcher nesting behavior or it may be the ultimate cause of proximate factors such as vegetation composition and structure, prey base, and microclimate.

Anthropogenic or natural modifications to surface water resources (i.e., fluvial hydrology and geomorphology) can modify existing and potential flycatcher breeding habitat and therefore have the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). For example, nine flycatcher territories at San Marcial on the middle Rio Grande in New Mexico exhibited a near absence of nesting attempts in 1996 when a combination of drought, upstream dam operations, and upstream withdrawals for irrigation removed all surface water (Johnson et al. 1999). This was in contrast to previous (1994, 1995) and subsequent (1997) years when active nests were documented at the site, with the river flowing in those years. A nearby control site that contained water exhibited multiple nesting attempts during all four years, leading Johnson et al. (1999) to suggest that the presence of water was a fundamental requirement for nesting. A similar pattern was observed along the Gila River in Arizona when decreased streamflow from 2002 to 2004 coincided with the number of flycatcher territories declining by nearly half each year (Munzer et al. 2005). Since 2004, flows within the Gila River have been greater and more consistent, and correspond with a continuing increase in flycatcher territories (14 to 97) from 2004 to 2009 (Graber and Koronkiewicz 2009b).

Flow characteristics of the lower Colorado River have been modified by numerous dams and irrigation withdrawals (Rosenberg et al. 1991). The river reach between Parker Dam and Imperial Dam is regulated by releases from Parker Dam, which has been in operation since 1939. Existing riparian habitat in the Parker to Imperial reach has likely adjusted to historical water release patterns from Parker Dam and appears to be in a stable or declining condition (LCR MSCP 2004). Implementation of the Secretarial Implementation Agreements/California 4.4 Plan (hereafter SIAs) by Reclamation would change the point of diversion for up to 400,000 acre-feet of California apportionment water for up to 75 years (USFWS 2001). The point of diversion, previously located below Parker Dam at Imperial Dam, would change to a point above Parker Dam, resulting in lower water levels in the river between Parker and Imperial. The change in point of diversion was scheduled to begin in 2002.

River flow changes related to the change in point of diversion have the potential to further modify riparian habitats below Parker Dam, habitats that are presently considered potentially suitable for willow flycatcher (USFWS 2001:47). Reclamation (2000) estimated that implementation of the SIAs will cause a drop in floodplain groundwater levels of 1.55 feet (0.47 m) or less. As a result, 372 acres (151 ha) of occupied[1] Southwestern Willow Flycatcher habitat could lose their moist soils. This loss could influence plant species composition (loss of cottonwood and willow) and structure (loss of vegetation volume) over an undetermined length of time. In addition, Reclamation estimated that 5,404 acres (2,187 ha) of

[1] As per the USFWS, occupied Southwestern Willow Flycatcher habitat is defined as patches of vegetation that are similar to and contiguous with areas where willow flycatchers were detected after 15 June in any year since surveys began in 1996.

potential flycatcher habitat could be influenced by the drop in groundwater level. These changes may affect the distribution, abundance, occupancy, and prey base of Southwestern Willow Flycatchers in the Parker to Imperial reach.

In 2004, Reclamation completed a pilot year of habitat monitoring by deploying temperature/humidity data loggers at several sites in the Parker to Imperial reach. Reclamation then initiated a more comprehensive, long-term study in 2005 for the purpose of addressing how the above hydrological changes might affect riparian habitats along the Parker to Imperial reach. The objective is to monitor 151 ha (372 acres) of occupied Southwestern Willow Flycatcher habitat between Parker and Imperial Dams for 10–15 years to determine how microclimate, vegetation, and groundwater conditions might be affected by the SIAs water transfer actions. Monitoring did not commence until after diversions started; therefore, antecedent conditions are unknown and monitoring analyses focus on detecting change through time rather than comparing current conditions to a baseline. An additional objective was to compare microclimate characteristics of sites in the Parker to Imperial reach with those at flycatcher breeding areas. This analysis was completed in previous years and is not repeated here. This chapter reports the results of habitat monitoring to date.

METHODS

In 2005, we selected a subset of sites that are currently surveyed for the presence of willow flycatchers for inclusion in the habitat monitoring study. We chose 11 sites distributed along the Parker to Imperial reach that are reasonably accessible, and where we believed groundwater levels were influenced primarily by river levels and not by outside sources such as irrigation return flows. Chosen sites equated to at least 75.3 ha (186 acres) on the California side of the lower Colorado River and at least 75.3 ha (186 acres) on the Arizona side. We also chose four control sites, two above Parker Dam and two below Imperial Dam, to distinguish any changes in microclimate, groundwater, or vegetation caused by water transfer actions from those caused by fluctuations in climate or rainfall. The 11 test sites are Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron, and the four control sites are Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North (Figure 7.1). We monitored these same 15 sites from 2005 to 2011. In August of 2006, we initiated habitat monitoring within a consistently occupied breeding site at Topock Marsh to obtain groundwater levels and patterns with which we can compare results obtained at the habitat monitoring sites. The analysis comparing Topock to the 15 habitat monitoring sites was completed in previous years and is not repeated here.

Temperature/Humidity Loggers

In 2005, we deployed HOBO H8 Pro (Onset Computer Corporation, Pocasset, MA) temperature/humidity data loggers at several locations within each site selected for habitat monitoring. All loggers collected data at 15-minute intervals and were placed in inverted plastic containers and camouflaged as described in Chapter 6. All 60 logger locations selected in 2005 were retained in 2006. Two additional data loggers were installed in the Topock Marsh monitoring site in August 2006. A portion of Gila Confluence North, one of the control sites below Imperial Dam, burned in December 2006. As a result of the fire, all vegetation at one HOBO location at the site was killed, and vegetation at another HOBO location was dramatically reduced. These two HOBOs were replaced in May 2007 with HOBOs at new locations within unburned portions of the site.

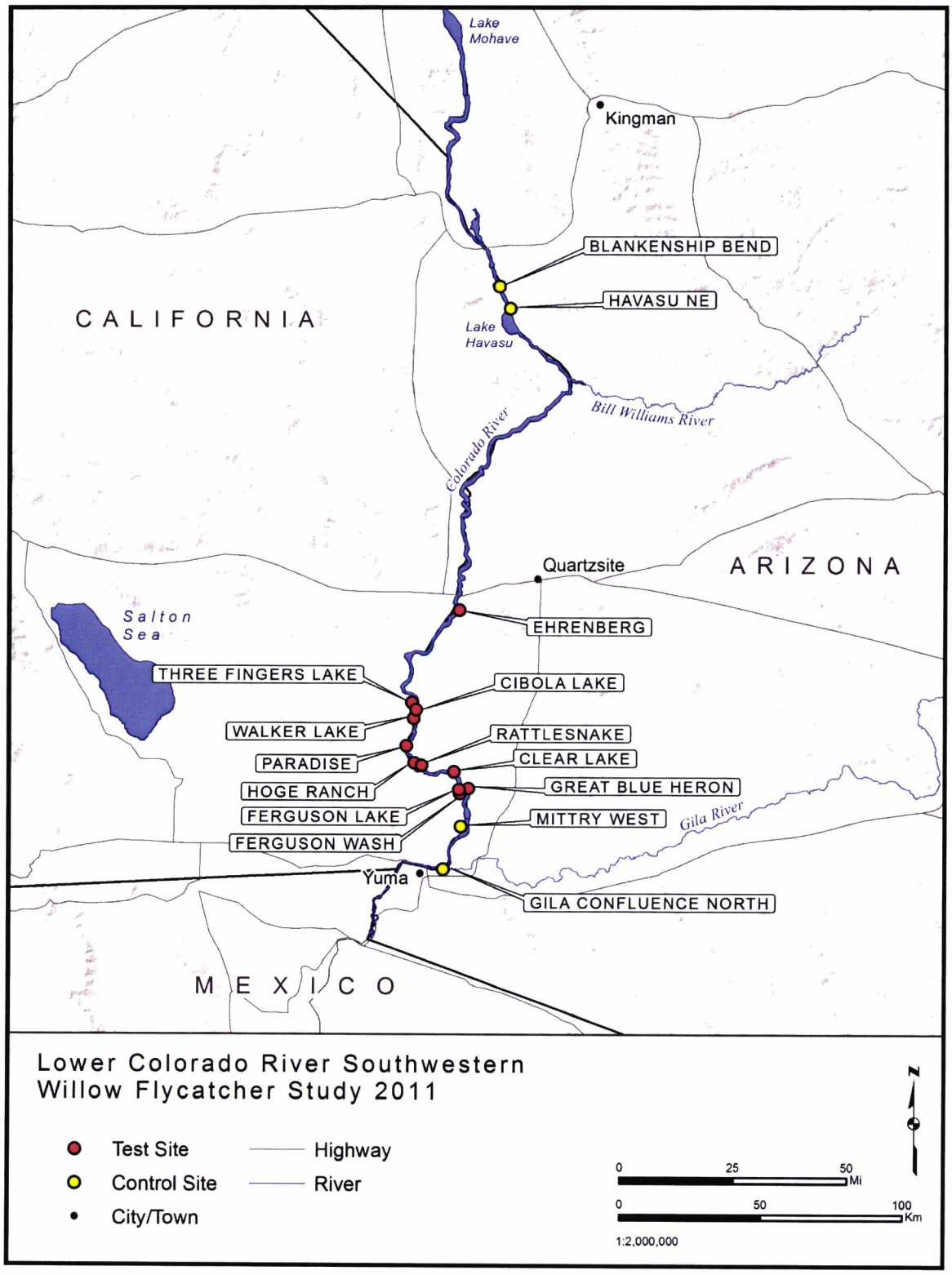


Figure 7.1. Locations of test and control sites, habitat monitoring study, 2005–2011.

HOBO loggers have been downloaded two or three times per year since installation. At each download, we examined the data to determine if there are any problems with data logger function. Data loggers were replaced whenever a potential problem with the sensors was detected. Battery level was also checked at each download, and the battery was replaced if needed.

Soil Moisture Measurements

Soil moisture beneath each HOBO logger was measured and recorded using a hand-held ThetaProbe ML2x coupled to an HH2 Moisture Meter Readout (Macaulay Land Use Research Institute, Aberdeen, UK, and Delta-T Devices, Cambridge, UK, respectively). Soil moisture measurements were collected during each presence/absence survey between 15 May and 25 July and when HOBO data were downloaded. Soil moisture measurements, percent of the area containing inundated or saturated soil, and distance to water were recorded as described in Chapter 6.

Vegetation Measurements

We completed vegetation measurements, following the methods described in Chapter 5, at each HOBO location after flycatcher surveys were completed in late July. All HOBO loggers were also downloaded at this time. Vegetation measurements were completed at the same locations as in 2005–2010 with the exception of Gila Confluence North, where vegetation measurements were collected at the two new HOBO locations established in 2007.

Groundwater Measurements

Piezometers were installed in May–August 2005 near each of the 15 sites selected for habitat monitoring. Analyses of groundwater data in previous years showed that releases from Parker Dam can be used to predict the groundwater level beneath the habitat polygons (e.g., McLeod et al. 2007, McLeod and Koronkiewicz 2009); consequently, these piezometers were removed in 2010. Analyses of the piezometer data are not repeated here. One additional piezometer was installed at Topock Marsh within occupied flycatcher habitat in 2006; see Chapter 8 for information regarding this piezometer.

Statistical Analyses

Microclimate

The following values were calculated for all 15 habitat monitoring sites:

- Mean soil moisture from plot center to 2.0 m from plot center
- Mean maximum diurnal temperature
- Mean minimum nocturnal temperature
- Mean daily temperature range (diurnal maximum minus nocturnal minimum)
- Mean diurnal vapor pressure
- Mean nocturnal vapor pressure

The diurnal and nocturnal periods were determined from the daily sunrise and sunset times reported for the region by the National Weather Service (2011).

We assigned all plots as a control site (above Parker Dam or below Imperial Dam) or as a test site (between Parker and Imperial). We analyzed between-year differences in humidity and soil moisture values within these two groups using linear mixed models and analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models. These analyses were restricted to 1 June–1 August. Analyses were conducted using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

We analyzed the between-year differences among the test sites compared to the control sites using repeated measures linear mixed models for canopy height, canopy closure, percent woody ground cover, three categories of stem sizes for both live and dead stems, the percentage of each stem size category that consisted of live stems, and the percentage of the basal area within the plot that consisted of native vegetation. In prior years we used repeated measures ANOVA for these analyses; however, repeated measures ANOVA excludes cases with missing values whereas linear mixed models allow for the inclusion of all data. We also used repeated measures linear mixed models to examine foliage density for live and dead vegetation summed over all height intervals. These analyses and all descriptive statistics were produced using SPSS® Version 16.0 (SPSS Inc.) software. We excluded vertical foliage density measurements at 5 m from plot center from the analysis so as to have comparable data across years.

RESULTS

Temperature/Humidity Logger Maintenance

All HOBO loggers were downloaded at the beginning and end of the 2011 field season. Four loggers had fallen to the ground over the winter because of sun damage to the logger housing. Five loggers that were in place over the winter had bad humidity sensors but useable temperature data, and one logger failed to collect data. Of the HOBO loggers in place May–August 2011, three failed to collect data, four had faulty humidity data, and four fell to the ground. Data from fallen loggers were not used in the analysis.

Microclimate

2011 Microclimate Descriptive Statistics

Soil moisture, temperature, and vapor pressure parameters from the 15 study sites monitored in 2011 exhibited substantial variation among sites (Table 7.1). Soil moisture varied from a low of 140.9 mV at Ferguson Wash to a high of 939.4 at Mittry West.

Mean maximum diurnal temperatures ranged from a low of 37.4°C at Rattlesnake to a high of 48.2°C at Cibola Lake. Mean minimum nocturnal temperatures ranged from a low of 15.1°C at Gila Confluence North to a high of 20.0°C at Three Fingers Lake. Mean daily temperature range varied from 19.5°C at Ferguson Lake to 28.9°C at Paradise.

Mean diurnal vapor pressure was lowest at Blankenship Bend (1106.6 Pa) and highest at Three Fingers Lake (1953.5 Pa). Mean nocturnal vapor pressure was lowest at Ferguson Wash (1080.9 Pa) and highest at Three Fingers Lake (1849.7 Pa).

Between-year Comparisons of Microclimate Characteristics

All microclimate characteristics varied significantly over time at test sites (Ehrenberg, Three Fingers Lake, Cibola Lake, Walker Lake, Paradise, Hoge Ranch, Rattlesnake, Clear Lake, Ferguson Lake, Ferguson Wash, and Great Blue Heron; Table 7.2). At control sites (Blankenship Bend, Havasu NE, Mittry West, and Gila Confluence North), mean minimum nocturnal temperature varied significantly over time, along with measures of soil moisture and humidity. Neither test nor control sites showed a unidirectional change in any of the microclimate measures in 2005–2011 (Figures 7.2–7.7), although both measures of humidity showed a generally decreasing trend at both test and control sites since 2006. The changes over time differed between test and control sites for soil moisture, mean diurnal vapor pressure, and mean nocturnal vapor pressure (right-most column of Table 7.2).

Soil moisture fluctuated among years at both test and control sites, but the patterns did not mirror one another (Figure 7.2). Between 2005 and 2006, soil moisture decreased more dramatically at control sites than at test sites, while between 2007 and 2008, soil moisture decreased at control sites but rose at test sites. Between 2009 and 2010, soil moisture decreased at test sites but rose at control sites. Diurnal vapor pressure rose more sharply at test sites than at control sites between 2005 and 2006 and then fell more sharply at test sites than at control sites between 2006 and 2007 (Figure 7.6), and nocturnal vapor pressure also showed larger fluctuations at test sites than at control sites.

Vegetation Measurements

Vegetation characteristics varied widely both between and within the selected habitat monitoring sites (Table 7.3). Average canopy height ranged from 3.3 m (Three Fingers Lake) to 9.8 m (Ehrenberg), and average canopy closure ranged from 66.9% (Ehrenberg) to 98.6% (Clear Lake). Measures of other habitat characteristics were similarly variable. Vertical foliage profiles for each site are shown in Figure 7.8. Sites typically exhibited the densest foliage within 3–5 m of the ground, and the majority of vegetation within 2–3 m of the ground typically consisted of dead branches.

Between-year Comparisons of Vegetation Characteristics

Many vegetation variables varied between years within the test and control groups (Table 7.4), but none of the variables exhibited change in a consistent direction over time (Figures 7.9–7.24). There was a significant interaction between year and location (meaning that the change between years among test sites was significantly different from the change at control sites) for woody ground cover ($P = 0.004$), number of live stems ≤2.5 cm dbh ($P = 0.043$), number of dead stems ≤ 2.5 cm dbh ($P = 0.040$), percent of live stems ≤2.5 cm dbh ($P = 0.022$), and dead vertical foliage hits ($P = 0.003$). Average woody ground cover increased at control plots between 2005 and 2006 and then decreased in 2007, while it did not change at test plots across those years. Overall, the number of live stems ≤2.5 cm dbh decreased through time at both test and control plots (Figure 7.12), while the number of dead stems ≤ 2.5 cm dbh decreased only at control plots (Figure 7.15), though there was considerable annual fluctuation for both variables. The percentage of live stems increased at control plots but decreased at test plots (Figure 7.18). The amount of dead vertical foliage hits increased through time at both test and control plots, but increased more rapidly at test plots (Figure 7.23).

Table 7.1. Microclimatic Data Summaries Collected From Habitat Monitoring Sites, Lower Colorado River, 1 May–31 July 2011*

Descriptive Statistics	Blankenship Bend	Havasu NE	Ehrenberg	Three Fingers Lake	Cibola Lake	Walker Lake	Paradise	Hoge Ranch	Rattlesnake	Clear Lake	Ferguson Lake	Ferguson Wash	Great Blue Heron	Mittry West	Gila Confluence North
Soil Moisture															
Mean soil moisture (mV)	850.2 (89.7)	267.4 (74.5)	641.3 (106.7)	425. (61.3)	494.6 (114.5)	900.7 (28.6)	707.0 (50.7)	829.5 (21.5)	735.1 (44.4)	424.7 (157.2)	925.7 (15.0)	140.9 (5.5)	876.0 (9.6)	939.4 (10.8)	399.3 (104.2)
Temperature															
Mean maximum diurnal temperature (°C)	42.4 (0.3)	44.9 (0.5)	45.6 (0.4)	46.4 (0.6)	48.2 (0.3)	44.1 (0.3)	45.7 (0.4)	45.1 (0.4)	37.4 (0.2)	40.1 (0.3)	38.9 (0.3)	40.0 (0.3)	39.7 (0.3)	42.2 (0.3)	42.9 (0.4)
Mean minimum nocturnal temperature (°C)	17.2 (0.3)	18.6 (0.3)	18.2 (0.4)	20.0 (0.6)	19.9 (0.3)	16.7 (0.3)	16.8 (0.3)	17.0 (0.3)	16.2 (0.3)	18.4 (0.3)	19.4 (0.2)	19.1 (0.3)	16.3 (0.3)	17.8 (0.3)	15.1 (0.4)
Mean daily temperature range (°C)	25.2 (0.4)	26.4 (0.6)	27.4 (0.5)	26.4 (1.0)	28.3 (0.4)	27.4 (0.4)	28.9 (0.5)	28.2 (0.4)	21.2 (0.3)	21.7 (0.4)	19.5 (0.3)	20.9 (0.3)	23.5 (0.3)	25.4 (0.4)	27.8 (0.4)
Humidity															
Mean diurnal vapor pressure (Pa)	1106.6 (33.8)	1342.7 (38.2)	1133.4 (42.1)	1953.5 (92.7)	1216.0 (44.5)	1139.2 (29.8)	1336.9 (43.3)	1318.2 (33.1)	1670.7 (42.8)	1334.5 (38.9)	1359.7 (30.1)	1244.9 (30.1)	1306.1 (38.3)	1297.5 (34.1)	1269.0 (34.6)
Mean nocturnal vapor pressure (Pa)	1185.3 (32.8)	1215.5 (34.0)	1197.1 (40.0)	1849.7 (81.7)	1321.3 (38.3)	1154.9 (26.0)	1332.9 (34.8)	1316.2 (30.4)	1620.5 (37.8)	1239.3 (32.3)	1378.6 (27.3)	1080.9 (26.3)	1292.7 (33.6)	1235.8 (28.9)	1236.4 (31.8)

* Data are presented as mean (standard error).

Table 7.2. Change in Microclimatic Variables at Habitat Monitoring Sites from 2005 to 2011*

Parameter	Test (n=45)								Control (n=15)								P-value for difference between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Soil Moisture																	
Mean soil moisture (mV)	645.7 (44.8)	634.4 (48.6)	662.9 (44.8)	705.8 (42.7)	699.2 (35.7)	651.4 (20.8)	636.2 (46.5)	<0.001	694.4 (89.8)	582.9 (98.1)	635.3 (98.4)	607.5 (90.7)	591.7 (90.6)	687.5 (36.3)	631.3 (96.4)	<0.001	<0.001
Temperature																	
Mean maximum diurnal temperature (°C)	44.9 (0.1)	46.1 (0.1)	45.2 (0.1)	46.5 (0.1)	43.8 (0.1)	45.0 (0.1)	44.0 (0.1)	<0.001	45.6 (0.2)	48.0 (0.2)	46.4 (0.2)	45.7 (0.2)	44.2 (0.2)	46.2 (0.2)	45.1 (0.2)	0.065	0.245
Mean minimum nocturnal temperature (°C)	20.7 (0.1)	22.7 (0.1)	20.4 (0.1)	20.7 (0.1)	21.2 (0.1)	20.4 (0.1)	20.1 (0.1)	<0.001	20.2 (0.2)	22.1 (0.2)	20.3 (0.2)	20.8 (0.2)	21.2 (0.1)	20.9 (0.2)	19.5 (0.2)	<0.001	0.423
Mean daily temperature range (°C)	24.2 (0.2)	23.5 (0.2)	24.8 (0.2)	25.8 (0.2)	22.6 (0.2)	24.6 (0.2)	23.9 (0.2)	<0.001	25.4 (0.2)	26.0 (0.3)	26.1 (0.3)	24.9 (0.3)	23.0 (0.2)	25.3 (0.3)	25.6 (0.3)	0.345	0.138
Humidity																	
Mean diurnal vapor pressure (Pa)	1797.2 (13.0)	2028.4 (13.5)	1737.9 (16.6)	1770.4 (12.8)	1758.9 (13.4)	1588.3 (12.6)	1556.0 (14.8)	<0.001	1726.3 (20.4)	1863.9 (21.9)	1696.9 (21.7)	1692.3 (20.5)	1701.1 (18.9)	1582.8 (17.3)	1493.4 (23.0)	<0.001	0.010
Mean nocturnal vapor pressure (Pa)	1686.3 (11.2)	1860.4 (10.5)	1852.7 (14.0)	1679.8 (10.2)	1618.0 (10.5)	1484.0 (10.3)	1507.7 (13.0)	<0.001	1638.2 (17.6)	1703.4 (18.7)	1559.9 (20.7)	1582.9 (18.4)	1583.2 (17.0)	1479.8 (15.8)	1431.0 (20.9)	<0.001	0.002

*Data are presented as means (standard error). The analysis was restricted to 1 June–1 August each year.

AR064996

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

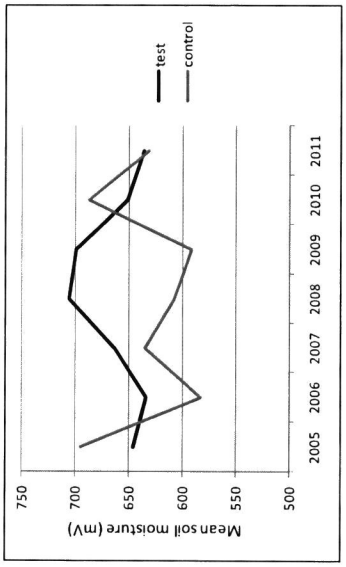


Figure 7.2. Mean soil moisture at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

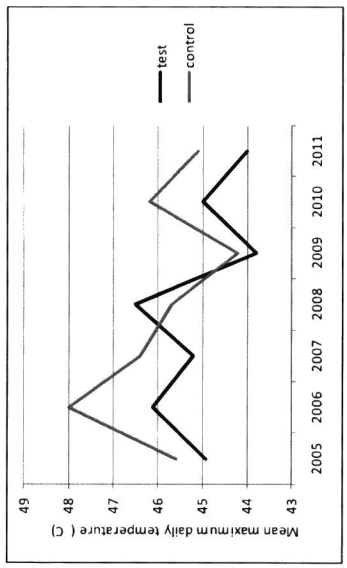


Figure 7.3. Mean maximum daily temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

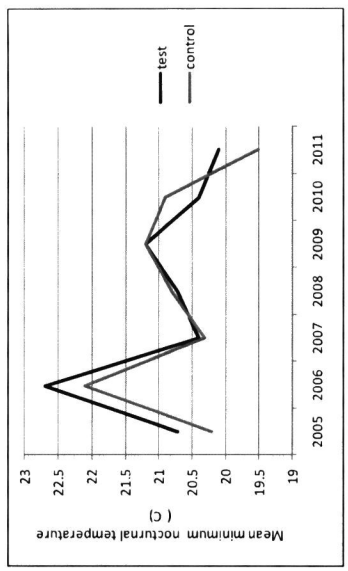


Figure 7.4. Mean minimum nocturnal temperature at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

Figure 7.5. Mean daily temperature range at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

Figure 7.6. Mean diurnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

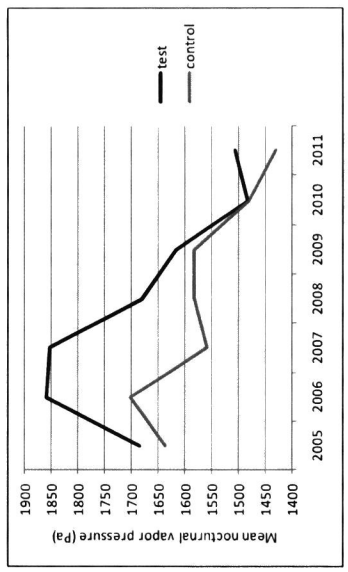


Figure 7.7. Mean nocturnal vapor pressure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

Table 7.3. Summary of Vegetation Characteristics at Habitat Monitoring Sites, Lower Colorado River, 2011*

Parameter	Blankenship Bend (n=4)	Havasu NE (n=4)	Ehrenberg (n=4)	Three Fingers Lake (n=5)	Cibola Lake (n=5)	Walker Lake (n=3)	Paradise (n=4)	Hoge Ranch (n=4)	Rattlesnake (n=4)	Clear Lake (n=3)	Ferguson Lake (n=5)	Ferguson Wash (n=4)	Great Blue Heron (n=4)	Mittry West (n=4)	Gila Confluence North (n=3)
Average canopy height (m)	6.2 (1.1)	3.9 (0.7)	9.8 (2.9)	3.3 (0.3)	3.9 (0.4)	7.2 (1.8)	7.8 (3.0)	4.6 (0.6)	8.1 (1.1)	7.1 (0.1)	5.2 (0.3)	5.9 (0.4)	7.7 (1.3)	7.5 (2.2)	7.4 (2.0)
	4.2–9.0	3.0–6.0	2.1–15.8	2.7–4.3	2.2–4.5	5.3–10.7	4.1–16.7	3.6–6.1	6.5–11.4	7.0–7.2	4.5–5.9	4.7–6.6	5.6–10.9	3.6–13.1	4.8–11.3
% total canopy closure	81.9 (9.6)	88 (6.6)	66.9 (14.5)	82.9 (6)	78.8 (14.5)	93.1 (3.3)	95.1 (2.3)	90.0 (3.5)	98.3 (0.7)	98.6 (1.7)	96.8 (1.6)	96.4 (1.7)	96.2 (1)	88.7 (6.4)	86.3 (6.7)
	53.1–92.2	69.3–97.4	41.1–95.8	59.4–92.7	20.8–96.9	87–98.4	89.6–99.5	82.3–98.4	96.4–100.0	95.3–100.5	92.2–100.0	92.7–99.5	93.2–97.9	69.8–97.4	75.5–98.4
% woody ground cover	76.3 (13.7)	44.7 (13.8)	38.9 (12.1)	13.9 (4.5)	34 (7.5)	79.7 (11.9)	90.9 (7.9)	60.1 (17.8)	65.1 (6.0)	51.6 (12.2)	47.2 (15.8)	35.4 (8.8)	39.8 (8.4)	41.7 (8.2)	55.4 (3.4)
	43.8–99.0	6.3–70.0	9.3–58.8	3.5–30.0	7.5–53.8	57.0–97.0	67.5–100.0	26.3–92.0	51.3–78.8	30.0–72.3	3.5–92.5	21.3–61.3	14.8–50.8	27.5–65.0	48.8–60.0
# live stems ≤2.5 cm dbh per ha	509 (360)	64 (64)	446 (331)	2266 (646)	229 (117)	212 (153)	350 (223)	796 (210)	509 (260)	255 (255)	1171 (415)	286 (210)	223 (109)	1910 (1069)	1188 (112)
	0–1528	0–255	0–1401	382–3820	0–509	0–509	127–1019	382–1273	0–1019	0–764	382–2419	0–891	0–509	0–3947	1019–1401
# live stems 2.6–8 cm dbh per ha	1432 (439)	509 (289)	668 (318)	5628 (1696)	3132 (816)	2080 (552)	3247 (2368)	2674 (597)	2324 (1216)	849 (612)	5195 (1045)	1910 (260)	3629 (1349)	3310 (909)	2928 (1083)
	255–2165	0–1273	0–1528	1783–11968	891–5984	1146–3056	382–10313	1655–3947	0–5475	0–2037	2165–8403	1401–2419	1783–7639	1401–5730	1273–4966
# live stems >8 cm dbh per ha	318 (82)	764 (172)	159 (61)	229 (199)	255 (90)	340 (278)	573 (489)	350 (109)	1337 (433)	1188 (363)	586 (154)	1114 (204)	1050 (141)	637 (356)	1316 (331)
	127–509	255–1019	0–255	0–1019	0–509	0–891	0–2037	127–637	127–2165	764–1910	127–1019	764–1528	637–1273	0–1655	764–1910
# dead stems ≤2.5 cm dbh per ha	95 (61)	0 (0)	159 (159)	331 (154)	76 (31)	0 (0)	191 (152)	64 (37)	255 (116)	0 (0)	306 (204)	127 (127)	127 (90)	1464 (667)	679 (405)
	0–255	0–0	0–637	0–764	0–127	0–0	0–637	0–127	0–509	0–0	0–1019	0–509	0–382	127–3183	0–1401
# dead stems 2.6–8 cm dbh per ha	859 (445)	32 (32)	700 (391)	942 (154)	840 (532)	127 (127)	509 (429)	2260 (1656)	796 (427)	170 (170)	764 (401)	541 (390)	541 (223)	318 (198)	1019 (515)
	0–2037	0–127	0–1655	509–1401	0–2928	0–382	0–1783	0–7130	0–1655	0–509	127–2292	0–1655	0–1019	0–891	0–1655
# dead stems >8 cm dbh per ha	95 (61)	64 (64)	0 (0)	0 (0)	25 (25)	0 (0)	0 (0)	0 (0)	127 (127)	297 (297)	0 (0)	64 (37)	159 (61)	64 (64)	42 (42)
	0–255	0–255	0–0	0–0	0–127	0–0	0–0	0–0	0–509	0–891	0–0	0–127	0–255	0–255	0–127
Percent basal area native	31.7 (19.5)	32.8 (23.6)	96.1 (2.4)	0.5 (0.5)	1.6 (1.3)	29.3 (29.3)	18.7 (18.3)	31.2 (19.2)	39.5 (21.4)	0.0 (0.0)	2.0 (1.9)	22.7 (13.7)	36.1 (15.7)	53.4 (22.4)	100.0 (0.0)
	0–80.0	0–100.0	89.1–99.5	0.0–2.3	0.0–6.8	0.0–87.9	0.0–73.5	0.0–85.1	0.0–100.0	0.0–0.0	0.0–9.6	0.0–55.1	0.0–76.4	0.0–91.4	100.0–100.0

* Data presented are means, (standard error), and range.

AR064998

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

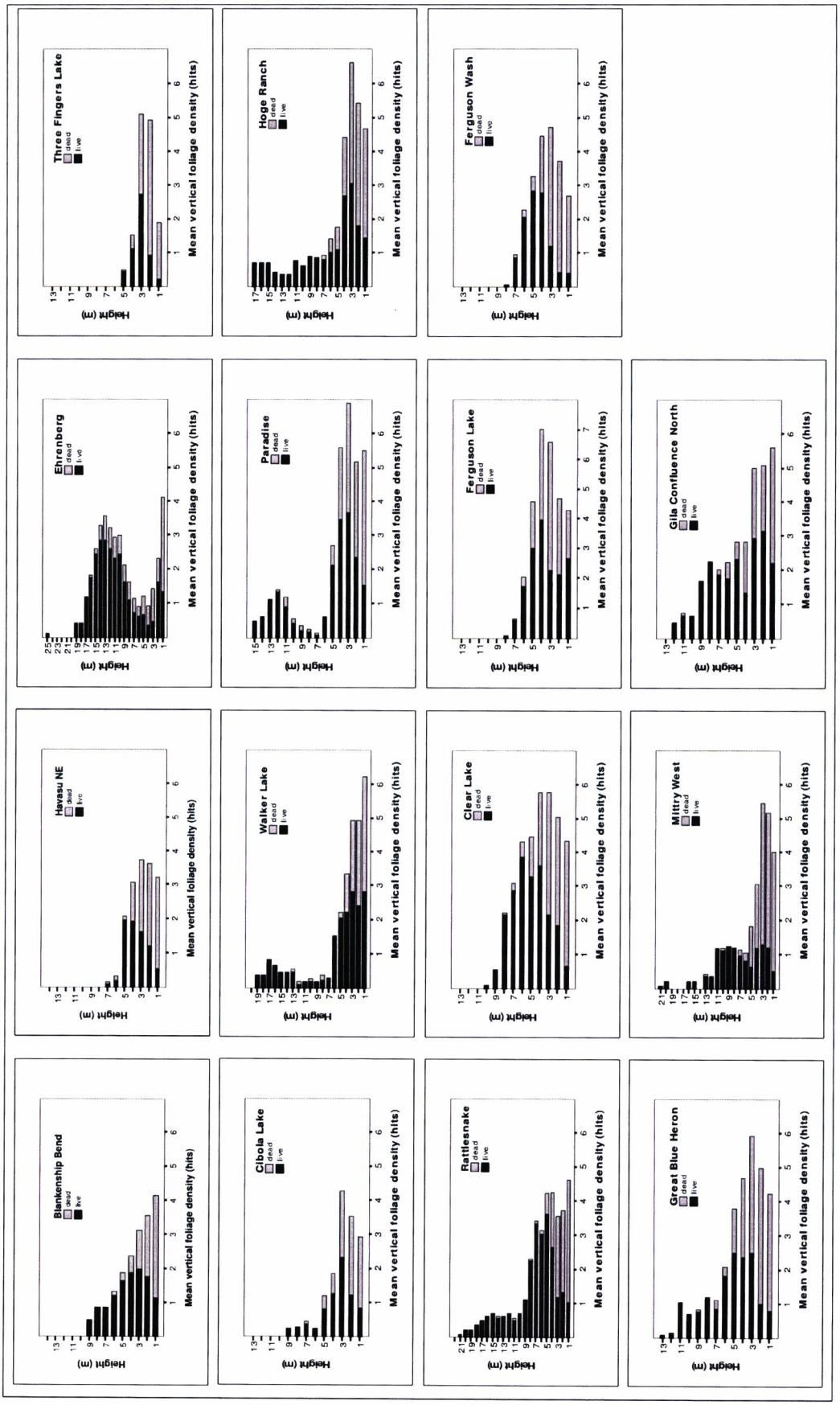


Figure 7.8. Vertical foliage profiles for each habitat monitoring site, lower Colorado River, 2011.

Table 7.4. Annual Means of Vegetation Characteristics at Plots between Parker and Imperial Dams (Test Sites) and Plots above Parker or below Imperial (Control Sites), 2005–2011

Parameter	Test (n=45)								Control (n=15)								P-value for difference in means between years among test sites compared to control sites
	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	2005	2006	2007	2008	2009	2010	2011	P-value for the difference between years	
Average canopy height (m)	6.6	7.0	5.8	6.7	7.1	6.5	6.2	0.055	6.6	7.0	6.8	7.7	7.0	6.9	6.2	0.004	0.493
% total canopy closure	84.7	78.3	87.9	88.1	86.7	85.3	89.7	<0.001	80.8	76.9	85.7	85.5	82.5	80.5	86.2	0.008	0.963
% woody ground cover	31.1	27.3	30.0	41.6	23.5	35.6	48.7	<0.001	24.4	46.7	40.2	53.0	31.4	38.0	54.5	<0.001	0.004
# live stems ≤2.5 cm dbh per ha	1932	2272	2515	1358	2530	1316	671	<0.001	985	2574	1842	883	1210	1010	900	<0.001	0.043
# live stems 2.6–8 cm dbh per ha	3107	2722	3143	3899	2314	3271	3030	<0.001	1655	2310	1918	2139	1401	1859	1986	0.002	0.517
# live stems >8 cm dbh per ha	481	430	654	671	597	637	628	0.025	603	646	730	730	546	586	722	0.048	0.587
# dead stems ≤2.5 cm dbh per ha	340	1282	1259	1084	1949	1075	161	<0.001	1214	1492	1367	1384	1455	552	552	<0.001	0.040
# dead stems 2.6–8 cm dbh per ha	1234	821	925	1879	1081	1310	778	0.015	1061	437	747	1392	609	475	526	<0.001	0.790
# dead stems >8 cm dbh per ha	48	59	96	108	91	110	54	0.096	59	82	127	59	118	85	68	0.892	0.866
% live stems ≤2.5 cm dbh	81.7	66.1	66.3	61.0	52.4	57.2	75.2	<0.001	51.9	63.2	55.7	41.4	41.8	70.3	65.8	0.082	0.022
% live stems 2.6–8 cm dbh	72.8	74.6	77.1	68.3	66.1	69.1	77.8	0.033	70.8	79.2	70.2	58.6	64.6	79.5	76.0	<0.001	0.139
% live stems >8 cm dbh	92.8	84.6	87.7	91.8	89.0	88.4	96.0	N/A[1]	90.8	89.1	89.4	89.9	81.9	84.5	86.0	N/A[1]	0.540
Percent basal area native	27.2	20.3	28.9	23.8	21.6	22.1	24.1	0.195	42.7	52.8	59.9	46.9	45.0	57.9	51.4	0.274	0.090
Total live foliage hits	17.4	17.7	11.3	17.0	19.3	17.1	17.8	<0.001	18.1	15.5	16.5	18.4	17.5	16.9	14.3	0.335	0.375
Total dead foliage hits	9.3	10.0	5.1	10.8	9.1	14.1	10.5	<0.001	8.4	6.6	6.1	11.0	6.3	8.5	9.2	0.042	0.003
Percent live foliage hits	62.7	62.0	65.8	58.7	63.8	56.1	59.3	0.006	69.1	70.0	69.6	64.8	72.9	67.6	58.7	0.065	0.281

[1] Model failed to converge; no P-value.

Table 7.5. Average Monthly Flows (cfs) Below Parker Dam, 2000–2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Difference (2001–present)	% Change (2001–present)
January	6,820	5,599	6,478	6,327	5,536	4,166	5,842	5,945	4,850	6,177	3,794	5,983	384	6.9%
February	9,123	8,505	8,978	6,881	7,129	4,888	7,798	8,491	8,232	7,137	5,960	6,470	-2,035	-23.9%
March	11,594	10,524	11,334	12,360	11,523	9,699	9,752	11,122	12,180	11,973	10,879	10,881	357	3.4%
April	14,613	14,090	13,610	13,803	12,824	11,356	11,985	12,618	14,293	13,184	11,259	12,594	-1,496	-10.6%
May	14,174	14,068	12,826	11,990	12,252	11,428	11,998	11,718	11,339	10,533	10,765	10,798	-3,270	-23.2%
June	13,803	14,733	13,713	12,778	12,741	12,444	12,383	12,116	11,957	9,992	10,931	11,394	-3,339	-22.7%
July	14,210	14,974	14,439	13,100	12,331	13,842	11,688	12,180	12,226	10,645	12,098	11,438	-3,536	-23.6%
August	11,441	12,047	12,118	10,803	11,420	10,316	10,141	10,317	10,720	9,459	10,508	8,951	-3,096	-25.7%
September	11,233	10,837	10,429	11,159	9,566	9,048	7,334	9,195	9,072	8,492	9,803	7,637	-3,200	-29.5%
October	9,362	8,852	8,765	9,761	7,405	6,967	7,424	7,204	7,568	7,241	7,562	7,111	-1,741	-19.7%
November	7,437	7,357	7,049	6,153	5,163	6,335	6,094	5,420	6,369	6,136	6,435		-922	-12.5%
December	6,706	5,970	5,615	5,737	4,129	4,841	5,507	4,079	3,829	4,872	4,315		-1,655	-27.7%

AR065000

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

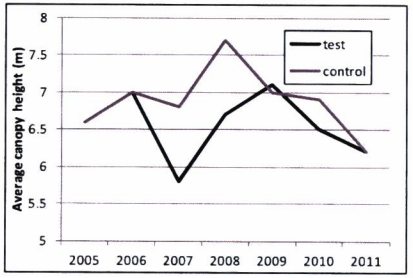


Figure 7.9. Average canopy height at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

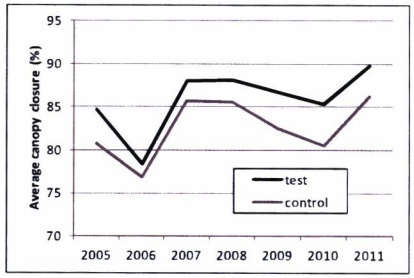


Figure 7.10. Average canopy closure at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

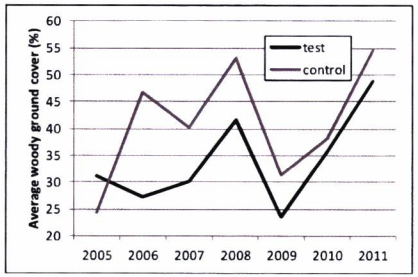


Figure 7.11. Average percent woody ground cover at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

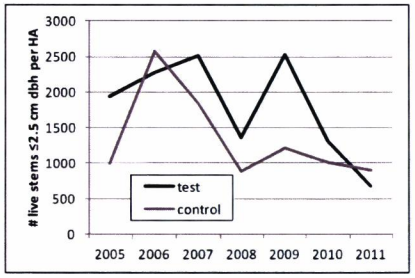


Figure 7.12. Average number of live stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

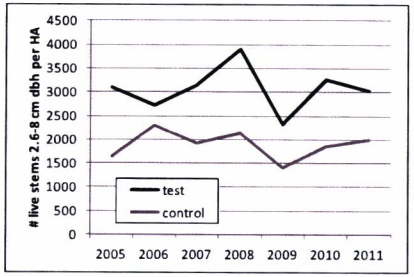


Figure 7.13. Average number of live stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

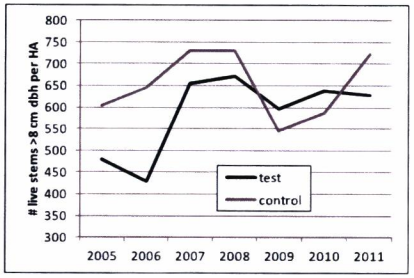


Figure 7.14. Average number of live stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

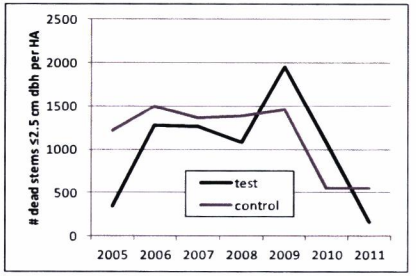


Figure 7.15. Average number of dead stems ≤2.5 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

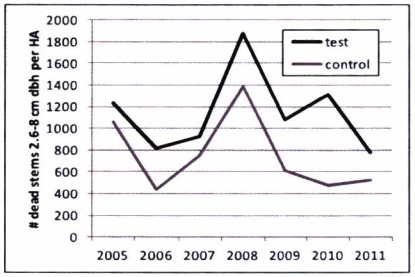


Figure 7.16. Average number of dead stems 2.6–8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

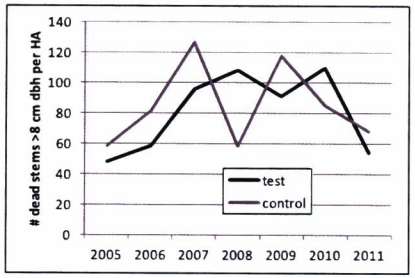


Figure 7.17. Average number of dead stems >8 cm dbh per hectare at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

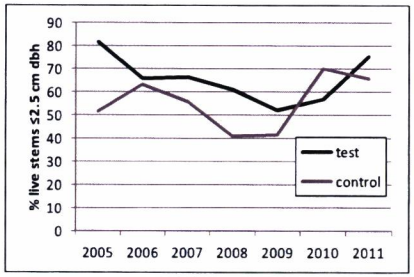


Figure 7.18. Percent of stems ≤2.5 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

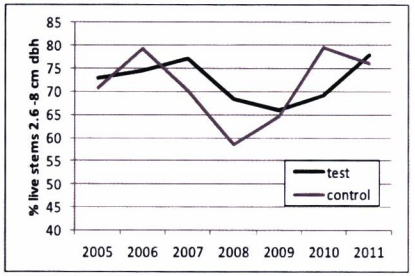


Figure 7.19. Percent of stems 2.6–8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

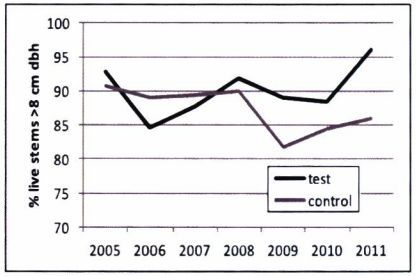


Figure 7.20. Percent of stems >8 cm dbh that were live at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

AR065001

Additional Documentation Attachment to Comment 2-F1
Attachment I-8

DISCUSSION

Microclimate

Between-year Comparisons of Microclimate Characteristics

Comparisons of microclimate characteristics among years in 2005–2011 at the habitat monitoring sites indicated hotter and more humid conditions in 2006 than in the other years and cooler conditions in 2009. The interannual changes in temperature were similar between test and control sites, suggesting that these changes were regional rather than being influenced by local conditions. The interannual changes in soil moisture in 2005–2006, 2007–2008, and 2009–2010 were not similar between test and control sites, with soil moisture declining more sharply at the control sites during the first two periods and then rising sharply during the third. This suggests that local conditions, in addition to regional climate, may have influenced soil moisture. However, the role of river flows in influencing soil moisture is unclear, given that no strong relationship was found between piezometer levels and soil moisture (McLeod and Koronkiewicz 2009). Although vapor pressure fluctuated more sharply between years at test versus control sites, both test and control sites exhibited fluctuations in vapor pressure that were consistent with the annual fluctuations in dew point recorded at the Needles, California weather station (Coop ID 46118; Figure 7.25). Thus, regional weather appears to have an overriding influence on humidity within both test and control sites.

Vegetation

Between-year differences across all sites were noted for many variables, but none showed unidirectional trends over time, suggesting there has been no overall, detectable change in vegetation. Many vegetation characteristics that varied over time showed parallel changes at control and test sites, suggesting either widespread yearly variation or observer variation between years.

Few variables showed changes that were specific to control or test sites, and several of those variables had marginally significant (> 0.01) *P*-values. Only woody ground cover and dead vertical foliage had *P*-values < 0.01. Ground cover did not differ from 2005 to 2007 at test locations but increased at control plots in 2006 and then decreased in 2007. It is not clear whether this represents actual changes in the amount of woody ground cover or whether it is a result of observer variation. Vertical foliage counts of dead vegetation have increased overall over the last several years at test plots, although there has been considerable yearly fluctuation, and the percentage of the vertical foliage that consists of live vegetation has dropped accordingly. The interannual fluctuations make it difficult to draw inferences about general trends in vegetation health. In addition, we have not recorded an increase in the number of dead stems, suggesting that there has been no noticeable increase in plant mortality (but see discussion of stem counts, below).

The pooling of all sites into a test vs. control analysis may obscure changes in vegetation at specific sites. For example, one vegetation plot at Ehrenberg contained a significant coyote willow component (98% of the total basal area) in 2005. The willow gradually died over the next several years until no live willow remained in 2009. Most of the vegetation along the LCR, including at the sites selected for habitat monitoring, consists primarily of tamarisk, which is less sensitive than willow to changes in water availability. Measurable changes in overall vegetation as a response to reduced groundwater levels may take several years to develop in tamarisk, or the tamarisk may change very little if at all.

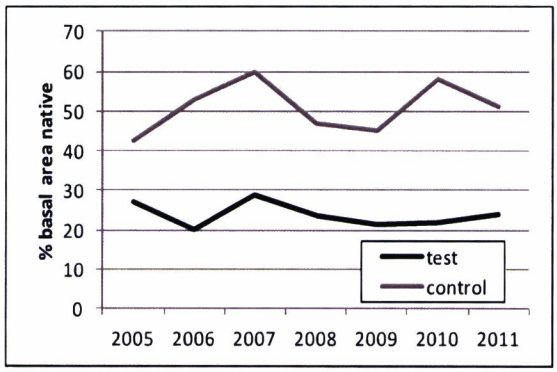


Figure 7.21. Percent of basal area that consisted of native vegetation at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

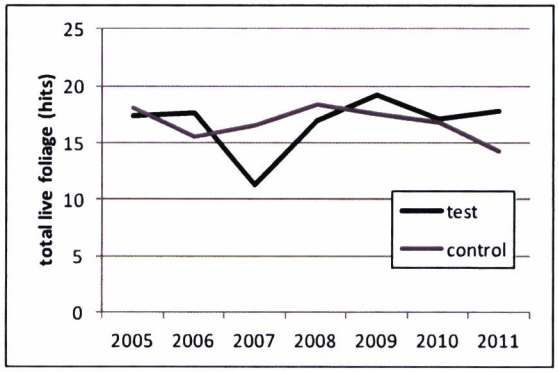


Figure 7.22. Total live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

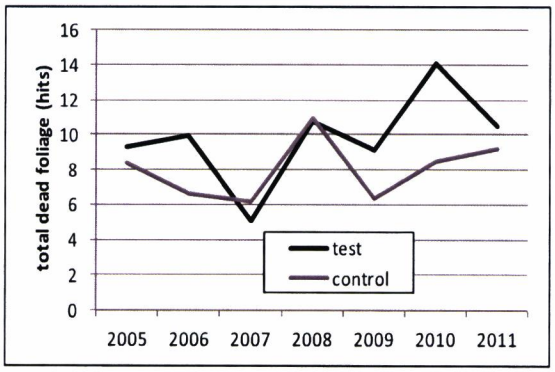


Figure 7.23. Total dead vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

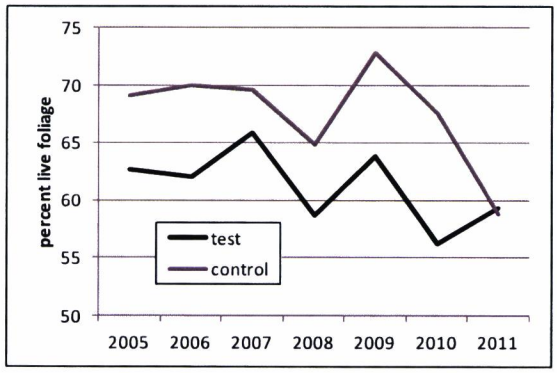


Figure 7.24. Percent live vertical foliage hits at test and control habitat monitoring sites, lower Colorado River, 2005–2011.

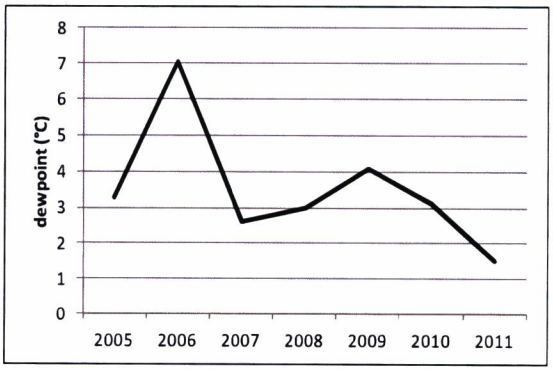


Figure 7.25. Mean dew point recorded at the Needles, California weather station, July and August, 2005–2011.

It has become apparent, after measuring the same vegetation plots for several consecutive years, that stem counts in very dense vegetation are inherently inaccurate and imprecise and can vary widely from year to year when there has likely been no appreciable change in stem density. Repeatability of stem counts depends on having a plot of fixed size. Each plot is divided into quadrants, with a rope having the 5-m distance (the edge of the plot) clearly marked extended in each cardinal direction from plot center. It can be nearly impossible to extend the rope flat or straight, introducing variability into the size of the plot. Even more problematic than this, however, is the inability of the observers, in very dense vegetation, to see the cardinal ropes from the center of the quadrant or to see the center of the plot from the edge to be able to envision an arc connecting the ends of two adjacent cardinal ropes and delineating the edge of the circular plot. Observers vary widely in their ability to estimate distance, and when reference points are not visible, it is very difficult to determine whether a stem near the edge of the plot falls within the plot or not. In 2009, we explicitly instructed observers to use a measuring tape to determine the distance from plot center for any stem for which inclusion in or exclusion from the plot seemed questionable.

This method should help reduce difficulties in producing repeatable stem counts but still depends on observers being able to tell when they are near the edge of the plot and taking the extra time to measure distance if the inclusion of a stem is in question. Another factor that inhibits accurate stem counts in dense vegetation is the difficulty in keeping track of which stems have been counted already and which have not. In 2009, we began using chalk to mark stems that had already been counted to try to minimize omission or double-counting of stems.

Given the difficulties in producing repeatable stem counts, absolute stem counts are likely not a suitable metric for detecting subtle changes in vegetation. The proportion of live stems may provide a more sensitive metric by which to detect change; the accuracy of this measure depends only on each observer counting live stems in a manner consistent with how s/he counts dead stems. Similarly, the proportion of live vertical foliage is likely to provide a more sensitive measure of changes in vegetation than do the absolute vertical foliage counts.

The detection of changes in vegetation as the result of the diversion of water at Parker rather than Imperial Dam is further hampered by the complete lack of vegetation measurements prior to the beginning of the diversion in 2002. Vegetation measurements did not commence until 2005, by which time it is possible that some changes in vegetation, particularly in sensitive species such as coyote willow, had already occurred as the result of decreasing flows from 2001 to 2005 (see Table 7.5). Other methods, such as analysis of satellite imagery, would have to be used to detect any changes in vegetation that might have occurred prior to 2005.

Groundwater Levels

Correlation of Piezometer Groundwater Levels with Soil Moisture Measurements

In previous years we correlated piezometer ground water levels and soil moisture measurements and found no strong linear relationship. The strongest relationships were found at sites that had the highest soil moisture values. This suggests that at sites where soil moisture is low, surface soil moisture content is not influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

This page intentionally left blank.

Chapter 8

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

INTRODUCTION

Monitoring of Southwestern Willow Flycatcher populations at Topock Marsh began in 1997, and data on number of flycatcher pairs and nest success are available for 1998–2011. The breeding population at Topock declined from a high of 29 pairs in 2004 to fewer than 10 pairs in 2007 and 2008. This decline prompted concern from USFWS about the flycatcher population at Topock, which was presumed to be the likely source population for any flycatchers that would colonize restoration areas on the lower Colorado River. USFWS and Reclamation initiated discussions after the breeding season of 2008 to identify habitat enhancement measures that could be implemented at Topock Marsh in an attempt to raise the number and productivity of flycatchers.

The affinity of breeding Southwestern Willow Flycatchers with standing water and saturated soil is noted consistently in the literature (e.g., Johnson et al. 1999, Munzer et al. 2005, McLeod et al. 2008a, Graber and Koronkiewicz 2009b), and flycatcher nests along the Middle Rio Grande that were above inundated or saturated soil all season produced more young per successful nest than nests that were above dry soil all season (Moore and Ahlers 2008). An examination of water levels within Topock Marsh from 1997 to the present shows that after 2004, water levels peaked at lower levels, high water levels were of shorter duration, and over-winter lows were lower than was the case prior to 2004 (Figure 8.1). Because of the influence of surface water on flycatcher occupancy and productivity, USFWS and Reclamation developed a plan to pump water into a portion of the flycatcher habitat at Topock Marsh.

Two adjacent areas within Topock, known as In Between and 800M, were selected in 2008 as the location for habitat enhancement via supplemental water delivery. The number of breeding flycatcher pairs in these areas declined steadily from 10 in 2004 to 0 in 2008, but the vegetation in the area had not changed markedly during that time (McLeod and Koronkiewicz 2010). The addition of surface water and saturated soil to this area might make it more attractive to flycatchers and increase nest success and productivity of any flycatchers that nest in the area. In addition, widespread inundation could make portions of In Between, 800M, and the surrounding area that typically had been dry during surveys since 2003 and not occupied by flycatchers more suitable for flycatcher occupancy.

Supplemental water delivery commenced in March 2011. We monitored hydrological, microclimate, and vegetation conditions at In Between, 800M, and the adjacent area of Pierced Egg in 2009 and 2010 to assess baseline habitat conditions. We completed the same monitoring in 2011 during water delivery.

METHODS

Water Delivery

Over the winter of 2010–2011, the water delivery system was installed. The system consisted of a Crisafulli trailer pump, modified to be hydraulically driven and capable of moving approximately 41.6 m^3 (11,000 gallons) of water per minute, along with a 0.61 m (24 inch) diameter pipe carrying the water into the target area (In Between, 800M, and Pierced Egg) from the open water of Topock Marsh.

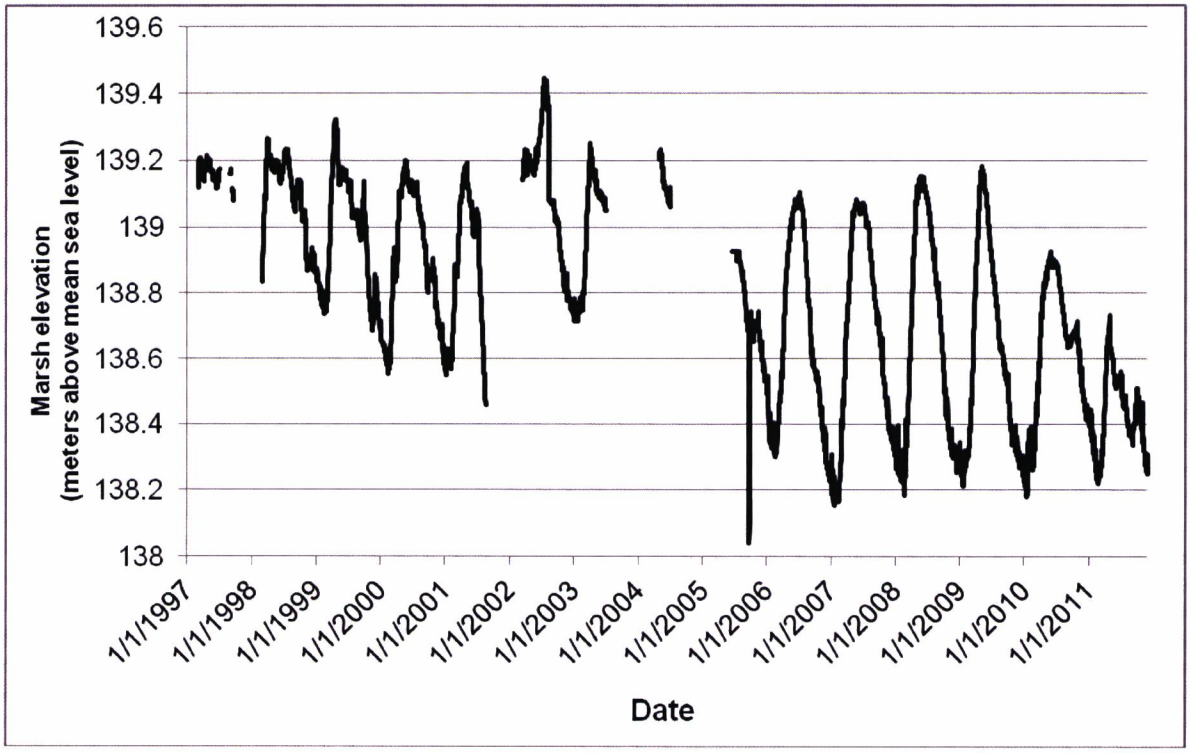


Figure 8.1. Marsh elevation (meters above mean sea level) measured at the South Dike at Topock Marsh, 1997–2011.

Surface Water Mapping

We mapped surface water at weekly intervals between 14 March and 21 July 2010. In 2011, we mapped water within the target area immediately prior to the initiation of water delivery on 1 March and for three days following the initial pumping. This provided baseline data on water levels, the maximum extent of water, and the longevity of water within the target area. We continued visiting In Between, 800M, and Pierced Egg at approximately weekly intervals through mid-July. During each visit, we traversed trails throughout each site and used GPS and aerial photographs to map the extent and depth of surface water within the sites. At the conclusion of each visit, we compiled our GPS points and field notes to prepare a hardcopy map of the sites, with areas of surface water and saturated soils delineated on the map and indexed to a key detailing the nature (e.g., pig wallow, open marsh, flooded forest) and depth of each wet area. All hardcopy maps were digitized after the field season using ArcGIS. From the digitized shapefiles, we calculated the percentage of the target area that contained surface water at each visit.

Groundwater Measurements

A 0.02 m (¾-inch) diameter shallow well, or piezometer, equipped with a pressure transducer and data logger was installed in 2006 in In Between at Topock Marsh as part of habitat monitoring between Parker and Imperial Dams (see Chapter 7). This piezometer is within the target area of water delivery and thus was left in place when the other piezometers used in the study were removed. This piezometer is described in McLeod et al. (2007) and has been downloaded approximately three times per year since installation. At each download we checked the battery level and function of the data logger. Batteries were replaced as necessary and data were examined to ascertain potential equipment malfunction.

Data Collection

A pressure transducer/data logger equipped with a vented cable collected data hourly at the piezometer. These devices measure and record pressure of the water column present in the well, and these pressure measurements are then converted into water levels (in distance below top of casing). With vented cables and data transfer ports there is no need to correct measurements for atmospheric pressure changes, and the data can be downloaded at the wellhead without disturbing the pressure transducer in the well.

During the initial installation of the pressure transducer, as well as at each data download thereafter, water level was manually measured in the piezometer using an electric water level sounder (Solinst-brand). This known water level was then used to program the pressure transducer with a baseline measurement from which all other automatically recorded water levels were calculated.

Data Validation

We have identified several potential sources of error in the water levels recorded by piezometers. We developed a rigorous protocol to validate each data download, determine if any errors exist with the data, and correct the raw data if possible. Specific sources of error are identified below.

Install Drift. Because piezometers are constructed such that the pressure transducer is almost the same diameter as the inside of the piezometer, removing and inserting the pressure transducers to change batteries can change the water levels in the piezometer temporarily but drastically.

Operational Drift. In rare cases, the accuracy of the data loggers can change in the time period between downloads.

Improper Setup. After downloading data, the data logger is reset for the next round of measurements. Conducting the startup procedure improperly can lead to errors; fortunately, most of these setup errors can be corrected. Common errors include mistakenly setting the type of reference used (i.e., recording water level elevation instead of depth), not resetting the starting water level reference value to the water level value measured manually in the field, and not restarting the data logger but continuing with the previous setup.

At each download, we compared the water level recorded by the piezometer with the manual measurement. We also checked the data logger parameters to determine whether the data logger was initialized properly. If a discrepancy >0.09 m (0.3 feet) existed between the data logger and the manual measurement, and this discrepancy could not be accounted for and corrected by examining the setup parameters and applying an appropriate correction factor, the data were not used for analysis.

Microclimate

In 2009, the In Between, 800M, and Pierced Egg polygons were stratified into use (occupied by flycatchers) and non-use (unoccupied by flycatchers) areas, as observed in 2003–2008. Use areas tend to be wetter than non-use areas and thus are presumably low-lying and more likely to be affected by water delivery into the habitat. We excluded the cattail marsh in the center of the 800M polygon from either the use or non-use areas. We superimposed a 25- x 25-m grid on a GIS software shapefile of the use and non-use areas, numbered the grid blocks, and selected blocks using a random number generator. We used the centroid of the selected block as the sample point and located each point in the field by navigating to the given coordinates using a Rino 110 GPS unit. We determined the exact location of each sample point by means of random number sequences as described in Chapter 6. All sample points used in 2009 were marked in the field with flagging that remained in place over the 2009–2010 and 2010–2011 winters,

allowing for relocation at the beginning of each subsequent season. We relocated each sample point in 2011 and redeployed a data logger in the same location. We used HOBO H8 Pro data loggers (see Chapter 6) to record temperature and humidity at each sample point at 15-minute intervals. Each logger remained in place until the end of the flycatcher breeding season. We collected soil moisture readings, as described in Chapter 6, below each data logger at bi-weekly intervals.

Vegetation

In late July of each year 2009–2011, at the end of the flycatcher breeding season, we collected vegetation measurements at each HOBO logger location. Vegetation plots were centered on the logger, and we collected the vegetation measurements described in Chapter 5, with the exception of stem counts. Given the relatively short time span between the implementation of water delivery and the subsequent vegetation measurements, any responses in vegetation are more likely to be apparent in canopy closure and vertical foliage density than in stem counts.

Data Analyses

We had originally stratified the sample points into use and non-use areas on the assumption that the use areas were more likely to be inundated during water delivery. The water that was pumped into the target area did not reach all the use areas; therefore, we reclassified the points into flooded and non-flooded areas (also referred to as flood groups) according to whether the point was within 20 m (i.e., within a distance that would be encompassed by a flycatcher territory [Sedgwick and Knopf 1992]) of the maximum extent of water recorded immediately post water delivery in 2011. We compared data collected during 2011 to those collected in 2010. We did not include data from 2009 in the comparison because temperature and humidity data collected at the Needles, California weather station (Coop ID 46118) indicated that weather conditions in 2011 were overall more similar to those in 2010 than in 2009, and similar weather data between years may facilitate interpretation of between-year comparisons.

Microclimate

Microclimate data were summarized as described in Chapter 6. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures analysis using a linear mixed model to compare the seasonal changes in flooded versus non-flooded areas in 2010 and 2011. We also used a repeated measures analysis using a linear mixed model to compare temperature and humidity variables the day after a flood event to those recorded the day before the flood event in flooded versus non-flooded areas in 2011. All analyses were completed using SAS® Version 9.2 (SAS Institute 2009).

Vegetation

Vertical foliage data were summarized as described in Chapter 5. Percent native vegetation was calculated as the percent of the foliage hits that consisted of native vegetation. We used the average nest height (3.78 m) recorded at In Between, 800M, and Pierced Egg from 2003 to 2008 to delineate the below, at, and above nest height categories. All data were summarized separately for flooded and non-flooded areas. We used a repeated measures linear mixed model to compare the conditions measured in each flood group in 2011 versus those measured at those same points in 2010. We also used this model to detect any year*flood group interactions, which indicate that the between-year change detected for a given variable in the flooded area differed from the change detected in the non-flooded areas. We used SPSS® Version 16.0 (SPSS Inc.) software for statistical analyses.

RESULTS

Water Delivery

Water delivery was initiated on 1 March and continued through 7 July. The pump was operated once a week for several hours (Table 8.1), and the hours of operation and flowmeter readings were recorded in a log book.

Table 8.1. Dates of Water Mapping and Water Delivery, Length of Pump Operation, and Total Pump Output, Topock Marsh, 2011

Date of Pumping	Hours Operated	Total Pump Output (millions of gallons)	Total Pump Output (cubic meters)	Date(s) of Water Mapping
1 Mar	4.7	3.10	11735	27–28 Feb, 1–3 Mar
10 Mar	5.9	3.89	14725	11 Mar
17 Mar	3.3	2.18	8252	18 Mar
24 Mar	4.8	3.17	12000	25 Mar
31 Mar	5.3	3.50	13249	1 Apr
7 Apr	4.5	2.97	11243	8 Apr
13 Apr	4.3	2.84	10751	15 Apr
21 Apr	4.3	2.84	10751	22 Apr
28 Apr	4.5	2.97	11243	29 Apr
5 May	5.6	3.70	10221	---
12 May	4.0	2.64	9994	14 May
19 May	4.1	2.71	10258	20 May
26 May	1.8	1.19	4505	24 and 29 May
2 Jun	3.5	2.31	8744	3 Jun
9 Jun[1]	4.2	2.77	10493	8 Jun
16 Jun[1]	4.2	2.77	10493	17 Jun
23 Jun	4.0	2.64	9994	22 Jun
30 Jun	4.5	2.97	11243	1 Jul
7 Jul	4.0	2.64	9994	6 and 15 Jul

[1] No data recorded, hours and pump output estimated from flowmeter reading on 23 Jun.

Surface Water Mapping

Immediately prior to the start of water delivery on 1 March, surface water was limited to pig wallows in Pierced Egg (Figure 8.2, map from 28 February). Surface water covered portions of In Between and 800M immediately after pumping on 1 March (Figure 8.2, map from 1 March). There was a noticeable decrease in water extent over the following two days (Figure 8.2, maps from 2 and 3 March; and Figure 8.3), but we determined that weekly pumping would be sufficient to maintain elevated water levels within the target area. From March to late May, all weekly visits occurred on the day immediately following water delivery. Starting in late May, we alternated our weekly visits to fall on the day before water delivery and the day after water delivery so we could document minimum and maximum extent of water (Table 8.1). During this latter part of the season, the extent of the inundated and saturated area in In

Between and 800M remained relatively constant throughout each week following pumping (Figure 8.4). In general, water delivery maintained water levels above those of 2010 (Figure 8.3), despite the markedly lower water levels within Topock Marsh in 2011 compared to 2010 (see Chapter 2).

We noted an increase in surface water within Pierced Egg starting in March and peaking by mid-April; by the end of April, Pierced Egg was completely dry (Figure 8.5). Surface water from the pumping did not flow into Pierced Egg, and the fluctuation of water levels in Pierced Egg was likely the result of a rise in local groundwater levels, which typically peak in April (see Groundwater Monitoring, below) and could also have been influenced by water delivery. The peak in groundwater levels is reflected in the overall percentage of In Between, 800M, and Pierced Egg that was inundated or saturated, which also peaked in mid-April and fell rapidly by early May (Figure 8.3). Water delivery appeared to result in a greater extent of surface water early in the season when overall groundwater levels throughout the area were relatively high. Later in the season, when overall groundwater levels had dropped, surface water was generally restricted to In Between, with portions of 800M sometimes having saturated soil.

Groundwater Monitoring

The piezometer at Topock Marsh shows that local groundwater levels typically peak each year in April (Figure 8.6). Daily cycles are apparent in the hydrograph across all years, showing low water levels during the afternoon hours when vegetation water demands and evapotranspiration are greatest and high water levels in early morning hours. The magnitude of the daily cycle is greatest during the summer months when vegetation demands are greatest and lowest during the winter months when cooler daily temperatures and dormant vegetation result in lower water demands.

Weekly trends in groundwater levels were apparent in March–July 2011 (Figure 8.7) and paralleled the pumping schedule, with groundwater rising on the day of pumping and falling through the week until the next pumping. When groundwater levels were at relatively high levels in March and April, each pumping session increased the groundwater level at the piezometer approximately 0.08 m (0.25 feet) and then the water level fell linearly through the week until the next pumping session. As water levels dropped in May and June, the effect of each pumping session on the water level at the piezometer increased; each pumping session increased the water level by up to 0.23 m (0.75 feet), and water levels fell more rapidly immediately following pumping than they did later in the week. The groundwater level recorded by the piezometer peaked at the highest level recorded in any year since 2006, showing that water delivery raised the local groundwater table within the target area despite the overall lower water table in the marsh (see Chapter 2).

Microclimate

In 2010, we deployed 15 HOBO loggers in the flooded area and 17 loggers in the non-flooded area between 14 and 29 March (Figure 8.8). All loggers functioned correctly in 2010. In 2011, we deployed HOBO loggers in these same locations between 27 February and 11 March. In 2011, two loggers, one in the flooded area and one in the non-flooded area, failed to launch and collected no data; one logger in the flooded area had a faulty humidity sensor, and humidity data from this logger were excluded from the analysis. Data analyses were restricted to the period between 1 April and 15 July to encompass the dates when all loggers were deployed in both years. In 2010, soil conditions became progressively drier throughout the season for both the flooded and non-flooded areas, while temperatures rose throughout the season and vapor pressure values showed the typical rise seen in July with the onset of summer monsoons

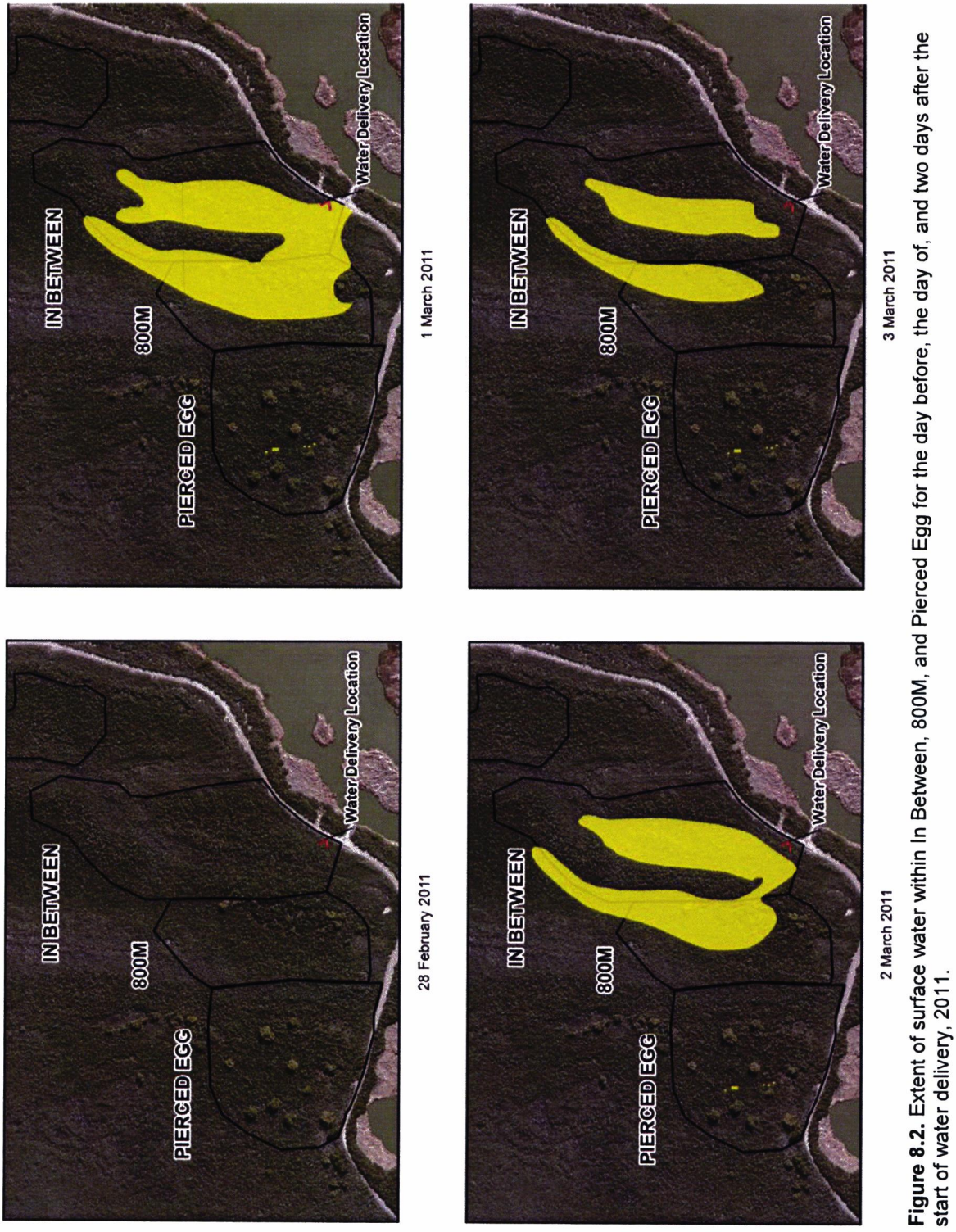


Figure 8.2. Extent of surface water within In Between, 800M, and Pierced Egg for the day before, the day of, and two days after the start of water delivery, 2011.

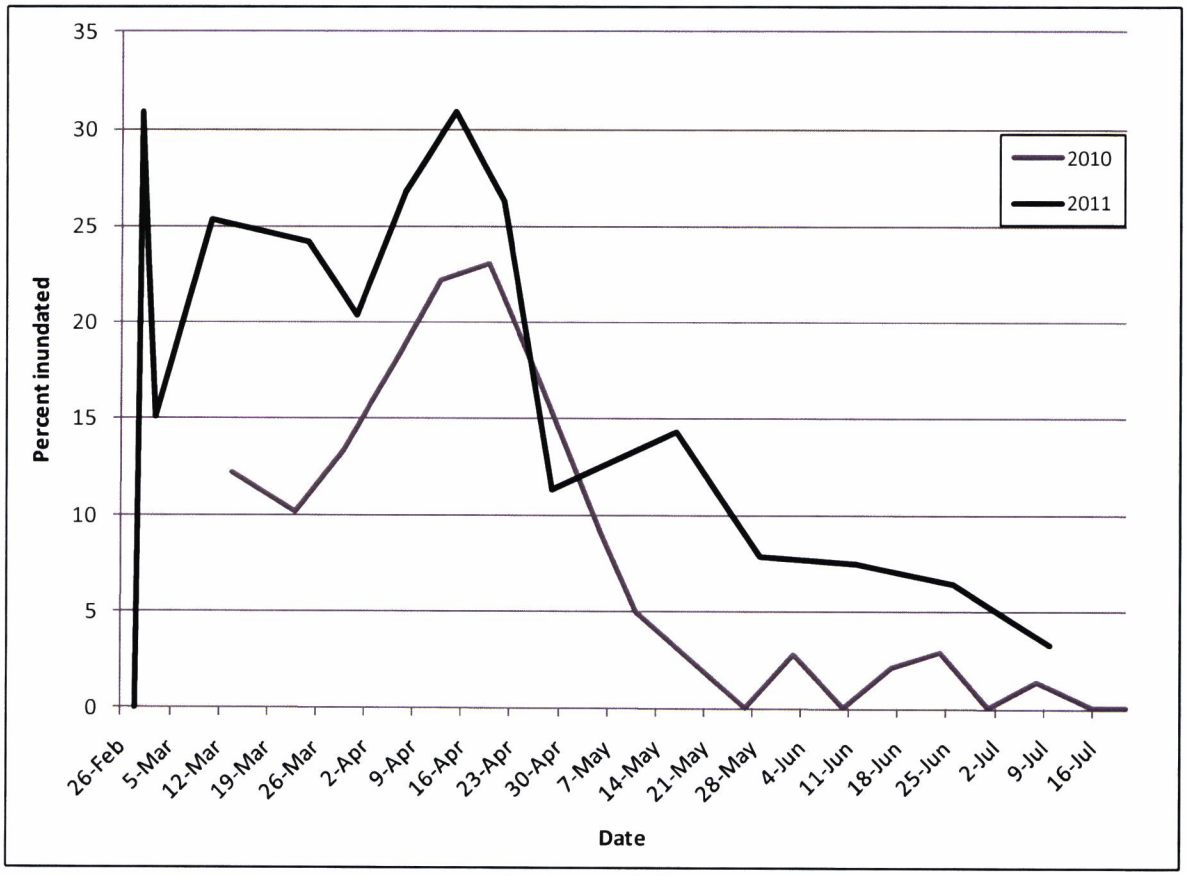


Figure 8.3. Percentage of In Between, 800M, and Pierced Egg, combined, that was inundated in March–July 2010 and 2011. Percentages are averaged over two-week periods for June and July 2011, because weekly visits alternated between the day before and the day after pumping.

(Tables 8.2 and 8.3). These same overall patterns were seen in 2011 (Tables 8.4 and 8.5). These data are shown graphically for easier comparison of data between years (Figures 8.9a–8.17a). Data are also shown as the difference between the flooded and non-flooded areas in both 2010 (the control year) and 2011 (Figures 8.9b–8.17b). If flooding had no effect, we would expect the differences between the flooded and non-flooded areas to be similar in both years.

Table 8.6 presents the significance test results (*P*-values) for the comparison of flooded versus non-flooded areas in 2010 and 2011. The first two columns show the comparison of each microclimate variable, overall across the season, in the flooded versus non-flooded areas in 2010 and 2011, respectively. Baseline data were collected in 2010, so significant *P*-values in this column indicate inherent differences between the flooded and non-flooded areas. A significant *P*-value in the column for a given year indicates a difference between flood groups, and corresponds to a significant gap between the solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. A significant *P*-value for a given variable in only one year but not both suggests an effect of flooding.

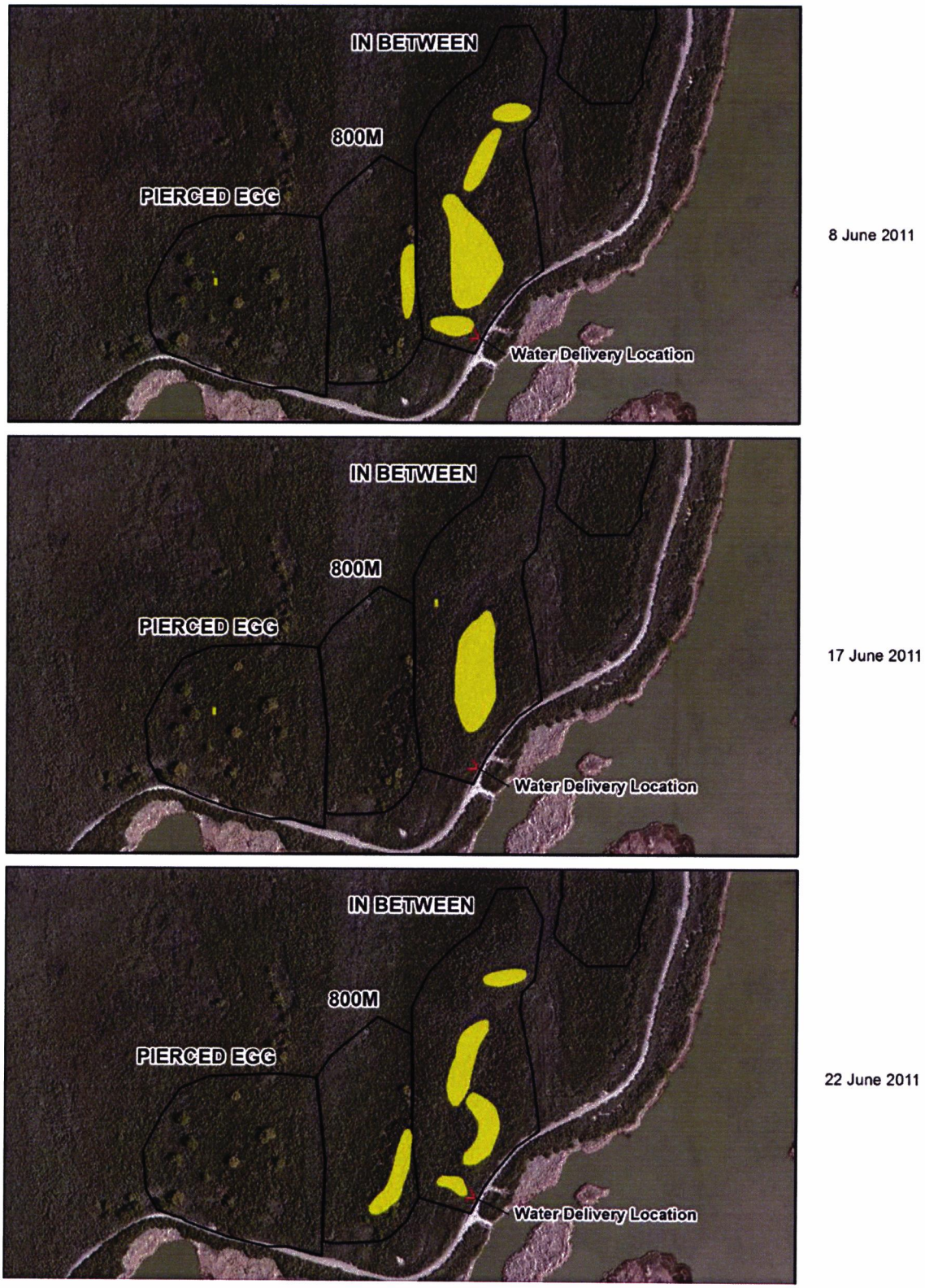


Figure 8.4. Extent of water within In Between, 800M, and Pierced Egg in June 2011.

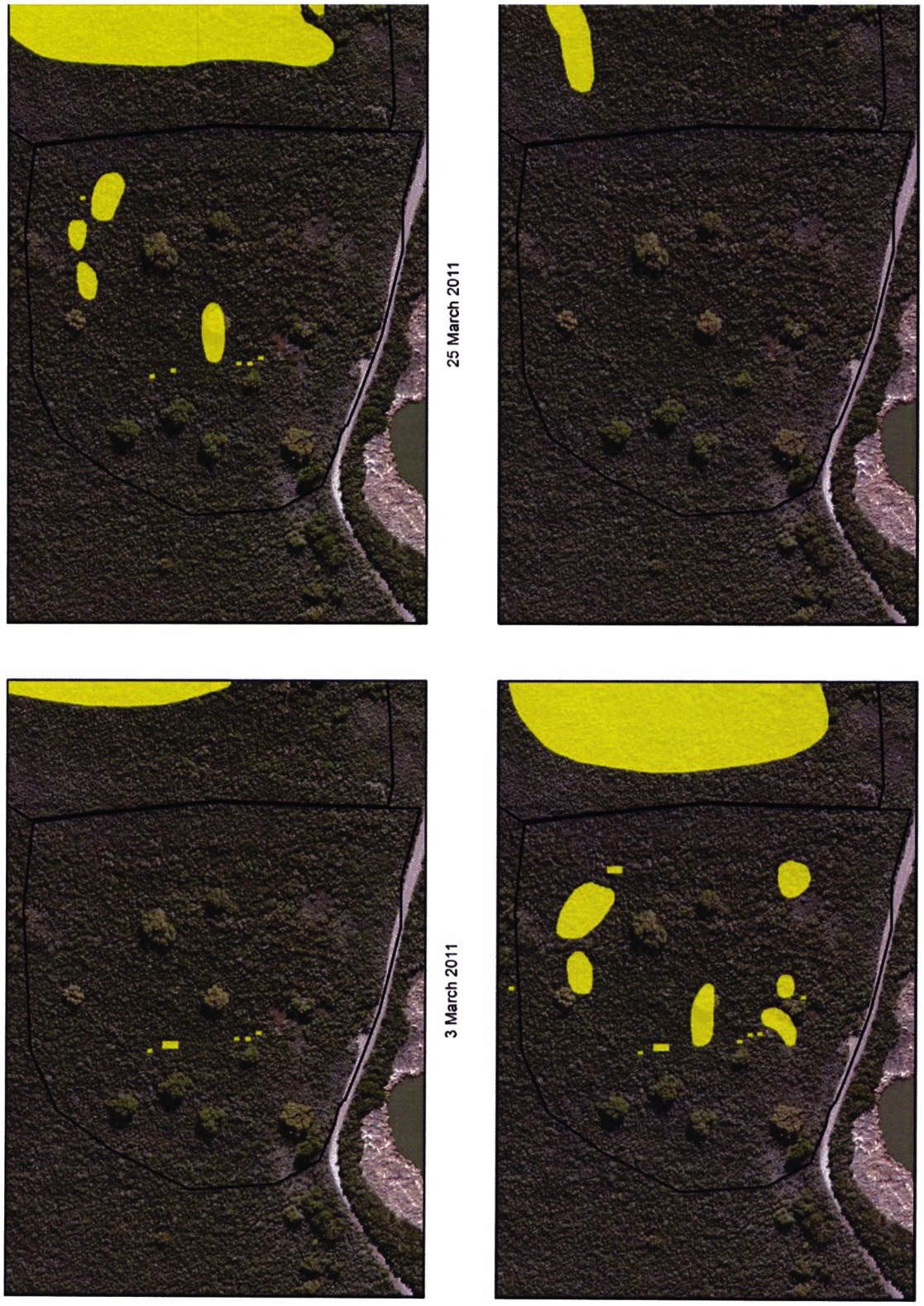


Figure 8.5. Water levels within Pierced Egg at approximately bi-weekly intervals in March and April, 2011.

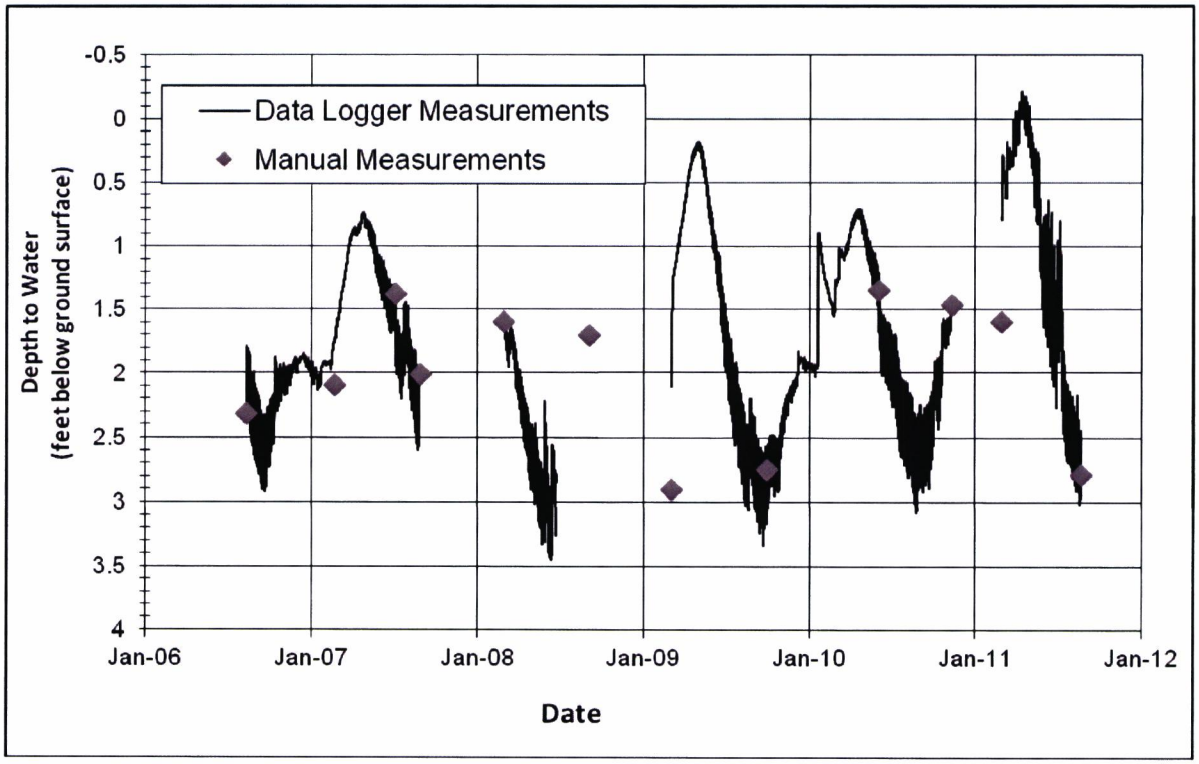


Figure 8.6. Topock Marsh hydrograph, 2006–2011.

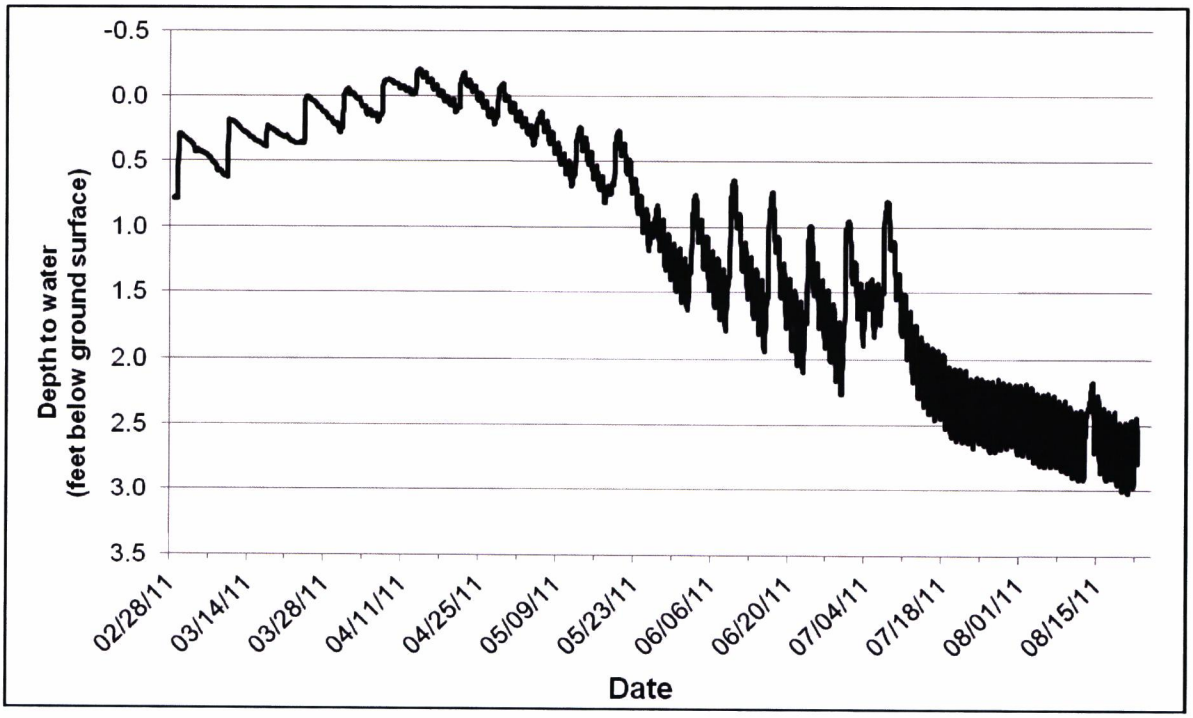


Figure 8.7. Topock Marsh hydrograph, February–July, 2011.

We also examined how each microclimate variable changed through the season. The third and fourth columns of Table 8.6 show *P*-values for the comparison of seasonal change in the flooded vs. non-flooded areas (i.e., the time*flood group interaction) in 2010 and 2011, respectively. Significant *P*-values in either column indicate that the microclimate variable changed through the season in the flooded area in a different way than in the non-flooded area in that year, and corresponds to non-parallel solid (flooded) and dashed (non-flooded) lines for that year in Figures 8.9a–8.17a. Again, a significant *P*-value for a given variable in one year but not the other suggests an effect of flooding.

We also examined between-year differences for soil moisture variables within the non-flooded and flooded areas (columns 5 and 6, respectively, of Table 8.6). We did not include results for the between-year analysis for temperature and humidity variables because significant between-year differences could be the result of variation in climate between years, and any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates an overall between-year difference within the flood group and corresponds to a significant gap between the gray (2010) and black (2011) lines for that flood group in Figures 8.9a–8.12a.

Finally, we compared change through the season for soil moisture variables in 2010 versus 2011 (i.e., the time*year interaction) within the non-flooded and flooded areas (columns 7 and 8, respectively, of Table 8.6). Again, we did not include the results of this analysis for temperature and humidity variables because any between-year differences are difficult to interpret in a meaningful way. A significant *P*-value indicates that, within the given flood group, the variable changed through time in 2010 in a different way than it changed through time in 2011. This corresponds to non-parallel gray (2010) and black (2011) lines for the flood group in Figures 8.9a–8.12a.

None of the measures of soil moisture and presence of surface water differed overall between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1). In 2011, three measures of surface water (distance to surface water, percentage of the area within 20 m that was flooded, and percentage of the area within 50 m that was flooded) differed between the flooded and non-flooded area (Table 8.6, column 2), with all three variables indicating wetter overall conditions in the flooded area (Figures 8.10–8.12). Soil moisture and both measures of the percentage of the area inundated showed a significant interaction between flood group and time in 2011 (Table 8.6, column 4); soil moisture declined more rapidly in the flooded versus the non-flooded area as the extent of the flooding decreased through the season (Figure 8.9), and the measures of the percentage inundated decreased throughout the season in the flooded area while they remained constant (at zero) through the season in the non-flooded area (Figures 8.11 and 8.12). The non-flooded area differed significantly between years in soil moisture, distance to water, and percentage of the area within 50 m that was inundated (Table 8.6, column 5); all measures reflected the overall lower marsh levels and resulting drier conditions in 2011. The flooded area differed between years in all measures of surface water (Table 8.6, column 5), with all variables indicating wetter conditions in 2011. Overall soil moisture in the flooded area did not differ significantly between years (Table 8.6, column 6) but did show a significant interaction between year and time (Table 8.6, column 8); soil moisture was higher in 2011 than in 2010 early in the season but had dropped to a lower level in 2011 than in 2010 by early June, again illustrating the overall dry conditions in 2011 (Figure 8.9).



Figure 8.8. Locations of HOBO data loggers and piezometer at Topock Marsh, 2009–2011.

Table 8.2. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area (n = 17), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	911.4 (14.0)	897.9 (13.4)	881.2 (14.0)	878.6 (10.8)	863.2 (9.8)	836.8 (12.1)	867.3 (16.3)
Mean distance to nearest standing water	31.0 (6.2)	31.9 (6.1)	62.5 (8.7)	68.5 (8.1)	101.6 (10.6)	98.4 (10.8)	110.3 (17.9)
% of area within 20 m that was inundated	10.7 (6.3)	10.0 (5.0)	1.9 (1.9)	1.9 (1.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	18.7 (5.6)	12.4 (3.8)	1.8 (1.0)	2.0 (1.1)	0.0 (0.0)	0.3 (0.3)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	35.3 (0.3)	36.2 (0.4)	38.4 (0.3)	38.5 (0.3)	41.9 (0.3)	43.1 (0.3)	43.4 (0.4)
Mean minimum nocturnal temperature (°C)	5.0 (0.2)	8.5 (0.3)	8.4 (0.2)	9.9 (0.2)	18.0 (0.2)	13.8 (0.2)	18.3 (0.2)
Mean daily temperature range (°C)	30.3 (0.3)	27.7 (0.4)	30.0 (0.3)	28.6(0.4)	23.9 (0.3)	29.4 (0.3)	25.1 (0.4)
Humidity							
Mean diurnal vapor pressure (Pa)	597.4 (9.3)	818.4 (13.4)	798.1 (14.1)	976.4 (16.2)	1588.5 (23.5)	1649.4 (28.5)	2279.7 (36.0)
Mean nocturnal vapor pressure (Pa)	652.2 (8.7)	888.1 (11.9)	890.9 (11.2)	1022.4 (12.4)	1537.7 (17.5)	1423.7 (16.8)	1929.9 (22.3)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

Table 8.3. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area (n = 15), 2010*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture							
Mean soil moisture (mV)	908.1 (13.7)	908.0 (12.9)	892.7 (13.8)	838.4 (20.6)	853.9 (11.8)	834.3 (19.8)	804.5 (17.9)
Mean distance to nearest standing water	44.9 (9.7)	42.8 (9.3)	54.0 (10.2)	60.6 (17.1)	102.8 (11.9)	115.0 (13.4)	192.0 (23.3)
% of area within 20 m that was inundated	8.0 (6.7)	6.2 (4.4)	5.3 (4.6)	6.4 (5.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
% of area within 50 m that was inundated	13.5 (4.8)	15.5 (4.8)	10.1 (4.1)	6.7 (4.4)	4.1 (3.0)	0.0 (0.0)	0.0 (0.0)
Temperature							
Mean maximum diurnal temperature (°C)	32.2 (0.3)	33.7 (0.4)	35.7 (0.3)	36.3 (0.4)	39.8 (0.4)	40.9 (0.4)	40.9 (0.4)
Mean minimum nocturnal temperature (°C)	6.0 (0.2)	9.4 (0.3)	9.1 (0.2)	10.6 (0.2)	18.7 (0.2)	14.5 (0.2)	18.9 (0.2)
Mean daily temperature range (°C)	26.2 (0.4)	24.3 (0.5)	26.6 (0.4)	25.7 (0.4)	21.1 (0.4)	26.5 (0.4)	22.0 (0.5)
Humidity							
Mean diurnal vapor pressure (Pa)	611.7 (10.1)	834.7 (14.5)	813.2 (15.4)	998.5 (17.9)	1595.6 (24.6)	1612.9 (26.8)	2209.8 (35.8)
Mean nocturnal vapor pressure (Pa)	676.5 (9.5)	913.3 (12.7)	906.3 (11.5)	1043.2 (13.0)	1535.3 (18.6)	1418.7 (16.8)	1921.6 (23.7)

* Data are presented as mean (standard error). Sample size indicates the number of data logger locations.

Table 8.4. Microclimate Measures at Topock Hydrology Monitoring Sites – Non-flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 17)							
Mean soil moisture (mV)	883.8 (14.4)	904.1 (13.3)	878.4 (22.7)	835.4 (16.8)	811.4 (19.0)	819.4 (12.1)	817.4 (11.4)
Mean distance to nearest standing water	N/A	N/A	122.0 (61.1)	138.9 (21.6)	149.4 (19.4)	120.4 (16.3)	115.6 (13.9)
% of area within 20 m that was inundated	3.6 (10.9)	N/A	0.0 (1.9)	0.0 (0.0)	0.0 (0.0)	0.0 (40.0)	1.7 (1.7)
% of area within 50 m that was inundated	3.6 (3.6)	N/A	1.9 (1.4)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.1 (0.1)
Temperature (n = 16)							
Mean maximum diurnal temperature (°C)	34.8 (0.5)	38.2 (0.3)	38.7 (0.3)	36.6 (0.3)	40.3 (0.3)	43.5 (0.2)	41.3 (0.3)
Mean minimum nocturnal temperature (°C)	6.8 (0.3)	11.0 (0.2)	9.3 (0.3)	11.6 (0.2)	12.5 (0.2)	18.0 (0.2)	20.0 (0.2)
Mean daily temperature range (°C)	28.1 (0.5)	27.2 (0.4)	29.4 (0.4)	25.0 (0.4)	27.8 (0.3)	25.5 (0.3)	21.3 (0.5)
Humidity (n = 16)							
Mean diurnal vapor pressure (Pa)	666.5 (14.2)	761.1 (13.8)	858.8 (15.9)	1066.2 (14.9)	1229.4 (24.5)	1598.9 (20.7)	2467.8 (43.7)
Mean nocturnal vapor pressure (Pa)	666.3 (12.5)	817.0 (13.8)	922.1 (13.6)	1033 (10.4)	1178.1 (19.1)	1436.8 (12.9)	2215.1 (32.2)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

Table 8.5. Microclimate Measures at Topock Hydrology Monitoring Sites – Flooded Area, 2011*

Microclimate Measure	April 1–15	April 16–30	May 1–15	May 16–31	June 1–15	June 16–30	July 1–15
Soil Moisture (n = 15)							
Mean soil moisture (mV)	955.6 (12.1)	944.3 (14.7)	893.7 (17.8)	867.8 (17.8)	779.1 (28.5)	768.8 (23.4)	809.6 (24.0)
Mean distance to nearest standing water	N/A	N/A	12.0 (4.7)	48.5 (23.6)	84.7 (20.5)	73.0 (18.7)	98.11 (20.0)
% of area within 20 m that was inundated	57.7 (10.9)	N/A	39.6 (10.0)	18.3 (8.1)	18.0 (8.3)	17.5 (6.4)	5.8 (3.2)
% of area within 50 m that was inundated	54.6 (10.5)	N/A	36.1 (7.7)	23.4 (8.3)	20.1 (9.7)	26.3 (8.7)	11.7 (4.9)
Temperature (n = 14)							
Mean maximum diurnal temperature (°C)	31.8 (0.5)	34.8 (0.3)	36.0 (0.4)	34.5 (0.4)	38.5 (0.3)	42.1 (0.3)	40.5 (0.4)
Mean minimum nocturnal temperature (°C)	8.1 (0.3)	12.1 (0.3)	10.3 (0.3)	12.3 (0.2)	13.2 (0.2)	18.9 (0.2)	20.6 (0.2)
Mean daily temperature range (°C)	23.7 (0.5)	22.7 (0.4)	25.6 (0.5)	22.2 (0.4)	25.2 (0.4)	23.2 (0.5)	19.9 (0.5)
Humidity (n = 13)							
Mean diurnal vapor pressure (Pa)	732.4(16.5)	843.4 (16.5)	917.4 (18.5)	1110.9 (16.2)	1250.5 (25.1)	1631.8 (21.3)	2501.8 (49.7)
Mean nocturnal vapor pressure (Pa)	773.6 (14.4)	926.0 (17.1)	1031.2 (16.0)	1112.5 (12.8)	1255.2 (21.5)	1516.9 (16.6)	2251.2 (35.6)

* Data are presented as mean (standard error). N/A = data not available. Sample size indicates the number of data logger locations at which useable data were collected.

All measures of temperature (mean daily maximum, mean daily minimum, mean temperature range) tended toward being different (*P*-values between 0.04 and 0.07) between flooded and non-flooded areas in 2010 under baseline conditions (Table 8.6, column 1), with the flooded area having lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range than the non-flooded area (Figures 8.13–8.15). This pattern persisted in 2011 (Table 8.6, column 2; Figures 8.13–8.15). The change in temperature variables through the season was similar in the flooded and non-flooded areas in 2010 (Table 8.6, column 3) but not in 2011 (Table 8.6, column 4). In 2011, the flooded area began the season with lower maximum temperatures, higher minimum temperatures, and a smaller daily temperature range when compared to the non-flooded area; these differences diminished steadily as the season progressed (Figures 8.13–8.15).

Diurnal and nocturnal vapor pressure did not differ significantly between flooded and non-flooded areas under baseline conditions in 2010 (Table 8.6, column 1). In 2011, both measures of humidity were higher in the flooded versus non-flooded area (Figures 8.16 and 8.17), but this difference was significant only for nocturnal vapor pressure (Table 8.6, column 2). The difference in nocturnal vapor pressure between flooded and non-flooded areas decreased through the season in 2011 (Table 8.6, column 4; Figure 8.17).

Comparison between day before and day after flood events – A comparison of temperature and humidity variables the day before and the day after each flood event in 2011 showed that, overall, flood events appeared to affect all temperature and humidity variables, and the effect was not constant through the season for any variable except mean diurnal vapor pressure (Table 8.7). The effect of flooding is graphed (Figures 8.18-8.22) to aid in interpretation of flooding effects. In each figure there are three graphs. The first graph shows the difference in the given microclimate variable between the day before and the day after each flood event for the flooded and non-flooded areas. The fluctuation in the non-flooded area between the day before and day after each flood events indicates the baseline change in general weather conditions; deviation in the flooded area from this baseline change suggests an effect of flooding. This deviation (the difference between the non-flooded and flooded areas) is depicted in the second graph in each figure. The third graph in each figure plots this deviation against baseline weather conditions to show whether the direction and magnitude of any effects of flooding varied based on underlying weather conditions.

Overall, the flooded area had a lower maximum diurnal temperature in relation to the non-flooded area on the day after a flood event than on the day before a flood event (Table 8.7, Figures 8.18a and 8.18b). The effect of flooding on the maximum diurnal temperature was related to the maximum temperature recorded on the day after a flood event in the non-flooded area (Figure 8.18c); flooding had the greatest effect of lowering the maximum temperature on hot days but raised the maximum temperature on relatively cool days. Overall, minimum nocturnal temperature on the day after a flood event was higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.19a and 8.19b). The effect of flooding on minimum nocturnal temperature did not appear to be related to minimum nocturnal temperature (Figure 8.19c). Overall, the daily temperature range on the day after a flood event was smaller in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.20a and 8.20b). This effect was strongly related to the maximum temperature on the day after a flood event, with flooding having the greatest effect of reducing the daily temperature range on hot days (Figure 8.20c).

Both diurnal and nocturnal vapor pressure on the day after a flood event were higher in the flooded area in relation to the non-flooded area than on the day before a flood event (Table 8.7, Figures 8.21a, 8.21b, 8.22a, and 8.22b). Diurnal vapor pressure was affected the most strongly in the middle of the season (Figure 8.21b), but this effect was not related to overall vapor pressure (Figure 8.21c). The effect on nocturnal vapor pressure was weakly, inversely related to ambient vapor pressure.

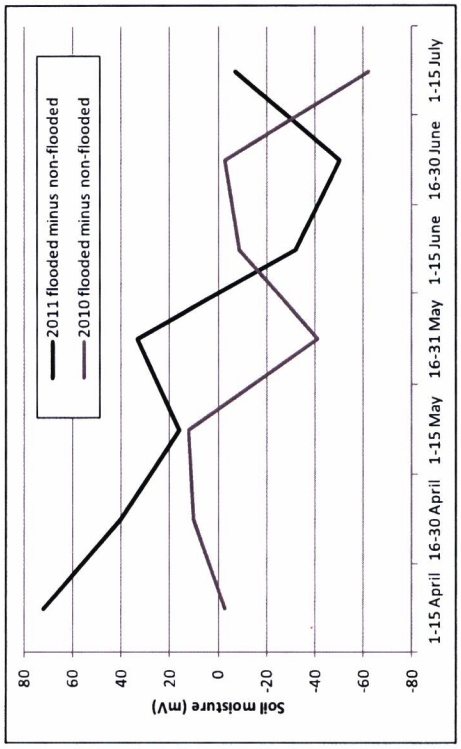


Figure 8.9b. Difference in soil moisture between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

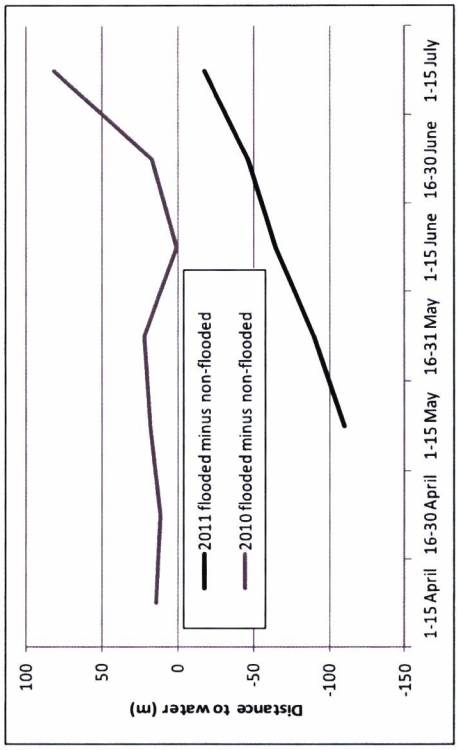


Figure 8.10b. Difference in distance to water between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

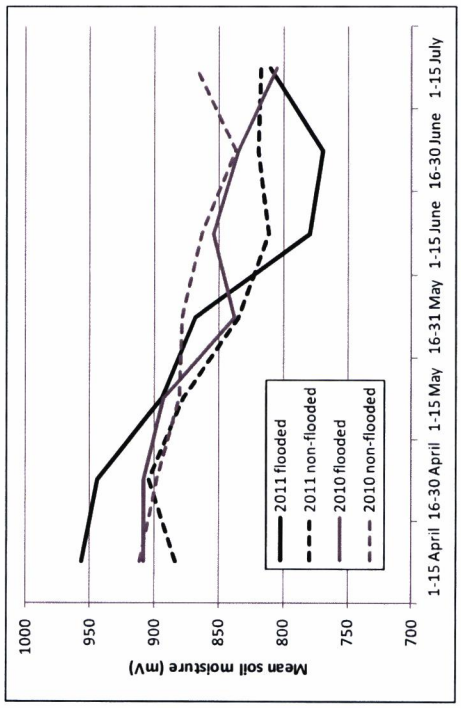


Figure 8.9a. Mean soil moisture by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

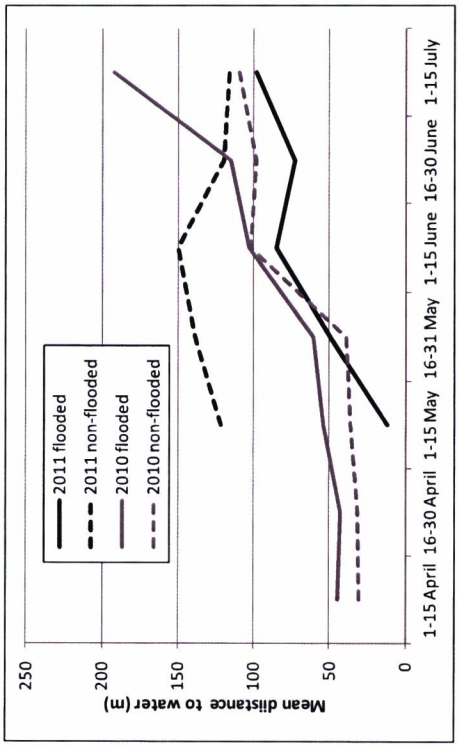


Figure 8.10a. Mean distance to water by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

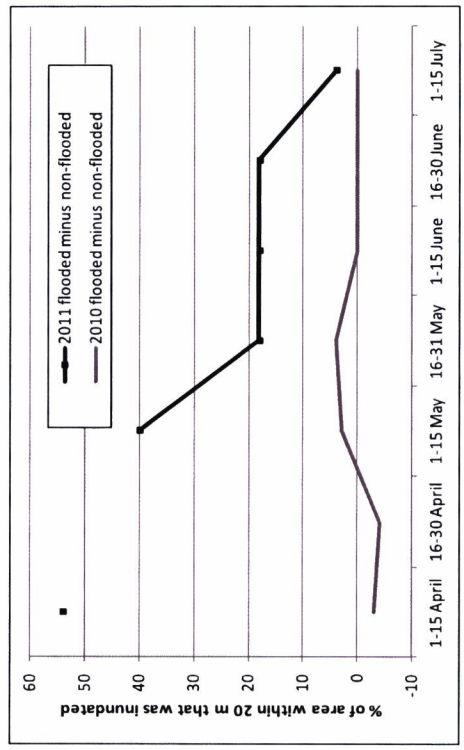


Figure 8.11b. Difference between flooded and non-flooded areas in percent of area within 20 m that was inundated, Topock Marsh, 2010 and 2011.

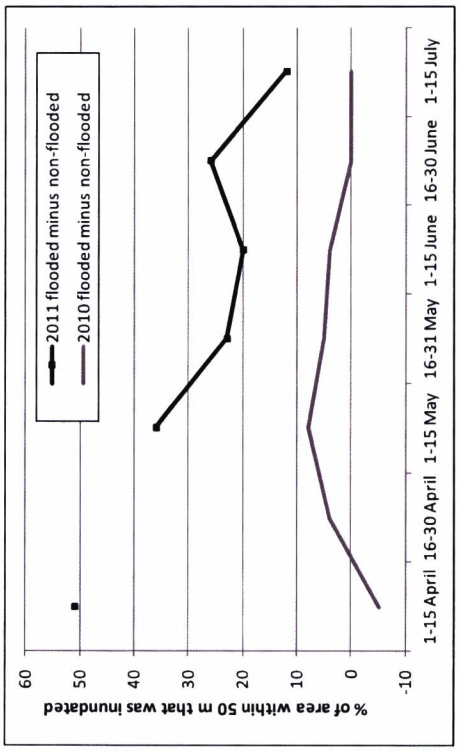


Figure 8.12b. Difference between flooded and non-flooded areas in percent of area within 50 m that was inundated, Topock Marsh, 2010 and 2011.

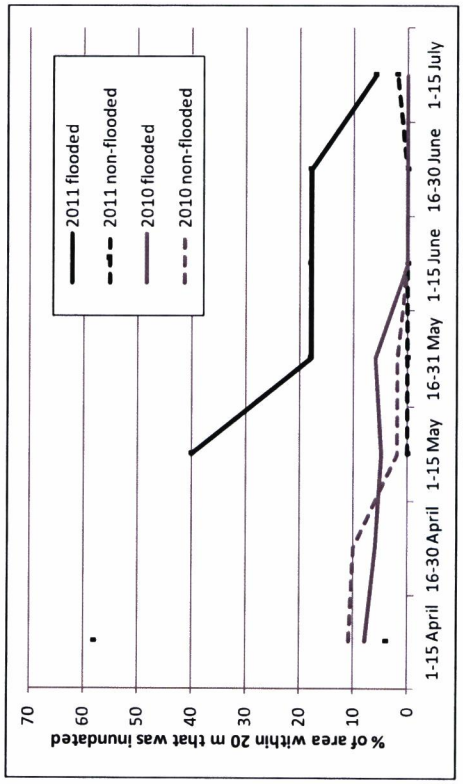


Figure 8.11a. Mean percent of area within 20 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

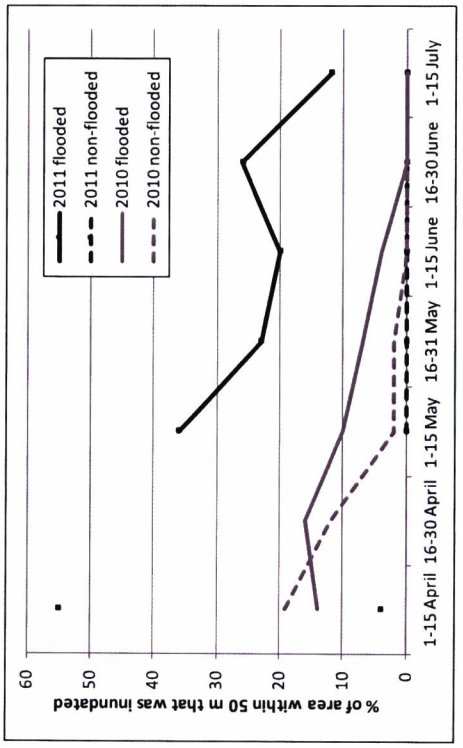


Figure 8.12a. Mean percent of area within 50 m that was inundated by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

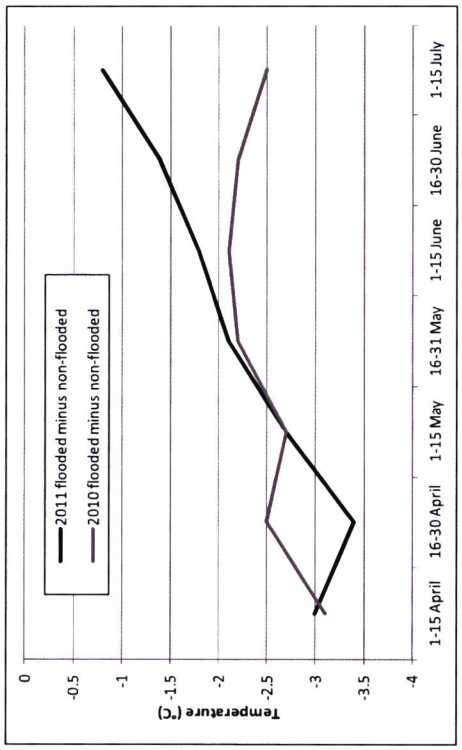


Figure 8.13b. Difference in mean maximum daily temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

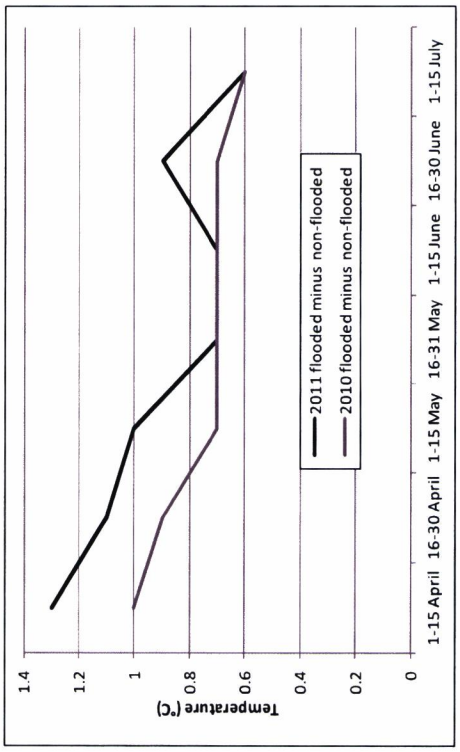


Figure 8.14b. Difference in mean minimum nocturnal temperature between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

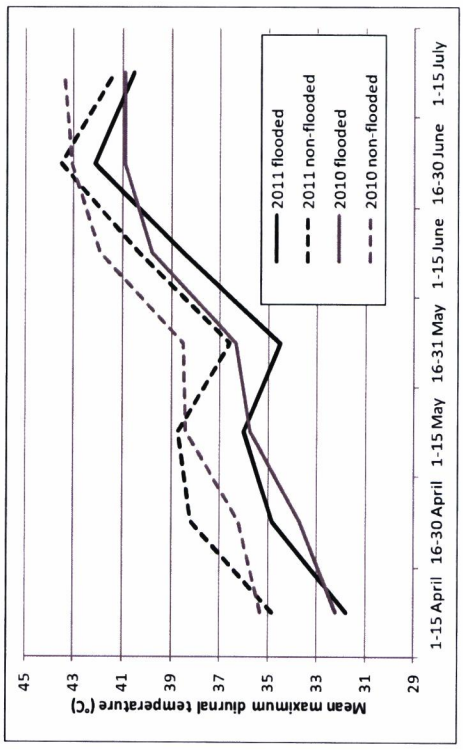


Figure 8.13a. Mean maximum diurnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

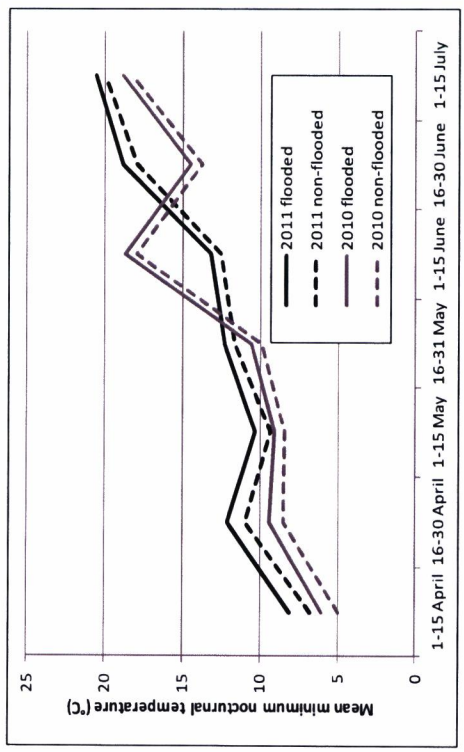


Figure 8.14a. Mean minimum nocturnal temperature by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

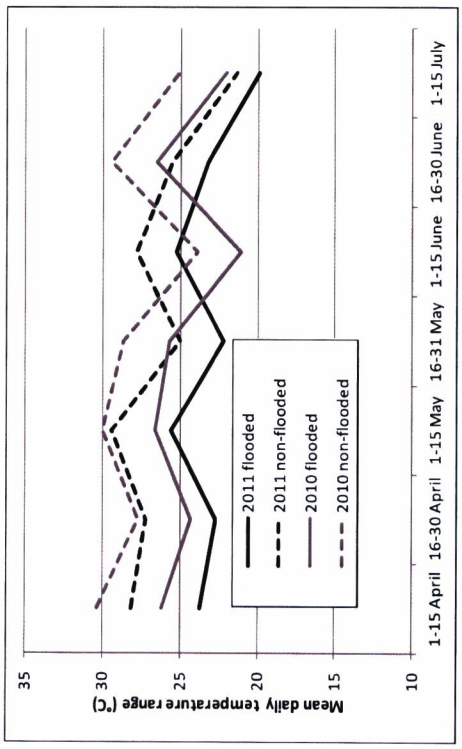


Figure 8.15a. Mean daily temperature range by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

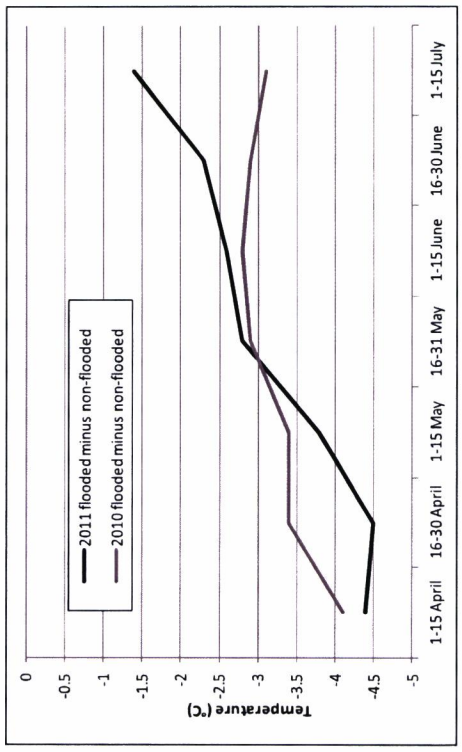


Figure 8.15b. Difference in daily temperature range between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

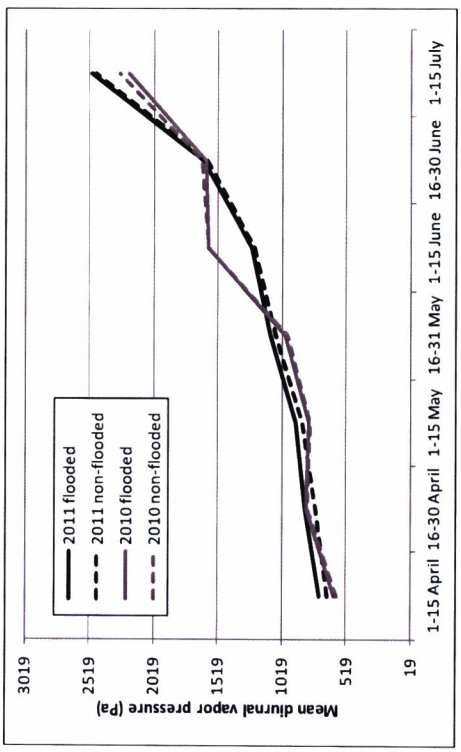


Figure 8.16a. Mean diurnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

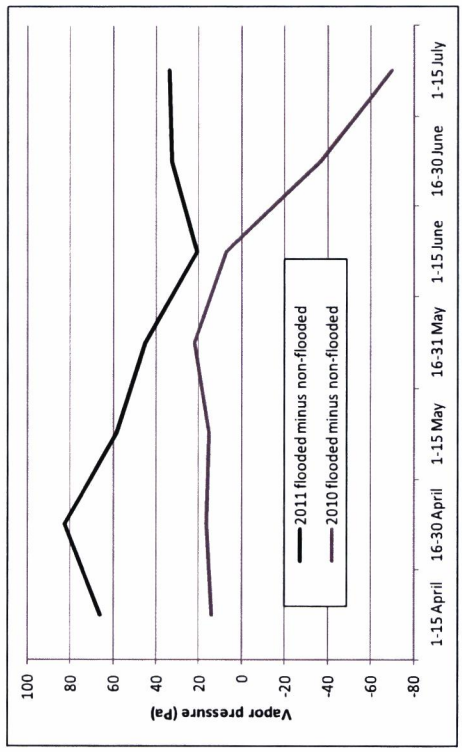


Figure 8.16b. Difference in diurnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

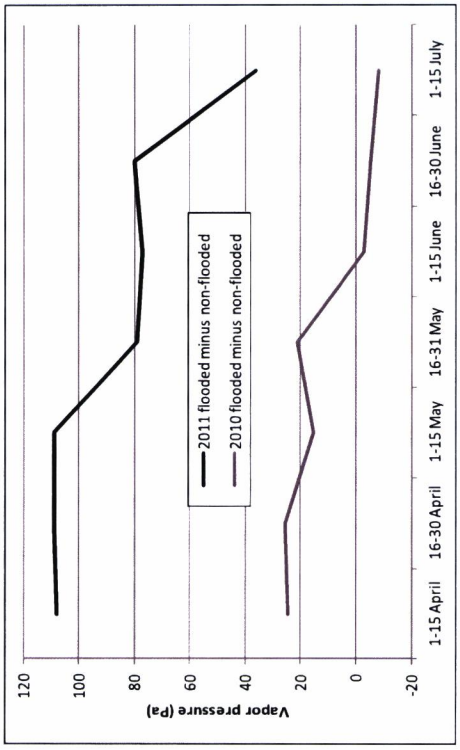


Figure 8.17b. Difference in nocturnal vapor pressure between flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

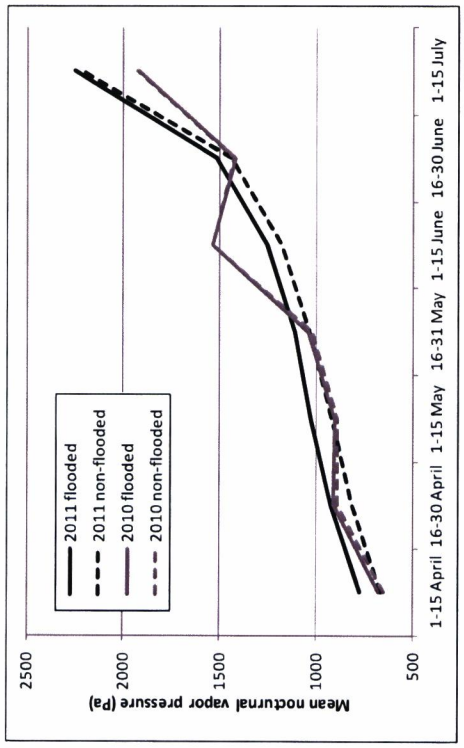


Figure 8.17a. Mean nocturnal vapor pressure by two-week periods in flooded and non-flooded areas, Topock Marsh, 2010 and 2011.

Table 8.6. *P*-values from Repeated Measures Linear Mixed Model Analysis of Flooded and Non-flooded Areas, Topock Marsh, 2010 and 2011.

	Flooded vs. non-flooded areas overall, within the year (between flood group differences)		Change over the season for flooded vs. non-flooded areas, by year (interaction between flood group and time)		2010 vs. 2011 overall, within flood group (between-year differences)		Change over the season for 2010 vs. 2011, by flood group (interaction between year group and time)	
Parameter	**2010**	**2011**	**2010**	**2011**	**Non-flooded**	**Flooded**	**Non-flooded**	**Flooded**
Soil Moisture								
Mean soil moisture (mV)	0.329	0.563	0.014	<0.001	<0.001	0.884	0.131	0.009
Mean distance to nearest standing water	0.124	0.009	<0.001	0.173	<0.001	<0.001	0.066	0.023
% of area within 20 m that was inundated	0.997	<0.001	0.750	<0.001	0.208	<0.001	0.718	0.010
% of area within 50 m that was inundated	0.497	<0.001	0.147	0.001	0.026	<0.001	0.004	0.407
Temperature								
Mean maximum diurnal temperature (°C)	0.067	0.071	0.954	0.009	--	--	--	--
Mean minimum nocturnal temperature (°C)	0.069	0.044	0.088	<0.001	--	--	--	--
Mean daily temperature range (°C)	0.041	0.047	0.802	0.001	--	--	--	--
Humidity								
Mean diurnal vapor pressure (Pa)	0.943	0.349	0.618	0.845	--	--	--	--
Mean nocturnal vapor pressure (Pa)	0.751	0.011	0.170	0.012	--	--	--	--

* Data restricted from April 1 through July 15 for both years. For 2011, distance-to-water measures do not include April and percent inundated measures do not include April 16-30.

AR065027

Table 8.7. Difference in Temperature and Humidity Measures Between the Day After and Day Before Pumping in Flooded and Non-flooded Areas, Topock Marsh, 2011*

	Maximum diurnal temperature		Minimum nocturnal temperature		Daily temperature range		Mean diurnal vapor pressure		Mean nocturnal vapor pressure	
Day of flooding	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded	Non-Flooded	Flooded
31 March	9.3	8.6	5.8	6.3	3.5	2.3	113.2	190.7	155.2	275.4
7 April	-18.9	-15.5	-1.5	-3.6	-17.4	-11.9	-194.4	-191.8	-443.1	-495.4
13 April	-5.5	-5.0	2.6	2.6	-8.0	-7.6	-263.6	-338.0	-263.7	-292.1
21 April	0.1	-0.9	-3.6	-2.9	3.6	2.0	-193.7	-154.0	-41.8	-21.3
28 April	2.4	1.9	11.1	9.1	-8.7	-7.2	201.0	239.3	-152.9	-264.2
5 May	3.0	2.0	4.5	4.3	-1.3	-2.3	261.9	323.6	260.4	249.5
12 May	5.5	5.0	2.8	4.0	2.7	1.0	95.5	149.7	93.4	175.2
19 May	11.9	11.1	-0.4	0.4	12.2	10.7	-269.0	-170.6	26.8	83.3
26 May	0.6	0.7	4.7	4.7	-4.1	-3.9	57.7	132.3	-38.9	50.1
2 June	4.8	3.6	-3.4	-2.5	8.2	6.1	-150.2	-40.7	93.0	158.1
9 June	3.0	3.0	1.3	2.4	1.8	0.5	196.3	220.0	96.7	157.7
16 June	-3.9	-4.4	3.5	4.4	-7.3	-8.7	-328.5	-223.9	-90.9	-61.9
23 June	-0.8	-1.7	4.8	5.5	-5.6	-7.2	-84.3	-85.4	-7.2	55.6
30 June	0.2	-0.7	-11.4	-11.3	11.6	10.6	522.0	587.7	402.6	565.5
7 July	11.0	8.0	0.7	1.5	10.3	6.5	-190.4	-136.2	-212.0	-178.1
Mean (SE)	1.5 (0.6)	1.0 (0.6)	1.4 (0.4)	1.7 (0.4)	0.1 (0.7)	-0.6 (0.6)	-15.1 (22.3)	33.5 (23.9)	-8.2 (18.3)	30.5 (24.0)
P-values, flooded vs. non-flooded areas, overall	0.034		0.031		0.008		0.011		0.007	
P-values, change over the season for flooded vs. non-flooded areas (interaction between flood group and time)	0.003		<0.001		<0.001		0.542		<0.001	

* Differences are the day after flooding minus the day before flooding.

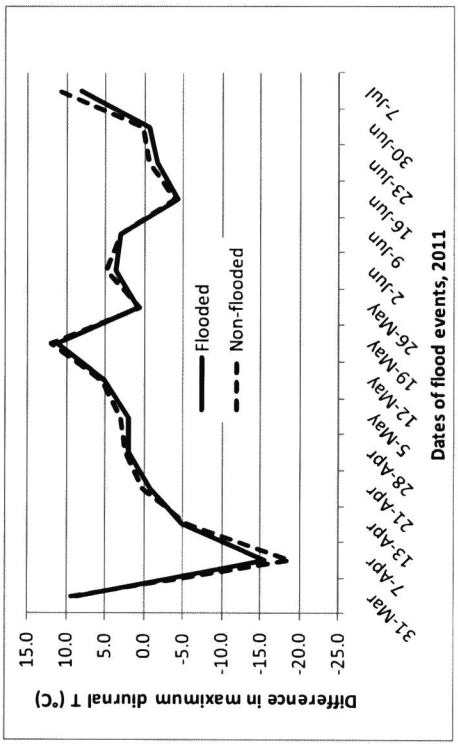


Figure 8.18a. Difference between the day before and day after (day after minus day before) each flood event in maximum diurnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

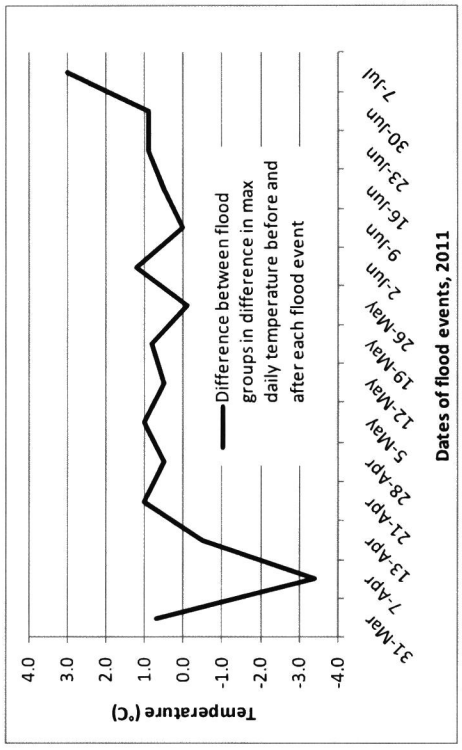


Figure 8.18b. Difference between flood groups (non-flooded minus flooded) in difference in maximum daily temperature before and after each flood event, Topock Marsh, 2011.

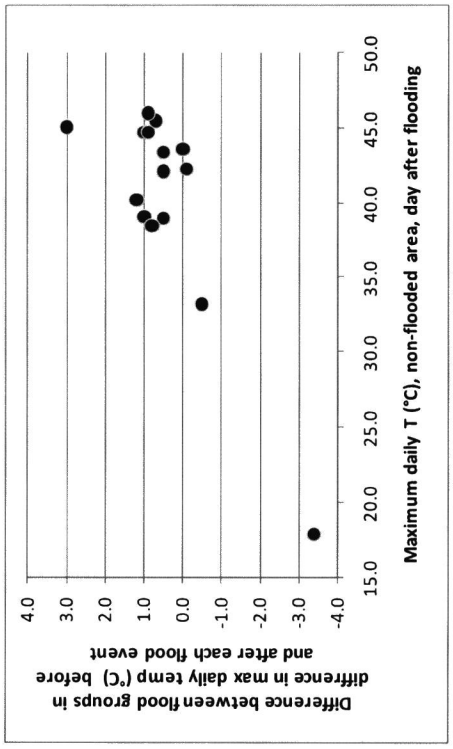


Figure 8.18c. Difference between flood groups in difference in maximum daily temperature before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

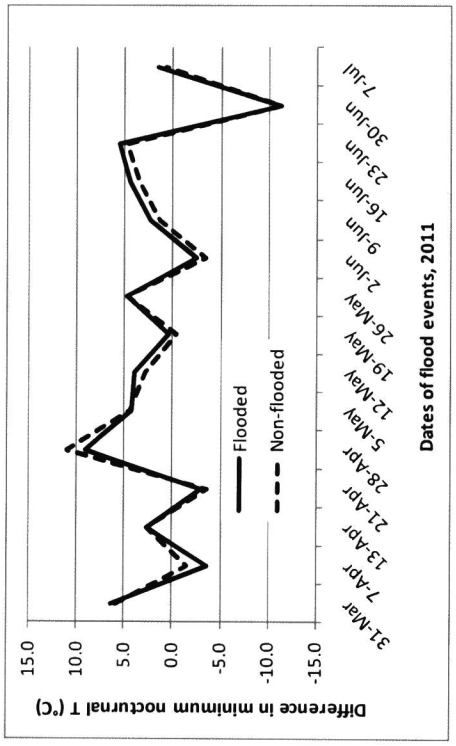


Figure 8.19a. Difference between the day before and day after (day after minus day before) each flood event in minimum nocturnal temperature, flooded and non-flooded areas, Topock Marsh, 2011.

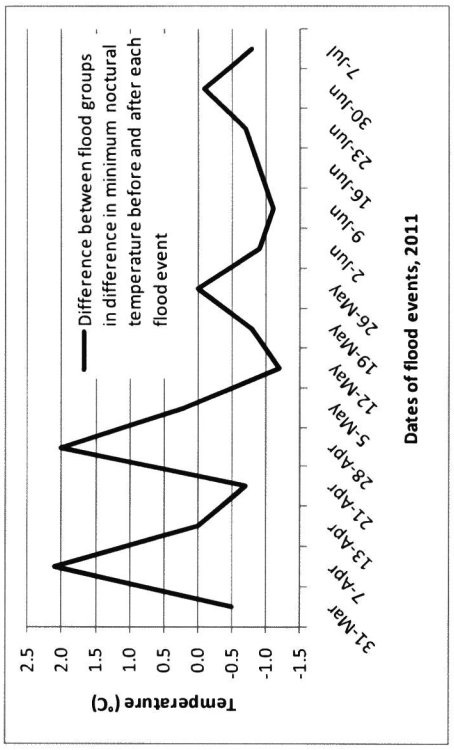


Figure 8.19b. Difference between flood groups (non-flooded minus flooded) in difference in minimum nocturnal temperature before and after each flood event, Topock Marsh, 2011.

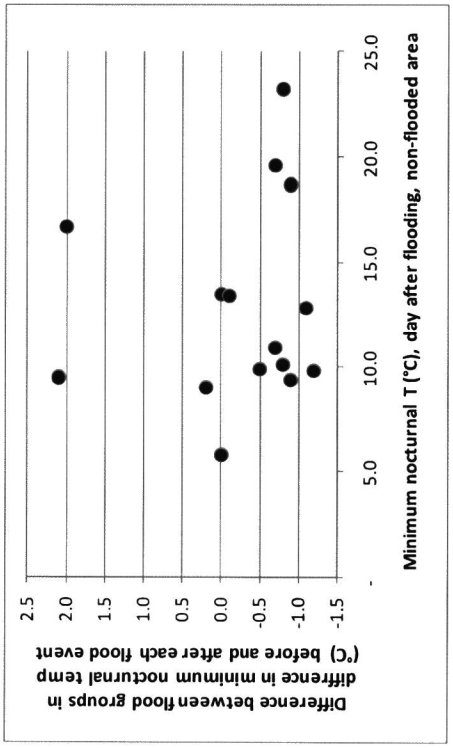


Figure 8.19c. Difference between flood groups in difference in minimum nocturnal temperature before and after each flood event, plotted against minimum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

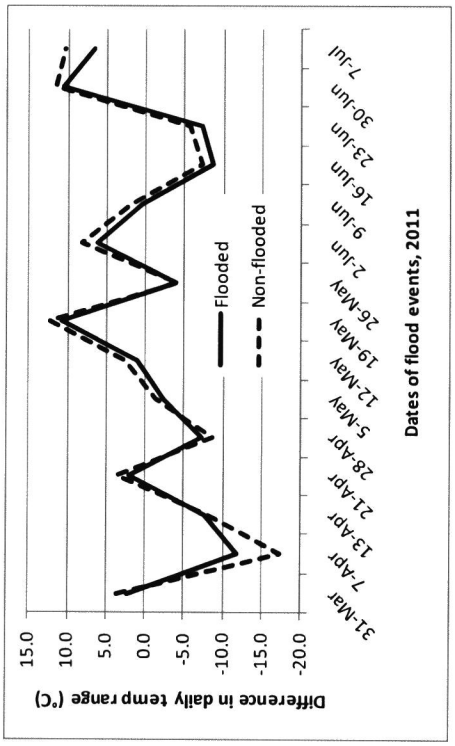


Figure 8.20a. Difference between the day before and day after (day after minus day before) each flood event in daily temperature range, flooded and non-flooded areas, Topock Marsh, 2011.

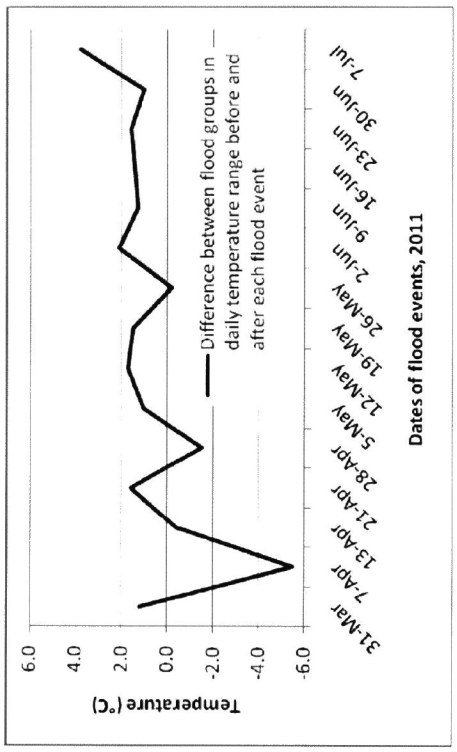


Figure 8.20b. Difference between flood groups (non-flooded minus flooded) in difference in daily temperature range before and after each flood event, Topock Marsh, 2011.

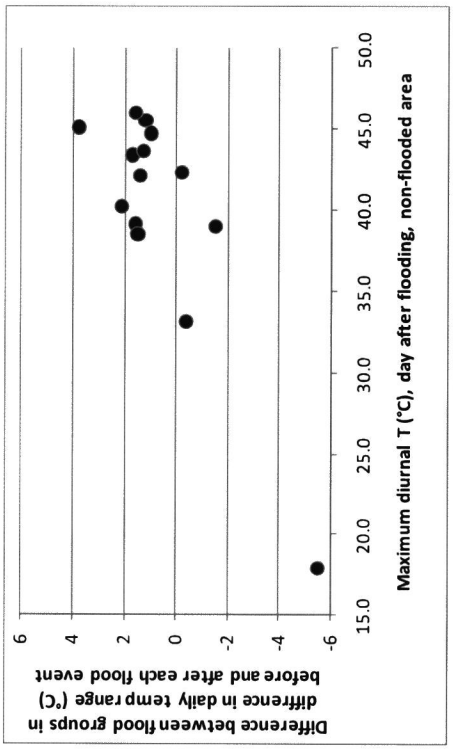


Figure 8.20c. Difference between flood groups in difference in daily temperature range before and after each flood event, plotted against maximum daily temperature in the non-flooded area on the day after flooding, Topock Marsh, 2011.

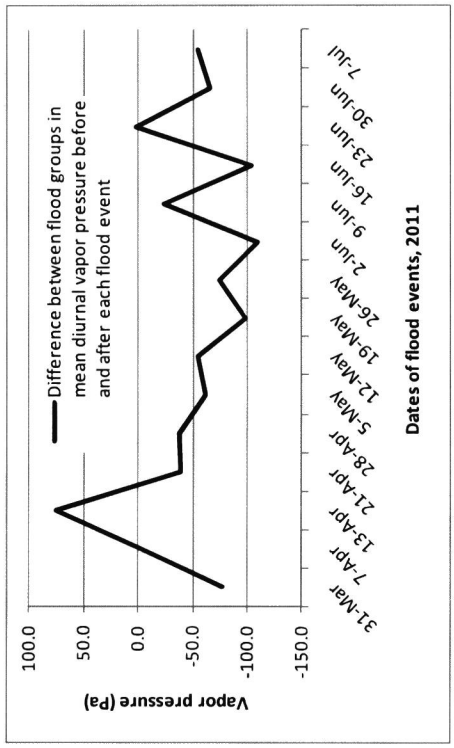


Figure 8.21b. Difference between flood groups (non-flooded minus flooded) in difference in mean diurnal vapor pressure before and after each flood event, Topock Marsh, 2011.

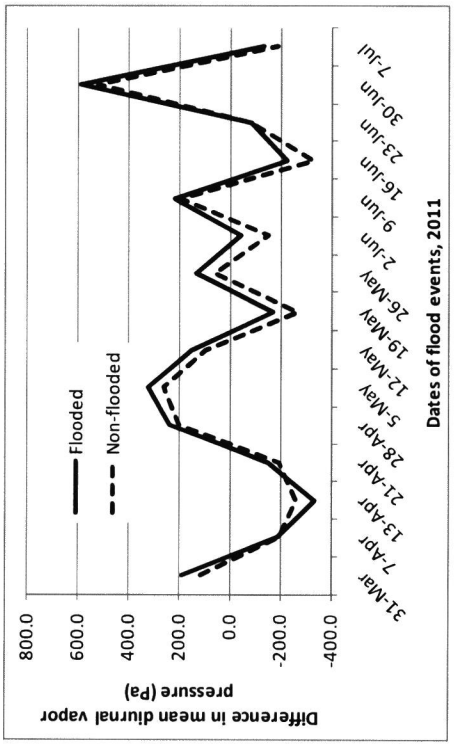


Figure 8.21a. Difference between the day before and day after (day after minus day before) each flood event in mean diurnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

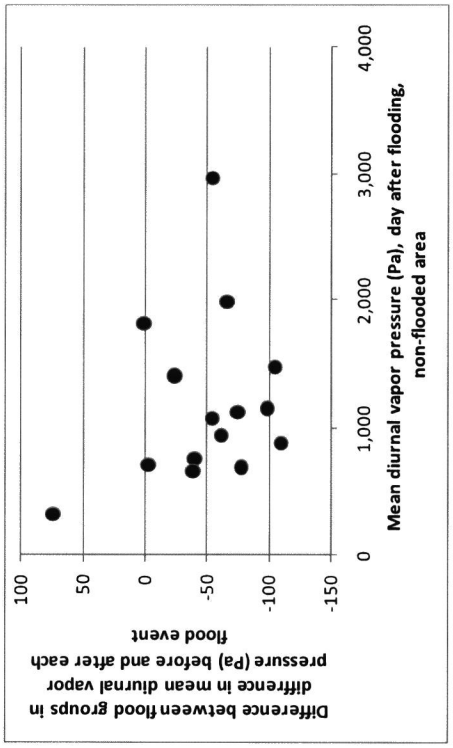


Figure 8.21c. Difference between flood groups in difference in mean diurnal vapor pressure before and after each flood event, plotted against mean diurnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

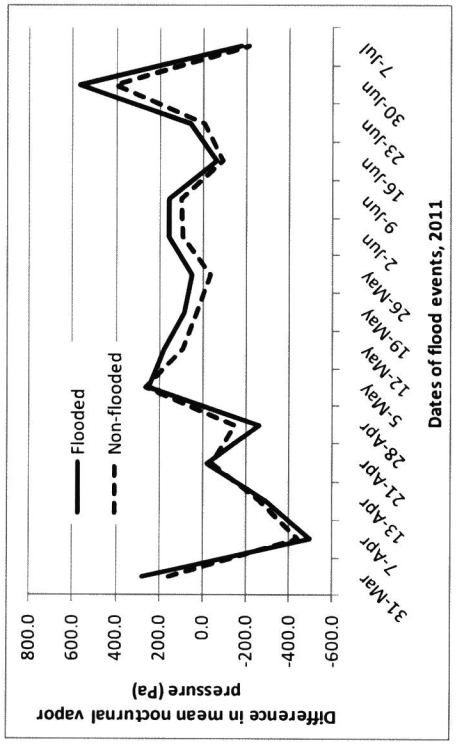


Figure 8.22a. Difference between the day before and day after (day after minus day before) each flood event in mean nocturnal vapor pressure, flooded and non-flooded areas, Topock Marsh, 2011.

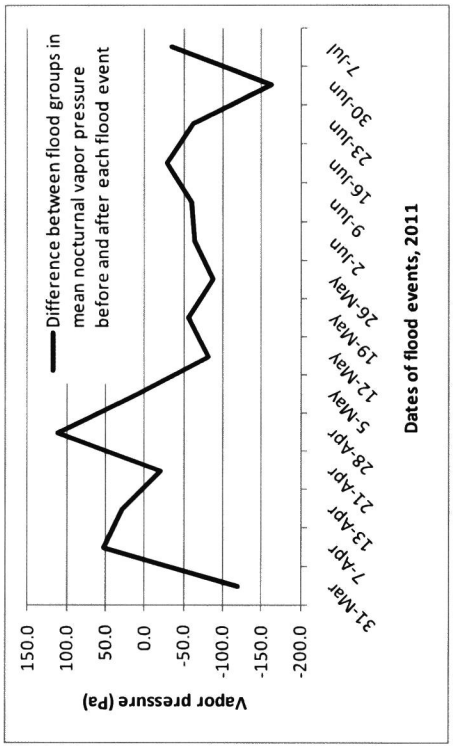


Figure 8.22b. Difference between flood groups (non-flooded minus flooded) in difference in mean nocturnal vapor pressure before and after each flood event, Topock Marsh, 2011.

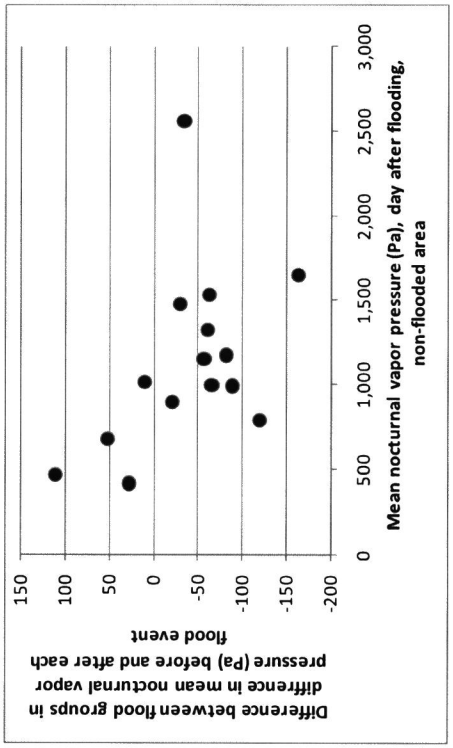


Figure 8.22c. Difference between flood groups in difference in mean nocturnal vapor pressure before and after each flood event, plotted against mean nocturnal vapor pressure in the non-flooded area on the day after flooding, Topock Marsh, 2011.

Vegetation

We collected vegetation data at all 15 flooded and 17 non-flooded locations. Vegetation characteristics in 2010 and 2011 are summarized in Table 8.8, and vertical foliage profiles are shown in Figures 8.23–8.26. Vegetation characteristics are typical of those documented in dense, tamarisk stands at Topock Marsh in previous years (McLeod et al. 2008a), with dense canopy closure and a small percentage of native vegetation.

Vegetation characteristics differed between years in both flooded and non-flooded areas in percent canopy closure, percent woody ground cover, and the amount of live vegetation in all height categories (Table 8.8, *P*-values in "Year" column). Percent canopy closure and percent woody ground cover was higher in 2011 than in 2010, while the number of hits of live vegetation recorded in all height categories was lower in 2011. Woody ground cover was the only variable that showed an interaction between year and flood group, meaning that the change in woody ground cover was different in the flooded area versus the non-flooded area (right-most column of Table 8.8). Woody ground cover increased more dramatically in the non-flooded area than in the flooded area.

Table 8.8. Summary of Vegetation Characteristics within Portions of Topock Marsh Selected for Habitat Enhancement, 2010 and 2011*

Parameter	2010		2011		*P*-value	
	Flooded	Non-flooded	Flooded	Non-flooded	Year	Year*flood group
Average canopy height (m)	6.3 (0.3)	5.9 (0.3)	6.2 (0.2)	5.9 (0.3)	0.725	0.904
	4.2–7.4	3.4–8.3	4.0–7.0	3.5–8.5		
% total canopy closure	89.5 (1.5)	88.7 (2)	94.3 (1)	90.7 (1.4)	0.007	0.260
	78.6–97.9	63–97.4	85.9–100	77.6–97.4		
% woody ground cover	23.7 (5.4)	13.2 (3.6)	45.8 (8.9)	77.1 (5.3)	<0.001	<0.001
	2.5–66.3	1–52.8	5.0–100.0	17.5–100		
Live vertical foliage (hits) below average nest height	2.6 (0.7)	3.0 (0.6)	1.4 (0.3)	2.1 (0.5)	0.018	0.718
	0.3–12.1	0.0–7.4	0.0–3.3	0.0–6.7		
Live vertical foliage (hits) at average nest height	2.6 (0.4)	2.7 (0.4)	1.6 (0.3)	2.0 (0.2)	<0.001	0.335
	0.1–5	0.8–6	0.2–3.8	0.3–3.9		
Live vertical foliage (hits) above average nest height	9.7 (0.7)	7.0 (1.1)	6.0 (0.6)	4.2 (0.7)	<0.001	0.433
	4.7–13.8	0.9–18.4	2.8–10.1	0.2–9.7		
Dead vertical foliage (hits) below average nest height	8.2 (0.7)	9.3 (0.5)	8.1 (0.7)	9.0 (0.6)	0.762	0.858
	2.4–13.1	5.1–13.4	4.8–13.4	5.1–14.2		
Dead vertical foliage (hits) at average nest height	1.9 (0.3)	2.0 (0.3)	2.2 (0.2)	1.9 (0.3)	0.460	0.241
	0.3–5.0	0.1–4.2	0.9–4.0	0.1–4.2		
Dead vertical foliage (hits) above average nest height	1.3 (0.4)	1.0 (0.2)	1.4 (0.3)	1.3 (0.2)	0.358	0.613
	0.0–3.9	0.0–2.9	0.0–3.2	0.0–4.1		
Percent native	0.0 (0.0)	5.3 (3.1)	0.0 (0.0)	7.5 (5)	0.680	0.680
	0.0–0.0	0.0–48.7	0.0–0.0	0.0–78.5		

* Data are presented as mean, standard error, and range. *P*-values for year indicate differences between years for both flooded and non-flooded locations combined. *P*-values for year*flooded indicate whether flooded areas changed between years differently than did non-flooded areas.

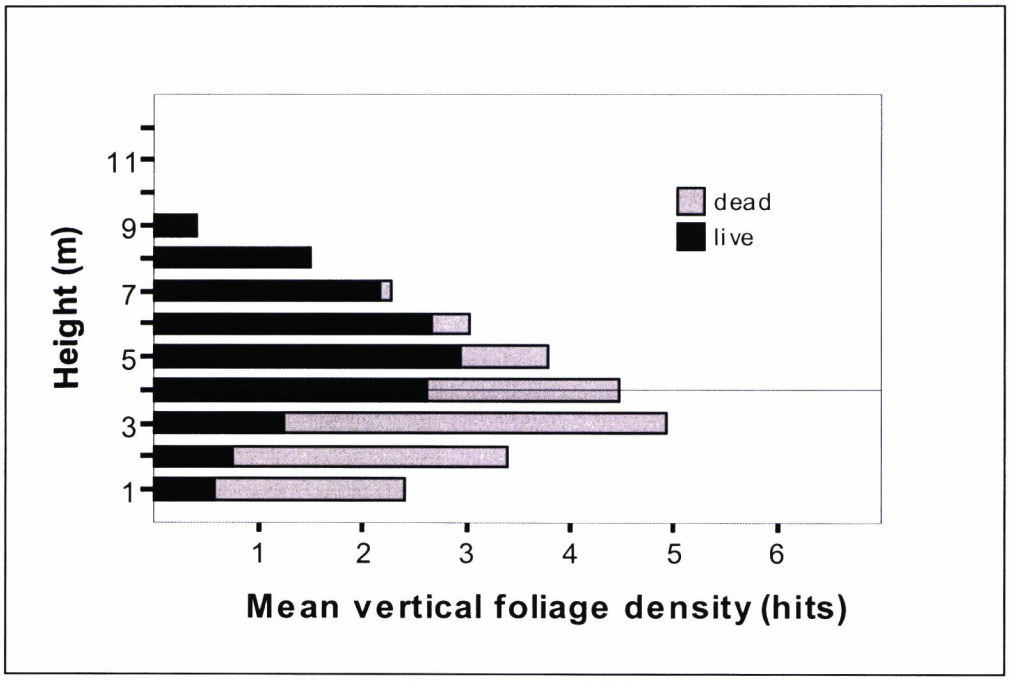


Figure 8.23. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

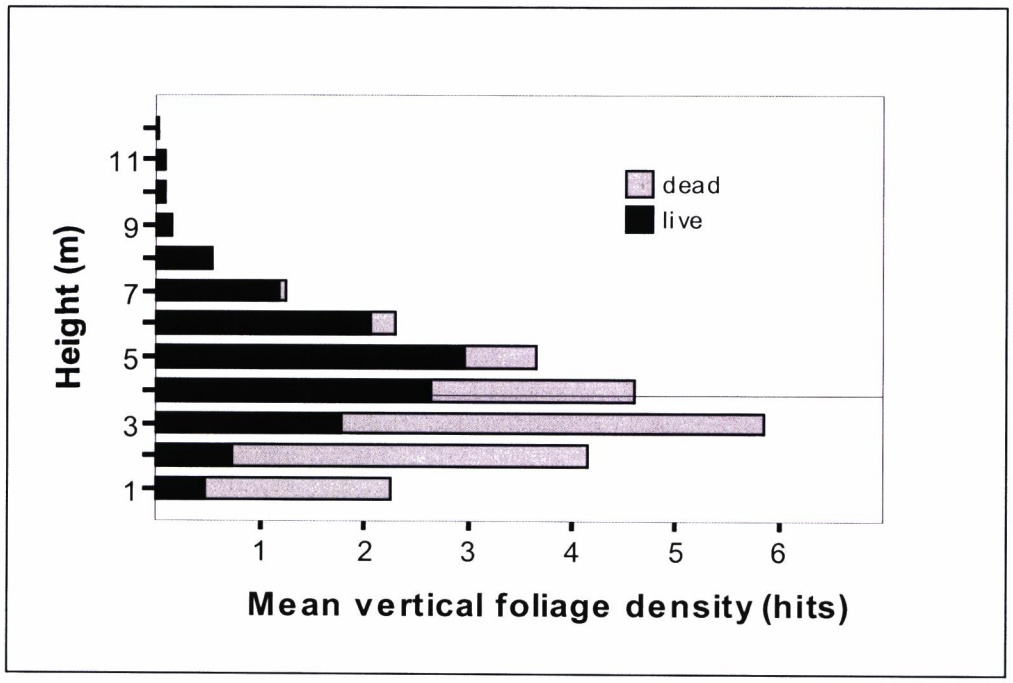


Figure 8.24. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2010. Horizontal line shows average nest height in the project area, 2003–2008.

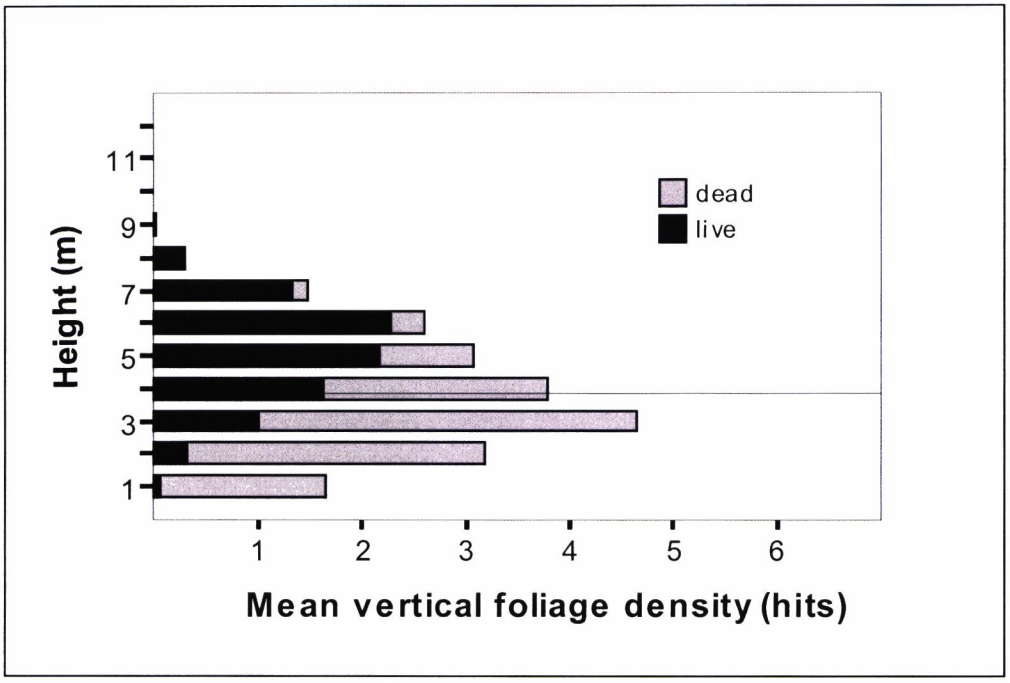


Figure 8.25. Vertical foliage density in flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

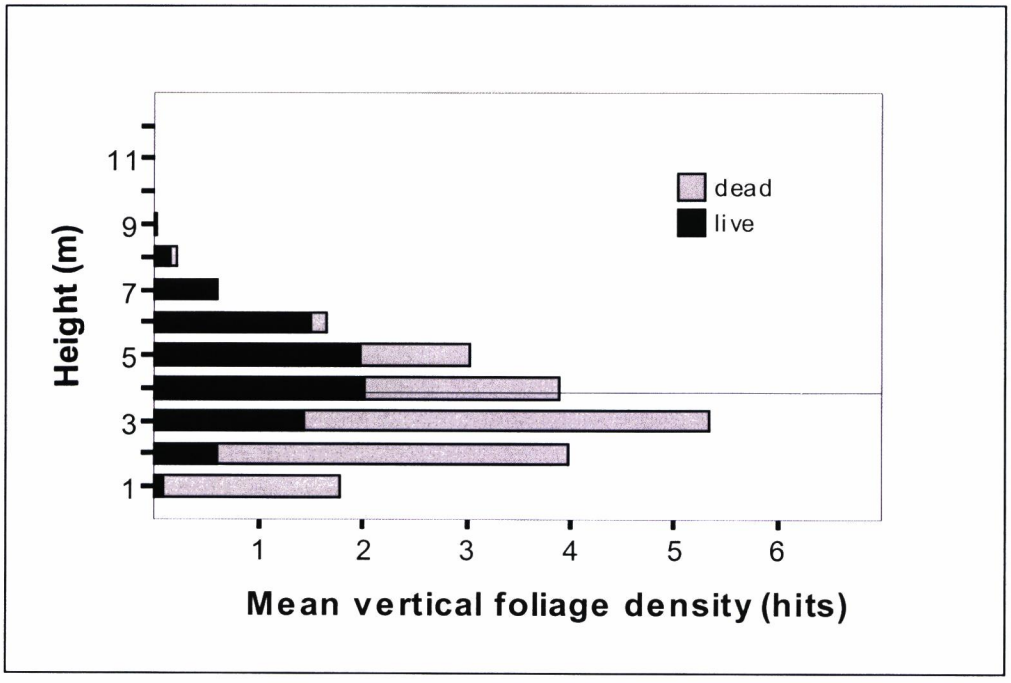


Figure 8.26. Vertical foliage density in non-flooded areas within the habitat enhancement project area, Topock Marsh, 2011. Horizontal line shows average nest height in the project area, 2003–2008.

DISCUSSION

Water delivery had the expected effect of increasing the extent and duration of surface water present within the target area in 2011 in comparison with the previous year, despite the overall lower level of Topock Marsh in 2011. Surface water from a given pumping event covered a larger extent and declined more slowly when the underlying water table was high, indicating that pumping was more effective in creating the surface water conditions favored by flycatchers when coupled with a high underlying water table.

In the area affected by flooding, water delivery had the expected effect of raising soil moisture, decreasing distance to water from the sample points, and increasing the percentage of the area surrounding each sample point that was inundated or saturated. Water delivery also appeared to increase humidity within the flooded area; both diurnal and nocturnal vapor pressure were higher in the flooded area than in the non-flooded area in 2011 but not in 2010. In addition to the overall effect on humidity, flooding also had short-term effects on humidity as shown by the analysis of conditions on the day before versus the day after each flood event. On average, flood events produced higher diurnal and nocturnal vapor pressure in the flooded area in comparison to the non-flooded area.

The effect of water delivery on temperature was not as clear. The analysis comparing the flooded and non-flooded areas throughout the year did not show a statistically significant overall effect of flooding on any of the temperature variables, but there was an interaction between flood group and time in 2011, showing that all temperature variables changed through the year in the flooded area in a different way than they changed in the non-flooded area. In 2011, the difference between the flooded and non-flooded areas in all temperature variables declined as the season progressed. An analysis of temperature variables on the day before versus the day after each flood event showed that, on average, flood events produced a lower maximum temperature, higher minimum temperature, and smaller daily temperature range in the flooded area in comparison to the non-flooded area. Thus, flood events did affect temperature, but these effects did not seem to persist across two-week periods. The interaction between flood group and time in 2011 suggests that the effect on temperature from a given flood event persisted for shorter periods of time as the season progressed.

Areas occupied by flycatchers typically have higher soil moisture, higher humidity, lower maximum temperatures, and smaller daily temperature ranges than unoccupied areas (McLeod et al. 2008a); thus, water delivery appeared to change the microclimate conditions within the flooded area in ways that would favor flycatcher occupancy.

The between-year changes in several of the vegetation variables appear somewhat contradictory, with canopy closure increasing between 2010 and 2011 but the amount of live vertical foliage decreasing between 2010 and 2011 in all height categories. It is difficult to distinguish between true changes in the vegetation and observer variation. The between-year differences were recorded in both flooded and non-flooded areas, indicating that flooding had no effect on changes in canopy closure or density of live vegetation. Woody ground cover increased between 2010 and 2011 in both flooded and non-flooded areas but increased much more dramatically in non-flooded areas. The overall increase in the percentage of woody ground cover could be strongly influenced by observer variation, but the significant interaction between year and flooded category suggests that the presence of surface water had an effect on the amount of woody cover, with flooding resulting in less woody cover. In general, water delivery did not appear to have any effects on vegetation that would influence flycatcher occupancy.

Water delivery resulted in the flooded area of In Between and 800M being the only portion of the sites surveyed for flycatchers within Topock Marsh that contained surface water during the 2011 breeding season (see Chapter 2). Five flycatcher territories were recorded in Topock Marsh in 2011 (see Chapters

2 and 3); one of these territories was within the flooded portion of 800M and consisted of an unpaired male flycatcher. This flycatcher was detected at the territory in 800M through the end of June and then was detected for a few days in early July at another site approximately 1.5 km away. In 2010, the area that was affected by flooding in 2011 contained two resident, unpaired male flycatchers; in 2009, this same area contained one resident, unpaired male flycatcher. Water delivery thus did not result in increased flycatcher occupancy in the target area.

The number of flycatchers at Topock Marsh has been declining since 2004 (see Chapter 2), and few flycatcher young have been produced locally in recent years (see Chapter 4). Thus, there may be few adult flycatchers in the local population, and the lack of response by flycatchers to water delivery may be indicative of there being few adults available to establish territories. In addition, low water levels in 2011 throughout areas of Topock Marsh that have been historically occupied by flycatchers likely reduced the overall suitability of the area for flycatchers. Although supplemental water delivery appeared to produce conditions that would be favorable to flycatcher occupancy, the confounding factors of dry conditions elsewhere in Topock Marsh and a low population may have limited the ability of flycatchers to colonize the area.

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

This page intentionally left blank.

Chapter 9

MANAGEMENT AND STUDY DESIGN RECOMMENDATIONS

For ease of reference this chapter summarizes all study design and management recommendations discussed in previous chapters.

BROADCAST SURVEYS

Pahranagat MAPS and Pahranagat South were affected prior to the start of the 2010 survey season by a fire that removed the understory and damaged the overstory trees. We did not survey these sites in 2011 but recommend revisiting them in another 2–3 years to determine whether the understory has recovered to the point where it might support breeding flycatchers. We do not recommend surveying these sites in 2012.

Littlefield Poles was affected in December 2010 by a flood that heavily scoured much of the surrounding area. Hydrology, stand density, and vegetation height were all negatively impacted by the flood. We recommend revisiting this site at the beginning of future breeding seasons to determine whether the vegetation and hydrology have recovered to the point where breeding flycatchers might be supported.

Bunker Marsh North was surveyed at the start of 2011, but surveys were discontinued in mid-June due to lack of surface water within the vegetation and extensive defoliation. We recommend reassessing the site at the beginning of the next breeding season and discontinuing surveys if the site is dry.

Mormon Mesa North and Hedgerow at Mormon Mesa have been completely dry for the last several years, and neither of these sites has supported breeding flycatchers since 2005. We visited each site once at the beginning of the 2011 season to determine whether the hydrology of the sites was altered by heavy flooding on the Virgin River in December 2010. Both sites were dry during the initial visit and surveys were discontinued. We recommend discontinuing surveys at these sites until another flood event occurs that has the potential to alter the hydrology within the site. Virgin River #1 South consists of two disjunct areas. The southern section had dry soils throughout the survey season. We recommend visiting the southern section at the beginning of the next breeding season and discontinuing surveys in this portion of the site if no surface water is present. Virgin River #2 received extensive sedimentation ranging in depth from 15 to 60 cm as a result of the December 2010 flood. Many of the Goodding willow, particularly in the southern third of the site, are dead or dying, and we recommend discontinuing surveys in the southern portion of the site.

We revisited Tractor in Topock Marsh at the beginning of the 2011 season. Vegetation structure at the site is not suitable for supporting breeding flycatchers, and we do not recommend future visits to this site.

At Bill Williams River NWR, we revisited New River for the first time since it was initially evaluated in 2008. In 2008, the vegetation appeared too young and sparse to support willow flycatchers. Vegetation at the site has matured somewhat since the visit in 2008 but still lacks the combination of extent, size, and density typical of occupied flycatcher habitat. The site should be reevaluated in another two or three years. Wispy Willow, a small area of new coyote willow growth downstream of Site #1, currently lacks the size to resemble occupied flycatcher habitat along the LCR, but the site should be reassessed in future years.

Ground reconnaissance of Laguna revealed that, overall, the site is lacking in vegetation of sufficient height and density to resemble suitable flycatcher habitat. Surface water was present only in one small area. Soils in most of the site were complete dry. We discontinued surveys after the initial visit because of the complete lack of potential flycatcher habitat.

COWBIRD CONTROL

The breeding site at Muddy River is a relatively small stand of tall trees and is bordered to the north by an extensive valley dominated by residential areas and agriculture and containing little riparian vegetation. Muddy River had 33–75% parasitism in six of the seven years when flycatchers have been monitored at the study area, and overall nest success was 29%, well below the average of 44% across all study areas in those years. Although the breeding site at Muddy River is not as isolated from surrounding riparian vegetation as the site at Pahranagat, cowbird trapping at Muddy River has the possibility of reducing the parasitism rate and increasing flycatcher nest success, and we recommend that cowbird trapping be instituted at Muddy River.

In 2010 and 2011, we addled cowbird eggs in easily accessible flycatcher nests, and this appeared to reduce the hatch rate of the cowbird eggs and did not cause desertion of any nests by the flycatchers. Although sample sizes were small, results also suggested that the number of flycatcher nestlings fledged per nest might be higher as a result of cowbird egg addling and cowbird nestling removal. We recommend this program be continued in the future.

HABITAT MONITORING: PARKER TO IMPERIAL DAMS

In previous years we correlated piezometer groundwater levels and soil moisture measurements and found no strong linear relationship (McLeod and Koronkiewicz 2009). Sites with high soil moisture values tended to show a weak, negative relationship between depth to groundwater and soil moisture, while sites with low soil moisture showed no relationship between depth to groundwater and soil moisture. This suggests that at sites where soil moisture is low, surface soil moisture content is not strongly influenced by groundwater levels, and soil moisture measurements are unlikely to reflect any changes in water availability caused by changing river levels. We recommend discontinuing soil moisture measurements at Havasu NE, Cibola Lake, Clear Lake, Ferguson Wash, and Gila Confluence North, where soil moisture values are consistently below 600 mV.

SURFACE HYDROLOGY, MICROCLIMATE, AND VEGETATION MONITORING: TOPOCK MARSH

The supplemental pumping at Topock Marsh showed that delivering surface water into potentially suitable flycatcher habitat can shift the hydrological and microclimate conditions towards those favored by flycatchers. The effectiveness of pumping depends in part on the underlying water table, with a high water table resulting in a greater extent and longer retention of surface water. Water delivery also had the greatest effect on moderating temperature when the underlying water table was high. Thus, weekly water delivery may be effective only under certain conditions, and more frequent pumping may be required to maintain favorable microclimate and hydrology if the water table is not immediately beneath the ground surface.

LITERATURE CITED

Brown, B.T., S.W. Carothers, and R.R. Johnson. 1987. Grand Canyon birds. The University of Arizona Press, Tucson. 302 pp.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241–257.

Busch, J.D., M.P. Miller, E.H. Paxton, M.K. Sogge, and P. Keim. 2000. Genetic variation in the endangered Southwestern Willow Flycatcher. Auk 117:586–595.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern Willow Flycatcher breeding site and territory summary – 2005. USGS Southwest Biological Science Center report to the U.S. Bureau of Reclamation.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern willow flycatcher final survey and monitoring report. Arizona Game and Fish Department, Research Technical Guidance Bulletin #10, Phoenix.

Finch, D.M., and J.F. Kelly. 1999. Status of management of the Southwestern Willow Flycatcher in New Mexico. Pages 197–203 *in* Finch, D.M., J.C. Whitney, J.F. Kelly and S.R. Loftin (eds.). Rio Grande ecosystems: linking land, water, and people. USDA Forest Service Rocky Mountain Research Station Proceedings, RMRS-P-7.

Flett, M.A., and S.D. Sanders. 1987. Ecology of a Sierra Nevada population of Willow Flycatchers. Western Birds 18:37–42.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society, Los Angeles, California.

Graber, A.E., and T.J. Koronkiewicz. 2009a. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2008. Final 2008 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 66 pp.

Graber, A.E., and T.J. Koronkiewicz. 2009b. Southwestern Willow Flycatcher surveys and nest monitoring along the Gila River between Coolidge Dam and South Butte 2009. Final 2009 summary report submitted to U.S. Bureau of Reclamation, Phoenix, Arizona, by SWCA Environmental Consultants, Flagstaff, Arizona. 25 pp.

Graber, A.E., D.M. Weddle, H.C. English, S.D. Stump, H.E. Telle, and L.A. Ellis. 2007. Southwestern willow flycatcher 2006 survey and nest monitoring report. Nongame and Endangered Wildlife Program. Technical report 249. Arizona Game and Fish Department, Phoenix.

Graf, W.L., J. Stromberg, and B. Valentine. 2002. Rivers, dams, and willow flycatchers: a summary of their science and policy connections. Geomorphology 47:169–188.

Hanski, I.A., and D. Simberloff. 1997. The metapopulation approach, its history, conceptual domain, and application to conservation. Pages 5–26 *in* Hanski, I.A. and Gilpin, M.E. (eds.). Metapopulation biology: Ecology, genetics, and evolution. Academic Press, San Diego, California.

Harris, J.H. 1991. Effects of Brown-headed Cowbirds on willow flycatcher nesting success along the Kern River, California. Western Birds 22:13–26.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow Flycatcher surveys in the Sierra Nevada. Western Birds 18:27–36.

Hill, G.E. 1988. Age, plumage brightness, territory quality, and reproductive success in the Black-headed Grosbeak. Condor 90:379–388.

Holmes, R.T., P.P. Marra, and T.W. Sherry. 1996. Habitat-specific demography of breeding Black-throated Blue Warblers (*Dendroica caerulescens*): Implications for population dynamics. Journal of Animal Ecology 65:183–195.

Howell, N.G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

Howlett, J.S., and B.J. Stutchbury. 1996. Nest concealment and predation in Hooded Warblers: experimental removal of nest cover. Auk 113:1–9.

James, F.C., and H.H. Shugart, Jr. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

Johnson, K., P. Mahlhop, C. Black, and K. Score. 1999. Reproductive failure of endangered Southwestern Willow Flycatchers on the Rio Grande, New Mexico. The Southwestern Naturalist 44:226–231.

Johnson, M.J., and M.K. Sogge. 1997. Southwestern Willow Flycatcher surveys along portions of the San Juan River, Utah (Montezuma Creek – Mexican Hat and Clay Hills Crossing), 1997. USGS Colorado Plateau Field Station, Flagstaff, Arizona.

Kenwood, K.E., and E.H. Paxton. 2001. Survivorship and movements of Southwestern Willow Flycatchers in Arizona – 2001. U.S. Geological Survey report to the U.S. Bureau of Reclamation, Phoenix, Arizona. 44 pp.

Koronkiewicz, T.J., S.N. Cardinal, M.K. Sogge, and E.H. Paxton. 2002. Survivorship and movements of Southwestern Willow Flycatchers at Roosevelt Lake, Arizona – 2002. Report to the U.S. Bureau of Reclamation, Phoenix, Arizona. USGS Southwest Science Center, Colorado Plateau Field Station, Flagstaff, Arizona. 43 pp.

Koronkiewicz, T.J., M.A. McLeod, B.T. Brown, and S.W. Carothers. 2006a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2005. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 176 pp.

Koronkiewicz, T.J., M.K. Sogge, C. Van Riper III, and E.H. Paxton. 2006b. Territoriality, site fidelity, and survivorship of willow flycatchers wintering in Costa Rica. Condor 108:558–570.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan. Final. December 17. (J&S 00450.00.) Sacramento, California.

Lowther, P.E. 1993. Brown-headed Cowbird (*Molothrus ater*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 47. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Lynn, J.C., T.J. Koronkiewicz, M.J. Whitfield, and M.K. Sogge. 2003. Willow flycatcher winter habitat in El Salvador, Costa Rica, and Panama: characteristics and threats. Pages 41–51 *in* Sogge, M.K., B.E. Kus, S.J. Sferra and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Marshall, R.M., and S.H. Stoleson. 2000. Threats. Pages 13–24 *in* Status, ecology, and conservation of the Southwestern Willow Flycatcher. USDA Forest Service General Technical Report, RMRS-GTR-60.

Martin, T.E., C.R. Paine, C.J. Conway, W.M. Hochachka, P. Allen, and W. Jenkins. 1997. Breeding Biology Research and Monitoring Database (BBIRD) Field Protocol. Montana Cooperative Wildlife Research Unit, University of Montana, Missoula.

Mayfield, H. 1961. Nesting success calculated from exposure. Wilson Bulletin 73(3):255–261.

Mayfield, H. 1975. Suggestions for calculating nest success. Wilson Bulletin 87(4):456–466.

McKernan, R.L. 1997. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 1 – 1996. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada,, [and] the U.S. Fish and Wildlife Service, Carlsbad, California by the San Bernardino County Museum, Redlands, California. 42 pp.

McKernan, R.L., and G. Braden. 1998. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 2 – 1997. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, [and] the U.S. Fish and Wildlife Service, Carlsbad, California, by the San Bernardino County Museum, Redlands, California. 64 pp.

McKernan, R.L., and G. Braden. 1999. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 3 – 1998. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 71 pp.

McKernan, R.L., and G. Braden. 2001a. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the Lower Colorado River: Year 4 – 1999. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 83 pp.

McKernan, R.L., and G. Braden. 2001b. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 5 – 2000. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, and the U.S. Bureau of Land Management, Caliente, Nevada, by the San Bernardino County Museum, Redlands, California. 86 pp.

McKernan, R.L., and G. Braden. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River, Year 6 – 2001. Unpublished report submitted to the U.S. Bureau of Reclamation, Boulder City, Nevada, the U.S. Fish and Wildlife Service, Carlsbad, California, and Reno, Nevada, by San Bernardino County Museum, Redlands, California. 58 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2009. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2008. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 153 pp.

McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 165 pp.

McLeod, M.A., and A.R. Pellegrini. 2011. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2010. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 166 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2007. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2006. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 194 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, W.J. Langeberg, and S.W. Carothers. 2008a. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2003–2007. Five-year summary report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 206 pp.

McLeod, M.A., T.J. Koronkiewicz, S.R. Nichols, B.T. Brown, and S.W. Carothers. 2008b. Southwestern Willow Flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries, 2007. Annual report submitted to U.S. Bureau of Reclamation, Boulder City, Nevada, by SWCA Environmental Consultants, Flagstaff, Arizona. 182 pp.

Moore, D., and D. Ahlers. 2008. 2007 Southwestern Willow Flycatcher study results: selected sites along the Rio Grande from Velarde to Elephant Butte Reservoir, New Mexico. Report prepared by Bureau of Reclamation, Technical Service Center, Denver, Colorado. 64 pp.

Munzer, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. Arizona Game and Fish Department, Phoenix, Arizona.

National Weather Service. 2011. Online: http://aa.usno.navy.mil/data/docs/RS_OneYear.html.

Paxton, E., S. Langridge, and M.K. Sogge. 1997. Banding and population genetics of Southwestern Willow Flycatchers in Arizona - 1997 Summary Report. USGS Colorado Plateau Research Station / Northern Arizona University report. 63 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in Central Arizona – a 10-year synthesis report. USGS Open-File Report 2007-1381.

Paxton, E.H., M.K. Sogge, T.J. Koronkiewicz, M.A. McLeod, and T.C. Theimer. 2010. Geographic variation in the plumage coloration of willow flycatchers *Empidonax traillii*. Journal of Avian Biology 41:128–138.

Periman, R.D., and J.F. Kelly. 2000. The dynamic environmental history of Southwest Willow Flycatcher habitat: A survey of changing riparian conditions through time. Pages 25–42 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson. 212 pp.

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. Handbook of field methods for monitoring landbirds. General Technical Report PSW-GTR-144. U.S. Forest Service Pacific Southwest Research Station, Albany, California. 41 pp.

Ridgely, R.S., and G. Tudor. 1994. The birds of South America; Volume II: the Suboscine passerines. University of Texas Press, Austin.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in Illinois. Pages 408–418. *In* J.M. Hagan III and D.W. Johnston (eds.). Ecology and Conservation of Neotropical migrant landbirds. Smithsonian Institution Press, Washington D.C.

Rosenberg, K.V., R. C. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson.

Rotenberry, J.T. 1985. The role of habitat in avian community composition: Physiognomy or floristics? Oecologia 67:213–217.

Rourke, J.W., T.D. McCarthey, R.F. Davidson, and A.M. Santaniello. 1999. Southwestern Willow Flycatcher nest monitoring protocol. Nongame and Endangered Wildlife Program Technical Report No. 144. Arizona Game and Fish Department, Phoenix.

SAS Institute Inc. 2009. SAS OnlineDoc®, Version 9.2. Cary, North Carolina.

Sedgwick, J.A. 2000. Willow flycatcher (*Empidonax traillii*). *In* Poole, A., and F. Gill (eds.). The birds of North America, No. 533. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Sedgwick, J.A., and W.M. Iko. 1999. Costs of Brown-headed Cowbird parasitism to willow flycatchers. Pages 167–181 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.).Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Sedgwick, J.A., and F.L. Knopf. 1992. Describing willow flycatcher habitats: scale perspectives and gender differences. The Condor 94:720–733.

Sogge, M.K., and R.M. Marshall. 2000. A survey of current breeding habitats. Pages 43–56 *in* Finch, D.M., and S.H. Stoleson (eds.). Status, ecology, and conservation of the Southwestern Willow Flycatcher. General Technical Report, RMRS-GTR-60. U.S. Forest Service, Rocky Mountain Research Station, Ogden, Utah. 131 pages.

Sogge, M.K., R.M. Marshall, S.J. Sferra, and T.J. Tibbits. 1997. A Southwestern Willow Flycatcher natural history summary and survey protocol. National Park Service Technical Report USGS/NAUCPRS/NRTR-97/12.

Sogge, M.K., J.C. Owen, E.H. Paxton, S.M. Langridge, and T.J. Koronkiewicz. 2001. A targeted mist net capture technique for the willow flycatcher. Western Birds 32:167–172.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher. U.S. Geological Survey Techniques and Methods 2A-10. 38 pp.

Stiles, F.G., and A.F. Skutch. 1989. A guide to the birds of Costa Rica. Cornell University Press, New York.

Sumner, M.E. 2000. Handbook of soil science. CRC Press, Boca Raton, Florida.

U.S. Bureau of Reclamation (Reclamation). 1999. Long-term restoration program for the historical Southwestern Willow Flycatcher (*Empidonax traillii extimus*) habitat along the lower Colorado River. Report submitted by USBR Lower Colorado Region to Lower Colorado Multi-Species Conservation Program. Boulder City, Nevada. 70 pp.

U.S. Bureau of Reclamation (Reclamation). 2000. Biological Assessment for proposed Interim Surplus Criteria, Secretarial Implementation Agreements for California Water Plan components and conservation measures on the Lower Colorado River (Lake Mead to the Southerly International Boundary). Prepared by U.S. Bureau of Reclamation, Lower Colorado Region. 80 pp.

U.S. Fish and Wildlife Service (USFWS). 1995. Final rule determining endangered status for the Southwestern Willow Flycatcher. Federal Register 60:10694–10715.

U.S. Fish and Wildlife Service (USFWS). 2000. Southwestern willow flycatcher protocol revision 2000. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service (USFWS). 2001. Biological opinion for Interim Surplus Criteria, Secretarial Implementation Agreements, and Conservation Measures on the Lower Colorado River, Lake Mead to the Southerly International Boundary, Arizona, California, and Nevada. Final Biological Opinion, U.S. Fish and Wildlife Service, Phoenix, Arizona. 90 pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Final recovery plan Southwestern Willow Flycatcher (*Empidonax trailli extimus*). Prepared by Southwestern Willow Flycatcher Recovery Team Technical Subgroup, August 2002.

Unitt, P. 1987. *Empidonax traillii extimus*: an endangered subspecies. Western Birds 18:137–162.

Unitt, P. 1997. Winter range of *Empidonax traillii extimus* as documented by existing museum collections. San Diego Natural History Museum report to U.S. Bureau of Reclamation, Phoenix, Arizona.

White, G.S., and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46 (supplement):S120–139.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to Brown-headed Cowbird parasitism. M.S. Thesis, California State University, Chico. 25 pp.

Whitfield, M.J., and M.K. Sogge. 1999. Range-wide impact of Brown-headed Cowbird parasitism on the Southwestern Willow Flycatcher (*Empidonax traillii extimus*). Pages 182–190 *in* Morrison, M.L., L.S. Hall, S.K. Robinson, S.I. Rothstein, D.C. Hahn, and T.D. Rich (eds.). Research and management of the Brown-headed Cowbird in western landscapes. Studies in Avian Biology No. 18. Cooper Ornithological Society.

Whitfield, M.J., M.K. Sogge, S.J. Sferra, and B.E. Kus. 2003. Ecology and behavior —Introduction. Pages 53–55 *in* Sogge, M.K., B.E. Kus, S.J. Sferra, and M.J. Whitfield (eds.). Ecology and conservation of the willow flycatcher. Studies in Avian Biology No. 26. Cooper Ornithological Society.

Wiens, J.A. 1989a. The ecology of bird communities. Volume 1: Foundations and patterns. Cambridge University Press, New York.

Wiens, J.A. 1989b. The ecology of bird communities. Volume 2: Processes and variations. Cambridge University Press, New York.

Woodward, H.D., and S.H. Stoleson. 2002. Brown-headed Cowbird attacks on Southwestern Willow Flycatcher nestlings. The Southwestern Naturalist 47(4):626–628.

Yong, W., and D.M. Finch. 1997. Migration of the willow flycatcher along the Middle Rio Grande. Wilson Bulletin 109:253–268.

Younker, G.L., and C.W. Andersen. 1986. Mapping methods and vegetation changes along the lower Colorado River between Davis Dam and the border with Mexico. Report submitted to Bureau of Reclamation, Lower Colorado Region, in fulfillment of Contract No. 6-CS-30-03800. 22 pp.

Acknowledgements

This project was made possible by the support of many persons, agencies, private landowners, and our dedicated staff and field crew. Work was conducted under the auspices of Federal Fish and Wildlife Threatened and Endangered Species Permit TE028605-4 and Master Banding Permit #23258. Funding was provided by the U.S. Bureau of Reclamation, Boulder City, Nevada (Contract No. GS-10F-0209L) and the Nevada Department of Wildlife, Reno, Nevada. Chris Dodge from Reclamation provided background information and guidance.

Many thanks to the following national wildlife refuges and personnel for all their assistance: Kevin DesRoberts, Chivia Horton, Laurie Simons, and Jim Doctor at Pahranagat NWR; Linda Miller, Jack Allen, Dr. Kathleen Blair, Dick Gilbert, and Stan Culling at the Lake Havasu NWR Complex; and Mike Oldham, Elaine Johnson, Brenda Zaun, Bill Seese, Joe Barnett, and Steven Rimer at the SW Arizona NWR Complex. Thanks to Keith Day and Rob Dobbs with the Utah Division of Wildlife Resources for their support in St. George. Also, we would like to thank Cris Tomlinson, Christy Klinger, and Tim Wood with Nevada Department of Wildlife for their support at Key Pittman Wildlife Management Area, River Ranch, Warm Springs Natural Area, and Overton Wildlife Management Area. Thanks to Dave Syzdek with Southern Nevada Water Authority for logistical support and site tours at Warm Springs Natural Area.

Thanks to the following agencies and personnel for assistance with obtaining permits: Greg Beatty, Erin McCarthy, Daniel Marquez, Melissa Castiano, Vanessa Martinez, Leilani Takano, and Corey Kallstrom with the U.S. Fish and Wildlife Service; Florence L. Soehnlein and Danny Bystrak with the Federal Bird Banding Laboratory; Melissa Swain with the Arizona Game and Fish Department; Gloria Shaw with Lake Mead National Recreation Area; Randi Logsdon, and Esther Burkett with the California Department of Fish and Game; Cris Tomlinson and Julie Meadows with the Nevada Department of Wildlife; Suzanne McMullin with the Utah Division of Wildlife Resources; Tom Denniston with the Bureau of Land Management, St. George; and Bill Dowdle with the Arizona State Lands Department. Robert Bunker, Bill Evans, and Gary Hafen granted access to their properties.

Thanks to Johnny, Mike, and Kathy at Monte Vista Marine for assisting with boating logistics. Mike Rose assisted with ATV logistics.

This project would not be a success without our dedicated staff and field personnel. Many, many thanks to Jessica Maggio and Kimberly Proa who went beyond their administrative duties and coordinated housing, permitting, payroll, vehicles, computers, safety, and telecommunications and handled all manner of crises with cheerful aplomb. A very special thanks to Glenn Dunno for his GIS talents. Thanks also to Shara Monik, Lisa Jackson, and Rose Burgess for administrative and accounting support. And sincere thanks to the 2011 field personnel for hard work, dedication, and sweat.

Appendix A

FIELD DATA FORMS

Willow Flycatcher (WIFL) Survey and Detection Form (revised April 2010)

Site Name_____ State_____ County _____
USGS Quad Name _____ Elevation _____ (meters)
Creek, River, Wetland, or Lake Name_____
Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? Yes___ No____

Survey Coordinates: Start: E_____ N_____ UTM Datum_____(See instructions)
Stop: E_____ N_____ UTM Zone _____
If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

***** Fill in additional site information on back of this page *****

Survey # / Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N / If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s)	Date Start Stop Total hrs ___						# Birds	Sex	UTM E	UTM N
Overall Site Summary Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total Survey Hrs		Total Adult Residents	Total Pairs	Total Territories	Total Nests	Were any Willow Flycatchers color-banded? Yes___ No ___ If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual _____ Date Report Completed_____ _____
US Fish and Wildlife Service Permit #_____ State Wildlife Agency Permit #_____

Submit form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual _____ Phone # _____
Affiliation _____ E-mail _____
Site Name _____ Date Report Completed _____
Was this site surveyed in a previous year? Yes___ No ___ Unknown ____
Did you verify that this site name is consistent with that used in previous years? Yes ____ No _____ Not Applicable ___
If site name is different, what name(s) was used in the past? _____
If site was surveyed last year, did you survey the same general area this year? Yes ____ No ____ If no, summarize below.
Did you survey the same general area during each visit to this site this year? Yes ____ No ____ If no, summarize below.

Management Authority for Survey Area: Federal____ Municipal/County ____ State ____ Tribal ____ Private ____
Name of Management Entity or Owner (e.g., Tonto National Forest) _____

Length of area surveyed: _____ (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

_____ Native broadleaf plants (entirely or almost entirely, > 90% native)

_____ Mixed native and exotic plants (mostly native, 50 - 90% native)

_____ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

_____ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific names.
_____

Average height of canopy (Do not include a range): _____ (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections; 2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests; 3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.
_____
_____
_____
_____
_____
_____

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

SWFL General Site Description

[Complete at least 3 times during season: early (10–25 May), mid-season (10–25 June), and late season (10–25 July)]

General Info

Study Area: _____ **Survey Site:** _____ **Date:** _____

Observer(s): _____ **early**____ **mid**____ **late**____ **other**____

Vegetation

Vegetation at site: >90% native 50–90% native 50–90% exotic >90% exotic

Canopy closure: <25% 25–50% 50–70% 70–90% >90%

Overstory height (m): _____ **Dominant overstory species:** TASP SAGO SAEX POFR Other _____

Understory height (m): _____ **Dominant understory species:** TASP SAGO SAEX PLSE Other _____

Other vegetation types present (e.g., cattail)? Yes No

If yes, type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____
type of vegetation: _____ **percentage of site:**_____

Hydrology

% of site inundated: _____

Describe type of surface water (e.g., open marsh, surface water within woody vegetation, stream, etc):

_____

Average depth of surface water:
toes (<5cm) ankles (5-15 cm) calves (15-40 cm) knees (40-60 cm)
thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)

% of site with saturated soils (do not include inundated areas in percentage!): _____

% of site with damp soils (do not include inundated or saturated areas): _____

If not inundated or saturated, distance (m) to standing water or saturated soil:_____

How was distance determined? Visually estimated in field Measured in field using GPS
Measured from aerial photograph Other _____

Describe type of nearest surface water: _____

Narrative and Pictorial Description

Does this description cover the entire site? Y N **If not, which portion is described?**_____
_____

On the reverse, sketch and label the locations of the major vegetation types you observed. Delineate marshes, open areas, and other habitat that may be unsuitable for flycatchers. If water was present, show its location.

Give a narrative description of the site, including adjacent habitats:

_____
_____
_____
_____
_____
_____
_____
_____

Additional comments:_____
_____
_____

STUDY AREA:_____ SITE:_____ BANDER:_____ DATE:_____ TIME:_____ TERR/NEST #:_____

UTM NAD___ Zone___ _____E _____N NBN:___ of ___

NOTES:_____

FEDERAL BAND #	COLOR COMBO L	COLOR COMBO R	STATUS	SEX	AGE	FECAL SAMPLE? (Y or N)	GENETIC SAMPLE? (Y or N)	# PHOTOS TAKEN

STATUS: NCP = new cap passive, NCT = new cap target, RCP = recap passive; RCT = recap target, NBN = nestling banded
SEX: U = unknown, F = female, M = male
AGE: AHY = after hatch year; SY = second year; L = nestling banded in nest; HY = hatch year/young of the year

Adults

CP	BP	WING CHORD (mm)	TAIL (mm)	CULMEN LENGTH (mm)	CULMEN WIDTH (mm)	FAT	RETAINED FEATHERS? Y or N, if Y use diagram, detail in notes	ACTIVE MOLT?

Nestlings

Developmental Age (days)	MASS (g)

CP: 0 = non-breeding, S = partial breeding, M = full breeding
BP: 0 = none, 1 = smooth, 2 = vascularized and filled with fluid, 3 = wrinkled, 4 = molting
FAT: 0 = no fat; 1 = trace of fat in furculum, deeply concave, scattered patches, less than 5 percent filled; 2 = thin layer of fat in furculum, less than a third filled, trace of thin layer of fat in abdomen; 3 = furculum is ½ filled or more; small patches, not covering some areas, on abdomen; 4 = furculum more than 2/3 filled, level with clavicles, slightly mounded on abdomen

If a genetic sample or metric was not taken, explain why in notes

BODY MOLT
(CIRCLE AREA OF MOLT, AND USE 1, 2, OR 3 TO DESIGNATE DEGREE OF MOLT)
1=LIGHT 2=MODERATE 3=HEAVY

Date: Page ___ of ___

OBS	STUDY AREA	TERR	NEST	COLOR COMBO LEFT LEG	COLOR COMBO RIGHT LEG	CONF LEVL	CAP?	# WIFLS	SEX	NBN (__of__)	OBSERVATIONS AND COMMENTS: discuss observations & activities. **If you assign gender, explain!**
											Service Band Number -
											Service Band Number =
											Service Band Number -
											Service Band Number -
											Service Band Number -
											Service Band Number -
											Service Band Number
											Service Band Number
											Service Band Number
											Service Band Number -
											Service Band Number -
											Service Band Number -
											Service Band Number -
											Service Band Number -

Willow Flycatcher Territory/Nest Record Form

Year _____ Study Area_____ Survey Site_____ Territory/Nest no._____

Territory/Nest Location:
NAD:_____ Zone:_____

Territory UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest UTMs:
Easting:_____
Northing:_____
GPS Accuracy: _____m

Nest Height:_____ m (approx) Nest Substrate:_____(e.g., TASP tamarisk, SAGO–Goodding willow, SAEX – coyote willow, etc.)

Distance to standing water or saturated soil.
When nest found: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____
Depth of surface water at nest (circle how wet you got when nest was found):
dry damp muddy toes (<5cm) ankles (5-15 cm) calves (15-40 cm)
knees (40-60 cm) thighs (60-80 cm) waist (100 cm) too deep to wade (>100 cm)
At hatch: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____
At fledge/fail: _____(m) Date _____ How determined? _____
UTME_____ UTMN_____ Accuracy _____

PLEASE DO NOT FILL OUT ANYTHING BELOW

Bird 1: Color band combination:_____ **Band Number:**_____ Female

Bird 2: Color band combination:_____ **Band Number:**_____ Male

Willow Flycatcher

Trans dates	B D (T/F)	
		Found
		First egg
		Clutch completion
		Hatching
		Fledged or Failed

Willow Flycatcher

No.	Presumed	Confirmed	
			Eggs
			Nestlings
			Fledglings

Cowbird

Trans dates	B D (T/F)	
		First egg
		Hatching
		Fledged

Cowbird

No.	Complete? (T/F)	
		Eggs
		Nestlings
		Fledgling

Outcome (Record code & describe):_____:

_____

_____

_____

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **PA**= parasitized, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **AD**= failure, entire clutch addled/infertile; **OT**= failure due to other, or unknown, causes.

Mayfield Success

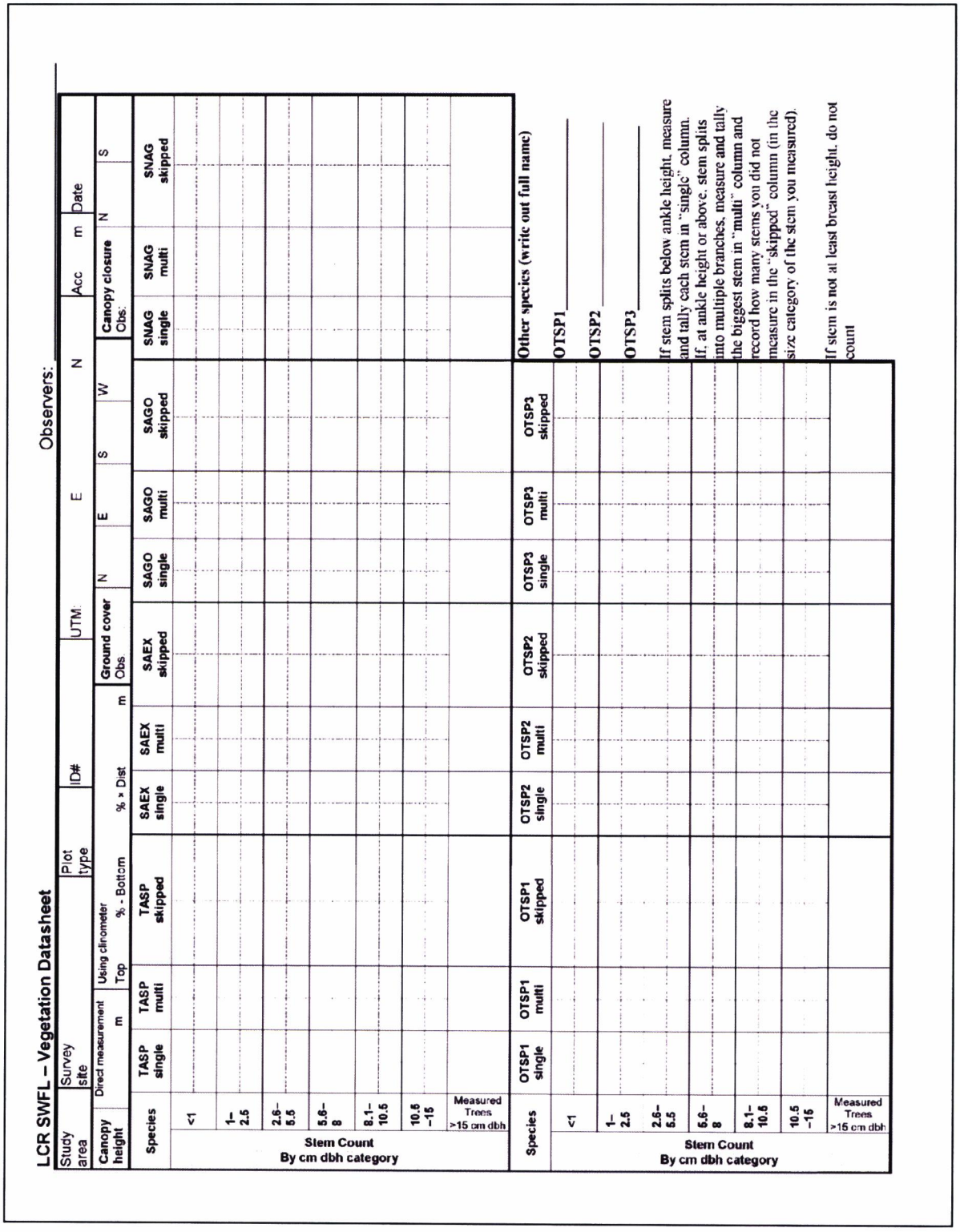
(WIFL) Period	# Exposure days	Success
Egg Laying		
Incubation		
Nestling		

Mayfield success codes: **S**= successful; **D**= depredated; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other than predation; **A**= abandoned with host egg(s) or young, **Z**= abandoned, no (zero) eggs laid.

Willow Flycatcher Territory/Nest Record Form (continued)

Study Area:_____ Survey Site:_____ Territory/Nest no.:_____

Date	Time In	Time Out	Obs	Mon Type	Stage	Adult pres.	# WI:	# CE	# WN	# CN	#WI	Age Yng	Comments



LCR SWFL – Vegetation Datasheet

Observers: _____

Study area	Survey site	Plot type	ID#	UTM:	E		N		Acc m	Date

Canopy height	Direct measurement m	Using clinometer Top	% - Bottom	% > Dist	m	Ground cover Obs:	N	E	S	W	N	Canopy closure Obs:	N	S

Species	TASP single	TASP multi	TASP skipped	SAEX single	SAEX multi	SAEX skipped	SAGO single	SAGO multi	SAGO skipped	SNAG single	SNAG multi	SNAG skipped
Stem Count By cm dbh category												
<1												
1–2.5												
2.6–5.5												
5.6–8												
8.1–10.5												
10.5–15												
Measured Trees >15 cm dbh												

Species	OTSP1 single	OTSP1 multi	OTSP1 skipped	OTSP2 single	OTSP2 multi	OTSP2 skipped	OTSP3 single	OTSP3 multi	OTSP3 skipped
Stem Count By cm dbh category									
<1									
1–2.5									
2.6–5.5									
6.6–8									
8.1–10.5									
10.5–15									
Measured Trees >15 cm dbh									

Other species (write out full name)

OTSP1_____

OTSP2_____

OTSP3_____

If stem splits below ankle height, measure and tally each stem in "single" column.

If, at ankle height or above, stem splits into multiple branches, measure and tally the biggest stem in "multi" column and record how many stems you did not measure in the "skipped" column (in the size category of the stem you measured).

If stem is not at least breast height, do not count

Vertical Foliage Sampling

	CENTER PLOT Observer: _____						
Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1*: _____	OTSP2*: _____	OTSP3*: _____
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10-cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
***Use same OTSP (1,2,3) as listed on main record.**

Notes:

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 1m Observer: _____ EAST 1m Observer: _____

Height (m)	Hits/Species							Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 1

Vertical Foliage Sampling

SOUTH 1m Observer: _____

Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

WEST 1m Observer: _____

Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.

*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

Vertical Foliage Sampling

Study Area:	Survey Site:	Plot type:	ID#	Date:

NORTH 5m Observer: _____ EAST 5m Observer: _____

Height (m)	Hits/Species						Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3		TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
10								10							
11								11							
12								12							
13								13							
14								14							
15								15							
16								16							
17								17							
18								18							
19								19							
20								20							
21								21							
22								22							
23								23							
24								24							
25								25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 1

Vertical Foliage Sampling

SOUTH 5m Observer: _____

Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

WEST 5m Observer: _____

Height (m)	Hits/Species						
	TASP	SAGO	SAEX	SNAG	OTSP1	OTSP2	OTSP3
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Record number of decimeters with hits on pole (within 10 cm radius) per 1-m interval up to 8 m; above 8 m, estimate 0, < 5, or > 5 or hits per meter interval.
*Use same OTSP (1,2,3) as listed on main record.

SIDE 2

SWFL Microclimate at Occupied Territories

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Year) – (Territory #)

UTM coordinates: E 0_ _ _ _ _ _ _ **N** _ _ _ _ _ _ _ _ **GPS Accuracy**: _____ m

Date territory first occupied: _____ **Date territory vacated** _____

New Location ID (if this logger was already in the field) _____–_____–_____

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____

Column 1: _____ Column 2: _____ Column 3:_____ Column 4:_____ Column 5: _____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Date: _____ Obs: _____ Date: _____ Obs: _____ Date: _____ Obs: _____

Habitat Monitoring Sites

Study Area _____ **Survey Site** _____ **LOCATION ID** _____–_____–_____
(Study area) – (Survey site) – (Number)

UTM coordinates: E 0__ __ __ __ __ __ **N** __ __ __ __ __ __ __ **Accuracy**: _____ m

T/RH Downloads

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Date:_____ Time:_____ Observer(s):_____ Was red LED blinking at download? Y or N

Logger 6-digit serial number (e.g., #630863):_____ Did you check red LED after (re)launch? Y or N

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Soil moisture data collected on the following dates (enter SM data directly into database):

Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____
Date: _____ Obs: _____	Date: _____ Obs: _____	Date: _____ Obs: _____

Location ID codes: Study area codes – Topock Marsh = TM, Topock Gorge = TG, Ehrenberg = EH, Cibola = CI, Imperial = IM, Mittry = MI, Yuma = YU. Survey site codes – In Between = IB, Blankenship = BK, Havasu NE = HV, Ehrenberg = EH, Three Fingers Lake = TF, Cibola Lake = CL, Walker Lake = WL, Paradise = PV, Hoge Ranch = HR, Rattlesnake = RS, Clear Lake = LK, Ferguson Lake = FL, Ferguson Wash = FW, Great Blue Heron = GB, Mittry West = MW, Gila Confluence North = GC

Microclimate at Hydro Monitoring Sites – Topock

Study Area _TOPO___ Survey Site _____ LOCATION ID: TM –HM–_____
(Location ID)

UTM coordinates: E 0_ _ _ _ _ _ _ N _ _ _ _ _ _ _ _ GPS Accuracy: _____ m

Temperature/Relative Humidity (T/RH)

Set-up: Date:_____ Time:_____ Observer(s)_____

Logger 6-digit serial number (e.g., #630863):_____ Was red LED checked at set-up? Y or N

What randomization sequence was used? Sequence #: _____
Column 1: _____ Column 2: _____ Column 3:_____

Est. actual height of logger _____ m

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Download: Date:_____ Time:_____ Observer(s):_____

Was red LED blinking at download? Y or N Did you check red LED after (re)launch? Y or N

Logger 6-digit serial number (do NOT copy from above; read the number on the logger!):_____

Did any events occur that might have interfered with accuracy of data gathered by this logger (e.g., blown out of tree, etc.)?
No Yes If yes, explain:

Was logger downloaded on-site? Y or N If N, date and time of download: Date: _____ Time: _____

Did you replace the existing logger? Y or N If Y, serial number of new logger: _____

Comments:

Soil Moisture (SM)

Date **soil sample** collected:_____

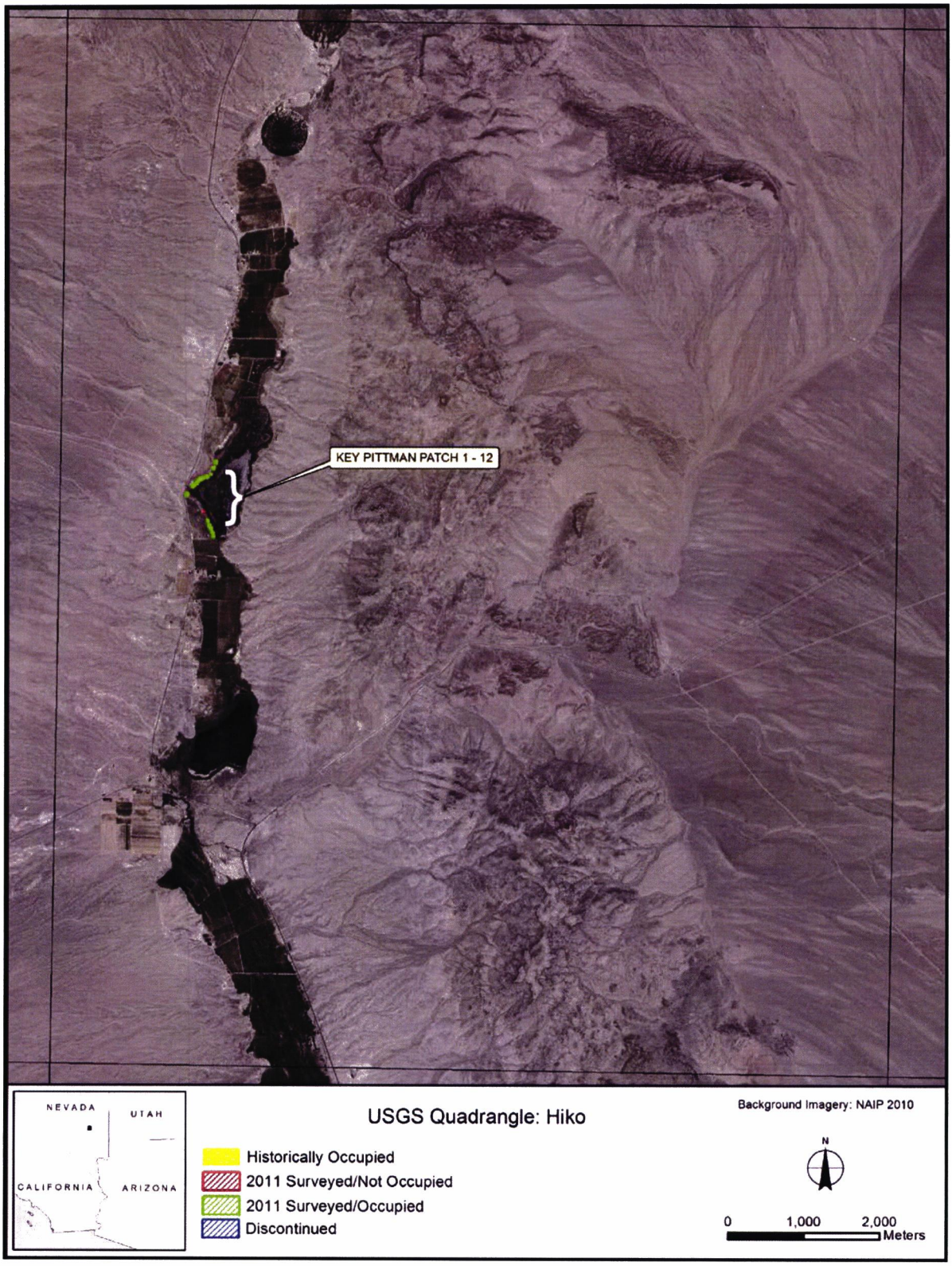
Soil moisture data collected on the following dates (enter SM data directly into database):

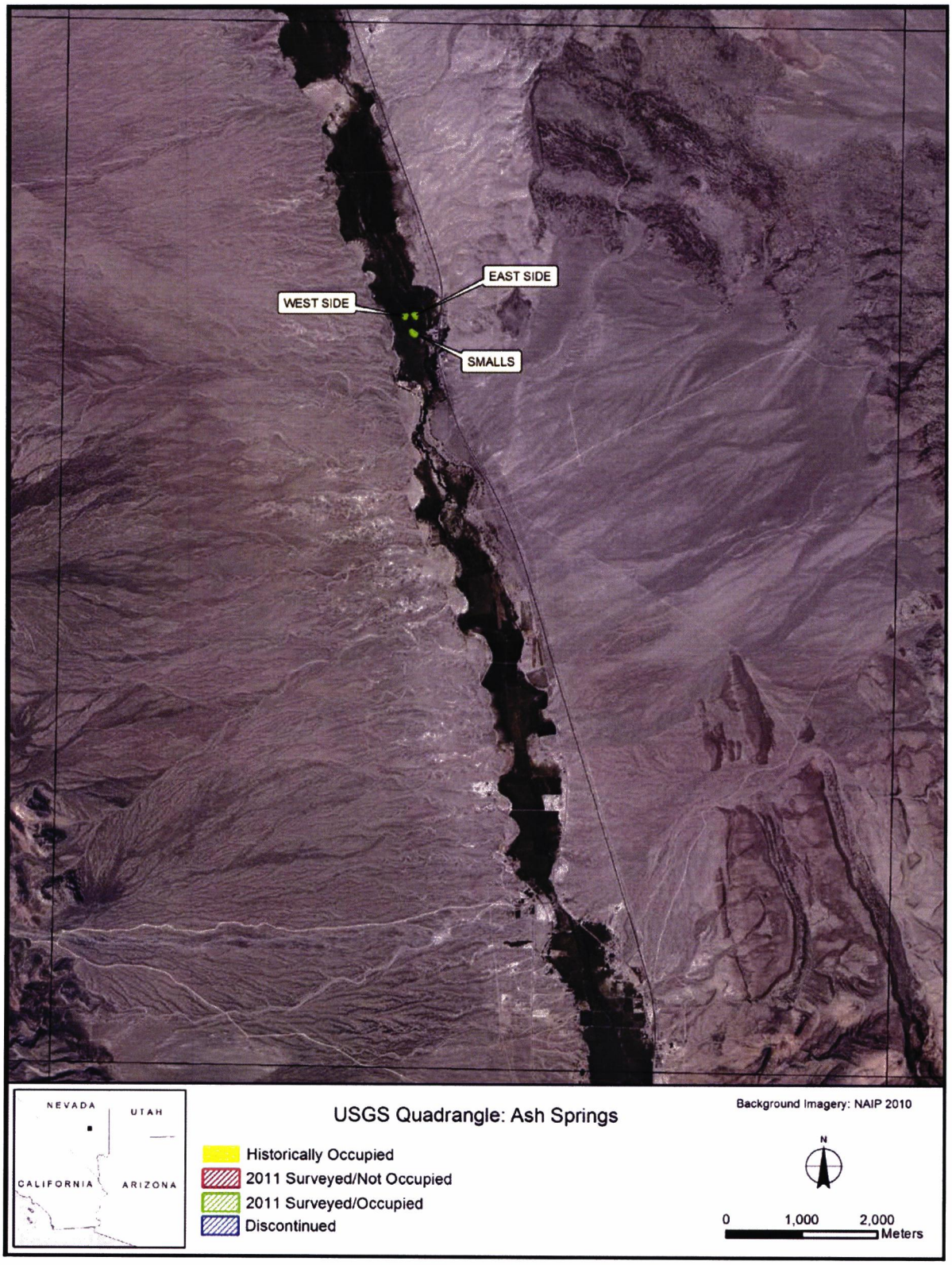
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____
Date: _____	Obs: _____	Date: _____	Obs: _____	Date: _____	Obs: _____

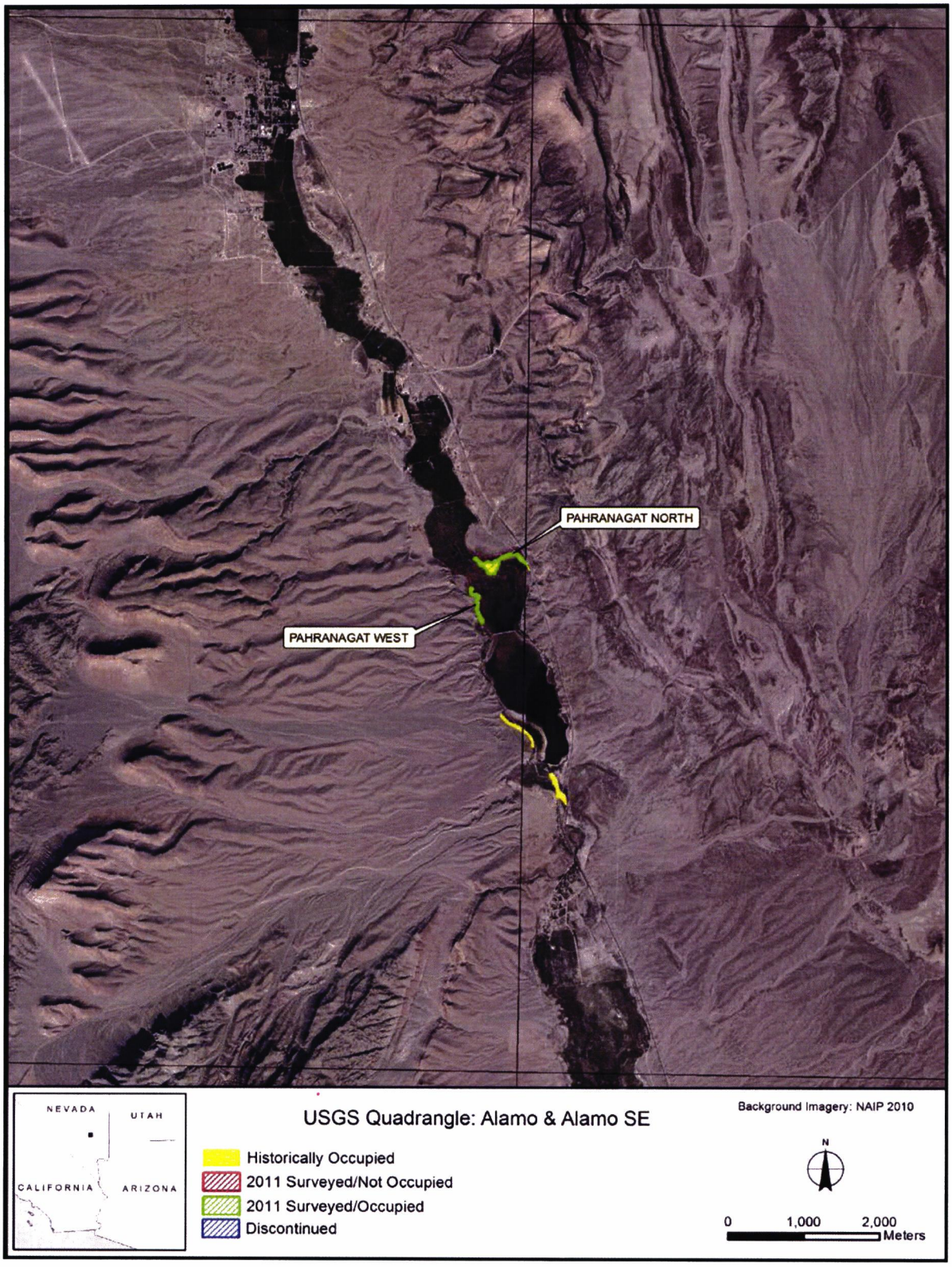
Appendix B

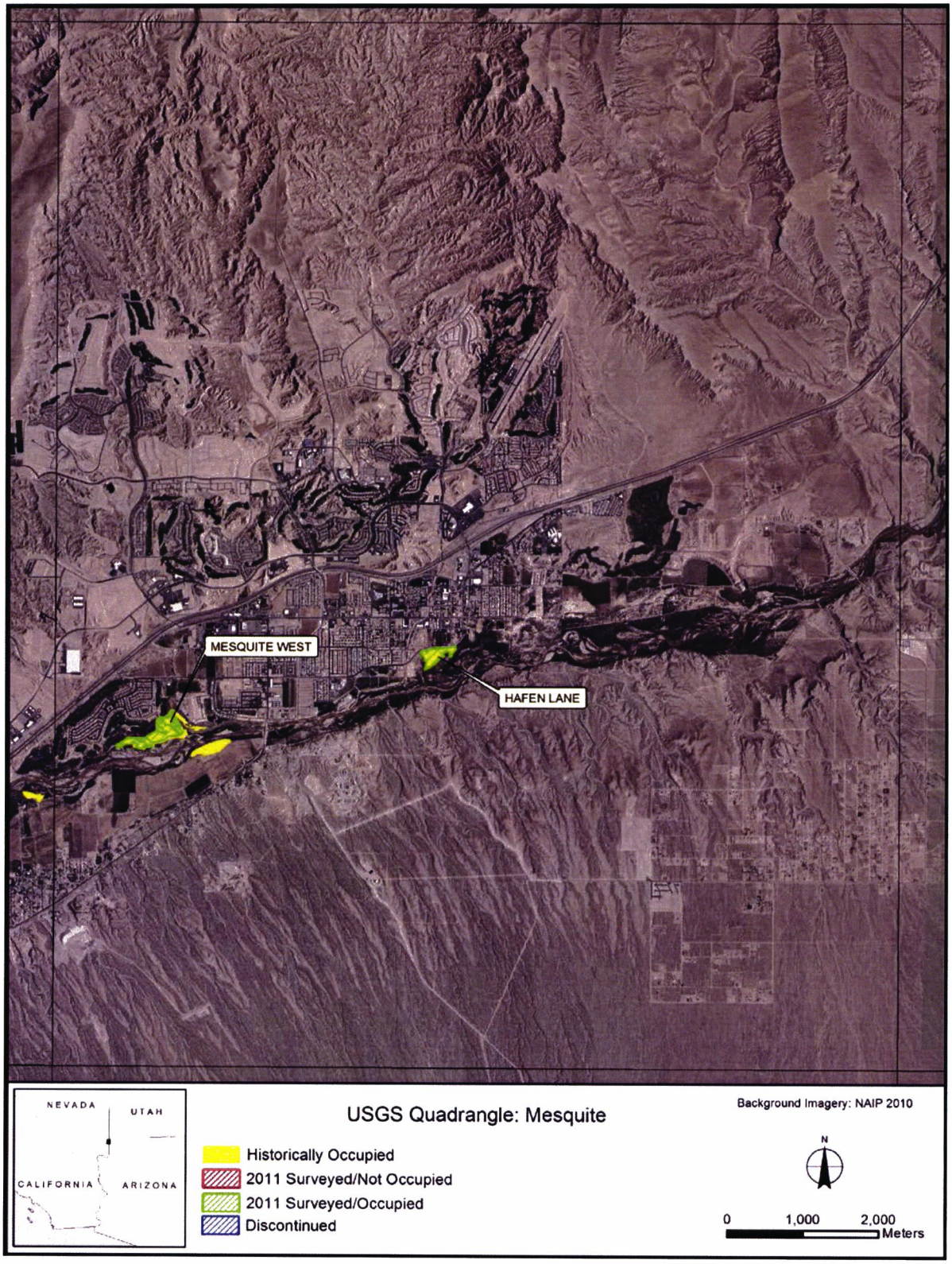
ORTHOPHOTOS SHOWING STUDY SITES

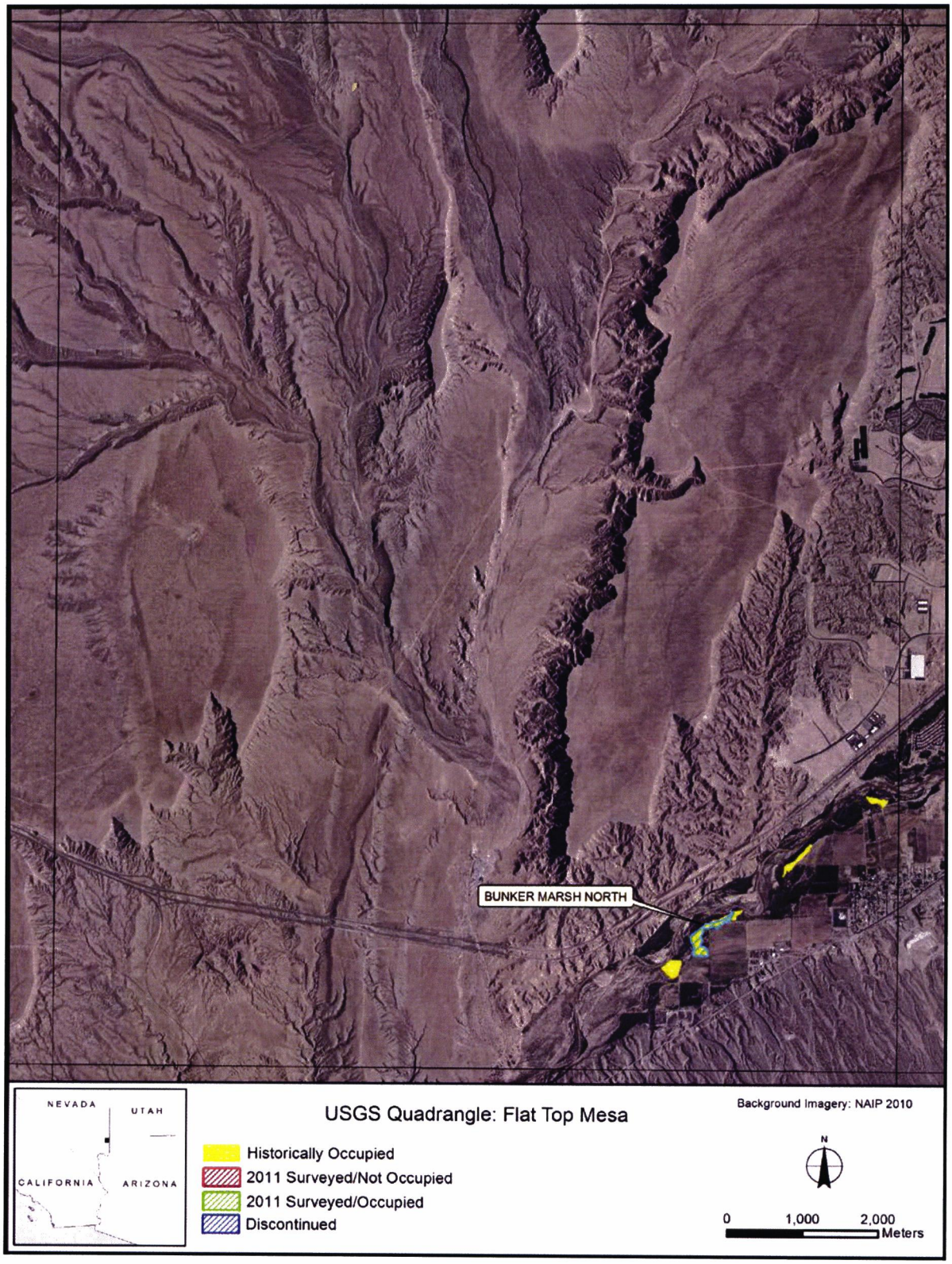

NEVADA
UTAH
CALIFORNIA
ARIZONA
MEXICO
KEY PITTMAN
RIVER RANCH
PAHRANAGAT NWR
WARM SPRINGS
MESQUITE
MORMON MESA
MUDDY RIVER
TOPOCK MARSH
BILL WILLIAMS RIVER NWR
PVER
CIBOLA
IMPERIAL
MITTRY LAKE
YUMA
St. George
Las Vegas
Kingman
Flagstaff
Quartzsite
Phoenix
Palm Springs
Yuma
Lake Mead
Lake Mohave
Lake Havasu
Salton Sea
Pahranagat Wash
Virgin River
Colorado River
Bill Williams River
Gila River
Verde River
Lower Colorado River Southwestern
Willow Flycatcher Study 2011
NDOW Study Area
Reclamation Study Area
City/Town
Highway
River
N
0 25 50 Mi
0 50 100 Km
1:3,300,000

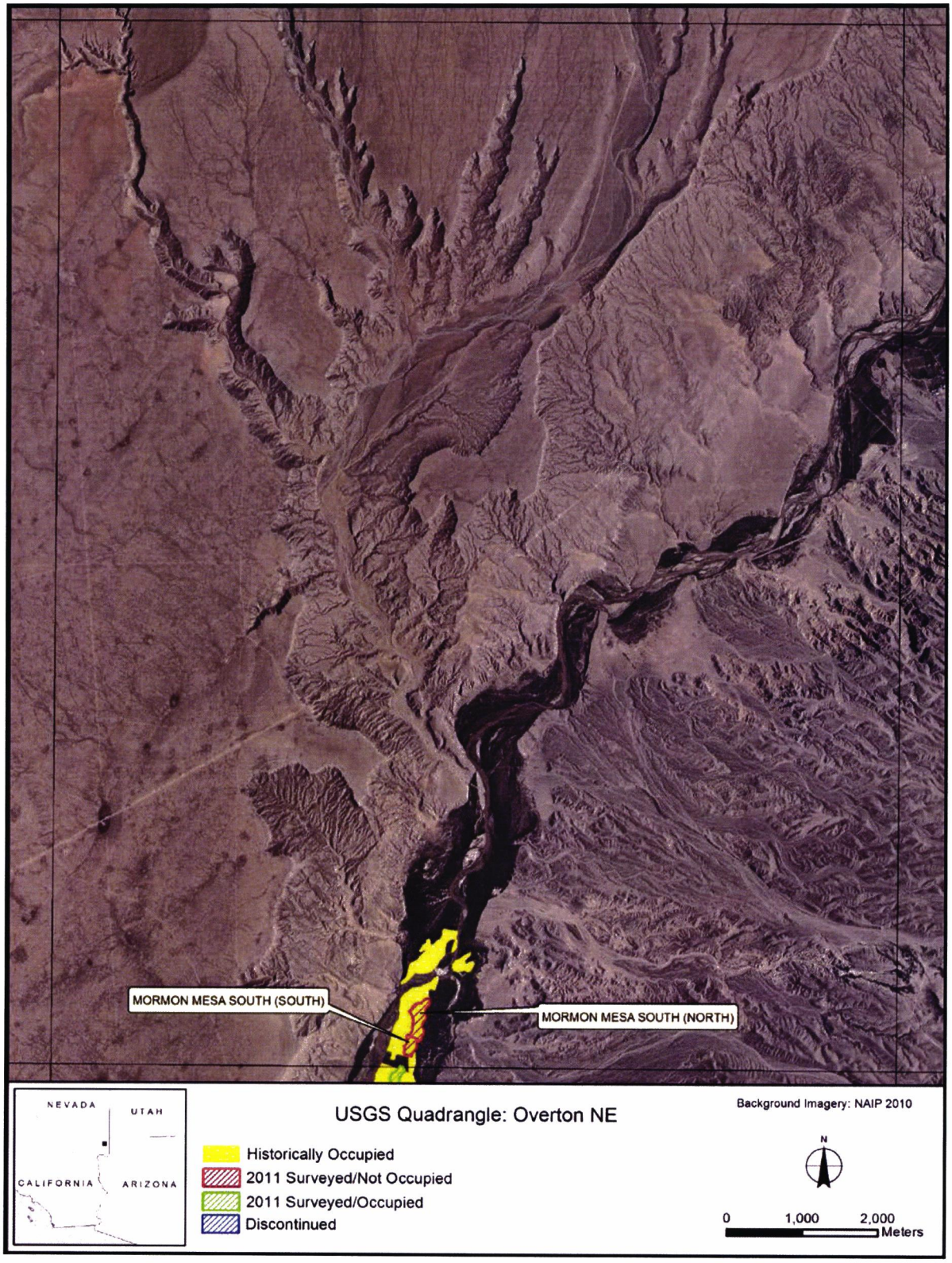

KEY PITTMAN PATCH 1 - 12
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Hiko
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

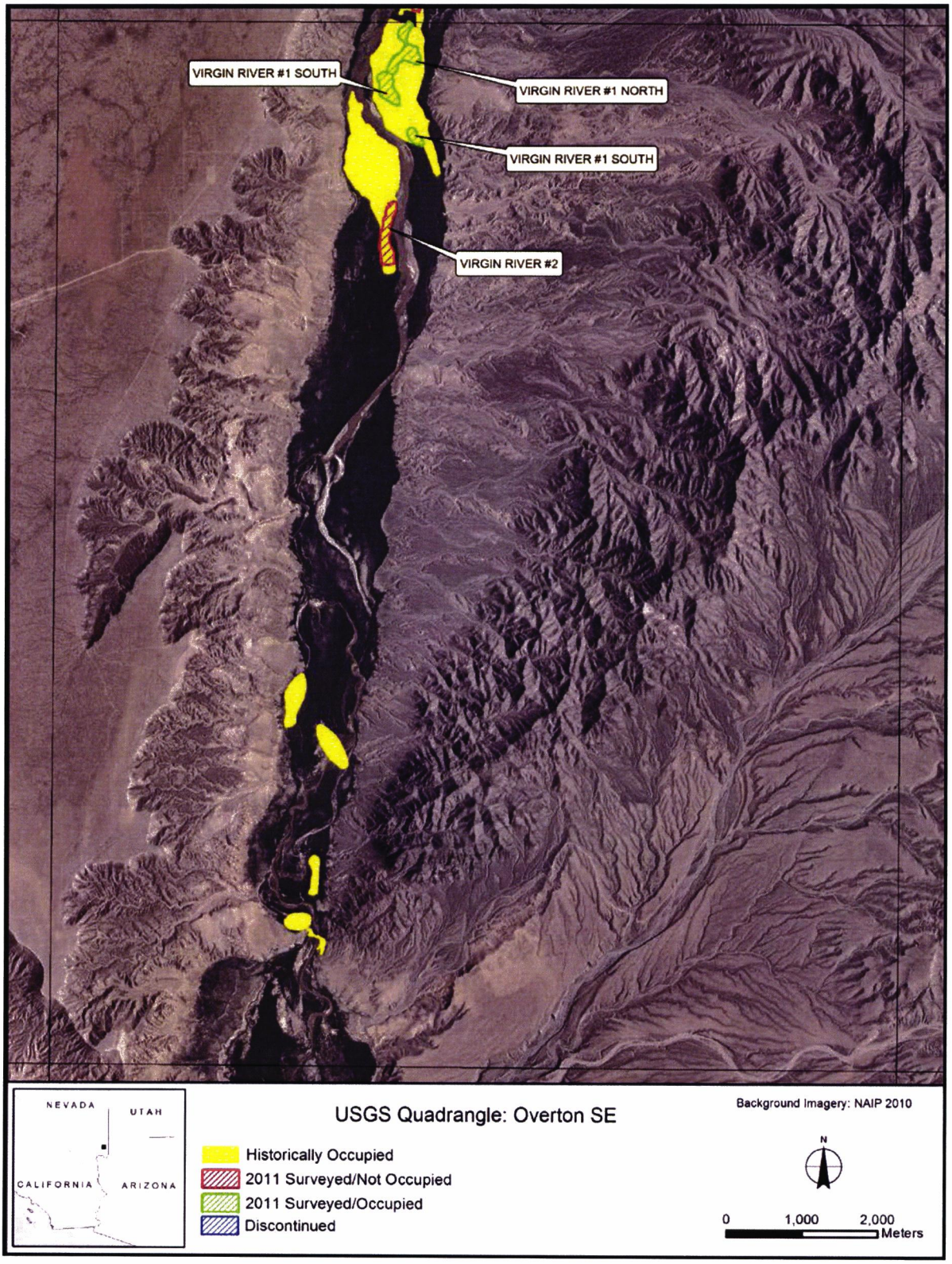

EAST SIDE
WEST SIDE
SMALLS
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Ash Springs
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

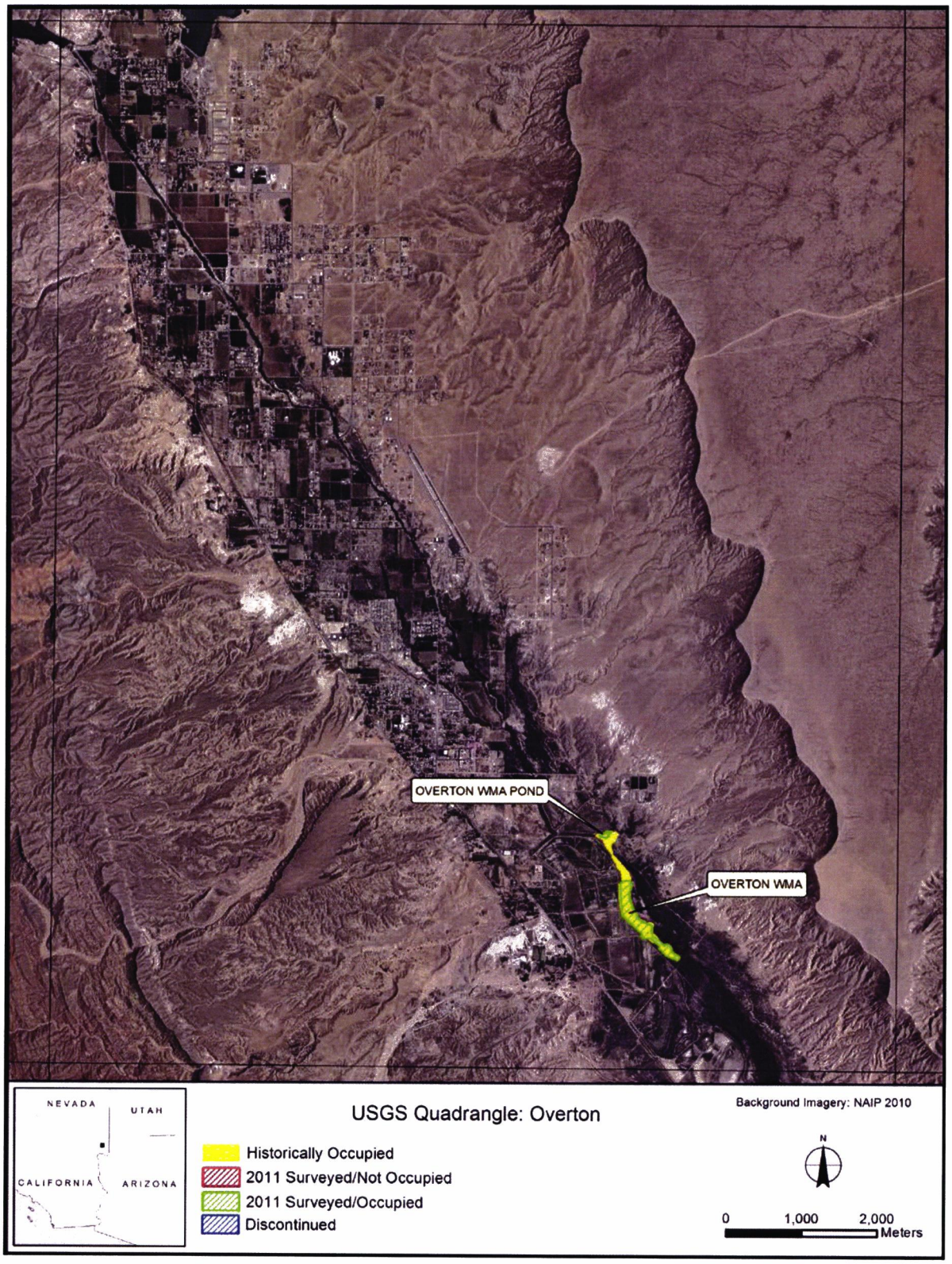

PAHRANAGAT NORTH
PAHRANAGAT WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Alamo & Alamo SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

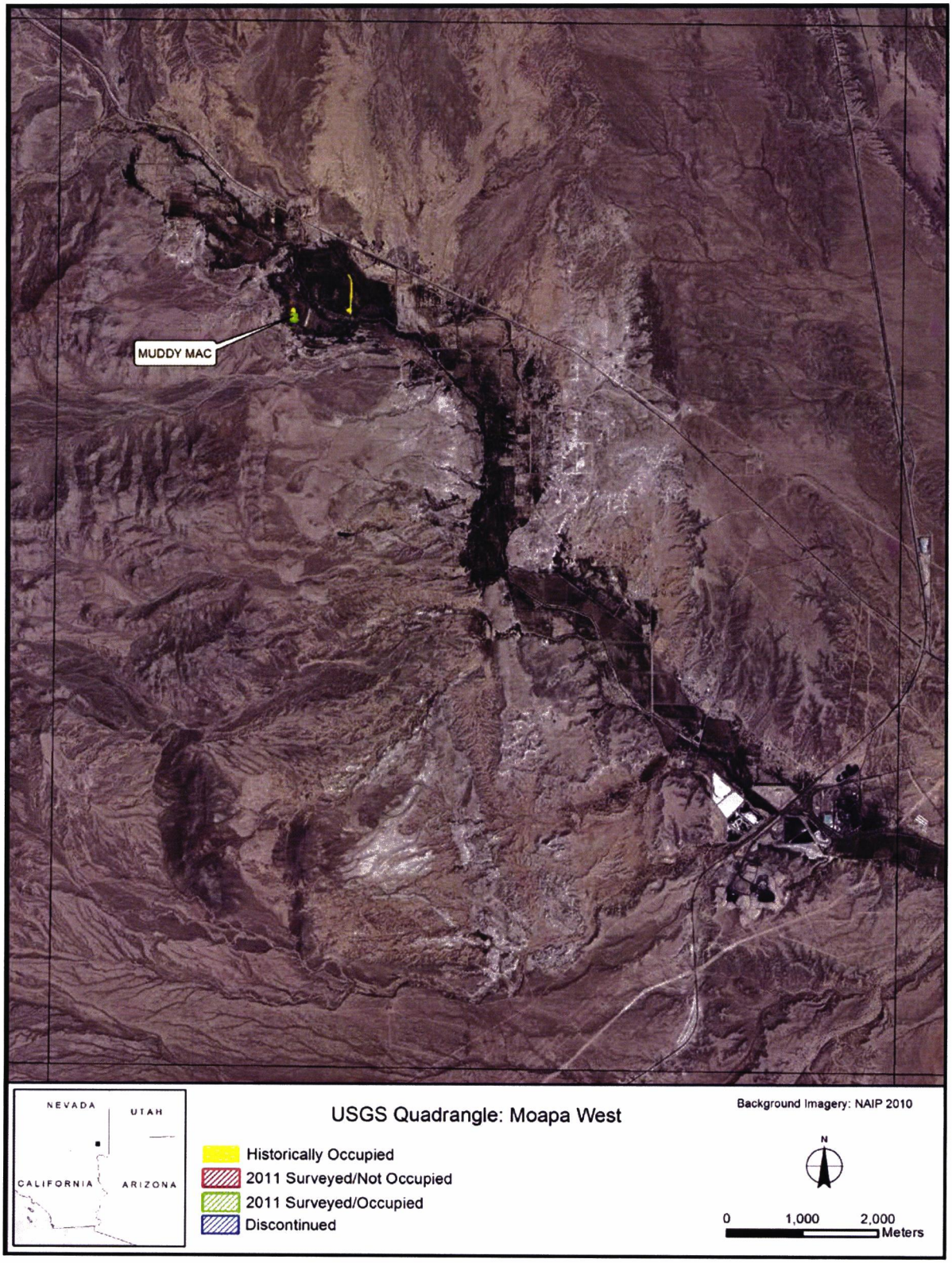

MESQUITE WEST
HAFEN LANE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Mesquite
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

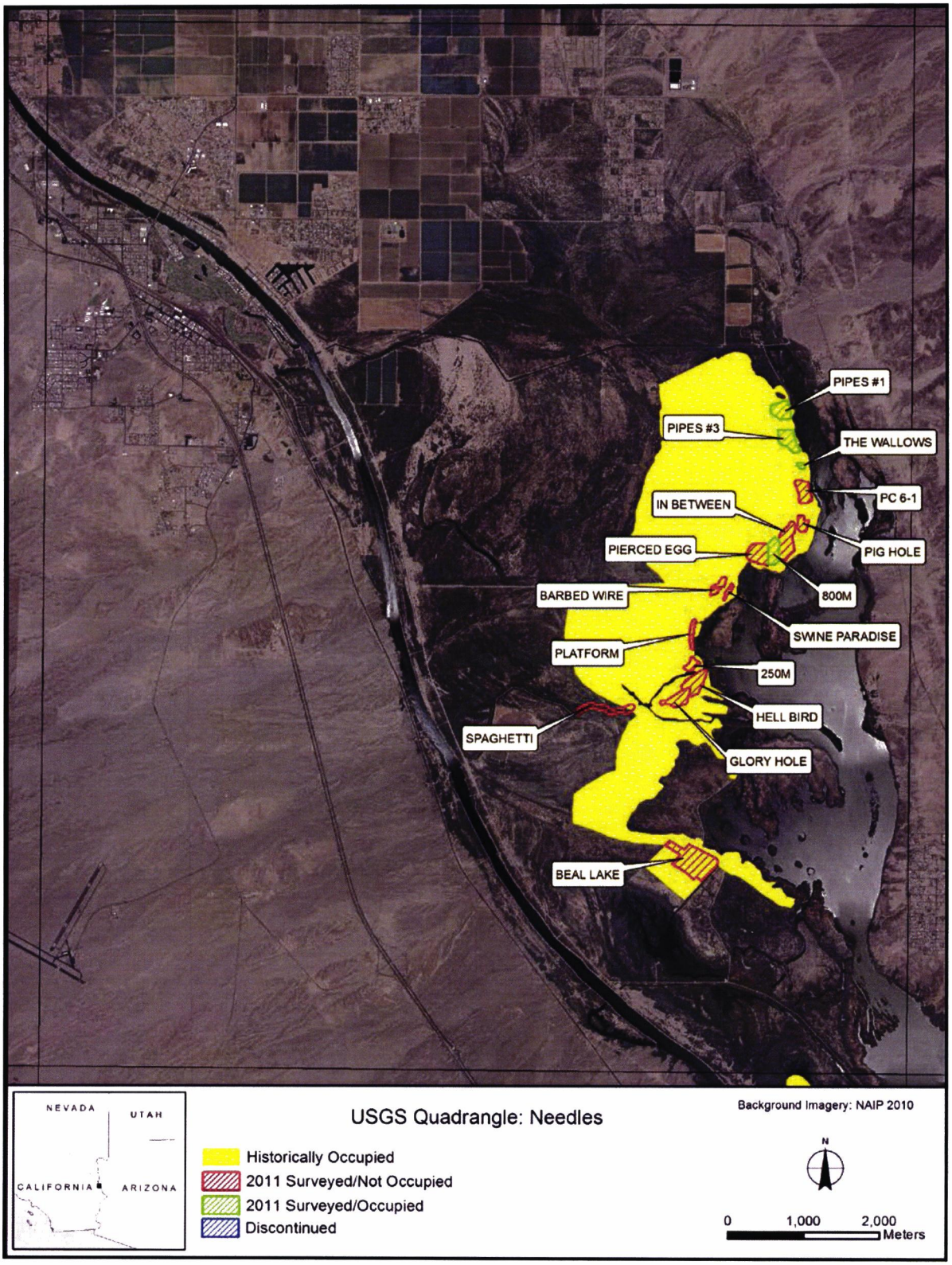

BUNKER MARSH NORTH
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Flat Top Mesa
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

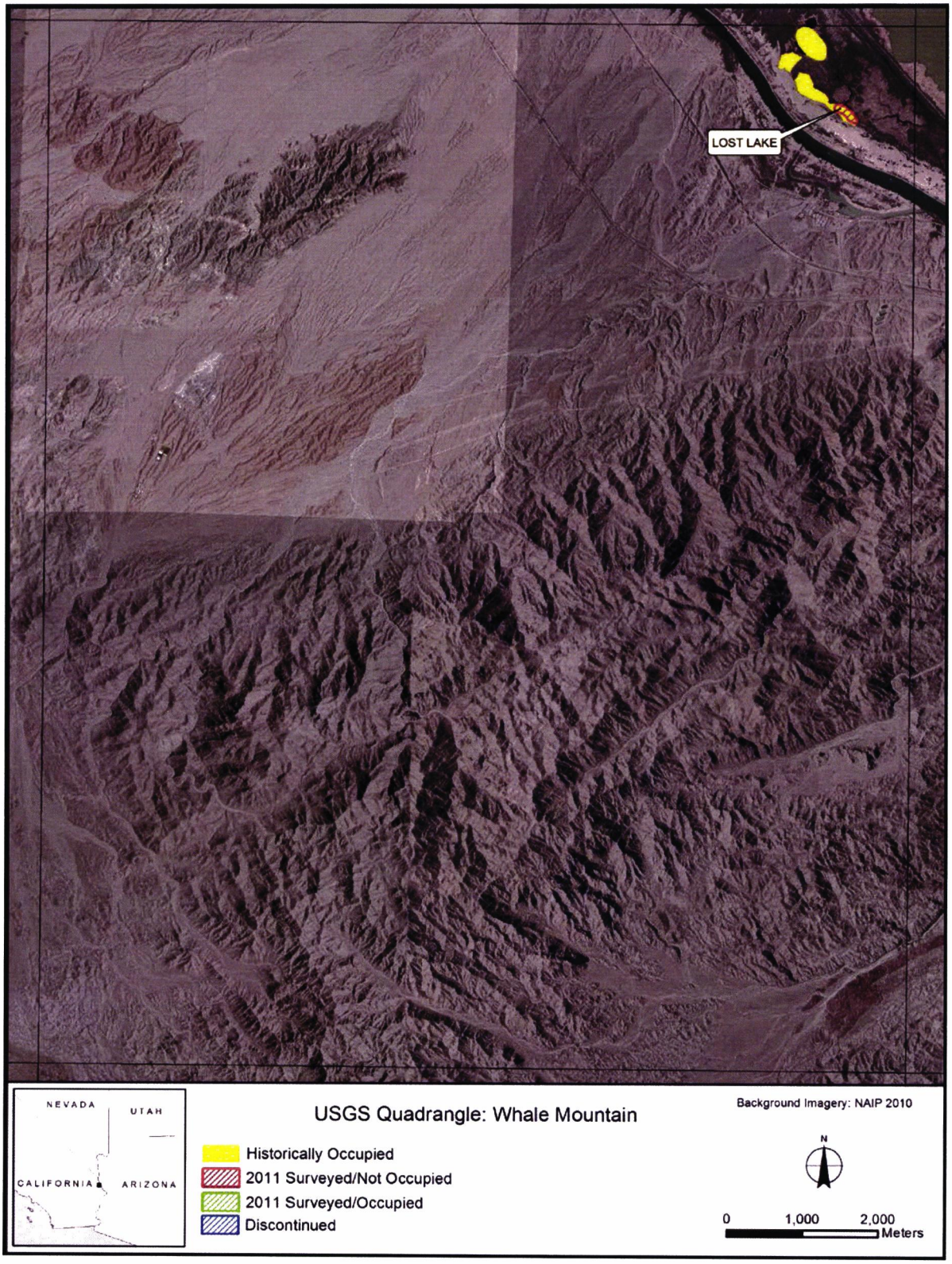

MORMON MESA SOUTH (SOUTH)
MORMON MESA SOUTH (NORTH)
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

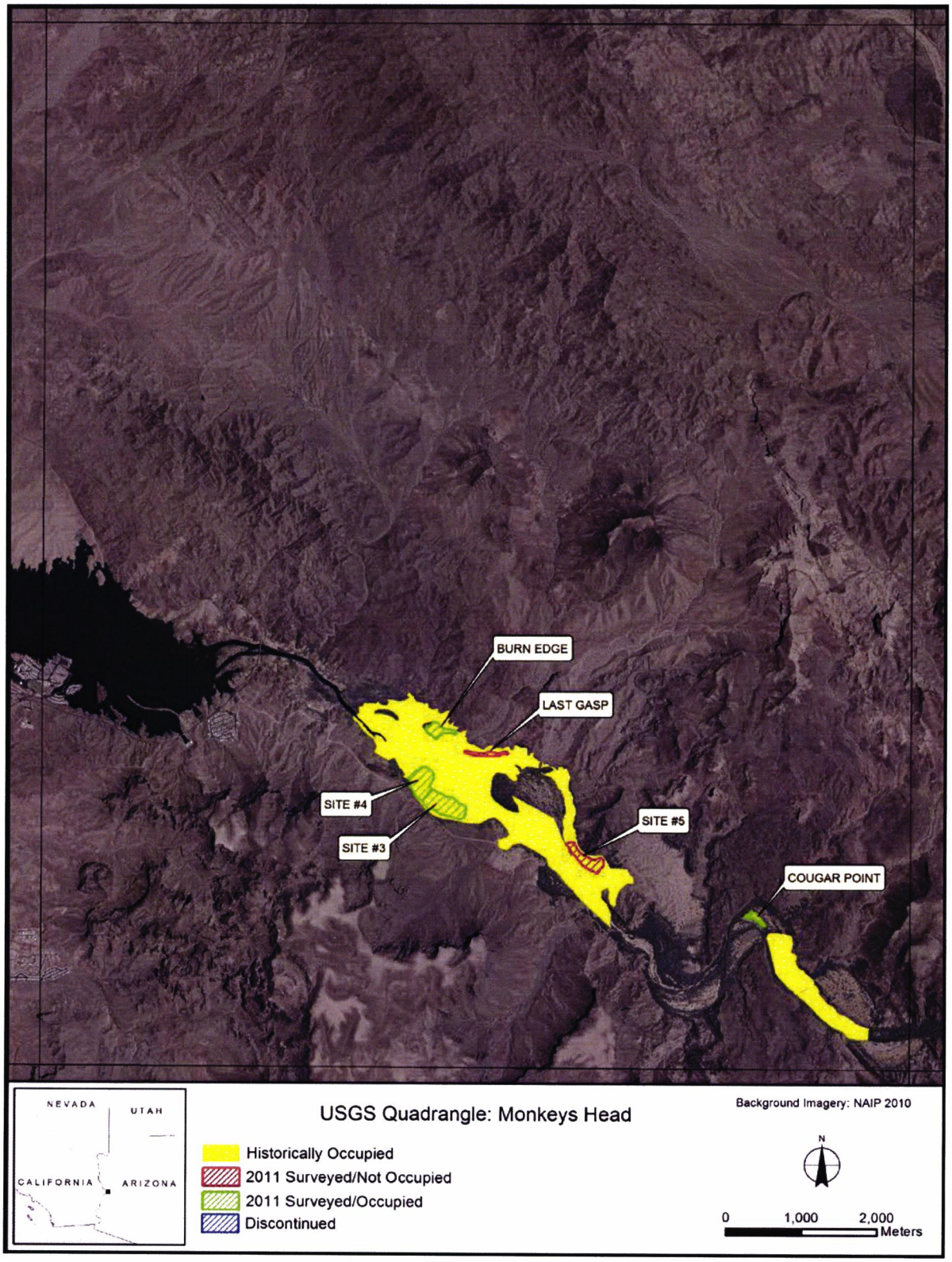

VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #1 NORTH
VIRGIN RIVER #1 SOUTH
VIRGIN RIVER #2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton SE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

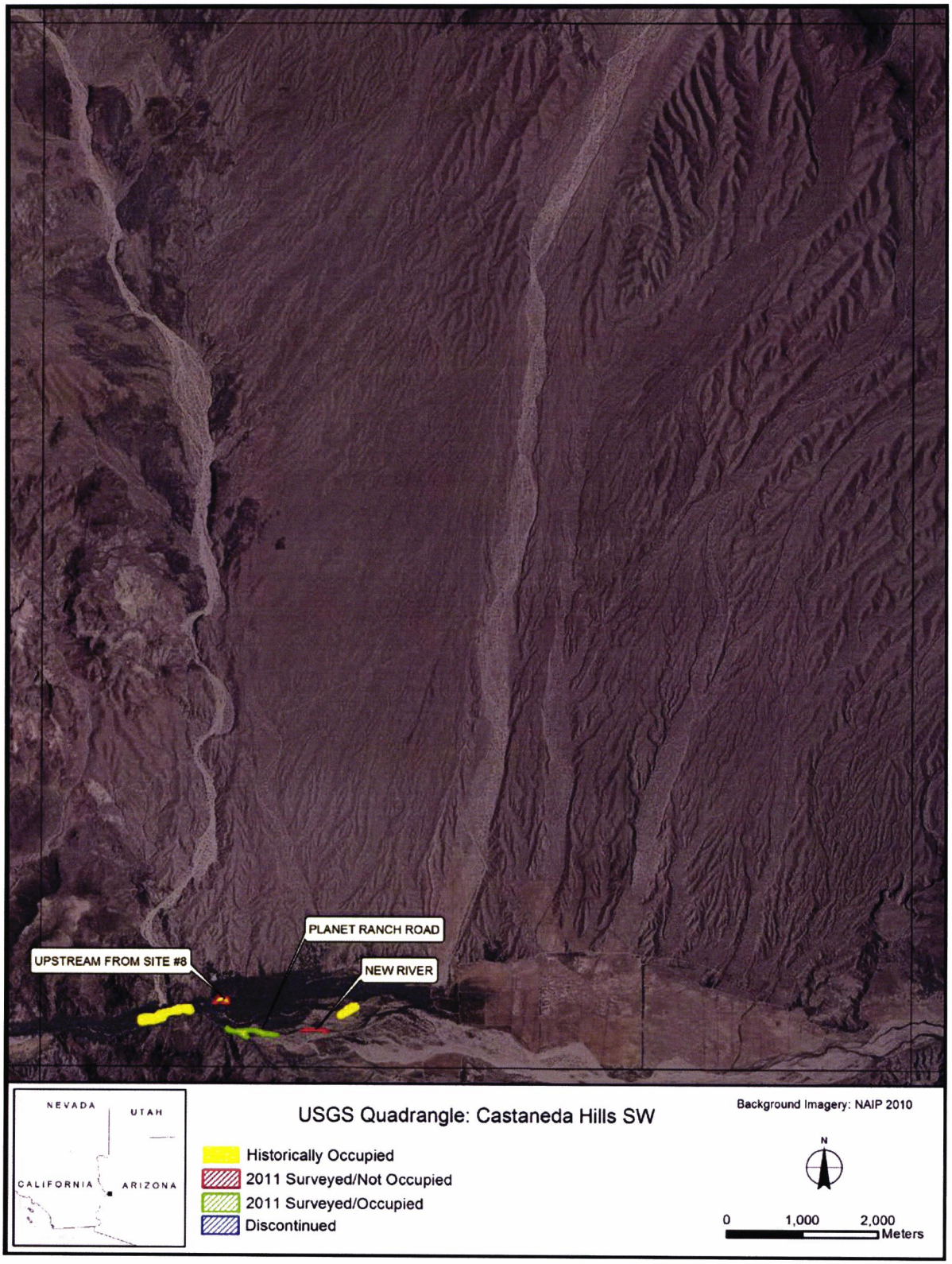

OVERTON WMA POND
OVERTON WMA
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Overton
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

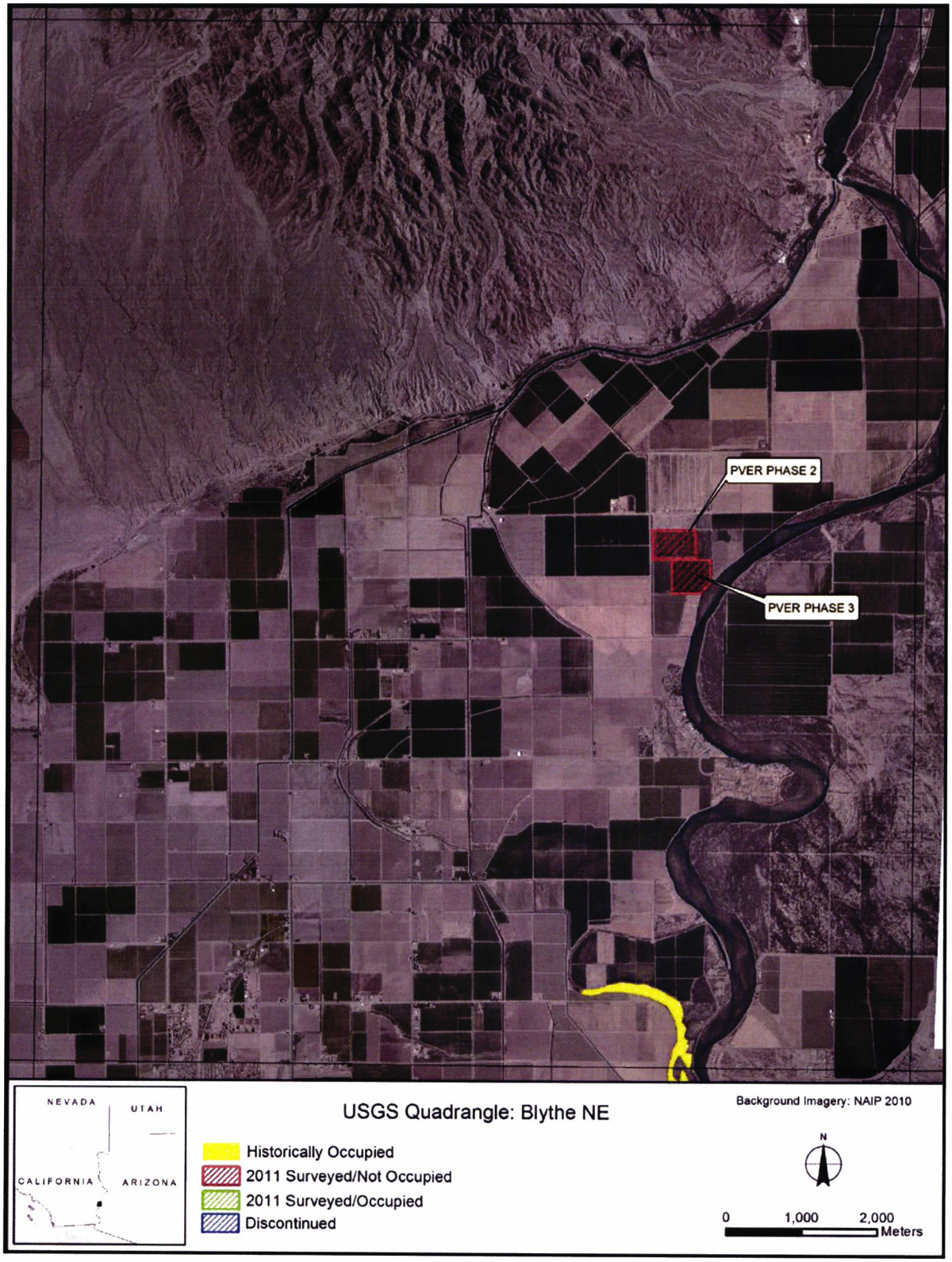

MUDDY MAC
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Moapa West
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


PIPES #1
PIPES #3
THE WALLOWS
PC 6-1
IN BETWEEN
PIG HOLE
PIERCED EGG
800M
BARBED WIRE
SWINE PARADISE
PLATFORM
250M
HELL BIRD
SPAGHETTI
GLORY HOLE
BEAL LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Needles
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

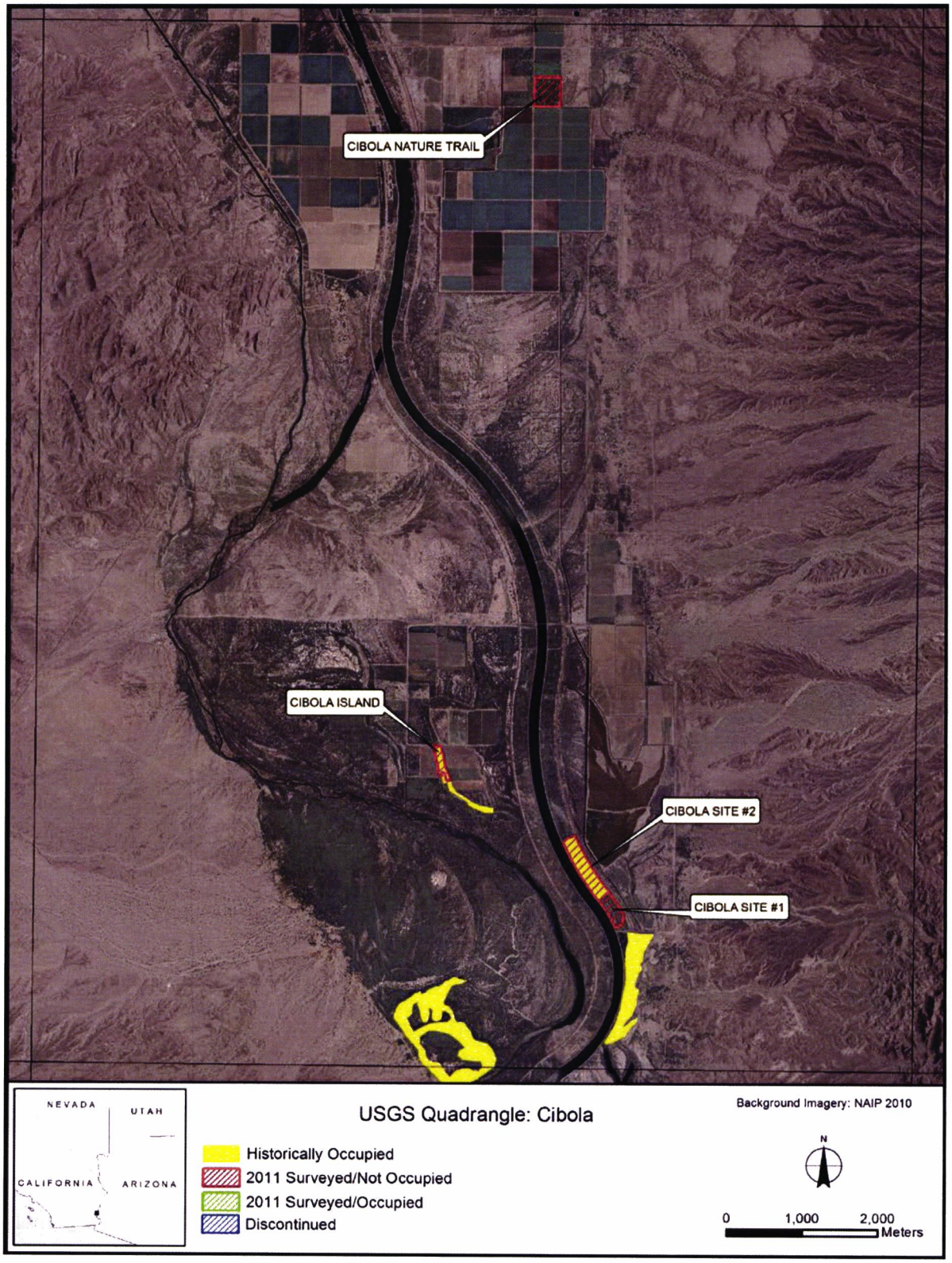

LOST LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Whale Mountain
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

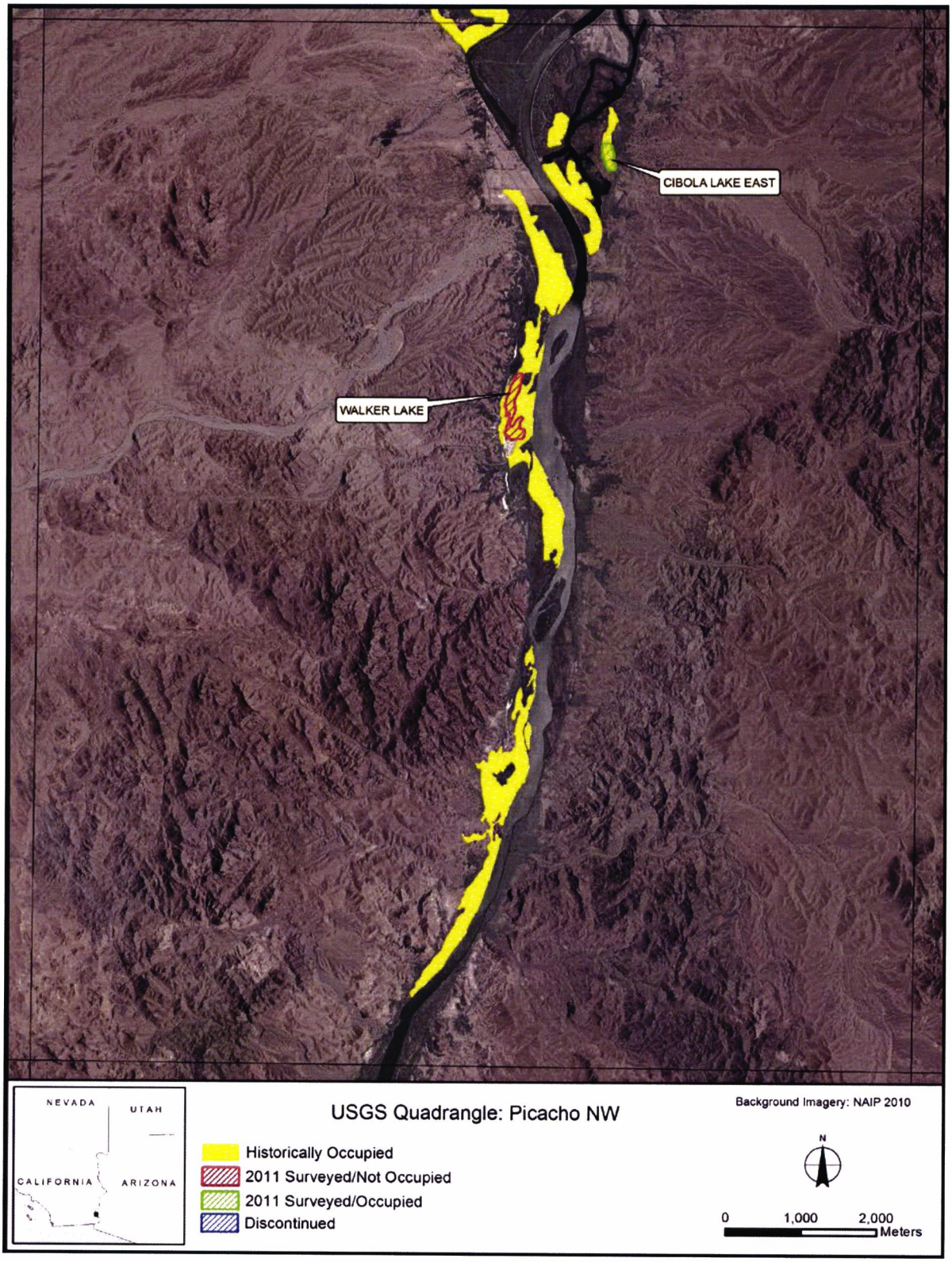

BURN EDGE
LAST GASP
SITE #4
SITE #3
SITE #5
COUGAR POINT
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Monkeys Head
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

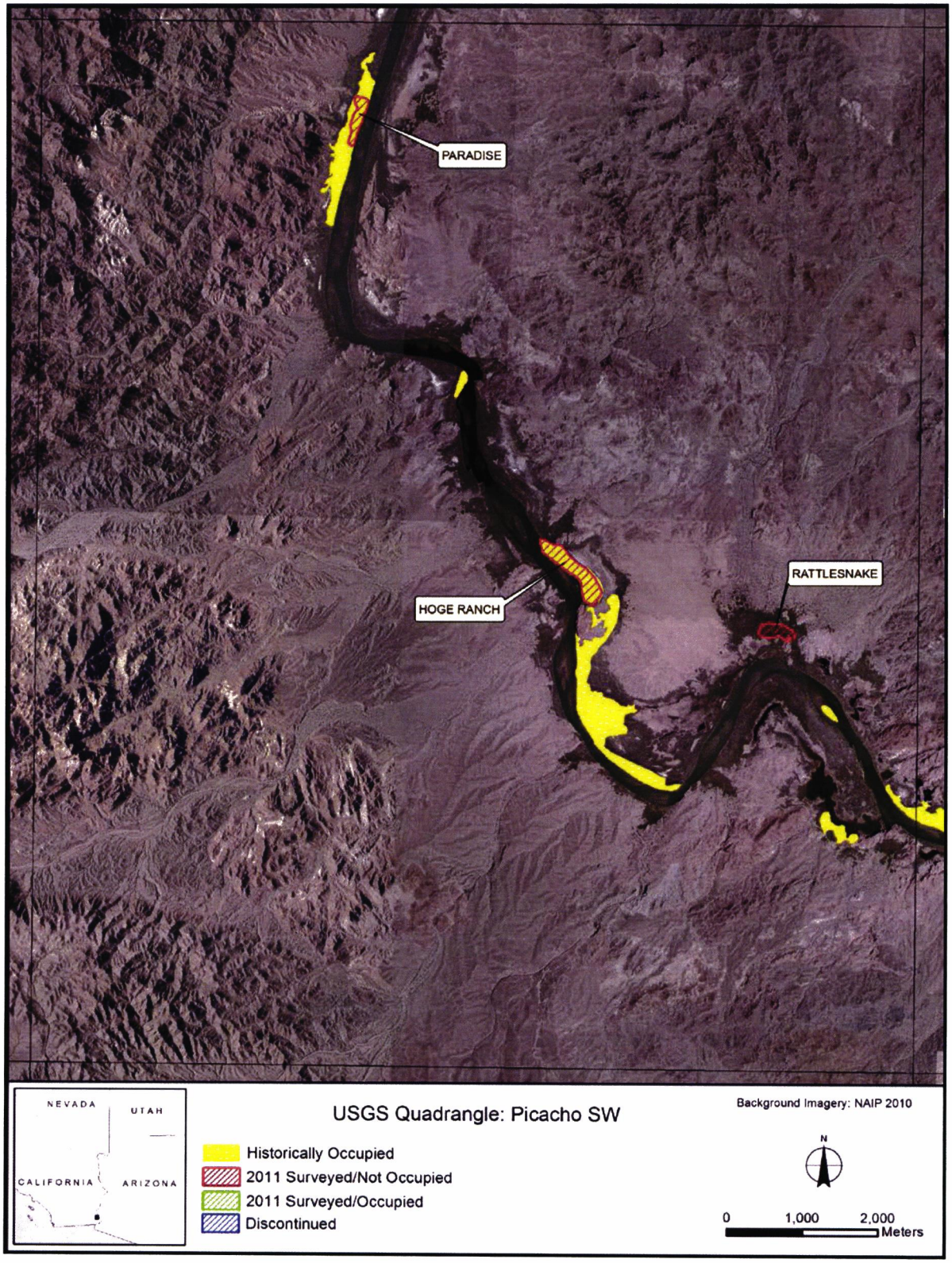

PLANET RANCH ROAD
UPSTREAM FROM SITE #8
NEW RIVER
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Castaneda Hills SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

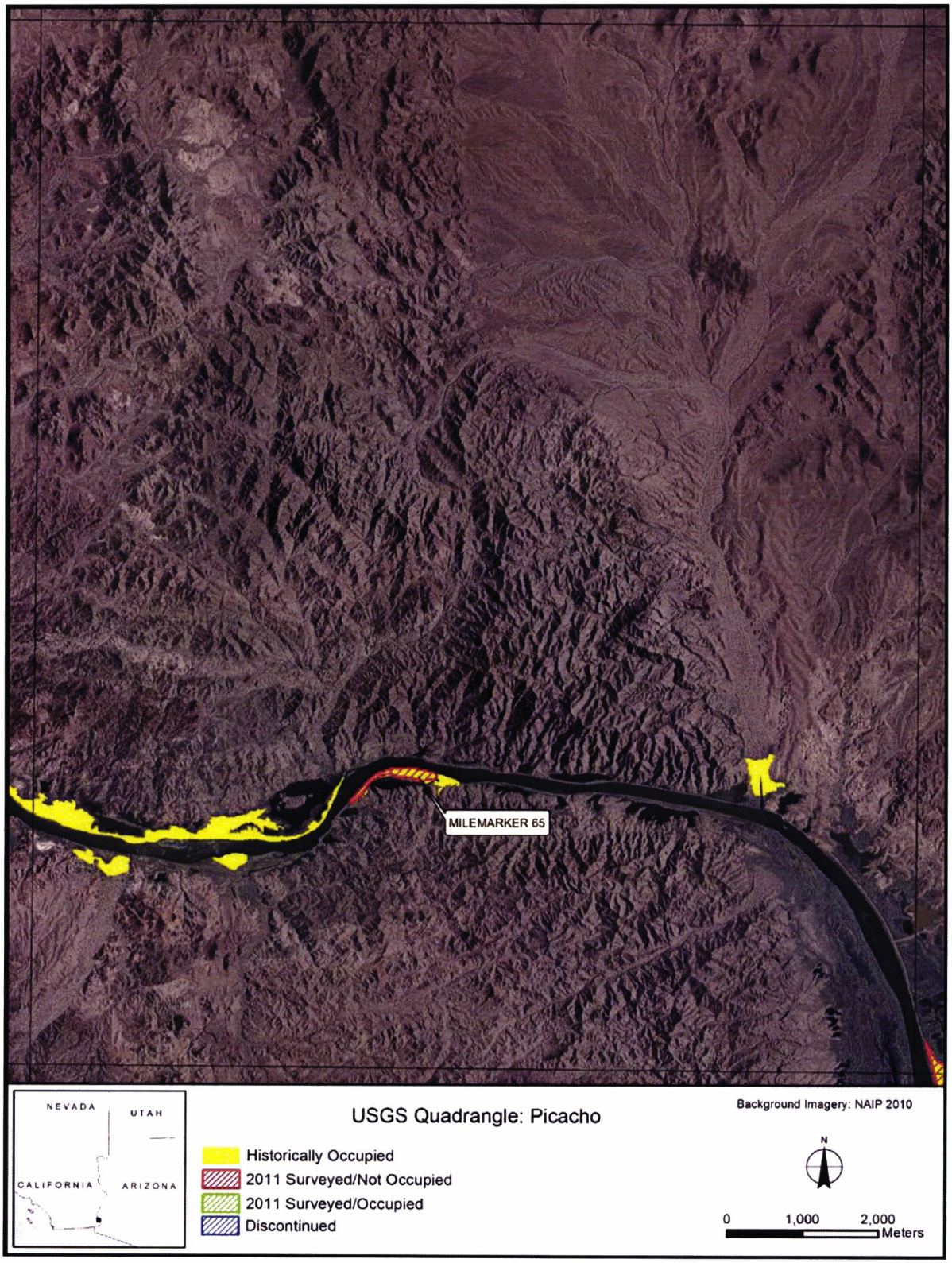

PVER PHASE 2
PVER PHASE 3
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Blythe NE
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

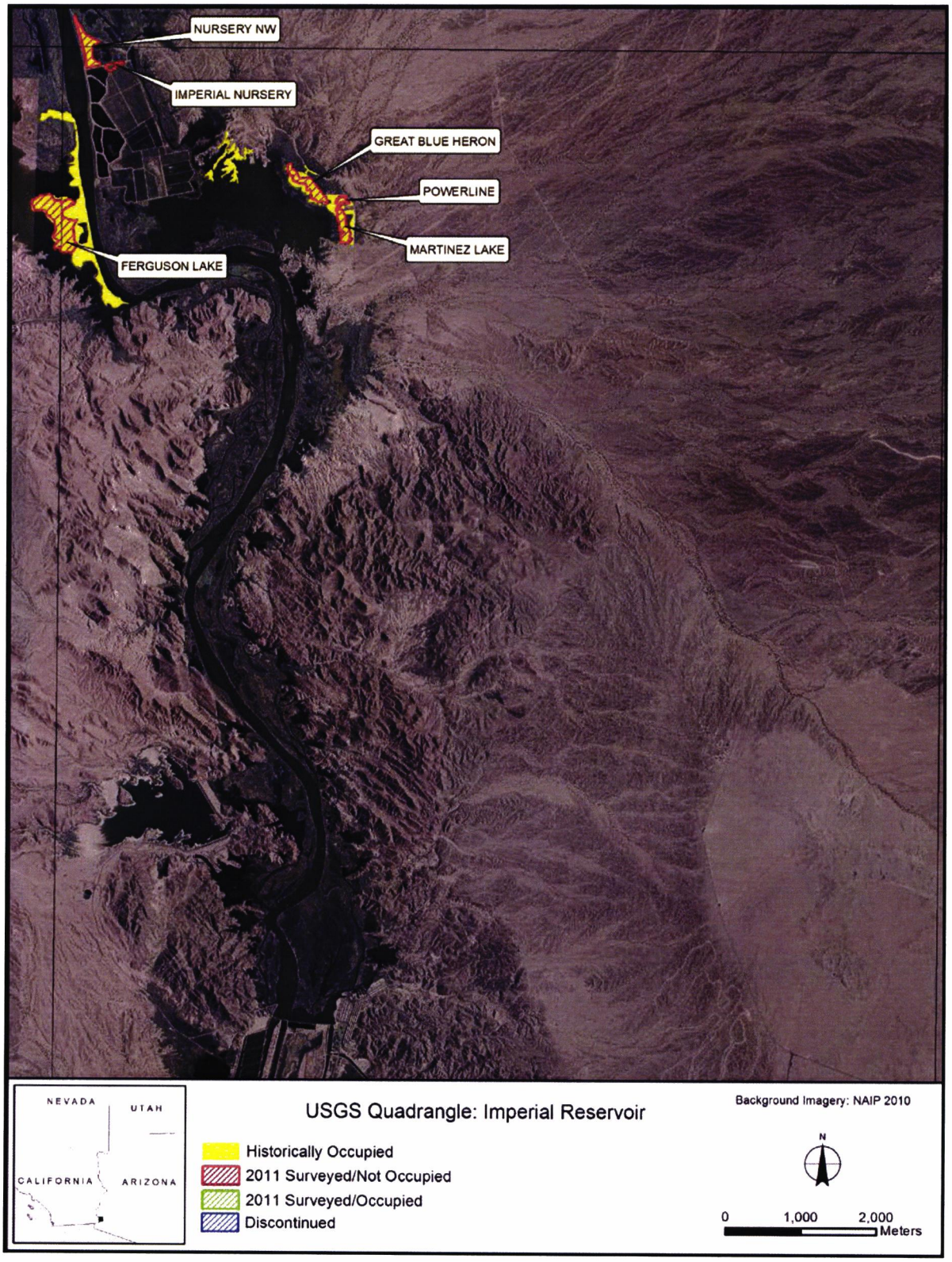

CVCA PHASE 1
CVCA PHASE 3
CVCA PHASE 2
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Palo Verde
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

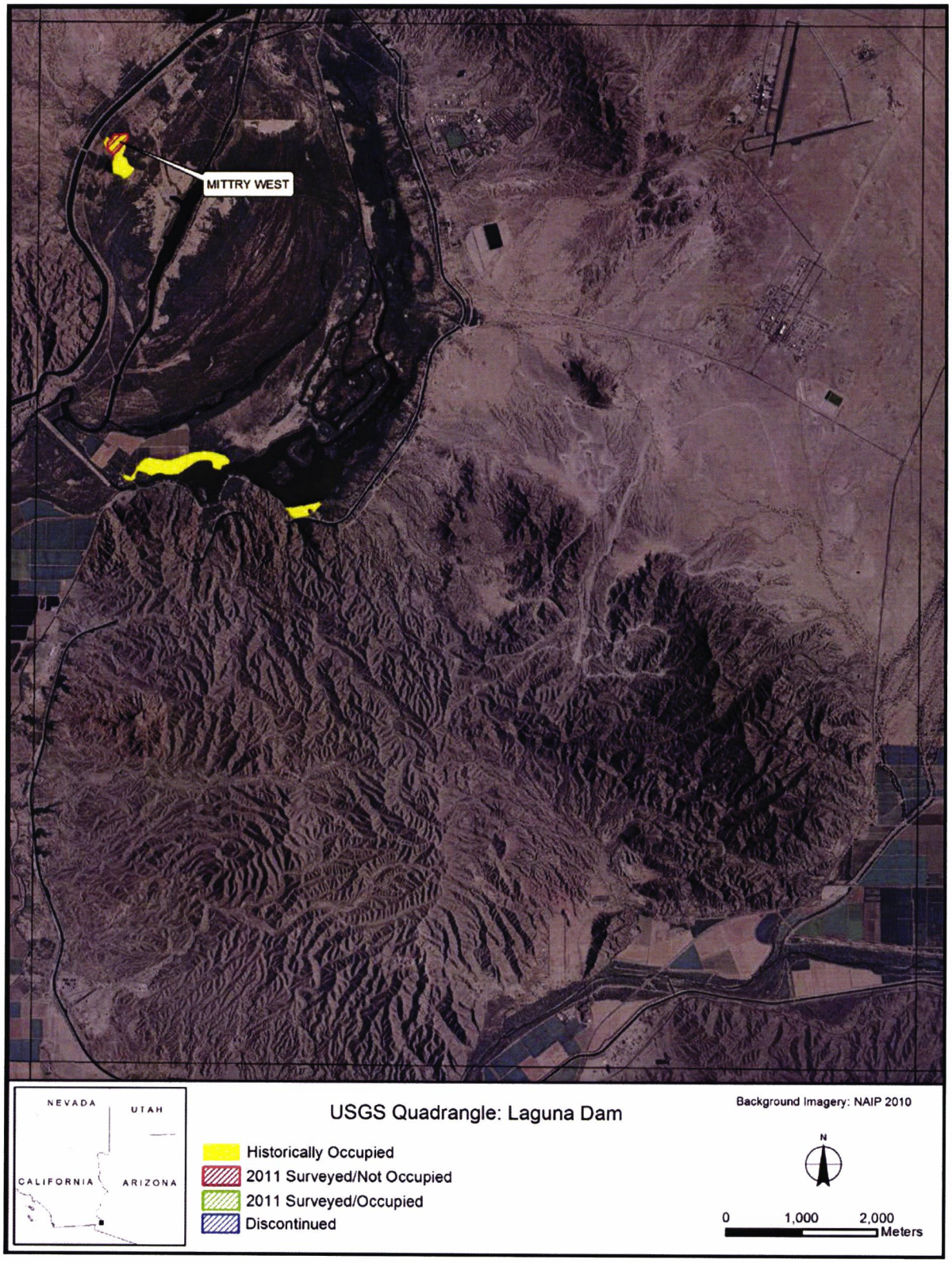

CIBOLA NATURE TRAIL
CIBOLA ISLAND
CIBOLA SITE #2
CIBOLA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Cibola
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

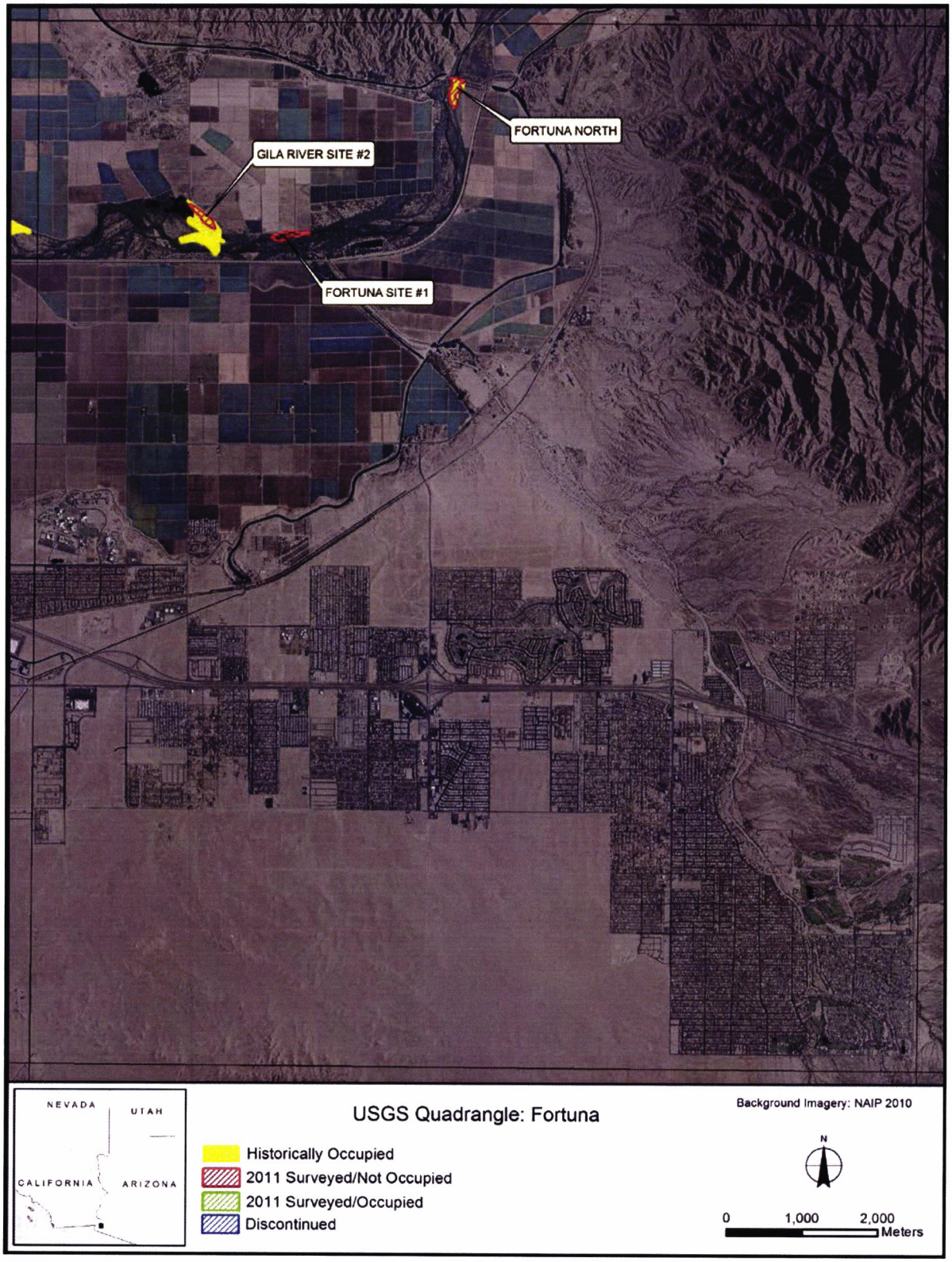

CIBOLA LAKE EAST
WALKER LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho NW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


PARADISE
HOGE RANCH
RATTLESNAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho SW
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MILEMARKER 65
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Picacho
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


NURSERY NW
IMPERIAL NURSERY
GREAT BLUE HERON
POWERLINE
MARTINEZ LAKE
FERGUSON LAKE
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Imperial Reservoir
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


MITTRY WEST
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Laguna Dam
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters


FORTUNA NORTH
GILA RIVER SITE #2
FORTUNA SITE #1
NEVADA
UTAH
CALIFORNIA
ARIZONA
USGS Quadrangle: Fortuna
Historically Occupied
2011 Surveyed/Not Occupied
2011 Surveyed/Occupied
Discontinued
Background Imagery: NAIP 2010
N
0
1,000
2,000
Meters

Appendix C

SOUTHWESTERN WILLOW FLYCATCHER SURVEY RESULTS, 2011

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011*

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Pahranagat Valley	KEPI[5]	NV	Patch 0	0.04	0	---	2[6]	1	1	1	0	0
		NV	Patch 1	0.1	0	---	2	1	1	1	0	0
		NV	Patch 2	0.1	0	---	2	1	1	2	0	0
		NV	Patch 3	0.1	0	---	1	1	0	0	1	0
		NV	Patch 4	0.1	0	---	2	1	1	1	3[7]	0
		NV	Patch 4.5	0.02	5	0.3	0	0	0	0	0	0
		NV	Patch 5	0.1	0	---	2	1	1	2	0	0
		NV	Patch 6	0.2	0	---	5[8]	3	3	3	0	0
		NV	Patch 7	0.1	0	---	2	1	1	2	0	0
		NV	Patch 8	0.1	0	---	2	1	1	2	0	0
		NV	Patch 9	0.3	0	---	4	2	2	3	0	0
		NV	Patch 10	0.1	0	---	3[8]	2	2	4	0	0
		NV	Patch 10.5	0.02	0	---	0	0	0	0	2[9]	0
		NV	Patch 11	0.1	0	---	4	2	2	6	1	0
		NV	Patch 12	0.1	0	---	3[8]	2	2	6	2	0
		NV	Fence[10]	---	0	---	0	0	0	0	0	1
Pahranagat Valley	RIRA[11]	NV	East Side	0.4	1	0.8	2[7]	1	1	3	0	0
		NV	West Side	0.3	1	---	3[6,9,12]	2	1	1	2	0
		NV	Smalls	0.5	1	---	1	1	1	0	0	0
Pahranagat Valley	PAHR	NV	North	4.6	4	1.5	14[13,14]	10	6	7	5[12]	2
		NV	West	1.5	5	3.1	0	0	0	0	1[14]	0
Virgin River	MESQ	NV	Hafen Lane	6.1	5	16.2	3[15]	1	1	1	0	0
		NV	West	10.4	5	7.4	11[16,17]	7	6	8	0	0
		NV	Bunker Marsh North[18]	7.1	2	3.7	0	0	0	0	0	0
Virgin River	MOME[19]	NV	Mormon Mesa South (North)	8.4	4	9.3	0	0	0	0	0	0
		NV	Mormon Mesa South (South)	3.4	3	4.8	0	0	0	0	0	0
		NV	Virgin River #1 (North)	11.4	4	12.9	4	2	2	1	1	0
		NV	Virgin River #1 (South)	11.1	3	5.5	19[20]	12	11	19	2[16]	0
		NV	Virgin River #2	11.2	5	16.8	0	0	0	0	0	0

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Muddy River	MUDD	NV	Overton WMA Pond	0.7	5	2.5	0	0	0	0	1	0
		NV	Overton WMA	14.9	6	18.0	13[15,20]	8	5	6	2	0
Muddy River	WMSP	NV	Muddy Mac[21]	0.7	0	---	2	1	1	1	0	3
Colorado River	TOPO	AZ	Pipes #1	5.2	5	8.5	1	1	0	0	0	0
		AZ	Pipes #3	5.7	5	4.6	2	1	1	1	1	0
		AZ	The Wallows	0.7	5	2.1	1	1	0	0	0	2
		AZ	PC6-1	4.8	5	8.0	0	0	0	0	0	1
		AZ	Pig Hole	2.4	5	5.1	0	0	0	0	0	0
		AZ	In Between	7.7	5	9.9	0	0	0	0	0	1
		AZ	800M	4.7	5	4.7	1	1	0	0	1	1
		AZ	Pierced Egg	6.7	5	8.5	0	0	0	0	0	4
		AZ	Swine Paradise	0.9	5	4.0	0	0	0	0	0	1
		AZ	Barbed Wire	2.1	5	4.0	0	0	0	0	0	0
		AZ	Platform	1.9	5	4.6	1	1	0	0	0	0
		AZ	250M	1.9	5	3.3	0	0	0	0	0	0
		AZ	Hell Bird	6.3	5	6.0	0	0	0	0	0	10
		AZ	Glory Hole	5.0	5	8.3	0	0	0	0	0	0
		AZ	Spaghetti	5.4	5	3.4	0	0	0	0	0	2
		AZ	Beal Lake	18.0	5	10.6	0	0	0	0	0	1
		AZ	Lost Lake	3.3	5	3.4	0	0	0	0	0	1
		AZ	Dock[10]	---	0	---	0	0	0	0	0	3
Bill Williams River	BIWI	AZ	Wispy Willow[18]	0.5	3	2.8	0	0	0	0	0	1
		AZ	Burn Edge	4.1	5	6.3	0	0	0	0	0	1
		AZ	Site #4	9.9	5	16.8	0	0	0	0	3	0
		AZ	Site #3	13.0	5	19.6	2	1	1	2	0	1
		AZ	Last Gasp	2.1	5	4.6	0	0	0	0	0	0
		AZ	Site #5	6.8	5	8.9	0	0	0	0	0	2
		AZ	Cougar Point[22]	1.3	0	---	2	1	1	1	0	0
		AZ	Upstream from Site #8	1.5	5	5.1	0	0	0	0	0	0

AR065093

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Bill Williams River	BIWI	AZ	Planet Ranch Road	3.3	5	12.0	3	2	2	3	0	2
		AZ	New River	0.6	5	3.9	0	0	0	0	0	0
Colorado River	PVER	CA	PVER Phase 2	21.4	6	16.5	0	0	0	0	0	11
		CA	PVER Phase 3	21.4	6	14.5	0	0	0	0	0	4
Colorado River	CIBO	AZ	CVCA Phase 1	26.2	6	16.0	0	0	0	0	0	12
		AZ	CVCA Phase 2	25.5	6	16.0	0	0	0	0	0	11
		AZ	CVCA Phase 3	38.4	5	14.0	0	0	0	0	0	18
		AZ	Cibola Nature Trail	13.7	5	6.0	0	0	0	0	0	1
		AZ	Cibola Island	4.2	3	2.3	0	0	0	0	0	0
		AZ	Cibola Site #2	16.4	5	6.2	0	0	0	0	0	5
		AZ	Cibola Site #1	7.7	5	4.1	0	0	0	0	0	0
		AZ	Cibola Lake #2 (East)	4.5	5	5.0	0	0	0	0	0	2
		CA	Walker Lake	11.4	3	4.9	0	0	0	0	0	1
Colorado River	IMPE	CA	Paradise	7.8	3	3.3	0	0	0	0	0	3
		AZ	Hoge Ranch	20.7	5	5.9	0	0	0	0	0	14
		AZ	Rattlesnake	7.6	5	6.4	0	0	0	0	0	5
		CA	Milemarker 65	10.0	2	0.9	0	0	0	0	0	1
		AZ	Nursery NW	7.0	5	6.9	0	0	0	0	0	6
		CA	Ferguson Lake	21.1	3	7.0	0	0	0	0	0	2
		AZ	Great Blue Heron	7.1	5	15.9	0	0	0	0	0	21
		AZ	Powerline	1.0	5	4.2	0	0	0	0	0	3
		AZ	Martinez Lake	4.6	5	8.8	0	0	0	0	0	2

Table C.1. Southwestern Willow Flycatcher Survey Results by Site along the Lower Colorado River and Tributaries, 2011* (Continued)

River Drainage	Study Area[1]	State	Survey Site[2]	Area (ha)	# Surveys	Survey Hours	Resident Adults	Territories	Pairs	Nests	Unknown Status	
											Before June 15[3]	After June 15[4]
Colorado River	MITT	CA	Mittry West	4.4	3	4.3	0	0	0	0	0	3
Colorado River	YUMA	AZ	Gila River Site #2	2.9	4	5.3	0	0	0	0	0	7
		AZ	Fortuna Site #1	3.2	4	6.1	0	0	0	0	0	15
		AZ	Fortuna North	3.8	4	9.5	0	0	0	0	0	7

* This table includes only sites where regular surveys were scheduled and does not include sites where habitat reconnaissance and opportunistic surveys were conducted.

[1] Study areas consist of 1-18 survey sites that are grouped geographically. Alpha codes are as follows: KEPI = Key Pittman Wildlife Management Area, RIRA = River Ranch, PAHR = Pahranagat National Wildlife Refuge (NWR), MESQ = Mesquite, MOME = Mormon Mesa, MUDD = Muddy River, WMSP = Warm Springs Natural Area, TOPO = Topock Marsh, BIWI = Bill Williams River NWR, PVER = Palo Verde Ecological Reserve, CIBO = Cibola, IMPE = Imperial, MITT = Mittry Lake, YUMA = Yuma.

[2] Survey site is equivalent to the Arizona Department of Game and Fish site definition.

[3] Total number of individuals recorded that could not be classified as resident or migrant because of brief appearance after 15 June.

[4] Total number of individuals who could not be classified as resident or migrant because of brief appearance before 15 June.

[5] Only the one unoccupied site was surveyed.

[6] This female moved from River Ranch West Side after an unsuccessful nesting attempt to Key Pittman Patch 0 where she tried a second nesting attempt of unknown fate.

[7] This adult, detected on 27 July in Key Pittman Patch 4, held a territory at River Ranch East Side until 25 July.

[8] One male was polygynous with two females.

[9] This individual, detected on 24 July in Key Pittman Patch 10.5, held a territory at River Ranch West Side until 1 July.

[10] Not an official survey site. Incidental detections recorded.

[11] Due to flycatcher occupancy, sites were surveyed only once. Survey time represents total survey time at all sites combined.

[12] This individual, detected 17–19 June at Pahranagat North, moved to River Ranch West Side where he held a territory from 23 June to 13 July.

[13] One male was polygynous with three females.

[14] One female moved from Pahranagat North and was detected on 21 July with a group of three fledglings.

[15] One male held a territory at Overton WMA until 17 July and then displaced the male at Hafen Lane.

[16] One male held a territory at Mesquite West and was then recaptured on 24 July at Virgin River #1 South.

[17] Two males polygynous with two females.

[18] Surveys discontinued because of poor quality habitat.

[19] Unusually high water levels within the Virgin River prevented technicians from completing all five surveys.

[20] One male bred at Overton WMA until 17 July, then moved to Virgin River #1 South and bred. His female at Virgin River #1 South mated consecutively with two males.

[21] No surveys conducted; site was occupied the entire season.

[22] Site not formally surveyed; not a formal site until an unrelated field crew reported a flycatcher in the area. When SWCA visited the territory, the male was no longer present (though had been noted by the other crew earlier in the season) and only the female remained, attending the nest.

Appendix D

DETECTIONS OF SPECIAL CONCERN SPECIES, 2011

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
PAHR	North	0	0	0	0	0	0	0	0	0	1	1	0
	West	0	0	0	0	0	0	0	0	0	10	0	1
MESQ	Hafen Lane	0	0	0	2	0	0	0	0	1	41	2	20
	West	0	0	0	0	0	0	0	0	0	49	0	22
	Bunker Marsh North	0	0	0	0	0	0	0	0	0	3	0	1
MOME	Mormon Mesa South	0	0	0	0	0	0	0	0	18	78	0	98
	Virgin River #1	0	0	0	0	0	0	0	0	2	27	2	37
	Virgin River #2	0	0	0	0	0	0	0	0	12	48	4	54
MUDD	Overton WMA	0	0	0	9	0	0	0	0	0	63	0	64
	Overton WMA Pond	0	0	0	0	0	0	0	0	1	17	2	16
TOPO	Pipes #1	0	0	0	0	0	0	0	0	0	1	1	42
	Pipes #3	0	0	0	0	0	0	4	0	0	11	5	41
	The Wallows	0	0	0	0	0	0	3	0	0	9	2	17
	PC6-1	0	0	0	0	0	0	1	0	1	9	3	60
	Pig Hole	0	0	0	0	0	0	0	0	0	3	0	27
	In Between	0	0	0	0	0	0	0	0	0	4	3	39
	800M	0	0	0	0	0	0	0	0	0	1	3	20
	Pierced Egg	0	0	0	0	0	0	5	0	0	19	5	55
	Swine Paradise	0	0	0	0	0	0	1	0	0	14	4	13
	Barbed Wire	0	0	0	0	0	0	1	0	0	5	6	26
	Platform	0	0	0	0	0	0	1	0	0	6	1	26
	250M	0	0	0	0	0	0	2	0	0	6	1	15
	Spaghetti	0	0	0	0	0	0	1	0	0	2	2	19
	Hell Bird	0	0	0	0	0	0	9	0	0	7	4	23
	Glory Hole	0	0	0	0	0	0	6	0	1	9	2	40

AR065097

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]											
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
TOPO	Beal Lake	0	0	0	3	0	0	1	0	40	22	10	57
	Lost Lake	0	0	2	0	0	0	0	0	0	5	2	8
BIWI	Wispy Willow	0	1	1	0	0	0	1	0	5	0	2	11
	Site #1[3]	0	0	2	0	0	0	1	0	1	0	1	3
	Site #2[3]	0	0	0	0	0	0	0	0	0	0	1	4
	Burn Edge	0	0	0	0	0	0	2	0	7	8	1	55
	Site #11[3]	0	0	0	0	0	0	2	0	1	0	0	5
	Site #4	0	0	0	0	0	0	22	0	11	32	11	97
	Site #3	0	0	0	3	1	0	4	0	11	51	8	119
	Last Gasp	0	0	0	0	0	0	6	0	1	5	1	70
	Site #5	0	0	0	1	0	0	7	0	13	16	6	81
	Mineral Wash[3]	0	0	0	0	0	0	0	0	8	5	0	9
	Beaver Pond[3]	0	0	0	0	0	0	3	0	8	14	1	35
	Upstream from Site #8	0	0	0	1	0	0	3	0	2	9	0	32
	Planet Ranch Road	1	0	0	3	0	0	6	0	14	22	5	44
	New River	2	0	0	2	0	0	0	0	9	2	1	22
PVER	PVER Phase 2	0	0	0	3	0	0	0	0	3	12	0	2
	PVER Phase 3	0	0	0	3	0	0	0	0	0	5	2	4
CIBO	CVCA Phase 1	0	0	0	5	0	0	1	0	0	10	6	7
	CVCA Phase 2	0	0	0	4	0	0	0	0	0	7	0	4
	CVCA Phase 3	0	0	0	0	0	0	0	0	0	1	4	4
	Cibola Nature Trail	0	0	0	0	0	0	0	0	1	17	1	13
	Cibola Island	0	0	0	3	0	0	0	0	0	0	0	4
	Cibola Site #2	0	1	0	0	0	0	0	0	0	0	0	14
	Cibola Site #1	0	0	3	0	0	0	3	0	0	1	1	10
	Cibola Lake #2 (East)	0	0	0	0	0	0	0	0	0	0	0	14

AR065098

Table D.1. Number of Detections of Each Special Concern Species Recorded at Each Survey Site, 2011 (Continued)

Study Area[1]	Survey Site	Special Concern Species[2]										
		BLRA	CLRA	LEBI	YBCU	ELOW	GIFL	GIWO	VEFL	BEVI	YWAR	SUTA	YBCH
CIBO	Walker Lake	0	0	0	0	0	0	4	0	0	0	0	8
IMPE	Paradise	0	0	0	0	0	0	4	0	0	0	0	6
	Hoge Ranch	0	0	3	0	0	0	2	0	0	0	0	13
	Rattlesnake	0	0	0	0	0	0	6	0	0	0	1	30
	Milemarker 65	0	0	1	0	0	0	0	0	0	1	0	4
	Nursery Northwest	7	0	2	0	0	0	1	0	1	3	0	22
	Ferguson Lake	0	0	9	0	0	0	2	0	0	0	0	19
	Great Blue Heron	0	0	0	0	0	0	13	0	1	16	2	67
	Powerline	0	1	1	0	0	0	5	0	0	1	1	15
	Martinez Lake	1	0	1	0	0	0	1	0	2	5	0	24
MITT	Mittry West	0	0	0	0	0	0	4	0	1	0	0	8
YUMA	Gila River Site #2	0	0	0	0	0	0	0	0	0	0	0	0
	Fortuna Site #1	0	0	0	0	0	0	0	0	0	1	1	9
	Fortuna North	0	0	0	0	0	0	0	0	0	1	0	14

[1] PAHR = Pahranagat NWR; MESQ = Mesquite; MOME = Mormon Mesa; MUDD = Muddy River; TOPO = Topock Marsh; BIWI = Bill Williams River NWR; PVER = Palo Verde Ecological Reserve; CIBO = Cibola; IMPE = Imperial; MITT = Mittry Lake; YUMA = Yuma.

[2] BLRA = Black Rail, CLRA = Clapper Rail, LEBI = Least Bittern, YBCU = Yellow Billed Cuckoo, ELOW = Elf Owl, GIFL = Gilded Flicker, GIWO = Gila Woodpecker, VEFL = Vermilion Flycatcher, BEVI = Bell's Vireo, YWAR = Yellow Warbler, SUTA = Summer Tanager, YBCH = Yellow-breasted Chat.

[3] Site surveyed only once as part of an opportunistic effort.

Appendix E

ALL WILLOW FLYCATCHERS COLOR-BANDED AND/OR RESIGHTED, 2003–2011

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011*

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1490-89889	M	J							R		D	D	D	D			
1590-97338	M	A	P				P	P	P	P							
1710-20312	M	J							R		T						
1710-20638	M	A		G	M	M	M	M	M	M	M						
2090-42022	F	J		M					Q								
2110-78841	F	J						T	T	T	T						
2110-78842	M	A						Q	Q	Q							
2110-78855	M	J						T	T								
2110-78861	M	J						T	M[4]	Q							
2110-78863	M	J						T	T	T							
2140-66502	M	J						Q	Q								
2140-66503	F	J						Q		Q							
2140-66517	F	A						Q	Q	Q	D						
2140-66518	M	A						Q	Q								
2140-66561	M	A						P			P	P	P	P			
2140-66564	F	J						P	P								
2140-66566	M	J						P			P						
2140-66568	M	A						P	P		P	P	P	P			
2140-66606	M	J		M		Q	Q		Q								
2140-66621	F	A				P	P	P	P	P							
2140-66627	F	A				P	P	P		P							
2140-66690	F	J					P								S		
2140-66693	M	J					M	Q	Q								
2140-66696	F	J					Q		Q								
2140-66697	M	J					Q			P	P	P	P	P	P		
2140-66709	M	A						Q	Q	Q		Q[5]	M	M	M	M	M
2140-66728	M	J					T			T							
2140-66743	M	J			T					T							
2140-66775	M	J				T	M		Q	Q	Q						
2190-76604	M	A					P		P	P	P	P					
2320-31401	M	A							B								
2320-31402	M	A							B								
2320-31403	M	A							Y								
2320-31404	F	A							B								
2320-31405	F	A							B								
2320-31406	U	J							B								
2320-31407	F	J							B	T							
2320-31408	U	J							B								
2320-31409	U	J							B								
2320-31410	U	J							B								
2320-31411	U	J							B								
2320-31412	M	A							B	B							
2320-31413	U	A							Q								
2320-31414	M	A								T	T						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31415	F	A								T							
2320-31416	U	J								T							
2320-31417	U	J								T							
2320-31418	M	A								T	T						
2320-31419	U	J								T							
2320-31420	U	J								T							
2320-31421	U	J								T							
2320-31422	U	J								T							
2320-31423	U	A								T							
2320-31424	M	J								T	T						
2320-31425	U	J								T							
2320-31426	F	A							M								
2320-31427	M	A							M								
2320-31428	M	J							Q	M	Q[6]		M	M			
2320-31429	U	J							Q								
2320-31430	U	J							P								
2320-31431	U	J							Q								
2320-31432	U	J							P								
2320-31433	U	J							Q								
2320-31434	U	J							Q								
2320-31435	U	J							P								
2320-31436	U	J							P								
2320-31437	U	J							P								
2320-31438	M	J							Q	Q							
2320-31439	U	J							Q								
2320-31440	F	J							Q	M							
2320-31441	U	J							M								
2320-31443	U	J							Q								
2320-31444	F	A							Q	Q	Q	Q			M		
2320-31445	F	A							Q	Q	Q	Q	Q	Q	Q	Q	
2320-31446	U	J								P							
2320-31447	U	J								P							
2320-31448	U	J								P							
2320-31449	U	J								P							
2320-31450	U	J								P							
2320-31451	M	A							P	P	P	P					
2320-31452	M	A							P								
2320-31453	M	A							P	P							
2320-31454	M	A							P	P							
2320-31455	M	A							P								
2320-31456	U	J							P								
2320-31457	M	J							P	K							
2320-31458	M	J							P		P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31459	M	J							P	P							
2320-31460	U	J							P								
2320-31461	U	J							P								
2320-31462	U	J							P								
2320-31463	F	J							P			K	K			K	
2320-31464	U	J							P								
2320-31465	U	J							P								
2320-31466	F	A							P								
2320-31467	M	J							P		P	P					
2320-31468	M	J							P		P	P		K			
2320-31469	U	J							P								
2320-31470	U	J							P								
2320-31471	M	J							Q	Q			M		M		
2320-31472	U	J							Q								
2320-31473	M	J							Q	Q							
2320-31474	U	J							Q								
2320-31475	M	J							P	L							
2320-31476	F	A							Q								
2320-31477	U	J							Q								
2320-31479	F	A							Q	Q							
2320-31480	F	J							Q	Q							
2320-31481	U	J							P								
2320-31482	U	J							P								
2320-31483	U	J								Q							
2320-31484	M	J								P	P			K	K		
2320-31485	F	A								M		M	M	M			
2320-31486	F	J							Q	L	Q	M	M	M			
2320-31487	U	J							Q								
2320-31488	U	J							Q								
2320-31489	U	A								M							
2320-31490	M	A								L	L[7]	Q	Q	Q	Q		
2320-31491	M	A								Q							
2320-31493	M	A								D							
2320-31494	U	A								Q							
2320-31495	M	A								T							
2320-31496	U	J								M							
2320-31497	U	J								M							
2320-31498	F	J								M		G[8]	Q	Q	Q	Q	
2320-31499	M	A								Q							
2320-31500	U	J								Q							
2320-31501	M	A							B								
2320-31502	F	A							T	T							
2320-31503	U	A								I							

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31504	U	A								I							
2320-31505	M	A								T							
2320-31506	U	J								T							
2320-31507	U	J								T							
2320-31508	U	J								T							
2320-31510	U	J								T							
2320-31511	U	J								T							
2320-31512	U	J								T							
2320-31513	U	J								T							
2320-31514	U	J								T							
2320-31515	F	A								T	T	T					
2320-31516	F	A								G							
2320-31517	M	A								G	M	M			M		
2320-31518	U	J								T							
2320-31519	U	J								T							
2320-31520	U	J								T							
2320-31521	F	A								T	T						
2320-31522	U	J											Q				
2320-31523	U	J											M				
2320-31524	U	J											P				
2320-31525	U	J											P				
2320-31526	F	A							T	T	T						
2320-31527	F	A							T								
2320-31528	M	A							T								
2320-31529	U	J							T								
2320-31530	U	J							T								
2320-31531	U	J							T								
2320-31532	U	J							T								
2320-31533	U	J							T								
2320-31534	U	J							T								
2320-31535	U	J							T								
2320-31536	U	J							T								
2320-31537	U	J							T								
2320-31538	M	A								T							
2320-31539	M	A								B							
2320-31540	F	A								T							
2320-31541	M	A								T	T						
2320-31542	U	J								T							
2320-31543	U	J								T							
2320-31544	U	J								T							
2320-31545	U	J											P				
2320-31546	U	J											P				
2320-31547	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31548	U	J											P				
2320-31549	U	J											P				
2320-31550	U	J											P				
2320-31551	M	A								Q							
2320-31552	M	A								M							
2320-31553	M	A								M		M					
2320-31554	U	J								T							
2320-31555	U	J								T							
2320-31556	U	J								T							
2320-31557	U	J								T							
2320-31558	U	J								T							
2320-31559	M	A								T	T	T	T				
2320-31560	M	A								T	T	T	T	T			
2320-31561	U	J								T							
2320-31562	M	J								T		T		T	T	T	
2320-31563	U	J								T							
2320-31564	U	J								T							
2320-31565	F	A								T	T						
2320-31566	U	J										T					
2320-31567	M	A								T	T						
2320-31568	F	A								P							
2320-31569	U	J								P							
2320-31570	U	J								P							
2320-31571	U	J								P							
2320-31572	M	A								M							
2320-31573	F	A								Q	Q	Q	Q	Q			
2320-31574	U	J									P						
2320-31575	U	J										Q					
2320-31576	M	A							T	T							
2320-31577	F	A							T	T	T						
2320-31578	U	A							Y								
2320-31579	U	A							Y								
2320-31580	U	A							Y								
2320-31581	U	J							T								
2320-31582	U	J							T								
2320-31583	U	J							T								
2320-31584	F	A							T	T	T	T					
2320-31585	U	J							T								
2320-31586	U	J							T								
2320-31587	U	J							T								
2320-31588	U	J							T								
2320-31589	M	A								P	P	P	P				
2320-31590	M	A								P	P	P	P	P			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31591	M	A								P	P	P	P				
2320-31593	M	A								P	P	P					
2320-31594	M	A								P							
2320-31595	M	A								P	P	P	P	P	P	P	P
2320-31596	M	A								P							
2320-31598	M	A								T							
2320-31599	U	A								I							
2320-31600	U	A								I							
2320-31601	U	J								P							
2320-31602	U	J								P							
2320-31603	U	J								P							
2320-31604	M	J								P		K	K				
2320-31605	U	J								P							
2320-31606	U	J								P							
2320-31607	U	J								P							
2320-31608	U	J								P							
2320-31609	U	J								P							
2320-31610	U	J								P							
2320-31611	U	J								Q							
2320-31612	U	J								Q							
2320-31616	F	J								Q		D					
2320-31617	U	J								Q							
2320-31618	F	J								Q	M	M	M				
2320-31619	U	J								M							
2320-31620	U	J								M							
2320-31621	F	A								M							
2320-31622	M	A								Q							
2320-31623	U	J								M							
2320-31624	U	J								M							
2320-31625	F	A								M							
2320-31627	M	A								Q							
2320-31628	U	A								M							
2320-31629	U	J								M							
2320-31630	U	J								Q							
2320-31631	F	J								Q		D	D				
2320-31632	F	A								Q		M	M	M[9]		M	M
2320-31633	U	J								Q							
2320-31634	U	J								Q							
2320-31635	M	A								K							
2320-31636	U	J								K							
2320-31637	F	J								K	P						
2320-31638	U	J								K							
2320-31639	U	J											P				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31640	U	J											Q				
2320-31641	U	J											Q				
2320-31642	U	J											Q				
2320-31643	U	J											P				
2320-31644	U	J											M				
2320-31645	U	J											M				
2320-31646	U	J											P				
2320-31647	U	J														M	
2320-31648	U	J														M	
2320-31649	U	J											P				
2320-31650	F	J										T	T				
2320-31651	M	A								M							
2320-31652	M	A								M	Q	Q					
2320-31653	M	A								M	M	M	M				
2320-31654	M	A								Q							
2320-31655	F	A								Q	Q	Q					
2320-31656	F	A								P	P	P					
2320-31657	F	A								P	P	P	P	P	P		
2320-31658	F	A								P							
2320-31659	M	J								Q		D	D	D		D	
2320-31660	F	J								Q			M	S	S	S	
2320-31661	F	A								P	P	P	P	P			
2320-31662	F	A								P							
2320-31663	F	A								P	P	P	P	P			
2320-31664	F	A								P							
2320-31665	U	J								P							
2320-31666	U	J								P							
2320-31667	U	J								P							
2320-31668	F	A								P							
2320-31669	F	A								P							
2320-31670	U	J											Q				
2320-31671	U	J										M					
2320-31672	U	J											P				
2320-31673	U	J										T					
2320-31674	M	J										P		K	K	K	
2320-31675	U	J									T						
2320-31676	U	J									T						
2320-31677	U	J										T					
2320-31678	U	J										P					
2320-31679	U	J											P				
2320-31680	U	J									T						
2320-31681	U	J									T						
2320-31682	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2320-31683	M	J									P		K				
2320-31684	U	J									P						
2320-31685	U	J									P						
2320-31686	M	J									P	P					
2320-31687	U	J									P						
2320-31688	M	J									Q	Q	Q	Q	Q	Q	Q
2320-31689	U	J									Q						
2320-31690	U	J									Q						
2320-31691	U	J									Q						
2320-31692	M	J									P	K					
2320-31693	U	J									P						
2320-31694	M	J									P		K	K			
2320-31695	F	J									P	P					
2320-31696	U	J									Q						
2320-31697	U	J									P						
2320-31698	F	J									P		P	P	P		
2320-31699	U	J									P						
2320-31700	U	J									P						
2360-59701	F	J									Q	Q					
2360-59702	M	J									Q	D	M				
2360-59703	U	J									Q						
2360-59704	U	J									M						
2360-59705	U	J									M						
2360-59706	U	J									K						
2360-59707	F	J									P	P					
2360-59708	F	J									P	P					
2360-59709	U	J									P						
2360-59710	U	J									P						
2360-59711	M	J									K			P	P	P	
2360-59712	M	J									K			P		P	P
2360-59713	U	J									K						
2360-59714	U	J									Q						
2360-59715	U	J									Q						
2360-59716	U	J									Q						
2360-59717	M	A								Q							
2360-59718	U	J									P						
2360-59719	U	J									T						
2360-59720	U	J									T						
2360-59721	U	J								P							
2360-59722	U	J									T						
2360-59723	U	J								P							
2360-59724	F	J								P		P					
2360-59725	U	J									B						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59727	M	J									B		B				
2360-59728	U	J									B						
2360-59729	U	J									T						
2360-59730	U	J									T						
2360-59731	U	J									T						
2360-59732	U	J									T						
2360-59733	U	J									T						
2360-59734	U	J									T						
2360-59735	U	J										P					
2360-59736	U	J										P					
2360-59737	U	J										D					
2360-59738	U	J										D					
2360-59739	U	J										Q					
2360-59740	U	J									P						
2360-59741	U	J									Q						
2360-59742	U	J									Q						
2360-59743	F	J											P	K			
2360-59744	U	J										T					
2360-59745	U	J										P					
2360-59746	U	J								G							
2360-59747	U	J										D					
2360-59748	U	J										D					
2360-59749	M	J										D	D[10]	M			
2360-59750	F	J										M	Q				
2360-59751	M	J										M	Q	Q	Q		
2360-59752	M	J										Q		Q	M		
2360-59753	U	J										Q					
2360-59754	M	J										Q	Q	Q	Q	P	P
2360-59755	U	J										Q					
2360-59756	U	J										P					
2360-59757	U	J								K							
2360-59758	U	J										P					
2360-59759	U	J										P					
2360-59760	U	J								L							
2360-59761	U	J								L							
2360-59762	U	J								Q							
2360-59763	U	J								Q							
2360-59764	U	J											P				
2360-59765	U	J											P				
2360-59766	U	J								Q							
2360-59767	U	J								K							
2360-59768	U	J										T					
2360-59769	U	J										M					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2360-59770	U	J								K							
2360-59771	U	J								G							
2360-59772	F	A								K							
2360-59773	U	J											Q				
2360-59775	U	J											Q				
2360-59776	U	J											Q				
2360-59777	F	J											Q				M
2360-59778	U	J											Q				
2360-59779	U	J											K				
2360-59780	U	J											K				
2360-59781	U	J											K				
2360-59782	F	J											K			M	
2360-59785	U	J									D						
2360-59786	U	J									D						
2360-59787	U	J									D						
2360-59788	F	J									D	D	M	M	M	M	M
2360-59789	U	J										Q					
2360-59790	U	J										Q					
2360-59791	U	J										P					
2360-59792	U	J										P					
2360-59793	U	J										P					
2360-59794	U	J										P					
2360-59795	U	J										P					
2360-59796	U	J										P					
2360-59797	M	J										P	P				
2360-59798	U	J										P					
2360-59799	M	J										M	D	M		M	
2360-59800	U	J								G							
2370-39901	U	A								P							
2370-39902	U	J								P							
2370-39904	U	J								P							
2370-39911	M	A									P						
2370-39912	M	A									Q		Q				
2370-39913	M	A									G						
2370-39914	U	J									P						
2370-39915	M	A									P	P	P	P[11]	P	P	
2370-39916	M	A										T	T	T			
2370-39917	U	A										Y					
2370-39918	U	A										Y					
2370-39919	U	A										Y					
2370-39920	U	A										Y					
2370-39921	U	A										Y					
2370-39922	U	A										Y					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39923	U	A										Y					
2370-39924	U	A										Y					
2370-39925	U	A										Y					
2370-39926	U	A										Y					
2370-39927	U	A										Y					
2370-39928	U	A										Y					
2370-39929	M	A										G	G				
2370-39930	M	J													M	Q	D[12]
2370-39932	F	A									B	B	B				
2370-39933	U	A									Y						
2370-39934	U	A									Y						
2370-39935	U	A									Y						
2370-39937	M	A										Q	Q	Q			
2370-39938	M	A										M	M	M	M	M	M
2370-39939	F	A										Q	Q				
2370-39940	M	A										M	M	M	Q		
2370-39941	M	J										Q	L[13]				
2370-39942	U	J										D					
2370-39943	U	J										D					
2370-39944	U	J										D					
2370-39945	U	J										P					
2370-39946	M	J										P	P				
2370-39947	U	J										P					
2370-39948	F	A										M					
2370-39949	U	J										Q					
2370-39950	U	J										Q					
2370-39951	M	A									P	P	P	P			
2370-39953	M	A									P	P	P	P			
2370-39954	M	A									Q	Q	Q	Q			
2370-39956	F	A									D	D	D			M	M
2370-39957	F	A									Q	Q					
2370-39958	F	A									P						
2370-39959	M	A									P		A				
2370-39960	M	A									K						
2370-39961	M	A									P						
2370-39962	F	A									P						
2370-39964	F	A									P	P	P				
2370-39965	U	A									D						
2370-39966	M	J									D		M				
2370-39967	M	A										M	D[14]	Q	Q		
2370-39968	M	A															D
2370-39969	F	A													B		
2370-39970	U	J															M

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-39971	U	A									P						
2370-39972	U	A									I						
2370-39973	U	A									Y						
2370-39974	U	A									I						
2370-39975	M	A									D	M					
2370-39976	M	A									D						
2370-39977	U	J									P						
2370-39978	F	A									P						
2370-39979	U	J									P						
2370-39980	M	J									P	K	K	K	K		
2370-39981	U	J									P						
2370-39982	U	A										Y					
2370-39983	U	A										Y					
2370-39984	U	A										Y					
2370-39985	U	A										Y					
2370-39986	M	A										G					
2370-39987	M	A										G					
2370-39988	M	A										G	M	M	M	M	
2370-39989	M	A										G					
2370-39990	F	A										G					
2370-39992	M	A										T					
2370-39993	U	A										Y					
2370-39994	U	A										Y					
2370-39995	U	A										Y					
2370-39996	U	A										Y					
2370-39997	U	A										Y					
2370-39998	U	A										Y					
2370-39999	M	A														Q	
2370-40000	M	A														D	D
2370-40001	U	J														P	
2370-40002	U	J														P	
2370-40003	M	A										T					
2370-40004	F	A										B			B		
2370-40005	U	J														S	
2370-40007	U	J														S	
2370-40008	U	J														D	
2370-40009	U	J														D	
2370-40010	U	J														D	K
2370-40011	F	A														Q	
2370-40012	M	A									Q	Q	Q				
2370-40013	M	A									P	P					
2370-40014	F	A									P	P	P				
2370-40016	U	J									P						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40017	M	A									M	M					
2370-40019	U	J									P						
2370-40020	U	J									P						
2370-40021	M	A									P	P					
2370-40022	M	A														K	
2370-40023	U	J													M		
2370-40024	M	J													K	K	K
2370-40025	U	J													K		
2370-40026	U	J													P		
2370-40027	F	J													P	E	K
2370-40029	M	J													M		D
2370-40030	U	J													M		
2370-40031	M	J													K	K	K
2370-40032	M	A									B						
2370-40033	U	A									Y						
2370-40034	U	A									Y						
2370-40035	U	A									Y						
2370-40036	M	A										G[15]					
2370-40037	F	A										G	M		M	M	M
2370-40038	M	A										G					
2370-40039	U	A										Y					
2370-40040	U	A										Y					
2370-40041	U	A										Y					
2370-40042	U	A										Y					
2370-40043	U	A										Y					
2370-40044	U	A										Y					
2370-40045	U	A										Y					
2370-40046	M	A										G	G[16]	M	M	M	M
2370-40047	F	A										P	P	P	P	P	P
2370-40048	U	J													T		
2370-40049	U	J													T		
2370-40050	U	J													T		
2370-40051	U	J														K	
2370-40052	M	A									B	B	B	B			
2370-40053	M	A									B						
2370-40054	M	A									B						
2370-40055	F	A									T						
2370-40056	M	A									T						
2370-40057	M	A										D					
2370-40058	M	A										M	B				
2370-40059	F	A										D	D	D			
2370-40060	M	A										P		P	P	P	P
2370-40061	F	A										P					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40062	F	A										P	P				
2370-40063	U	J										Q					
2370-40064	U	J										P					
2370-40065	U	J										Q					
2370-40066	F	A										Q	Q	Q	Q		
2370-40067	U	J										Q					
2370-40068	U	J										Q					
2370-40069	U	J										M					
2370-40070	U	J										M					
2370-40071	U	J										P					
2370-40072	U	J													M		
2370-40073	F	A													P	P	
2370-40074	U	J													P		
2370-40075	U	J													P		
2370-40076	U	J													P		
2370-40078	U	J															K
2370-40079	U	J															K
2370-40080	U	J										Q					
2370-40081	M	A										K					
2370-40082	F	A										K					
2370-40083	U	J										Q					
2370-40084	U	J										Q					
2370-40085	U	J											Q				
2370-40086	U	J											Q	M	M		
2370-40087	F	A											Q	Q	Q	Q	Q
2370-40088	M	A														D	D
2370-40089	U	J														M	
2370-40090	U	J														M	
2370-40091	F	J														M	D
2370-40093	U	J														M	
2370-40096	U	J												K			
2370-40097	M	J												K		K	K
2370-40098	U	J												K			
2370-40099	U	J													S		
2370-40100	U	J										K					
2370-40101	U	J										K					
2370-40102	U	J										K					
2370-40103	U	J										Q					
2370-40104	U	J										Q					
2370-40105	U	J										Q					
2370-40106	U	J										Q					
2370-40107	U	J										Q					
2370-40108	U	J										Q					

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40110	U	J											T				
2370-40111	U	J											T				
2370-40112	M	J											T			T	
2370-40113	U	J											B				
2370-40114	M	J											T		T		
2370-40115	U	J											T				
2370-40116	U	J											T				
2370-40117	U	J											T				
2370-40118	U	J											T				
2370-40119	U	J											T				
2370-40120	U	J											T				
2370-40121	U	J											T				
2370-40122	U	J											T				
2370-40123	U	J											T				
2370-40124	M	J											T		M		
2370-40125	U	J											T				
2370-40126	M	A											G				
2370-40127	M	A											G				
2370-40129	M	A											G				
2370-40130	F	A													B		
2370-40132	F	A											T				
2370-40133	F	A											B				
2370-40134	U	A											B				
2370-40135	F	A											B				
2370-40136	F	A											T				
2370-40137	M	A											B				
2370-40138	M	A											T				
2370-40139	M	A											T	T			
2370-40140	F	A													P		
2370-40141	M	A													K	K	K
2370-40142	U	J													M		
2370-40143	U	J													Q		
2370-40144	M	J													M	T	
2370-40145	U	J													M		
2370-40146	U	J													S		
2370-40147	F	J												S	D		
2370-40148	F	J												S	S	S	S
2370-40149	U	J												S			
2370-40150	U	J													M		
2370-40151	F	J													M	M	
2370-40152	U	J													M		
2370-40153	U	J													S		
2370-40154	U	J													S		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2370-40155	M	A													L		
2370-40156	M	A													B		
2370-40157	M	A											P		P	P	
2370-40158	M	J											B		T		
2370-40159	U	J											B				
2370-40160	F	A											G				
2370-40161	M	A											M	M	M		
2370-40162	U	J													B		
2370-40163	U	J													B		
2370-40164	U	J											Q				
2370-40165	M	A													B		
2370-40166	U	A											P				
2370-40167	U	J											P				
2370-40168	F	A											P	P	P		
2370-40169	U	J											M				
2370-40170	F	A											Q	Q			
2370-40171	F	A											D				
2370-40173	M	A											M	M	M	M	
2370-40174	U	J													M		
2370-40175	M	J													M	Q	Q
2370-40176	M	A													M		
2370-40177	U	J														T	
2370-40179	U	J														K	
2370-40180	M	A													B		
2370-40181	M	A													T		
2370-40182	U	J													B		
2370-40183	F	A											M				
2370-40184	M	A											D				
2370-40185	M	A											P				
2370-40186	M	A											D				
2370-40187	M	A											K				
2370-40188	U	J											Q				
2370-40190	M	J											P				K
2370-40191	F	A											M	M	M		
2370-40192	F	A											D			B	
2370-40193	F	A											Q	Q	Q	D	
2370-40194	F	A											P	P	P	P	
2370-40195	F	A											P	P	P		
2370-40197	M	A											M	Q	Q	M	M
2370-40199	U	J											P				
2390-92348	F	J		T						T							
2390-92350	M	A				M	Q		Q	Q							
2390-92365	M	J				D			Q	Q	Q						

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2390-92410	M	A					Q		Q								
2390-92420	M	J					Q	Q	Q								
2390-92421	M	J					Q	Q	Q	Q	M	M					
2390-92427	F	J					M		Q								
2390-92433	M	J					Q		Q	Q							
2390-92434	M	J					Q	Q		Q	Q	Q	Q	Q	Q	M	M
2390-92451	F	J			M	M		Q		Q							
2390-92470	F	J					Q			Q							
2390-92475	M	J					M	Q	Q	Q	Q	Q	Q	Q			
2430-61006	U	A											Y				
2430-61007	U	A											Y				
2430-61008	U	A											Y				
2430-61009	U	A											Y				
2430-61010	U	A											Y				
2430-61011	U	A											Y				
2430-61012	U	A											Y				
2430-61013	U	A											Y				
2430-61014	U	A											Y				
2430-61015	U	A											Y				
2430-61016	U	A											Y				
2430-61017	U	A											Y				
2430-61018	U	A											Y				
2430-61019	U	A											Y				
2430-61020	U	A											Y				
2430-61021	U	A											Y				
2430-61023	U	A											Y				
2430-61024	U	A											Y				
2430-61025	U	A											Y				
2430-61026	U	A											Y				
2430-61027	U	A											Y				
2430-61028	U	A											Y				
2430-61029	U	A											Y				
2430-61030	U	A											Y				
2430-61031	U	A											Y				
2430-61032	U	A											Y				
2430-61033	U	A											Y				
2430-61034	U	A											Y				
2430-61035	U	A											Y				
2430-61036	U	A											Y				
2430-61037	U	A											Y				
2430-61038	U	A											Y				
2430-61039	U	A											Y				
2430-61040	U	A											Y				

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61041	U	A											Y				
2430-61042	U	A											Y				
2430-61043	U	A											Y				
2430-61044	U	A											Y				
2430-61045	U	A											Y				
2430-61046	U	A											Y				
2430-61047	U	A											Y				
2430-61048	U	A											Y				
2430-61049	U	A											Y				
2430-61050	U	A											Y				
2430-61051	U	A											Y				
2430-61052	U	A											Y				
2430-61053	U	A											Y				
2430-61054	U	A											Y				
2430-61055	U	A											Y				
2430-61056	U	A											Y				
2430-61058	U	A											Y				
2430-61059	U	A											Y				
2430-61060	U	A											Y				
2430-61061	U	A											Y				
2430-61062	U	A											Y				
2430-61063	U	A											Y				
2430-61064	U	A											Y				
2430-61065	U	A											Y				
2430-61067	U	A											Y				
2430-61068	U	A											Y				
2430-61069	U	A											Y				
2430-61070	U	A											Y				
2430-61071	U	A											Y				
2430-61072	M	A												G			T
2430-61073	M	A												B			
2430-61074	U	J												B			
2430-61075	U	J												B			
2430-61076	U	J												B			
2430-61077	U	J												M			
2430-61078	U	J												Q			
2430-61079	F	A												M			
2430-61080	M	A												P	P	P	P
2430-61081	U	J												M			
2430-61082	U	J												Q			
2430-61083	M	A												P	P	P	P
2430-61084	M	J												Q		D	
2430-61085	M	A													D	D	D

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61086	U	J													M		
2430-61087	F	A													P	P	P
2430-61088	M	A														N	D
2430-61089	U	J														M	
2430-61090	U	J														M	
2430-61091	U	J														S	
2430-61092	F	A														S	
2430-61093	M	A														S	S
2430-61094	U	J														D	
2430-61095	M	A														M	
2430-61096	F	A														L	
2430-61097	U	J														P	
2430-61098	M	J														P	E[17]
2430-61099	U	J														K	E[18]
2430-61100	F	A														K	K
2430-61101	U	J												K			
2430-61102	U	J												K			
2430-61103	M	A												D			
2430-61104	M	A												M			
2430-61105	M	A												Q			
2430-61106	M	J												P		M	M
2430-61107	U	J												P			
2430-61108	U	J												P			
2430-61109	F	A												K			
2430-61110	U	J												K			
2430-61111	U	J												P			
2430-61112	U	J												P			
2430-61113	U	J												P			
2430-61114	M	J												P		K	K
2430-61115	U	J												P			
2430-61116	F	A												M	M		
2430-61117	U	J												P			
2430-61118	M	J												P	M	M	K
2430-61119	U	J												P			
2430-61120	F	J												P	P	P	P
2430-61121	U	J												Q			
2430-61122	U	J												P			
2430-61123	F	J												P		P	
2430-61124	F	J												P		K	
2430-61125	M	A												K			
2430-61126	U	J												S			
2430-61127	M	A												P	P		
2430-61128	U	J												M			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61129	U	J												Q			
2430-61130	U	J												Q			
2430-61131	U	J												M			
2430-61132	U	J												M			
2430-61133	U	J												M			
2430-61134	M	A												T		N	N
2430-61135	M	A												T	T	T	
2430-61136	M	A												B	B	B	B
2430-61137	F	A												B	B	B	B
2430-61138	F	A												B			
2430-61139	F	A												T			
2430-61140	U	J												B			
2430-61141	U	J												B			
2430-61142	U	J												B			
2430-61143	U	J												T			
2430-61144	U	J												T			
2430-61145	U	J												T			
2430-61151	U	J														K	
2430-61152	U	J														P	
2430-61153	F	A													M		
2430-61154	F	J													Q	S	S
2430-61155	U	J													Q		
2430-61156	U	J													K		
2430-61157	U	J													K		
2430-61158	M	A													K	K	K
2430-61159	M	J													M		K
2430-61160	U	J													M		
2430-61161	U	J													D		
2430-61162	M	A													S		
2430-61163	F	A														K	
2430-61165	M	J												Q	Q	M	
2430-61167	M	A												M	M	M	M
2430-61168	U	J												M			
2430-61169	U	J												M			
2430-61170	U	J												M			
2430-61171	U	J												M			
2430-61172	F	J												M	M		
2430-61173	U	J												M	M		
2430-61174	F	J												M		Q	
2430-61175	U	J												Q			
2430-61176	M	J												Q		P	P
2430-61177	U	J												Q			
2430-61178	M	A												K			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61179	M	A												K	P	P	P
2430-61180	M	A												K		K	K
2430-61181	F	A												K	K		
2430-61182	M	A												K			
2430-61183	M	A												K			
2430-61184	U	J												Q			
2430-61185	F	J												Q	M		
2430-61186	U	J												Q			
2430-61187	M	J												Q	L	L	
2430-61188	U	J												Q			
2430-61189	M	J												Q		M	
2430-61190	U	J												Q			
2430-61191	M	J												M	D		
2430-61192	U	J												M			
2430-61193	U	J												M			
2430-61194	U	J												Q	Q		
2430-61195	U	J												Q			
2430-61196	U	J												Q			
2430-61197	M	J												P		K	K
2430-61198	U	J												P	Q		
2430-61199	U	J												P			
2430-61200	U	J												P			
2430-61202	U	J												M			
2430-61203	U	J												M			
2430-61204	U	J												M			
2430-61205	U	J												M			
2430-61206	M	J												M		M	
2430-61207	F	J												M	D	D	
2430-61208	U	J												D			
2430-61209	M	A												V	D		
2430-61210	U	A												K			
2430-61211	U	J												S			
2430-61212	U	J												M			
2430-61213	U	J														K	
2430-61214	M	A															K
2430-61215	U	J															P
2430-61216	U	J															Q
2430-61217	U	J															Q
2430-61218	U	J															P
2430-61219	U	J															M
2430-61220	U	J															P
2430-61221	U	J														P	
2430-61223	U	J												D			

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2430-61224	U	J												D			
2430-61225	U	J												D			
2430-61226	U	J														P	
2430-61227	U	J														P	
2430-61228	U	J														K	
2430-61229	U	J														K	
2430-61230	F	A														S	S
2430-61231	U	J														S	
2430-61232	U	J														L	
2430-61233	U	J														L	
2430-61234	F	A														Q	Q
2430-61235	U	J														Q	
2430-61236	U	J														K	
2430-61237	U	J															B
2430-61271	U	J													P		
2430-61276	U	J														Q	
2430-61277	U	J													P		
2430-61278	M	J													P		
2430-61279	F	J													P	K	K
2430-61280	U	J														M	
2430-61285	U	J													M		
2540-58101	U	J														K	
2540-58102	U	J														K	
2540-58103	U	J														K	
2540-58104	M	J														K	
2540-58105	U	J														Q	
2540-58106	U	J														Q	
2540-58107	M	J														Q	
2540-58108	U	A															T
2540-58109	M	A															P[19]
2540-58110	F	A															P
2540-58111	F	A															P
2540-58112	U	J															Q
2540-58113	U	J															M
2540-58114	U	J															P
2540-58115	U	J															B
2540-58116	U	J														B	
2540-58117	U	J														B	
2540-58118	U	J														K	
2540-58119	U	J														K	
2540-58120	F	A															B
2540-58132	M	A													S	S	S
2540-58141	U	J													M		

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58142	U	J													M		
2540-58143	M	A													D		
2540-58144	U	J													K		
2540-58145	U	J													K		
2540-58146	M	A													B		
2540-58147	U	J														B	
2540-58148	U	J														Q	
2540-58149	U	J														Q	
2540-58150	U	J														Q	
2540-58151	U	J														Q	
2540-58152	F	A															Q
2540-58154	M	J													M	T	D[20]
2540-58155	U	J													M		
2540-58156	F	A														K	K
2540-58157	U	J														K	E
2540-58158	M	J														K	K
2540-58159	F	J														K	K
2540-58160	U	J														S	
2540-58161	U	J														L	
2540-58162	U	J														K	
2540-58163	U	J														K	
2540-58164	U	J														K	
2540-58165	F	J														K	K
2540-58166	U	J														K	
2540-58172	M	A															Q
2540-58173	U	J															M
2540-58174	U	J															M
2540-58175	F	A															K
2540-58176	M	A															Q
2540-58177	F	A															K
2540-58178	U	J															K
2540-58179	U	J															K
2540-58180	U	J															K
2540-58182	U	J															K
2540-58183	U	J															K
2540-58184	F	A															M
2540-58185	U	J													P		
2540-58186	M	A													S		
2540-58187	F	A													P		K
2540-58188	U	J													P		
2540-58189	F	A													P		
2540-58190	U	J														T	
2540-58191	U	J														P	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58192	M	A														Q	Q[21]
2540-58193	F	A														N	N
2540-58194	U	J														D	
2540-58195	U	J														P	
2540-58196	U	J														P	
2540-58197	U	J														P	
2540-58198	U	J														P	
2540-58199	U	J														K	
2540-58200	U	J														K	
2540-58201	U	J														K	P
2540-58202	M	A														K	
2540-58203	F	A														K	K
2540-58204	F	A														K	
2540-58205	U	J														K	
2540-58206	U	J														P	
2540-58207	U	J														P	
2540-58208	U	J														P	
2540-58209	F	A														P	
2540-58211	U	J															K
2540-58212	U	J															K
2540-58213	U	J															M
2540-58214	U	J															K
2540-58216	U	J													M		
2540-58217	M	A													S	S	
2540-58218	U	J													S		
2540-58219	U	J													Q		
2540-58220	M	A														B	B
2540-58221	M	A														B	
2540-58222	U	J														K	
2540-58223	M	A														K	K
2540-58224	F	J														K	K
2540-58225	U	J														K	
2540-58226	F	A														K	
2540-58227	M	A														T	
2540-58228	M	A														T	T
2540-58229	M	A														B	
2540-58230	F	A														B	B
2540-58231	F	A														T	M
2540-58232	U	J														T	
2540-58233	F	A														N	
2540-58235	U	J														N	
2540-58236	U	J														N	
2540-58237	U	J														K	

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2540-58238	F	J														K	E[22]
2540-58239	U	J														K	
2540-58240	F	J														K	E
2540-58241	F	A														K	K
2540-58242	U	J														K	
2540-58243	U	J														K	
2540-58244	U	J														K	
2540-58245	M	A															P
2540-58246	M	A															E
2540-58247	U	J															K
2540-58274	U	J															N
2540-58275	U	J															N
2540-58276	U	J															K
2540-58277	U	J															K
2540-58278	U	L															D
2540-58279	U	J															D
2540-58280	U	J															K
2540-58282	U	J															K
2540-58283	U	J															K
2540-58284	U	J															P
2540-58285	U	J															P
2540-58286	U	J															P
2540-58287	M	A															S
2540-58288	U	J														P	
2540-58289	F	A														K	
2540-58290	U	J														K	
2540-58291	U	J														K	
2540-58292	U	J														K	
2540-58293	F	A														P	P
2540-58294	U	J														P	
2540-58295	U	J														P	
2540-58296	U	J														P	
2540-58297	F	A															K
2540-58298	U	J															K
2540-58299	U	J															K
2540-58378	U	J															K
2540-58385	U	J															S
2540-58386	F	A															K
2540-58387	M	A															K
2590-53101	U	J															P
2590-53102	U	J															P
2590-53103	U	J															P
2590-53104	U	J															P

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2590-53105	F	A															D
2590-53106	U	J															M
2590-53107	U	J															M
2590-53108	F	A															D
2590-53109	U	J															P
2590-53110	F	A															K
2590-53111	U	J															K
2590-53112	U	J															K
2590-53113	U	J															K
2590-53114	U	J															K
2590-53115	U	J															M
2590-53116	U	J															M
2590-53117	U	J															M
2590-53118	U	J															K
2590-53119	U	J															M
2590-53121	F	A															K
2590-53122	U	J															K
2590-53123	U	J															K
2590-53124	M	A															K
2590-53125	U	J															K
2590-53126	U	J															D
2590-53127	U	J															K
2590-53141	U	J															M
2590-53142	U	J															M
2590-53143	U	J															N
2590-53144	U	J															K
2590-53145	M	A															S
2590-53147	U	J															D
2590-53148	U	A															K
2590-53149	U	J															K
2590-53150	U	J															M
2590-53151	U	J															M
2590-53152	U	J															Q
2590-53154	U	J															Q
2590-53162	M	A															T
2590-53163	F	A															B
2590-53164	U	J															B
2590-53171	F	A															E
2590-53172	U	J															K
2590-53173	F	A															K
2590-53182	U	J															B

Table E.1. Willow flycatchers banded and/or resighted by SWCA at sites along the Virgin and lower Colorado Rivers in 2003–2011 (Continued)

Original Federal Band Number	Sex[2]	Age When Banded[3]	Study Area Detected[1]														
			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3500-68963	U	J								T							
3500-68968	U	J								P							
3500-68969	U	J								P							
3500-68972	F	J								P	P	P					

* Table includes individuals banded at sites prior to 2003 (Braden and McKernan, unpubl. data) and recaptured or resighted by SWCA.

[1] K = Key Pittman, E = River Ranch, P = Pahranagat NWR, W = Meadow Valley Wash, L = Littlefield, Q = Mesquite, M = Mormon Mesa, D = Muddy River, N = Warm Springs, G = Grand Canyon, T = Topock Marsh, B = Bill Williams River NWR, I = Imperial, Y = Yuma, S = St. George, V = Las Vegas Wash, R = Roosevelt Lake, A = Ash Meadows. Study area indicated is the study area where the individual was first detected during the given season. Within-season movements are indicated with individual footnotes.

[2] M = male, F = female, U = unknown.

[3] A = adult, J = juvenile.

[4] Within-season movement from Mormon Mesa to Mesquite.

[5] Within-season movement from Mesquite to Mormon Mesa.

[6] Within-season movement from Mesquite to Mormon Mesa.

[7] Within-season movement from Littlefield to Mesquite.

[8] Within-season movement from Grand Canyon to Mesquite.

[9] Within-season movement from Mormon Mesa to Muddy River.

[10] Within-season movement from Muddy River to Mormon Mesa.

[11] Within-season movement from Pahranagat to Key Pittman.

[12] Within-season movement from Muddy River to Mesquite.

[13] Within-season movement from Littlefield to Mesquite.

[14] Within-season movement from Muddy River to Mesquite.

[15] Within-season movement from Grand Canyon to Mesquite.

[16] Within-season movement from Grand Canyon to Mormon Mesa.

[17] Within-season movement from River Ranch to Key Pittman.

[18] Within-season movement from River Ranch to Key Pittman.

[19] Within-season movement from Pahranagat to River Ranch.

[20] Within-season movement from Muddy River to Mormon Mesa. Likely also within-season movement from Topock to Muddy River in 2010.

[21] Within-season movement from Mesquite to Mormon Mesa.

[22] Within-season movement from River Ranch to Key Pittman.

Appendix F

CONTRIBUTING PERSONNEL

Contributor	Role
Steven W. Carothers, Ph.D.	Principal-in-Charge
Mary Anne McLeod, M.S.	Project Manager/Scientist/Field Supervisor
Thomas J. Koronkiewicz, M.S.	Senior Scientist/Banding Lead
Wendy Langeberg, Ph.D.	Statistician
Glenn A. Dunno, M.A.	GIS Specialist
DeAnne Rietz, M.S.	Hydrologist
Jessica Maggio	Project Administrator/Formatting Specialist
Kimberly Proa	Administrative Assistant/Data Entry
Dorothy A. House, M.A.	Technical Editor
Anne Pellegrini	Project Coordinator
Sarah Nichols	Assistant Project Coordinator
Danielle Ethier	Field Coordinator
Iwona Kuczyńska	Field Coordinator
Katie Barnes	Bander/Nest Monitor
Ashley Daniels	Bander/Nest Monitor
Jill Peiffer	Bander/Nest Monitor
Josh Sayers	Bander/Nest Monitor
Ryan Davis	Surveyor/Nest Monitor
Greg Joder	Surveyor/Nest Monitor
Alex McDonnell	Surveyor/Nest Monitor
Zach Mobley	Surveyor/Nest Monitor
Amber Swicegood	Surveyor/Nest Monitor
Tim Schreckengost	Surveyor
Jesse Vooz	Surveyor

Transportation Projects

The following specific transportation-related projects are covered by this Plan (Table 7-8). Their locations are shown in Figure 7-3.

Table 7-8. Covered Road Construction or Widening Projects within the Plan area

CPA Subregion	Road	Segment	Existing Number of Lanes	Proposed Number of Lanes	Estimated Impact to PAMA[1] (acres)
Bonsall	Camino del Rey (SA 100)	SR-76 / Mission Road to Camino del Cielo	2	4	4.39
	East Vista Way (SF 1304)	SR-76 / Mission Road to Vista city limits	2	4	0.32
	Gopher Canyon Road (SF 1415)	East Vista Way to Old Highway 395 / Champagne Blvd.	2	4	13.69
	North River Road (SA 430)	Oceanside city limits to SR 76 / Mission Road	2	4	2.47
	Old Highway 395 / Champagne Blvd	I-15 interchange to North County Metro Subregion boundary	2	4	20.52
	SR-76 / Mission Road	South Mission Road to Oceanside city limits.	2	6	27.03
	SR-76 / Pala Road	Fallbrook CPA boundary to South Mission Road	2	4	0.10
Fallbrook	Fallbrook Street (SF 1416)	S. Mission St to Stage Coach Lane	0	2	0
	E. Fallbrook Street extension (SF 1416)	Stage Coach Lane to Reche Road	0	2	0
	Pepper Tree Lane (SC 90)	S. Mission Road to Stage Coach Lane	0	2	0
	Pala Mesa Drive	S. Mission Road. to SR-76	0	2	4.38
	Pankey Road (SC 260.2)	SR-76 to Pala Mesa Drive	0	2	0.92
	Rice Canyon Road	Fallbrook/Rainbow CPA boundary to SR-76	0	2	52.64
	Couser Canyon Road	SR-76 to Fallbrook/Valley Center CPA boundary	0	2	32.35
	Meadowood/Passarelle Road	SR-76 to Canonita Drive	0	4	2.60
	E. Mission Road (SF 1305)	Brandon Road to Old Highway 395/I-15	2	4	0
	S. Mission Road (SF 1305)	W. Mission Road to SR-76	2	4	0
	Old Highway 395 (SA 15)	Pala Mesa Drive to SR-76	2	4	5.65
	SR-76 (Pala Road)	Bonsall CPA to Couser Canyon Road	2	4	34.76
	Mar Vista Ave	Buena Vista Drive to Oceanside city limit (ultimately to Cannon Rd. in Carlsbad)	0	2	0
	Las Posas Road	San Marcos Boundary to Buena Creek Road	0	2	32.07

North County Metro	Jesmond Dene Road (East/West Segment)	North Broadway to Centre City Parkway	0	2	10.86
	North Broadway	Reidy Canyon Road to Mountain Meadow/Mirar de Valle Road	0	2	18.57
	Mirar de Valle Road	Mountain Meadow Road to Valley Center Road	0	2	2.15
	Monte Vista Drive	South Santa Fe Avenue (Vista) to Buena Creek Road	2	4	0
	Buena Creek Road (Western Segment)	South Santa Fe Avenue to Sugarbush	2	4	0
	Smilax Road	Oleander Avenue to South Santa Fe Avenue	2	4	0
	Buena Creek Road (Twin Oaks Valley Segment)	Sugarbush Drive to Twin Oaks Valley Road	2	4	0
	Champagne Boulevard	Mountain Meadow Road to Old Castle Road	2	4	9.59
	North Centre City Parkway	Mountain Meadow Road to Nutmeg Street	2	4	14.79
	Rock Springs Road	West Montiel Road to Bennett Avenue	2	4	0
	Nordahl Road	Rock Springs Road to El Norte Parkway	2	4	0
North County Metro	Via Rancho Parkway	Del Dios Highway to Old Via Rancho Drive	2	4	0
	Gamble Lane	Felicita Road to Calle Catalina Road	2	4	0
	San Pasqual Valley Road (Highway 78)	Birch Avenue to Bear Valley Parkway	2	4	0
	San Pasqual Valley Rd (Hwy 78)	Bear Valley Parkway to San Pasqual Road	2	4	0
	Bear Valley Parkway	Zlatibor Ranch Road to Austin Way	2	4	0
	Sycamore Avenue	South Santa Fe Avenue to Highway 78	2	6	0
	Deer Springs Road	I-15 to Buena Creek Road	2	6	10.66
	Rancho Santa Fe Road	Melrose Drive (Vista) to San Marcos Boulevard (San Marcos)	4	6	0
Pala Pauma	Cole Grade Road (Proposed Extension)	Entire new road extension (north side of SR 76)	0	2	0
Rainbow	Old Highway 395 (SA 15)	Rainbow Valley West Boulevard to Mission Interchange	2	4	6.45
Ramona	SA603	Montecito Way to SR-76	0	2	23.70
	Dye Street	SR-67 to Dye Road	0	2	0
	Dye Road (Southern Bypass) (SC 950)	San Vicente to Creelman Lane/Keyes Road	0	2	14.82
	Keyes Road (Southern Bypass) (SA 300)	Old Julian Hwy to SR-78	0	2	0
	Ramona Street (SC 930)	SR-67 to Creelman	0	2	0
	SR-67	Poway city limits to Archie	2	4	0

		Moore Road			
	SR-78/Pine Street	Ash Street to Main Street	2	4	0
	SR-67/Main Street	Etcheverry Street to Pala Street	3	4	0
San Dieguito	Village Road	Country Club Road to Citricado Parkway	0	2	6.62
	Citracado Parkway	Within Planning Area boundary	0	4	7.70
Valley Center	New Road 3A	Old Highway 395 to West Lilac Road	0	2	2.49
	New Road 3B	West Lilac Road to Cole Grade Road at Cool Valley Road	0	2	16.22
	Miller Road	Wilhite Lane to Villa Sierra Road	0	2	0
	Mirar de Valle Road (SC 990.2)	North County Metro boundary to New Road 16A (unbuilt)	0	2	11.84
	New Road	Valley Center Road at Woods Valley Road to Mirar de Valle Road at New Road 16A	0	2	0
	New Road	Lilac to Mirar de Valle Road	0	4	0
	Lilac Road (SF 1415)	Anthony Road to Valley Center Road	2	4	0
	Cole Grade Road (SA 120)	Cool Valley Road to Valley Center Road	2	4	0
Valley Center	Cole Grade Road Extension	Valley Center Road to New South Bypass Road (New Road 13A)	2	4	0
	Valley Center Road (SF 639)	Community boundary to Banbury Drive	2	4	6.79
TOTAL					**461.40**

[1]Several transportation projects are not actually within the PAMA because a road corridor was specifically excluded (i.e., SR-76), but PAMA is located on both sides of the road corridor. In this situation, the impact to PAMA has been estimated as though the segment lies within PAMA.